Accumulator Scrutineering

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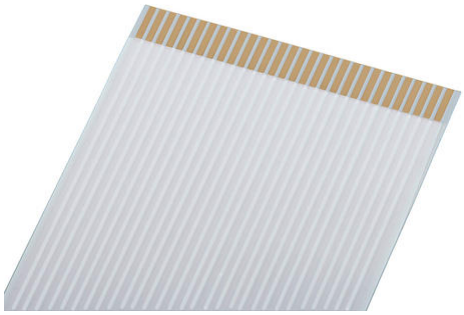
Accumulator Compartment

Part Number : 150390359
Product Description : 1.00mm Pitch Premo-Flex FFC Jumper, Same Side Contacts (Type A), 76.00mm Cable Length, Gold (Au) Plating, 20 Circuits
Series Number : 15039
Status : Active
Product Category : Flat-Flexible Cable (FFC)



Documents & Resources

Drawings

150390359_sd.pdf

Specifications

PS-15039-001-001.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Not Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2023)8585-DC (23 Jan 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC
- Low-Halogen

Industry Documents

- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474

- chemSHERPA (xml)

Substances of Interest

- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	Flat-Flexible Cable (FFC)
Series	15039
Description	1.00mm Pitch Premo-Flex FFC Jumper, Same Side Contacts (Type A), 76.00mm Cable Length, Gold (Au) Plating, 20 Circuits
Comments	Contacts on the same side, Type A
Product Name	Premo-Flex FFC Jumper
UPC	193264175376

Electrical

Current - Maximum per Contact	1.2A
Voltage - Maximum	60V AC

Physical

Cable Length	76.00mm
Circuits (Loaded)	20
Contact Layout Type	A (same side)
Design Feature	Flexible
Material - Plating Mating	Gold
Packaging Type	Bag
Pitch - Mating Interface	1.00mm
Temperature Range - Operating	-40° to +105°C
Termination Style	FFC Connector
Wire/Cable Type	Flat Flex Cable
Wire Size (AWG)	N/A

Mates With / Use With

Mates with Part(s)

Description	Part Number
Easy-On FFC/FPC Connector, 1.00mm Pitch, FD19 Series, Right-Angle, Bottom Contact, 1.90mm Height, 20 Circuits, Gold over Nickel Plating	2005280200
Easy-On FFC/FPC Connector, 1.00mm Pitch, Slider Series, Right-Angle, Top Contact, 2.70mm Height, 20 Circuits, Gold Plating	522072060
Easy-On FFC/FPC Connector, 1.00mm Pitch, Slider Series, Right-Angle, Bottom Contact, 3.00mm Height, 20 Circuits, Gold Plating	522712069
Easy-On FFC/FPC Connector, 1.00mm Pitch, Slider Series, Vertical, 5.75mm Height, 20 Circuits, Gold Plating	526102072
1.00mm Pitch Easy-On FFC/FPC Connector, Surface Mount, Vertical, Non-ZIF, Gold (Au) Plating, 20 Circuits	528082072
1.00mm Pitch Easy-On FFC/FPC Connector, Surface Mount, Vertical, Non-ZIF, Gold (Au) Plating, with Pick-and-Place Polyimide Tape, 20 Circuits	528082073

PRODUCT FAMILY SPECIFICATION FOR 1.00 mm PITCH FLAT FLEX CABLE (FFC) (105°C, Au PLATING)

Revision List

REVISION	MODIFICATION	DATE
A	First release	2010/03/17
B	Corrected insulation resistance	2019/09/18
C	New format	2022/08/23
D	Number of circuits updated	2022/12/07
E	Flex life cycles update	2023/12/06

1 SCOPE

This specification covers the 1.00mm center FFC (Flat Flexible Cable) jumper cable, 105°C, using gold plated copper conductor.

2 PRODUCT DESCRIPTION

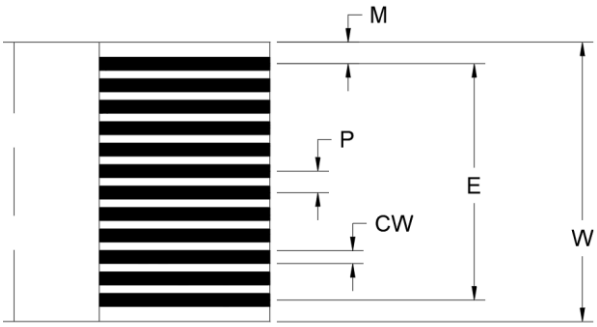
2.1 Product name and series number

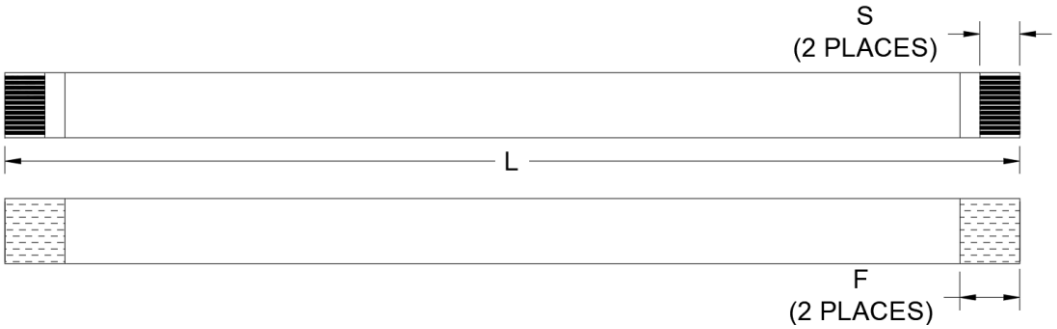
Product name: 1.00MM PITCH FFC JUMPER CABLE (105°C, Au PLATING)
Product material no: 15039-XXXX

2.2 Dimensions, materials, and markings

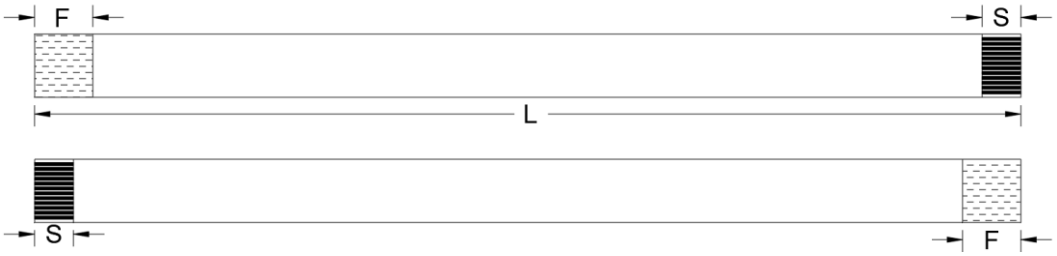
Product dimensions (in mm) according to SD-15039-001.

Number of conductors	N	Refer to sales drawing
Pitch	P	1.00 ± 0.08
Span	E	1.00 (N-I) ± 0.15
Total width	W	1.00 (N+I) ± 0.10
Conductor width	CW	0.70 ± 0.03
Margin width	M	1.0 ± 0.20
Strip length	S	4.00 ± 0.80
End thickness of the connection area	Tc	0.30 ± 0.05
End thickness of the insulated area	Ti	0.27 ± 0.05
Insulated length	L	20 to 60 ± 2.00 61 to 100 ± 3.00 101 to 200 ± 4.00 201 to 3999 ± 5.00 4000 to 5999 ± 10.00 6000 to 9999 ± 15.00
Reinforcement length	F	8.00 ± 2.00
End squareness	s-s’	0.40 max.





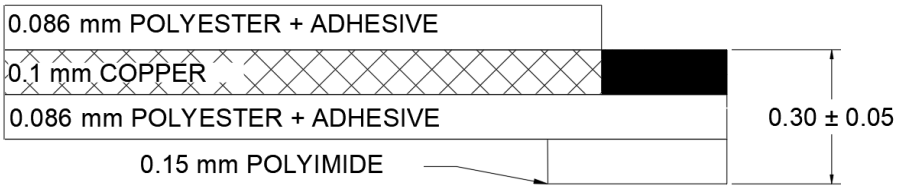
Type A (Contacts on the same side)



Type D (Contacts on the opposite side)

2.3 COMPOSITION

- Conductor: Material: Copper
  Thickness: 0.10 mm nominal
  Plating: 0.3 µm Ni min & 0.05µm Au min.
- Insulation tape: Material: Polyester + Flame retardant adhesive
  Thickness: 0.086 mm typical
  Color: White
- Reinforcement tape: Material: Polyester + Adhesive
  Thickness: 0.155 mm nominal



2.4 Current and applicable conductors

Conductor Width	Conductor Thickness	Cross section	Current
0.7 mm	0.1 mm	0.07mm²	1.25 A

3 ELECTRICAL AND PHYSICAL SPECIFICATION

3.1 Electrical requirements

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
1	**Conductor resistance**	ASTM B 193	300 ohms/km MAXIMUM
2	**Insulation resistance cond. to cond.**	400 V DC	10 Mohms.m MINIMUM
3	**Dielectric test**	400 V AC for 1 minute	No disruptive discharge
4	**Continuity test**	3.0 V DC at 0.1mA	passed
5	**Voltage rating**		60 V AC MAXIMUM
6	**Current rating**	1.25 A (all conductors under load) at 23°C	40°C heat rise MAX
7	**Impedance cond/cond balanced method**	FFC at 1 MHz	120 Ω TYP
8	**Capacitance cond/cond balanced method**	FFC at 1 KHz	50 pF/m

3.2 Physical requirements

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
9	**Temperature rating**		-40°C to +105°C
10	**Heat resistance**	168 hours at 136°C	Insulation resistance Dielectric test
11	**Thermal shock**	30 minutes at –55°C 5 minutes at +25°C 30 minutes at +85°C 5 minutes at +25°C	Insulation resistance after 25 cycles
12	**Cold coiling**	96 hours at –40°C / The sample will be wound on a 3mm dia. Mandrel	Insulation resistance Dielectric test Visual inspection
13	**Wear by abrasion**	Test following EN3475-503 Weight: 500g Speed: 60 cycles/min Abrasion tool: 0.13mm dia.	10,000 cycles MINIMUM
14	**Folding**	The specimen shall be folded manually at 180°	Continuity after 20 times
15	**Flex Lifecycles**	Speed: 100 cycles/min R: 10 mm Temp: 23°C 	50,000 cycles MIN
16	**Moisture resistance**	96 hours at 60°C, 95% RH	Insulation resistance Dielectric test
17	**Flame resistance**	UL 758 VW-1	Passed

18	**Solderability**	Immersion of the area which is intended for soldering into a tin bath at 250 ± 10°C for 30 seconds	No delamination Solder reflow below 1 mm

4 UL APPROVAL

These products are UL compliant under:
UL style 20706
Temperature rating: 105°C
Voltage rating: 60 V AC

5 ROHS COMPLIANCE

This Flat Flexible Cable product family is compliant to RoHS Directive (EU) 2015/863.

molex

Part Number : 2043130006
Product Description : Sentrality 6.00mm Top-entry, Knurled Press-fit Socket Assembly with +/-1.00mm Self-alignment Capability, Tray
Series Number : 204313
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2043130006_sd.pdf

2043650006-PK-000.pdf

3D Models and Design Files

2043130006_stp.zip

Specifications

2043130006-PS-000.pdf

2043130006-TS-000.pdf

2043131234-TS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)4144-DC (27 June 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC

- Low-Halogen

Industry Documents
- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest
- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	204313
Description	Sentrality 6.00mm Top-entry, Knurled Press-fit Socket Assembly with +/-1.00mm Self-alignment Capability, Tray
Application	Busbar-to-Board, Busbar-to-Busbar, Power
Comments	Current and voltage performances are dependent upon application variables.
Component Type	PCB Receptacle
Product Name	Sentrality
UPC	191130149902

Electrical

Current - Maximum per Contact	140.0A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	1

Circuits (maximum)	1
Diameter	6.00mm
Durability (mating cycles max)	200
Glow-Wire Capable	No
Guide to Mating Part	Yes
Height Above Board	3.40mm
Material - Metal	Copper Alloy
Material - Plating Mating	Gold
Material - Plating Termination	Silver
Mating Orientation	Top-entry
Net Weight	10.302/g
Number of Rows	1
Orientation	Vertical
Packaging Type	Tray
PCB Retention	None
Pitch - Mating Interface	N/A
Polarized to Mating Part	No
Polarized to PCB	No
Temperature Range - Operating	-40° to +125°C
Termination Interface Style	Press-Fit

Mates With / Use With

Mates with Part(s)

Description	Part Number
Sentrality Pins	203263

molex

Part Number : 2032630026
Product Description : Sentrality 6.00mm Knurled Press-fit Pin, 14.00mm Engagement Length, Bag
Series Number : 203263
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2032630026_sd.pdf

2032630006-PK-000.pdf

3D Models and Design Files

2032630026_stp.zip

Specifications

2043130018-AS-000.pdf

2043130006-PS-000.pdf

2043131234-TS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not saleable
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)7663-DC (21 Jan 2025)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC
- Low-Halogen

Industry Documents

- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest

- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	203263
Description	Sentrality 6.00mm Knurled Press-fit Pin, 14.00mm Engagement Length, Bag
Application	Board-to-Board, Busbar-to-Board, Busbar-to-Busbar, Power
Component Type	PCB Header
Product Name	Sentrality
UPC	193264044658

Electrical

Current - Maximum per Contact	140.0A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	1
Circuits (maximum)	1
Diameter	6.00mm
Durability (mating cycles max)	200
Glow-Wire Capable	No
Guide to Mating Part	No

Height Above Board	14.00mm
Material - Metal	Copper Alloy
Material - Plating Mating	Silver
Material - Plating Termination	Silver
Net Weight	4.464/g
Number of Rows	1
Orientation	Vertical
Packaging Type	Bag
PCB Retention	None
Pitch - Mating Interface	N/A
Polarized to Mating Part	No
Polarized to PCB	No
Temperature Range - Operating	-40° to +125°C
Termination Interface Style	Press-Fit

Mates With / Use With

Mates with Part(s)

Description	Part Number
Sentrality Top-entry Surface Mount Socket Assemblies	204318
Sentrality Top-entry Surface Mount Socket Assemblies with Self-alignment Capability	204365
Sentrality Top-entry Knurled Press-Fit Socket Assemblies with Self-alignment Capability	204313
Sentrality Top-entry Knurled Press-Fit Socket Assemblies	204316
Sentrality 3.40mm Right-Angle Socket Assemblies	205000

molex

Part Number : 2032630006
Product Description : Sentrality 6.00mm Knurled Press-fit Pin, 26.00mm Engagement Length, Bag
Series Number : 203263
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2032630006_sd.pdf

2032630006-PK-000.pdf

3D Models and Design Files

2032630006_stp.zip

Specifications

2043130006-PS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)4144-DC (27 June 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC
- Low-Halogen

Industry Documents

- IPC 1752A Class C
- IPC 1752A Class D

- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest
- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	203263
Description	Sentrality 6.00mm Knurled Press-fit Pin, 26.00mm Engagement Length, Bag
Application	Board-to-Board, Busbar-to-Board, Busbar-to-Busbar, Power
Component Type	PCB Header
Product Name	Sentrality
UPC	191130149858

Electrical

Current - Maximum per Contact	140.0A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	1
Circuits (maximum)	1
Diameter	6.00mm
Durability (mating cycles max)	200
Glow-Wire Capable	No
Guide to Mating Part	No
Height Above Board	26.00mm
Material - Metal	Copper Alloy

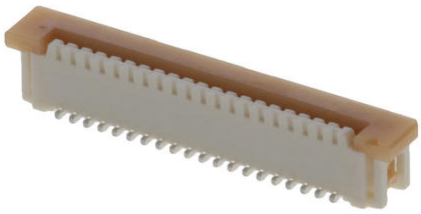
Material - Plating Mating	Silver
Material - Plating Termination	Silver
Net Weight	7.527/g
Number of Rows	1
Orientation	Vertical
Packaging Type	Bag
PCB Retention	None
Pitch - Mating Interface	N/A
Polarized to Mating Part	No
Polarized to PCB	No
Temperature Range - Operating	-40° to +125°C
Termination Interface Style	Press-Fit

Mates With / Use With

Mates with Part(s)

Description	Part Number
Sentrality Top-entry Surface Mount Socket Assemblies	204318
Sentrality Top-entry Surface Mount Socket Assemblies with Self-alignment Capability	204365
Sentrality Top-entry Knurled Press-Fit Socket Assemblies with Self-alignment Capability	204313
Sentrality Top-entry Knurled Press-Fit Socket Assemblies	204316
Sentrality 3.40mm Right-Angle Socket Assemblies	205000

Part Number : 526102072
Product Description : Easy-On FFC/FPC Connector, 1.00mm Pitch, Slider Series, Vertical, 5.75mm Height, 20 Circuits, Gold Plating
Series Number : 52610
Status : Active
Product Category : FFC / FPC Connectors



Documents & Resources

Drawings

526102072_sd.pdf

3D Models and Design Files

526102072.dxf

526102072_stp.zip

Specifications

526100003-A00.pdf

SPK-52610-003-001.pdf

PS-52610-007-001.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Compliant with Exemption 44; 33
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Not Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)6225-DC (07 Nov 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS

- REACH SVHC
- Low-Halogen

Industry Documents
- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest
- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	FFC / FPC Connectors
Series	Slider
Description	Easy-On FFC/FPC Connector, 1.00mm Pitch, Slider Series, Vertical, 5.75mm Height, 20 Circuits, Gold Plating
Product Name	Easy-On
UPC	822350243704

Agency

CSA	LR19980
UL	E29179

Electrical

Current - Maximum per Contact	1.0A
Voltage - Maximum	125V

Physical

Actuator Type	Slider
Circuits (Loaded)	20
Circuits (maximum)	20

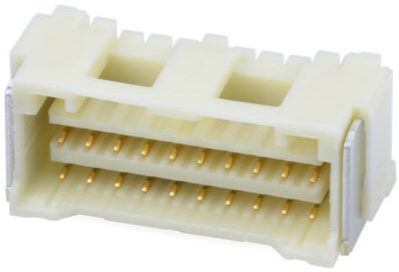
Color - Resin	Natural
Contact Position	N/A
Durability (mating cycles max)	30
Flammability	94V-0
Mated Height	5.75mm
Material - Metal	Phosphor Bronze
Material - Plating Mating	Gold
Material - Plating Termination	Tin
Material - Resin	Nylon
Net Weight	929.900/mg
Orientation	Vertical
Packaging Type	Embossed Tape on Reel
PCB Locator	No
PCB Mounting	Surface Mount
PCB Retention	None
PC Tail Length	2.00mm
Pitch - Mating Interface	1.00mm
Pitch - Termination Interface	1.00mm
Polarized to PCB	No
Stackable	No
Temperature Range - Operating	-40° to +85°C
Wire/Cable Type	FFC/FPC

Mates With / Use With

Mates with Part(s)

Description	Part Number
1.00mm Pitch Premo-Flex FFC Jumpers	15039

molex



Part Number : 2132282010
Product Description : 1.50mm Pitch CLIK-Mate Wire-to-Board PCB Receptacle, Dual Row, Surface Mount, Right-Angle, 0.10µm Gold (Au) Plating, 20 Circuits, Natural
Series Number : 213228
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2132282010_sd.pdf

3D Models and Design Files

2132282010.dxf

2132282010_stp.zip

Specifications

2132289200-SPK-200.pdf

5031491002-PS-000.pdf

5031490002-PS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Compliant with Exemption 44; 34; 33
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Not Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)6225-DC (07 Nov 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC
- Low-Halogen

Industry Documents

- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest

- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	213228
Description	1.50mm Pitch CLIK-Mate Wire-to-Board PCB Receptacle, Dual Row, Surface Mount, Right-Angle, 0.10µm Gold (Au) Plating, 20 Circuits, Natural
Application	Signal, Wire-to-Board
Component Type	PCB Receptacle
Product Name	CLIK-Mate
UPC	193264244966

Agency

UL	E29179

Electrical

Current - Maximum per Contact	2.0A
Voltage - Maximum	100V AC (RMS)/DC

Physical

Circuits (Loaded)	20
Circuits (maximum)	20
Color - Resin	Natural
Durability (mating cycles max)	30
Glow-Wire Capable	No
Guide to Mating Part	Yes
Keying to Mating Part	Yes
Lock to Mating Part	Yes
Material - Metal	Copper Alloy
Material - Plating Mating	Gold
Material - Resin	Polyamide
Number of Rows	2
Orientation	Right Angle
Packaging Type	Embossed Tape on Reel
PCB Locator	No
PCB Retention	Yes
Pitch - Mating Interface	1.50mm
Pitch - Termination Interface	1.50mm
Plating min - Mating	0.102µm
Plating min - Termination	0.102µm
Polarized to Mating Part	Yes
Polarized to PCB	No
Stackable	No
Temperature Range - Operating	-40° to +105°C
Termination Interface Style	Surface Mount

Mates With / Use With

Mates with Part(s)

Description	Part Number
1.50mm Pitch CLIK-Mate Dual Row Plug Housings	503149

NTC Thermistors, Mini Epoxy PVC Twin Insulated Leads

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | Related Documents

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	4.7K to 100K	Ω
Tolerance on R_{25}-value	± 1.0 to ± 5.0	%
$B_{25/85}$-value	3435 to 4190	K
Tolerance on $B_{25/85}$	± 0.5 to ± 1.5	%
Operating temperature range at zero dissipation	-40 to 105	°C
Maximum power dissipation at 55 °C	100	mW
Accuracy of temperature measurement (for 1 % types)	± 0.5 between 0 and 40 ± 1.0 between -40 and 80	°C
Dissipation factor δ (in still air)	≈ 3	mW/K
Response time (in oil)	≈ 2.5	s
Climatic category (LCT / UCT / days)	40 / 105 / 28	
Minimum dielectric withstanding voltage between leads and coated body	500	V_{RMS}
Weight (40 mm length)	0.2	g

FEATURES

- High adhesive strength between the PVC wire and the encapsulating lacquer
- Accurate down to ± 0.3 °C
- Small body of max. 3 mm for easy installation
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free Available

e3 RoHS COMPLIANT

APPLICATIONS

- Temperature measurement, sensing, and control
- On battery packs, heat-sinks, tubing, enclosures, etc.

DESCRIPTION

These sensors consist of small NTC chip soldered between stranded AWG #30, 105 °C resistant, PVC (UL2651). The conductors are overall tinned. They are lacquered and insulated with a black epoxy coating.

MARKING

Black lacquered body without additional mark

PACKAGING

SPQ: 125 items (for standard 40 mm lead wire length)

MOUNTING

Important mounting and handling instructions: see www.vishay.com/doc?29222

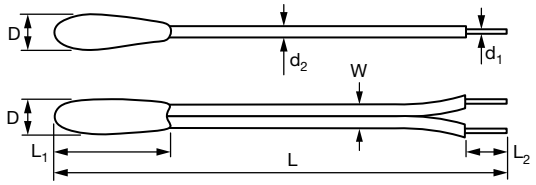
By soldering the wire end, or crimping connector. The body can be inserted in a tube, free in air, tape attached or glued. Not intended for fluid immersed applications or continuous contact with water. Not for potting in hard material or over-molding applications. Consult Vishay for specific application or mounting.

DESIGN-IN SUPPORT

- NTC curve computation: www.vishay.com/thermistors/ntc-rt-calculator/
- Other R/T curves available on request
- The lead length can be customized
- Connectors can be added to the wire end
- Consult Vishay for multistranded conductors for connector crimping

DIMENSIONS in millimeters

Electronic components of assessed quality measured in accordance with IEC 60539-1

Outline	NTCLE413E2
	
Ø D max.	3.0
L	Refer to the “Electrical Data and Ordering Information” table
L_1 max.	10
L_2	3 ± 1
W	2 (for information)
Ø d_1	0.3 ± 0.03
Ø d_2	1 (for information)

For technical questions, contact: nlr@vishay.com
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Table 3

PART IDENTIFICATION	R_{25}		$B_{25/85}$	
	kΩ	± %	K	± %
NTCLE413 10K 1 % B3435 K	10	1	3435	1.0

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES							
TEMPERATURE (°C)	R_T (Ω)	R_T/R_{25}	R-TOL. (± %)	α (%/K)	T-TOL. (± °C)	$R_{MIN.}$ (Ω)	$R_{MAX.}$ (Ω)
-40.0	190 953	19.095	4.24	-5.46	0.78	182 848	199 057
-35.0	145 953	14.595	3.93	-5.30	0.74	140 213	151 693
-30.0	112 440	11.244	3.63	-5.14	0.71	108 354	116 526
-25.0	87 285	8.7285	3.35	-4.99	0.67	84 364	90 206
-20.0	68 260	6.8260	3.07	-4.85	0.63	66 164	70 355
-15.0	53 762	5.3762	2.80	-4.71	0.60	52 254	55 270
-10.0	42 636	4.2636	2.55	-4.57	0.56	41 549	43 723
-5.0	34 038	3.4038	2.30	-4.44	0.52	33 254	34 822
0.0	27 348	2.7348	2.07	-4.31	0.48	26 783	27 913
5.0	22 108	2.2108	1.84	-4.19	0.44	21 702	22 515
10.0	17 979	1.7979	1.62	-4.08	0.40	17 689	18 270
15.0	14 706	1.4706	1.40	-3.96	0.35	14 499	14 912
20.0	12 094	1.2094	1.20	-3.86	0.31	11 949	12 239
25.0	10 000	1.0000	1.00	-3.75	0.27	9900.0	10 100
30.0	8310.8	0.83108	1.19	-3.65	0.33	8211.7	8409.8
35.0	6941.1	0.69411	1.38	-3.55	0.39	6845.5	7036.7
40.0	5824.9	0.58249	1.56	-3.46	0.45	5734.1	5915.6
45.0	4910.6	0.49106	1.73	-3.37	0.51	4825.6	4995.7
50.0	4158.3	0.41583	1.90	-3.28	0.58	4079.2	4237.3
55.0	3536.2	0.35362	2.06	-3.20	0.65	3463.2	3609.2
60.0	3019.7	0.30197	2.22	-3.12	0.71	2952.5	3086.8
65.0	2588.8	0.25888	2.38	-3.04	0.78	2527.3	2650.4
70.0	2228.0	0.22280	2.53	-2.96	0.85	2171.7	2284.3
75.0	1924.6	0.19246	2.67	-2.89	0.92	1873.1	1976.0
80.0	1668.4	0.16684	2.81	-2.82	1.00	1621.5	1715.3
85.0	1451.3	0.14513	2.95	-2.75	1.07	1408.5	1494.2
90.0	1266.7	0.12667	3.08	-2.69	1.15	1227.7	1305.8
95.0	1109.2	0.11092	3.21	-2.62	1.22	1073.6	1144.8
100.0	974.26	0.097426	3.34	-2.56	1.30	941.74	1006.8
105.0	858.33	0.085833	3.46	-2.50	1.38	828.62	888.04

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Type C2Q

Surface Mount Very Fast-Acting Chip Fuse

HF Pb C2Q Series – 0603 Size RoHS Compliant

Features

- Fast-acting
- Small size, 0603 SMD
- Current rating from 250mA to 5A
- Wide operating temperature range from -55℃ to 125℃
- Tape and Reel for automatic SMD placement
- Compatible with 260℃ IR Pb-free and wave soldering process
- Full compliance with EU Directive 2011/65/EU and amending directive 2015/863 (MSL = 1)
- Halogen Free and Lead Free
- AEC-Q Compliant
- Meets Bel automotive qualification*

  * - Largely based on internal AEC-Q test plan

Applications

- Notebook
- LCD monitor
- PC computer
- Office electronic equipment
- Industrial equipment
- Medical equipment
- POE, POE+
- LCD / LED monitor
- Power supply
- LCD / LED TV
- DC-DC Converter

UK CA c UL us CE

AEC-Q Compliant

LEAD FREE = Pb

HALOGEN FREE = HF

Electrical Characteristics (UL STD.248-14)

Testing Current	Blow Time	
	Minimum	Maximum
100%	4 Hrs.	N/A
200%	N/A	5 Sec
300%	N/A	0.2 Sec

Safety Agency Approvals

Safety Agency	Safety Agency Certificate	Ampere Rating/ Voltage Rating	Ampere Range / Volt @ I.R. ability*
c UL us	E506667	250mA-4A/32V AC 63V DC	250mA-4A/32V AC @ 35A 63V DC @ 50A
		5A / 32V AC & DC	5A / 32V AC & DC @ 50A
*I.R.= Interrupting Rating = Short Circuit Rating(Amps)			

Physical Specifications

Materials	Body : Ceramic Substrate
	Terminations : Ag / Ni / Sn (100% Lead-free)
	Element Cover Coating : Lead-free Glass
Marking	On Fuse :
	None
	On Label :
	"bel", "C2Q", "Current Rating", "Voltage Rating", "Interrupting Rating", "Appropriate Safety Logos" and " RoHS ", " e "(China RoHS compliant).

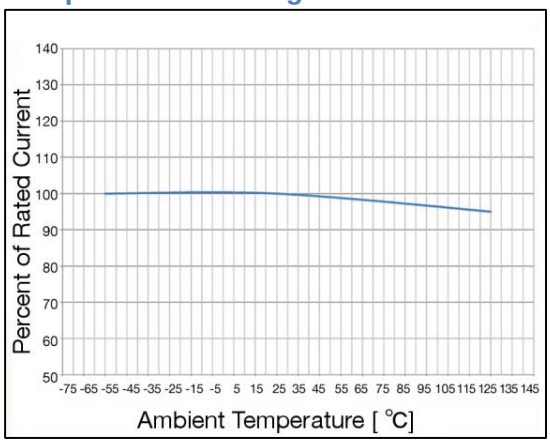
bel POWER SOLUTIONS & PROTECTION

a bel group

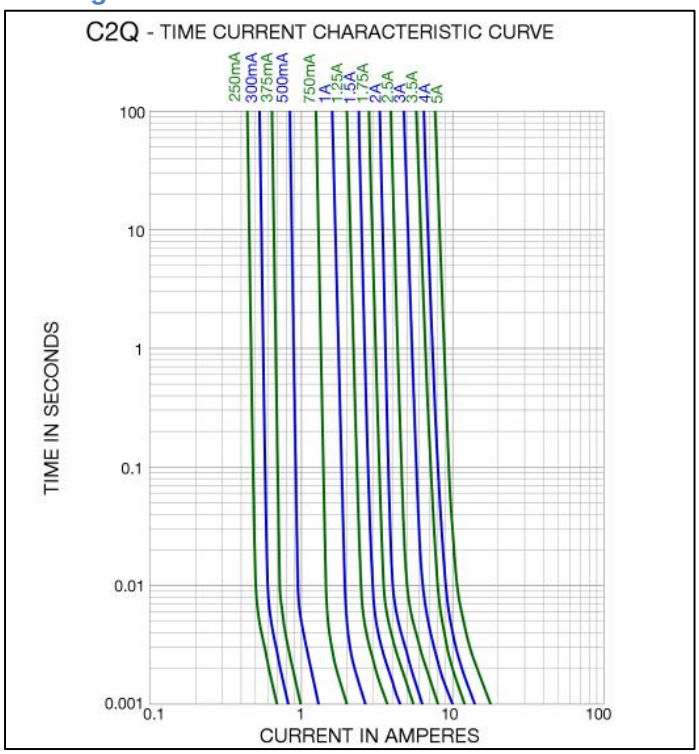
Specifications subject to change without notice

belfuse.com/circuit-protection

Temperature Derating Curve



Average Time Current Curve



Electrical Specifications

Catalog Number	Ampere Rating (A)	Nominal Cold Resistance (ohms)	Nominal Volt-drop @100% In (Volt)	Voltage and Interrupting Ratings	Nominal Melting I²T @10 In (A² Sec)	Nominal Power Dissipation @100% In (W)	Agency Approvals
							c UL us
C2Q 250	250mA	0.77	0.243	See Table of Safety Approvals on Page 1 for Voltage and associated Interrupting Ratings	0.00001	0.06	Y
C2Q 300	300mA	0.54	0.217		0.00003	0.07	Y
C2Q 375	375mA	0.42	0.196		0.00004	0.07	Y
C2Q 500	500mA	0.28	0.171		0.00015	0.09	Y
C2Q 750	750mA	0.17	0.159		0.0005	0.12	Y
C2Q 1	1A	0.122	0.154		0.0010	0.15	Y
C2Q 1.25	1.25A	0.092	0.152		0.0018	0.19	Y
C2Q 1.5	1.5A	0.073	0.146		0.0025	0.22	Y
C2Q 1.75	1.75A	0.063	0.144		0.0044	0.25	Y
C2Q 2	2A	0.053	0.133		0.0063	0.27	Y
C2Q 2.5	2.5A	0.042	0.130		0.0074	0.33	Y
C2Q 3	3A	0.034	0.130		0.018	0.39	Y
C2Q 3.5	3.5A	0.028	0.131		0.021	0.46	Y
C2Q 4	4A	0.023	0.131		0.042	0.52	Y
C2Q 5	5A	0.019	0.131		0.055	0.66	Y

Consult manufacturer for other ratings

Environmental Specifications

Bel Fuse Inc.
300 Executive Drive, Suite 300
West Orange, NJ 07052 USA

+1 201.432.0463
Bel.US.CS@belf.com
belfuse.com/circuit-protection

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Front Compartment

adler®

AE5 500 Vdc EV FUSE

DESCRIPTION

Adler AE5 series EV fuses are specially engineered and tested to provide best-in-class protection performance in protecting high power battery charging and managing systems of Electrical Vehicles and Hybrid Electrical Vehicles, up to 500 Vdc In ratings from 50A to 800A.

AGENCY INFORMATION

- Designed to JASO D622, ISO 8820-8, GB/T 31465
- UL, TUV certified (50A-400A),UL, TUV 400-800A in process
- Manufactured under IATF 16949 quality system
- RoHS and REACH Compliant

FEATURES

- Reliable clearing of DC fault currents
- High cycling performance
- Low watt losses
- Ultra-compact size and power density
- High breaking capacity to 50kA
- Operation as low as 200% In overload protection
- Full coverage of battery module current
- QR code marks on each fuse for traceability

APPICATIONS

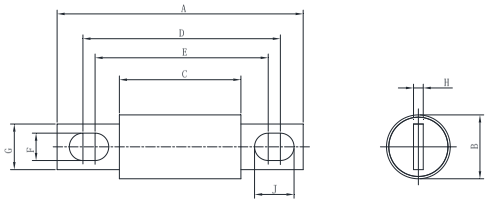
- Battery Charging Protection
- BMS Protection

PART NUMBERING SYSTEM

AE5 3100 6 25

- 25 — Body Size: 21, 25, 31, 38, 51
- 6 — Voltage Code: 500 Vdc
- 3100 — Ampere Code: See Table 2
- AE5 — Product Series: AE5

DIMENSIONS (mm)



Fuse Size	A ± 0.8mm	B ± 0.5mm	C ± 0.8mm	D ± 0.8mm	E ± 0.8mm	F ± 0.5mm	G ± 0.5mm	H ± 0.25mm	J ± 0.5mm
Φ21x40	81	21	40	66	57	8.5	15	3.2	13
Φ25x44	89	25	44	73	71	9	18	3.2	10
Φ31x53	92	31	53	76	69	8.5	22	5	12
Φ38x53	110	38	53	88	70	10.5	24.8	6	19.5
Φ51x53	110	51	53	90	71	10.5	38	6	20

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Document No: AE5DS01 A/9
Effective Date: 20240607

adlerelectric.com info@adlerelectric.com
ADLER Elektrotechnik Xi'an Co. Ltd. (Manufacturing)
ADLER Elektrotechnik Dongguan Co. Ltd. (Manufacturing)

Fuse Size	Box specifications (mm)	Packing quantity / per container	Weight / PCS (g)	Recommended Screw	Recommended tightening torque (N·m)
Φ21x40	380×245×200	192pcs	52±3%	M8	12±1
Φ25x44	380×245×200	120pcs	82±3%	M8	12±1
Φ31x53	380×245×200	75pcs	145±3%	M8	12±1
Φ38x53	380×245×200	64pcs	227±3%	M10	20±1
Φ51x53	380×245×200	24pcs	392±3%	M10	20±1

Table 1

ELECTRICAL SPECIFICATIONS

Size (mm)	Part Number	Rated Current	Ampere Code	Rated Voltage	Breaking Capacity			Melting I^2t	Clearing I^2t	Watt Loss (W)
					TUV	UL	Self-Certified	(A^2 s)	(A^2 s)	0.5 I_n
21x40	AE52500620	50A	2500	500Vdc	30kA	50kA	50kA	201	1510	1.4
	AE52600620	60A	2600	500Vdc	30kA	50kA	50kA	274	2164	1.5
	AE52700620	70A	2700	500Vdc	30kA	50kA	50kA	345	2933	1.8
	AE52800620	80A	2800	500Vdc	30kA	50kA	50kA	392	3565	2.1
	AE53100620	100A	3100	500Vdc	30kA	50kA	50kA	639	6826	2.4
	AE53125620	125A	3125	500Vdc	30kA	50kA	50kA	930	11396	2.9
	AE53150620	150A	3150	500Vdc	30kA	50kA	50kA	1062	14680	3.6
25x44	AE53100625	100A	3100	500Vdc	30kA	50kA	50kA	806	7258	2.4
	AE53125625	125A	3125	500Vdc	30kA	50kA	50kA	1260	11340	3.1
	AE53150625	150A	3150	500Vdc	30kA	50kA	50kA	1814	16330	3.8
	AE53175625	175A	3175	500Vdc	30kA	50kA	50kA	2474	22755	4.2
	AE53200625	200A	3200	500Vdc	30kA	50kA	50kA	3455	31097	4.9
	AE53225625	225A	3225	500Vdc	30kA	50kA	50kA	5040	40320	5.3
	AE53250625	250A	3250	500Vdc	30kA	50kA	50kA	6870	46500	5.9

31x53	AE53200631	200A	3200	500Vdc	30kA	50kA	50kA	4907	45631	5.2
	AE53225631	225A	3225	500Vdc	30kA	50kA	50kA	6192	55109	5.6
	AE53250631	250A	3250	500Vdc	30kA	50kA	50kA	7677	65256	6.1
	AE53300631	300A	3300	500Vdc	30kA	50kA	50kA	12700	102871	6.9
	AE53350631	350A	3350	500Vdc	30kA	50kA	50kA	15142	116596	8.3
	AE53400631	400A	3400	500Vdc	30kA	50kA	50kA	18620	139400	9.0
38x53	AE53400638	400A	3400	500Vdc	○	○	50kA	30897	185382	9.0
	AE53500638	500A	3500	500Vdc	○	○	50kA	59600	274000	11.6
	AE53550638	550A	3550	500Vdc	○	○	50kA	105700	290670	15.7
	AE53600638	600A	3600	500Vdc	○	○	50kA	133000	310400	18.2
51x53	AE53500651	500A	3500	500Vdc	50kA	50kA	50kA	50454	252272	11.3
	AE53550651	550A	3550	500Vdc	50kA	50kA	50kA	59080	295400	11.9
	AE53600651	600A	3600	500Vdc	50kA	50kA	50kA	71269	313583	14.2
	AE53700651	700A	3700	500Vdc	50kA	50kA	50kA	103000	449000	15.5
	AE53800651	800A	3800	500Vdc	50kA	50kA	50kA	131000	532000	17.3

Table 2

TUV File: J50437773; J50437772; J50433104

UL File：E506668(φ21-φ31) E485737(φ51)

○ --- certification is processing

Time constant: 2 ± 0.5ms

OPERATING CONDITIONS

Where the following conditions apply, fuses complying with this standard are deemed capable of operating satisfactorily without further qualification.

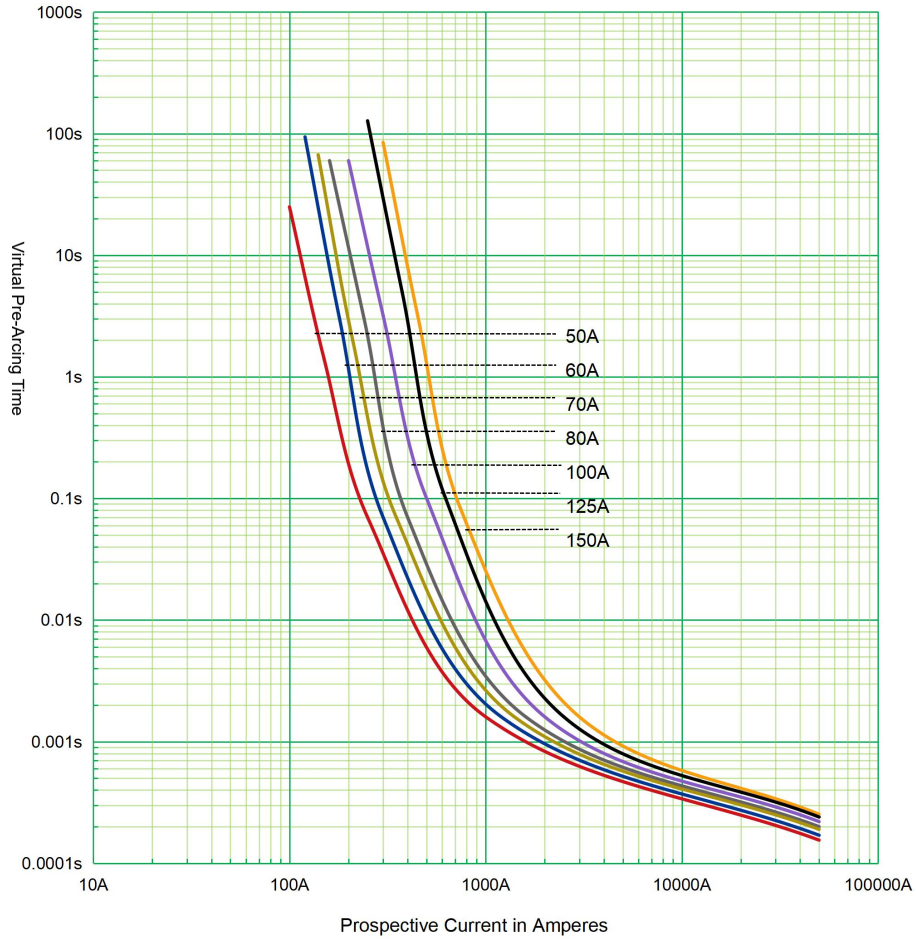
- Normal temperature: -5℃-40℃，permissible operating temperature：-40℃-120℃.
- The altitude of the normal site of installation of the fuses does not exceed 2000m above sea level and permissible altitude site of installation does not exceed 5000m.
- The air is clean and its relative humidity does not exceed 50 % at the maximum temperature of 40℃.
- Higher relative humidity is permitted at lower temperatures, e.g. 90 % at 20℃.
- Pollution grade III.
- Under these conditions, moderate condensation may occasionally occur due to variation in temperature.
- For operating conditions other than above, please contact manufacturer.

STORAGE

During transportation and storage, avoid water seepage and mechanical damage.

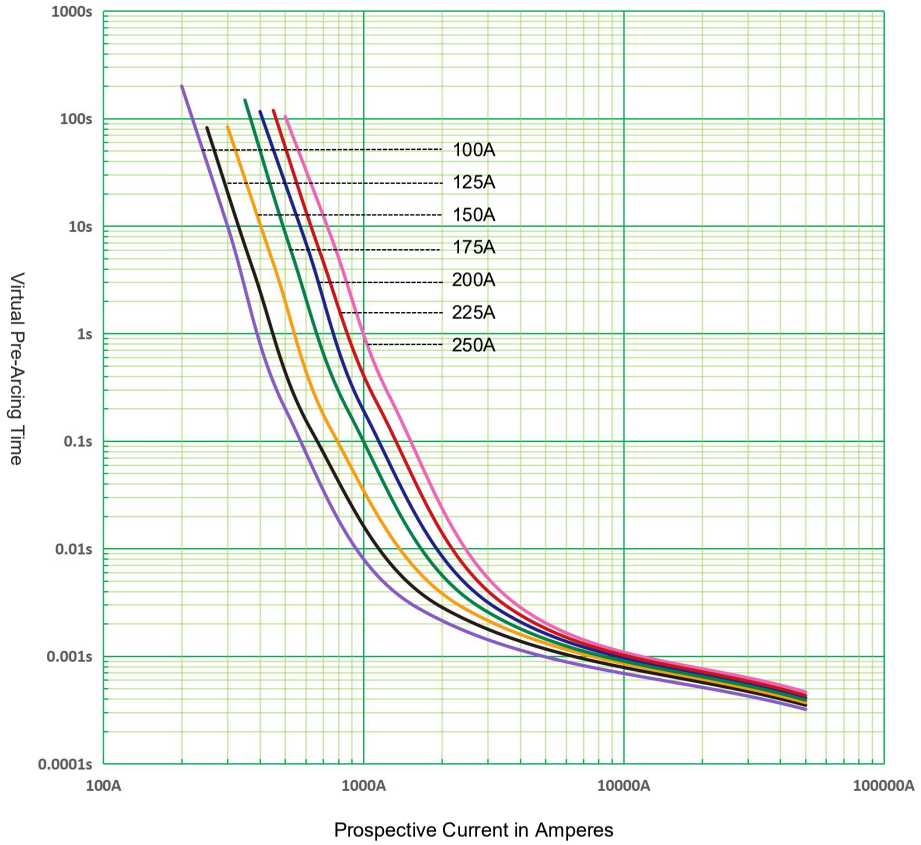
TIME CURRENT CURVE

AE5xxxx620 50A – 150A



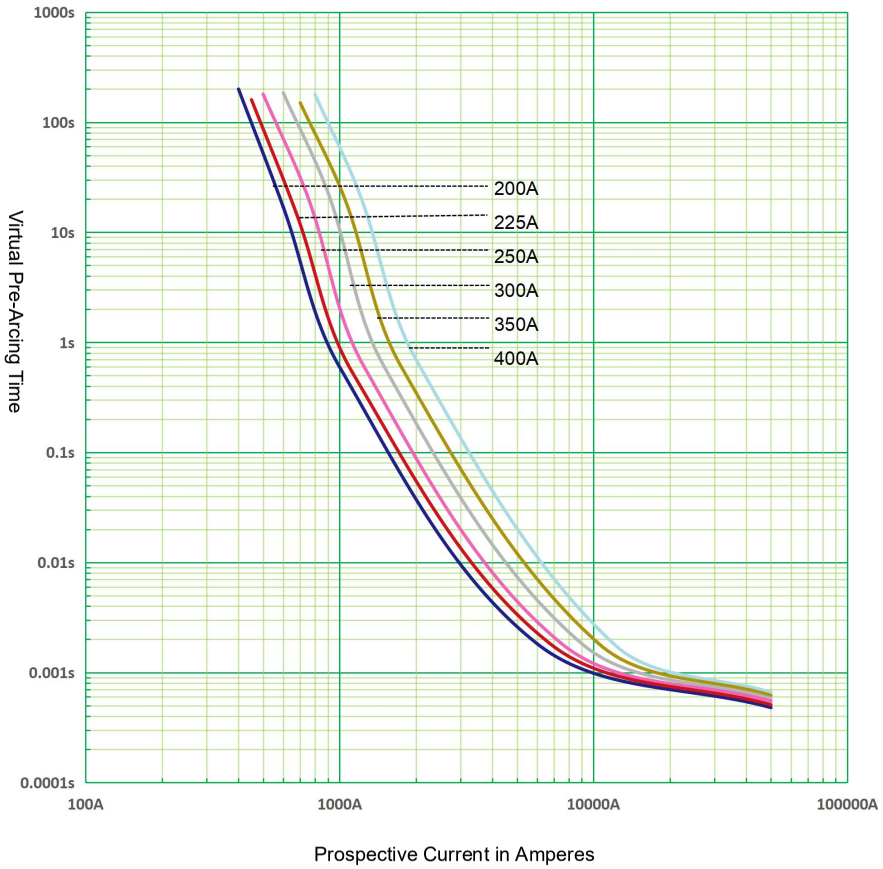
TIME CURRENT CURVE

AE5xxxx625 100A – 250A



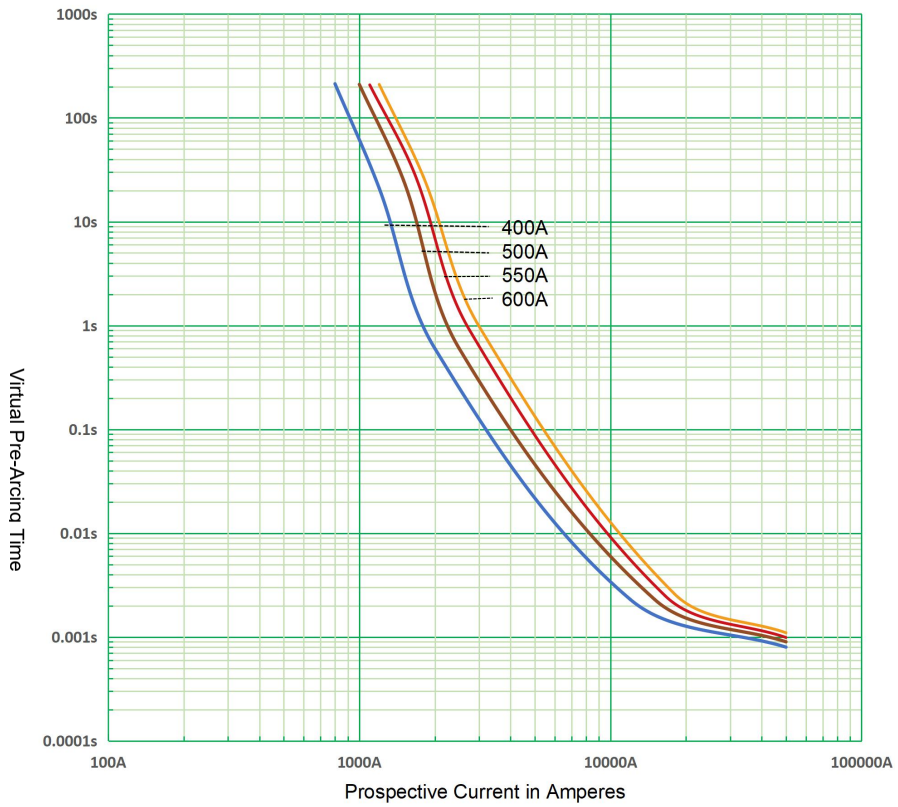
TIME CURRENT CURVE

AE5xxxx631 200A – 400A



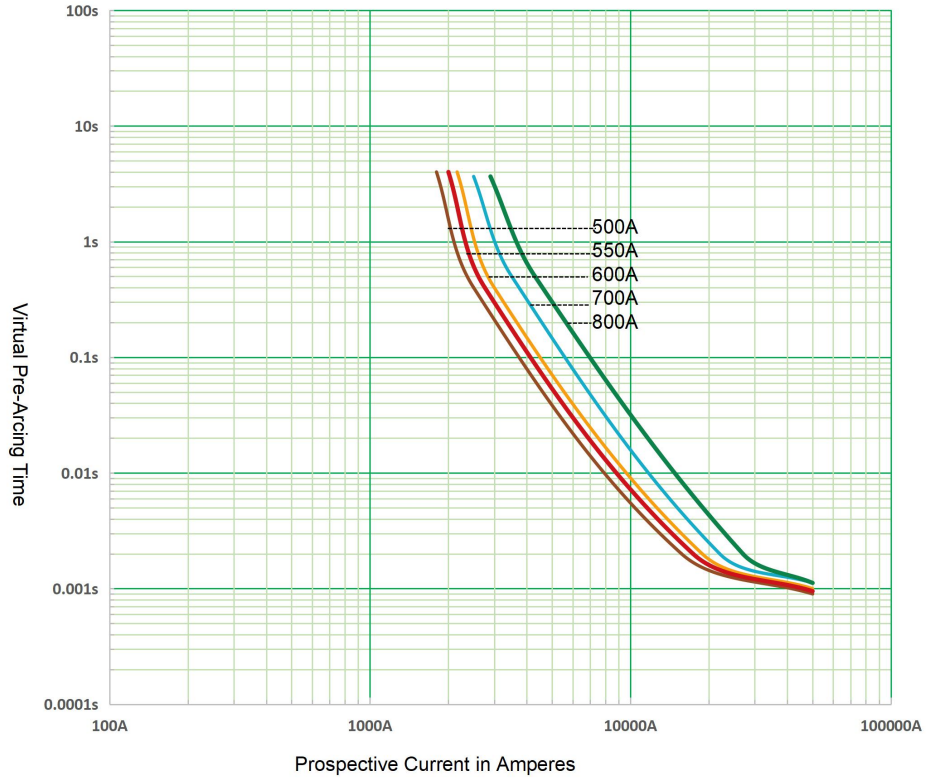
TIME CURRENT CURVE

AE5xxxx638 400A – 600A

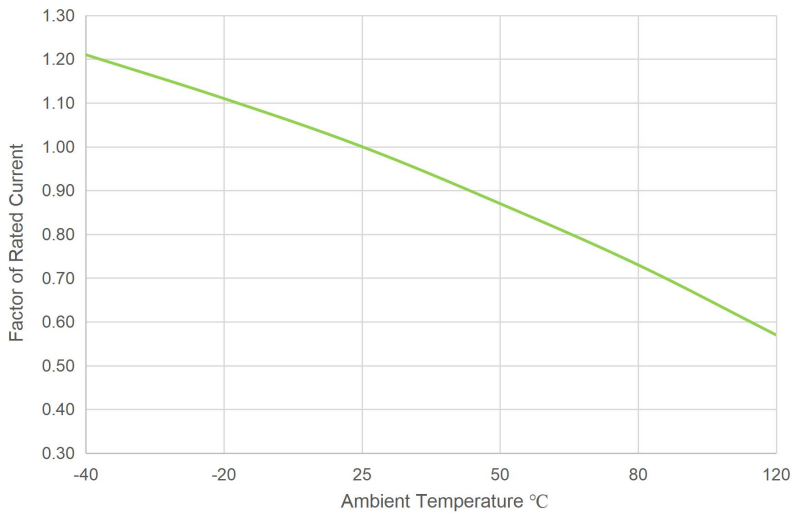


TIME CURRENT CURVE

AE5xxxx651 500A – 800A



Temperature derating curve



WEB RESOURCES

Download the latest technical documents: www.adlerelectric.com. Specifications are subject to change without notice.

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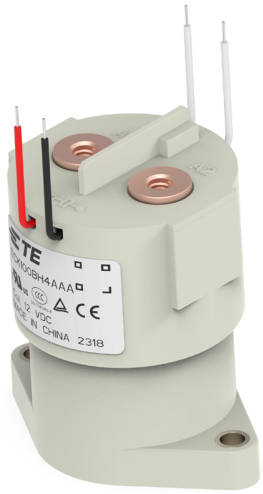
HIGH VOLTAGE DC CONTACTOR ECK100B SERIES

UP TO 150AMP, BI-DIRECTIONAL

INTRODUCTION

TE Connectivity (TE)'s ECK100B series high-voltage DC contactor is designed for control in high voltage applications like battery energy storage system, solar inverters, and EV charging applications. It can be used in 1000 VDC voltage systems and the enhanced contacts design provides for higher electrical endurance. The contacts provided in this series allows bi-directional load and are hermetically sealed with ceramic sealing technology, making it safer and reliable.



FEATURES

- Hermetically sealed with ceramic technology
- Allow bi-directional load for main contacts
- Continuous current carrying capacity of up to 150 A
- Enhanced breaking capacity up to 1000 VDC
- Auxiliary contact version available
- Compatibility with DC-1 utilization category in IEC60947-4-1

APPLICATIONS

- DC charging station
- Electric vehicle
- Automated Guided Vehicles (AGV)
- Electric forklift
- Battery energy storage systems
- Photovoltaic inverter

APPROVALS

- UL: E82292
- TUV: R50616669
- CE: 724_00007
- CCC approved

High Voltage DC Contactor ECK100B Series

CONTACT DATA

Contact current	150 A (at 40 °C) 100 A (at 85 °C)
Maximum switching voltage	1000 VDC
Contact arrangement	1 Form X (SPST-NO-DM)
Initial contact voltage drop	≤80 mV (100 A, after 1 minute)
Maximum short circuit current	1500 A, 30 ms 1000 A, 50 ms
Operate time, maximum (at 23 ºC)	30 ms
Release time, maximum (at 23ºC)	10 ms
Mechanical life	300,000 cycles

Note:

For contact current of 150 A (at 40 °C), recommended connection conductor size is AWG 2 (33.6 mm²). For contact current 100 A (at 85 °C), recommended connection conductor size AWG 4 (21.2 mm²). Smaller conductor size are also applicable but end users are requested to verify with application requirements and take active cooling actions to support long term performance.

CONTACT RATINGS

Load	Cycles
100A, 450 VDC, make/break, resistive	6,000
100A, 800VDC, make/break, resistive	1,000
100A, 1000VDC, make/break, resistive	1,000
150A, 1000VDC, make/break, resistive	100
300A, 500VDC, make/break, resistive	5

CE DECLARATION (IEC60947-4-1)

Rated Operational Current	Utilization Category	Switching Cycles
50A	DC-1	6,050

AUXILIARY CONTACT DATA

Contact form	1 Form A (SPST-NO)
Contact current, maximum	2 A, 30 VDC
Contact current, minimum	10 mA, 24 VDC
Contact resistance, maximum	0.4 Ω at 30 VDC / 0.15 Ω at 125 VAC

COIL VERSIONS, DC COIL

Coil code	Nominal voltage	Nominal operating current	Operate voltage	Maximum operating voltage	Release voltage	Coil power
4	12 VDC	0.462 A	≤9 VDC	13.2 VDC	≥1.2 VDC	5.5 W
5	24 VDC	0.249 A	≤18 VDC	26.4 VDC	≥2.4 VDC	6 W
6	48 VDC	0.122 A	≤36 VDC	52.8 VDC	≥4.8 VDC	6 W

All figures are given for coil without pre-energization, at ambient temperature +23°C.

INSULATION DATA

Dielectric withstand voltage (leakage current <1mA)	
between open main contacts	4,300 Vrms
between main contact and coil	4,300 Vrms
between main contacts and auxiliary contacts	4,300 Vrms
between open auxiliary contacts	750 Vrms
Initial insulation resistance at 1000VDC	
between insulated elements	> $1x10^9$ Ω

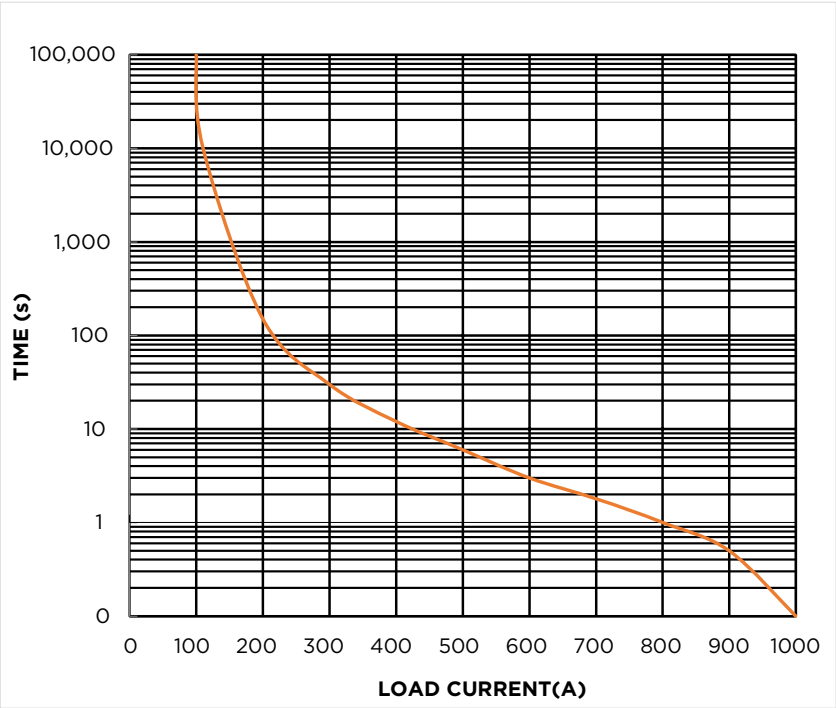
Note: End of life is reached when insulation resistance is <50 MΩ @ 1,000 V.

OTHER DATA

Material compliance: EU RoHS/ELV, China RoHS, REACH, and for halogen content refer to the product Compliance Support Center at www.te.com/customersupport/rohssupportcenter	
Protection category	IP67
Ambient temperature	-40 °C to 85 °C
Shock 11ms ½ sine (functional)	20G peak
Vibration sine, peak (functional)	6G, 10 Hz - 2000 Hz
Terminal type	Screw for main load contact, wire for coil and auxiliary contact
Weight	0.18 kg

High Voltage DC Contactor ECK100B Series

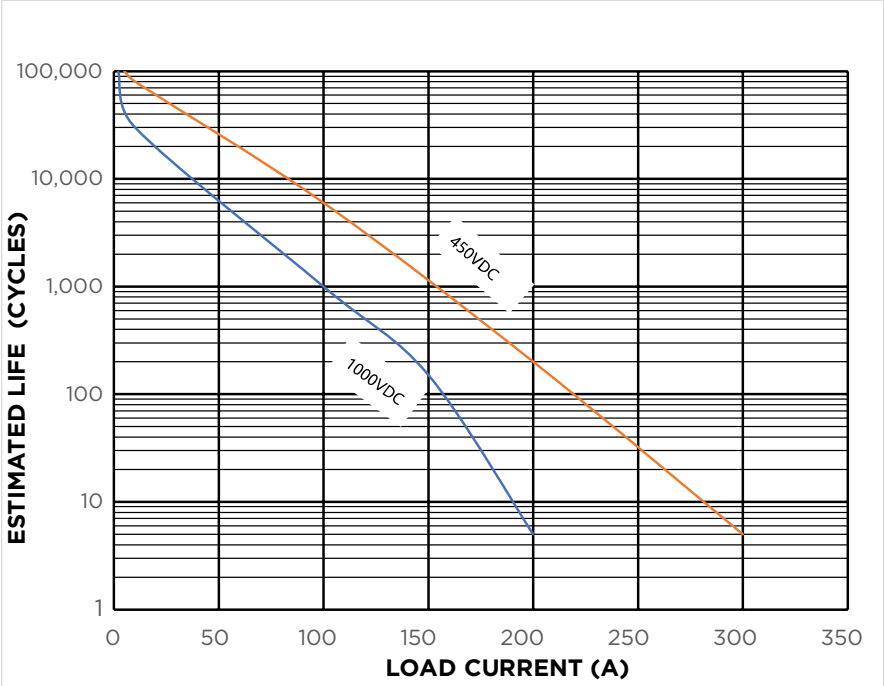
CURRENT CARRYING CAPABILITY CURVE



Note:

1. The data is measured at the environment temperature 85 °C with cross section area of wire 35 mm² min.

ESTIMATED MAKE AND BREAK POWER SWITHCHING RATINGS



Notes:

1. The curve was created based on extrapolated data with few typical points, users are recommended to confirm performance in actual application.
2. The typical data were estimated with resistive load at room temperature.

IVT-S // HIGH PRECISION CURRENT MEASUREMENT

1. Introduction 1
2. Application 1
3. Functionality description 2
4. Measurement description 5
5. Technical Data 11
6. Mechanical data 13
7. Part description / Ordering 18
8. CANbus protocol 19
9. Startup 41
10. Qualification 42
11. Index 44

1. Introduction

The IVT-S is a high precision current measurement system, designed for DC applications, especially for automotive application. The product is based on a modular design and provides flexibility for fast adaptations to meet customer requirements in the automotive and the industrial area. The continuous current measurement has a range up to ±2500 A. At higher currents (i.e. peaks) the measurement range will extend automatically.
The shunt-based measurement method uses a 16-bit analog-digital-converter to transform the voltage drop into a digital signal. The communication is based on a CAN bus 2.0a interface. A CAN description file (CAN-dbc) is available and supports fast system integration.

2. Application

The IVT-S is designed for a wide range of DC applications.

For example:

- Hybrid and full electric drives
- Uninterruptible Power Supply (UPS) systems
- Stationary energy storage systems
- Fuel cells
- All battery and storage based applications

No	Item	Unit	Min	Max
23	U1 measurement minimum	V	- 32.000	+ 32.000
24	U2 measurement maximum	V	- 32.000	+ 32.000
25	U2 measurement minimum	V	- 32.000	+ 32.000
26	U3 measurement maximum	V	- 32.000	+ 32.000
27	U3 measurement minimum	V	- 32.000	+ 32.000
28	Temperature measurement maximum	1/10 °C	- 500	+ 2000
29	Temperature measurement minimum	1/10 °C	- 500	+ 2000

3.5. Firmware update

To update the firmware, the IVT has an implemented bootloader. Firmware update can only be done by Isabellenhütte.

3.6. Galvanic isolation

This functionality is designed for high voltage applications.
With the isolation module the sensor can be used with different potential levels on power supply (low voltage side) and shunt (high voltage side).

Isolation voltage according DIN EN 60664-1:2008-01 Declarations are valid at the following condition: Sea level under 2000m	
Max Working Isolation Voltage	1000V RMS CATI 600V RMS CATI-II 300V RMS CATI-III
Basis Isolation DC Voltage	1000 V
Reinforced Isolation DC Voltage	600 V
Highest allowed transient overvoltage	6000V (for 1s)
Minimum External Clearance distance	> 40 mm
Minimum External Creepage distance	> 50 mm
Minimum Internal Clearance	8 mm
Material Group housing	IIIa
Material Group connectors	II

<u>Note:</u> For high voltages, it is recommended to use an insulation monitor.

3.7. Flammability

We confirm, that the IVT-S uses exclusively UL94-V0 materials. This applies to the following components:

- Housing
- Connectors
- PCB

3.8. Communication interface

The IVT-S uses the standard CAN 2.0 a protocol.

The complete protocol description is listed in chapter 8.

5. Technical Data

5.1. Operation conditions

Parameter	Min	Typical	Max	Unit
Ambient Temperature	-40		+105	°C
Operating Temperature Shunt[1]	-40		+125	°C
Supply Voltage (V_{cc})	5.5	12	40	V
Current Consumption		30	80	mA
Re-/ Startup Time		350	400	ms
Waiting Time Power On/Off	2			ms
Isolation	According to chapter 3.6			

5.2. Maximum ratings

Parameter	Min		Max	Unit
Storage Temperature	-40		+125	°C
Storage Humidity			95	%
Supply Voltage	-42		42	V

Parameter Shunt	Value					Unit
Nominal Measurement Range (depending on shunt)	±100	±300	±500	±1000	±2500	A
Extended Load (**max. time**)						
5min	±120	±320	±730	±1100	±2700	A
30s	±200	±430	±860	±1400	±3200	A
10s	±300	±600	±1000	±2000	±4300	A
1s	±900	±1600	±2700	±5500	±11300	A
200ms	±2000	±3600	±6000	±12000	±24000	A

5.3. Current measurement

Parameter	Value					Unit
Nominal Measurement Range	±100	±300	±500	±1000	±2500	A
Typical Shunt Resistance	285	95	35	20	5	µΩ
Power Loss	< 3	< 9	< 9	< 20	< 32	W
Overcurrent Measurement Range	±800	±2500	±6900	±12200	±48000	A
Initial Accuracy[2]	±0.1					%rdg[3]
Total Accuracy[2]	±0.4					%rdg[3]
Offset	8	25	75	125	500	mA
Linearity	0.01					% of range
Noise	5	15	40	70	280	mA (RMS)
Resolution	3	10	27	47	186	mA
Accuracy Overcurrent Range	± 3					%rdg
Offset Overcurrent Range	60	200	540	940	3720	mA
Linearity Overcurrent Range	0.1					% of range
Noise Overcurrent Range	40	120	320	560	2240	mA (RMS)
Resolution Overcurrent Range	24	80	216	376	1488	mA

[1] Results from 105°C ambient temperature + 20°C self-heating at hotspot (resistance material)
[2] In nominal measurement range
[3] Failure of reading

5.4. Voltage measurement

Parameter	Value			Unit
Nominal Measurement Range		±1000		V
Extended Range (nonlinear)		±1200		V
Typical Input Resistance		4		MΩ
Initial Accuracy		0.1		% of reading
Total Accuracy		0.5		% of reading
Offset		100		mV
Linearity		0.01		% of range
Noise[4]		60		mV (RMS)
Resolution		30		mV

5.5. Communication

Interface	Specification	Speed	Termination	Max Number of Unit
CAN	2.0 a	250 kbit/s; 500 kbits/s; 1 Mbit/s	120 Ω	6

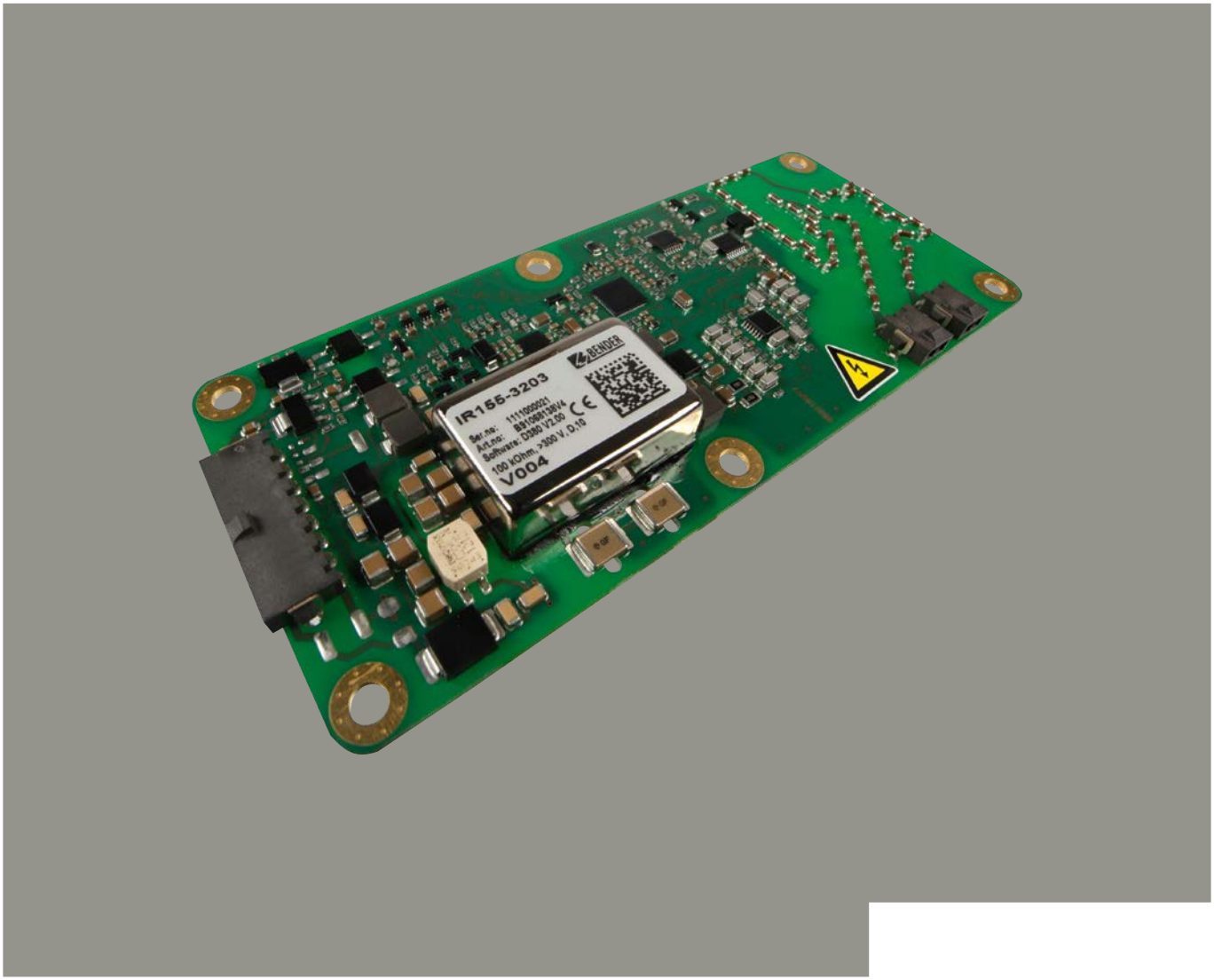
	Direction		Min	Max	Unit
V_{IH}	High-Level Input Voltage	TXD,S	2	5.25	V
V_{IL}	Low-Level Input Voltage	TXD,S	0	0.8	V
V_{ID}	Differential Input Voltage		-6	6	V
I_{OH}	High-Level Output Current	Driver	-70		mA
		Receiver	2		mA
I_{OL}	Low-Level Output Current	Driver	70		mA
		Receiver	2		mA

[4] Without averaging

ISOMETER® IR155-3203/IR155-3204

Insulation monitoring device (IMD) for unearthed DC drive systems (IT systems) in electric vehicles

Version V004



IR155-32xx-V004_D00115_05_D_XXEN/06.2024

Technical data

Insulation coordination acc. to IEC 60664-1

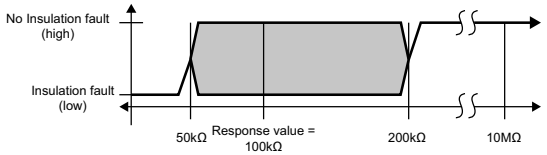
Protective separation (reinforced insulation)	
	between (L+/L-) – (Kl. 31, Kl. 15, E, KE, M_{HS}, M_{LS}, OK_{HS})
Voltage test	AC 3500 V/1 min
Supply/IT system being monitored	
Supply voltage U_S	DC 10…36 V
Max. operating current I_S	150 mA
Max. current I_k	2 A
	6 A/2 ms inrush current
HV voltage range (L+/L-) U_n	AC 0…1000 V (peak value)
	0…660 V RMS (10 Hz…1 kHz)
	DC 0…1000 V
Power consumption	< 2 W

Response values

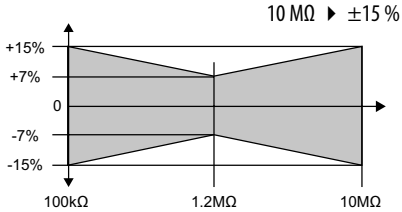
Response value hysteresis (DCP)	25 %
Response value R_{an}	100 kΩ…1 MΩ
Undervoltage detection	0…500 V

Measuring range

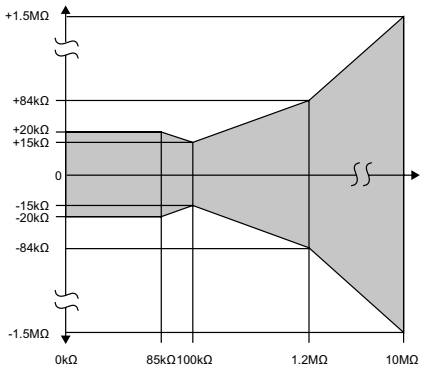
Measuring range	0…10 MΩ
Undervoltage detection	0…500 V default setting: 0 V (inactive)
Relative uncertainty	
SST (≤ 2 s)	good > 2* R_{an}; bad < 0.5* R_{an}
Relative uncertainty DCP	0…85 kΩ ▸ ±20 kΩ
(default setting 100 kΩ)	100 kΩ…10 MΩ ▸ ±15%
Relative uncertainty output M (fundamental frequency)	±5 % at each frequency
	(10 Hz; 20 Hz; 30 Hz; 40 Hz; 50 Hz)
Relative uncertainty	
undervoltage detection	U_n ≥ 100 V ▸ ±10 %; at U_n ≥300 V ▸ ±5 %
Relative uncertainty (SST)	"Good condition" ≥ 2* R_{an}
	"Bad condition" ≤ 0.5* R_{an}



Relative uncertainty DCP	100 kΩ…10 MΩ ±15 %
	100 kΩ…1.2 MΩ ▸ ±15 % to ±7 %
	1.2 MΩ ▸ ±7 %
	1.2…10 MΩ ▸ ±7 % to ±15 %
	10 MΩ ▸ ±15 %



Absolute uncertainty	0…85 kΩ ▸ ±20 kΩ



Time response

Response time t_{an} (OK_{HS}; SST)	t_{an} ≤ 2 s (typ. < 1 s at U_n > 100 V)
Response time t_{an} (OK_{HS}; DCP)	
(when changing over from R_F = 10 MΩ to R_{an}/2; at C_e = 1 µF; U_n = DC 1000 V)	
	t_{an} ≤ 20 s (at F_{ave} = 10*)
	t_{an} ≤ 17.5 s (at F_{ave} = 9)
	t_{an} ≤ 17.5 s (at F_{ave} = 8)
	t_{an} ≤ 15 s (at F_{ave} = 7)
	t_{an} ≤ 12.5 s (at F_{ave} = 6)
	t_{an} ≤ 12.5 s (at F_{ave} = 5)
	t_{an} ≤ 10 s (at F_{ave} = 4)
	t_{an} ≤ 7.5 s (at F_{ave} = 3)
	t_{an} ≤ 7.5 s (at F_{ave} = 2)
	t_{an} ≤ 5 s (at F_{ave} = 1)
	during the self test t_{an} + 10 s
Switch-off time t_{ab} (OK_{HS}; DCP)	
(when changing over from R_{an}/2 to R_F = 10 MΩ; at C_e = 1 µF; U_n = DC 1000 V	
	t_{ab} ≤ 40 s (at F_{ave} = 10)
	t_{ab} ≤ 40 s (at F_{ave} = 9)
	t_{ab} ≤ 33 s (at F_{ave} = 8)
	t_{ab} ≤ 33 s (at F_{ave} = 7)
	t_{ab} ≤ 33 s (at F_{ave} = 6)
	t_{ab} ≤ 26 s (at F_{ave} = 5)
	t_{ab} ≤ 26 s (at F_{ave} = 4)
	t_{ab} ≤ 26 s (at F_{ave} = 3)
	t_{ab} ≤ 20 s (at F_{ave} = 2)
	t_{ab} ≤ 20 s (at F_{ave} = 1)
	during a self test t_{ab} + 10 s
Duration of the self test	10 s
	(every five minutes; should be added to t_{an}/t_{ab})

Measuring circuit

System leakage capacitance C_e	≤ 1 µF
Smaller measurement range and increased measuring time at C_e	> 1 µF
	(e.g. max. range 1 MΩ @ 3 µF,
	t_{an} = 68 s when changing over from R_F 1 MΩ to R_{an}/2)
Measuring voltage U_M	±40 V
Measuring current I_M at R_F = 0	±33 µA
Impedance Z_i at 50 Hz	≥ 1.2 MΩ
Internal DC resistance R_i	≥ 1.2 MΩ

* F_{ave} = 10 is recommended for electric and hybrid vehicles

Output

Measurement output (M)

M_{HS} switches to U_S – 2 V (3204)
(external pull-down resistor to Kl. 31 necessary 2.2 kΩ)

M_{LS} switches to Kl. 31 + 2 V (3203)
(external pull-up resistor to Kl. 15 reqired 2.2 kΩ

0 Hz ▸ Hi > short-circuit to
U_b + (Kl. 15); Low > IMD off or short-circuit to Kl. 31

10 Hz ▸ Normal condition
Insulation measurement DCP;
starts two seconds after power on;
First successful insulation measurement at ≤ 17.5 s
PWM active 5…95 %

20 Hz ▸ undervoltage condition
Insulation measurement DCP (continuous measurement);
starts two seconds after power on;
PWM active 5…95 %
First successful insulation measurement at ≤ 17.5 s
Undervoltage detection 0…500 V
(Bender configurable)

30 Hz ▸ Speed start measurement
Insulation measurement (only good/bad evaluation)
starts directly after power on ≤ 2 s;
PWM 5…10 % (good) and 90…95 % (bad)

40 Hz ▸ Device error
Device error detected; PWM 47.5…52.5 %

50 Hz ▸ Connection fault earth
Fault detected on the earth connection (Kl. 31)
PWM 47.5…52.5 %

Status output (OK_{HS})

OK_{HS} switches to U_S – 2 V
(external pull-down resistor to Kl. 31 required 2.2 kΩ)

High ▸ No fault; R_F > response value
Low ▸ Insulation resistance ≤ response value detected;
Device error; Fault in the earth connection
Undervoltage detected or device switched off

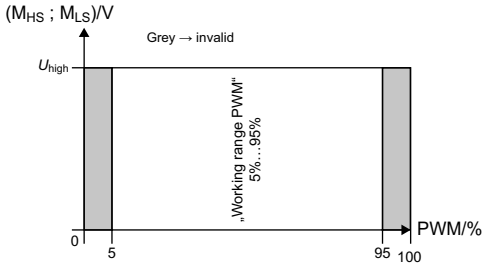
Operating principle PWM driver

- Condition "Normal" and "Undervoltage detected" (10 Hz; 20 Hz)

Duty cycle 5 % = > 50 MΩ (∞)
Duty cycle 50 % = 1200 kΩ
Duty cycle 95 % = 0 kΩ

$$R_F = \frac{90\ \% \times 1200\ k\Omega}{dc_{meas} - 5\%} - 1200\ k\Omega$$

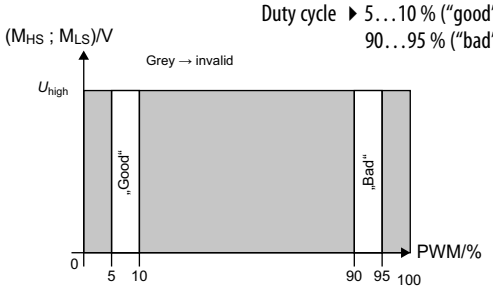
dc_{meas} = measured duty cycle (5 %…95 %)



Operating principle PWM driver

- Condition "SST" (30 Hz)

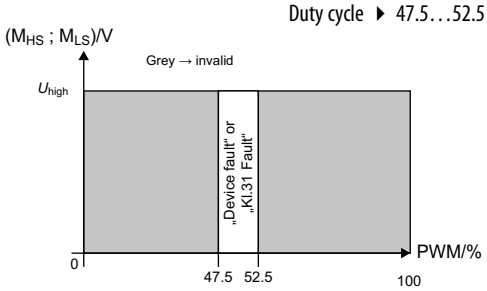
Duty cycle ▸ 5…10 % ("good")
90…95 % ("bad")



Operating principle PWM driver

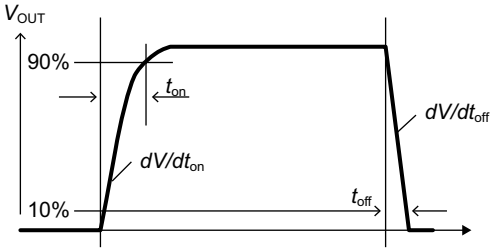
- Condition "Device error" and "Kl.31 fault" (40 Hz; 50 Hz;)

Duty cycle ▸ 47.5…52.5 %



Load current I_L	80 mA
Turn-on time ▸ to 90 % V_{out}	max. 125 µs
Turn-off time ▸ to 10 % V_{out}	max. 175 µs
Slew rate on ▸ 10…30 % V_{out}	max. 6 V/µs
Slew rate off ▸ 70…40 % V_{out}	max. 8 V/µs

Timing 3204 (inverse to 3203)



EMC

Load dump protection	< 50 V
Measurement method	Bender-DCP technology
Factor averaging	
F_{ave} (output M)	1…10 (factory set: 10)

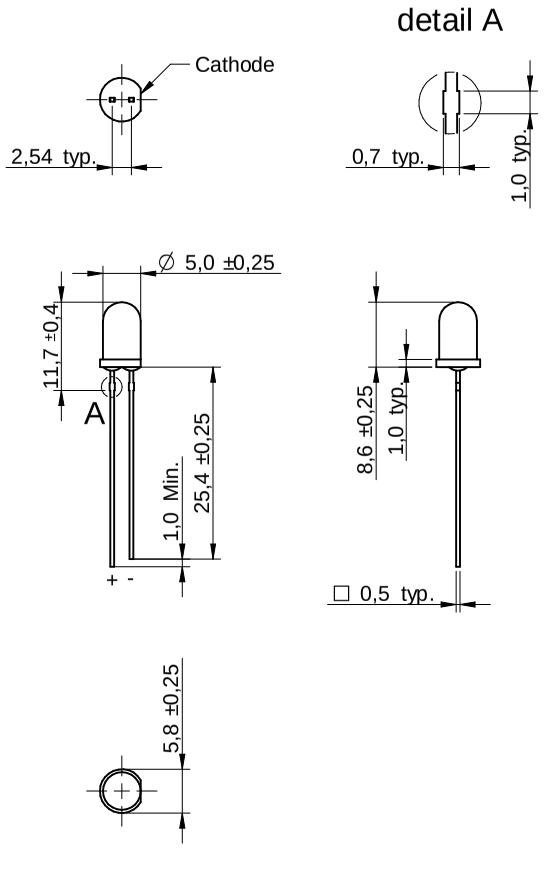
ESD protection

Contact discharge – directly to terminals	≤ 10 kV
Contact discharge – indirectly to environment	≤ 25 kV
Air discharge – handling of the PCB	≤ 6 kV

Connection

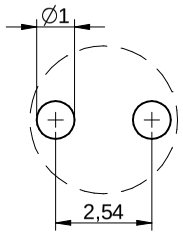
On-board connectors	TYCO-MICRO MATE-N-LOK 1 x 2-1445088-8 (Kl. 31, Kl.15, E, KE, M_{HS}, M_{LS}, OK_{HS} 2 x 2-1445088-2 (L+, L-); The connection between the respective connecting pins at L+ or L- may only be used as redundancy. Cannot be used for looping through!
Crimp contacts	TYCO-MICRO MATE-N-LOK Gold 14 x 1-794606-1 Conductor cross section: AWG 20…24
Enclosure for crimp contacts	TYCO-MICRO MATE-N-LOK receptor HSG single R -1445022-8 TYCO-MICRO MATE-N-LOK receptor HSG single R -1445022-2

Dimensions: [mm]



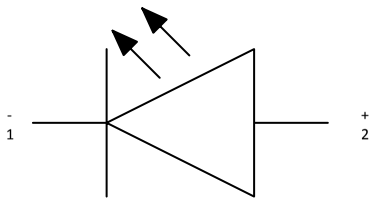
Scale - 1:1

Recommended Hole Pattern: [mm]



Scale - 5:1

Schematic:



Absolute Maximum Ratings (Ambient Temperature 25°C):

Properties		Test conditions	Value	Unit
Power Dissipation	P_{Diss}		78	mW
Peak Forward Current	$I_{F\ Peak}$	duty/ 10 @ 1 kHz	100	mA
Continuous Forward Current	I_F		30	mA
Reverse Voltage	V_{REV}		5	V
ESD Threshold/ Human Body Model	$V_{ESD\ HBM}$		2000	V

Optical Properties:

Chip Technology	AlInGaP
Emitting Color	Red
Lens Type	Waterclear

General Information:

Operating Temperature	-40 up to +85 °C
Storage Conditions (in original packaging)	< 40 °C ; < 75 % RH
Storage Conditions (for single parts)	-40 up to +100 °C
Moisture Sensitivity Level (MSL)	1

Würth Elektronik eiSos GmbH & Co. KG
EMC & Inductive Solutions

Max-Eyth-Str. 1
74638 Waldenburg
Germany
Tel. +49 (0) 79 42 945 - 0

www.we-online.com
eiSos@we-online.com

WÜRTH ELEKTRONIK

CREATED	CHECKED	GENERAL TOLERANCE	PROJECTION METHOD
DaSc	PLD	DIN ISO 2768-1m	

DESCRIPTION

WL-TMRW THT Mono-color Round Waterclear

ORDER CODE

151054RS03000

SIZE	REVISION	STATUS	DATE (YYYY-MM-DD)	BUSINESS UNIT	PAGE
5 mm	001.002	Valid	2018-11-02	eiPal	1/8

This electronic component has been designed and developed for usage in general electronic equipment only. This product is not authorized for use in equipment where a higher safety standard and reliability standard is especially required or where a failure of the product is reasonably expected to cause severe personal injury or death, unless the parties have executed an agreement specifically governing such use. Moreover Würth Elektronik eiSos GmbH & Co KG products are neither designed nor intended for use in areas such as military, aerospace, aviation, nuclear control, submarine, transportation (automotive control, train control, ship control), transportation signal, disaster prevention, medical, public information network etc.. Würth Elektronik eiSos GmbH & Co KG must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability evaluation checks for safety must be performed on every electronic component which is used in electrical circuits that require high safety and reliability functions or performance.

QS series

Snap-in panel mount LED indicators

DISTINCTIVE FEATURES

6 mm, 8 mm, 10 mm and 12 mm Ø cut-out sizes

Front panel snap-in mounting requires no additional hardware

Standard intensity diffused LED or high brightness LED for daylight viewing

GENERAL SPECIFICATIONS

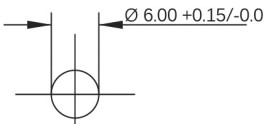
- Operating Temperature Range: -30 °C to +65 °C (–22 °F to +149 °F)
- Max Reverse Voltage: 5 V
- Life Expectancy: 100,000 hours
- Max Panel Thickness: 0.8 to 1.6 mm

MATERIALS

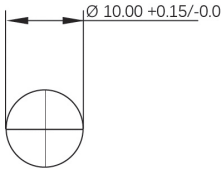
- Moulded polycarbonate

MOUNTING

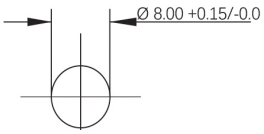
QS6 SERIES PANEL CUT-OUT



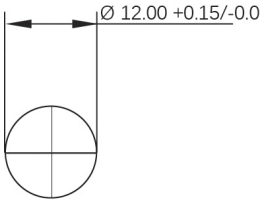
QS10 SERIES PANEL CUT-OUT



QS8 SERIES PANEL CUT-OUT



QS12 SERIES PANEL CUT-OUT



The company reserves the right to change specifications without notice.

LED characteristics are dependent upon environmental conditions. Therefore published data should be considered nominal and subject to variations.

QS series

Snap-in panel mount LED indicators

ELECTRICAL SPECIFICATIONS

STANDARD LED INTENSITY

LED COMPONENT SPECIFICATIONS			
	6 mm Intensity	8, 10 & 12 mm Intensity	Forward Voltage
HE Red	40 mcd	100 mcd	2.0 V
Green	40 mcd	60 mcd	2.2 V
Yellow	30 mcd	50 mcd	2.1 V
Orange	30 mcd	30 mcd	2.5 V
Blue	1,200 mcd	1,600 mcd	3.8 V
White (clear)	1,200 mcd	1,600 mcd	3.8 V
Bi-color (Typical) (Red/Green)	60 mcd	45 mcd	2.0 V
Tri-color (Typical) (Red/Green/Yellow)	-	60/15/13mcd	2.5 V

Bi-color - The color is changed by reversing the polarity of the supply voltage.
Tri-color - The indicator has red and green LEDs, when both connected yellow is produced.

HIGH BRIGHTNESS LED INTENSITY

LED COMPONENT SPECIFICATIONS			
	6 mm Intensity	8, 10 & 12 mm Intensity	Forward Voltage
HE Red	3,700 mcd	6,000 mcd	2.2 V
Green	2,000 mcd	1,900 mcd	3.2 V
Yellow	1,200 mcd	2,100 mcd	2.0 V
Orange	8,000 mcd	4,200 mcd	2.2 V

- The operating voltage must not be exceeded by more that 10% as this will result in reduced life expectancy
- Luminous intensity is measured at 20 mA on a discrete led unless otherwise stated.
- Luminous intensities and color shades of white LEDs may vary within a batch.
- Luminous intensity will be reduced with lower operating current.

Voltage	Operating Voltage	Operating Current
	(Min to Max)	(Typical All Types)
02 (No Resistor)	2.1 to 3.3 VDC	20 mA max*
6 VDC	5.4 to 6.6 VDC	20 mA
12 VDC	10.8 to 13.2 VDC	20 mA
24 VDC	21.6 to 26.4 VDC	20 mA
28 VDC	25.2 to 30.8 VDC	20 mA
110 VAC (not available on QS6)	99 to 110 VAC	6 mA
220 VAC (not available on QS6)	207 to 253 VAC	3 mA

* Customer to supply resistor for desired operating current.

QS series

Snap-in panel mount LED indicators

BUILD YOUR PART NUMBER

QS

SERIES

MOUNTING HOLE

6	Ø6 mm
8	Ø8 mm
10	Ø10 mm
12	Ø12 mm

TERMINALS

1	Solder lug/faston
3	Wires

TYPE OF ILLUMINATION

XX	Fixed Light
YY	Bi-color
ZZ	Tri-color (10 mm only)
KK	Flashing light (12 - 28 VDC)

LED COLOR

R	Red
G	Green
Y	Yellow
B	Blue
W	White (clear)
O	Orange
HR	Hyper Bright Red
HG	Hyper Bright Green
HY	Hyper Bright Yellow
HO	Hyper Bright Orange
RG	Red/Green
RYG	Red/Yellow/Green (10 mm Only)

VOLTAGE

02	No resistor*
06	6 VDC
12	12 VDC
24	24 VDC
28	28 VDC
110	110 VAC
220	220 VAC

* please refer to the forward voltage in electrical specifications

ABOUT THIS SERIES

Notice: please note that not all combinations of above numbers are available. Not all LED flashing options are available in this range, please contact APEM.

- Gold solder lug/Faston terminal denotes Anode (+), silver terminal denotes Cathode (-)
- Standard wire length is 200mm, QS6 & QS8 24 AWG UL1061, QS10 & QS12 22 AWG UL1061, red wire denotes Anode (+), black wire denotes Cathode (-) for other wire lengths consult APEM
- For LEDs with alternate voltages and multi-voltage options consult APEM.
- Bi-color LEDs, by connecting the gold Faston (+) one color is produced, by reversing the supply voltage another color is produced. Bi-color are available up to 28 VDC.
- Take care when soldering (recommended solder temperature 270 °C - 2 sec).
- The Tri-color LED has red and green LEDs when both are connected yellow is produced.
- We recommend using high brightness LEDs for use at 220 VAC
- 6 mm not available in 110 VAC or 220 VAC
- Mains voltage product is not recommended for use on 3 phase appliances

molex

Part Number : 2043130006
Product Description : Sentrality 6.00mm Top-entry, Knurled Press-fit Socket Assembly with +/-1.00mm Self-alignment Capability, Tray
Series Number : 204313
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2043130006_sd.pdf

2043650006-PK-000.pdf

3D Models and Design Files

2043130006_stp.zip

Specifications

2043130006-PS-000.pdf

2043130006-TS-000.pdf

2043131234-TS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)4144-DC (27 June 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC

- Low-Halogen

Industry Documents
- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest
- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	204313
Description	Sentrality 6.00mm Top-entry, Knurled Press-fit Socket Assembly with +/-1.00mm Self-alignment Capability, Tray
Application	Busbar-to-Board, Busbar-to-Busbar, Power
Comments	Current and voltage performances are dependent upon application variables.
Component Type	PCB Receptacle
Product Name	Sentrality
UPC	191130149902

Electrical

Current - Maximum per Contact	140.0A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	1

Circuits (maximum)	1
Diameter	6.00mm
Durability (mating cycles max)	200
Glow-Wire Capable	No
Guide to Mating Part	Yes
Height Above Board	3.40mm
Material - Metal	Copper Alloy
Material - Plating Mating	Gold
Material - Plating Termination	Silver
Mating Orientation	Top-entry
Net Weight	10.302/g
Number of Rows	1
Orientation	Vertical
Packaging Type	Tray
PCB Retention	None
Pitch - Mating Interface	N/A
Polarized to Mating Part	No
Polarized to PCB	No
Temperature Range - Operating	-40° to +125°C
Termination Interface Style	Press-Fit

Mates With / Use With

Mates with Part(s)

Description	Part Number
Sentrality Pins	203263

molex

Part Number : 2032630006
Product Description : Sentrality 6.00mm Knurled Press-fit Pin, 26.00mm Engagement Length, Bag
Series Number : 203263
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2032630006_sd.pdf

2032630006-PK-000.pdf

3D Models and Design Files

2032630006_stp.zip

Specifications

2043130006-PS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)4144-DC (27 June 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC
- Low-Halogen

Industry Documents

- IPC 1752A Class C
- IPC 1752A Class D

- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest
- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	203263
Description	Sentrality 6.00mm Knurled Press-fit Pin, 26.00mm Engagement Length, Bag
Application	Board-to-Board, Busbar-to-Board, Busbar-to-Busbar, Power
Component Type	PCB Header
Product Name	Sentrality
UPC	191130149858

Electrical

Current - Maximum per Contact	140.0A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	1
Circuits (maximum)	1
Diameter	6.00mm
Durability (mating cycles max)	200
Glow-Wire Capable	No
Guide to Mating Part	No
Height Above Board	26.00mm
Material - Metal	Copper Alloy

Material - Plating Mating	Silver
Material - Plating Termination	Silver
Net Weight	7.527/g
Number of Rows	1
Orientation	Vertical
Packaging Type	Bag
PCB Retention	None
Pitch - Mating Interface	N/A
Polarized to Mating Part	No
Polarized to PCB	No
Temperature Range - Operating	-40° to +125°C
Termination Interface Style	Press-Fit

Mates With / Use With

Mates with Part(s)

Description	Part Number
Sentrality Top-entry Surface Mount Socket Assemblies	204318
Sentrality Top-entry Surface Mount Socket Assemblies with Self-alignment Capability	204365
Sentrality Top-entry Knurled Press-Fit Socket Assemblies with Self-alignment Capability	204313
Sentrality Top-entry Knurled Press-Fit Socket Assemblies	204316
Sentrality 3.40mm Right-Angle Socket Assemblies	205000

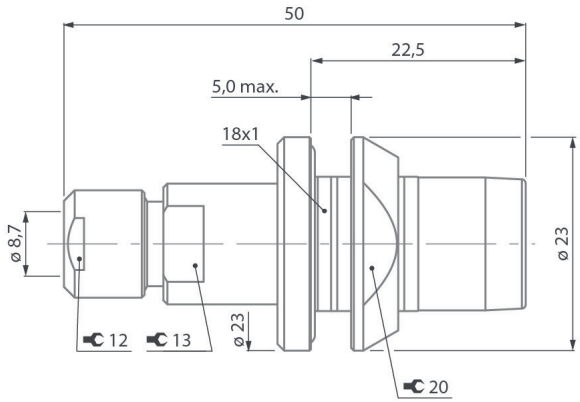
PANEL REAR MOUNTED CABLE RECEPTACLE

GENERAL INFORMATIONS

Part number	135211
Designation	DKBE 104 A087-80E+
Product line	Core Series Brass
Series size	104
Connector type	Receptacle
Body style design	Cable mounted
Housing material	Brass
Housing color	Grey
Contact termination	Solder
Contact gender	Female
Contact configuration	Mixed low voltage
Locking system	Plug-related
Mounting type	Panel Rear Mounted
Cable diameter (min - max) *[mm]*	-
Panel cut-out diameter *[mm]*	18.1
Data protocol compliance	USB 2.0 up to 480Mbit/s

Picture for illustration purpose only.
Contact configuration may vary- refer to pin layout.

DIMENSIONS



KEYING CODE

PIN LAYOUT

All dimensions and images shown are in millimeters and are for reference only.

ELECTRICAL & CONTACT CONFIGURATION

Number of contacts	Contact type	Insultator material	Contact Ø *[mm]*	Pin Ø *[mm]*	Ground pin Ø *[mm]*	Wire size min *[AWG]*	Wire size max *[AWG]*	Test voltage AC r.m.s *[kV] in mated position*		Test voltage DC *[kV] in mated position*		Current per contact *[A]*
								Contact to body	Contact to contact	Contact to body	Contact to contact	
2	Low voltage	PEEK	2.3	-	-	-	11	1.5	1.6	2.2	2.5	28
2	Low voltage	PEEK	0.9	-	-	-	21	2	1.6	2.8	2.5	3

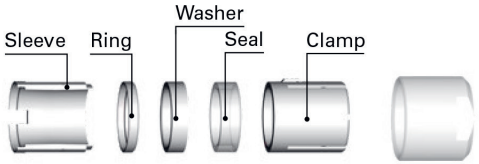
ENVIRONMENTAL & MECHANICAL DATA

Characteristic	Value	Standard
Corrosion resistance	Salt mist, 1000 hours ; 5% salt solution, 35°C	IEC 60068-2-11 Test Ka // MIL-STD-202 Method 101 Condition A // EIA-364-26
Endurance	10’000	IEC 60512-2-1, Test 2a // IEC 60512-2-2, Test 2b
Vibration resistance	10 to 2000 Hz, 1,5 mm or 15 g, 12 sweep cycles per axis, 20 minutes per 10-2000-10 Hz sweep cycle, no discontinuity > 1us	MIL-STD-202 Method 204 Condition B
Shock resistance	On request	On request

For this connector, you need to select from the following clamp sets

E ENVIRONMENTAL CLAMP SET

Environmentally sealed clamp for use with shielded or unshielded cables.



Characteristic	Value	Standard
Sealing performance	IP68 / IP69K	IEC 60529
Operation temperature	From -50 °C to 130 °C	IEC 60512-6-11 i+j // IEC 60068-2-14-Nb

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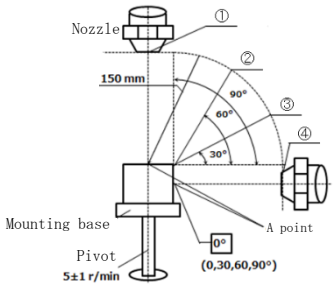
In case of consideration for using Automotive equipment / device which demand high reliability, kindly contact our sales window correspondents.

APPLICABLE STANDARD				
RATING	OPERATING TEMPERATURE RANGE	-40 °C TO +125 °C	STORAGE TEMPERATURE RANGE	-10 °C TO +60 °C (1)
	VOLTAGE	1 60 V AC/DC	STORAGE HUMIDITY RANGE	RELATIVE HUMIDITY 85% MAX (NOT DEWED)
	CURRENT	2 A		

SPECIFICATIONS

ITEM	TEST METHOD	REQUIREMENTS	QT	AT
CONSTRUCTION				
GENERAL EXAMINATION	VISUALLY AND BY MEASURING INSTRUMENT.	ACCORDING TO DRAWING.	×	×
MARKING	CONFIRMED VISUALLY.		×	×
ELECTRIC CHARACTERISTICS				
CONTACT RESISTANCE	1A DC.	8 mΩ MAX .	—	—
CONTACT RESISTANCE MILLIVOLT LEVEL METHOD	20 mV AC MAX, 0.1 mA(DC OR 1000Hz)	8 mΩ MAX .	—	—
INSULATION RESISTANCE	500V DC.	100 MΩMIN.	×	—
VOLTAGE PROOF	1000 V AC FOR 1 min. 1	NO BREAKDOWN.	—	—
MECHANICAL CHARACTERISTICS				
MECHANICAL OPERATION	30 TIMES INSERTIONS AND EXTRACTIONS.	① CONTACT RESISTANCE: 16 mΩ MAX. ② NO DAMAGE, CRACK AND LOOSENESS OF PARTS.	— ×	— —
VIBRATION	FREQUENCY 20 TO 200Hz (88m/s²) SWEEP TIME 3min.(ROUND TRIP) AT 3h FOR 3 DIRECTIONS.	① NO ELECTRICAL DISCONTINUITY OF 7ΩMIN, 1μs MIN. ② CONTACT RESISTANCE: 16 mΩ MAX. ③ NO DAMAGE, CRACK AND LOOSENESS OF PARTS.	— — ×	— — —
SHOCK	981m/s² DURATION OF PULSE 6ms AT 3 TIMES FOR 6 DIRECTIONS.	① NO ELECTRICAL DISCONTINUITY OF 7ΩMIN, 1μs MIN. ② NO DAMAGE, CRACK AND LOOSENESS OF PARTS.	— ×	— —
LOCK STRENGTH	MEASURE BREAK STRENGTH OF THE LOCK BY PULLING THE CONNECTOR IN THE MATING DIRECTION.	100N MIN.	×	—
ENVIRONMENTAL CHARACTERISTICS				
DAMP HEAT (STEADY STATE)	EXPOSED AT 60 °C, 90 ～ 95 %, 96 h.	① CONTACT RESISTANCE: 16 mΩ MAX. ② INSULATION RESISTANCE:100 MΩ MIN. ③ NO DAMAGE, CRACK AND LOOSENESS OF PARTS.	— × ×	— — —
RAPID CHANGE OF TEMPERATURE	TEMPERATURE- 40 →ROOM TEMP →125°C→ ROOM TEMP TIME 30 → 5 → 30 → 5 min UNDER 1000 CYCLES.	① CONTACT RESISTANCE: 16 mΩ MAX. ② NO DAMAGE, CRACK AND LOOSENESS OF PARTS.	— ×	— —
DRY HEAT	EXPOSED AT 140°C, 120 h.	① CONTACT RESISTANCE: 16 mΩ MAX. ② NO DAMAGE, CRACK AND LOOSENESS OF PARTS.	— ×	— —
COLD	EXPOSED AT -40°C, 120 h.	① CONTACT RESISTANCE: 16 mΩ MAX. ② NO DAMAGE, CRACK AND LOOSENESS OF PARTS.	— ×	— —
RESISTANCE TO SO_2 GAS	EXPOSED IN 25 PPM AT 75% MIN FOR 96h.	CONTACT RESISTANCE: 16 mΩ MAX.	—	—
RESISTANCE TO HIGH-PRESSURE WASHING 1	AFTER HEATING AT 120°C FOR 120 h, WATER AT 80°C, 10 MPa, FOR 30 sec AT THE POSITIONS OF ① TO ④. ROTATE THE MOUNTING BASE AT 5 r/min.	① NO WATER PENETRATION PERMITTED. ② INSULATION RESISTANCE:100 MΩ MIN.	× ×	— —



	COUNT	DESCRIPTION OF REVISIONS	DESIGNED	CHECKED	DATE
1	3	DIS-T-00005917	AN. SAIKI	HH. TSUKUMO	20200312

REMARK
(NOTE1) "STORAGE" means a long-term storage state for the unused product.

APPROVED	HK. UMEHARA	20190207
CHECKED	HH. TSUKUMO	20190207
DESIGNED	AS. SHIBAHARA	20190207
DRAWN	GYEONGMIN LEE	20190207

Note QT:Qualification Test AT:Assurance Test X:Applicable Test

DRAWING NO. ELC-378448-00-00

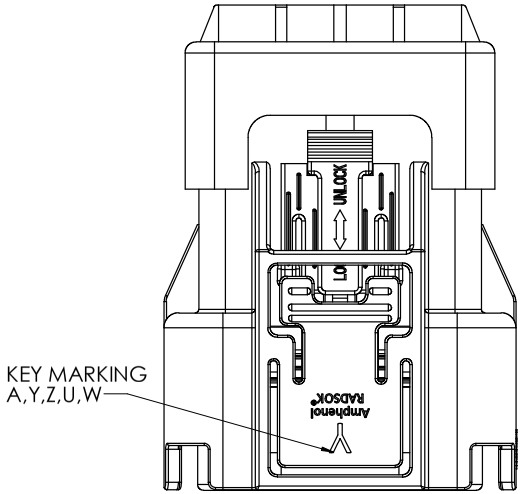
HRS	SPECIFICATION SHEET	PART NO.	ZE064W-14DP-HU/R(A)	
	HIROSE ELECTRIC CO., LTD.	CODE NO.	CL753-2008-0-00	1 1/1

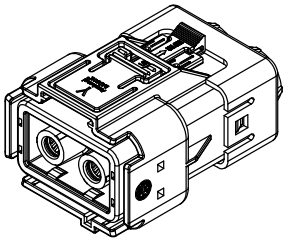
FORM HD0011-2-1

GENERAL TOLERANCE					
DIM.RANGE	0.5 - 3	>3-6	>6-30	>30-120	>120-400
TOLERANCE	±0.1	±0.1	±0.2	±0.3	±0.5

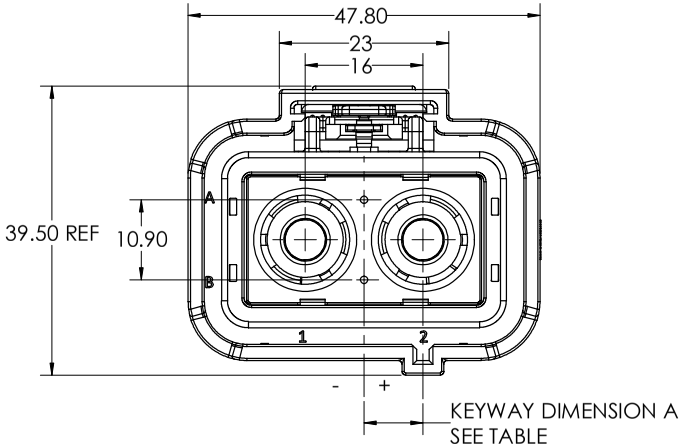
CUSTOMER DRAWING

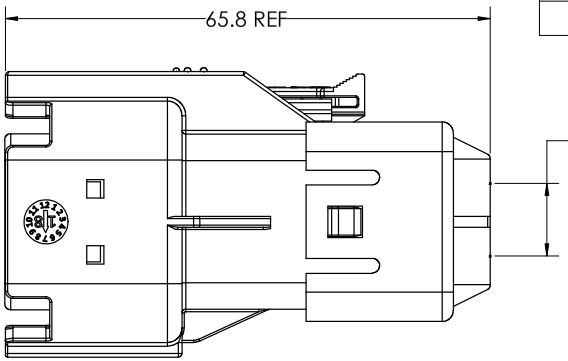
REVISION		
REV.	DESCRIPTION	DATE
C	MODIFY DESIGN	2016-11-29
D	UPDATE RoHS LABLE	2017-03-11
E	UPDATE CODE NUMBER AND MFG NUMBER	2018-06-28
F	UPDATE CONNECTOR LENGTH	2019-01-16
G	UPDATE CODE NUMBER	2019-02-21





SEPCIFICATION	
CONTACT SIZE	5.7 MM (RADSOK CONTACT) / #20 (HVIL CONTACT)
CONTACT TEST CURRENT	120 Amps Max / 5 Amps
OPERATING VOLTAGE	600V AC
OPERATING TEMPERATRUE	-40°C TO 125 °C
DIELECTRIC WITHATANDING VOLTAGE	2500V AC
NUMBER OF CANTACT	2&2
DURABILITY	100 (MIN)
WATER PROOF	IP67 (MATED)
FINGER PROOF	YES
HVIL	OPTION
SALT SPRAY	96 H





RECOMMENDED CABLE OD RANGE:
25MM² CABLE SIZE 13.9±0.3MM
16MM² CABLE SIZE 11.2±0.3MM

3. FOR ORDRING INFORMATION, PLEASE SEE CODE NUMBER REFERANCE. TO COMPLETE IT, ADD APPLICABLE CHARACTERS FOR DESIRED REQUIREMENT. SEE PAGE 2 FOR DETAIL INFORMATION.

2. THE DRAWING ILLUSTRATE FINALL ASSEMBLY. FOR STORAGE AND SHIPPING, THE POWER &HVIL CONTACTS ARE SHIPPED UNASSEMBLED.

1. THE REFERENCED PRODUCT SHALL BE COMPLIANT TO RoHS DIRECTIVE.

NOTES:

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION MAY NOT BE DISCLOSED TO OTHERS FOR ANY PURPOSE OR USED FOR MANUFACTURING PURPOSES WITHOUT WRITTEN PERMISSION FROM THE AMPHENOL CORP.

UNLESS OTHERWISE SPECIFIED
LINEAR DIMENSIONS ARE IN: MILLIMETERS
TOLERANCES:
ANGLES= ±2°
DEFAULT LINEAR TOLERANCES SEE TABLE
DIM. & TOL. PER ASME Y14.5M-1994;
DRM PER MIL-DTL-31000;
OTHER AMPHENOL STANDARDS: 9-3800
LEGENDS:
△ =FLAG NOTE CALL OUT REFERENCE
THIRD ANGLE PROJECTION

APPROVALS		DATE
PREPARED BY:	THOR YAN	2018-06-28
ENGINEER IN CHANGE:	SEVEN XIE	
DESIGN MANAGER:	ROB WENG	
PRODUCT GROUP:	C&3	
AIPG DIVISION:		
MATERIAL SPEC	PROCESS SPEC	
N/A	N/A	

AMPHENOL INDUSTRIAL OPERATIONS
Amphenol Technology(Zhuhai)Co.,Ltd
No.63, Xinghan Road, Sanzao Town, Jinwan, Zhuhai, PRC

ELECTRICAL PLUG CONNECTOR WITH HVIL & SHIELDING 2PORTS, Epower-lite SERIES

SIZE	CAGE CODE	DOCUMENT NUMBER	REV
C	77820	C( )-738986-2( )S( )	G

SCALE: 1:2 | REF: | SHEET 1 OF 2

(G) CODE NUMBER REFERANCE: ELPA2( )( )( )

KEYWAY MARKING
SEE TABLE 1

WIRE SIZE
SEE TABLE 1

HVIL&EMI OPTION
SEE TABLE 1

TABLE 1			
ITEM NO.	DESCRIPTION	CODE NUMBER	DIMENSION A
KEYWAY MARKING	KEYWAY A	A	4
	KEYWAY Y	Y	8
	KEYWAY Z	Z	0
	KEYWAY U	U	-8
	KEYWAY W	W	-4
WIRE SIZE	25 MM^2	25	
	16 MM^2	16	
HVIL & EMI OPTION	YES EMI & YES HVIL	--	
	YES EMI & NO HVIL	01	
	NO EMI & YES HVIL	10	
	NO EMI & NO HVIL	11	

MFG NUMBER REFERANCE: C( )-738986-2( )S( )

HVIL&EMI OPTION
SEE TABLE 2

KEYWAY MARKING
SEE TABLE 2

WIRE SIZE
SEE TABLE 2

TABLE 2			
ITEM NO.	DESCRIPTION	MFG NUMBER	DIMENSION A
KEYWAY MARKING	KEYWAY A	A	4
	KEYWAY Y	Y	8
	KEYWAY Z	Z	0
	KEYWAY U	U	-8
	KEYWAY W	W	-4
WIRE SIZE	25 MM^2	2	
	16 MM^2	1	
HVIL & EMI OPTION	YES EMI & YES HVIL	10	
	YES EMI & NO HVIL	20	
	NO EMI & YES HVIL	30	
	NO EMI & NO HVIL	40	

NOTES:

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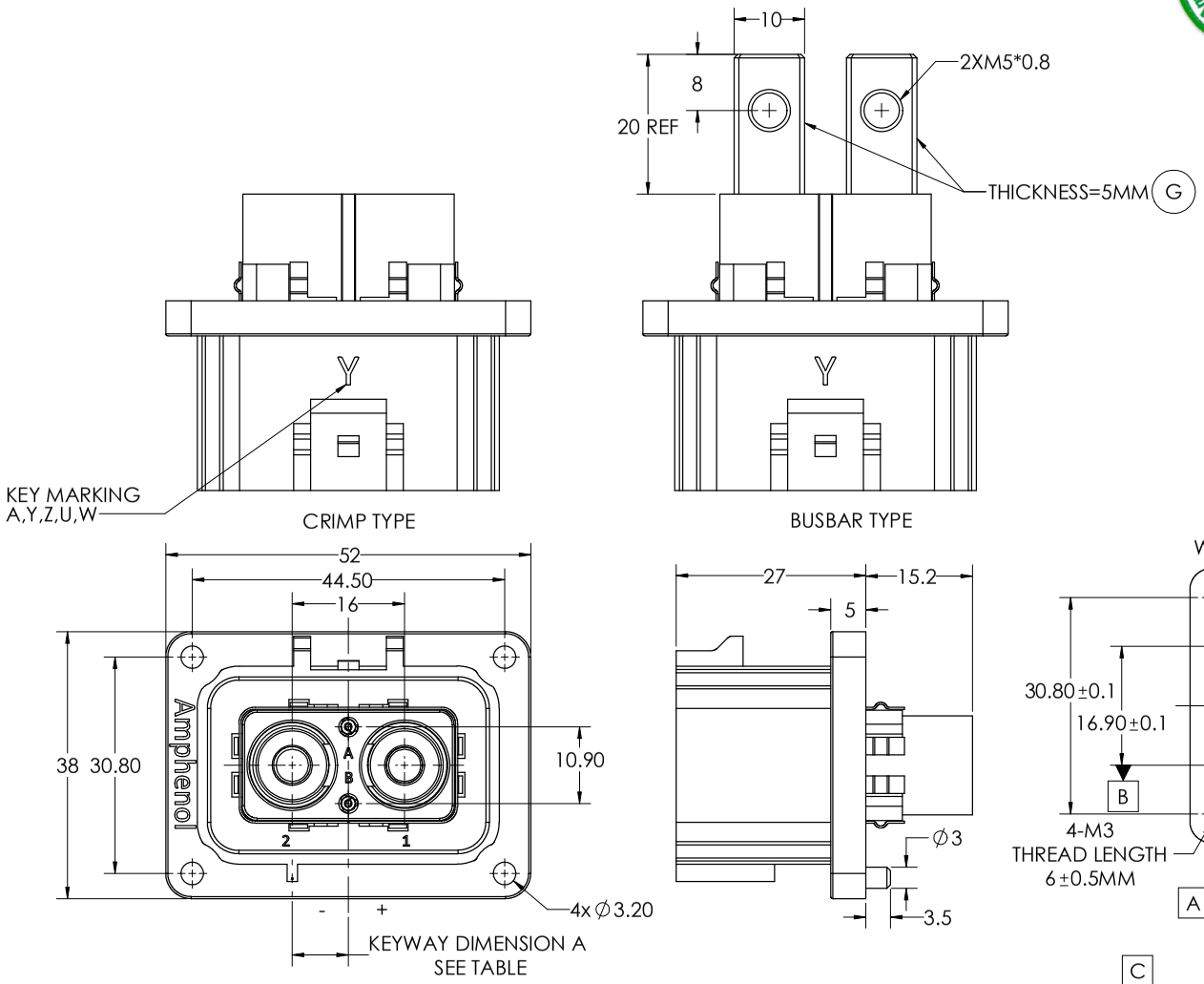
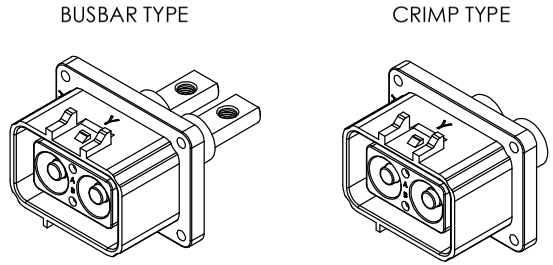
SIZE	CAGE CODE	DOCUMENT NUMBER	REV
C	77820	C( )-738986-2( )S( )	G
SCALE: 2:1	REF:		SHEET 2 OF 2

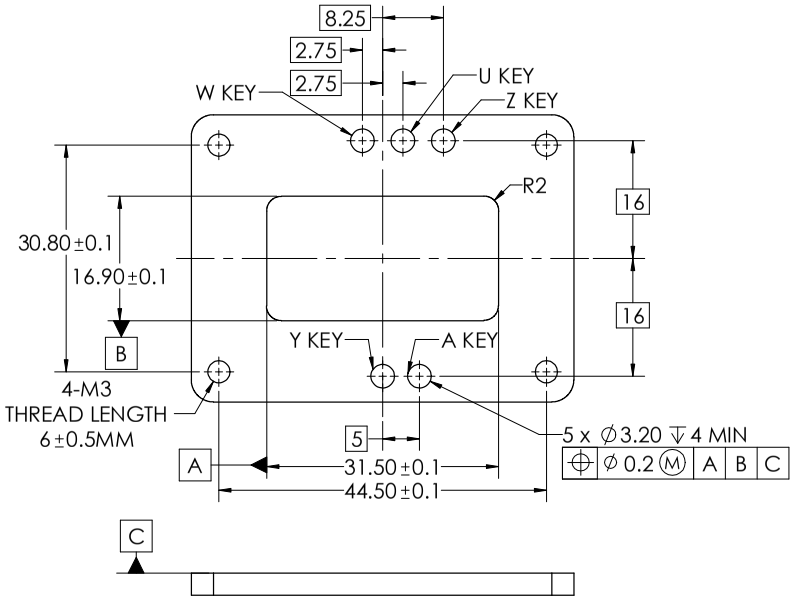
GENERAL TOLERANCE					
DIM.RANGE	0.5 - 3	>3-6	>6-30	>30-120	>120-400
TOLERANCE	±0.1	±0.1	±0.2	±0.3	±0.5

CUSTOMER DRAWING

REVISION		
REV.	DESCRIPTION	DATE
C	MODIFY DESIGN	2016-11-23
D	UPDATE RoHS LABLE	2017-03-11
E	UPDATE CODE NUMBER AND MFG NUMBER	2018-06-28
F	ADD BUSBAR TYPE	2018-09-19
G	UPDATE CODE NUMBER	2019-02-21







RECOMMENDED CUT-OUT PANEL LAYOUT DIMENSIONS

3. FOR ORDRING INFORMATION, PLEASE SEE CODE NUMBER REFERANCE. TO COMPLETE IT, ADD APPLICABLE CHARACTERS FOR DESIRED REQUIREMENT. SEE PAGE 2 FOR DETAIL INFORMATION.

2. THE DRAWING ILLUSTRATE FINALL ASSEMBLY. FOR STORAGE AND SHIPPING, THE POWER &HVIL CONTACTS ARE SHIPPED UNASSEMBLED.

1. THE REFERENCED PRODUCT SHALL BE COMPLIANT TO RoHS DIRECTIVE

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UNLESS OTHERWISE SPECIFIED

LINEAR DIMENSIONS ARE IN: **MILLIMETERS**
TOLERANCES:
ANGLES= ±2°
DEFAULT LINEAR TOLERANCES SEE TABLE

DIM. & TOL. PER ASME Y14.5M-1994;
DRM PER MIL-DTL-31000;
OTHER AMPHENOL STANDARDS: 9-3800

LEGENDS:
△ =FLAG NOTE CALL OUT REFERENCE

THIRD ANGLE PROJECTION

APPROVALS		DATE
PREPARED BY:	THOR YAN	2019-02-21
ENGINEER IN CHANGE:	SEVEN XIE	
DESIGN MANAGER:	ROB WENG	
PRODUCT GROUP:	C&3	
AIPG DIVISION:		

MATERIAL SPEC	PROCESS SPEC
N/A	N/A

AMPHENOL INDUSTRIAL OPERATIONS
Amphenol Technology(Zhuhai)Co.,Ltd
No.63, Xinghan Road, Sanzao Town, Jinwan, Zhuhai, PRC

ELECTRICAL RECEPTACLE CONNECTOR WITH HVIL & SHIELDING 2PORTS, Epower-lite SERIES U

SIZE	CAGE CODE	DOCUMENT NUMBER	REV
C	77820	C( )-738985-2( )P( )	G
SCALE: 2:1	REF: N/A		SHEET 1 OF 2

CODE NUMBER REFERANCE: ELRA2( )( )( ) (G)

KEYWAY MARKING
SEE TABLE 1

PIN TYPE
SEE TABLE 1

HVIL&EMI OPTION
SEE TABLE 1

MFG NUMBER REFERANCE: C( )-738985-2( )P( )

HVIL&EMI OPTION
SEE TABLE 2

KEYWAY MARKING
SEE TABLE 2

PIN TYPE
SEE TABLE 2

TABLE 1			
ITEM NO.	DESCRIPTION	CODE NUMBER	DIMENSION A
KEYWAY MARKING	KEYWAY A	A	-4
	KEYWAY Y	Y	-8
	KEYWAY Z	Z	0
	KEYWAY U	U	8
	KEYWAY W	W	4
PIN TYPE	25 MM^2 CRIMP	25	
	16 MM^2 CRIMP	16	
	BUSBAR	03	
HVIL & EMI OPTION	YES EMI & YES HVIL	--	
	YES EMI & NO HVIL	01	
	NO EMI & YES HVIL	10	
	NO EMI & NO HVIL	11	

SEPCIFICATION	
CONTACT SIZE	5.7 MM (RADSOK CONTACT) / #20 (HVIL CONTACT)
CONTACT TEST CURRENT	POWER 120 Amps Max HVIL 5 Amps
OPERATING VOLTAGE	600V AC
OPERATING TEMPERATRUE	-40°C TO 125°C
DIELECTRIC WITHATANDING VOLTAGE	2500V AC
NUMBER OF CANTACT	2&2
DURABILITY	100 (MIN)
WATER PROOF	IP67 (MATED)
FINGER PROOF	YES
HVIL	OPTION
SALT SPRAY	96 H

TABLE 2			
ITEM NO.	DESCRIPTION	MFG NUMBER	DIMENSION A
KEYWAY MARKING	KEYWAY A	A	-4
	KEYWAY Y	Y	-8
	KEYWAY Z	Z	0
	KEYWAY U	U	8
	KEYWAY W	W	4
PIN TYPE	BUSBAR	3	
	25 MM^2	2	
	16 MM^2	1	
HVIL & EMI OPTION	YES EMI & YES HVIL	10	
	YES EMI & NO HVIL	20	
	NO EMI & YES HVIL	30	
	NO EMI & NO HVIL	40	

NOTES:

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SIZE	CAGE CODE	DOCUMENT NUMBER	REV
C	77820	C( )-738985-2( )P( )	G
SCALE: 2:1	REF:	N/A	SHEET 2 OF 2

PLASTIK 70 SUPER

Effective protection for electronic circuits and assemblies.

1. GENERAL DESCRIPTION

Quick drying, colorless transparent insulating and protective coating based on novel acrylic resins.

2. FEATURES

•PLASTIK 70 SUPER is a low viscosity, solvent drying acrylic based conformal coating with excellent insulating properties. The lacquer is colorless transparent and elastic. It resists to extreme temperatures in the range from – 40°C to + 125°C.
Perfect protection and insulation in hot/humid environment.
PLASTIK 70 SUPER is colorless-transparent and as such is not visual on the printed circuit board surface.
Contains a pigment that gives a fluorescent blue glow when exposed to UV light.
Without silicones.
For repair works PLASTIK 70 SUPER can be soldered through or be totally removed with Kontakt Chemie THINNER 70

3. APPLICATIONS

PLASTIK 70 SUPER can be used in applications such as aeronautics, marine, aerospace, telecommunications, electronic materials, automotive electricity etc.
PLASTIK 70 SUPER is used as a durable protection on all electronic assemblies which have to resist extreme climatic conditions.

4. DIRECTIONS

For small runs and service applications, the easiest way to apply PLASTIK 70 SUPER is from an aerosol can. Spray from a distance of 20 to 30 cm on the dry and degreased surface. As pre-cleaning of PCB's, we do recommend the use of KONTAKT PCC to remove greases, dirt and flux residues. When finished spraying, clean the aerosol valve by turning the can upside down and pressing the button until only propellant escapes.

For serial production runs, PLASTIK 70 SUPER in bulk can be applied by brush or by dipping. For spraying, two parts per volume PLASTIK 70 SUPER is diluted with up to one part of Kontakt Chemie THINNER 70. The exact mixing ratio must be determined by trials with the equipment concerned.

CRC INDUSTRIES EUROPE BV
Touwslagerstraat 1 - 9240 Zele, Belgium
Tel. +32 (0)52 45 60 11 - Fax. +32 (0)52 45 00 341
www.kontaktchemie.com

For dip coating it is also necessary to fix the immersion time and the withdrawal speed. The faster the removal from the bulk, then thicker the film will be. Dipping baths have to be carefully protected to ensure no entrapment of conductive stuck-on residues.

PLASTIK 70 SUPER contains solvents like butyl acetate. Printed circuit board materials and electronic components generally have a good compatibility with these solvents. In case of plastic surfaces (e.g. housings) a compatibility test is always recommend. It is necessary in particular, to test its suitability for plastics susceptible to stress cracking (e.g. polycarbonate).

PLASTIK 70 SUPER contains flammable solvents and hence when working with the product, make sure there is good ventilation in the workplace. Remove all possible ignition sources.

A safety data sheet (SDS) according to EU directive 91/155/EEC and amendments is available for all CRC products.

5. TYPICAL PRODUCT DATA

Aspect	:	liquid.
Density	:	0.85 - 0.91 g/cm³
Viscosity bulk	:	15 - 20 mPa.s
Solid content (bulk)	:	16 - 20 %
Flashpoint (bulk)	:	< 0°C
Coat thickness	:	20 to 40 microns
Coverage (bulk)	:	approx. 4.5 m2/litre
Drying time at ambient temperature (HR 50%)	:	dust-free : 20 à 30 min dry to touch : 20 à 30 min fully dried : 1 day

Electrical characteristics:

Dielectric strength	:	value > 85 kV/mm
Surface resistivity	:	value > 1 x 1012 Ω
Volume resistivity	:	value > 1 x 1013 Ω cm
Resistance to thermal choc	:	excellent
(7 cycles in 24 h / temperatures from - 40 °C to + 85 °C).		
Resistance to humid heat	:	excellent
(24 h at + 55°C and 95% HR plus 24 h at +25°C and 95% HR).		

Temperature resistance (tested at ambient temperature):

After exposure at – 40°C during 6h	:	excellent
After exposure at +125°C during 6h	:	excellent
Fungal growth (test method D850)	:	none

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www.kontaktchemie.com

6. APPROVALS:

UL 94 Flammability test rating : V-0

7. PACKAGING

Aerosol : 400 ml
Canister : 5L

PLASTIK 70 THINNER
Canister: 1L
5L

All statements in this publication are based on service experience and/or laboratory testing. Because of the wide variety of equipment and conditions and the unpredictable human factors involved, we recommend that our products be tested on-the-job prior to use. All information is given in good faith but without warranty neither expressed nor implied.
This Technical Data Sheet may already have been revised at this moment for reason such as legislation, availability of components and newly acquired experiences. The latest and only valid version of this Technical Data Sheet will be sent to you upon simple request or can be found on our website: www.crcind.com.
We recommend you to register on this website for this product so you will be able to receive any future updated version automatically.

Version : 4.2
Date: 12 August 2022

CRC INDUSTRIES EUROPE BV
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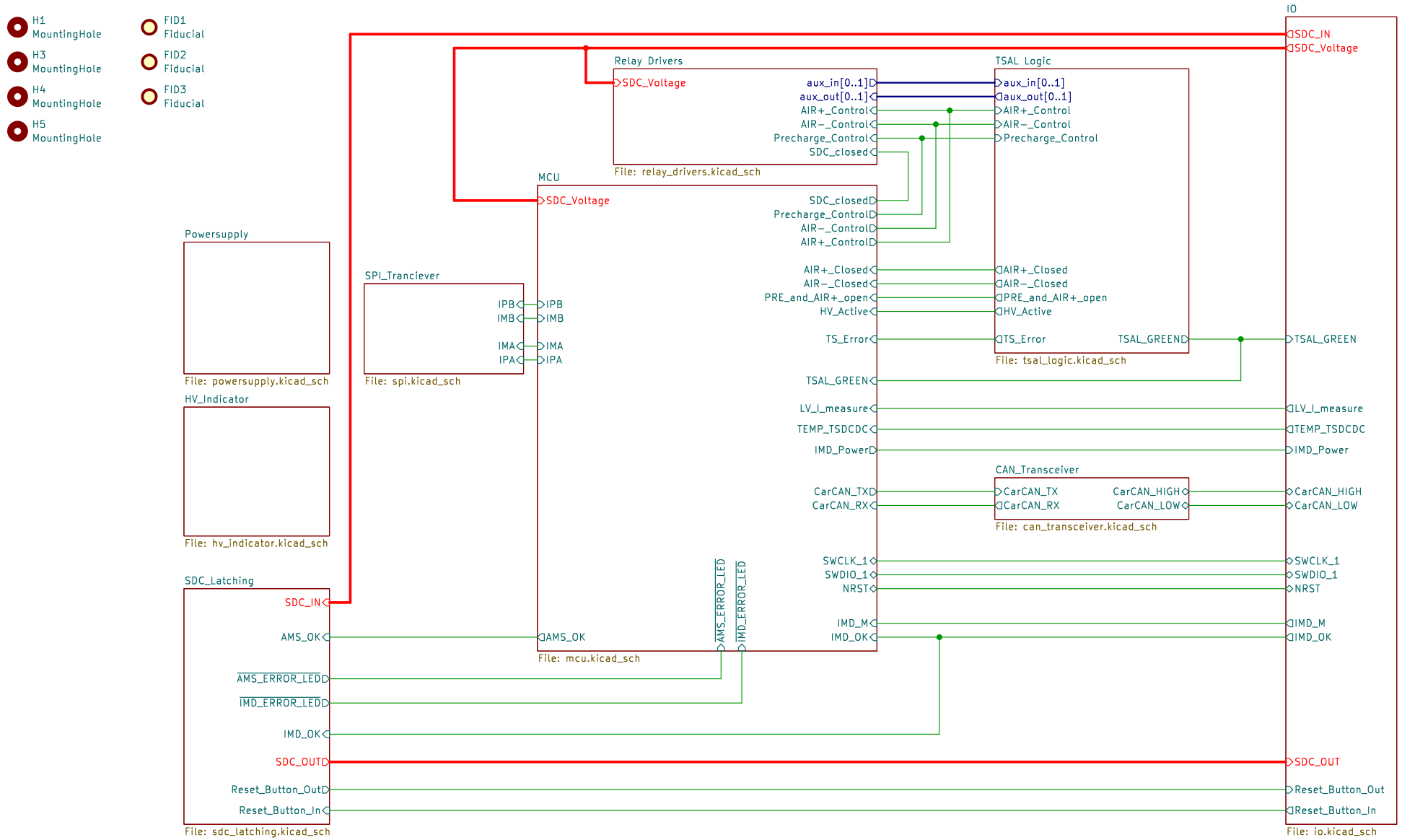
AMS Master

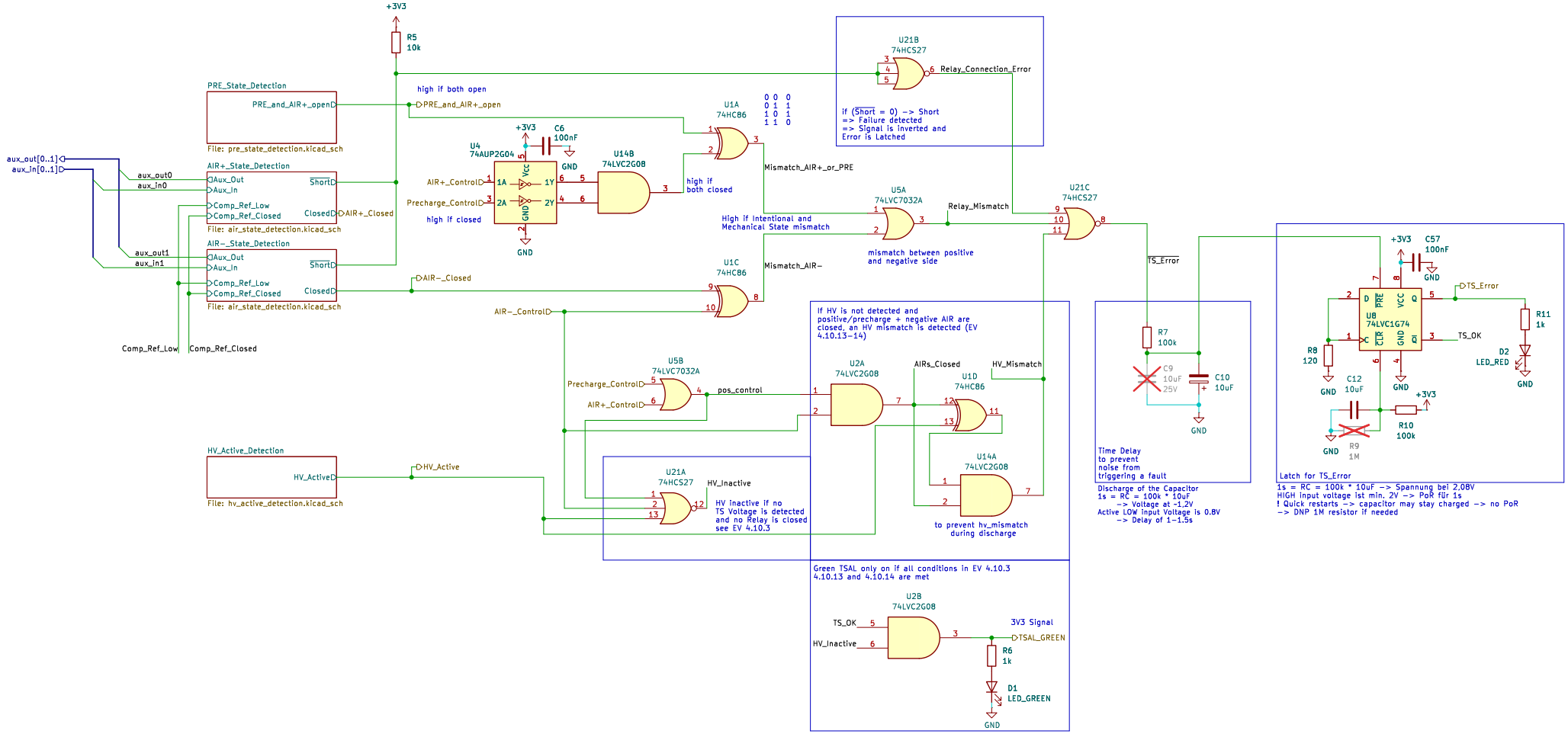


FT25 V2 or FT26:

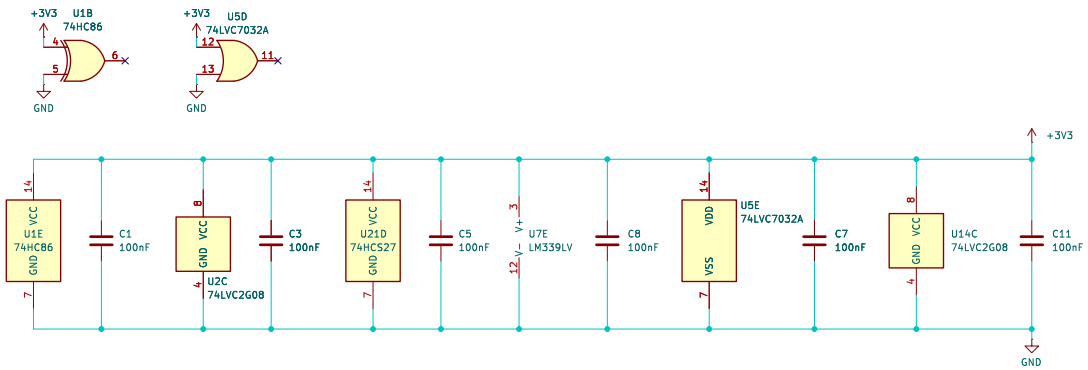
TSAL Sheet:
- schaltung im Dischargefall (U14A) vereinfachen

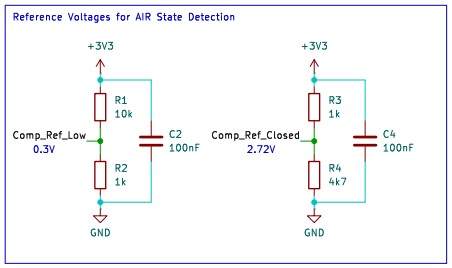
- "Bei U5B hast du ja schon PC_ctl OR AIR+_ctl, das müsste man nur noch invertieren. Zum invertieren könnte man auch einfach das übrige U1B benutzen (XOR(a,1) == NOT(a)). Aber besser natürlich den Pull umdrehen und einfach zwei "closed" Signale vergleichen. " – Oskar

FASTTUBE	
Title: AMS Master Rootsheet	Rev: V1
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A4 Page: 1/15



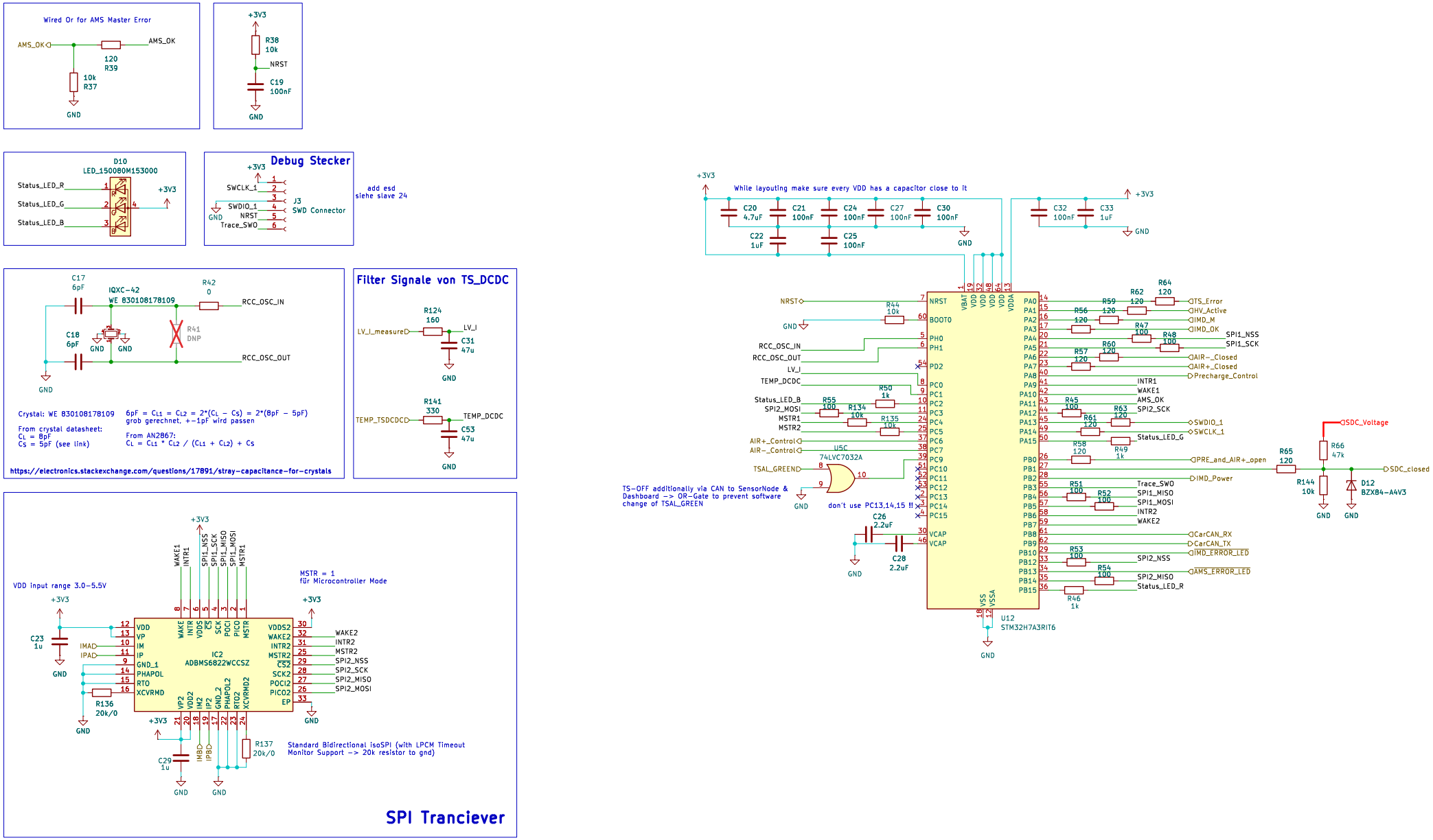
TSAL_GREEN signal leads dashboard
and to the TSAL driver board





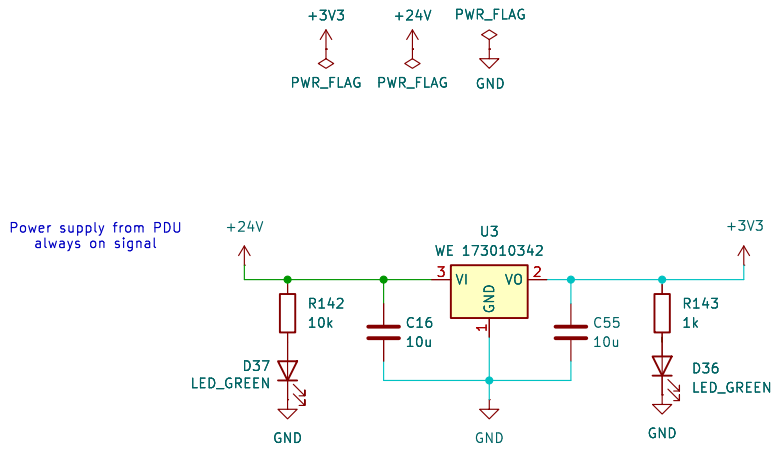
FASTTUBE

Title: TSAL Logic	**Rev: V1**
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A3 | Page: 2/15



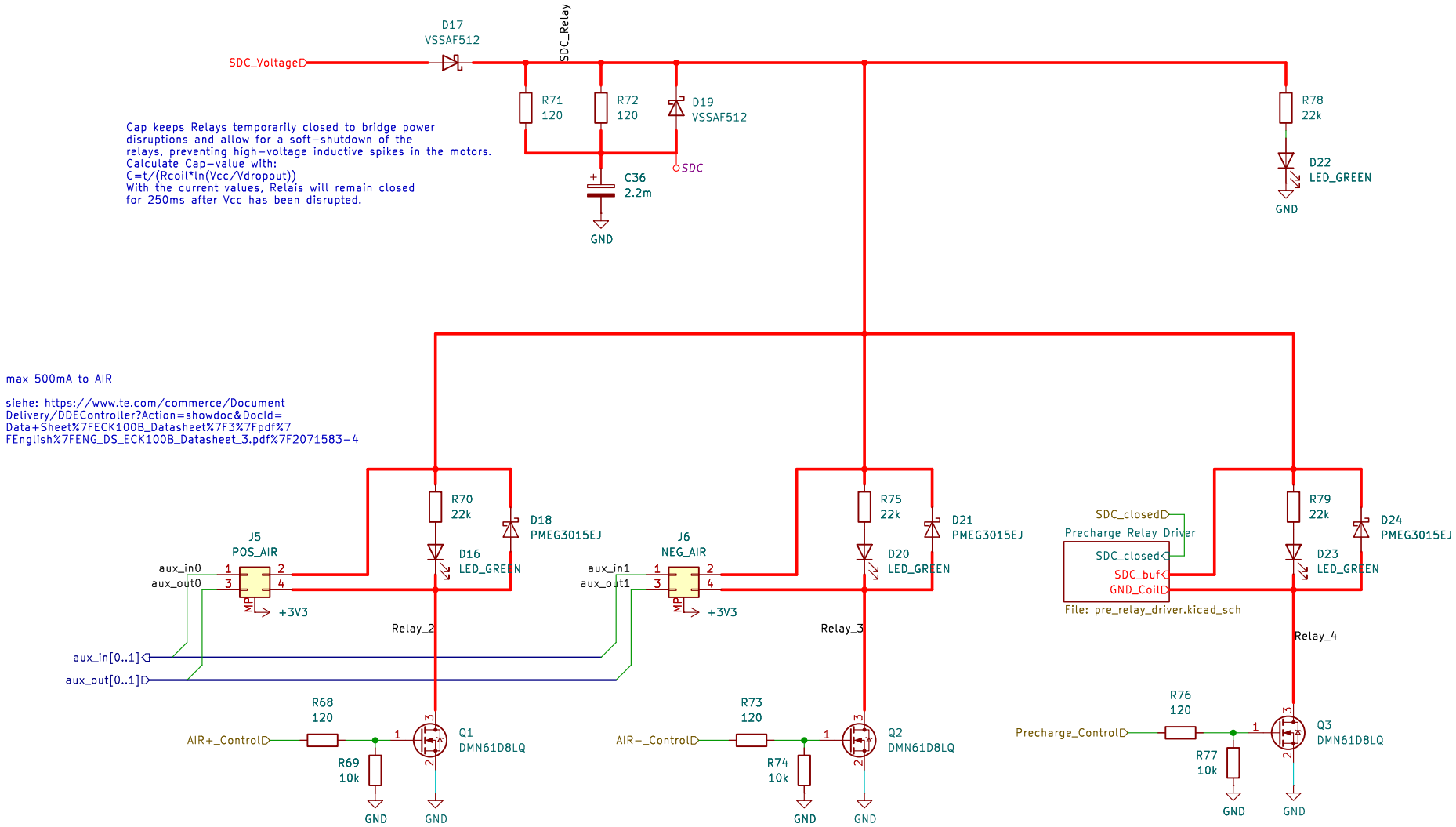
FASTTUBE

Title: Microcontroller	**Rev: V1**
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A3 | Page: 7/15



FASTTUBE

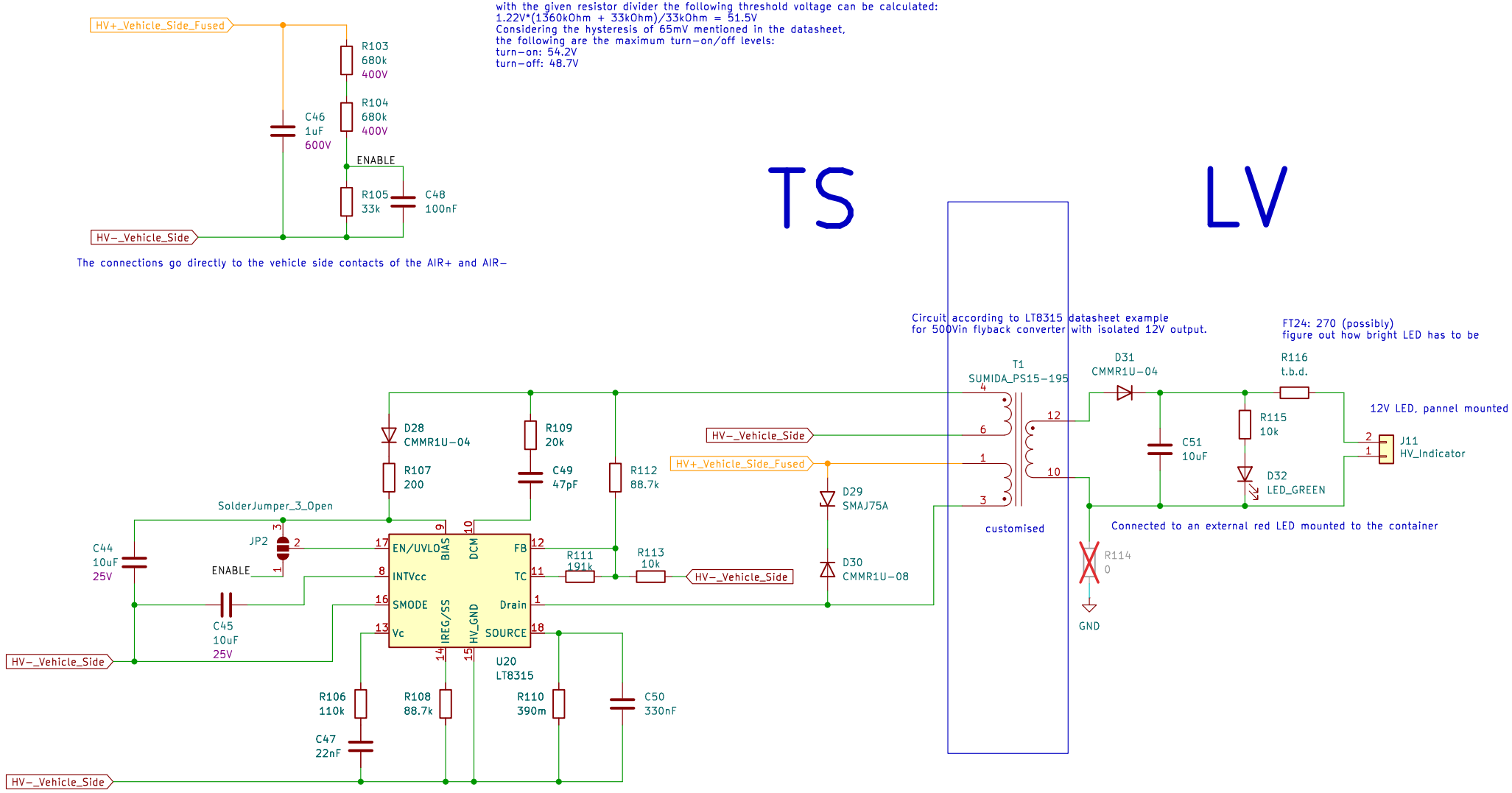
Title: Powersupply	**Rev: V1**
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 | Page: 8/15



FASTTUBE

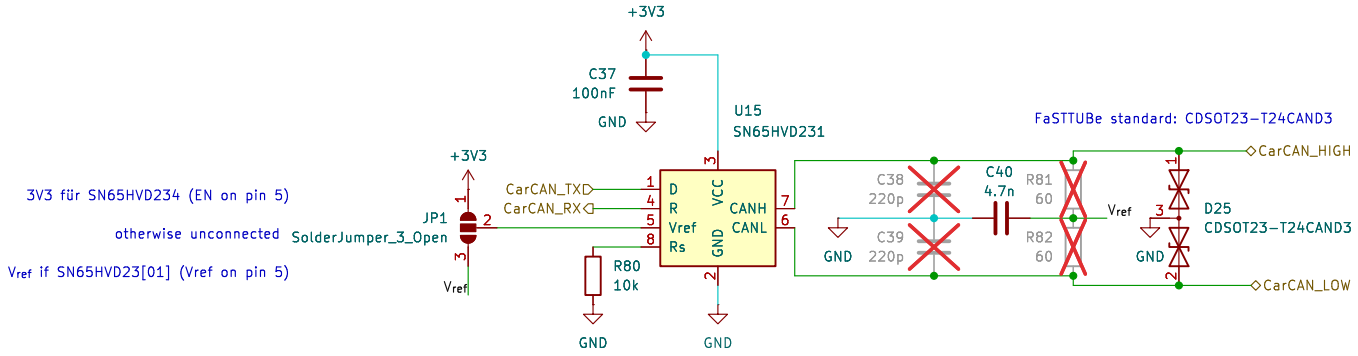
Title: Relay Drivers	**Rev: V1**
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A4 | Page: 9/15

HV Indicator nicht verändert, wie FT24



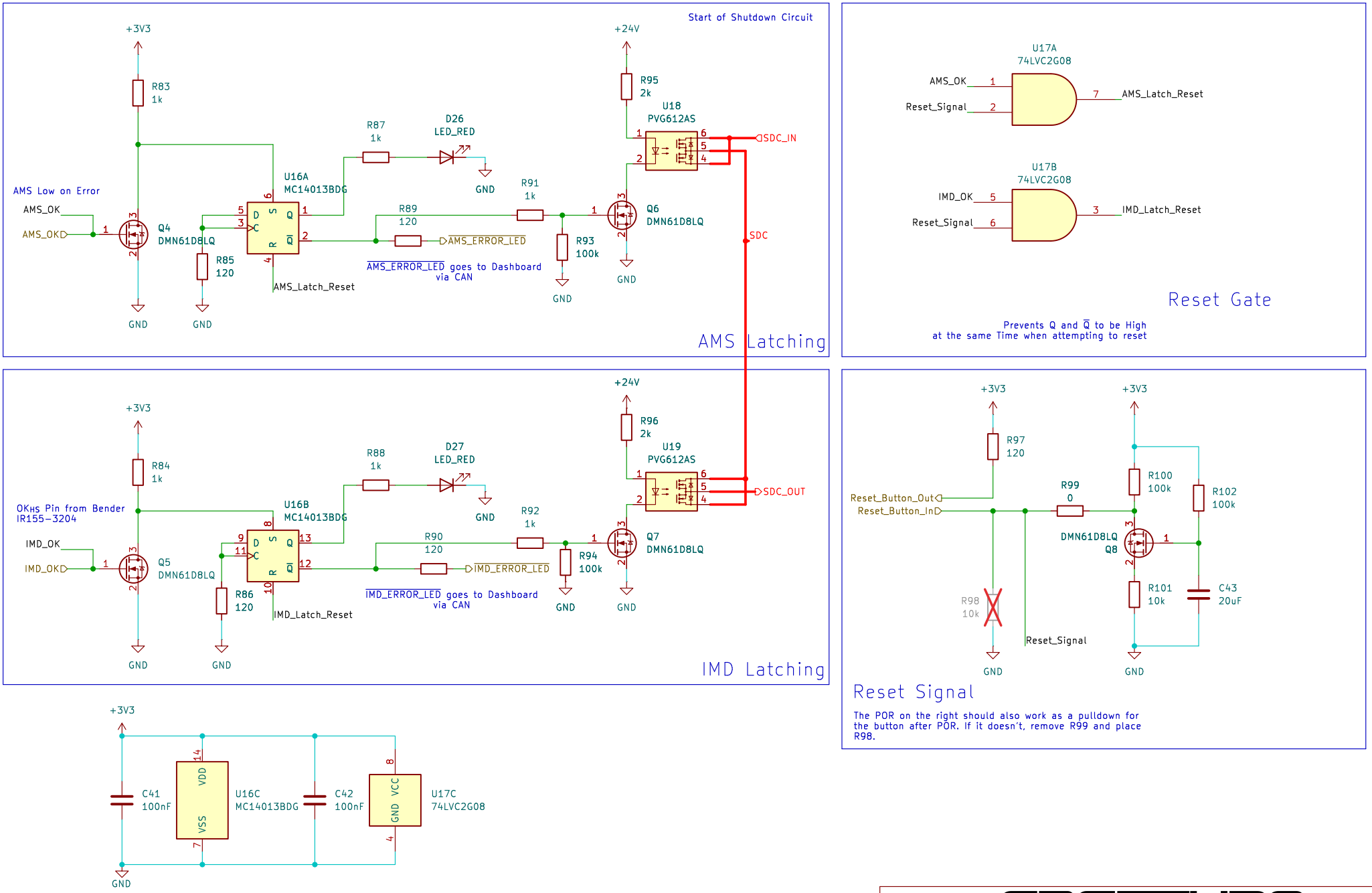
FASTTUBE

Title: HV Indicator Driver	**Rev: V1**
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A4 | Page: 11/15



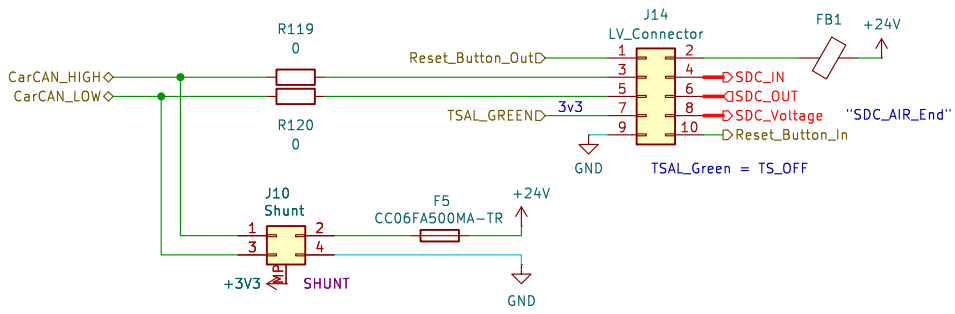
FaSTTUBe

Title: CAN Transciever	Rev: V1
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 Page: 11/15



FASTTUBE

Title: SDC Latching	**Rev: V1**
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A4 | Page: 12/15

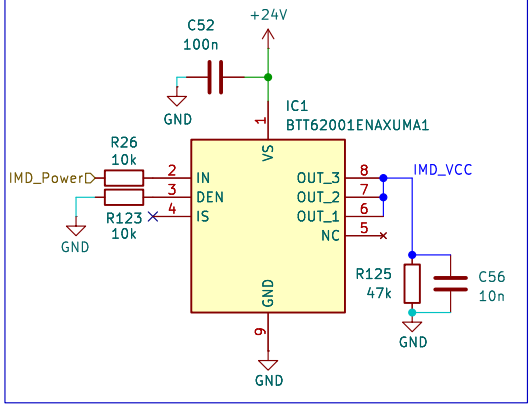


SHUNT:
IVT-S-300-U3-I-CAN1-12/24
max. 80mA

Datasheet
https://www.isabellenhuetteusa.com/wp-content/uploads/2022/07/Datasheet-IVT-S-V1.03.pdf

Main Connector

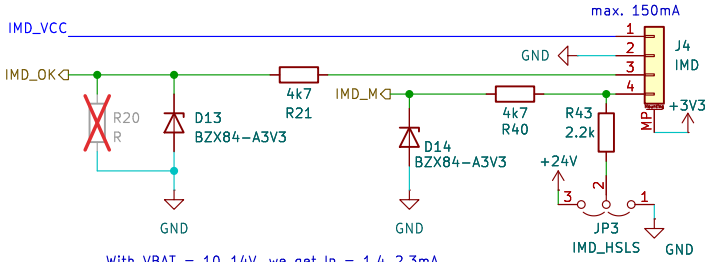
IMD Supply



IMD Connector

IMD – Datasheet

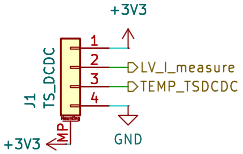
https://www.bender.de/fileadmin/content/Products/d/e/IR155-32xx-V004_D00115_D_XXEN.pdf



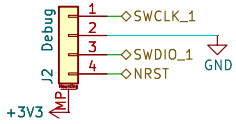
With VBAT = 10..14V, we get I_R = 1.4..2.3mA.
This should™ put the Zener at ~3V.

Connect to GND for -3204
Connect to +24V for -3203

TSDCDC Connector

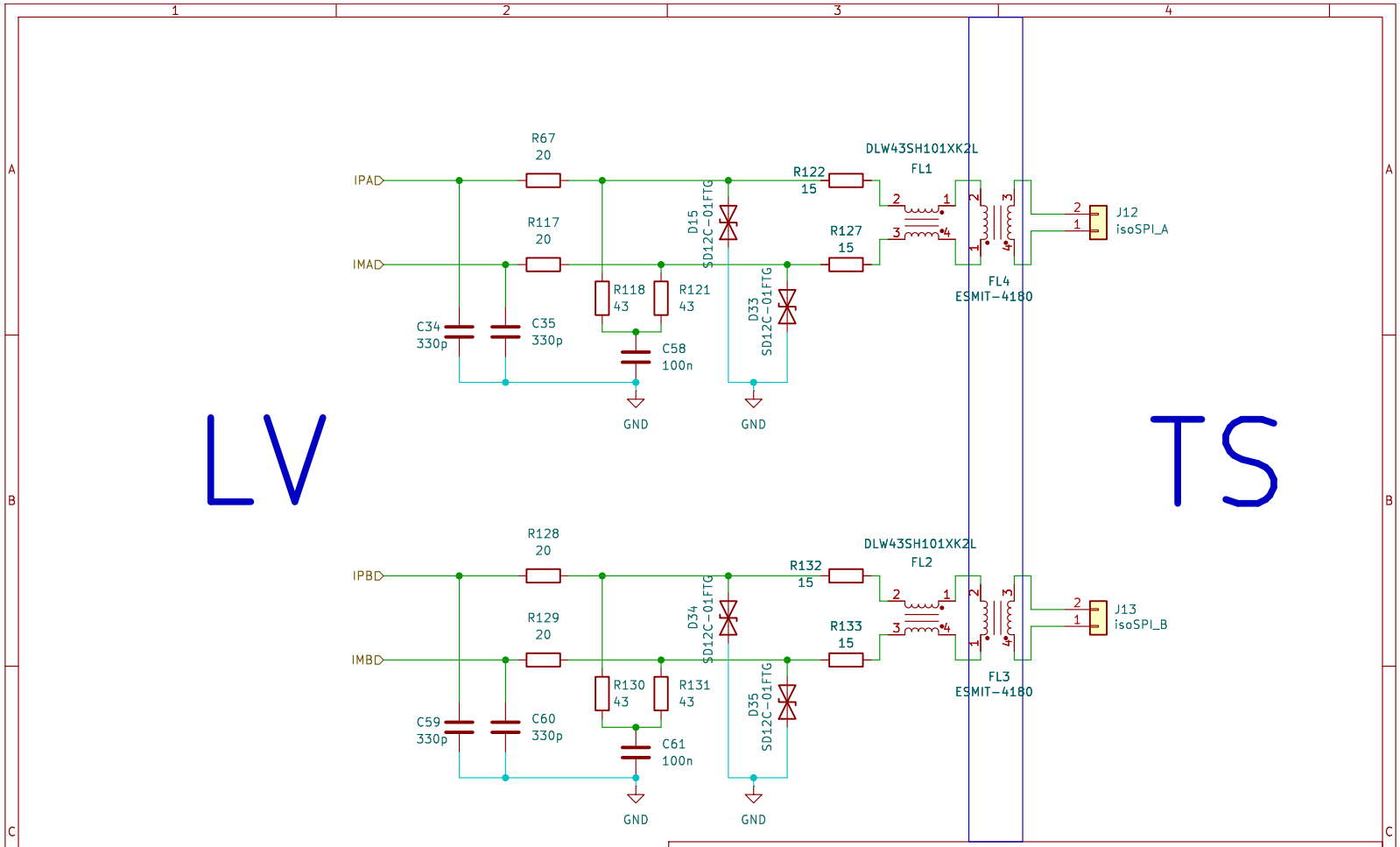


Debug Connector



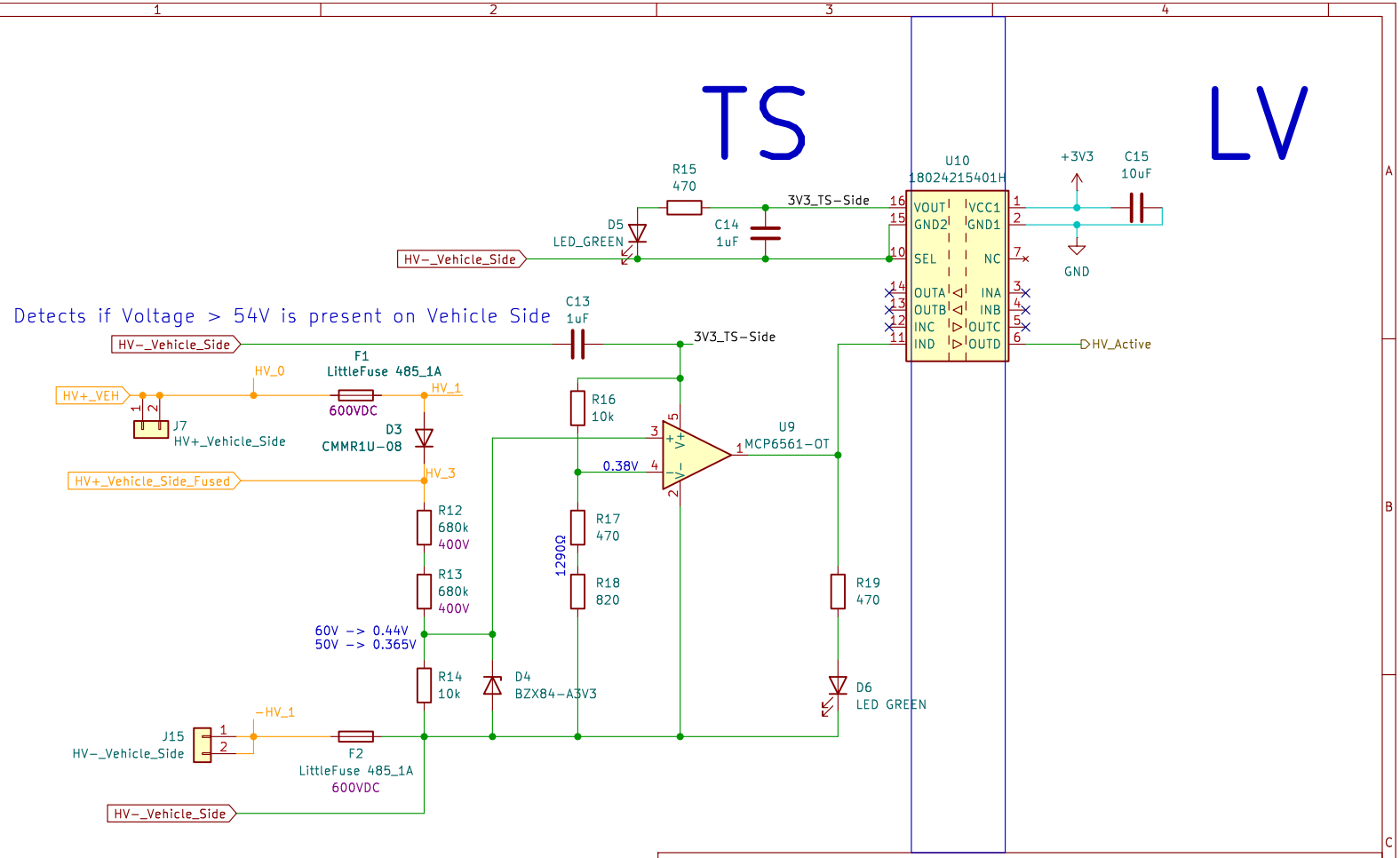
FASTTUBE

Title: Input/Output	Rev: V1
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 Page: 13/15



FASTTUBE

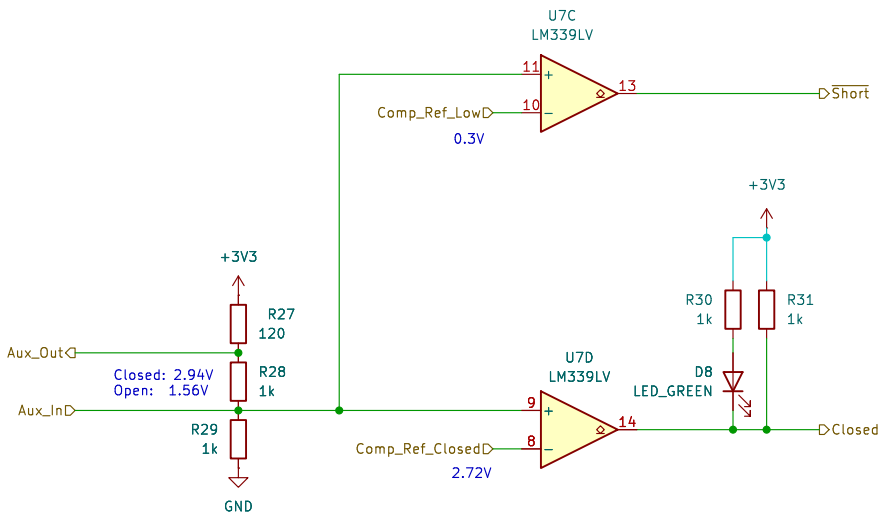
Title: Isolated SPI Transciever	Rev: V1
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 | Page: 14/15



FASTTUBE

Title: TSAL HV Detection	**Rev: V1**
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 | Page: 3/15

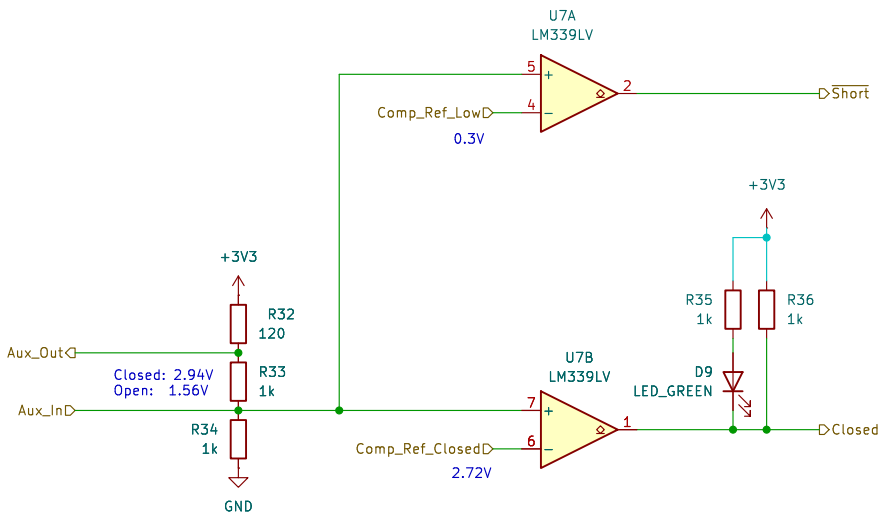
Accumulator TSAL – Relay state detection



FASTTUBE

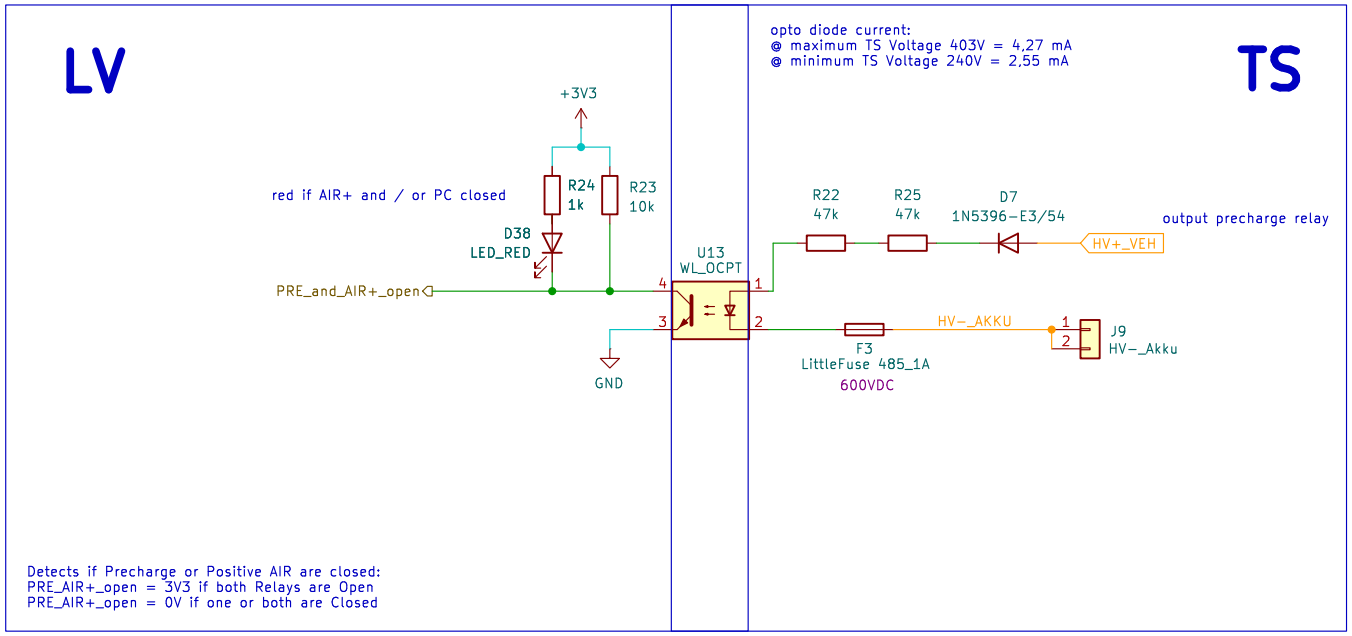
Title: AIR Relay State Detection	Rev: V1
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 Page: 4/15

Accumulator TSAL – Relay state detection



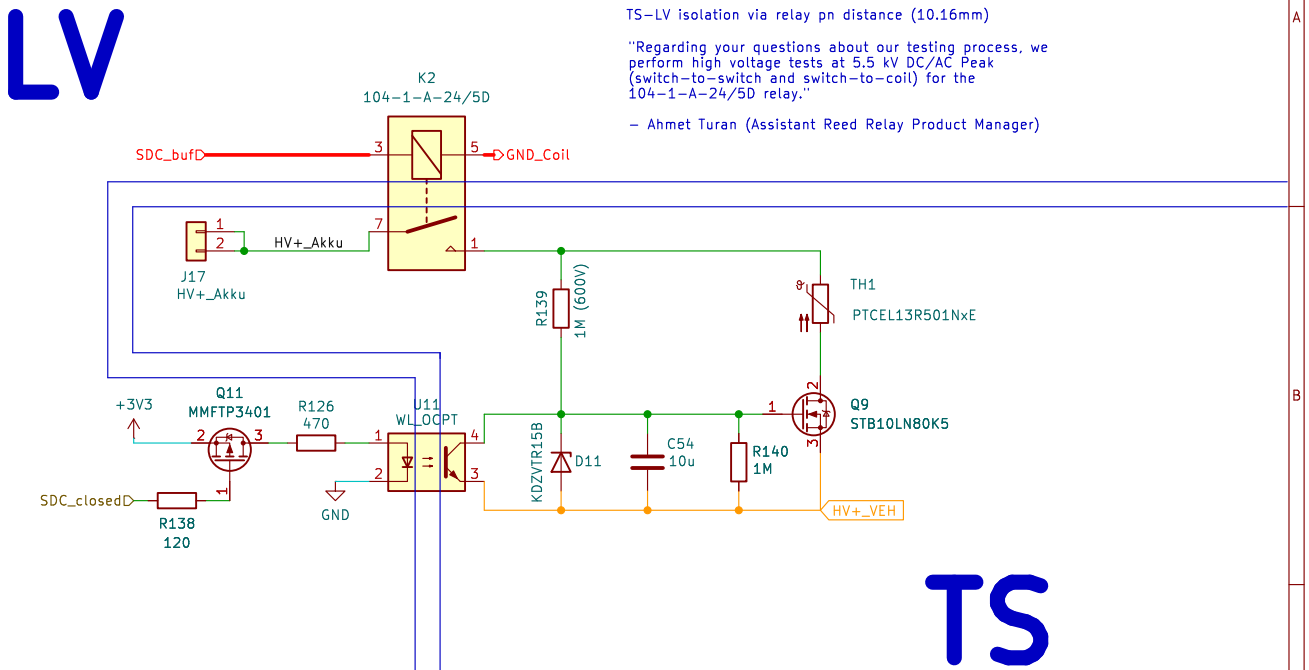
FASTTUBE

Title: AIR Relay State Detection	Rev: V1
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 Page: 5/15



FASTTUBE

Title: Precharge State Detection	Rev: V1
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 Page: 6/15



FASTTUBE

Title: Precharge Relay Driver	Rev: V1
	Date: 2025-03-09
Project: Master_FT25	Exp. Date: 2025-05-01
Author: Lene Marquardt	Size: A5 Page: 10/15

Type 0ACJ

High Voltage DC, SMD Fuse

0ACJ Series | RoHS Compliant

Features

- Surface mount design to save space
- Ceramic tube, silver plated cap construction
- Compatible with 260℃, IR Pb-free solder process
- Wide operating temperature range, -40℃ to 125℃
- Tape & Reel for auto-insert SMD process
- MSL = 1
- RoHS compliant with exemption 7(a)
  Fully compliance with EU Directive 2011/65/EU and amending directive 2015/863
- AEC-Q Compliant
- Meets Bel automotive qualification*

* - Largely based on internal AEC-Q test plan

AEC-Q Compliant

Applications

- Battery Management Systems, (BMS)
- Li-ion Battery Packs
- DC-DC Converters
- Uninterruptible Power Supply (UPS) - Single phase and 3-Phase
- 380VDC server / lighting in data center

Physical Specifications

Materials	Body : Ceramic
	Cap : Silver plated copper
Marking	On Fuse :
	"Current Rating"
	On Label :
	"bel", "0ACJ", "Current Rating", "Voltage Rating", "Interrupting Rating", and " ", " "(China RoHS compliant).

Electrical Characteristics

% of Ampere Rating (A)	Opening Time	
	Min	Max
100%	4 hour	-
200%	-	120 sec

Safety Agency Approvals

Safety Agency	Ampere Rating / Voltage Rating	Ampere Range / Volt @ I.R. ability**
	1-3.15A/600V DC /400V DC /350V AC 4-5A/500V DC /400V DC /350V AC 6-7.5A/400V DC /350V AC	1-3.15A/600V @ 100A DC /400V @ 200A DC /350V @ 100A AC 4-5A/500V @ 100A DC /400V @ 200A DC /350V @ 100A AC 6-7.5A/400V @ 200A DC /350V @ 100A AC

** AC Interrupting Rating (measured at designated voltage, 100% power factor); DC Interrupting Rating (measured at designated voltage, time constant of less than 50 microseconds, battery source)

Specifications subject to change without notice

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Electrical Specifications

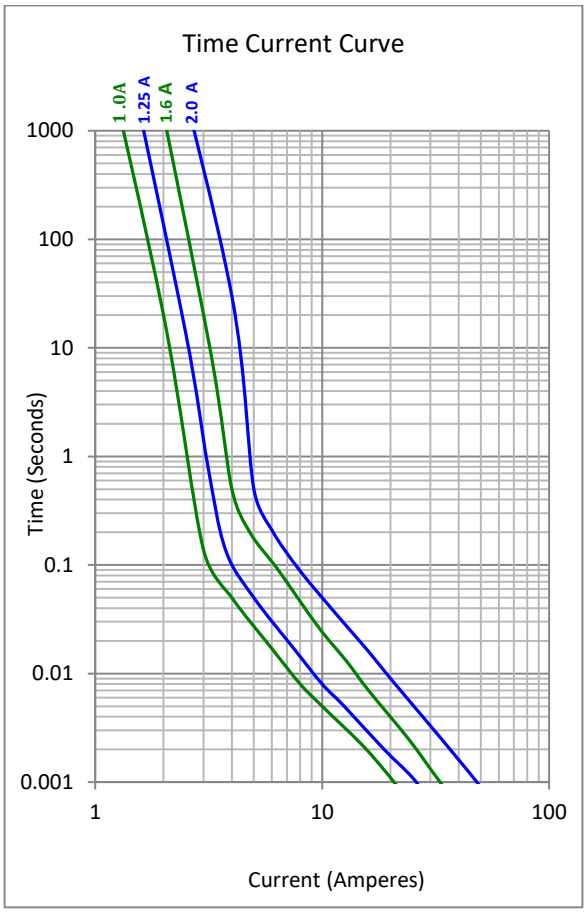
Part Number	Ampere Rating	Alpha Mark	Voltage and Interrupting Ratings	Typical Cold. Resistance (mohms)**	Typical Voltage Drop (mV)	Typical Pre-Arcing I²t (A²Sec)***
0ACJ-1000-XX	1A	1	See Table of Ratings on Page 1 for Voltage and associated Interrupting Ratings	252	335	0.50
0ACJ-1250-XX	1.25A	1.25		192	325	0.95
0ACJ-1600-XX	1.6A	1.6		116	230	2.3
0ACJ-2000-XX	2A	2		93	255	4.1
0ACJ-2500-XX	2.5A	2.5		51	174	2.6
0ACJ-3150-XX	3.15A	3.15		39	165	3.0
0ACJ-4000-XX	4A	4		31	175	5.5
0ACJ-5000-XX	5A	5		20	155	11.5
0ACJ-6000-XX	6A	6		16.3	155	15
0ACJ-7500-XX	7.5A	7.5		13.5	165	25

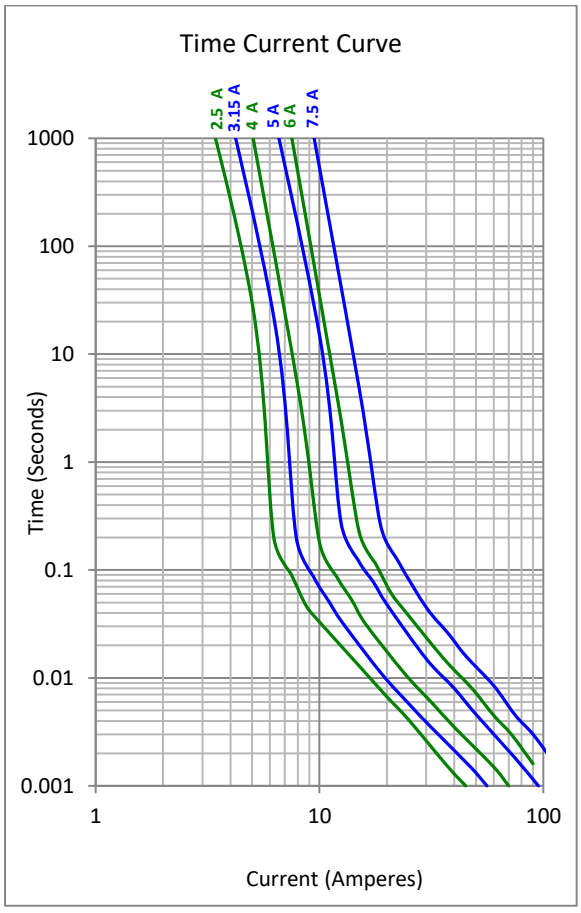
Consult manufacturer for other ratings

** DC Cold Resistance are measured at <10% of rated current in ambient temperature of 25℃

*** Typical Pre-arcing I²t are measured at 10In Current, DC battery bank.

Time Current Curve





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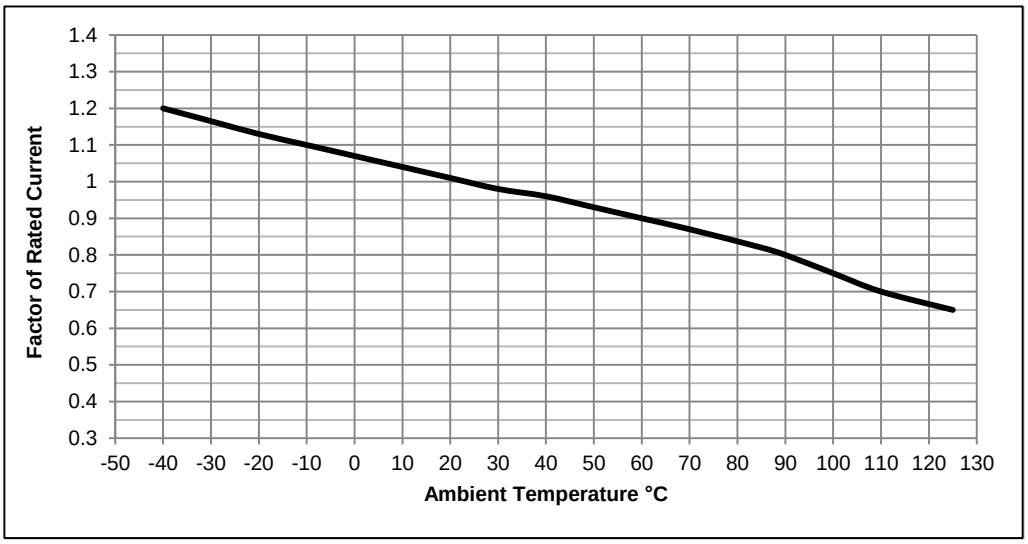
Temperature derating curve

Normal Operating Temperature: 25℃ ± 2℃

Operating Temperature: -40℃ to 125℃ with proper correction factor applied.

Chart of correction factor



Soldering Characteristics

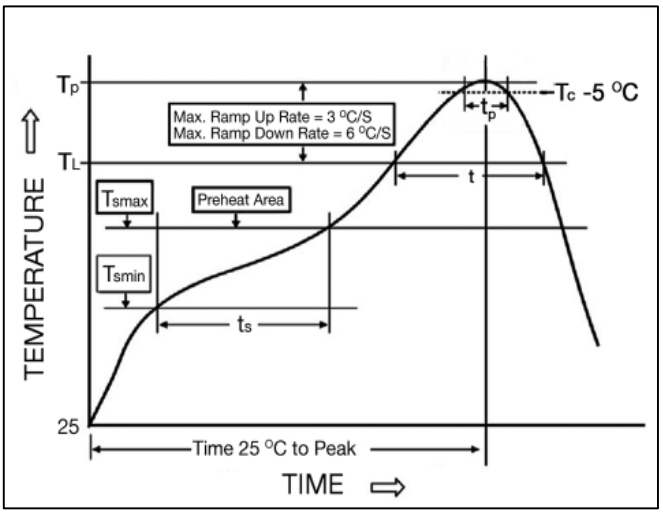
Reflow Soldering

- Temperature: 260° C
- Time: 30 Seconds Maximum

Manual Soldering (not recommended)

- Temperature: 350° C
- Time: 5 Seconds Maximum

Profile Feature	
Preheat & Soak Temperature min (T_{smin}) Temperature max (T_{smax}) Time (T_{smin} to T_{smax}) (t_s)	**Lead(Pb) free solder** 150℃ 200℃ 60-120 seconds
Average ramp-up rate(T_{smax} to T_p)	3℃ / second max.
Liquidous temperature(T_L) Time at liquidous (t_L)	217℃ 60 – 150 seconds
Peak package body temperature (T_p)	260℃
Time (tp) within 5℃ of the specified classification temperature (T_c)	30 seconds
Average ramp-down rate(T_p to T_{smax})	6℃ / second max.
Time 25℃ to peak temperature	8 minutes max.



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4 Channel Digital Isolator with Integrated 0.65W Isolated DC/DC Power Module

DESCRIPTION

The CDIP 18024x15401x is a 4 channel digital isolator that includes an integrated isolated DC/DC converter.

A single supply voltage is necessary to power both the primary side channels and the integrated isolated power supply. The integrated power supply generates the required isolated secondary supply voltage.

The integrated power module has integrated protection systems that guard against thermal overstress with thermal shutdown and protect against electrical damage using overcurrent, short-circuit and undervoltage circuitry.

The CDIP digital isolator ensures fast time to market and low development costs.

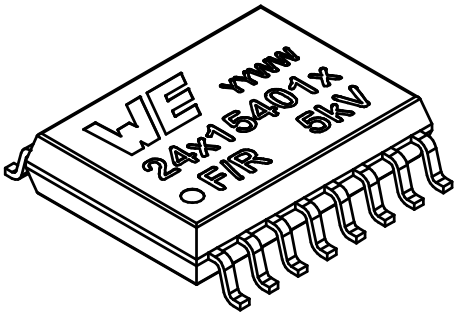
The digital isolator is available in an SOIC-16WB package (10.3 x 10.3 x 2.65)mm.

TYPICAL APPLICATIONS

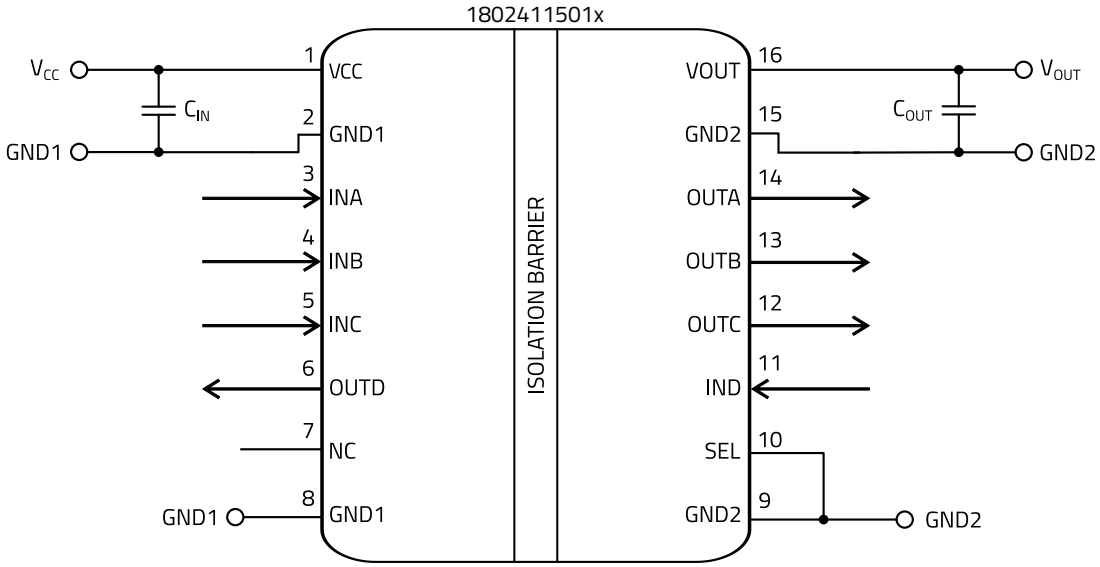
- Isolated communication interfaces (SPI, CAN, RS-232. RS-485)
- Motor control
- Battery management systems
- Solar inverters
- Test and measurement systems
- Programmable logic controller (PLC) interfaces

FEATURES

- Reinforced isolation: 5kV$_{RMS}$ for 60s
- Input voltage range: 3.15V to 5.5V
- User-selectable output voltage: 5V or 3.3V
- Data rate up to 100Mbps
- ±150kV/µs typ. CMTI
- Available channel configurations: 4/0, 3/1 and 2/2
- Default channel output status: high or low
- Low propagation delay: 10ns typ.
- Ambient temperature range: -40°C to 125°C
- RoHS and REACh compliant
- Complies with EN55032 (CISPR-32) class B conducted and radiated emissions standard
- UL1577 recognized
- DIN EN IEC 60747-17 (VDE 0884-17):2021-10 certified



TYPICAL CIRCUIT DIAGRAM



The above digram indicates only one of the possible channel configurations available.

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4 ABSOLUTE MAXIMUM RATINGS

Caution:
Exceeding the listed absolute maximum ratings may affect the device negatively and may cause permanent damage.

Table 4: Absolute maximum ratings.

SYMBOL	PARAMETER	LIMIT		UNIT
		MIN[1]	MAX[1]	
VCC	Supply pin voltage	-0.5	6	V
VOUT	Isolated supply output voltage pin	-0.5	6	V
INX, OUTX	Voltage at INX, OUTX, SEL pins	-0.5	V_{CC} + 0.5[2]	V
I_{OUTX}	Channel output current	-20	20	mA
$T_{storage}$	Assembled, non-operating storage temperature	-65	150	°C
V_{ESD}	ESD voltage (HBM)[4]	-6	6	kV
V_{ESD}	ESD voltage (CDM)[4]	-2	2	kV

5 OPERATING CONDITIONS

Operating conditions are conditions under which the device is intended to be functional. All values are either referenced to GND1 or GND2.

MIN and MAX limits are valid for the recommended ambient temperature range of -40°C to 125°C.

Table 5: Operating conditions.

SYMBOL	PARAMETER	MIN[1]	TYP[3]	MAX[1]	UNIT
V_{CC}	Supply voltage[9]	3.15	—	5.5	V
V_{INX_H}	Logic input high threshold	2.0	—	—	V
V_{INX_L}	Logic input low threshold	—	—	0.8	V
I_{OH}	High-level channel output current V_{OUT} = 5V	-4	—	—	mA
	High-level channel output current V_{OUT} = 3.3V	-2	—	—	mA
I_{OL}	Low-level channel output current V_{OUT} = 5V	—	—	4	mA
	Low-level channel output current V_{OUT} = 3.3V	—	—	2	mA
DR	Data rate	0	—	100	Mbps
PW	Signal pulse width	5	—	—	ns
T_a	Ambient temperature range	-40	—	125	°C

6 THERMAL SPECIFICATIONS

Caution:
Exceeding the listed absolute maximum ratings may affect the device negatively and may cause permanent damage.

Table 6: Thermal specifications.

SYMBOL	PARAMETER	TEST CONDITIONS	MIN[1]	TYP[3]	MAX[1]	UNIT
Θ_{JA}	Junction-to-ambient thermal resistance [5]		—	68.5	—	°C/W
P_D	Maximum power dissipation	V_{CC}=5.5V, V_{OUT}=5V, I_{OUT}=0.13A, 50% duty cycle square signal on all channels with C_L=15pF	—	—	1	W

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8 ISOLATION SPECIFICATIONS

Table 11: Isolation specification table.

SYMBOL	PARAMETER	TEST CONDITIONS	VALUE	UNIT
CLR	External clearance	Shortest distance through air between terminals	8	mm
CPG	External creepage	Shortest distance across package surface between terminals	8	mm
C_{IO}	Barrier capacitance, input to output	V_{IO} = 0.4 x sin (2πft), f = 1MHz	3.5	pF
R_{IO}	Isolation resistance	V_{IO} = 500V, T_A = 25°C	$>10^{12}$	Ω
		V_{IO} = 500V, 100°C$\leq T_A \leq$ 125°C	$>10^{11}$	Ω
		V_{IO} = 500V at T_A = 150°C	$>10^{9}$	Ω
DTI	Distance through the insulation	Minimum internal clearance	19	µm
CTI	Comparative tracking index	DIN EN 60112 (VDE 0303-11); IEC 60112	>600	V
	IEC 60664-1 material group		I	
	IEC 60664-1 overvoltage category	Rated mains voltage $\leq$300 V_{RMS}	I-IV	
		Rated mains voltage $\leq$600 V_{RMS}	I-IV	
		Rated mains voltage $\leq$1000 V_{RMS}	I-III	
DIN EN IEC 60747-17 (VDE 0884-17):2021-10				
V_{IORM}	Max. repetitive peak isolation voltage	AC voltage (bipolar)	1414	V_{PK}
V_{IOWM}	Max. working isolation voltage	AC voltage; Time-dependent dielectric breakdown (TDDB) test	1000	V_{RMS}
		DC voltage	1414	V_{DC}
V_{IOTM}	Max. transient isolation voltage	V_{TEST} = V_{IOTM}, t = 60s (qualification); V_{TEST} = 1.2 x V_{IOTM}, t = 1s (100% production)	7070	V_{PK}
V_{IOSM}	Max. surge isolation voltage	Test method per IEC 60065, 1.2/50 µs waveform, V_{TEST} = 1.6 x V_{IOSM} (qualification)	7070	V_{PK}
q_{pd}	Apparent charge	Method a, after input/output safety test subgroup 2/3, V_{ini} = V_{IOTM}, t_{ini} = 60s; $V_{pd(m)}$ = 1.2 x V_{IORM}, t_m = 10s	$\leq$5	pC
		Method a, after environmental tests subgroup 1, V_{ini} = V_{IOTM}, t_{ini} = 60s; $V_{pd(m)}$ = 1.6 x V_{IORM}, t_m = 10s	$\leq$5	pC
		Method b1, at routine test (100% production) and preconditioning (type test), V_{ini} = 1.2 x V_{IOTM}, t_{ini} = 1s; $V_{pd(m)}$ = 1.875 x V_{IORM}, t_m = 1s	$\leq$5	pC
	Pollution degree		2	
UL1577				
$V_{ISO(max)}$	Max. withstanding isolation voltage	V_{TEST} = V_{ISO}, t = 60s (qualification), V_{TEST} = 1.2 x V_{ISO}, t = 1s (100% production)	5000	V_{RMS}

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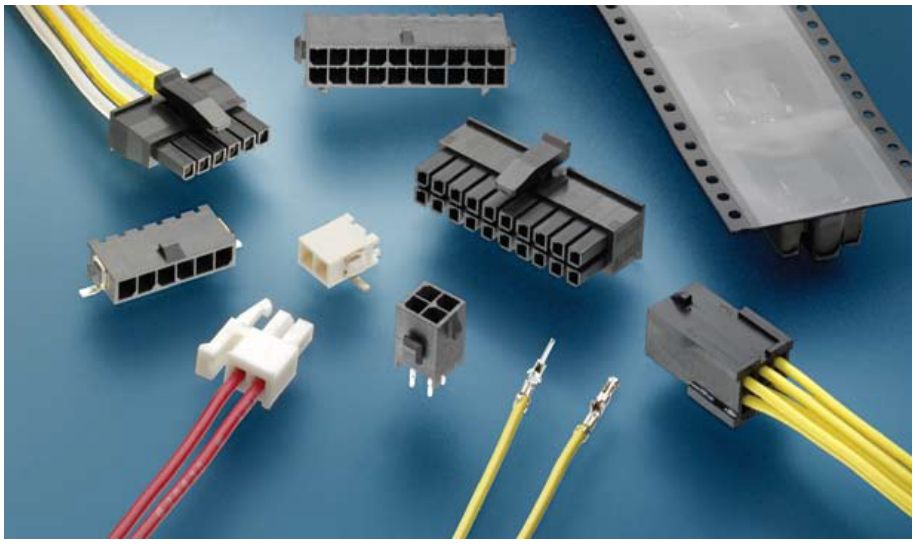

MICRO MATE-N-LOK CONNECTOR SYSTEM

Quick Reference Guide

The Micro MATE-N-LOK 3 mm connector system offers wire-to-wire and wire-to-board connections with contacts on a 3 mm (0.118) centerline and current ratings up to 5 Amps max. per line. Both single-row and dual-row configurations are available. Crimp, snap-in pin and receptacle contacts are used to terminate 30-18 (0.05-0.9 mm^2) AWG wire with insulation diameters up to 1.52 mm. Plug and receptacle housings allow wire-to-wire and wire-to-panel configurations and header assemblies offer wire-to-board connections in vertical and right angle configurations. These IR reflow process compatible headers are available in through-hole and surface mount configurations with multiple board mount options.

QUESTIONS THAT WILL HELP YOU BETTER SELECT THE PRODUCT THAT YOU NEED:

What are the current and voltage requirements for your application?

The Micro MATE-N-LOK 3 mm connector system has a maximum current rating of 5 Amps per line and is rated for 250 Volts AC/DC.

What are the wire type and size requirements?

The Micro MATE-N-LOK 3 mm connector system contacts are approved for use with 22-18 (0.3-0.9), 24-20 (0.2-0.6) and 30-26 (0.05-0.15) AWG wire with a maximum insulation diameter of 0.110 (2.79).

What are the number of positions?

The Micro MATE-N-LOK 3 mm connector system is available in 2-12 position single row and 2-24 position dual row configurations on a 3.0 mm pitch.

What are the operating temperature requirements?

The Micro-MATE-N-LOK 3 mm connector system has a maximum operating temperature of 105°C. For more information regarding operating temperatures refer to Product Specification 108-1836.

What packaging types are offered for headers and housings?

The Micro MATE-N-LOK 3 mm connector system offers tape and reel packaging for surface mount headers, tray packaging for thru-board headers and bulk packaging for all receptacle and plug housings.

What is the benefit of choosing low-profile receptacle housings?

The Micro MATE-N-LOK 3 mm connector system offers a low profile receptacle housing for applications that need to meet minimal height requirements. This low profile design offers a mated height of only 4.7 mm and is available in 2, 3 and 4 positions, in black or natural color.

What is the benefit of using an 18 AWG select circuit receptacle housing?

The Micro MATE-N-LOK 3 mm connector system offers a special 18 AWG wire-to-board select circuit housing for low voltage lighting applications. Designed to accommodate 18 AWG UL1007 wire in select circuits of the 2, 3, 4, 5 and 6 position housings, this product is ideal to minimize millivolt drops on long wire runs sometimes required by low voltage conventional and solid state lighting.

What flame resistant material options are available?

The Micro MATE-N-LOK 3 mm connector system is available with multiple flammability options, including UL 94 V-0, UL 94 V-2, and glow wire tested (GWT).

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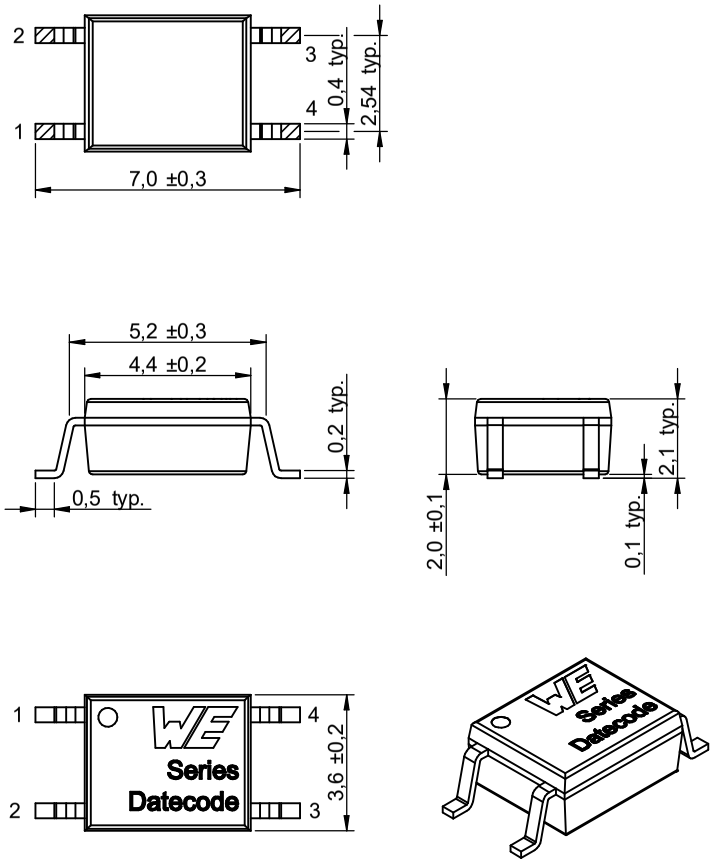
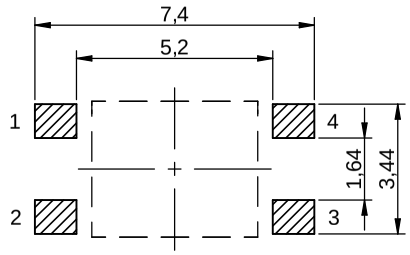
France:	+33 (0) 1-3420-8686
Netherlands:	+31 (0) 73-6246-999
China:	+86 (0) 400-820-6015

Dimensions: [mm]



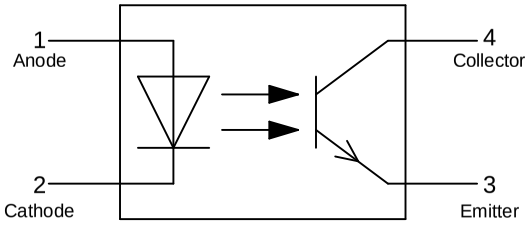
Scale - 5:1

Recommended Land Pattern: [mm]



Scale - 5:1

Schematic:



General Properties:

Type	Optocoupler Phototransistor
Input	DC
Package	SOP 4
Plastic Housing Color	White

Certification:

RoHS Approval	Compliant [2011/65/EU&2015/863]
REACh Approval	Conform or declared [(EC)1907/2006]
Halogen Free	Conform [JEDEC JS709B]
Halogen Free	Conform [IEC 61249-2-21]
VDE Approval	40051484 [DIN EN 60747-5-5 (VDE0884-5); EN 60747-5-5:2011; A1:2015]
cULus Approval	E513104 [UL 1577]
CQC Approval	CQC20001274583 [GB4943.1-2001; GB8898-2011]

General Information:

Operating Temperature	-55 up to +110 °C
Storage Conditions (for single parts)	-55 up to +125 °C
Storage Conditions (in original packaging)	< 40 °C ; < 75 % RH
Moisture Sensitivity Level (MSL)	1

Product Marking:

Pin 1 Anode	0
Marking	356B (Series 356, Binning B)
Marking - Date Code	YWW

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CHECKED	REVISION	DATE (YYYY-MM-DD)	GENERAL TOLERANCE	PROJECTION METHOD
SaVo	001.004	2023-08-22	DIN ISO 2768-1m	

DESCRIPTION
WL-OCPT Optocoupler Phototransistor

ORDER CODE
140356145200

SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	1/12

This electronic component has been designed and developed for usage in general electronic equipment only. This product is not authorized for use in equipment where a higher safety standard and reliability standard is especially required or where a failure of the product is reasonably expected to cause severe personal injury or death, unless the parties have executed an agreement specifically governing such use. Moreover Würth Elektronik eiSos GmbH & Co KG products are neither designed nor intended for use in areas such as military, aerospace, aviation, nuclear control, submarine, transportation, transportation signal, disaster prevention, medical, public information network etc.. Würth Elektronik eiSos GmbH & Co KG must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability evaluation checks for safety must be performed on every electronic component which is used in electrical circuits that require high safety and reliability functions or performance.

Absolute Maximum Ratings Input Properties (Ambient Temperature 25 °C unless otherwise specified):

Properties		Test conditions	Value	Unit
Forward Current	$I_{F\ max.}$		60	mA
Peak Forward Current	$I_{F\ Peak}$	duty/ 100 @ 100 Hz	1	A
Input Power Dissipation	P_I		100	mW
Reverse Voltage	V_{REV}		6	V

Absolute Maximum Ratings Output Properties: (Ambient Temperature 25 °C unless otherwise specified):

Properties		Value	Unit
Collector Emitter Voltage	V_{CE}	80	V
Emitter Collector Voltage	V_{EC}	7	V
Collector Current	$I_{CE.P}$	50	mA
Output Power Dissipation	P_O	150	mW

Absolute Maximum Ratings Common Properties:

Properties		Test conditions	Value	Unit
Power Dissipation [1)]	P_{Diss}		200	mW
Isolation Voltage	V_{ISO}	AC for 1 Minute, RH 40~60 %	3750	V (RMS)

[1)] Total power dissipation of the whole component

Electrical & Optical Input Properties:

Properties		Test conditions	Value		Unit
			typ.	max.	
Forward Voltage	V_F	I_F = 10 mA	1.24	1.4	V
Reverse Current	I_{REV}	V_{REV} = 6 V		10	µA
Input Capactiance	C_{in}	V = 0 V f = 1 kHz	10		pF

Electrical & Optical Output Properties:

Properties		Test conditions	Value		Unit
			min.	max.	
Collector-Emitter Dark Current	$I_{CEO.Dark}$	V_{CE} = 20 V I_F = 0		100	nA
Collector-Emitter Breakdown Voltage	$V_{(BR)CE}$	I_C = 100 µA I_F = 0	80		V
Emitter-Collector Breakdown Voltage	$V_{(BR)EC}$	I_E = 100 µA I_F = 0	7		V

Electrical & Optical Transfer Properties:

Properties		Test conditions	Value			Unit
			min.	typ.	max.	
Current Transfer Ratio	CTR	I_F = 5 mA V_{CE} = 5 V	130		260	%
Collector-Emitter Saturation Voltage	V_{CEsat}	I_F = 20 mA I_C = 1 mA		0.06	0.2	V
Rise Time	t_r	V_{CE} = 2 V I_C = 2 mA R_L = 100 Ω		3	18	µs
Fall Time	t_f	V_{CE} = 2 V I_C = 2 mA R_L = 100 Ω		4	18	µs
Cut-Off Frequency	f_c	V_{CE} = 2 V I_C = 2 mA R_L = 100 Ω -3 dB		80		kHz
Floating Capacitance	C_{IO}	V = 0 V f = 1 MHz		0.4		pF
Isolation Resistance	R_{ISO}	DC = 500 V 40~60 % R.H.	1	100		TΩ

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MORE THAN YOU EXPECT

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CHECKED	REVISION	DATE (YYYY-MM-DD)	GENERAL TOLERANCE	PROJECTION METHOD
SaVo	001.004	2023-08-22	DIN ISO 2768-1m	

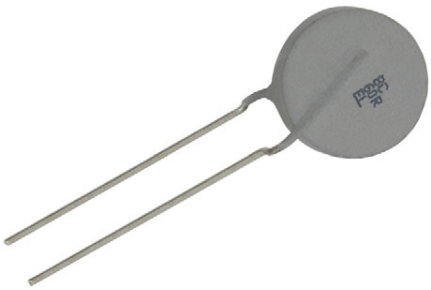
DESCRIPTION
WL-OCPT Optocoupler Phototransistor

ORDER CODE
140356145200

SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	2/12

This electronic component has been designed and developed for usage in general electronic equipment only. This product is not authorized for use in equipment where a higher safety standard and reliability standard is especially required or where a failure of the product is reasonably expected to cause severe personal injury or death, unless the parties have executed an agreement specifically governing such use. Moreover Würth Elektronik eiSos GmbH & Co KG products are neither designed nor intended for use in areas such as military, aerospace, aviation, nuclear control, submarine, transportation, transportation signal, disaster prevention, medical, public information network etc.. Würth Elektronik eiSos GmbH & Co KG must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability evaluation checks for safety must be performed on every electronic component which is used in electrical circuits that require high safety and reliability functions or performance.

PTC Thermistors, Inrush Current Limiter



LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models

QUICK REFERENCE DATA		
PARAMETER [1]	VALUE	UNIT
Resistance at 25 °C (R_{25}) [2]	60 to 1000	Ω
Switching temperature	130 to 140	°C
Maximum inrush current	10 to 40	A
Maximum AC voltage [2]	350 to 800	V_{RMS}
Maximum DC voltage [2]	500 to 1200	V_{DC}
Maximum peak voltage [3]	4000	V_P
Maximum energy at 25 °C [1]	150 to 240	J
Operating temperature range	-40 to 105	°C
Storage temperature range	-55 to 165	°C
Dissipation factor	14.5 to 19.5	mW/K
Thermal time constant (τ_c) (still air cooling)	130 to 155	s
Weight	3.5 to 5.7	g

Notes

(1) Definitions, measurements, and tests are made in accordance with standard IEC 60738-1 "Thermistors - Directly heated positive temperature coefficient" and AEC-Q200 stress test qualification for passive components

(2) Other resistance values and maximum operating voltages available on request.
Matched resistance values available on request

(3) Maximum peak voltages are based on 8/20 μs pulses that can be applied with limited none-switching energy

AGENCY APPROVALS

Agency approval documents, please see:

www.vishay.com/ppg?29165&documents

UL recognition standard for safety is UL 1434: "Thermistor-Type Devices". UL file E148885

FEATURES

- High energy absorption levels up to 150 J and 240 J
- High number of inrush-power cycles: > 100 000 cycles
- Highly resistant against non-switching peak-powers of up to 25 kW
- Can handle high direct voltage up to 1200 V
- Self protecting in case of overload with no risk of over-heating
- AEC-Q200 qualified
- C-UL-US recognized under file E148885 for AC and DC use
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

APPLICATIONS

Inrush current limiting and load-dump resistor in:

- AC/DC and DC/DC converters
- Load dump and DC-Link circuits
- Emergency discharge circuits
- OBC, battery charging equipment
- Motor drives
- Welding equipment

PTCEL thermistors have resistance values that can change instantly based on the applied voltage levels and varying body temperatures.

DESCRIPTION

These directly heated ceramic-based doped barium titanate thermistors have a positive temperature coefficient and are primarily intended for inrush current limiting and overload protection. They consist of a ceramic pellet soldered between two tinned CCS wires and coated with a UL 94 V-0 compliant high temperature silicone lacquer. The body is marked with the logo, cold resistance value, EL on one side and date code on the opposite side.

MOUNTING

Important mounting and handling instructions, see:

www.vishay.com/doc?29223

By soldering in any position.

Not intended for potting or sealing.

Maximum surface temperature in case of overload can reach 200 °C.

PACKAGING

PTC thermistors are available in 200 pieces individually packed in layered PET trays or tape on reel 500 pieces.

For technical questions, contact: nlr@vishay.com

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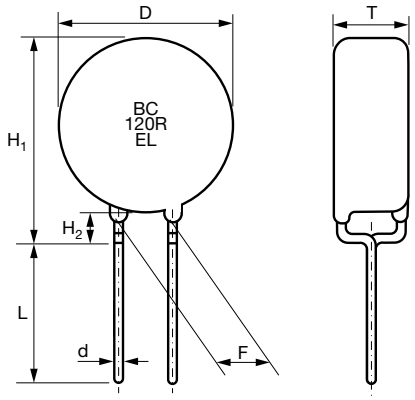
ELECTRICAL DATA AND ORDERING INFORMATION

PART NUMBER [1]	R_{25} (Ω)	R_{25} TOL. (%)	$V_{MAX.}$ (V_{RMS})	$V_{LINK\ MAX.}$ (V_{DC})	$R_{MIN.}$ < 1.5 V_{DC} (Ω)	I_{HOLD} AT 25°C (mA)	C_{th} (J/K)	$E_{MAX.}$ 1 CYCLE AT 25°C (J)	τ_{th} (s)	LEAD PITCH F (mm)	UL RECOG.
PTCEL13R600LxE	60	30	350	500	32	120	1.45	150	130	5.0	✓
PTCEL13R121MxE	120	30	440	625	64	85	1.45	150	130	5.0	✓
PTCEL13R251NxE	250	30	480	680	130	60	1.45	150	130	5.0	✓
PTCEL13R501RxE	500	30	560	800	260	42	1.45	150	130	5.0	✓
PTCEL13R102SxE	1000	30	600	850	520	30	1.45	140	130	5.0	✓
PTCEL17R600MxE	60	30	440	625	32	140	2.3	240	155	5.0	✓
PTCEL17R600MxE303	60	30	440	625	32	140	2.3	240	155	7.5	✓
PTCEL17R121NxE	120	30	460	650	64	100	2.3	240	155	5.0	✓
PTCEL17R251SxE	250	30	600	850	130	70	2.3	240	155	5.0	✓
PTCEL17R501TxE	500	30	700	1000	260	50	2.3	230	155	5.0	✓
PTCEL17R501TxE302	500	30	700	1000	260	50	2.3	230	155	7.5	✓
PTCEL17R501TxE401	500	30	700	1000	260	50	2.3	230	155	10.0	✓
PTCEL17R102UxE404	1000	30	800	1200	500	35	2.3	230	155	10.0	

Note

(1) Replace the x by B for bulk or T for tape and reel

OUTLINE AND DIMENSIONS



COMPONENT DIMENSIONS in millimeters

SYMBOL	PTCEL13		PTCEL17		
D	13.5 max.		16.5 max.		
d	0.6 ± 0.05		0.8 ± 0.05		
H_1	17 max.		20 max.		
H_2	3 ± 1		3 ± 1		
T	7.0 max.		7.5 max.		
F [1]	5.0 ± 0.8	7.5 ± 0.8	5.0 ± 0.8	7.5 ± 0.8	10.0 ± 0.8
L [2]	20 min.	18 min.	20 min.	18 min.	16 min.

Notes

(1) F pitch = see “Electrical Data and Ordering Information” table for available wire pitch part numbers

(2) L lead length corresponds to available wire pitch part numbers

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REQUIRED NUMBER OF PTC THERMISTORS TO LIMIT CURRENT AND ABSORB ENERGY

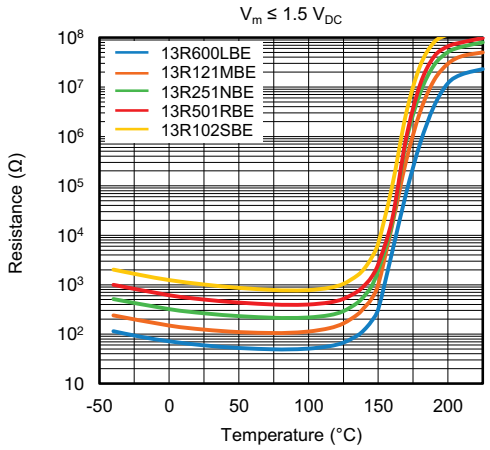
By using several PTC's in a series / parallel network, the maximum current limitation and absorbed energy levels can be further optimized. For homogeneous current and energy distribution it is recommended to combine only PTCEL of the same size and matched resistance value. Energy absorption per PTC in a network depends on current distribution in the network and as such on the individual PTC resistance value. PTCEL thermistors might be used in a series connection to further lower the inrush current, but not to increase the maximum allowed voltage levels. Following formula may be used to calculate the minimum number of PTCEL thermistors of the same size and matched resistance value that are required in a DC link or other capacitor bank application to properly charge or discharge a given amount of non-repetitive energy without follow current. The formula is valid for one charge or discharge operation within cool down period of at least 5 times the thermal time constant and for which the T_{PTC} equals the T_{amb} before a consecutive operation.

$$N \geq \frac{K \times C \times V^2}{2 \times C_{th} \times (T_{sw} - T_{amb})}$$

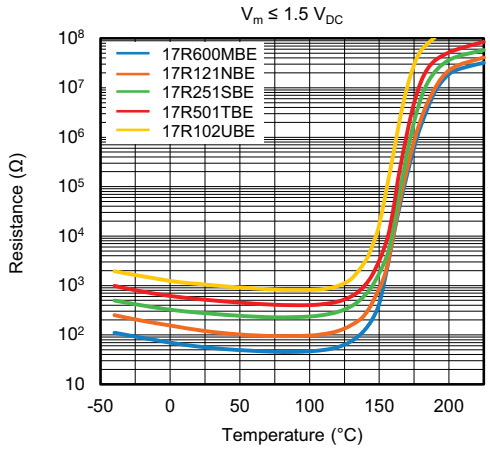
Notes

- N is the number of PTCEL required in the network
- C is the total capacitor value to charge or discharge in F
- V is the maximum DC voltage on the capacitor C
- C_{th} is the thermal capacity of one PTC in [J/K] (see table)
- T_{sw} is the minimum switching temperature of the PTCEL (130 °C)
- T_{amb} is the maximum ambient temperature at which the PTC needs to operate
- K is the factor that determines the charging operation mode
  K = 1 for DC charging or discharging
  K = 0.96 for 3-phase rectified charging
  K = 0.76 for single phase rectified charging

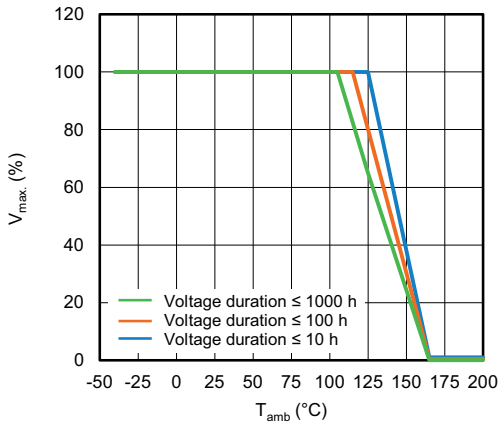
RESISTANCE VS. TEMPERATURE FOR PTCEL13 (Typical)



RESISTANCE VS. TEMPERATURE FOR PTCEL17 (Typical)



$V_{max.}$ DERATING VS. T_{amb}



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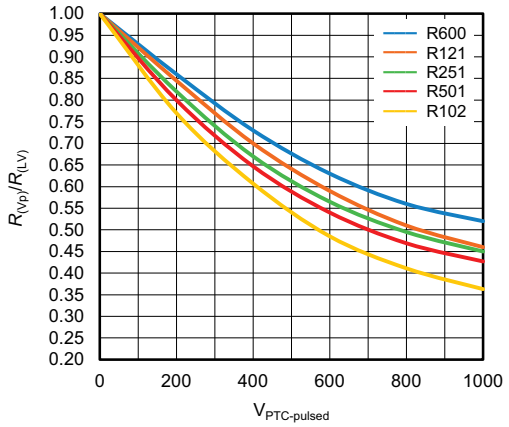
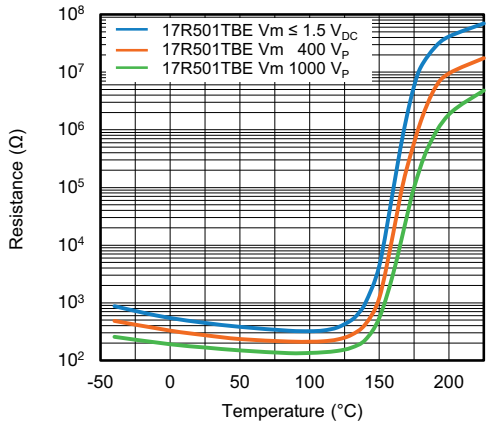
PTC RESISTANCE UNDER PULSED VOLTAGE



RESISTANCE VS. TEMPERATURE PULSED

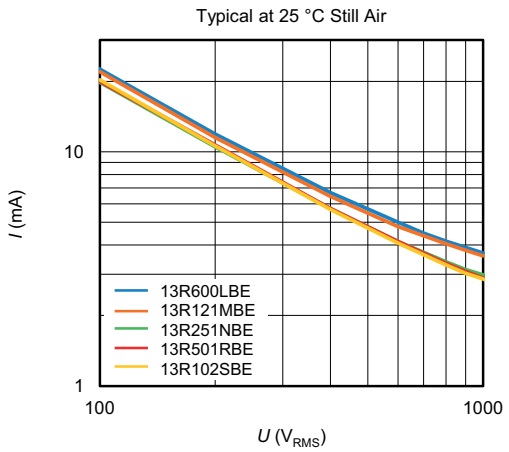
(Typical)



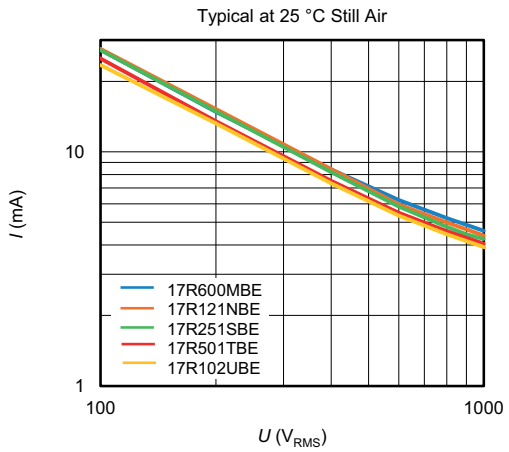
Notes

- The minimum PTC resistance values under (pulsed) voltage are depending on actual minimum resistance value in the temperature range of 70 °C to 100 °C. The actual voltage dependency effect or $R_{(Vp)}/R_{(LV)}$ ratio of ceramic PTC is depending on its resistance values at low voltage ($R_{(LV)}$). The different curves represent the influence of (pulsed) voltage related to the PTCEL value types in the minimum resistance temperature range of 70 °C to 100 °C. A PTC resistance value $R_{(LV)}$ can be taken from the "Resistance vs Temperature" graphs and multiplied by a corresponding ratio to estimate the (minimum) resistance value and determine a maximum peak current at a defined voltage. Example: a PTCEL17R501TBE type has a $R_{min.}$ (see Electrical Data table) of 260 Ω at around 90 °C, and at a 1000 V peak-voltage the resistance will drop to 260 Ω x 0.43 (red curve) = 112 Ω, which will give rise to a peak-current of around 9 Ap. Actual peak currents that could be reached at certain voltage levels can be more precisely evaluated by using the available SPICE models
- Also check the graph "Resistance vs. Temperature Pulsed" to see the typical resistance to voltage dependency effect on a PTCEL17R501TBE

RESIDUAL CURRENT VS. VOLTAGE FOR PTCEL13



RESIDUAL CURRENT VS. VOLTAGE FOR PTCEL17



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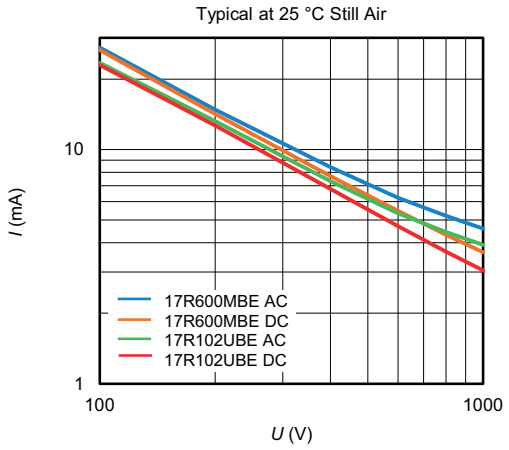
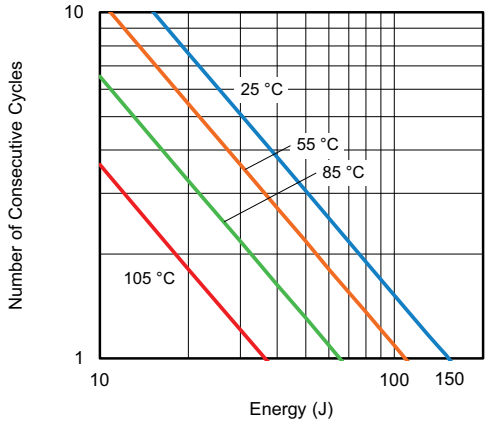
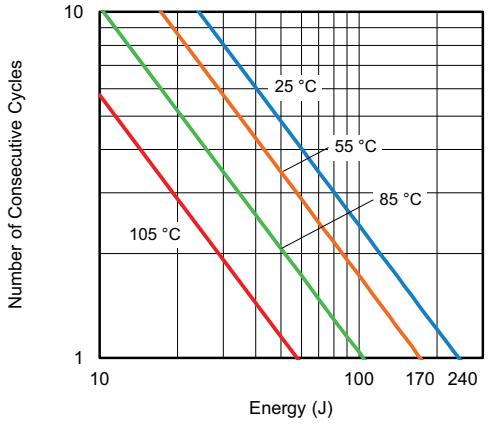
RESIDUAL CURRENT VS. VOLTAGE AC / DC



CONSECUTIVE ENERGY AT DIFFERENT T_{amb} FOR PTCEL13



CONSECUTIVE ENERGY AT DIFFERENT T_{amb} FOR PTCEL17



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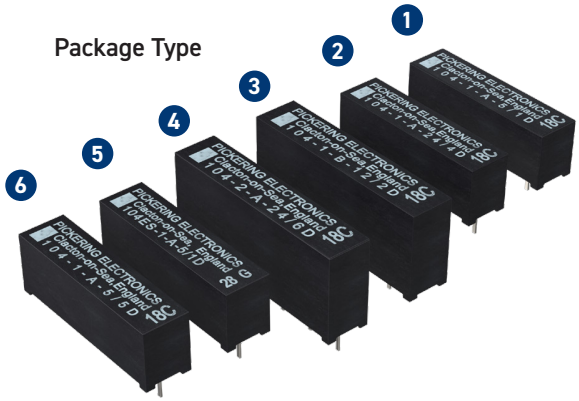
High Voltage SIL/SIP Reed Relays

Series 104

- Up to **5 kV** stand-off NEW
- Switching Voltage up to **1500 VDC** NEW
- Small size. Stacking on **0.25 Inches** pitch
- Internal mu-metal magnetic screen
- Optional electrostatic screen NEW
- **104HT** High temperature versions available NEW
- One or two switches in a single package
- **1 Form A**, **2 Form A** & **1 Form B** configurations
- Dry switches
- **5 V**, **12 V** or **24 V** Coils with optional internal diode
- Ideal for mixed semiconductor testers, renewable energies and much more (see below)
- Additional build options are available including many pin configurations
- Many benefits compared to industry standard relays (see last page)



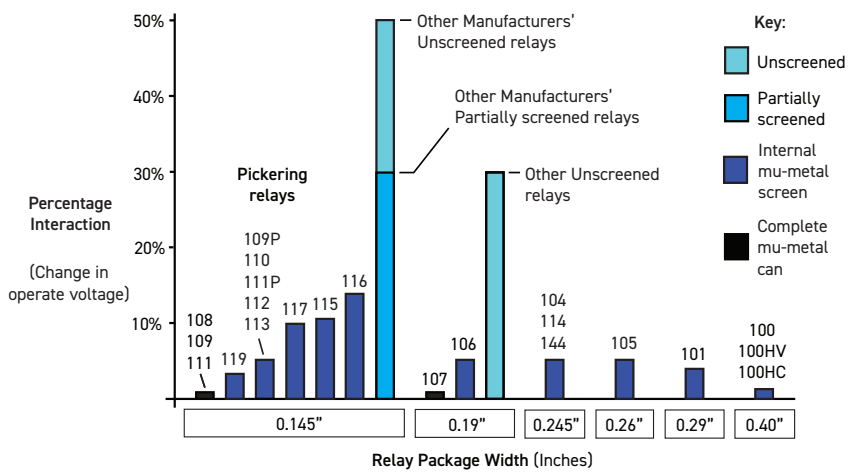
The Series 104 reed relays are ideal for mixed signal semiconductor testers, cable testing, monitoring photovoltaic efficiency, EVs & charge point testing, mining gas analysis, medical electronics, in-circuit test equipment, high voltage instrumentation, and much more.

The range features an internal mu-metal screen to eliminate problems that would otherwise be experienced due to magnetic interaction when they are closely stacked.

There is an option for an electrostatic shield between the switch and the coil to help minimise noise between the coil drive and high voltage circuits.

Where extended operating temperature ranges are required, options are designed to work from -40 °C to +125 °C, or custom versions up to +150 °C.

Five types of dry switches are available, capable of standing-off 1.5, 2, 3, 4 or 5 kV DC. The 1.5 kV and 2 kV versions are rated to switch up to 1000 VDC, for 3 kV, 4 kV and 5 kV versions, under certain conditions, this can be extended to 1500 VDC. The 3, 4 & 5 kV versions also have an increased clearance between the switch and coil pins to accommodate the higher voltage. For information on the recommended spacing between high voltage parts, please see page 3.



Magnetic Interaction

This chart demonstrates the percentage changes in operate voltage due to magnetic interaction depending on the level of magnetic screening offered from the relay package. For more information on magnetic interaction **click here**.

ISSUE 4.0 JUL 2024

Switch Ratings - Dry Switches

1 Form A (energize to make)	1 Form B (energize to break)	2 Form A (energize to make)
1500 VDC min stand-off 1000 VDC switching at 25 W	1500 VDC min stand-off 1000 VDC switching at 25 W	1500 VDC min stand-off 1000 VDC switching at 25 W
2000 VDC min stand-off 1000 VDC. switching at 25 W	2000 VDC min stand-off 1000 VDC switching at 25 W	2000 VDC min stand-off 1000 VDC switching at 25 W
3000 VDC min stand-off 1000* VDC switching at 25 W	–	–
4000 VDC min stand-off 1000* VDC switching at 25 W	–	–
5000 VDC min stand-off 1000* VDC switching at 25 W	–	–

* For higher standoff versions, switching voltages greater than 1000 VDC are possible at reduced current and power, see the Extending Switching Voltages table below.

Dry Reed: Series 104 switch ratings - contact ratings for each switch type

Switch No	Switch form	Power rating	Max. switch current	Max. carry current	Max. switching volts	Min. stand-off volts	Life expectancy ops typical (see Note[1])	Operate time inc bounce (max)	Release time	Special features
1	A or B	25 W	1.0 A	1.5 A	1000	1500	10^8	1.0 ms	0.3 ms	High voltage
2	A or B	25 W	1.0 A	1.5 A	1000	2000	10^8	1.0 ms	0.3 ms	High voltage
3	A	25 W	1.0 A	1.5 A	1000*	3000	10^8	1.0 ms	0.3 ms	High voltage
4	A	25 W	1.0 A	1.5 A	1000*	4000	10^8	1.0 ms	0.3 ms	High voltage
5	A	25 W	1.0 A	1.5 A	1000*	5000	10^8	1.0 ms	0.3 ms	High voltage

* For higher standoff versions, switching voltages greater than 1000 VDC are possible at reduced current and power, see the Extending Switching Voltages table below.

Note[1]: Life Expectancy

The life of a reed relay depends upon the switch load and end of life criteria. For example, for an 'end of life' contact resistance specification of 1Ω, switching low loads (10 V at 10 mA resistive) or when 'cold' switching, typical life is approx 1×10^9 ops. At the maximum load (resistive), typical life is 1×10^7 ops. In the event of abusive conditions, e.g. high currents due to capacitive inrushes, this figure reduces considerably. Pickering will be pleased to perform life testing with any particular load condition.

Dry Reed: Series 104 switch ratings - Extended Switching Voltages

Switch No	Switch form	Max. switch current	Max. switching volts	Switched power	Typical life expectancy
3, 4 or 5	A	1 mA	1250	1.25 W	10^7
3, 4 or 5	A	4 mA	1250	5 W	5×10^6
3, 4 or 5	A	8 mA	1250	10 W	10^6
3, 4 or 5	A	1 mA	1500	1.5 W	10^6
3, 4 or 5	A	2 mA	1500	3 W	5×10^5

For more detailed information on switching voltages greater than 1000 VDC please see our application note extending switching voltages or contact our technical team techsales@pickeringrelay.com

Operating Voltages - Standard

Coil voltage - nominal	Must operate voltage - maximum at 25 °C	Must release voltage - minimum at 25 °C
5 V	3.75 V	0.5 V
12 V	9 V	1.2 V
24 V	18 V	2.4 V

Operating Voltages - HT (High Temperature) Versions

Coil voltage - nominal	Must operate voltage		Must release voltage	
	maximum at 25 °C	maximum at 125 °C	minimum at 25 °C	minimum at 125 °C
5 V	2.75 V	3.75 V	0.5 V	0.5 V
12 V	6 V	9 V	1.2 V	1.2 V
24 V	12 V	18 V	2.4 V	2.4 V

Environmental Specification/Mechanical Characteristics

In applications where a higher or lower operating temperature range is required, the 104HT range has been designed to maintain optimum performance from -40 °C to +125 °C.

Standard Operating Temperature Range	-20 °C to +85 °C
Standard Storage Temperature Range	-35 °C to +100 °C
104HT Operating Temperature Range	-40 °C to +125 °C
104HT Storage Temperature Range	-40 °C to +150 °C
Shock Resistance	50 g
Vibration Resistance (10 - 2000 Hz)	20 g
Soldering Temperature (max) (10 s max)	270 °C
Washability (Proper drying process is recommended)	Fully Sealed

Washing Guidelines

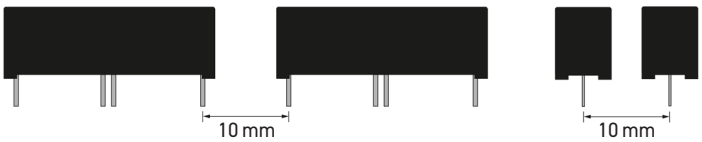
Pickering do not make any specific recommendations on washing reed relays, due to the large number of factors in cleaning processes, however we do have suggestions on best practices. Click here for more information.

Extended Operating Temperature Range

With the copper coil winding wire having a resistance/temperature coefficient of approximately 0.4% per °C, changes in temperature will result in changes in operating voltage. A standard reed relay is designed to have optimum performance up to the maximum operating temperature of +85 °C, the 104HT range has increased coil drive to ensure the same performance up to 125 °C, and with certain considerations, up to +150 °C. For more information, see our Temperature guide or contact techsales@pickeringrelay.com

Recommended Spacing for High Voltage Parts

When working with high voltages, the recommended space between pins is 2 mm per 1 kV stand-off voltage. For example, the 5 kV version of the 104 should have a gap of 10 mm between the pins.



Dry Relay: Series 104 Coil Data and Type Numbers

Device Type	Type Number	Coil (V)	Coil resistance	Max. contact resistance (initial)	Insulation resistance (minimum at 25 °C) (see Note[4])		Capacitance (typical) (see Note[2])	
					Switch to coil	Across switch	Closed switch to coil	Across open switch
1 Form A Switch No. 1 (1.5 kV) Package Type 1 *	104-1-A-5/1D	5	375 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104-1-A-12/1D	12	1000 Ω					
	104-1-A-24/1D	24	3000 Ω					
1 Form A Switch No. 2 (2 kV) Package Type 1 *	104-1-A-5/2D	5	375 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104-1-A-12/2D	12	1000 Ω					
	104-1-A-24/2D	24	3000 Ω					
1 Form A Switch No. 3 (3 kV) Package Type 2	104-1-A-5/3D	5	220 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104-1-A-12/3D	12	500 Ω					
	104-1-A-24/3D	24	3000 Ω					
1 Form A Switch No. 4 (4 kV) Package Type 2	104-1-A-5/4D	5	220 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104-1-A-12/4D	12	500 Ω					
	104-1-A-24/4D	24	3000 Ω					
1 Form A Switch No. 5 (5 kV) Package Type 6 *	104-1-A-5/5D	5	220 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104-1-A-12/5D	12	500 Ω					
	104-1-A-24/5D	24	3000 Ω					
1 Form B Switch No. 1 (1.5 kV) Package Type 3	104-1-B-5/1D	5	750 Ω	0.20 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104-1-B-12/1D	12	2000 Ω					
	104-1-B-24/1D	24	3000 Ω					
1 Form B Switch No. 2 (2 kV) Package Type 3	104-1-B-5/2D	5	750 Ω	0.20 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104-1-B-12/2D	12	2000 Ω					
	104-1-B-24/2D	24	3000 Ω					
2 Form A Switch No. 1 (1.5 kV) Package Type 4	104-2-A-5/1D	5	250 Ω	0.20 Ω	10^{12} Ω	10^{12} Ω	See Note[3]	See Note[3]
	104-2-A-12/1D	12	750 Ω					
	104-2-A-24/1D	24	2000 Ω					
2 Form A Switch No. 2 (2 kV) Package Type 4	104-2-A-5/2D	5	250 Ω	0.20 Ω	10^{12} Ω	10^{12} Ω	See Note[3]	See Note[3]
	104-2-A-12/2D	12	750 Ω					
	104-2-A-24/2D	24	2000 Ω					

When an internal diode is required, the suffix D is added to the part number as shown in the table.

* Package Type 2 available, contact Pickering for more details.

Note[2]: Capacitance across open switch

The capacitance across the open switch was measured with other connections guarded.

Note[3]: Capacitance values

The value will depend upon on the mode of connection/guarding of unused terminals. Please contact technical sales for details.

Note[4]: Insulation resistance

Insulation resistance will reduce at higher temperatures. For more information on temperature effects **click here**, or **contact Pickering** for more in depth guidance.

Dry Relay: Series 104 (Electrostatic Shield) Coil Data and Type Numbers

Device Type	Type Number	Coil (V)	Coil resistance	Max. contact resistance (initial)	Insulation resistance (minimum at 25 °C) (see Note[3])		Capacitance (typical) (see Note[2])	
					Switch to coil	Across switch	Closed switch to coil	Across open switch
1 Form A (ES Shielded) Switch No. 1 (1.5 kV) Package Type 5	104ES-1-A-5/1D	5	150 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104ES-1-A-12/1D	12	600 Ω					
	104ES-1-A-24/1D	24	2000 Ω					
1 Form A (ES Shielded) Switch No. 2 (2 kV) Package Type 5	104ES-1-A-5/2D	5	150 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104ES-1-A-12/2D	12	600 Ω					
	104ES-1-A-24/2D	24	2000 Ω					
1 Form A (ES Shielded) Switch No. 3 (3 kV) Package Type 5	104ES-1-A-5/3D	5	50 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104ES-1-A-12/3D	12	400 Ω					
	104ES-1-A-24/3D	24	1200 Ω					

When an internal diode is required, the suffix D is added to the part number as shown in the table.

Dry Relay: Series 104 (High Temperature) Coil Data and Type Numbers

Device Type	Type Number	Coil (V)	Coil resistance	Max. contact resistance (initial)	Insulation resistance (minimum at 25 °C) (see Note[3])		Capacitance (typical) (see Note[2])	
					Switch to coil	Across switch	Closed switch to coil	Across open switch
1 Form A (HT High Temp) Switch No. 1 (1.5 kV) Package Type 1	104HT-1-A-5/1D	5	300 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104HT-1-A-12/1D	12	750 Ω					
	104HT-1-A-24/1D	24	3000 Ω					
1 Form A (HT High Temp) Switch No. 2 (2 kV) Package Type 1	104HT-1-A-5/2D	5	300 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104HT-1-A-12/2D	12	750 Ω					
	104HT-1-A-24/2D	24	3000 Ω					
1 Form A (HT High Temp) Switch No. 3 (3 kV) Package Type 2	104HT-1-A-5/3D	5	125 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104HT-1-A-12/3D	12	500 Ω					
	104HT-1-A-24/3D	24	2500 Ω					
1 Form A (HT High Temp) Switch No. 4 (4 kV) Package Type 2	104HT-1-A-5/4D	5	125 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104HT-1-A-12/4D	12	500 Ω					
	104HT-1-A-24/4D	24	2500 Ω					
1 Form A (HT High Temp) Switch No. 5 (5 kV) Package Type 6	104HT-1-A-5/5D	5	125 Ω	0.15 Ω	10^{12} Ω	10^{12} Ω	2.5 pF	0.1 pF
	104HT-1-A-12/5D	12	500 Ω					
	104HT-1-A-24/5D	24	2500 Ω					

When an internal diode is required, the suffix D is added to the part number as shown in the table.

Note[2]: Capacitance across open switch

The capacitance across the open switch was measured with other connections guarded.

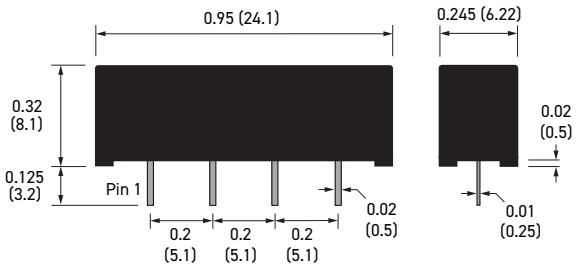
Note[3]: Insulation resistance

Insulation resistance will reduce at higher temperatures. For more information on temperature effects **click here**, or **contact Pickering** for more in depth guidance.

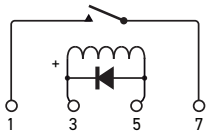
Pin Configuration, Weights and Dimensional Data (dimensions in inches, millimeters in brackets)

Package Type 1

Weight: Typical 2.06 g



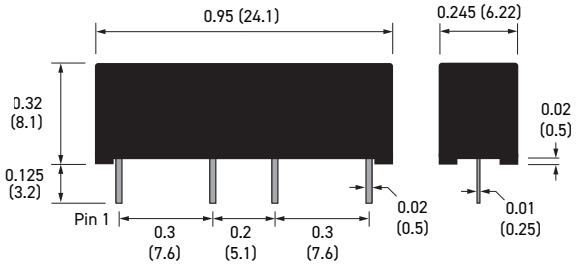
1 Form A



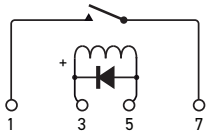
Switch No. 1 (1.5 kV stand-off)
Switch No. 2 (2 kV stand-off)

Package Type 2

Weight: Typical 2.06 g



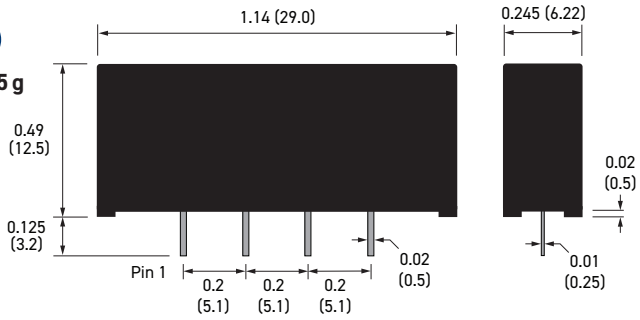
1 Form A



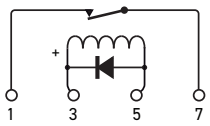
Switch No. 3 (3 kV stand-off)
Switch No. 4 (4 kV stand-off)
Additional Build Options:
Switch No. 1 (1.5 kV stand-off)
Switch No. 2 (2 kV stand-off)
Switch No. 5 (5 kV stand-off)

Package Type 3

Weight: Typical 3.75 g



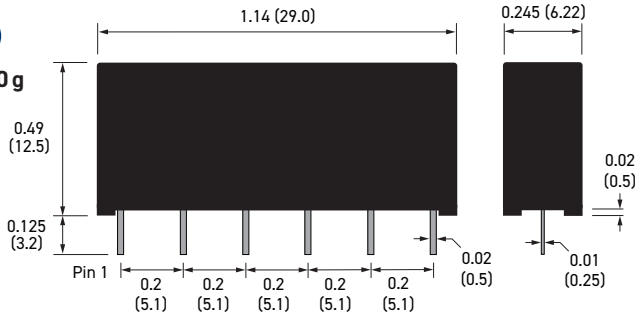
1 Form B (see Note)



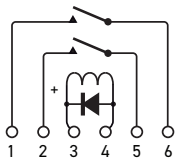
Switch No. 1 (1.5 kV stand-off)
Switch No. 2 (2 kV stand-off)

Package Type 4

Weight: Typical 3.70 g



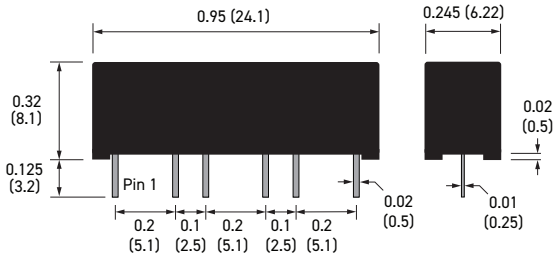
2 Form A



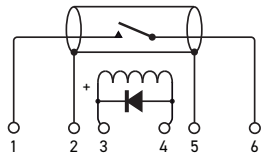
Switch No. 1 (1.5 kV stand-off)
Switch No. 2 (2 kV stand-off)

Package Type 5

Weight: Typical 1.94 g



1 Form A Coaxial



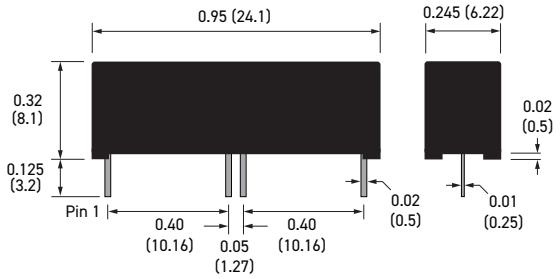
Switch No. 1 (1.5 kV stand-off)
Switch No. 2 (2 kV stand-off)
Switch No. 3 (3 kV stand-off)

Important: Where the optional internal diode is fitted or for all Form B types, the correct coil polarity must be observed, as shown by the + symbol on the schematics.

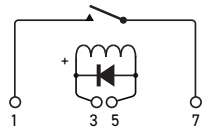
Pin Configuration, Weights and Dimensional Data Continued (dimensions in inches, millimeters in brackets)

Package Type 6

Weight: Typical 2.06 g



1 Form A



Switch No. 5 (5 kV stand-off)

Important: Where the optional internal diode is fitted, the correct coil polarity must be observed, as shown by the + symbol on the schematic.

The technical information shown in this data sheet could contain inaccuracies or typographical errors. This information may be periodically changed or updated and these changes will be included in future versions of this data sheet.

For different values, latest specifications and product details, please contact your local Pickering sales office.

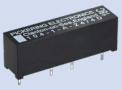
For FREE evaluation samples go to: pickeringrelay.com/samples

Mercury Relays

Mercury relays no longer form part of our standard range due to ROHS guidelines, although some exceptions may apply. For more information please visit pickeringrelay.com/mercuryreedrelays, email techsales@pickeringrelay.com, or call +44 (0) 1255 428141.

Similar Relays Comparison

If the Series 104 is unsuitable for your application, Pickering also manufactures four other series of reed relays with similar characteristics, but in different package sizes.

Series Name		131-1-A	119-1-A			119-2-A	119-1-B		104-1-A & 104HT-1-A					104ES-1-A		
Physical Outline																
Depth	mm (inches)	3.7 (0.145)	3.7 (0.145)						6.3 (0.245)							
Width	mm (inches)	12.5 (0.49)	15.1 (0.595)		20.1 (0.79)		15.1 (0.595)		24.1 (0.95)							
Height	mm (inches)	6.6 (0.26)	6.6 (0.26)			8.9 (0.35)	8.9 (0.35)		8.2 (0.32)							
Package Volume (mm³)		306	369		491	662	498		1 & 2 1245		2 1245		6 1245	5 1245		
Typical Weights (g)		0.58	0.67		0.74	1.06	0.89		2.06		2.06		2.06	1.94		
Contact Configuration		1-A (SPST)	1-A (SPST)			2-A (DPST)	1-B (SPNC)		1-A (SPST)					1-A (SPST)		
Reed Switch Type		Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
Stand-off Voltage (V)		1500	1500	2000	3000	1500	1500	2000	1500	2000	3000	4000	5000	1500	2000	3000
Switching Voltage (V)		1000	1000						1000		1000 (1500)			1000	1000	1000
Switching Current (A)		0.7	0.7						1		1			1	1	1
Carry Current (A)		1.25	1.25						1.5		1.5			1.5	1.5	1.5
Switch Power (W)		10	10						25		25 (3)			25	25	25

STB10LN80K5

N-channel 800 V, 0.55 Ω typ., 8 A MDmesh™ K5 Power MOSFET in a D²PAK package

Datasheet - production data

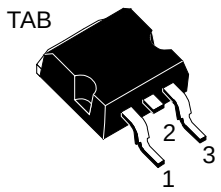
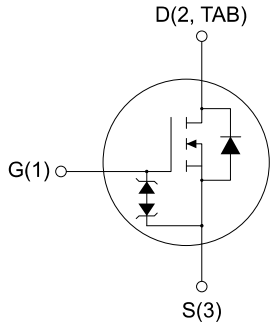


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STB10LN80K5	800 V	0.63 Ω	8 A

- Industry's lowest $R_{DS(on)}$ x area
- Industry's best figure of merit (FoM)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1: Device summary

Order code	Marking	Package	Packing
STB10LN80K5	10LN80K5	D^2PAK	Tape and reel

This is information on a product in full production. www.st.com

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at T_C = 25 °C	8	A
I_D	Drain current (continuous) at T_C = 100 °C	5	A
I_D (1)	Drain current (pulsed)	32	A
P_{TOT}	Total dissipation at T_C = 25 °C	110	W
dv/dt (2)	Peak diode recovery voltage slope	4.5	V/ns
dv/dt (3)	MOSFET dv/dt ruggedness	50	
T_j	Operating junction temperature range	- 55 to 150	°C
T_{stg}	Storage temperature range		

Notes:

(1)Pulse width limited by safe operating area.

(2)I_{SD} ≤ 8 A, di/dt ≤ 100 A/µs; V_{DS} peak < $V_{(BR)DSS}$

(3)V_{DS} ≤ 640 V

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.14	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	35	°C/W

Notes:

(1)When mounted on FR-4 board of 1 inch² , 2 oz Cu

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	2.7	A
E_{AS}	Single pulse avalanche energy (starting Tj = 25 ° C, I_D = I_{AR}, V_{DD} = 50 V)	240	mJ

2 Electrical characteristics

T_C = 25 ° C unless otherwise specified

Table 5: On/off-state

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	800			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 800 V			1	µA
		V_{GS} = 0 V, V_{DS} = 800 V T_C = 125 °C			50	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ± 20 V			± 10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 4 A		0.55	0.63	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	427	-	pF
C_{oss}	Output capacitance		-	43	-	pF
C_{rss}	Reverse transfer capacitance		-	0.25	-	pF
$C_{o(tr)}$ (1)	Equivalent capacitance time related	V_{DS} = 0 to 640 V, V_{GS} = 0 V	-	72	-	pF
$C_{o(er)}$ (2)	Equivalent capacitance energy related			27	-	pF
R_g	Intrinsic gate resistance	f = 1 MHz , I_D= 0 A	-	7	-	Ω
Q_g	Total gate charge	V_{DD} = 640 V, I_D = 8 A V_{GS}= 10 V See *Figure 16: "Test circuit for gate charge behavior"*	-	15	-	nC
Q_{gs}	Gate-source charge		-	4.2	-	nC
Q_{gd}	Gate-drain charge		-	9	-	nC

Notes:

(1)Time related is defined as a constant equivalent capacitance giving the same charging time as Coss when V_{DS} increases from 0 to 80% V_{DSS}

(2)Energy related is defined as a constant equivalent capacitance giving the same stored energy as Coss when V_{DS} increases from 0 to 80% V_{DSS}

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD}= 400 V, I_D = 4 A, R_G = 4.7 Ω V_{GS} = 10 V See *Figure 15: "Test circuit for resistive load switching times"* and *Figure 20: "Switching time waveform"*	-	11.8	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time		-	28	-	ns
t_f	Fall time		-	13	-	ns

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		8	A
I_{SDM} (1)	Source-drain current (pulsed)		-		32	A
V_{SD} (2)	Forward on voltage	I_{SD} = 8 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 8 A, di/dt = 100 A/µs, V_{DD} = 60 V See *Figure 17: "Test circuit for inductive load switching and diode recovery times"*	-	350		ns
Q_{rr}	Reverse recovery charge		-	3.9		µC
I_{RRM}	Reverse recovery current		-	22.5		A
t_{rr}	Reverse recovery time	I_{SD} = 8 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_j = 150 °C See *Figure 17: "Test circuit for inductive load switching and diode recovery times"*	-	505		ns
Q_{rr}	Reverse recovery charge		-	5		µC
I_{RRM}	Reverse recovery current		-	20		A

Notes:

(1)Pulse width limited by safe operating area

(2)Pulsed: pulse duration = 300 µ s, duty cycle 1.5%

Table 9: Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	I_{GS}= ± 1mA, I_D= 0 A	30	-	-	V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection,thus eliminating the need for additional external componentry.

2.2 Electrical characteristics (curves)

Figure 2: Safe operating area

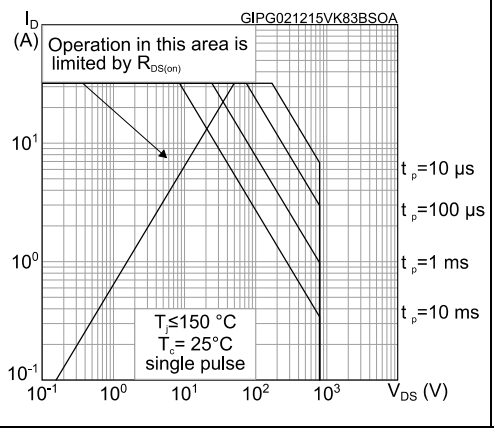


Figure 3: Thermal impedance

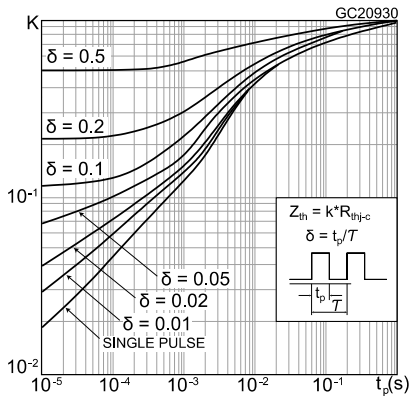


Figure 4: Output characteristics

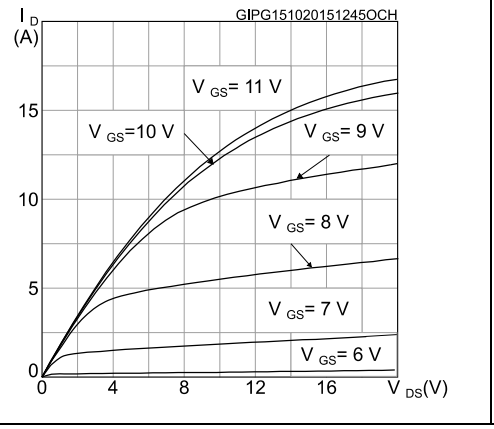


Figure 5: Transfer characteristics

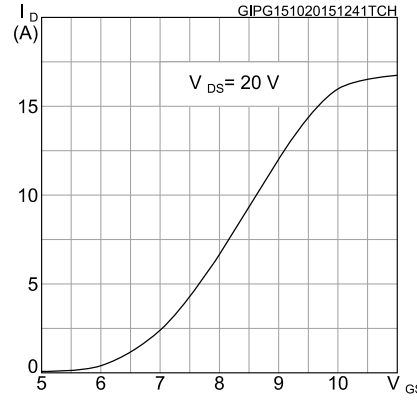


Figure 6: Gate charge vs gate-source voltage

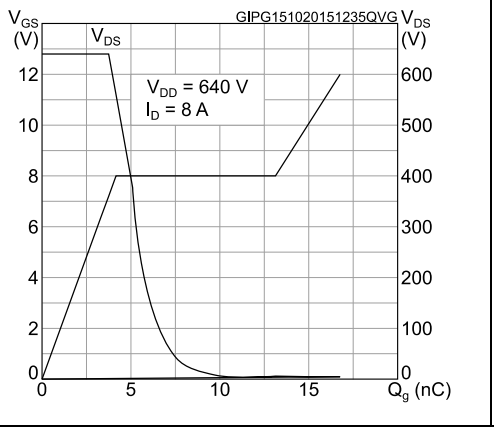
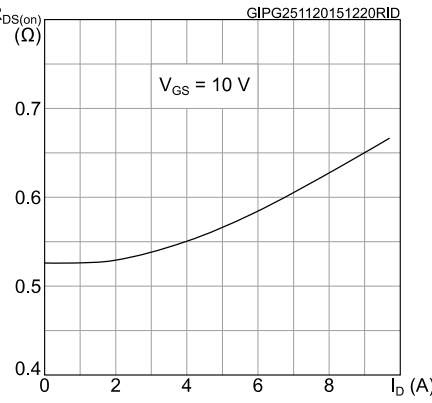


Figure 7: Static drain-source on-resistance



International
IOR Rectifier

Series PVG612APbF

Microelectronic Power IC

HEXFET® Power MOSFET Photovoltaic Relay
Single-Pole, Normally-Open, 0-60V, 2.0A AC / 4.0A DC

General Description

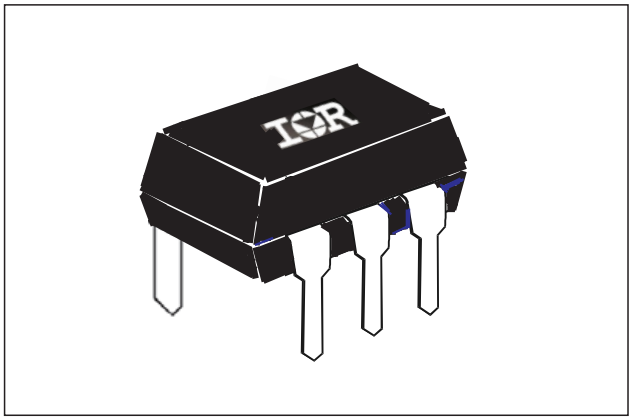
The PVG612A Series Photovoltaic Relay is a single-pole, normally open solid-state relay that can replace electromechanical relays in many applications. It utilizes International Rectifier's proprietary HEXFET power MOSFET as the output switch, driven by an integrated circuit photovoltaic generator of novel construction. The output switch is controlled by radiation from a GaAlAs light emitting diode (LED) which is optically isolated from the photovoltaic generator.

These units exceed the performance capabilities of electromechanical relays in operating life, sensitivity, stability of on-resistance, miniaturization, insensitivity to magnetic fields and ruggedess. The compact PVG612A is particularly suited for isolated switching of high currents from 12 to 48 Volt AC or DC power sources.

Series PVG612A Relays are packaged in a 6-pin, molded DIP package with either thru-hole or surface mount (gull-wing) terminals. It is available in standard plastic shipping tubes or on tape-and-reel. Please refer to Part Identification information opposite.

Features

- Bounce-free operation
- High load current capacity
- High off-state resistance
- Linear AC/DC operation
- 4,000 V_{RMS} I/O Isolation
- Solid-State reliability
- UL recognized
- ESD Tolerance:
  - 4000V Human Body Model
  - 500V Machine Model



Applications

- Programmable Logic Controllers
- Computers and Peripheral Devices
- Audio Equipment
- Power Supplies and Power Distribution
- Control of Displays and Indicators
- Industrial Automation

Part Identification

PVG612APbF	thru-hole
PVG612ASPbF	surface-mount
PVG612AS-TPbF	surface-mount, tape and reel

(HEXFET is the registered trademark for International Rectifier Power MOSFETs)

Electrical Specifications (-40°C ≤ T_A ≤ +85°C unless otherwise specified)

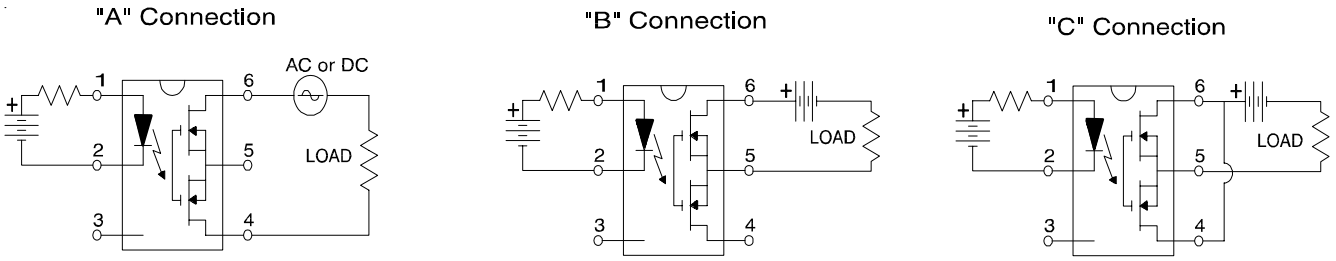
INPUT CHARACTERISTICS	Limits	Units
Minimum Control Current (see figure 1)	5.0	mA
Maximum Control Current for Off-State Resistance @ T_A = +25°C	0.4	mA
Control Current Range (Caution: current limit input LED, see figure 6)	5.0 - 25	mA
Maximum Reverse Voltage (1mA max.)	6.0	V

OUTPUT CHARACTERISTICS		Limits	Units
Operating Voltage Range		0 to ±60	V(DC or AC peak)
Maximum Continuous Load Current @ T_A = +40°C, 10mA Control (see figure 1)	A Connection	2.0	A (AC or DC)
	B Connection	2.5	A (DC)
	C Connection	4.0	A (DC)
Maximum Pulsed Load Current @ T_A =+25°C (100 ms @ 10% Duty Cycle)	A Connection	7.5	A (AC or DC)
	B Connection	8.5	A (DC)
	C Connection	15.5	A (DC)
Typical Thermal Resistance (Rthja, Junction-to-Ambient)	A Connection	79.1	(°C/W)
	B Connection	112.2	(°C/W)
	C Connection	81.0	(°C/W)
Maximum On-State Resistance @T_A =+25°C For 1A pulsed load, 10mA Control (see figure 4)	A Connection	100	mΩ
	B Connection	50	mΩ
	C Connection	35	mΩ
Maximum Off-State Leakage @ 60V, T_A =+25°C		1.0	µA
Maximum Turn-On Time @T_A =+25°C (see figures 7 & 8) For 500mA, 50V_{DC} load, 10mA Control, 10mS pulse width		3.5	ms
Maximum Turn-Off Time @T_A =+25°C (see figures 7 & 8) For 500mA, 50V_{DC} load, 10mA Control, 10mS pulse width		0.5	ms
Typical Output Capacitance @ Vdd=50V, f=1MHz (see figure 2)		105	pF

GENERAL CHARACTERISTICS		Limits	Units
Minimum Dielectric Strength, Input-Output		4000	V_{RMS}
Minimum Insulation Resistance, Input-Output, @T_A =+25°C, 50%RH, 100V_{DC}		10^{12}	Ω
Maximum Capacitance, Input-Output		1.0	pF
Maximum Pin Soldering Temperature (10 seconds maximum)		+260	°C
Ambient Temperature Range:	Operating	-40 to +85	
	Storage	-40 to +100	

International Rectifier does not recommend the use of this product in aerospace, avionics, military or life support applications. Users of this International Rectifier product in such applications assume all risks of such use and indemnify International Rectifier against all damages resulting from such use.

Connection Diagrams



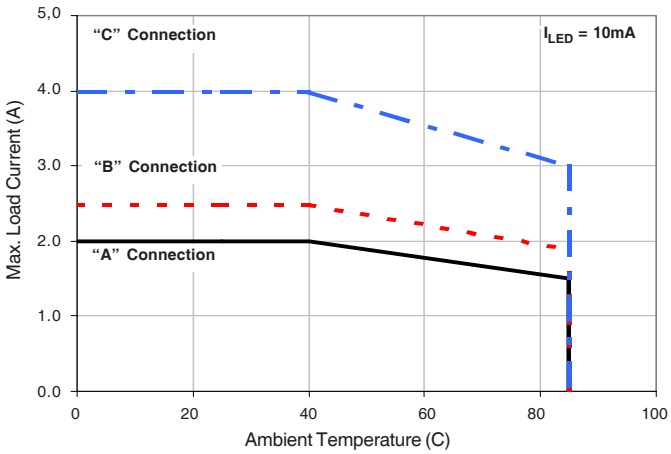


Figure 1. Current Derating Curves

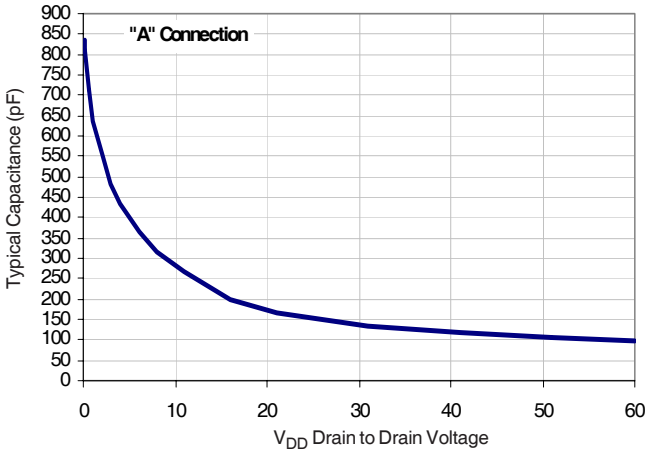


Figure 2. Typical Output Capacitance

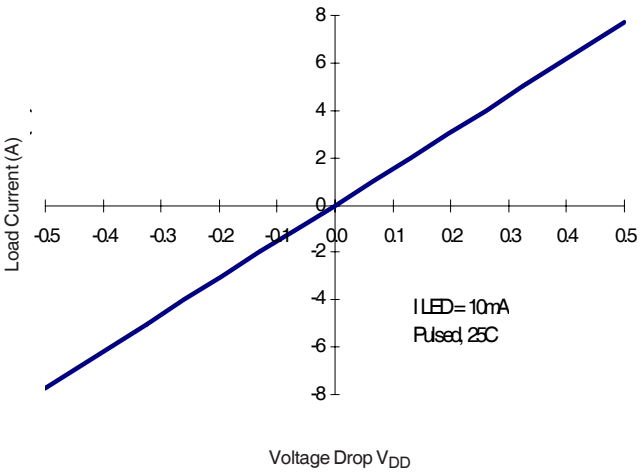


Figure 3. Typical Linearity Characteristics

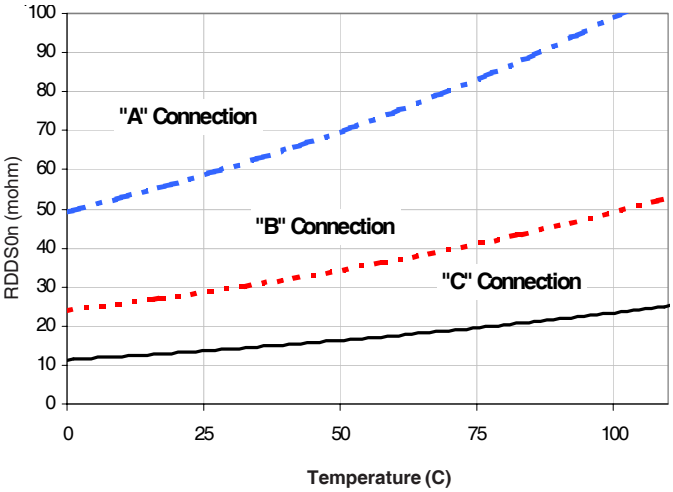


Figure 4. Typical Normalized On-Resistance

ESMIT-4180/C
CBM5D33

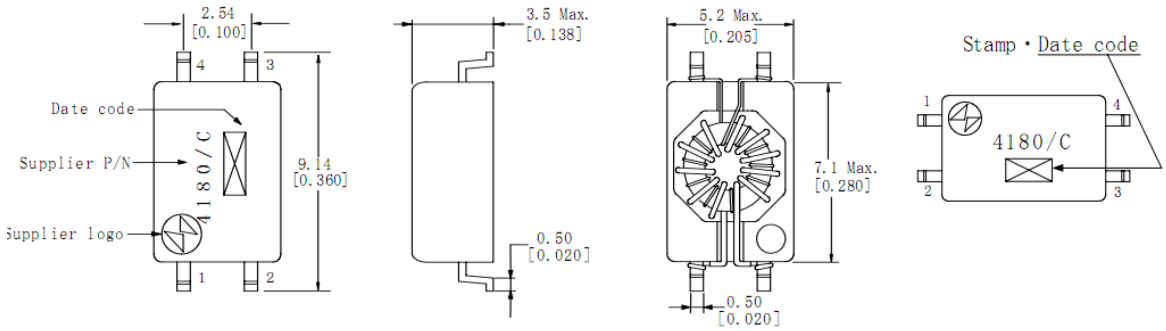
Description

- Reference Design in Freescale HV/EV Battery Management
- Low Profile
- Qualified to AEC-Q200
- High Voltage Isolation 3750Vrms
- Operating Temperature: -40˚C to +105˚C
- Optimize Core Material for low temperature operation
- For BMS – low voltage applications <less than 100v of working voltage>

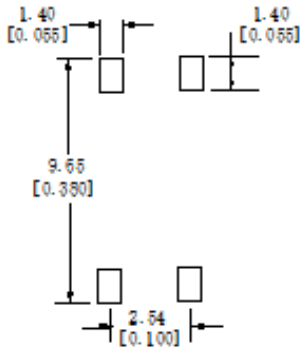
Applications

- Automotive applications (AEC-Q200 only of reliability test)
  ※There is a difficult case to cope with your request for the use of automotive application.
- Industrial applications

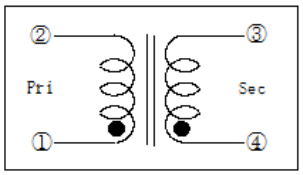
Dimension – mm [inch]



Recommended land pattern - mm [inch]



Schematics (Bottom)



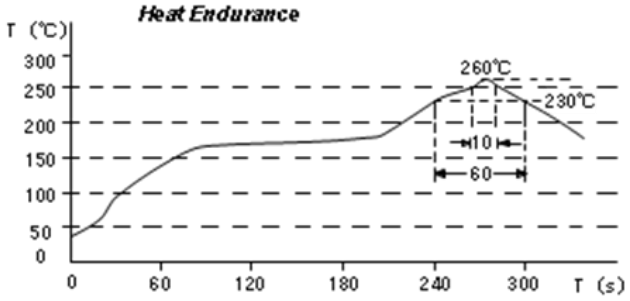
Note： This specification is subject to change without notice. Please contact your nearest sales office for updated information when placing an order.

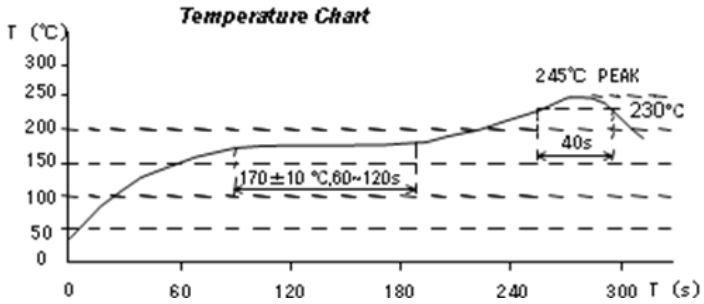
ESMIT-4180/C
CBM5D33

Electrical Characteristics @ 25˚C

PARAMETER	CONDITIONS	VALUE	UNITS	TOLERANCE
Inductance (OCL)	100 kHz, 0.01 V, (1-2)	125	µH	Min.
Inductance (OCL)	100 kHz, 0.01v , (1.2), -40˚C	120	µH	Nom.
DC Resistance (DCR)	(1-2)	0.25	Ω	Max.
	(4-3)	0.25	Ω	Ma.
Dielectric Breakdown Isolation (equivalent to 1 min, 3000 Vrms)	1 sec, (1-4) Max Leakage current 0.5mA	3750	Vrms	Min.
Operating Temperature		-40 to +105	˚C	Nom.

Soldering Reflow Profile





For sales office information, please click here to visit our website.

Note : This specification is subject to change without notice. Please contact your nearest sales office for updated information when placing an order.

Spec. No. : S－0227－6427

To: ADI LT8315

Date of application

2019 (year) 03 (month) 13 (day)

Approval Sheet

■ Part number : PS15－195

■ Document attached ☐ No ☑ Yes(See Below)

* Scope and Precautions S-074-1511	*
*	*
*	*
*	*

■ Tick the relevant box "☑".

☑ New product / New specification

☐ New part(s) is added to approved specification

☐ Revision of approved specification

■ Note

This specification will be considered accepted upon receipt of your order.

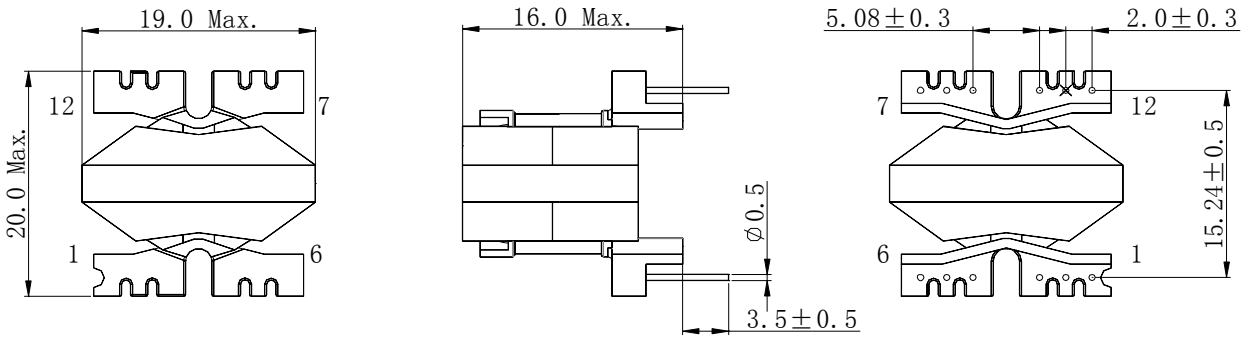
Approved by	Sales Sumida America Components Inc. Approval: Salesman: Check: BU MAGA 2019.03.12 HENRY WEI 韦少宏 Design: BU MAGA 2019.03.12 NELSON JIANG 姜志明

Specification

Type
RM6B

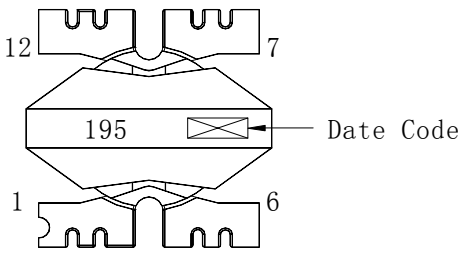
1. Scope & Precautions
   Refer to S-074-1511.

2. Appearance
   2-1. Dimensions(mm)

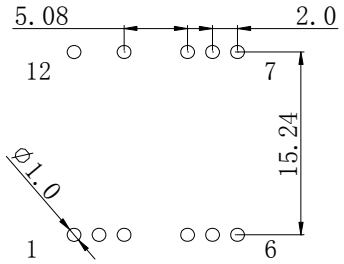


＊ The dimension of terminals don't include the solder icicle.
＊ Dimension without tolerance is reference value.
＊ "×" indicates no terminal.
＊ Pin pitch shall be measured at the root of terminal.

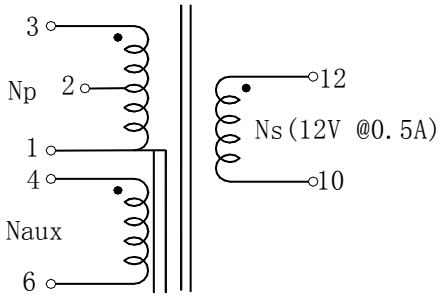
2-2. Stamp



2-3. Recommended land pattern(mm)



3. Coil specification
   3-1. Schematic



"●" Indicates the same polarity.

RoHS
compliance Cd:Max.0.01wt% others:Max.0.1wt%

Note:	Spec. No. S－0227－6427 2/3

3-2.Electrical characteristics(at25℃)

Item	Pin	Specification	Measuring conditions
Inductance	(1-3)	4500μH±10% within	10kHz/0.1V
Leakage inductance	(1-3)	70μH Max.	100kHz/0.1V Tie 4+6+10+12
D.C.R.	(1-3)	14.5Ω Max.	
	(12-10)	4.8Ω Max.	
	(4-6)	5.3Ω Max.	
Turns ratio	Np/Ns/Naux	3:1:1	
Withstanding voltage	(Np,Naux)-Ns	DC 3000V, 1Second	1.0mA
Rated current	(1-3)	0.4A DC	

＊ The rated current applied on this coil causing its initial inductance roll off 20%.

４. General characteristics

4-1.Storage temperature range ： －40℃ ～ ＋125℃

4-2.Operating temperature range ： －40℃ ～ ＋125℃(Including coil’s temperature rise)

TS DC-DC

2 Layer PCB
70µm Copper Layer

HV | LV

4mm

HV−Symbol

FTLogo_med

Logo

3V3 (3V)
U2 1.24V (1.4) 10mA
BAT54 0.5V
R3 1.56 V (1.1 V)
1.56 V / 10 mA = 156R (7.3 mA 3V)
E12 150 R Pmax. 15 mW

3V3 (3V)
LED 2V 1mA
BAT54 0.5 V
R1 0.8 V (0.5V)
0.8 V / 1mA = 800R (0.6 mA 3V)
E12 820R Pmax. 0.8 mW

normally open switch and
button cell on sidepanel

to master pcb

current signal filter on master pcb
fg −3db = 19.4 Hz
R = 1 k
C = 8.2 µF

temp signal filter
on master pcb
fg −3db = 10.3 Hz
R = 330
C = 47 µF

PWR_FLAG +VIN
PWR_FLAG −VIN

2,5 V * 96 = 240 V
600 W / 240 V = 2,5 A

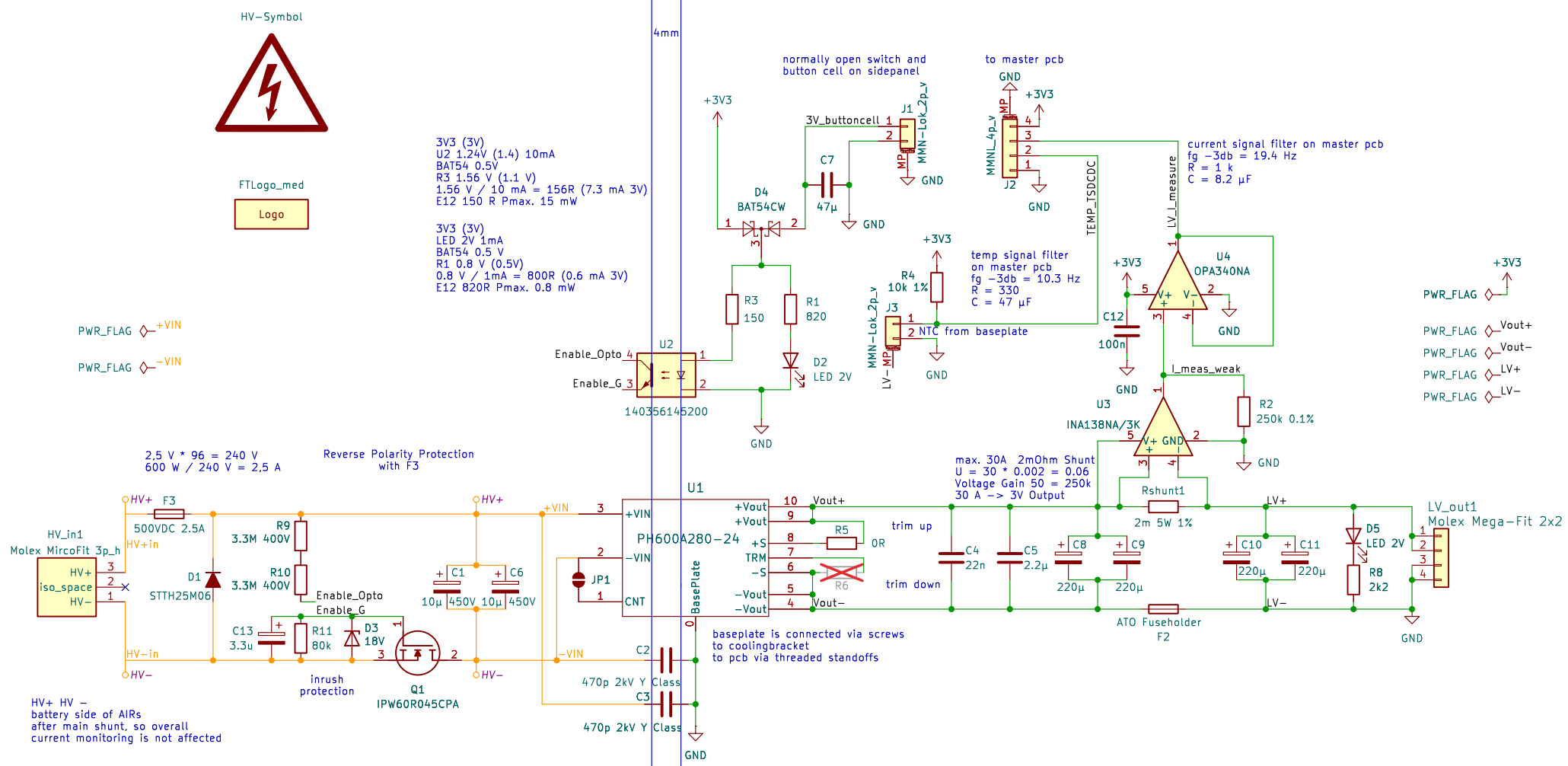
Reverse Polarity Protection
with F3

max. 30A 2mOhm Shunt
U = 30 * 0.002 = 0.06
Voltage Gain 50 = 250k
30 A −> 3V Output

HV+ HV −
battery side of AIRs
after main shunt, so overall
current monitoring is not affected

inrush
protection

baseplate is connected via screws
to coolingbracket
to pcb via threaded standoffs



FASTTUBE

Title: TS−DCDC	**Rev: V3**
	Date: 2025−05−02
Project: TDK_DCDC_pcb	Exp. Date: 2025−05−13
Author: Frederico Boavida	Size: A4 | Page: 1/1

50W to 600W, 200 to 425VDC Input DC-DC Converters

https://product.tdk.com/en/power/ph-a
www.emea.lambda.tdk.com/ph-a

Industrial COTS COMM

The PH-A series of isolated DC-DC converters operate from a wide range 200 to 425Vdc input and are available in multiple power levels from 50 to 600W. Output voltages cover 3.3V to 48V and can be adjusted using the trim terminal by up to -60% to +20%. All models feature remote sense and remote on/off and can be conduction cooled to a cold plate or mounted with an optional heatsink. The 300 and 600W models are certified to EN 62477-1 (OVC III) for use in industrial robots connected to an incoming distribution panel, avoiding the requirement for an isolation transformer. These efficient converters are also well suited for HVDC (High Voltage Direct Current) power transmission systems and renewable energy applications.

Features	Benefits
• Wide Range 200 to 425Vdc Input	• Suitable for HVDC Applications
• Baseplate Cooled	• Can be Conduction or Convection Cooled (With an Optional Heatsink)
• -40 to 100°C Baseplate Temperature	• Operates in Harsh Environments
• Certified to IEC/EN62477-1 (OVC III)	• No External Transformer Needed
• Up to 93% Efficient	• Easier To Cool In the End System

Model Selector

Model	Output Voltage (V)	Adjustment Range (V)	Maximum Current (A)	Maximum Power (W)	Input Current (A) 280V input, 100% load	Efficiency (%) 280V input, 100% load	Overvoltage Protection (%) (2)
PH75A280-3.3	3.3	2.97 - 3.96	15	49.5	0.22	83	130 - 200
PH100A280-3.3	3.3	2.97 - 3.96	20	66	0.29	83	130 - 200
PH50A280-5	5	4 - 6	10	50.0	0.21	86	125 - 150
PH75A280-5	5	4 - 6	15	75.0	0.32	86	125 - 150
PH100A280-5	5	4 - 6	20	100.0	0.42	86	125 - 150
PH300A280-5	5	2.5 - 6	60	300.0	1.22	89	125 - 145
PH50A280-12	12	9.6 - 13.2	4.2	50.4	0.2	89	115 - 145
PH75A280-12	12	9.6 - 13.2	6.3	75.6	0.31	89	115 - 145
PH100A280-12	12	9.6 - 13.2	8.4	100.8	0.41	89	115 - 145
PH150A280-12	12	9.6 - 13.2	12.5	150.0	0.62	88	115 - 145
PH300A280-12	12	4.8 - 14.4	25	300.0	1.22	89	125 - 145
PH75A280-15	15	12 - 16.5	5	75.0	0.3	90	115 - 145
PH150A280-15	15	12 - 16.5	10	150.0	0.6	90	115 - 145
PH50A280-24	24	19.2 - 26.4	2.1	50.4	0.2	89	115 - 145
PH75A280-24	24	19.2 - 26.4	3.2	76.8	0.31	90	115 - 145
PH100A280-24	24	19.2 - 26.4	4.2	100.8	0.4	90	115 - 145
PH150A280-24	24	19.2 - 26.4	6.3	151.2	0.61	89	115 - 145
PH300A280-24	24	9.6 - 28.8	12.5	300.0	1.2	90.5	125 - 145
PH600A280-24	24	14.4 - 28.8	25	600.0	2.33	93	125 - 145
PH75A280-28	28	22.4 - 30.8	2.7	75.6	0.3	90	115 - 145
PH150A280-28	28	22.4 - 30.8	5.4	151.2	0.61	90	115 - 145
PH300A280-28	28	11.2 - 33.6	10.8	302.4	1.2	91	125 - 145
PH50A280-48	48	38.4 - 52.8	1.1	52.8	0.21	89	115 - 145
PH75A280-48	48	38.4 - 52.8	1.6	76.8	0.31	90	115 - 145
PH100A280-48	48	38.4 - 52.8	2.1	100.8	0.4	90	115 - 145
PH150A280-48	48	38.4 - 52.8	3.2	153.6	0.6	90	115 - 145
PH300A280-48	48	19.2 - 57.6	6.3	302.4	1.19	92	125 - 145

Options

Suffix	Description
Blank	M3 tapped mounting inserts
/T	3.3mm non-threaded inserts

Heat Sink Accessories

Suffix	Description
HAQ-10T	PH50A to 150A 25mm transverse fins
HAH-10T	PH300A and 600A 25mm transverse fins
HAH-15L	PH300A and 600A 38mm longitudinal fins

Related Products

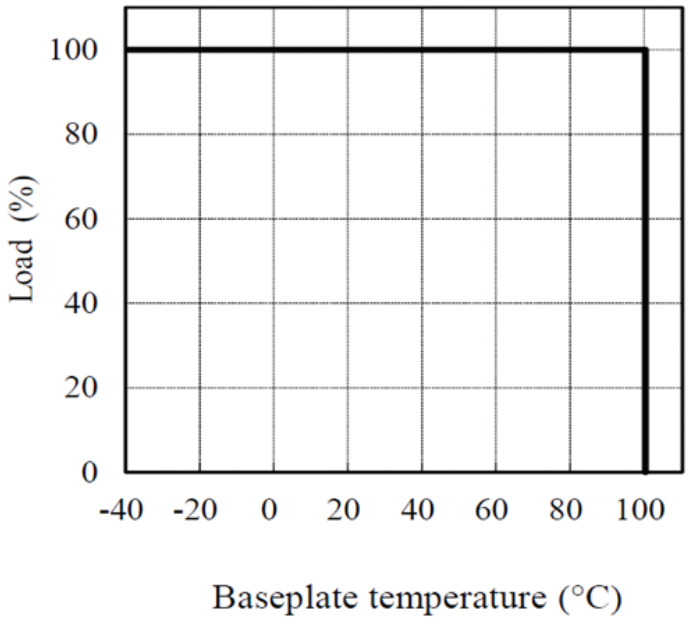
Type	Part Number	Description
DC-DC Converters	PH-A series	1200W, 200 to 425V Input DC-DC Converters
DC-DC Converters	CN200B110 to CN300B110	200 to 300W, 43 to 160V Input DC-DC Converters

Specifications

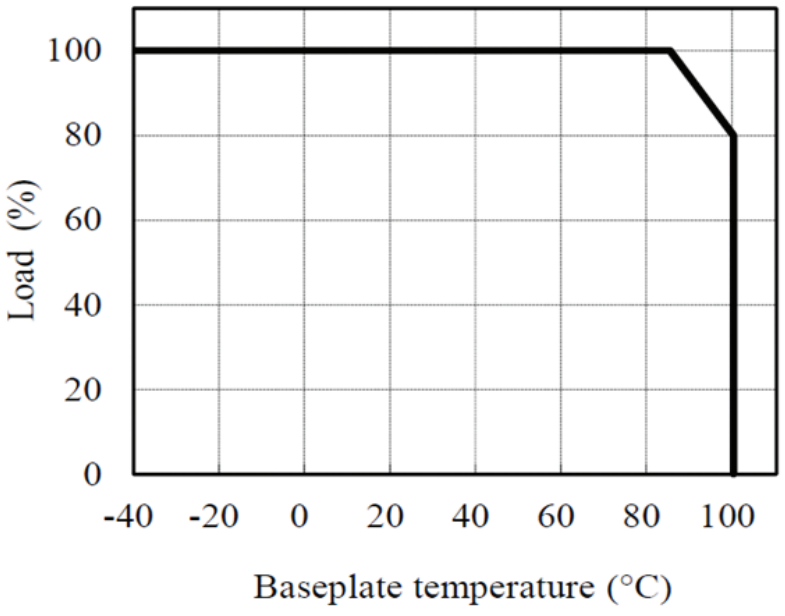
Model		PH50A to PH150A	PH300A to PH600A
Input			
Input Voltage range	Vdc	200 - 425	
Input Current (280Vdc)	A	See model selector	
No Load Power Consumption	W	See evaluation data on website	
Efficiency (280Vdc)	-	See model selector	
Safety Certifications and Markings	-	IEC/UL/CSA/EN62368-1, 60950-1, EN62477-1 OVC III (PH300A and 600A only), CE Mark and UKCA Mark	
Output			
Line Regulation	mV	3.3V - 5V: 10; 12V: 24; 15V: 30, 24V: 48, 28V: 56, 48V: 96	
Load Regulation	mV	3.3V - 5V: 10; 12V: 24; 15V: 30, 24V: 48, 28V: 56, 48V: 96	
Ripple & Noise	mV	3.3V - 5V: 100; 12V - 15V: 150; 24V: 240, 28V: 280, 48V: 400 (1)	
Temperature Coefficient	%/°C	0.02	
Minimum Load	-	No minimum load required	
Overcurrent Protection	%	102 - 150 Constant current style. (PH600A constant current and hiccup)	
Overvoltage Protection	V	Yes, see model selector	
Remote Sense	-	Yes	
Remote On/Off	-	Yes; Low = ON, High = OFF	
Parallel Operation	-	Not possible	
Series Operation	-	Possible, see installation manual	
Environmental			
Operating Temperature	°C	-40 to +100 Base-plate, -40 to +85 Ambient (See derating section)	
Storage Temperature	°C	-40 to +100	
Humidity (non condensing)	%RH	5 - 95 Operating and Non Operating	
Cooling	-	Conduction, convection or forced air (See Installation Manual for heatsink selection)	
Altitude	m	3,000	
Withstand Voltage (For 1 minute)	Vac	Input to Base-plate: 2,500; Input to Output 3,000; Output to Base-plate: 500	
Isolation Resistance	MΩ	>100 at 25°C, 70%RH & 500Vdc	
Vibration	-	Non Operating, 10-55Hz (sweep for 1 min.) Amplitude 0.825mm constant (Max 49 m/s^2) X,Y,Z 1 hour each	
Shock	-	196.1m/s^2	
Other			
Weight (Typ)	g	55	100
Size (WxHxD)	mm	37.2 x 12.7 x 58.3	61.0 x 12.7 x 57.9
Size (WxHxD)	Inches	1.46 x 0.5 x 2.30	2.4 x 0.5 x 2.28
MTBF - Telcordia SR-332 issue 3 (3)	Hours	2 128,235	1,174,511
Warranty	yrs	5 years	

Notes
See website for detailed specifications, test methods and installation manual
(1) PH300A280-48 480mV
(2) Cycle input or remote on/off to reset
(3) PH100A280-48 model, 40°C baseplate, full load, 280Vdc input. PH300A280-24 model, 40°C baseplate, full load, 280Vdc input, ground benign (See full reliability data on website)

Derating Curve (PH50A to PH300A)



Derating Curve (PH600A)



CoolMOS® Power Transistor

Product Summary

V_{DS}	600	V
$R_{DS(on),max}$	0.045	Ω
$Q_{g,typ}$	150	nC

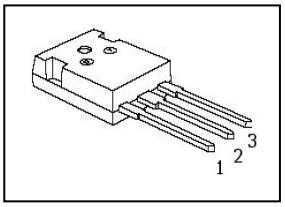
Features

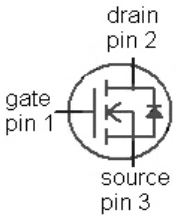
- Worldwide best $R_{ds,on}$ in TO247
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Automotive AEC Q101 qualified
- Green package (RoHS compliant)

CoolMOS CPA is specially designed for:

- DC/DC converters for Automotive Applications

PG-TO247-3





Type	Package	Marking
IPW60R045CPA	PG-TO247-3	6R045A

Maximum ratings, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	T_C=25 °C	60	A
		T_C=100 °C	38	
Pulsed drain current[1)]	$I_{D,pulse}$	T_C=25 °C	230	
Avalanche energy, single pulse	E_{AS}	I_D=11 A, V_{DD}=50 V	1950	mJ
Avalanche energy, repetitive t_{AR}[1),2)]	E_{AR}	I_D=11 A, V_{DD}=50 V	3	
Avalanche current, repetitive t_{AR}[1),2)]	I_{AR}		11	A
MOSFET dv/dt ruggedness	dv/dt	V_{DS}=0...480 V	50	V/ns
Gate source voltage	V_{GS}	static	±20	V
Power dissipation	P_{tot}	T_C=25 °C	431	W
Operating temperature	T_j		-40 ... 150	°C
Storage temperature	T_{stg}		-40 ... 150	
Mounting torque		M3 and M3.5 screws	60	Ncm

Maximum ratings, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	I_S	T_C=25 °C	44	A
Diode pulse current[1)]	$I_{S,pulse}$		230	
Reverse diode dv/dt[3)]	dv/dt		15	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal characteristics						
Thermal resistance, junction - case	R_{thJC}		-	-	0.29	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	62	
Soldering temperature, wavesoldering only allowed at leads	T_{sold}	1.6 mm (0.063 in.) from case for 10 s	-	-	260	°C
Electrical characteristics, at T_j=25 °C, unless otherwise specified						
Static characteristics						
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0 V, I_D=250 µA	600	-	-	V
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=3 mA	2.5	3	3.5	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	-	10	µA
Gate-source leakage current	I_{GSS}	V_{GS}=20 V, V_{DS}=0 V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=44 A, T_j=25 °C	-	0.04	0.045	Ω
		V_{GS}=10 V, I_D=44 A, T_j=150 °C	-	0.11	-	
Gate resistance	R_G	f=1 MHz, open drain	-	1.3	-	Ω

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Dynamic characteristics						
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=100 V, f=1 MHz	-	6800	-	pF
Output capacitance	C_{oss}		-	320	-	
Effective output capacitance, energy related[4)]	$C_{o(er)}$	V_{GS}=0 V, V_{DS}=0 V to 480 V	-	310	-	
Effective output capacitance, time related[5)]	$C_{o(tr)}$		-	820	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=400 V, V_{GS}=10 V, I_D=44 A, R_G=3.3 Ω	-	30	-	ns
Rise time	t_r		-	20	-	
Turn-off delay time	$t_{d(off)}$		-	100	-	
Fall time	t_f		-	10	-	
Gate Charge Characteristics						
Gate to source charge	Q_{gs}	V_{DD}=400 V, I_D=44 A, V_{GS}=0 to 10 V	-	34	-	nC
Gate to drain charge	Q_{gd}		-	51	-	
Gate charge total	Q_g		-	150	190	
Gate plateau voltage	$V_{plateau}$		-	5.0	-	V
Reverse Diode						
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=44 A, T_j=25 °C	-	0.9	1.2	V
Reverse recovery time	t_{rr}	V_R=400 V, I_F=I_S, di_F/dt=100 A/µs	-	600	-	ns
Reverse recovery charge	Q_{rr}		-	17	-	µC
Peak reverse recovery current	I_{rrm}		-	60	-	A

1) Pulse width t_p limited by $T_{j,max}$

2) Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

3) $I_{SD}\leq I_D$, $di/dt\leq$100A/µs, V_{DClink} = 400V, $V_{peak}<V_{(BR)DSS}$, $T_j<T_{jmax}$, identical low side and high side switch

4) $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

5) $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

Type 0ACG

500VDC, SMD Fuse

HF 0ACG Series RoHS Compliant

Features

- Surface mount design to save space
- Ceramic tube, silver plated cap construction
- Compatible with 260℃, IR Pb-free solder process
- Wide operating temperature range, -40℃ to 125℃
- Tape & Reel for auto-insert SMD process
- MSL = 1
- Complies with IEC 60127-7 standard
- RoHS compliant with exemption 7(a)
  Full compliance with EU Directive 2011/65/EU and amending directive 2015/863
- AEC-Q Compliant
- Meets Bel automotive qualification*

* - Largely based on internal AEC-Q test plan

Applications

- Battery Management Systems, (BMS)
- Li-ion Battery Packs
- DC-DC Converters

HALOGEN FREE = HF

AEC-Q Compliant

Physical Specifications

Materials	Body : Ceramic
	Cap : Silver plated copper
Marking	On Fuse :
	"Current Rating"
	On Label :
	"bel", "0ACG", "Current Rating", "Voltage Rating", "Interrupting Rating", "Appropriate Safety Logos"and " ", " "(China RoHS compliant).

Electrical Characteristics

% of Ampere Rating (A)	Operating Time	
	Min	Max
125%	1 hour	-
200%	-	120 sec
1000%		1 sec

Safety Agency Approvals

Safety Agency	Ampere Rating / Voltage Rating	Ampere Range / Volt @ I.R. ability**
	1-3.15A/500V DC /350V DC /350V AC 4-5A/450V DC /125V DC /350V AC	1-3.15A/500V @ 100A DC /350V @1500A DC /350V @ 100A AC 4-5A/450V @ 100A DC /125V @ 1500A DC /350V @ 100A AC

** AC Interrupting Rating (measured at designated voltage, 100% power factor); DC Interrupting Rating (measured at designated voltage, time constant of less than 50 microseconds, battery source)

Specifications subject to change without notice

bel POWER SOLUTIONS & PROTECTION
a bel group

belfuse.com/circuit-protection

Electrical Specifications

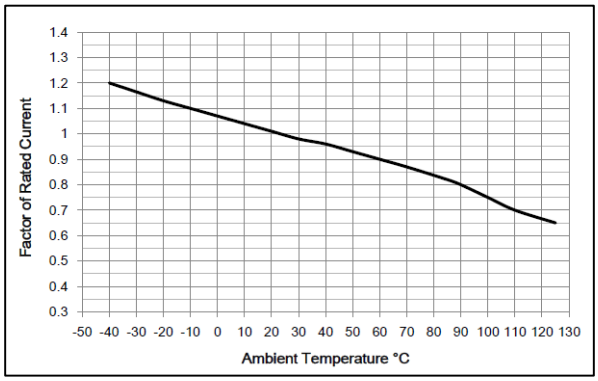
Part Number	Ampere Rating	Alpha Mark	Voltage and Interrupting Ratings	Typical Cold. Resistance (mohms)**	Typical Voltage Drop (mV)	Typical Pre-Arcing I²t (A²Sec)***
0ACG-1000-XX	1A	1	See Table of Ratings on Page 1 for Voltage and associated Interrupting Ratings	220	220	0.50
0ACG-1250-XX	1.25A	1.25		140	210	0.95
0ACG-1600-XX	1.6A	1.6		90	190	2.3
0ACG-2000-XX	2A	2		70	185	4.1
0ACG-2500-XX	2.5A	2.5		40	120	2.6
0ACG-3150-XX	3.15A	3.15		31.5	140	3.3
0ACG-4000-XX	4A	4		24.5	140	5.5
0ACG-5000-XX	5A	5		17.5	130	11.5

Consult manufacturer for other ratings
** DC Cold Resistance are measured at <10% of rated current in ambient temperature of 25℃
*** Typical Pre-arcing I2t are measured at 10In Current, DC battery bank.

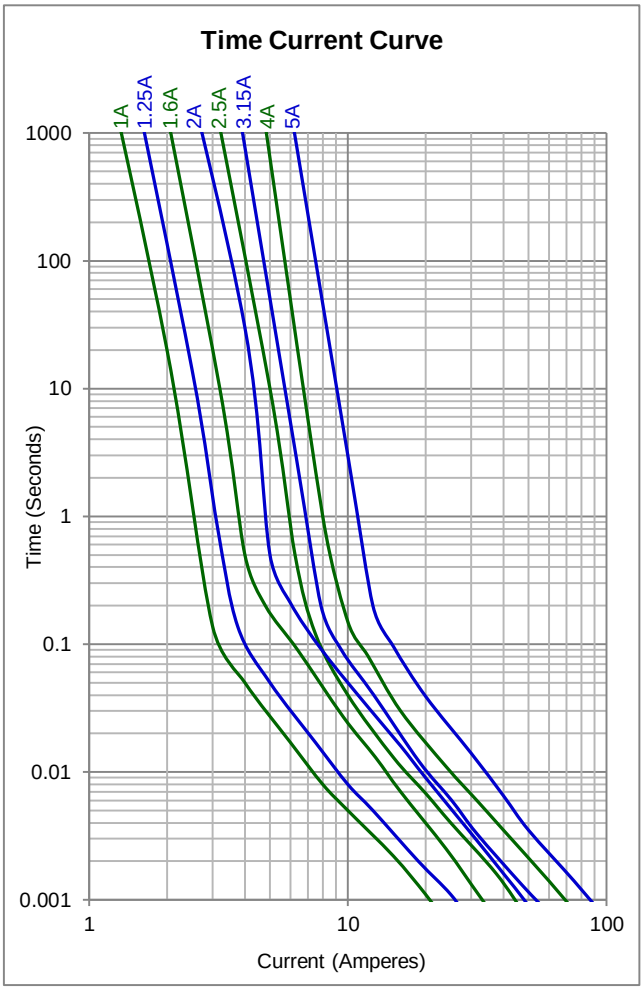
Temperature derating curve

Normal Operating Temperature: 25℃ ± 2℃
Operating Temperature: -40℃ to 125℃ with proper correction factor applied.

Chart of correction factor



Time Current Curve



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EMI Suppression Safety Capacitor, Ceramic Disc, Class X1, 760 V_{AC}, Class Y1, 500 V_{AC}

LINKS TO ADDITIONAL RESOURCES

3D Models SPICE Models

QUICK REFERENCE DATA				
DESCRIPTION	VALUE			
Ceramic Class	1		2	
Ceramic Dielectric	U2J	U2J	Y5S, Y5U, Y5V	Y5S, Y5U, Y5V
Voltage (V_{AC})	500	760	500	760
Min. Capacitance (pF)	10		33	
Max. Capacitance (pF)	22		4700	
Mounting	Radial			

OPERATING TEMPERATURE RANGE
-40 °C to +125 °C

TEMPERATURE CHARACTERISTICS
Class 1: U2J
Class 2: Y5S, Y5U, Y5V

SECTIONAL SPECIFICATIONS
Climatic category (according to EN 60058-1)
Class 1 and class 2: 40 / 125 / 21

COATING
According to UL 94 V-0
Epoxy resin, isolating, flame retardant
Halogen-free available
Reinforced insulation

APPROVALS
IEC 60384-14
UL 60384-14
DIN EN 60384-14
CSA E60384-1:03, CSA E60384-14:09
CQC11-471112-2009

PACKAGING
Bulk, tape and reel, taped ammopack

FEATURES
- Complying with IEC 60384-14
- High reliability
- Vertical (inline) kinked or straight leads
- Singlelayer AC disc safety capacitors
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb e3 RoHS COMPLIANT HALOGEN FREE GREEN (5-2008)

APPLICATIONS
- X1, Y1 according to IEC 60384-14
- Line-to-line filtering (Class X)
- Line-to-ground filtering (Class Y)
- Primary and secondary coupling (SMPS)
- EMI / RFI suppression and filtering

DESIGN
The capacitor consists of a ceramic disc which is silver plated on both sides. Connection leads are made of tinned copper clad steel having a diameter of 0.6 mm.
The capacitors may be supplied with vertical (inline) kinked leads having a lead spacing of 10.0 mm, or 12.5 mm. Encapsulation is made of flame retardant epoxy resin in accordance with UL 94 V-0.

CAPACITANCE RANGE
10 pF to 4700 pF

RATED VOLTAGE U_R
IEC 60384-14:
(X1): 760 V_{AC}, 50 Hz
(Y1): 500 V_{AC}, 50 Hz
1500 V_{DC}

TEST VOLTAGE
Component test (100 %):
4000 V_{AC}, 50 Hz, 2 s
Random sampling test (destructive test):
4000 V_{AC}, 50 Hz, 60 s
Voltage proof of coating (destructive test):
4000 V_{AC}, 50 Hz, 60 s

INSULATION RESISTANCE
≥ 10 000 MΩ

CAPACITANCE TOLERANCE
± 20 % (code M); ± 10 % (code K)

DISSIPATION FACTOR
Class 1: max. 0.5 % (1 MHz)
Class 2: max. 2.5 % (1 kHz)

For technical questions, contact: cdc@vishay.com
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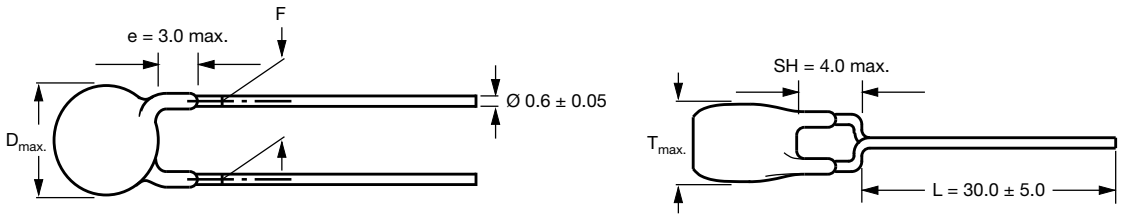
DIMENSIONS in millimeters



Capacitors with 10.0 mm or 12.5 mm lead spacing

TECHNICAL DATA

CAPACITANCE C (pF)	CAPACITANCE TOLERANCE (%)	BODY DIAMETER $D_{max.}$ (mm)	BODY THICKNESS $T_{max.}$ (mm)	LEAD SPACING F (mm) ± 1 mm	PART NUMBER MISSING DIGITS SEE ORDERING CODE BELOW
U2J					
10	± 10	8.0	5.0	10.0 or 12.5	VY1100K31U2JQ6###
15					VY1150K31U2JQ6###
22					VY1220K31U2JQ6###
Y5S					
33	± 10	8.0	5.0	10.0 or 12.5	VY1330K31Y5SQ6###
47					VY1470K31Y5SQ6###
68					VY1680K31Y5SQ6###
100					VY1101K31Y5SQ6###
150					VY1151K31Y5SQ6###
220					VY1221K31Y5SQ6###
330					VY1331K31Y5SQ6###
Y5U					
470	± 20 (1)	8.0	5.0	10.0 or 12.5	VY1471#31Y5UQ6###
680					VY1681#31Y5UQ6###
1000		9.0			VY1102#35Y5UQ6###
1500		10.5			VY1152#41Y5UQ6###
2200		12.0			VY1222#47Y5UQ6###
3300		15.0			VY1332#59Y5UQ6###
3900		15.5			VY1392#61Y5UQ6###
4700		16.0			VY1472#63Y5UQ6###
Y5V MINI SIZE SERIES					
1000	± 20	7.5	5.5	10.0 or 12.5	VY1102M29Y5VQ6###
1500		8.5			VY1152M33Y5VQ6###
2200		9.5			VY1222M37Y5VQ6###
3300		11.0			VY1332M43Y5VQ6###
3900		12.0			VY1392M47Y5VQ6###
4700		13.0			VY1472M51Y5VQ6###

Notes

- Straight leads available on request
- Coating extension DR valid for straight leads only

(1) ± 10 % available on request

For technical questions, contact: cdc@vishay.com
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APPROVALS

IEC 60384-14 - Safety tests
This approval together with CB test certificate substitutes all national approvals.

CB Certificate

Y1-capacitor: CB test certificate:	US-26561-UL	10 pF to 4.7 nF	500 V_{AC}
X1-capacitor: CB test certificate:	US-26561-UL	10 pF to 4.7 nF	760 V_{AC}

VDE

Y1-capacitor: VDE marks approval:	40012673	10 pF to 4.7 nF	500 V_{AC}
X1-capacitor: VDE marks approval:	40012673	10 pF to 4.7 nF	760 V_{AC}

DIN EN 60384-14 VDE 0565-1-1:2006-04 - Safety tests

Underwriters Laboratories Inc./Canadian Standards Association

Y1-capacitor: CSA test certificate:	E183844	10 pF to 4.7 nF	500 V_{AC}
X1-capacitor: CSA test certificate:	E183844	10 pF to 4.7 nF	760 V_{AC}

UL 60384-14, CSA E60384-1:03, CSA E60384-14:09

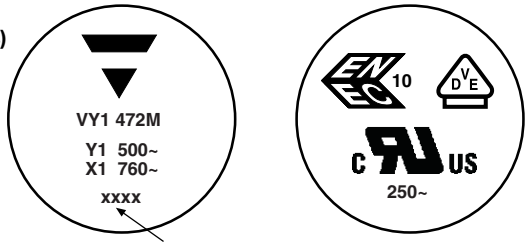
Fixed capacitors for electromagnetic interference suppression and connection to the supply mains.

CQC

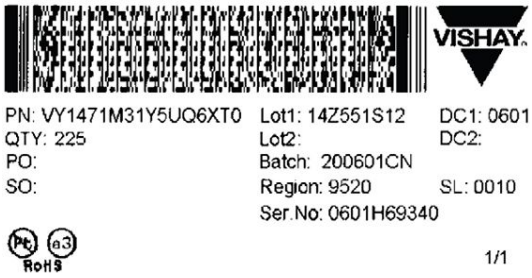
Y1-capacitor: CQC test certificate:	CQC05001015032	10 pF to 4.7 nF	500 V_{AC}
X1-capacitor: CQC test certificate:	CQC05001015032	10 pF to 4.7 nF	760 V_{AC}

MARKING

Sample (2 sides)



4 digit date code
(year/week; add suffix "V" for mini size series)



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molex

Part Number : 768250004
Product Description : Mega-Fit Right-Angle Header, 4 Circuits, Tin (Sn) Plating, UL 94 V-0, Glow-Wire Capable, Tray
Series Number : 76825
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

768250004_sd.pdf

768250001-PK-000.pdf

3D Models and Design Files

768250004_stp.zip

SYM-76825-0004-001.zip

Specifications

AS-76823-100-001.pdf

1720631000-PS-000.pdf

PS-76823-100-001.pdf

1720631000-TS-000.pdf

TS-76823-100-001.pdf

TS-76825-001-001.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Compliant with Exemption 44; 33
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)7663-DC (21 Jan 2025)

EU RoHS	Compliant per EU 2015/863

Compliance Statements
- EU RoHS
- REACH SVHC
- Low-Halogen

Industry Documents
- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest
- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	76825
Description	Mega-Fit Right-Angle Header, 4 Circuits, Tin (Sn) Plating, UL 94 V-0, Glow-Wire Capable, Tray
Application	Power, Wire-to-Board
Component Type	PCB Header
Product Name	Mega-Fit
UPC	887191453842

Agency

CSA	LR19980
UL	E29179

Electrical

Current - Maximum per Contact	23.5A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	4
Circuits (maximum)	4
Color - Resin	Black
First Mate / Last Break	No
Flammability	94V-0
Glow-Wire Capable	Yes
Keying to Mating Part	Yes
Lock to Mating Part	Yes
Mated Height	16.78mm
Material - Metal	Copper
Material - Plating Mating	Matte Tin
Material - Plating Termination	Matte Tin
Material - Resin	High Temperature Thermoplastic
Net Weight	2.836/g
Number of Rows	2
Orientation	Right Angle
Packaging Type	Tray
PCB Locator	Yes
PCB Retention	Yes
PCB Thickness - Recommended	1.57mm, 2.36mm
Pitch - Mating Interface	5.70mm
Pitch - Termination Interface	5.70mm
Plating min - Mating	1.524µm
Plating min - Termination	1.270µm
Polarized to Mating Part	Yes
Polarized to PCB	Yes
Shrouded	Yes
Temperature Range - Operating	-40° to +105°C
Termination Interface Style	Through Hole
Unmated Height	14.53mm

Solder Process Data

Max-Duration	30

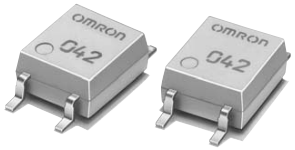
G3VM-601G1

MOS FET Relays

Ultrasensitive MOS FET Relays in 600-V Load series for electric power saving.

- **Continuous load current of 70 mA.**

RoHS compliant

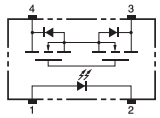


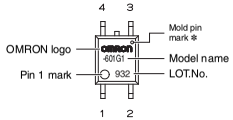
Note: The actual product is marked differently from the image shown here.

■ Application Examples

- **Communication equipment**
- **Test & Measurement equipment**
- **Security equipment**
- **Amusement equipment**
- **Industrial equipment**
- **Various battery-driven devices**

■ Terminal Arrangement/Internal Connections





Note: The actual product is marked differently from the image shown here.
✻ The indentation in the corner diagonally opposite from the pin 1 mark is from a pin on the mold.

■ List of Models

Package type	Contact form	Terminals	Load voltage (peak value) ✻	Model	Minimum package quantity	
					Number per tube	Number per tape and reel
SOP4	1a (SPST-NO)	Surface-mounting Terminals	600 V	**G3VM-601G1**	100	-
				G3VM-601G1 (TR)	-	2,500

✻ The AC peak and DC value are given for the load voltage.

■ Absolute Maximum Ratings (Ta = 25°C)

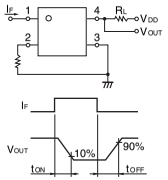
	Item	Symbol	Rating	Unit	Measurement conditions
Input	**LED forward current**	I_F	30	mA	
	Repetitive peak LED forward current	I_{FP}	1	A	100 μs pulses, 100 pps
	LED forward current reduction rate	ΔI_F/°C	−0.3	mA/°C	Ta ≥ 25°C
	LED reverse voltage	V_R	5	V	
	Connection temperature	T_J	125	°C	
Output	**Load voltage (AC peak/DC)**	V_{OFF}	600	V	
	Continuous load current (AC peak/DC)	I_O	70	mA	
	ON current reduction rate	ΔI_O/°C	−0.7	mA/°C	Ta ≥ 25°C
	Pulse ON current	I_{OP}	0.21	A	t = 100 ms, Duty = 1/10
	Connection temperature	T_J	125	°C	
Dielectric strength between I/O (See note 1.)		V_{I-O}	1500	Vrms	AC for 1 min
Ambient operating temperature		Ta	−40 to +85	°C	With no icing or condensation
Ambient storage temperature		Tstg	−55 to +125	°C	With no icing or condensation
Soldering temperature		-	260	°C	10 s

Note: 1. The dielectric strength between the input and output was checked by applying voltage between all pins as a group on the LED side and all pins as a group on the light-receiving side.

■ Electrical Characteristics (Ta = 25°C)

	Item	Symbol	Minimum	Typical	Maximum	Unit	Measurement conditions
Input	**LED forward voltage**	V_F	1.1	1.27	1.4	V	I_F = 10 mA
	Reverse current	I_R	-	-	10	μA	V_R = 5 V
	Capacity between terminals	C_T	-	30	-	pF	V = 0, f = 1 MHz
	Trigger LED forward current	I_{FT}	-	-	0.2	mA	I_O = 70 mA
Output	Maximum resistance with output ON	R_{ON}	-	35	60	Ω	I_F = 0.5mA, I_O = 70 mA, t < 1 s
	Current leakage when the relay is open	I_{LEAK}	-	1	1000	nA	V_{OFF} = 600 V
	Capacity between terminals	Coff	-	75	-	pF	V = 0, f = 1 MHz
Capacity between I/O terminals		C_{I-O}	-	0.8	-	pF	f = 1 MHz, V_S = 0 V
Insulation resistance between I/O terminals		R_{I-O}	1000	-	-	MΩ	V_{I-O} = 500 VDC, RoH ≤ 60 %
Turn-ON time		t_{ON}	-	2	10	ms	I_F = 0.5 mA, R_L = 200 Ω,
Turn-OFF time		t_{OFF}	-	1	5	ms	V_{DD} = 10 V (See note 2.)

Note: 2. Turn-ON and Turn-OFF Times



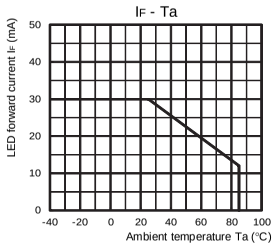
■Recommended Operating Conditions

Use the G3VM under the following conditions so that the Relay will operate properly.

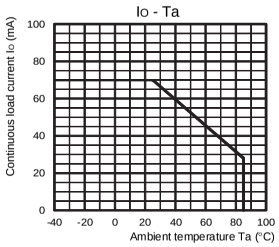
Item	Symbol	Minimum	Typical	Maximum	Unit
Load voltage (AC peak/DC)	V_{DD}	-	-	480	V
Operating LED forward current	I_F	-	0.5	25	mA
Continuous load current (AC peak/DC)	I_O	-	-	60	mA
Ambient operating temperature	Ta	−20	-	65	°C

■Engineering Data

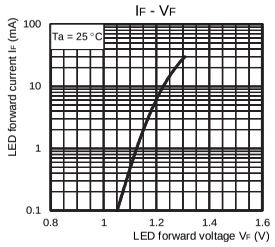
LED forward current vs. Ambient temperature



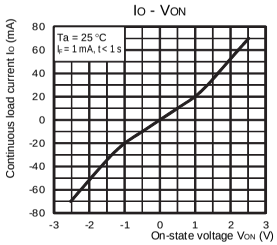
Continuous load current vs. Ambient temperature



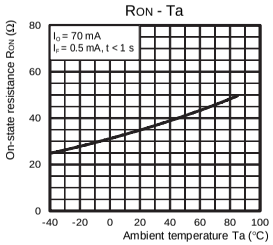
LED forward current vs. LED forward voltage



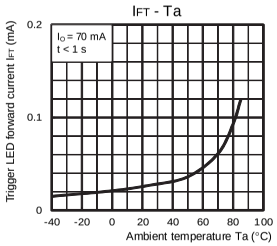
Continuous load current vs. On-state voltage



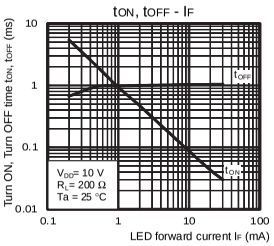
On-state resistance vs. Ambient temperature



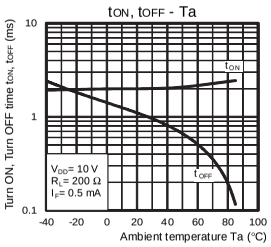
Trigger LED forward current vs. Ambient temperature



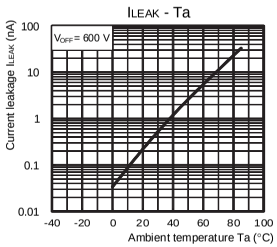
Turn ON, Turn OFF time vs. LED forward current



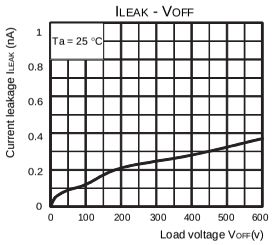
Turn ON, Turn OFF time vs. Ambient temperature



Current leakage vs. Ambient temperature



Current leakage vs. Load voltage



■Safety Precautions

- Refer to **"Common Precautions"** for all G3VM models.

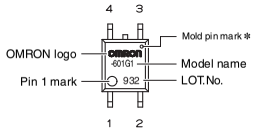
Appearance/Dimensions

SOP4 type

■ Appearance

SOP (Small Outline Package)

SOP4



Note: The actual product is marked differently from the image shown here.

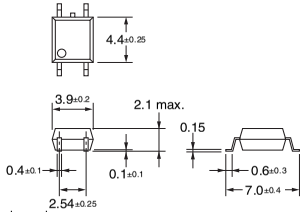
∗ The indentation in the corner diagonally opposite from the pin 1 mark is from a pin on the mold.

■ Dimensions

(Unit: mm)

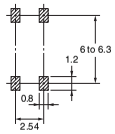
Surface-mounting Terminals

Weight: 0.1 g



Actual Mounting Pad Dimensions

(Recommended Value, TOP VIEW)



Note: The actual product is marked differently from the image shown here.

Application examples provided in this document are for reference only. In actual applications, confirm equipment functions and safety before using the product.
Consult your OMRON representative before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems or equipment that may have a serious influence on lives and property if used improperly. Make sure that the ratings and performance characteristics of the product provide a margin of safety for the system or equipment, and be sure to provide the system or equipment with double safety mechanisms.

Note: Do not use this document to operate the Unit.

OMRON Corporation

ELECTRONIC AND MECHANICAL COMPONENTS COMPANY **Contact: www.omron.com/ecb**

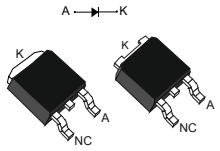
Cat. No. K259-E1-02

0613(0613)(O)

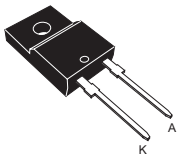
STTH25M06

Datasheet

600 V, 25 A ultrafast high voltage diode



DPAK



TO220FPAC

Features

- Ultrafast recovery, soft recovery
- Low power losses at high switching frequency operations
- Low leakage current
- High junction temperature
- High overcurrent capability
- ECOPACK2 compliant

Applications

- PFC
- Boost diode
- LLC clamping diode

Description

The STTH25M06 is an ultrafast recovery power rectifier especially suited for boost or LLC clamping circuits working at high switching frequencies in heavy duty applications such as air conditioning equipment or telecom power supplies.

Designed with the latest ST's ultrafast technology, this 600 V 25 A diode in DPAK and TO-220FPAC has a robust behavior against electrostatic discharge and high overcurrent capability.

Product status
STTH25M06

Product summary	
Symbol	Value
$I_{F(AV)}$	25 A
V_{RRM}	600 V
$t_{rr(typ.)}$	25 ns
$T_{j(max.)}$	175 °C
$V_{F(typ.)}$	1.6 V

1 Characteristics

Table 1. Absolute ratings (limiting values at 25 °C, unless otherwise specified)

Symbol	Parameter		Value	Unit
V_{RRM}	Repetitive peak reverse voltage		600	V
$I_{F(AV)}$	Average forward current		25	A
I_{FSM}	Surge non repetitive forward current	t_p = 10 ms sinusoidal	170	A
T_{stg}	Storage temperature range		-65 to +175	°C
T_j	Maximum operating junction temperature		+175	°C

Table 2. Thermal resistance parameter

Symbol	Parameter		Typ. value	Unit
$R_{th(j-c)}$	Junction to case	DPAK	0.5	°C/W
		TO-220FPAC	2.45	

For more information, please refer to the following application note :

- AN5088 : Rectifiers thermal management, handling and mounting recommendations

Table 3. Static electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_R(1)	Reverse leakage current	T_j = 25 °C	V_R = 600 V	-		60	µA
		T_j = 125 °C		-	70	800	
V_F(2)	Forward voltage drop	T_j = 25 °C	I_F = 15 A	-	2.1		V
		T_j = 150 °C		-	1.3		
		T_j = 25 °C	I_F = 25 A	-	2.5	3.4	
		T_j = 150 °C		-	1.6	2.0	

1. *Pulse test: t_p = 5 ms, δ < 2%*
2. *Pulse test: t_p = 380 µs, δ < 2%*

To evaluate the conduction losses, use the following equation:

$P = 1.04 \times I_{F(AV)} + 0.0385 \times I_F{}^2{}_{(RMS)}$

For more information, please refer to the following application notes related to the power losses :

- AN604: Calculation of conduction losses in a power rectifier
- AN4058: Calculation of turn-off power losses generated by an ultrafast diode

Table 4. Dynamic electrical characteristics

Symbol	Parameters	Test conditions		Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	T_j = 25 °C	I_F = 1 A dI_F/dt = -50 A/µs V_R = 30 V	-		50	ns
			I_F = 1 A dI_F/dt = -100 A/µs V_R = 30 V	-	25	35	
		T_j = 125 °C	I_F = 15 A dI_F/dt = -200 A/µs V_R = 400 V	-	55		
			I_F = 25 A dI_F/dt = -200 A/µs V_R = 400 V	-	60		
I_{RM}	Reverse recovery current	T_j = 125 °C	I_F = 25 A dI_F/dt = -200 A/µs V_R = 400 V	-	7		A
Q_{rr}	Reverse recovery charge			-	250		nC

Cables

2200 US Highway 27 South
Richmond, IN 47374
Tel: 1-800-52 ALPHA
Web: www.alphawire.com

Customer Specification

PART NO. 6711

Construction

	Diameters (In)	
1) Component 1	1 X 1 HOOKUP	
a) Conductor	26 (7/34) AWG Tinned Copper	0.019
b) Insulation	0.0095" Wall, Nom. MPPE	0.038+/- 0.002
(1) Color(s)	WHITE, BLACK, RED, GREEN, YELLOW, BLUE, BROWN ORANGE, SLATE, VIOLET, GREEN/YELLOW, PINK BLACK/WHITE, GREEN/WHITE, BLUE/WHITE, WHITE/GREEN WHITE/BROWN, WHITE/RED, WHITE/BLUE, WHITE/VOILET YELLOW/WHITE, DARK BLUE, WHITE/ORANGE WHITE/SLATE, RED/BLACK, WHITE/YELLOW	

Applicable Specifications

1) UL	AWM/STYLE 11028	105°C / 600 V_{RMS}
	VW-1	
2) CSA International	C(RU) AWM I A/B FT1	105°C / 600 V_{RMS}
3) Other	Halogen-Free	
	IEC 60332-2 Flame Behavior	
4) CE:	EU Low Voltage Directive 2014/35/EU	

Environmental

1) EU Directive 2011/65/EU(RoHS2), EU Directive 2015/863/EU (RoHS3):	
	All materials used in the manufacture of this part are in compliance with European Directive 2011/65/EU and the amending Directive 2015/863/EU of 4 June 2015 regarding the restriction of use of certain hazardous substances in electrical and electronic equipment.
2) REACH Regulation (EC 1907/2006):	
	This product does not contain Substances of Very High Concern (SVHC) listed on the European Union's REACH candidate list in excess of 0.1% mass of the item.

Properties

Physical & Mechanical Properties	
1) Temperature Range	-40 to 105°C
2) Bend Radius	5X Cable Diameter
3) Pull Tension	2.18 Lbs, Maximum
Electrical Properties	(For Engineering purposes only)
1) Voltage Rating	600 V_{RMS}
2) Inductance	0.06 µH/ft, Nominal
3) Conductor DCR	41 Ω/1000ft @20°C, Nominal

Other

Packaging	Flange x Traverse x Barrel (inches)
a) 25000 DR	23 x 20 x 0 Max. 2 separate pieces; Min length/piece 5000 FT.
b) 5000 FT	9 x 4.5 x 3.5 Continuous length
c) 1000 FT	6.5 x 3 x 3.25 Continuous length
d) 100 FT	3.75 x 2 x 1.75 Continuous length
	[Spool dimensions may vary slightly]
Notes:	
a) The following colors are availible by special order only: PINK, BLACK/WHITE, GREEN/WHITE, BLUE/WHITE, WHITE/GREEN, WHITE/BROWN, WHITE/RED, WHITE/BLUE, WHITE/VOILET, YELLOW/WHITE, WHITE/ORANGE, WHITE/SLATE, RED/BLACK, WHITE/YELLOW.	

www.alphawire.com

Alpha Wire
2200 US Highway 27 South
Richmond, IN 47374

Tel: 1-800-52 ALPHA

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EU/UK/China ROHS CERTIFICATE OF COMPLIANCE

To Whom It May Concern:

Alpha Wire Part Number: 6711

6711, RoHS-Compliant Commencing With 7/1/2009 Production

Note: all colors and put-ups

This document certifies that the Alpha part number cited above, including all packaging materials, is manufactured in accordance with Directive 2011/65/EU of the European Parliament, better known as the RoHS Directive (commonly known as RoHS 2), with regards to restrictions of the use of certain hazardous substances used in the manufacture of electrical and electronic equipment. This certification extends to amending Directive 2015/863/EU which expanded the list of restricted substances to 10 items (commonly known as RoHS 3). This product also complies with UK - RoHS. The reader is referred to these Directives for the specific definitions and extents of the Directives. **No Exemptions are required for RoHS Compliance on this item**. Additionally, Alpha certifies that the listed part number is in compliance with China RoHS "Marking for Control of Pollution by Electronic Information Products" standard SJ/T 11364-2014. This product is also in compliance with China RoHS 2 per GB/T 26572-2011.

Substance	**Maximum Control Value**
Lead	0.1% by weight (1000 ppm)
Mercury	0.1% by weight (1000 ppm)
Cadmium	0.01% by weight (100 ppm)
Hexavalent Chromium	0.1% by weight (1000 ppm)
Polybrominated Biphenyls (PBB)	0.1% by weight (1000 ppm)
Polybrominated Diphenyl Ethers (PBDE) ,	
Including Deca-BDE	0.1% by weight (1000 ppm)
Bis(2-ethylhexyl) phthalate (DEHP)	0.1% by weight (1000 ppm)
Butyl benzyl phthalate (BBP)	0.1% by weight (1000 ppm)
Dibutyl phthalate (DBP)	0.1% by weight (1000 ppm)
Diisobutyl phthalate (DIBP)	0.1% by weight (1000 ppm)

The information provided in this document and disclosure is correct to the best of Alpha Wire's knowledge, information and belief at the date of its release. The information provided is designed only as a general guide for the safe handling, storage, and any other operation of the product itself or the one that it will become part of. The intent of this document is not to be considered a warranty or quality specification. Regulatory information is for guidance purposes only. Product users are responsible for determining the applicability of legislation and regulations based on their individual usage of the product.

Authorized Signatory for the Alpha Wire:

Dave Watson, Director of Engineering 6/9/2025

Alpha Wire
2200 US Highway 27 South
Richmond, IN 47374
Tel: 1-908-925-8000

Alpha Wire | 711 Lidgerwood Avenue, Elizabeth, NJ 07207
Tel: 1-800-52 ALPHA (25742), Web: www.alphawire.com

Customer Specification
PART NO. 782201

Construction

		Diameters (In)
1) Component 1	1 X 1 HOOKUP	
a) Conductor	22 (SOLID) AWG TC	0.025
b) Insulation	0.032" Wall, Nom. PVC	0.089+/- 0.004
(1) Print	ALPHA WIRE E163869-* RU AWM 1015/1230 105C 600V VW-1 22 AWG --- LLXXXXX CSA AWM I A/B 105C 600V FT1 OR TEW 105C 600V FT1 CE ROHS {0} * = Factory Code *[Note: Product may have c(UL) or CSA markings depending upon plant of manufacture.]*	
(2) Color(s)	WHITE, BLACK, RED, GREEN, YELLOW, BLUE, BROWN ORANGE, SLATE, VIOLET	

Applicable Specifications

1) UL	AWM/STYLE 1015	105°C / 600 V_{RMS}
	AWM/STYLE 1230	105°C / 600 V_{RMS}
	VW-1	
2) CSA International	AWM I A/B	105°C / 600 V_{RMS}
	FT1	
	TEW-105	105°C / 600 V_{RMS}
3) CE:	EU Low Voltage Directive 2006/95/EC	

Environmental

1) EU Directive 2011/65/EU(RoHS2):

	All materials used in the manufacture of this part are in compliance with European Directive 2011/65/EU regarding the restriction of use of certain hazardous substances in electrical and electronic equipment. Consult Alpha Wire's web site for RoHS C of C.
2) REACH Regulation (EC 1907/2006):	
	This product does not contain Substances of Very High Concern (SVHC) listed on the European Union's REACH candidate list in excess of 0.1% mass of the item. For up-to-date information, please see Alpha's REACH SVHC Declaration.
3) California Proposition 65:	The outer surface materials used in the manufacture of this part meet the requirements of California Proposition 65.

Properties

Physical & Mechanical Properties	
1) Temperature Range	-40 to 105°C
2) Bend Radius	5X Cable Diameter
3) Pull Tension	5 Lbs, Maximum
Electrical Properties	(For Engineering purposes only)
1) Voltage Rating	600 V_{RMS}
2) Inductance	0.09 µH/ft, Nominal
3) Conductor DCR	16.9 Ω/1000ft @20°C, Nominal

Other

Packaging	Flange x Traverse x Barrel (inches)
a) 2000 FT	12 x 4.5 x 3.5 Continuous length
b) 1000 FT	6.5 x 6 x 1.9 Continuous length
c) 500 FT	6.5 x 4 x 2.5 Continuous length
d) 100 FT	3.5 x 3 x 1.125 Continuous length
e) Bulk(Made-to-order)	
	[Spool dimensions may vary slightly]
Notes:	
a) Certain colors and put-up combinations may only be available by special order, minimums may apply.	

Alpha Wire | 711 Lidgerwood Avenue, Elizabeth, NJ 07207

Tel: 1-800-52 ALPHA (25742)

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EU/China ROHS CERTIFICATE OF COMPLIANCE

To Whom It May Concern:

Alpha Wire Part Number: 782201

782201, RoHS-Compliant Commencing With 7/1/2005 Production

Note: all colors and put-ups

This document certifies that the Alpha part number cited above is manufactured in accordance with Directive 2011/65/EU of the European Parliament, better known as the RoHS Directive (commonly known as RoHS 2), with regards to restrictions of the use of certain hazardous substances used in the manufacture of electrical and electronic equipment. This certification extends to amending Directive 2015/863/EU which expanded the list of restricted substances to 10 items (commonly known as RoHS 3) The reader is referred to these Directives for the specific definitions and extents of the Directives. **No Exemptions are required for RoHS Compliance on this item**. Additionally, Alpha certifies that the listed part number is in compliance with China RoHS "Marking for Control of Pollution by Electronic Information Products" standard SJ/T 11364-2014.

Substance	Maximum Control Value
Lead	0.1% by weight (1000 ppm)
Mercury	0.1% by weight (1000 ppm)
Cadmium	0.01% by weight (100 ppm)
Hexavalent Chromium	0.1% by weight (1000 ppm)
Polybrominated Biphenyls (PBB)	0.1% by weight (1000 ppm)
Polybrominated Diphenyl Ethers (PBDE) ,	
Including Deca-BDE	0.1% by weight (1000 ppm)
Bis(2-ethylhexyl) phthalate (DEHP)	0.1% by weight (1000 ppm)
Butyl benzyl phthalate (BBP)	0.1% by weight (1000 ppm)
Dibutyl phthalate (DBP)	0.1% by weight (1000 ppm)
Diisobutyl phthalate (DIBP)	0.1% by weight (1000 ppm)

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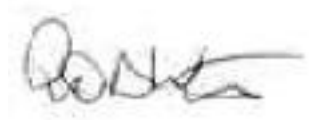
Authorized Signatory for the Alpha Wire:



Dave Watson, Director of Engineering & QA 9/29/2020

Alpha Wire

711 Lidgerwood Ave.

Elizabeth, NJ 07207

Tel: 1-908-925-8000

Mouser Electronics

Authorized Distributor

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782201 BL001 782201 WH001 782201 VI001 782201 BK001 782201 RD001 782201 BL005 782201 VI005 782201 YL005 782201 SL005 782201 RD005 782201 BR001 782201 YL001 782201 GR005 782201 BK005 782201 WH005 782201 GR001 782201 OR005 782201 BR005 782201 SL001 782201 OR001

Application

ÖLFLEX® HEAT SiF A are UL/cRU certified, heat resistant silicone single cores for the European and North American market, for fixed installation under low mechanical stress. They are halogen-free and feature low toxicity of gases and corrosivity in case of fire. They are characterized by good ozone and UV resistances and suitable for use under high ambient temperatures provided adequate ventilation.

Application range:
Control cabinets, wiring and connecting in devices and apparatus engineering, heating elements, air-conditioning, sauna and solaria construction as well as in other operating ranges.
Use acc. to UL: Internal wiring of appliances where totally enclosed.
Use acc. to cRU: CSA AWM I A/B, internal wiring of equipment with or without mechanical abuse.

Design

Design	based on EN 50525-2-41 acc. to UL 758, Style 3644 CSA AWM C22.2 No. 210-15
Certification	UL AWM Style 3644, UL 758 cRU AWM I A/B, C22.2 No. 210-15
Conductor	fine wire strands of non-porous tinned copper acc. to IEC 60228 resp. EN 60228, class 5
Insulation	Silicone compound acc. to UL 1581, table 50.210 (150°C) and EI2 acc. to EN 50363-1
Core identification code	Available core colours: GN-YE / BK / BN / BU / GY / WH / OG / GN / YE / VT / RD / DBU

Electrical properties at 20 °C

Nominal voltage	U_0 /U:	600/1000 V
	UL/cRU:	1000 V
Test voltage	3000 V AC	

Mechanical and thermal properties

Minimum bending radius	fixed installation: 6 x outer diameter One bend at end of core: 3 x outer diameter	
Temperature range	fixed installation:	(UL/CSA) up to +150°C (EN) -50°C up to +180°C (adequate ventilation required)
Flammability	flame retardant acc. to	IEC 60332-1-2 resp. EN 60332-1-2 UL: Horizontal Flame Test
Halogen free	acc. to IEC 60754-1 resp. EN 60754-1	
Corrosivity of gases	acc. to IEC 60754-2 resp. EN 60754-2	
Toxicity	acc. to EN 50305	
UV resistance	acc. to EN ISO 4892-2, method A (change of color allowed)	
Ozone resistance	acc. to EN 50396, method B	

General requirements	These cables are conform to the EU-Directive 2014/35/EU (Low Voltage Directive)
Environmental information	These cables meet the substance-specific requirements of the EU Directive 2011/65/EU (RoHS).

We reserve all rights according to DIN ISO 16016.
PD 0019/05_04.18EN

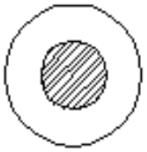
Datasheet

Product Name:	UL11028 26AWG
Product Discription:	UL11028 26AWG
Specification No.:	SPEC-UL11028-26AWG
Customer's Name:	

Description

Rated Voltage:	600V
Rated Temperature:	105℃
Reference Standard:	UL758,UL1581

Cross Section



Marking

E254881 AWM STYLE 11028 26AWG 105℃ 600V VW-1
C AWM I A 105℃ 600V FT1 -LF- -HF- ELETECK

Applications

For internal wiring of electrical equipment

Revisions

Version	Description	Drawn by	Approved by	Date
0	New document issue	YanBin	David Lin	########

Construction

Conductor	**Stranded Tinned Copper**		
Size(AWG)	26		
Construction(±0.008mm)	7/0.16		
Stranded Dia.(mm)Ref.	0.48		
Insulation Material	mPPE		
Insulation Color	ANY COLOR		
Ave Thickness(mm)	0.20		
Min Thickness(mm)	0.18		
Insulation Dia.(±0.05mm)	1.00		

Remark:

8724458 Black	8724467 Brown	8724476 Green	8724489 Orange
8724460 Red	8724470 Yellow	8724482 Grey	
8724464 Blue	8724473 White	8724486 Violet	

Characteristics

Test Item		Standard Value
Test Material		mPPE(RoHS)
Before Aging	**Tensile Strength(Mpa)**	⩾21.37
	Elongation(%)	⩾175
Aging Condiction		136±2℃*168hrs
After Aging	**Tensile Strength(Mpa)**	⩾85% of original
	Elongation(%)	⩾50% of original
Deformation(121±1℃*250g)		⩽50%
Cold Bend(-10±1℃*4hrs)		No crack
Heat Shock(121±1℃*1hr)		No crack
Max.DC Resistance(20℃ Ω/km)		150
Flammability Test		VW-1

Customer Approve

Seal & Stamp

Signature:

Date:

RS, Professionally Approved Products, gives you professional quality parts across all products categories. Our range has been testified by engineers as giving comparable quality to that of the leading brands without paying a premium price.

Technical data sheet

Article number:
308-30300 HIS-3-3/1

Product Group	Heat shrinkable tubing 3:1 on a reel
Product Family	HIS-3
Material	Polyolefin, cross-linked (PO-X)
Colour	Black (BK)

Behaviour at Heat Shock	not fluid, not dripping, not cracking
Behaviour at Low Temperature [Test method]	not cracking [UL 224]
Dielectric Strength [Test method]	32 kV/mm [IEC 60243]
Elongation at break [Test method]	800 [ASTM D2671]
Elongation At Heat Aging	400 %
Flammability	UL 224 VW-1
Heat Aging Test [Test method]	168h/175°C [UL 224]
Heat Shock Test	4h/250°C
Insulation Class	B (VDE 0530)
Longitudinal Change After Shrinkage	+/-5%
Min. Shrink Temperature - °C	+100 °C
Minimum Tensile Strength At Heat Aging	13 MPa
Operating Temperature	-55 °C to +135 °C
Package Content packed in	pcs.
Pack Cont.	10 m
Recov. Ø d max.	1.0 mm
Shrink Ratio	3:1
Specifications	ANSI/UL 224, C22.2 no. 198.1-06
Supplied Ø D min.	3.2 mm
Tensile Strength [Test method]	14 MPa [ASTM D2671]
UL-File Number	E143529
Wall (WT)	0.55 mm

RoHS

created on 11. April 2025, 9:25 pm

Technical changes and errors reserved. It´s up to the customer to check the suitability for a specific application by means of tests.

Technical data sheet

Article number:
308-31200 HIS-3-12/4

Product Group	Heat shrinkable tubing 3:1 on a reel
Product Family	HIS-3
Material	Polyolefin, cross-linked (PO-X)
Colour	Black (BK)

Behaviour at Heat Shock	not fluid, not dripping, not cracking
Behaviour at Low Temperature [Test method]	not cracking [UL 224]
Dielectric Strength [Test method]	32 kV/mm [IEC 60243]
Elongation at break [Test method]	800 [ASTM D2671]
Elongation At Heat Aging	400 %
Flammability	UL 224 VW-1
Heat Aging Test [Test method]	168h/175°C [UL 224]
Heat Shock Test	4h/250°C
Insulation Class	B (VDE 0530)
Longitudinal Change After Shrinkage	+/-5%
Min. Shrink Temperature - °C	+100 °C
Minimum Tensile Strength At Heat Aging	13 MPa
Operating Temperature	-55 °C to +135 °C
Package Content packed in	pcs.
Pack Cont.	5 m
Recov. Ø d max.	4.0 mm
Shrink Ratio	3:1
Specifications	ANSI/UL 224, C22.2 no. 198.1-06
Supplied Ø D min.	12.7 mm
Tensile Strength [Test method]	14 MPa [ASTM D2671]
UL-File Number	E143529
Wall (WT)	0.80 mm

RoHS

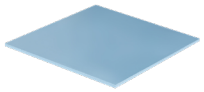
created on 16. May 2025, 1:49 pm

Technical changes and errors reserved. It´s up to the customer to check the suitability for a specific application by means of tests.

Accumulator Mechanical

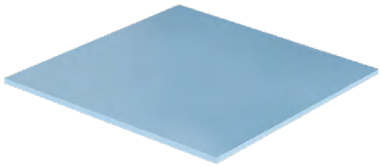
TP-2 (APT2560)

Economic Thermal Pad

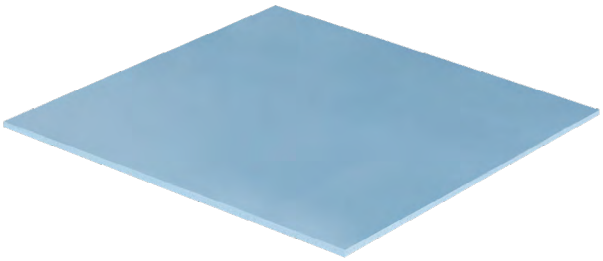


50 x 50 mm

120 x 20 mm



145 x 145 mm



290 x 290 mm

General Specifications

Colour	Blue
Hardness	80 Shore OO
Continuous Use Temperature	-40~200°C
Specific Gravity	3.2 g/cm^3

Tensile Strength	35.56 psi
Dielectric Constant @1MHz	13.03@ 1MHz
Volume Resistance	1 x 10^{12} Ω-cm
Flammability	UL94 V-0

Shipping Information

50 x 50 mm, 1 mm

Box Dimension	80 (L) x 62 (W) x 1.5 (H) mm
Gross Weight	12 g
SKU	ACTPD00002A
EAN	4895213700580
UPC	87276700764-2

120 x 20 mm, 0.5 mm, 2 Pack

Box Dimension	150 (L) x 45 (W) x 2 (H) mm
Gross Weight	12 g
SKU	ACTPD00012A
EAN	4895213702119
UPC	84003340000-8

120 x 20 mm, 1 mm, 2 Pack

Box Dimension	120 (L) x 20 (W) x 3 (H) mm
Gross Weight	21 g
SKU	ACTPD00013A
EAN	4895213702126
UPC	84003340001-5

120 x 20 mm, 1 mm

Box Dimension	150 (L) x 45 (W) x 2 (H) mm
Gross Weight	13 g
SKU	ACTPD00010A
EAN	4895213702126
UPC	84003340001-5

TP-2 (APT2560)

Economic Thermal Pad

ARCTIC

Shipping Information

145 x 145 mm, 0.5 mm

Box Dimension	169 (L) x 164 (W) x 1.5 (H) mm
Gross Weight	52 g
SKU	ACTPD00004A
EAN	4895213700597
UPC	87276700766-6

290 x 290 mm, 0.5 mm

Box Dimension	320 (L) x 315 (W) x 1.5 (H) mm
Gross Weight	220 g
SKU	ACTPD00017A
EAN	4895213702300
UPC	84003340019-0

145 x 145 mm, 1.5 mm

Box Dimension	169 (L) x 164 (W) x 2.5 (H) mm
Gross Weight	114 g
SKU	ACTPD00006A
EAN	4895213700610
UPC	87276700768-0

290 x 290 mm, 1 mm

Box Dimension	320 (L) x 315 (W) x 2 (H) mm
Gross Weight	348 g
SKU	ACTPD00018A
EAN	4895213702317
UPC	84003340020-6

Carbon Neutral
green.arctic.de

All materials are compatible with RoHS requirements.

Werkstoffdatenblatt

Aluminiumlegierung

Materials Services
Technology, Innovation
& Sustainability

Werkstoffbezeichnung:	EN-Werkstoff-Nr.	DIN-Werkstoff-Nr.
	EN AW-7075 [EN AW-Al Zn5,5MgCu]	3.4365

Geltungsbereich

Dieses Datenblatt gilt für warm- und kaltgewalzte Flachprodukte sowie für gezogene und gepresste Langprodukte aus der Aluminium-Zink-Legierung EN AW-7075.

Anwendung

Der Werkstoff EN AW-7075 weist unter den aushärtbaren Aluminiumlegierungen die höchsten Festigkeitswerte auf und besitzt aber nur eine mäßige Korrosionsbeständigkeit in der Witterung und in Meerwasser. Der Werkstoff gilt aufgrund des Kupfergehalts als nicht schweißbar bzw. es besteht Heißrissgefahr beim Schweißen. Der Werkstoff findet zum Beispiel Anwendung für hochfeste Strukturkomponenten in der Luftfahrt.

Die Legierung EN AW-7075 ist aushärtbar und nicht geeignet für das dekorative Anodisieren.

Chemische Zusammensetzung in %

Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Al
≤ 0,4	≤ 0,5	1,2–2,0	≤ 0,30	2,1–2,9	0,18–0,28	5,1–6,1	≤ 0,20	Rest

Andere Beimengungen[a]: Einzeln: max. 0,05 % Insgesamt[b]: max. 0,15 %

[a] „Andere Beimengungen“ schließen die aufgeführten Elemente ein, für die keine Grenzwerte angegeben sind, und auch die nicht aufgeführten metallischen Elemente. Der Hersteller kann Proben auf Spurenelemente hin analysieren, die nicht in der Registrierung oder Spezifikation festgelegt sind. Eine solche Analyse ist jedoch nicht gefordert und erfasst nicht unbedingt alle metallischen Elemente, die zur Gruppe „Andere Beimengungen“ gehören. Sollte eine Analyse des Herstellers oder Käufers ergeben, dass ein Element der Gruppe „Andere Beimengungen“ die Grenze von „Einzeln“ übersteigt oder dass mehrere Elemente der Gruppe „Andere Beimengungen“ zusammen die Grenze von „Insgesamt“ überschreiten, muss das Material als nicht konform betrachtet werden.

[b] Die Summe dieser „Anderen Beimengungen“, deren Massenanteil einzeln 0,010 % oder mehr beträgt, wird mit zwei Dezimalstellen vor der Summenbildung ausgedrückt

Mechanische Eigenschaften bei Raumtemperatur (gezogene Stangen)

Lieferzustand	Maße		Dehngrenze	Zugfestigkeit	Bruchdehnung		Härte[1)]
	D[a)] [mm]	S[b)] [mm]	$R_{p0,2}$ [N/mm²]	R_m [N/mm²]	A [%]	A_{50} [%]	HBW
O, H111	≤ 80	≤ 80	≤ 165	≤ 275	≥ 10	≥ 8	60
T6	≤ 80	≤ 80	≥ 485	≥ 540	≥ 7	≥ 6	150
T651	≤ 80	≤ 80	≥ 485	≥ 540	≥ 5	≥ 4	150
T73[d)]	≤ 80	≤ 80	≥ 385	≥ 455	≥ 10	≥ 8	135
T7351[d)]	≤ 80	≤ 80	≥ 385	≥ 455	≥ 8	≥ 6	135

MANAGEMENT SYSTEM CERTIFICATION
DNV·GL
ISO 9001 = ISO 14001
ISO 50001 = OHSAS 18001

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Mechanische Eigenschaften bei Raumtemperatur (gezogene Rohre)

Lieferzustand	Maße	Dehngrenze	Zugfestigkeit	Bruchdehnung		Härte[1)]
	t[c)] [mm]	$R_{p0,2}$ [N/mm²]	R_m [N/mm²]	A [%]	A_{50} [%]	HBW
O, H111	≤ 20	≤ 165	≤ 275	≥ 10	≥ 8	60
T6	≤ 20	≥ 485	≥ 540	≥ 7	≥ 6	150
T6510/T6511	≤ 20	≥ 485	≥ 540	≥ 5	≥ 4	150
T73[d)]	≤ 20	≥ 385	≥ 455	≥ 10	≥ 8	135
T73510[d)]/T73511[d)]	≤ 20	≥ 385	≥ 455	≥ 8	≥ 6	135

Mechanische Eigenschaften bei Raumtemperatur (Bleche, Bänder und Platten)

Lieferzustand	Nenndicke	Dehngrenze	Zugfestigkeit	Bruchdehnung		Härte[1)]
	[mm]	$R_{p0,2}$ [N/mm²]	R_m [N/mm²]	A_{50} [%]	A [%]	HBW
O	≥ 0,4–12,5	≤ 145	≤ 275	≥ 10	-	55
	> 12,5–75,0	-	≤ 275	-	≥ 9	
T6//T62/T651	≥ 0,4–0,8	≥ 460	≥ 525	≥ 6	-	157
	> 0,8–1,5	≥ 460	≥ 540	≥ 6	-	160
	> 1,5–3,0	≥ 470	≥ 540	≥ 7	-	161
	> 3,0–6,0	≥ 475	≥ 545	≥ 8	-	163
	> 6,0–12,5	≥ 460	≥ 540	≥ 8	-	160
	> 12,5–25,0	≥ 470	≥ 540	-	≥ 6	161
	> 25,0–50,0	≥ 460	≥ 530	-	≥ 5	158
	> 50,0–60,0	≥ 440	≥ 525	-	≥ 4	155
	> 60,0–80,0	≥ 420	≥ 495	-	≥ 4	147
	> 80,0–90,0	≥ 390	≥ 490	-	≥ 4	144
	> 90,0–100,0	≥ 360	≥ 460	-	≥ 3	135
	> 100,0–120,0	≥ 300	≥ 410	-	≥ 2	119
	> 120,0–150,0	≥ 260	≥ 360	-	≥ 2	104
	> 150,0–200,0	≥ 240	≥ 360	-	≥ 2	-
	> 200,0–300,0	≥ 220	≥ 360	-	≥ 1	-

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Mechanische Eigenschaften bei Raumtemperatur (Bleche, Bänder und Platten) (fortgesetzt)

Lieferzustand	Nenndicke [mm]	Dehngrenze $R_{p0,2}$ [N/mm²]	Zugfestigkeit R_m [N/mm²]	Bruchdehnung A_{50} [%]	Bruchdehnung A [%]	Härte[1)] HBW
T652	> 150,0–200,0	≥ 240	≥ 360	≥ 2	-	-
	> 200,0–300,0	≥ 220	≥ 360	≥ 1	-	-
T76[d)]/T7651[d)]	≥ 1,5–3,0	≥ 425	≥ 500	≥ 7	-	149
	> 3,0–6,0	≥ 425	≥ 500	≥ 8	-	149
	> 6,0–12,5	≥ 415	≥ 490	≥ 7	-	146
T73[d)]/T7351[d)]	≥ 1,5–3,0	≥ 385	≥ 460	≥ 7	-	137
	> 3,0–6,0	≥ 385	≥ 460	≥ 8	-	137
	> 6,0–12,5	≥ 390	≥ 475	≥ 7	-	140
	> 12,5–25,0	≥ 390	≥ 475	-	≥ 6	140
	> 25,0–50,0	≥ 390	≥ 475	-	≥ 5	140
	> 50,0–60,0	≥ 360	≥ 455	-	≥ 5	133
	> 60,0–80,0	≥ 340	≥ 440	-	≥ 5	129
	> 80,0–100,0	≥ 340	≥ 430	-	≥ 5	126

Mechanische Eigenschaften bei Raumtemperatur (stranggepresste Stangen)

Lieferzustand	Maße D[a)] [mm]	Maße S[b)] [mm]	Dehngrenze $R_{p0,2}$ [N/mm²]	Zugfestigkeit R_m [N/mm²]	Bruchdehnung A [%]	Bruchdehnung A_{50} [%]	Härte[1)] HBW
O, H111	≤ 200	≤ 200	≤ 165	≤ 275	≥ 10	≥ 8	60
T6, T6510, T6511	≤ 25	≤ 25	≥ 480	≥ 540	≥ 7	≥ 5	150
	25 < D ≤ 100	25 < D ≤ 100	≥ 500	≥ 560	≥ 7	-	
	100 < D ≤ 150	100 < D ≤ 150	≥ 440	≥ 550	≥ 5	-	
	150 < D ≤ 200	150 < D ≤ 200	≥ 400	≥ 440	≥ 5	-	
T73, T73510, T73511	≤ 25	≤ 25	≥ 420	≥ 485	≥ 7	≥ 5	135
	25 < D ≤ 75	25 < D ≤ 75	≥ 405	≥ 475	≥ 7	-	
	75 < D ≤ 100	75 < D ≤ 100	≥ 390	≥ 470	≥ 6	-	
	100 < D ≤ 150	100 < D ≤ 150	≥ 360	≥ 440	≥ 6	-	

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Mechanische Eigenschaften bei Raumtemperatur (stranggepresste Rohre)

Lieferzustand	Maße	Dehngrenze	Zugfestigkeit	Bruchdehnung		Härte[1)]
	t[c)] [mm]	$R_{p0,2}$ [N/mm²]	R_m [N/mm²]	A [%]	A_{50} [%]	HBW
O, H111	≤ 10	≤ 165	≤ 275	≥ 10	-	60
T6, T6510, T6511	≤ 5 5 < t ≤ 10 10 < t ≤ 50	≥ 485 ≥ 505 ≥ 495	≥ 540 ≥ 560 ≥ 560	≥ 8 ≥ 7 ≥ 6	≥ 6 ≥ 5 ≥ 4	150
T73, T73510, T73511	≤ 5 5 < t ≤ 10 10 < t ≤ 50	≥ 400 ≥ 420 ≥ 405	≥ 470 ≥ 485 ≥ 475	≥ 7 ≥ 8 ≥ 8	≥ 5 ≥ 6 -	135

Mechanische Eigenschaften bei Raumtemperatur (stranggepresste Profile)

Lieferzustand	Wanddicke	Dehngrenze	Zugfestigkeit	Bruchdehnung		Härte[1)]
	t [mm]	$R_{p0,2}$ [N/mm²]	R_m [N/mm²]	A [%]	A_{50} [%]	HBW
T6, T6510, T6511	≤ 25 25 < t ≤ 60	≥ 460 ≥ 470	≥ 530 ≥ 540	≥ 6 ≥ 6	≥ 4 -	150
T73, T73510, T73511	≤ 25	≥ 420	≥ 485	≥ 7	≥ 5	135

1) Nur zur Information
a) D = Durchmesser von Rundstangen
b) S = Schlüsselweite von Vierkant- und Sechskantstangen, Dicke von Rechteckstangen
c) t = Wanddicke von Rohren
d) Wert in Klammern gilt für Rohre

Anhaltsangaben für einige physikalische Eigenschaften

Dichte bei 20 °C [kg/dm³]	Elektrische Leitfähigkeit [MS/m]	Wärmeleitfähigkeit [W/m•K]	Spezifische Wärmekapazität [J/kg•K]	Elastizitätsmodul [MPa]	Schubmodul [MPa]
2,80	19–23	130–160	862	72000	27100

Mittlerer linearer Wärmeausdehnungskoeffizient 10^{-6} K^{-1}

-50–20 °C	20–100 °C	20–200 °C	20–300 °C
21,6	23,4	24,3	25,2

Hinweise auf Temperaturen für die Wärmebehandlung

Weichglühen, Rekristallisationsglühen		
Temperatur	Aufheizzeit	Abkühlbedingungen
380–420 °C	2,0–3,0 h	≤ 30 °C/h bis 230 °C + 3–5h Haltezeit, unterhalb 230 °C an Luft

Aushärten			
Lösungsglühen	Abschrecken	Kaltauslagerung	Warmauslagern
470–480 °C	Wasser	Üblicherweise Warmauslagern	1. Stufe: 110 –125 °C, 12–24h 2. Stufe: 165 –185 °C, 4–6h

Verarbeitung/Schweißen

Der Werkstoff ist aufgrund des Kupfergehalts von 1,2–2,0 % anfällig für Heißrisse und wird daher üblicherweise nicht geschweißt. Das Fügen erfolgt bevorzugt durch Nieten, Schrauben und Kleben.

Bemerkungen

Der Werkstoff ist gemäß DIN EN 602 **nicht** für den Einsatz in Kontakt mit Lebensmitteln zugelassen.

Herausgeber

thyssenkrupp Materials Services GmbH
Technology, Innovation & Sustainability (TIS)
thyssenkrupp Allee 1
45143 Essen

Literaturhinweis

DIN EN 485-2 : 2016-10 — Beuth Verlag GmbH, Postfach, D-10772 Berlin
DIN EN 573-3 : 2013-12
DIN EN 754-2 : 2017-02
DIN EN 755-2 : 2016-10
Aluminium-Werkstoff-Datenblätter — Aluminium-Verlag Marketing & Kommunikation GmbH
Aluminiumtaschenbuch Band 1 – 3 — D-40003 Düsseldorf

Wichtiger Hinweis

Die in diesem Datenblatt enthaltenen Angaben über die Beschaffenheit oder Verwendbarkeit von Materialien bzw. Erzeugnissen sind keine Eigenschaftszusicherungen, sondern dienen der Beschreibung.
Die Angaben, mit denen wir Sie beraten wollen, entsprechen den Erfahrungen des Herstellers und unseren eigenen. Eine Gewähr für die Ergebnisse bei der Verarbeitung und Anwendung der Produkte können wir nicht übernehmen.

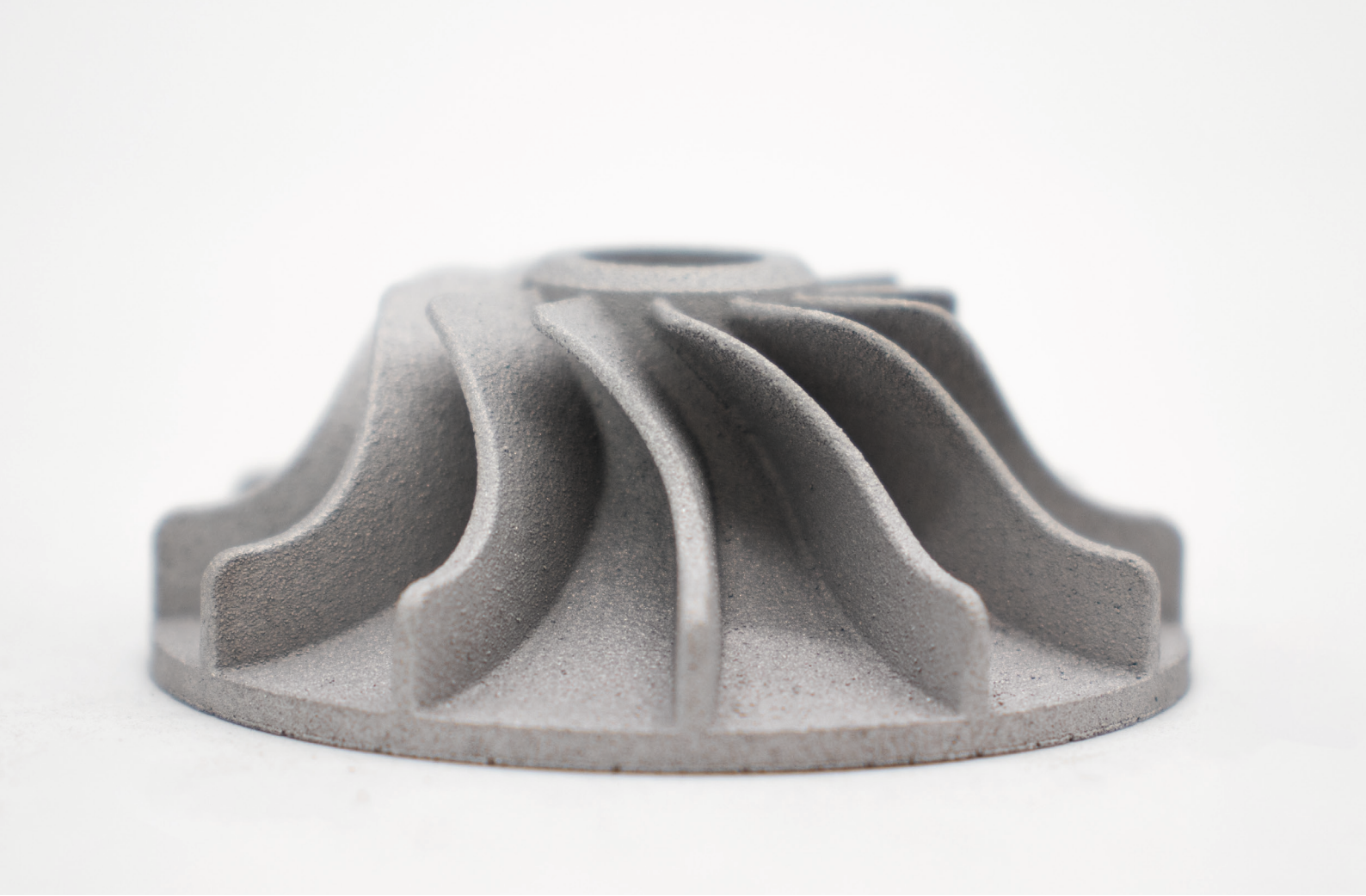
ONE CLICK METAL

Aluminium AlSi10Mg (3. 2382)

MATERIAL DATA SHEET

www.oneclickmetal.com

2023.06



AlSi10Mg (3.2382)

The material AlSi10Mg is a high strength Aluminum alloy with age hardening properties. Apart from increasing the hardness of the material, the presence of Silicon also has a positive impact in the viscosity of the melt pool, making the alloy more processable than pure Aluminum in additive manufacturing. It is a common material in the aviation due to its excellent thermal conductivity, higher weight to strength ratio, good corrosion resistance and good processability. It is also often used in the casting industry as thin-walled components with good mechanical properties can be manufactured using this alloy.

Properties

- High strength and hardness
- Good thermal properties
- Good processability
- High corrosion resistance

Applications

- Aviation and Aerospace
- Automotive
- Prototype cast parts
- Serial parts

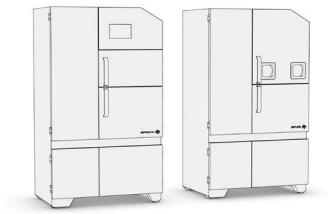
Powder properties

Chemical Composition (wt.%)

Element	Min.	Max.
Si	9.0	11.0
Mg	0.2	0.45
Al	Balance	

Process information

System Set-up	MPRINT
Parameter	AlSi10Mg 20µm
Software	Netfabb
Powder part-no.	MSUPPLY AlSi10Mg
Layer thickness	20µm
Coater	X-Lip
Inert gas	Nitrogen
Sieve	80µm



Physical and Mechanical Properties

In as-built condition the tensile strength of the material is approx. 400 N/mm². In addition, it is possible to perform a P6 heat treatment to achieve higher ductility.

Physical properties

Defects	Result
Average defect (%)	<0.5

Mechanical properties ISO6892-1

Vertical	Yield strength Rp0.2 [MPa]	Tensile strength Rm [MPa]	Elongation at break A [%]
Average	207	411	5
Absolute Standard Deviation	3	12	1

BUILDING TRUST

PRODUCT DATA SHEET

SikaPower®-752 FR

2-component epoxy structural adhesive

TYPICAL PRODUCT DATA (FURTHER VALUES SEE SAFETY DATA SHEET)

Properties		SikaPower®-752 FR (A)	SikaPower®-752 FR (B)
Chemical base		Resin	Curing agent
Color (CQP001-1)		Black	Beige
	mixed	Black	
Density (uncured)		1.40 g/cm^3	1.30 g/cm^3
	mixed	1.38 g/cm^3	
Mixing ratio	A : B by volume	100 : 50	
	A : B by weight	100 : 47	
Viscosity (CQP538-2)	Brookfield	150 Pa·s	220 Pa·s
		90 Pa·s	
Pot-life (CQP021-1)		120 minutes [A]	
Handling time (CQP580-1, -6 / ISO 4587)	time to reach 1 MPa	8 hours [A]	
Shore D hardness (CQP023-1 / ISO 868)		85	
Tensile strength (CQP543-1 / ISO 527)		42 MPa	
Elongation at break (CQP543-1 / ISO 527)		3 %	
Tensile lap-shear strength (CQP046-9 / ISO 4587)		22 MPa	
Shelf life (CQP016-1)		6 months [B]	

CQP = Corporate Quality Procedure

A) 23 °C / 50 % r. h.

B) stored below 25 °C

DESCRIPTION

SikaPower®-752 FR is 2-component high performance epoxy adhesive, with good mechanical properties and anti-aging properties. It is suitable for large surface bonding.

PRODUCT BENEFITS

- Long open time
- Nano reinforcement system
- High strength and high peel strength
- Flame retardant and self-extinguishing
- Contains glass beads of 200 µm (max)
- Passes EN 45545

AREAS OF APPLICATION

SikaPower®-752 FR is suitable for structural bonding with high strength and flame retardant requirements in the industrial applications. Suitable substrate materials are honeycomb panels, aluminium, stainless steel, composite materials, wood, and thermoplastic panels.

This product is suitable for experienced professional users only. Tests with actual substrates and conditions have to be performed ensuring adhesion and material compatibility.

CURE MECHANISM
SikaPower®-752 FR cures by chemical reaction of the two components at room temperature. Higher temperatures speed up the curing process and lower temperatures slow down the curing process.

CHEMICAL RESISTANCE
In view of potential chemical or thermal exposure, it is required to conduct a project related testing.

METHOD OF APPLICATION
Surface preparation
Surfaces must be clean, dry and free from grease, oil and dust. Surface treatment depends on the specific nature of the substrates and is crucial for a long lasting bond. All pretreatment steps must be confirmed by preliminary tests on original substrates considering specific conditions in the assembly process.

Application
SikaPower®-752 FR is dispensed from 2:1 dual cartridges with adequate manual or pneumatic guns. Extrude adhesive without mixer to equalize the filling levels. Attach the mixer and dispose the first few cm of the bead before the application.

To ensure good mixing quality the defined static mixer is to be used.
SikaPower®-752 FR can also be processed from pails with adequate 2-component equipment.
For advice on selecting and setting up a suitable pump system, contact the System Engineering Department of Sika Industry.

Removal
Uncured SikaPower®-752 FR may be removed from tools and equipment with Sika® Remover-208 or another suitable solvent. Once cured, the material can only be removed mechanically.
Hands and exposed skin have to be washed immediately using hand wipes such as Sika® Cleaner-350H or a suitable industrial hand cleaner and water.
Do not use solvents on skin.

FURTHER INFORMATION
The information herein is offered for general guidance only. Advice on specific applications is available on request from the Technical Department of Sika Industry.
Copies of the following publications are available on request:
- Safety Data Sheets

PACKAGING INFORMATION
SikaPower®-752 FR (A)

Pail	23 l

SikaPower®-752 FR (B)

Pail	23 l

SikaPower®-752 FR (A+B)

Dual cartridge	400 ml
Mixer: OC-MGQ 10-19D	

BASIS OF PRODUCT DATA
All technical data stated in this document are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

HEALTH AND SAFETY INFORMATION
For information and advice regarding transportation, handling, storage and disposal of chemical products, users shall refer to the actual Safety Data Sheets containing physical, ecological, toxicological and other safety-related data.

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BUILDING TRUST

PRODUCT DATA SHEET

SikaPower®-752 L120 FR BLACK (AB) (Adekit H9952BK)

TWO-COMPONENT EPOXY ADHESIVE

SELF-EXTINGUISHING ACCORDING TO EN 45545-2, FAR 25§853, ABD0031 - HIGH AGEING RESISTANCE

DESCRIPTION

High performances assembly

Bonding of panels: honeycomb, aluminum sheet, stainless-steel sheet, composite materials, wood, thermoplastics, foam…

Bonding of Carbon & glass epoxy composite, Polyester composite, metal structure

PROPERTIES

- High performances two components Epoxy adhesive, especially formulated to bond high dimensions surfaces and providing high level of mechanical and aging properties.
- Nano enhanced systems
- **Self- extinguishing according to EN 45545-2, FAR 25 (FAR 25§853) and AITM (ABD0031) Standards.**
- Contains 250 µm beads to calibrate adhesive thickness
- High sheer and peel
- Long open time for big parts assembly

PHYSICAL PROPERTIES

Composition		RESIN	HARDENER	MIX	METHOD
Mix ratio by weight		100	47		
Mix ratio by volume at 25 °C		100	50		
Aspect		Thixotropic paste	Thixotropic paste	Thixotropic paste	
Colour		Black	Beige	Black	
Viscosity at 25 °C (KP)	(Pa.s)	145	185	80	LT-001/vit.10
		350	600	230	LT-001/vit.2.5
Density at 25 °C (KP)		1.40	1.30	-	LT-020
Density of cured product at 23 °C		-	-	1.38	LT-047
Pot life on 100 g at 23 °C (KP)	(min)	-	-	120	LT-002-B

(KP) Key properties. These values are enclosed in Certificate of Analysis.

MECHANICAL PROPERTIES [1]

Hardness	(Shore D)	85	ISO 868
Tensile strength	(MPa)	42	ISO 527
Elongation at break	(%)	3	ISO 527
YOUNG Modulus [2]	(Mpa)	4000	ISO 527
Recommended use temperature	(°C)	15 to 30	
Working temperature [3]	(°C)	- 40 to 150	LT-006-B

(1) Cured 16 hours at 70 °C

(2) Cured 1 h at 80 °C

(3) Working temperature is defined as the temperature at which product keeps 80% of its initial Lap Shear Strength after 1000 hours ageing at this temperature, value on Aluminium, measured at 23 °C.

SELF-EXTINGUISHING PROPERTIES

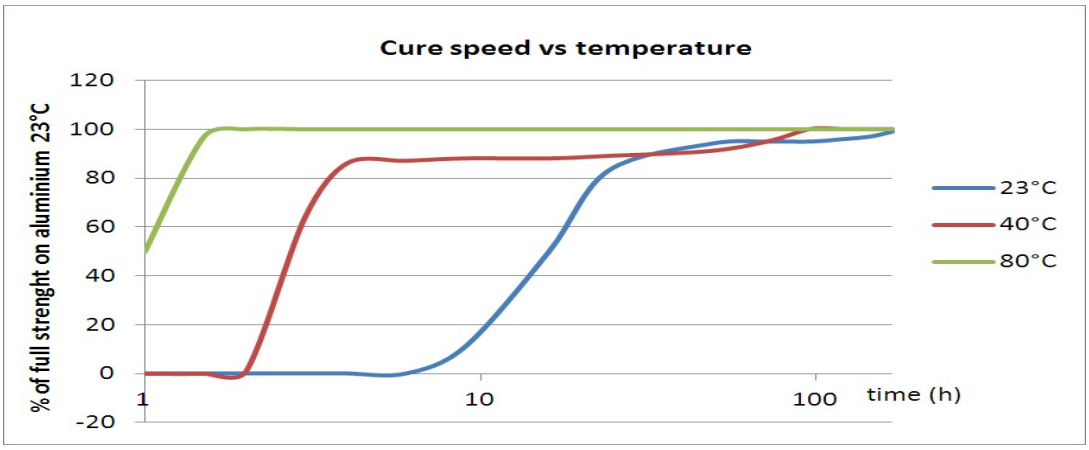
FIRE / SMOKE PROPERTIES – **RAILWAY APPLICATIONS**

Fire protection on railway vehicles Part 2 : requirements for fire behavior of materials and components	R1 HL3 R2 HL3 R3 HL3 R6 HL3 R7 HL3 R17 HL3	**EN 45545-2**

FIRE / SMOKE PROPERTIES – **AIRCRAFT APPLICATIONS**

	NORME	EXIGENCE
Determination of the resistance of the material to flame Vertical Bunsen Burner, 60 s ignition time	AITM 2-0002 A (issue 3)	ABD0031 (issue G)
	CS 25 App. F Part. I §(a)(1)(i)	CS 25 §853(a), Amdt 20
	FAR 25 App. F Part. I §(a)(1)(i)	FAR 25 §853(a), Amdt 25-116
Determination of the resistance of the material to flame Vertical Bunsen Burner, 12 s ignition time	AITM 2-0002 B (issue 3)	ABD0031 (issue G)
	CS 25 App. F Part. I §(a)(1)(ii)	CS 25 §853(a), Amdt 20
	FAR 25 App. F Part. I §(a)(1)(ii)	FAR 25 §853(a), Amdt 25-116
Determination of the Specific Optical Density of Smoke	AITM 2-0007 A (issue 3)	ABD0031 (issue G)
	CS 25 App. F Part. V	CS 25 §853(d), Amdt 20
	FAR 25 App. F Part. V	FAR 25 §853(d), Amdt 25-116
Determination of the Toxic Components on Combustion Products	AITM 3-0005 (issue 2)	ABD0031 (issue G)

CURING DATAS



HANDLING TIME (1)

At 23 °C	(h)	8	LT-006-B

(1) Handling time is defined as the time needed to obtain Lap Shear Strength on Aluminium at 23 °C, of 1 MPa.

MECHANICAL PROPERTIES ON ASSEMBLIES (1)

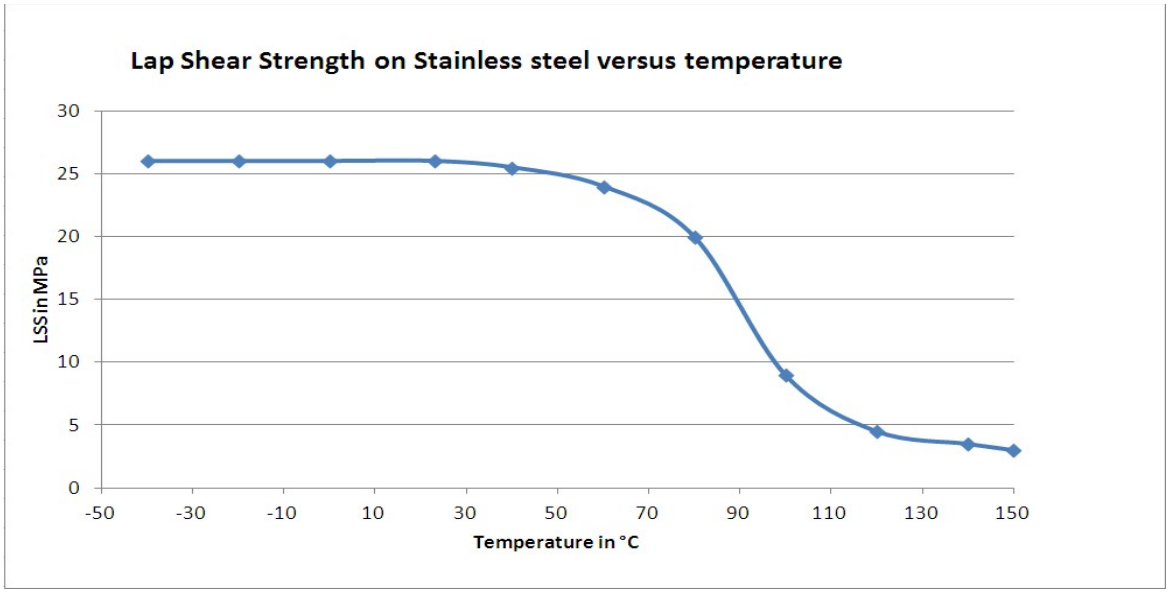
	LAP SHEAR STRENGTH AT 23 °C (MPa)		METHOD
Aluminium 2017A (sandblasted)	**Initial**	**22 SCF**	LT-006-B
	After wet cataplasm 7 days at 70 °C / 100 % RH	**22 SCF**	
	After wet cataplasm 14 days at 70 °C / 100 % RH	**20 SCF**	
	After wet cataplasm 21 days at 70 °C / 100 % RH	**17 SCF**	
	After wet cataplasm 28 days at 70 °C / 100 % RH	**17 SCF**	
Stainless Steel 304 (sandblasted)	**Initial**	**25 SCF**	
	After wet cataplasm 7 days at 70 °C / 100 % RH	**24 SCF**	
Electro-galvanized Steel (sandblasted)	**Initial**	**22 AF**	
	After wet cataplasm 7 days at 70 °C / 100 % RH	**16 SCF**	
Pre preg Carbone Composite		**17 SCF**	
Polyamide		**5 SF**	

(1) Cured 16 hours at 70°C

SCF: Special Cohésive Failure, AF: Adhesive Failure, SF: Substrate Failure, according to EN ISO 10365 Standard.

FLOATING ROLLER PEEL STRENGTH AT 23°C

Aluminium 2017A (sandblasted)	(kN/m)	**Initial**	5	ISO 4578
		After wet cataplasm 7 days at 70 °C / 100 % RH	4.5	



PROCESSING

- **Equipment**: SikaPower®-752 L120 FR BLACK (AB) packaged in 50 ml and 400 ml cartridges and require a manual or pneumatic gun.
  Please consult our technical department for applications needing a machine.
- **Substrate preparation**: The item to be bonded must be free of all dirt, oil or other foreign matter. A clean, dry surface is a must.
  Consult our Technical Support about surface preparations.

HANDLING PRECAUTIONS

Normal health and safety precautions should be observed when handling these products:

- Ensure good ventilation.
- Wear gloves, glasses and protective clothes.

For further information, please consult the Safety Data Sheet.

STORAGE CONDITIONS

Shelf life of **SikaPower®-752 L120 FR BLACK (AB)** is **24 months** in a dry place and in original unopened containers at a temperature between 15 °C and 25° C.

Shelf life of **SikaPower®-752 L120 FR (A) BLACK** (Resin) is **24 months** in a dry place and in original unopened containers at a temperature between 15 °C and 25° C.

Shelf life of **SikaPower®-752 FR (B)** (Hardener) is **24 months** in a dry place and in original unopened containers at a temperature between 15 °C and 25° C.

PACKAGING

▪ SikaPower®-752 L120 FR BLACK (AB) / 50ml	Box of 12 cartridge
▪ SikaPower®-752 L120 FR BLACK (AB) / 400ml	Box of 12 cartridge
▪ SikaPower®-752 L120 FR (A) BLACK (Resin)	Pails of 39 kg
▪ SikaPower®-752 FR (B) (Hardener)	Pails of 37 kg
▪ **KIT** SikaPower®-752 L120 FR (A) BLACK + SikaPower®-752 FR (B)	(2 x 39 kg + 37 kg)

FURTHER INFORMATION

The information herein is offered for general guidance only. Advice on specific applications is available on request from the Technical Department of Sika Advanced Resins. Copies of the following publications are available on request: Safety Data Sheets.

VALUE BASES

All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

HEALTH AND SAFETY INFORMATION

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LEGAL NOTICE

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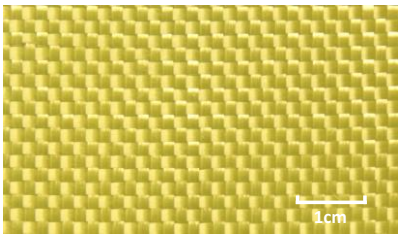
Certificate of Conformance

FABRIC		**Art. 301 ARAMID UD TAPE**
SETTINGS	WARP	6,60 thr/cm
	WEFT	3,10 thr/cm x 2
MATERIAL	WARP	Twaron, HM 1055 2420 dtex
	WEFT	Glass, PPG EC9 34 tex x 2 S152 1383
WEAVE PATTERN		Plain
WEIGHT PER SQM		205 grams
REMARKS		We certify that the material covered by this document was manufactured according to the manufacturing specification.

Technisches Datenblatt
technical data sheet
HP-P170A

Produktkennung / ***product identification***

Artikelnummer: article number:	HP-P170A
Bezeichnung: name:	Aramidgewebe aramid fabric



Technische Spezifikation / ***technical specification***

Flächengewicht / areal weight	170	g/m²	± 5%	
Bindung / weave style	Leinwand / plain			
Kettfaden / yarn type in warp	158	Tex		
Kettdichte / density warp	5,2	Fd/cm / y/cm	± 2%	
Schussfaden / yarn type in weft	158	Tex		
Schussdichte / density weft	5,2	Fd/cm / y/cm	± 2%	
Schlichte / finish / sizing:	EP / UP			

Aufmachung / ***dimensions***

Länge / length:	100	lfm / lm	± 2%	
Breite / width:	100	cm	± 2%	

*Abweichende Breiten auf Anfrage möglich / customized widths on request are available

Verpackung / ***packaging***

Hülsendurchmesser / tube diameter:	76 / 152	mm	innen / inside	
Folie / foil:	LDPE		schwarz / black	

Die Angaben in diesem Produktdatenblatt wurden nach bestem Wissen zusammengestellt und entsprechen unserem derzeitigen Erkenntnisstand. Eine Verbindlichkeit kann hieraus jedoch nicht abgeleitet werden.
All information is believed to be accurate but is given without acceptance of liability. Users should make their own assessment of the suitability of any product for the purpose required.

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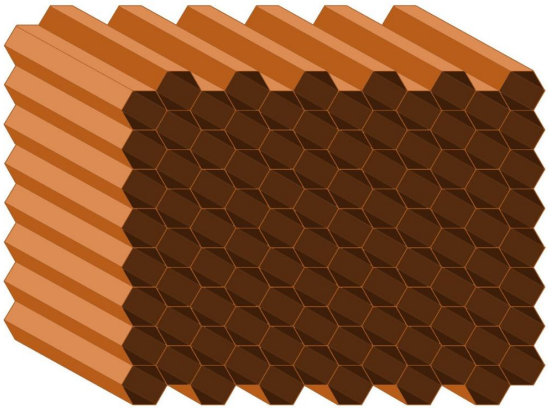
Revision 03/2019-MZ

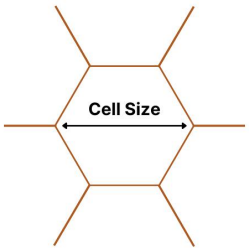
FIBERMAX

MAIN CHARACTERISTICS OF ARAMID HONEYCOMB TYPICAL PROPERTIES FORM: Hexagonal - Rectangular							
			Compression	Plate Shear			
Type	Cell Size (inch)	Weight (PCF)	Strength (PSI)	Strength (PSI“L”dir)	Strength (PSI“W”dir)	Modulus (KSI“L”dir)	Modulus (KSI"W"dir)
I	1/8	3.00	279.92	182.75	89.92	5.80	3.33
I	1/8	4.00	484.43	248.00	136.33	7.83	4.49
I	1/8	5.00	662.83	307.48	200.15	10.29	5.22
I	1/8	6.00	923.90	333.59	226.26	12.03	6.38
I	3/16	2.00	114.58	87.00	46.41	4.35	2.03
I	3/16	3.00	290.08	172.59	89.92	5.80	3.33
I	3/16	4.00	475.73	216.10	152.29	7.54	4.64
I	3/16	6.00	896.34	284.27	237.86	9.86	6.52

All the data furnished above is indicative.

Type: I = Industrial
Cell shape: Hexagonal
Cell size: Cell diameter, quoted in inches, e.g. 1/8 inch = (1/8 x 25.4) = 3.175 mm
Weight: Density in pounds per cubic feet, e.g. 3.00 pcf = (3.00 x 16) = 48 kg/m³
Max recommended processing temperature: 250 ºC
Recommended application temperature range (for the final product:) -55 ºC ~ +175 ºC
Min sheet size: 2445 X 1250 mm





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28th of October St No 8A, 37300
Agria, Greece, EU

EU ORDERING INFO
Tel: +302428092210
Email: sales@fibermax.eu

Head office: Fibremax Ltd
35 Grafton Way, W1T 5DB
London, UK

Tooling & Composites

Product Data Sheet
Version 04 / 2014

Biresin® CR132 FR
Composite resin system

Areas of Application
- For wet lay-up processing
- Specially for applications when higher temperature resistance is required
- Production of flame retardant parts

Product Benefits
- Flame retardant
- UL94 V-0 Classification with -2 hardener
- Fast infiltration of dry fabrics and nonwovens
- Glass transition temperatures up to 130°C dependent on curing conditions

Description
- Basis: Two-component-epoxy-system
- Resin (A): **Biresin® CR132 FR**, epoxy resin, white
- Hardener (B): **Biresin® CH132-2**, amine, blue
- Hardener (B): **Biresin® CH132-5**, amine, blue
- Hardener (B): **Biresin® CH132-7**, amine, blue

Physical Data		Resin (A)	Hardener (B)		
Individual Components		**Biresin® CR132 FR**	**Biresin® CH132-2**	**Biresin® CH132-5**	**Biresin® CH132-7**
Viscosity, 25°C	mPas	5,000	< 10	< 10	20
Density, 25°C	g/ml	1.26	0.95	0.93	0.93
Mixing ratio	in parts by weight	100	20	20	23
			Mixture		
Potlife, 100 g / RT, approx. values	min		60	160	200
Mixed viscosity, 25°C, approx. values	mPas		1,330	2,100	1,900

Mechanical Data, neat resin specimen: approx. values after 8 h / 125°C					
Biresin® CR132 FR resin (A)		with hardener (B)	**Biresin® CH132-2**	**Biresin® CH132-5**	**Biresin® CH132-7**
Density	ISO 1183	g/cm³	1.24	1.24	1.24
Flexural E-Modulus	ISO 178	MPa	4,000	3,900	3,800
Tensile E-Modulus	ISO 527	MPa	3,600	3,600	3,500
Flexural strength	ISO 178	MPa	70	70	67
Compressive strength	ISO 604	MPa	124	123	117
Tensile strength	ISO 527	MPa	52	43	42
Elongation at break	ISO 527	%	1.6	1.4	1.4
Impact resistance	ISO 179	kJ/m²	15	10	12
Glass transition temperature	ISO 11357	°C	132	142	133

Processing

- The material and processing temperatures should be from 18 to 35°C.
- The resin component must be mixed thoroughly before use.
- To clean brushes or tools immediately Sika Reinigungsmittel 5 is recommended.
- Additional informations are available in “Processing Instructions for Composite Resins”.

Packaging

Individual components	**Biresin® CR132 FR** resin (A)	250 kg; 10 kg net
	Biresin® CH132-2 hardener (B)	2.8 kg net
	Biresin® CH132-5 hardener (B)	900 kg; 180 kg; 2.8 kg net
	Biresin® CH132-7 hardener (B)	180 kg; 3.2 kg net

Storage

- Minimum shelf life of Biresin® CR132 FR resin (A) is 24 month and of Biresin® CH132-2 hardener (B), Biresin® CH132-5 hardener (B) and Biresin® CH132-7 hardener (B) is 12 month under room conditions (18 - 25°C), when stored in original unopened containers.
- After prolonged storage at low temperature, crystallisation of resin may occur. This is easily removed by warming up for a sufficient time to 50-60°C.
- Containers must be closed tightly immediately after use. The residual material needs to be used up as soon as possible.

Health and Safety Information

For information and advice on the safe handling, storage and disposal of chemical products, users shall refer to the most recent Safety Data Sheet (SDS) containing physical, ecological, toxicological and other safetyrelated data.

Disposal considerations

Product Recommendations: Must be disposed of in a special waste disposal unit in accordance with the corresponding regulations.
Packaging Recommendations: Completely emptied packagings can be given for recycling. Packaging that cannot be cleaned should be disposed of as product waste.

Value Bases

All technical data stated in this Product Data Sheet are based on laboratory tests. Actual measured data may vary due to circumstances beyond our control.

Legal Notice

The information, and, in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika‘s current knowledge and experience of the products when properly stored, handled and applied under normal conditions in accordance with Sika‘s recommendations. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The user of the product must test the product’s suitability for the intended application and purpose. Sika reserves the right to change the properties of its products. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users must always refer to the most recent issue of the local Product Data Sheet for the product concerned, copies of which will be supplied on request.

Further information available at:

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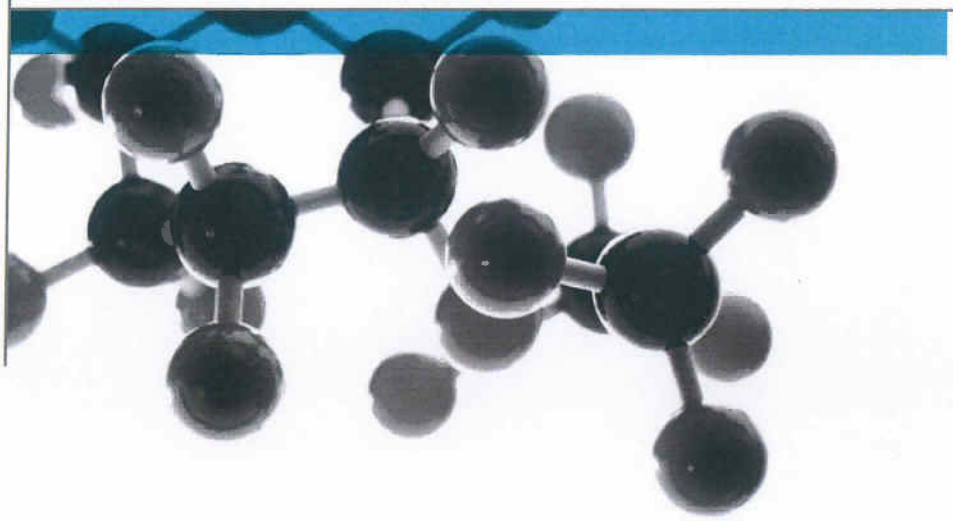
UL-94



Vertical Burning Test For Classifying Materials V-0, V-1 Or V-2

A Report To: Sika Deutschland GmbH

Document Reference: 316414

Date: 20th March 2012

Issue: 2

Testing
Advising
Assuring

Registered Office: Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian EH28 8PL United Kingdom. Reg No.SC 70429
This report in issued in accordance with our terms and conditions, a copy of which is available on request.

UKAS TESTING
0249

Executive Summary

Objective

To determine the performance of the following material when tested in accordance with Section 8 - "50W (20mm) Vertical Burning Test for Classifying Materials V-0, V-1 or V-2" of UL94 - `Test for Flammability of Plastics Materials for Parts in Devices and Appliances'.

Generic Description	Product reference	Thickness	Density
Flame retardant grade epoxy resin system	"Biresin CR132FR"	4mm	1.24g/cm³
Please see page 5 of this test report for the full description of the product tested			

Test Sponsor

Sika Deutschland GmbH, Stuttgarter Str. 139, D-72574 Bad Urach, Germany

Test Results:

When the test results are assessed using the test criteria specified in the Standard, the material, when tested at a nominal thickness of 4mm, is classified as "V-0".

Date of Test

8th March 2012

Reason for revision

This report replaces issue 1 (dated 13th March 2012) of the same number which has now been withdrawn. The product reference "CR32FR" detailed in the issue 1 report is incorrect and the correct product reference "CR132FR" has been detailed in this issue 2 report.

Signatories

Responsible Officer T. Mort * Senior Technical Officer	Authorised S. Deeming * Operations Manager

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 20th March 2012

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Product Data Sheet

bisco®
TRUSTED TO THE EXTREME

BISCO® HT-800 Medium Silicone Foam

BISCO® HT-800 medium cellular silicone foam embodies the transition from soft and conformable to firm and durable, as it offers the lightness of a foam while also exhibiting enhanced sponge rubber sealing capabilities. Patented chemistry and cell structure provide a long-term performance advantage.

Features & Benefits:

- Highly versatile medium firm foam
- Excellent memory and low stress relaxation reduces maintenance costs associated with gasket failures
- Resistance to UV, ozone, and extreme temperatures for consistent performance across many environments
- Rated to most stringent UL flame standards

† FDA compliant in accordance with regulation 21 CFR 177.2600

PROPERTY	TEST METHOD	TYPICAL VALUE*	SPECIFICATION**
PHYSICAL			
Color	Visual	**Black, Gray, Red**	---
Thickness, mm (inches)	Internal	**0.79 - 12.70 (0.031 - 0.500)**	See "Width Tolerance" table
Density, kg/m^3 (lb./ft^3)	Internal	352 (22)	**300 - 473 (18.7 - 29.5)**
Compression Force Deflection, kPa (psi)	ASTM D1056	67 (9.7)	**41 - 97 (6 - 14)**
Compression Set, %	ASTM D1056 100°C (212°F) / 22 hrs / 50%	2.4	< 5
Water Absorption, %	Internal 2" below water surface / 24 hrs / change in weight	0.5	< 5
FLAMMABILITY			
Flame Resistance	UL 94 (File E83967)	Meets	V-0
Flame Spread Index (Is)	ASTM E162	Meets	Flaming Mode < 35
Smoke Density (Ds)	ASTM E662	Meets	Flaming Mode, 1.5 min, < 100 Flaming Mode, 4.0 min, < 200
Burn Length	FMVSS 302	Meets	< 100 mm/min
THERMAL			
Temperature Range, °C (°F)	Internal	-55 to +200 (-67 to +392)	---
Thermal Conductivity, W/m °K	ASTM C518	0.076	---
Low Temperature Flex	ASTM D1056 -55°C (-67°F) / 5 hrs	Pass	---
Low Temperature Brittleness	ASTM D746 -55°C (-67°F) / 3 min	Pass	---

Specification values in bold are tested on a batch basis.

ROGERS CORPORATION

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bisco®
TRUSTED TO THE EXTREME

PROPERTY	TEST METHOD	TYPICAL VALUE*	SPECIFICATION**
OUTGASSING			
Total Mass Loss (%)	ASTM E595 (4x10* -6 Torr)	0.98	---
Collected Volatile Condesible Materials (CVCM) (%)	ASTM E595 (4x10* -6 Torr)	0.25	---
Water Vapor Regain (%)	ASTM E595 (4x10* -6 Torr)	0.03	---
ELECTRIC			
Dielectric Strength, Volts/mil	ASTM D149	75	---
Dielectric Constant, 1 kHz	ASTM D150	1.7	---
Dissipation Factor, 1 kHz	ASTM D495	0.005	---
Dry Arc Resistance, Seconds	ASTM D495	125	---
Volume Resistivity, Ohm-cm	ASTM D257	10^14	---

Standard Thickness Tolerances

NOMINAL THICKNESS mm (inches)	TOLERANCE mm (inches)
0.79 (0.031)	+ 0.381/0.102 (+ 0.015/-0.004)
1.60 (0.063)	± 0.508 (± 0.020)
2.39 (0.094)	± 0.508 (± 0.020)
3.18 (0.125)	± 0.635 (± 0.025)
4.78 (0.188)	± 0.635 (± 0.025)
6.35 (0.250)	± 0.762 (± 0.030)
9.53 (0.375)	± 1.143 (± 0.045)
12.70 (0.500)	± 1.270 (± 0.050)

Slit Material and Tape (PSA) Width Tolerances

NOMINAL WIDTH mm (inches)	TOLERANCE mm (inches)
> 0 - 76 (> 0 - 3)	± 1.60 (± 0.063)
> 76 - 203 (> 3 - 8)	± 2.39 (± 0.094)
> 203 - 305 (> 8 - 12)	± 3.18 (± 0.125)
> 305 - 457 (> 12 - 18)	± 4.78 (± 0.188)
> 457 - 660 (> 18 - 26)	± 5.56 (± 0.219)
> 660 - 914 (> 26 - 36)	+ 25.4/- 0 (+ 1/- 0)

VALUE ADDED OFFERINGS

- Adhesive (PSA) lamination
- Slit material/tapes

SPECIFICATION

- AMS3195

† Statement of FDA compliance is based solely on the following: HT-800 (Gray) silicone foams (i) are compounded and cured under conditions of good manufacturing practice; and (ii) have been subjected to annual extraction testing in accordance with FDA Regulation 21 CFR 177.2600 paragraphs (e) and (f) and found to meet all extractives limitations, both of which are criteria set forth in 21 CFR 177.2600 as necessary for rubber articles intended for repeated use in those areas specified in the regulation.

Notes:

*Typical Value- Value is based on historical data. Please note the frequency of testing varies.
**Specification- Applies to physical properties only, which are based on Rogers' internal benchmark and standard BISCO specification values. Additional industry specifications are available as well. All other properties are based on industry standard guidelines.

For more information and to request a sample, please contact our team of experts at solutions@rogerscorp.com

ROGERS CORPORATION

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TECAPEEK natural - Stock Shapes (rods, plates, tubes)

Chemical Designation
PEEK (Polyetheretherketone)

Colour
beige opaque

Density
1.31 g/cm^3

Main features
- good heat deflection temperature
- good machinability
- inherent flame retardant
- resistance against high energy radiation
- good slide and wear properties
- very good chemical resistance
- high creep resistance
- hydrolysis and superheated steam resistant

Target Industries
- chemical technology
- mechanical engineering
- food technology
- electronics
- energy industry
- oil and gas industry
- aircraft and aerospace technology
- automotive industry
- semiconductor technology
- vacuum technology

Mechanical properties	parameter	value	unit	norm		comment
Tensile strength	50mm/min	116	MPa	DIN EN ISO 527-2		(1) For tensile test: specimen type 1b (2) For flexural test: support span 64mm, norm specimen. (3) Specimen 10x10x10mm (4) Specimen 10x10x50mm, modulus range between 0.5 and 1% compression. (5) For Charpy test: support span 64mm, norm specimen. n.b. = not broken
Modulus of elasticity (tensile test)	1mm/min	4200	MPa	DIN EN ISO 527-2	1)	
Tensile strength at yield	50mm/min	116	MPa	DIN EN ISO 527-2		
Elongation at yield (tensile test)	50mm/min	5	%	DIN EN ISO 527-2		
Elongation at break (tensile test)	50mm/min	15	%	DIN EN ISO 527-2		
Flexural strength	2mm/min, 10 N	175	MPa	DIN EN ISO 178	2)	
Modulus of elasticity (flexural test)	2mm/min, 10 N	4200	MPa	DIN EN ISO 178		
Compression strength	1% / 2% / 5% 5mm/min, 10 N	23/43/102	MPa	EN ISO 604	3)	
Compression modulus	5mm/min, 10 N	3400	MPa	EN ISO 604	4)	
Impact strength (Charpy)	max. 7,5J	n.b.	kJ/m^2	DIN EN ISO 179-1eU	5)	
Notched impact strength (Charpy)	max. 7,5J	4	kJ/m^2	DIN EN ISO 179-1eA		
Shore hardness	D	89		DIN EN ISO 868		

Thermal properties	parameter	value	unit	norm		comment
Glass transition temperature		150	°C	DIN EN ISO 11357	1)	(1) Found in public sources. (2) Found in public sources. Individual testing regarding application conditions is mandatory.
Melting temperature		341	°C	DIN EN ISO 11357		
Heat distortion temperature	HDT, Method A	162	°C	ISO-R 75 Method A		
Service temperature	short term	300	°C		2)	
Service temperature	long term	260	°C	-		
Thermal expansion (CLTE)	23-60°C, long.	5	10^{-5} K^{-1}	DIN EN ISO 11359-1;2		
Thermal expansion (CLTE)	23-100°C, long.	5	10^{-5} K^{-1}	DIN EN ISO 11359-1;2		
Thermal expansion (CLTE)	100-150°C, long.	7	10^{-5} K^{-1}	DIN EN ISO 11359-1;2		
Specific heat		1.1	J/(g*K)	ISO 22007-4:2008		
Thermal conductivity		0.27	W/(K*m)	ISO 22007-4:2008		

Electrical properties	parameter	value	unit	norm		comment
surface resistivity	Silver electrode, 23°C, 12% r.h.	10^{15}	Ω	-	1)	(1) Specimen in 20mm thickness (2) Specimen in 1mm thickness
volume resistivity	Silver electrode, 23°C, 12% r.h.	10^{15}	Ω*cm	DIN IEC 60093		
Dielectric strength	23°C, 50% r.h.	73	kV/mm	ISO 60243-1	2)	
Resistance to tracking (CTI)	Platin electrode, 23°C, 50% r.h., solvent A	125	V	DIN EN 60112		

Other properties	parameter	value	unit	norm		comment
Water absorption	24h / 96h (23°C)	0.02 / 0.03	%	DIN EN ISO 62	1)	(1) Ø ca. 50mm, h=13mm (2) + good resistance (3) - poor resistance
Resistance to hot water/ bases		+		-	2)	
Resistance to weathering		-		-	3)	
Flammability (UL94)	listed (value at 1.5mm)	V0		DIN IEC 60695-11-10;		

- TECAPEEK products may be based on Victrex® PEEK or Solvay KetaSpire® polymer

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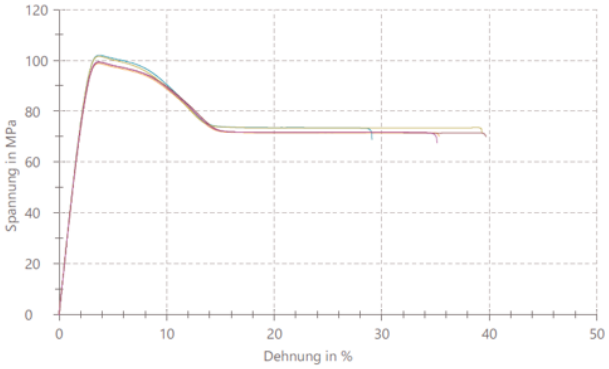
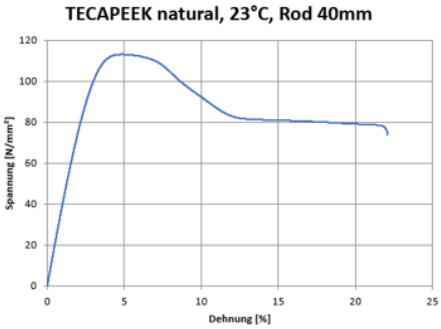
Date: 2023/07/19

Version: AG

TECAPEEK natural, 70°C, machined test specimens out of 60mm thick sheet





70°C

Modulus of elasticity: 3950 MPa
Tensile strength: 100,2 MPa
Elongation at break: 35,6 %

Comparison data Ensinger TDS

TECAPEEK natural

Modulus of elasticity: 4200 MPa
Tensile strength: 116 MPa
Elongation at break: 15 %

Tg: 150 °C
Tm: 341°C

L&W Steckerladen GmbH
Industriestr. 4
22869 Schenefeld
Tel.: 040 - 8 39 39 19-0
Fax: 040 - 8 39 39 19-15
Mail: info@steckerladen.de

blanking piece M20 x 1,5

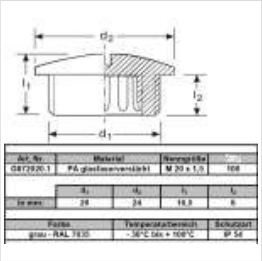
Product no.: G872020.1

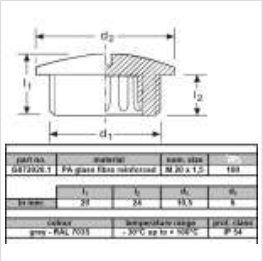
locking plug with flange
metric thread
blanking piece
polyamide PA glass fibre reinforced
temperature range -30 - +100 °C
self-extinguishing class V0 (UL 94)
insert protection IP 54
lightgrey RAL 7035

Price:

Qty	Price
from 1 pcs.	per 0,27 EUR
from 10 pcs.	per 0,23 EUR
from 100 pcs.	per 0,22 EUR

19 % VAT incl. excl. Shipping costs





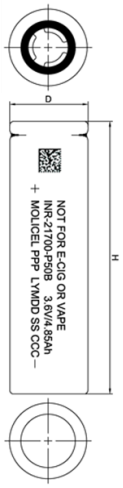
LITHIUM-ION RECHARGEABLE BATTERY

PRODUCT DATA SHEET
MODEL INR-21700-P50B

■ CELL CHARACTERISTICS

Capacity	Typical	5000 mAh 18.0 Wh
	Minimum	4850 mAh 17.5 Wh
Cell Voltage	Nominal	3.6 V
	Charge	4.2 V
	Discharge	2.5 V
Charge Current (70ºC cut-off)	Standard	5.0 A
	Maximum	25 A
Charge Time	Standard	1.5 hr
Discharge Current (80ºC cut-off)	Continuous	60 A
Ambient Temperature	Charge	-20℃ to 60℃
	Discharge	-40℃ to 60℃
Energy Density	Volumetric	714 Wh/l
	Gravimetric	260 Wh/kg
Typical Impedance	AC (30%SOC)	6.5 mΩ
	DC (50%SOC)	12.8 mΩ

■ PHYSICAL CHARACTERISTICS

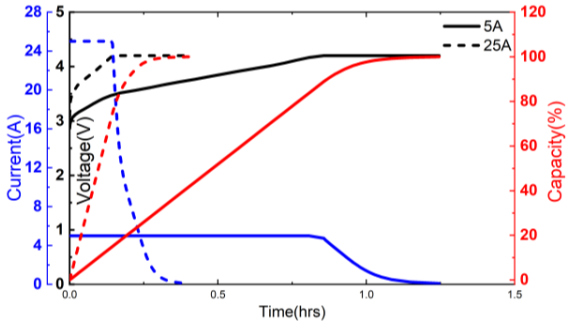


Shape	Cylindrical
Can	Steel
Diameter	21.55 mm (Max)
Height	70.15 mm (Max)
Weight	71 g (Max)

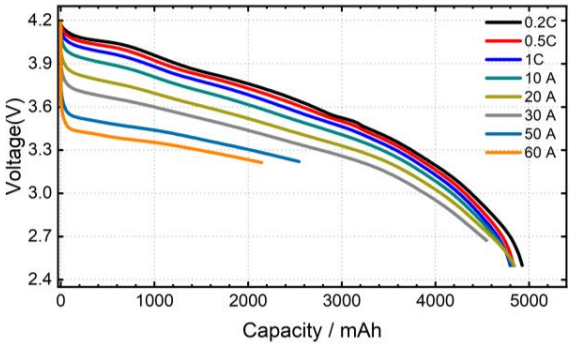
The information contained herein is for reference only and does not imply a performance guarantee or a product warranty. Specifications and characteristics are subject to change without prior notice.
This product is not designed or produced for use in any vape or e-cigarette devices.

For application specific information, please contact E-One Moli Energy Sales and Applications or the nearest MOLICEL® recognized agent.
Version 1.1

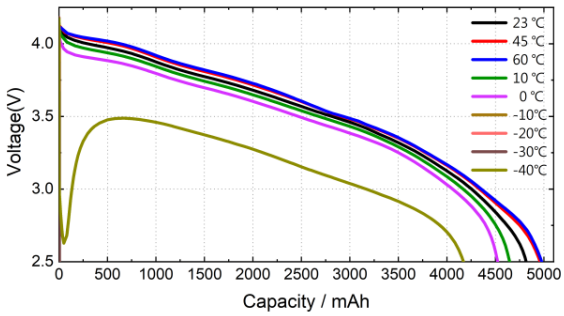
■ Charge Characteristics



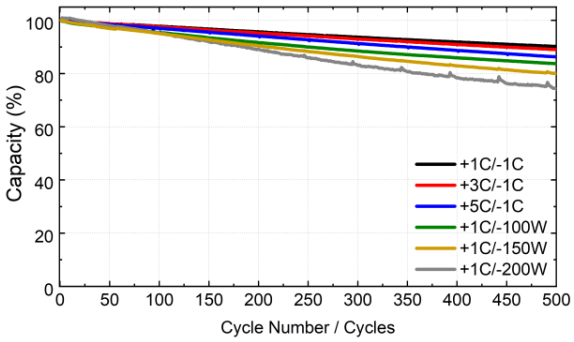
■ Discharge Rate Characteristics



■ Discharge Temperature Characteristics



■ Cycle Characteristics



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http://www.molicel.com

TECAPEEK natural - Stock Shapes (rods, plates, tubes)

Chemical Designation
PEEK (Polyetheretherketone)

Colour
beige opaque

Density
1.31 g/cm^3

Main features
- good heat deflection temperature
- good machinability
- inherent flame retardant
- resistance against high energy radiation
- good slide and wear properties
- very good chemical resistance
- high creep resistance
- hydrolysis and superheated steam resistant

Target Industries
- chemical technology
- mechanical engineering
- food technology
- electronics
- energy industry
- oil and gas industry
- aircraft and aerospace technology
- automotive industry
- semiconductor technology
- vacuum technology

Mechanical properties	parameter	value	unit	norm		comment
Tensile strength	50mm/min	116	MPa	DIN EN ISO 527-2		(1) For tensile test: specimen type 1b (2) For flexural test: support span 64mm, norm specimen. (3) Specimen 10x10x10mm (4) Specimen 10x10x50mm, modulus range between 0.5 and 1% compression. (5) For Charpy test: support span 64mm, norm specimen. n.b. = not broken
Modulus of elasticity (tensile test)	1mm/min	4200	MPa	DIN EN ISO 527-2	1)	
Tensile strength at yield	50mm/min	116	MPa	DIN EN ISO 527-2		
Elongation at yield (tensile test)	50mm/min	5	%	DIN EN ISO 527-2		
Elongation at break (tensile test)	50mm/min	15	%	DIN EN ISO 527-2		
Flexural strength	2mm/min, 10 N	175	MPa	DIN EN ISO 178	2)	
Modulus of elasticity (flexural test)	2mm/min, 10 N	4200	MPa	DIN EN ISO 178		
Compression strength	1% / 2% / 5% 5mm/min, 10 N	23/43/102	MPa	EN ISO 604	3)	
Compression modulus	5mm/min, 10 N	3400	MPa	EN ISO 604	4)	
Impact strength (Charpy)	max. 7,5J	n.b.	kJ/m^2	DIN EN ISO 179-1eU	5)	
Notched impact strength (Charpy)	max. 7,5J	4	kJ/m^2	DIN EN ISO 179-1eA		
Shore hardness	D	89		DIN EN ISO 868		

Thermal properties	parameter	value	unit	norm		comment
Glass transition temperature		150	°C	DIN EN ISO 11357	1)	(1) Found in public sources. (2) Found in public sources. Individual testing regarding application conditions is mandatory.
Melting temperature		341	°C	DIN EN ISO 11357		
Heat distortion temperature	HDT, Method A	162	°C	ISO-R 75 Method A		
Service temperature	short term	300	°C		2)	
Service temperature	long term	260	°C	-		
Thermal expansion (CLTE)	23-60°C, long.	5	10^{-5} K^{-1}	DIN EN ISO 11359-1;2		
Thermal expansion (CLTE)	23-100°C, long.	5	10^{-5} K^{-1}	DIN EN ISO 11359-1;2		
Thermal expansion (CLTE)	100-150°C, long.	7	10^{-5} K^{-1}	DIN EN ISO 11359-1;2		
Specific heat		1.1	J/(g*K)	ISO 22007-4:2008		
Thermal conductivity		0.27	W/(K*m)	ISO 22007-4:2008		

Electrical properties	parameter	value	unit	norm		comment
surface resistivity	Silver electrode, 23°C, 12% r.h.	10^{15}	Ω	-	1)	(1) Specimen in 20mm thickness (2) Specimen in 1mm thickness
volume resistivity	Silver electrode, 23°C, 12% r.h.	10^{15}	Ω*cm	DIN IEC 60093		
Dielectric strength	23°C, 50% r.h.	73	kV/mm	ISO 60243-1	2)	
Resistance to tracking (CTI)	Platin electrode, 23°C, 50% r.h., solvent A	125	V	DIN EN 60112		

Other properties	parameter	value	unit	norm		comment
Water absorption	24h / 96h (23°C)	0.02 / 0.03	%	DIN EN ISO 62	1)	(1) Ø ca. 50mm, h=13mm (2) + good resistance (3) - poor resistance
Resistance to hot water/ bases		+		-	2)	
Resistance to weathering		-		-	3)	
Flammability (UL94)	listed (value at 1.5mm)	V0		DIN IEC 60695-11-10;		

- TECAPEEK products may be based on Victrex® PEEK or Solvay KetaSpire® polymer

Our information and statements reflect the current state of our knowledge and shall inform about our products and their applications. They do not assure or guarantee chemical resistance, quality of products and their merchantability in a legally binding way. Our products are not defined for use in medical or dental implants. Existing commercial patents have to be observed. The corresponding values and information are no minimum or maximum values, but guideline values that can be used primarily for comparison purposes for material selection. These values are within the normal tolerance range of product properties and do not represent guaranteed property values. Therefore they shall not be used for specification purposes. Unless otherwise noted, these values were determined by tests at reference dimensions (typically rods with diameter 40-60 mm according to DIN EN 15860) on extruded and machined specimen. As the properties depend on the dimensions of the semi-finished products and the orientation in the component (esp. in reinforced grades), the material may not be used without a separate testing under individual circumstances. The customer is solely responsible for the quality and suitability of products for the application and has to test usage and processing prior to use. Data sheet values are subject to periodic review, the most recent update can be found at www.ensingerplastics.com. Technical changes reserved.

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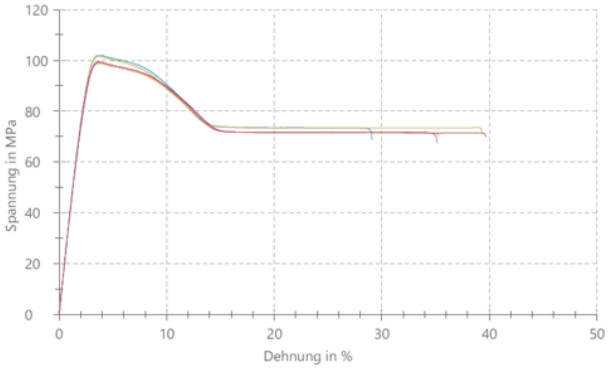
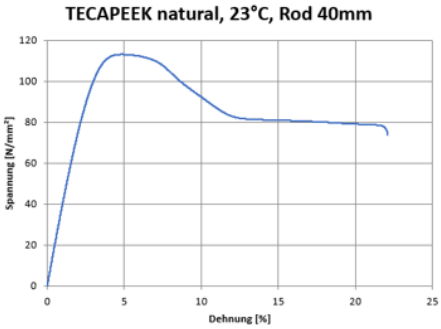
Date: 2023/07/19

Version: AG

TECAPEEK natural, 70°C, machined test specimens out of 60mm thick sheet





70°C

Modulus of elasticity: 3950 MPa
Tensile strength: 100,2 MPa
Elongation at break: 35,6 %

Comparison data Ensinger TDS

TECAPEEK natural

Modulus of elasticity: 4200 MPa
Tensile strength: 116 MPa
Elongation at break: 15 %

Tg: 150 °C
Tm: 341°C

LOTTE ADVANCED MATERIALS

ISO Property

INFINO	Grade	NH-1015V
	Resin Type	PC/ABS

Laptop, Home Appliances

Item	Measuring Method	Condition	Unit	Value
Physical				
Specific Gravity	ISO 1183	Natural or representative color	-	1.17
Melt Flow Index	ISO 1133	220℃, 10kg	g/10min	30
Mechanical				
Tensile Strength at Yield	ISO 527	50mm/min	MPa	61
Tensile Strain at break	ISO 527	50mm/min	%	45
Tensile Modulus	ISO 527	50mm/min	MPa	2500
Tensile Strength at break	ISO 527	50mm/min	MPa	48
Flexural Strength	ISO 178	2mm/min	MPa	89
Flexural Modulus	ISO 178	2mm/min	MPa	2550
Izod Impact Strength(notched)	ISO 180 1A	at 23˚C, 4mm	KJ/m2	14
Charpy Impact Strength(V-notched)	ISO 180 1A	at 23˚C, 4mm	KJ/m2	17
Rockwell Hardness	ISO 2039-2	R-Scale	-	118
Thermal				
Heat Deflection Temperature(Unannealed)	ISO 75-2	1.8MPa, 4.0mm	˚C	82
Heat Deflection Temperature(Unannealed)	ISO 75-2	0.45MPa, 4.0mm	˚C	94
Heat Deflection Temperature(Annealing)	ISO 75-2	1.8MPa, 4.0mm	˚C	97
Heat Deflection Temperature(Annealing)	ISO 75-2	0.45MPa, 4.0mm	˚C	102
VICAT Softening Temperatur	ISO 306	B/50	˚C	100
VICAT Softening Temperatur	ISO 306	B/120	˚C	103
RTI, Ele	UL 746B	1.5, V-0	˚C	90
RTI, Imp	UL 746B	1.5, V-0	˚C	85

RTI, Str	UL 746B	1.5, V-0	˚C	90
Flammability				
Flammability	UL94	V-0	mm	1.5
Flammability	UL94	5VB	mm	2

1. The value above is the representative value of the NP or representative color and may have deviation. It can only be used for selecting materials.
2. The value above shall not be regarded as a material specification and cannot be used for molding designs.

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※ The last update date : 05/13/2014

exolon GROUP

Product Data Sheet, January 2020

Makrolon® FR

Solid flame retardant polycarbonate sheet

I Line
Innovative

Your benefits:

- excellent fire rating
- resistance to a wide range of temperatures
- extreme impact strength

Solid **Makrolon® FR** sheets are flame retardant polycarbonate sheets. They offer extreme impact strength that exceeds the physical properties of other products of their class. Makrolon® sheets resist temperatures of -100 to +120 °C and exhibit high optical clarity.

Makrolon® FR sheets have excellent fire ratings. They are UL94-V0 rated as of 2 mm thickness, comply with EN 45545-2 (European fire standard for rail applications) requirement R4, R22, R23 and R24 and meet FAR 25.853 (a)(1)(i).

Makrolon® FR clear 099 is a clear transparent sheet with good light transmission.

Makrolon® FR DX 139 is a diffuser sheet with a cool and fresh color appearance, even when the LEDs are in off mode.

Makrolon® FR sheets are the perfect choice for a long service life because of their good material performance.

Applications:
Typical applications for **Makrolon® FR** sheets include:

- lighting fixtures on railway vehicles
- electro technical components and guards which have to comply with UL94, EN 45545-2 or FAR 25.853 requirements
- any application where improved fire behaviour is needed for fire safe solutions

The sheets offer protection against involuntary breakage and willful destruction. **Makrolon® FR DX** sheets can be thermoformed, cold-curved and machined with ease.

	Test Conditions	Typical Values[1]	Unit	Test Method
PHYSICAL				
Density		1200	kg/m³	ISO 1183-1
Water absorption saturation	water at 23°C	0.3	%	ISO 62
Water absorption equilibrium	23°C, 50 % RH	0.12	%	ISO 62
Refractive Index	Procedure A	1,587	-	ISO 489
MECHANICAL				
Tensile modulus	1 mm/min	2400	MPa	ISO 527-1,-2
Yield stress	50 mm/min	>60	MPa	ISO 527-1,-2
Yield strain	50 mm/min	6	%	ISO 527-1,-2
Nominal strain at break	50 mm/min	>50	%	ISO 527-1,-2
Flexural modulus	2 mm/min	2400	MPa	ISO 178
Flexural strength	2 mm/min	>90	MPa	ISO 178
Charpy impact strength	23°C, unnotched	non-break	kJ/m²	ISO 179-1eU
Charpy impact strength	23°C, 3 mm, notched	70P	kJ/m²	ISO 179-1eU
Izod impact strength	23°C, 3.2 mm, notched	80P	kJ/m²	ISO 180-A
THERMAL				
Vicat softening temperature	50 N; 50°C/h	146	°C	ISO 306
Thermal conductivity	23°C	0.2	W/(mK)	ISO 8302
Coefficient of thermal expension	23 to 55°C	0.70	10^{-4} K	ISO 11359-1,-2
Temperature of deflection under load	1.8 Mpa	127	°C	ISO 75-1,-2
	0.45 Mpa	139	°C	ISO 75-1,-2
ELECTRICAL				
Electrical strength	1 mm	34	kV/mm	IEC 60243-1
Volume resistivity		1E14	Ohm.m	IEC 60093
Surface resistivity		1E16	Ohm	IEC 60093
Relative permittivity	100 Hz	3.1	-	IEC 60250
Relative permittivity	1 MHz	3	-	IEC 60250
Dissipation factor	100 Hz	10 10^{-4}	-	IEC 60250
Dissipation factor	1 MHz	90 10^{-4}	-	IEC 60250

[1] These values are measured on injection molded samples, and are not intended for specification purposes.

Product Data Sheet, January 2020

Makrolon® FR

Solid flame retardant polycarbonate sheet

Ideas, innovative, intelligent, interesting...
Exolon Group i-line represents the next generation of quality products. This seal guarantees innovative and intelligent first-class solutions at all times for a multitude of requirements.

Available dimensions:
Makrolon® FR clear 099: available as 2, 3 and 5 mm sheet thickness in the format 2.050 x 3.050 mm
Makrolon® FR DX white 139*: in 3 mm sheet thickness in the format 2.050 x 3.050 mm
*Other sizes, colours or sheet thicknesses on request.

Permanent Service Temperature: without load approx. 120 °C.

Fire Rating*:

Country	Standard	Rating	Thickness	Colour
Europe	EN 45545-2	R1/ HL1, R3/HL2, R4/ HL3 R22, R23, R24/ HL3	1.5 - 5 mm 2 - 5 mm	all colours
Germany	DIN 5510-2	S3/ SR2/ ST2	5.0 mm	clear 099
USA	UL 94 FAR 25.853	V0 Part 1, (a)(1)(i) – 60 sec Part 1, (a)(1)(ii) – 12 sec	≥ 2,0 mm 2 – 5 mm	all colours clear 099

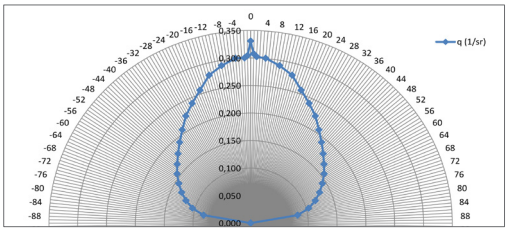
* Fire certificates are limited in time and scope, always check if the mentioned certificate is valid for the purchased polycarbonate sheet type at the date of delivery. Polycarbonate sheets may change their fire behavior due to ageing and weathering. The indicated fire rating was tested on new / unweathered product in accordance with the indicated fire classification standards.

Light transmission in %, test method according to ISO 13468-2
The stated thicknesses are not all available as standard. The stated values are typical values only.

	Makrolon® FR clear 099				Makrolon® FR DX white 139
Sheet thickness (mm)	3	4	5	6	3
Light transmission (%)	88	86	85	84	53

Light diffusion Makrolon® FR DX:

Spatial distribution of the luminance coefficient q



Results were derived from BTDF measurements:

	Makrolon® FR DX white 139
Sample thickness (mm)	3
Half-power angle [γ]	2 x 50°
Light diffusion factor [σ]	63%

T_c and R_a for the combination of illuminant A and **Makrolon® FR DX** cool 139, as a function of the transmission angle.

Illuminant A	Transmission angle (°)	R_a	T_c (K)
R_a	0	97.62	2708
99.58	1	97.67	2710
T_c(K)	2	97.66	2714
2856	5	97.62	2726

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Technical data sheet

Article number:
308-30300 HIS-3-3/1

Product Group	Heat shrinkable tubing 3:1 on a reel
Product Family	HIS-3
Material	Polyolefin, cross-linked (PO-X)
Colour	Black (BK)

Behaviour at Heat Shock	not fluid, not dripping, not cracking
Behaviour at Low Temperature [Test method]	not cracking [UL 224]
Dielectric Strength [Test method]	32 kV/mm [IEC 60243]
Elongation at break [Test method]	800 [ASTM D2671]
Elongation At Heat Aging	400 %
Flammability	UL 224 VW-1
Heat Aging Test [Test method]	168h/175°C [UL 224]
Heat Shock Test	4h/250°C
Insulation Class	B (VDE 0530)
Longitudinal Change After Shrinkage	+/-5%
Min. Shrink Temperature - °C	+100 °C
Minimum Tensile Strength At Heat Aging	13 MPa
Operating Temperature	-55 °C to +135 °C
Package Content packed in	pcs.
Pack Cont.	10 m
Recov. Ø d max.	1.0 mm
Shrink Ratio	3:1
Specifications	ANSI/UL 224, C22.2 no. 198.1-06
Supplied Ø D min.	3.2 mm
Tensile Strength [Test method]	14 MPa [ASTM D2671]
UL-File Number	E143529
Wall (WT)	0.55 mm

RoHS

created on 11. April 2025, 9:25 pm

Technical changes and errors reserved. It´s up to the customer to check the suitability for a specific application by means of tests.

Technical data sheet

Article number:
308-31200 HIS-3-12/4

Product Group	Heat shrinkable tubing 3:1 on a reel
Product Family	HIS-3
Material	Polyolefin, cross-linked (PO-X)
Colour	Black (BK)

Behaviour at Heat Shock	not fluid, not dripping, not cracking
Behaviour at Low Temperature [Test method]	not cracking [UL 224]
Dielectric Strength [Test method]	32 kV/mm [IEC 60243]
Elongation at break [Test method]	800 [ASTM D2671]
Elongation At Heat Aging	400 %
Flammability	UL 224 VW-1
Heat Aging Test [Test method]	168h/175°C [UL 224]
Heat Shock Test	4h/250°C
Insulation Class	B (VDE 0530)
Longitudinal Change After Shrinkage	+/-5%
Min. Shrink Temperature - °C	+100 °C
Minimum Tensile Strength At Heat Aging	13 MPa
Operating Temperature	-55 °C to +135 °C
Package Content packed in	pcs.
Pack Cont.	5 m
Recov. Ø d max.	4.0 mm
Shrink Ratio	3:1
Specifications	ANSI/UL 224, C22.2 no. 198.1-06
Supplied Ø D min.	12.7 mm
Tensile Strength [Test method]	14 MPa [ASTM D2671]
UL-File Number	E143529
Wall (WT)	0.80 mm

RoHS

created on 16. May 2025, 1:49 pm

Technical changes and errors reserved. It´s up to the customer to check the suitability for a specific application by means of tests.

molex

Part Number : 2043130006
Product Description : Sentrality 6.00mm Top-entry, Knurled Press-fit Socket Assembly with +/-1.00mm Self-alignment Capability, Tray
Series Number : 204313
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2043130006_sd.pdf

2043650006-PK-000.pdf

3D Models and Design Files

2043130006_stp.zip

Specifications

2043130006-PS-000.pdf

2043130006-TS-000.pdf

2043131234-TS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)4144-DC (27 June 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC

- Low-Halogen

Industry Documents
- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest
- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	204313
Description	Sentrality 6.00mm Top-entry, Knurled Press-fit Socket Assembly with +/-1.00mm Self-alignment Capability, Tray
Application	Busbar-to-Board, Busbar-to-Busbar, Power
Comments	Current and voltage performances are dependent upon application variables.
Component Type	PCB Receptacle
Product Name	Sentrality
UPC	191130149902

Electrical

Current - Maximum per Contact	140.0A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	1

Circuits (maximum)	1
Diameter	6.00mm
Durability (mating cycles max)	200
Glow-Wire Capable	No
Guide to Mating Part	Yes
Height Above Board	3.40mm
Material - Metal	Copper Alloy
Material - Plating Mating	Gold
Material - Plating Termination	Silver
Mating Orientation	Top-entry
Net Weight	10.302/g
Number of Rows	1
Orientation	Vertical
Packaging Type	Tray
PCB Retention	None
Pitch - Mating Interface	N/A
Polarized to Mating Part	No
Polarized to PCB	No
Temperature Range - Operating	-40° to +125°C
Termination Interface Style	Press-Fit

Mates With / Use With

Mates with Part(s)

Description	Part Number
Sentrality Pins	203263

molex

Part Number : 2032630026
Product Description : Sentrality 6.00mm Knurled Press-fit Pin, 14.00mm Engagement Length, Bag
Series Number : 203263
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2032630026_sd.pdf

2032630006-PK-000.pdf

3D Models and Design Files

2032630026_stp.zip

Specifications

2043130018-AS-000.pdf

2043130006-PS-000.pdf

2043131234-TS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not saleable
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)7663-DC (21 Jan 2025)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC
- Low-Halogen

Industry Documents

- IPC 1752A Class C
- IPC 1752A Class D
- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest

- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	203263
Description	Sentrality 6.00mm Knurled Press-fit Pin, 14.00mm Engagement Length, Bag
Application	Board-to-Board, Busbar-to-Board, Busbar-to-Busbar, Power
Component Type	PCB Header
Product Name	Sentrality
UPC	193264044658

Electrical

Current - Maximum per Contact	140.0A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	1
Circuits (maximum)	1
Diameter	6.00mm
Durability (mating cycles max)	200
Glow-Wire Capable	No
Guide to Mating Part	No

Height Above Board	14.00mm
Material - Metal	Copper Alloy
Material - Plating Mating	Silver
Material - Plating Termination	Silver
Net Weight	4.464/g
Number of Rows	1
Orientation	Vertical
Packaging Type	Bag
PCB Retention	None
Pitch - Mating Interface	N/A
Polarized to Mating Part	No
Polarized to PCB	No
Temperature Range - Operating	-40° to +125°C
Termination Interface Style	Press-Fit

Mates With / Use With

Mates with Part(s)

Description	Part Number
Sentrality Top-entry Surface Mount Socket Assemblies	204318
Sentrality Top-entry Surface Mount Socket Assemblies with Self-alignment Capability	204365
Sentrality Top-entry Knurled Press-Fit Socket Assemblies with Self-alignment Capability	204313
Sentrality Top-entry Knurled Press-Fit Socket Assemblies	204316
Sentrality 3.40mm Right-Angle Socket Assemblies	205000

molex

Part Number : 2032630006
Product Description : Sentrality 6.00mm Knurled Press-fit Pin, 26.00mm Engagement Length, Bag
Series Number : 203263
Status : Active
Product Category : PCB Headers and Receptacles

Documents & Resources

Drawings

2032630006_sd.pdf

2032630006-PK-000.pdf

3D Models and Design Files

2032630006_stp.zip

Specifications

2043130006-PS-000.pdf

Product Environment Compliance..

Compliance

GADSL/IMDS	Not Relevant
China RoHS	per SJ/T 11365-2006
EU ELV	Not Relevant
Low-Halogen Status	Low-Halogen per IEC 61249-2-21
REACH SVHC	Not Contained per D(2024)4144-DC (27 June 2024)
EU RoHS	Compliant per EU 2015/863

Compliance Statements

- EU RoHS
- REACH SVHC
- Low-Halogen

Industry Documents

- IPC 1752A Class C
- IPC 1752A Class D

- Molex Product Compliance Declaration
- IEC-62474
- chemSHERPA (xml)

Substances of Interest
- PFAS

EU RoHS Certificate of Compliance

Additional Product Compliance Information

Part Details

General

Status	Active
Category	PCB Headers and Receptacles
Series	203263
Description	Sentrality 6.00mm Knurled Press-fit Pin, 26.00mm Engagement Length, Bag
Application	Board-to-Board, Busbar-to-Board, Busbar-to-Busbar, Power
Component Type	PCB Header
Product Name	Sentrality
UPC	191130149858

Electrical

Current - Maximum per Contact	140.0A
Voltage - Maximum	600V

Physical

Breakaway	No
Circuits (Loaded)	1
Circuits (maximum)	1
Diameter	6.00mm
Durability (mating cycles max)	200
Glow-Wire Capable	No
Guide to Mating Part	No
Height Above Board	26.00mm
Material - Metal	Copper Alloy

Material - Plating Mating	Silver
Material - Plating Termination	Silver
Net Weight	7.527/g
Number of Rows	1
Orientation	Vertical
Packaging Type	Bag
PCB Retention	None
Pitch - Mating Interface	N/A
Polarized to Mating Part	No
Polarized to PCB	No
Temperature Range - Operating	-40° to +125°C
Termination Interface Style	Press-Fit

Mates With / Use With

Mates with Part(s)

Description	Part Number
Sentrality Top-entry Surface Mount Socket Assemblies	204318
Sentrality Top-entry Surface Mount Socket Assemblies with Self-alignment Capability	204365
Sentrality Top-entry Knurled Press-Fit Socket Assemblies with Self-alignment Capability	204313
Sentrality Top-entry Knurled Press-Fit Socket Assemblies	204316
Sentrality 3.40mm Right-Angle Socket Assemblies	205000

Charger / Battery Hand Cart

FORMEX™ GK PRODUCT DATA

FLAME RETARDANT POLYPROPYLENE SHEET

ITW Electronic Components FORMEX
425 North Gary Ave.
Carol Stream, IL 60188
Phone: 630-315-2171
Website: www.itwformex.com

	TEST METHOD	FORMEX GK-5	FORMEX GK-10	FORMEX GK-17	FORMEX GK-30	FORMEX GK-40	FORMEX GK-62
Color		Black	Natural & Black	Natural & Black	Natural & Black	Natural & Black	Natural & Black
MANUFACTURING SPECIFICATION							
Thickness							
inches		0.005 (+0.001 / -0.001)	0.010 (+0.003 / -0.0015)	0.017 (+0.003 / -0.001)	0.030 (+0.002 / -0.002)	0.040 (+0.002 / -0.002)	0.062 (+0.004 / -0.004)
millimeters		0.127 (+0.025 / -0.025)	0.25 (+0.08 / -0.04)	0.43 (+0.08 / -0.03)	0.76 (+0.05 / -0.05)	1.02 (+0.05 / -0.05)	1.57 (+0.10 / -0.10)
UL FLAMMABILITY RATING / PERFORMANCE LEVELS							
Flammability	UL 94	VTM-0	VTM-0	V-0	V-0	V-0	V-0
Relative Temperature Index	UL 746B						
Electrical		115°C / 239°F	115°C / 239°F	115°C / 239°F	115°C / 239°F	115°C / 239°F	115°C / 239°F
Mechanical Without Impact		115°C / 239°F	115°C / 239°F	115°C / 239°F	115°C / 239°F	115°C / 239°F	115°C / 239°F
High Current Arc Ignition - PLC (arcs to ignite)	UL 746A	0	0	0	0	0	0
High Voltage Arc Tracking - PLC (in / min)	UL 746A	0	0	0	0	0	0
Hot Wire Ignition - PLC (seconds)	UL 746A	4	4	4	4	4	4
Comparative Tracking Index - PLC	ASTM D-3638	0	0	0	0	0	0
TYPICAL MECHANICAL PROPERTIES VALUES							
Tensile Yield - psi	ASTM D-882 / ISO 527-1,-2						
Machine Direction		3,700	4,400	4,400	4,000	4,000	4,000
Transverse Direction		3,000	3,200	3,200	3,200	3,700	3,700
TYPICAL PHYSICAL PROPERTIES VALUES							
Density - gm/cc	ASTM D-792 / ISO 1183-1, Method A	1.035	1.035	1.035	1.035	1.035	1.035
Oxygen Index - %	ASTM D-2863 / ISO 4589--1,-2	29	29	29	29	29	29
Water Absorption - % Change in weight	ASTM D-570 / ISO 62, Method 4	0.06%	0.06%	0.06%	0.06%	0.06%	0.06%
Heat Deflection Temperature under load	ASTM D-648 0.45MPa / ISO 75-1,-2,Method B	121°C / 250°F	121°C / 250°F	121°C / 250°F	121°C / 250°F	121°C / 250°F	121°C / 250°F
Surface Energy - dynes / cm (as produced)	ASTM D-2578	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50	≥ 50
TYPICAL ELECTRICAL PROPERTIES VALUES							
Comparative Tracking Index - volts	IEC 60112	600	600	600	600	600	600
Dielectric Breakdown - volts	ASTM D-149 / IEC 60243-1	11,000	16,264	20,292	29,610	33,380	41,558
Dielectric Strength - volts / mil	ASTM D-149 / IEC 60243-1	2,200	1,626	1,194	987	834	670
Volume Resistivity - ohm-cm	ASTM D-257 / IEC 62631-3-1	3.97×10^{15}	3.97×10^{15}	3.97×10^{15}	3.97×10^{15}	3.97×10^{15}	3.97×10^{15}
Dielectric Constant	ASTM D-150 / IEC 60250, 1MHz	1.90	1.90	1.90	1.90	1.90	1.90
Dissipation Factor	ASTM D-150 / IEC 60250, 1MHz	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023
PACKAGING INFORMATION							
Standard Configuration		Roll	Roll	Roll	Roll & Sheet	Sheet	Sheet
Core ID - inches (millimeters)		6 (152)	6 (152)	6 (152)	6 (152)	-	-
Roll OD - inches (millimeters) (approximate)		11 (289)	18 (457)	18 (457)	18 (457)	-	-
Roll Width - inches (millimeters)		24 (610)	24 (610)	24 (610)	24 (610)	-	-
Roll Weight - lbs (kgs) (approximate)		57 (26)	198 (90)	178 (81)	192 (87)	-	-
Length/Roll - feet (meters)		1,000 (304.8)	2,000 (609.6)	1,000 (304.8)	600 (182.9)	-	-
Area/Roll - square feet (square meters)		2,000 (185.8)	4,000 (371.6)	2,000 (185.8)	1,200 (111.5)	-	-
Area/Roll - square feet (square meters)		-	-	-	24 x 48 (610 x 1,219)	24 x 48 (610 x 1,219)	24 x 48 (610 x 1,219)

Notice: The above data is believed to be accurate and reliable. ITW assumes no responsibility for end-use application, and no performance warranty is expressed or implied.
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E121855

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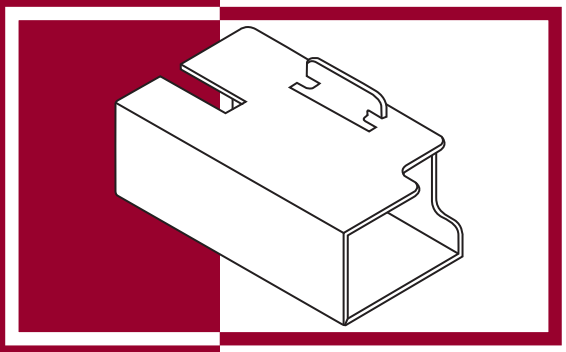
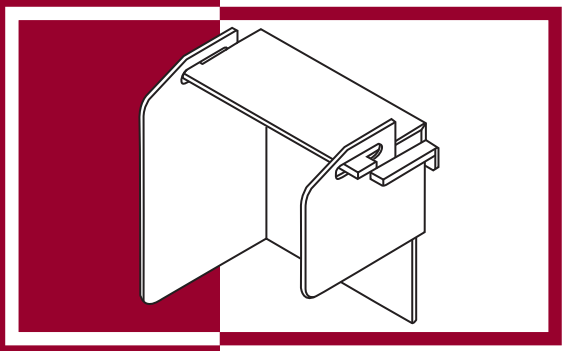
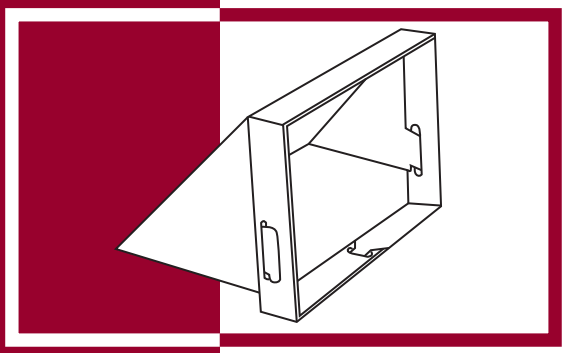
ITW Formex®



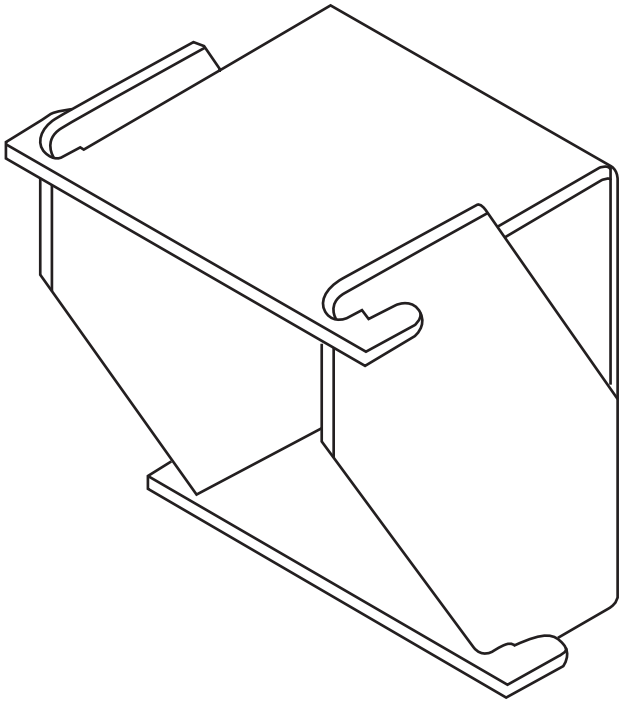




FORMEX™ GK

FLAME RETARDANT

POLYPROPYLENE SHEET



- Flammability Rating UL 94 VTM-0
- H20 Absorption 0.06%
- Temperature Rating 115°C / 239°F
- Dielectric Strength 2,200 Volts / mil @0.005"
- UL Recognized File E121855

For more information or Formex GK samples, please contact us at 630-315-2171.

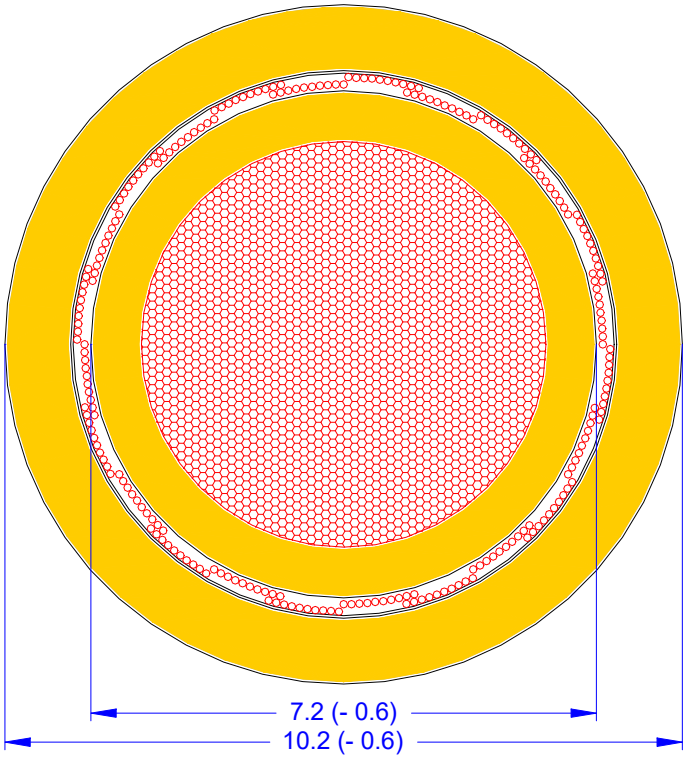
425 N. Gary Ave. Carol Stream, IL 60188 www.itwformex.com

Automotive Leitung geschirmt für elektrische Fahrzeugantriebe

FHLR2GCB2G
16 mm² / 0,21 T180 0,6/1,0 kV

Shielded cable for automotive electric powertrain

FHLR2GCB2G
16 mm² / 0.21 T180 0.6/1.0 kV



Aufbauvorschrift	LV 216-2 Tabelle A.2 Daimler AG C51 / 10.14 VW N 107 755	***Specification***	*LV 216-2 table A.2* *Daimler AG C51 / 10.14* *VW N 107 755*
Ader 16 mm²		***Core 16 mm²***	
Leiterwerkstoff:	E-Cu ETP1 nach DIN EN 13602	*Conductor material:*	*E-Cu ETP1 according* *DIN EN 13602*
Leiteraufbau:	Litze Cu.-blank 512 (±5 %) x max. 0,21 mm	*Conductor design:*	*stranded bare copper* *512 (±5 %) x max. 0.21 mm*
Leiterdurchmesser:	max. 5,8 mm [1)]	*Conductor diameter:*	*max. 5.8 mm [1)]*
Isolationswerkstoff:	mod. Siliconkautschuk SiR	*Core insulation:*	*mod. Silicon rubber SiR*
Aderdurchmesser:	7,2 mm (- 0,6)	*Core diameter:*	*7.2 mm (- 0.6)*
Isolationswanddicke:	min. 0,52 mm	*Insulation wall thickness:*	*min. 0.52 mm*
Aderfarbe:	orange ähnlich RAL 2003	*Colour code:*	*orange similar RAL 2003*
Abschirmung		***Shielding***	
Abschirmgeflecht:	Cu.-verzinnt max. 0,16 mm optische Bedeckung min. 85 %	*Screening braid:*	*Tinned copper max. 0.16mm* *optical covering min. 85 %*
Schirmfolie:	ALU-kaschierte PET-Folie Metallseite innen Überlappung min. 20 %	*Foiled shielding:*	*ALU-PET foil* *Metal side in contact to screen* *overlap min. 20 %*
Außenmantel		***Outer sheath***	
Mantelwerkstoff:	mod. Siliconkautschuk SiR	*Sheath material:*	*mod. Silicon rubber SiR*
Außendurchmesser:	10,2 mm (- 0,6)	*Outer diameter:*	*10.2 mm (- 0.6)*
Isolationswanddicke:	min. 0,7 mm	*Insulation wall thickness:*	*min. 0.7 mm*
Mantelfarbe:	orange ähnlich RAL 2003	*Colour code:*	*orange similar RAL 2003*

Coroplast Fritz Müller GmbH & Co. KG
Wittener Straße 271
42279 Wuppertal, Germany

T +49 202 2681 0
www.coroflex-cable.com
info@coroflex-cable.com

Herstellerkennung
Mantelaufdruck:

Marking
Outer sheath is printed:

COROFLEX [nnn] 9-2611 FHLR2GCB2G 16 mm²/T180 ϟ ATTENTION HIGH VOLTAGE MAX 600 V AC / 1000 V DC ϟ [xx…xx]

[nnn]:	Codierung Produktionsstandort	*[nnn]:*	*Code of production plant*
[xx…xx]:	Interne Codierung	*[xx…xx]:*	*Internal Code*
Druckabstand:	max. 200 mm	*Distance of marking:*	*max. 200 mm*

Elektrische Eigenschaften			***Electrical properties***		
Leiterwiderstand: *(DC, 20°C)*	max. 1,16 mΩ/m max. 7,6 mΩ/m	Leiter Abschirmung	*Conductor resistance:* *(DC, 20°C))*	*max. 1.16 mΩ/m* *max. 7.6 mΩ/m*	*Conductor* *Shielding*
Prüfspannung:	eff. 8,0 kVolt eff. 5,0 kVolt	Sparktester 5 Minuten	*Test voltage:*	*eff. 8.0 kVolt* *eff. 5.0 kVolt*	*spark test* *5 minutes*
Nennspannung: *(AC / DC)*	max. 600 / 1000 Volt		*Nominal voltage:* *(AC / DC)*	*max. 600 / 1000 Volt*	
Kapazitätsbelag: *Induktivitätsbelag:* *Wellenwiderstand:*	nom. 605 pF/m nom. 110 nH/m nom. 10 Ohm	Ader-Schirm	*Capacitance:* *Inductance:* *Impedance:*	*nom. 605 pF/m* *nom. 110 nH/m* *nom. 10 Ohm*	*core-screen*

Mechanische Eigenschaften		***Mechanical properties***	
Biegeradius:		*Bend radius:*	
- min. 3 x Außen-∅:	statische Verlegung	*- min. 3 x cable-∅*	*static installation*
- min. 6 x Außen-∅:	dynamische Verlegung	*- min. 6 x cable-∅:*	*dynamic installation*
Leitungsgewicht:	ca. 221 g/m	*Weight of cable:*	*approx. 221 g/m*

Thermische Eigenschaften			***Thermal properties***		
Temperaturbereich:	-40 °C bis +180 °C	3.000 h	*Operating temperature:*	*-40 °C to +180 °C*	*3000 h*
Kurzzeitalterung:	bis +205 °C	240 h	*Short term ageing*	*up to +205 °C*	*240 h*

[1] *max. conductor diameter: average value of the measured largest and smallest conductor diameter under the core insulation*

Änderungsindex *Version*	Erstellt *Creator*	Ausgabedatum *Date of Issue*	Beschreibung *Description*
A 9	Wichmann	2012-12-08	Nomenklatur, Aufdruck und Nennspannung modifiziert *cable-nomenclature, marking and nominal voltage modified*
A 10	Eck	2016-01-19	Nomenklatur, Aufdruck und Nennspannung modifiziert; Widerstand Abschirmung war nom. / *cable-nomenclature, marking and nominal voltage modified, Resistance shielding was nom.*
A 11	Wichmann	2016-08-30	Update Format Deratingkurven / *update format of derating curves*
A 12	Eck	2017-02-17	Biegeradius modifiziert; Bending radius *modified*
A 13	Blome	2020-04-01	Brand Coroplast zu Coroflex / *Brand Coroplast to Coroflex*

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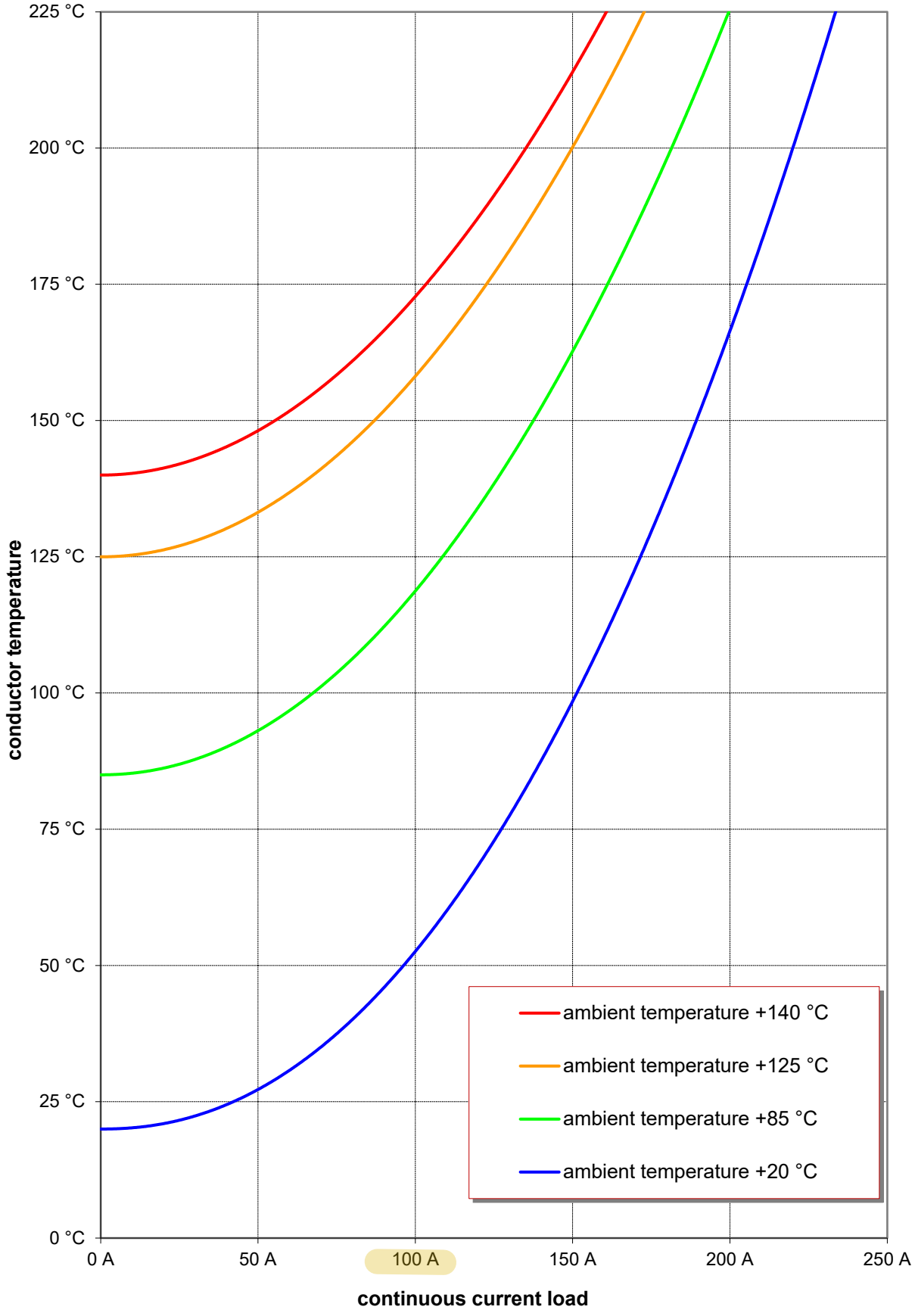
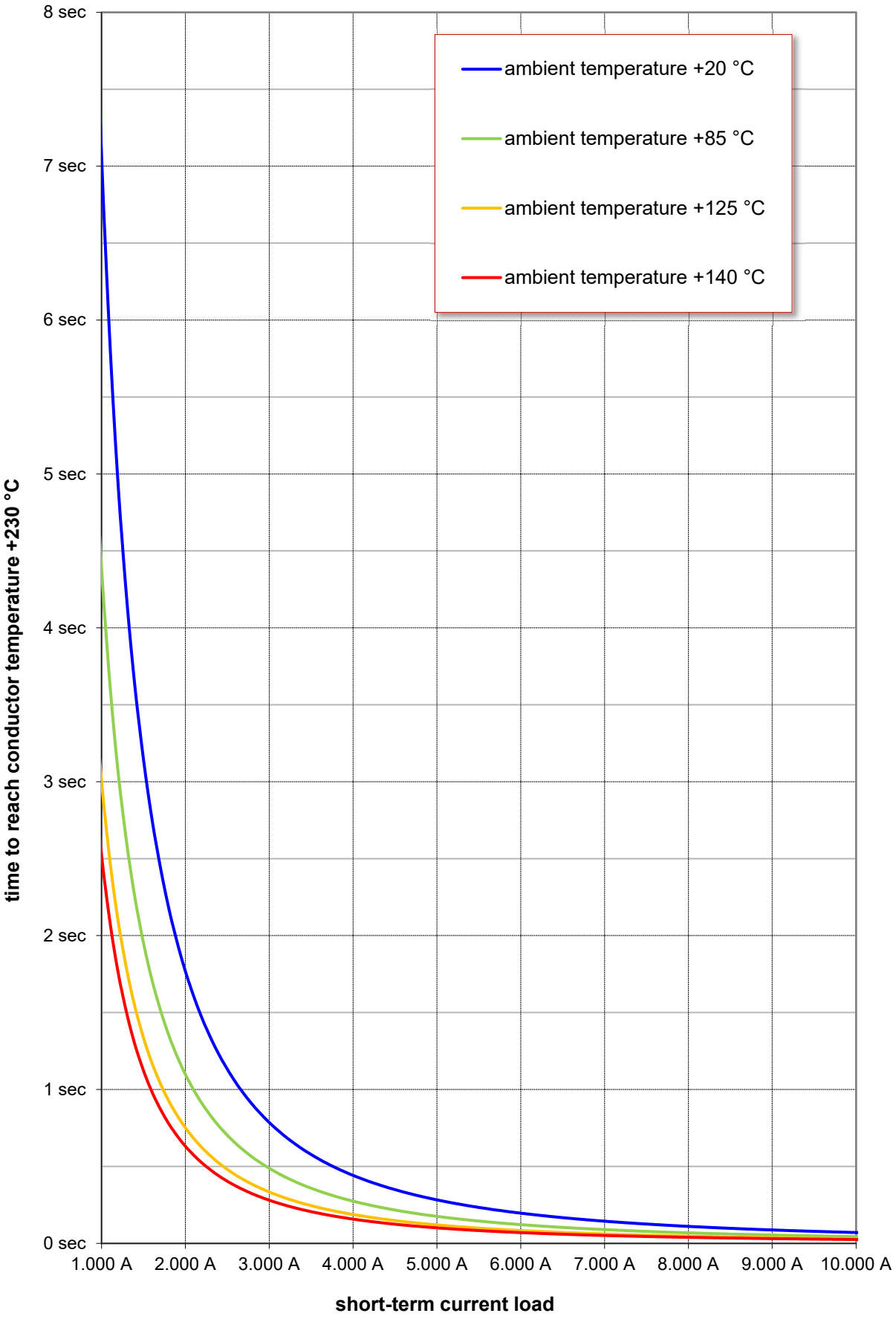
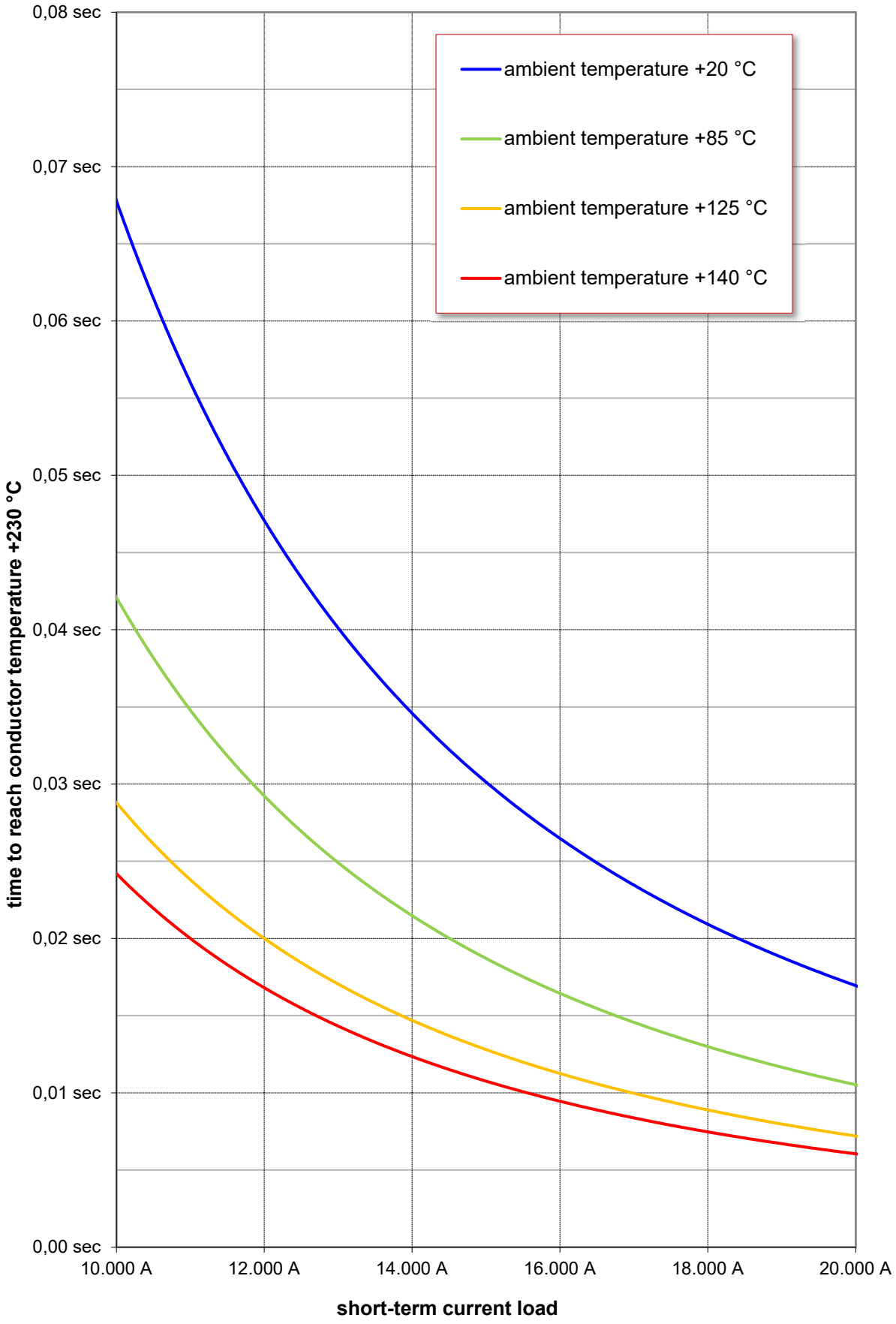
Annex: Continuous current loading on conductor as a function of ambient temperature calculated simulation according to LV112-3



Annex: Short-term current loading on conductor as a function of ambient temperature calculated simulation according to LV112-3



Annex: Short-term current loading on conductor as a function of ambient temperature calculated simulation according to LV112-3



DELTA ELEKTRONIKA B.V.
DC POWER SUPPLIES

Vissersdijk 4, 4301 ND
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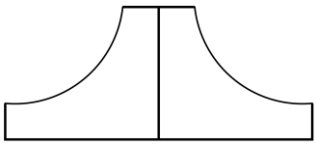
SM15K - Series 15kW DC POWER SUPPLIES

Bi-Directional - Constant Power

Models	Voltage range	Current range
SM 70-CP-450	0 - 70 V	– 450 - 450 A
SM 210-CP-150	0 - 210 V	– 150 - 150 A
SM 500-CP-90	0 - 500 V	– 90 - 90 A
SM 1500-CP-30	0 - 1500 V	– 30 - 30 A



Features

- Bi-Directional power supply, standard 15kW Source & Sink
- Flexible output with constant power characteristic
- Power Regeneration Technology: sink power is not dissipated but fed back into the grid
- Designed for long life at continuous full power
- Excellent dynamic response to load changes, digital controlled with the possibility to adapt to the type of load
- Very low heat dissipation, efficiency 95% or more
- Protected against all overload and short circuit conditions

Functionalities

- Operation on a wide range of three phase AC input voltages
- Standard Ethernet & Web interface
- EMC surpasses CE requirements: low emission & high immunity
- Low audible noise: temperature controlled cooling fans
- Durable digital encoders for voltage & current adjustment and menu operation
- Large user display, menu driven operations

	SM 70-CP-450	SM 210-CP-150	SM 500-CP-90	SM 1500-CP-30
DC Power terminals				
voltage range	0 - 70 V	0 - 210 V	0 - 500 V	0 - 1500 V
current range	– 450 - 450 A	– 150 - 150 A	– 90 - 90 A	– 30 - 30 A
Absolute maximum Sink voltage ***Warning!*** *Higher voltages will damage the unit!*	≤ 74 V	≤ 220 V	≤ 525 V	≤ 1575 V
Minimum Sink Voltage @ var. sink current: *Note that unit switches automatically between Source <-> Sink.*	1.2 V @ – 450 A 0.8 V @ – 215 A 0.8 V @ – 45 A	3.0 V @ – 150 A 1.5 V @ – 75 A 1.5 V @ – 15 A	5.5 V @ – 90 A 3.0 V @ – 30 A 1.0 V @ – 10 A	16.0 V @ – 30 A 7.0 V @ – 10 A 2.0 V @ – 3 A
AC Input				
3 phase, 48 - 62 Hz	342 - 528 V			
rated voltage range	380 - 480 V			
rated frequency	50 / 60 Hz			
rated current	maximum 27 A			
current (400 V / 3 ph, 15kW)	23 A			
power factor, 15kW, 7.5kW	0.996 / 0.988			
internal fuses	30 AT			
standby input power (V_o=I_o=0)	96 W			
standby input power (V_o=V_{max})	180 W			
Efficiency *(Sink & Source mode):*				
400 V AC, 3 ph input,				
15 kW, I_{out}=100%	95 %			
15 kW, U_{out}=100%	96 %			
Regulation				
Load 0 - 100% **CV**	6 mV	5 mV	4 mV	10 mV
Line 342 - 528 V AC **CV** (external voltage sense)	< 1 mV	< 1 mV	< 1 mV	< 1 mV
Load 0 - 100% **CC**	35 mA	12 mA	8 mA	2 mA
Line 342 - 528 V AC **CC** (internal voltage sense, after warm up)	4 mA	3 mA	1 mA	1 mA
Ripple + noise *(CC-ripple at full load)*				
Source mode:	33 V / 450 A	100 V / 150 A	167 V / 90 A	500 V / 30 A
rms (BW=300 kHz) **CV**	10 mV	30 mV	10 mV	25 mV
p-p (BW=20 MHz) **CV**	60 mV	150 mV	55 mV	150 mV
rms (BW=300 kHz) **CC**	100 mA	t.b.d.	45 mA	12 mA
p-p (BW=20 MHz) **CC**	-	-	200 mA	70 mA
Source mode:	70 V / 215 A	210 V / 71.5 A	500 V / 30 A	1500 V / 10 A
rms (BW=300 kHz) **CV**	10 mV	20 mV	25mV	35mV
p-p (BW=20 MHz) **CV**	60 mV	125 mV	115mV	250mV
rms (BW=300 kHz) **CC**	100 mA	t.b.d.	45 mA	5 mA
p-p (BW=20 MHz) **CC**	-	-	200 mA	25 mA
Sink mode:	33 V / 450 A	100 V / 150 A	167 V / 90 A	500 V / 30 A
rms (BW=300 kHz) **CV**	8 mV	30 mV	7 mV	15 mV
p-p (BW=20 MHz) **CV**	50 mV	150 mV	35 mV	130 mV
rms (BW=300 kHz) **CC**	100 mA	t.b.d.	45 mA	10 mA
p-p (BW=20 MHz) **CC**	-	-	200 mA	60 mA
Sink mode:	70 V / 215 A	210 V / 71.5 A	500 V / 30 A	1500 V / 10 A
rms (BW=300 kHz) **CV**	8 mV	20 mV	10 mV	25 mV
p-p (BW=20 MHz) **CV**	50 mV	125 mV	50 mV	200 mV
rms (BW=300 kHz) **CC**	100 mA	t.b.d.	90 mA	3 mA
p-p (BW=20 MHz) **CC**	-	-	320 mA	12 mA
Programming & monitoring accuracy *(excluding INT MOD ANA)*				
Voltage	± 0.08%			
Current	± 0.15%			
Temp. coeff., per °C **CV**	20.10^{-6}			
CC	50.10^{-6}			
Stability [1]				
after 1 hr warm-up, during 8 hrs **CV**	50.10^{-6}			
CC	80.10^{-6}			
t_{amb} = 25 ± 1 °C, V_{in} = 400 VAC (internal voltage sensing for CC-stab.)				

Notes: 1. Measured at full load. 2. Signal latency depends on the interface used & data traffic. 3. See "Safety Instructions"

Programming speed [2] *Note: Values on **resistive load**, unit in **CV-mode**.* *With other load, or in CC-mode, values can be longer.*	**SM 70-CP-450**	**SM 210-CP-150**	**SM 500-CP-90**	**SM 1500-CP-30**
Rise time (10 - 90%)				
output voltage step	0 → 33 V	0 → 100 V	0 → 167 V	0 → 500 V
time, (load = 15 kW)	2.2 ms	1.6 ms	1.5 ms	1.5 ms
time, (load = 1500 W)	1.5 ms	1.3 ms	1 ms	1 ms
output voltage step	0 → 70 V	0 → 210 V	0 → 500 V	0 → 1500 V
time, (load = 15 kW)	5.5 ms	3 ms	4.5 ms	4.5 ms
time, (load = 1500 W)	3.5 ms	2.7 ms	3.5 ms	3.5 ms
Fall time (90 - 10%)				
output voltage step	33 → 0 V	100 → 0 V	167 → 0 V	500 → 0 V
time, (load = 15 kW)	1.5 ms	1.3 ms	0.8 ms	0.8 ms
time, (load = 1500 W)	1.5 ms	1.3 ms	0.9 ms	0.9 ms
output voltage step	70 → 0 V	210 → 0 V	500 → 0 V	1500 → 0 V
time, (load = 15 kW)	2.6 ms	2.5 ms	2.5 ms	2.8 ms
time, (load = 1500 W)	3.5 ms	2.5 ms	3.5 ms	3.5 ms
DC Output Capacitance				
X-capacitors (typical)	22000 µF	1170 µF	560 µF	58 µF
Y-capacitors (typical)	950 nF	950 nF	145 nF	145 nF

	SM 70-CP-450	**SM 210-CP-150**	**SM 500-CP-90**	**SM 1500-CP-30**
Recovery time output voltage	33 V, 225 → 450 A	100 V, 75 → 150 A	167 V, 45 → 90 A	500 V, 15 → 30 A
recovery within	100 mV	500 mV	750 mV	2.8 V
di/dt of load step	5 A/µs	2.4 A/µs	0.8 A/µs	0.25 A/µs
time, @ 50 - 100% load step	100 µs	100 µs	100 µs	100 µs
max. deviation	0.8 V	1.4 V	2.8 V	9.0 V
output voltage	70 V, 112 → 215 A	210V, 36 → 72 A	500 V, 15 → 30 A	1500 V, 5 → 10 A
recovery within	100 mV	250 mV	500 mV	1.2 V
di/dt of load step	2 A/µs	1.15 A/µs	0.25 A/µs	0.085 A/µs
time, @ 50 - 100% load step	100 µs	100 µs	150 µs	150 µs
max. deviation	0.3 V	0.75 V	1.2 V	3.5 V
*Note: Values are with **Local Sensing**.* *With Remote Sensing + long cables, values can be different.*				
Pulsating load				
max. tolerable AC component of load current				
f > 1 kHz	60 Arms	15 Arms	15 Arms	5 Arms
f < 1 kHz	450 Apeak	150 Apeak	90 Apeak	30 Apeak

Insulation		
AC power terminals / DC pwr terminals	3750 Vrms (1 min.)	3750 Vrms (1 min.)
creepage / clearance	8 mm	8 mm
AC power terminals / case	2500 Vrms	2500 Vrms
DC power terminals / case	1000 V DC [3]	1500 V DC [3]
Safety	EN 60950 / EN 61010	
EMC Generic Emission	**EN 61000-6-3,** residential, **light** industrial environment (EN 55022 **B**)	
Generic Immunity	**EN 61000-6-2,** industrial environment	
Operating Temperature at full load	– 20 to + 50 °C derate output to 75% at 60 °C	
Humidity	maximum 95% RH, non condensing, up to 40 °C maximum 75% RH, non condensing, up to 50 °C	
Storage temperature	– 40 to + 85 °C	
Thermal protection	output shuts down in case of insufficient cooling	
MTBF	500 000 hrs	

	SM 70-CP-450	**SM 210-CP-150**	**SM 500-CP-90**	**SM 1500-CP-30**
Hold-Up time (@ 400 VAC input)				
V_{out} = 100%, P_{out} = 15 kW	10 ms	10 ms	15 ms	15 ms
I_{out} = 100%, P_{out} = 15 kW	10 ms	10 ms	15 ms	15 ms
V_{out} = 100%, P_{out} = 7.5 kW	25 ms	20 ms	35 ms	35 ms
Turn on delay after mains switch on	2.5 s			
Inrush current	23 A			

Notes: 1. Measured at full load. 2. Signal latency depends on the interface used & data traffic. 3. See "Safety Instructions"

	SM 70-CP-450	SM 210-CP-150	SM 500-CP-90	SM 1500-CP-30
Series operation max. total voltage Master / Slave operation	Not possible	Not possible	750V* 1000V** maximum 6 units [3] **) units delivered before Q4 / 2018* ***) units delivered Q4 / 2018 or newer* *Contact factory for upgrading to enable 1000V series operation for older units.*	Not possible
Parallel operation Master / Slave operation	maximum 60 units			
Remote sensing max. voltage drop per load lead	default 1 V, can be set to 10 V			
Limits **Voltage** adjust range **Current** adjust range **Power** adjust range **Voltage** OverLoad level **Voltage** Self-Protection level	0 - 101 % 0 - 101 % 0 - 101 % 102.5 % - unit will continue to operate (OL-indication in display) 105 % - output is automatically disabled (PROT-indication in display)			
Potentiometers front panel control with knobs resolution	15 bits			
Meters scale voltage scale current scale power accuracy read output	4 digit 0.00 - 70.00 V – 450.0 - 450.0 A – 15000 - 15000 W 0.2% + 2 digit	4 digit 0.0 - 210.0 V – 150.0 - 150.0 A – 15000 - 15000 W 0.2% + 2 digit	4 digit 0.0 - 500.0 V – 90.0 - 90.0 A – 15000 - 15000 W 0.2% + 2 digit	4 digit 0 - 1500 V – 30.00 - 30.00 A – 15000 - 15000 W 0.2% + 2 digit

Mounting	stacking of units allowed, air flow is from left to right	
AC Terminals (CON A)	screw terminals for wire 4 mm^2, 3 phase + earth (no neutral)	
DC Terminals (CON B1 & B2)	M12 bolts	M8 bolts
Programming connectors (LAN)	standard with RJ45-connector for Ethernet at rear panel	
Interlock (CON F)	input for contact at rear panel	
Cooling audio noise level air flow	low noise blower, fan speed adapts to temperature of internal system ca. 50 dBA at full load, 25 °C ambient temperature, 1 m distance ca. 65 dBA at full load, 50 °C ambient temperature, 1 m distance From left to right	
Enclosure degree of protection	IP20	
Dimensions front panel: h x w behind front panel: h x w x d	132 x 483 mm (19", 3 U) 128 x 448 x 591 mm (excluding feet) no extra depth is required with optional interfaces assembled	
Weight	27 kg	

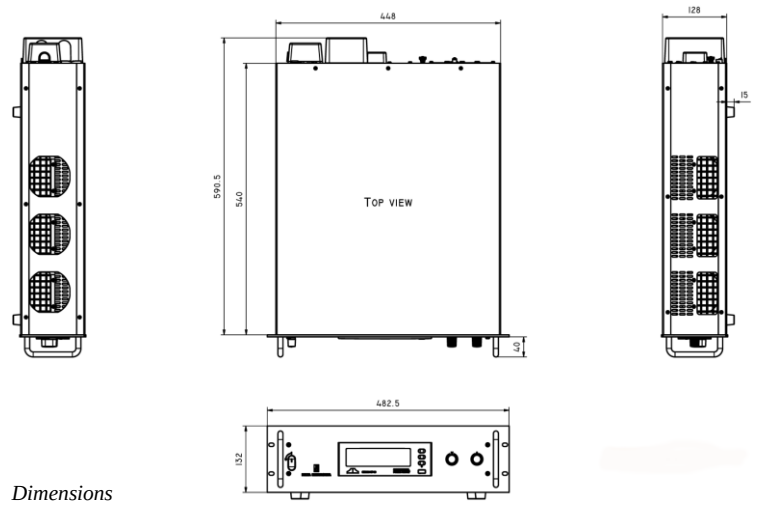
CV = Constant Voltage
CC = Constant Current
CP = Constant Power

Specifications measured at t_{amb} = 25 ± 5 °C and Vin = 400 VAC, 50 Hz unless otherwise noted.

The information in this document is subject to change without notice.

Notes:

1. *Measured at full load.*
2. *Signal latency depends on the interface used and data traffic.*
3. *See safety Instructions in the operating manual.*



Dimensions

Typical Applications

- Solar inverter testing, PV-Simulation
- Car testing systems
- ATE in industrial production lines
- Plasma chambers
- Automotive battery simulations
- Controlled battery (dis)charging
- Lasers
- Sustainable energy
- Driving PWM-Controlled DC motors
- Accurate current sources
- Aerospace and military equipment

Standard Features

Bi-Directional Two-Quadrant Output

Full power Bi-Directional two quadrant operation maintains the DC output voltage constant whether the output power is positive or negative. Ideal for PWM-speed controlled DC-Motors and ATE systems.

Digital CV-, CC- and CP-Settings

Reliable, long-life digital encoders are implemented at the front panel. Includes total front panel lock (also for CV- / CC-knobs) and a coarse or fine pitch adjustment depending on the turning speed.

Sequencer

Arbitrary Waveform generator or standalone automation.

High Voltage Isolation

A high DC output isolation allows floating operation up to 1000 V for SM70-CP-450, SM210-CP-150 and SM500-CP-90, and up to 1500 V for SM1500-CP-30.

Ethernet Interface

Ethernet interface for programming and monitoring

USB-Input

Not yet available:
Front and rear panel USB-Input for exchange of settings and waveforms (Host / Type-A), or for controlling the unit (Device / Type-B).

Options

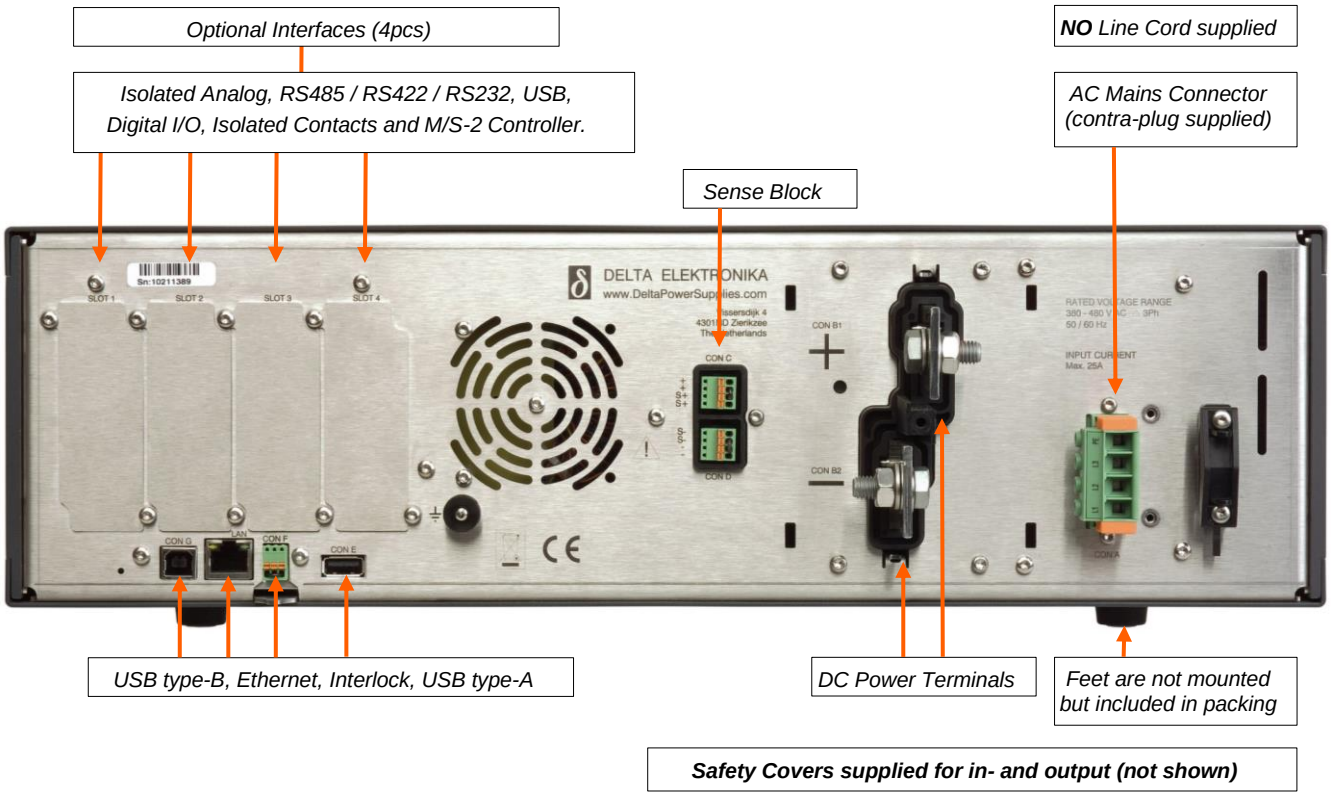
Software control and Interfaces

Field installable interfaces:

- Master / Slave controller
- Isolated Contacts
- Serial controller with multiple protocols: RS 232, RS 485, RS 422 and USB (Device)
- Digital I/O
- Isolated Analog Programming

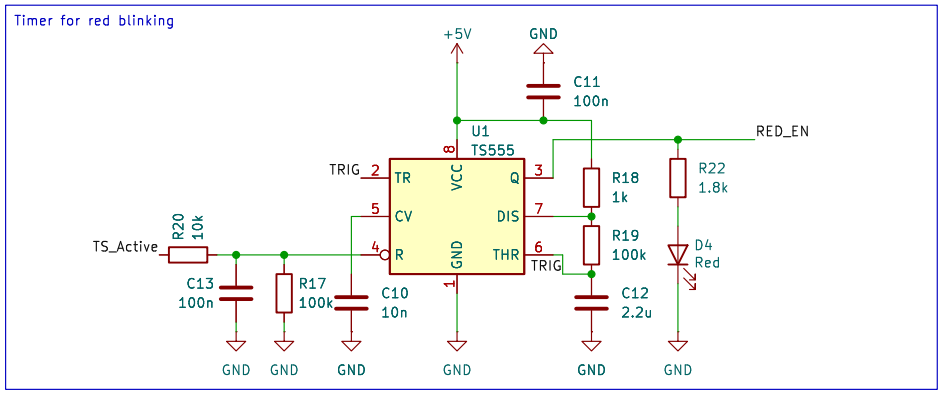
Order Codes :

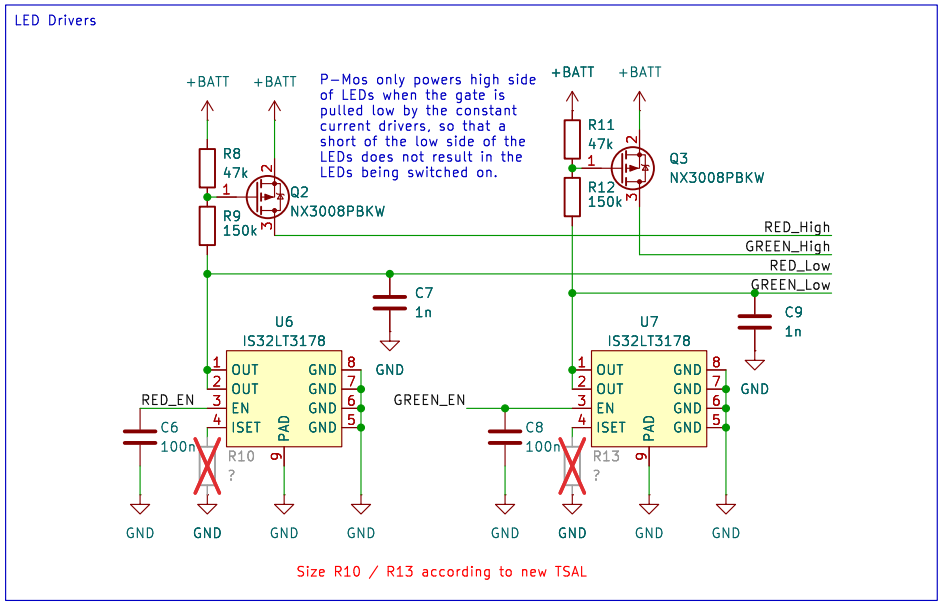
- INT MOD M/S-2
- INT MOD CON
- INT MOD SER
- INT MOD DIG
- INT MOD ANA

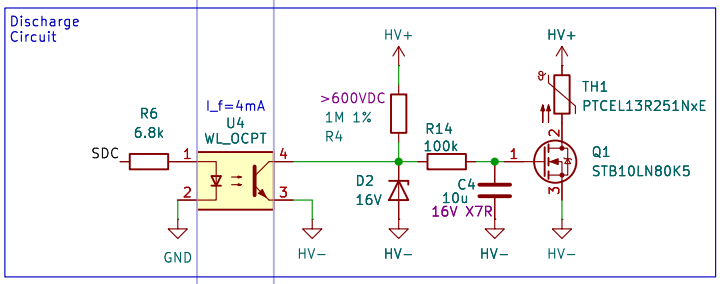

Optional Interfaces (4pcs)
Isolated Analog, RS485 / RS422 / RS232, USB, Digital I/O, Isolated Contacts and M/S-2 Controller.
NO Line Cord supplied
AC Mains Connector (contra-plug supplied)
Sense Block
DELTA ELEKTRONIKA
www.DeltaPowerSupplies.com
USB type-B, Ethernet, Interlock, USB type-A
DC Power Terminals
Feet are not mounted but included in packing
Safety Covers supplied for in- and output (not shown)

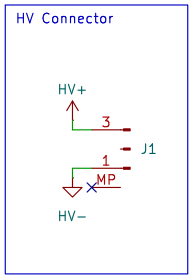
TSAL driver board and DC-link voltage detection

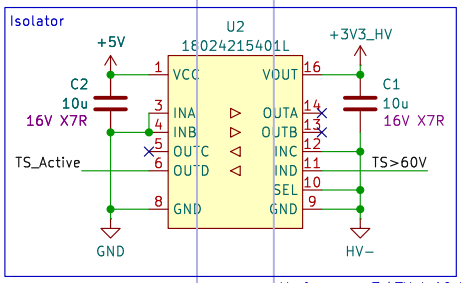
LV | TS

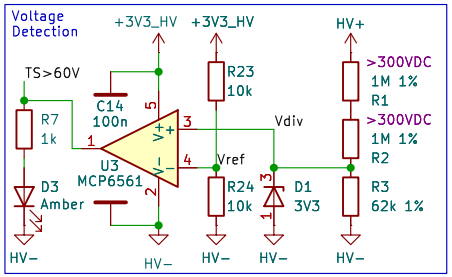




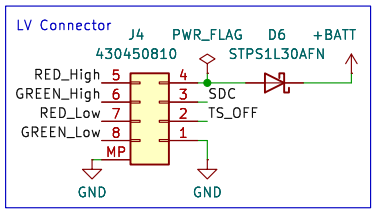


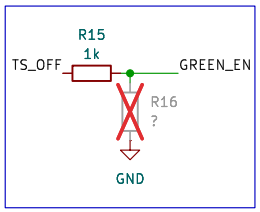


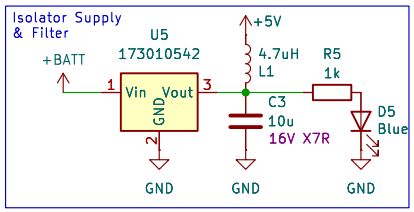




Vref_max = 3.47V * 10.1kΩ / (10.1kΩ + 9.9kΩ) = 1.76V
Vdiv@60V_min = 60V * 61.38Ω / (2*990kΩ + 61.38kΩ) = 1.8V
Vhyst_max@75deg = 6mV < 40mV (1.80V-1.76V)



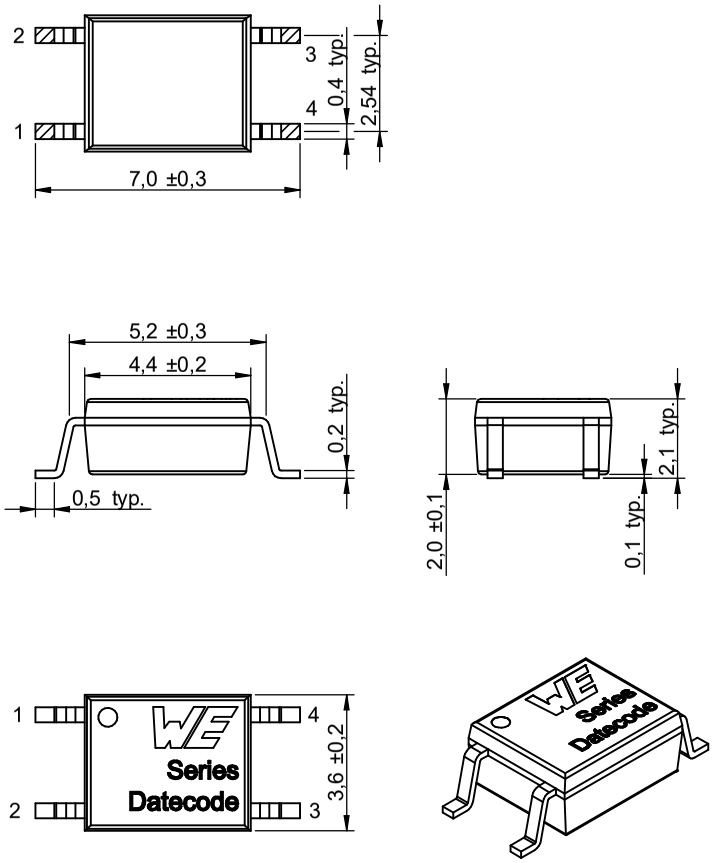




FASTTUBE

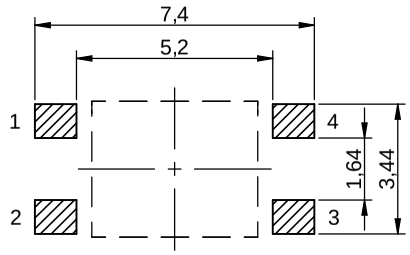
Title: Discharge Circuit	**Rev: V1**
	Date: 2024-11-10
Project: DC	Exp. Date: 2025-04-27
Author: Karlsson Winkels	Size: A4 | Page: 1/1

Dimensions: [mm]



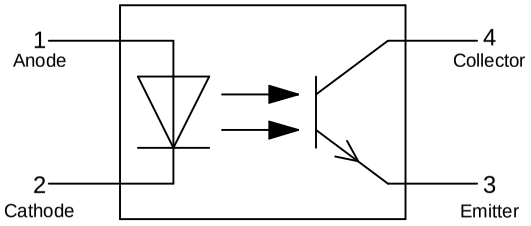
Scale - 5:1

Recommended Land Pattern: [mm]



Scale - 5:1

Schematic:



General Properties:

Type	Optocoupler Phototransistor
Input	DC
Package	SOP 4
Plastic Housing Color	White

Certification:

RoHS Approval	Compliant [2011/65/EU&2015/863]
REACh Approval	Conform or declared [(EC)1907/2006]
Halogen Free	Conform [JEDEC JS709B]
Halogen Free	Conform [IEC 61249-2-21]
VDE Approval	40051484 [DIN EN 60747-5-5 (VDE0884-5); EN 60747-5-5:2011; A1:2015]
cULus Approval	E513104 [UL 1577]
CQC Approval	CQC20001274583 [GB4943.1-2001; GB8898-2011]

General Information:

Operating Temperature	-55 up to +110 °C
Storage Conditions (for single parts)	-55 up to +125 °C
Storage Conditions (in original packaging)	< 40 °C ; < 75 % RH
Moisture Sensitivity Level (MSL)	1

Product Marking:

Pin 1 Anode	0
Marking	356B (Series 356, Binning B)
Marking - Date Code	YWW

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CHECKED	REVISION	DATE (YYYY-MM-DD)	GENERAL TOLERANCE	PROJECTION METHOD
SaVo	001.004	2023-08-22	DIN ISO 2768-1m	

DESCRIPTION
WL-OCPT Optocoupler Phototransistor

ORDER CODE
140356145200

SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	1/12

This electronic component has been designed and developed for usage in general electronic equipment only. This product is not authorized for use in equipment where a higher safety standard and reliability standard is especially required or where a failure of the product is reasonably expected to cause severe personal injury or death, unless the parties have executed an agreement specifically governing such use. Moreover Würth Elektronik eiSos GmbH & Co KG products are neither designed nor intended for use in areas such as military, aerospace, aviation, nuclear control, submarine, transportation, transportation signal, disaster prevention, medical, public information network etc.. Würth Elektronik eiSos GmbH & Co KG must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability evaluation checks for safety must be performed on every electronic component which is used in electrical circuits that require high safety and reliability functions or performance.

Absolute Maximum Ratings Input Properties (Ambient Temperature 25 °C unless otherwise specified):

Properties		Test conditions	Value	Unit
Forward Current	$I_{F\ max.}$		60	mA
Peak Forward Current	$I_{F\ Peak}$	duty/ 100 @ 100 Hz	1	A
Input Power Dissipation	P_I		100	mW
Reverse Voltage	V_{REV}		6	V

Absolute Maximum Ratings Output Properties: (Ambient Temperature 25 °C unless otherwise specified):

Properties		Value	Unit
Collector Emitter Voltage	V_{CE}	80	V
Emitter Collector Voltage	V_{EC}	7	V
Collector Current	$I_{CE.P}$	50	mA
Output Power Dissipation	P_O	150	mW

Absolute Maximum Ratings Common Properties:

Properties		Test conditions	Value	Unit
Power Dissipation [1)]	P_{Diss}		200	mW
Isolation Voltage	V_{ISO}	AC for 1 Minute, RH 40~60 %	3750	V (RMS)

[1)] Total power dissipation of the whole component

Electrical & Optical Input Properties:

Properties		Test conditions	Value		Unit
			typ.	max.	
Forward Voltage	V_F	I_F = 10 mA	1.24	1.4	V
Reverse Current	I_{REV}	V_{REV} = 6 V		10	µA
Input Capactiance	C_{in}	V = 0 V f = 1 kHz	10		pF

Electrical & Optical Output Properties:

Properties		Test conditions	Value		Unit
			min.	max.	
Collector-Emitter Dark Current	$I_{CEO.Dark}$	V_{CE} = 20 V I_F = 0		100	nA
Collector-Emitter Breakdown Voltage	$V_{(BR)CE}$	I_C = 100 µA I_F = 0	80		V
Emitter-Collector Breakdown Voltage	$V_{(BR)EC}$	I_E = 100 µA I_F = 0	7		V

Electrical & Optical Transfer Properties:

Properties		Test conditions	Value			Unit
			min.	typ.	max.	
Current Transfer Ratio	CTR	I_F = 5 mA V_{CE} = 5 V	130		260	%
Collector-Emitter Saturation Voltage	V_{CEsat}	I_F = 20 mA I_C = 1 mA		0.06	0.2	V
Rise Time	t_r	V_{CE} = 2 V I_C = 2 mA R_L = 100 Ω		3	18	µs
Fall Time	t_f	V_{CE} = 2 V I_C = 2 mA R_L = 100 Ω		4	18	µs
Cut-Off Frequency	f_c	V_{CE} = 2 V I_C = 2 mA R_L = 100 Ω -3 dB		80		kHz
Floating Capacitance	C_{IO}	V = 0 V f = 1 MHz		0.4		pF
Isolation Resistance	R_{ISO}	DC = 500 V 40~60 % R.H.	1	100		TΩ

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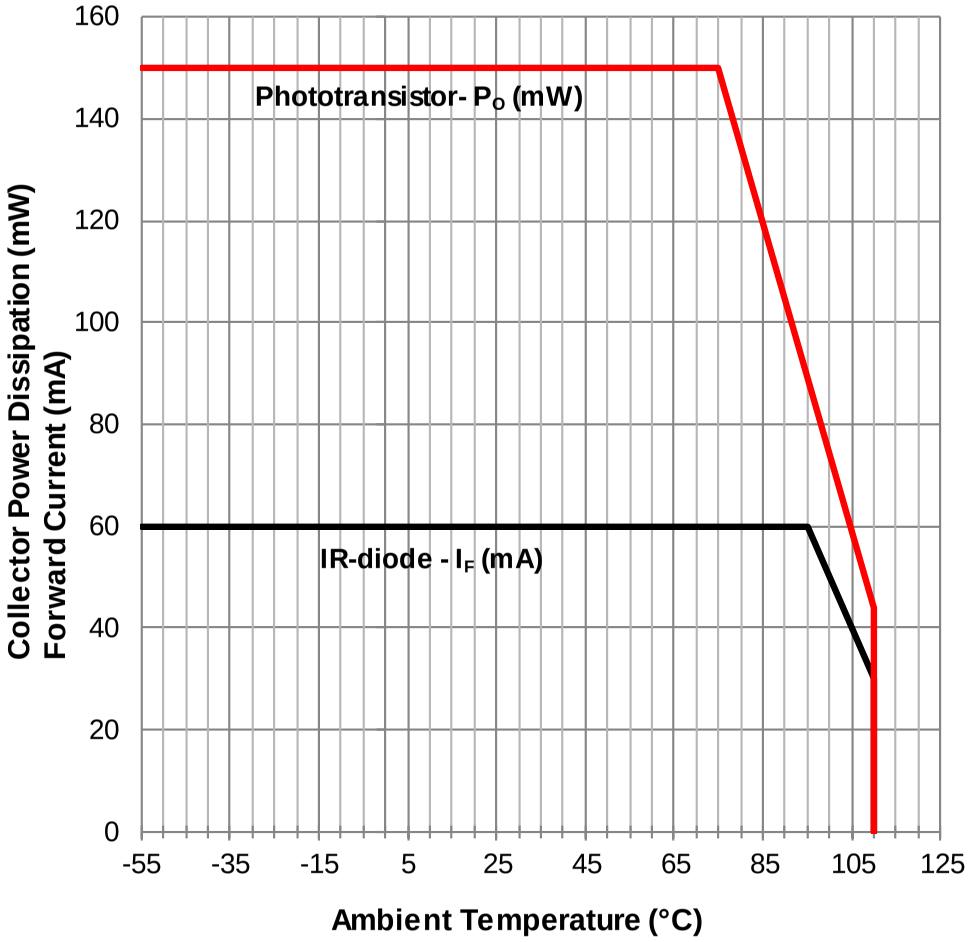
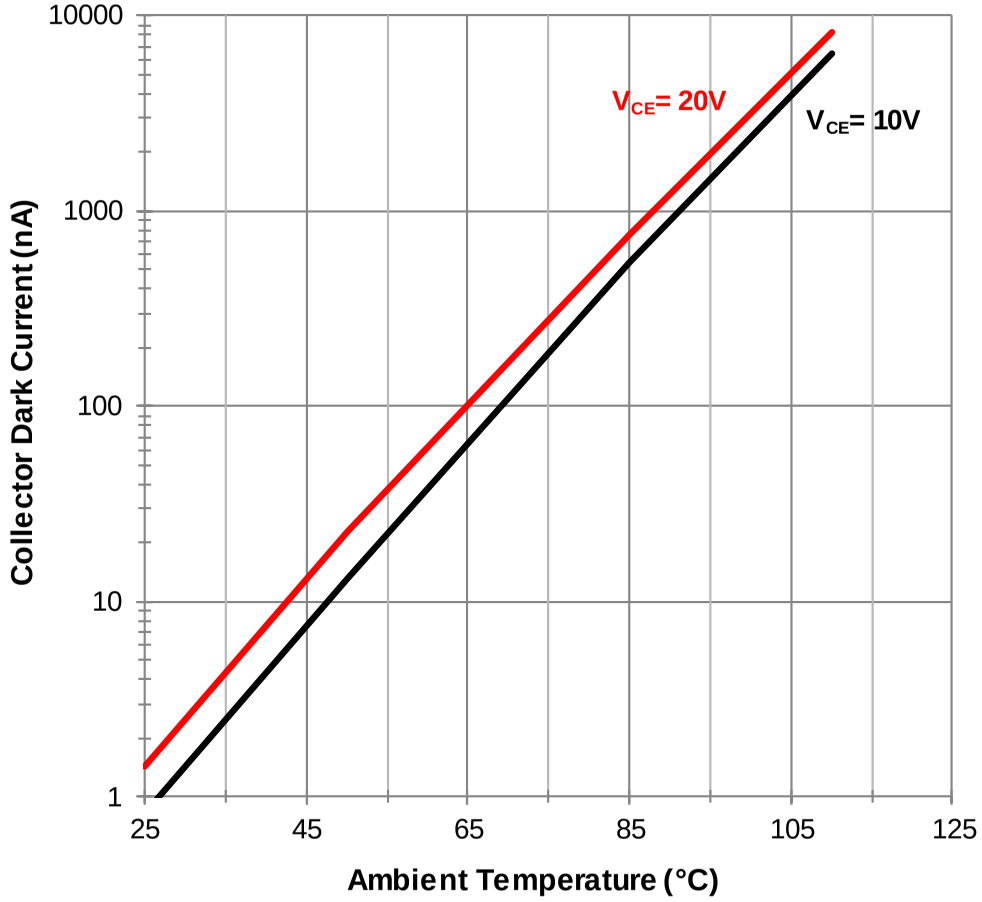
Total Power Dissipation vs. Ambient Temperature:



Collector Dark Current vs. Ambient Temperature:



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DESCRIPTION
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SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	3/12

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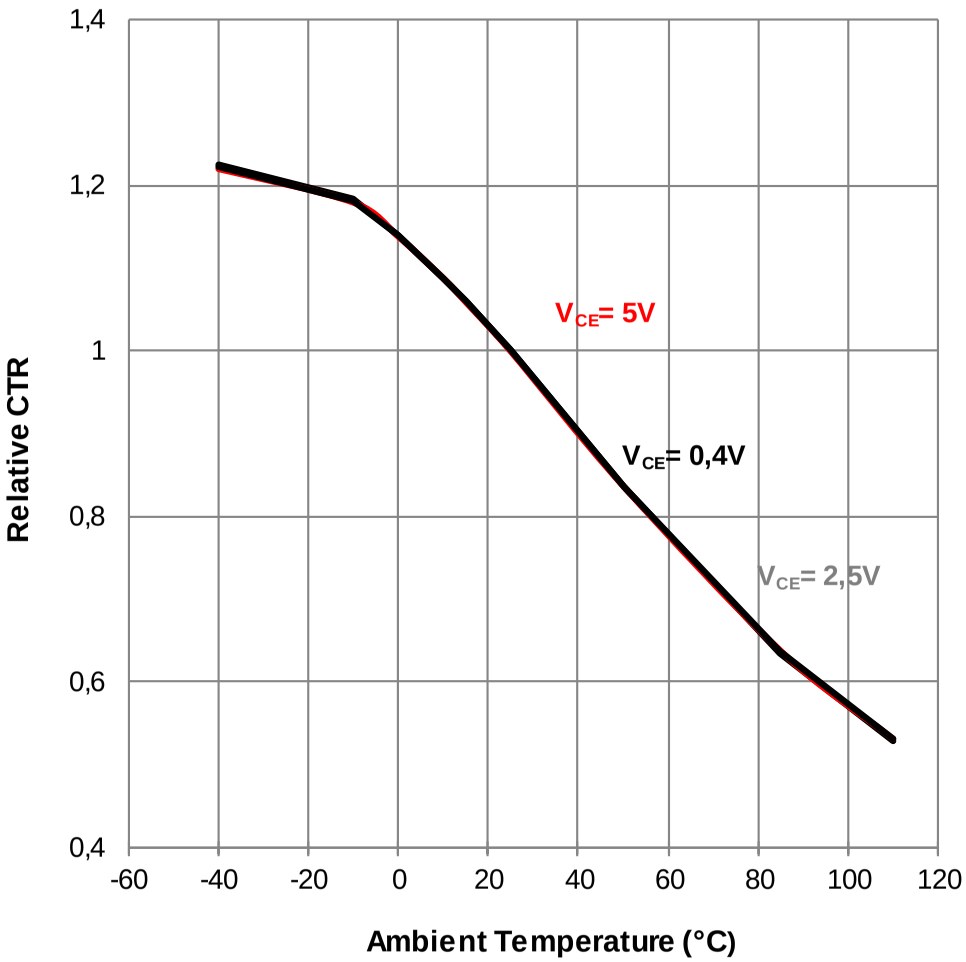
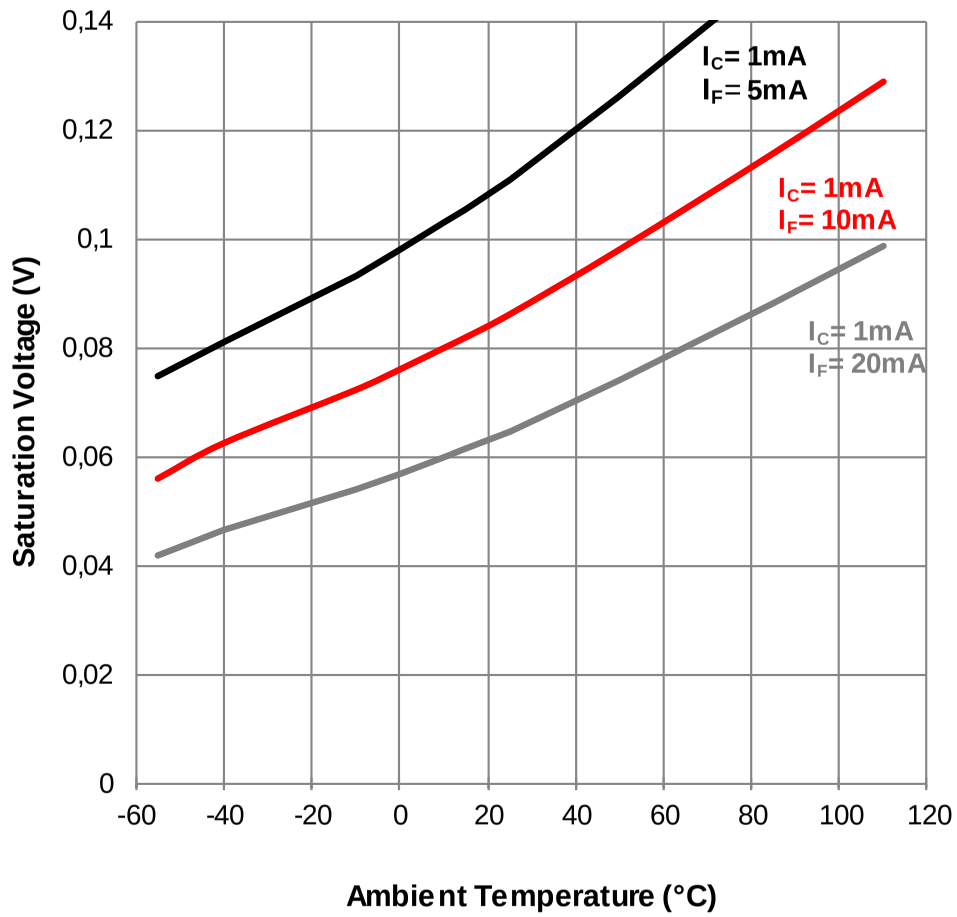
Relative CTR vs. Ambient Temperature:



Testcondition: IF= 5mA; Normalized to TA= 25°C

Collector-Emitter Saturation Voltage vs. Ambient Temperature:



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SaVo	001.004	2023-08-22	DIN ISO 2768-1m	

DESCRIPTION
WL-OCPT Optocoupler Phototransistor

ORDER CODE
140356145200

SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	4/12

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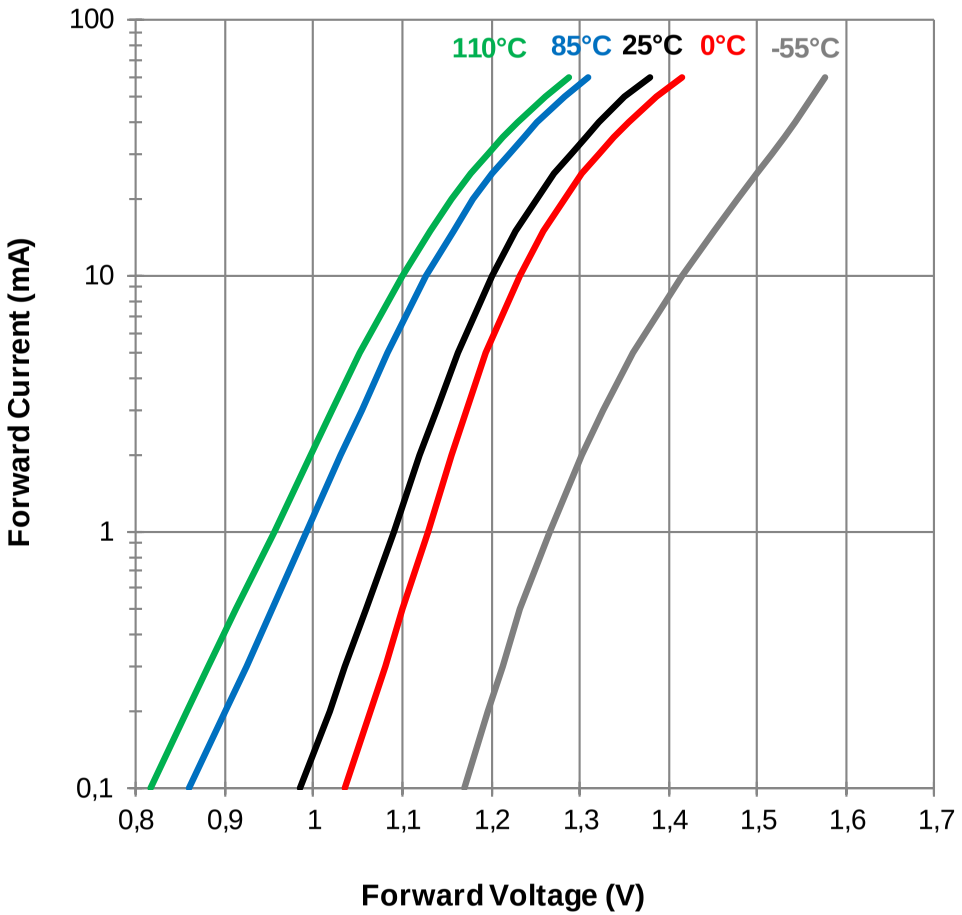
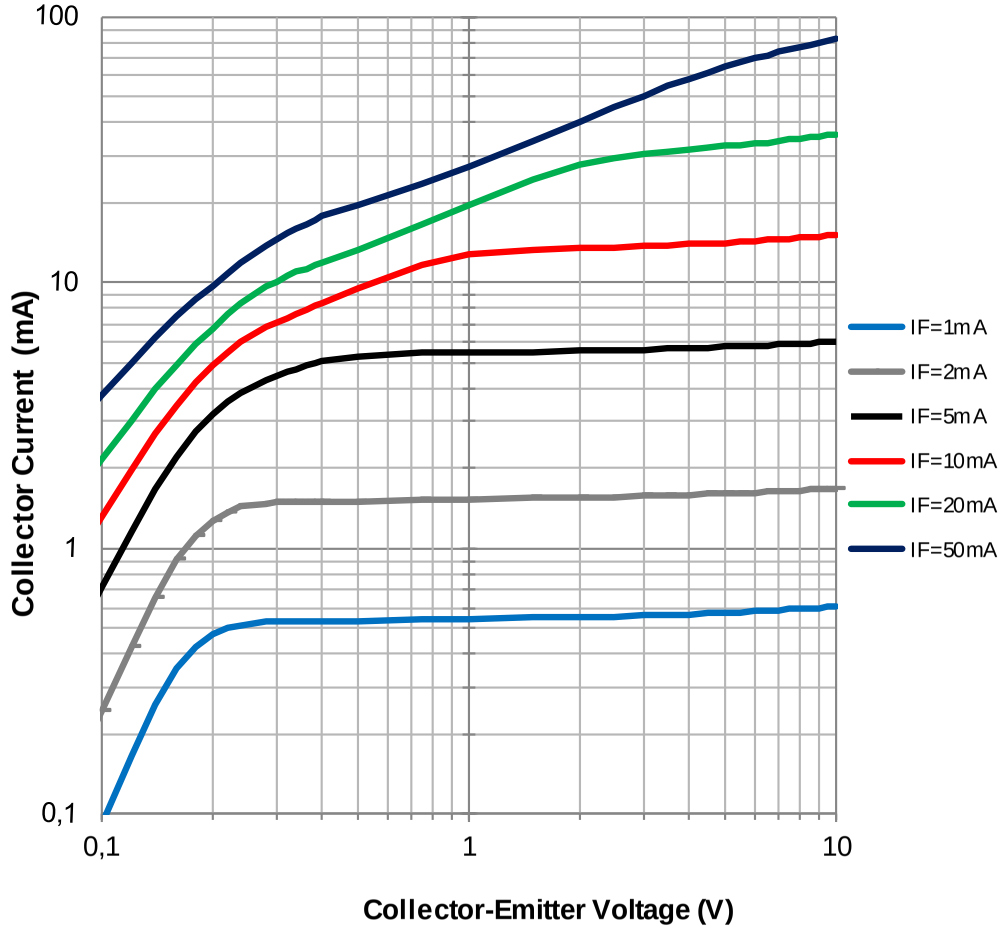
Forward Current vs. Forward Voltage:



Collector Current vs. Collector-Emitter Voltage:



Testcondition: TA= 25°C

CHECKED	REVISION	DATE (YYYY-MM-DD)	GENERAL TOLERANCE	PROJECTION METHOD
SaVo	001.004	2023-08-22	DIN ISO 2768-1m	

DESCRIPTION

WL-OCPT Optocoupler Phototransistor

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SOP4	eiPal	Valid	5/12

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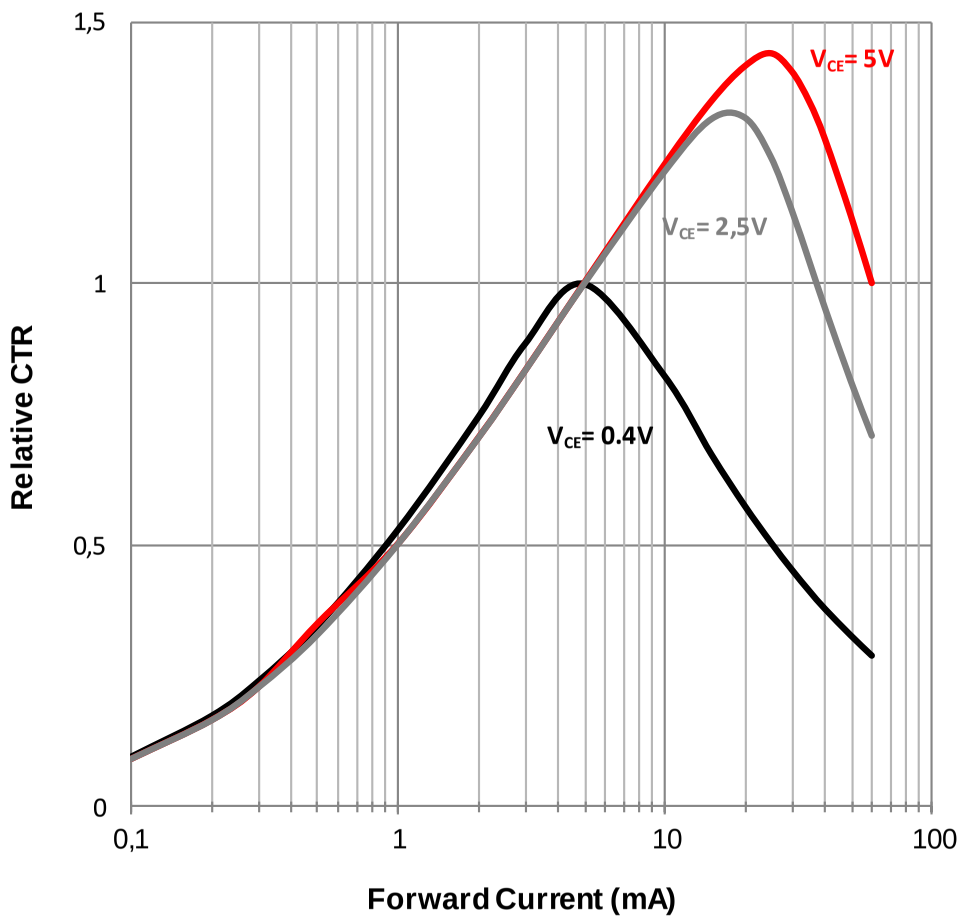
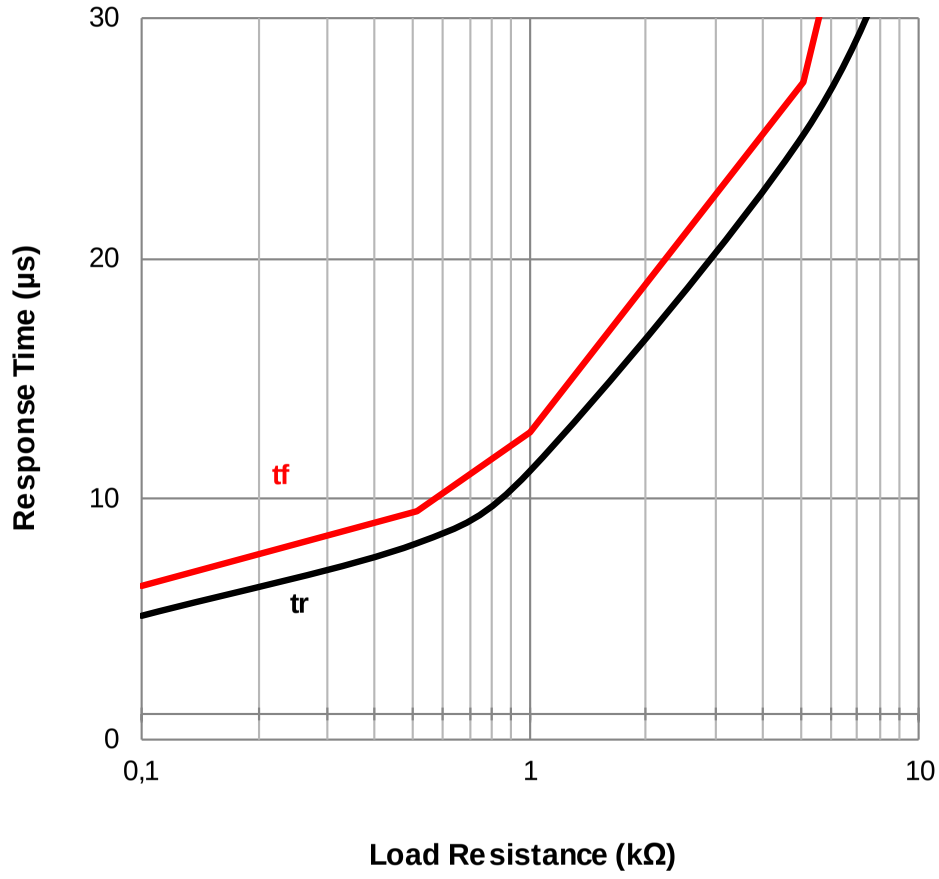
Relative CTR vs. Forward Current:



Testcondition: I_F= 5mA; TA= 25°C

Switching time vs. Load Resistance:



Testcondition: I_C= 2mA; V_{CE}= 2V; TA= 25°C

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CHECKED	REVISION	DATE (YYYY-MM-DD)	GENERAL TOLERANCE	PROJECTION METHOD
SaVo	001.004	2023-08-22	DIN ISO 2768-1m	

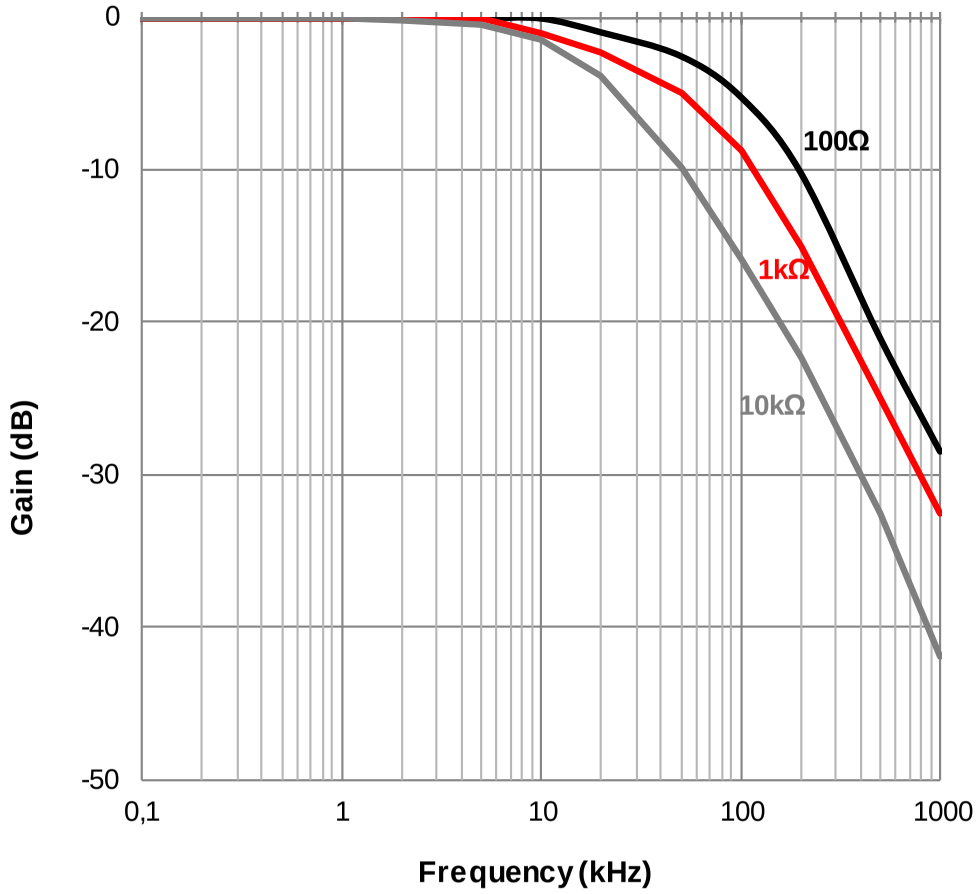
DESCRIPTION
WL-OCPT Optocoupler Phototransistor

ORDER CODE
140356145200

SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	6/12

This electronic component has been designed and developed for usage in general electronic equipment only. This product is not authorized for use in equipment where a higher safety standard and reliability standard is especially required or where a failure of the product is reasonably expected to cause severe personal injury or death, unless the parties have executed an agreement specifically governing such use. Moreover Würth Elektronik eiSos GmbH & Co KG products are neither designed nor intended for use in areas such as military, aerospace, aviation, nuclear control, submarine, transportation, transportation signal, disaster prevention, medical, public information network etc.. Würth Elektronik eiSos GmbH & Co KG must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability evaluation checks for safety must be performed on every electronic component which is used in electrical circuits that require high safety and reliability functions or performance.

Gain vs. Frequency:



Testcondition: I_C= 2mA; V_{CE}= 2V; TA= 25°C

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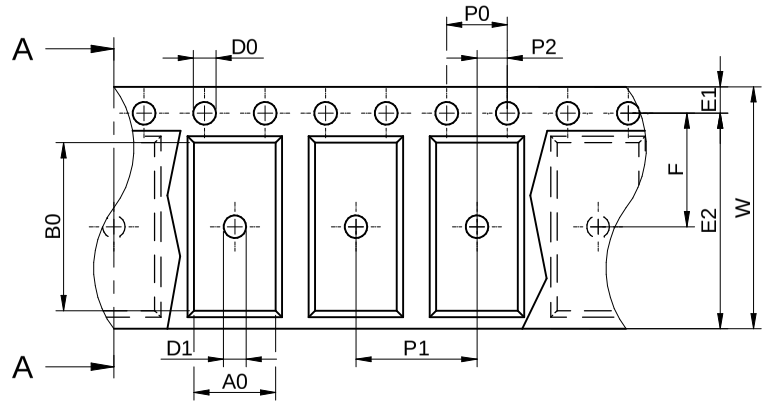
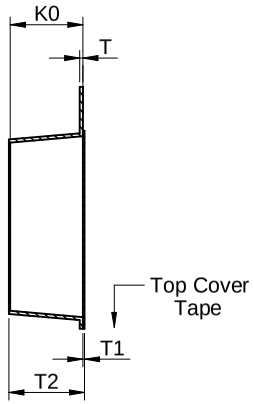
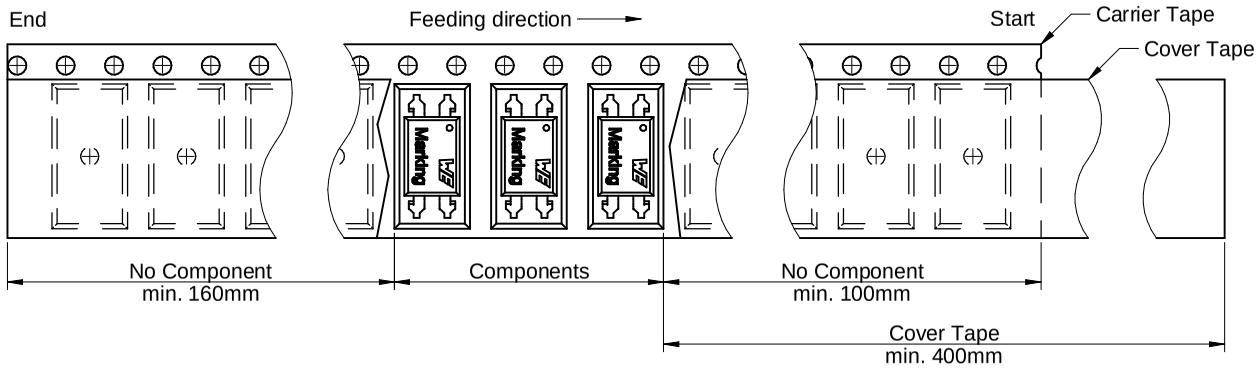
Packaging Specification - Tape: [mm]



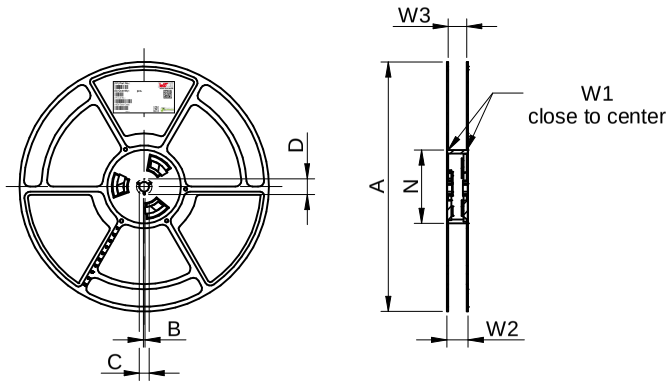


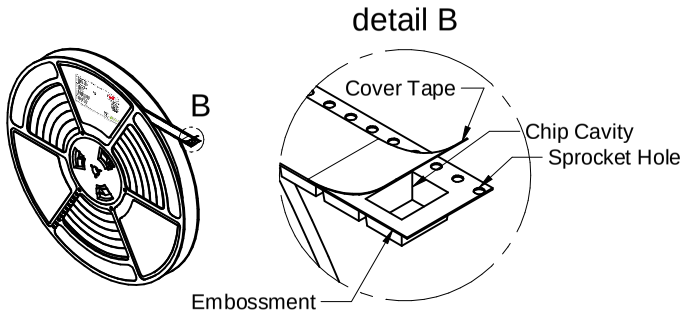


Packaging is referred to the international standard **IEC 60286-3:2019**

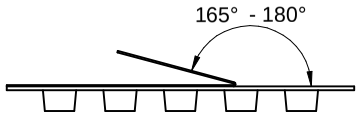
Tape Type	A0 (mm)	B0 (mm)	W (mm)	T (mm)	T1 (mm)	T2 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	D0 (mm)	D1 (mm)	E1 (mm)	E2 (mm)	F (mm)	Material	Qty. (pcs.)
	typ.	typ.	+0,3/ -0,1	ref.	ref.	typ.	typ.	±0,1	±0,1	±0,1	+0,1/ -0,0	min.	±0,1	min.	±0,1		
2a	4,70	10,50	16,00	0,40	0,10	4,60	4,20	4,00	8,00	2,00	1,50	1,50	1,75	14,25	7,50	Polystyrene	3000

Packaging Specification - Reel: [mm]





	A (mm)	B (mm)	C (mm)	D (mm)	N (mm)	W1 (mm)	W2 (mm)	W3 (mm)	W3 (mm)	Material
Tolerance	± 2,0	typ.	typ.	typ.	typ.	typ.	typ.	min.	max.	
Value	330,00	2,20	13,00	20,90	97,20	16,70	20,70	15,90	19,40	Polystyrene



		Pull-off force
Tape width	16 mm	0,1 N - 1,3 N

RoHS COMPLIANT · REACh COMPLIANT · HALOGEN FREE

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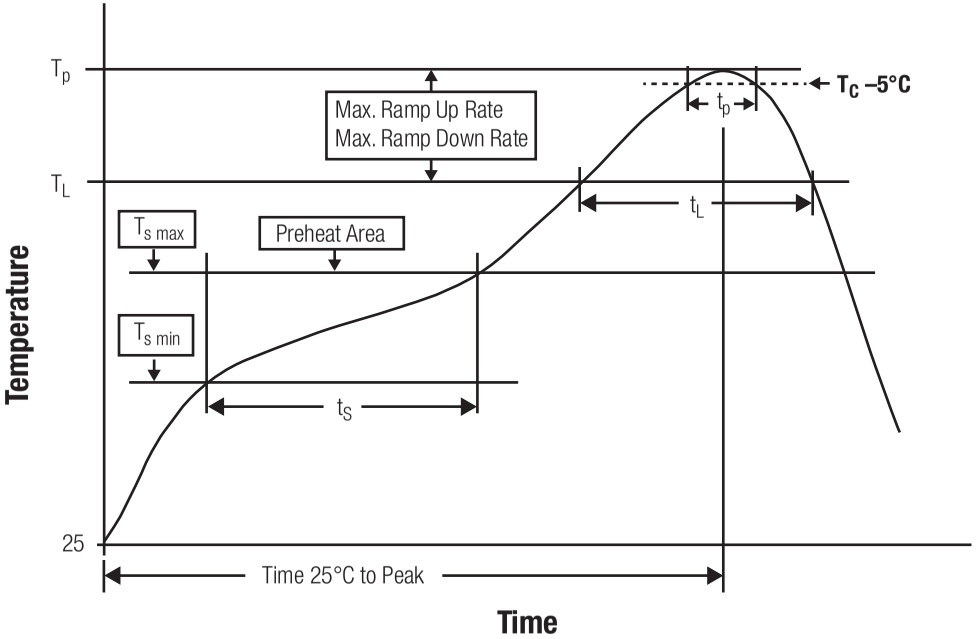
Classification Reflow Profile for SMT components:



Classification Reflow Soldering Profile:

Profile Feature		Value
Preheat Temperature Min	$T_{s\,min}$	150 °C
Preheat Temperature Max	$T_{s\,max}$	200 °C
Preheat Time t_s from $T_{s\,min}$ to $T_{s\,max}$	t_s	max. 60 - 120 seconds
Ramp-up Rate (T_L to T_P)		3 °C/ second max.
Liquidous Temperature	T_L	217 °C
Time t_L maintained above T_L	t_L	max. 60 seconds
Peak package body temperature	T_p	$T_p \leq T_c$, see Table below
Time within 5°C of actual peak temperature	t_p	max. 10 seconds
Ramp-down Rate (T_P to T_L)		6 °C/ second max.
Time 25°C to peak temperature		max. 220 seconds

refer to IPC/ JEDEC J-STD-020E

Package Classification Reflow Temperature (T_C):

Properties	Volume mm³ <350	Volume mm³ 350-2000	Volume mm³ >2000
PB-Free Assembly | Package Thickness < 1.6 mm	260 °C	260 °C	260 °C
PB-Free Assembly | Package Thickness 1.6 mm - 2.5 mm	260 °C	250 °C	245 °C
PB-Free Assembly | Package Thickness > 2.5 mm	250 °C	245 °C	245 °C
Applied cycles	2 cycles max.		

refer to IPC/ JEDEC J-STD-020E

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Cautions and Warnings:

The following conditions apply to all goods within the product series of Optoelectronic Components of Würth Elektronik eiSos GmbH & Co. KG:

General:

- This optoelectronic component is designed and manufactured for use in general electronic equipment.
- Würth Elektronik must be asked for written approval (following the PPAP procedure) before incorporating the components into any equipment in fields such as military, aerospace, aviation, nuclear control, submarine, transportation (automotive control, train control, ship control), transportation signal, disaster prevention, medical, public information network, etc. where higher safety and reliability are especially required and/or if there is the possibility of direct damage or human injury.
- Optoelectronic components that will be used in safety-critical or high-reliability applications, should be pre-evaluated by the customer.
- The optoelectronic component is designed and manufactured to be used within the datasheet specified values. If the usage and operation conditions specified in the datasheet are not met, the wire insulation may be damaged or dissolved.
- Do not drop or impact the components, the component may be damaged
- Würth Elektronik products are qualified according to international standards, which are listed in each product reliability report. Würth Elektronik does not warrant any customer qualified product characteristics beyond Würth Elektroniks' specifications, for its validity and sustainability over time.
- The responsibility for the applicability of the customer specific products and use in a particular customer design is always within the authority of the customer. All technical specifications for standard products also apply to customer specific products.
- Unless Würth Elektroik has given its express consent, the customer is under no circumstances entitled to reverse engineer, disassemble or otherwise attempt to extract knowledge or design information from the optoelectronic component.

Product specific:

Soldering:

- The solder profile must comply with the technical product specifications. All other profiles will void the warranty.
- All other soldering methods are at the customers' own risk
- The soldering pad pattern shown above is a general recommendation for the easy assembly of optoelectronic components. If a high degree of precision is required for the selected application (i.e. high density assembly), the customer must ensure that the soldering pad pattern is optimized accordingly.

Cleaning and Washing:

- Washing agents used during the production to clean the customer application might damage or change the characteristics of the optoelectronic component body, marking or plating. Washing agents may have a negative effect on the long-term functionality of the product.
- Using a brush during the cleaning process may break the optoelectronic component body. Therefore, we do not recommend using a brush during the PCB cleaning process.

Potting:

- If the product is potted in the customer application, the potting material might shrink or expand during and after hardening. Shrinking could lead to an incomplete seal, allowing contaminants into the optoelectronic component body, pins or termination. Expansion could damage the components. We recommend a manual inspection after potting to avoid these effects.

Storage Conditions:

- A storage of Würth Elektronik products for longer than 12 months is not recommended. Within other effects, the terminals may suffer degradation, resulting in bad solderability. Therefore, all products shall be used within the period of 12 months based on the day of shipment.
- Do not expose the optoelectronic component to direct sunlight.
- The storage conditions in the original packaging are defined according to DIN EN 61760-2.
- For a moisture sensitive component, the storage condition in the original packaging is defined according to IPC/JEDEC-J-STD-033. It is also recommended to return the optoelectronic component to the original moisture proof bag and reseal the moisture proof bag again.
- The storage conditions stated in the original packaging apply to the storage time and not to the transportation time of the components.

Packaging:

- The packaging specifications apply only to purchase orders comprising whole packaging units. If the ordered quantity exceeds or is lower than the specified packaging unit, packaging in accordance with the packaging specifications cannot be ensured.

Handling:

- Violation of the technical product specifications such as exceeding the nominal rated current, will void the warranty.
- The product design may influence the automatic optical inspection.
- Certain optoelectronic component surfaces consist of soft material. Pressure on the top surface has to be handled carefully to prevent negative influence to the function and reliability of the optoelectronic components.
- ESD prevention methods need to be applied for manual handling and processing by machinery.
- Resistors for protection are obligatory.
- In addition to optoelectronic components testing, products incorporating these devices have to comply with the safety precautions given in IEC 60825-1, IEC 62471 and IEC 62778.

Technical specification:

- The typical and/or calculated values and graphics of technical parameters can only reflect statistical figures. The actual parameters of each single product, may differ from the typical and/or calculated values or the typical characteristic line.

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- In the characteristics curves, all values given in dotted lines may show a higher deviation than the paramters mentioned above.
- On each reel, only one bin is sorted and taped. The bin is defined on the current transfer ratio.
- In order to ensure highest availability, the reel binning of standard deliveries can vary. A single bin cannot be ordered. Please contact us in advance, if you need a particular bin sorting before placing your order.
- These cautions and warnings comply with the state of the scientific and technical knowledge and are believed to be accurate and reliable. However, no responsibility is assumed for inaccuracies or incompleteness.

The customer has the sole responsibility to ensure that he uses the latest version of this datasheet, which is available on Würth Elektronik's homepage. Unless otherwise agreed in writing (i.e. customer specific specification), changes to the content of this datasheet may occur without notice, provided that the changes do not have a significant effect on the usability of the optoelectronic components.

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Important Notes

The following conditions apply to all goods within the product range of Würth Elektronik eiSos GmbH & Co. KG:

1. General Customer Responsibility

Some goods within the product range of Würth Elektronik eiSos GmbH & Co. KG contain statements regarding general suitability for certain application areas. These statements about suitability are based on our knowledge and experience of typical requirements concerning the areas, serve as general guidance and cannot be estimated as binding statements about the suitability for a customer application. The responsibility for the applicability and use in a particular customer design is always solely within the authority of the customer. Due to this fact it is up to the customer to evaluate, where appropriate to investigate and decide whether the device with the specific product characteristics described in the product specification is valid and suitable for the respective customer application or not.

2. Customer Responsibility related to Specific, in particular Safety-Relevant Applications

It has to be clearly pointed out that the possibility of a malfunction of electronic components or failure before the end of the usual lifetime cannot be completely eliminated in the current state of the art, even if the products are operated within the range of the specifications.
In certain customer applications requiring a very high level of safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health it must be ensured by most advanced technological aid of suitable design of the customer application that no injury or damage is caused to third parties in the event of malfunction or failure of an electronic component. Therefore, customer is cautioned to verify that data sheets are current before placing orders. The current data sheets can be downloaded at www.we-online.com.

3. Best Care and Attention

Any product-specific notes, cautions and warnings must be strictly observed. Any disregard will result in the loss of warranty.

4. Customer Support for Product Specifications

Some products within the product range may contain substances which are subject to restrictions in certain jurisdictions in order to serve specific technical requirements. Necessary information is available on request. In this case the field sales engineer or the internal sales person in charge should be contacted who will be happy to support in this matter.

5. Product R&D

Due to constant product improvement product specifications may change from time to time. As a standard reporting procedure of the Product Change Notification (PCN) according to the JEDEC-Standard inform about minor and major changes. In case of further queries regarding the PCN, the field sales engineer or the internal sales person in charge should be contacted. The basic responsibility of the customer as per Section 1 and 2 remains unaffected.

6. Product Life Cycle

Due to technical progress and economical evaluation we also reserve the right to discontinue production and delivery of products. As a standard reporting procedure of the Product Termination Notification (PTN) according to the JEDEC-Standard we will inform at an early stage about inevitable product discontinuance. According to this we cannot guarantee that all products within our product range will always be available. Therefore it needs to be verified with the field sales engineer or the internal sales person in charge about the current product availability expectancy before or when the product for application design-in disposal is considered. The approach named above does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

7. Property Rights

All the rights for contractual products produced by Würth Elektronik eiSos GmbH & Co. KG on the basis of ideas, development contracts as well as models or templates that are subject to copyright, patent or commercial protection supplied to the customer will remain with Würth Elektronik eiSos GmbH & Co. KG. Würth Elektronik eiSos GmbH & Co. KG does not warrant or represent that any license, either expressed or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, application, or process in which Würth Elektronik eiSos GmbH & Co. KG components or services are used.

8. General Terms and Conditions

Unless otherwise agreed in individual contracts, all orders are subject to the current version of the “General Terms and Conditions of Würth Elektronik eiSos Group”, last version available at www.we-online.com.

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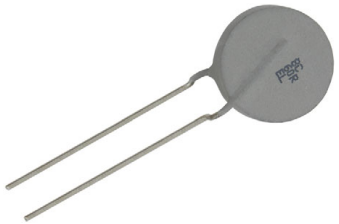
PTC Thermistors, Inrush Current Limiter



LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models

QUICK REFERENCE DATA		
PARAMETER (1)	VALUE	UNIT
Resistance at 25 °C (R_{25}) (2)	60 to 1000	Ω
Switching temperature	130 to 140	°C
Maximum inrush current	10 to 40	A
Maximum AC voltage (2)	350 to 800	V_{RMS}
Maximum DC voltage (2)	500 to 1200	V_{DC}
Maximum peak voltage (3)	4000	V_P
Maximum energy at 25 °C (1)	150 to 240	J
Operating temperature range	-40 to 105	°C
Storage temperature range	-55 to 165	°C
Dissipation factor	14.5 to 19.5	mW/K
Thermal time constant (τ_c) (still air cooling)	130 to 155	s
Weight	3.5 to 5.7	g

Notes

(1) Definitions, measurements, and tests are made in accordance with standard IEC 60738-1 "Thermistors - Directly heated positive temperature coefficient" and AEC-Q200 stress test qualification for passive components

(2) Other resistance values and maximum operating voltages available on request.
Matched resistance values available on request

(3) Maximum peak voltages are based on 8/20 µs pulses that can be applied with limited none-switching energy

AGENCY APPROVALS

Agency approval documents, please see:

www.vishay.com/ppg?29165&documents

UL recognition standard for safety is UL 1434: "Thermistor-Type Devices". UL file E148885

FEATURES

- High energy absorption levels up to 150 J and 240 J
- High number of inrush-power cycles: > 100 000 cycles
- Highly resistant against non-switching peak-powers of up to 25 kW
- Can handle high direct voltage up to 1200 V
- Self protecting in case of overload with no risk of over-heating
- AEC-Q200 qualified
- C-UL-US recognized under file E148885 for AC and DC use
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

APPLICATIONS

Inrush current limiting and load-dump resistor in:

- AC/DC and DC/DC converters
- Load dump and DC-Link circuits
- Emergency discharge circuits
- OBC, battery charging equipment
- Motor drives
- Welding equipment

PTCEL thermistors have resistance values that can change instantly based on the applied voltage levels and varying body temperatures.

DESCRIPTION

These directly heated ceramic-based doped barium titanate thermistors have a positive temperature coefficient and are primarily intended for inrush current limiting and overload protection. They consist of a ceramic pellet soldered between two tinned CCS wires and coated with a UL 94 V-0 compliant high temperature silicone lacquer. The body is marked with the logo, cold resistance value, EL on one side and date code on the opposite side.

MOUNTING

Important mounting and handling instructions, see:

www.vishay.com/doc?29223

By soldering in any position.

Not intended for potting or sealing.

Maximum surface temperature in case of overload can reach 200 °C.

PACKAGING

PTC thermistors are available in 200 pieces individually packed in layered PET trays or tape on reel 500 pieces.

For technical questions, contact: nlr@vishay.com
THIS DOCUMENT IS SUBJECT TO CHANGE WITHOUT NOTICE. THE PRODUCTS DESCRIBED HEREIN AND THIS DOCUMENT ARE SUBJECT TO SPECIFIC DISCLAIMERS, SET FORTH AT www.vishay.com/doc?91000

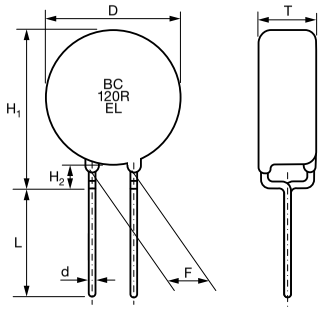
ELECTRICAL DATA AND ORDERING INFORMATION

PART NUMBER [1]	R_{25} (Ω)	R_{25} TOL. (%)	$V_{MAX.}$ (V_{RMS})	$V_{LINK\ MAX.}$ (V_{DC})	$R_{MIN.}$ < 1.5 V_{DC} (Ω)	I_{HOLD} AT 25°C (mA)	C_{th} (J/K)	$E_{MAX.}$ 1 CYCLE AT 25°C (J)	τ_{th} (s)	LEAD PITCH F (mm)	UL RECOG.
PTCEL13R600LxE	60	30	350	500	32	120	1.45	150	130	5.0	✓
PTCEL13R121MxE	120	30	440	625	64	85	1.45	150	130	5.0	✓
PTCEL13R251NxE	250	30	480	680	130	60	1.45	150	130	5.0	✓
PTCEL13R501RxE	500	30	560	800	260	42	1.45	150	130	5.0	✓
PTCEL13R102SxE	1000	30	600	850	520	30	1.45	140	130	5.0	✓
PTCEL17R600MxE	60	30	440	625	32	140	2.3	240	155	5.0	✓
PTCEL17R600MxE303	60	30	440	625	32	140	2.3	240	155	7.5	✓
PTCEL17R121NxE	120	30	460	650	64	100	2.3	240	155	5.0	✓
PTCEL17R251SxE	250	30	600	850	130	70	2.3	240	155	5.0	✓
PTCEL17R501TxE	500	30	700	1000	260	50	2.3	230	155	5.0	✓
PTCEL17R501TxE302	500	30	700	1000	260	50	2.3	230	155	7.5	✓
PTCEL17R501TxE401	500	30	700	1000	260	50	2.3	230	155	10.0	✓
PTCEL17R102UxE404	1000	30	800	1200	500	35	2.3	230	155	10.0	

Note

(1) Replace the x by B for bulk or T for tape and reel

OUTLINE AND DIMENSIONS



COMPONENT DIMENSIONS in millimeters					
SYMBOL	PTCEL13		PTCEL17		
D	13.5 max.		16.5 max.		
d	0.6 ± 0.05		0.8 ± 0.05		
H_1	17 max.		20 max.		
H_2	3 ± 1		3 ± 1		
T	7.0 max.		7.5 max.		
F [1]	5.0 ± 0.8	7.5 ± 0.8	5.0 ± 0.8	7.5 ± 0.8	10.0 ± 0.8
L [2]	20 min.	18 min.	20 min.	18 min.	16 min.

Notes

(1) F pitch = see “Electrical Data and Ordering Information” table for available wire pitch part numbers

(2) L lead length corresponds to available wire pitch part numbers

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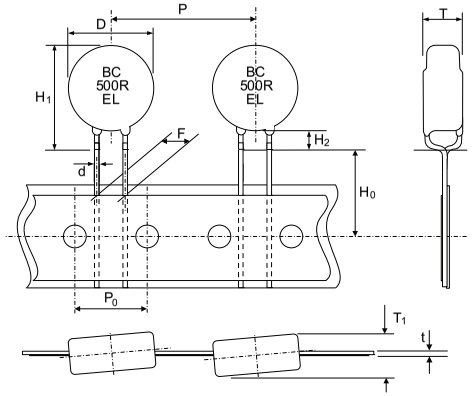
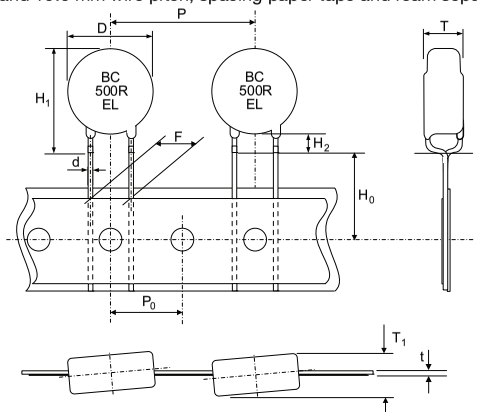
TAPE AND REEL DIMENSIONS

Taping on reel with F = 5.0 mm wire pitch, spacing paper tape and foam separator tape used on reel.



Taping on reel with F = 7.5 mm and 10.0 mm wire pitch, spacing paper tape and foam separator tape used on reel.



DIMENSIONS in millimeters (standard cardboard tape W 18 mm according IEC 60286-2)		
SYMBOL	**PARAMETER**	**VALUE**
D	Body diameter	See bulk dimensions
d	Lead diameter	See bulk dimensions
P	Component pitch	25.4 ± 1.0
P_0	Feedhole pitch	12.7 ± 0.3
F	Lead center to lead center distance (between component and tape)	
	13R and 17R type *TE (leads between feedholes)	5.0 +0.5/-0.2
	13R and 17R type *TE3xx (feedhole between leads)	7.5 +0.5/-0.2
	17R type *TE4xx (feedhole between leads)	10.0 +0.5/-0.2
H_0	Lead wire clinch height	16.0 ± 0.5
H_2	Component bottom to seating plane	3.0 ± 1.0
H_1	Component top to seating plane	See bulk dimensions
T	Body thickness	See bulk dimensions
t	Total tape thickness	1.7 max.
T_1	Total thickness	T + 1.0 max.

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REQUIRED NUMBER OF PTC THERMISTORS TO LIMIT CURRENT AND ABSORB ENERGY

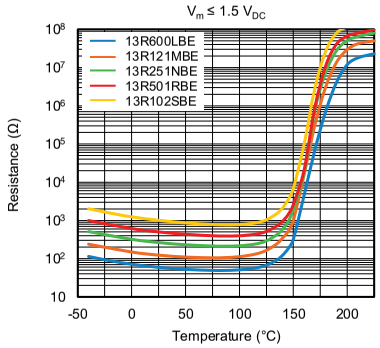
By using several PTC's in a series / parallel network, the maximum current limitation and absorbed energy levels can be further optimized. For homogeneous current and energy distribution it is recommended to combine only PTCEL of the same size and matched resistance value. Energy absorption per PTC in a network depends on current distribution in the network and as such on the individual PTC resistance value. PTCEL thermistors might be used in a series connection to further lower the inrush current, but not to increase the maximum allowed voltage levels. Following formula may be used to calculate the minimum number of PTCEL thermistors of the same size and matched resistance value that are required in a DC link or other capacitor bank application to properly charge or discharge a given amount of non-repetitive energy without follow current. The formula is valid for one charge or discharge operation within cool down period of at least 5 times the thermal time constant and for which the T_{PTC} equals the T_{amb} before a consecutive operation.

$$N \geq \frac{K \times C \times V^2}{2 \times C_{th} \times (T_{sw} - T_{amb})}$$

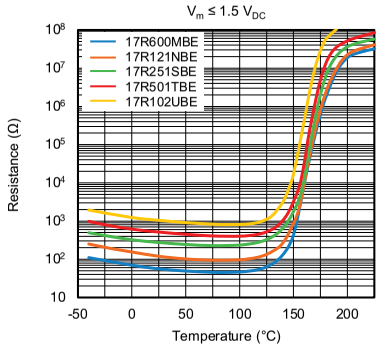
Notes

- N is the number of PTCEL required in the network
- C is the total capacitor value to charge or discharge in F
- V is the maximum DC voltage on the capacitor C
- C_{th} is the thermal capacity of one PTC in [J/K] (see table)
- T_{sw} is the minimum switching temperature of the PTCEL (130 °C)
- T_{amb} is the maximum ambient temperature at which the PTC needs to operate
- K is the factor that determines the charging operation mode
  K = 1 for DC charging or discharging
  K = 0.96 for 3-phase rectified charging
  K = 0.76 for single phase rectified charging

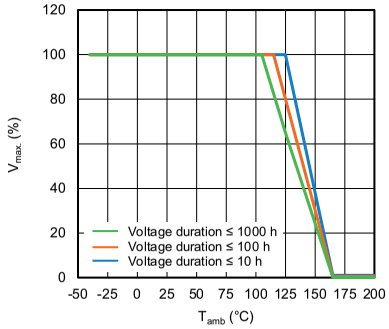
RESISTANCE VS. TEMPERATURE FOR PTCEL13 (Typical)



RESISTANCE VS. TEMPERATURE FOR PTCEL17 (Typical)



$V_{max.}$ DERATING VS. T_{amb}



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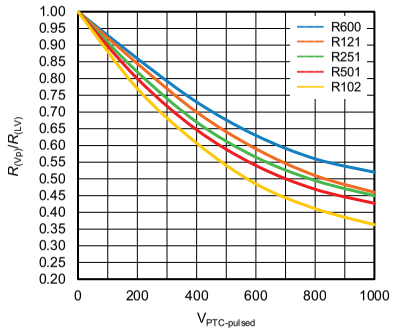
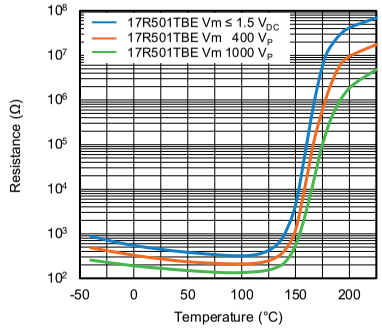
PTC RESISTANCE UNDER PULSED VOLTAGE



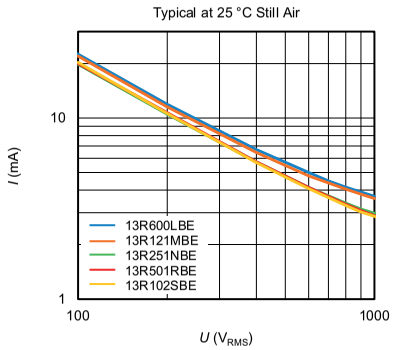
RESISTANCE VS. TEMPERATURE PULSED
(Typical)



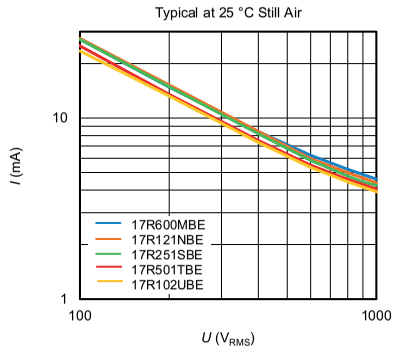
Notes

- The minimum PTC resistance values under (pulsed) voltage are depending on actual minimum resistance value in the temperature range of 70 °C to 100 °C. The actual voltage dependency effect or $R_{(Vp)}/R_{(LV)}$ ratio of ceramic PTC is depending on its resistance values at low voltage ($R_{(LV)}$). The different curves represent the influence of (pulsed) voltage related to the PTCEL value types in the minimum resistance temperature range of 70 °C to 100 °C. A PTC resistance value $R_{(LV)}$ can be taken from the "Resistance vs Temperature" graphs and multiplied by a corresponding ratio to estimate the (minimum) resistance value and determine a maximum peak current at a defined voltage. Example: a PTCEL17R501TBE type has a $R_{min.}$ (see Electrical Data table) of 260 Ω at around 90 °C, and at a 1000 V peak-voltage the resistance will drop to 260 Ω x 0.43 (red curve) = 112 Ω, which will give rise to a peak-current of around 9 Ap. Actual peak currents that could be reached at certain voltage levels can be more precisely evaluated by using the available SPICE models
- Also check the graph "Resistance vs. Temperature Pulsed" to see the typical resistance to voltage dependency effect on a PTCEL17R501TBE

RESIDUAL CURRENT VS. VOLTAGE FOR PTCEL13



RESIDUAL CURRENT VS. VOLTAGE FOR PTCEL17



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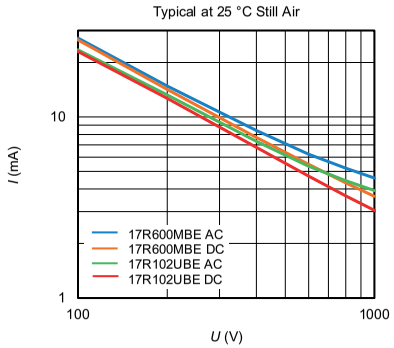
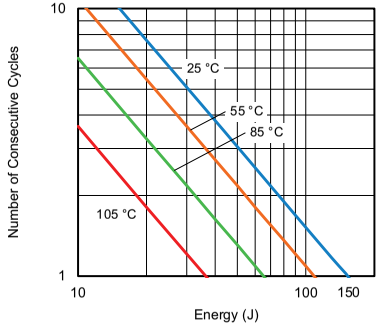
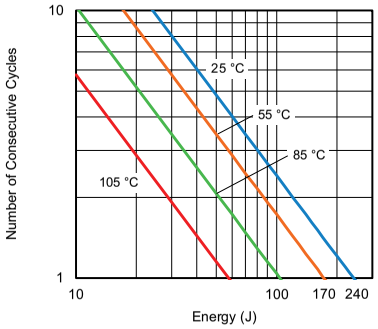
RESIDUAL CURRENT VS. VOLTAGE AC / DC



CONSECUTIVE ENERGY AT DIFFERENT T_{amb} FOR PTCEL13



CONSECUTIVE ENERGY AT DIFFERENT T_{amb} FOR PTCEL17



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STB10LN80K5

N-channel 800 V, 0.55 Ω typ., 8 A MDmesh™ K5 Power MOSFET in a D²PAK package

Datasheet - production data

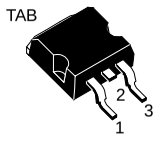
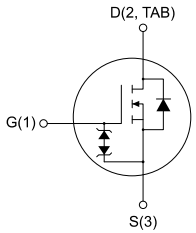


Figure 1: Internal schematic diagram



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STB10LN80K5	800 V	0.63 Ω	8 A

- Industry's lowest $R_{DS(on)}$ x area
- Industry's best figure of merit (FoM)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1: Device summary

Order code	Marking	Package	Packing
STB10LN80K5	10LN80K5	D^2PAK	Tape and reel

This is information on a product in full production. www.st.com

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2 Electrical characteristics 4

2.2 Electrical characteristics (curves) 6

3 Test circuits 9

4 Package information 10

4.1 D2PAK package information 10

4.2 Packing information 13

5 Revision history 15

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at T_C = 25 °C	8	A
I_D	Drain current (continuous) at T_C = 100 °C	5	A
I_D (1)	Drain current (pulsed)	32	A
P_{TOT}	Total dissipation at T_C = 25 °C	110	W
dv/dt (2)	Peak diode recovery voltage slope	4.5	V/ns
dv/dt (3)	MOSFET dv/dt ruggedness	50	
T_j	Operating junction temperature range	- 55 to 150	°C
T_{stg}	Storage temperature range		

Notes:

(1) Pulse width limited by safe operating area.

(2) I_{SD} ≤ 8 A, di/dt ≤ 100 A/µs; V_{DS} peak < $V_{(BR)DSS}$

(3) V_{DS} ≤ 640 V

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.14	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	35	°C/W

Notes:

(1) When mounted on FR-4 board of 1 inch², 2 oz Cu

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	2.7	A
E_{AS}	Single pulse avalanche energy (starting Tj = 25 ° C, I_D = I_{AR}, V_{DD} = 50 V)	240	mJ

2 Electrical characteristics

T_C = 25 ° C unless otherwise specified

Table 5: On/off-state

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	800			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 800 V			1	µA
		V_{GS} = 0 V, V_{DS} = 800 V T_C = 125 °C			50	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ± 20 V			± 10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 4 A		0.55	0.63	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	427	-	pF
C_{oss}	Output capacitance		-	43	-	pF
C_{rss}	Reverse transfer capacitance		-	0.25	-	pF
$C_{o(tr)}$ (1)	Equivalent capacitance time related	V_{DS} = 0 to 640 V, V_{GS} = 0 V	-	72	-	pF
$C_{o(er)}$ (2)	Equivalent capacitance energy related			27	-	pF
R_g	Intrinsic gate resistance	f = 1 MHz , I_D= 0 A	-	7	-	Ω
Q_g	Total gate charge	V_{DD} = 640 V, I_D = 8 A V_{GS}= 10 V See *Figure 16: "Test circuit for gate charge behavior"*	-	15	-	nC
Q_{gs}	Gate-source charge		-	4.2	-	nC
Q_{gd}	Gate-drain charge		-	9	-	nC

Notes:

(1)Time related is defined as a constant equivalent capacitance giving the same charging time as Coss when V_{DS} increases from 0 to 80% V_{DSS}

(2)Energy related is defined as a constant equivalent capacitance giving the same stored energy as Coss when V_{DS} increases from 0 to 80% V_{DSS}

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD}= 400 V, I_D = 4 A, R_G = 4.7 Ω V_{GS} = 10 V See *Figure 15: "Test circuit for resistive load switching times"* and *Figure 20: "Switching time waveform"*	-	11.8	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time		-	28	-	ns
t_f	Fall time		-	13	-	ns

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		8	A
I_{SDM} (1)	Source-drain current (pulsed)		-		32	A
V_{SD} (2)	Forward on voltage	I_{SD} = 8 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 8 A, di/dt = 100 A/µs,	-	350		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V	-	3.9		µC
I_{RRM}	Reverse recovery current	See *Figure 17: "Test circuit for inductive load switching and diode recovery times"*	-	22.5		A
t_{rr}	Reverse recovery time	I_{SD} = 8 A, di/dt = 100 A/µs,	-	505		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_j = 150 °C	-	5		µC
I_{RRM}	Reverse recovery current	See *Figure 17: "Test circuit for inductive load switching and diode recovery times"*	-	20		A

Notes:

(1)Pulse width limited by safe operating area

(2)Pulsed: pulse duration = 300 µ s, duty cycle 1.5%

Table 9: Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	I_{GS}= ± 1mA, I_D= 0 A	30	-	-	V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection,thus eliminating the need for additional external componentry.

2.2 Electrical characteristics (curves)

Figure 2: Safe operating area

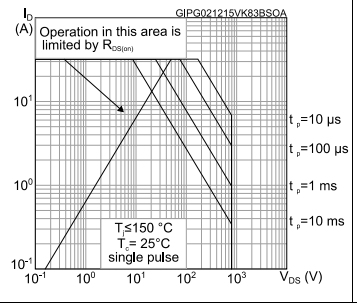


Figure 3: Thermal impedance

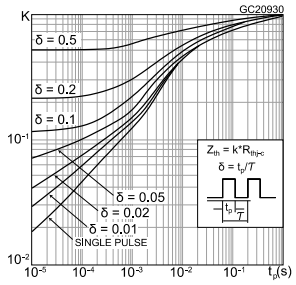


Figure 4: Output characteristics

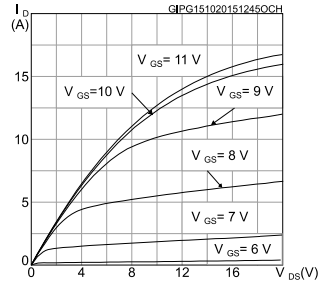


Figure 5: Transfer characteristics

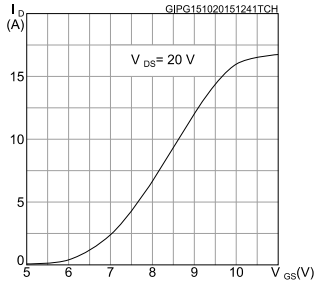


Figure 6: Gate charge vs gate-source voltage

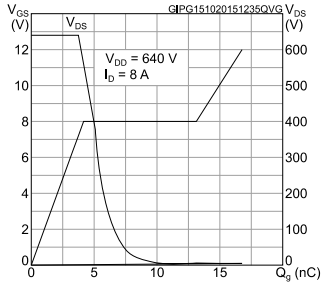


Figure 7: Static drain-source on-resistance

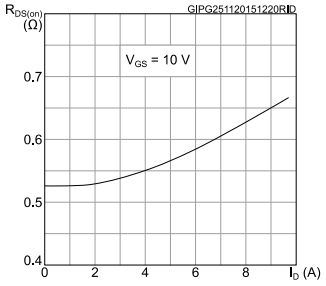


Figure 8: Capacitance variations

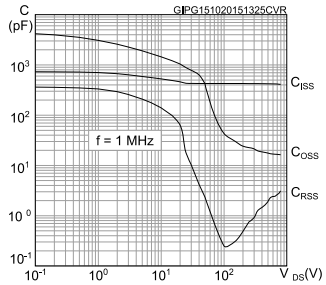


Figure 9: Normalized gate threshold voltage vs temperature

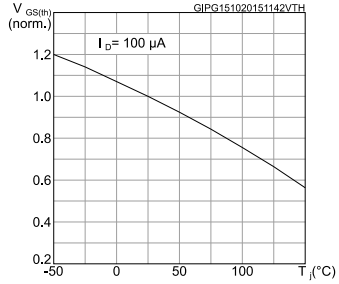


Figure 10: Normalized on-resistance vs temperature

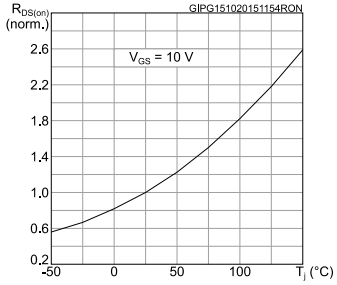


Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

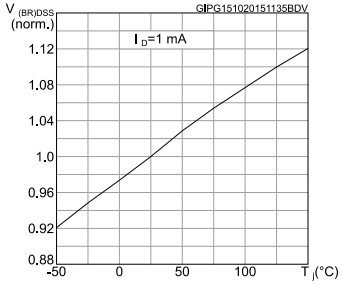


Figure 12: Output capacitance stored energy

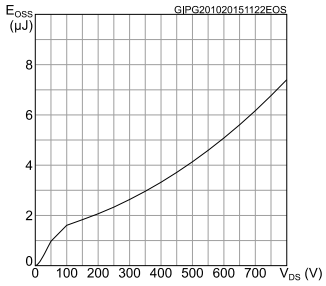


Figure 13: Source-drain diode forward characteristics

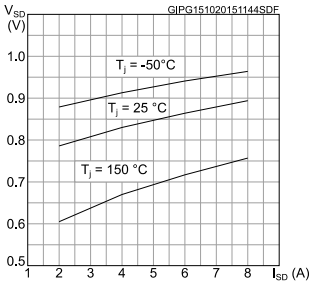
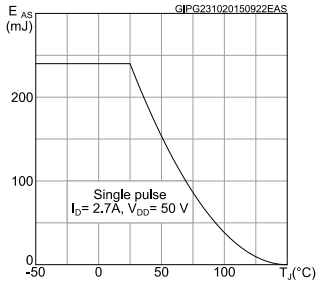


Figure 14: Maximum avalanche energy vs starting T_J



3 Test circuits

Figure 15: Test circuit for resistive load switching times

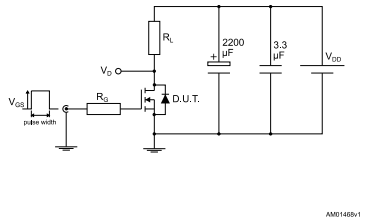


Figure 16: Test circuit for gate charge behavior

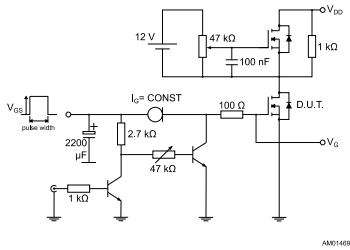


Figure 17: Test circuit for inductive load switching and diode recovery times

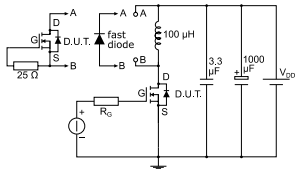


Figure 18: Unclamped inductive load test circuit

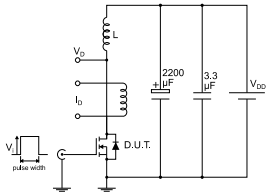


Figure 19: Unclamped inductive waveform

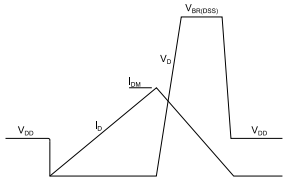
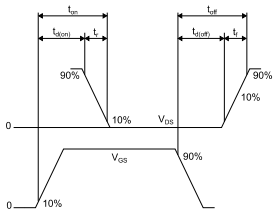


Figure 20: Switching time waveform



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: ***www.st.com***. ECOPACK® is an ST trademark.

4.1 D²PAK package information

Figure 21: D²PAK (TO-263) type A package outline

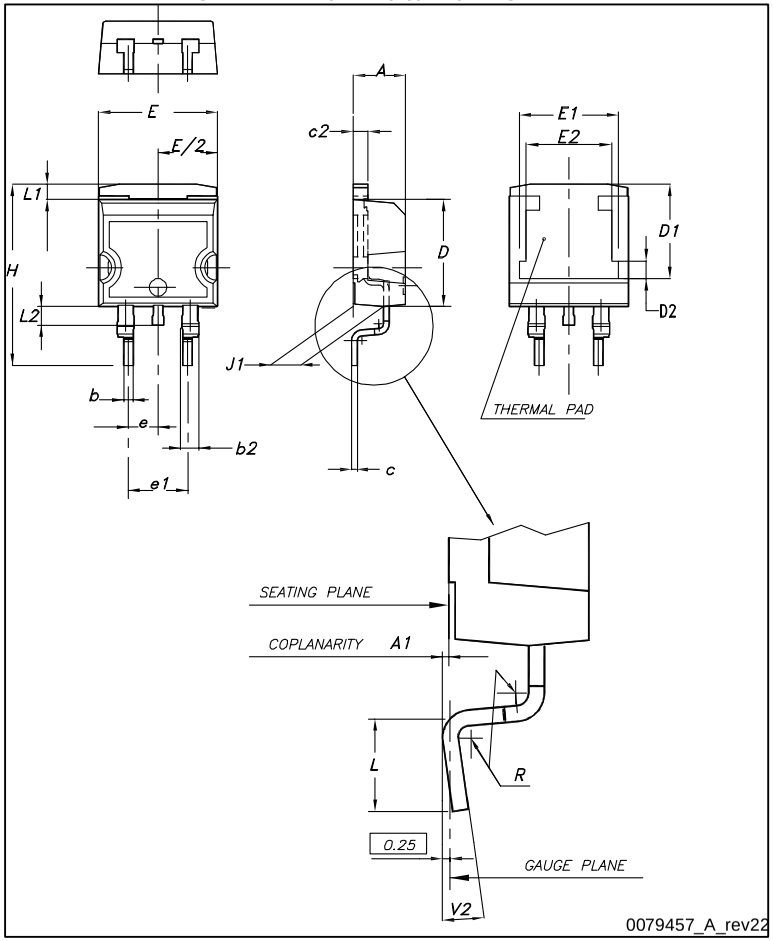
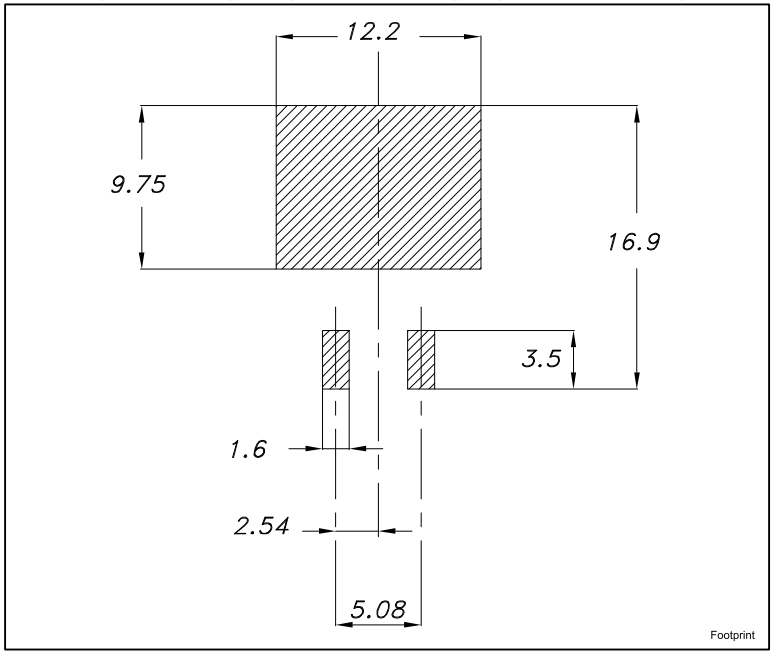


Table 10: D²PAK (TO-263) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 22: D²PAK (TO-263) recommended footprint (dimensions are in mm)



4.2 Packing information

Figure 23: Tape outline

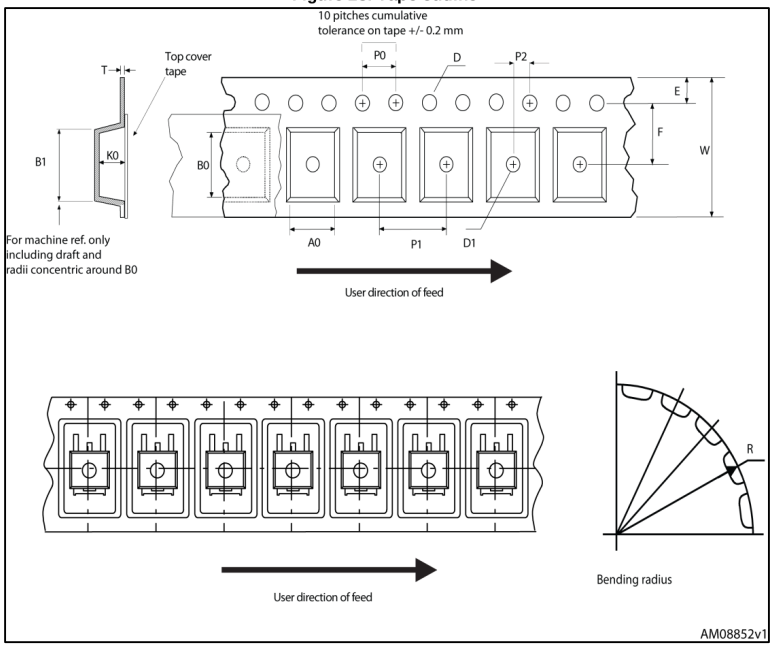


Figure 24: Reel outline

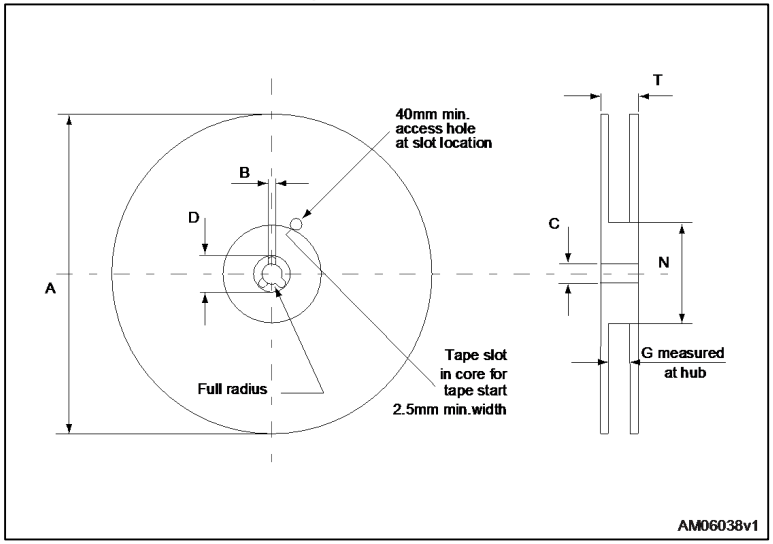


Table 11: D²PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

5 Revision history

Table 12: Document revision history

Date	Revision	Changes
04-May-2015	1	First release.
08-Feb-2016	2	Modified: *Table 2: "Absolute maximum ratings"*, *Table 3: "Thermal data"*, *Table 4: "Avalanche characteristics"*, *Table 5: "On/off-state"*, *Table 7: "Switching times"* and *Table 8: "Source-drain diode"* Added: *Section 3.1: "Electrical characteristics (curves)"* Datasheet promoted from preliminary data to production data Minor text changes

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International
IOR Rectifier

Series PVG612APbF

Microelectronic Power IC

HEXFET® Power MOSFET Photovoltaic Relay
Single-Pole, Normally-Open, 0-60V, 2.0A AC / 4.0A DC

General Description

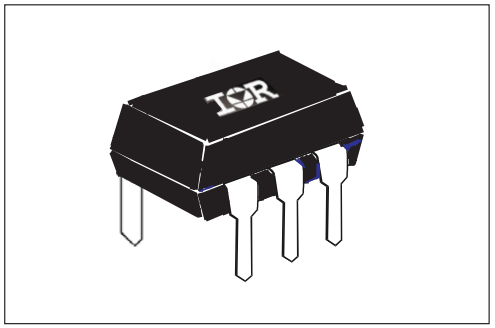
The PVG612A Series Photovoltaic Relay is a single-pole, normally open solid-state relay that can replace electromechanical relays in many applications. It utilizes International Rectifier's proprietary HEXFET power MOSFET as the output switch, driven by an integrated circuit photovoltaic generator of novel construction. The output switch is controlled by radiation from a GaAlAs light emitting diode (LED) which is optically isolated from the photovoltaic generator.

These units exceed the performance capabilities of electromechanical relays in operating life, sensitivity, stability of on-resistance, miniaturization, insensitivity to magnetic fields and ruggedess. The compact PVG612A is particularly suited for isolated switching of high currents from 12 to 48 Volt AC or DC power sources.

Series PVG612A Relays are packaged in a 6-pin, molded DIP package with either thru-hole or surface mount (gull-wing) terminals. It is available in standard plastic shipping tubes or on tape-and-reel. Please refer to Part Identification information opposite.

Features

- Bounce-free operation
- High load current capacity
- High off-state resistance
- Linear AC/DC operation
- 4,000 V_{RMS} I/O Isolation
- Solid-State reliability
- UL recognized
- ESD Tolerance:
  - 4000V Human Body Model
  - 500V Machine Model



Applications

- Programmable Logic Controllers
- Computers and Peripheral Devices
- Audio Equipment
- Power Supplies and Power Distribution
- Control of Displays and Indicators
- Industrial Automation

Part Identification

PVG612APbF	thru-hole
PVG612ASPbF	surface-mount
PVG612AS-TPbF	surface-mount, tape and reel

(HEXFET is the registered trademark for International Rectifier Power MOSFETs)

Electrical Specifications (-40°C ≤ T_A ≤ +85°C unless otherwise specified)

INPUT CHARACTERISTICS	Limits	Units
Minimum Control Current (see figure 1)	5.0	mA
Maximum Control Current for Off-State Resistance @ T_A = +25°C	0.4	mA
Control Current Range (Caution: current limit input LED, see figure 6)	5.0 - 25	mA
Maximum Reverse Voltage (1mA max.)	6.0	V

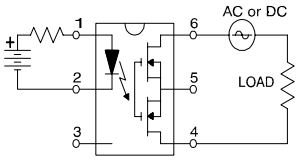
OUTPUT CHARACTERISTICS		Limits	Units
Operating Voltage Range		0 to ±60	$V_{(DC\ or\ AC\ peak)}$
Maximum Continuous Load Current @ T_A = +40°C, 10mA Control (see figure 1)	A Connection	2.0	A (AC or DC)
	B Connection	2.5	A (DC)
	C Connection	4.0	A (DC)
Maximum Pulsed Load Current @ T_A =+25°C (100 ms @ 10% Duty Cycle)	A Connection	7.5	A (AC or DC)
	B Connection	8.5	A (DC)
	C Connection	15.5	A (DC)
Typical Thermal Resistance (Rthja, Junction-to-Ambient)	A Connection	79.1	(°C/W)
	B Connection	112.2	(°C/W)
	C Connection	81.0	(°C/W)
Maximum On-State Resistance @T_A =+25°C For 1A pulsed load, 10mA Control (see figure 4)	A Connection	100	mΩ
	B Connection	50	mΩ
	C Connection	35	mΩ
Maximum Off-State Leakage @ 60V, T_A =+25°C		1.0	µA
Maximum Turn-On Time @T_A =+25°C (see figures 7 & 8) For 500mA, 50V_{DC} load, 10mA Control, 10mS pulse width		3.5	ms
Maximum Turn-Off Time @T_A =+25°C (see figures 7 & 8) For 500mA, 50V_{DC} load, 10mA Control, 10mS pulse width		0.5	ms
Typical Output Capacitance @ Vdd=50V, f=1MHz (see figure 2)		105	pF

GENERAL CHARACTERISTICS		Limits	Units
Minimum Dielectric Strength, Input-Output		4000	V_{RMS}
Minimum Insulation Resistance, Input-Output, @T_A =+25°C, 50%RH, 100V_{DC}		10^{12}	Ω
Maximum Capacitance, Input-Output		1.0	pF
Maximum Pin Soldering Temperature (10 seconds maximum)		+260	°C
Ambient Temperature Range:	Operating	-40 to +85	
	Storage	-40 to +100	

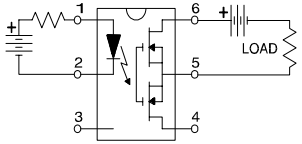
International Rectifier does not recommend the use of this product in aerospace, avionics, military or life support applications. Users of this International Rectifier product in such applications assume all risks of such use and indemnify International Rectifier against all damages resulting from such use.

Connection Diagrams

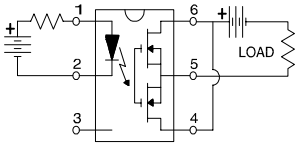
"A" Connection



"B" Connection



"C" Connection



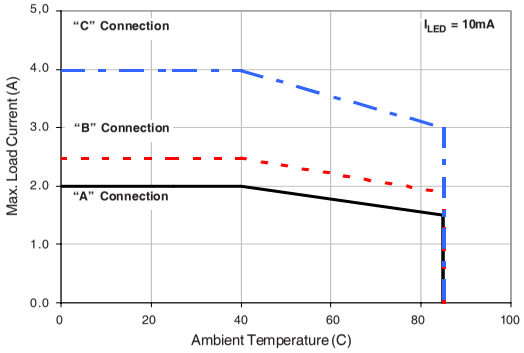


Figure 1. Current Derating Curves

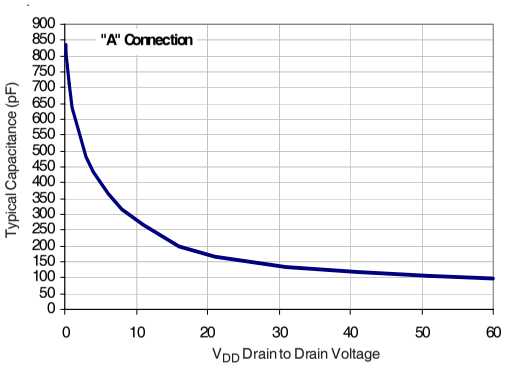


Figure 2. Typical Output Capacitance

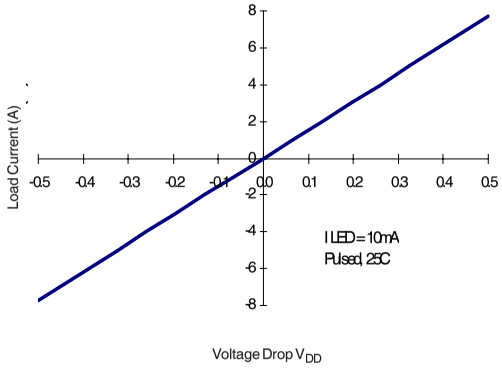


Figure 3. Typical Linearity Characteristics

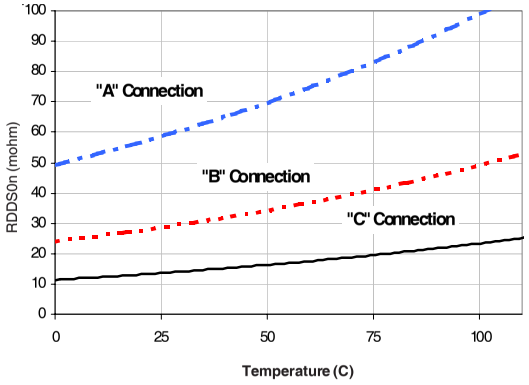


Figure 4. Typical Normalized On-Resistance

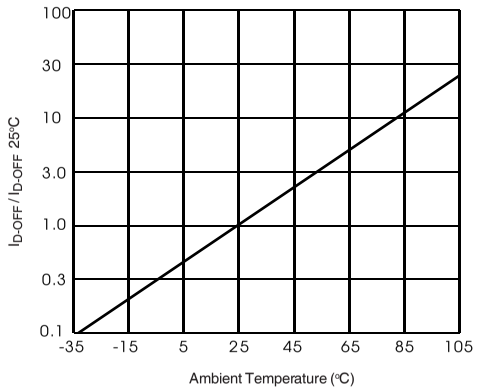


Figure 5. Typical Normalized Off-State Leakage

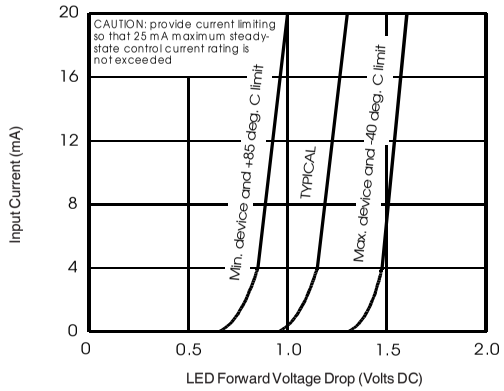


Figure 6. Input Characteristics (Current Controlled)

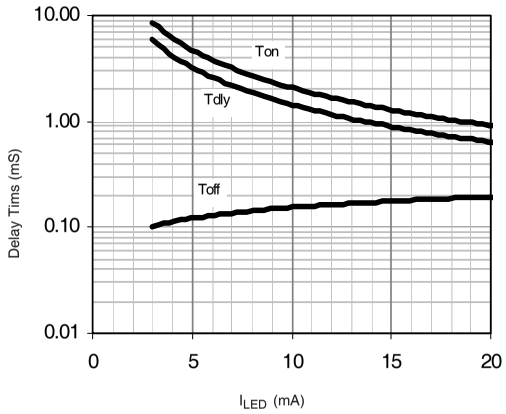


Figure 7. Typical Delay Times

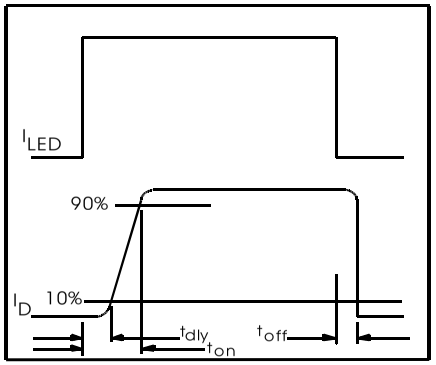
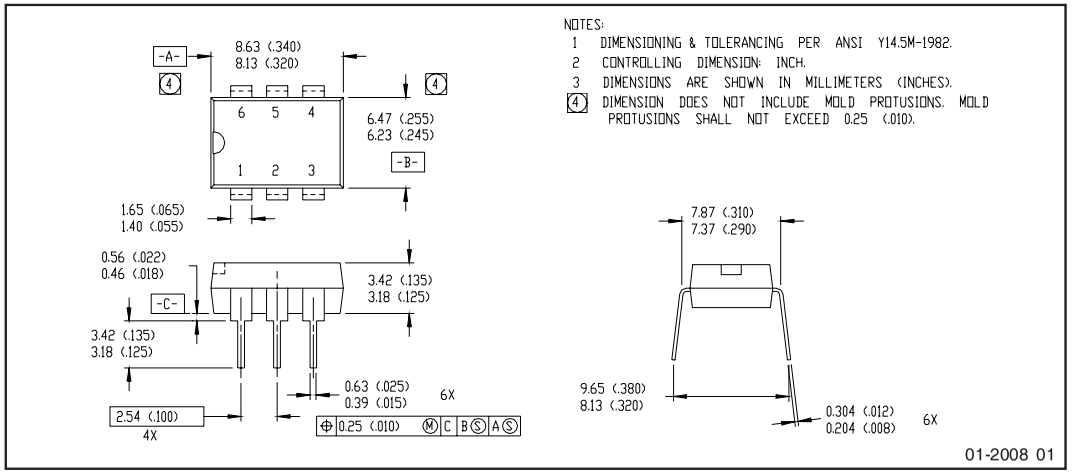
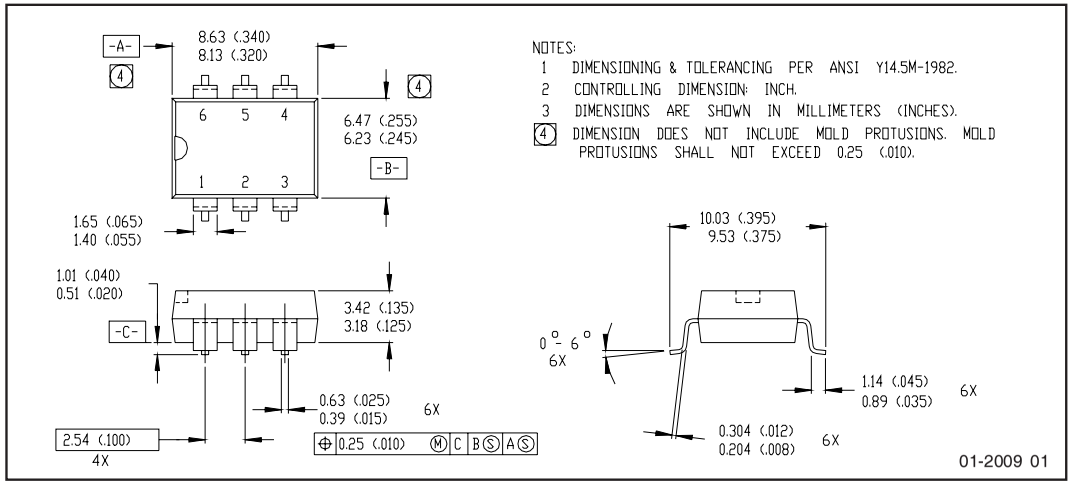


Figure 8. Delay Time Definitions

Case Outlines





Note: For the most current drawing please refer to IR website at: http://www.irf.com/package/

Qualification information†

Qualification level	Industrial (per JEDEC JESD47I †† guidelines)	
Moisture Sensitivity Level	PVG612APbF	N/A
	PVG612ASPbF	MSL4 (per JEDEC J-STD-020E & JEDEC J-STD-033C ††)
	PVG612AS-TPbF	
RoHS compliant	Yes	

† Qualification standards can be found at International Rectifier's web site: http://www.irf.com/product-info/reliability
†† Applicable version of JEDEC standard at the time of product release

Revision History

Date	Comments
5/4/2015	• Added Qualification Information Table on page 6 • Updated data sheet with new IR corporate template

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IS32LT3177/78

10-TO-200MA CONSTANT-CURRENT LED DRIVER FOR AUTOMOTIVE

June 2024

GENERAL DESCRIPTION

The IS32LT3177 and IS32LT3178 are adjustable linear current devices with excellent temperature stability. A single resistor is all that is required to set the operating current from 10mA to 200mA. The devices can operate from an input voltage from 2.9V to 40V with a minimal voltage headroom of 1.0V (Typ.) at 150mA. Designed with a low dropout voltage; the device can drive LED strings close to the supply voltage without switch capacitors or inductors.

The IS32LT3177/78 simplifies designs by providing a stable current without the additional requirement of inductors, FETs or diodes. The complete constant current driver requires only a current set resistor and a small PCB area making designs both efficient and cost effective.

The EN Pin of the IS32LT3177 can be tied to V_{BAT} or PSM (Power Supply Modulation) signal for high side dimming. The EN Pin of the IS32LT3178 can function as the PWM signal input used for MCU PWM dimming.

As a current sink it is ideal for LED lighting applications or current limiter for power supplies.

The device is provided in a lead (Pb) free, SOT23-6 and SOP-8-EP packages.

FEATURES

- Low-side current sink
  - Adjustable from 10mA to 150mA (SOT23-6)/200mA (SOP-8-EP) with external resistor selection
- Wide input voltage range from
  - 2.9V to 40V (IS32LT3178)
  - 5V to 40V (IS32LT3177)
  with a low dropout of typical 1.0V at 150mA
- Up to 1kHz PWM input (IS32LT3178 only)
- Protection features:
  - 0.6%/K current roll off at high temp over 145°C for thermal protection
  - Output current limit
  - Thermal shutdown
- Up to 0.77W (SOT23-6)/2.32W (SOP-8-EP) power dissipation in a small package
- RoHS & Halogen-Free Compliance
- TSCA Compliance
- AEC-Q100 Qualified with Temperature Grade 1: -40°C to 125°C

APPLICATIONS

- Automotive and avionic lighting
- Stop/tail light
- Turn light
- Retail lighting in fridge, freezer case and vending machines

TYPICAL APPLICATION CIRCUIT

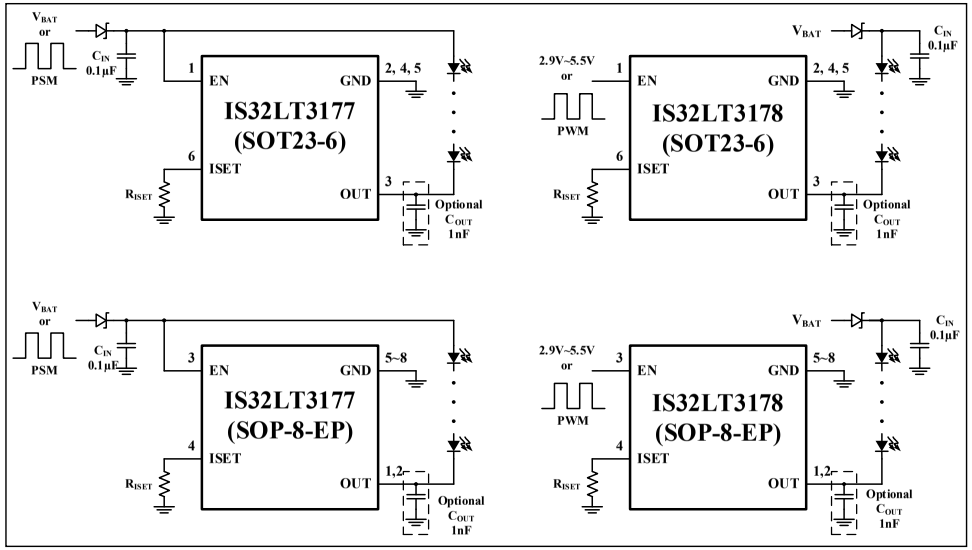


Figure 1 Typical Application Circuit

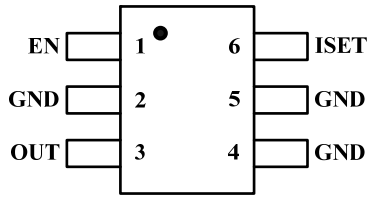
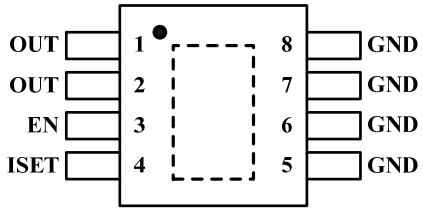
Note 1: All GND pins must be connected to ground.

Note 2: C_{IN} must be placed close to IC. If no PSM dimming requirement, please use larger value for C_{IN}.

Note 3: C_{OUT} is optional. When the LED connection wire is long, the C_{OUT} should be placed close to OUT pin to avoid EMI interference.

Note 4: R_{ISET} MUST be placed close to ISET and GND pins to improve the Electro-Magnetic Susceptibility (EMS) performance.

PIN CONFIGURATION

Package	Pin Configuration (Top View)
SOT23-6	
SOP-8-EP	

PIN DESCRIPTION

No.		Pin	Description
SOT23-6	**SOP-8-EP**		
3	1, 2	OUT	Current sink.
1	3	EN	Enable pin (PWM input IS32LT3178 only).
6	4	ISET	Output current setting pin. Connect a resistor between this pin and GND to set the maximum output current.
2, 4, 5	5~8	GND	Ground pin. All GND pins must be connected to supply ground.
-		Thermal Pad	Connect to GND.

ORDERING INFORMATION
Automotive Range: -40°C to +125°C

Order Part No.	Package	QTY/Reel
IS32LT3177-STLA3-TR IS32LT3178-STLA3-TR	SOT23-6, Lead-free	3000
IS32LT3177-GRLA3-TR IS32LT3178-GRLA3-TR	SOP-8-EP, Lead-free	2500

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a.) the risk of injury or damage has been minimized;
b.) the user assume all such risks; and
c.) potential liability of Lumissil Microsystems is adequately protected under the circumstances

ABSOLUTE MAXIMUM RATINGS (Note 5)

Maximum enable voltage, $V_{EN(MAX)}$ only for IS32LT3177 $V_{EN(MAX)}$ only for IS32LT3178	44V 6.0V
Maximum output current, $I_{OUT(MAX)}$	250mA
Maximum output voltage, $V_{OUT(MAX)}$	44V
Reverse voltage between all terminals, V_R	0.5V
Power dissipation, $P_{D(MAX)}$ (Note 6)	0.77W (SOT23-6) 2.32W (SOP-8-EP)
Maximum junction temperature, T_{JMAX}	+150°C
Storage temperature range, T_{STG}	-65°C ~ +150°C
Operating temperature range, T_A=T_J	-40°C ~ +125°C
Package thermal resistance, junction to ambient (4-layer standard test PCB based on JESD 51-2A), θ_{JA}	130°C/W (SOT23-6) 43.1°C/W (SOP-8-EP)
Package thermal resistance, junction to thermal PAD (4-layer standard test PCB based on JESD 51-8), θ_{JP}	1.41°C/W (SOP-8-EP)
ESD (HBM) ESD (CDM)	±2kV ±750V

Note 5: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 6: Detail information please refer to package thermal de-rating curve on Page 16.

ELECTRICAL CHARACTERISTICS

"●" This symbol in the table means these parameters are for IS32LT3177.
"○" This symbol in the table means these parameters are for IS32LT3178.
"♦" This symbol in the table means these limits are guaranteed at room temp T_J= 25°C.
"◊" This symbol in the table means these limits are guaranteed at full temp range T_J= -40°C~ +125°C.
Test condition is T_J= -40°C~+125°C, unless otherwise specified. (Note 7)

Symbol	Parameter	Condition			Min.	Typ.	Max.	Unit
V_{BD_OUT}	OUT pin breakdown voltage	V_{EN}= 0V			40			V
I_{EN}	Enable current	V_{EN}= 12V, R_{ISET}=16kΩ		●		0.5	1.00	mA
		V_{EN}= 3.3V, R_{ISET}=16kΩ		○		0.5	1.00	
V_{ISET}	Current setting reference voltage					1.0		V
I_{OUT}	Output current	V_{OUT}= 0.8V, V_{EN}= 12V, R_{ISET}= 160kΩ	●	♦		10		mA
				◊		10		
		V_{OUT}= 0.8V, V_{EN}= 3.3V, R_{ISET}= 160kΩ	○	♦		10		
				◊		10		
		V_{OUT}> 1.0V, V_{EN}= 12V, R_{ISET}= 16kΩ, SOP-8-EP	●	♦	97	100	103	mA
				◊	95	100	105	
		V_{OUT}> 1.0V, V_{EN}= 3.3V, R_{ISET}= 16kΩ, SOP-8-EP	○	♦	97	100	103	
				◊	95	100	105	
		V_{OUT}> 1.0V, V_{EN}= 12V, R_{ISET}= 16kΩ, SOT23-6	●	♦	96.5	100	103.5	
				◊	94	100	106	
		V_{OUT}> 1.0V, V_{EN}= 3.3V, R_{ISET}= 16kΩ, SOT23-6	○	♦	96.5	100	103.5	
				◊	94	100	106	

ELECTRICAL CHARACTERISTICS (CONTINUE)

Symbol	Parameter	Condition			Min.	Typ.	Max.	Unit
I_{OUT}	Output current	V_{OUT}> 1.5V, V_{EN}= 12V, R_{ISET}= 10.6kΩ, SOT23-6	●	♦	145.5	150	154.5	mA
				◊	142.5	150	157.5	
		V_{OUT}> 1.5V, V_{EN}= 3.3V, R_{ISET}= 10.6kΩ, SOT23-6	○	♦	145.5	150	154.5	
				◊	142.5	150	157.5	
		V_{OUT}> 1.5V, V_{EN}= 12V, R_{ISET}= 8kΩ, SOP-8-EP	●	♦	194	200	206	mA
				◊	190	200	210	
		V_{OUT}> 1.5V, V_{EN}= 3.3V, R_{ISET}= 8kΩ, SOP-8-EP	○	♦	194	200	206	
				◊	190	200	210	

DC CHARACTERISTICS WITH STABILIZED LED LOAD

"●" This symbol in the table means these parameters are for IS32LT3177.
"○" This symbol in the table means these parameters are for IS32LT3178.

Test condition is T_J= -40°C~+125°C, unless otherwise specified. (Note 7)

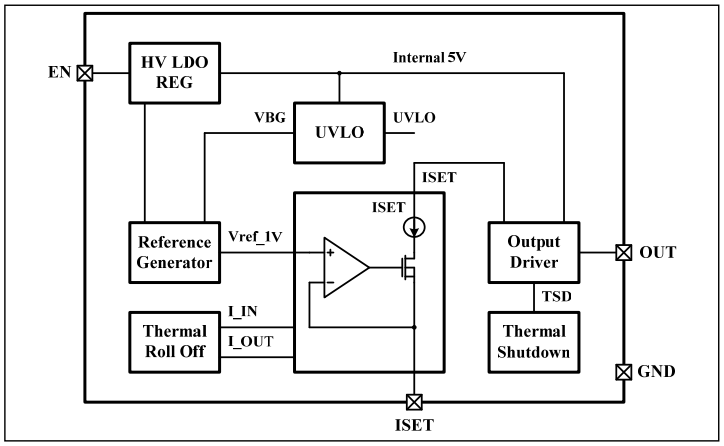
Symbol	Parameter	Condition		Min.	Typ.	Max.	Unit
I_{OUT_LIMIT}	Output current limit	R_{ISET}= GND, V_{EN}= 12V	●		295		mA
		R_{ISET}= GND, V_{EN}= 3.3V	○		295		
V_{UVLO}	EN pin undervoltage lockout threshold	V_{EN} rising	●		3.1	3.6	V
			○		1.9	2.4	
		V_{EN} falling	●	2.4	2.9		
			○	1.2	1.7		
V_{EN}	Sufficient supply voltage on EN pin	10mA≤I_{OUT}≤200mA, V_{OUT}=2V	●	5		40	V
		10mA≤I_{OUT}≤150mA, V_{OUT}=2V, SOT23-6	○	2.9		5.5	
		150mA < I_{OUT} ≤ 200mA, V_{OUT}=2V, SOP-8-EP		3.1		5.5	
V_{HR}	Minimum required headroom voltage on OUT pin	I_{OUT}=150mA, SOT23-6	●	1.2			V
		I_{OUT}= 150mA, SOT23-6	○	1.2			
		I_{OUT}= 200mA, SOP-8-EP	●	1.5			
		I_{OUT}= 200mA, SOP-8-EP	○	1.5			
t_{ON}	EN pin enabling time	V_{OUT} > 1.5V, V_{EN} = 5V, R_{ISET}= 16kΩ	●			10	μs
		V_{OUT} > 1.5V, V_{EN} = 3.3V, R_{ISET}= 16kΩ	○			10	
T_{RO}	Thermal roll off threshold	Current decreasing slope rate: -0.6%/°C (Note 8)			145		°C
T_{SD}	Thermal shutdown threshold	Temperature rising (Note 8)			170		°C
T_{SD_HY}	Thermal shutdown hysteresis	Temperature falling (Note 8)			30		°C

Note 7: Production testing of the device is performed at 25°C. Functional operation of the device and parameters specified over -40°C to +125°C temperature range, are guaranteed by design and characterization.

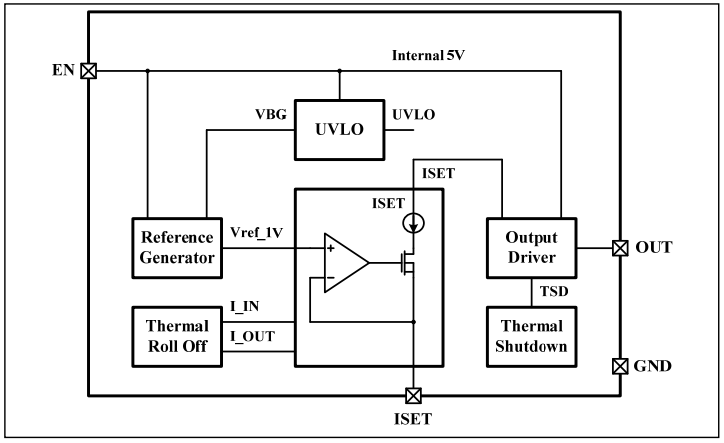
Note 8: Guaranteed by design.

FUNCTIONAL BLOCK DIAGRAM

IS32LT3177



IS32LT3178



TYPICAL PERFORMANCE CHARACTERISTICS

IS32LT3177

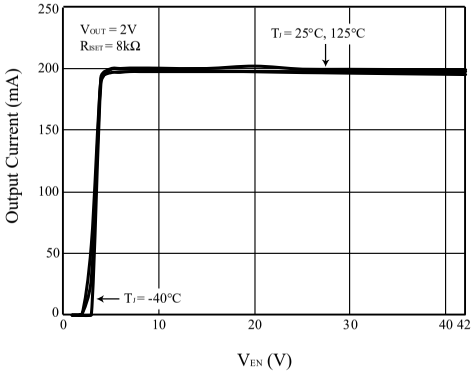


Figure 2 Output Current vs. V_{EN}

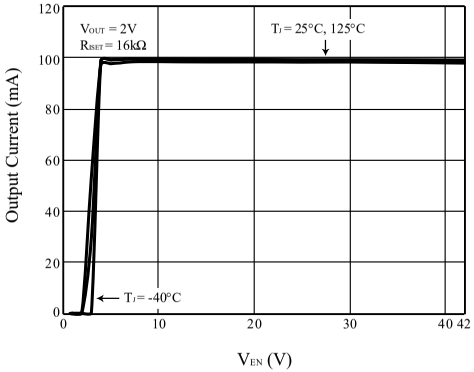


Figure 3 Output Current vs. V_{EN}

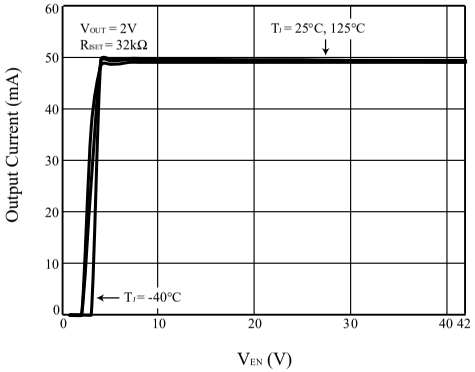


Figure 4 Output Current vs. V_{EN}

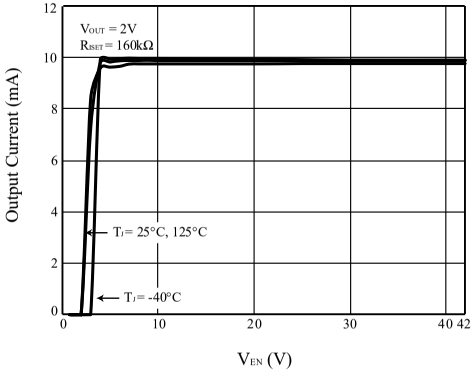


Figure 5 Output Current vs. V_{EN}

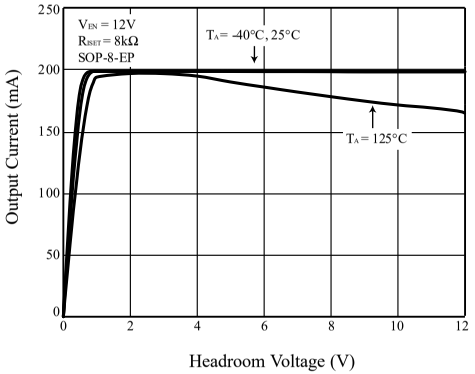


Figure 6 Output Current vs. Headroom Voltage

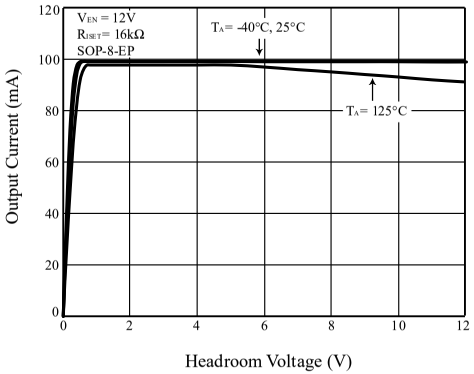


Figure 7 Output Current vs. Headroom Voltage

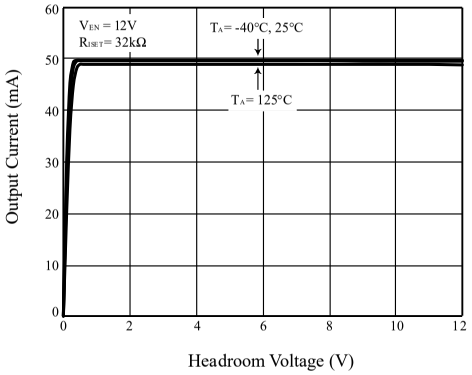


Figure 8 Output Current vs. Headroom Voltage

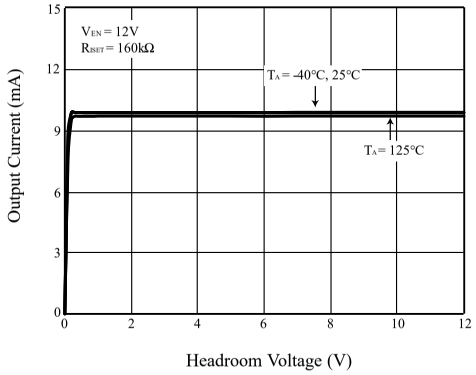


Figure 9 Output Current vs. Headroom Voltage

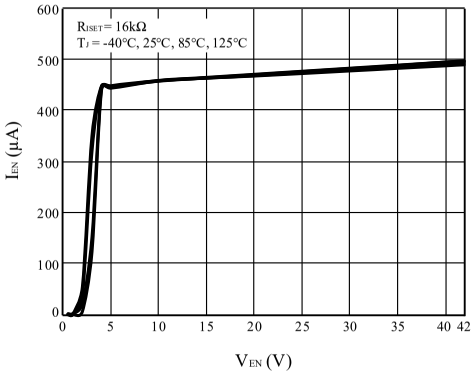


Figure 10 I_{EN} vs. V_{EN}

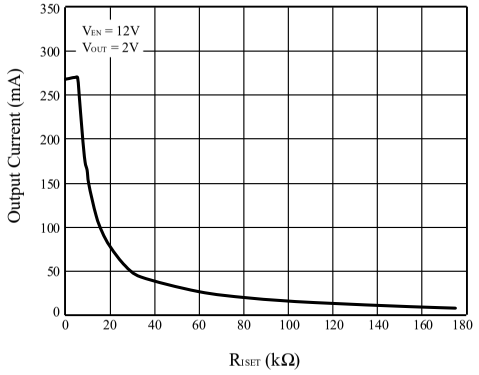


Figure 11 Output Current vs. R_{ISET}

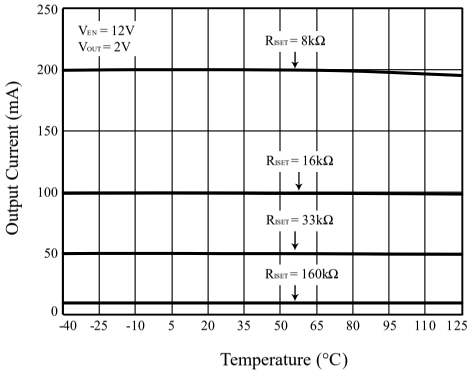


Figure 12 Output Current vs. Temperature

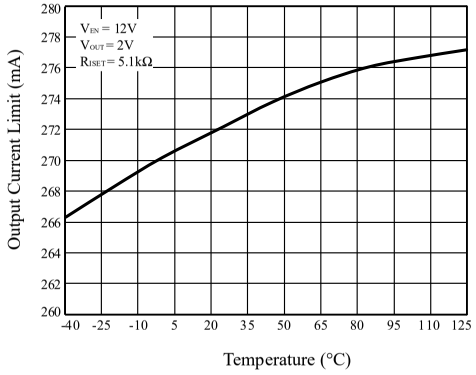


Figure 13 Output Current Limit vs. Temperature

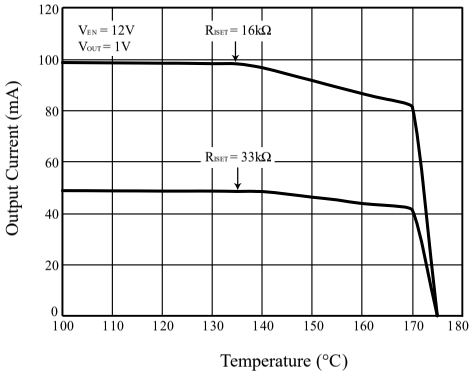


Figure 14 Output Current vs. Temperature (Thermal Roll Off)

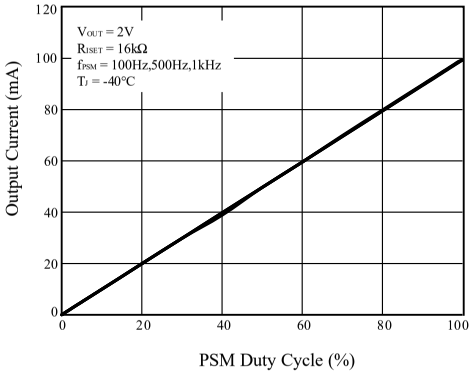


Figure 15 Output Current vs. PSM Duty Cycle

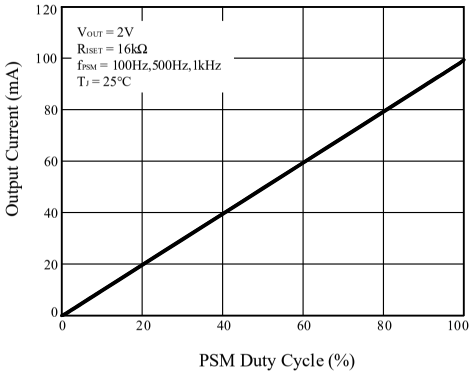


Figure 16 Output Current vs. PSM Duty Cycle

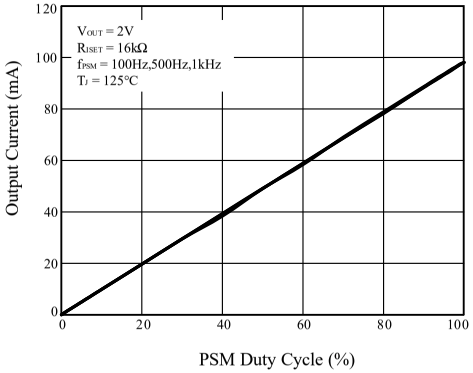


Figure 17 Output Current vs. PSM Duty Cycle

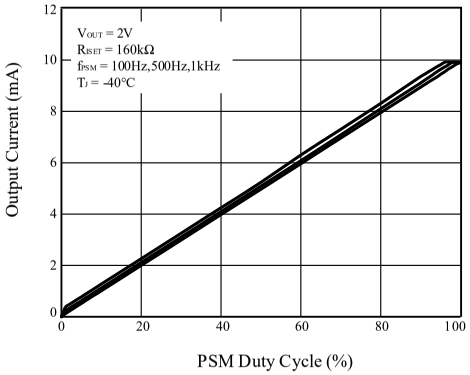


Figure 18 Output Current vs. PSM Duty Cycle

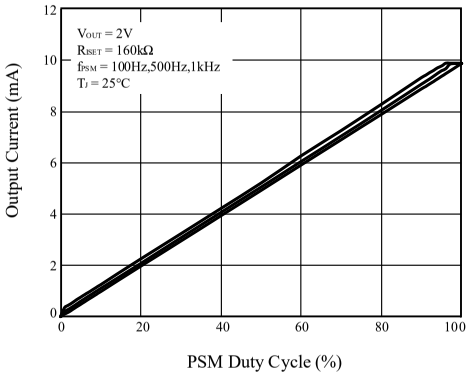


Figure 19 Output Current vs. PSM Duty Cycle

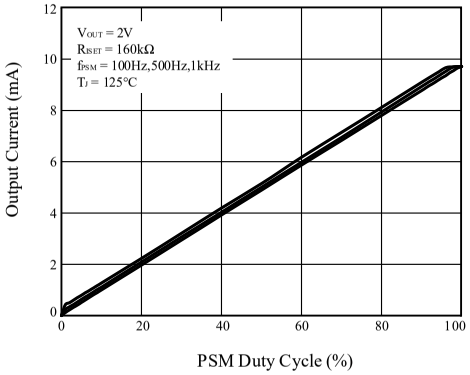


Figure 20 Output Current vs. PSM Duty Cycle

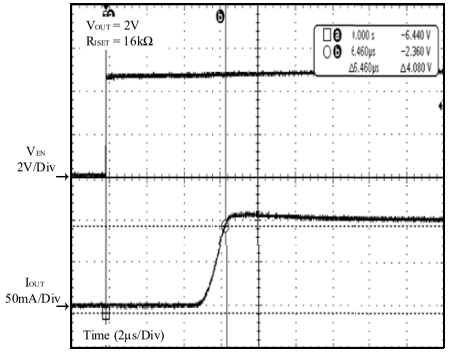


Figure 21 Start Up

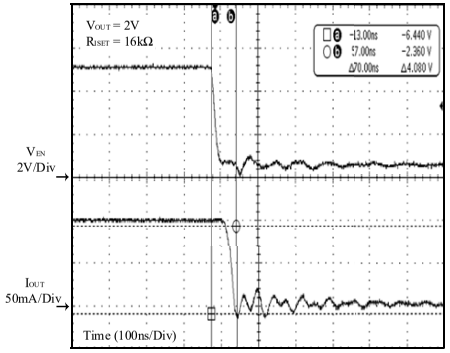


Figure 22 Shut Down

IS32LT3178

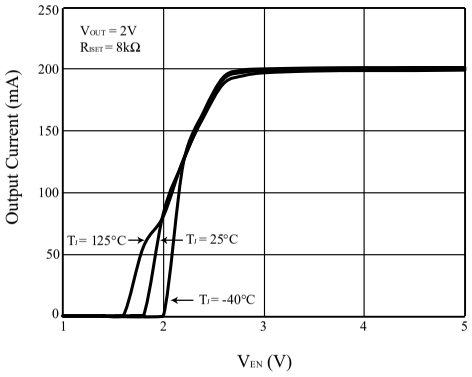


Figure 23 Output Current vs. V_{EN}

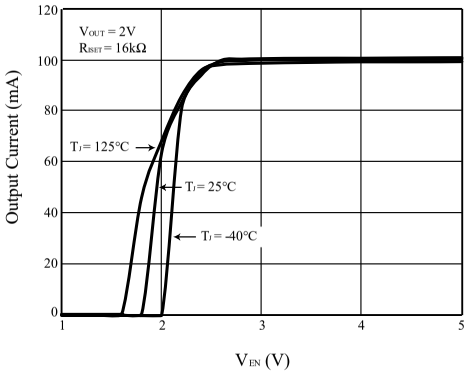


Figure 24 Output Current vs. V_{EN}

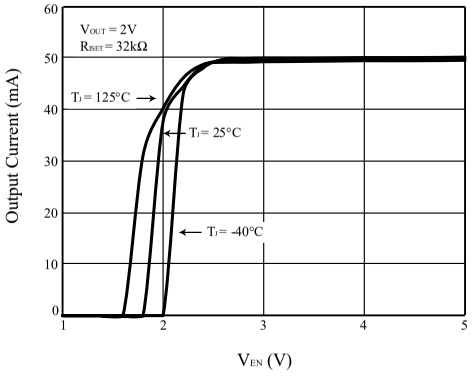


Figure 25 Output Current vs. V_{EN}

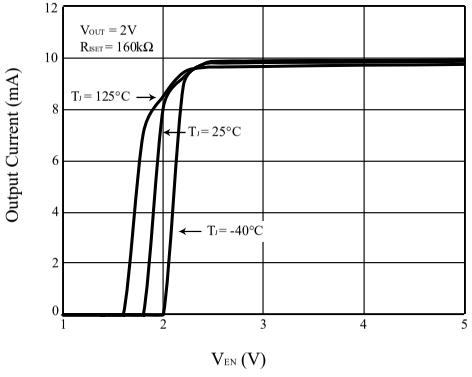


Figure 26 Output Current vs. V_{EN}

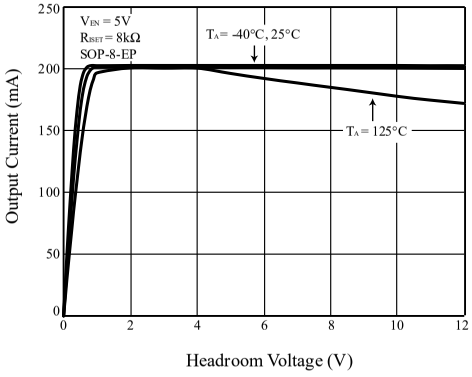


Figure 27 Output Current vs. Headroom Voltage

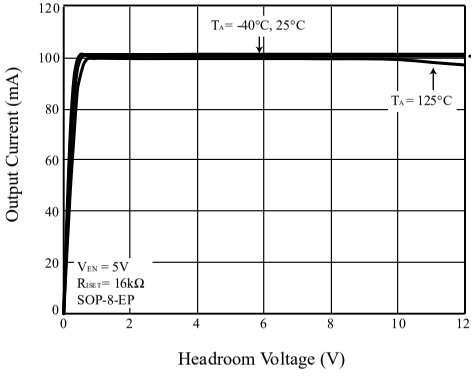


Figure 28 Output Current vs. Headroom Voltage

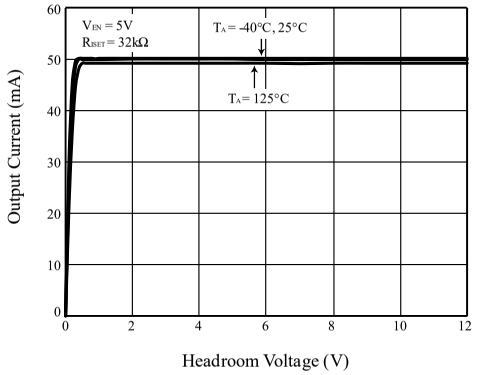


Figure 29 Output Current vs. Headroom Voltage

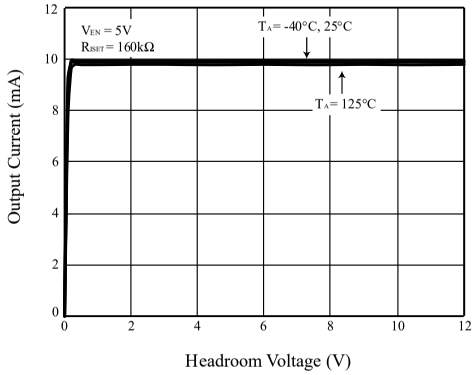


Figure 30 Output Current vs. Headroom Voltage

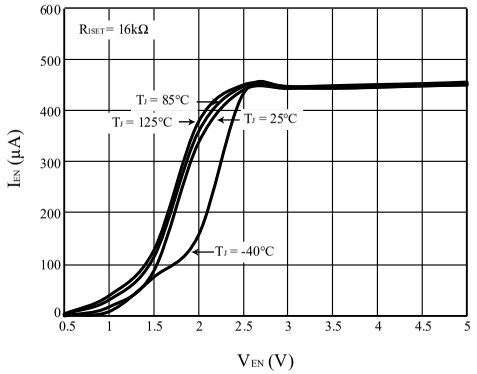


Figure 31 I_{EN} vs. V_{EN}

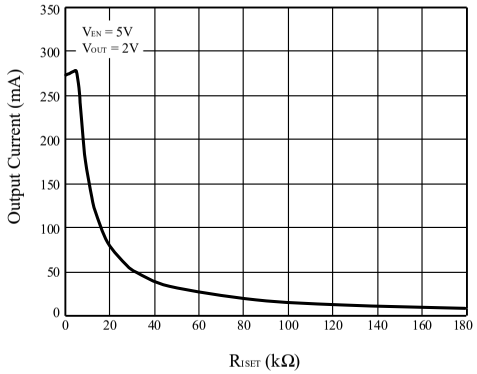


Figure 32 Output Current vs. R_{ISET}

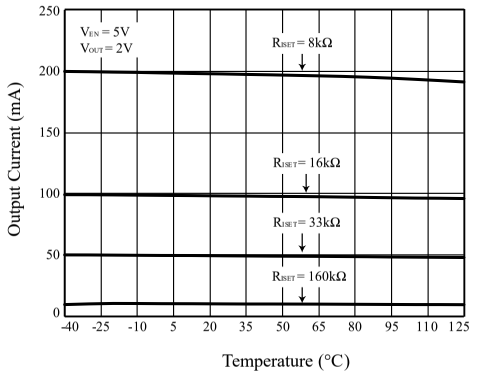


Figure 33 Output Current vs. Temperature

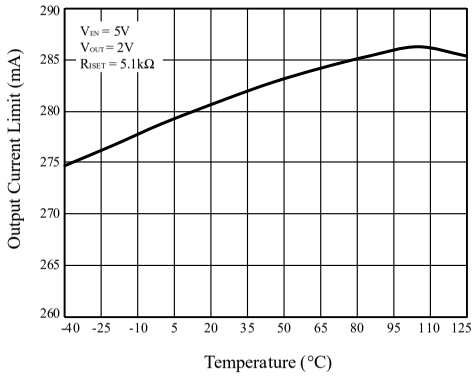


Figure 34 Output Current Limit vs. Temperature

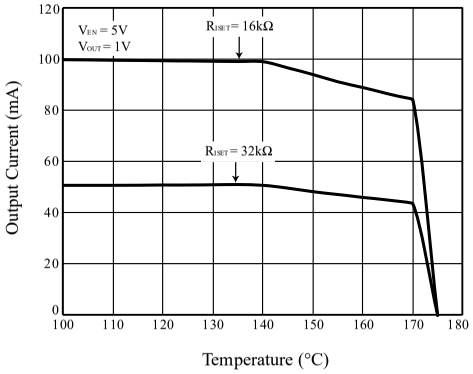


Figure 35 Output Current vs. Temperature (Thermal Roll Off)

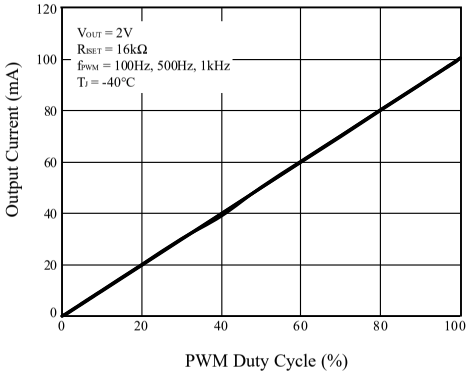


Figure 36 Output Current vs. PWM Duty Cycle

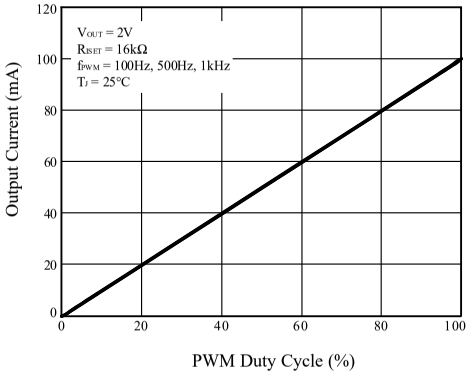


Figure 37 Output Current vs. PWM Duty Cycle

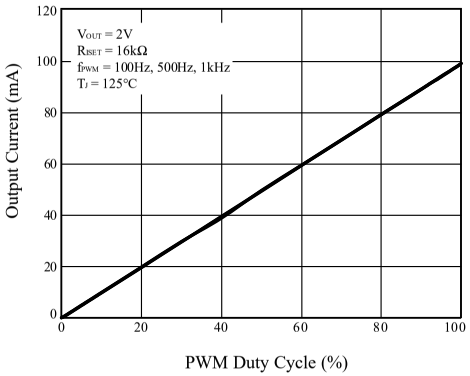


Figure 38 Output Current vs. PWM Duty Cycle

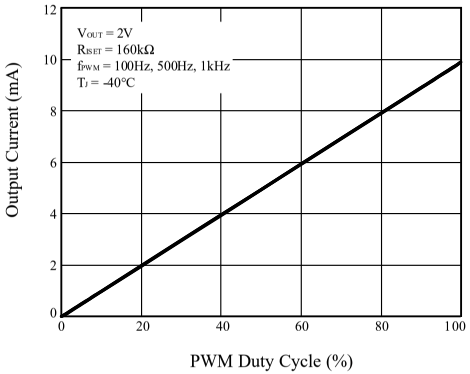


Figure 39 Output Current vs. PWM Duty Cycle

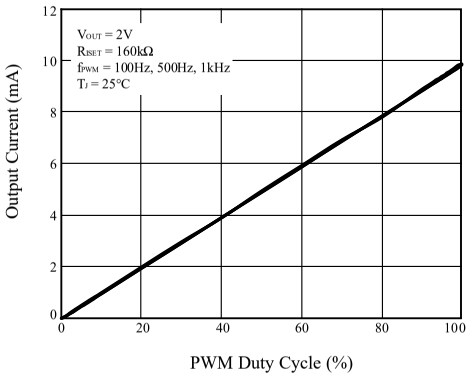


Figure 40 Output Current vs. PWM Duty Cycle

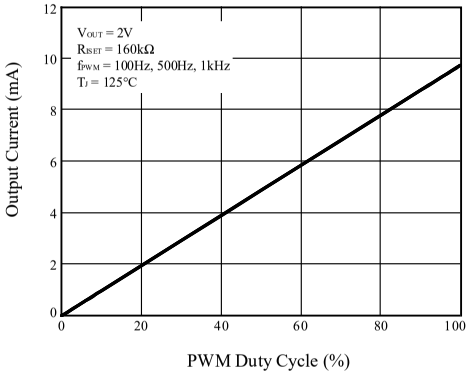


Figure 41 Output Current vs. PWM Duty Cycle

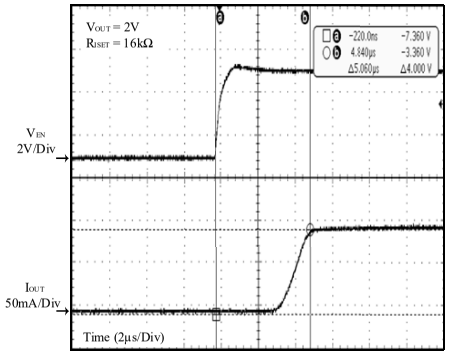


Figure 42 Start Up

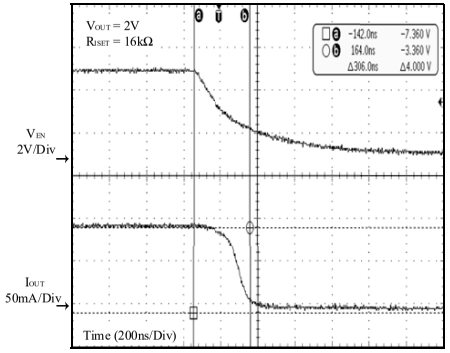


Figure 43 Shut Down

APPLICATIONS INFORMATION

IS32LT3177/78 provides an easy constant current sink solution for LED lighting applications. It uses an external resistor to adjust the LED current from 10mA to 150mA (SOT23-6)/200mA (SOP-8-EP). The LED current can be determined by the external resistor R_{ISET} as Equation (1):

$$R_{ISET} = \frac{V_{ISET} \times 1600}{I_{SET}} \qquad (1)$$

10.6kΩ≤R_{ISET}≤160kΩ for SOT23-6 package, and 8kΩ≤R_{ISET}≤160kΩ for SOP-8-EP package.

Where R_{ISET} is in Ω, I_{SET} is desired LED current in Amp and V_{ISET} = 1.0V (Typ.)

R_{ISET} must be a 1% accuracy resistor with good temperature characteristics in order to ensure stable output current. The device limits the maximum output current to I_{OUT_LIMIT} to protect itself from an output overcurrent condition caused by a low value. Do not leave ISET pin floating.

HIGH INPUT VOLTAGE APPLICATION

When driving a long string of LEDs whose total forward voltage drop exceeds the IS32LT3177 V_{BD_OUT} limit of 40V, it is possible to stack several LEDs (such as 2 LEDs) between the EN pin and the OUT pins, and so the voltage on the EN pin is higher than 5V. The remaining string of LEDs can then be placed between power supply $+V_S$ and EN pin, (Figure 44). The number of LEDs required to stack at EN pin will depend on the LED's forward voltage drop (V_F) and the $+V_S$ value.

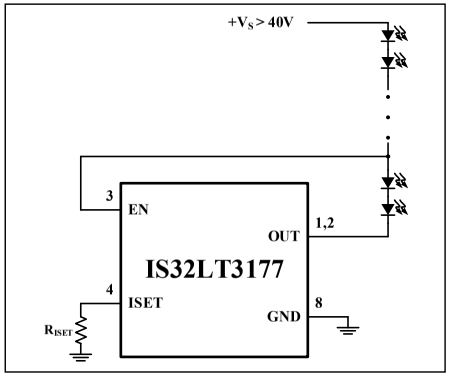


Figure 44 High Input Voltage Application Circuit

Note: when operating the IS32LT3177 at voltages exceeding the device operating limits, care needs to be taken to keep the EN pin and OUT pin voltage below 40V.

THERMAL PROTECTION AND DISSIPATION

The IS32LT3177/78 implements thermal roll off protection to reduce the LED current when the package's thermal dissipation is exceeded and prevent "thermal runaway". The thermal roll off begins from 145°C, and linearly decreases following the junction temp to 85% of the set current value at T_{SD} (170°C). Please see Figure 14 and 35. In the event that the junction temperature exceeds 170°C, the device will go into shutdown mode. At this point, the IC begins to cool off and will resume operation once the junction temperature goes below 140°C.

When operating the chip at high ambient temperatures, or when driving maximum load current, care must be taken to avoid exceeding the package power dissipation limits. Exceeding the package dissipation will cause the device to enter thermal protection mode. The maximum package power dissipation can be calculated using the following Equation (2):

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}} \qquad (2)$$

Where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance; a metric for the relative thermal performance of a package.

The recommended maximum operating junction temperature, $T_{J(MAX)}$, is 125°C and so the maximum ambient temperature is determined by the package parameter; θ_{JA}. The θ_{JA} for the IS32LT3177/78 SOT23-6 package is 130°C/W and SOP-8-EP package is 43.1°C/W.

Therefore the maximum power dissipation at T_A= 25°C is:

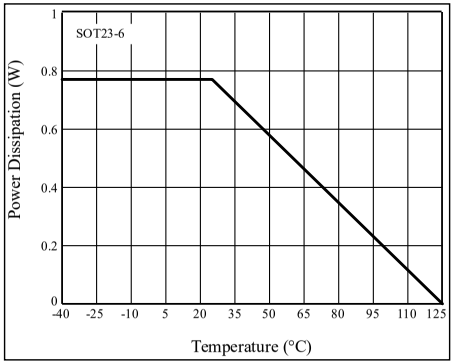
$$P_{D(MAX)} = \frac{125°C - 25°C}{130°C/W} \approx 0.77W \quad \text{(SOT23-6)}$$

$$P_{D(MAX)} = \frac{125°C - 25°C}{43.1°C/W} \approx 2.32W \quad \text{(SOP-8-EP)}$$

The actual power dissipation P_D is:

$$P_D = V_{OUT} \times I_{OUT} + V_{EN} \times I_{EN} \qquad (3)$$

To ensure optimum performance, the die temperature (T_J) of the IS32LT3177/78 should not exceed 125°C. The graph below gives details for the package power derating.



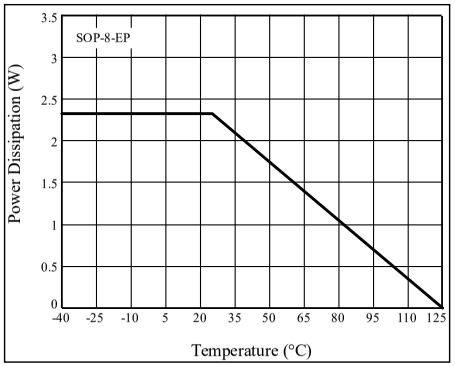


Figure 45 P_D vs. T_A

A lower thermal resistance is achieved by mounting the IS32LT3177/78 on a standard FR4 double-sided printed circuit board (PCB) with a grounded copper area of a few square inches on each side of the board under the IS32LT3177/78. Multiple thermal solid vias (not web or spoke type), as shown in Figure 46, help to conduct heat from the exposed pad of the IS32LT3177/78 to the grounded copper area on each side of the board. The recommended via diameter is 0.5mm with spacing of 1mm. The thermal resistance can be further reduced by using a metal-clad PCB or by adding a heatsink.

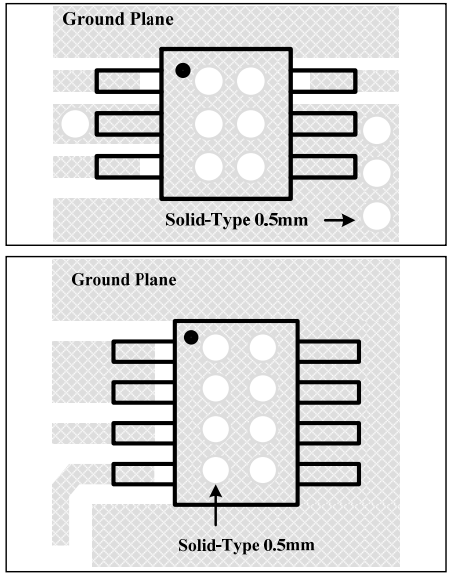


Figure 46 Board Via Layout For Thermal Dissipation

CLASSIFICATION REFLOW PROFILES

Profile Feature	Pb-Free Assembly
Preheat & Soak Temperature min (Tsmin) Temperature max (Tsmax) Time (Tsmin to Tsmax) (ts)	150°C 200°C 60-120 seconds
Average ramp-up rate (Tsmax to Tp)	3°C/second max.
Liquidous temperature (TL) Time at liquidous (tL)	217°C 60-150 seconds
Peak package body temperature (Tp)*	Max 260°C
Time (tp)** within 5°C of the specified classification temperature (Tc)	Max 30 seconds
Average ramp-down rate (Tp to Tsmax)	6°C/second max.
Time 25°C to peak temperature	8 minutes max.

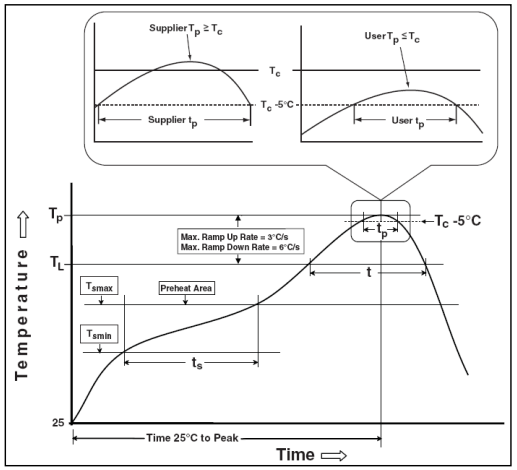
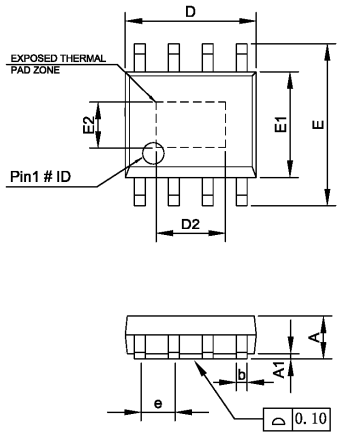
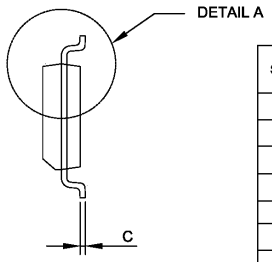


Figure 47 Classification Profile

PACKAGE INFORMATION

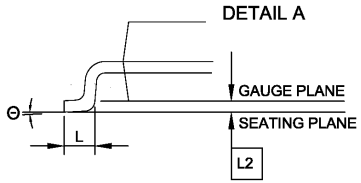
SOP-8-EP





SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	–	–	1.70
A1	–	–	0.15
E1	3.70	3.90	4.10
E	5.80	6.00	6.20
D	4.70	4.90	5.10
b	0.31	–	0.51
e	1.27BSC		
L	0.40	–	1.27
L2	0.25BSC		
θ	0°	–	8°
C	0.10	–	0.25
D2	1.50	–	–
E2	1.00	–	–

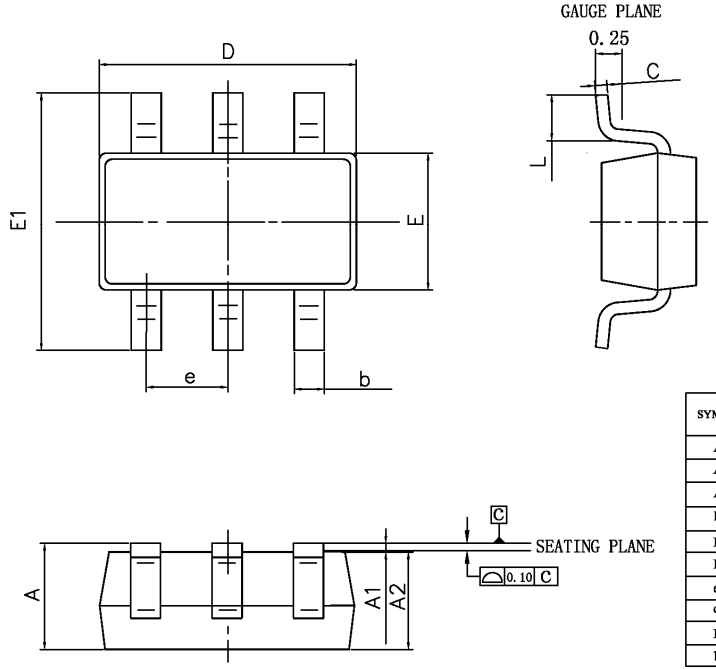
233-570-289 Rev. B



NOTE :

1. CONTROLLING DIMENSION : MM
2. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION.
4. REFERENCE DOCUMENT: JEDEC MS-012
5. THE SHAPE OF BODY AND THERMAL PAD SHOW DIFFERENT SHAPE AMONG DIFFERENT FACTORIES.

SOT-23-6

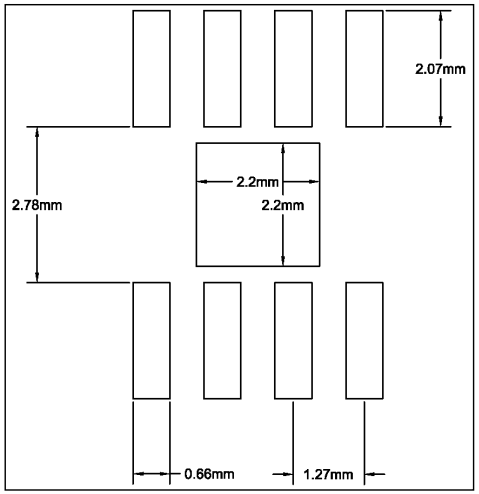


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.35
A1	0.00	0.05	0.10
A2	1.00	1.10	1.20
D	2.72	2.92	3.12
E1	2.60	2.80	3.00
E	1.40	1.60	1.80
e	0.95BSC		
c	0.10	—	0.20
L	0.30	0.40	0.60
b	0.30	0.40	0.50

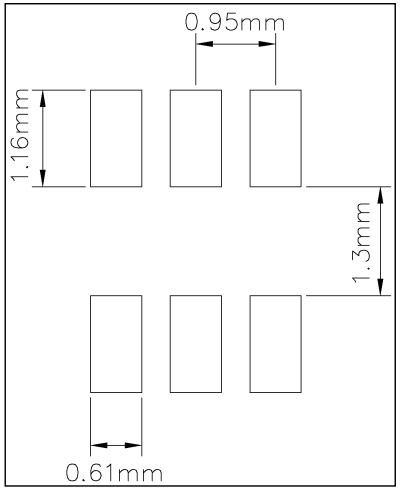
233-570-255 Rev. A

RECOMMENDED LAND PATTERN

SOP-8-EP



SOT-23-6



Note:

1. Land pattern complies to IPC-7851.
2. All dimensions in MM.
3. This document (including dimensions, notes & specs) is a recommendation based on typical circuit board manufacturing parameters. Since land pattern design depends on many factors unknown (eg. User's board manufacturing specs), user must determine suitability for use.

REVISION HISTORY

Revision	Detail Information	Date
0A	Initial release	2018.08.06
0B	1. Update FEATURES information 2. Update SOP-8-EP POD 3. Update V_{EN} value	2018.11.20
A	1. Add note 4 for Figure 1 2. Update EC table	2019.04.03
B	Revise I_{OUT_LIMIT} typical value to 295mA	2020.09.25
C	1. Update to new Lumissil logo 2. Add RoHS and update AECQ information 3. EC condition “T_J = T_A = ” changes to “T_J= ”	2024.06.06

Reference

[1] *TE ECK100BH5AAA Datasheet*. www.te.com, 11.2024