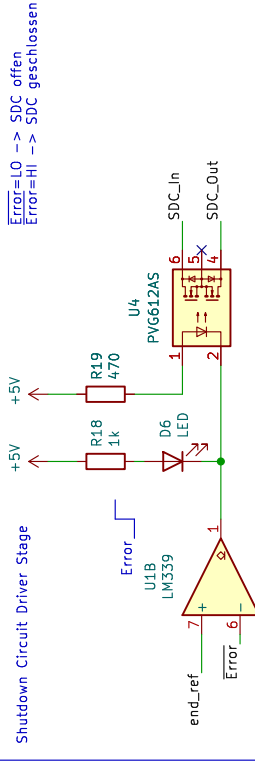
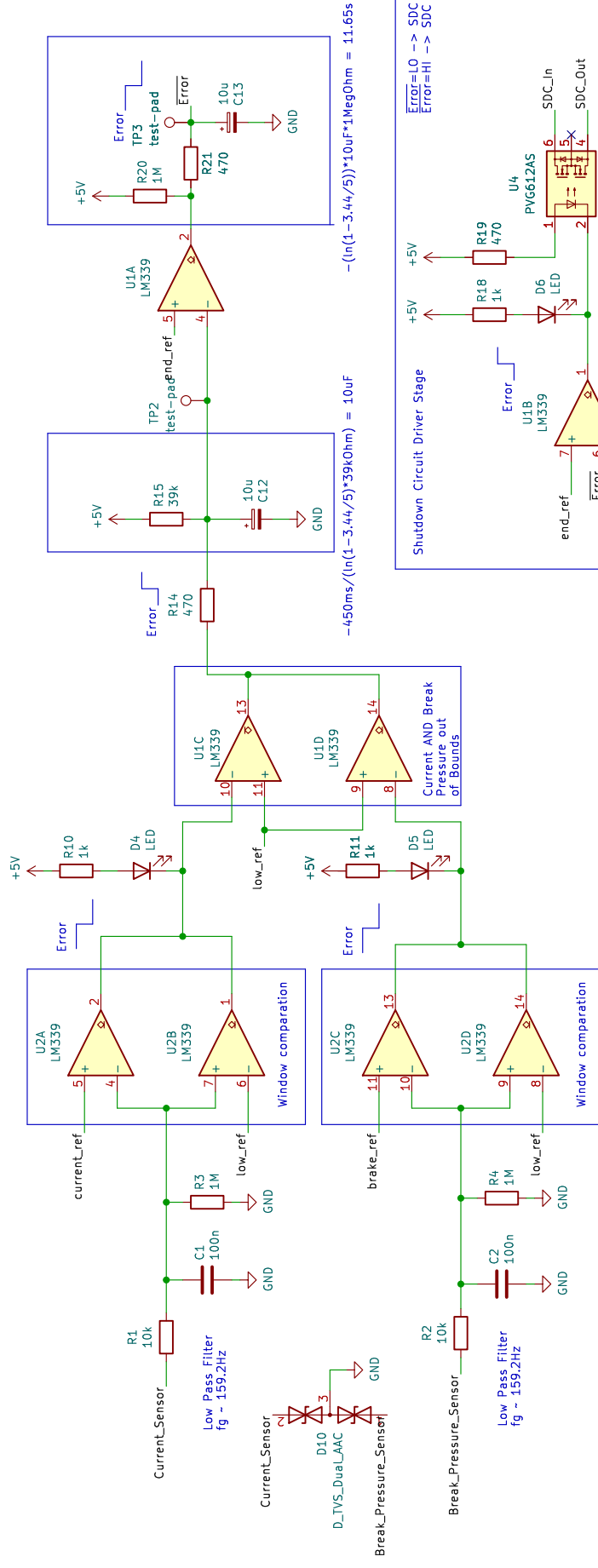


Electrical Scrutineering

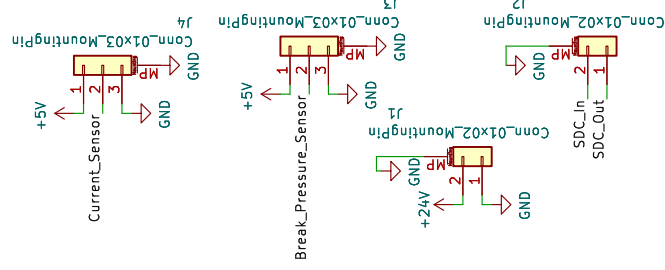
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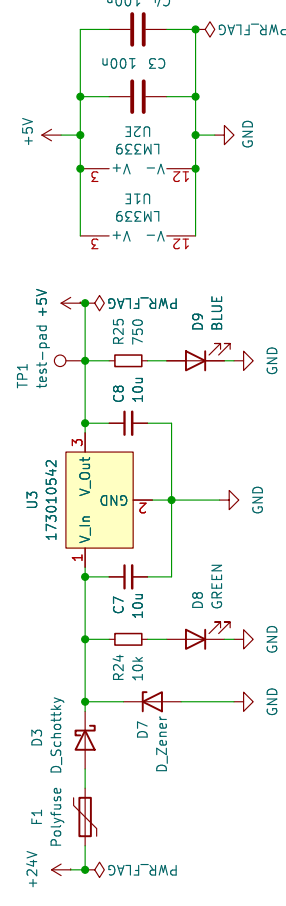
BSFD



Connector



Power

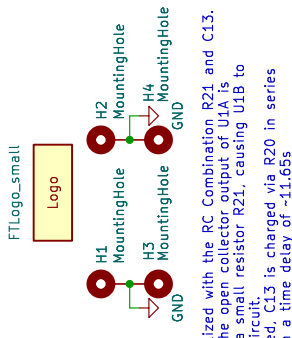


Power Limit = 5kW
 TS Maximum Voltage = 403V
 5kW/403.2V = 12.401A

Current Sensor Comparator Voltage (LEM HO 50-S):
 Sensor Offset = 2.5V
 Sensitivity = 0.016V/A (range: -125A+125A, output:
 => 2.5V + 0.016V/A * 12.401A = 2.698V

ADZ SME 700bar pressure sensor
 Radiometric output from 0.5V-4.5V ==> 0..200bar
 => 0.020 V/bar

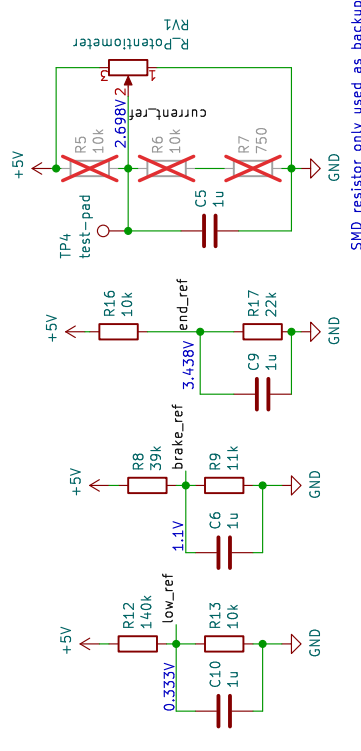
Break Pressure Sensor Voltage:
 0.5V + 30bar * 0.020V/bar = 1.1V



Error Latching is realized with the RC Combination R21 and C13. In case of an Error the open collector output of U1A is discharging C13 via a small resistor R21, causing U1B to open the Shutdown Circuit.

If the Error is removed, C13 is charged via R20 in series with R21, resulting in a time delay of ~1.65s

Voltage References



SMD resistor only used as backup

FASTUBE

Rev: V1

Rev. VI
Date: 2025-03-20

Project: ET25 BSPD

Author: Johnny Hsu

Size: A4 Page: 1/1

BEDIENUNGSANLEITUNG

Drucktransmitter in Miniturbauform

Baureihe SME

Einbau und Inbetriebnahme sind nach dieser Bedienungsanleitung und nur von autorisiertem Personal vorzunehmen.



(Abbildung ähnlich)

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OPERATING INSTRUCTIONS

Pressure Transmitter in Miniature Design

SME Series

This product must be installed and taken into operation in accordance with these Operating Instructions and by authorized personnel only.



(similar image)

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MANUEL D'UTILISATION

Transmetteur de pression dans la conception miniature

Gamme SME

L'installation et la mise en marche sont à réaliser conformément aux instructions décrites dans ce manuel d'utilisation et exclusivement par un personnel certifié.



(Représentation similaire)

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Technische Daten *

Typ	Spannung	Spannung radiometrisch
Ausgangssignal*	0...5 V _{cc}	0,5...4,5 V _{cc}
Betriebsspannung (U _B)	8...32 V _{cc}	5 V _{cc} ±10%
zulässiger Lastwiderstand (R _L)	> 2,5 KΩ	> 4,7 KΩ
Genauigkeit*	≤ 0,5% full scale bei Raumtemperatur	
Druckbereich	siehe Typenschild	
Einstellzeit	< 1 ms	
Temperaturbereich*	-40...125°C Messmedium -40...85°C Umgebung	
Gewicht	~20 g (abhängig von der Ausführung)	
Abmessungen	Abhängig von der Bauform (Gewinde, elektr. Anschluss, usw.)	
IP Schutzklasse*	IP67 bei Flanschstecker M5x0,5 / Kabel	
Werkstoff*	Gehäuse: Edelstahl Membran: Edelstahl	

Technical specifications *

Type	Voltage	Radiometric voltage
output signal*	0...5 V _{cc}	0,5...4,5 V _{cc}
Operating voltage (U _B)	8...32 V _{cc}	5 V _{cc} ±10%
Admissible load resistance (R _L)	> 2,5 KΩ	> 4,7 KΩ
Precision*	≤ 0,5% full scale at room temperature	
Pressure range	See type plate	
Time of adjustment*	< 1 ms	
Temperature range*	-40...125°C measuring medium -40...85°C ambient	
Weight	~20 g (dependent on version)	
Dimensions	Dependent on design (thread, electrical connection, etc.)	
IP protection class*	IP67 for flange plug M5x0,5 / cable	
Material applied*	Housing: stainless steel Membrane: stainless steel	

Données techniques *

Type	Tension	Tension quotientométrique
Signal de sortie*	0...5 V _{cc}	0,5...4,5 V _{cc}
Tension d'utilisation (U _B)	8...32 V _{cc}	5 V _{cc} ±10%
Impédance admise de charge (R _L)	> 2,5 KΩ	> 4,7 KΩ
Précision*	≤ 0,5% de la déviation max. à température ambiante	
Classe de pression	Voir la plaquette indicatrice	
Temps de réponse*	< 1 ms	
Gamme de température*	-40...125°C fluide de mesure -40...85°C conditions ambiantes	
Poids	~20 g (selon la mise en œuvre)	
Dimensions	Selon le modèle de construction (filet, raccord électrique, etc.)	
Classe de protection IP*	IP67 par prise femelle à bride M5x0,5 / câble	
Matériau*	Boltier : acier inoxydable Membrane: acier inoxydable	

Anschlüsse *

Kabelausgang
Strom
rt : UB+
sw: UB-
ws: out

Der elektrische Anschluss muss entsprechend dem jeweiligen Anschlussschema erfolgen, soweit keine anderen vereinbart wurden.

* Kundenspezifische Anpassungen sind realisierbar.

Connections *

Cable port
Power
red : UB+
black: UB-
white: out

The electrical connection must be made in accordance with the respective connection diagram unless otherwise agreed upon.

* Custom-made adjustments are possible.

Raccords *

Sortie du câble
Tension
rouge: UB+
noir: UB-
blanc: out

Les raccords électriques doivent se faire conformément au schéma concerné, sauf accords différents.

* Modifications possibles, à la demande du client.

Vorraussetzungen für den Produkteinsatz	Requirements of product application	Conditions d'utilisation du produit
 Allgemeine, stets zu beachtende Hinweise für den ordnungsgemäßen und sicheren Einsatz des Drucktransmitters: · Befolgen Sie unbedingt die Hinweise und Warnungen in dieser Bedienungsanleitung. · Beachten Sie bei Installation und Betrieb des Drucktransmitters die BG-Vorschriften / Unfallverhütungsvorschriften der Berufsgenossenschaften, des Technischen Überwachungsvereins (TÜV) oder die entsprechenden nationalen Bestimmungen Ihres Landes. · Die Drucktransmitter der Baureihe SME sind für das Erfassen des Druckes in Anlagen und Systemen mit gasförmigen und flüssigen Medien geeignet. · Halten Sie die angegebenen Grenzwerte dieser Bedienungsanleitung bzw. des technischen Datenblattes wie z.B. Drücke, Kräfte und Temperaturen ein. · Berücksichtigen Sie die vorherrschenden Umgebungsbedingungen (Temperatur, Luftdruck, Luftfeuchtigkeit, etc.). · Setzen Sie das Produkt niemals starken Vibrationen oder Stößen aus. · Verwenden Sie den Drucktransmitter nur im Originalzustand. Nehmen Sie keine eigenmächtigen Veränderungen daran vor. Das Gerät enthält keine Bauteile die einer Wartung bedürfen. · Entfernen Sie vor Inbetriebnahme alle Transport- und Schutzverpackungen (z. B. Schutzfolien, Kappen oder Kartons). · Entsorgen Sie die einzelnen Werkstoffe in Recycling-Sammelbehältern.	 Notes generally to be borne on the proper and safe use of the pressure transmitter: · Observe the notes and warnings of these operating instructions by all means. · When installing and taking into operation the pressure transmitter, please observe the accident prevention regulations as defined by the German Statutory Accident Insurance, by the German technical service corporation TÜV or pursuant to the national regulations applicable in your country. · Pressure transmitters of the SME series are suited for measuring pressure in plants and systems with gaseous and liquid media. · Please observe the limit values defined in these Operating Instructions or the technical specification sheets, such as pressure, force and temperature. · Please consider the prevailing ambient conditions (temperature, air pressure, humidity, etc.). · Never expose the product to heavy vibrations or physical impact. · Use the pressure transmitter in its original state only. Do not tamper with the product. The device contains no components that would require any maintenance. · Before taking it into operation, remove all transit or protection packaging (e.g. protective film, caps or cardboard packaging). · Dispose of the various materials by returning them to recycling banks. 	 Recommandations générales à toujours respecter pour une utilisation adaptée et sécurisée du transmetteur de pression électronique: · Suivez à la lettre les recommandations et les mises en garde contenues dans ce manuel. · Lors de l'installation et de l'utilisation du transmetteur de pression électronique, respectez les réglementations BG / les consignes de prévention des accidents du travail de la profession, du Service d'Inspection Technique (TÜV) ou les réglementations nationales correspondantes, propres à votre pays. · Les transmetteur de pression électroniques de la gamme SME sont conçus pour mesurer la pression au sein d'installations et de systèmes contenant des fluides sous forme gazeuse ou liquide. · Veillez à respecter les valeurs limites indiquées dans ce manuel et/ou dans la fiche technique pour ce qui est par ex. des pressions, des forces et des températures. · Tenez compte des conditions ambiantes (température, pression atmosphérique, humidité, etc.). · N'exposez jamais le produit à de fortes vibrations ou à des chocs intenses. · N'utilisez le transmetteur de pression que dans son état d'origine. N'entreprenez aucune modification vous-même sur l'appareil. L'appareil ne contient aucun composant qui nécessite un quelconque entretien. · Retirez l'appareil de tout emballage de transport ou de protection avant de vous en servir (films plastique, couvercles ou cartonnage par ex.). · Jetez les matériaux dans des réservoirs collecteurs de recyclage. 
Betriebsbedingungen	Operating conditions	Conditions d'utilisation
 Abweichungen von den im technischen Datenblatt angegebenen Umgebungsbedingungen (z.B. Temperaturbereich) können zur Beschädigung des Drucktransmitters führen. Die Schutzklasse IP65/IP67* ist nicht uneingeschränkt auf alle Umgebungsbedingungen übertragbar. Sie gelten (wenn nicht anders angegeben) mit angeschloss-nem Gegenstecker. Die Überprüfung, ob die eingesetzte Steckverbindung anderen als den angegebenen Bestimmungen und Vorschriften entspricht bzw. ob diese in speziellen, von uns nicht vorgesehenen Anwendungen eingesetzt werden kann, obliegt dem Anwender. Die im technischen Datenblatt angegebenen Werte für die Überdrucksicherheit (Überlast Bereich bzw. Berstdruck) beziehen sich auf den hydraulisch bzw. pneu-matisch beaufschlagten Teil des Drucktransmitters.	 Deviations from the ambient conditions as specified in the technical data sheet (such as the temperature range) may result in damage to the pressure transmitter. The Protection class IP65/IP67* is not absolutely transferable to any ambient condition. They apply (if not stated otherwise) with a counter-plug connected. It is the user's liability to check whether the connection applied corresponds with regulations and provisions other than those specified or whether such connection can be used in special applications that cannot be anticipated by us. The values quoted in the technical data sheet for excess pressure safety (excess load range or burst pressure) refer to the hydraulically or pneumatically exposed part of the pressure transmitter.	 Des variations par rapport aux conditions ambiantes mentionnées dans la fiche technique (la déviation de température par exemple) peuvent endommager le transmetteur de pression . La classe de protection IP65/IP67* n'est pas transférable à toutes les conditions ambiantes sans restriction. Elle vaut (sauf indication contraire) pour un boîtier connecté. Il revient à l'utilisateur de vérifier si le raccordement utilisé correspond à d'autres dispositions et réglementations que celles indiquées et/ou si celui-ci eut être employé pour des utilisations spéciales, non prévues par nous. Les données fournies par la fiche technique pour la sécurité surpression (domaine de surcharge et/ou pression de rupture) se réfèrent au composant du transmetteur de pression qui est soumis à une pression hydraulique et/ou pneumatique.
Einbau des Drucktransmitters	How to install the pressure transmitter	Montage du transmetteur de pression
 · Benutzen Sie den passenden Schraubenschlüssel um den Drucktransmitter in den vorgesehenen Druckanschluss einzuschrauben. Das Anzugsdrehmoment beträgt ungefähr 10 Nm. · Zum Abdichten des Systems verwenden Sie den für diesen Typ vorgeschriebenen Dichtungsring mit den entsprechenden Abmessungen. · Die gesamte Verdrahtung muss den lokalen Bestimmungen entsprechen und darf nur durch autorisiertes Personal durchgeführt werden. Hoch- und Niederspannungsleitungen sind voneinander zu trennen. Verwenden Sie ein dem Umfeld entsprechendes Kabel. Der elektrische Anschluss muss entsprechend dem jeweiligen Anschlussschema erfolgen, soweit keine anderen vereinbart wurden. Ansonsten kann es zum Ausfall/Zerstörung führen. Auf quetschfreie Kabelverlegung ist zu achten.  Achten Sie auf eine korrekte Lage aller Dichtungen und eine sachgemäße Montage, da sonst die IP Schutzklasse nicht garantiert werden kann	 · Use an appropriate wrench to insert the pressure transmitter into the respective pressure connection. The torque is approximately 10 Nm. · For sealing the system, use the sealing ring of the respective dimensions specified for this type. · The entire wiring must meet local regulations and must be performed by authorized personnel only. High and low voltage lines are to be kept separate. Use cable that is appropriate to the installation environment. Electrical power must be connected in accordance with the respective connection diagram, unless otherwise agreed upon. Damage/destruction may result otherwise. · Do not crush cables.  Provide for correctly positioning all seals and for appropriate assembly, since otherwise the IP protection class cannot be warranted.	 · Utilisez la bonne clé pour visser le transmetteur de pression dans le connecteur côté refoulement prévu à cet effet. Le couple de serrage est d'environ 10 Nm. · Utilisez, pour étanchéifier le système, le joint d'étanchéité prévu pour le modèle et aux dimensions adaptées. · L'ensemble du câblage doit respecter les réglementations locales et ne peut être réalisé que par un personnel certifié. Il faut faire la distinction entre lignes à haute et à basse tension. Utilisez un câble adapté à l'environnement. La connexion électrique doit se faire en respectant le schéma correspondant, sauf accords différents. Sans quoi on peut assister à une défaillance/détérioration du produit. · Attention à ce que les câbles ne soient pas écrasés sur leur trajectoire.  Prenez garde à ce que toutes les garnitures d'étanchéité soient en bon état et à ce que le montage soit adéquat, sans quoi la classe de protection IP ne peut être garantie.
Ausbau des Drucktransmitters	How to remove the pressure transmitter	Démontage du transmetteur de pression
 · Achten Sie auf die Einhaltung der notwendigen Sicherheitsbestimmungen beim Ausbau des Drucktransmitters. · Das Drucksystem muss sich beim Demontieren in einem drucklosen Zustand befinden.	 · Please observe applicable safety regulations when removing the pressure transmitter. · When disassembling the pressure system, it must be depressurized.	 · Prenez garde à respecter les consignes de sécurité propres au démontage du transmetteur de pression · Le système de pression ne doit être soumis à aucune pression lors du démontage.
Zeichenerklärung	Signs and symbols	Légende
 Hinweis  Achtung  Gefahr  Recycling	 Note  Caution  Danger  Recycling	 Remarque  Attention  Danger  Recyclage
Änderungen im Sinne des technischen Fortschritts vorbehalten. Stand: Dezember - 2010 Rev. 1	Subject to change due to technical progress. Reviewed last: December - 2010 Rev. 1	Sous réserve de modifications servant le progrès technique. État: Décembre-2010 Rev. 1

Microelectronic Power IC

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

General Description

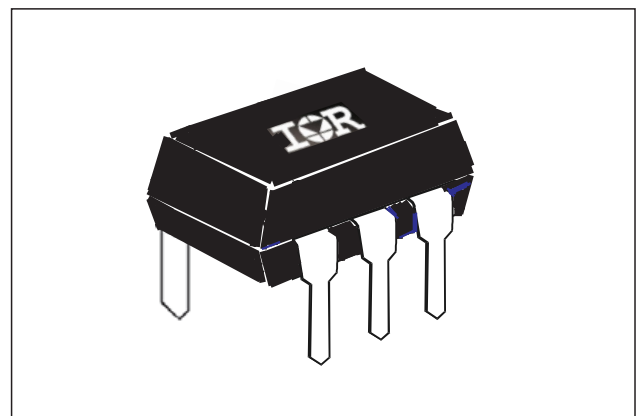
The PVG612A Series Photovoltaic Relay is a single-pole, normally open solid-state relay that can replace electromechanical relays in many applications. It utilizes International Rectifier's proprietary HEXFET power MOSFET as the output switch, driven by an integrated circuit photovoltaic generator of 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 ruggedness. 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 ($-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ unless otherwise specified)

INPUT CHARACTERISTICS	Limits	Units
Minimum Control Current (see figure 1)	5.0	mA
Maximum Control Current for Off-State Resistance @ $T_A = +25^{\circ}\text{C}$	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

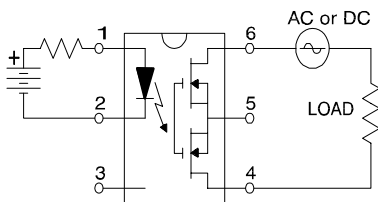
OUTPUT CHARACTERISTICS	Limits	Units
Operating Voltage Range	0 to ± 60	$V_{(\text{DC or AC peak})}$
Maximum Continuous Load Current @ $T_A = +40^{\circ}\text{C}$, 10mA Control (see figure 1)		
A Connection	2.0	A (AC or DC)
B Connection	2.5	A (DC)
C Connection	4.0	A (DC)
Maximum Pulsed Load Current @ $T_A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

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

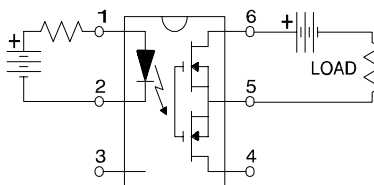
International Rectifier does not recommend the use of this product in aerospace, avionics, military or life support applications. Users of this International Rectifier product in such applications assume all risks of such use and indemnify International Rectifier against all damages resulting from such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

Connection Diagrams

"A" Connection



"B" Connection



"C" Connection

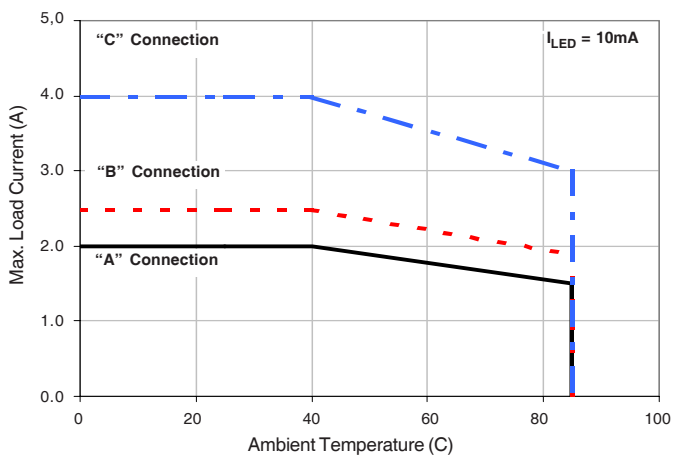
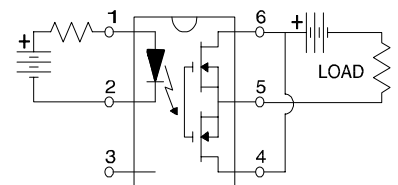


Figure 1. Current Derating Curves

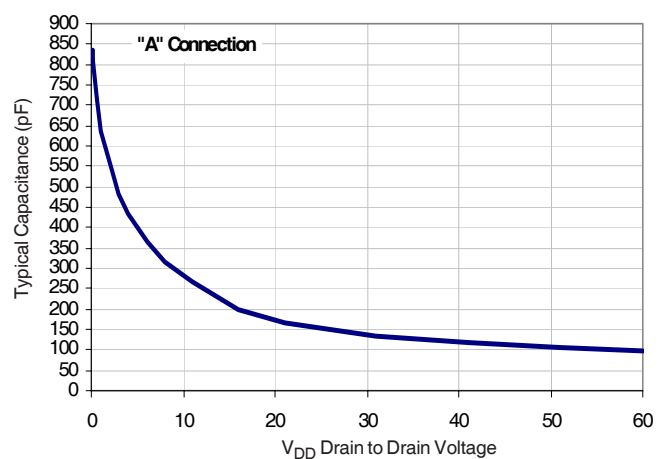


Figure 2. Typical Output Capacitance

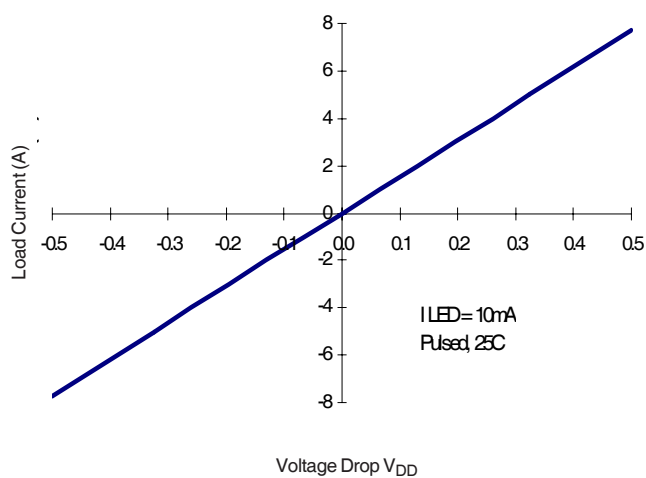


Figure 3. Typical Linearity Characteristics

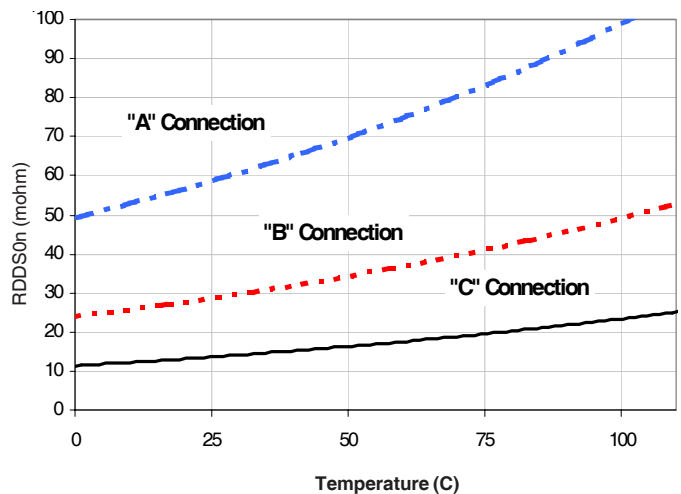


Figure 4. Typical Normalized On-Resistance

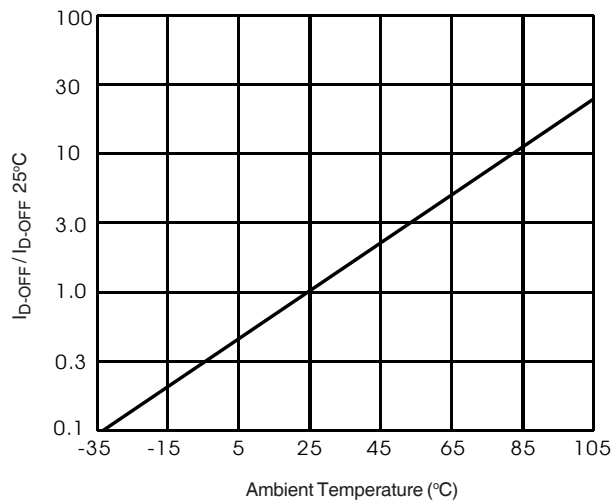


Figure 5. Typical Normalized Off-State Leakage

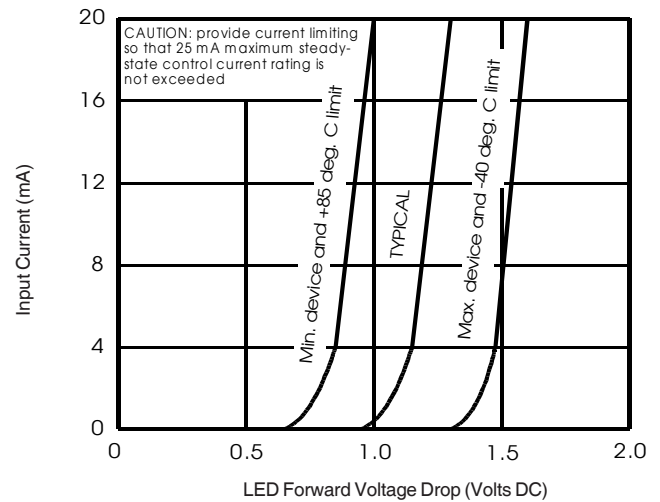


Figure 6. Input Characteristics (Current Controlled)

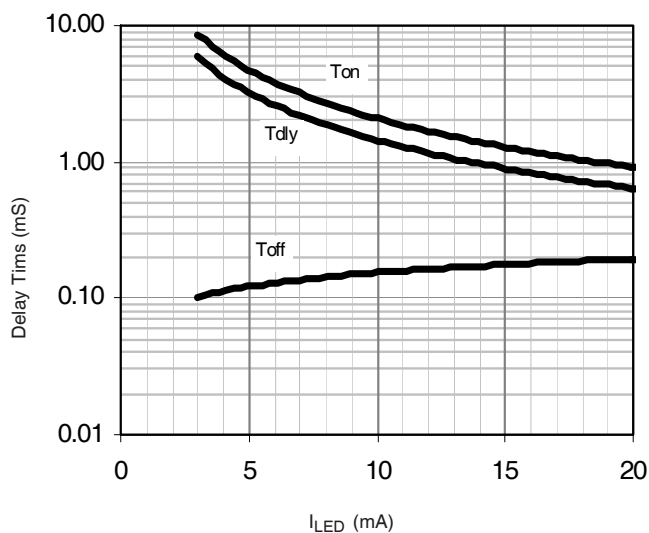


Figure 7. Typical Delay Times

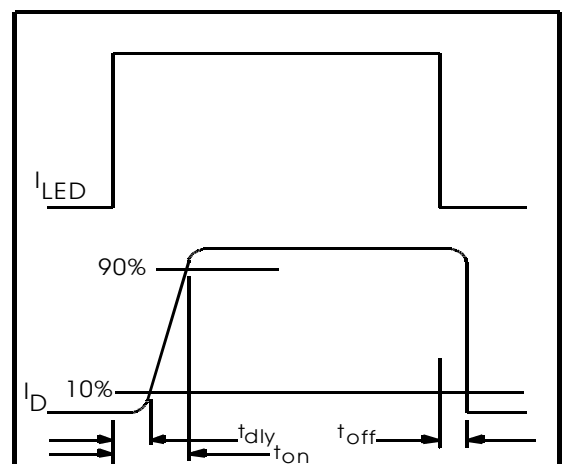


Figure 8. Delay Time Definitions

Current Transducer HO-S series

$I_{PN} = 50, 100, 150, 200, 240, 250 \text{ A}$

Ref: HO 50-S, HO 100-S, HO 150-S, HO 200-S, HO 240-S, HO 250-S

For the electronic measurement of current: DC, AC, pulsed..., with galvanic separation between the primary and the secondary circuit.



Features

- Open loop multi-range current transducer
- Voltage output
- Single power supply +5 V
- Overcurrent detection $2.93 \times I_{PN}$ (peak value)
- Galvanic separation between primary and secondary circuit
- Low power consumption
- Compact design for panel mounting
- Aperture: $15 \times 8 \text{ mm}$
- Factory calibrated
- Connection mating with JST:
 - housing PHR-5
 - contact SPH-00xT
- Repositionable mounting foot
- **Dedicated parameter settings available on request (see page 14).**

Advantages

- Low offset drift
- Over-drivable U_{ref}
- 8 mm creepage /clearance
- Fast response
- Low profile 2 mm pitch connector for 24 to 32 AWG wire.

Applications

- AC variable speed and servo motor drives
- Static converters for DC motor drives
- Battery supplied applications
- Uninterruptible Power Supplies (UPS)
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications
- Combiner box
- MPPT.

Standards

- IEC 61800-1: 1997
- IEC 61800-2: 2015
- IEC 61800-3: 2004
- IEC 61800-5-1: 2007
- IEC 62109-1: 2010
- UL 508: 2013.

Application Domain

- Industrial.

Absolute maximum ratings

Parameter	Symbol	Unit	Value
Supply voltage (not destructive)	U_C	V	8
Supply voltage (not entering non standard modes)	U_C	V	6.5
Primary conductor temperature	T_B	°C	120
Electrostatic discharge voltage	U_{ESD}	kV	2

Stresses above these ratings may cause permanent damage. Exposure to absolute maximum ratings for extended periods may degrade reliability.

UL 508: Ratings and assumptions of certification

File # E189713 Volume: 2 Section: 5

Standards

- CSA C22.2 NO. 14-10 INDUSTRIAL CONTROL EQUIPMENT - Edition 12
- UL 508 STANDARD FOR INDUSTRIAL CONTROL EQUIPMENT - Edition 17

Ratings

Parameter	Symbol	Unit	Value
Primary involved potential		V AC/DC	600
Max surrounding air temperature	T_A	°C	105
Primary current	I_P	A	According to series primary current
Secondary supply voltage	U_C	V DC	5
Output voltage	U_{out}	V	0 to 5

Conditions of acceptability

- 1 - These devices have been evaluated for overvoltage category III and for use in pollution degree 2 environment.
- 2 - A suitable enclosure shall be provided in the end-use application.
- 3 - The terminals have not been evaluated for field wiring.
- 5 - Primary terminals shall not be straightened since assembly of housing case depends upon bending of the terminals.
- 6 - Any surface of polymeric housing have not been evaluated as insulating barrier.
- 7 - Low voltage control circuit shall be supplied by an isolating source (such as a transformer, optical isolator, limiting impedance or electro-mechanical relay).

Marking

Only those products bearing the UR Mark should be considered to be Listed or Recognized and covered under UL's Follow-Up Service. Always look for the Mark on the product.

Insulation coordination

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC insulation test 50/60 Hz/1 min	U_d	kV	4.3	
Impulse withstand voltage 1.2/50 μ s	U_{Ni}	kV	8	
Partial discharge RMS test voltage (adjusted $q_m < 10$ pC)	U_t	V	1500	Busbar / Secondary, jumpers/ secondary
Clearance (pri. - sec.)	d_{Cl}	mm	> 8	Shortest distance through air
Creepage distance (pri. - sec.)	d_{Cp}	mm	> 8	Shortest path along device body
Clearance (pri. - sec.)	-	mm	> 8	When mounted on PCB with recommended layout
Case material	-	-		V0 according to UL 94
Comparative tracking index	CTI		600	
Application example	-	V	600	Reinforced insulation according to IEC 61800-5-1, CAT III PD2
Application example	-	V	1000	Basic insulation according to IEC 61800-5-1, CAT III PD2

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Ambient operating temperature	T_A	°C	-40		105	
Ambient storage temperature	$T_{A st}$	°C	-40		105	
Mass	m	g		32		

Electrical data HO 50-S-0100

At $T_A = 25\text{ °C}$, $U_C = +5\text{ V}$, $R_L = 10\text{ k}\Omega$ unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

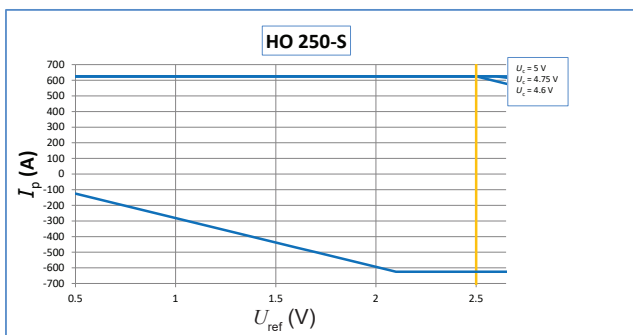
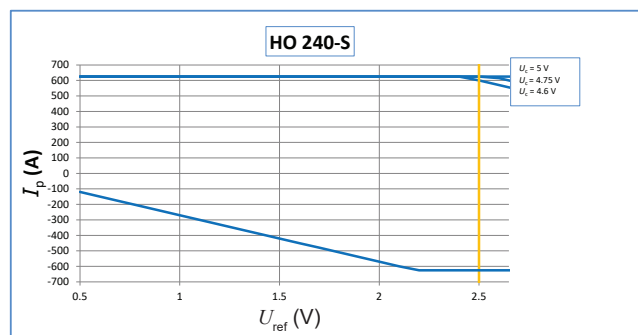
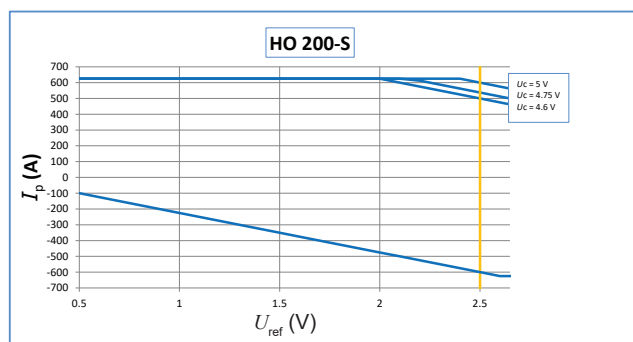
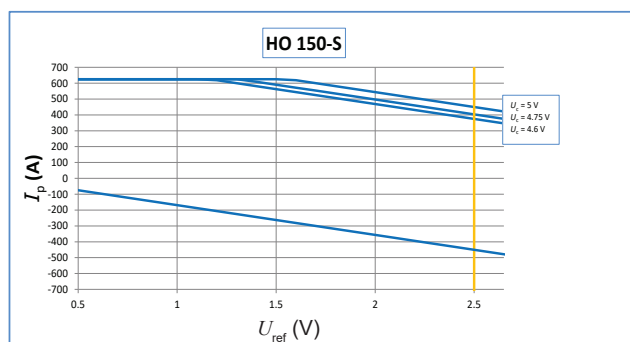
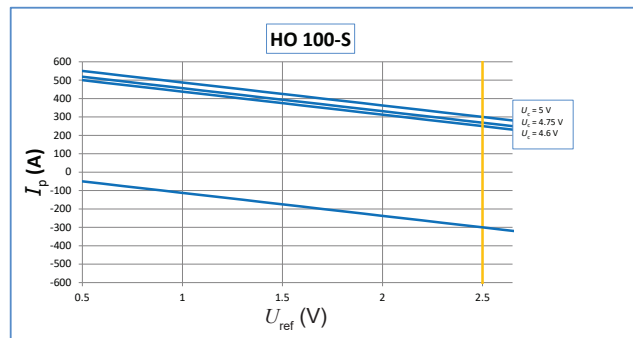
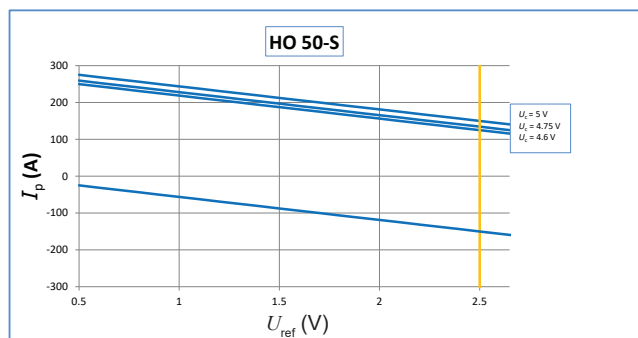
Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		50		
Primary current, measuring range	I_{PM}	A	-125		125	@ $U_C \geq 4.6\text{ V}$
Number of primary turns	N_P	-		1		See application information
Supply voltage ¹⁾	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage (output)	U_{ref}	V	2.48	2.5	2.52	Internal reference
Reference voltage (input)	U_{ref}	V	0.5		2.65	External reference
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	-2		2	Over operating temperature range
U_{ref} output resistance	R_{ref}	Ω	130	200	300	Series
U_{out} output resistance	R_{out}	Ω		2	5	Series
Load capacitance	C_L	nF	0		6	
OCD output on resistance	$R_{on\text{ OCD}}$	Ω	70	95	150	Open drain, active low Over operating temperature range
OCD detection hold time	$t_{hold\text{ OCD}}$	ms	0.7	1	1.4	Additional time after threshold has released
EEPROM control	U_{out}	mV	0		50	U_{out} forced to GND when EEPROM in an error state ²⁾
Electrical offset voltage @ $I_P = 0\text{ A}$	U_{OE}	mV	-5		5	$U_{out} - U_{ref}$ @ $U_{ref} = 2.5\text{ V}$
Electrical offset current referred to primary	I_{OE}	A	-0.3125		0.3125	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	-170		170	-40 °C ... 105 °C
Temperature coefficient of U_{OE}	TCU_{OE}	mV/K	-0.075		0.075	-40 °C ... 105 °C
Temperature coefficient of I_{OE}	TCI_{OE}	mA/K	-4.69		4.69	-40 °C ... 105 °C
External detection threshold sensitivity	S_{th}	mV/A		16		800 mV @ I_{PN}
Sensitivity error @ I_{PN}	ε_S	%	-0.5		0.5	Factory adjustment (straight bus-bar)
Temperature coefficient of S	TCS	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	-0.75		0.75	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	-0.5		0.5	
Magnetic offset current (@ $10 \times I_{PN}$) referred to primary	I_{OM}	A	-0.92		0.92	One turn
Delay time to 10 % of the final output value I_{PN} step	t_{D10}	μs			2.5	@ 50 A/ μs
Delay time @ 90 % of the final output value I_{PN} step	t_{D90}	μs			3.5	@ 50 A/ μs
Frequency bandwidth (-3 dB)	BW	kHz		100		Small signals
Noise voltage spectral density (100 Hz ... 100 kHz)	u_{no}	$\mu\text{V}/\sqrt{\text{Hz}}$			10.2	
RMS noise voltage (DC ... 10 kHz) (DC ... 100 kHz) (DC ... 1 MHz)	U_{no}	mVpp		5.6 16.3 30.6		
Primary current, detection threshold	I_{PTh}	A	$2.64 \times I_{PN}$	$2.93 \times I_{PN}$	$3.22 \times I_{PN}$	Peak value $\pm 10\%$, overcurrent detection OCD
Sum of sensitivity and linearity error @ I_{PN}	ε_{SL}	% of I_{PN}	-1.25		1.25	
Sum of sensitivity and linearity error @ I_{PN} @ $T_A = +105\text{ °C}$	ε_{SL105}	% of I_{PN}	-4.80		4.80	See formula note ³⁾
Sum of sensitivity and linearity error @ I_{PN} @ $T_A = +85\text{ °C}$	ε_{SL85}	% of I_{PN}	-3.91		3.91	See formula note ³⁾

Notes: ¹⁾ 3.3 V SP version available

²⁾ EEPROM in an error state makes the transducer behave like a reverse current saturation. Use of the OCD may help to differentiate the two cases

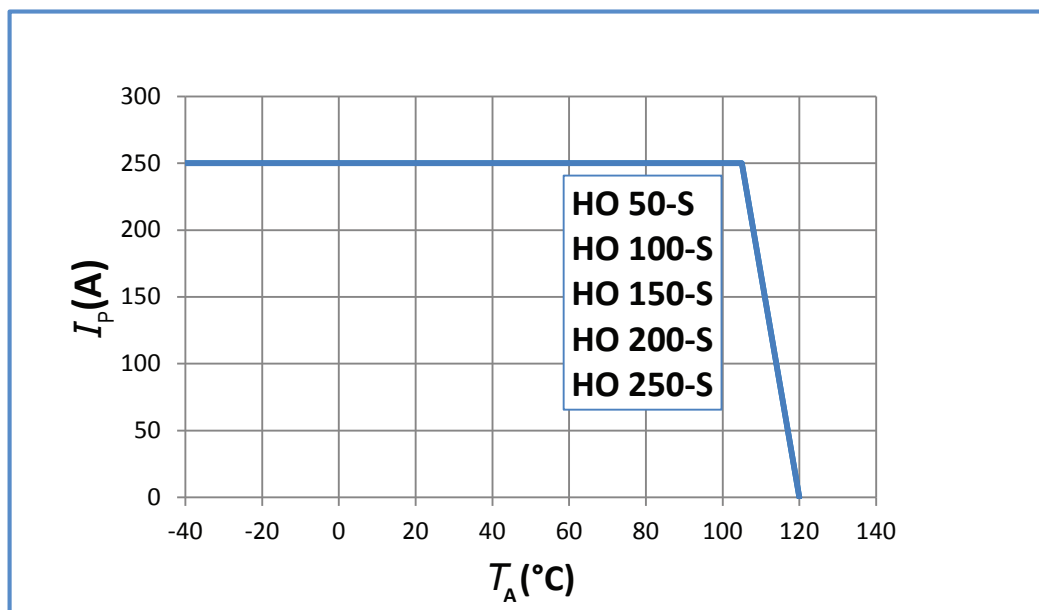
³⁾ Sum of sensitivity and linearity error @ T_A (% of I_{PN}) = $\varepsilon_{SL} + \left(\frac{TCS}{10000} \times (T_A - 25) \right) + \left(\frac{TCI_{OE}}{10000 \times I_{PN}} \times 100 \times (T_A - 25) \right)$

HO-S series, measuring range versus external reference voltage



Maximum continuous DC current

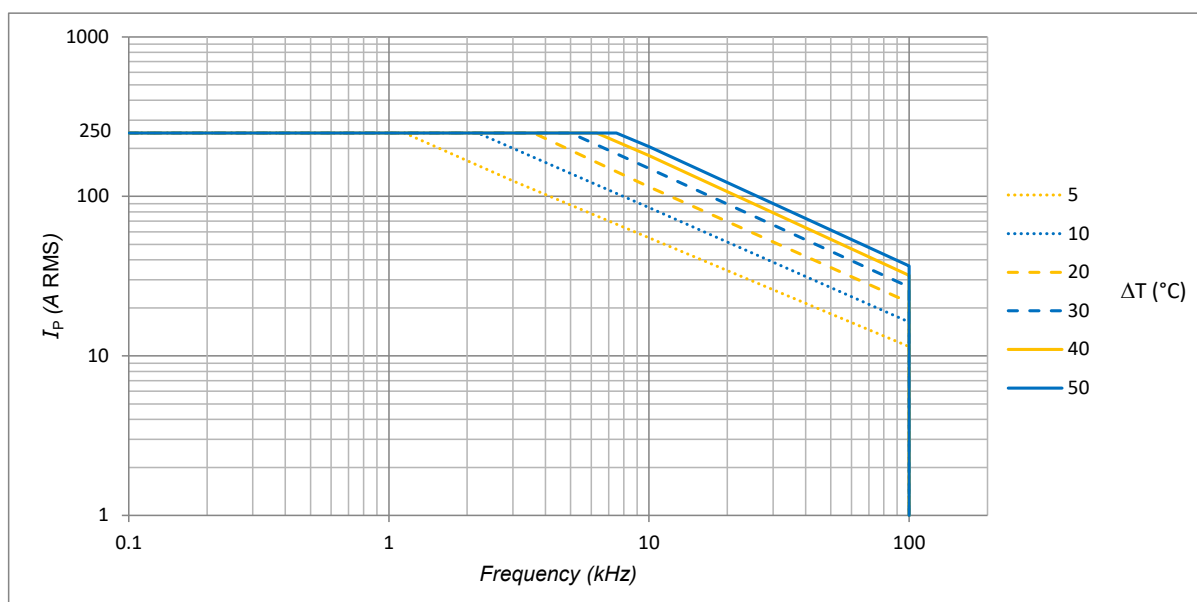
For all ranges:



Important notice: whatever the usage and/or application, the transducer primary bar temperature shall not go above the maximum rating of 120 °C as stated in page 3 of this datasheet.

Frequency derating versus primary current and core temperature increase ΔT (°C)

Primary current in A RMS is sine wave.



Example:

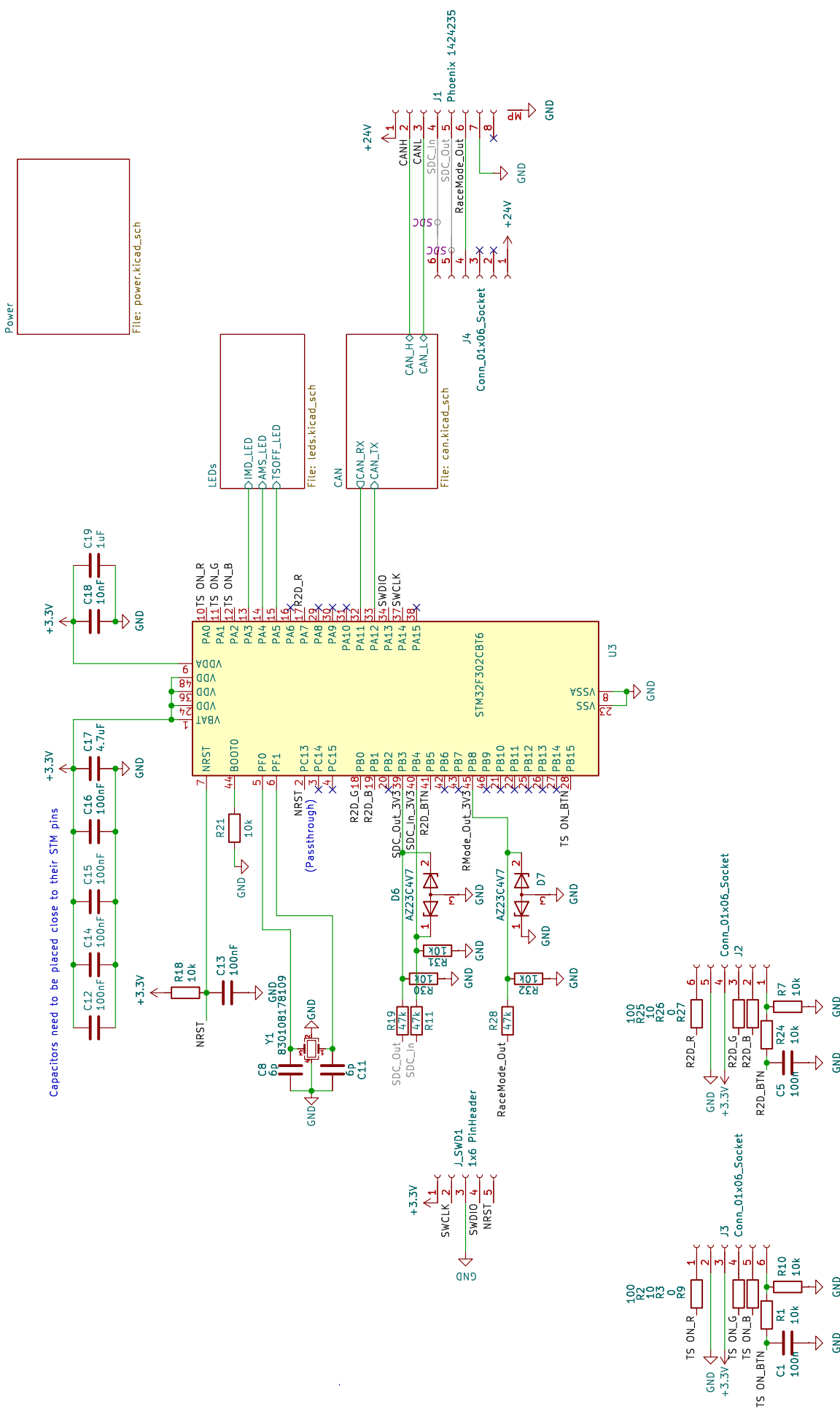
Primary current ripple (sine wave): 50 A RMS

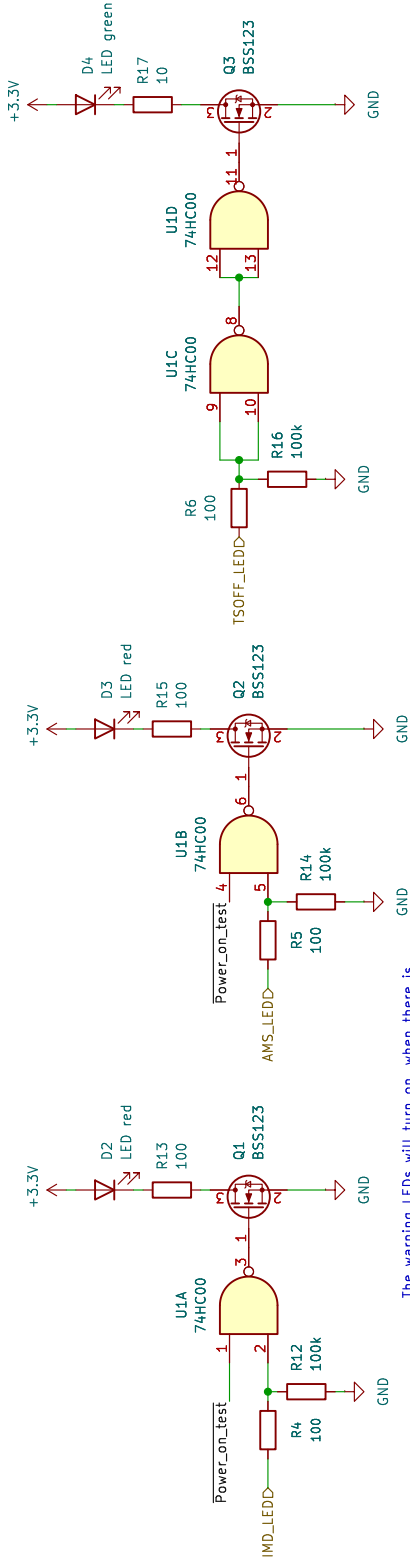
Ripple frequency: 20 kHz

- the core temperature increase is 10 °C

System Critical Signals

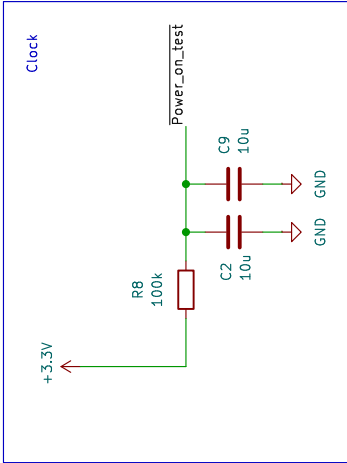
Dashboard



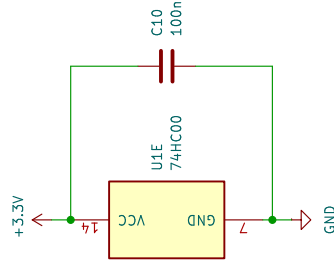


The warning LEDs will turn on, when there is no input signal or when the cable for the signal is started to ground or disconnected. Initially the LEDs for the AMS and the IMD will turn on, to show the functionality of these.

TS Off signal from Acc Tsal



Timer sequence ~2s to light up the LEDs at the beginning



FASTTUBE

Title: Cockpit LED Driver

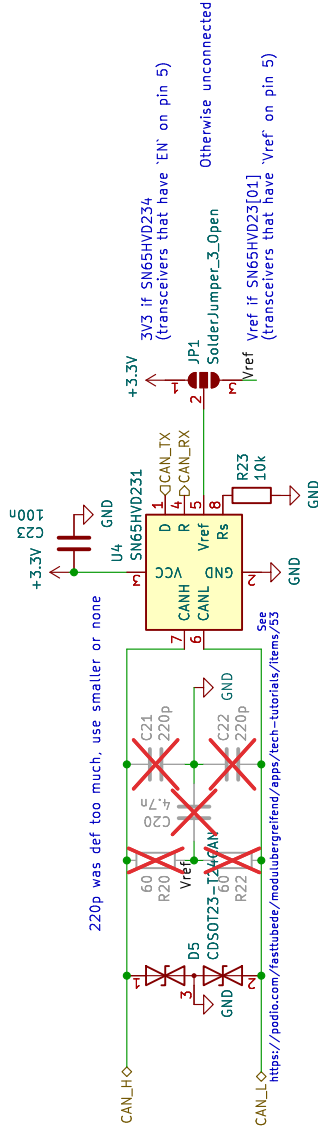
Rev: V1

Date: 2025-03-26

Project: dashboard-FT25

Exp. Date: 2025-05-01

Author: Finley Troalic

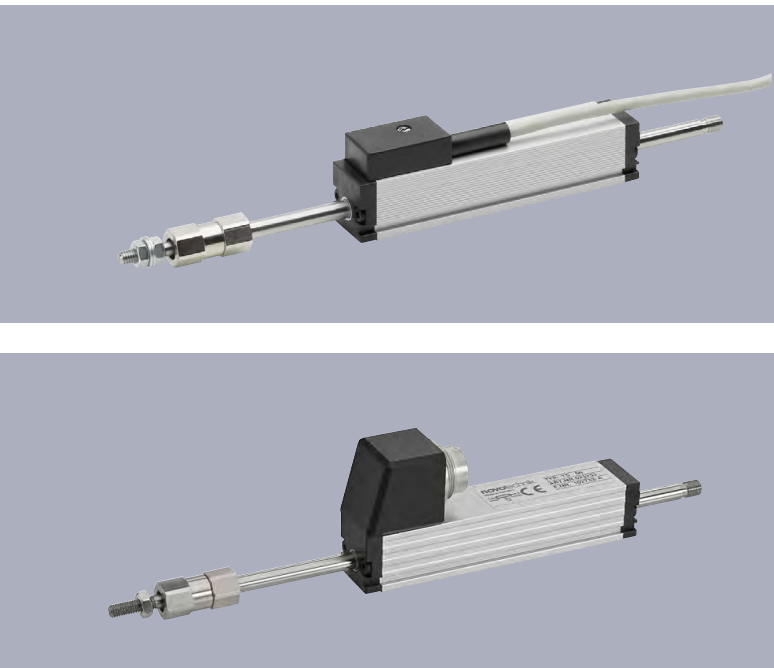


FASTTUBE

Rev: V1	
Date: 2025-03-26	
Project: dashboard-FT25	
Author: Finley Troalic	
Exp. Date: 2025-05-01	
Size: A4	Page: 4 / 4

Position Transducer potentiometric up to 150 mm

Series T / TS



Position transducers employing conductive plastic tracks provide direct, accurate measurement of travel in display or control systems.

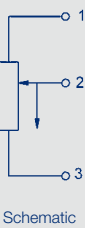
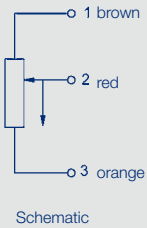
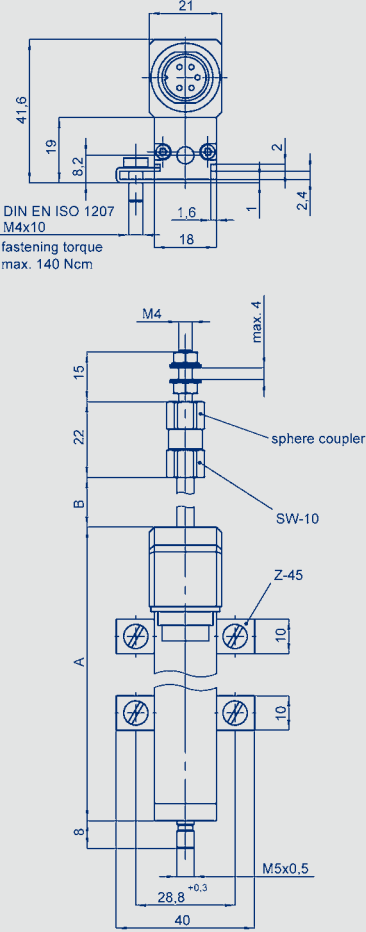
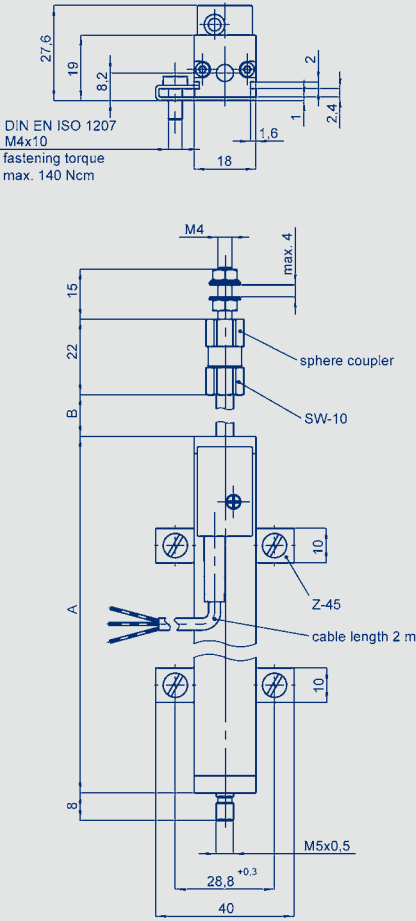
The push rod is supported on both ends by metal glide bearings, allowing high lateral forces on the tip of the rod. The elastomer-damped wiper provides reliable contact when experiencing shock or vibration.

A ball coupling enables backlash-free operation, even with parallel or angular misalignment. The coupling may be fitted to either end of the shaft

Special features

- long life up to 100 million movements, depending on application
- outstanding linearity - up to $\pm 0.075\%$
- Repeatability to $\pm 0.002\text{ mm}$
- actuating shaft with double-sided support
- special ball-coupling eliminates sideways forces
- high operational speeds - up to 10 m/s
- insensitive to shock and vibration
- T-series with cable or TS-series with connector versions available

Description	
Housing	aluminium, anodized
Mounting	adjustable clamps
Actuating rod	stainless steel AISI 303
Ball coupling	hardened ball, external thread M5 x 0.5, with spring pressure against hardened plate surface
Bearings	both ends in glide bearings
Resistance element	conductive-plastic
Wiper assembly	precious metal multi-finger wiper, elastomer damped
Electrical connections	
Series T	3-wire, PVC-cable, $3 \times 0.14\text{ mm}^2$, shielded, 2 m length
Series TS	5-pin round connector IEC 130-9



ALCOSWITCH PUSHBUTTON EMERGENCY STOP SWITCH

ILLUMINATED AND NON-ILLUMINATED

INTRODUCTION

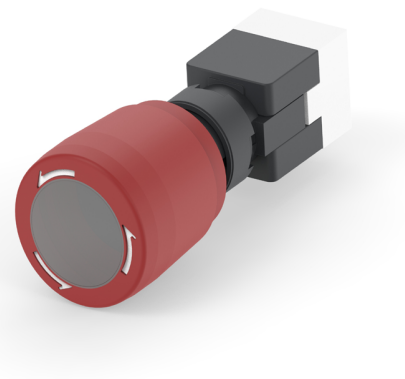
TE Connectivity (TE)'s PBES16 Series pushbutton emergency stop switch is offered as an illuminated and non-illuminated switch with two different actuator button styles, multiple lighting options, agency approvals, and meets IEC 60947-5-1 & IEC 60947-5-5 standards. The PBES16 series comes equipped with a 20N actuation force for ruggedized applications. It helps avoiding accidental actuations and is IP65 rated to resist harsh environments.

FEATURES

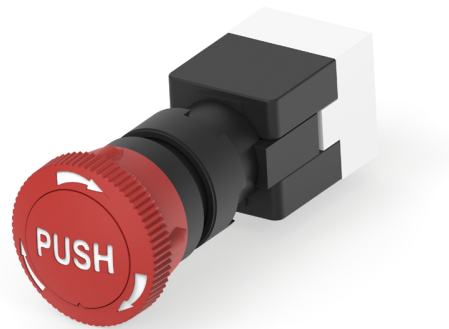
- IP65 rated
- IEC 60947-5-1 & IEC 60947-5-5
- 16mm mounting hole
- Simple easy mounting
- Solder to wire or quick connect disconnect terminals
- Gold plating
- Illuminated & non-illuminated
- LED & incandescent
- High actuation force

APPROVALS

- UL: E60363
- TUV: B 047175 0033 REV. 01



PBES16L



PBES16N

ALCOSWITCH Pushbutton Emergency Stop Switch

Illuminated and Non-Illuminated

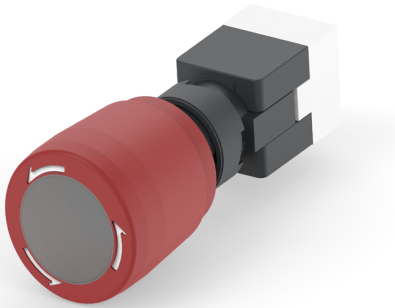
PRODUCT SPECIFICATION

Mechanical Life	>100,000 Operations	
Electrical Life	>50,000 Operations	
Motion Tolerance	< 20 Operations/Minute (Mechanical and Electrical Life)	
Degree of Protection	IP65	
Panel Thickness	0.5mm to 5mm	
Mounting Torque	1.1 N-m	
Maximum Insulation Voltage	1500VAC 60Hz, 10mA, 1 minute	
Insulation Resistance	100MΩ @500 VDC, 100mA, 1 minute	
Storage Temperature	-40 °C to +85 °C	
Operating Temperature	-25 °C to +55 °C (-25 °C to +70 °C Without Lamp)	
Contact Resistance	<= 50 mΩ (Initial)	
Operating Forces	Push - Lock 20 +0/-10N, Turn - Reset 0.06 N-m	
Operating Travel	PBES16L	Push - Lock 3.6 + 0/-0.6 mm, Turn - Reset CCW 30°
	PBES16N	Push - Lock 3.3 + 0.3 mm, Turn - Reset CW 30°
Pollution Degree	3	

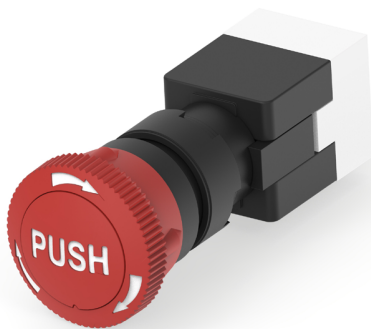
ELECTRICAL RATINGS

Rated Insulation Voltage (Ui)	300V	
Conventional Enclosed Thermal Current (Ithe)	5A	
Rated Operational Voltage (Ue)	125 V	250 V
Utilization Category	Rated Operational Current (Ie)	
AC-15	3	1.5
DC-13	0.22	0.11

SWITCH STYLES



PBES16L - ILLUMINATED
(WITH OR WITHOUT LAMP)



PBES16N - NON-ILLUMINATED

Side Panel

LAS SERIES

24V COMPACT SPST MANUAL BATTERY DISCONNECT SWITCH



08098700



08099000

Description

Ideal for low-amp, low-voltage applications in off-road and construction vehicles and agricultural and marine equipment, the LAS Series 24V Compact SPST Manual Battery Disconnect Switch is available with M8 studs and a 100A continuous current rating or M10 studs and a 150A continuous current rating.

This battery disconnect switch features a compact design with pass-through mounting for installation where space is limited.

The removable, red handle is easy to see and helps ensure safe operation of the compact battery switch by authorized personnel. Select models come with a rubber cap that provides protection when the actuator is removed.

Web Resources

Download 2D print, installation guide and technical resources at: littelfuse.com/LAS

Ordering Information

PART NUMBER	DESCRIPTION	ACTUATOR	IGNITION PROTECTION	OUTPUT TERMINAL	NORMAL POSITION
08098700	24V 100A Compact SPST Manual Battery Disconnect Switch	key	-	2xM8	OFF
08098700-BP	24V 100A Compact SPST Manual Battery Disconnect Switch	key	-	2xM8	OFF
08098700-BX	24V 100A Compact SPST Manual Battery Disconnect Switch	key	-	2xM8	OFF
08098771	24V 100A Compact SPST Manual Battery Disconnect Switch - Actuator Not Included	not supplied	-	2xM8	OUT (OFF)
08098780	24V 150A Compact SPST Manual Battery Disconnect Switch	key	-	2xM10	OFF
08098780-BP	24V 150A Compact SPST Manual Battery Disconnect Switch	key	-	2xM10	OFF
08098780-BX	24V 150A Compact SPST Manual Battery Disconnect Switch	key	-	2xM10	OFF
08098781	24V 150A Compact SPST Manual Battery Disconnect Switch with Removable T-Handle	key		2xM10	OFF
08098790	24V 100A Compact SPST Manual Battery Disconnect Switch	key	-	2xM8	OFF
08098791	24V 100A Compact SPST Manual Battery Disconnect Switch with UL94 V-0 Rating	key	VO	2xM8	OFF
08099000	24V 100A Compact SPST Manual Battery Disconnect Switch with Rubber Cap	key	-	2xM8	OUT (OFF)
08099080	24V 150A Compact SPST Manual Battery Disconnect Switch with Rubber Cap	key	-	2xM10	OUT (OFF)
08099080-BP	24V 150A Compact SPST Manual Battery Disconnect Switch with Rubber Cap	key	-	2xM10	OUT (OFF)
08099080-BX	24V 150A Compact SPST Manual Battery Disconnect Switch with Rubber Cap	key	-	2xM10	OUT (OFF)
08099090	24V 100A Compact SPST Manual Battery Disconnect Switch	key	-	2xM8	OUT (OFF)

Specifications

Max Continuous Voltage:	24V
Max Continuous Current Rating:	100A, 150A
Current Inrush Rating:	500A, 1000A
Operating Temp Range:	-40°C / +80°C, -40°C / +85°C
Ingress Protection:	IP43
Mounting Method:	Pass-through
Mounting Hole:	2 * Ø6.5mm + 1 * Ø24mm
Mounting Stem:	Ø22mm
Circuitry:	SPST

Applications

- Off-Road Vehicles
- Agricultural
- Construction
- Heavy-Duty Trucks
- Marine

Features and Benefits

- 24V low-voltage disconnect switch with single-pole, single-throw (SPST) circuitry
- Available with 100A (M8 studs) or 150A (M10 studs) continuous current rating to match your low-amp application
- Compact design enables pass-through installation in equipment and vehicles with limited space
- Removable, red handle is highly visible and helps ensure safe operation
- Rubber cap on select models protects the battery cutoff switch when the handle is removed
- Weatherproof to IP43 standards

Sicherheits-Einbaubuchse

- zum Einbauen in Frontplatten bis 6 mm Dicke
- Befestigung mittels einer Schlitzmutter M12 x 0,75 und einer Federscheibe
- Montagebohrung Ø 12,2+0,1 mm
- Montage mittels Montagewerkzeug MWZ 8 und MWZ 15, siehe Kapitel Zubehör
- die Montageanleitung MA 007 und den Warnhinweis 005 finden Sie unter www.schuetzinger.de

Best.-Nr. SEB 6445 Ni / ..(Farbe)

- Kontaktteile **vernickelt**
- Isolierteile PA 6.6 (Polyamid) UL94 - V2
- Befestigungsmutter (Schlitzmutter) M12 x 0,75
- Farben** siehe Tabelle

Best.-Nr. SEB 6445 Au / ..(Farbe)

- wie oben, jedoch
- Kontaktteile **vergoldet**
- Farben** siehe Tabelle



MA 007



WH 005

Safety threaded socket

- for fixture in panels up to 6 mm thick
- fixed by: slotted nut M12 x 0.75 and spring washer
- hole Ø 12.2+0.1 mm
- fixture using special tools MWZ 8 and MWZ 15, see chapter accessories
- please visit www.schuetzinger.de to find the assembly instruction MA 007 and the warning notice WH 005

Order No. SEB 6445 Ni / ..(colour)

- contact parts **nickel-plated**
- insulation PA 6.6 (Polyamid) UL94 - V2
- fastening nut (slotted nut) M12 x 0.75
- colours** see table

Order No. SEB 6445 Au / ..(colour)

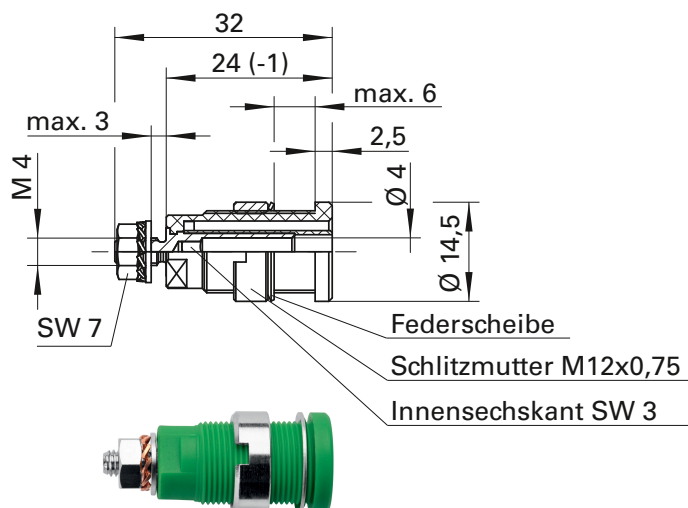
- as above
- contact parts **gold-plated**
- colours** see table



MA 007



WH 005



Allgemeine Angaben		General information	
Best.-Nr. ¹⁾	SEB 6445 Ni / ..(Farbe) Kontaktteile vernickelt	Order No. ¹⁾	SEB 6445 Ni / ..(colour) contact parts nickel-plated
	SEB 6445 Au / ..(Farbe) Kontaktteile vergoldet		SEB 6445 Au / ..(colour) contact parts gold-plated
Farben	schwarz, rot, blau, gelb, grün, grau, braun, weiß, orange, violett, grüngelb	colours	black, red, blue, yellow, green, grey, brown, white, orange, purple, green-yellow
Technische Daten		Technical data	
Anschluss	M4	terminal	M4
Durchgangswiderstand	7 mΩ / 5 mΩ	transition resistance	7 mΩ / 5 mΩ
Bemessungsspannung ²⁾	1000 V CAT III	rated voltage ²⁾	1000 V CAT III
Bemessungsstrom ²⁾	32 A	rated current ²⁾	32 A
Betriebstemperatur	von -25 °C bis +80 °C	operating temperature	from -25 °C to +80 °C
Anzugsdrehmoment der Befestigungsmutter	45 Ncm	max. torque fastening nut	45 Ncm
Anzugsdrehmoment der Mutter M4	100 Ncm	max. torque nut M4	100 Ncm

¹⁾ andere Kontaktoberflächen, Farben und Anschlüsse auf Anfrage

²⁾ bei normalen Umgebungstemperaturen

¹⁾ other contact platings, colours and terminals on request

²⁾ at normal ambient temperatures

Cables

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
	<i>[Spool dimensions may vary slightly]</i>
Notes:	
a) The following colors are available 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.	

1249500	DATA SHEET	
valid from: 15.03.2022	ÖLFLEX® HEAT 180 SiF A	

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 solarium 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 conform to the EU-Directive 2014/35/EU (Low Voltage Directive)

Environmental information

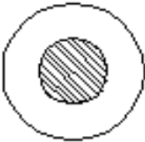
These cables meet the substance-specific requirements of the EU Directive 2011/65/EU (RoHS).

Creator: LABU / PDC	Document: DB1249500EN	Page 1 of 1
Released: ALTE / PDC	Version: 04	

 Datasheet				Product Name:		UL11028 26AWG	
				Product Description:		UL11028 26AWG	
				Specification No.:		SPEC-UL11028-26AWG	
				Customer's Name:			
				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				Customer Approve			
Test Material		Test Item		Standard Value			
Before Aging	Tensile Strength(Mpa)		mPPE(RoHS)				Seal & Stamp
	Elongation(%)		≥21.37 ≥175				
Aging Condition		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		Signature:			
Max.DC Resistance(20℃ Ω/km)		150					
Flammability Test		VW-1		Date:			

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

Cross Section



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

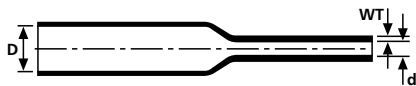
Applications			
For internal wiring of electrical equipment			

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

Technical data sheet

Article number:
308-30300

HIS-3-3/1



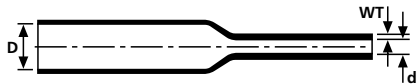
Product Group	Heat shrinkable tubing 3:1 on a reel
Product Family	HIS-3
Material	Polyolefin, cross-linked (PO-X)
Colour	Black (BK)
Behaviour at Heat Shock	not fluid, not dripping, not cracking
Behaviour at Low Temperature [Test method]	not cracking [UL 224]
Dielectric Strength [Test method]	32 kV/mm [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



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

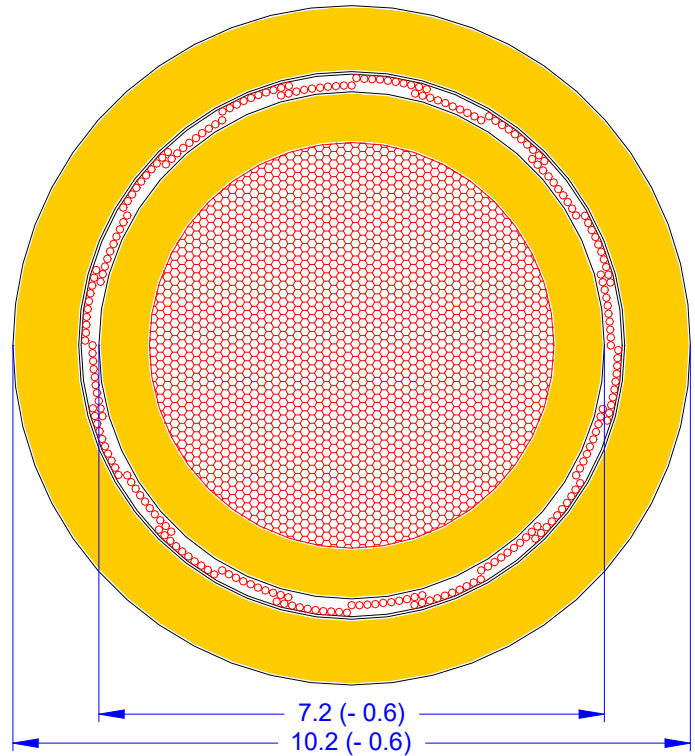


**Automotive Leitung geschirmt
für elektrische Fahrzeugantriebe**

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 Leiterwerkstoff: Leiteraufbau: Leiterdurchmesser: Isolationswerkstoff: Aderdurchmesser: Isolationswanddicke: Aderfarbe:	E-Cu ETP1 nach DIN EN 13602 Litze Cu.-blank 512 (±5 %) x max. 0,21 mm max. 5,8 mm ¹⁾ mod. Siliconkautschuk SiR 7,2 mm (- 0,6) min. 0,52 mm orange ähnlich RAL 2003	Core 16 mm² Conductor material: Conductor design: Conductor diameter: Core insulation: Core diameter: Insulation wall thickness: Colour code:	E-Cu ETP1 according DIN EN 13602 stranded bare copper 512 (±5 %) x max. 0.21 mm max. 5.8 mm ¹⁾ mod. Silicon rubber SiR 7.2 mm (- 0.6) min. 0.52 mm orange similar RAL 2003
Abschirmung Abschirmgeflecht: Schirmfolie:	Cu.-verzinkt max. 0,16 mm optische Bedeckung min. 85 % ALU-kaschierte PET-Folie Metallseite innen Überlappung min. 20 %	Shielding Screening braid: Foiled shielding:	Tinned copper max. 0.16mm optical covering min. 85 % ALU-PET foil Metal side in contact to screen overlap min. 20 %
Außenmantel Mantelwerkstoff: Außendurchmesser: Isolationswanddicke: Mantelfarbe:	mod. Siliconkautschuk SiR 10,2 mm (- 0,6) min. 0,7 mm orange ähnlich RAL 2003	Outer sheath Sheath material: Outer diameter: Insulation wall thickness: Colour code:	mod. Silicon rubber SiR 10.2 mm (- 0.6) min. 0.7 mm orange similar RAL 2003

Herstellerkennung

Mantelaufdruck:

COROFLEX [nnn] 9-2611 FHRL2GCB2G 16 mm²/T180 ⚡ ATTENTION HIGH VOLTAGE MAX 600 V AC / 1000 V DC ⚡ [xx...xx]

[nnn]:

Codierung Produktionsstandort

[xx...xx]:

Interne Codierung

Druckabstand:

max. 200 mm

Marking

Outer sheath is printed:

[nnn]:

Code of production plant

[xx...xx]:

Internal Code

Distance of marking:

max. 200 mm

Elektrische Eigenschaften

Leiterwiderstand:
(DC, 20°C)

max. 1,16 mΩ/m
max. 7,6 mΩ/m

Leiter
Abschirmung

Prüfspannung:

eff. 8,0 kV
eff. 5,0 kV

Sparktester
5 Minuten

Nennspannung:
(AC / DC)

max. 600 / 1000 Volt

Kapazitätsbelag:
Induktivitätsbelag:
Wellenwiderstand:

nom. 605 pF/m
nom. 110 nH/m
nom. 10 Ohm

Ader-Schirm

Electrical properties

Conductor resistance:
(DC, 20°C)

max. 1.16 mΩ/m
max. 7.6 mΩ/m

Conductor
Shielding

Test voltage:

eff. 8.0 kV
eff. 5.0 kV

spark test
5 minutes

Nominal voltage:
(AC / DC)

max. 600 / 1000 Volt

Capacitance:
Inductance:
Impedance:

nom. 605 pF/m
nom. 110 nH/m
nom. 10 Ohm

core-screen

Mechanische Eigenschaften

Biegeradius:

- min. 3 x Außen-Ø:
- min. 6 x Außen-Ø:

statische Verlegung
dynamische Verlegung

Leitungsgewicht:

ca. 221 g/m

Mechanical properties

Bend radius:

- min. 3 x cable-Ø:
- min. 6 x cable-Ø:

static installation
dynamic installation

Weight of cable:

approx. 221 g/m

Thermische Eigenschaften

Temperaturbereich:
Kurzzeitalterung:

-40 °C bis +180 °C 3.000 h
bis +205 °C 240 h

Thermal properties

Operating temperature:
Short term ageing

-40 °C to +180 °C 3000 h
up to +205 °C 240 h

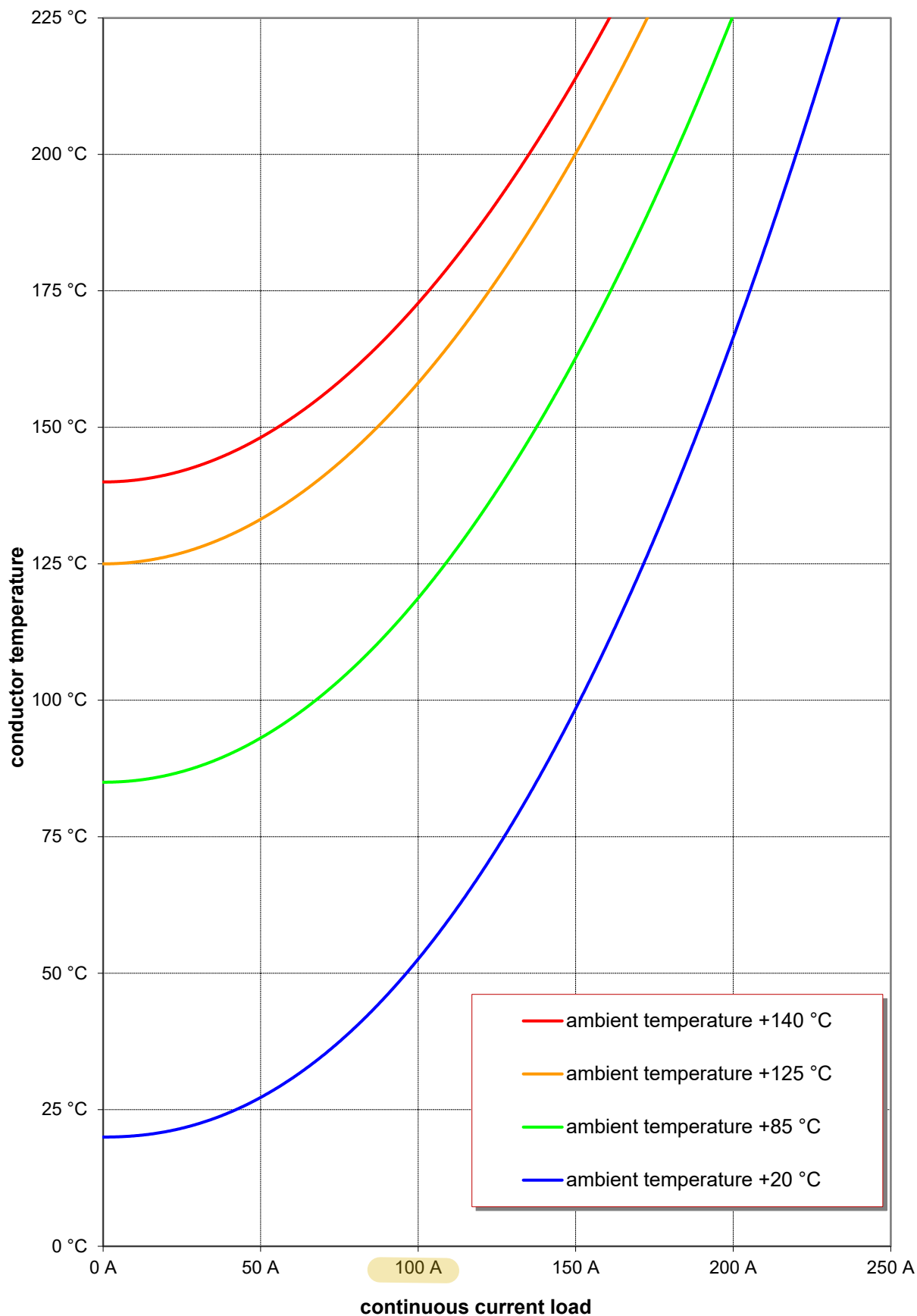
¹⁾ max. conductor diameter: average value of the measured largest and smallest conductor diameter under the core insulation

Änderungsindex Version	Erstellt Creator	Ausgabedatum Date of Issue	Beschreibung Description
A 9	Wichmann	2012-12-08	Nomenklatur, Aufdruck und Nennspannung modifiziert <i>cable-nomenclature, marking and nominal voltage modified</i>
A 10	Eck	2016-01-19	Nomenklatur, Aufdruck und Nennspannung modifiziert; Widerstand Abschirmung war nom. / <i>cable-nomenclature, marking and nominal voltage modified, Resistance shielding was nom.</i>
A 11	Wichmann	2016-08-30	Update Format Deratingkurven / <i>update format of derating curves</i>
A 12	Eck	2017-02-17	Biegeradius modifiziert; Bending radius <i>modified</i>
A 13	Blome	2020-04-01	Brand Coroplast zu Coroflex / <i>Brand Coroplast to Coroflex</i>

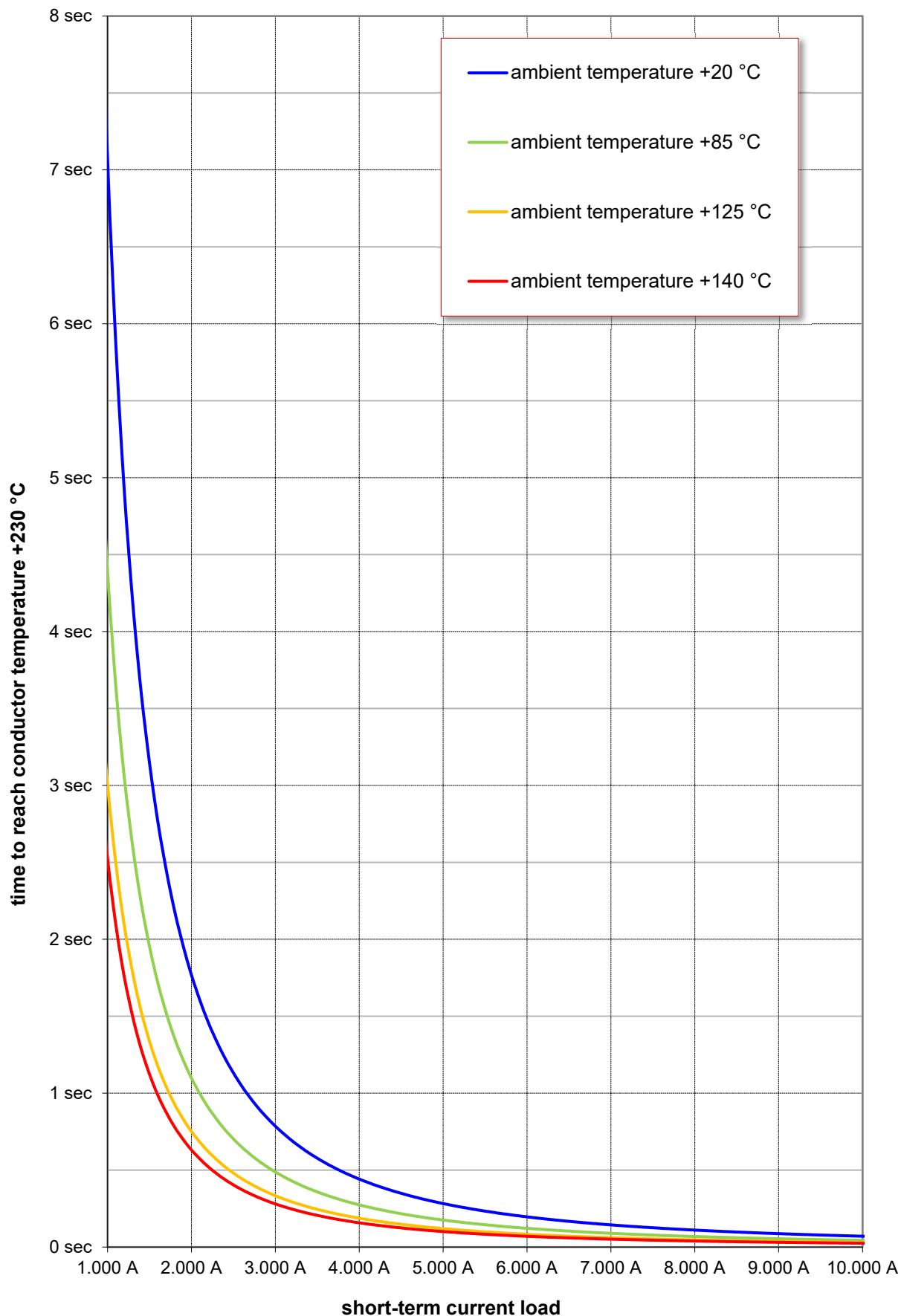
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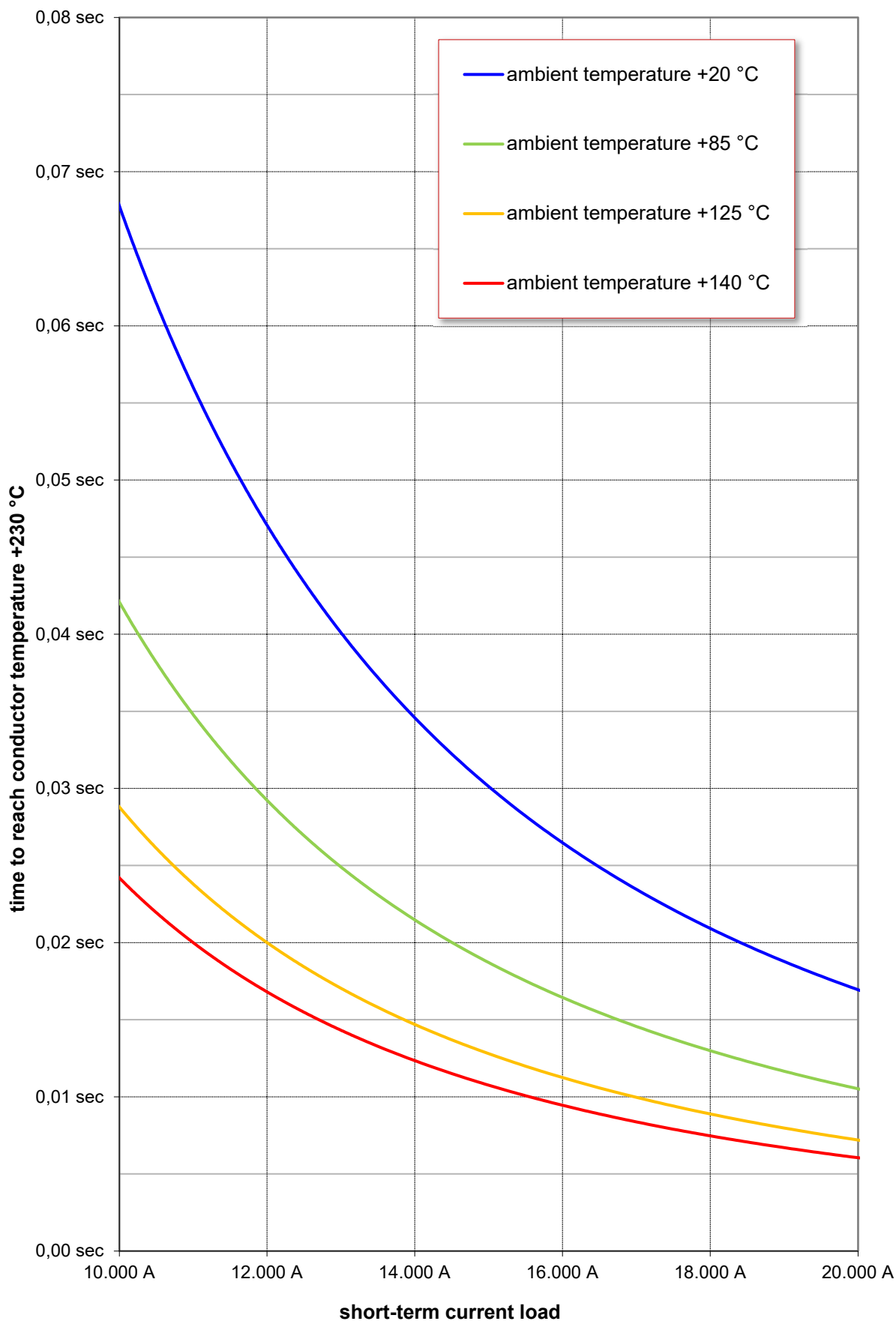
Annex: Continuous current loading on conductor as a function of ambient temperature
calculated simulation according to LV112-3



Annex: Short-term current loading on conductor as a function of ambient temperature
calculated simulation according to LV112-3

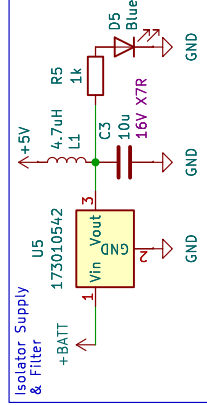
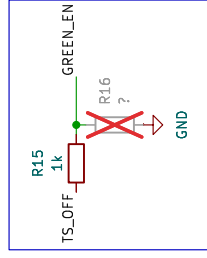
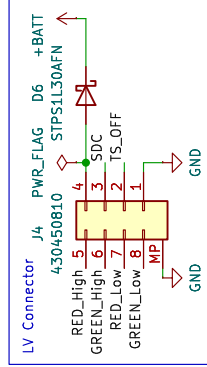
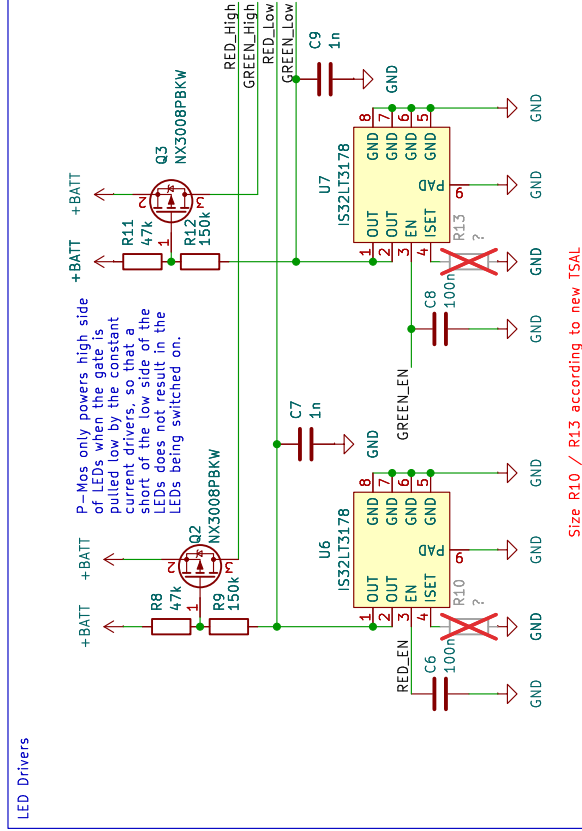
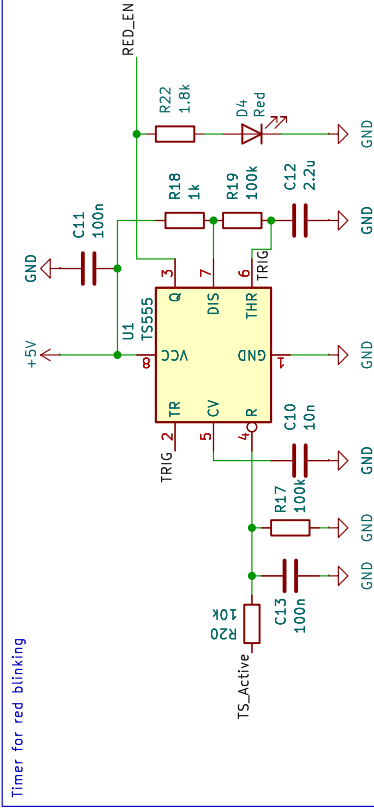


Annex: Short-term current loading on conductor as a function of ambient temperature
calculated simulation according to LV112-3

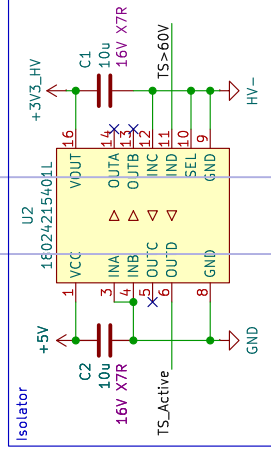
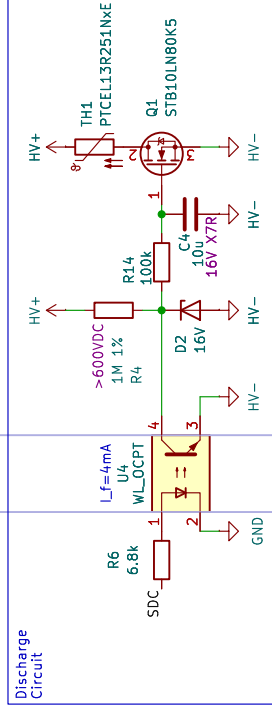


HEVB

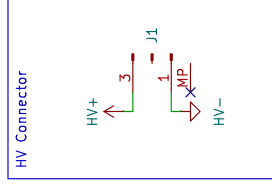
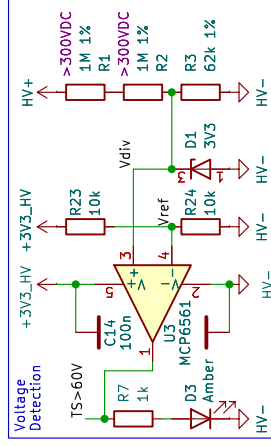
TSAL driver board and DC-link voltage detection



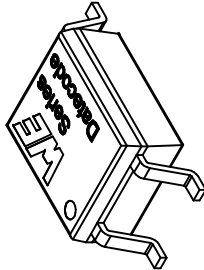
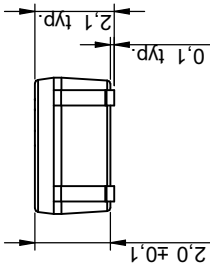
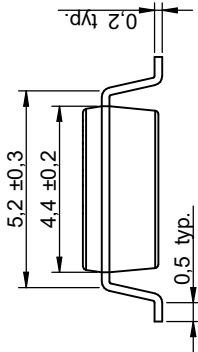
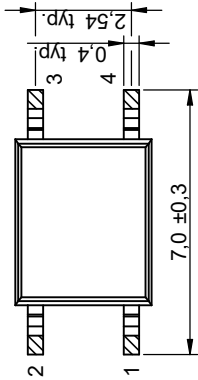
LVTS



$$\begin{aligned} V_{ref_max} &= 3.47V * 10.1k\Omega / (10.1k\Omega + 9.9k\Omega) = 1.76V \\ V_{div@60V_min} &= 60V * 61.38k\Omega / (2*990k\Omega + 61.38k\Omega) = 1.8V \\ V_{hyst_max@75deg} &= 6mV < 40mV \quad (1.80V - 1.76V) \end{aligned}$$

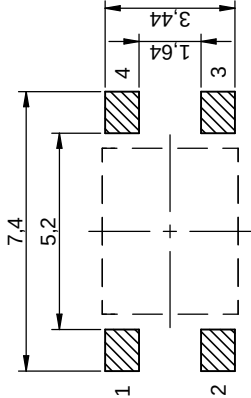


Dimensions: [mm]



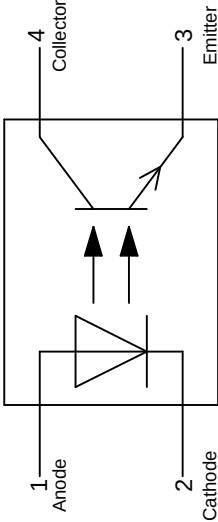
Scale - 5:1

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 [(EO)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

CHECKED SdV			REVISION 001.004	DATE (YY-MM-DD) 2023-08-22	GENERAL TOLERANCE DIN ISO 2768-1m	PROJECTION METHOD
DESCRIPTION WL-OCPT Optocoupler Phototransistor			ORDER CODE 140356145200			
SIZE/TYPE SOP4	BUSINESS UNIT eIPal	STATUS Valid			PAGE 1/12	

WURTH ELEKTRONIK
MORE THAN YOU EXPECT

Würth Elektronik eSOS GmbH & Co. KG
EMC & Inductive Solutions
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74638 Waldenburg
Germany
Tel. +49 (0) 79 42 945 - 0
www.we-online.com
eSOS@we-online.com

The 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. Würth Elektronik eSOS GmbH & Co. KG makes no warranty, representation or assumption, either expressed or implied, for the use of the product in such applications. The user of the product in such applications must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability validation 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_{CEP} 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 Capacitance	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.	
Current Transfer Ratio	β I_C = 5 mA V_{CE} = 5 V	130		%
Collector-Emitter Saturation Voltage	V_{CEsat} I_F = 20 mA I_C = 1 mA		0.06	V
Rise Time	t_r V_{CE} = 2 V I_C = 2 mA R_L = 100 Ω		3	µs
Fall Time	t_f V_{CE} = 2 V I_C = 2 mA R_L = 100 Ω		4	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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DIN ISO 2768-1m

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2023-08-22

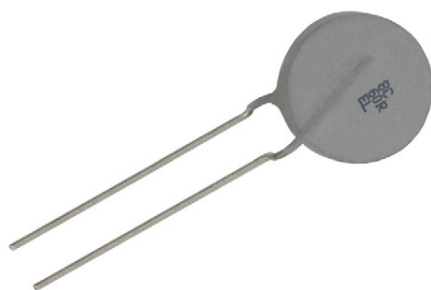
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DESCRIPTION

The 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. Manufacturer Würth Elektronik eSos GmbH & Co. KG neither assumes nor accepts any liability for damages of any kind, with the exception of damages caused by intentional or grossly negligent actions. The electronic component is not suitable for use in safety-critical applications without additional safety measures. The electronic component is not suitable for use in applications 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. Manufacturer Würth Elektronik eSos GmbH & Co. KG must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability validation 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



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 μ s pulses that can be applied with limited non-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.

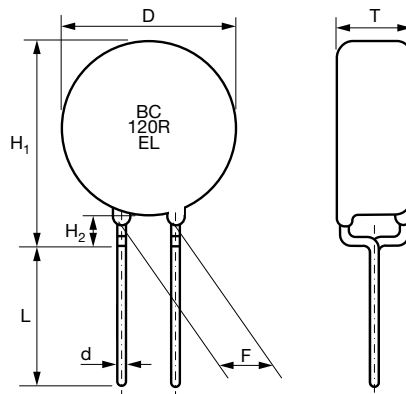
PACKAGING

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

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

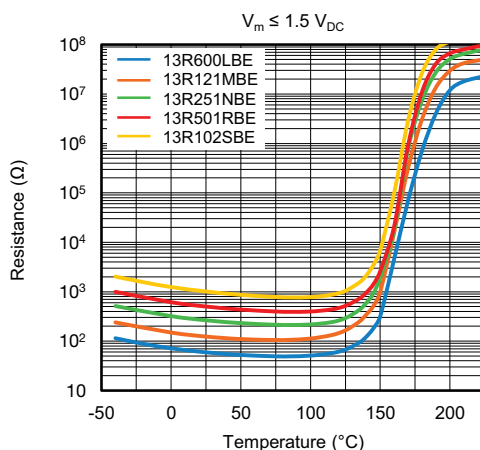
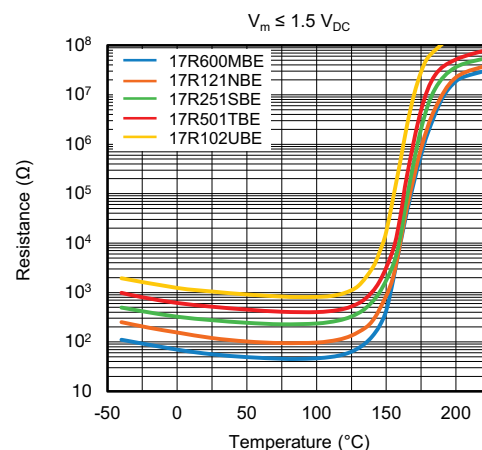
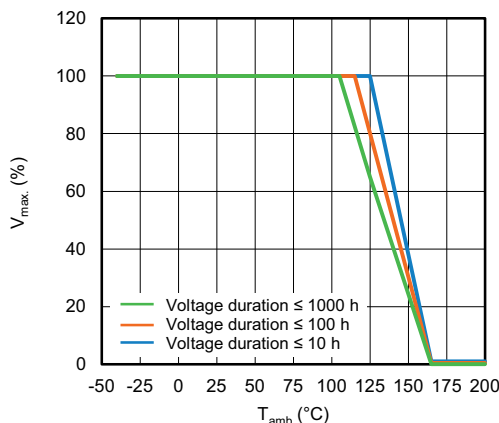
**REQUIRED NUMBER OF PTC THERMISTORS TO LIMIT CURRENT AND ABSORB ENERGY**

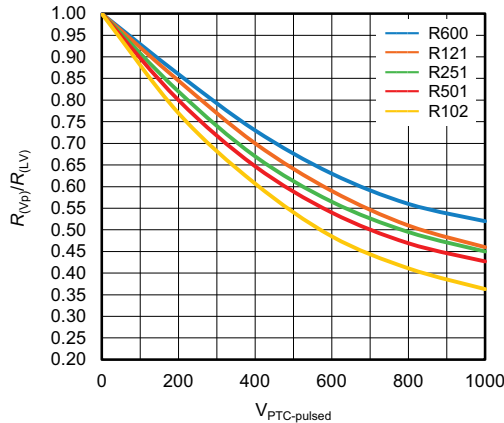
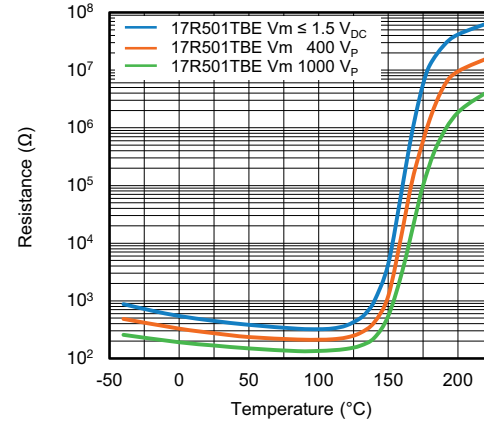
By using several PTC's in a series / parallel network, the maximum current limitation and absorbed energy levels can be further optimized. For homogeneous current and energy distribution it is recommended to combine only PTCEL of the same size and matched resistance value. Energy absorption per PTC in 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.

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

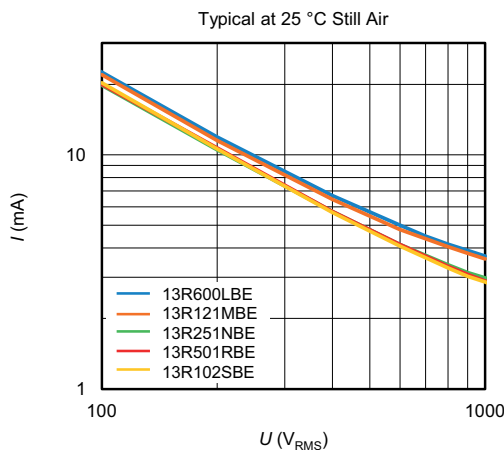
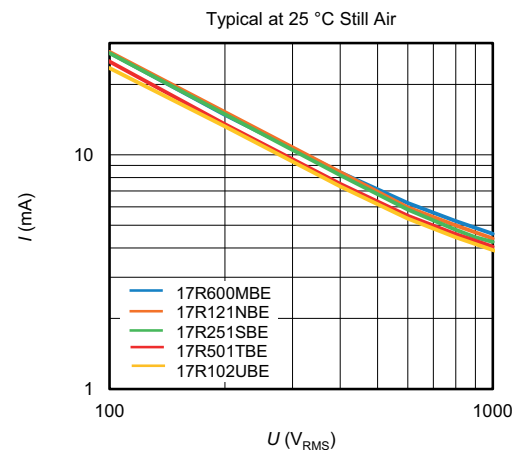
Notes

- 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}**

PTC RESISTANCE UNDER PULSED VOLTAGE

RESISTANCE VS. TEMPERATURE PULSED
(Typical)

Notes

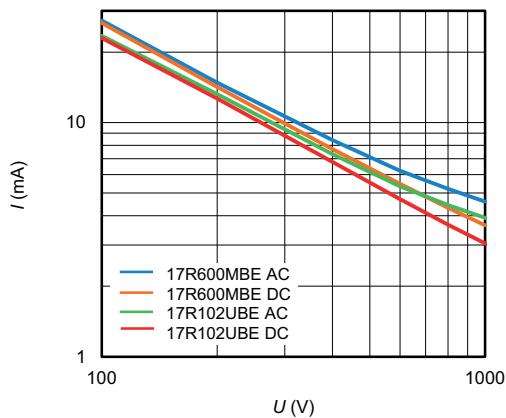
- The minimum PTC resistance values under (pulsed) voltage are depending on actual minimum resistance value in the temperature range of 70 $^{\circ}\text{C}$ to 100 $^{\circ}\text{C}$. The actual voltage dependency effect or $R_{(Vp)}/R_{(LV)}$ ratio of ceramic PTC is depending on its resistance values 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 $^{\circ}\text{C}$ to 100 $^{\circ}\text{C}$. 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 $^{\circ}\text{C}$, and at a 1000 V peak-voltage the resistance will drop to 260 $\Omega \times 0.43$ (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


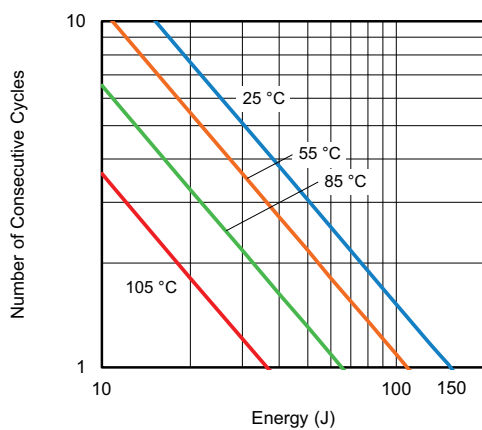


RESIDUAL CURRENT VS. VOLTAGE AC / DC

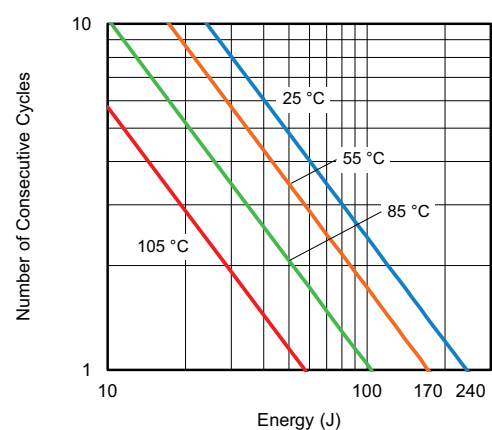
Typical at 25 °C Still Air



CONSECUTIVE ENERGY AT DIFFERENT T_{amb} FOR PTCEL13



CONSECUTIVE ENERGY AT DIFFERENT T_{amb} FOR PTCEL17



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

Datasheet - production data

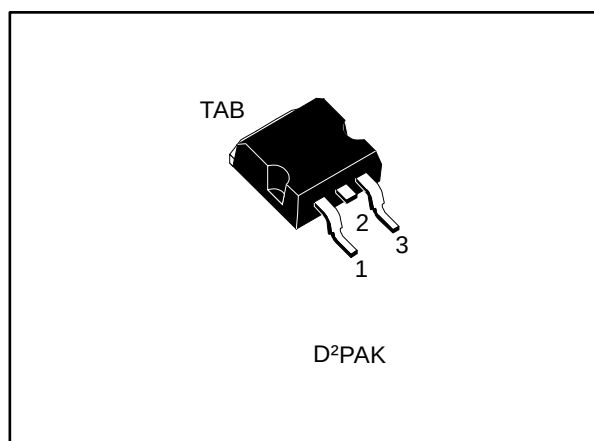
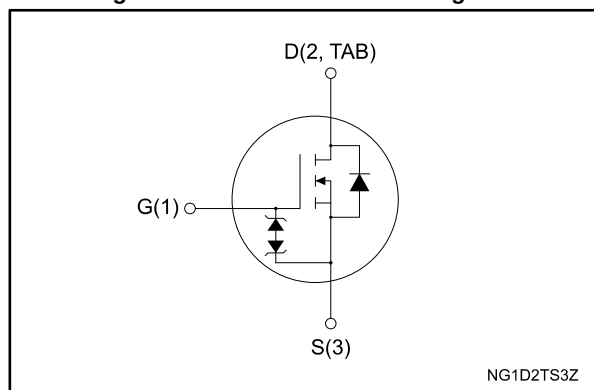


Figure 1: Internal schematic diagram



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 ² PAK	Tape and reel

Contents

1	Electrical ratings	3
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 $T_C = 25\text{ }^{\circ}\text{C}$	8	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	5	A
$I_D^{(1)}$	Drain current (pulsed)	32	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	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	$^{\circ}\text{C}$
T_{stg}	Storage temperature range		

Notes:

⁽¹⁾ Pulse width limited by safe operating area.

⁽²⁾ $I_{SD} \leq 8\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$

⁽³⁾ $V_{DS} \leq 640\text{ V}$

Table 3: Thermal data

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

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 $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	240	mJ

2 Electrical characteristics

$T_C = 25^\circ\text{C}$ unless otherwise specified

Table 5: On/off-state

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

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	427	-	pF
C_{oss}	Output capacitance		-	43	-	pF
C_{rss}	Reverse transfer capacitance		-	0.25	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }640\text{ V}$, $V_{GS} = 0\text{ V}$	-	72	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			27	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	7	-	Ω
Q_g	Total gate charge	$V_{DD} = 640\text{ V}$, $I_D = 8\text{ A}$ $V_{GS} = 10\text{ V}$ 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 C_{oss} 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 C_{oss} 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	$V_{DD} = 400\text{ V}$, $I_D = 4\text{ A}$, $R_G = 4.7\text{ }\Omega$ $V_{GS} = 10\text{ V}$	-	11.8	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time	See Figure 15: "Test circuit for resistive load switching times" and Figure 20: "Switching time waveform"	-	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	$I_{SD} = 8\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ 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	$I_{SD} = 8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ 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 μs , 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	$I_{GS} = \pm 1\text{ mA}$, $I_D = 0\text{ A}$	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)

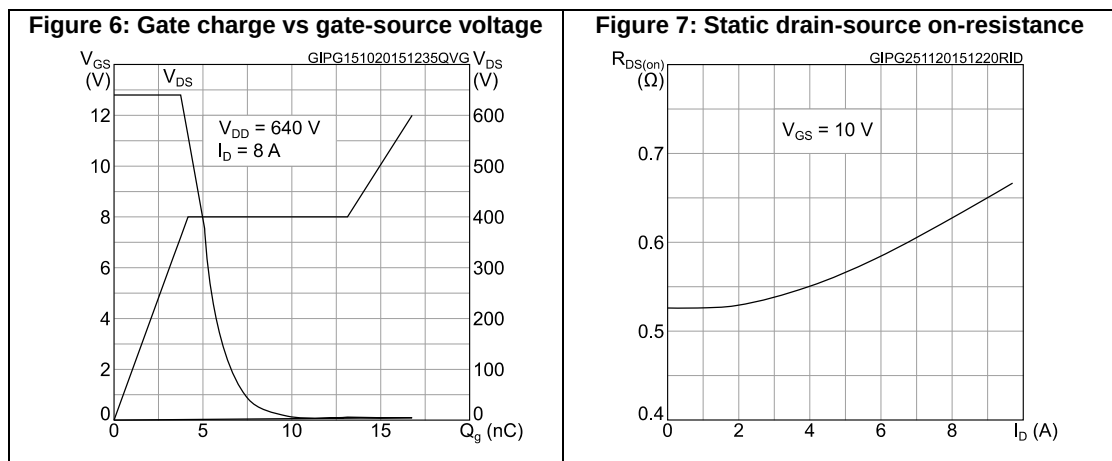
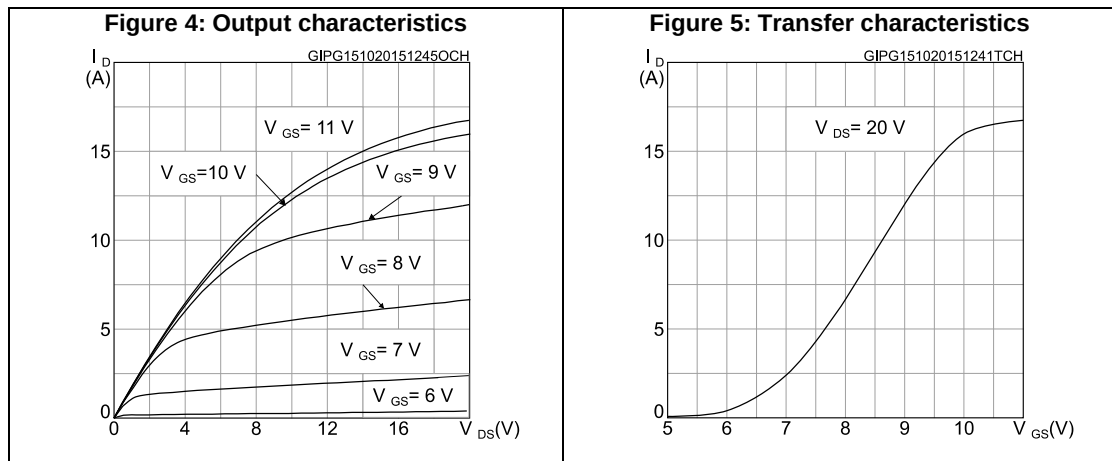
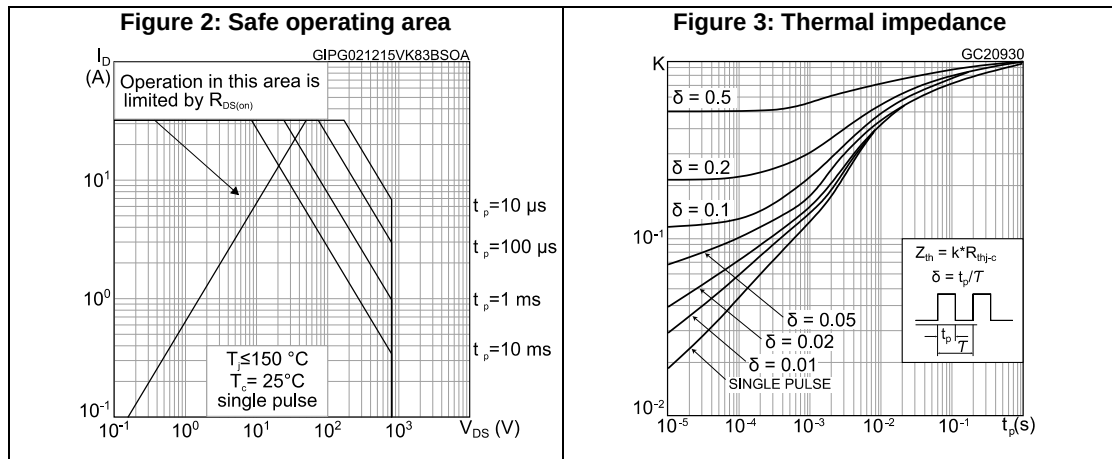


Figure 8: Capacitance variations

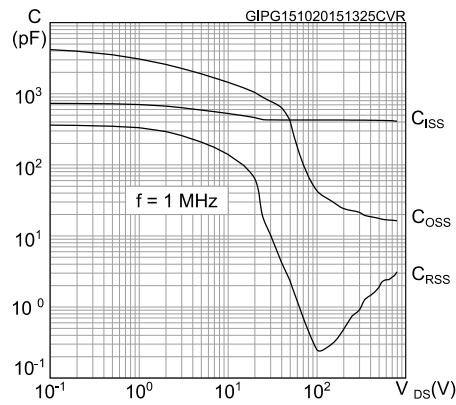


Figure 9: Normalized gate threshold voltage vs temperature

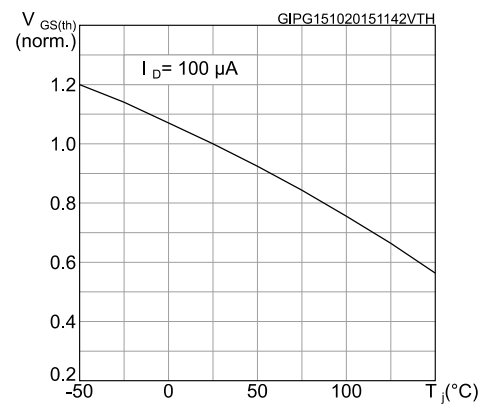


Figure 10: Normalized on-resistance vs temperature

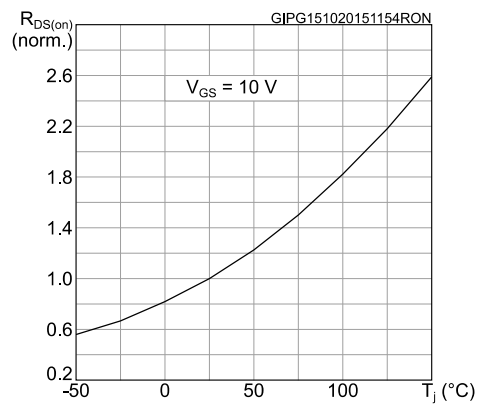
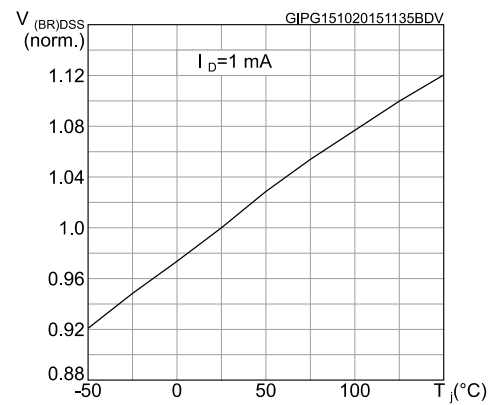
Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

Figure 12: Output capacitance stored energy

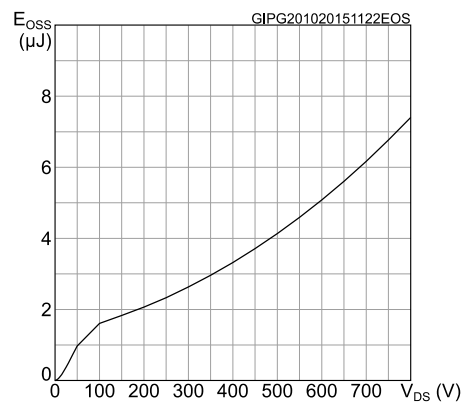
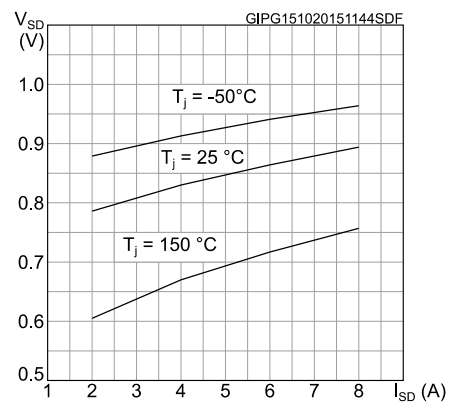


Figure 13: Source-drain diode forward characteristics



Microelectronic Power IC

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

General Description

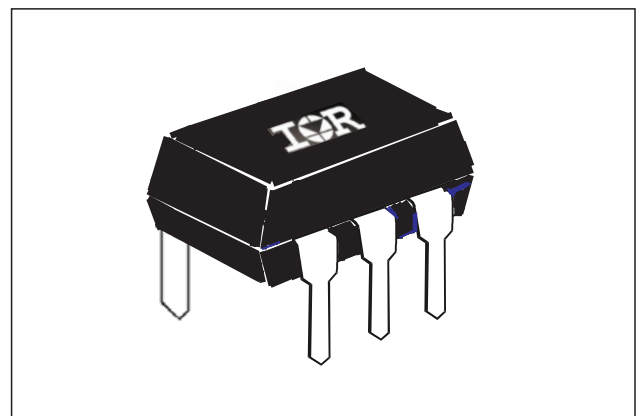
The PVG612A Series Photovoltaic Relay is a single-pole, normally open solid-state relay that can replace electromechanical relays in many applications. It utilizes International Rectifier's proprietary HEXFET power MOSFET as the output switch, driven by an integrated circuit photovoltaic generator of 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 ruggedness. 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 ($-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ unless otherwise specified)

INPUT CHARACTERISTICS	Limits	Units
Minimum Control Current (see figure 1)	5.0	mA
Maximum Control Current for Off-State Resistance @ $T_A = +25^{\circ}\text{C}$	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

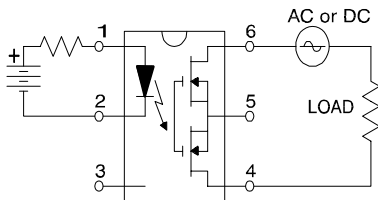
OUTPUT CHARACTERISTICS	Limits	Units
Operating Voltage Range	0 to ± 60	$V_{(\text{DC or AC peak})}$
Maximum Continuous Load Current @ $T_A = +40^{\circ}\text{C}$, 10mA Control (see figure 1)		
A Connection	2.0	A (AC or DC)
B Connection	2.5	A (DC)
C Connection	4.0	A (DC)
Maximum Pulsed Load Current @ $T_A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

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

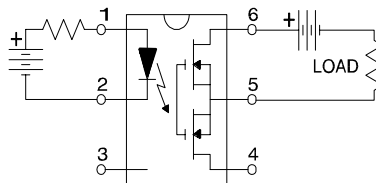
International Rectifier does not recommend the use of this product in aerospace, avionics, military or life support applications. Users of this International Rectifier product in such applications assume all risks of such use and indemnify International Rectifier against all damages resulting from such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

Connection Diagrams

"A" Connection



"B" Connection



"C" Connection

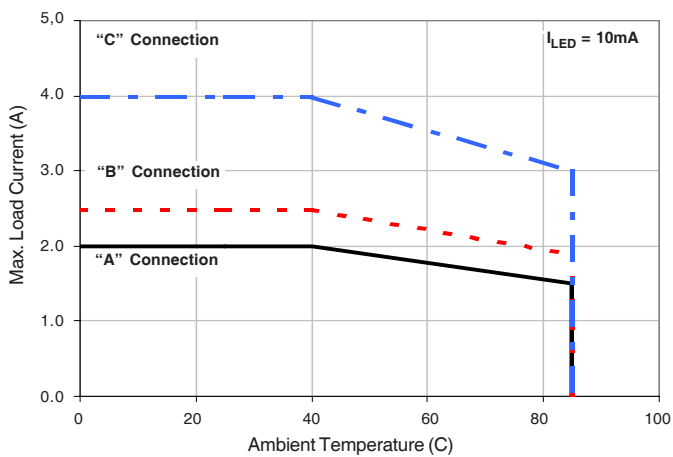
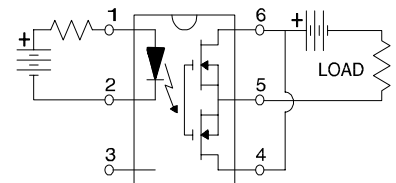


Figure 1. Current Derating Curves

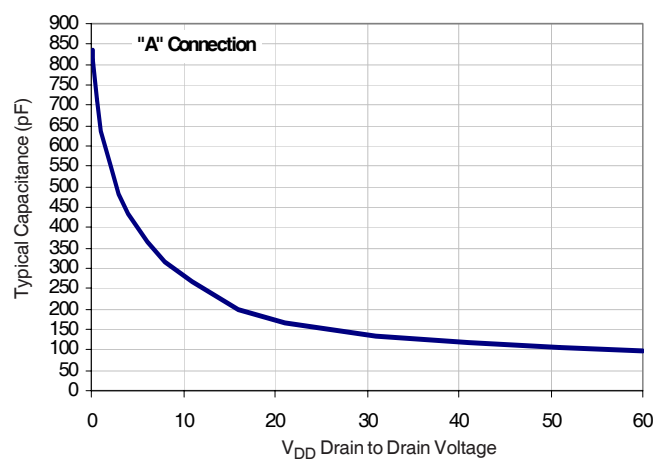


Figure 2. Typical Output Capacitance

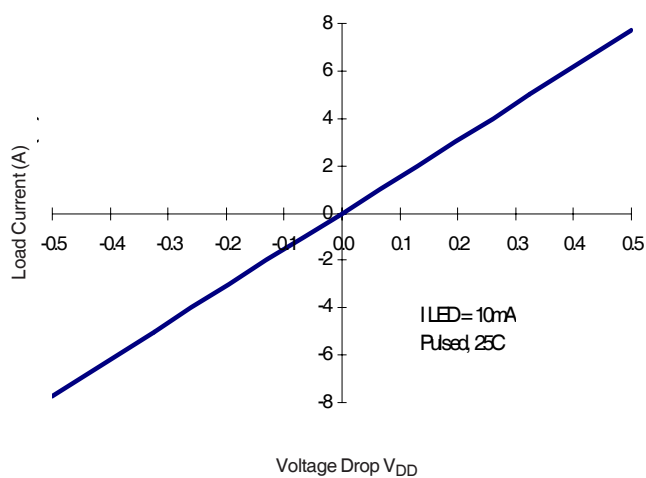


Figure 3. Typical Linearity Characteristics

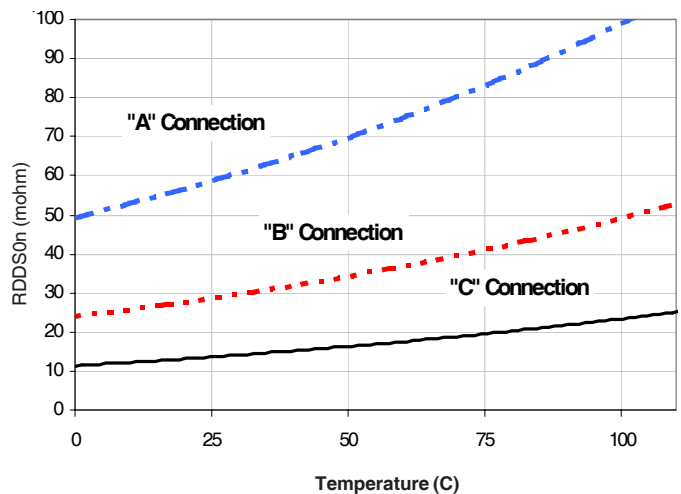


Figure 4. Typical Normalized On-Resistance

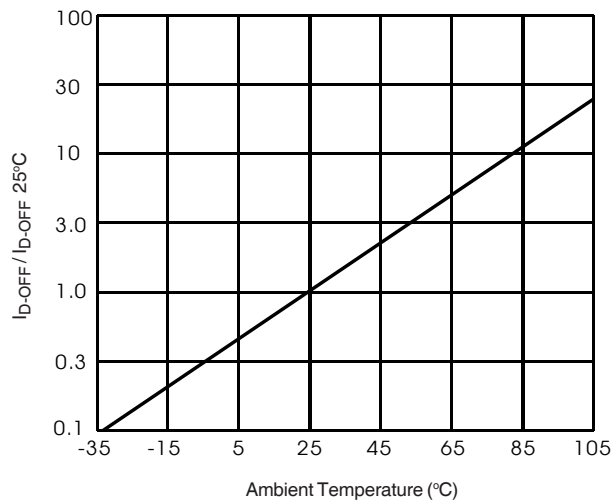


Figure 5. Typical Normalized Off-State Leakage

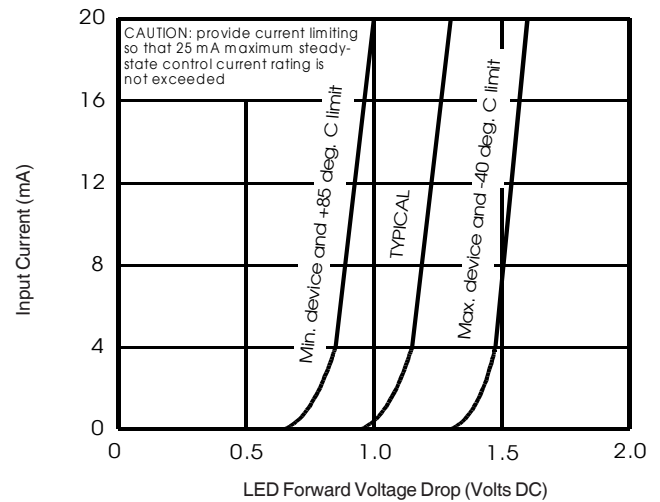


Figure 6. Input Characteristics (Current Controlled)

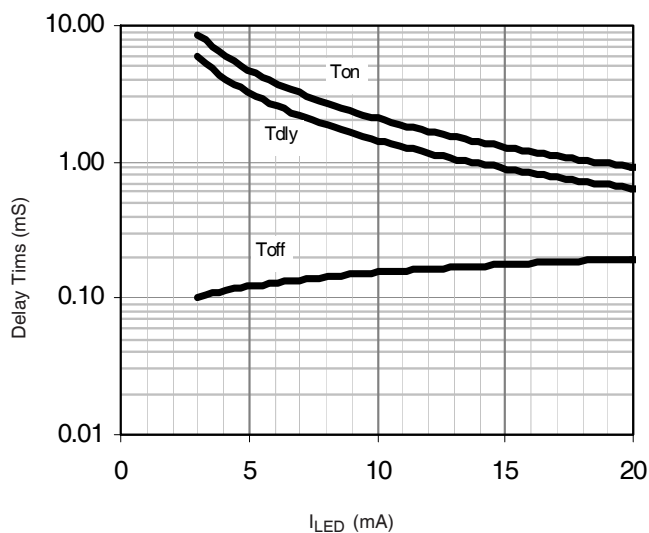


Figure 7. Typical Delay Times

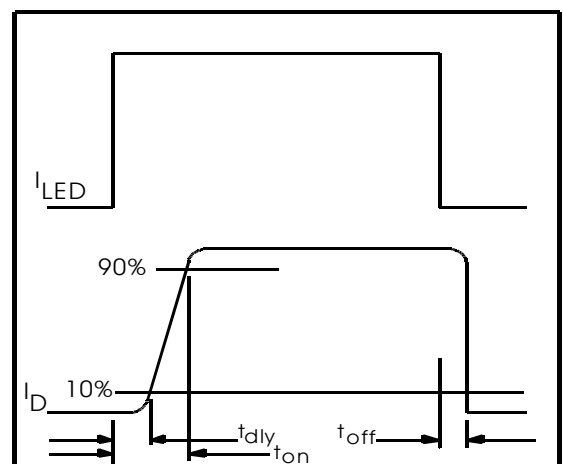


Figure 8. Delay Time Definitions

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

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)	±2kV
ESD (CDM)	±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 $T_J = 25^\circ\text{C}$.

“◇” This symbol in the table means these limits are guaranteed at full temp range $T_J = -40^\circ\text{C} \sim +125^\circ\text{C}$.

Test condition is $T_J = -40^\circ\text{C} \sim +125^\circ\text{C}$, 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	$V_{EN} = 12V, R_{ISET} = 16k\Omega$	●	0.5	1.00	mA
		$V_{EN} = 3.3V, R_{ISET} = 16k\Omega$	○	0.5	1.00	
V_{ISET}	Current setting reference voltage			1.0		V
I_{OUT}	Output current	$V_{OUT} = 0.8V, V_{EN} = 12V, R_{ISET} = 160k\Omega$	●	♦	10	mA
				◇	10	
		$V_{OUT} = 0.8V, V_{EN} = 3.3V, R_{ISET} = 160k\Omega$	○	♦	10	
				◇	10	
		$V_{OUT} > 1.0V, V_{EN} = 12V, R_{ISET} = 16k\Omega, \text{SOP-8-EP}$	●	♦	97	mA
				◇	95	
		$V_{OUT} > 1.0V, V_{EN} = 3.3V, R_{ISET} = 16k\Omega, \text{SOP-8-EP}$	○	♦	97	
				◇	95	
		$V_{OUT} > 1.0V, V_{EN} = 12V, R_{ISET} = 16k\Omega, \text{SOT23-6}$	●	♦	96.5	mA
				◇	94	
		$V_{OUT} > 1.0V, V_{EN} = 3.3V, R_{ISET} = 16k\Omega, \text{SOT23-6}$	○	♦	96.5	mA
				◇	94	

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	V
			○		1.9	
		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		V
		10mA ≤ I _{OUT} ≤ 150mA, V _{OUT} = 2V, SOT23-6	○	2.9		
		150mA < I _{OUT} ≤ 200mA, V _{OUT} = 2V, SOP-8-EP		3.1		
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.

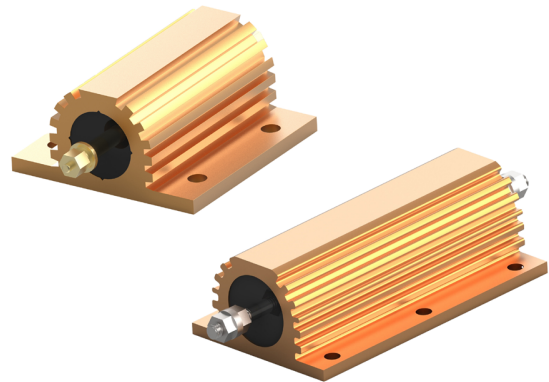
Note 8: Guaranteed by design.

ALUMINIUM HOUSED POWER RESISTORS

TYPE HS SERIES

INTRODUCTION

TE Connectivity (TE) is one of the leading European suppliers of standard and custom designed aluminium housed resistors for general-purpose use, power supplies, power generation and the traction and drives industries. The HS Series product offering, a range of extremely stable, high-quality wire wound resistors are made from quality materials for optimum reliability and stability, capable of dissipating high power in a limited space with relatively low surface temperature. The aluminium housing in these resistors help rapidly dissipate power to a specified heat sink.



This latest revision of the datasheet introduces two new additions to the series: the HSCS stud terminal type HSC75, 100, and 150, and the HSHC type with power ratings from 350W to 500W, giving this series the widest range of power ratings currently on offer. TE is happy to advise on the use of these resistors for pulse applications and high voltage use. On request, TE can modify and test these resistors specifically to conform to relevant international, military or customer specifications. Low ohmic values, alternative mountings, and alternative termination types are also available on request.

FEATURES

- Established product with proven reliability leading the way with over 50 years of design and manufacturing experience.
- 5 Watts to 500 Watts: Largest range on the market.
- Versatile product bench mark in wide range of industries.
- Custom designs, windings, terminations, mountings available on request.
- Low resistance, low inductance and higher voltage versions available specialising the standard.

APPLICATIONS

- Braking resistor
- Balancing resistor
- Capacitor charging & discharging
- Crowbar
- Filter
- Electrical machinery general use

CHARACTERISTICS - ELECTRICAL

HSA & HSC - 5 Watts to 75 Watts

	HSA5	HSA10	HSA25	HSA50	HSC75
Dissipation @ 25°C with heatsink (Watts):	10	16	25	50	75
Without heatsink (Watts):	5.5	8	12.5	20	45
Ohmic value minimum (Ohms):	R01	R01	R01	R01	R05
Ohmic value maximum (Ohms):	10K	15K	36K	100K	50K
Operating temperature	-55-200°C				
Maximum working voltage (DC or AC rms) Volts:	150	250	500	1250	1400
Isolation voltage (DC or AC pk) Volts:	1400	1400	2500	2500	3500
Dielectric strength (AC Peak) Volts:	1400	1400	2500	2500	5000
Stability (resistance change, 1000 hours) (%):	1	1	1	1	2
Standard heatsink - area (mm ²):	41500	41500	53500	53500	99500
Thickness (mm):	1	1	1	1	3
Number of mounting holes:	2 hole	2 hole	2 hole	2 hole	4 hole

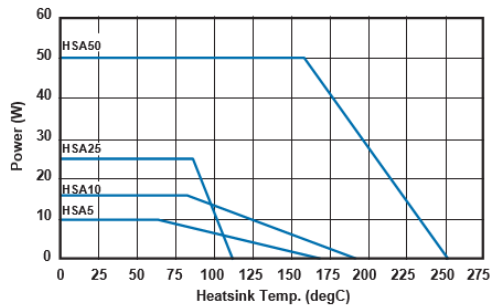
Aluminium Housed Power Resistors

Type HS Series

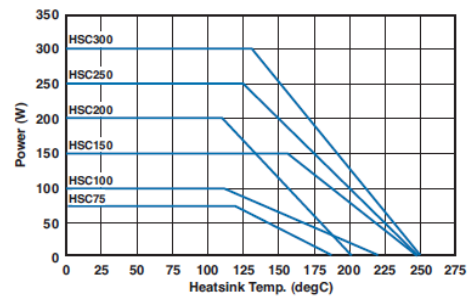
DERATING CURVE

N.B. The graphs plot power against allowable heatsink temperature range and not the temperature the heatsink will rise to under this power condition, nor the ambient temperature.

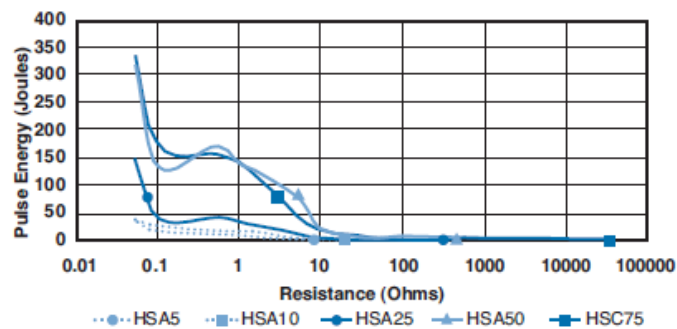
HSA5 - 50



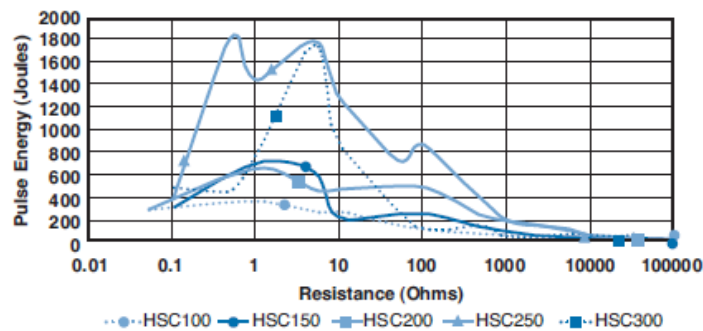
HSC75 - 300



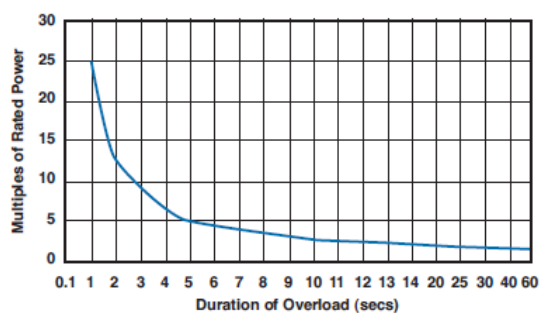
Pulse Energy HSA5 to HSC75 (pulse length 200ms)



Pulse Energy HSC100 to HSC300 (pulse length 200ms)

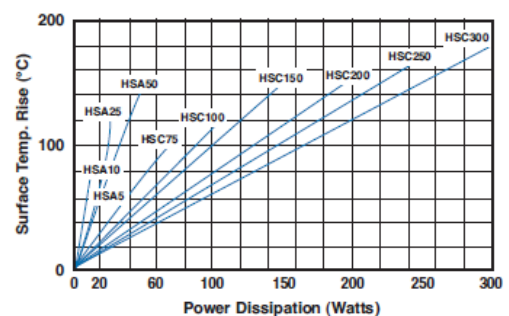


Power Overload



This graph indicates the amount that the rated power (at 20°C) of the standard HS series resistor may be increased for overloads of 100ms to 60s

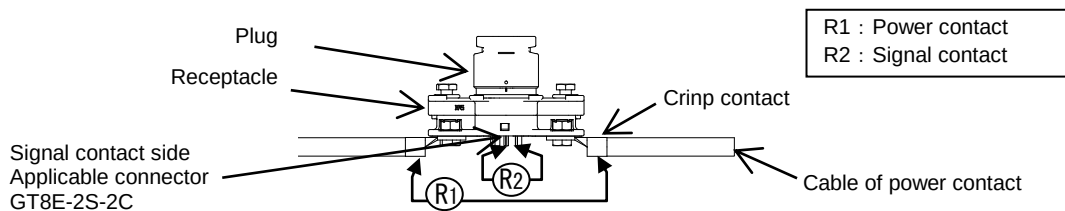
Surface Temperature Rise



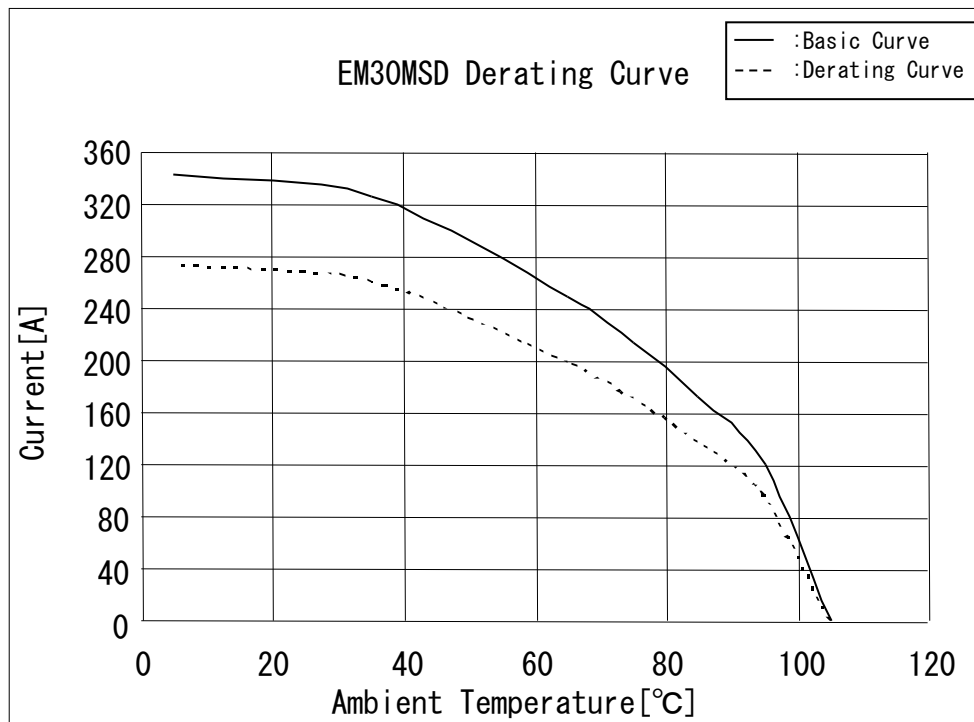
For resistor mounted on standard heatsink, related to power dissipation

APPLICABLE STANDARD		TÜV approved (J50385364). UL approved (E474564).															
Rating	Operating Temperature Range	-40 °C to +105 °C ⁽⁵⁾	Storage Temperature Range	-10°C to +60°C													
	Voltage	Power Contact : AC/DC 1500 V Signal Contact : AC/DC 250 V															
	Current	Power Contact : 200 A ⁽³⁾ Signal Contact : 1 A	Applicable Cable	100 mm ² min (AWG#4/0 min)													
SPECIFICATIONS																	
ITEM		TEST METHOD		REQUIREMENTS	QT AT												
CONSTRUCTION																	
General Examination		Examined visually and with a measuring instrument.		According to the drawing.	X X												
Marking		Confirmed visually.			X X												
ELECTRICAL CHARACTERISTICS																	
Contact Resistance ⁽²⁾	Measured at DC 1A.(Power contact)		0.5 mΩ MAX.	X	X												
	Measured at DC 1A.(Signal contact include GT8E-2S-2C)		90 mΩ MAX.	X	X												
Insulation Resistance	Measured at 500 V DC.		5000 MΩ MIN.	X	X												
Voltage Proof	4500 V AC applied for 1 min. (Power contact)		No breakdown.	X	X												
	750 V AC applied for 1 min. (Signal contact)			X	X												
MECHANICAL CHARACTERISTICS																	
Mating and Unmating Forces	Measured with an applicable connector. Without locking device.		Mating and unmating forces: 100 N MAX. (Between EM30MSD-A Plug and Receptacle)	X	—												
Mechanical Operation	Mated and unmated 200 times. (Between EM30MSD-A Plug and Receptacle)		Contact resistance: 0.75 mΩ MAX. (Power contact) Contact resistance: 150 mΩ MAX. (Signal contact include GT8E-2S-2C)	X	—												
	Mated and unmated 30 times. (Between EM30MSD-A Receptacle and GT8E-2S-2C)		Contact resistance : 150 mΩ MAX (Signal contact include GT8E-2S-2C)	X	—												
Vibration 1	Frequency: 10 Hz to 55 to 10 Hz every cycle (5 min per cycle) Single amplitude: 0.75 mm Performed over 10 cycles in each of three mutually perpendicular directions.		1) No electrical discontinuity of more than 10 μs. 2) No damage, cracks or looseness of parts.	X	—												
Vibration 2 (Random) (ISO16750-3 / JASO D 014-3)	Frequency : 10 TO 2000 (Hz), Acceleration spectrum density : 57.9 m/s ² , At 8 h, for 3 directions.		1) No electrical discontinuity of more than 10 μs. 2) No damage, cracks or looseness of parts.	X	—												
Shock	Acceleration: 490 m/s ² , Half sine wave pulses of 11 ms. Performed 3 times in each of three mutually perpendicular directions.		1) No electrical discontinuity of more than 10 μs. 2) No damage, cracks or looseness of parts.	X	—												
ENVIRONMENTAL CHARACTERISTICS																	
Rapid Change of Temperature	Temperature: -40 → R/T ⁽¹⁾ → +125 → R/T °C Time: 30 → 2 to 3 → 30 → 2 to 3 min for 5 cycles.		1) Insulation resistance: 5000 MΩ MIN. 2) No damage, cracks or looseness of parts.	X	—												
Damp Heat, Steady State	Subjected to a temperature of +40°C, at a humidity of 90 to 95% for 96 hours.		1) Insulation resistance: 50 MΩ MIN. (At high humidity) 2) Insulation resistance: 500 MΩ MIN. (When dry) 3) No damage, cracks or looseness of parts.	X	—												
Corrosion Salt Mist ⁽⁴⁾	Subjected to 5% salt spray for 48 hours.		No heavy corrosion which impairs functionality.	X	—												
Sealing ⁽⁴⁾	Subjected to a depth of 2 m for 14 days. (IPX8 Waterproof)(JIS C 0920:2003)		No water penetration into the connector.	X	—												
Air Tightness ⁽⁴⁾	17.6 kPa of air pressure applied to the inside of the mated connector for 30 seconds.		No air bubbles emitted from the inside of the connector.	X	—												
<table border="1"> <thead> <tr> <th></th> <th>COUNT</th> <th>DESCRIPTION OF REVISIONS</th> <th>DESIGNED</th> <th>CHECKED</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>							COUNT	DESCRIPTION OF REVISIONS	DESIGNED	CHECKED	DATE						
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REMARK Notes (1) R/T : Room Temperature (2) Measured contact resistance at the points shown in Fig.1 on the next page. (3) Delaying curve shown in Fig.2 on the next page. (4) Corrosion salt mist, Sealing and Air tightness shall be tested under mated condition with an applicable connector. (5) Operating temperturte range includes the temperature rise by current carrying.			APPROVED	TP. KOMATSU	20220808												
			CHECKED	HY. KOBAYASHI	20220808												
			DESIGNED	TY. SUZUKI	20220805												
			DRAWN	TY. SUZUKI	20220805												
Unless otherwise specified, refer to IEC 60512 (JIS C 5402).																	
Note QT:Qualification Test AT:Assurance Test X:Applicable Test			DRAWING NO.		ELC-119542-04-00												
	SPECIFICATION SHEET		PART NO.	EM30MSD-A (04)													
	HIROSE ELECTRIC CO., LTD.		CODE NO.	CL0138-0206-0-04	1/2												

FIG.1 Measuring point of contact resistance



[Reference]



Measurement method:

Mated plug and receptacle with 100 mm² cable.

Note:

Derating curve could vary depending on cable type and each measurement even under the same conditions.

Therefore, above data are guidelines and not connector specifications.

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SPECIFICATION SHEET

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CODE NO.

CL0138-0206-0-04



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Reference

- [1] *TE ECK100BH5AAA Datasheet*. www.te.com, 11.2024