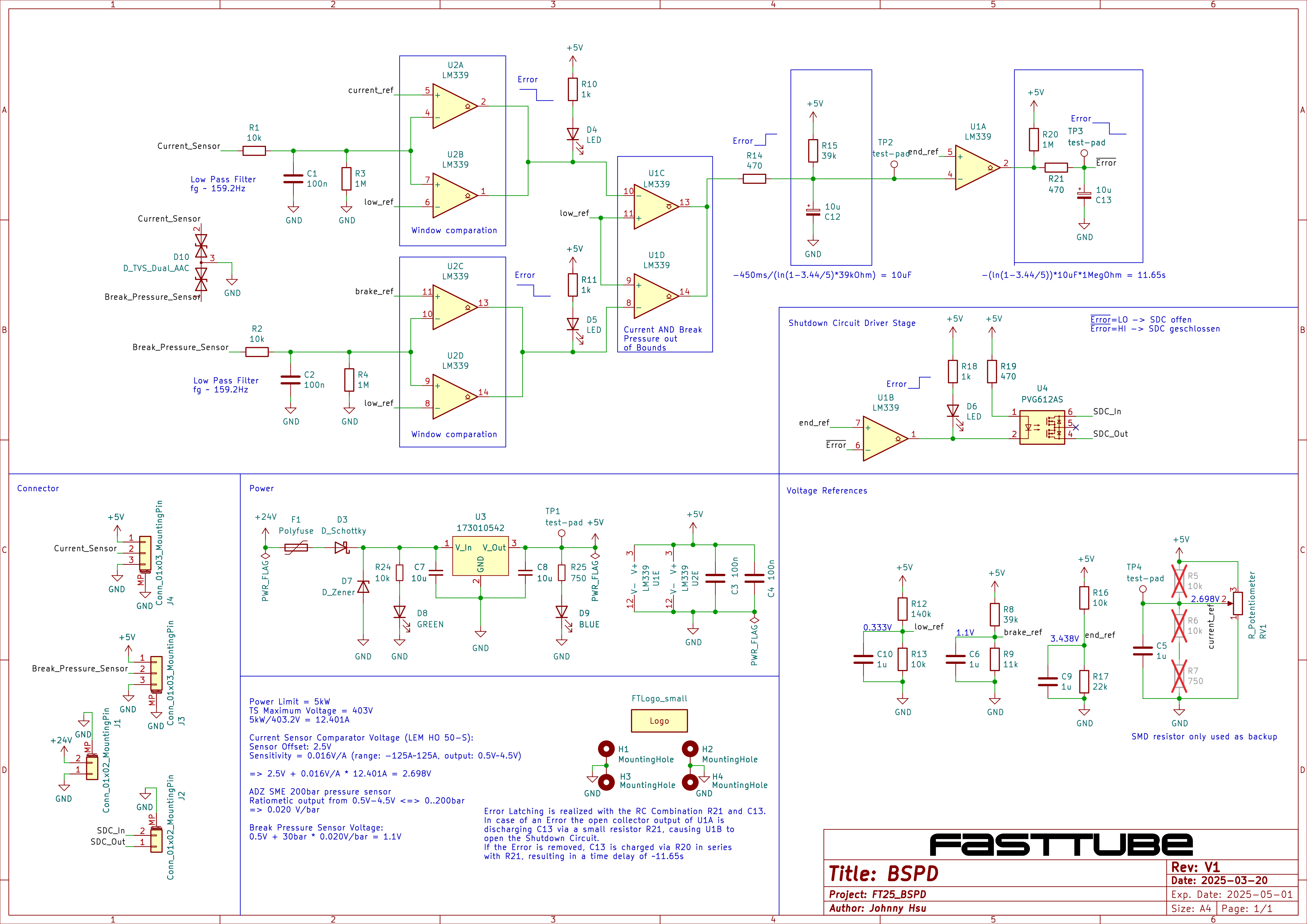
Electrical Scrutineering

Contents

BSPD



U2A LM339
U2B LM339
U2C LM339
U2D LM339
current_ref
low_ref
brake_ref
Current_Sensor
R1 10k
C1 100n
R3 1M
Low Pass Filter
fg ~ 159.2Hz
Window comparation
D10 D_TVS_Dual_AAC
Break_Pressure_Sensor
R2 10k
C2 100n
R4 1M
Error
R10 1k
D4 LED
R11 1k
D5 LED
U1C LM339
U1D LM339
Current AND Break Pressure out of Bounds
R14 470
R15 39k
C12 10u
TP2 test-pad
end_ref
U1A LM339
R20 1M
R21 470
TP3 test-pad
C13 10u
−450ms/(ln(1−3.44/5)*39kOhm) = 10uF
−(ln(1−3.44/5))*10uF*1MegOhm = 11.65s
Shutdown Circuit Driver Stage
Error=LO −> SDC offen
Error=HI −> SDC geschlossen
R18 1k
R19 470
D6 LED
U1B LM339
U4 PVG612AS
SDC_In
SDC_Out
Connector
J4 Conn_01x03_MountingPin
J3 Conn_01x03_MountingPin
J1 Conn_01x02_MountingPin
J2 Conn_01x02_MountingPin
Power
+24V
F1 Polyfuse
D3 D_Schottky
D7 D_Zener
R24 10k
D8 GREEN
C7 10u
U3 173010542
V_In V_Out GND
C8 10u
TP1 test-pad
R25 750
D9 BLUE
PWR_FLAG
U1E LM339
U2E LM339
C3 100n
C4 100n
+5V
GND
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: 0.5V-4.5V)
=> 2.5V + 0.016V/A * 12.401A = 2.698V
ADZ SME 200bar pressure sensor
Ratiometic output from 0.5V−4.5V <=> 0..200bar
=> 0.020 V/bar
Break Pressure Sensor Voltage:
0.5V + 30bar * 0.020V/bar = 1.1V
FTLogo_small
Logo
H1 MountingHole
H2 MountingHole
H3 MountingHole
H4 MountingHole
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 ~11.65s
Voltage References
R12 140k
R13 10k
C10 1u
0.333V
R8 39k
R9 11k
C6 1u
1.1V
R16 10k
R17 22k
C9 1u
3.438V
TP4 test-pad
R5 10k
R6 10k
R7 750
C5 1u
2.698V
RV1 R_Potentiometer
SMD resistor only used as backup
FASTTUBE
Title: BSPD
Project: FT25_BSPD
Author: Johnny Hsu
Rev: V1
Date: 2025−03−20
Exp. Date: 2025−05−01
Size: A4
Page: 1/1

BEDIENUNGSANLEITUNG

Drucktransmitter in Miniturbauform

Baureihe SME

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

CE

(Abbildung ähnlich)

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Technische Daten *

Typ	Spannung	Spannung radiometrisch
Ausgangssignal*	0...5 V_{DC}	0,5...4,5 V_{DC}
Betriebsspannung (U_B)	8...32 V_{DC}	5 V_{DC} ±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	

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.

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.

CE

(similar image)

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Technical specifications *

Type	Voltage	Radiometric voltage
output signal*	0...5 V_{DC}	0,5...4,5 V_{DC}
Operating voltage (U_B)	8...32 V_{DC}	5 V_{DC} ±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	

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.

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.

CE

(Représentation similaire)

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Données techniques *

Type	Tension	Tension quotientométrique
Signal de sortie*	0...5 V_{DC}	0,5...4,5 V_{DC}
Tension d'utilisation (U_B)	8...32 V_{DC}	5 V_{DC} ±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*	Boîtier : acier inoxydable Membrane: acier inoxydable	

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

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 / Unfallverhüttungsvorschriften 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.
- Berücksichten 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 Kartonagen).
- Entsorgen Sie die einzelnen Werkstoffe in Recycling-Sammelbehältern.

Betriebsbedingungen

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 angeschlossenem 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. pneumatisch beaufschlagten Teil des Drucktransmitters.

Einbau des Drucktransmitters

- Benutzen Sie den passenden Schraubenschlüssel um den Drucktransmitter in den vorgesehen Druckanschluss einzuschrauben. Das Anzugsdrehmoment beträgt ungefähr 10 Nm.
- Zum Abdichten des Systems verwenden Sie den für diesen Typ vorgeschrieben 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

Ausbau des Drucktransmitters

- Achten Sie auf die Einhaltung der notwendigen Sicherheitsbestimmungen beim Ausbau des Drucktransmitters.
- Das Drucksystem muss sich beim Demontieren in einem drucklosen Zustand befinden.

Zeichenerklärung

Hinweis | Achtung | Gefahr | Recycling

Änderungen im Sinne des technischen Fortschritts vorbehalten.
Stand: Dezember - 2010 Rev. 1

Requirements of product application

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.

Operating conditions

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.

How to install the pressure transmitter

- 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.

How to remove the pressure transmitter

- Please observe applicable safety regulations when removing the pressure transmitter.
- When disassembling the pressure system, it must be depressurized.

Signs and symbols

Note | Caution | Danger | Recycling

Subject to change due to technical progress.
Reviewed last: December - 2010 Rev. 1

Conditions d'utilisation du produit

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.

Conditions d'utilisation

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.

Montage du transmetteur de pression

- 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.

Démontage du transmetteur de pression

- 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.

Légende

Remarque | Attention | Danger | Recyclage

Sous réserve de modifications servant le progrès technique.
État: Décembre-2010 Rév. 1

International
IOR Rectifier

Series PVG612APbF

Microelectronic Power IC

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

General Description

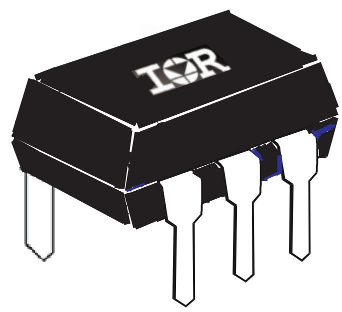
The PVG612A Series Photovoltaic Relay is a single-pole, normally open solid-state relay that can replace electromechanical relays in many applications. It utilizes International Rectifier's proprietary HEXFET power MOSFET as the output switch, driven by an integrated circuit photovoltaic generator of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

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

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

Features

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



Applications

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

Part Identification

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

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

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

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

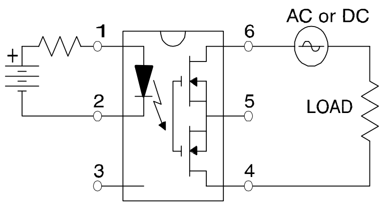
OUTPUT CHARACTERISTICS		Limits	Units
Operating Voltage Range		0 to ±60	$V_{(DC\ or\ AC\ peak)}$
Maximum Continuous Load Current @ T_A = +40°C, 10mA Control (see figure 1)	A Connection	2.0	A (AC or DC)
	B Connection	2.5	A (DC)
	C Connection	4.0	A (DC)
Maximum Pulsed Load Current @ T_A =+25°C (100 ms @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

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

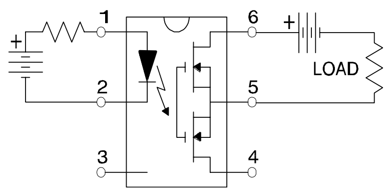
International Rectifier does not recommend the use of this product in aerospace, avionics, military or life support applications. Users of this International Rectifier product in such applications assume all risks of such use and indemnify International Rectifier against all damages resulting from such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

Connection Diagrams

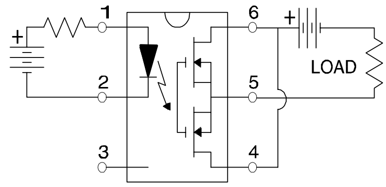
"A" Connection



"B" Connection



"C" Connection



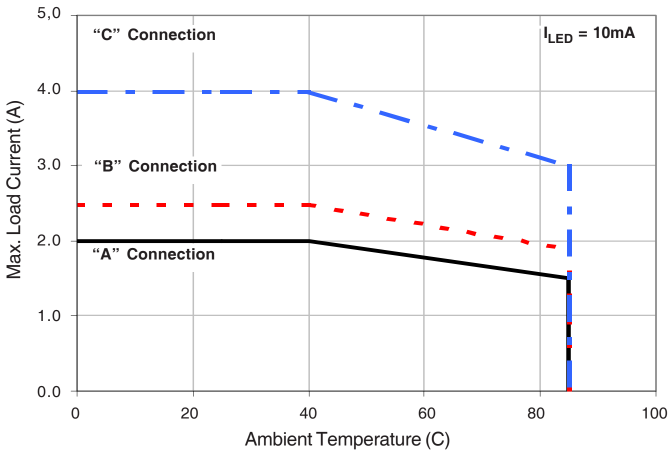


Figure 1. Current Derating Curves

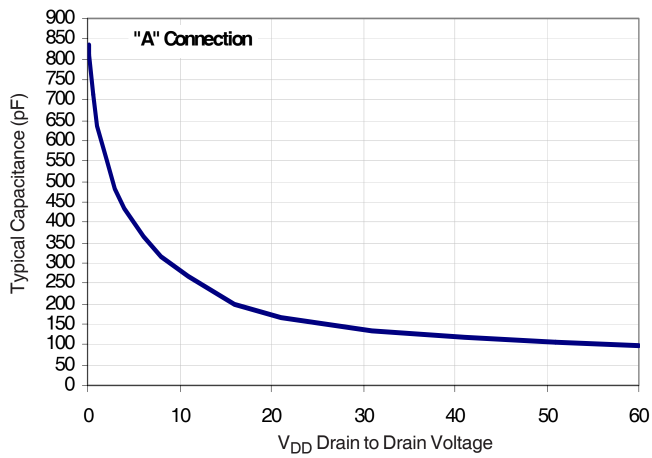


Figure 2. Typical Output Capacitance

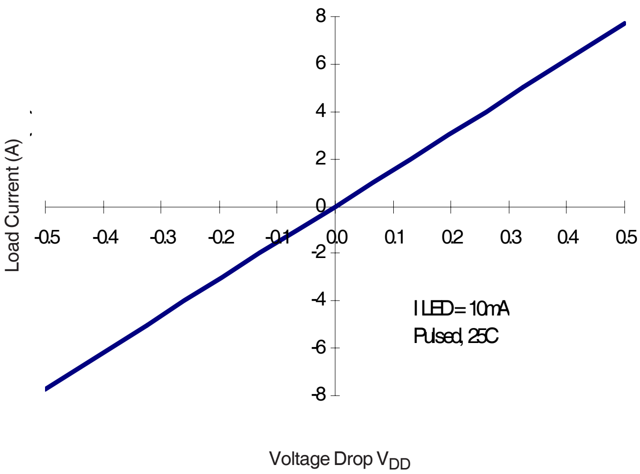


Figure 3. Typical Linearity Characteristics

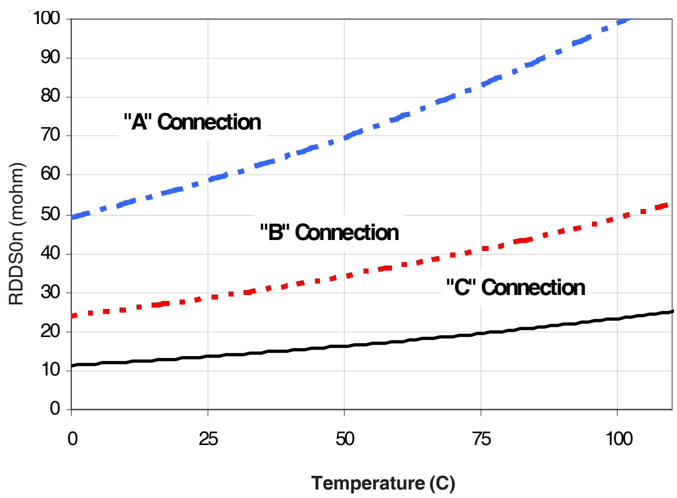


Figure 4. Typical Normalized On-Resistance

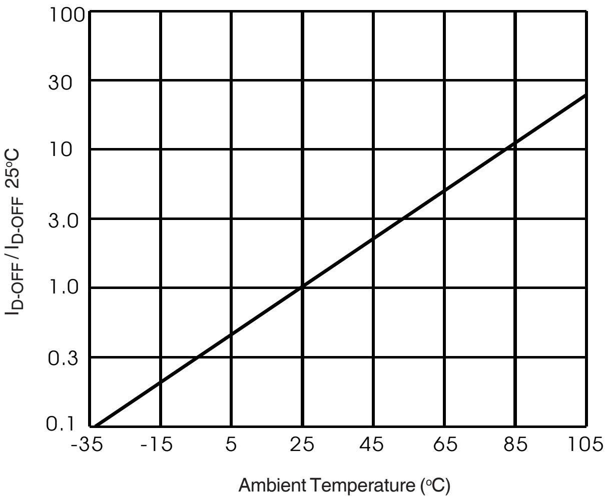


Figure 5. Typical Normalized Off-State Leakage

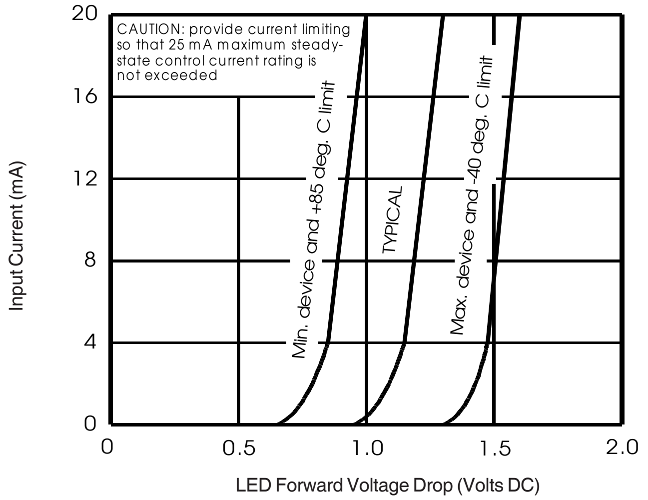


Figure 6. Input Characteristics (Current Controlled)

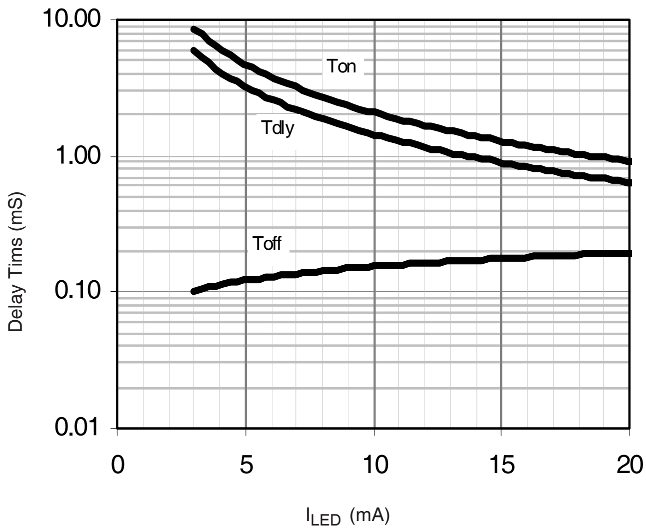


Figure 7. Typical Delay Times

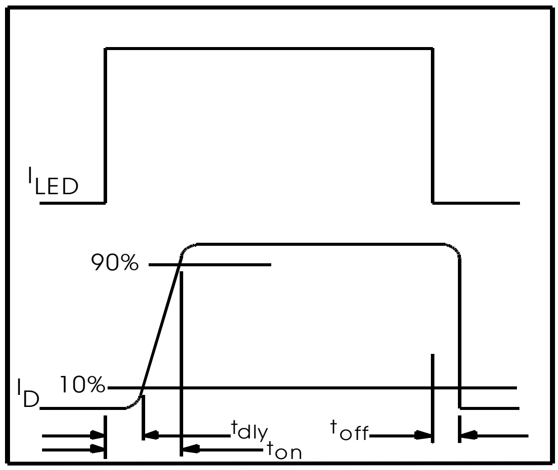
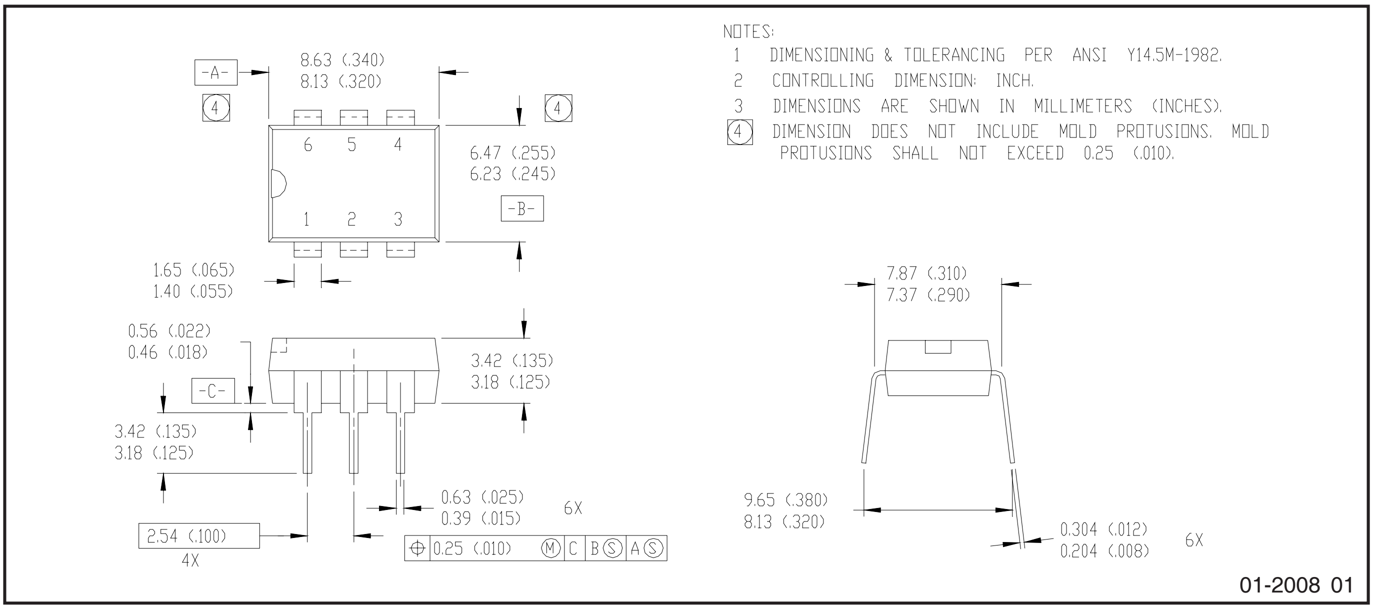
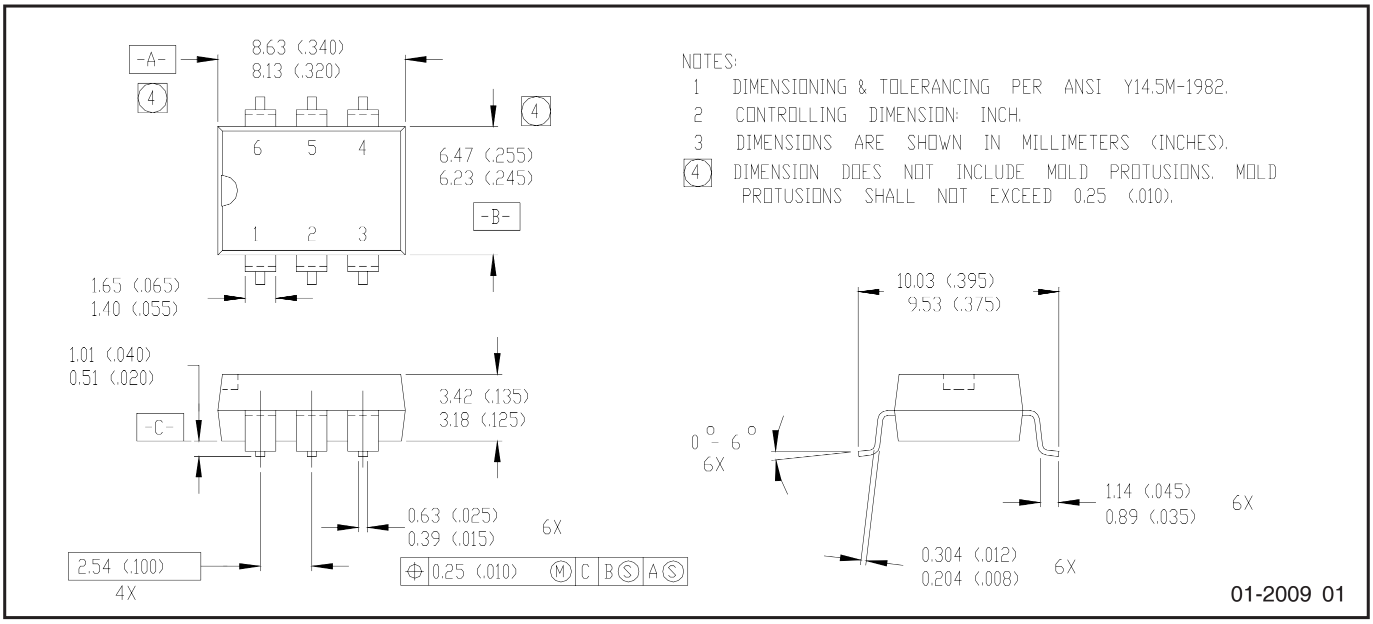


Figure 8. Delay Time Definitions

Case Outlines





Note: For the most current drawing please refer to IR website at: http://www.irf.com/package/

Qualification information†

Qualification level	Industrial (per JEDEC JESD47I †† guidelines)	
Moisture Sensitivity Level	PVG612APbF	N/A
	PVG612ASPbF	MSL4 (per JEDEC J-STD-020E & JEDEC J-STD-033C ††)
	PVG612AS-TPbF	
RoHS compliant	Yes	

† Qualification standards can be found at International Rectifier's web site: http://www.irf.com/product-info/reliability
†† Applicable version of JEDEC standard at the time of product release

Revision History

Date	Comments
5/4/2015	• Added Qualification Information Table on page 6 • Updated data sheet with new IR corporate template

International Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA
Data and specifications subject to change without notice
To contact International Rectifier, please visit http://www.irf.com/whoto-call/

Current Transducer HO-S series I_{PN} = 50, 100, 150, 200, 240, 250 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 × I_{PN} (peak value)
- Galvanic separation between primary and secondary circuit
- Low power consumption
- Compact design for panel mounting
- Aperture: 15 × 8 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.

Safety

Caution

If the device is used in a way that is not specified by the manufacturer, the protection provided by the device may be compromised.
Always inspect the electronics unit and connecting cable before using this product and do not use it if damaged.
Mounting assembly shall guarantee the maximum primary conductor temperature, fulfill clearance and creepage distance, minimize electric and magnetic coupling, and unless otherwise specified can be mounted in any orientation.

Caution, risk of electrical shock

This transducer must be used in limited-energy secondary circuits SELV according to IEC 61010-1, in electric/electronic equipment with respect to applicable standards and safety requirements in accordance with the manufacturer's operating specifications.

Use caution during installation and use of this product; certain parts of the module can carry hazardous voltages and high currents (e.g. power supply, primary conductor).
Ignoring this warning can lead to injury and or/or cause serious damage.
De-energize all circuits and hazardous live parts before installing the product.
All installations, maintenance, servicing operations and use must be carried out by trained and qualified personnel practicing applicable safety precautions.

This transducer is a build-in device, whose hazardous live parts must be inaccessible after installation.
This transducer must be mounted in a suitable end-enclosure.
Besides make sure to have a distance of minimum 30 mm between the primary terminals of the transducer and other neighboring components.

Main supply must be able to be disconnected.
Always inspect the flexible probe for damage before using this product.
Never connect or disconnect the external power supply while the primary circuit is connected to live parts.
Never connect the output to any equipment with a common mode voltage to earth greater than 30 V.
Always wear protective clothing and gloves if hazardous live parts are present in the installation where the measurement is carried out.
This transducer is a built-in device, not intended to be cleaned with any product. Nevertheless if the user must implement cleaning or washing process, validation of the cleaning program has to be done by himself.
When defining soldering process, please use no cleaning process only.

ESD susceptibility
The product is susceptible to be damaged from an ESD event and the personnel should be grounded when handling it.

Do not dispose of this product as unsorted municipal waste. Contact a qualified recycler for disposal.

Underwriters Laboratory Inc. recognized component

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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.

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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 µs	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		

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Electrical data HO 50-S-0100

At T_A = 25 °C, U_C = +5 V, R_L = 10 kΩ 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 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	$R_{on\ OCD}$	Ω	70	95	150	Open drain, active low Over operating temperature range
OCD detection hold time	$t_{hold\ OCD}$	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 A	U_{OE}	mV	−5		5	$U_{out} - U_{ref}$ @ U_{ref} = 2.5 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 × 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	$t_{D\ 10}$	µs			2.5	@ 50 A/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\ 90}$	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}	µV/√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	$I_{P\ Th}$	A	2.64 × I_{PN}	2.93 × I_{PN}	3.22 × I_{PN}	Peak value ±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 °C	$\varepsilon_{SL\ 105}$	% of I_{PN}	−4.80		4.80	See formula note [3]
Sum of sensitivity and linearity error @ I_{PN} @ T_A = +85 °C	$\varepsilon_{SL\ 85}$	% 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 $@ T_A (\% \text{ of } I_{PN}) = \varepsilon_{SL} + (\frac{TCS}{10000} \times (T_A - 25) + \frac{TCI_{OE}}{10000 \times I_{PN}} \times 100 \times (T_A - 25))$

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Electrical data HO 100-S-0100

At T_A = 25 °C, U_C = +5 V, R_L = 10 kΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{P N}$	A		100		
Primary current, measuring range	$I_{P M}$	A	−250		250	@ U_C ≥ 4.6 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 @ $I_{P M}$	$U_{out} - U_{ref}$	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	$R_{on\ OCD}$	Ω	70	95	150	Open drain, active low Over operating temperature range
OCD detection hold time	$t_{hold\ OCD}$	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 A	$U_{O E}$	mV	−5		5	$U_{out} - U_{ref}$ @ U_{ref} = 2.5 V
Electrical offset current referred to primary	$I_{O E}$	A	−0.625		0.625	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	−170		170	−40 °C … 105 °C
Temperature coefficient of $U_{O E}$	$TCU_{O E}$	mV/K	−0.075		0.075	−40 °C … 105 °C
Temperature coefficient of $I_{O E}$	$TCI_{O E}$	mA/K	−9.375		9.375	−40 °C … 105 °C
External detection threshold sensitivity	S_{th}	mV/A		8		800 mV @ $I_{P N}$
Sensitivity error @ $I_{P N}$	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 … $I_{P N}$	ε_L	% of $I_{P N}$	−0.5		0.5	
Linearity error 0 … $I_{P M}$	ε_L	% of $I_{P M}$	−0.5		0.5	
Magnetic offset current (@ 10 × $I_{P N}$) referred to primary	$I_{O M}$	A	−0.92		0.92	One turn
Delay time to 10 % of the final output value $I_{P N}$ step	$t_{D 10}$	µs			2.5	@ 50 A/µs
Delay time @ 90 % of the final output value $I_{P N}$ step	$t_{D 90}$	µs			3.5	@ 50 A/µs
Frequency bandwidth (−3 dB)	BW	µs		100		
Noise voltage spectral density (100 Hz … 100 kHz)	u_{no}	µV/√Hz			6	Small signals
RMS noise voltage (DC … 10 kHz) (DC … 100 kHz) (DC … 1 MHz)	U_{no}	mVpp		3.6 8.7 16.9		
Primary current, detection threshold	$I_{P Th}$	A	2.64 × $I_{P N}$	2.93 × $I_{P N}$	3.22 × $I_{P N}$	Peak value ±10 %, overcurrent detection OCD
Sum of sensitivity and linearity error @ $I_{P N}$	$\varepsilon_{S L}$	% of $I_{P N}$	−1		1	
Sum of sensitivity and linearity error @ $I_{P N}$ @ T_A = +105 °C	$\varepsilon_{S L 105}$	% of $I_{P N}$	−4.55		4.55	See formula note [3]
Sum of sensitivity and linearity error @ $I_{P N}$ @ T_A = +85 °C	$\varepsilon_{S L 85}$	% of $I_{P N}$	−3.66		3.66	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 $@\ T_A\ (\%\ \text{of}\ I_{P N}) = \varepsilon_{S L} + (\frac{TCS}{10000} \times (T_A - 25) + \frac{TCI_{O E}}{10000 \times I_{P N}} \times 100 \times (T_A - 25))$

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Electrical data HO 150-S-0100

At T_A = 25 °C, U_C = +5 V, R_L = 10 kΩ 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		150		
Primary current, measuring range	I_{PM}	A	−375		375	@ $U_C \geq 4.6$ 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	$R_{on\ OCD}$	Ω	70	95	150	Open drain, active low Over operating temperature range
OCD detection hold time	$t_{hold\ OCD}$	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 A	U_{OE}	mV	−5		5	$U_{out} - U_{ref}$ @ U_{ref} = 2.5 V
Electrical offset current referred to primary	I_{OE}	A	−0.94		0.94	
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	−14.1		14.1	−40 °C … 105 °C
External detection threshold sensitivity	S_{th}	mV/A		5.333		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}	−0.5		0.5	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × 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	$t_{D\ 10}$	µs			2.5	@ 50 A/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\ 90}$	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}	µV/√Hz			4.5	
RMS noise voltage (DC … 10 kHz) (DC … 100 kHz) (DC … 1 MHz)	U_{no}	mVpp		 2.9 6.2 12.3		
Primary current, detection threshold	I_{PTh}	A	2.64 × I_{PN}	2.93 × I_{PN}	3.22 × I_{PN}	Peak value ±10 %, overcurrent detection OCD
Sum of sensitivity and linearity error @ I_{PN}	ε_{SL}	% of I_{PN}	−1		1	
Sum of sensitivity and linearity error @ I_{PN} @ T_A = +105 °C	$\varepsilon_{SL\ 105}$	% of I_{PN}	−4.55		4.55	See formula note [3]
Sum of sensitivity and linearity error @ I_{PN} @ T_A = +85 °C	$\varepsilon_{SL\ 85}$	% of I_{PN}	−3.66		3.66	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 $@\ T_A\ (\%\ \text{of}\ I_{PN}) = \varepsilon_{SL} + (\frac{TCS}{10000} \times (T_A - 25) + \frac{TCI_{OE}}{10000 \times I_{PN}} \times 100 \times (T_A - 25))$

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Electrical data HO 200-S-0100

At T_A = 25 °C, U_C = +5 V, R_L = 10 kΩ 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		200		
Primary current, measuring range	I_{PM}	A	−500		500	@ $U_C \geq$ 4.6 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	$R_{on\ OCD}$	Ω	70	95	150	Open drain, active low Over operating temperature range
OCD detection hold time	$t_{hold\ OCD}$	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 A	U_{OE}	mV	−5		5	$U_{out} - U_{ref}$ @ U_{ref} = 2.5 V
Electrical offset current referred to primary	I_{OE}	A	−1.25		1.25	
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	−18.75		18.75	−40 °C … 105 °C
External detection threshold sensitivity	S_{th}	mV/A		4		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}	−0.5		0.5	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × 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	$t_{D\,10}$	µs			2.5	@ 50 A/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\,90}$	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}	µV/√Hz			3.7	
RMS noise voltage (DC … 10 kHz) (DC … 100 kHz) (DC … 1 MHz)	U_{no}	mVpp		2.5 5 10		
Primary current, detection threshold	$I_{P\,Th}$	A	2.64 × I_{PN}	2.93 × I_{PN}	3.22 × I_{PN}	Peak value ±10 %, overcurrent detection OCD
Sum of sensitivity and linearity error @ I_{PN}	ε_{SL}	% of I_{PN}	−1		1	
Sum of sensitivity and linearity error @ I_{PN} @ T_A = +105 °C	$\varepsilon_{SL\,105}$	% of I_{PN}	−4.55		4.55	See formula note [3]
Sum of sensitivity and linearity error @ I_{PN} @ T_A = +85 °C	$\varepsilon_{SL\,85}$	% of I_{PN}	−3.66		3.66	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}) $= \varepsilon_{SL} + (\frac{TCS}{10000} \times (T_A - 25) + \frac{TCI_{OE}}{10000 \times I_{PN}} \times 100 \times (T_A - 25))$

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Electrical data HO 240-S-0100

At T_A = 25 °C, U_C = +5 V, R_L = 10 kΩ 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		240		
Primary current, measuring range	I_{PM}	A	−600		600	@ $U_C \geq$ 4.6 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	$R_{on\,OCD}$	Ω	70	95	150	Open drain, active low Over operating temperature range
OCD detection hold time	$t_{hold\,OCD}$	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 A	U_{OE}	mV	−5		5	$U_{out} - U_{ref}$ @ U_{ref} = 2.5 V
Electrical offset current referred to primary	I_{OE}	A	−1.5		1.5	
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	−22.5		22.5	−40 °C … 105 °C
External detection threshold sensitivity	S_{th}	mV/A		3.333		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}	−0.5		0.5	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × 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	$t_{D\,10}$	µs			2.5	@ 50 A/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\,90}$	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}	µV/√Hz			3.5	
RMS noise voltage (DC … 10 kHz) (DC … 100 kHz) (DC … 1 MHz)	U_{no}	mVpp		 2.5 5 8.7		
Primary current, detection threshold	$I_{P\,Th}$	A	2.64 × I_{PN}	2.93 × I_{PN}	3.22 × I_{PN}	Peak value ±10 %, overcurrent detection OCD
Sum of sensitivity and linearity error @ I_{PN}	ε_{SL}	% of I_{PN}	−1		1	
Sum of sensitivity and linearity error @ I_{PN} @ T_A = +105 °C	$\varepsilon_{SL\,105}$	% of I_{PN}	−4.55		4.55	See formula note [3]
Sum of sensitivity and linearity error @ I_{PN} @ T_A = +85 °C	$\varepsilon_{SL\,85}$	% of I_{PN}	−3.66		3.66	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}) = $\varepsilon_{SL} + \left(\frac{TCS}{10000} \times (T_A - 25) + \frac{TCI_{OE}}{10000 \times I_{PN}} \times 100 \times (T_A - 25)\right)$

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Electrical data HO 250-S-0100

At T_A = 25 °C, U_C = +5 V, R_L = 10 kΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{P N}$	A		250		
Primary current, measuring range	$I_{P M}$	A	−625		625	@ $U_C \geq$ 4.6 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 @ $I_{P M}$	$U_{out} - U_{ref}$	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	$R_{on\ OCD}$	Ω	70	95	150	Open drain, active low Over operating temperature range
OCD detection hold time	$t_{hold\ OCD}$	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 A	$U_{O E}$	mV	−5		5	$U_{out} - U_{ref}$ @ U_{ref} = 2.5 V
Electrical offset current referred to primary	$I_{O E}$	A	−1.57		1.57	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	−170		170	−40 °C … 105 °C
Temperature coefficient of $U_{O E}$	$TCU_{O E}$	mV/K	−0.075		0.075	−40 °C … 105 °C
Temperature coefficient of $I_{O E}$	$TCI_{O E}$	mA/K	−23.5		23.5	−40 °C … 105 °C
External detection threshold sensitivity	S_{th}	mV/A		3.2		800 mV@ $I_{P N}$
Sensitivity error @ $I_{P N}$	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 … $I_{P N}$	ε_L	% of $I_{P N}$	−0.5		0.5	
Linearity error 0 … $I_{P M}$	ε_L	% of $I_{P M}$	−0.5		0.5	
Magnetic offset current (@ 10 × $I_{P N}$) referred to primary	$I_{O M}$	A	−0.92		0.92	One turn
Delay time to 10 % of the final output value $I_{P N}$ step	$t_{D\ 10}$	µs			2.5	@ 50 A/µs
Delay time @ 90 % of the final output value $I_{P N}$ step	$t_{D\ 90}$	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}	µV/√Hz			3.5	
RMS voltage (DC … 10 kHz) (DC … 100 kHz) (DC … 1 MHz)	U_{no}	mVpp		 2.5 5 8.7		
Primary current, detection threshold	$I_{P Th}$	A	2.64 × $I_{P N}$	2.93 × $I_{P N}$	3.22 × $I_{P N}$	Peak value ±10 %, overcurrent detection OCD
Sum of sensitivity and linearity error @ $I_{P N}$	$\varepsilon_{S L}$	% of $I_{P N}$	−1		1	
Sum of sensitivity and linearity error @ $I_{P N}$ @ T_A = +105 °C	$\varepsilon_{S L\ 105}$	% of $I_{P N}$	−4.55		4.55	See formula note [3]
Sum of sensitivity and linearity error @ $I_{P N}$ @ T_A = +85 °C	$\varepsilon_{S L\ 85}$	% of $I_{P N}$	−3.66		3.66	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 $I_{P N}$) = $\varepsilon_{S L}$ + ($\frac{TCS}{10000}$ x (T_A - 25) + $\frac{TCI_{O E}}{10000 \times I_{P N}}$ x 100 x (T_A - 25))

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Definition of typical, minimum and maximum values

Minimum and maximum values for specified limiting and safety conditions have to be understood as such as well as values shown in “typical” graphs.

On the other hand, measured values are part of a statistical distribution that can be specified by an interval with upper and lower limits and a probability for measured values to lie within this interval.

Unless otherwise stated (e.g. “100 % tested”), the LEM definition for such intervals designated with “min” and “max” is that the probability for values of samples to lie in this interval is 99.73 %.

For a normal (Gaussian) distribution, this corresponds to an interval between −3 sigma and +3 sigma. If “typical” values are not obviously mean or average values, those values are defined to delimit intervals with a probability of 68.27 %, corresponding to an interval between −sigma and +sigma for a normal distribution.
Typical, maximal and minimal values are determined during the initial characterization of the product.

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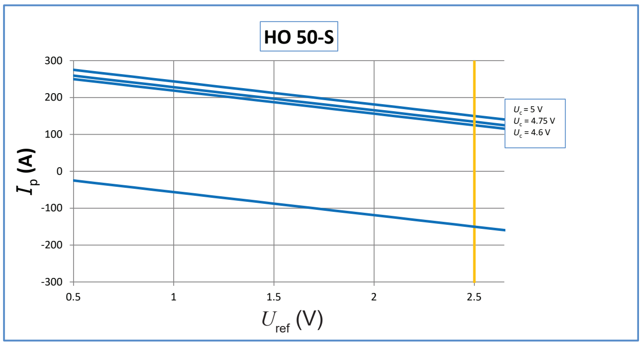
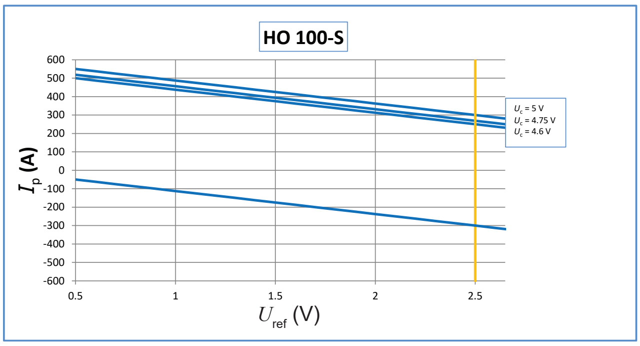
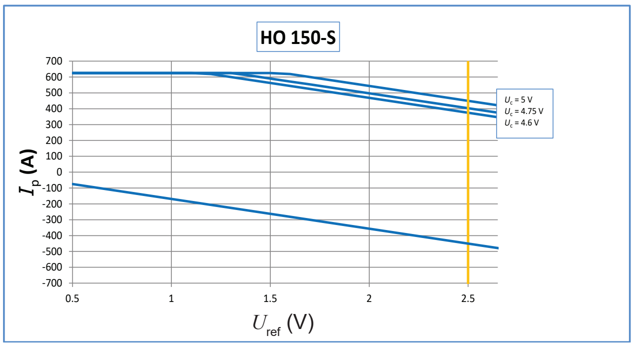
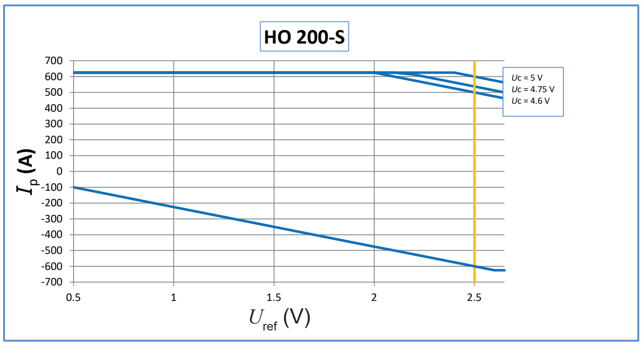
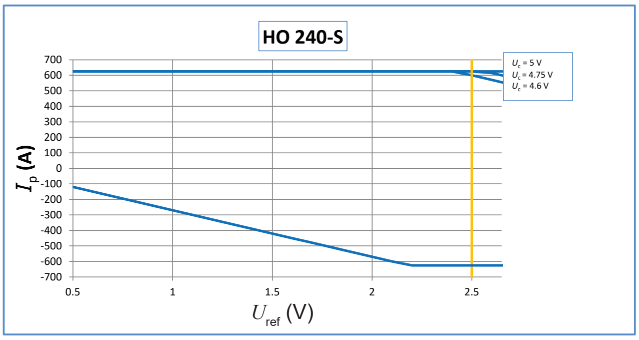
HO-S series, measuring range versus external reference voltage

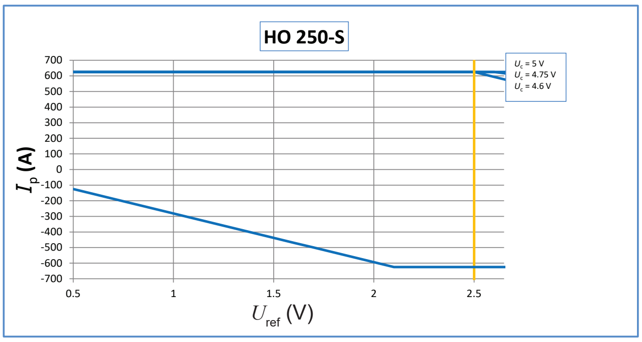












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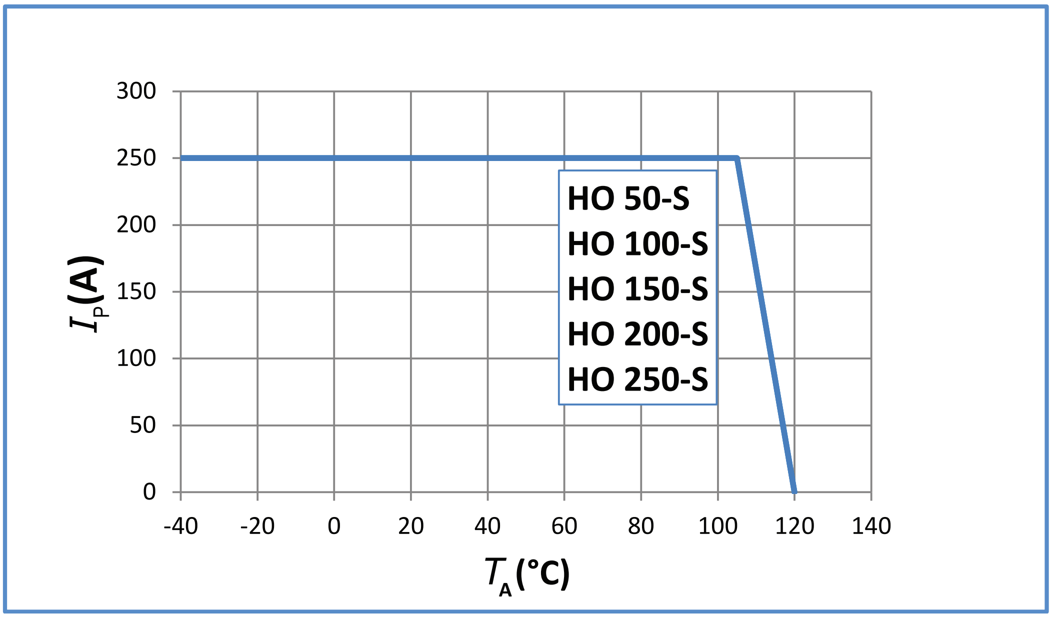
Maximum continuous DC current

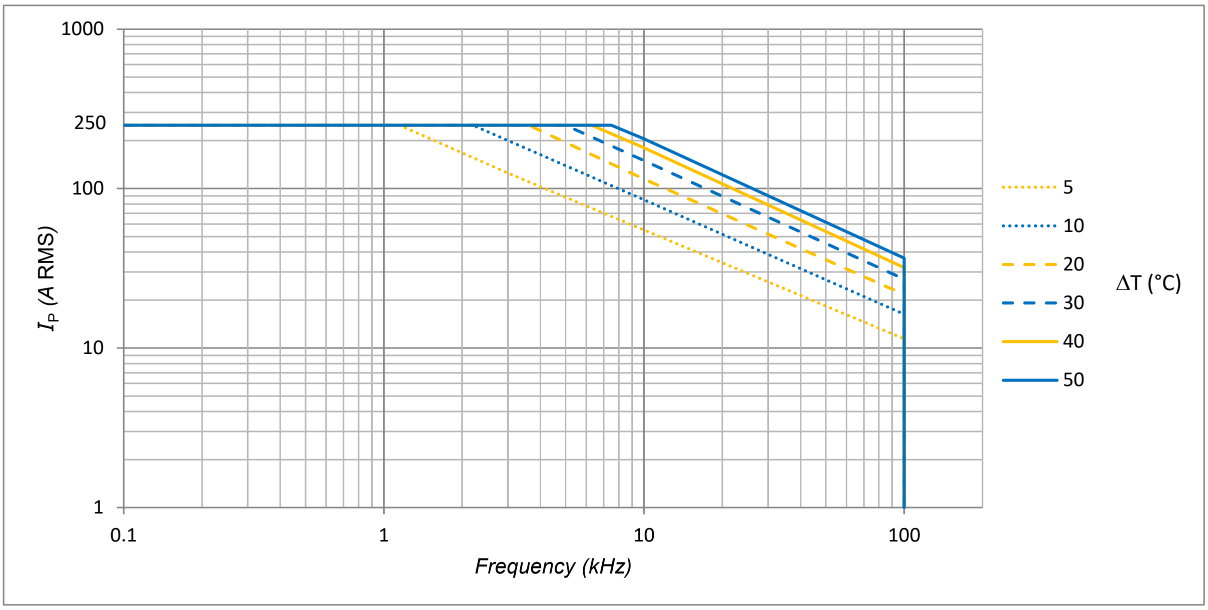
For all ranges:



<u>Important notice</u>: 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

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HO-S series: name and codification

HO family products may be ordered ***on request*** [1] with a dedicated setting of the parameters as described below (standard products are delivered with the setting 0100 according to the table).

HO-S-XXXX

Internal reference [2]

0	2.5 V
1	1.65 V
2	1.5 V
3	0.5 V
4	External U_{ref} only

Delay time

0	4 µs
1	3.5 µs
2	6 µs

EEPROM Control

0	YES
1	NO

Over current detection (× I_{PN}***)*** [3]

0	2.93	A	0.68
1	3.59	B	0.93
2	3.99	C	1.17
3	4.77	D	1.44
4	5.19	E	1.60
5	5.76	F	1.91
6	1.68	G	2.08
7	2.35	H	2.31

Standard products: HO 50-S-0100; HO 100-S-0100; HO 100-S-3110; HO 150-S-0100; HO 200-S-0100; HO 200-S-0107; HO 240-S-0100; HO 250-S-0100; HO 250-S-010D

Notes: [1] For dedicated settings, minimum quantities apply, please contact your local LEM support.

[2] U_{ref} electrical data

U_{ref} parameter	U_{ref} (V)			TCU_{ref} (ppm/K)	
	min	typ	max	min	max
0	2.48	2.5	2.52	−170	−70
1	1.63	1.65	1.67	−170	170
2	1.48	1.5	1.52	−170	170
3	0.49	0.5	0.51	−250	250

[3] OCD (× I_{PN}) correction table versus range and temperature
All other values or empty cells: no change

HO-S-010x				
OCD Parameter	I_{PN} (A) all temperatures			
	150	200	240	250
A				
B				
C				
D				
E				
6				
F				
G				
H				
7				
0				
1				
2				
3			510	5.60
4			6.70	7.30
5		6.25		-

Tolerance on OCD value	
±20 %	
±15 %	
±10 %	No change
-	Do not use

Application information

- HOxx-S series is designed to be used with a bus-bar or a cable [1] to carry the current through the aperture with a maximum cross-section of 8 × 15 mm
- Use of a bare conductor is not recommended with panel mounting (either horizontal or vertical) as insulation distances might be compromised between the busbar and fixation screws.

Insulation distance (nominal values):

	d_{Cp}	d_{Cl}
Between primary busbar and secondary pin	14.6 mm	-
Between primary busbar and core	-	11.34 mm
Between core and secondary terminal	-	1.18 mm

Note: [1] The maximum magnetic offset referred to primary is inversely proportional to the number of turns, thus is divided by 2 with 2 turns

Remark

Installation of the transducer must be done unless otherwise specified on the datasheet, according to LEM Transducer Generic Mounting Rules. Please refer to LEM document N°ANE120504 available on our Web site: **https://www.lem.com/en/file/3137/download/.**

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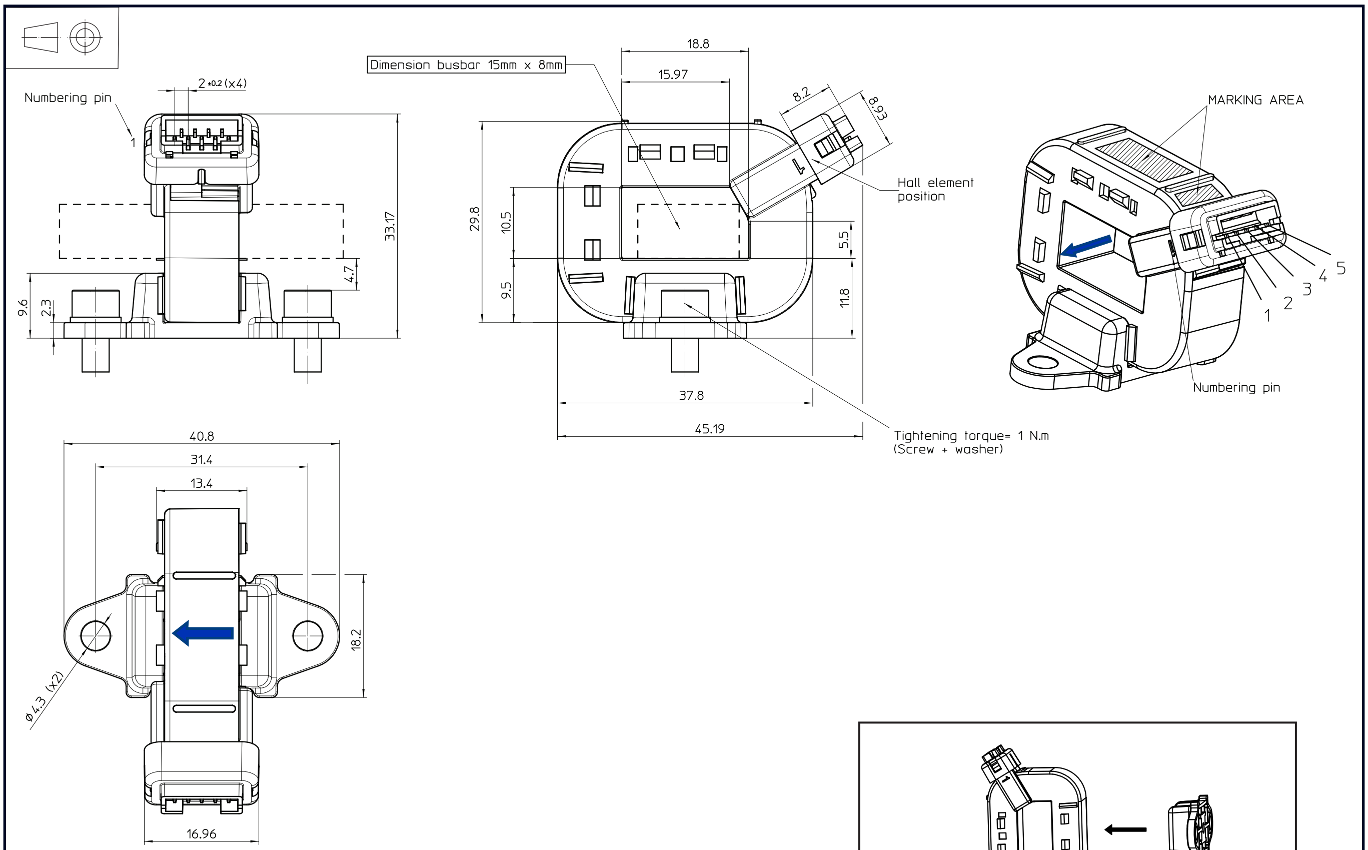
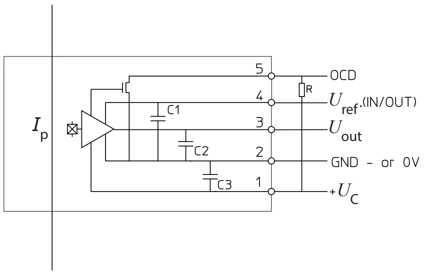
Dimensions HO-S series (mm, general linear tolerance ±0.3 mm)

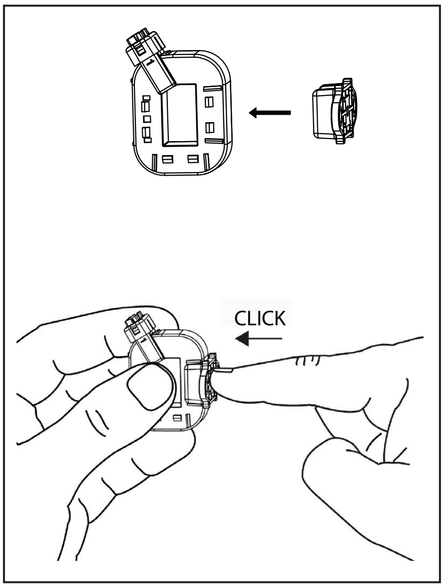
Mounting example: horizontal



Connection



C1	47 nF
C2	4.7 nF
C3	47 nF



Remarks:

- U_{out} is positive with respect to U_{ref} when positive I_P flows in direction of the arrow shown on the drawing above.
- Connection system: equivalent to JST B5B-PH type
- Mounting foot may be removed and repositioned as shown on pages 16,17 and 18 of this datasheet. We recommend to change the mounting foot position just once.

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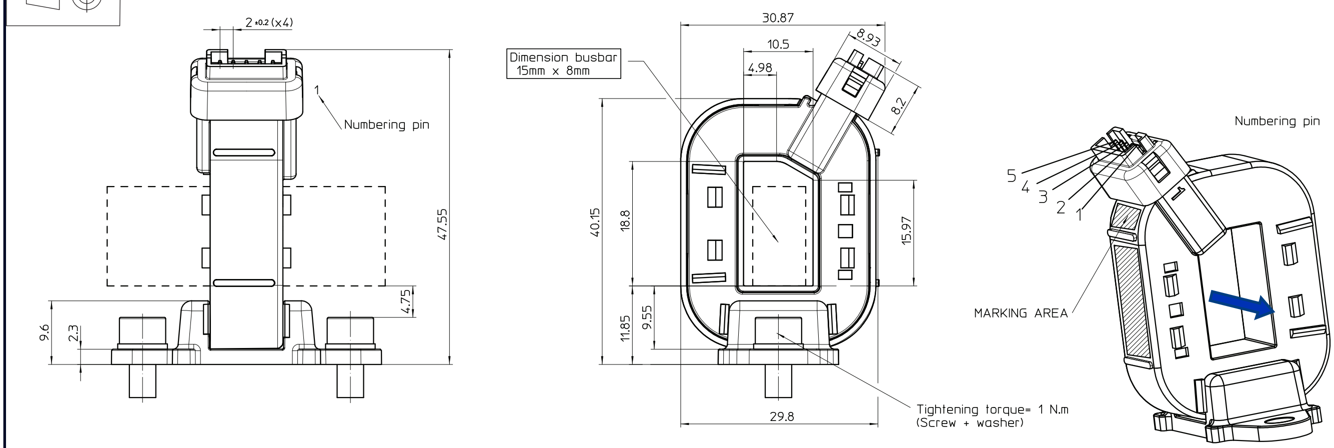
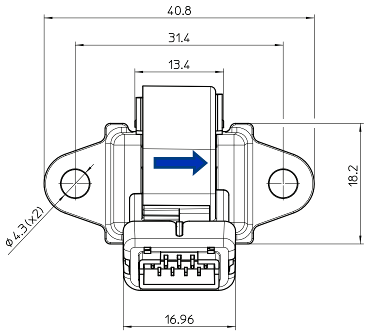
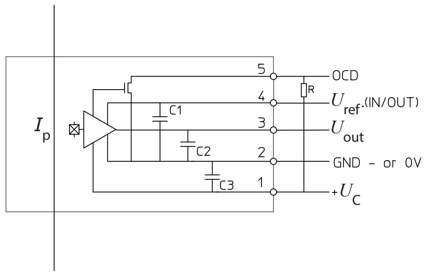
Dimensions HO-S series (mm, general linear tolerance ±0.3 mm)

Mounting example: vertical

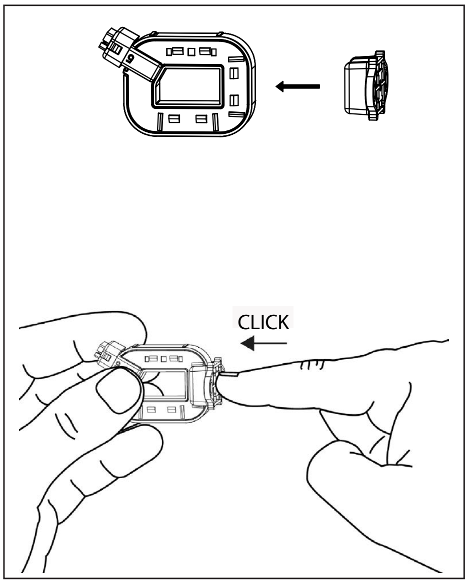




Connection



C1	47 nF
C2	4.7 nF
C3	47 nF



Remarks:

- U_{out} is positive with respect to U_{ref} when positive I_P flows in direction of the arrow shown on the drawing above.
- Connection system: equivalent to JST B5B-PH type
- Mounting foot may be removed and repositioned as shown on pages 16,17 and 18 of this datasheet. We recommend to change the mounting foot position just once.

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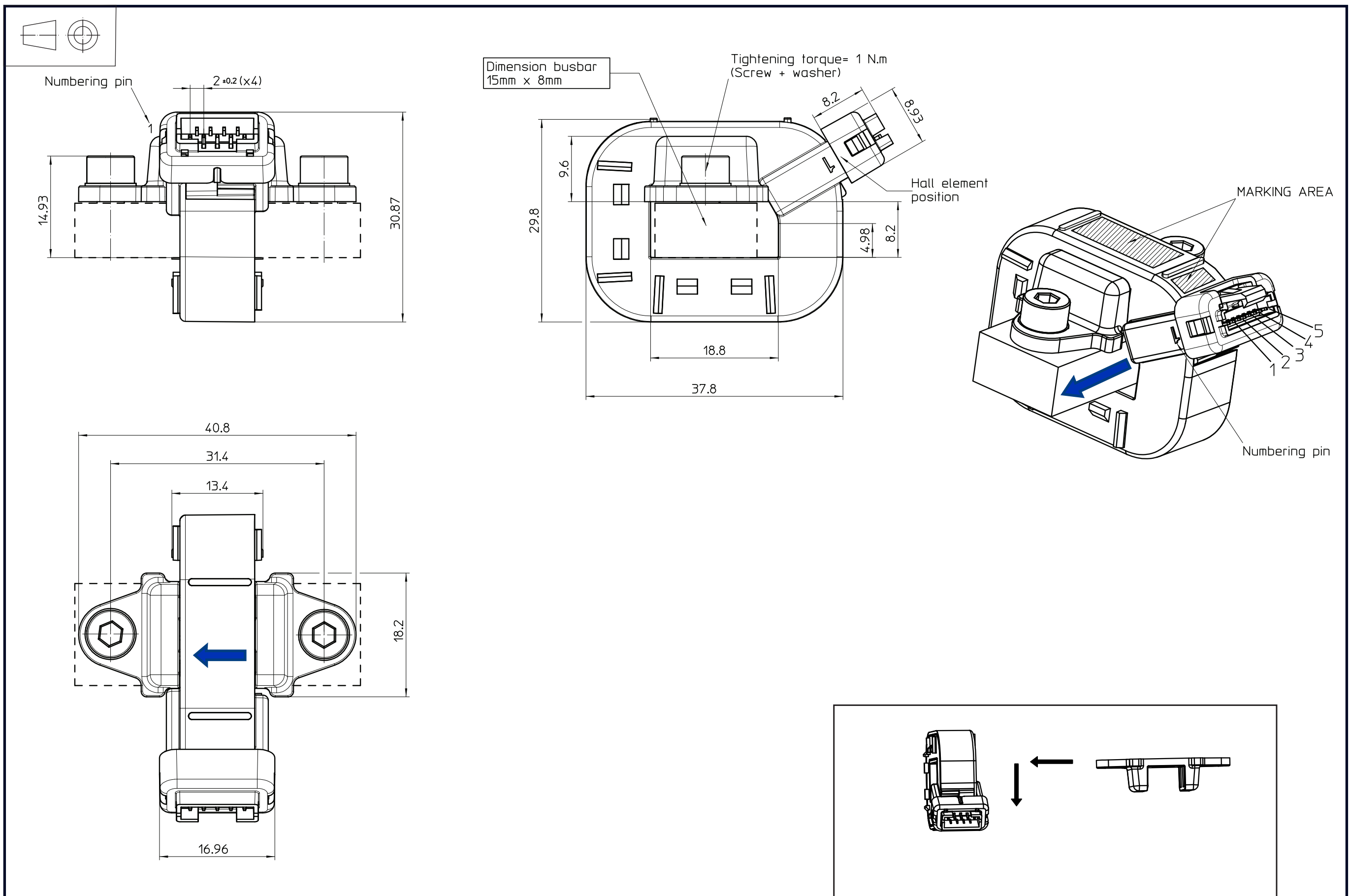
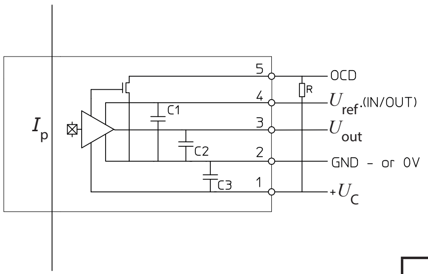
Dimensions HO-S series (mm, general linear tolerance ±0.3 mm)

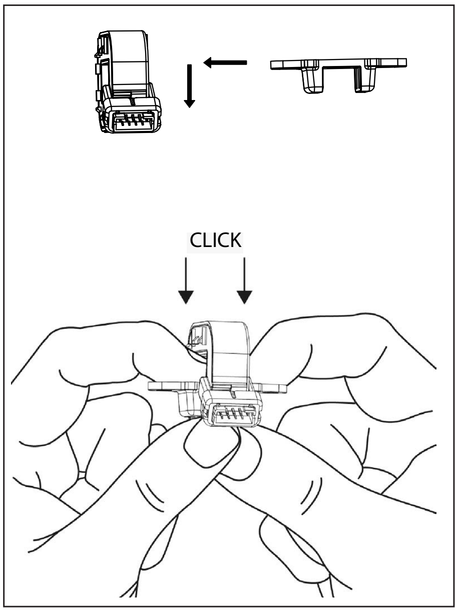
Mounting example: busbar



Connection



C1	47 nF
C2	4.7 nF
C3	47 nF



Remarks:

- U_{out} is positive with respect to U_{ref} when positive I_P flows in direction of the arrow shown on the drawing above.
- Connection system: equivalent to JST B5B-PH type
- Mounting foot may be removed and repositioned as shown on pages 16,17 and 18 of this datasheet. We recommend to change the mounting foot position just once.

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Cables

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

Customer Specification

PART NO. 6711

Construction

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

Applicable Specifications

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

Environmental

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

Properties

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

Other

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

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Richmond, IN 47374

Tel: 1-800-52 ALPHA

EU/UK/China ROHS CERTIFICATE OF COMPLIANCE

To Whom It May Concern:

Alpha Wire Part Number: 6711

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

Note: all colors and put-ups

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

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

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

Authorized Signatory for the Alpha Wire:

Dave Watson, Director of Engineering 6/9/2025

Alpha Wire
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Richmond, IN 47374
Tel: 1-908-925-8000

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 solaria construction as well as in other operating ranges.
Use acc. to UL: Internal wiring of appliances where totally enclosed.
Use acc. to cRU: CSA AWM I A/B, internal wiring of equipment with or without mechanical abuse.

Design

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

Electrical properties at 20 °C

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

Mechanical and thermal properties

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

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

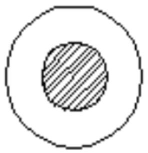
Datasheet

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

Description

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

Cross Section



Marking

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

Applications

For internal wiring of electrical equipment

Revisions

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

Construction

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

Remark:

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

Characteristics

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

Customer Approve

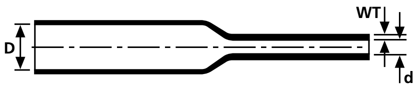
Seal & Stamp

Signature:

Date:

Technical data sheet

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



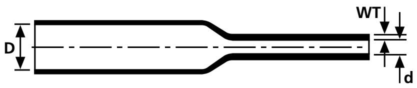
Product Group	Heat shrinkable tubing 3:1 on a reel
Product Family	HIS-3
Material	Polyolefin, cross-linked (PO-X)
Colour	Black (BK)

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

created on 11. April 2025, 9:25 pm

Technical data sheet

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



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

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

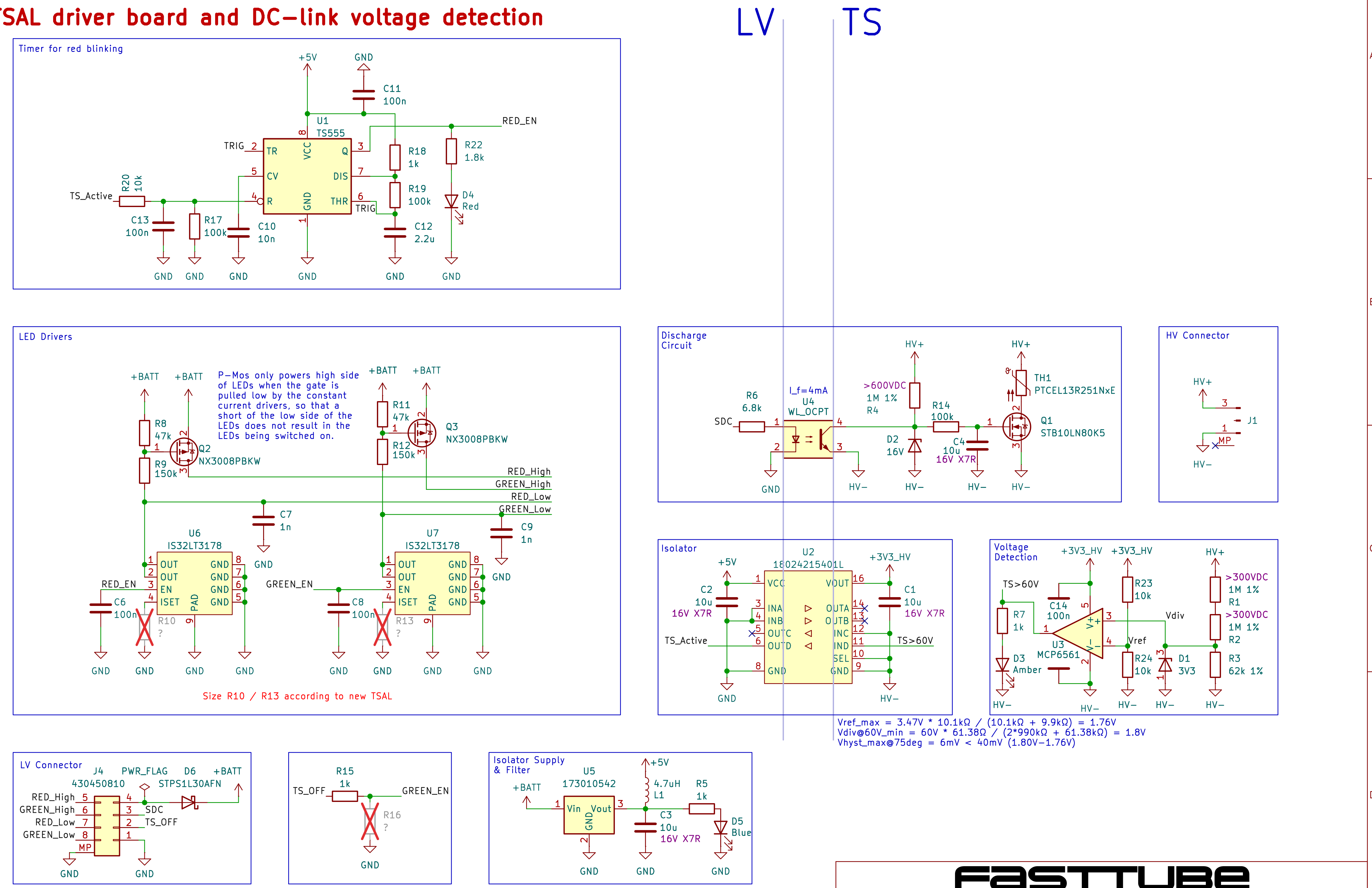
RoHS

c US

created on 16. May 2025, 1:49 pm

HVB

TSAL driver board and DC-link voltage detection



FASTTUBE

Title: Discharge Circuit

Rev: V1

Date: 2024-11-10

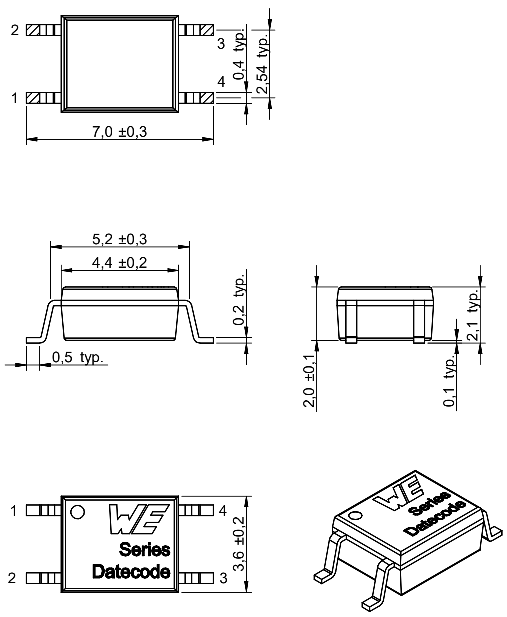
Project: DC

Exp. Date: 2025-04-27

Author: Karlsson Winkels

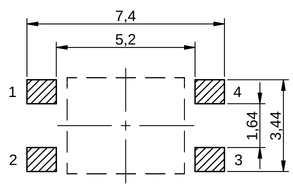
Size: A4 | Page: 1/1

Dimensions: [mm]



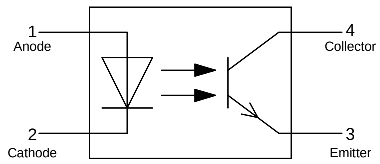
Scale - 5:1

Recommended Land Pattern: [mm]



Scale - 5:1

Schematic:



General Properties:

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

Certification:

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

General Information:

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

Product Marking:

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

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

DESCRIPTION

WL-OCPT Optocoupler Phototransistor

ORDER CODE

140356145200

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

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74638 Waldenburg
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Tel. +49 (0) 79 42 945 - 0
www.we-online.com
eiSos@we-online.com

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

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

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

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

Absolute Maximum Ratings Common Properties:

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

[1] Total power dissipation of the whole component

Electrical & Optical Input Properties:

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

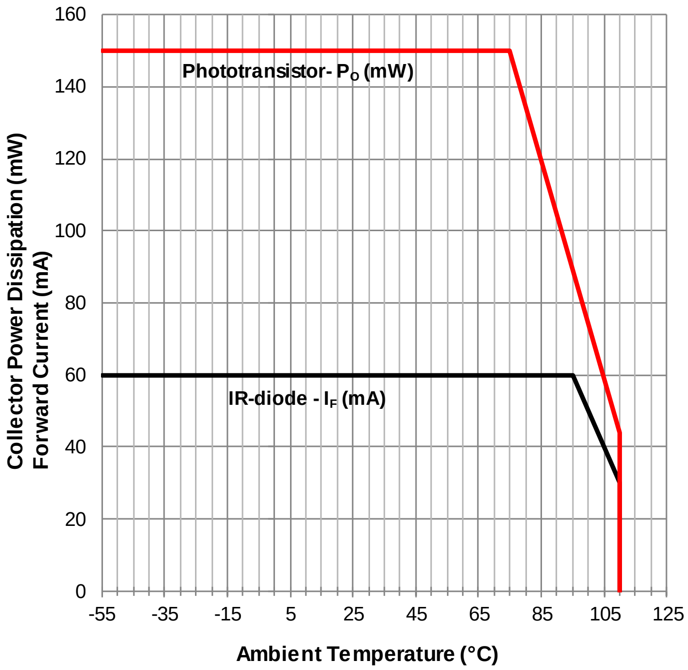
Electrical & Optical Output Properties:

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

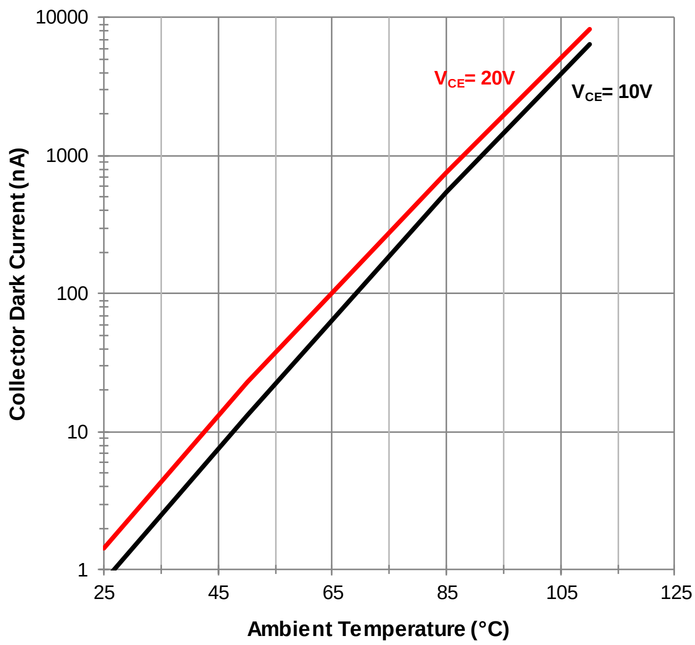
Electrical & Optical Transfer Properties:

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

Total Power Dissipation vs. Ambient Temperature:



Collector Dark Current vs. Ambient Temperature:



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

DESCRIPTION
WL-OCPT Optocoupler Phototransistor

ORDER CODE
140356145200

SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	3/12

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EMC & Inductive Solutions
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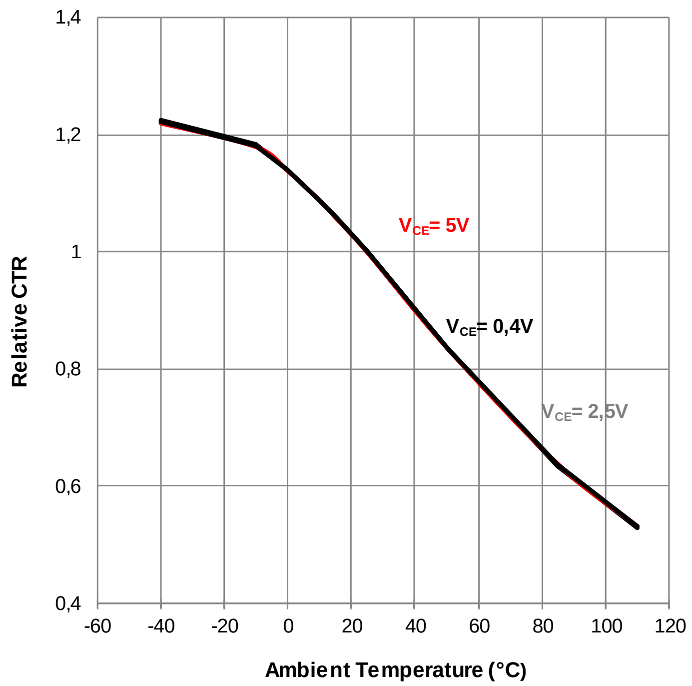
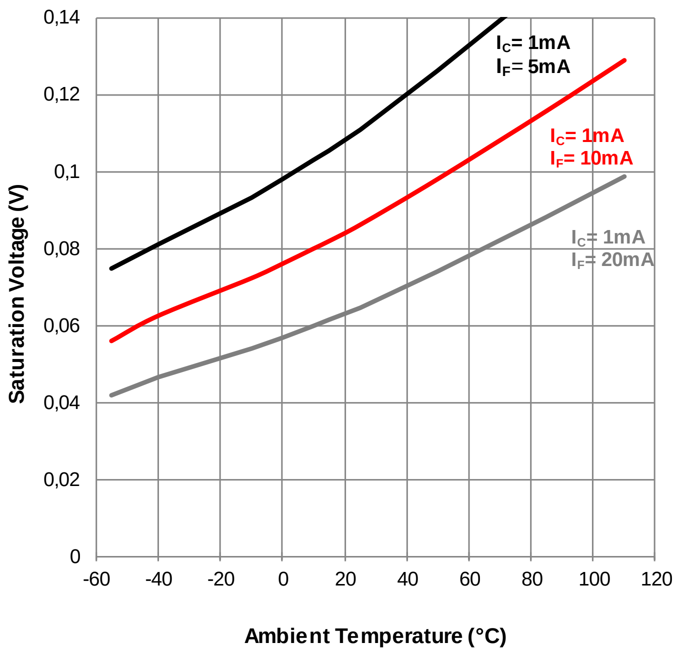
Tel. +49 (0) 79 42 945 - 0
www.we-online.com
eiSos@we-online.com

Relative CTR vs. Ambient Temperature:

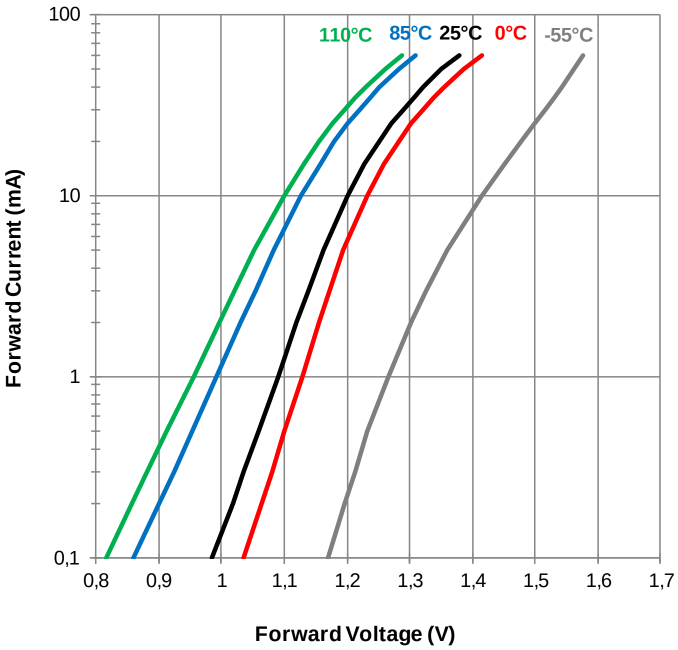


Testcondition: IF= 5mA; Normalized to TA= 25°C

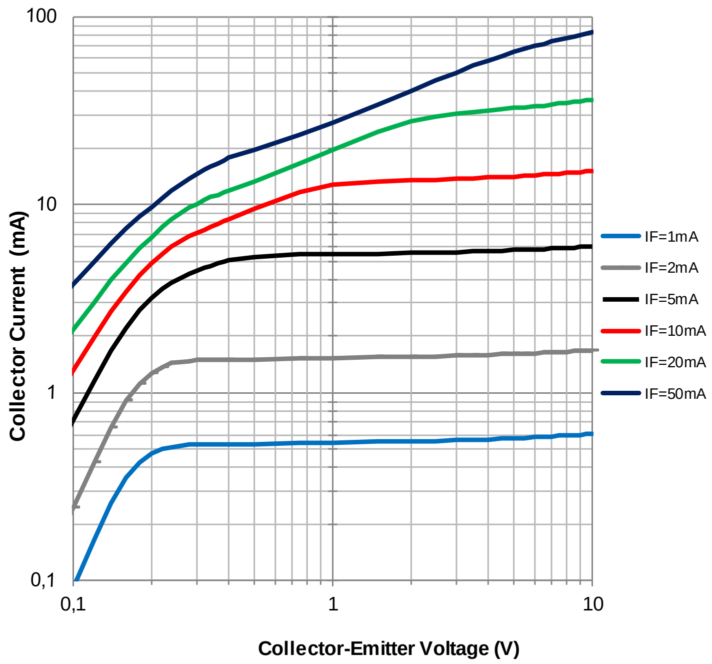
Collector-Emitter Saturation Voltage vs. Ambient Temperature:



Forward Current vs. Forward Voltage:



Collector Current vs. Collector-Emitter Voltage:



Testcondition: TA= 25°C

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

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DESCRIPTION
WL-OCPT Optocoupler Phototransistor

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

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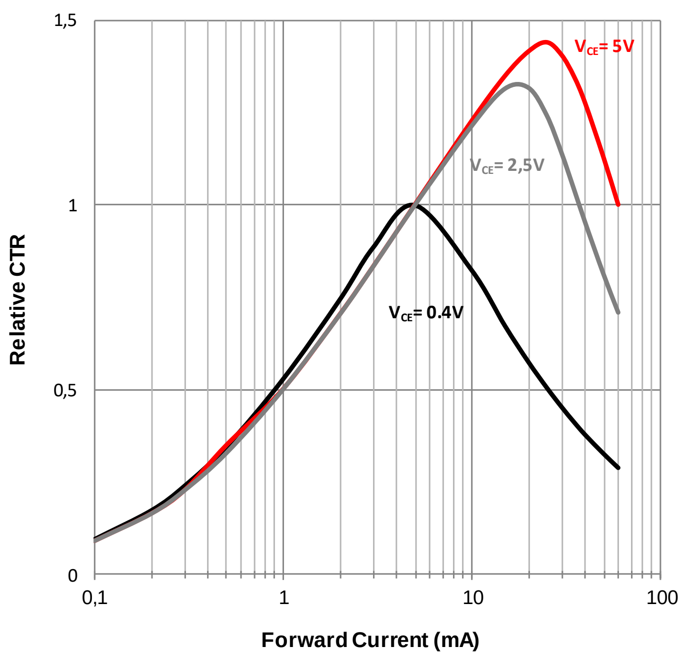
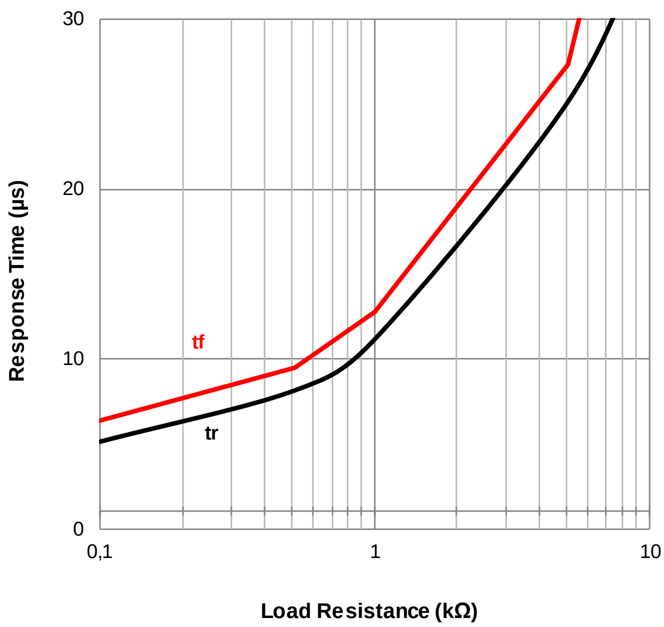
SOP4	eiPal	Valid	5/12

Relative CTR vs. Forward Current:



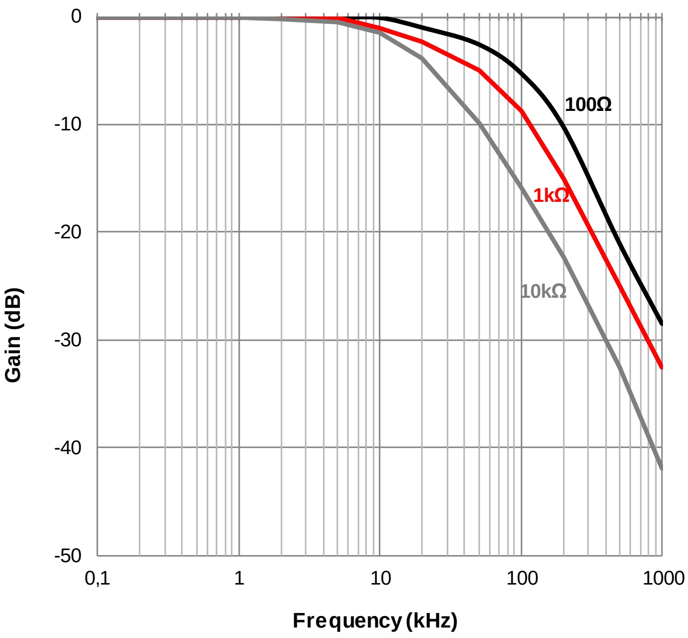
Testcondition: I_F= 5mA; TA= 25°C

Switching time vs. Load Resistance:



Testcondition: I_C= 2mA; V_{CE}= 2V; TA= 25°C

Gain vs. Frequency:



Testcondition: I_C= 2mA; V_{CE}= 2V; TA= 25°C

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

DESCRIPTION
WL-OCPT Optocoupler Phototransistor

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SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	7/12

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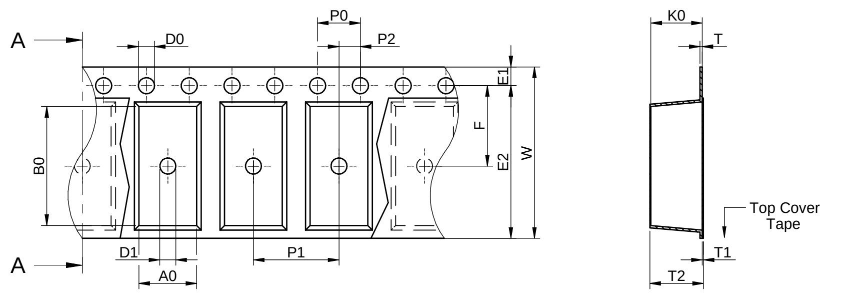
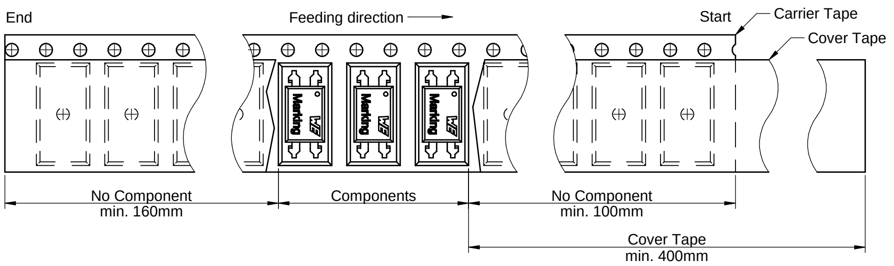
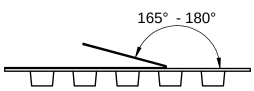
Packaging Specification - Tape: [mm]





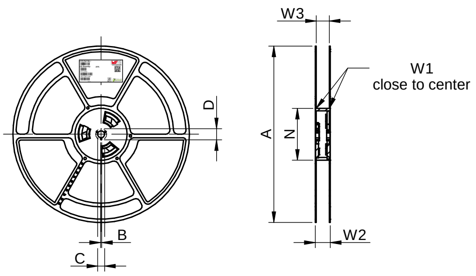
Packaging is referred to the international standard **IEC 60286-3:2019**

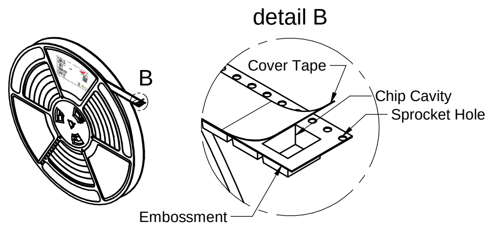
Tape Type	A0 (mm)	B0 (mm)	W (mm)	T (mm)	T1 (mm)	T2 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	D0 (mm)	D1 (mm)	E1 (mm)	E2 (mm)	F (mm)	Material	Qty. (pcs.)
	typ.	typ.	+0,3/ -0,1	ref.	ref.	typ.	typ.	±0,1	±0,1	±0,1	+0,1/ -0,0	min.	±0,1	min.	±0,1		
2a	4,70	10,50	16,00	0,40	0,10	4,60	4,20	4,00	8,00	2,00	1,50	1,50	1,75	14,25	7,50	Polystyrene	3000



		Pull-off force
Tape width	**16 mm**	0,1 N - 1,3 N

Packaging Specification - Reel: [mm]





	A (mm)	B (mm)	C (mm)	D (mm)	N (mm)	W1 (mm)	W2 (mm)	W3 (mm)	W3 (mm)	Material
Tolerance	± 2,0	typ.	typ.	typ.	typ.	typ.	typ.	min.	max.	
Value	330,00	2,20	13,00	20,90	97,20	16,70	20,70	15,90	19,40	Polystyrene

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

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DESCRIPTION

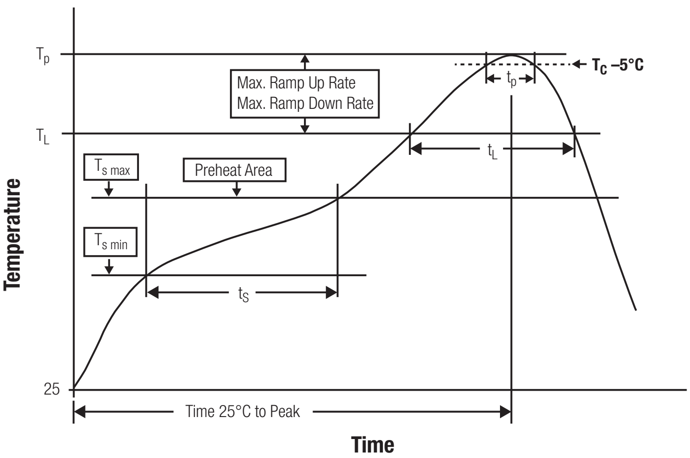
WL-OCPT Optocoupler Phototransistor

ORDER CODE

140356145200

SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	8/12

Classification Reflow Profile for SMT components:



Classification Reflow Soldering Profile:

Profile Feature		Value
Preheat Temperature Min	$T_{s\,min}$	150 °C
Preheat Temperature Max	$T_{s\,max}$	200 °C
Preheat Time t_s from $T_{s\,min}$ to $T_{s\,max}$	t_s	max. 60 - 120 seconds
Ramp-up Rate (T_L to T_P)		3 °C/ second max.
Liquidous Temperature	T_L	217 °C
Time t_L maintained above T_L	t_L	max. 60 seconds
Peak package body temperature	T_p	$T_p \leq T_c$, see Table below
Time within 5°C of actual peak temperature	t_p	max. 10 seconds
Ramp-down Rate (T_P to T_L)		6 °C/ second max.
Time 25°C to peak temperature		max. 220 seconds

refer to IPC/ JEDEC J-STD-020E

Package Classification Reflow Temperature (T_C):

Properties	Volume mm³ <350	Volume mm³ 350-2000	Volume mm³ >2000
PB-Free Assembly I Package Thickness < 1.6 mm	260 °C	260 °C	260 °C
PB-Free Assembly I Package Thickness 1.6 mm - 2.5 mm	260 °C	250 °C	245 °C
PB-Free Assembly I Package Thickness > 2.5 mm	250 °C	245 °C	245 °C
Applied cycles	2 cycles max.		

refer to IPC/ JEDEC J-STD-020E

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

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DESCRIPTION

WL-OCPT Optocoupler Phototransistor

ORDER CODE

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SIZE/TYPE	BUSINESS UNIT	STATUS	PAGE
SOP4	eiPal	Valid	9/12

Cautions and Warnings:

The following conditions apply to all goods within the product series of Optoelectronic Components of Würth Elektronik eiSos GmbH & Co. KG:

General:

- This optoelectronic component is designed and manufactured for use in general electronic equipment.
- Würth Elektronik must be asked for written approval (following the PPAP procedure) before incorporating the components into any equipment in fields such as military, aerospace, aviation, nuclear control, submarine, transportation (automotive control, train control, ship control), transportation signal, disaster prevention, medical, public information network, etc. where higher safety and reliability are especially required and/or if there is the possibility of direct damage or human injury.
- Optoelectronic components that will be used in safety-critical or high-reliability applications, should be pre-evaluated by the customer.
- The optoelectronic component is designed and manufactured to be used within the datasheet specified values. If the usage and operation conditions specified in the datasheet are not met, the wire insulation may be damaged or dissolved.
- Do not drop or impact the components, the component may be damaged
- Würth Elektronik products are qualified according to international standards, which are listed in each product reliability report. Würth Elektronik does not warrant any customer qualified product characteristics beyond Würth Elektroniks' specifications, for its validity and sustainability over time.
- The responsibility for the applicability of the customer specific products and use in a particular customer design is always within the authority of the customer. All technical specifications for standard products also apply to customer specific products.
- Unless Würth Elektroik has given its express consent, the customer is under no circumstances entitled to reverse engineer, disassemble or otherwise attempt to extract knowledge or design information from the optoelectronic component.

Product specific:

Soldering:

- The solder profile must comply with the technical product specifications. All other profiles will void the warranty.
- All other soldering methods are at the customers' own risk
- The soldering pad pattern shown above is a general recommendation for the easy assembly of optoelectronic components. If a high degree of precision is required for the selected application (i.e. high density assembly), the customer must ensure that the soldering pad pattern is optimized accordingly.

Cleaning and Washing:

- Washing agents used during the production to clean the customer application might damage or change the characteristics of the optoelectronic component body, marking or plating. Washing agents may have a negative effect on the long-term functionality of the product.
- Using a brush during the cleaning process may break the optoelectronic component body. Therefore, we do not recommend using a brush during the PCB cleaning process.

Potting:

- If the product is potted in the customer application, the potting material might shrink or expand during and after hardening. Shrinking could lead to an incomplete seal, allowing contaminants into the optoelectronic component body, pins or termination. Expansion could damage the components. We recommend a manual inspection after potting to avoid these effects.

Storage Conditions:

- A storage of Würth Elektronik products for longer than 12 months is not recommended. Within other effects, the terminals may suffer degradation, resulting in bad solderability. Therefore, all products shall be used within the period of 12 months based on the day of shipment.
- Do not expose the optoelectronic component to direct sunlight.
- The storage conditions in the original packaging are defined according to DIN EN 61760-2.
- For a moisture sensitive component, the storage condition in the original packaging is defined according to IPC/JEDEC-J-STD-033. It is also recommended to return the optoelectronic component to the original moisture proof bag and reseal the moisture proof bag again.
- The storage conditions stated in the original packaging apply to the storage time and not to the transportation time of the components.

Packaging:

- The packaging specifications apply only to purchase orders comprising whole packaging units. If the ordered quantity exceeds or is lower than the specified packaging unit, packaging in accordance with the packaging specifications cannot be ensured.

Handling:

- Violation of the technical product specifications such as exceeding the nominal rated current, will void the warranty.
- The product design may influence the automatic optical inspection.
- Certain optoelectronic component surfaces consist of soft material. Pressure on the top surface has to be handled carefully to prevent negative influence to the function and reliability of the optoelectronic components.
- ESD prevention methods need to be applied for manual handling and processing by machinery.
- Resistors for protection are obligatory.
- In addition to optoelectronic components testing, products incorporating these devices have to comply with the safety precautions given in IEC 60825-1, IEC 62471 and IEC 62778.

Technical specification:

- The typical and/or calculated values and graphics of technical parameters can only reflect statistical figures. The actual parameters of each single product, may differ from the typical and/or calculated values or the typical characteristic line.

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

Würth Elektronik eiSos GmbH & Co. KG
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www.we-online.com
eiSos@we-online.com

- In the characteristics curves, all values given in dotted lines may show a higher deviation than the paramters mentioned above.
- On each reel, only one bin is sorted and taped. The bin is defined on the current transfer ratio.
- In order to ensure highest availability, the reel binning of standard deliveries can vary. A single bin cannot be ordered. Please contact us in advance, if you need a particular bin sorting before placing your order.
- These cautions and warnings comply with the state of the scientific and technical knowledge and are believed to be accurate and reliable. However, no responsibility is assumed for inaccuracies or incompleteness.

The customer has the sole responsibility to ensure that he uses the latest version of this datasheet, which is available on Würth Elektronik's homepage. Unless otherwise agreed in writing (i.e. customer specific specification), changes to the content of this datasheet may occur without notice, provided that the changes do not have a significant effect on the usability of the optoelectronic components.

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Important Notes

The following conditions apply to all goods within the product range of Würth Elektronik eiSos GmbH & Co. KG:

1. General Customer Responsibility

Some goods within the product range of Würth Elektronik eiSos GmbH & Co. KG contain statements regarding general suitability for certain application areas. These statements about suitability are based on our knowledge and experience of typical requirements concerning the areas, serve as general guidance and cannot be estimated as binding statements about the suitability for a customer application. The responsibility for the applicability and use in a particular customer design is always solely within the authority of the customer. Due to this fact it is up to the customer to evaluate, where appropriate to investigate and decide whether the device with the specific product characteristics described in the product specification is valid and suitable for the respective customer application or not.

2. Customer Responsibility related to Specific, in particular Safety-Relevant Applications

It has to be clearly pointed out that the possibility of a malfunction of electronic components or failure before the end of the usual lifetime cannot be completely eliminated in the current state of the art, even if the products are operated within the range of the specifications.
In certain customer applications requiring a very high level of safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health it must be ensured by most advanced technological aid of suitable design of the customer application that no injury or damage is caused to third parties in the event of malfunction or failure of an electronic component. Therefore, customer is cautioned to verify that data sheets are current before placing orders. The current data sheets can be downloaded at www.we-online.com.

3. Best Care and Attention

Any product-specific notes, cautions and warnings must be strictly observed. Any disregard will result in the loss of warranty.

4. Customer Support for Product Specifications

Some products within the product range may contain substances which are subject to restrictions in certain jurisdictions in order to serve specific technical requirements. Necessary information is available on request. In this case the field sales engineer or the internal sales person in charge should be contacted who will be happy to support in this matter.

5. Product R&D

Due to constant product improvement product specifications may change from time to time. As a standard reporting procedure of the Product Change Notification (PCN) according to the JEDEC-Standard inform about minor and major changes. In case of further queries regarding the PCN, the field sales engineer or the internal sales person in charge should be contacted. The basic responsibility of the customer as per Section 1 and 2 remains unaffected.

6. Product Life Cycle

Due to technical progress and economical evaluation we also reserve the right to discontinue production and delivery of products. As a standard reporting procedure of the Product Termination Notification (PTN) according to the JEDEC-Standard we will inform at an early stage about inevitable product discontinuance. According to this we cannot guarantee that all products within our product range will always be available. Therefore it needs to be verified with the field sales engineer or the internal sales person in charge about the current product availability expectancy before or when the product for application design-in disposal is considered. The approach named above does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.

7. Property Rights

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8. General Terms and Conditions

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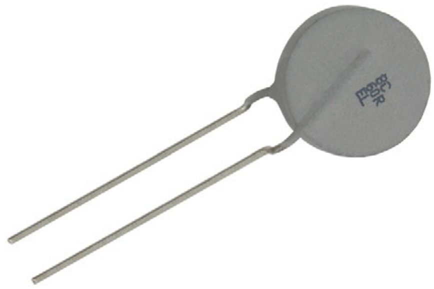
PTC Thermistors, Inrush Current Limiter



c US

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models

QUICK REFERENCE DATA

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

Notes

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

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

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

AGENCY APPROVALS

Agency approval documents, please see:

www.vishay.com/ppg?29165&documents

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

FEATURES

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

Pb
e3
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.

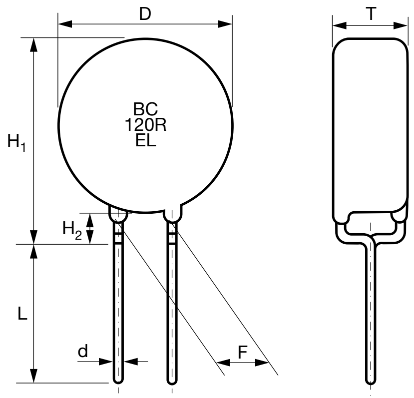
ELECTRICAL DATA AND ORDERING INFORMATION

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. cURus
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.

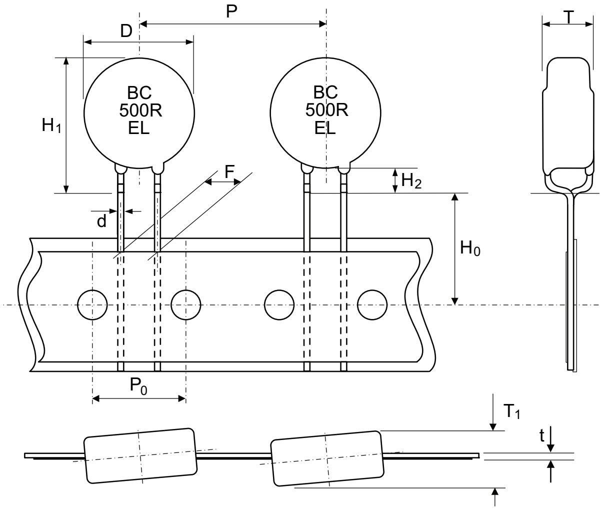
Notes

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

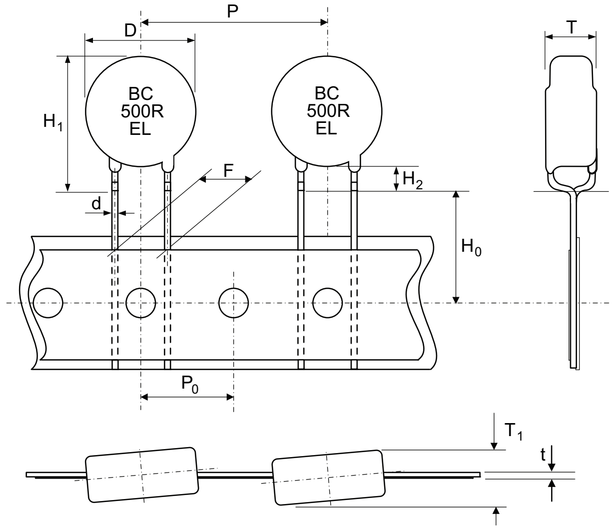
(2) L lead length corresponds to available wire pitch part numbers

TAPE AND REEL DIMENSIONS

Taping on reel with F = 5.0 mm wire pitch, spacing paper tape and foam separator tape used on reel.



Taping on reel with F = 7.5 mm and 10.0 mm wire pitch, spacing paper tape and foam separator tape used on reel.



DIMENSIONS in millimeters (standard cardboard tape W 18 mm according IEC 60286-2)

SYMBOL	PARAMETER	VALUE
D	Body diameter	See bulk dimensions
d	Lead diameter	See bulk dimensions
P	Component pitch	25.4 ± 1.0
P_0	Feedhole pitch	12.7 ± 0.3
F	Lead center to lead center distance (between component and tape)	
	13R and 17R type *TE (leads between feedholes)	5.0 +0.5/-0.2
	13R and 17R type *TE3xx (feedhole between leads)	7.5 +0.5/-0.2
	17R type *TE4xx (feedhole between leads)	10.0 +0.5/-0.2
H_0	Lead wire clinch height	16.0 ± 0.5
H_2	Component bottom to seating plane	3.0 ± 1.0
H_1	Component top to seating plane	See bulk dimensions
T	Body thickness	See bulk dimensions
t	Total tape thickness	1.7 max.
T_1	Total thickness	T + 1.0 max.

REQUIRED NUMBER OF PTC THERMISTORS TO LIMIT CURRENT AND ABSORB ENERGY

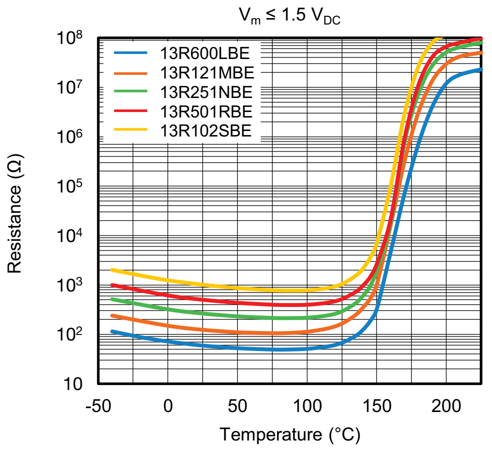
By using several PTC's in a series / parallel network, the maximum current limitation and absorbed energy levels can be further optimized. For homogeneous current and energy distribution it is recommended to combine only PTCEL of the same size and matched resistance value. Energy absorption per PTC in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

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

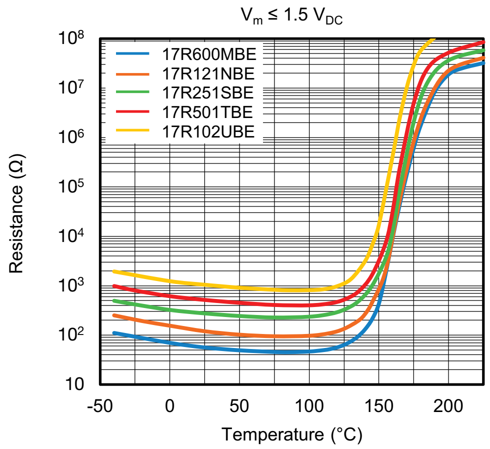
Notes

- 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

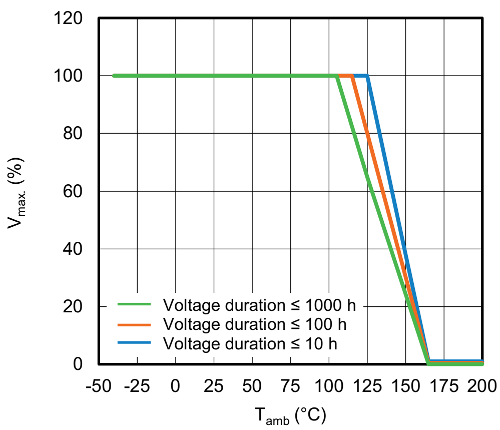
RESISTANCE VS. TEMPERATURE FOR PTCEL13 (Typical)



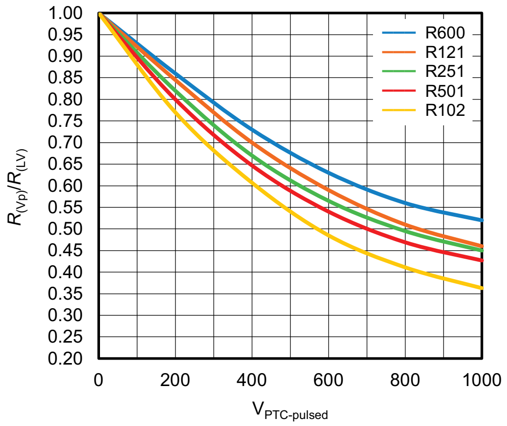
RESISTANCE VS. TEMPERATURE FOR PTCEL17 (Typical)



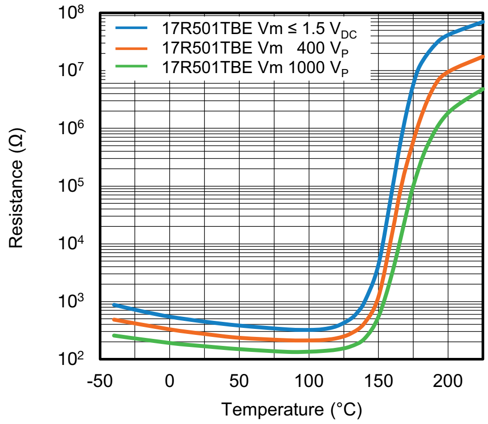
$V_{max.}$ DERATING VS. T_{amb}



PTC RESISTANCE UNDER PULSED VOLTAGE



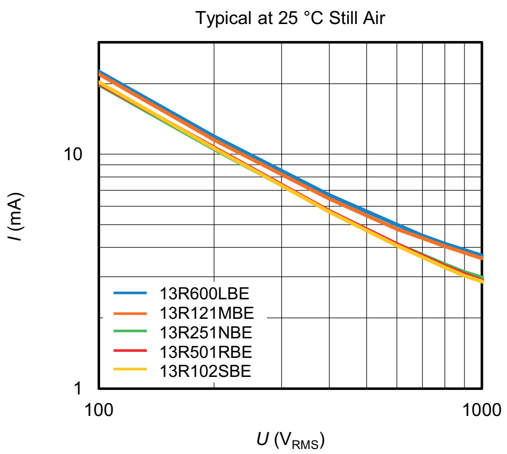
RESISTANCE VS. TEMPERATURE PULSED
(Typical)



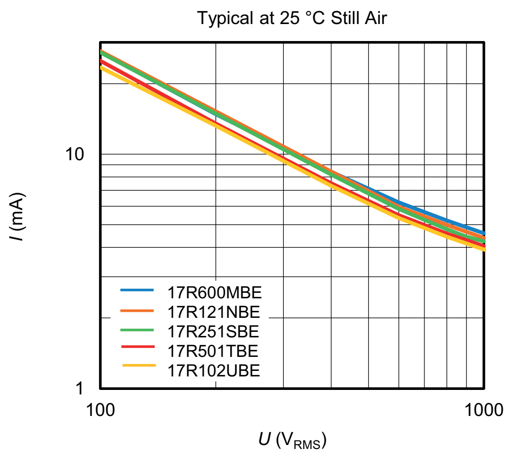
Notes

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

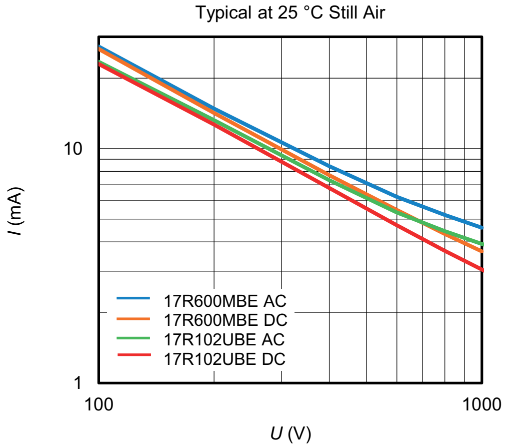
RESIDUAL CURRENT VS. VOLTAGE FOR PTCEL13



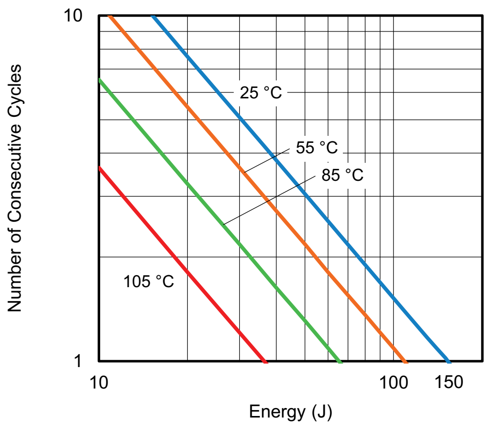
RESIDUAL CURRENT VS. VOLTAGE FOR PTCEL17



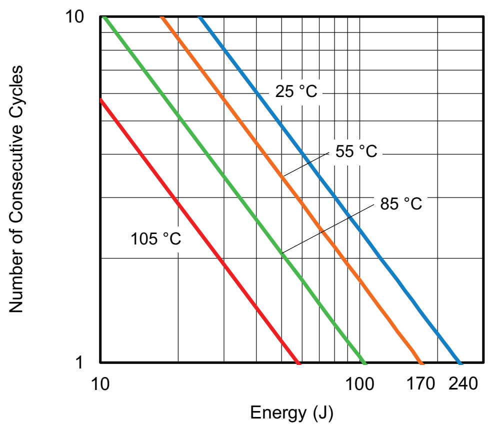
RESIDUAL CURRENT VS. VOLTAGE AC / DC



CONSECUTIVE ENERGY AT DIFFERENT T_{amb} FOR PTCEL13



CONSECUTIVE ENERGY AT DIFFERENT T_{amb} FOR PTCEL17



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STB10LN80K5

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

Datasheet - production data

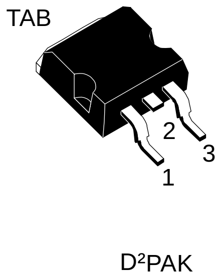
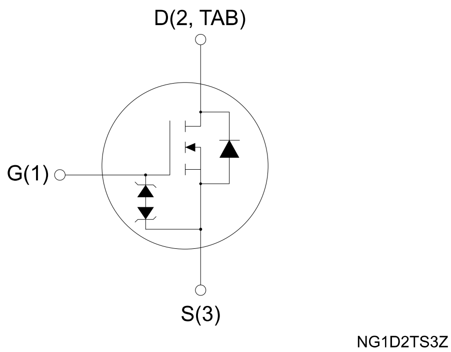


Figure 1: Internal schematic diagram



Features

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

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

Applications

- Switching applications

Description

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

Table 1: Device summary

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

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

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

Notes:

(1)Pulse width limited by safe operating area.

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

(3)V_{DS} ≤ 640 V

Table 3: Thermal data

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

Notes:

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

Table 4: Avalanche characteristics

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

2 Electrical characteristics

T_C = 25 ° C unless otherwise specified

Table 5: On/off-state

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

Table 6: Dynamic

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

Notes:

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

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

Table 7: Switching times

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

Table 8: Source-drain diode

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

Notes:

(1)Pulse width limited by safe operating area

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

Table 9: Gate-source Zener diode

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

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

2.2 Electrical characteristics (curves)

Figure 2: Safe operating area

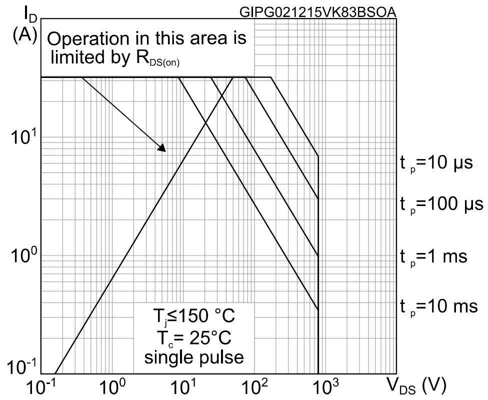


Figure 3: Thermal impedance

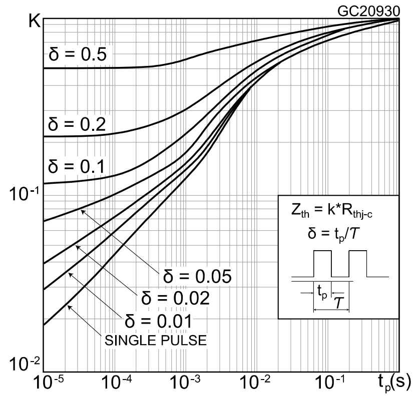


Figure 4: Output characteristics

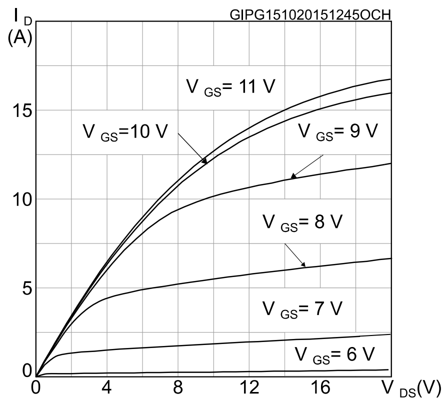


Figure 5: Transfer characteristics

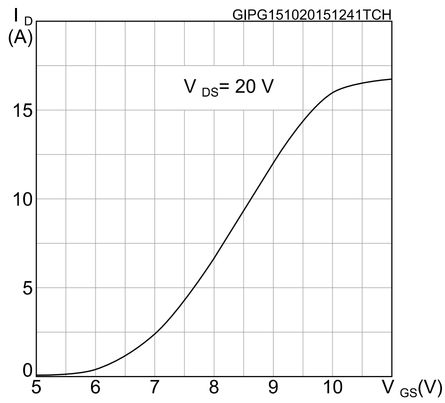


Figure 6: Gate charge vs gate-source voltage

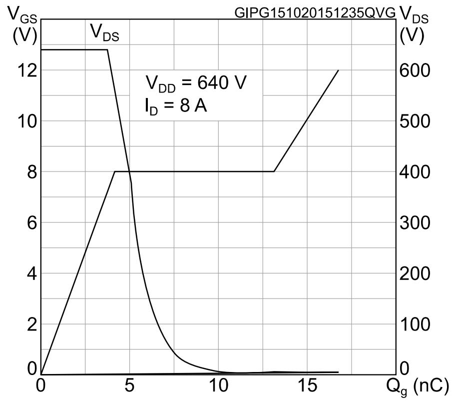


Figure 7: Static drain-source on-resistance

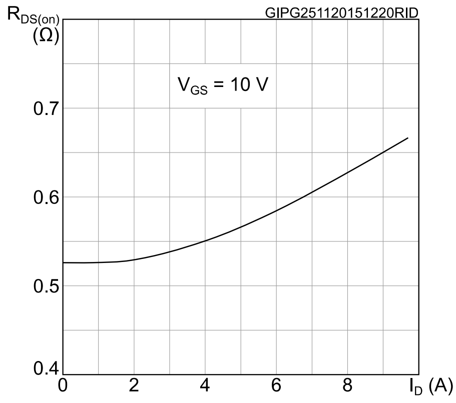


Figure 8: Capacitance variations

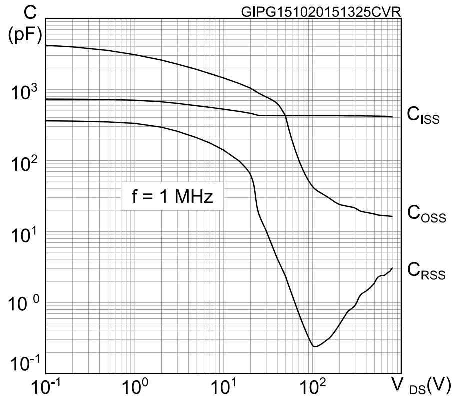


Figure 9: Normalized gate threshold voltage vs temperature

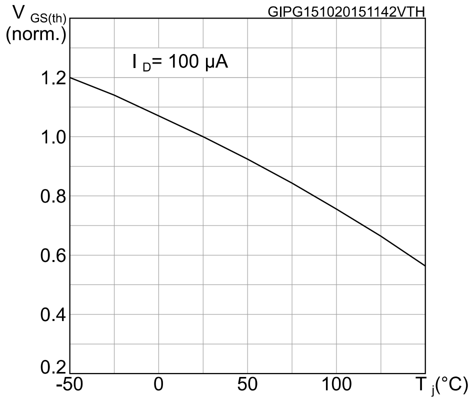


Figure 10: Normalized on-resistance vs temperature

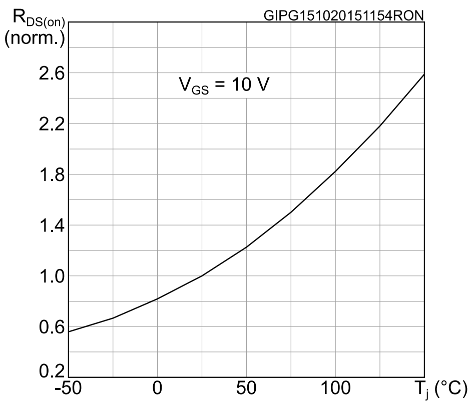


Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

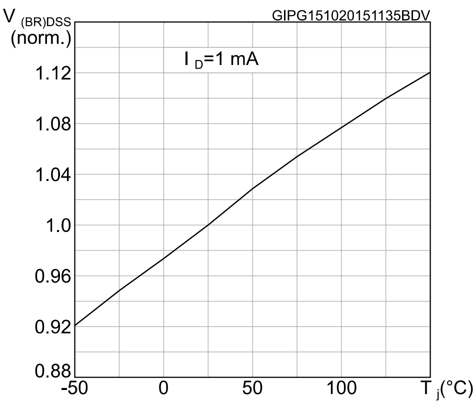


Figure 12: Output capacitance stored energy

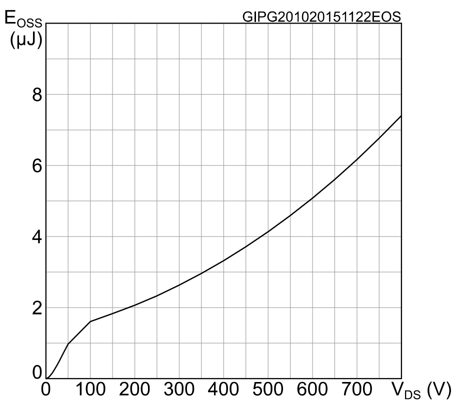


Figure 13: Source-drain diode forward characteristics

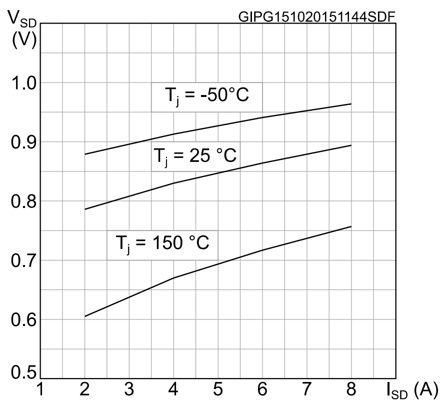
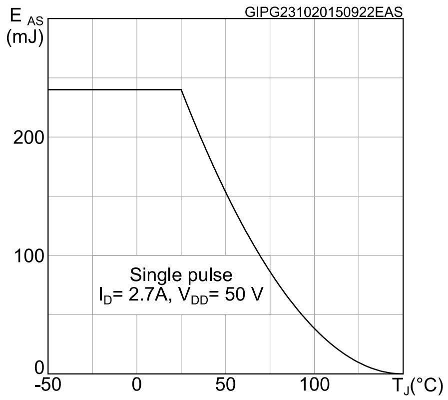


Figure 14: Maximum avalanche energy vs starting T_J



3 Test circuits

Figure 15: Test circuit for resistive load switching times

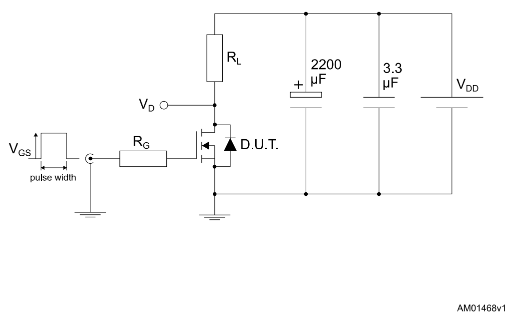


Figure 16: Test circuit for gate charge behavior

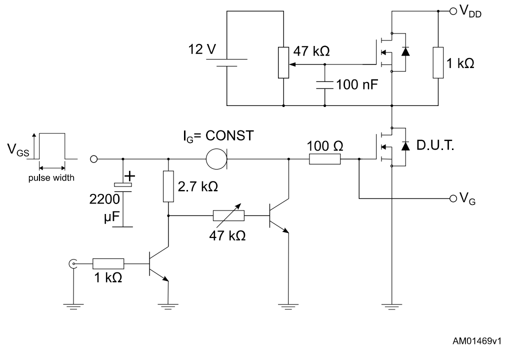


Figure 17: Test circuit for inductive load switching and diode recovery times

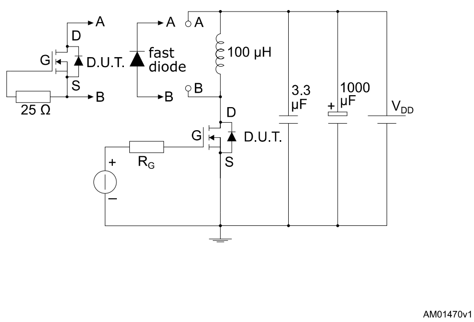


Figure 18: Unclamped inductive load test circuit

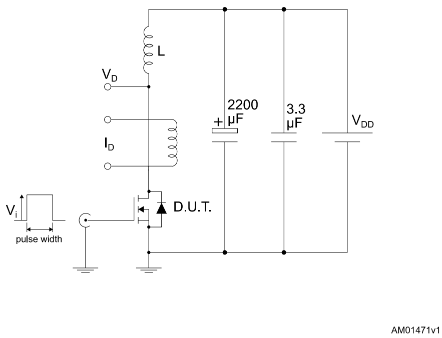


Figure 19: Unclamped inductive waveform

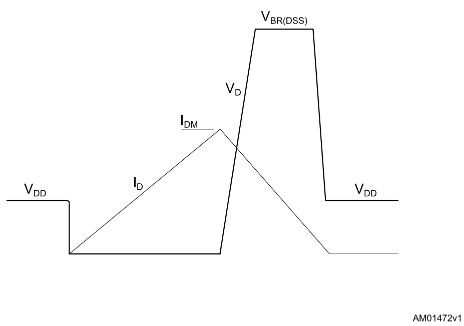
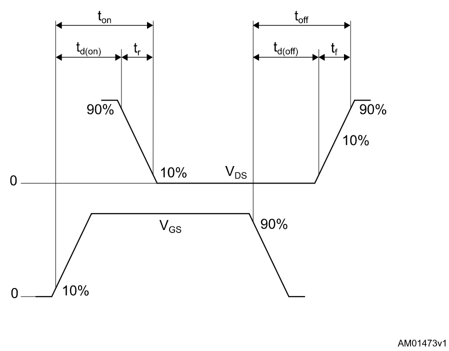


Figure 20: Switching time waveform



4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: ***www.st.com***. ECOPACK® is an ST trademark.

4.1 D^2PAK package information

Figure 21: D²PAK (TO-263) type A package outline

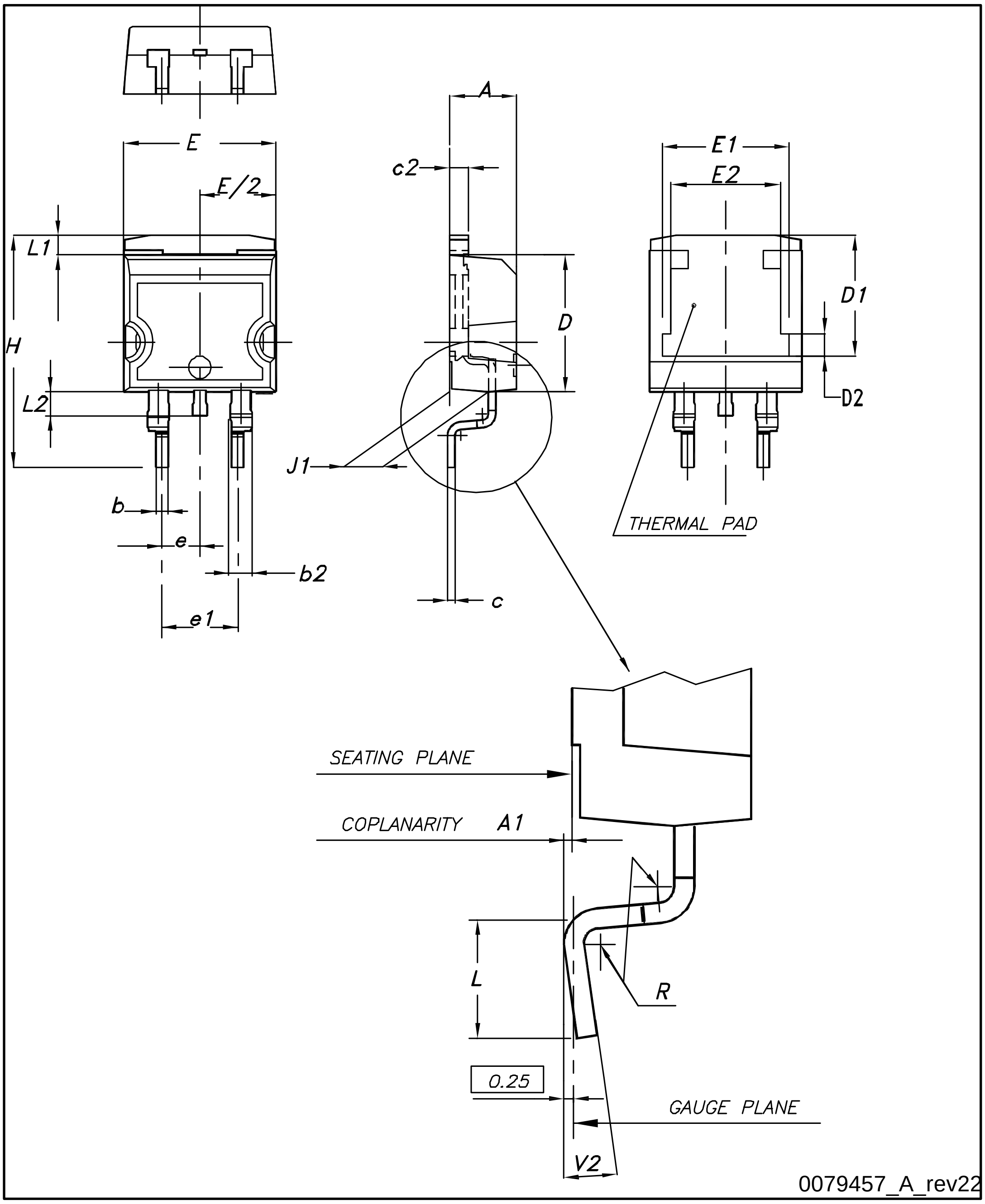
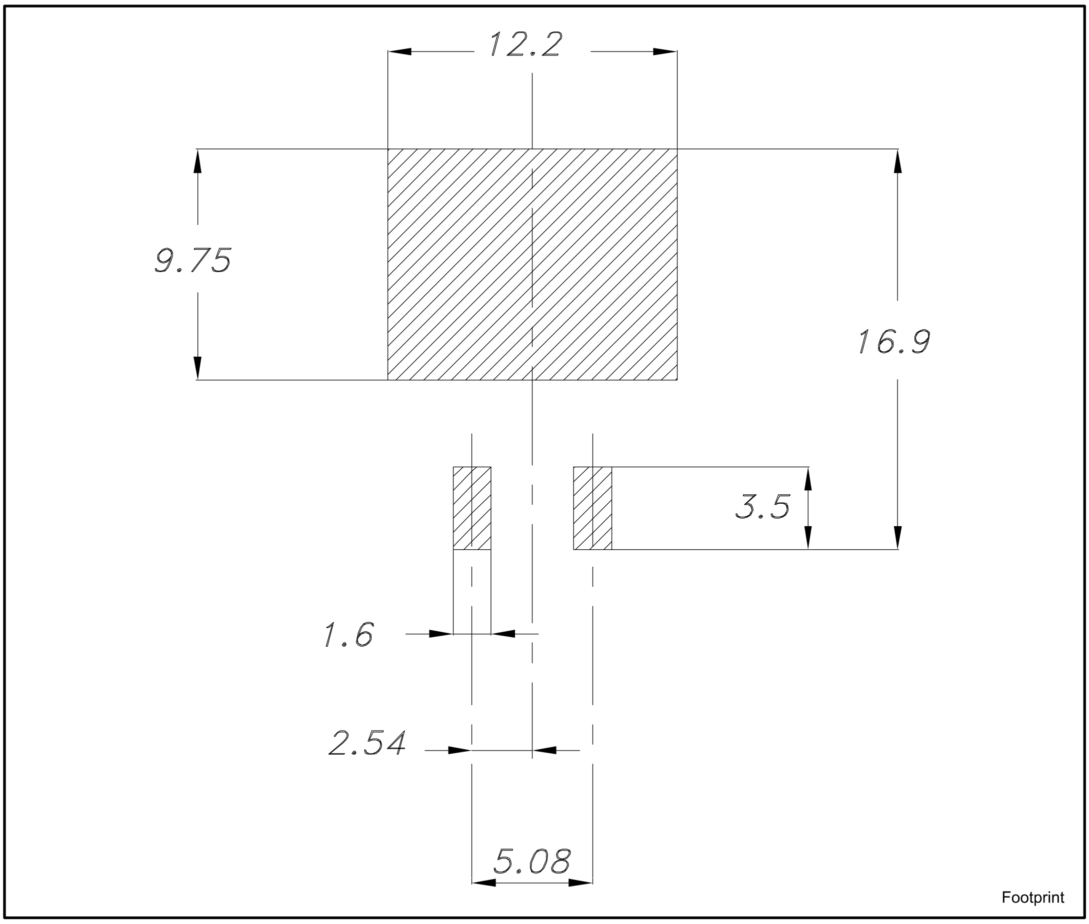


Table 10: D²PAK (TO-263) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 22: D²PAK (TO-263) recommended footprint (dimensions are in mm)



4.2 Packing information

Figure 23: Tape outline

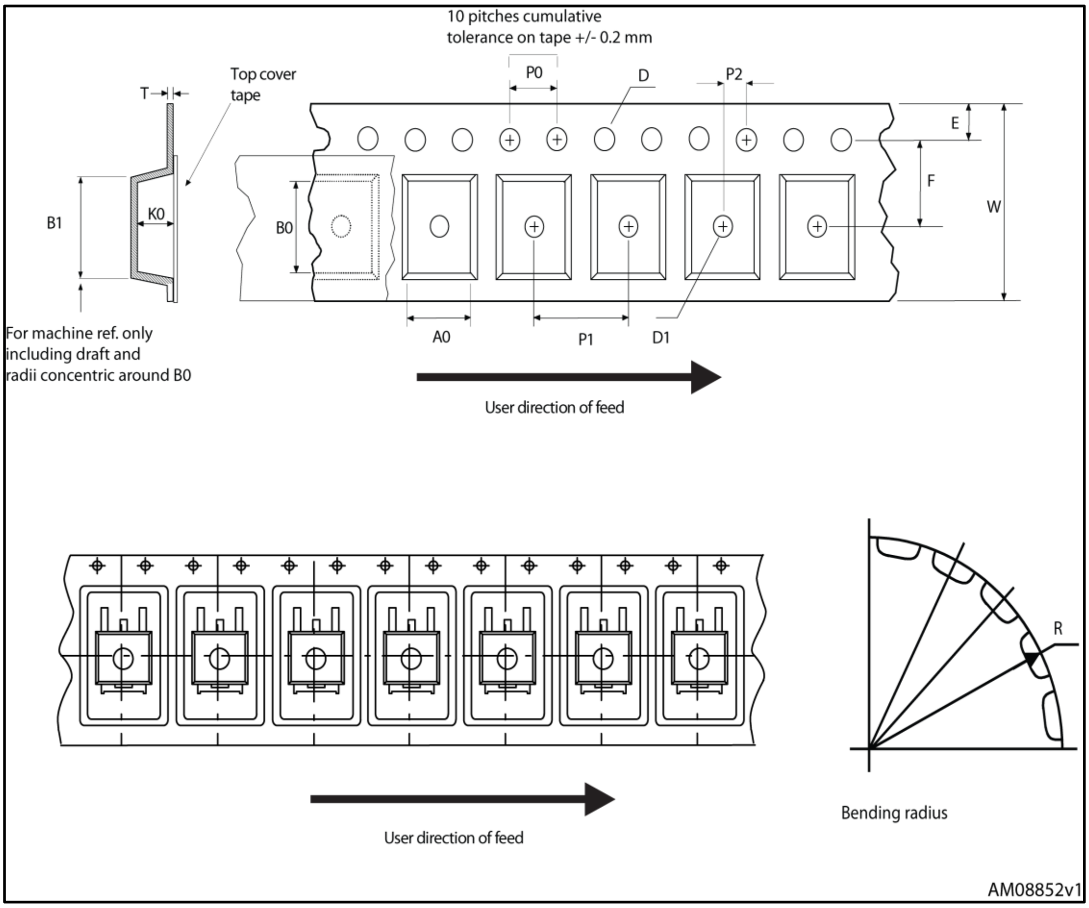


Figure 24: Reel outline

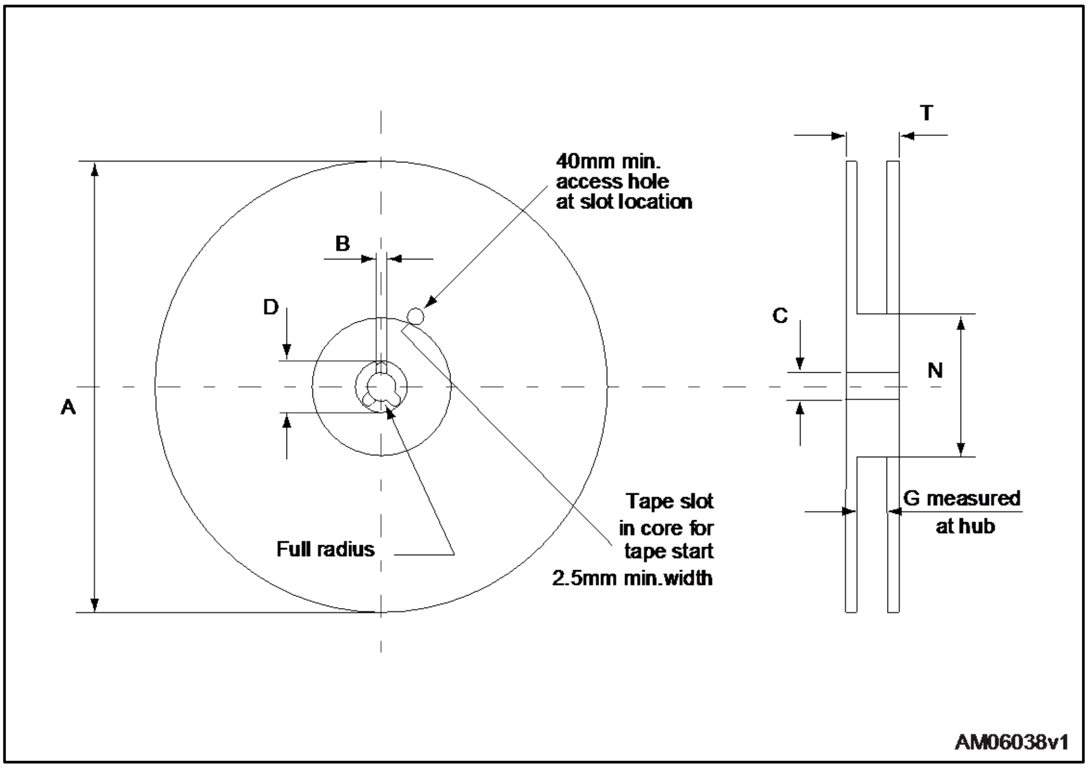


Table 11: D²PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

5 Revision history

Table 12: Document revision history

Date	Revision	Changes
04-May-2015	1	First release.
08-Feb-2016	2	Modified: *Table 2: "Absolute maximum ratings"*, *Table 3: "Thermal data"*, *Table 4: "Avalanche characteristics"*, *Table 5: "On/off-state"*, *Table 7: "Switching times"* and *Table 8: "Source-drain diode"* Added: *Section 3.1: "Electrical characteristics (curves)"* Datasheet promoted from preliminary data to production data Minor text changes

IMPORTANT NOTICE – PLEASE READ CAREFULLY

10-TO-200MA CONSTANT-CURRENT LED DRIVER FOR AUTOMOTIVE

June 2024

GENERAL DESCRIPTION

The IS32LT3177 and IS32LT3178 are adjustable linear current devices with excellent temperature stability. A single resistor is all that is required to set the operating current from 10mA to 200mA. The devices can operate from an input voltage from 2.9V to 40V with a minimal voltage headroom of 1.0V (Typ.) at 150mA. Designed with a low dropout voltage; the device can drive LED strings close to the supply voltage without switch capacitors or inductors.

The IS32LT3177/78 simplifies designs by providing a stable current without the additional requirement of inductors, FETs or diodes. The complete constant current driver requires only a current set resistor and a small PCB area making designs both efficient and cost effective.

The EN Pin of the IS32LT3177 can be tied to V_{BAT} or PSM (Power Supply Modulation) signal for high side dimming. The EN Pin of the IS32LT3178 can function as the PWM signal input used for MCU PWM dimming.

As a current sink it is ideal for LED lighting applications or current limiter for power supplies.

The device is provided in a lead (Pb) free, SOT23-6 and SOP-8-EP packages.

FEATURES

- Low-side current sink
  - Adjustable from 10mA to 150mA (SOT23-6)/200mA (SOP-8-EP) with external resistor selection
- Wide input voltage range from
  - 2.9V to 40V (IS32LT3178)
  - 5V to 40V (IS32LT3177)
  with a low dropout of typical 1.0V at 150mA
- Up to 1kHz PWM input (IS32LT3178 only)
- Protection features:
  - 0.6%/K current roll off at high temp over 145°C for thermal protection
  - Output current limit
  - Thermal shutdown
- Up to 0.77W (SOT23-6)/2.32W (SOP-8-EP) power dissipation in a small package
- RoHS & Halogen-Free Compliance
- TSCA Compliance
- AEC-Q100 Qualified with Temperature Grade 1: -40°C to 125°C

APPLICATIONS

- Automotive and avionic lighting
- Stop/tail light
- Turn light
- Retail lighting in fridge, freezer case and vending machines

TYPICAL APPLICATION CIRCUIT

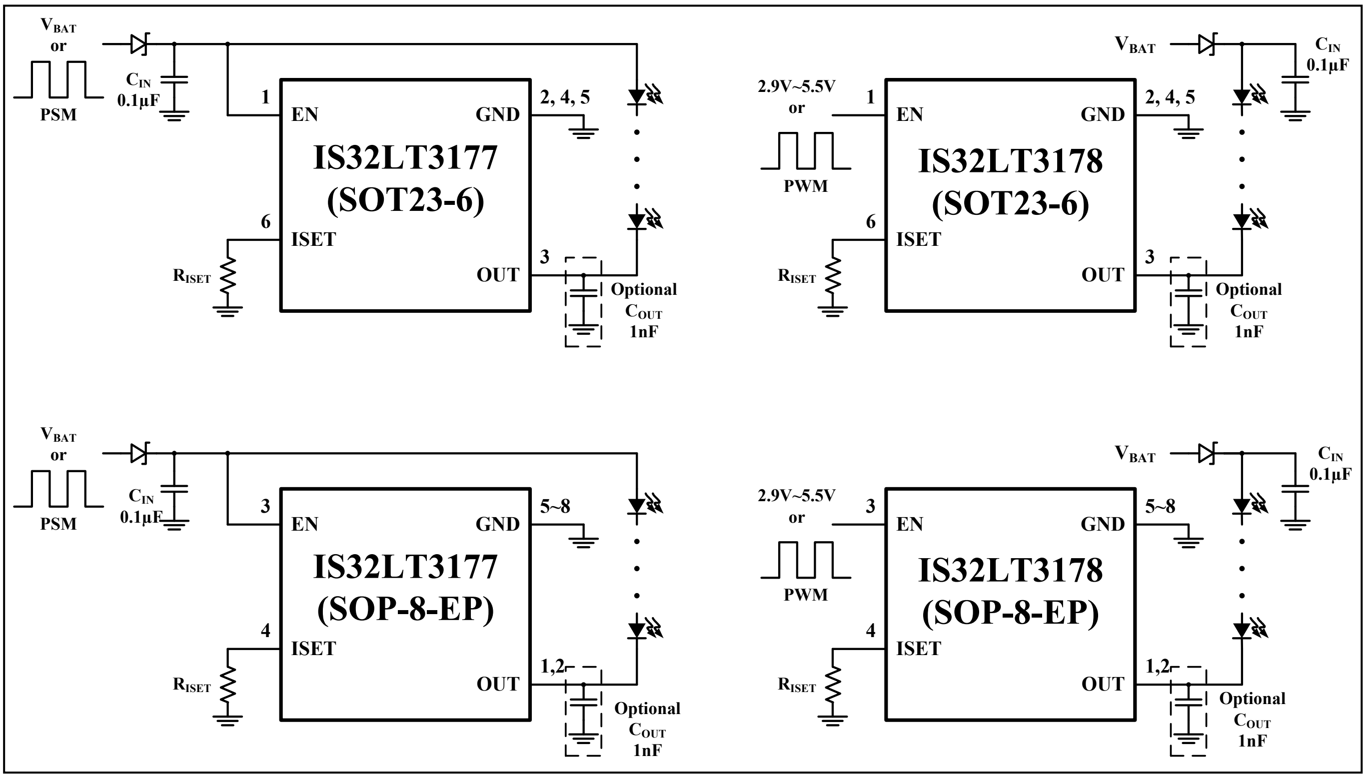


Figure 1 Typical Application Circuit

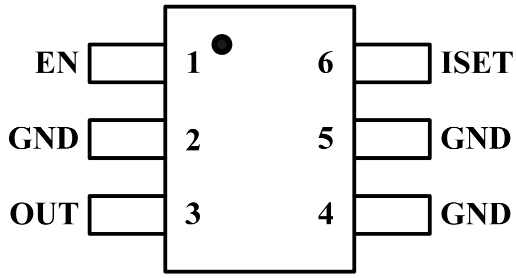
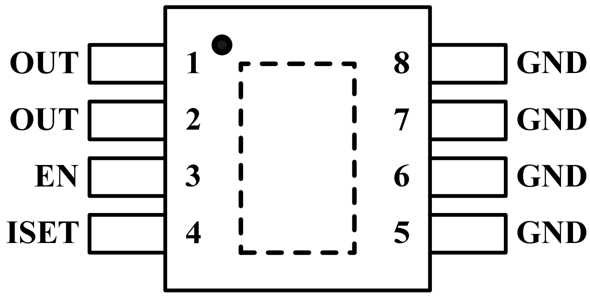
Note 1: All GND pins must be connected to ground.

Note 2: C_{IN} must be placed close to IC. If no PSM dimming requirement, please use larger value for C_{IN}.

Note 3: C_{OUT} is optional. When the LED connection wire is long, the C_{OUT} should be placed close to OUT pin to avoid EMI interference.

Note 4: R_{ISET} MUST be placed close to ISET and GND pins to improve the Electro-Magnetic Susceptibility (EMS) performance.

PIN CONFIGURATION

Package	**Pin Configuration (Top View)**
SOT23-6	
SOP-8-EP	

PIN DESCRIPTION

No.		**Pin**	**Description**
SOT23-6	**SOP-8-EP**		
3	1, 2	OUT	Current sink.
1	3	EN	Enable pin (PWM input IS32LT3178 only).
6	4	ISET	Output current setting pin. Connect a resistor between this pin and GND to set the maximum output current.
2, 4, 5	5~8	GND	Ground pin. All GND pins must be connected to supply ground.
-		Thermal Pad	Connect to GND.

ORDERING INFORMATION
Automotive Range: -40°C to +125°C

Order Part No.	Package	QTY/Reel
IS32LT3177-STLA3-TR IS32LT3178-STLA3-TR	SOT23-6, Lead-free	3000
IS32LT3177-GRLA3-TR IS32LT3178-GRLA3-TR	SOP-8-EP, Lead-free	2500

ABSOLUTE MAXIMUM RATINGS (Note 5)

Maximum enable voltage, $V_{EN(MAX)}$ only for IS32LT3177 $V_{EN(MAX)}$ only for IS32LT3178	44V 6.0V
Maximum output current, $I_{OUT(MAX)}$	250mA
Maximum output voltage, $V_{OUT(MAX)}$	44V
Reverse voltage between all terminals, V_R	0.5V
Power dissipation, $P_{D(MAX)}$ (Note 6)	0.77W (SOT23-6) 2.32W (SOP-8-EP)
Maximum junction temperature, T_{JMAX}	+150°C
Storage temperature range, T_{STG}	-65°C ~ +150°C
Operating temperature range, T_A=T_J	-40°C ~ +125°C
Package thermal resistance, junction to ambient (4-layer standard test PCB based on JESD 51-2A), θ_{JA}	130°C/W (SOT23-6) 43.1°C/W (SOP-8-EP)
Package thermal resistance, junction to thermal PAD (4-layer standard test PCB based on JESD 51-8), θ_{JP}	1.41°C/W (SOP-8-EP)
ESD (HBM) ESD (CDM)	±2kV ±750V

Note 5: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 6: Detail information please refer to package thermal de-rating curve on Page 16.

ELECTRICAL CHARACTERISTICS

"●" This symbol in the table means these parameters are for IS32LT3177.
"○" This symbol in the table means these parameters are for IS32LT3178.
"♦" This symbol in the table means these limits are guaranteed at room temp T_J= 25°C.
"◊" This symbol in the table means these limits are guaranteed at full temp range T_J= -40°C~ +125°C.

Test condition is T_J= -40°C~+125°C, unless otherwise specified. (Note 7)

Symbol	Parameter	Condition			Min.	Typ.	Max.	Unit
V_{BD_OUT}	OUT pin breakdown voltage	V_{EN}= 0V			40			V
I_{EN}	Enable current	V_{EN}= 12V, R_{ISET}=16kΩ	●			0.5	1.00	mA
		V_{EN}= 3.3V, R_{ISET}=16kΩ	○			0.5	1.00	mA
V_{ISET}	Current setting reference voltage					1.0		V
I_{OUT}	Output current	V_{OUT}= 0.8V, V_{EN}= 12V, R_{ISET}= 160kΩ	●	♦		10		mA
				◊		10		
		V_{OUT}= 0.8V, V_{EN}= 3.3V, R_{ISET}= 160kΩ	○	♦		10		
				◊		10		
		V_{OUT}> 1.0V, V_{EN}= 12V, R_{ISET}= 16kΩ, SOP-8-EP	●	♦	97	100	103	mA
				◊	95	100	105	
		V_{OUT}> 1.0V, V_{EN}= 3.3V, R_{ISET}= 16kΩ, SOP-8-EP	○	♦	97	100	103	
				◊	95	100	105	
		V_{OUT}> 1.0V, V_{EN}= 12V, R_{ISET}= 16kΩ, SOT23-6	●	♦	96.5	100	103.5	
				◊	94	100	106	
		V_{OUT}> 1.0V, V_{EN}= 3.3V, R_{ISET}= 16kΩ, SOT23-6	○	♦	96.5	100	103.5	
				◊	94	100	106	

ELECTRICAL CHARACTERISTICS (CONTINUE)

Symbol	Parameter	Condition			Min.	Typ.	Max.	Unit
I_{OUT}	Output current	V_{OUT}> 1.5V, V_{EN}= 12V, R_{ISET}= 10.6kΩ, SOT23-6	●	♦	145.5	150	154.5	mA
				◊	142.5	150	157.5	
		V_{OUT}> 1.5V, V_{EN}= 3.3V, R_{ISET}= 10.6kΩ, SOT23-6	○	♦	145.5	150	154.5	
				◊	142.5	150	157.5	
		V_{OUT}> 1.5V, V_{EN}= 12V, R_{ISET}= 8kΩ, SOP-8-EP	●	♦	194	200	206	mA
				◊	190	200	210	
		V_{OUT}> 1.5V, V_{EN}= 3.3V, R_{ISET}= 8kΩ, SOP-8-EP	○	♦	194	200	206	
				◊	190	200	210	

DC CHARACTERISTICS WITH STABILIZED LED LOAD

"●" This symbol in the table means these parameters are for IS32LT3177.
"○" This symbol in the table means these parameters are for IS32LT3178.
Test condition is T_J= -40°C~+125°C, unless otherwise specified. (Note 7)

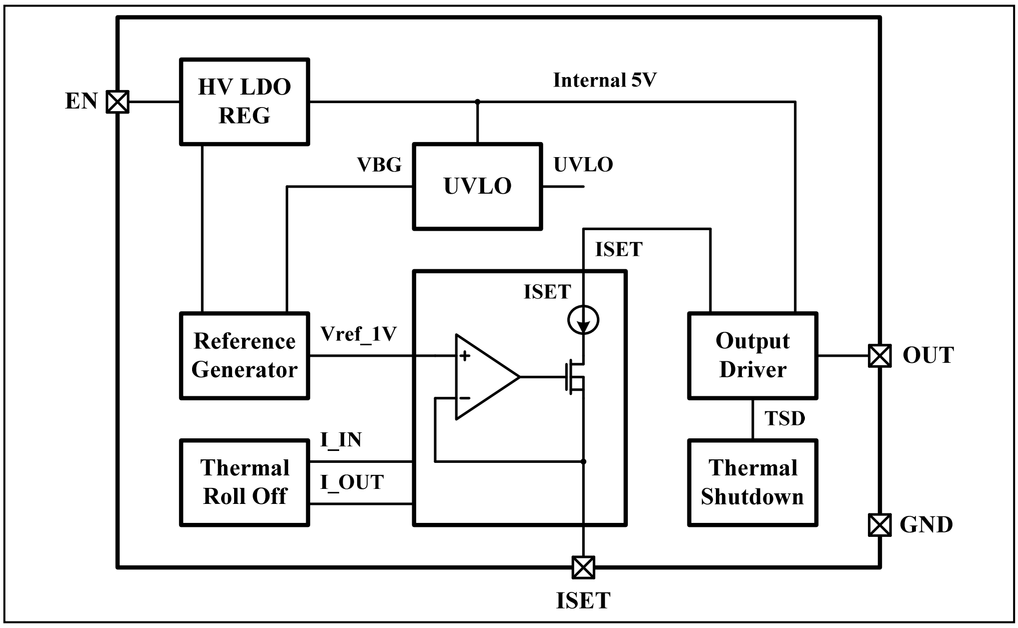
Symbol	Parameter	Condition		Min.	Typ.	Max.	Unit
I_{OUT_LIMIT}	Output current limit	R_{ISET}= GND, V_{EN}= 12V	●		295		mA
		R_{ISET}= GND, V_{EN}= 3.3V	○		295		
V_{UVLO}	EN pin undervoltage lockout threshold	V_{EN} rising	●		3.1	3.6	V
			○		1.9	2.4	
		V_{EN} falling	●	2.4	2.9		
			○	1.2	1.7		
V_{EN}	Sufficient supply voltage on EN pin	10mA≤I_{OUT}≤200mA, V_{OUT}=2V	●	5		40	V
		10mA≤I_{OUT}≤150mA, V_{OUT}=2V, SOT23-6	○	2.9		5.5	
		150mA < I_{OUT} ≤ 200mA, V_{OUT}=2V, SOP-8-EP	○	3.1		5.5	
V_{HR}	Minimum required headroom voltage on OUT pin	I_{OUT}=150mA, SOT23-6	●	1.2			V
		I_{OUT}= 150mA, SOT23-6	○	1.2			
		I_{OUT}= 200mA, SOP-8-EP	●	1.5			
		I_{OUT}= 200mA, SOP-8-EP	○	1.5			
t_{ON}	EN pin enabling time	V_{OUT} > 1.5V, V_{EN} = 5V, R_{ISET}= 16kΩ	●			10	μs
		V_{OUT} > 1.5V, V_{EN} = 3.3V, R_{ISET}= 16kΩ	○			10	
T_{RO}	Thermal roll off threshold	Current decreasing slope rate: -0.6%/°C (Note 8)			145		°C
T_{SD}	Thermal shutdown threshold	Temperature rising (Note 8)			170		°C
T_{SD_HY}	Thermal shutdown hysteresis	Temperature falling (Note 8)			30		°C

Note 7: Production testing of the device is performed at 25°C. Functional operation of the device and parameters specified over -40°C to +125°C temperature range, are guaranteed by design and characterization.

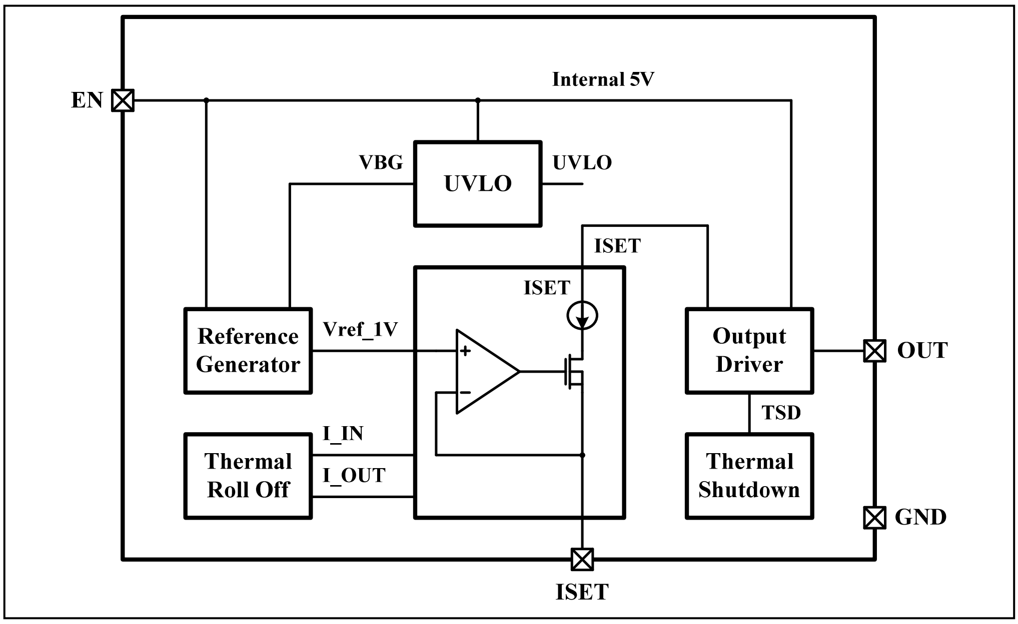
Note 8: Guaranteed by design.

FUNCTIONAL BLOCK DIAGRAM

IS32LT3177



IS32LT3178



TYPICAL PERFORMANCE CHARACTERISTICS

IS32LT3177

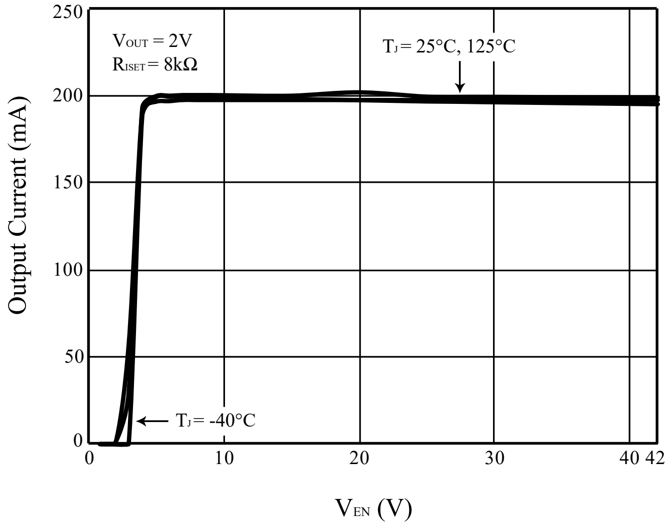


Figure 2 Output Current vs. V_{EN}

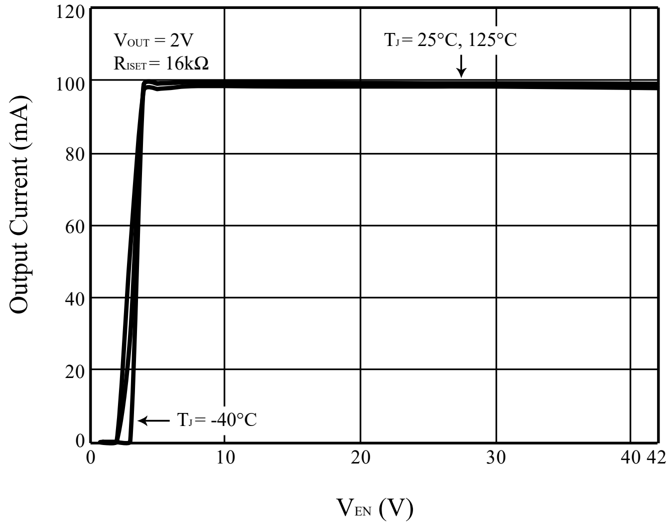


Figure 3 Output Current vs. V_{EN}

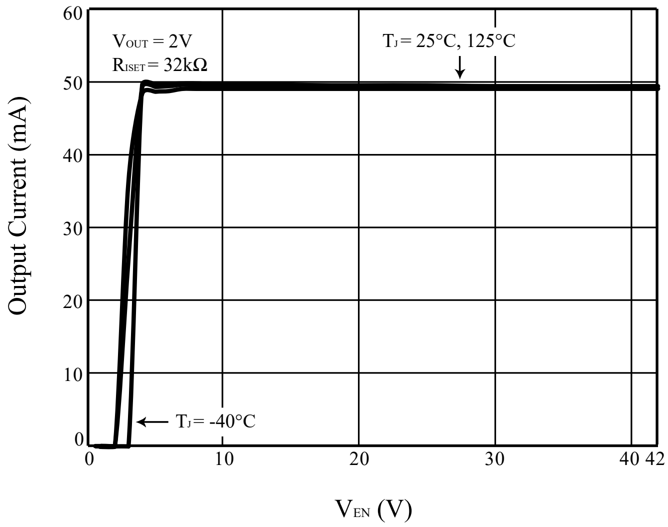


Figure 4 Output Current vs. V_{EN}

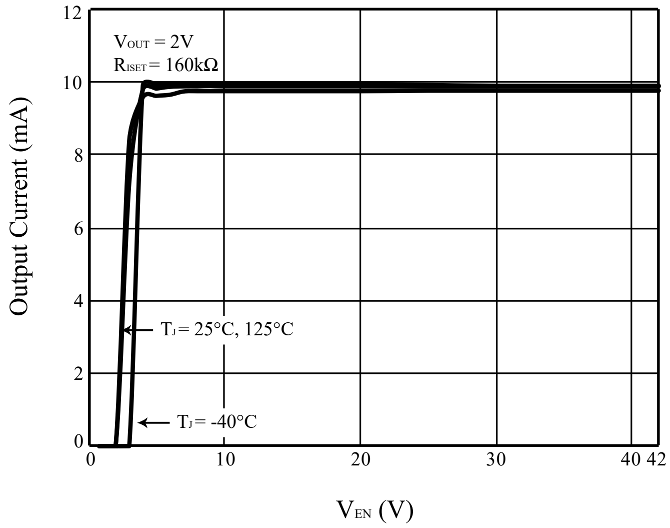


Figure 5 Output Current vs. V_{EN}

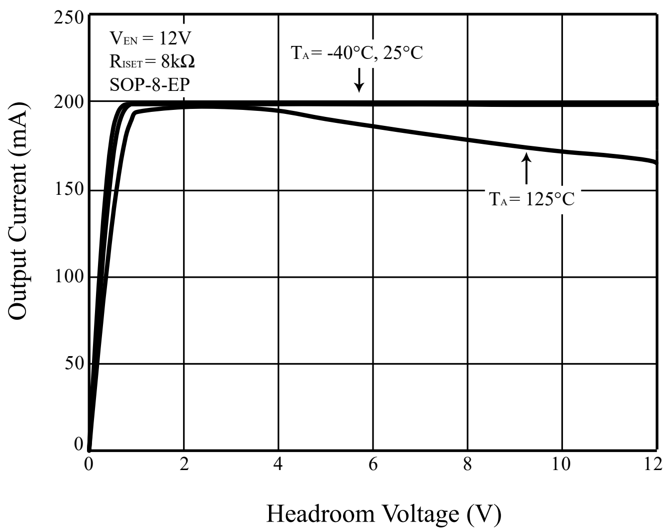


Figure 6 Output Current vs. Headroom Voltage

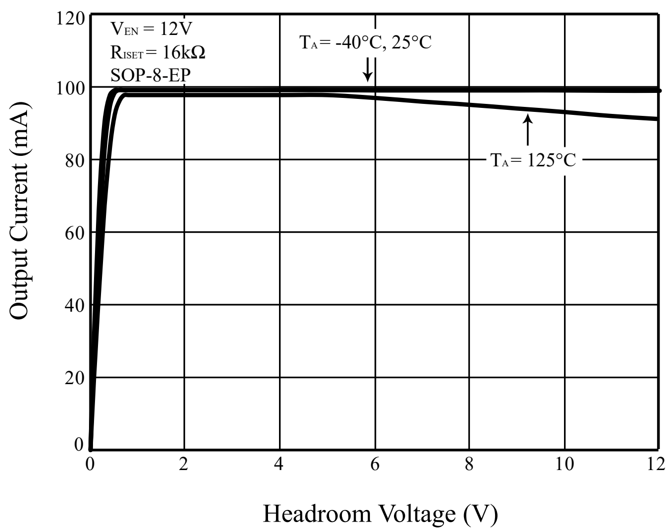


Figure 7 Output Current vs. Headroom Voltage

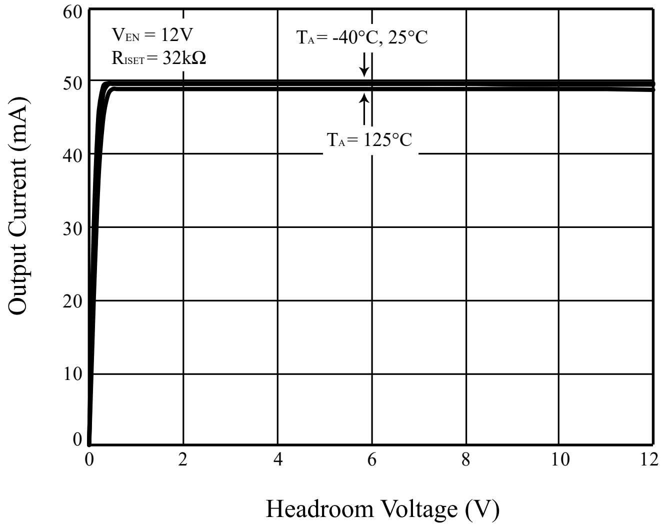


Figure 8 Output Current vs. Headroom Voltage

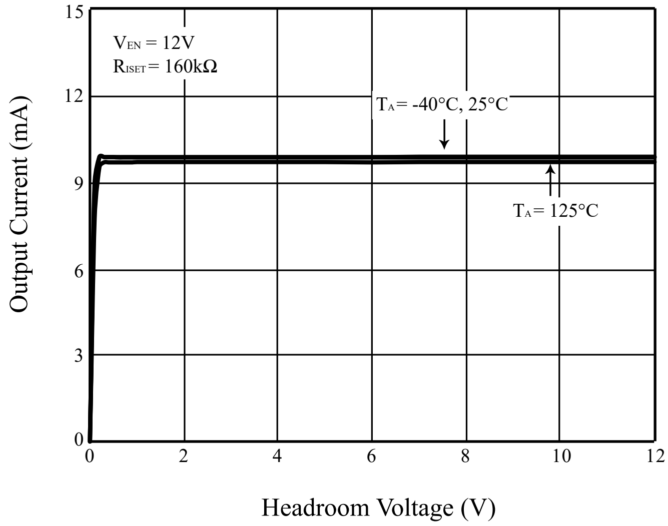


Figure 9 Output Current vs. Headroom Voltage

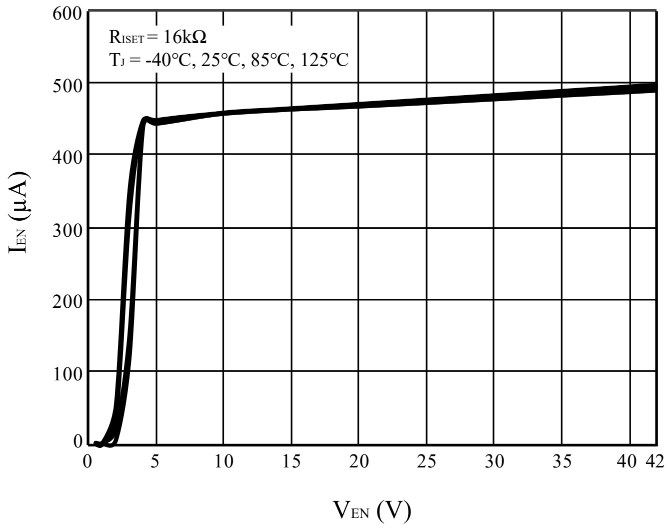


Figure 10 I_{EN} vs. V_{EN}

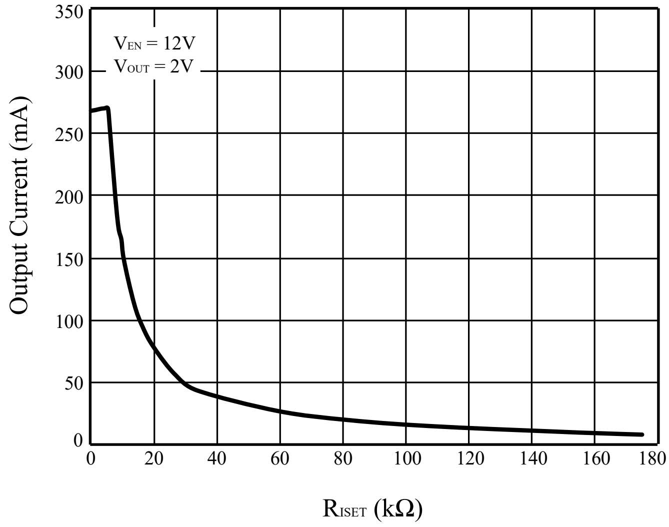


Figure 11 Output Current vs. R_{ISET}

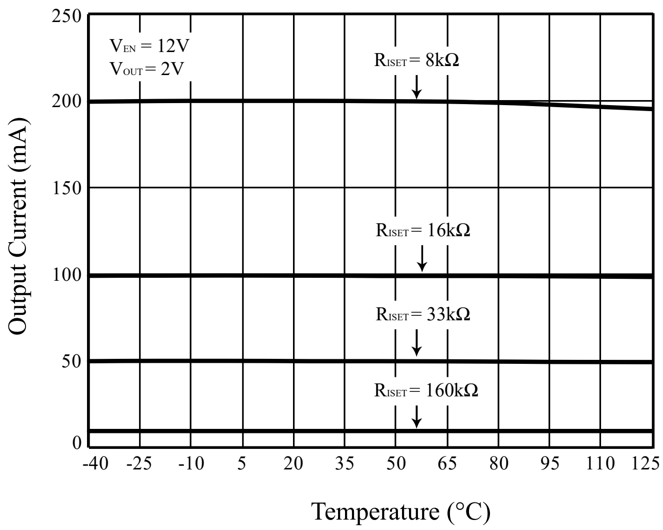


Figure 12 Output Current vs. Temperature

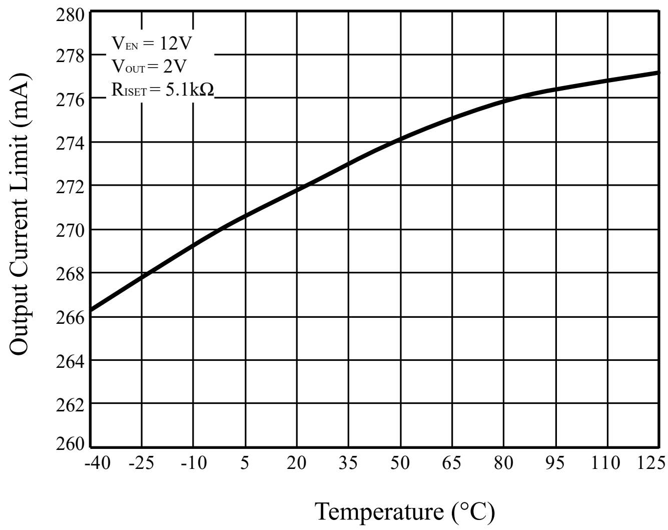


Figure 13 Output Current Limit vs. Temperature

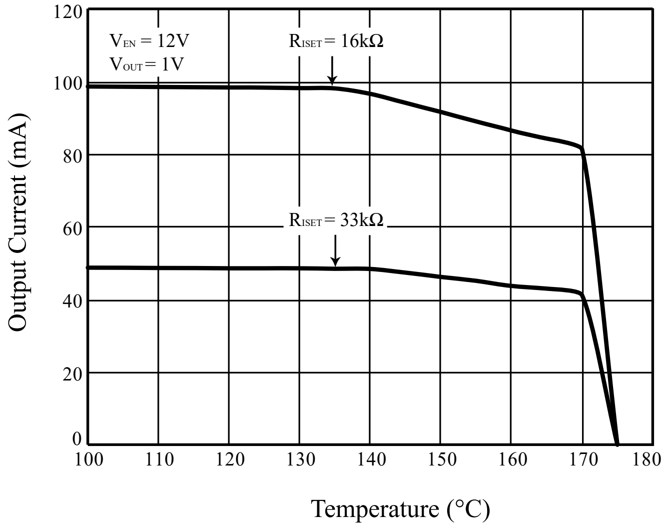


Figure 14 Output Current vs. Temperature (Thermal Roll Off)

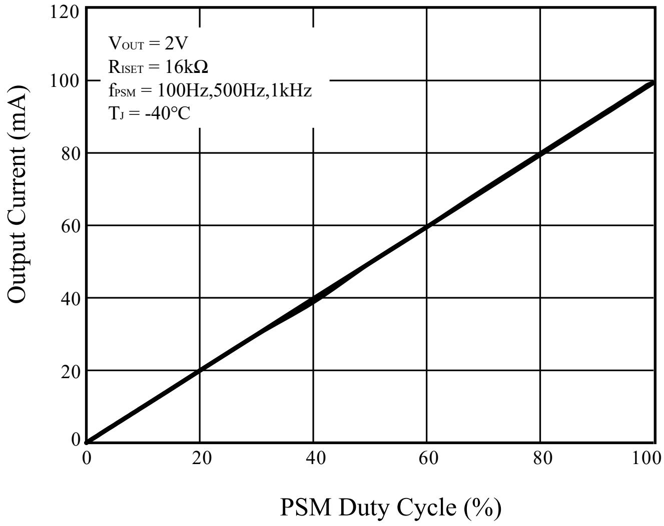


Figure 15 Output Current vs. PSM Duty Cycle

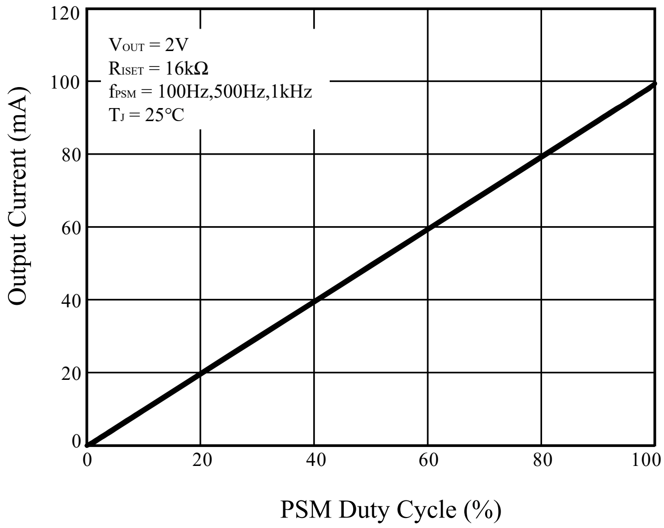


Figure 16 Output Current vs. PSM Duty Cycle

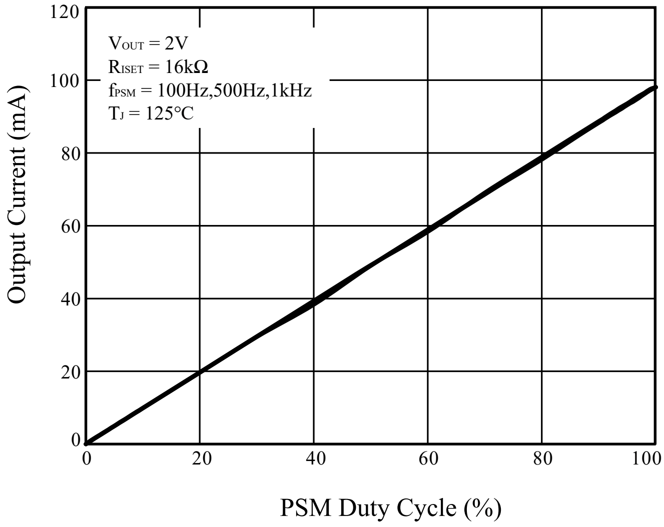


Figure 17 Output Current vs. PSM Duty Cycle

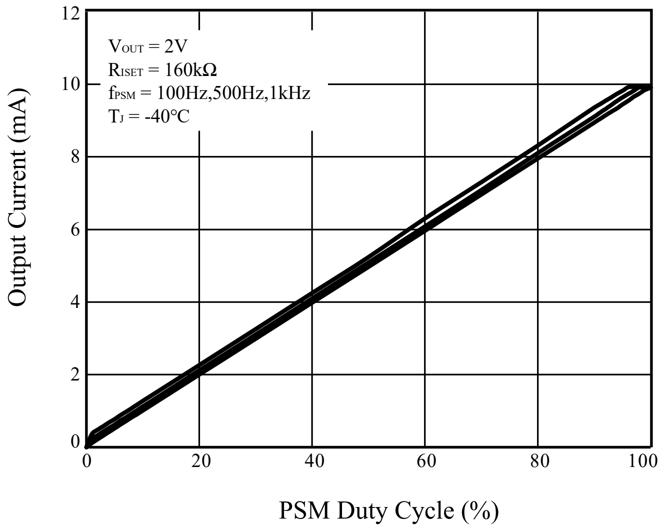


Figure 18 Output Current vs. PSM Duty Cycle

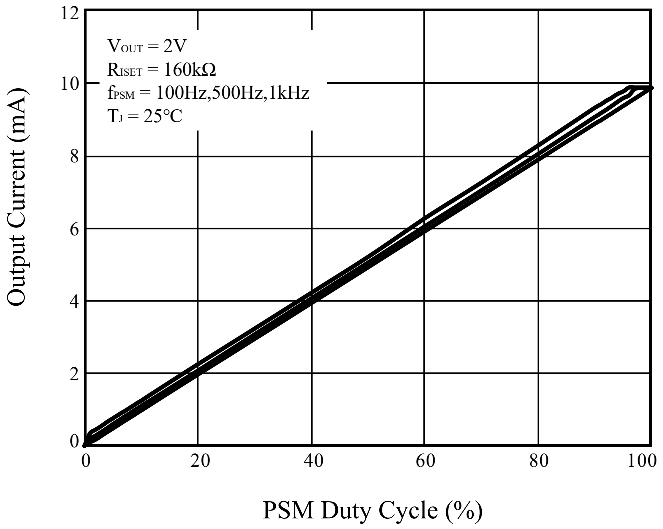


Figure 19 Output Current vs. PSM Duty Cycle

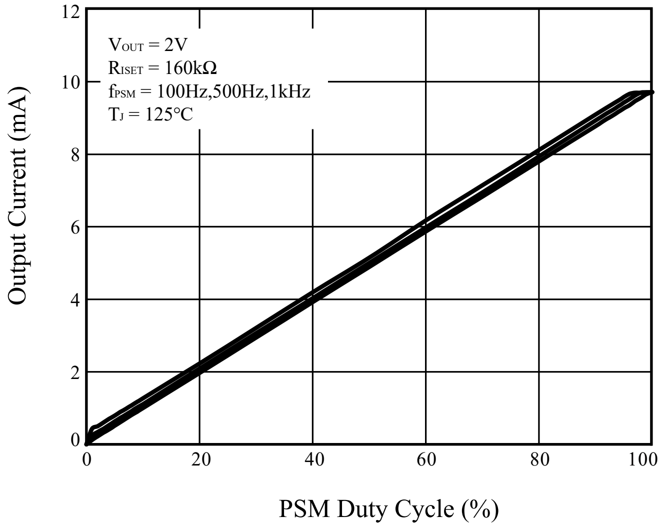


Figure 20 Output Current vs. PSM Duty Cycle

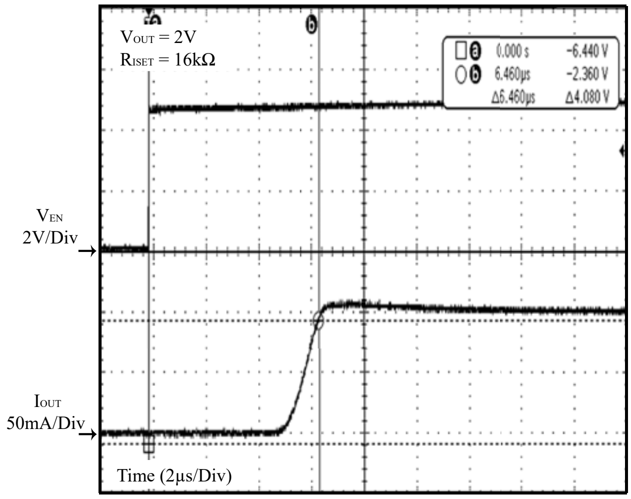


Figure 21 Start Up

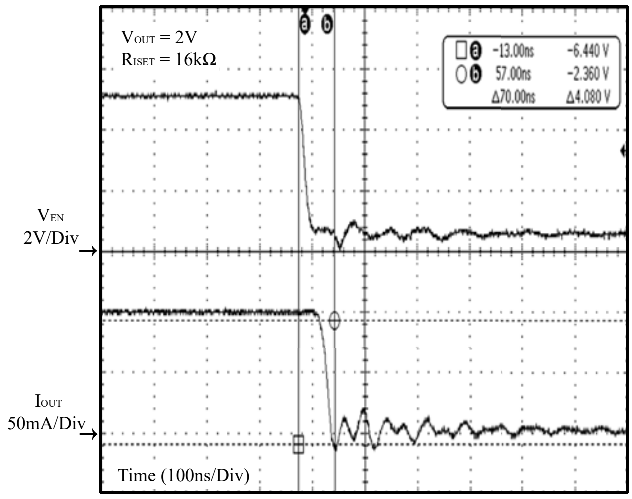


Figure 22 Shut Down

IS32LT3178

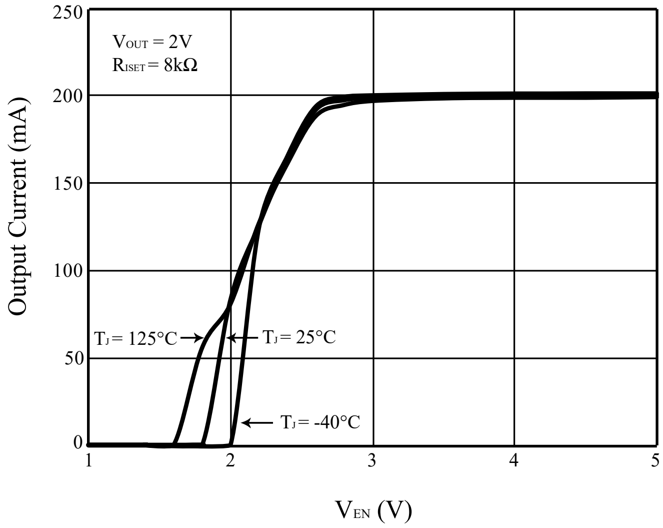


Figure 23 Output Current vs. V_{EN}

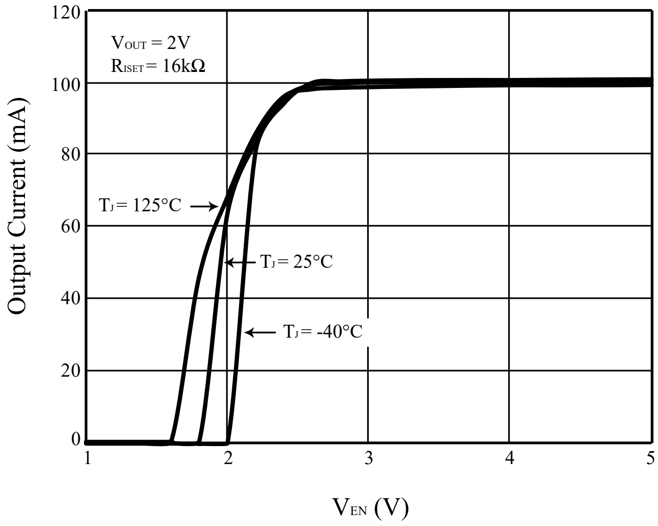


Figure 24 Output Current vs. V_{EN}

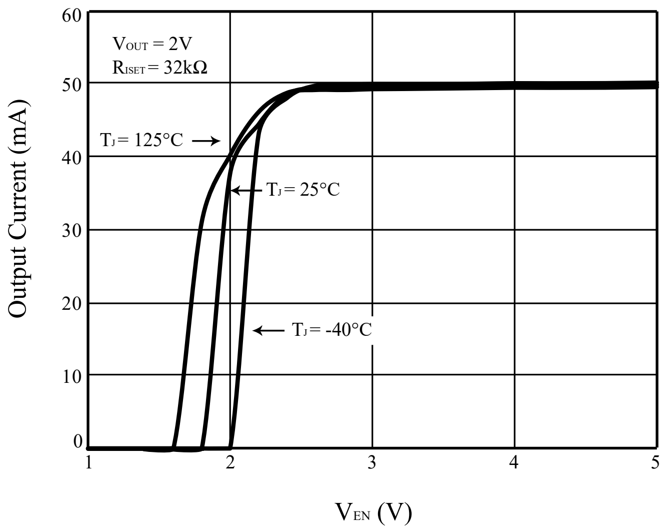


Figure 25 Output Current vs. V_{EN}

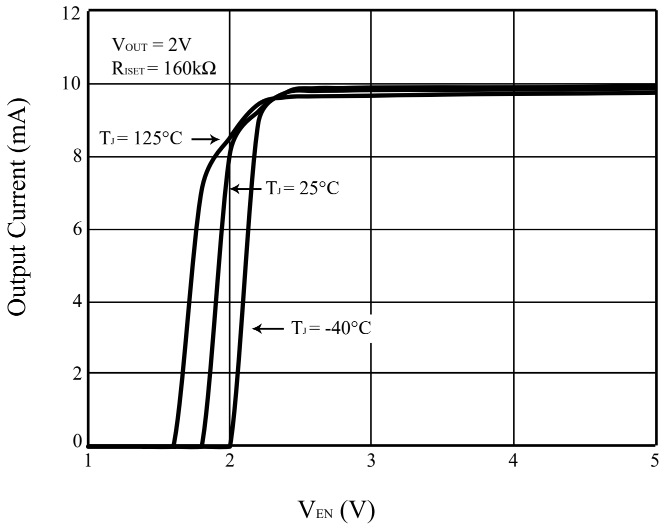


Figure 26 Output Current vs. V_{EN}

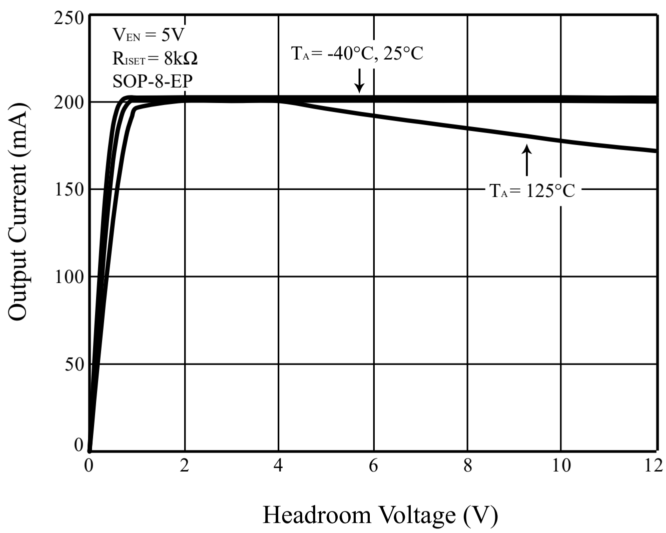


Figure 27 Output Current vs. Headroom Voltage

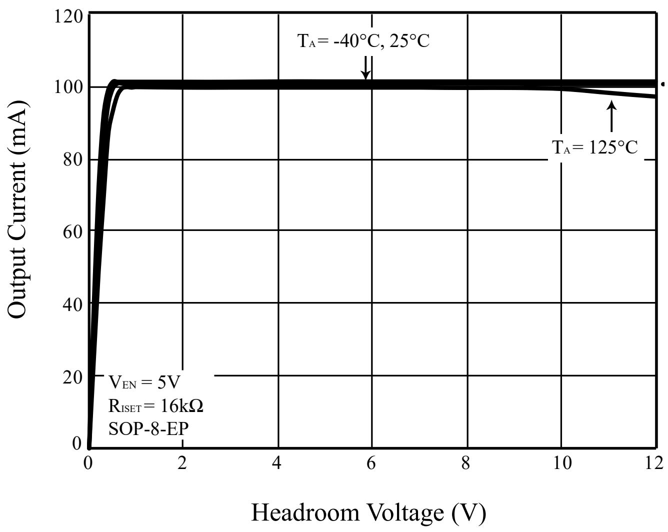


Figure 28 Output Current vs. Headroom Voltage

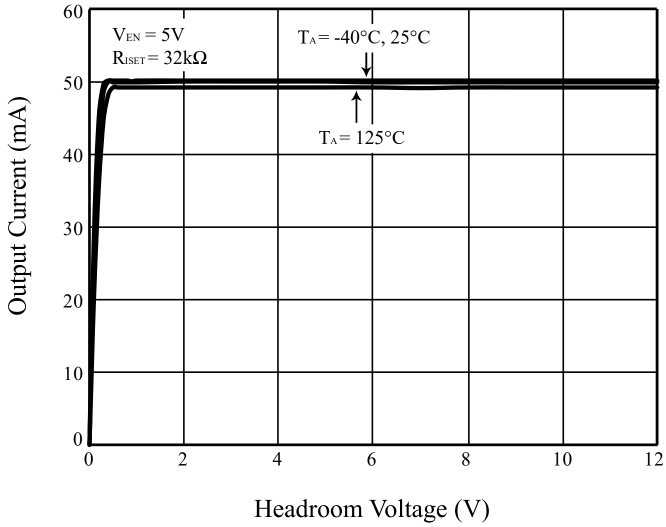


Figure 29 Output Current vs. Headroom Voltage

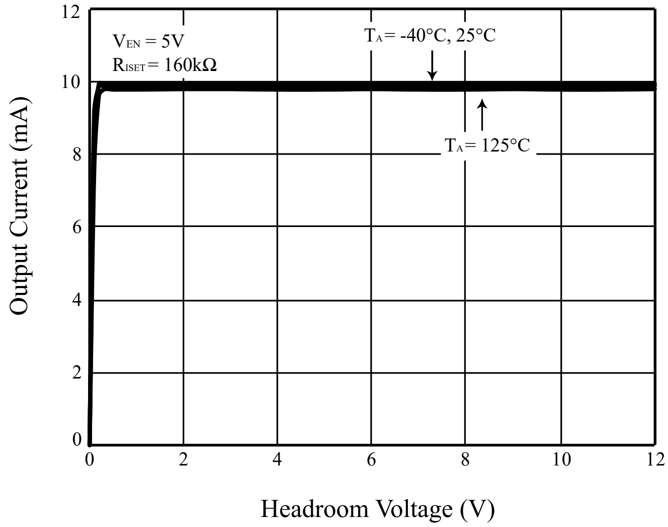


Figure 30 Output Current vs. Headroom Voltage

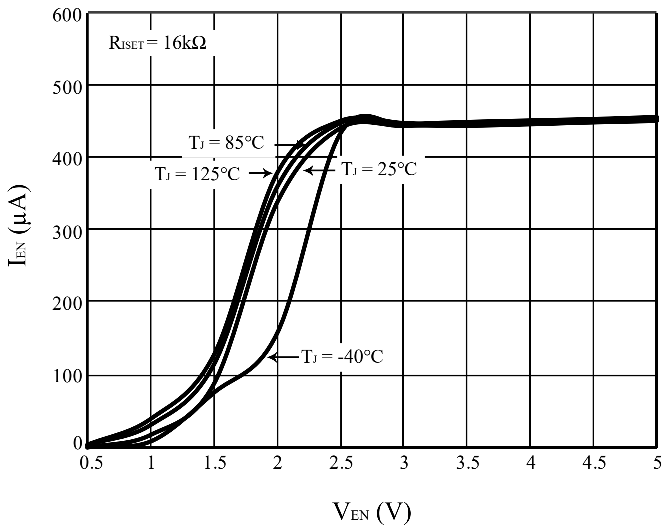


Figure 31 I_{EN} vs. V_{EN}

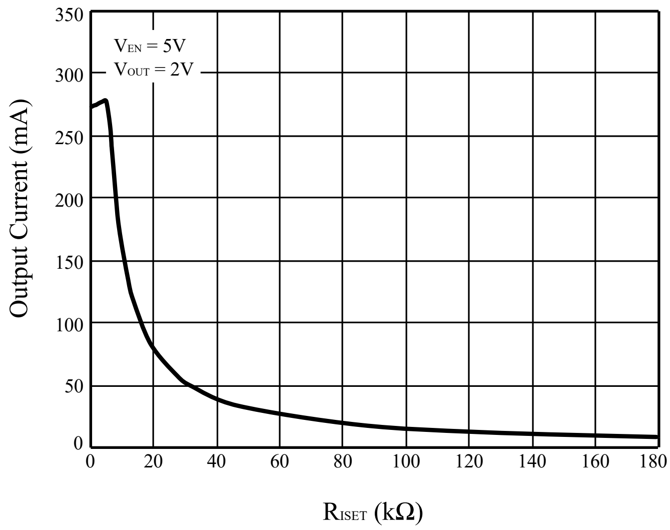


Figure 32 Output Current vs. R_{ISET}

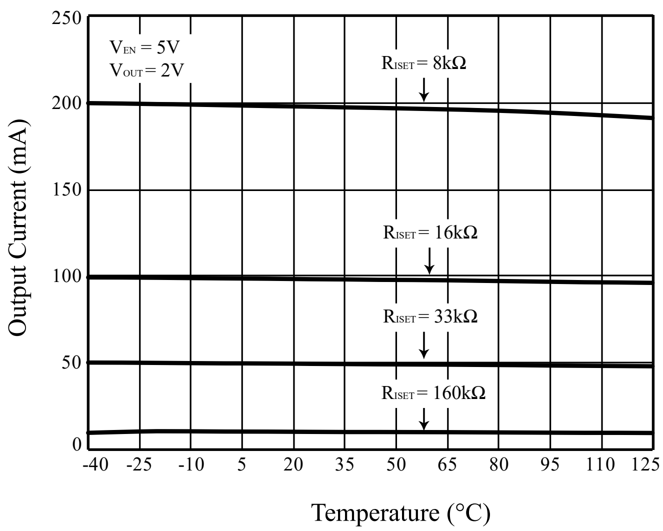


Figure 33 Output Current vs. Temperature

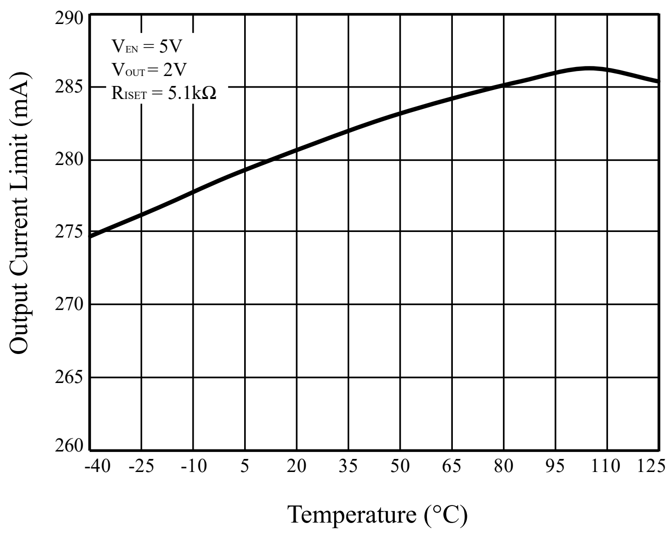


Figure 34 Output Current Limit vs. Temperature

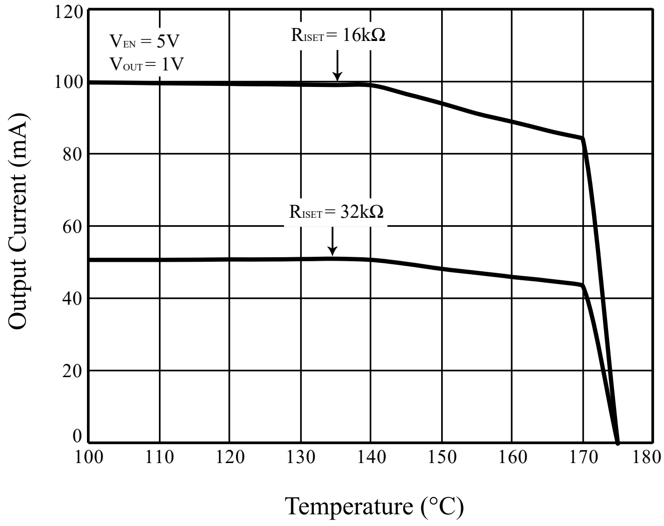


Figure 35 Output Current vs. Temperature (Thermal Roll Off)

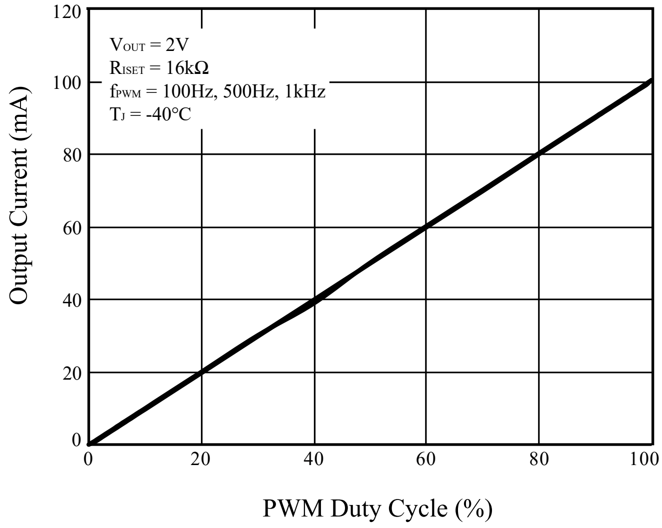


Figure 36 Output Current vs. PWM Duty Cycle

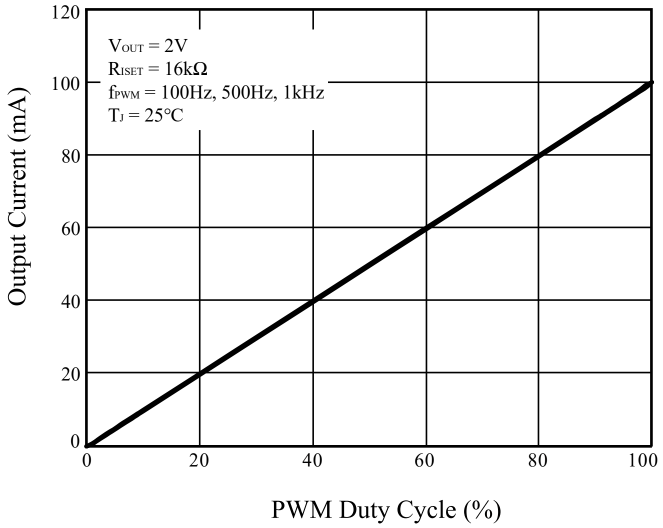


Figure 37 Output Current vs. PWM Duty Cycle

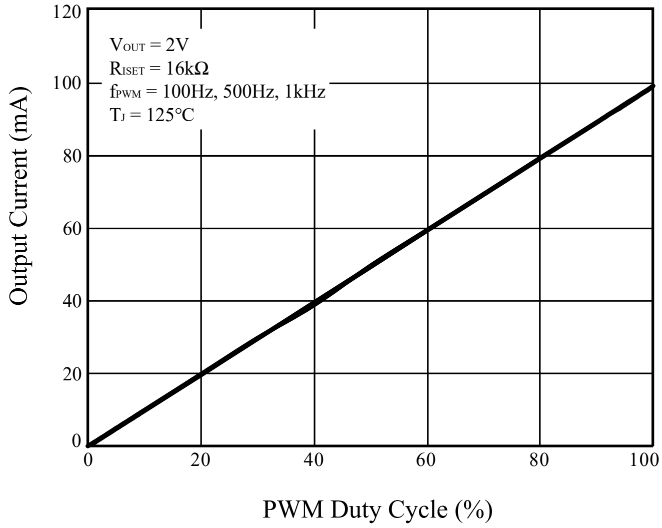


Figure 38 Output Current vs. PWM Duty Cycle

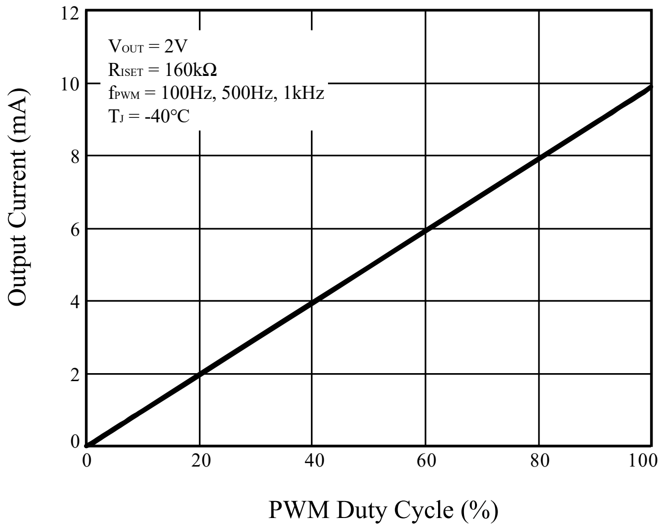


Figure 39 Output Current vs. PWM Duty Cycle

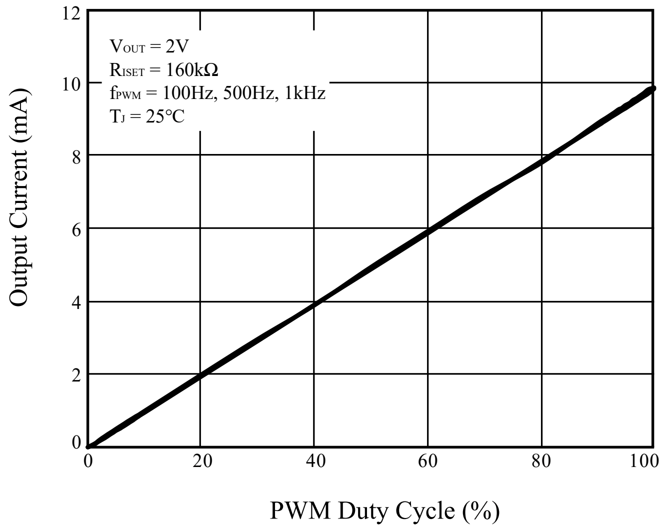


Figure 40 Output Current vs. PWM Duty Cycle

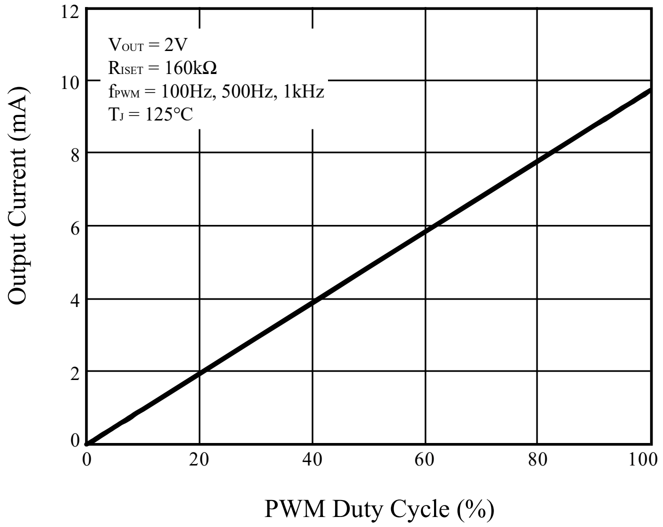


Figure 41 Output Current vs. PWM Duty Cycle

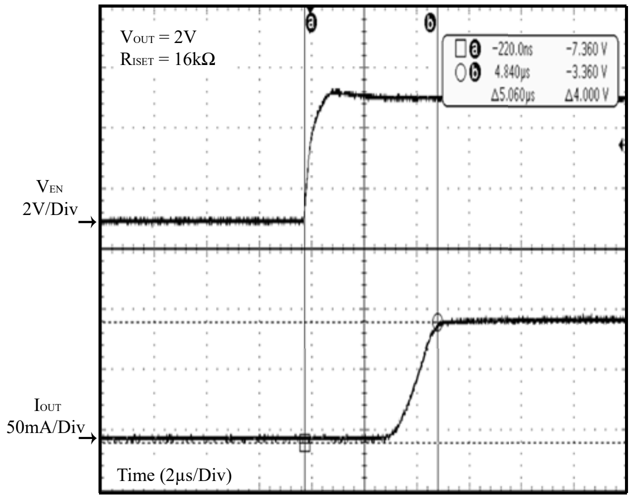


Figure 42 Start Up

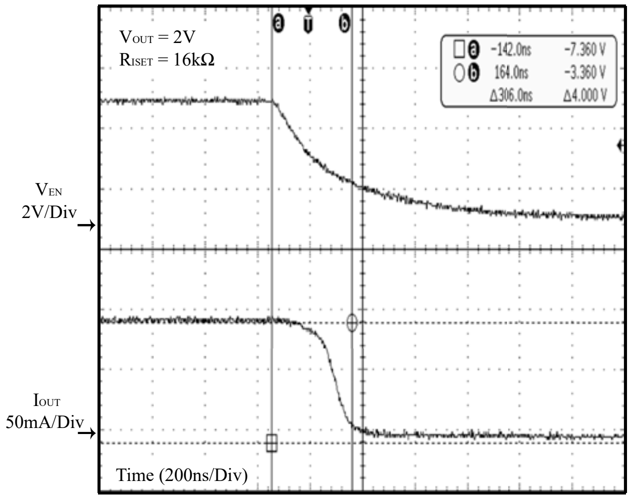


Figure 43 Shut Down

APPLICATIONS INFORMATION

IS32LT3177/78 provides an easy constant current sink solution for LED lighting applications. It uses an external resistor to adjust the LED current from 10mA to 150mA (SOT23-6)/200mA (SOP-8-EP). The LED current can be determined by the external resistor R_{ISET} as Equation (1):

$$R_{ISET} = \frac{V_{ISET} \times 1600}{I_{SET}} \qquad (1)$$

10.6kΩ≤R_{ISET}≤160kΩ for SOT23-6 package, and 8kΩ≤R_{ISET}≤160kΩ for SOP-8-EP package.

Where R_{ISET} is in Ω, I_{SET} is desired LED current in Amp and V_{ISET} = 1.0V (Typ.)

R_{ISET} must be a 1% accuracy resistor with good temperature characteristics in order to ensure stable output current. The device limits the maximum output current to I_{OUT_LIMIT} to protect itself from an output overcurrent condition caused by a low value. Do not leave ISET pin floating.

HIGH INPUT VOLTAGE APPLICATION

When driving a long string of LEDs whose total forward voltage drop exceeds the IS32LT3177 V_{BD_OUT} limit of 40V, it is possible to stack several LEDs (such as 2 LEDs) between the EN pin and the OUT pins, and so the voltage on the EN pin is higher than 5V. The remaining string of LEDs can then be placed between power supply $+V_S$ and EN pin, (Figure 44). The number of LEDs required to stack at EN pin will depend on the LED's forward voltage drop (V_F) and the $+V_S$ value.

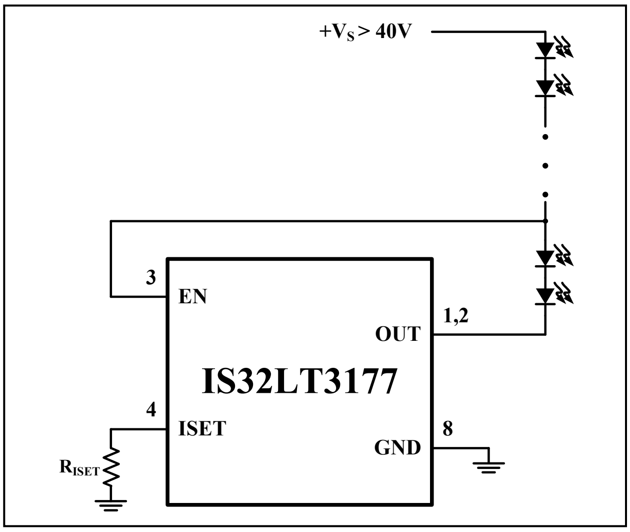


Figure 44 High Input Voltage Application Circuit

Note: when operating the IS32LT3177 at voltages exceeding the device operating limits, care needs to be taken to keep the EN pin and OUT pin voltage below 40V.

THERMAL PROTECTION AND DISSIPATION

The IS32LT3177/78 implements thermal roll off protection to reduce the LED current when the package's thermal dissipation is exceeded and prevent "thermal runaway". The thermal roll off begins from 145°C, and linearly decreases following the junction temp to 85% of the set current value at T_{SD} (170°C). Please see Figure 14 and 35. In the event that the junction temperature exceeds 170°C, the device will go into shutdown mode. At this point, the IC begins to cool off and will resume operation once the junction temperature goes below 140°C.

When operating the chip at high ambient temperatures, or when driving maximum load current, care must be taken to avoid exceeding the package power dissipation limits. Exceeding the package dissipation will cause the device to enter thermal protection mode. The maximum package power dissipation can be calculated using the following Equation (2):

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}} \qquad (2)$$

Where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance; a metric for the relative thermal performance of a package.

The recommended maximum operating junction temperature, $T_{J(MAX)}$, is 125°C and so the maximum ambient temperature is determined by the package parameter; θ_{JA}. The θ_{JA} for the IS32LT3177/78 SOT23-6 package is 130°C/W and SOP-8-EP package is 43.1°C/W.

Therefore the maximum power dissipation at T_A= 25°C is:

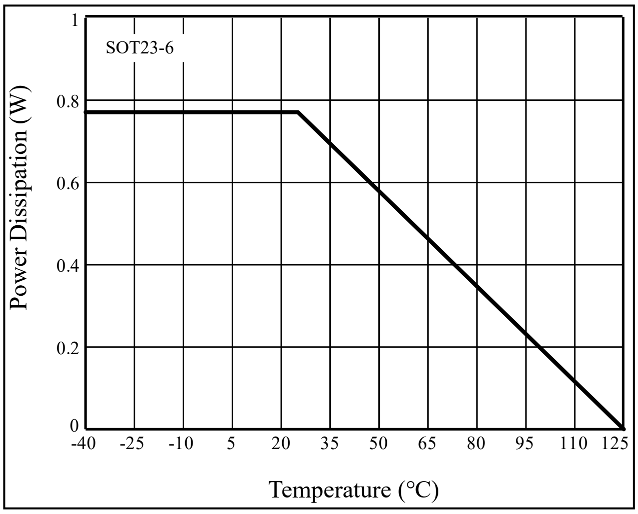
$$P_{D(MAX)} = \frac{125°C - 25°C}{130°C/W} \approx 0.77W \quad \text{(SOT23-6)}$$

$$P_{D(MAX)} = \frac{125°C - 25°C}{43.1°C/W} \approx 2.32W \quad \text{(SOP-8-EP)}$$

The actual power dissipation P_D is:

$$P_D = V_{OUT} \times I_{OUT} + V_{EN} \times I_{EN} \qquad (3)$$

To ensure optimum performance, the die temperature (T_J) of the IS32LT3177/78 should not exceed 125°C. The graph below gives details for the package power derating.



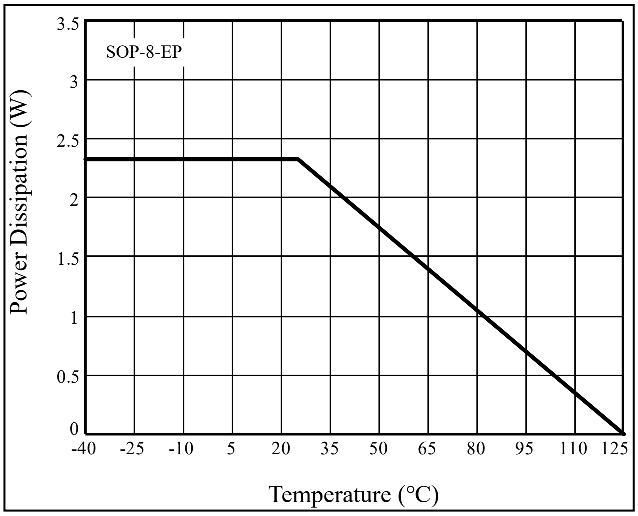
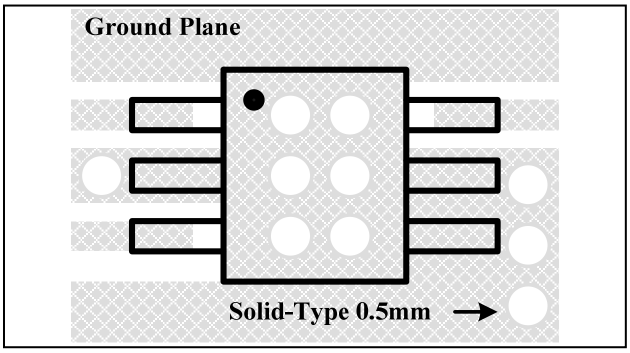


Figure 45 P_D vs. T_A

A lower thermal resistance is achieved by mounting the IS32LT3177/78 on a standard FR4 double-sided printed circuit board (PCB) with a grounded copper area of a few square inches on each side of the board under the IS32LT3177/78. Multiple thermal solid vias (not web or spoke type), as shown in Figure 46, help to conduct heat from the exposed pad of the IS32LT3177/78 to the grounded copper area on each side of the board. The recommended via diameter is 0.5mm with spacing of 1mm. The thermal resistance can be further reduced by using a metal-clad PCB or by adding a heatsink.



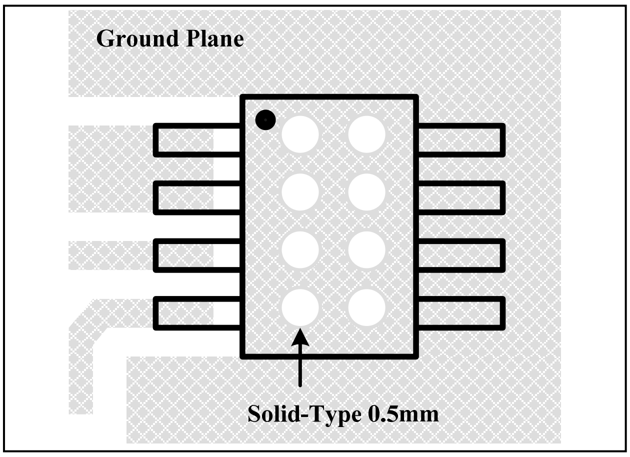


Figure 46 Board Via Layout For Thermal Dissipation

CLASSIFICATION REFLOW PROFILES

Profile Feature	Pb-Free Assembly
Preheat & Soak Temperature min (Tsmin) Temperature max (Tsmax) Time (Tsmin to Tsmax) (ts)	150°C 200°C 60-120 seconds
Average ramp-up rate (Tsmax to Tp)	3°C/second max.
Liquidous temperature (TL) Time at liquidous (tL)	217°C 60-150 seconds
Peak package body temperature (Tp)*	Max 260°C
Time (tp)** within 5°C of the specified classification temperature (Tc)	Max 30 seconds
Average ramp-down rate (Tp to Tsmax)	6°C/second max.
Time 25°C to peak temperature	8 minutes max.

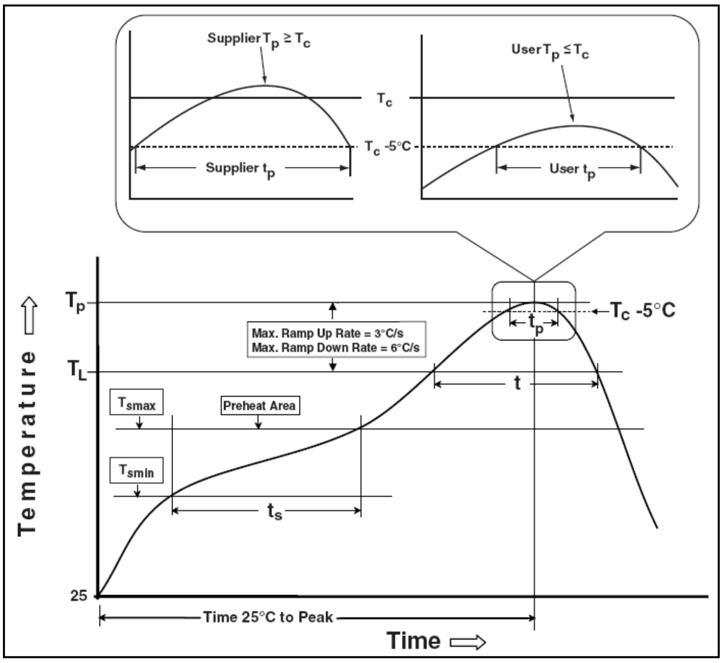
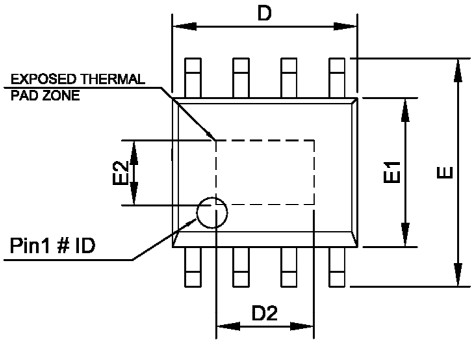
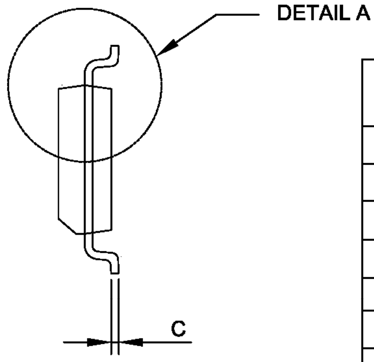


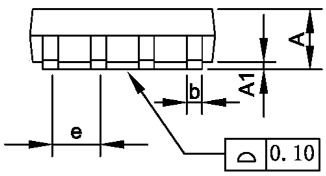
Figure 47 Classification Profile

PACKAGE INFORMATION

SOP-8-EP

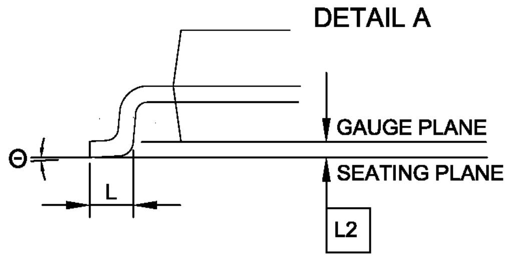






SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	–	–	1.70
A1	–	–	0.15
E1	3.70	3.90	4.10
E	5.80	6.00	6.20
D	4.70	4.90	5.10
b	0.31	–	0.51
e	1.27BSC		
L	0.40	–	1.27
L2	0.25BSC		
θ	0°	–	8°
C	0.10	–	0.25
D2	1.50	–	–
E2	1.00	–	–

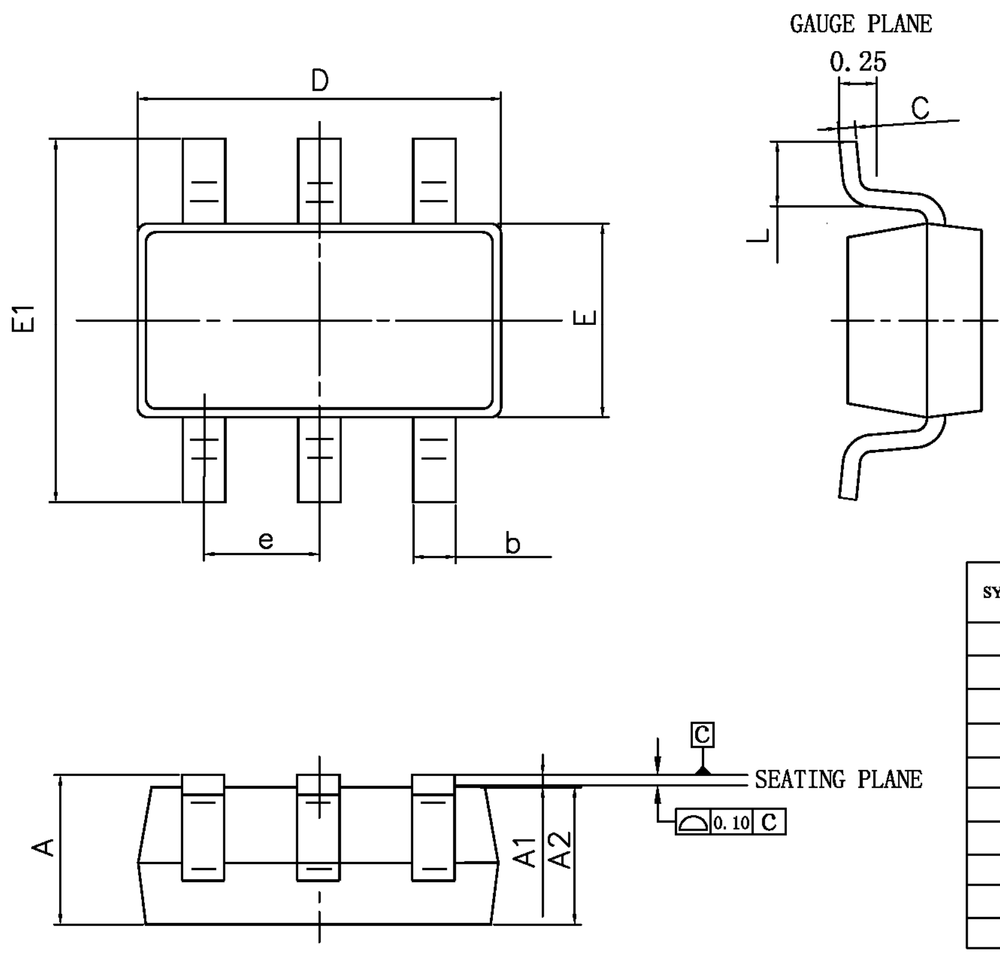
233-570-289 Rev. B



NOTE :

1. CONTROLLING DIMENSION : MM
2. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION.
4. REFERENCE DOCUMENT: JEDEC MS-012
5. THE SHAPE OF BODY AND THERMAL PAD SHOW DIFFERENT SHAPE AMONG DIFFERENT FACTORIES.

SOT-23-6

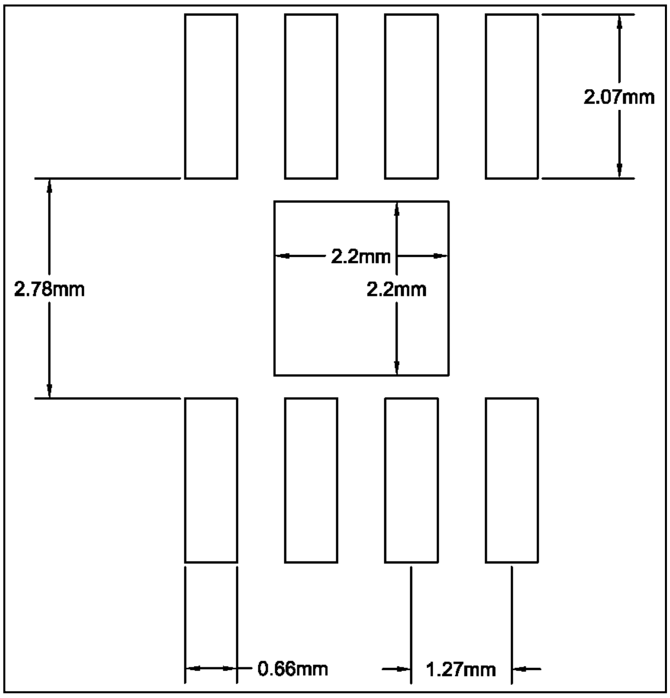


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1. 35
A1	0.00	0.05	0. 10
A2	1. 00	1.10	1. 20
D	2. 72	2.92	3. 12
E1	2. 60	2. 80	3. 00
E	1. 40	1. 60	1. 80
e	0. 95BSC		
c	0. 10	—	0. 20
L	0. 30	0. 40	0. 60
b	0. 30	0. 40	0. 50

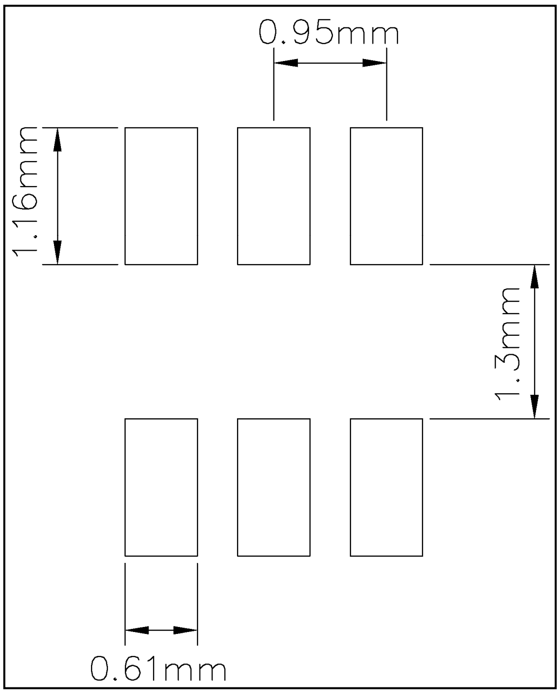
233-570-255 **Rev. A**

RECOMMENDED LAND PATTERN

SOP-8-EP



SOT-23-6



Note:

1. Land pattern complies to IPC-7851.
2. All dimensions in MM.
3. This document (including dimensions, notes & specs) is a recommendation based on typical circuit board manufacturing parameters. Since land pattern design depends on many factors unknown (eg. User's board manufacturing specs), user must determine suitability for use.

REVISION HISTORY

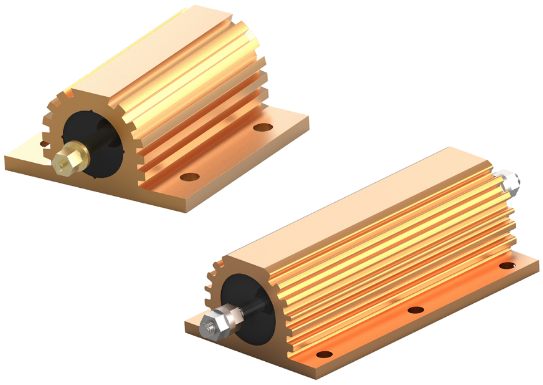
Revision	Detail Information	Date
0A	Initial release	2018.08.06
0B	1. Update FEATURES information 2. Update SOP-8-EP POD 3. Update V_{EN} value	2018.11.20
A	1. Add note 4 for Figure 1 2. Update EC table	2019.04.03
B	Revise I_{OUT_LIMIT} typical value to 295mA	2020.09.25
C	1. Update to new Lumissil logo 2. Add RoHS and update AECQ information 3. EC condition "T_J = T_A = " changes to "T_J= "	2024.06.06

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

HSC – 100 Watts to 300 Watts

	HSC100	HSC150	HSC200	HSC250	HSC300
Dissipation @ 25°C with heatsink (Watts):	100	150	200	250	300
Without heatsink:	50	55	50	60	75
Ohmic value minimum (Ohms):	R05	R10	R10	R10	R10
Maximum (Ohms):	100K	100K	50K	68K	82K
Operating temperature	-55-200°C				
Maximum working voltage (DC or AC rms) Volts:	1900	2500	1900	2200	2500
Isolation voltage (DC or AC pk) Volts:	3500	3500	3600	3600	3600
Dielectric strength (AC Peak) Volts:	5000	5000	5600	5600	5600
Stability (resistance change, 1000 hours) (%):	2	2	3	3	3
Standard heatsink – area (mm^2):	99500	99500	375000	476500	578000
Thickness (mm):	3	3	3	3	3
Number of mounting holes:	4 hole	4 hole	6 hole	6 hole	6 hole

HSHC – 350 Watts to 500 Watts

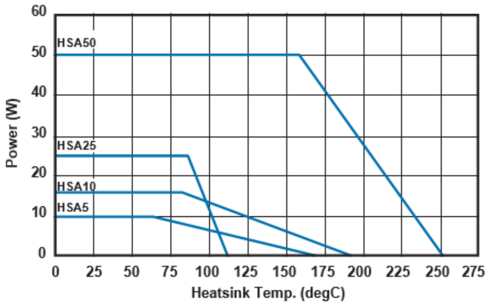
	HSHC350	HSHC400	HSHC450	HSHC500
Dissipation @ 25°C with heatsink (Watts):	350	400	450	500
Without heatsink (Watts):	85	100	110	125
Ohmic value minimum (Ohms):	1R0	1R0	1R0	1R0
Maximum (Ohms):	100K	100K	100K	100K
Operating temperature	-55-200°C			
Maximum working voltage (DC or AC rms) Volts:	2500	2500	2500	2500
Isolation voltage (DC or AC pk) Volts:	3600	3600	3600	3600
Dielectric strength (AC Peak) Volts:	5000	5000	5000	5000
Stability (resistance change, 1000 hours) (%):	3	3	3	3
Standard heatsink – area (mm^2):	578000	578000	578000	578000
Thickness (mm):	3	3	3	3
Number of mounting holes:	6 hole	6 hole	6 hole	6 hole

Long term stability	For improvements in long-term stability, resistors must be derated as follows: for 50% of stated ΔR maximum dissipation must not exceed 70% of rating: for 25% of stated ΔR maximum, dissipation must not exceed 50% of rating.
Insulation resistance	Dry: 10,000MΩ minimum. After moisture test: 1000MΩ minimum
Heat dissipation	Although the use of proprietary heat sinks with lower thermal resistance is acceptable, up rating is not recommended. The use of proprietary heat sink compound to improve thermal conductivity is recommended for optimum performance of all sizes but essential for higher power ratings (200W and higher)
Resistance tolerance	±5% Standard. Other options on request.
Specification	Temperature coefficient of resistance: ≤100R, ±50ppm/°C; >100R, ±25ppm/°C Tolerance, 5% standard: 10%, 3%, 2%, 0.5% & 0.25% available Tolerance for values below R10, 10% standard
Shelf life	24 Months when stored in original packaging away from chemical pollution

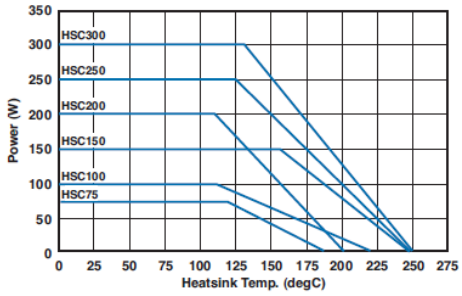
DERATING CURVE

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.

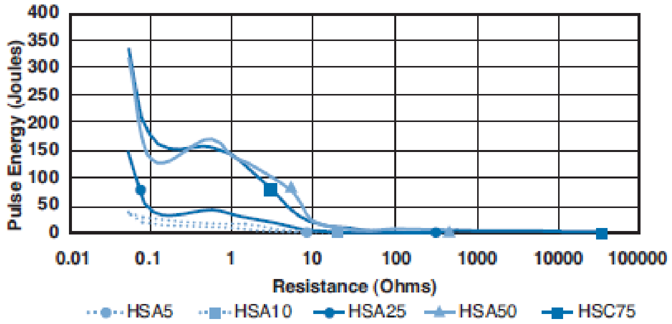
HSA5 - 50



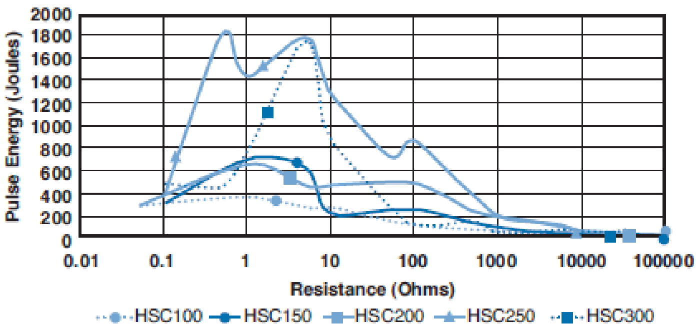
HSC75 - 300



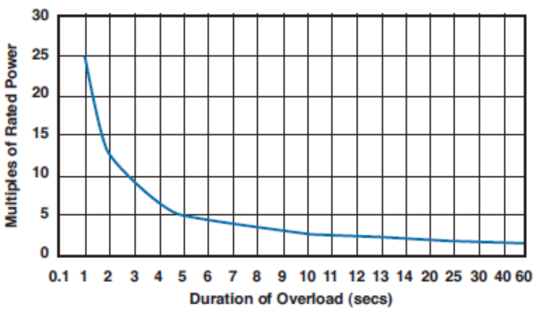
Pulse Energy HSA5 to HSC75 (pulse length 200ms)



Pulse Energy HSC100 to HSC300 (pulse length 200ms)

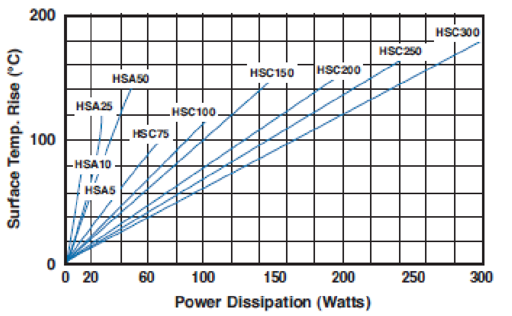


Power Overload



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

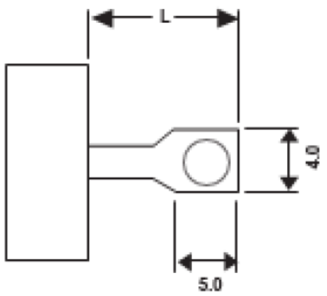
Surface Temperature Rise



For resistor mounted on standard heatsink, related to power dissipation

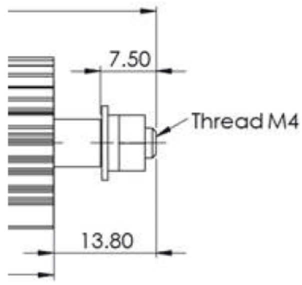
PRODUCT SPECIFICATIONS (Unit:mm)

HSA5 – HSC150 Standard

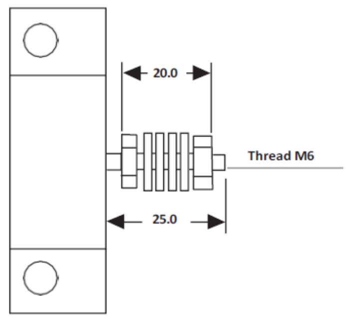


Standard Type	L
HSA5, 10	7
HSA25, 50	10
HSC75, 100, 150	8

HSC75S – HSC150S

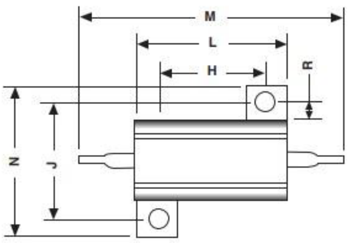


HSC200 – HSC300 & HSHC350 – HSHC500



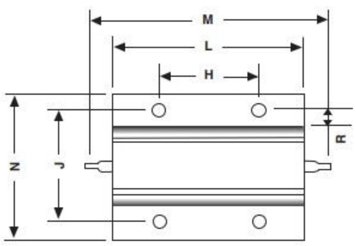
DIMENSIONS (Unit:mm)

HSA5 – HSA50



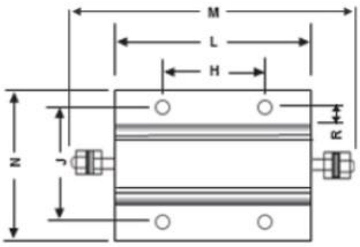
HSA5 – HSA10 : Mounting Hole 2 x 2.4mm
HSA25 – HSA50 : Mounting Hole 2 x 3.3mm

HSC75 – HSC150



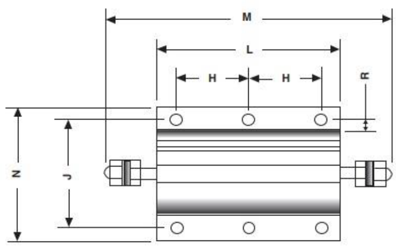
HSC75 – HSC150 : Mounting Hole 4 x 4.4mm

HSC75S – HSC150S



HSC75 – HSC150 : Mounting Hole 4 x 4.4mm

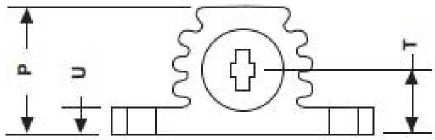
HSC300 – HSC300, HSHC350 – HSHC500



HSC200 – HSC250 : Mounting Hole 2 x 2.4mm
HSC300, HSHC350 - HSHC500 : Mounting Hole 2 x 3.3mm

DIMENSIONS (continued)

End Elevation (all models)



Type	H ±0.3	J ±0.3	L maximum	M maximum	N maximum	P maximum	R minimum	T±0.5	U maximum
HSA5	11.3	12.4	17.0	30.0	17.0	9.0	1.9	4.3	2.5
HSA10	14.3	15.9	21.0	36.5	21.0	11.0	1.9	5.2	3.2
HSA25	18.3	19.8	29.0	51.0	28.0	15.0	2.8	7.2	3.2
HSA50	39.7	21.4	51.0	72.5	30.0	17.0	2.8	8.2	3.2
HSC75	29.0	37.0	49.0	71.0	48.0	24.0	5.0	11.5	3.5
HSC100	35.0	37.0	66.0	87.5	48.0	24.0	5.0	11.5	3.5
HSC150	58.0	37.0	98.0	122.0	48.0	24.0	5.0	11.5	3.5
HSC200	35.0	57.2	90.0	143.0	73.0	42.0	5.6	20.25	5.3
HSC250	44.5	57.2	109.0	163.0	73.0	42.0	5.6	20.25	5.3
HSC300	52.0	59.0	128.0	180.0	73.0	42.0	5.6	20.25	5.3
HSC75S	29.0	37.0	49.0	78.0	48.0	24.0	5.0	11.5	3.5
HSC100S	35.0	37.0	66.0	94.0	48.0	24.0	5.0	11.5	3.5
HSC150S	58.0	37.0	98.0	127.0	48.0	24.0	5.0	11.5	3.5
HSHC350	61.50	59.0	147	196.0	73	42.0	5.6	20.25	5.3
HSHC400	71.0	59.0	166	215.0	73	42.0	5.6	20.25	5.3
HSHC450	80.5	59.0	185	234.0	73	42.0	5.6	20.25	5.3
HSHC500	90.0	59.0	204	253.0	73	42.0	5.6	20.25	5.3

ORDERING INFORMATION

Part Number

HS A 50 680R J

Common part

HS	Standard
HSH	High power
NHS	Low inductance

Mounting style

A	Single opposing mounting feet
B	Flange one side
C	Flange two sides

Power rating

10 Watt	HSA5
16 Watt	HSA10
25 Watt	HSA25
50 Watt	HSA50
75 Watt	HSA75, etc,

Tolerance

F	1%
G	2%
E	3%
J	5%
K	10%

Resistance Value

R10	0.1 ohm (1000 mille ohms)
1R0	1 ohm (1000 mille ohms)
1K0	1K (1000 ohms)

Terminal

	Standard
S	Screw

te.com

1773035 Rev. E 04/24 ED

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 inclede GT8E-2S-2C)	X	–
	Mated and unmated 30 times. (Between EM30MSD-A Receptacle and GT8E-2S-2C)	Contact resistance : 150 mΩ MAX (Signal contact inclede 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	–

	COUNT	DESCRIPTION OF REVISIONS	DESIGNED	CHECKED	DATE
△					

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.

Unless otherwise specified, refer to IEC 60512 (JIS C 5402).

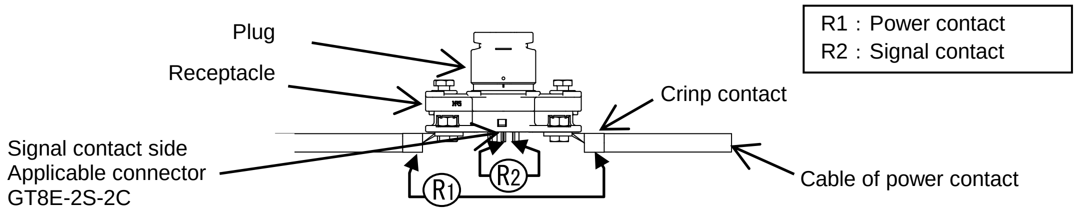
APPROVED	TP. KOMATSU	20220808
CHECKED	HY. KOBAYASHI	20220808
DESIGNED	TY. SUZUKI	20220805
DRAWN	TY. SUZUKI	20220805

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

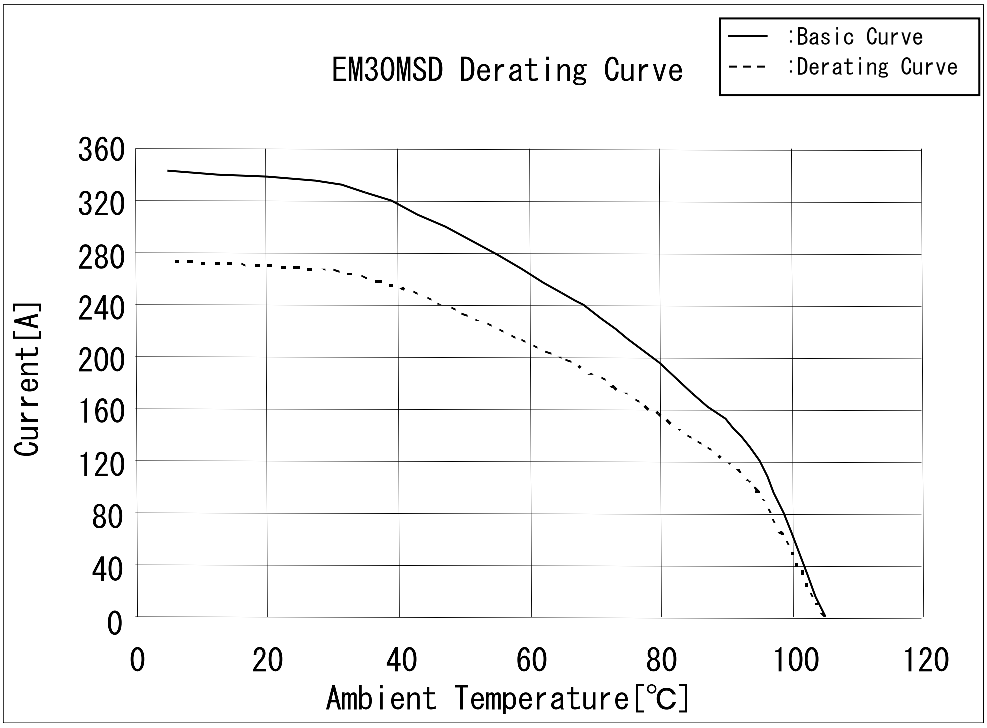
		DRAWING NO.	ELC-119542-04-00	
HRS	SPECIFICATION SHEET	PART NO.	EM30MSD-A(04)	
	HIROSE ELECTRIC CO., LTD.	CODE NO.	CL0138-0206-0-04	△ 1/2

FORM HD0011-2-1

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.

Note QT:Qualification Test AT:Assurance Test X:Applicable Test		DRAWING NO.	ELC-119542-04-00	
HRS	SPECIFICATION SHEET	PART NO.	EM30MSD-A(04)	
	HIROSE ELECTRIC CO., LTD.	CODE NO.	CL0138-0206-0-04	△0 2/2

Reference

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