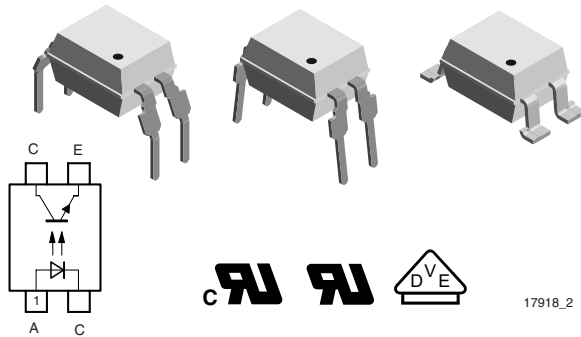


## Optocoupler, Phototransistor Output, High Temperature, 110 °C, Rated



### DESCRIPTION

The VO615A consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4-pin plastic dual in line package.

The elements are mounted on one leadframe, providing a fixed distance between input and output for highest safety requirements.

### APPLICATIONS

Circuits for safe protective separation against electrical shock according to safety class II (reinforced isolation):

- for appl. class I - IV at mains voltage  $\leq 300$  V
- for appl. class I - IV at mains voltage  $\leq 600$  V according to table 1 of IEC 60664-1, suitable for:
  - Switch-mode power supplies
  - Line receiver
  - Computer peripheral interface
  - Microprocessor system interface

### FEATURES

- CTR offered in 9 groups
- Isolation materials according to UL94-VO
- Pollution degree 2 (DIN/VDE 0110/resp. IEC 60664)
- Climatic classification 40/110/21 (IEC 60068 part 1)
- Temperature range - 40 °C to + 110 °C
- Rated impulse voltage (transient overvoltage)  $V_{IOTM} = 8 \text{ kV}_{\text{peak}}$
- Isolation test voltage (partial discharge test voltage)  $V_{\text{pd}} = 1.6 \text{ kV}$
- Rated isolation voltage (RMS includes DC)  $V_{IOWM} = 600 V_{\text{RMS}}$
- Rated recurring peak voltage (repetitive)  $V_{IORM} = 850 V_{\text{peak}}$
- Creepage current resistance according to VDE 0303/IEC 60112 comparative tracking index:  $\text{CTI} \geq 175$
- Thickness through insulation  $\geq 0.75 \text{ mm}$
- External creepage distance  $> 8 \text{ mm}$


**RoHS**  
COMPLIANT

### AGENCY APPROVALS

- BSI: EN 60065:2002, EN 60950:2000 certificate 8967/8968
- DIN EN 60747-5-2 (VDE 0884) pending  
DIN EN 60747-5-5 pending
- FIMKO pending

### ORDER INFORMATION

PART	REMARKS
VO615A	CTR 50 to 600 %, DIP-4
VO615A-1	CTR 40 to 80 %, DIP-4
VO615A-2	CTR 63 to 125 %, DIP-4
VO615A-3	CTR 100 to 200 %, DIP-4
VO615A-4	CTR 160 to 320 %, DIP-4
VO615A-5	CTR 50 to 150 %, DIP-4
VO615A-6	CTR 100 to 300 %, DIP-4
VO615A-7	CTR 80 to 160 %, DIP-4
VO615A-8	CTR 130 to 260 %, DIP-4
VO615A-9	CTR 200 to 400 %, DIP-4
VO615A-X006	CTR 50 to 600 %, DIP-4, 400 mil (option 6)
VO615A-1X006	CTR 40 to 80 %, DIP-4, 400 mil (option 6)
VO615A-2X006	CTR 63 to 125 %, DIP-4, 400 mil (option 6)
VO615A-3X006	CTR 100 to 200 %, DIP-4, 400 mil (option 6)
VO615A-4X006	CTR 160 to 320 %, DIP-4, 400 mil (option 6)
VO615A-5X006	CTR 50 to 150 %, DIP-4, 400 mil (option 6)

ORDER INFORMATION	
PART	REMARKS
VO615A-6X006	CTR 100 to 300 %, DIP-4, 400 mil (option 6)
VO615A-7X006	CTR 80 to 160 %, DIP-4, 400 mil (option 6)
VO615A-8X006	CTR 130 to 260 %, DIP-4, 400 mil (option 6)
VO615A-9X006	CTR 200 to 400 %, DIP-4, 400 mil (option 6)
VO615A-X007	CTR 50 to 600 %, SMD-4 (option 7)
VO615A-1X007	CTR 40 to 80 %, SMD-4 (option 7)
VO615A-2X007	CTR 63 to 125 %, SMD-4 (option 7)
VO615A-3X007	CTR 100 to 200 %, SMD-4 (option 7)
VO615A-4X007	CTR 160 to 320 %, SMD-4 (option 7)
VO615A-5X007	CTR 50 to 150 %, SMD-4 (option 7)
VO615A-6X007	CTR 100 to 300 %, SMD-4 (option 7)
VO615A-7X007	CTR 80 to 160 %, SMD-4 (option 7)
VO615A-8X007	CTR 130 to 260 %, SMD-4 (option 7)
VO615A-9X007	CTR 200 to 400 %, SMD-4 (option 7)
VO615A-X009	CTR 50 to 600 %, SMD-4 (option 9)
VO615A-1X009	CTR 40 to 80 %, SMD-4 (option 9)
VO615A-2X009	CTR 63 to 125 %, SMD-4 (option 9)
VO615A-3X009	CTR 100 to 200 %, SMD-4 (option 9)
VO615A-4X009	CTR 160 to 320 %, SMD-4 (option 9)

**Note**

For additional information on the possible lead bend and VDE options refer to option information.

ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		$V_R$	6	V
Forward current		$I_F$	60	mA
Forward surge current	$t_p \leq 10 \mu\text{s}$	$I_{FSM}$	1.5	A
LED power dissipation	at 25 °C	$P_{diss}$	100	mW
<b>OUTPUT</b>				
Collector emitter voltage		$V_{CEO}$	70	V
Emitter collector voltage		$V_{ECO}$	7	V
Collector current		$I_C$	50	mA
Collector peak current	$t_p/T = 0.5, t_p \leq 10 \text{ ms}$	$I_{CM}$	100	mA
Output power dissipation	at 25 °C	$P_{diss}$	150	mW
<b>COUPLER</b>				
Isolation test voltage (RMS)	$t = 1 \text{ min}$	$V_{ISO}$	5000	$V_{RMS}$
Operating ambient temperature range		$T_{amb}$	- 40 to + 110	°C
Storage temperature range		$T_{stg}$	- 40 to + 125	°C
Soldering temperature <sup>(2)</sup>	2 mm from case, $\leq 10 \text{ s}$	$T_{sld}$	260	°C

**Notes**

<sup>(1)</sup>  $T_{amb} = 25 \text{ °C}$ , unless otherwise specified.

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

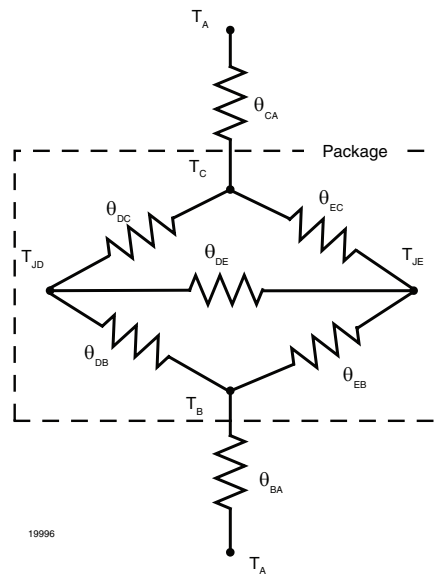
<sup>(2)</sup> Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

<b>THERMAL CHARACTERISTICS (1)</b>				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Maximum LED junction temperature		$T_{jmax}$	125	°C
Maximum output die junction temperature		$T_{jmax}$	125	°C
Thermal resistance, junction emitter to board		$\theta_{EB}$	173	°C/W
Thermal resistance, junction emitter to case		$\theta_{EC}$	149	°C/W
Thermal resistance, junction detector to board		$\theta_{DB}$	111	°C/W
Thermal resistance, junction detector to case		$\theta_{DC}$	127	°C/W
Thermal resistance, junction emitter to junction detector		$\theta_{ED}$	173	°C/W
Thermal resistance, board to ambient (2)		$\theta_{BA}$	197	°C/W
Thermal resistance, case to ambient (2)		$\theta_{CA}$	4041	°C/W

**Notes**

(1) The thermal model is represented in the thermal network below. Each resistance value given in this model can be used to calculate the temperatures at each node for a given operating condition. The thermal resistance from board to ambient will be dependent on the type of PCB, layout and thickness of copper traces. For a detailed explanation of the thermal model, please reference Vishay's Thermal Characteristics of Optocouplers Application note.

(2) For 2 layer FR4 board (4" x 3" x 0.062).



ELECTRICAL CHARACTERISTICS (1)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>						
Forward voltage	$I_F = \pm 50 \text{ mA}$	$V_F$		1.25	1.6	V
Junction capacitance	$V_R = 0, f = 1 \text{ MHz}$	$C_j$		50		pF
<b>OUTPUT</b>						
Collector emitter voltage	$I_C = 1 \text{ mA}$	$V_{CE0}$	70			V
Emitter collector voltage	$I_E = 100 \mu\text{A}$	$V_{ECO}$	7			V
Collector emitter cut-off current	$V_{CE} = 20 \text{ V}, I_f = 0, E = 0$	$I_{CEO}$		10	100	nA
<b>COUPLER</b>						
Collector emitter saturation voltage	$I_F = 10 \text{ mA}, I_C = 1 \text{ mA}$	$V_{CEsat}$			0.3	V
Cut-off frequency	$V_{CE} = 5 \text{ V}, I_F = 10 \text{ mA}, R_L = 100 \Omega$	$f_c$		110		kHz
Coupling capacitance	$f = 1 \text{ MHz}$	$C_k$		0.3		pF

**Note**

$T_{amb} = 25 \text{ }^\circ\text{C}$ , unless otherwise specified.

Minimum and maximum values are testing requirements. Typical values are characteristics of the device and are the result of engineering evaluation. Typical values are for information only and are not part of the testing requirements.

CURRENT TRANSFER RATIO							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
$I_C/I_F$	$V_{CE} = 5 \text{ V}, I_F = 1 \text{ mA}$	VO615A-1	CTR	13	30		%
		VO615A-2	CTR	22	45		%
		VO615A-3	CTR	34	70		%
		VO615A-4	CTR	56	90		%
	$V_{CE} = 5 \text{ V}, I_F = 5 \text{ mA}$	VO615A	CTR	50		600	%
		VO615A-5	CTR	50		150	%
		VO615A-6	CTR	100		300	%
		VO615A-7	CTR	80		160	%
		VO615A-8	CTR	130		260	%
		VO615A-9	CTR	200		400	%
	$V_{CE} = 5 \text{ V}, I_F = 10 \text{ mA}$	VO615A-1	CTR	40		80	%
		VO615A-2	CTR	63		125	%
		VO615A-3	CTR	100		200	%
		VO615A-4	CTR	160		320	%



Optocoupler, Phototransistor Output, Vishay Semiconductors  
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MAXIMUM SAFETY RATINGS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>						
Forward current		$I_F$			130	mA
<b>OUTPUT</b>						
Power dissipation		$P_{diss}$			265	mW
<b>COUPLER</b>						
Safety temperature		$T_{si}$			150	°C

**Note**

According to DIN EN 60747-5-2 (VDE 0884)/DIN EN 60747-5-5 pending (see figure 1). This optocoupler is suitable for safe electrical isolation only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.

INSULATION RATED PARAMETERS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Partial discharge test voltage - routine test	100 %, $t_{test} = 1$ s	$V_{pd}$	1.6			kV
Partial discharge test voltage - lot test (sample test)	$t_{Tr} = 60$ s, $t_{test} = 10$ s, (see figure 2)	$V_{pd}$	1.3			kV
Insulation resistance	$V_{IO} = 500$ V	$R_{IO}$	$10^{12}$			$\Omega$
	$V_{IO} = 500$ V, $T_{amb} = 100$ °C	$R_{IO}$	$10^{11}$			$\Omega$
	$V_{IO} = 500$ V, $T_{amb} = 150$ °C (construction test only)	$R_{IO}$	$10^9$			$\Omega$
Rated impulse voltage		$V_{IOTM}$			8	kV
Max. working voltages	Recurring peak voltage	$V_{IORM}$	850			$V_{peak}$

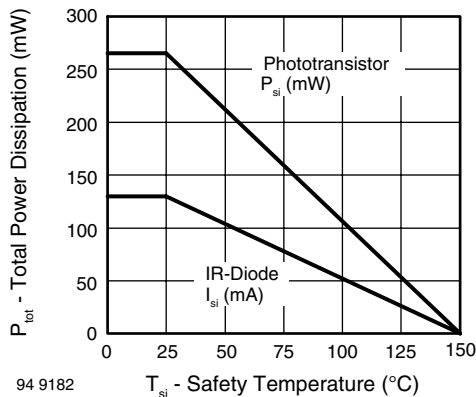


Fig. 1 - Derating Diagram

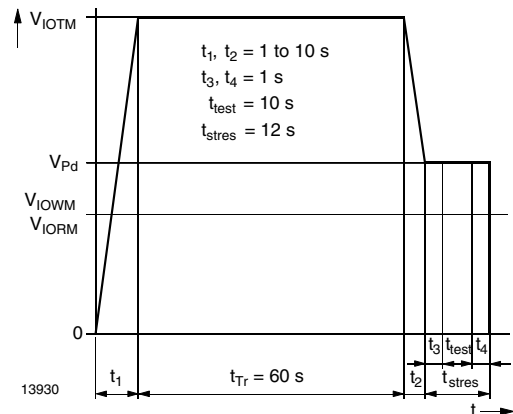
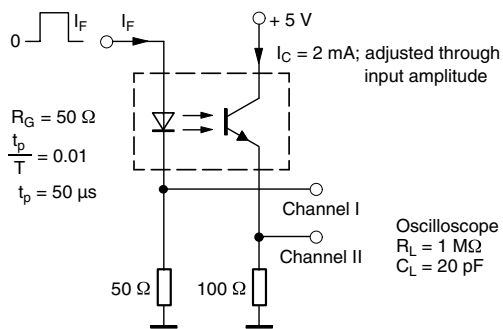


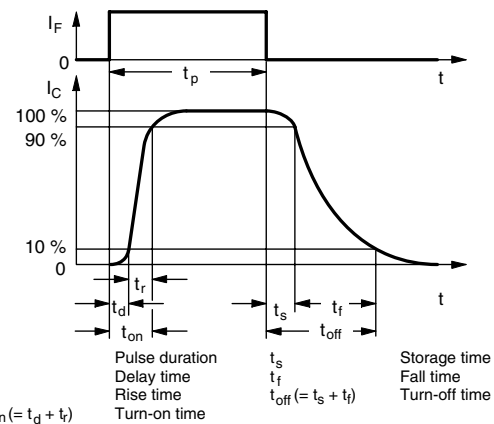
Fig. 2 - Test Pulse Diagram for Sample Test According to DIN EN 60747-5-2 (VDE 0884)/DIN EN 60747-; IEC 60747

SWITCHING CHARACTERISTICS						
PARAMETER	TEST CONDITION	SYMBOL	MIN	TYP.	MAX	UNIT
Delay time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)	$t_d$		3.0		$\mu\text{s}$
Rise time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)	$t_r$		3.0		$\mu\text{s}$
Fall time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)	$t_f$		4.7		$\mu\text{s}$
Storage time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)	$t_s$		0.3		$\mu\text{s}$
Turn-on time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)	$t_{on}$		6.0		$\mu\text{s}$
Turn-off time	$V_S = 5\text{ V}$ , $I_C = 2\text{ mA}$ , $R_L = 100\ \Omega$ , (see figure 3)	$t_{off}$		5.0		$\mu\text{s}$
Turn-on time	$V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ , (see figure 4)	$t_{on}$		9.0		$\mu\text{s}$
Turn-off time	$V_S = 5\text{ V}$ , $I_F = 10\text{ mA}$ , $R_L = 1\text{ k}\Omega$ , (see figure 4)	$t_{off}$		10.0		$\mu\text{s}$



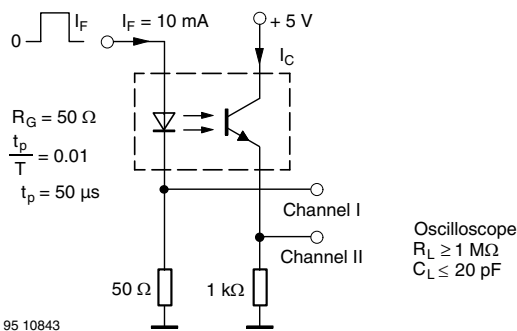
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Fig. 3 - Test Circuit, Non-Saturated Operation



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Fig. 5 - Switching Times



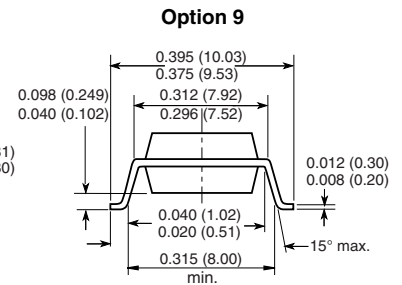
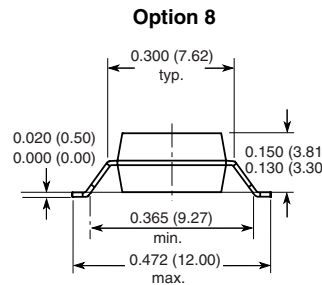
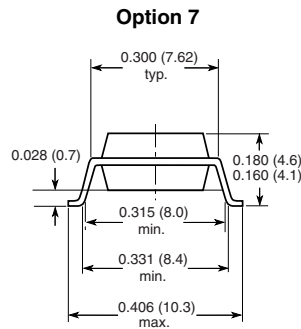
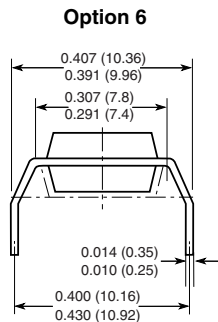
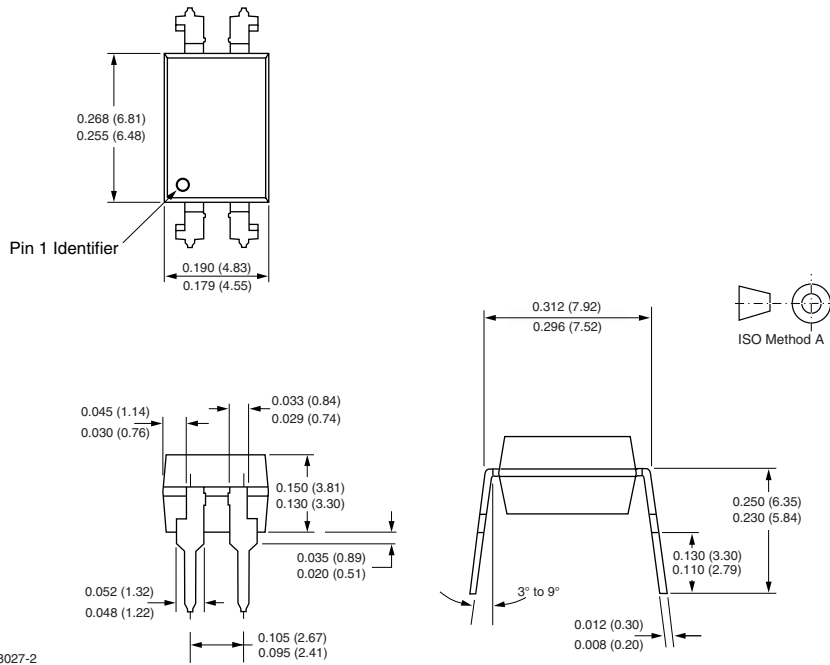
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Fig. 4 - Test Circuit, Saturated Operation

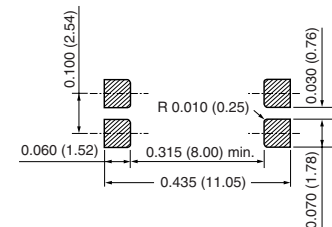
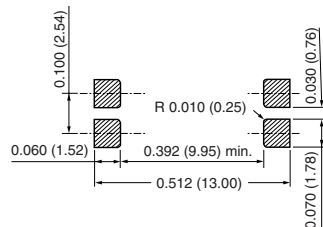
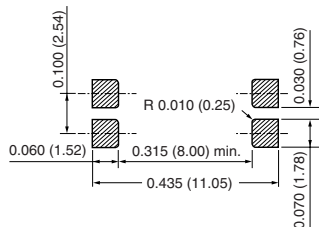


Optocoupler, Phototransistor Output, Vishay Semiconductors  
High Temperature, 110 °C, Rated

PACKAGE DIMENSIONS in millimeters



20802





## **OZONE DEPLETING SUBSTANCES POLICY STATEMENT**

It is the policy of Vishay Semiconductor GmbH to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

Vishay Semiconductor GmbH has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively.
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA.
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

Vishay Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

We reserve the right to make changes to improve technical design  
and may do so without further notice.

Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use Vishay Semiconductors products for any unintended or unauthorized application, the buyer shall indemnify Vishay Semiconductors against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

Vishay Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany





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