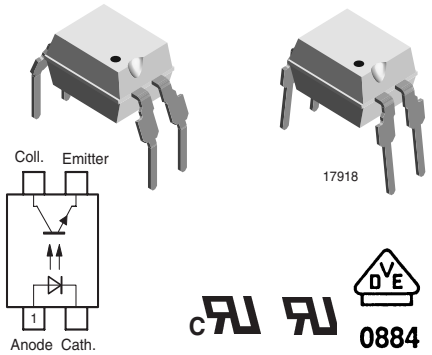
Optocoupler with Phototransistor Output

Features

- CTR offered in 9 Groups
- Isolation materials according to UL94-VO
- Pollution degree 2
  (DIN/VDE 0110 / resp. IEC 664)
- Climatic classification 55/100/21 (IEC 68 part 1)
- Special construction:
  Therefore, extra low coupling capacity of typical 0.2 pF, high **C**ommon **M**ode **R**ejection
- Low temperature coefficient of CTR
- Temperature range - 40 to + 110 °C



- Coupling System U
- Rated impulse voltage (transient overvoltage)
  V_{IOTM} = 8 kV_{peak}
- Isolation test voltage (partial discharge test voltage) V_{pd} = 1.6 kV
- Rated isolation voltage (RMS includes DC)
  V_{IOWM} = 600 V_{RMS} (848 V_{peak})
- Rated recurring peak voltage (repetitive)
  V_{IORM} = 600 V_{RMS}
- Creepage current resistance according to VDE 0303/IEC 112 **C**omparative **T**racking **I**ndex:
  CTI ≥ 175
- Thickness through insulation ≥ 0.75 mm
- Internal creepage distance > 4 mm
- External creepage distance > 8 mm

Agency Approvals

- BSI: EN 60065:2002, EN 60950:2000
Certificate number 7081 and 7402
- FIMKO (SETI): EN 60950:2000
Certificate number FI 18973
- Underwriters Laboratory (UL)
File number E 76222
- VDE IEC 60747
Certificate number 115667

Applications

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

• For appl. class I - IV at mains voltage ≤ 300 V

• For appl. class I - III at mains voltage ≤ 600 V according to VDE 0884, table 2, suitable for:

Switch-mode power supplies, line receiver, computer peripheral interface, microprocessor system interface, with operating temperature up to 110°C

Description

The TCET111.(G) consists of a phototransistor optically coupled to a gallium arsenide infrared-emitting diode in a 4-lead plastic dual inline package.

The elements are mounted on one lead frame using a **coplanar technique**, providing a fixed distance between input and output for highest safety requirements.

VDE Standards

These couplers perform safety functions according to the following equipment standards:

VDE 0884 / IEC 60747:2003

Optocoupler for electrical safety requirements

IEC 60950

Office machines (applied for reinforced isolation for mains voltage < 400 V_{RMS})

VDE 0804

Telecommunication apparatus and data processing

IEC 60065

Safety for mains-operated electronic and related household apparatus

Order Information

Part	Remarks
TCET1110 (G)	50 to 600 %
TCET1111 (G)	40 to 80 %
TCET1112 (G)	63 to 125 %
TCET1113 (G)	100 to 200 %
TCET1114 (G)	160 to 320 %
TCET1115 (G)	50 to 150 %
TCET1116 (G)	100 to 300 %
TCET1117 (G)	80 to 160 %
TCET1118 (G)	130 to 260 %
TCET1119 (G)	200 to 400 %

G = Lead form 10.16 mm; G is not marked on the body,

4 Pin = Single Channel

Absolute Maximum Ratings

T_{amb} = 25 °C, unless otherwise specified

Stresses in excess of the absolute Maximum Ratings can cause permanent damage to the devise. 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 Rating for extended periods of the time can adversely affect reliability.

Emitter

Parameter	Test condition	Symbol	Value	Unit
Reverse voltage		V_R	6	V
Forward current		I_F	60	mA
Forward surge current	$t_p \leq 10$ µs	I_{FSM}	1.5	A
Power dissipation		P_{Diss}	100	mW
Junction temperature		T_j	125	°C

Detector

Parameter	Test condition		Symbol	Value	Unit
Collector emitter voltage			V_{CEO}	70	V
Emitter collector voltage			V_{ECO}	7	V
Collector current			I_C	50	mA
Collector peak current	$t_p/T = 0.5$, $t_p \leq 10$ ms		I_{CM}	100	mA
Power dissipation			P_{Diss}	150	mW
Junction temperature			T_j	125	°C

Coupler

Parameter	Test condition		Symbol	Value	Unit
Isolation test voltage (RMS)	t = 1 min		V_{IO}	5	kV
Total power dissipation			P_{tot}	250	mW
Operating ambient temperature range			T_{amb}	- 40 to + 110	°C
Storage temperature range			T_{stg}	- 55 to + 125	°C
Soldering temperature	2 mm from case t ≤ 10 s		T_{sd}	260	°C

Electrical Characteristics

T_{amb} = 25 °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.

Emitter

Parameter	Test condition		Symbol		Typ.	Max	Unit
Forward voltage	I_F = ± 50 mA		V_F		1.25	1.6	V
Junction capacitance	V_R = 0 V, f = 1 MHz		C_j		50		pF

Detector

Parameter	Test condition		Symbol	Min	Typ.	Max	Unit
Collector emitter voltage	I_C = 1 mA		V_{CEO}	70			V
Emitter collector voltage	I_E = 100 µA		V_{ECO}	7			V
Collector emitter cut-off current	V_{CE} = 20 V, I_f = 0, E = 0		I_{CEO}		10	100	nA

Coupler

Parameter	Test condition		Symbol		Typ.	Max	Unit
Collector emitter saturation voltage	I_F = 10 mA, I_C = 1 mA		V_{CEsat}			0.3	V
Cut-off frequency	V_{CE} = 5 V, I_F = 10 mA, R_L = 100 Ω		f_c		110		kHz
Coupling capacitance	f = 1 MHz		C_k		0.3		pF

Current Transfer Ratio

Parameter	Test condition	Part	Symbol	Min	Typ.	Max	Unit
I_C/I_F	V_{CE} = 5 V, I_F = 1 mA	TCET1111 (G)	CTR	0.13	0.30		%
	V_{CE} = 5 V, I_F = 1 mA	TCET1112 (G)	CTR	0.22	0.45		%
	V_{CE} = 5 V, I_F = 1 mA	TCET1113 (G)	CTR	0.34	0.70		%
	V_{CE} = 5 V, I_F = 1 mA	TCET1114 (G)	CTR	0.56	0.90		%
	V_{CE} = 5 V, I_F = 5 mA	TCET1110 (G)	CTR	0.50		6.0	%
	V_{CE} = 5 V, I_F = 5 mA	TCET1115 (G)	CTR	0.5		1.5	%
	V_{CE} = 5 V, I_F = 5 mA	TCET1116 (G)	CTR	1.0		3.0	%
	V_{CE} = 5 V, I_F = 5 mA	TCET1117 (G)	CTR	0.8		1.6	%
	V_{CE} = 5 V, I_F = 5 mA	TCET1118 (G)	CTR	1.3		2.6	%
	V_{CE} = 5 V, I_F = 5 mA	TCET1119 (G)	CTR	2.0		4.0	%
	V_{CE} = 5 V, I_F = 10 mA	TCET1111 (G)	CTR	0.40		0.8	%
	V_{CE} = 5 V, I_F = 10 mA	TCET1112 (G)	CTR	0.63		1.25	%
	V_{CE} = 5 V, I_F = 10 mA	TCET1113 (G)	CTR	1.0		2.0	%
	V_{CE} = 5 V, I_F = 10 mA	TCET1114 (G)	CTR	1.6		3.2	%

Maximum Safety Ratings

(according to VDE 0884) 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.

Emitter

Parameter		Symbol			Max	Unit
Forward current		I_F			130	mA

Detector

Parameter		Symbol			Max	Unit
Power dissipation		P_{Diss}			265	mW

Coupler

Parameter		Symbol			Max	Unit
Rated impulse voltage		V_{IOTM}			8	kV
Safety temperature		T_{si}			150	°C

Insulation Rated Parameters

Parameter	Test condition	Symbol	Min			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), (see figure 2)	t_{Tr} = 60 s, t_{test} = 10 s	V_{IOTM}	8			kV
	t_{Tr} = 60 s, t_{test} = 10 s	V_{pd}	1.3			kV
Insulation resistance	V_{IO} = 500 V	R_{IO}	10^{12}			Ω
	V_{IO} = 500 V, T_{amb} = 100 °C	R_{IO}	10^{11}			Ω
	V_{IO} = 500 V, T_{amb} = 150 °C (construction test only)	R_{IO}	10^{9}			Ω

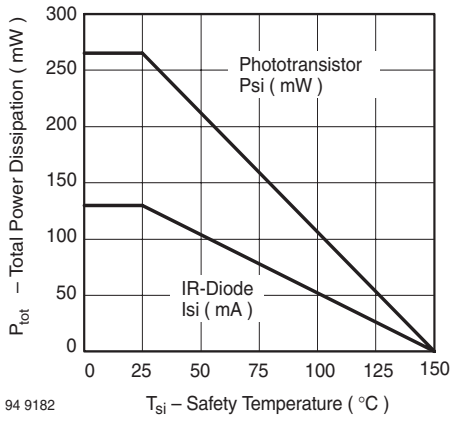


Figure 1. Derating diagram

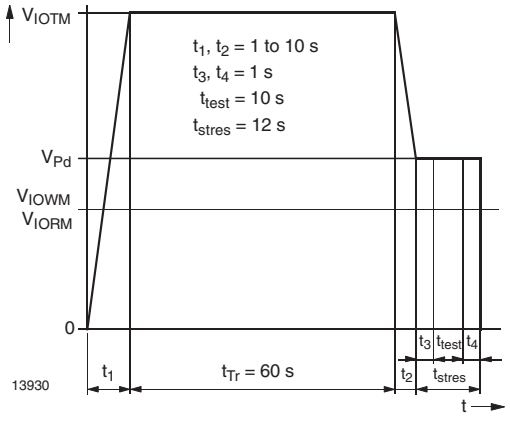


Figure 2. Test pulse diagram for sample test according to DIN VDE 0884; IEC60747

Switching Characteristics

Parameter	Test condition		Symbol		Typ.		Unit
Delay time (see figure 3)	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω		t_d		3.0		µs
Rise time (see figure 3)	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω		t_r		3.0		µs
Turn-on time (see figure 3)	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω		t_{on}		6.0		µs
Storage time (see figure 3)	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω		t_s		0.3		µs
Fall time (see figure 3)	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω		t_f		4.7		µs
Turn-off time (see figure 3)	V_S = 5 V, I_C = 2 mA, R_L = 100 Ω		t_{off}		5.0		µs
Turn-on time see figure 4)	V_S = 5 V, I_F = 10 mA, R_L = 1 kΩ		t_{on}		9.0		µs
Turn-off time see figure 4)	V_S = 5 V, I_F = 10 mA, R_L = 1 kΩ		t_{off}		10.0		µs

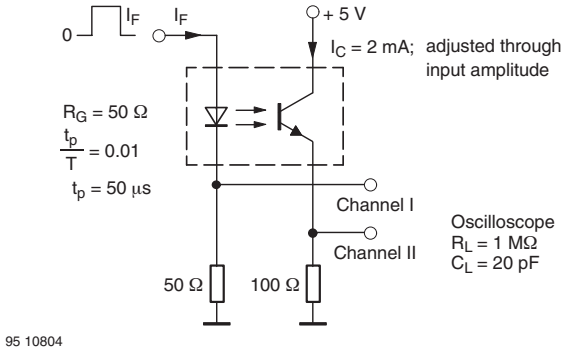


Figure 3. Test circuit, non-saturated operation

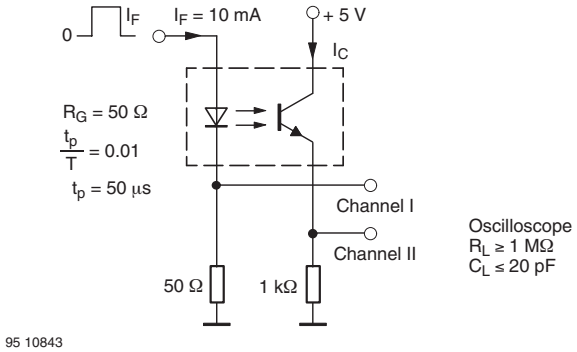


Figure 4. Test circuit, saturated operation

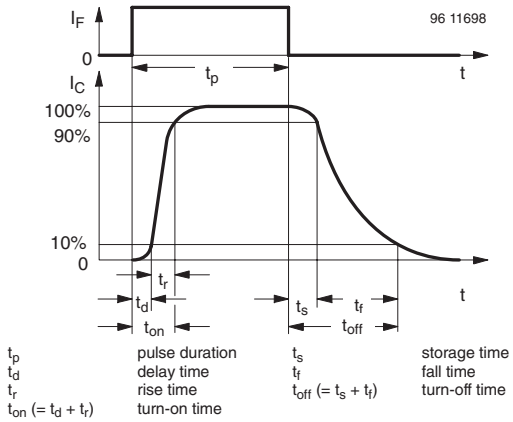


Figure 5. Switching times

Typical Characteristics (T_{amb} = 25 °C unless otherwise specified)

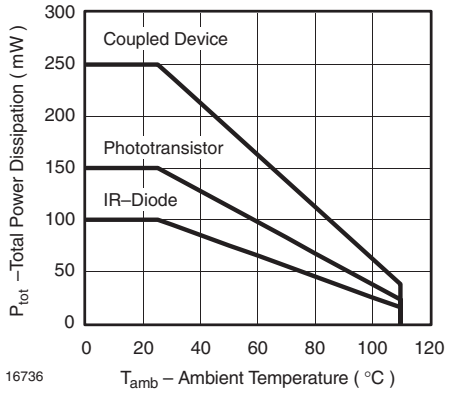


Figure 6. Total Power Dissipation vs. Ambient Temperature

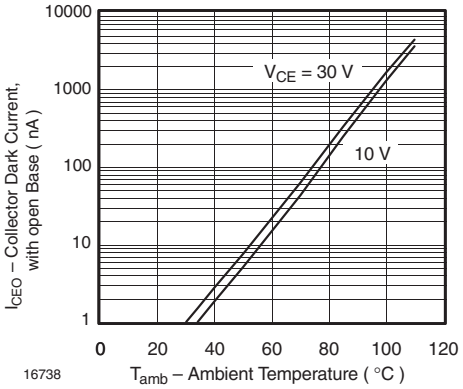


Figure 9. Collector Dark Current vs. Ambient Temperature

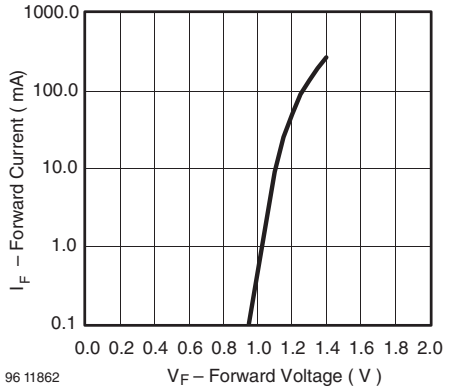


Figure 7. Forward Current vs. Forward Voltage

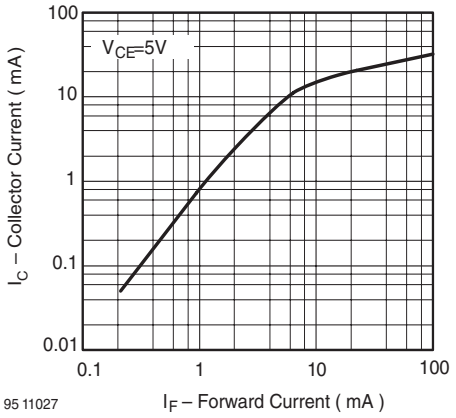


Figure 10. Collector Current vs. Forward Current

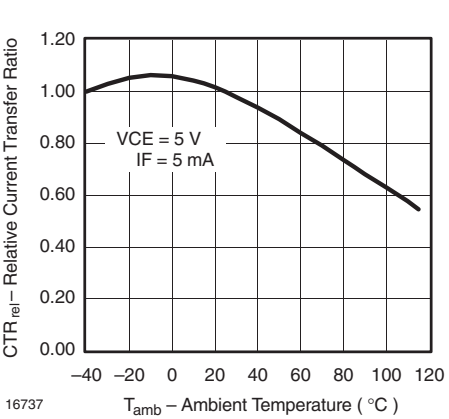


Figure 8. Relative Current Transfer Ratio vs. Ambient Temperature

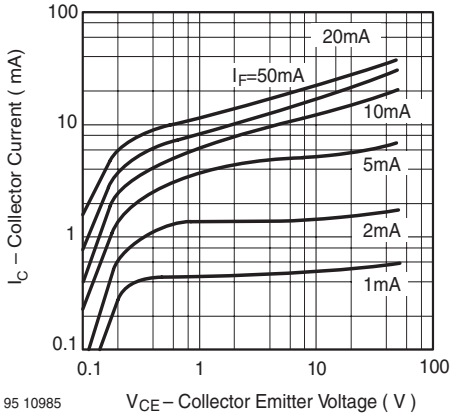


Figure 11. Collector Current vs. Collector Emitter Voltage

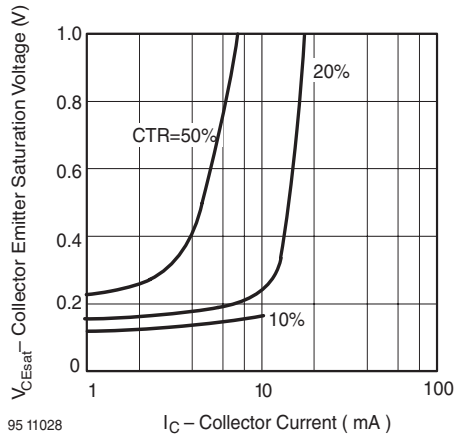


Figure 12. Collector Emitter Saturation Voltage vs. Collector Current

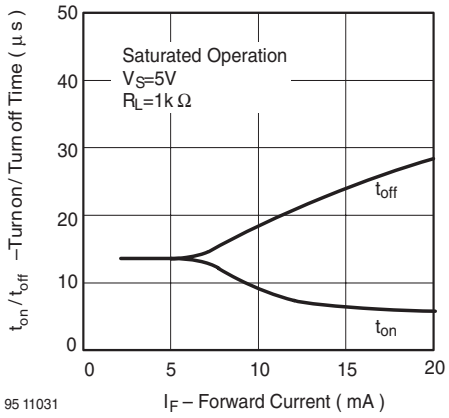


Figure 15. Turn on / off Time vs. Forward Current

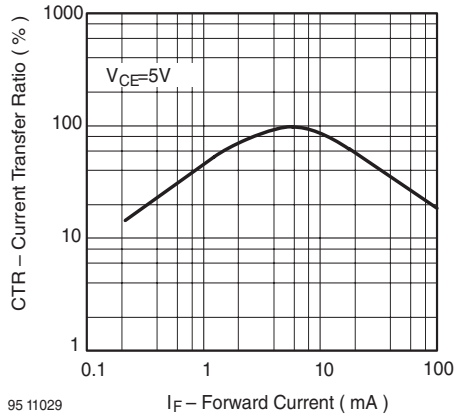


Figure 13. Current Transfer Ratio vs. Forward Current

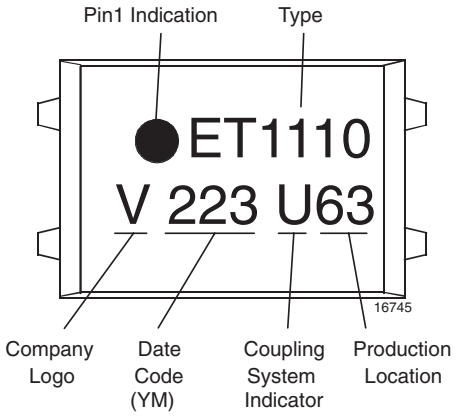


Figure 16. Marking example

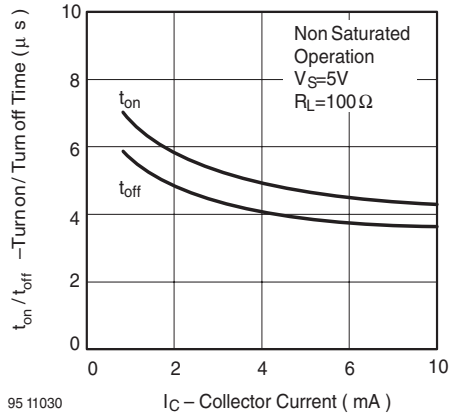
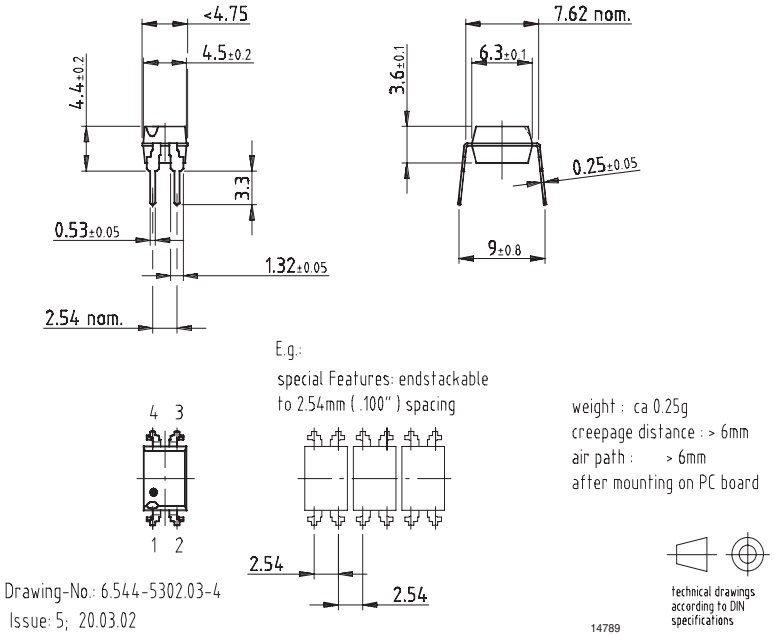
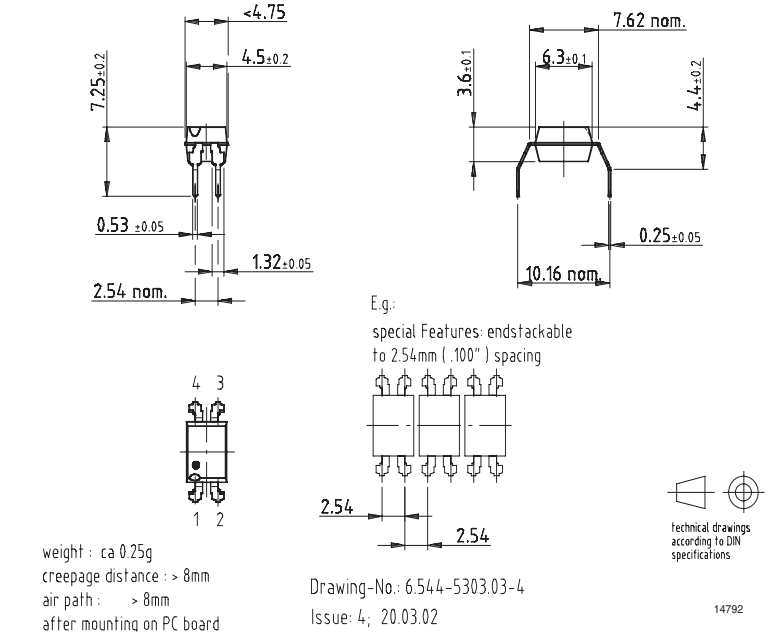


Figure 14. Turn on / off Time vs. Collector Current

Package Dimension of TCET111. in mm



Package Dimension of TCLT11.G in mm



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 operatingsystems 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
Telephone: 49 (0)7131 67 2831, Fax number: 49 (0)7131 67 2423