Photocouplers Infrared LED & Photo Transistor

TLP620M,TLP620MF

1. Applications

- Programmable Logic Controllers (PLCs)
- I/O Interface Boards

2. General

TLP620M is a low AC input type phototransistor coupler that consists of a phototransistor optically coupled to two antiparallel infrared emitting diode in a 4pin DIP.
TLP620M is guaranteed high isolation voltage (5000 Vrms) and wide operating temperature (-55 to 125 ℃).
Since TLP620M are connected antiparallel by two LEDs, it is suitable for AC current input.
TLP620MF is a lead forming type for the long creepage mounting of TLP620M.

3. Features

(1) Collector-emitter voltage: 80 V (min)

(2) Current transfer ratio: 50 % (min) (@I_F = ±0.5 mA, V_{CE} = 5 V)
GB Rank: 100 % (min) (@I_F = ±0.5 mA, V_{CE} = 5 V)

(3) Isolation voltage: 5000 Vrms (min)

(4) Operating temperature: -55 to 125 ℃

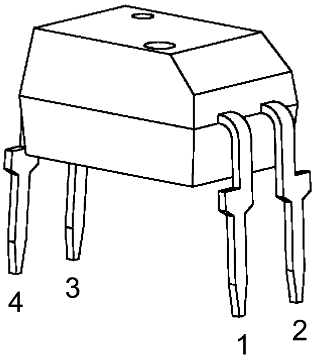
(5) Safety standards
UL-recognized: UL 1577, File No.E67349
cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349
VDE-approved: EN IEC 60747-5-5, EN IEC 62368-1 **(Note 1)**
CQC-approved: GB4943.1 Japan Factory

Note 1: When a VDE approved type is needed, please designate the **Option (D4)**.

Start of commercial production
2019-05

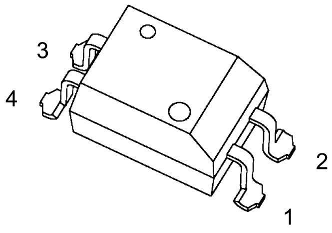
4. Packaging (Note)

TLP620M



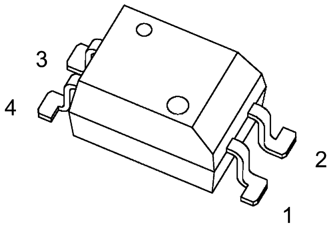
11-5B2S

TLP620M(LF1,TP1)



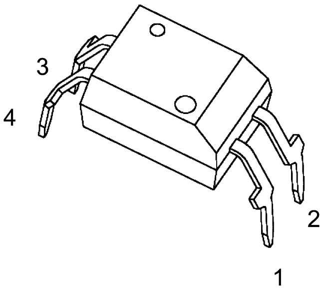
11-5B201S

TLP620M(LF5,TP5)



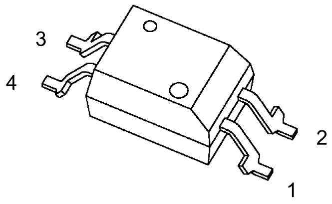
11-5B205S

TLP620MF



11-5B202S

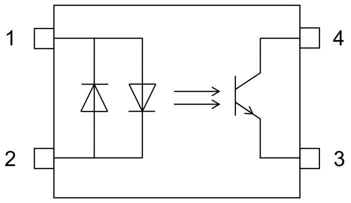
TLP620MF(LF4,TP4)



11-5B204S

Note: Through-hole type: TLP620M, TLP620MF
Lead forming option: (LF1), (LF4), (LF5)
Taping option: (TP1), (TP4), (TP5)

5. Pin Assignment



1: Anode, Cathode
2: Cathode, Anode
3: Emitter
4: Collector

6. Mechanical Parameters

Characteristics	7.62 mm Pitch TLP620M type (Min)	10.16 mm Pitch TLP620MF type (Min)	Unit
Creepage distances	7.0	8.0	mm
Clearance	7.0	8.0	
Internal isolation thickness	0.4	0.4	

7. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 ℃)

	Characteristics	Symbol	Note	Rating	Unit
LED	R.M.S. forward current	$I_{F(RMS)}$		±50	mA
	Input forward current derating ($T_a \geq 90$ °C)	$\Delta I_F/\Delta T_a$		-1.11	mA/°C
	Input forward current (pulsed)	I_{FP}	(Note 1)	±1	A
	Input power dissipation	P_D		100	mW
	Input power dissipation derating ($T_a \geq 90$ °C)	$\Delta P_D/\Delta T_a$		-2.22	mW/°C
	Junction temperature	T_j		135	°C
Detector	Collector-emitter voltage	V_{CEO}		80	V
	Emitter-collector voltage	V_{ECO}		7	V
	Collector current	I_C		50	mA
	Collector power dissipation	P_C		150	mW
	Collector power dissipation derating ($T_a \geq 25$ °C)	$\Delta P_C/\Delta T_a$		-1.36	mW/°C
	Junction temperature	T_j		135	°C
Common	Operating temperature	T_{opr}		-55 to 125	°C
	Storage temperature	T_{stg}		-55 to 125	°C
	Lead soldering temperature (10 s)	T_{sol}		260	°C
	Total power dissipation	P_T		250	mW
	Total power dissipation derating ($T_a \geq 25$ °C)	$\Delta P_T/\Delta T_a$		-2.27	mW/°C
	Isolation voltage (AC, 60 s, R.H. ≤ 60 %)	BV_S	(Note 2)	5000	Vrms

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Pulse width (PW) ≤ 0.1 ms, f = 100 Hz

Note 2: This device is considered as a two-terminal device: Pins 1 and 2 are shorted together, and pins 3 and 4 are shorted together.

8. Electrical Characteristics (Unless otherwise specified, T_a = 25 ℃)

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	V_F		$I_F = \pm 10$ mA	1.1	1.25	1.4	V
	Input capacitance	C_t		V = 0 V, f = 1 MHz	—	85	—	pF
Detector	Collector-emitter breakdown voltage	$V_{(BR)CEO}$		I_C = 0.5 mA	80	—	—	V
	Emitter-collector breakdown voltage	$V_{(BR)ECO}$		I_E = 0.1 mA	7	—	—	V
	Dark Current	I_{DARK}		V_{CE} = 48 V	—	0.001	0.08	µA
				V_{CE} = 48 V, T_a = 85 °C	—	—	50	µA
	Collector-emitter capacitance	C_{CE}		V = 0 V, f = 1 MHz	—	5	—	pF

9. Coupled Electrical Characteristics (Unless otherwise specified, T_a = 25 ℃)

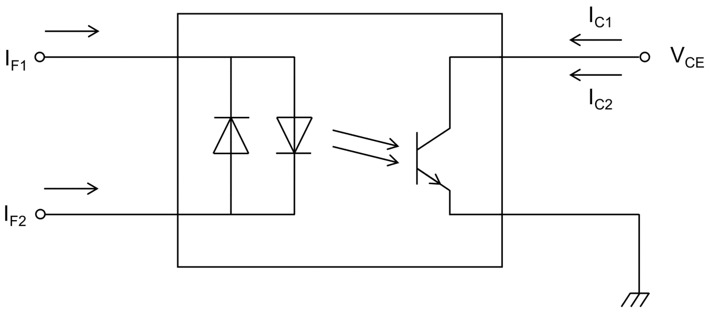
Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Current transfer ratio	I_C/I_F	(Note 1)	I_F = ±5 mA, V_{CE} = 5 V	50	—	600	%
			I_F = ±5 mA, V_{CE} = 5 V, GB Rank	100	—	600	
			I_F = ±0.5 mA, V_{CE} = 5 V	50	—	600	
			I_F = ±0.5 mA, V_{CE} = 5 V, GB Rank	100	—	600	
Saturated current transfer ratio	$I_C/I_{F(sat)}$		I_F = ±1 mA, V_{CE} = 0.3 V	—	150	—	
			I_F = ±1 mA, V_{CE} = 0.3 V, GB Rank	80	—	—	
Collector-emitter saturation voltage	$V_{CE(sat)}$		I_C = 2.4 mA, I_F = ±8 mA	—	—	0.3	V
			I_C = 0.2 mA, I_F = ±1 mA	—	0.12	—	
			I_C = 0.2 mA, I_F = ±1 mA, GB Rank	—	—	0.3	
OFF-state collector current	$I_{C(off)}$		V_F = ±0.7 V, V_{CE} = 48 V	—	—	10	µA
Collector current ratio	I_C(ratio)		See Fig. 9.1. $I_C(I_F = -0.5\ mA)/I_C(I_F = 0.5\ mA)$	0.33	1	3	—

Note 1: See Table 9.1 for current transfer ratio.

Table 9.1 Current Transfer Ratio (CTR) Rank (Note) (Unless otherwise specified, T_a = 25 ℃)

Rank	Rank short code	Note	Test Condition	Current transfer ratio I_C/I_F (min)	Current transfer ratio I_C/I_F (max)	Marking of classification	Unit
Blank	—		I_F = ±5 mA, V_{CE} = 5 V I_F = ±0.5 mA, V_{CE} = 5 V	50	600	Blank, YE, GR, GB, BL	%
Y	—		I_F = ±5 mA, V_{CE} = 5 V I_F = ±0.5 mA, V_{CE} = 5 V	50	150	YE	
GR	—		I_F = ±5 mA, V_{CE} = 5 V I_F = ±0.5 mA, V_{CE} = 5 V	100	300	GR	
GB	—		I_F = ±5 mA, V_{CE} = 5 V I_F = ±0.5 mA, V_{CE} = 5 V	100	600	GB, GR, BL	
BL	—		I_F = ±5 mA, V_{CE} = 5 V I_F = ±0.5 mA, V_{CE} = 5 V	200	600	BL	

Note: Specify both the part number and a rank in this format when ordering.
Example: TLP620M(GB,E
For safety standard certification, however, specify the part number alone.
Example: TLP620M(GB,E → TLP620M



$$I_C(\text{ratio}) = \frac{I_{C2}(I_F = I_{F2},\ V_{CE} = 5\ V)}{I_{C1}(I_F = I_{F1},\ V_{CE} = 5\ V)}$$

Fig. 9.1 Collector Current Ratio Test Circuit

10. Isolation Characteristics (Unless otherwise specified, T_a = 25 ℃)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Total capacitance (input to output)	C_S	(Note 1)	V_S = 0 V, f = 1 MHz	—	0.5	—	pF
Isolation resistance	R_S	(Note 1)	V_S = 500 V, R.H. ≤ 60 %	10^{12}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	5000	—	—	Vrms

Note 1: This device is considered as a two-terminal device: Pins 1 and 2 are shorted together, and pins 3 and 4 are shorted together.

11. Switching Characteristics (Unless otherwise specified,T_a = 25 ℃)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Rise time	t_r		V_{CC} = 10 V, I_C = 2 mA, R_L = 100 Ω	—	2	—	μs
Fall time	t_f			—	3	—	
Turn-on time	t_{on}			—	3	—	
Turn-off time	t_{off}			—	3	—	
Turn-on time	t_{on}		See Fig. 11.1 R_L = 1.9 kΩ, V_{CC} = 5 V, I_F = ±16 mA	—	1	—	μs
Storage time	t_s			—	15	—	
Turn-off time	t_{off}			—	30	—	
Turn-on time	t_{on}		See Fig. 11.1 R_L = 4.7 kΩ, V_{CC} = 5 V, I_F = ±1.6 mA	—	8	—	μs
Storage time	t_s			—	10	—	
Turn-off time	t_{off}			—	47	—	

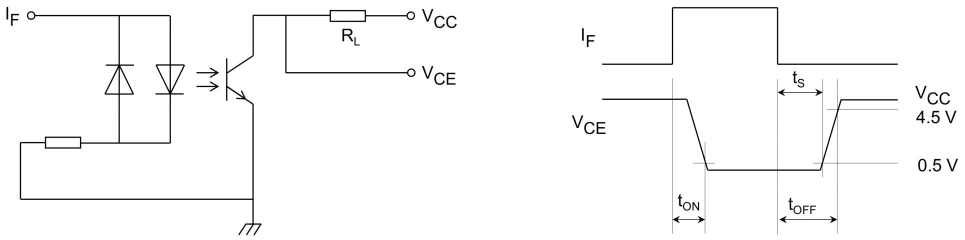


Fig. 11.1 Switching Time Test Circuit and Waveform

12. Characteristics Curves (Note)

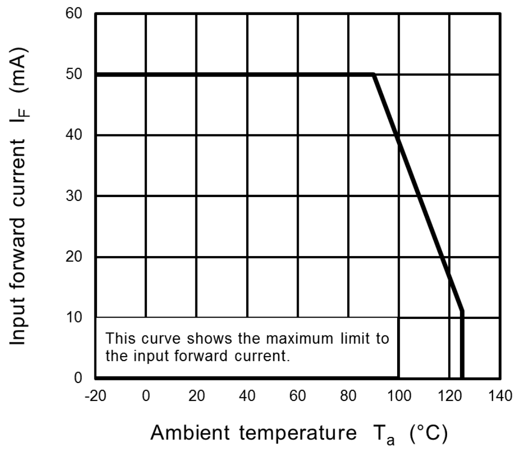


Fig. 12.1 I_F - T_a

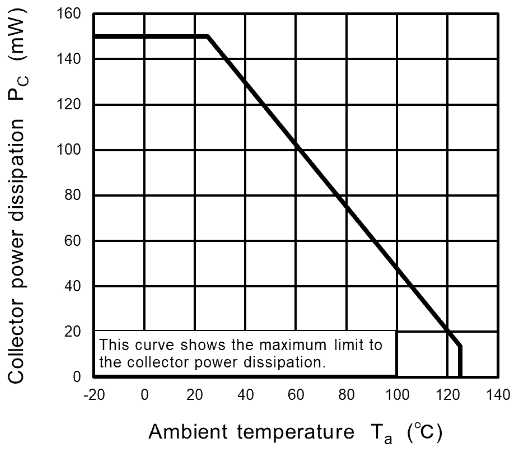


Fig. 12.2 P_C - T_a

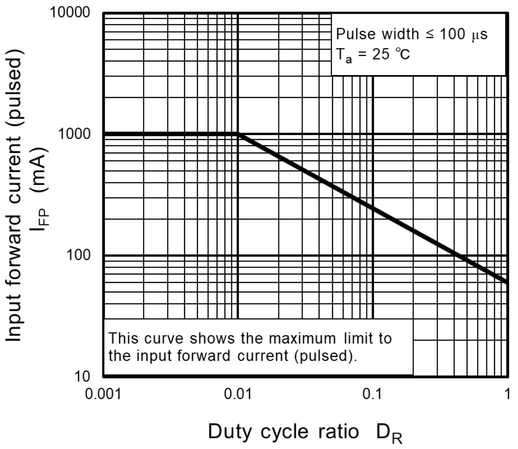


Fig. 12.3 I_{FP} - D_R

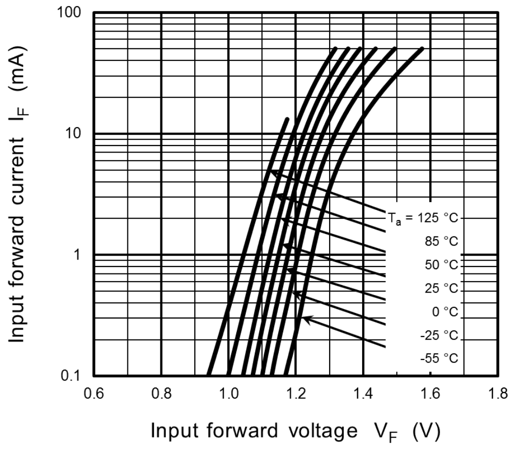


Fig. 12.4 I_F - V_F

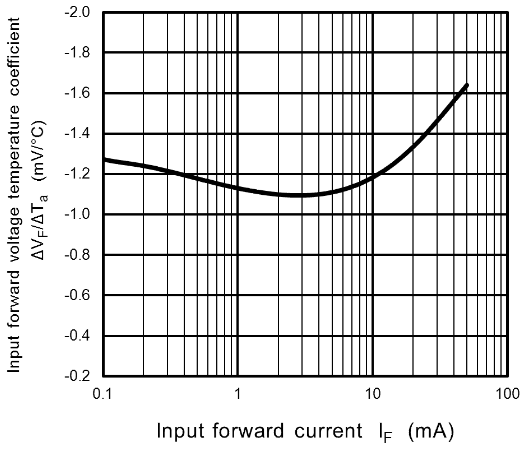


Fig. 12.5 $\Delta V_F/\Delta T_a$ - I_F

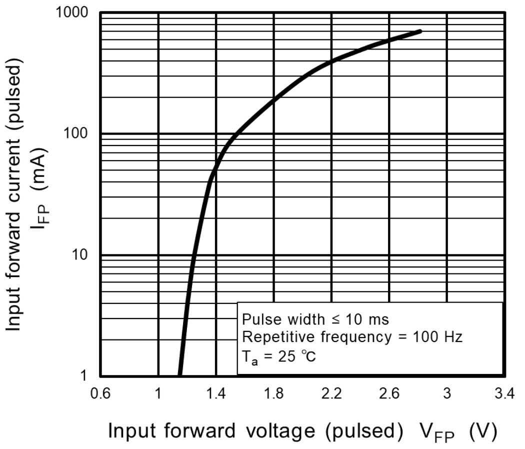


Fig. 12.6 I_{FP} - V_{FP}

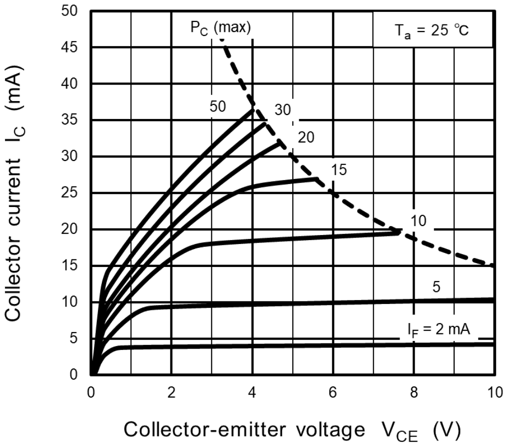


Fig. 12.7 I_C - V_{CE}

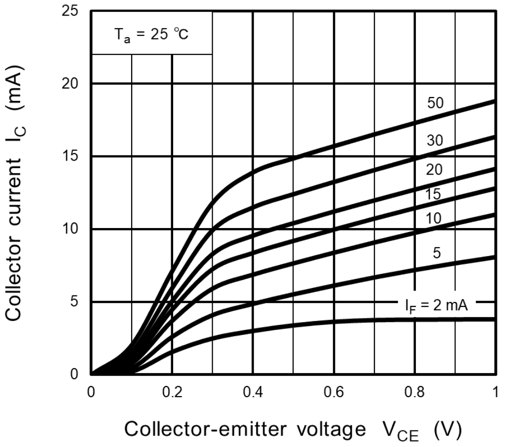


Fig. 12.8 I_C - V_{CE}

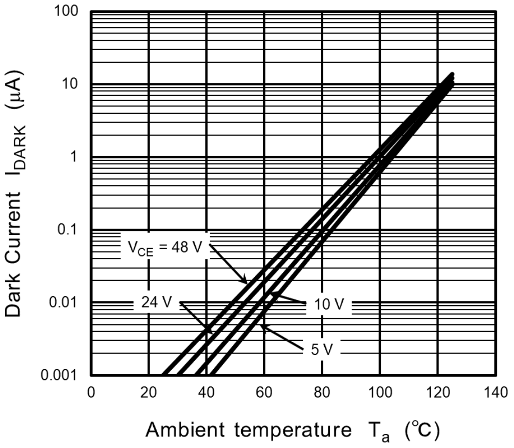


Fig. 12.9 I_{DARK} - T_a

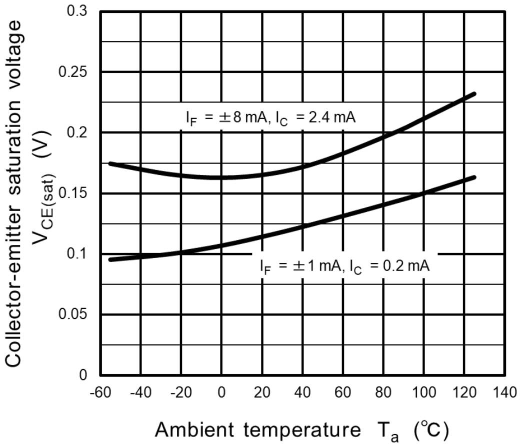


Fig. 12.10 $V_{CE(sat)}$ - T_a

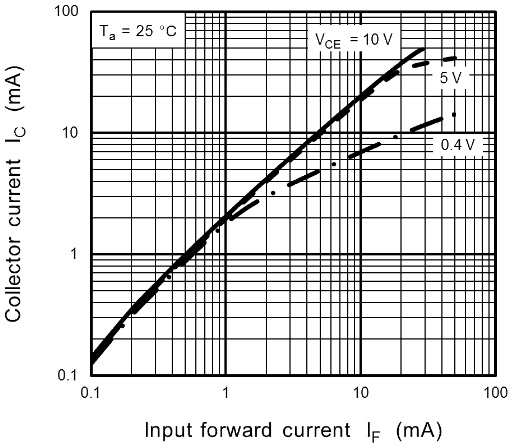


Fig. 12.11 I_C - I_F

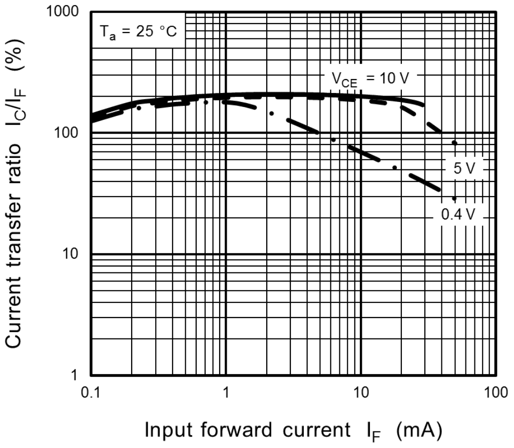


Fig. 12.12 I_C/I_F - I_F

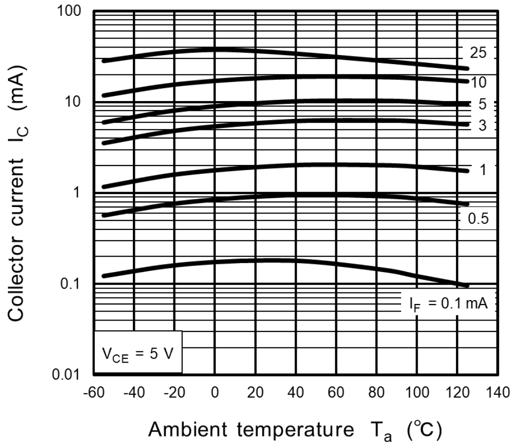


Fig. 12.13 I_C - T_a

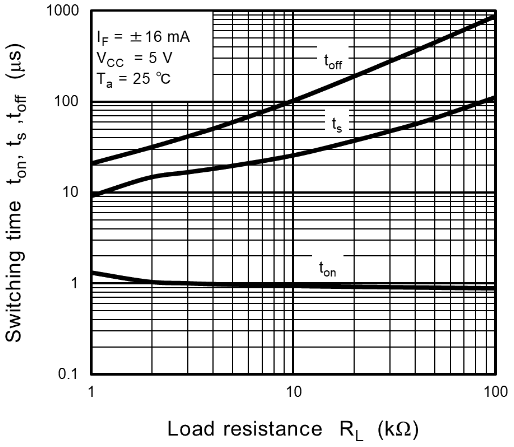


Fig. 12.14 Switching Time - R_L

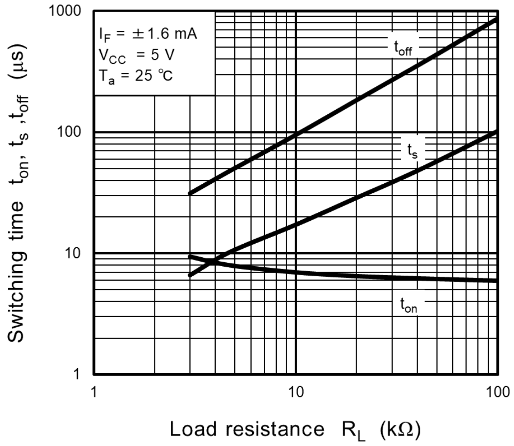


Fig. 12.15 Switching Time - R_L

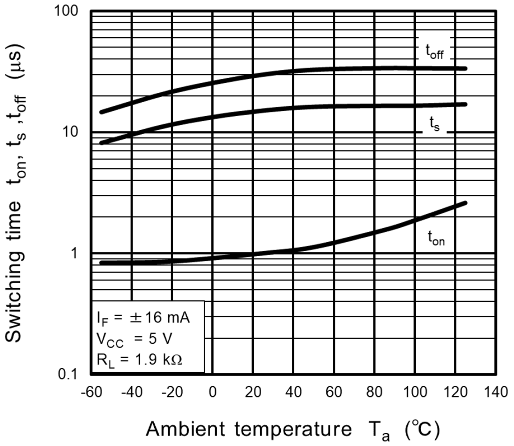


Fig. 12.16 Switching Time - T_a

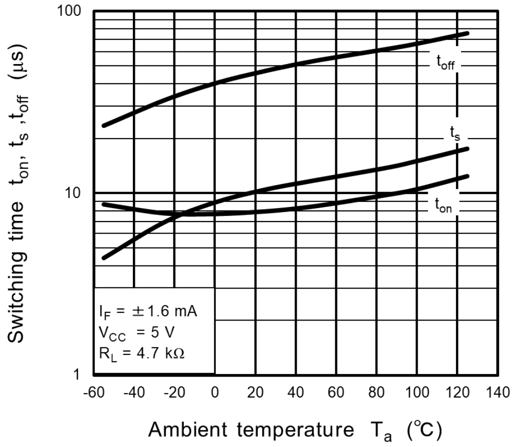


Fig. 12.17 Switching Time - T_a

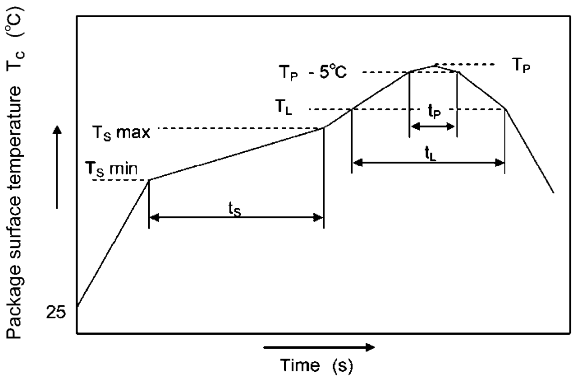
Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

13. Soldering and Storage

13.1. Precautions for Soldering

The soldering temperature should be controlled as closely as possible to the conditions shown below, irrespective of whether a soldering iron or a reflow soldering method is used.

- When using soldering reflow.
  The soldering temperature profile is based on the package surface temperature.
  (See the figure shown below, which is based on the package surface temperature.)
  Reflow soldering must be performed once or twice.
  The mounting should be completed with the interval from the first to the last mountings being 2 weeks.



	Symbol	Min	Max	Unit
Preheat temperature	T_S	150	200	°C
Preheat time	t_S	60	120	s
Ramp-up rate (T_L to T_P)			3	°C/s
Liquidus temperature	T_L	217		°C
Time above T_L	t_L	60	150	s
Peak temperature	T_P		260	°C
Time during which T_c is between (T_P – 5) and T_P	t_P		30	s
Ramp-down rate (T_P to T_L)			6	°C/s

An Example of a Temperature Profile When Lead(Pb)-Free Solder Is Used

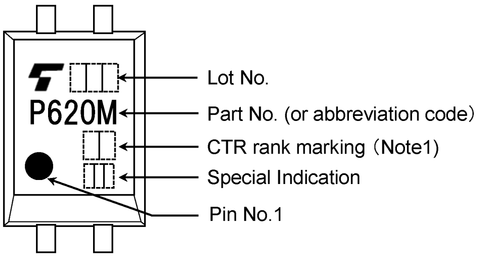
- When using soldering flow
  Preheat the device at a temperature of 150 °C (package surface temperature) for 60 to 120 seconds.
  Mounting condition of 260 °C within 10 seconds is recommended.
  Flow soldering must be performed once.
- When using soldering Iron
  Complete soldering within 10 seconds for lead temperature not exceeding 260 °C or within 3 seconds not exceeding 350 °C
  Heating by soldering iron must be done only once per lead.

13.2. Precautions for General Storage

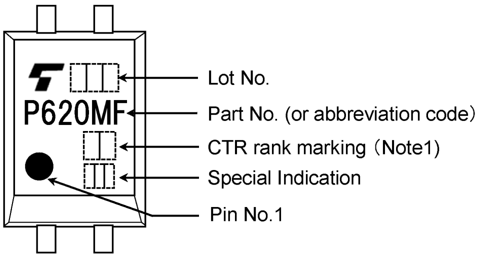
- Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- Follow the precautions printed on the packing label of the device for transportation and storage.
- Keep the storage location temperature and humidity within a range of 5 °C to 35 °C and 45 % to 75 %, respectively.
- Do not store the devices in locations with poisonous gases (especially corrosive gases) or in dusty conditions.

- Store the devices in locations with minimal temperature fluctuations. Rapid temperature changes during storage can cause condensation, resulting in lead oxidation or corrosion, which will deteriorate the solderability of the leads.
- When restoring devices after removal from their packing, use anti-static containers.
- Do not allow loads to be applied directly to devices while they are in storage.

14. Marking (Note)



Marking example of TLP620M



Marking example of TLP620MF

Note: Special indication is put for the traceability enhancement.
Information of special indication
e.g. A01
A: Factory administration number
01: A counting of the number is started on every week from 01.
and reset when Lot No or weekly code is changed.

Note: A different marking is used for photocouplers that have been qualified according to option (D4) of EN IEC 60747. See Fig.15.4 and Fig.15.5.

Note1: For the CTR rank mark, please refer to the marking of classification in table 9.1 CTR rank table.

15. EN IEC 60747-5-5 Option (D4) Specification

- Part number: TLP620M, TLP620MF **(Note 1)**
- The following part naming conventions are used for the devices that have been qualified according to option (D4) of EN IEC 60747.

Example: TLP620M(D4GBT1,E

D4: EN IEC 60747 option
GB: CTR rank
T1: Tape type (TP1)
E: [[G]]/RoHS COMPATIBLE **(Note 2)**

Note 1: Use TOSHIBA standard type number for safety standard application.
e.g., TLP620M(D4GBT1,E → TLP620M

Note 2: Please contact your Toshiba sales representative for details on environmental information such as the product's RoHS compatibility.
RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Description		Symbol	Rating	Unit
Application classification for rated mains voltage ≤ 600 Vrms for rated mains voltage ≤ 1000 Vrms			I-IV I-III	—
Climatic classification			55 / 125 / 21	—
Pollution degree			2	—
Maximum operating insulation voltage	TLPxxxx type	V_{IORM}	890	Vpeak
	TLPxxxxF type		1140	
Input to output test voltage, Method A V_{pr} = 1.6 × V_{IORM}, type and sample test t_p = 10 s, partial discharge < 5 pC	TLPxxxx type	V_{pr}	1424	Vpeak
	TLPxxxxF type		1824	
Input to output test voltage, Method B V_{pr} = 1.875 × V_{IORM}, 100 % production test t_p = 1 s, partial discharge < 5 pC	TLPxxxx type	V_{pr}	1670	Vpeak
	TLPxxxxF type		2140	
Highest permissible overvoltage (transient overvoltage, t_{pr} = 60 s)		V_{TR}	8000	Vpeak
Safety limiting values (max. permissible ratings in case of fault, also refer to thermal derating curve) current (input current I_F, P_{so} = 0) power (output or total power dissipation) temperature		I_{si} P_{so} T_s	400 700 150	mA mW °C
Insulation resistance	V_{IO} = 500 V, T_a = 25 °C V_{IO} = 500 V, T_a = 100 °C V_{IO} = 500 V, T_a = T_s	R_{si}	$\geq 10^{12}$ $\geq 10^{11}$ $\geq 10^{9}$	Ω

Fig. 15.1 EN IEC 60747 Insulation Characteristics

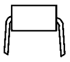
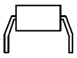
		 7.62 mm pitch TLPxxx type	 10.16 mm pitch TLPxxxF type
Minimum creepage distance	Cr	7.0 mm	8.0 mm
Minimum clearance	Cl	7.0 mm	8.0 mm
Minimum insulation thickness	ti	0.4 mm	
Comparative tracking index	CTI	500	

Fig. 15.2 Insulation Related Specifications (Note)

Note: If a printed circuit is incorporated, the creepage distance and clearance may be reduced below this value. (e.g., at a standard distance between soldering eye centers of 7.5 mm). If this is not permissible, the user shall take suitable measures.

Note: This photocoupler is suitable for **safe electrical isolation** only within the safety limit data. Maintenance of the safety data shall be ensured by means of protective circuits.

Fig. 15.3 Marking on packing for EN IEC 60747

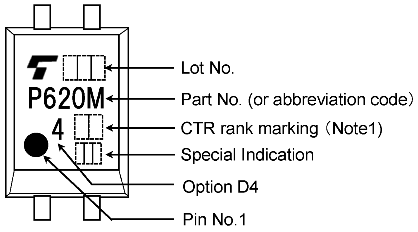


Fig. 15.4 Marking Example of TLP620M

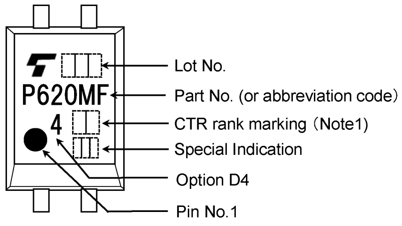


Fig. 15.5 Marking Example of TLP620MF

Note: Special indication is put for the traceability enhancement.
Information of special indication
e.g. A01
A: Factory administration number
01: A counting of the number is started on every week from 01.
and reset when Lot No or weekly code is changed.

Note: The above marking is applied to the photocouplers that have been qualified according to option (D4) of EN IEC 60747.

Note1: For the CTR rank mark, please refer to the marking of classification in table 9.1 CTR rank table.

Figure 1 Partial discharge measurement procedure according to EN IEC 60747
Destructive test for qualification and sampling tests.

Method A

(for type and sampling tests, destructive tests)

t_1, t_2 = 1 to 10 s
t_3, t_4 = 1 s
t_p (Measuring time for partial discharge) = 10 s
t_b = 12 s
t_{ini} = 60 s

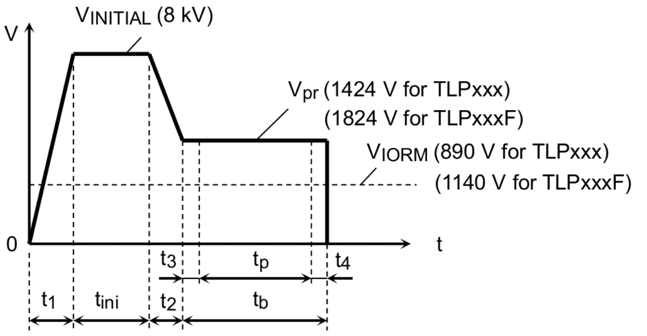


Figure 2 Partial discharge measurement procedure according to EN IEC 60747
Non-destructive test for 100 % inspection.

Method B

(for sample test, non-destructive test)

t_3, t_4 = 0.1 s
t_p (Measuring time for partial discharge) = 1 s
t_b = 1.2 s

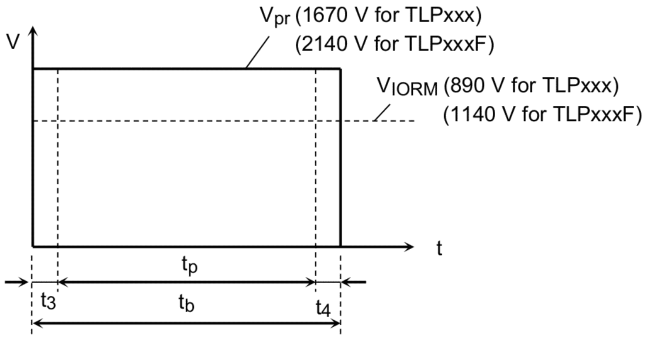


Figure 3 Dependency of maximum safety ratings on ambient temperature

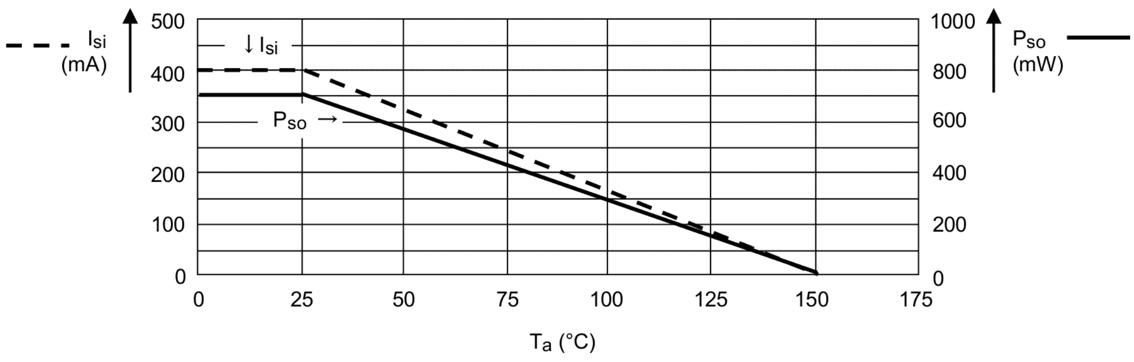
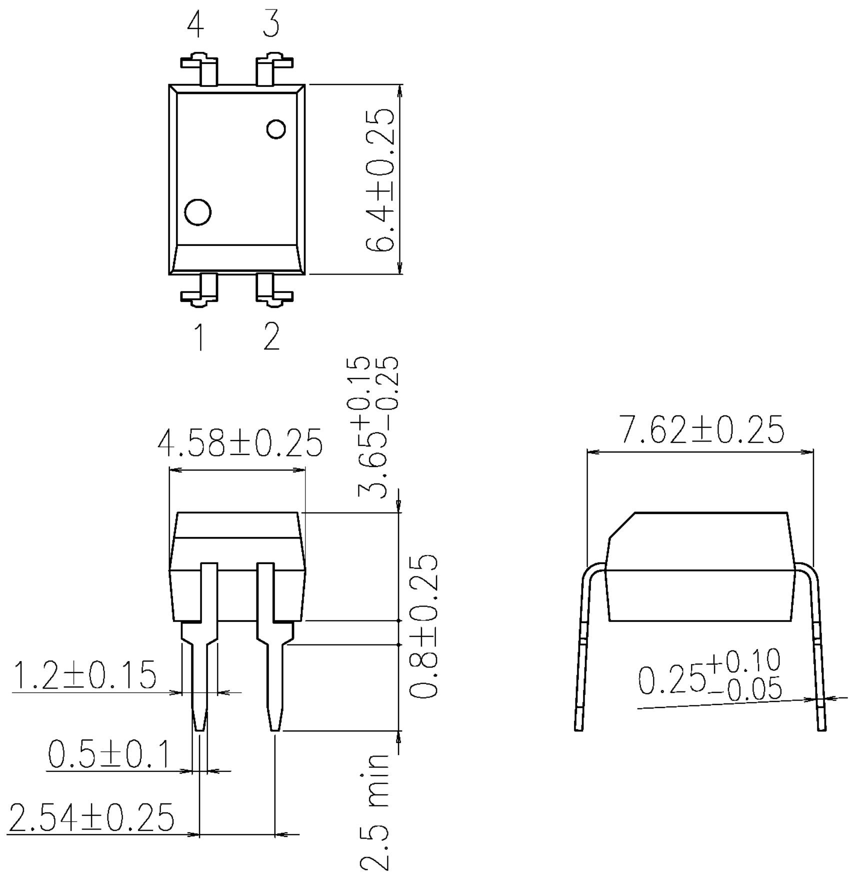


Fig. 15.6 Measurement Procedure

Package Dimensions

Unit: mm

TLP620M



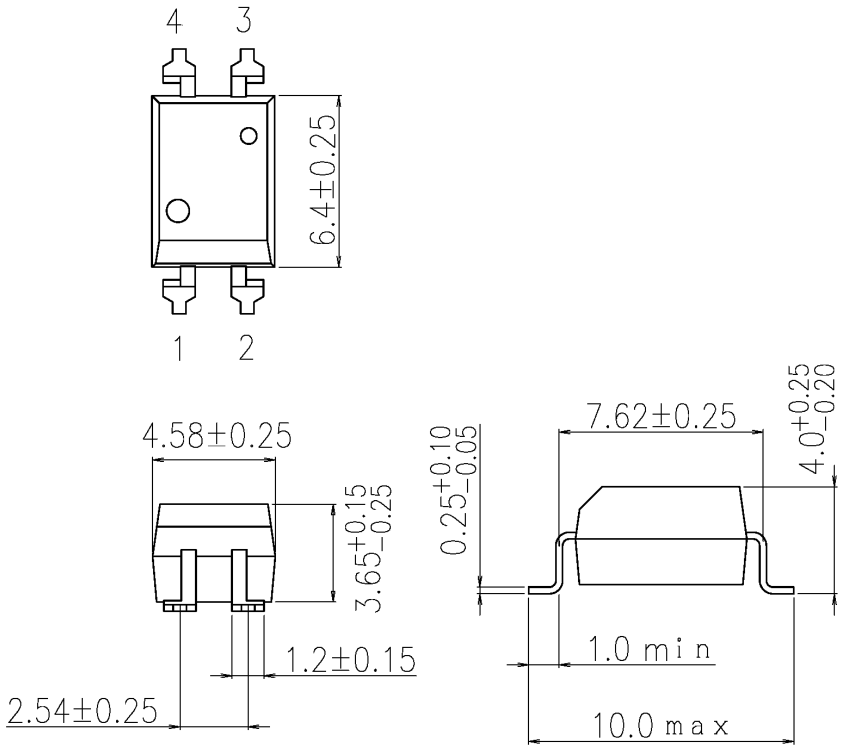
Weight: 0.24 g (typ.)

Package Name(s)
TOSHIBA: 11-5B2S

Package Dimensions

Unit: mm

TLP620M(LF1,TP1)



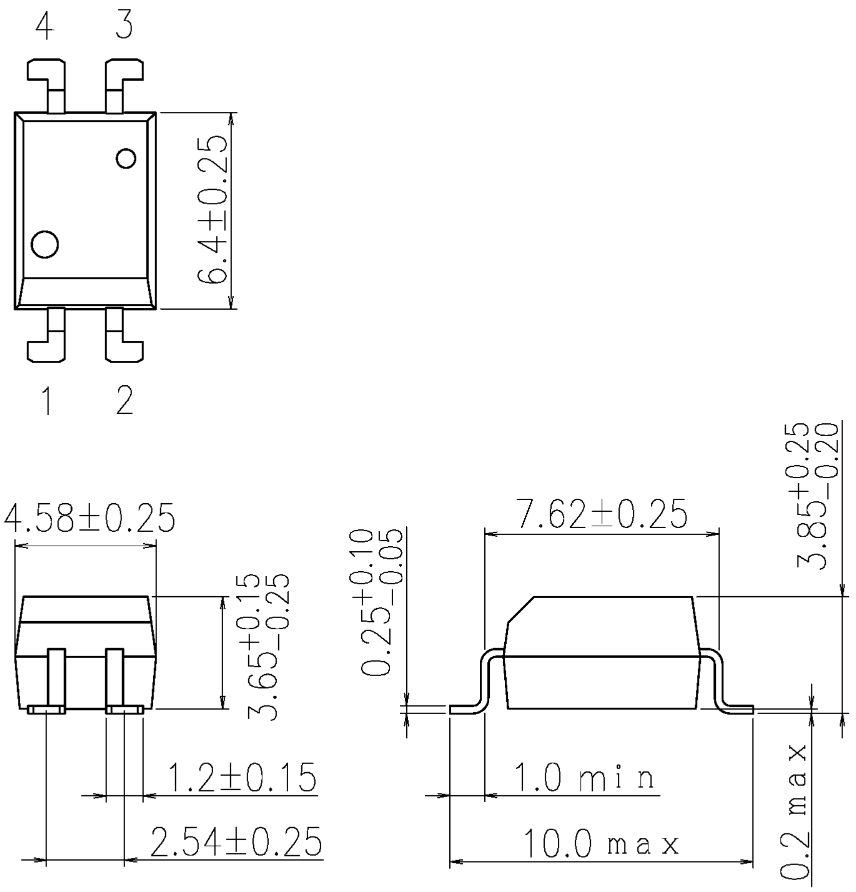
Weight: 0.24 g (typ.)

Package Name(s)
TOSHIBA: 11-5B201S

Package Dimensions

Unit: mm

TLP620M(LF5,TP5)



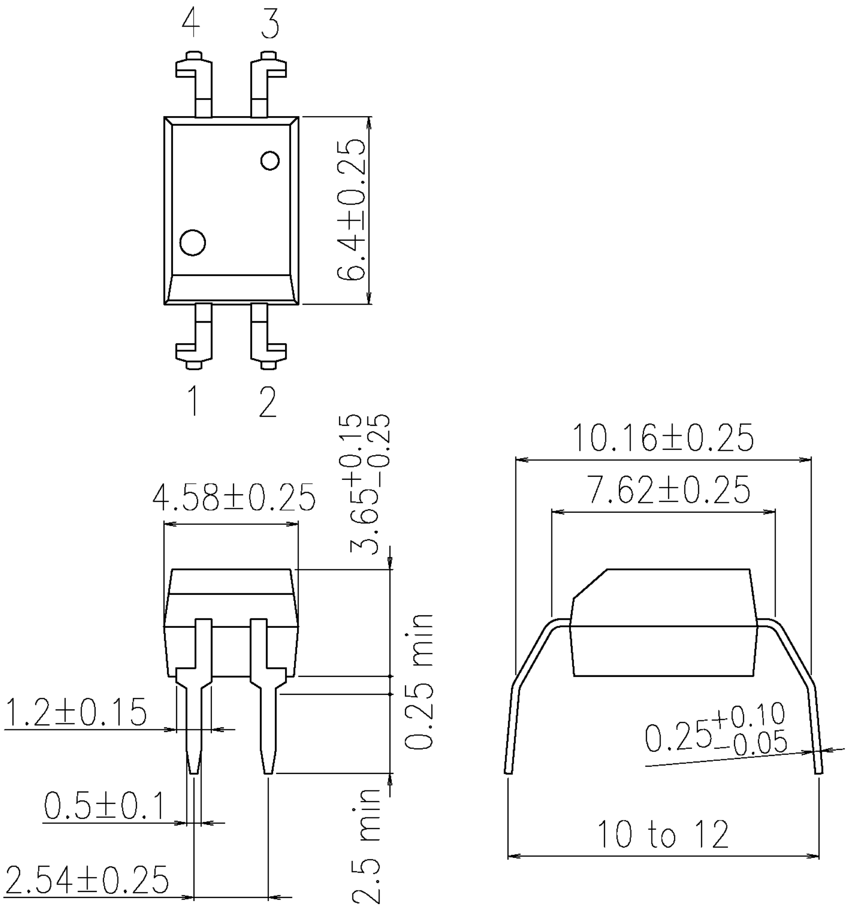
Weight: 0.24 g (typ.)

Package Name(s)
TOSHIBA: 11-5B205S

Package Dimensions

Unit: mm

TLP620MF



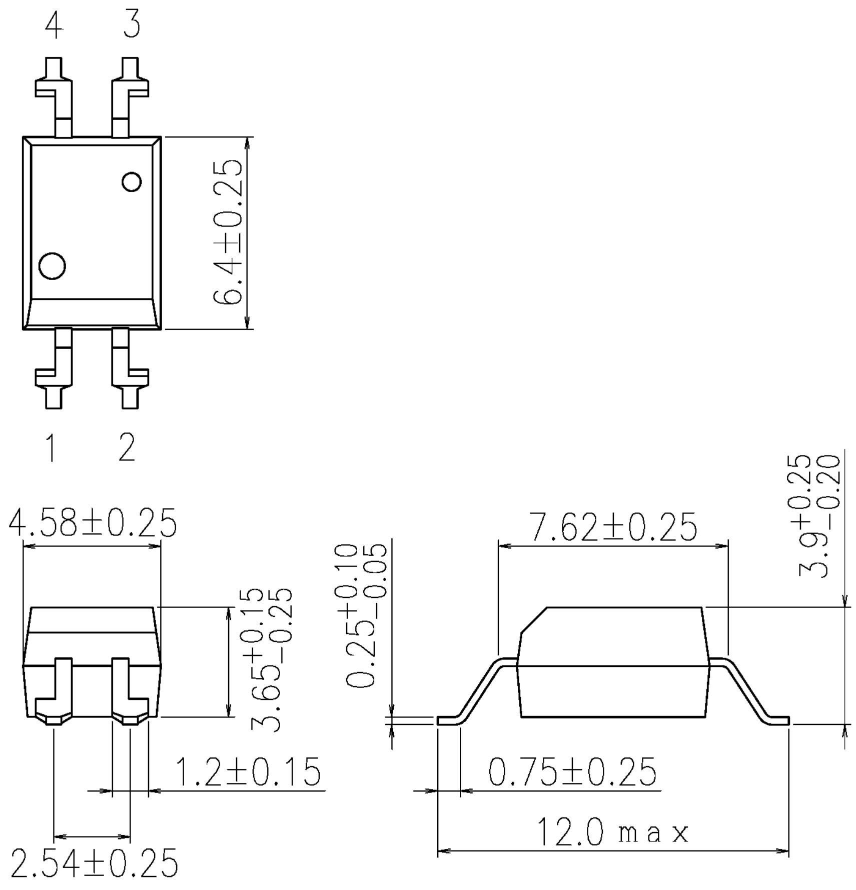
Weight: 0.24 g (typ.)

Package Name(s)
TOSHIBA: 11-5B202S

Package Dimensions

Unit: mm

TLP620MF(LF4,TP4)



Weight: 0.24 g (typ.)

Package Name(s)
TOSHIBA: 11-5B204S

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