Photocouplers Photorelay

TLP3545A,TLP3545AF

1. Applications

- Mechanical relay replacements
- Heating, ventilation and air conditioning (HVAC)
- Security Systems
- Factory Automation (FA)
- Measuring Instruments

2. General

The TLP3545A and TLP3545AF photorelay consist of a photo MOSFET optically coupled to an infrared LED. It is housed in a 6-pin DIP package. The low ON-state resistance and the high permissible ON-state current of the TLP3545A and TLP3545AF make it suitable for power line control applications.

3. Features

(1) Normally opened (1-Form-A)
(2) OFF-state output terminal voltage: 60 V (min)
(3) Trigger LED current: 3 mA (max)
(4) ON-state current: 4 A (max) (A connection)
(5) ON-state resistance: 60 mΩ (max) (A connection)
(6) Isolation voltage: 2500 Vrms (min)
(7) Safety standards
UL-recognized: UL 1577, File No.E67349
cUL-recognized: CSA Component Acceptance Service No.5A File No.E67349
UL-recognized: UL 508, File No.E499232 **(Note 1)**
VDE-approved: EN 60747-5-5 **(Note 2)**

(Note 1):Please refer Absolute Maximum Ratings (UL-recognized UL 508) for UL 508 products.
(Note 2):When a VDE approved type is needed, please designate the **Option (D4)**.

4. Mechanical Parameters

Characteristics	7.62-mm pitch TLP3545A	10.16-mm pitch TLP3545AF	Unit
Creepage distances	7.0 (min)	8.0 (min)	mm
Clearance distances	7.0 (min)	8.0 (min)	
Internal isolation thickness	0.4 (min)	0.4 (min)	

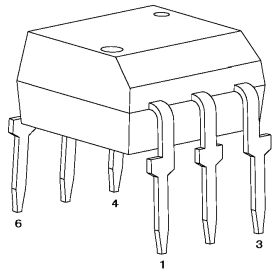
Start of commercial production
2017-11

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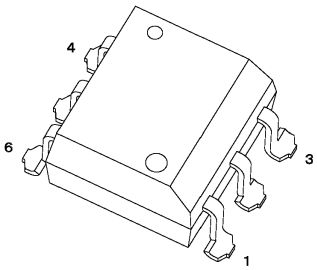
5. Packaging (Note)

TLP3545A



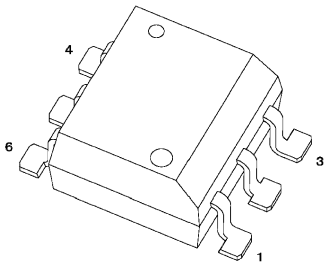
11-7A8S

TLP3545A(LF1,TP1)



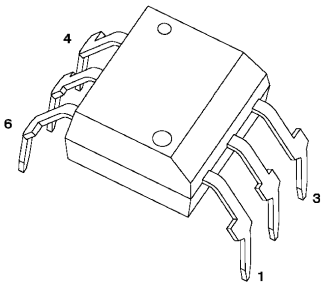
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TLP3545A(LF5,TP5)



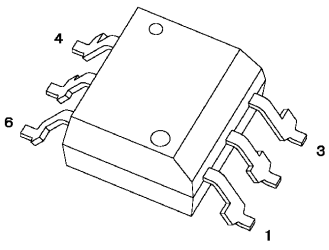
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TLP3545AF



11-7A802S

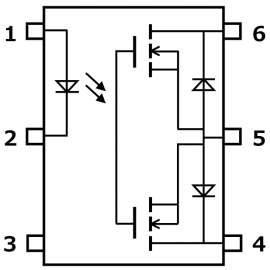
TLP3545AF(LF4,TP4)



11-7A804S

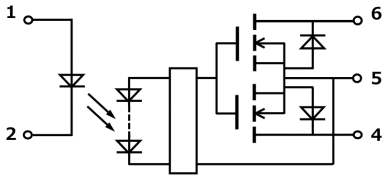
Note: Through-hole type: TLP3545A, TLP3545AF
Lead forming option: (LF1), (LF4), (LF5)
Taping option: (TP1), (TP4), (TP5)

6. Pin Assignment



1: Anode
2: Cathode
3: N.C.
4: Drain
5: Source
6: Drain

7. Internal Circuit



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8. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

	Characteristics		Symbol	Note	Rating	Unit
LED	Input forward current		I_F		30	mA
	Input forward current derating	($T_a \geq$ 25 °C)	$\Delta I_F/\Delta T_a$		-0.3	mA/°C
	Input forward current (pulsed)	(100 μs pulse, 100 pps)	I_{FP}		1	A
	Input reverse voltage		V_R		6	V
	Input power dissipation		P_D		50	mW
	Input power dissipation derating	($T_a \geq$ 25 °C)	$\Delta P_D/\Delta T_a$		-0.5	mW/°C
	Junction temperature		T_j		125	°C
Detector	OFF-state output terminal voltage		V_{OFF}		60	V
	ON-state current (A connection)		I_{ON}	(Note 1)	4	A
	ON-state current (B connection)				4	
	ON-state current (C connection)				8	
	ON-state current derating (A connection)	($T_a \geq$ 25 °C)	$\Delta I_{ON}/\Delta T_a$	(Note 1)	-40	mA/°C
	ON-state current derating (B connection)	($T_a \geq$ 25 °C)			-40	
	ON-state current derating (C connection)	($T_a \geq$ 25 °C)			-80	
	ON-state current (pulsed)	(t = 100 ms, duty = 1/10)	I_{ONP}		12	A
	Output power dissipation		P_O		700	mW
	Output power dissipation derating	($T_a \geq$ 25 °C)	$\Delta P_O/\Delta T_a$		-7.0	mW/°C
	Junction temperature		T_j		125	°C
Common	Storage temperature		T_{stg}		-55 to 125	°C
	Operating temperature		T_{opr}		-40 to 110	°C
	Lead soldering temperature	(10 s)	T_{sol}		260	°C
	Isolation voltage	(AC, 60 s, R.H. ≤ 60 %)	BV_S	(Note 2)	2500	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: For an application circuit example, see Chapter 16.2.

Note 2: This device is considered as a two-terminal device: Pins 1, 2 and 3 are shorted together, and pins 4, 5 and 6 are shorted together.

9. Recommended Operating Conditions (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Supply voltage	V_{DD}		—	—	48	V
Input forward current	I_F		5	10	25	mA
ON-state current(A connection)	I_{ON}		—	—	4	A
Operating temperature	T_{opr}		-40	—	85	°C

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this data sheet should also be considered.

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10. Absolute Maximum Ratings (UL-recognized: UL 508) (Note) (Unless otherwise specified, T_a = 25 °C)

	Characteristics		Symbol	Note	Rating	Unit
LED	Input forward current		I_F		30	mA
	Input forward current derating	($T_a \geq 25$ °C)	$\Delta I_F/\Delta T_a$		-0.3	mA/°C
	Input forward current (pulsed)	(100 μs pulse, 100 pps)	I_{FP}		1	A
	Input reverse voltage		V_R		6	V
	Input power dissipation		P_D		50	mW
	Input power dissipation derating	($T_a \geq 25$ °C)	$\Delta P_D/\Delta T_a$		-0.5	mW/°C
	Junction temperature		T_j		105	°C
Detector	OFF-state output terminal voltage		V_{OFF}		60	V
	ON-state current (A connection)		I_{ON}	(Note 1)	4	A
	ON-state current (B connection)				4	
	ON-state current (C connection)				8	
	ON-state current derating (A connection)	($T_a \geq 25$ °C)	$\Delta I_{ON}/\Delta T_a$	(Note 1)	-40	mA/°C
	ON-state current derating (B connection)	($T_a \geq 25$ °C)			-40	
	ON-state current derating (C connection)	($T_a \geq 25$ °C)			-80	
	ON-state current (pulsed)	(t = 100 ms, duty = 1/10)	I_{ONP}		12	A
	Output power dissipation		P_O		700	mW
	Output power dissipation derating	($T_a \geq 25$ °C)	$\Delta P_O/\Delta T_a$		-7.0	mW/°C
	Junction temperature		T_j		105	°C
Common	Storage temperature		T_{stg}		-55 to 125	°C
	Case temperature		T_c		105	°C
	Operating temperature		T_{opr}		-40 to 85	°C
	Lead soldering temperature	(10 s)	T_{sol}		260	°C
	Isolation voltage	(AC, 60 s, R.H. ≤ 60 %)	BV_S	(Note 2)	2500	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: For an application circuit example, see Chapter 16.2.

Note 2: This device is considered as a two-terminal device: Pins 1, 2 and 3 are shorted together, and pins 4, 5 and 6 are shorted together.

11. Recommended Operating Conditions (UL-recognized: UL 508) (Note)

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Supply voltage	V_{DD}		—	—	48	V
Input forward current	I_F	(Note 1)	5	10	19.5	mA
ON-state current(A connection)	I_{ON}	(Note 1)	—	—	2.6	A
Operating temperature	T_{opr}		-20	—	85	°C

Note: The recommended operating conditions are given as a design guide necessary to obtain the intended performance of the device. Each parameter is an independent value. When creating a system design using this device, the electrical characteristics specified in this data sheet should also be considered.

Note 1: The above recommended operating conditions are at T_a = 60 °C.
However, within the derating range of the characteristic curves of "I_F - T_a", "I_{ON} - T_a", it can be used up to 85 °C.

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12. Electrical Characteristics (Unless otherwise specified, T_a = 25 °C)

	Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
LED	Input forward voltage	V_F		I_F = 10 mA	1.50	1.64	1.80	V
	Input reverse current	I_R		V_R = 5 V	—	—	10	μA
	Input capacitance	C_t		V = 0 V, f = 1 MHz	—	70	—	pF
Detector	OFF-state current	I_{OFF}		V_{OFF} = 60 V	—	0.01	1	μA
	Output capacitance	C_{OFF}		V = 0 V, f = 1 MHz	—	640	—	pF

13. Coupled Electrical Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Trigger LED current	I_{FT}		I_{ON} = 1 A	—	0.3	3	mA
Return LED current	I_{FC}		I_{OFF} = 10 μA	0.01	—	—	
ON-state resistance (A connection)	R_{ON}	(Note 1)	I_{ON} = 3 A, I_F = 5 mA, t < 1 s	—	35	60	mΩ
ON-state resistance (B connection)			I_{ON} = 4 A, I_F = 5 mA, t < 1 s	—	18	—	
ON-state resistance (C connection)			I_{ON} = 8 A, I_F = 5 mA, t < 1 s	—	9	—	

Note 1: For an application circuit example, see Chapter 16.2.

14. Isolation Characteristics (Unless otherwise specified, T_a = 25 °C)

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	—	0.8	—	pF
Isolation resistance	R_S	(Note 1)	V_S = 500 V, R.H. ≤ 60 %	5×10^{10}	10^{14}	—	Ω
Isolation voltage	BV_S	(Note 1)	AC, 60 s	2500	—	—	Vrms

Note 1: This device is considered as a two-terminal device: Pins 1, 2 and 3 are shorted together, and pins 4, 5 and 6 are shorted together.

15. Switching Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit
Turn-on time	t_{ON}		See Fig. 15.1. R_L = 200 Ω, V_{DD} = 20 V, I_F = 5 mA	—	1.2	5	ms
Turn-off time	t_{OFF}			—	0.1	0.5	
Turn-on time	t_{ON}		See Fig. 15.1. R_L = 200 Ω, V_{DD} = 20 V, I_F = 10 mA	—	0.5	3	
Turn-off time	t_{OFF}			—	0.1	0.5	

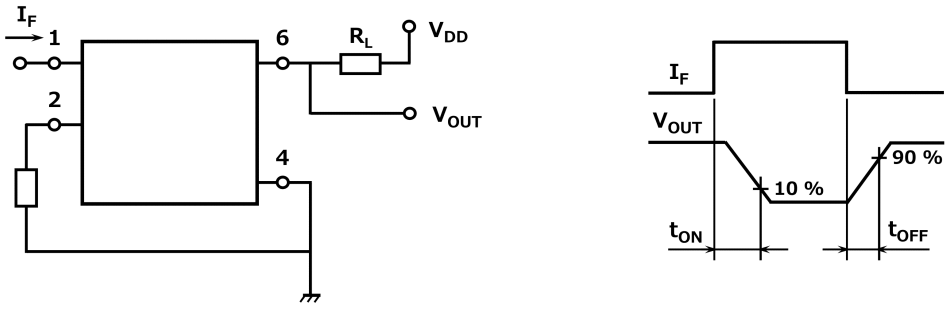


Fig. 15.1 Switching Time Test Circuit and Waveform

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16. Characteristics Curves and Circuit Connections

16.1. Characteristics Curves (Note)

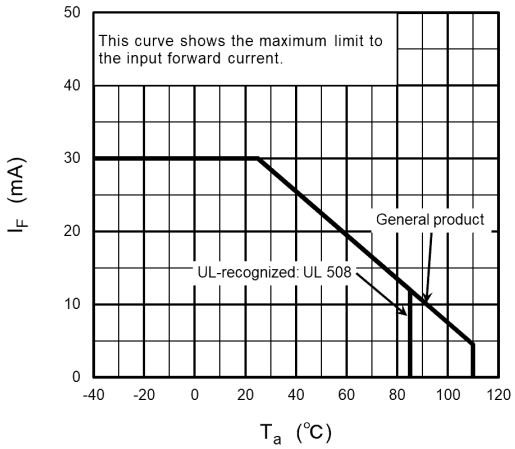


Fig. 16.1.1 I_F - T_a

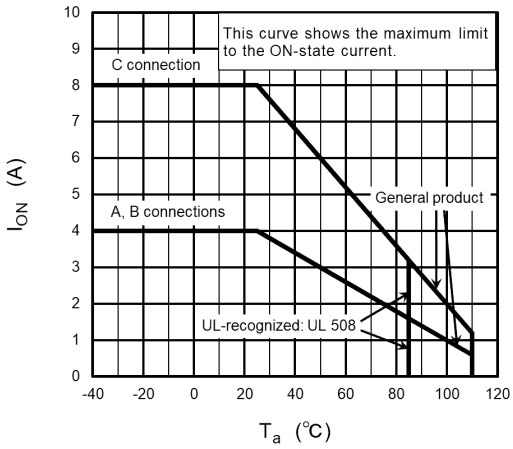


Fig. 16.1.2 I_{ON} - T_a

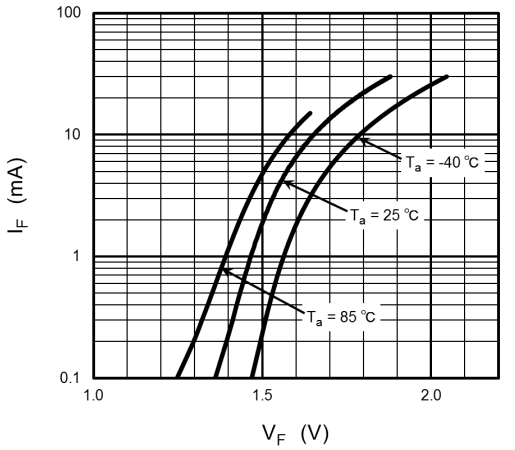


Fig. 16.1.3 I_F - V_F

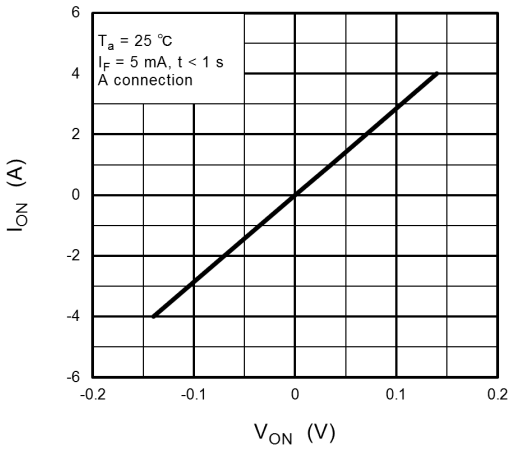


Fig. 16.1.4 I_{ON} - V_{ON}

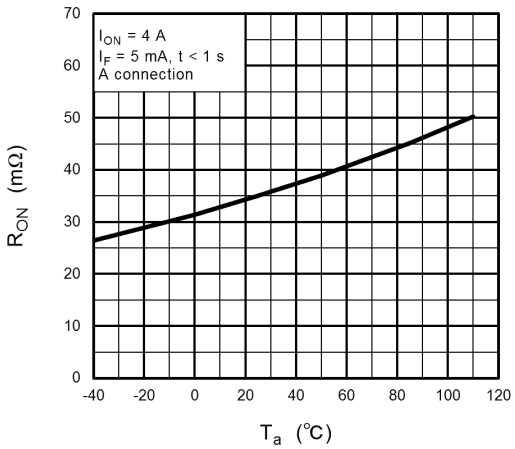


Fig. 16.1.5 R_{ON} - T_a

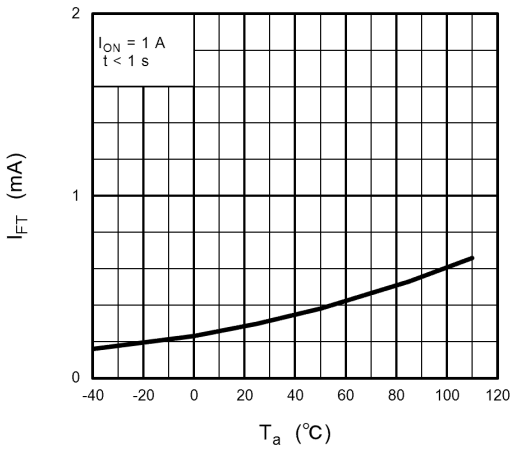


Fig. 16.1.6 I_{FT} - T_a

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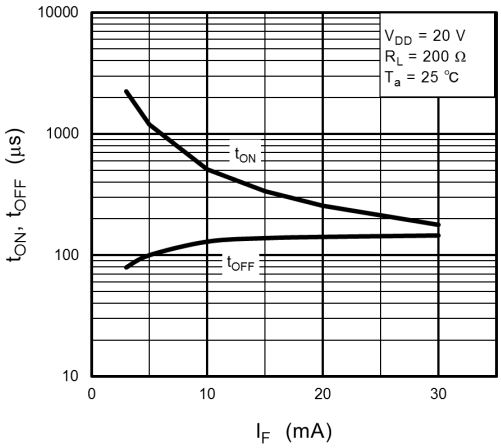


Fig. 16.1.7 t_{ON}, t_{OFF} - I_F

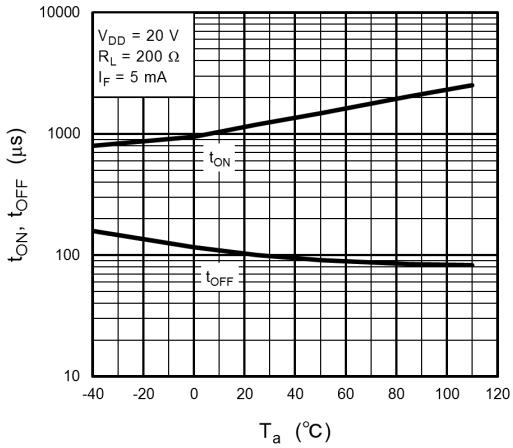


Fig. 16.1.8 t_{ON}, t_{OFF} - T_a

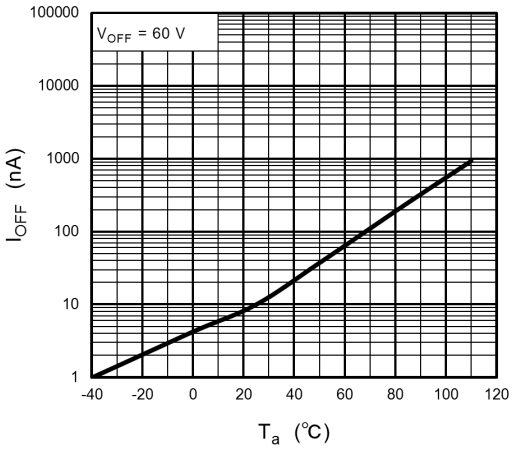


Fig. 16.1.9 I_{OFF} - T_a

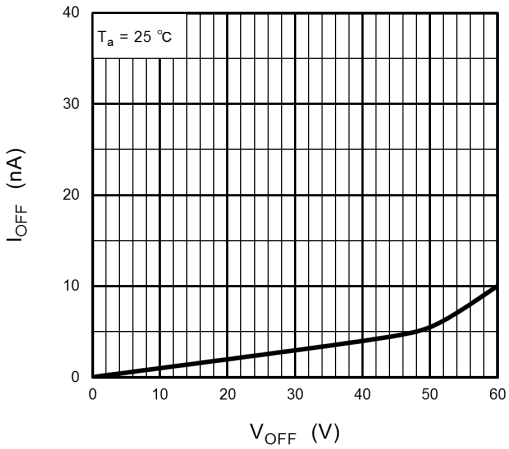


Fig. 16.1.10 I_{OFF} - V_{OFF}

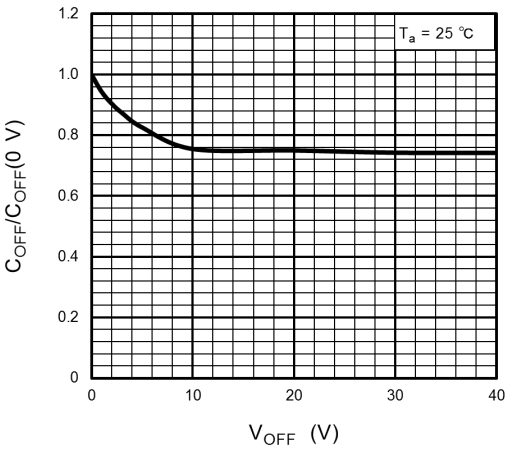


Fig. 16.1.11 C_{OFF}/C_{OFF}(0 V) - V_{OFF}

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

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16.2. Circuit Connections

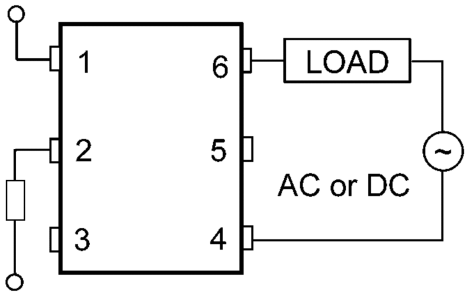


Fig. 16.2.1 A Connection

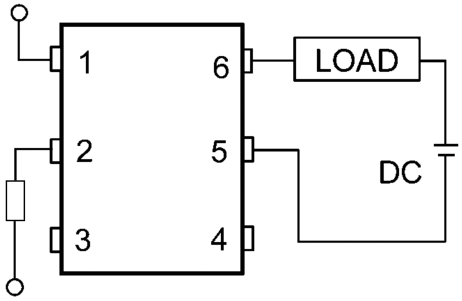


Fig. 16.2.2 B Connection

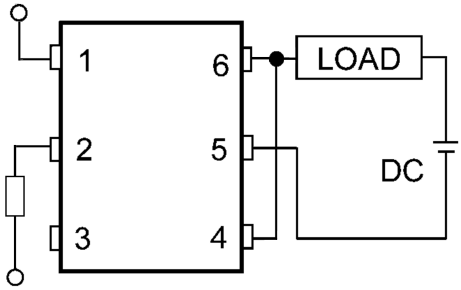


Fig. 16.2.3 C Connection

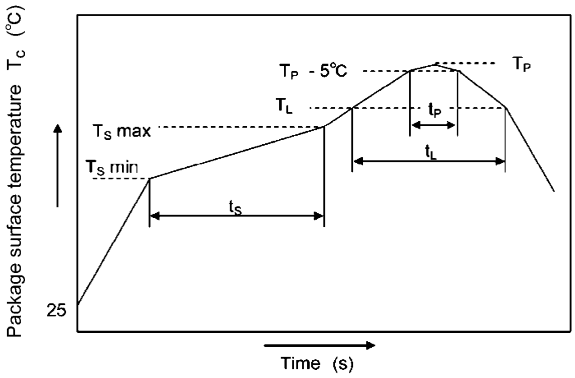
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17. Soldering and Storage

17.1. 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

- 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.

17.2. Precautions for General Storage

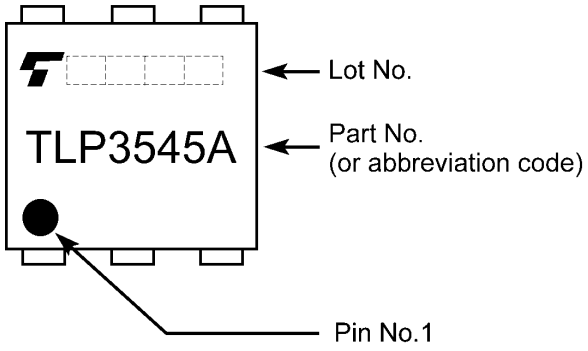
- Avoid storage locations where devices may be exposed to moisture or direct sunlight.
- Follow the precautions printed on the packing label of the device for transportation and storage.
- Keep the storage location temperature and humidity within a range of 5 °C to 35 °C and 45 % to 75 %, respectively.
- Do not store the products in locations with poisonous gases (especially corrosive gases) or in dusty conditions.
- Store the products 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.
- If devices have been stored for more than two years under normal storage conditions, it is recommended that you check the leads for ease of soldering prior to use.

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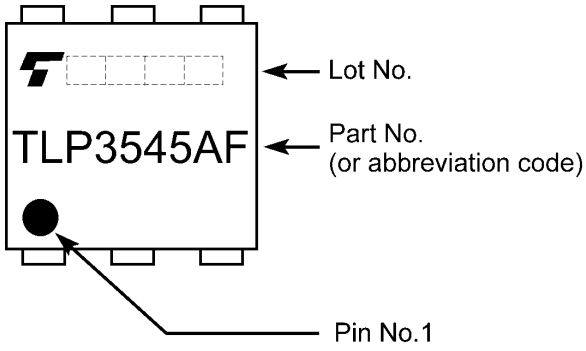
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18. Marking

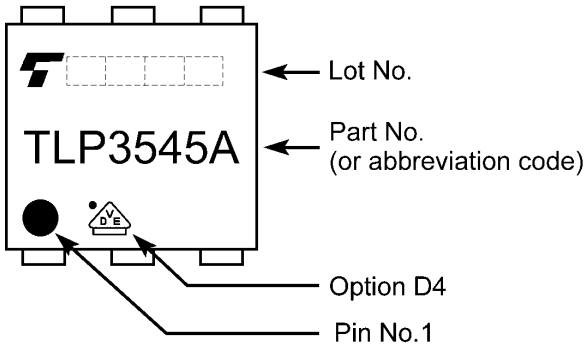
TLP3545A



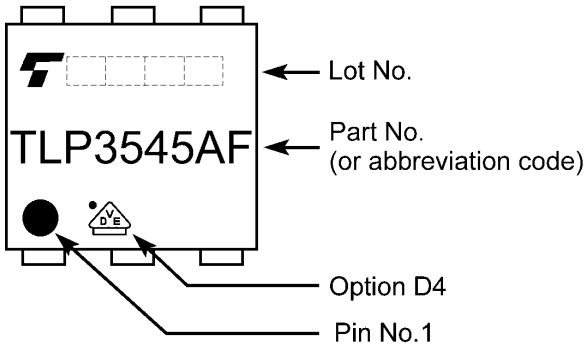
TLP3545AF



TLP3545A



TLP3545AF



Marking of EN 60747-5-5 option (VDE-approved) (Note 1)

Marking of EN 60747-5-5 option (VDE-approved) (Note 1)

Note 1: The above marking is applied to the photocouplers that have been qualified according to option (D4) of EN 60747.

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19. Ordering Information (Example of Item Name)

Item Name	Packaging (Note 1)	VDE Option	Packing (MOQ)
TLP3545A(F	TH		Magazine (50 pcs)
TLP3545A(LF1,F	LF1		Magazine (50 pcs)
TLP3545A(LF5,F	LF5		Magazine (50 pcs)
TLP3545A(TP1,F	LF1		Tape and reel (1500 pcs)
TLP3545A(TP5,F	LF5		Tape and reel (1500 pcs)
TLP3545A(D4,F	TH	EN 60747-5-5	Magazine (50 pcs)
TLP3545A(D4LF1,F	LF1	EN 60747-5-5	Magazine (50 pcs)
TLP3545A(D4LF5,F	LF5	EN 60747-5-5	Magazine (50 pcs)
TLP3545A(D4TP1,F	LF1	EN 60747-5-5	Tape and reel (1500 pcs)
TLP3545A(D4TP5,F	LF5	EN 60747-5-5	Tape and reel (1500 pcs)
TLP3545AF(F	TH, Wide forming		Magazine (50 pcs)
TLP3545AF(LF4,F	LF4, Wide forming		Magazine (50 pcs)
TLP3545AF(TP4,F	LF4, Wide forming		Tape and reel (1000 pcs)
TLP3545AF(D4,F	TH, Wide forming	EN 60747-5-5	Magazine (50 pcs)
TLP3545AF(D4LF4F	LF4, Wide forming	EN 60747-5-5	Magazine (50 pcs)
TLP3545AF(D4TP4F	LF4, Wide forming	EN 60747-5-5	Tape and reel (1000 pcs)

Note 1: TH: Through-hole, LF: Lead forming for surface mount

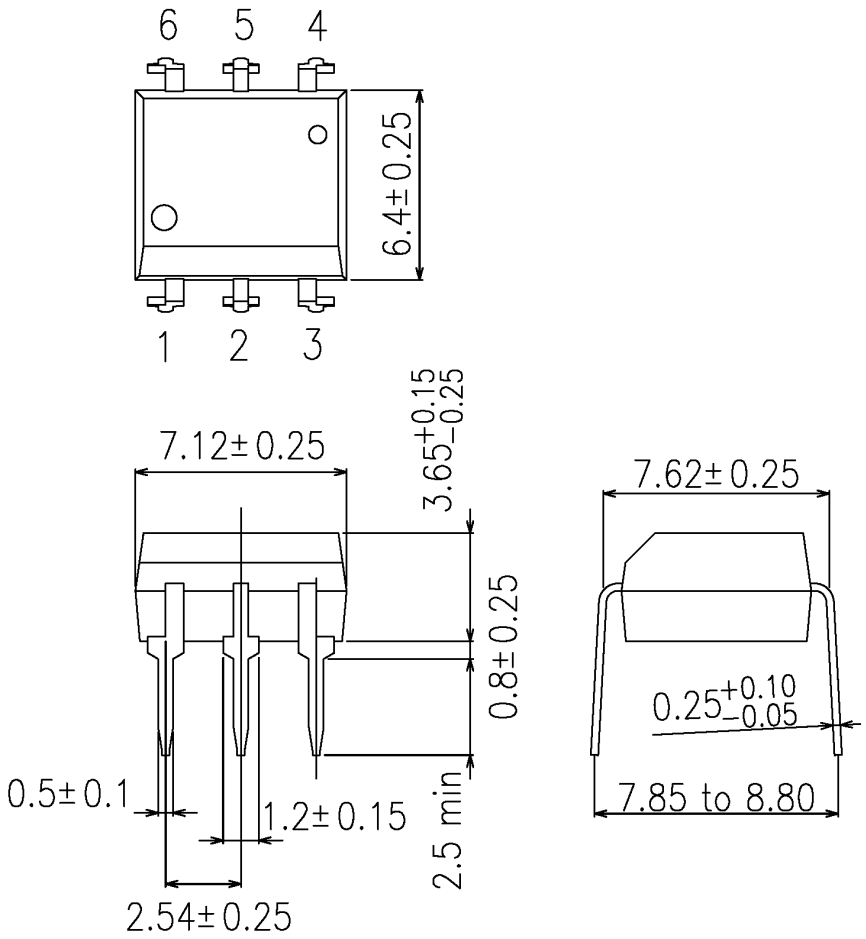
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Package Dimensions

Unit: mm

TLP3545A



Weight: 0.4 g (typ.)

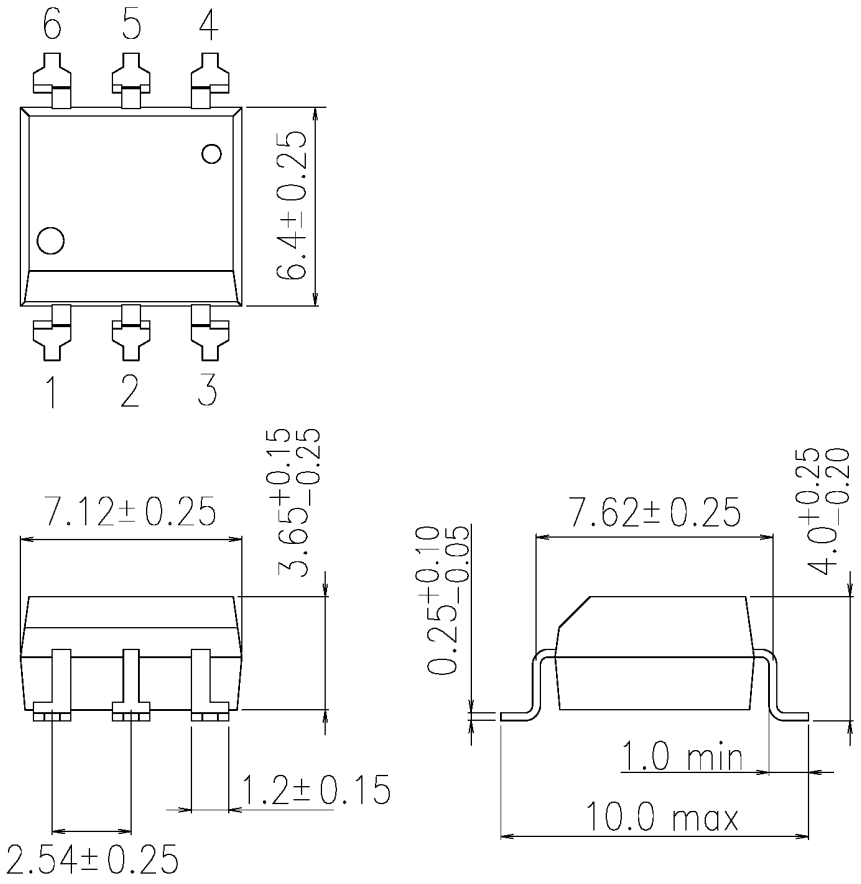
Package Name(s)
TOSHIBA: 11-7A8S

Downloaded from Arrow.com.

Package Dimensions

Unit: mm

TLP3545A(LF1,TP1)



Weight: 0.39 g (typ.)

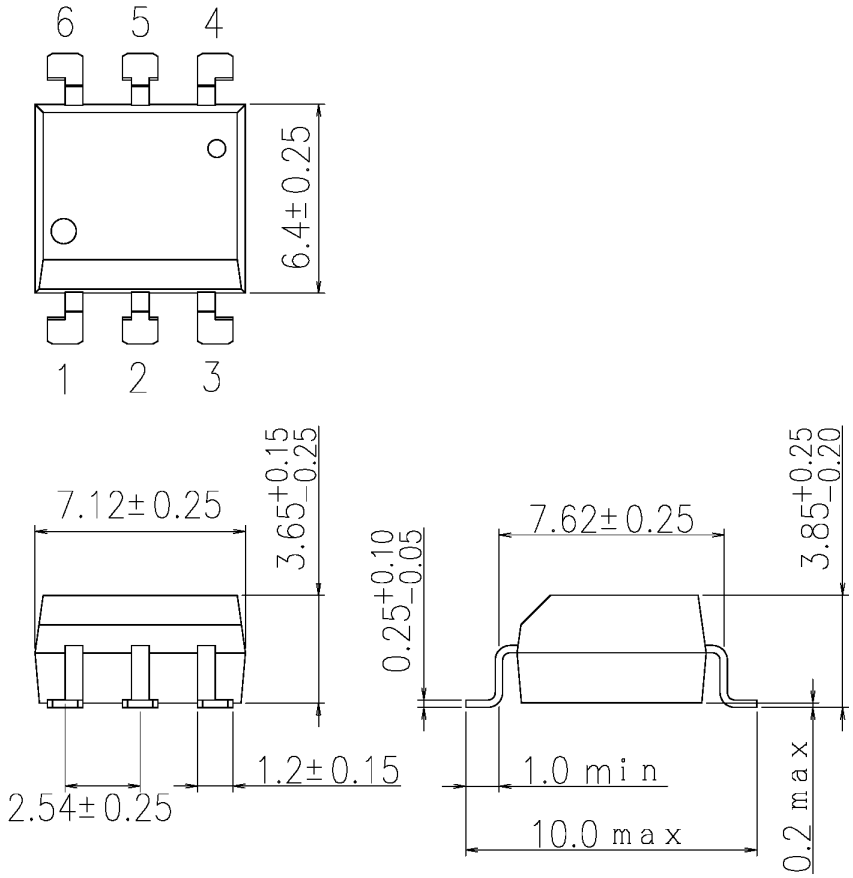
Package Name(s)
TOSHIBA: 11-7A801S

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Package Dimensions

Unit: mm

TLP3545A(LF5,TP5)



Weight: 0.39 g (typ.)

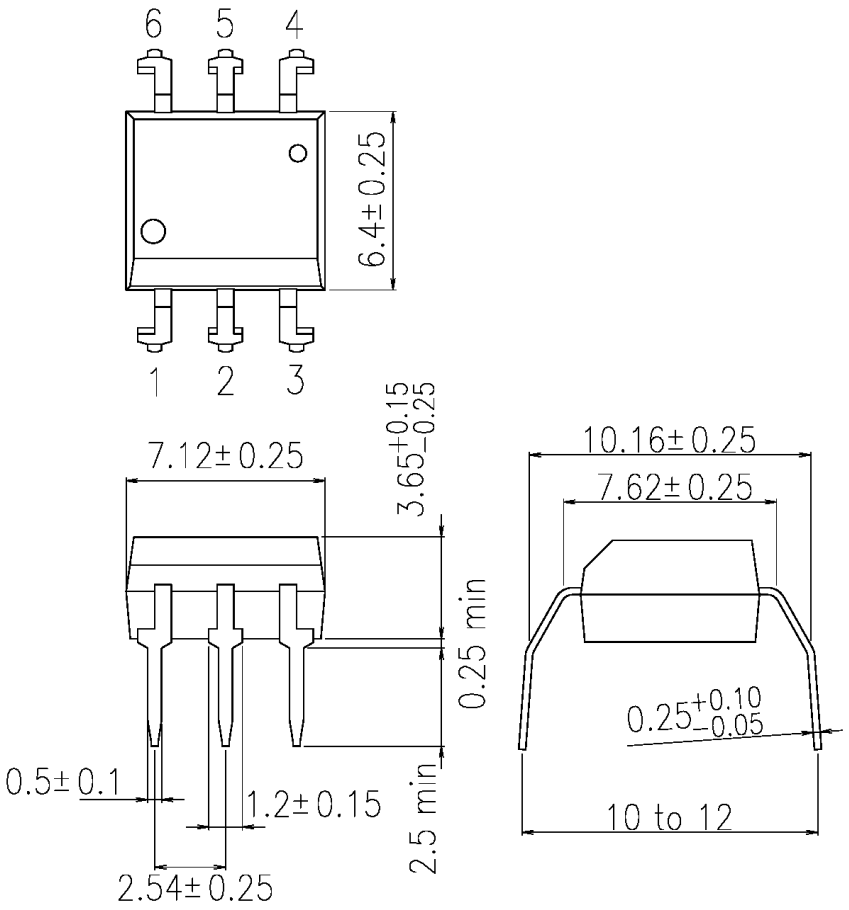
Package Name(s)
TOSHIBA: 11-7A805S

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Package Dimensions

Unit: mm

TLP3545AF



Weight: 0.4 g (typ.)

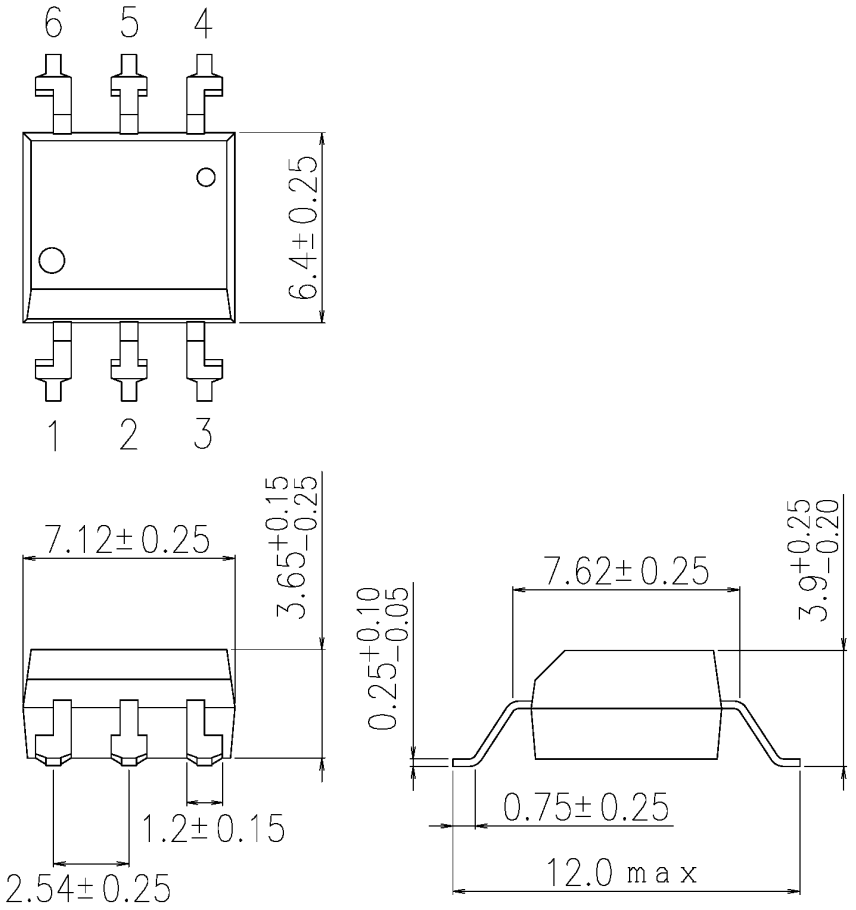
Package Name(s)
TOSHIBA: 11-7A802S

Downloaded from Arrow.com.

Package Dimensions

Unit: mm

TLP3545AF(LF4,TP4)



Weight: 0.39 g (typ.)

Package Name(s)
TOSHIBA: 11-7A804S

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