

# RV1S9993A / RV1S9994A

10 A OUTPUT CURRENT, HIGH CMTI  
 IGBT, GaN FET, SiC FET and Si power MOSFET gate drive  
 15 mm LONG CREEPAGE DISTANCE (LSDIP8) PHOTOCOUPLER

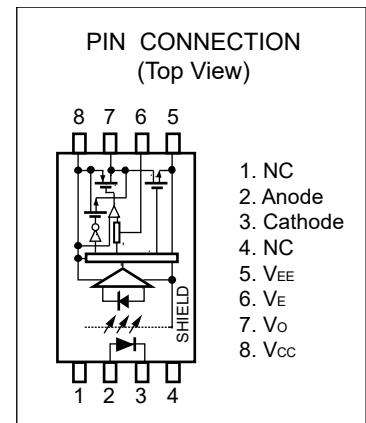
R08DS0324EJ0100  
 Rev.1.00  
 Dec. 12, 2025

## DESCRIPTION

The RV1S9993A / RV1S9994A are optically coupled isolators containing an AlGaAs LED on the input side and a photodiode with a signal processing circuit and power MOSFETs built in one chip on the output side. The RV1S9993A / RV1S9994A are designed specifically for high common mode transient immunity (CMTI), high speed switching and high temperature operation up to  $T_A = 125\text{ }^\circ\text{C}$ . They are suitable for driving IGBT, GaN FET, SiC FET and Si power MOSFET gate drive.

## FEATURES

- Product portfolio with two different UVLO (Under Voltage Lock Out) characteristics
  - RV1S9993A:  $V_{UVLO} = 9.6\text{ V MAX.}$
  - RV1S9994A:  $V_{UVLO} = 13.4\text{ V MAX.}$
- Long creepage distance (15 mm MIN., LSDIP8)
- Peak output current (10 A MAX.)
- High speed switching ( $t_{PLH}, t_{PHL} = 95\text{ ns MAX.}$ )
- Pulse width distortion ( $|t_{PLH} - t_{PHL}| = 35\text{ ns MAX.}$ )
- High common mode transient immunity ( $|CM_H|, |CM_L| = 100\text{ kV}/\mu\text{s MIN.}$ )
- High Operating ambient temperature (125 °C MAX.)
- High isolation voltage ( $BV = 7\ 500\text{ Vr.m.s.}$ )
- Embossed tape product:
  - RV1S9993ACCSP-10Yx#KC0: 1 000 pcs/reel
  - RV1S9994ACCSP-10Yx#KC0: 1 000 pcs/reel
- Pb-free product
- Safety standard
  - UL : UL1577, Double protection
  - VDE : DIN EN IEC 60747-5-5, DIN EN IEC 62368-1, Reinforced insulation (Option)

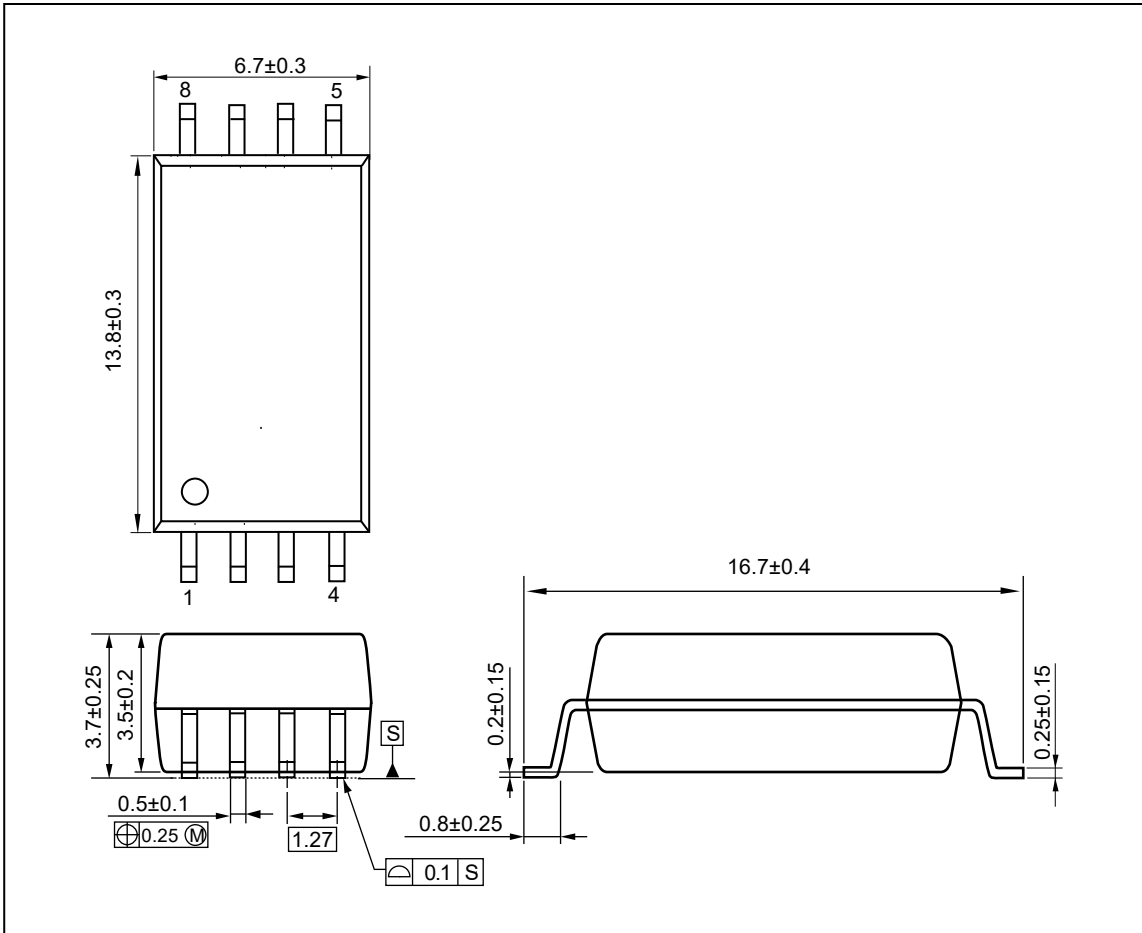


## APPLICATIONS

- IGBT, GaN FET, SiC FET and Si power MOSFET gate drive
- Industrial inverter / AC servo
- Solar and wind power conditioner

Start of mass production  
 Dec.2025

PACKAGE DIMENSIONS (UNIT: mm)

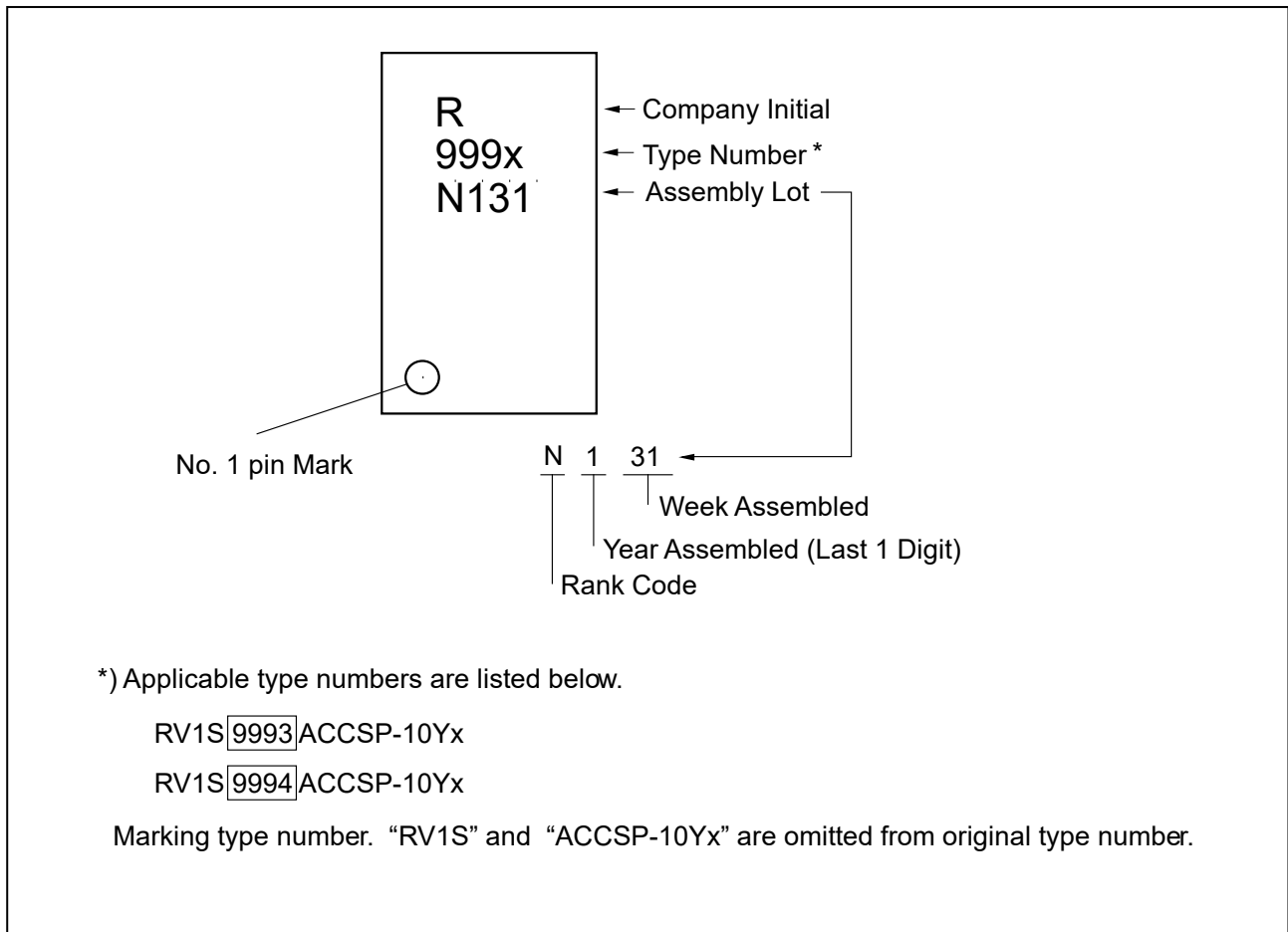


Weight: 0.642 g (TYP.)

PHOTOCOUPLER CONSTRUCTION

Parameter	MIN.
Air Distance	14.5 mm
Creepage Distance	15 mm
Isolation Distance	0.4 mm

MARKING EXAMPLE



ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number *1	
RV1S9993ACCSP -10YC	RV1S9993ACCSP -10YC#SC0	Pb-Free and Halogen Free (Ni/Pd/Au)	Embossed Tape 10 pcs	UL Approved	RV1S9993A	
	RV1S9993ACCSP -10YC#KC0		Embossed Tape 1 000 pcs/reel			
RV1S9993ACCSP -10YV	RV1S9993ACCSP -10YV#SC0		Embossed Tape 10 pcs	UL, VDE Approved		
	RV1S9993ACCSP -10YV#KC0		Embossed Tape 1 000 pcs/reel			
RV1S9994ACCSP -10YC	RV1S9994ACCSP -10YC#SC0		Embossed Tape 10 pcs	UL Approved		RV1S9994A
	RV1S9994ACCSP -10YC#KC0		Embossed Tape 1 000 pcs/reel			
RV1S9994ACCSP -10YV	RV1S9994ACCSP -10YV#SC0	Embossed Tape 10 pcs	UL, VDE Approved			
	RV1S9994ACCSP -10YV#KC0	Embossed Tape 1 000 pcs/reel				

Notes:\*1. For the application of the safety standard, the following part number should be used.

ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25 °C, unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Diode	Forward Current	I <sub>F</sub>	25	mA
	Peak Transient Forward Current (Pulse Width < 1μs)	I <sub>F (TRAN)</sub>	1.0	A
	Reverse Voltage	V <sub>R</sub>	5	V
	Power Dissipation *1	P <sub>D</sub>	45	mW
Detector	High Level Peak Output Current *2	I <sub>OH (PEAK)</sub>	10.0	A
	Low Level Peak Output Current *2	I <sub>OL (PEAK)</sub>	10.0	A
	Supply Voltage 1	(V <sub>CC</sub> - V <sub>EE</sub> )	-0.3 to 35	V
	Supply Voltage 2	(V <sub>CC</sub> - V <sub>E</sub> )	-0.3 to 35 - (V <sub>E</sub> - V <sub>EE</sub> )	V
	Supply Voltage 3	(V <sub>E</sub> - V <sub>EE</sub> )	-0.3 to 17	V
	Output Voltage	V <sub>O</sub>	0 to V <sub>CC</sub>	V
	Power Dissipation *3	P <sub>C</sub>	250	mW
Isolation Voltage *4		BV	7 500	Vr.m.s.
Operating Ambient Temperature		T <sub>A</sub>	-40 to +125	°C
Storage Temperature		T <sub>stg</sub>	-40 to +150	°C

Notes: \*1. Reduced at a rate of 1.2 mW/°C above T<sub>A</sub> = 110 °C.

\*2. Maximum pulse width = 10 μs, Maximum duty cycle = 0.2 %.

\*3. Reduced at a rate of 2.8 mW/°C above T<sub>A</sub> = 90 °C.

\*4. AC voltage for 1 minute at T<sub>A</sub> = 25 °C, RH = 60 % between input and output.

Pins 1-2 shorted together, 3-5 shorted together.

## RECOMMENDED OPERATING CONDITIONS

Parameter		Symbol	MIN.	TYP.	MAX.	Unit
Supply Voltage 1	RV1S9993A	(V <sub>CC</sub> - V <sub>EE</sub> )	10		30	V
	RV1S9994A		15		30	
Supply Voltage 2	RV1S9993A	(V <sub>CC</sub> - V <sub>E</sub> )	10		30 - (V <sub>E</sub> - V <sub>EE</sub> )	V
	RV1S9994A		15		30 - (V <sub>E</sub> - V <sub>EE</sub> )	
Supply Voltage 3	RV1S9993A	(V <sub>E</sub> - V <sub>EE</sub> )	0		15	V
	RV1S9994A		0		10	
Forward Current (ON)		I <sub>F (ON)</sub>	12	14	16	mA
Forward Voltage (OFF)		V <sub>F (OFF)</sub>	-2		0.8	V
Operating Ambient Temperature		T <sub>A</sub>	-40		+125	°C

## ELECTRICAL CHARACTERISTICS

(at recommended operating conditions,  $V_{EE} = V_E = \text{GND}$ , unless otherwise specified)

Parameter		Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit	
Diode	Forward Voltage	$V_F$	$I_F = 14 \text{ mA}$ , $T_A = 25 \text{ }^\circ\text{C}$	1.4	1.6	1.8	V	
	Reverse Current	$I_R$	$V_R = 3 \text{ V}$ , $T_A = 25 \text{ }^\circ\text{C}$			10	$\mu\text{A}$	
	Input Capacitance	$C_i$	$V_F = 0 \text{ V}$ , $f = 1 \text{ MHz}$ , $T_A = 25 \text{ }^\circ\text{C}$		30		pF	
Detector	High Level Output Current	$I_{OH}$	$V_O = (V_{CC} - 4 \text{ V})^{*2, *5}$		-6.8	-3.0	A	
			$V_O = (V_{CC} - 10 \text{ V})^{*3, *5}$			-9		
	Low Level Output Current	$I_{OL}$	$V_O = (V_{EE} + 2.5 \text{ V})^{*2, *5}$	3	5.9		A	
			$V_O = (V_{EE} + 10 \text{ V})^{*3, *5}$	9				
	High Level Output Voltage	$V_{OH}$	$I_O = -100 \text{ mA}^{*4}$	$V_{CC} - 0.3$	$V_{CC} - 0.1$		V	
	Low Level Output Voltage	$V_{OL}$	$I_O = 100 \text{ mA}$		0.1	0.3	V	
	High Level Supply Current	$I_{CCH}$	$V_O = \text{Open}$ , $I_F = 14 \text{ mA}^{*5}$		2.5	4	mA	
	Low Level Supply Current	$I_{CCL}$	$V_O = \text{Open}$ , $V_F = 0 \text{ to } 0.8 \text{ V}^{*5}$		2.8	4	mA	
	RV1S9993A	UVLO Threshold	$V_{UVLO+}$	$V_O > 5 \text{ V}$ , $I_F = 14 \text{ mA}$	7.6	8.6	9.6	V
			$V_{UVLO-}$		6.6	7.6	8.6	V
		UVLO Hysteresis	$UVLO_{HYS}$		0.3	1.0		V
	RV1S9994A	UVLO Threshold	$V_{UVLO+}$	$V_O > 5 \text{ V}$ , $I_F = 14 \text{ mA}$	10.8	12.0	13.4	V
			$V_{UVLO-}$		9.5	11.0	12.5	V
		UVLO Hysteresis	$UVLO_{HYS}$		0.4	1.0		V
Coupled	Threshold Input Current (L $\rightarrow$ H)	$I_{FLH}$	$I_O = 0 \text{ mA}$ , $V_O > 5 \text{ V}^{*5}$		3.0	8.0	mA	
	Threshold Input Voltage (H $\rightarrow$ L)	$V_{FHL}$	$I_O = 0 \text{ mA}$ , $V_O < 5 \text{ V}$	0.8			V	

Notes: \*1. Typical values at  $T_A = 25 \text{ }^\circ\text{C}$ ,  $V_{CC} - V_{EE} = 30 \text{ V}$ \*2. Maximum pulse width = 50  $\mu\text{s}$ , Maximum duty cycle = 0.5 %.\*3. Maximum pulse width = 10  $\mu\text{s}$ , Maximum duty cycle = 0.2 %.\*4.  $V_{OH}$  is measured with the DC load current in this testing (Maximum pulse width = 2 ms, Maximum duty cycle = 20%).

\*5. The polarity of the current flowing from the external circuit to the RV1S9993A / RV1S9994A is positive.

## SWITCHING CHARACTERISTICS

(at recommended operating conditions,  $V_{EE} = V_E = \text{GND}$ , unless otherwise specified)

Parameter	Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit	
Propagation Delay Time (L → H)	$t_{PLH}$	$R_g = 4.7 \Omega$ , $C_g = 10 \text{ nF}$ , $f = 10 \text{ kHz}$ , Duty Cycle = 50 %, $I_F = 14 \text{ mA}$ , $C_{IN} = 60 \text{ pF}$ , $R_{IN} = 240 \Omega$		48	95	ns	
Propagation Delay Time (H → L)	$t_{PHL}$			42	95	ns	
Pulse Width Distortion	$PWD =  t_{PHL} - t_{PLH} $				6	35	ns
Propagation Delay Difference Between Any Two Parts	$PDD = t_{PHL} - t_{PLH}$			-35		35	ns
Rise Time	$t_r$				10		ns
Fall Time	$t_f$				10		ns
Common Mode Transient Immunity at High Level Output	$ CM_H $	$T_A = 25 \text{ }^\circ\text{C}$ , $I_F = 14 \text{ mA}$ , $V_{CC} = 30 \text{ V}$ , $V_{O(MIN.)} = 26 \text{ V}$ , $V_{CM} = 1.5 \text{ kV}$	100			kV/ $\mu\text{s}$	
Common Mode Transient Immunity at Low Level Output	$ CM_L $	$T_A = 25 \text{ }^\circ\text{C}$ , $I_F = 0 \text{ mA}$ , $V_{CC} = 30 \text{ V}$ , $V_{O(MAX.)} = 1 \text{ V}$ , $V_{CM} = 1.5 \text{ kV}$	100			kV/ $\mu\text{s}$	

Notes: \*1. Typical values at  $T_A = 25 \text{ }^\circ\text{C}$ ,  $V_{CC} - V_{EE} = 30 \text{ V}$

TEST CIRCUIT

Fig. 1  $I_{OH}$  Test Circuit

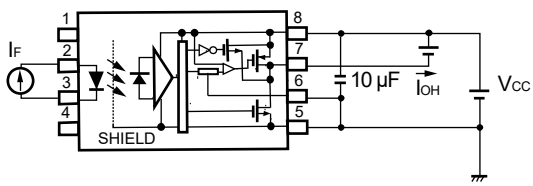


Fig. 2  $I_{OL}$  Test Circuit

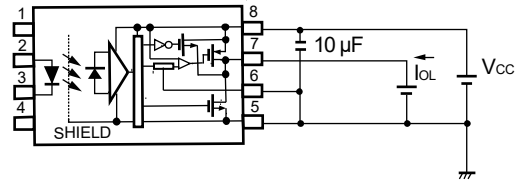


Fig. 3  $V_{OH}$  Test Circuit

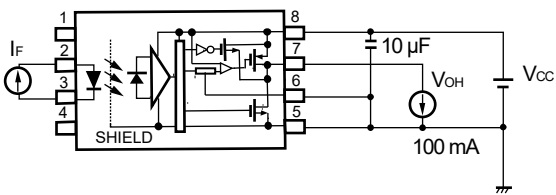


Fig. 4  $V_{OL}$  Test Circuit

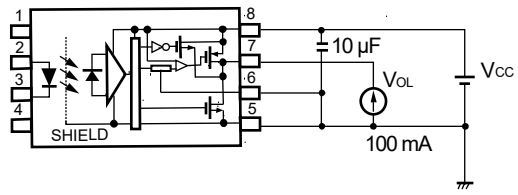


Fig. 5  $I_{CCH}$  Test Circuit

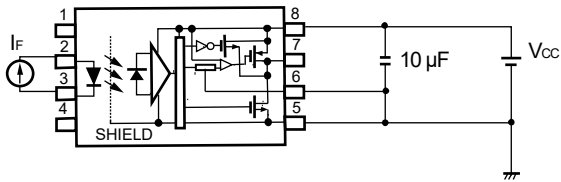


Fig. 6  $I_{CCL}$  Test Circuit

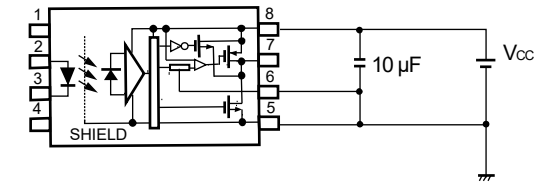


Fig. 7  $V_{UVLO}$  Test Circuit

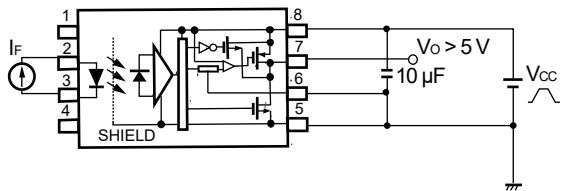


Fig. 8  $I_{FLH}$  Test Circuit

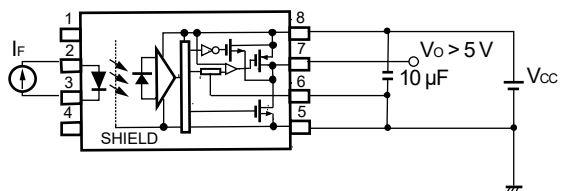


Fig. 9  $t_{PLH}$ ,  $t_{PHL}$ ,  $t_r$ ,  $t_f$  Test Circuit and Wave Forms

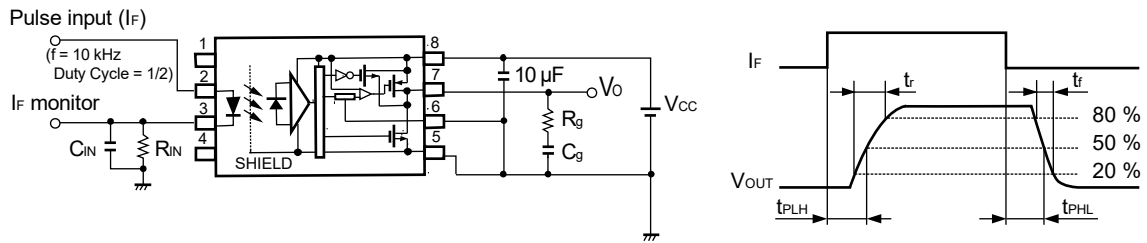
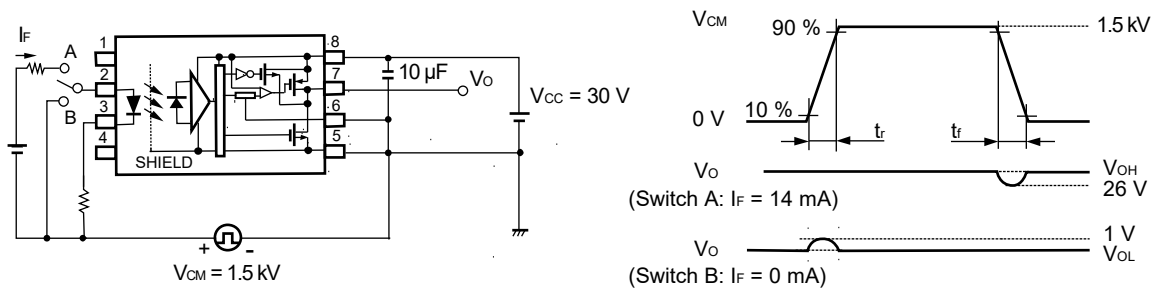
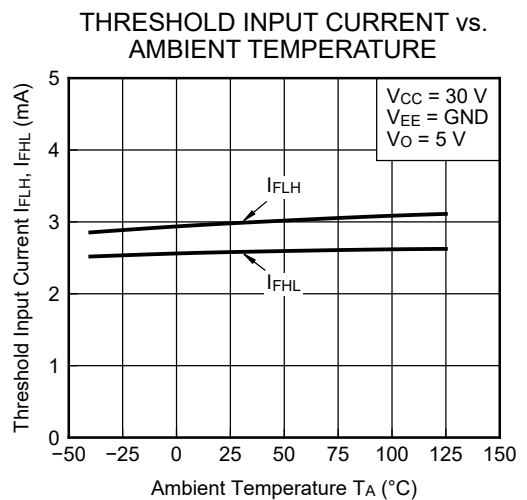
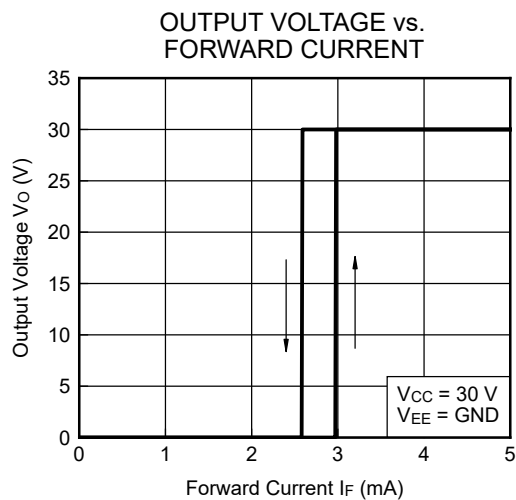
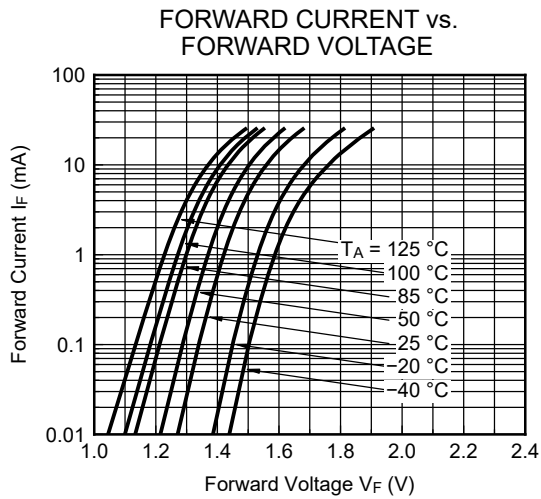
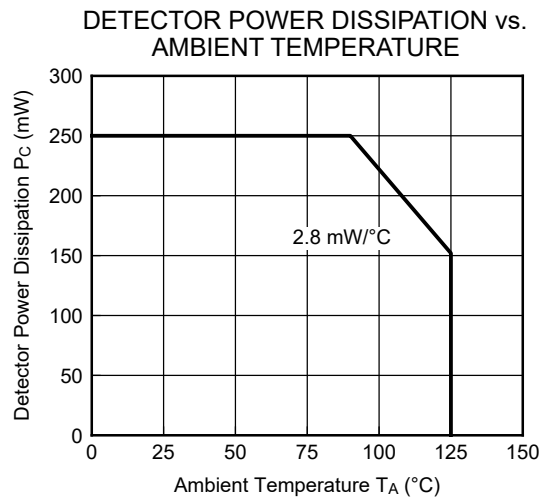
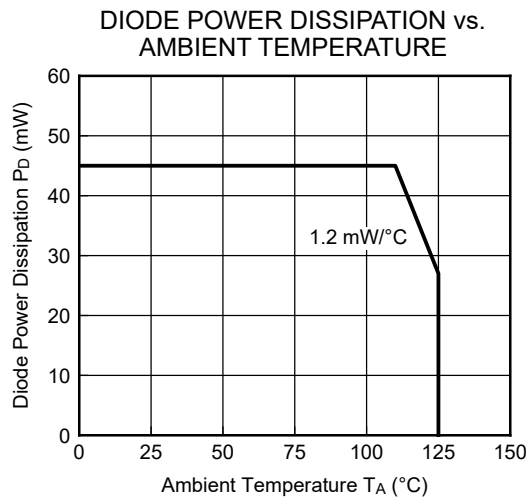


Fig. 10 Test circuit for common mode transient immunity and Wave Forms



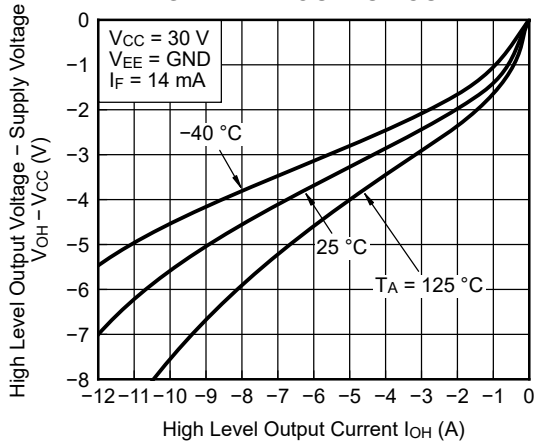
TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise specified)



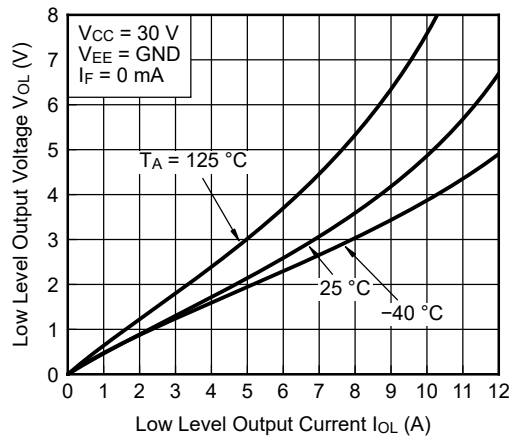
Remark The graphs indicate nominal characteristics.

TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^\circ\text{C}$ , unless otherwise specified)

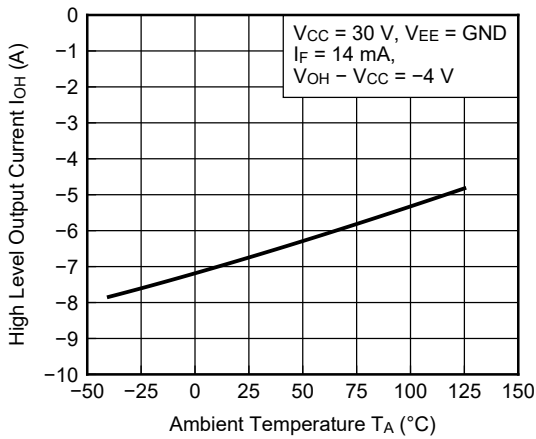
HIGH LEVEL OUTPUT VOLTAGE – SUPPLY VOLTAGE vs. HIGH LEVEL OUTPUT CURRENT



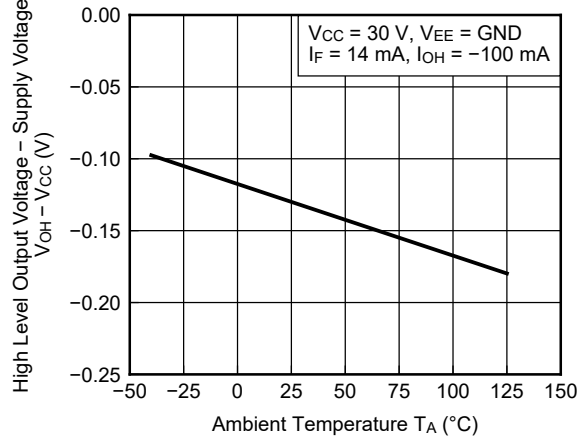
LOW LEVEL OUTPUT VOLTAGE vs. LOW LEVEL OUTPUT CURRENT



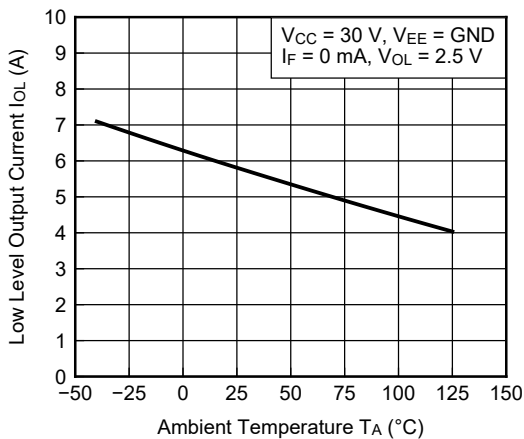
HIGH LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE



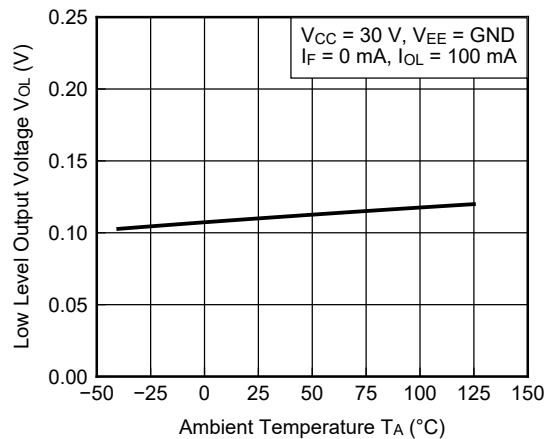
HIGH LEVEL OUTPUT VOLTAGE – SUPPLY VOLTAGE vs. AMBIENT TEMPERATURE



LOW LEVEL OUTPUT CURRENT vs. AMBIENT TEMPERATURE

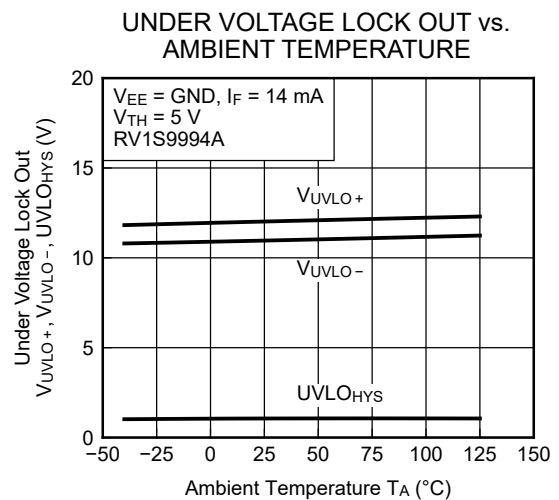
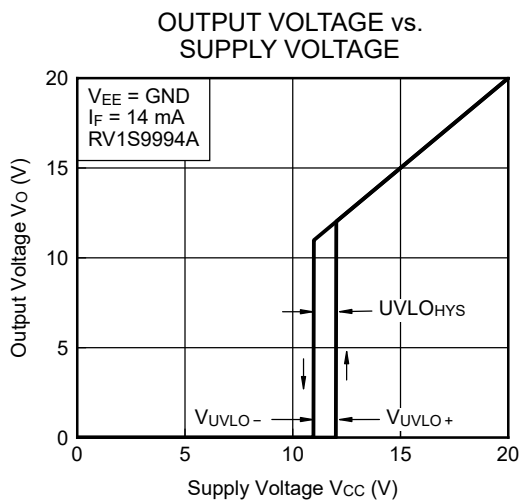
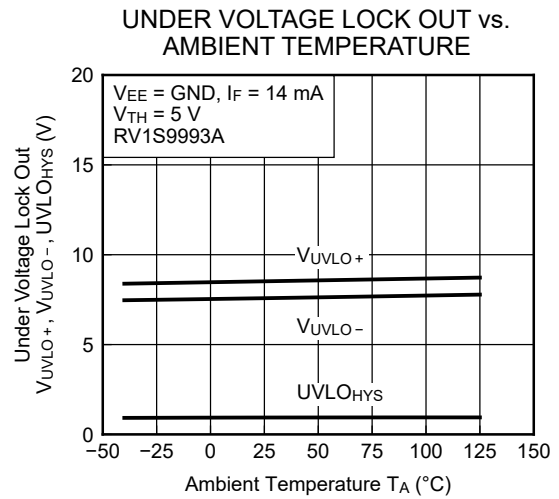
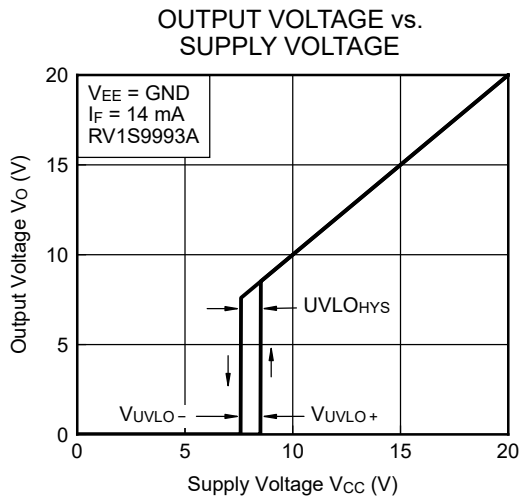
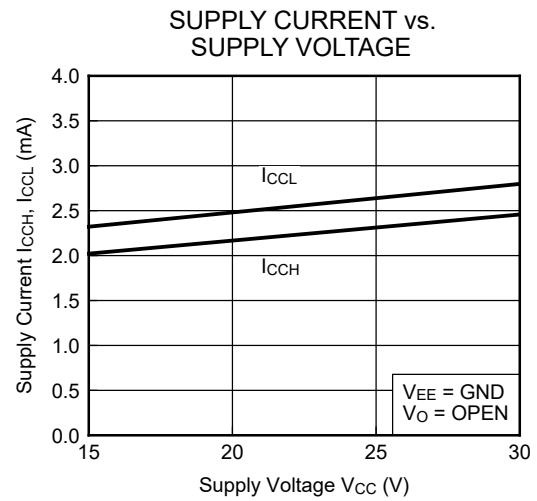
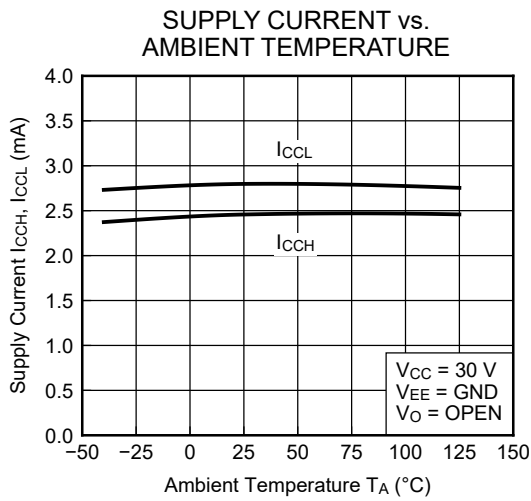


LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



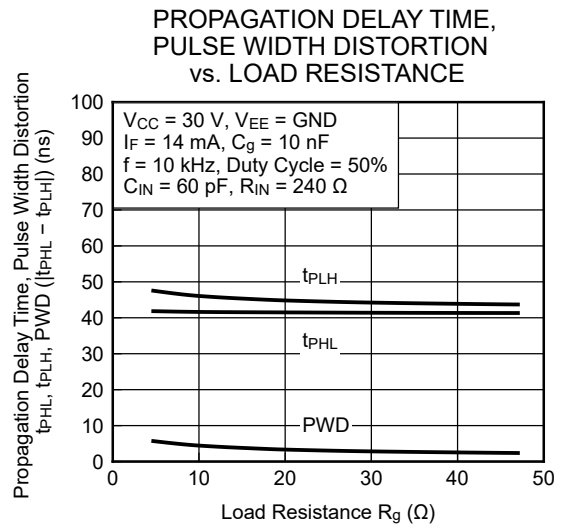
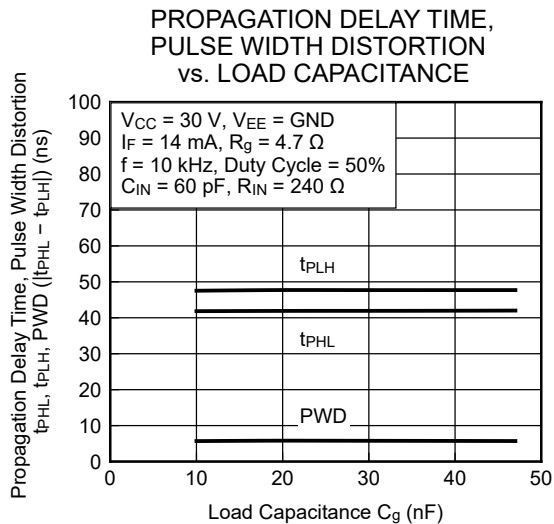
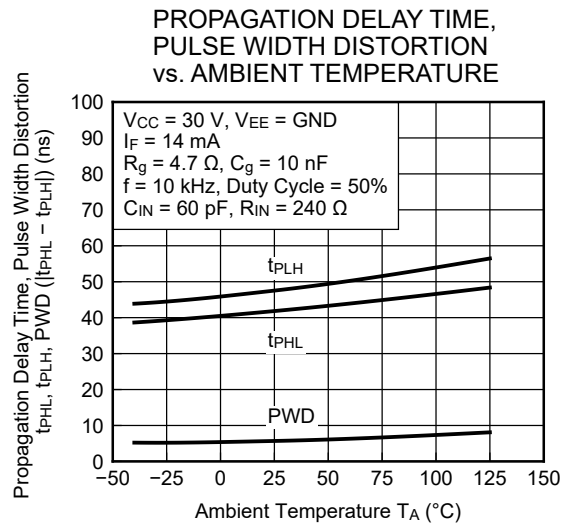
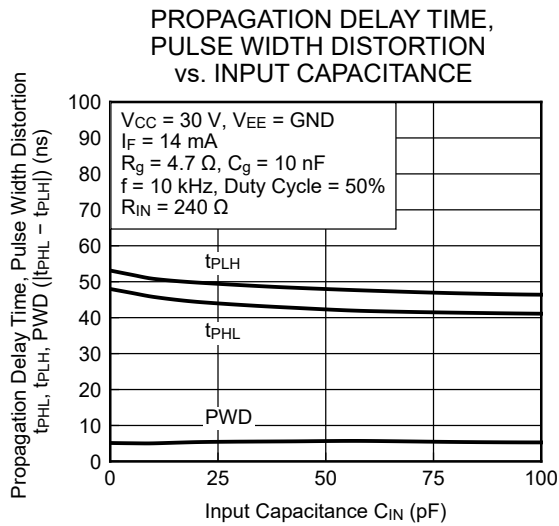
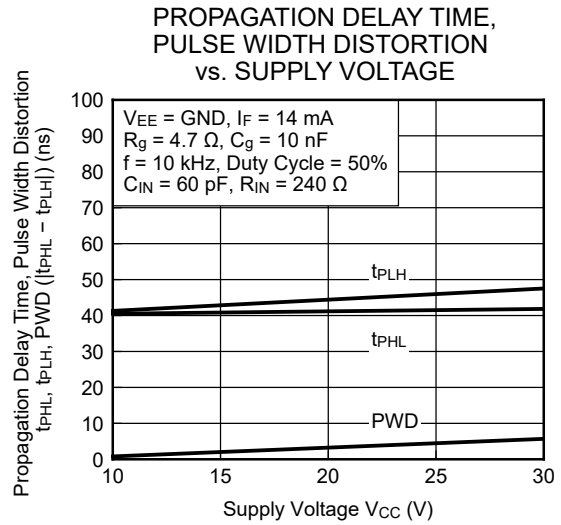
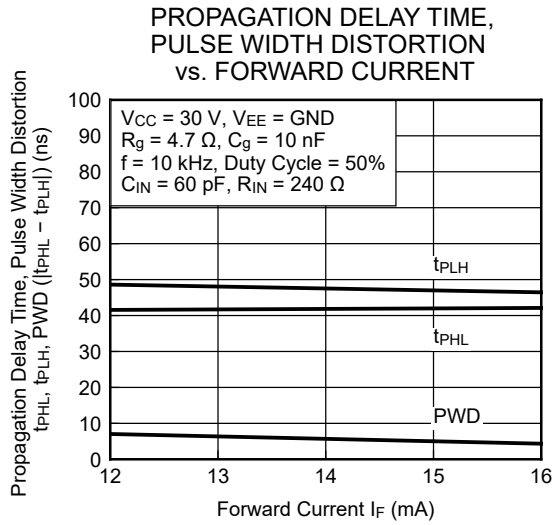
Remark The graphs indicate nominal characteristics.

TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C, unless otherwise specified)



Remark The graphs indicate nominal characteristics.

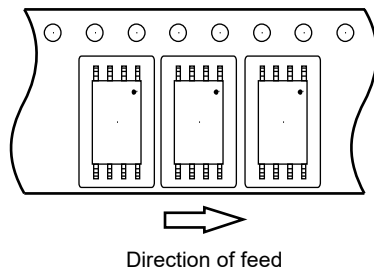
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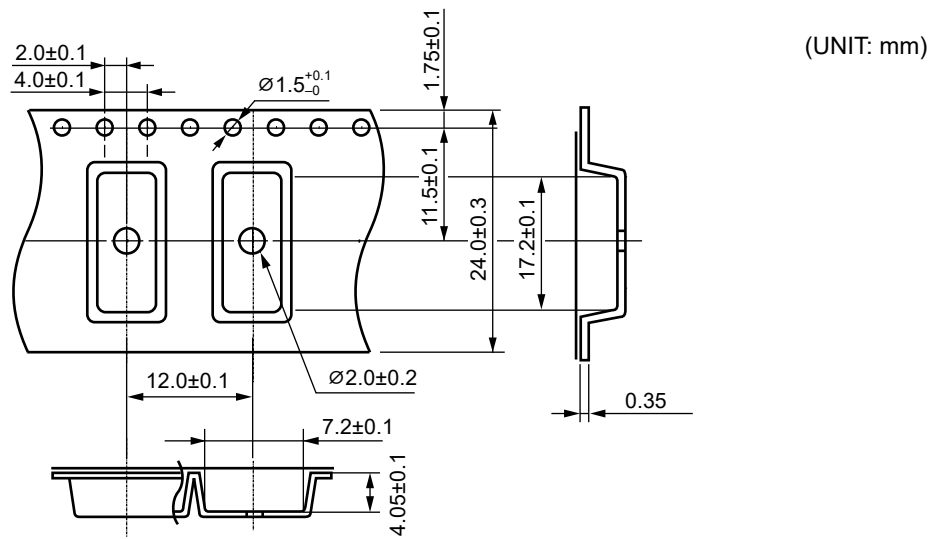
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

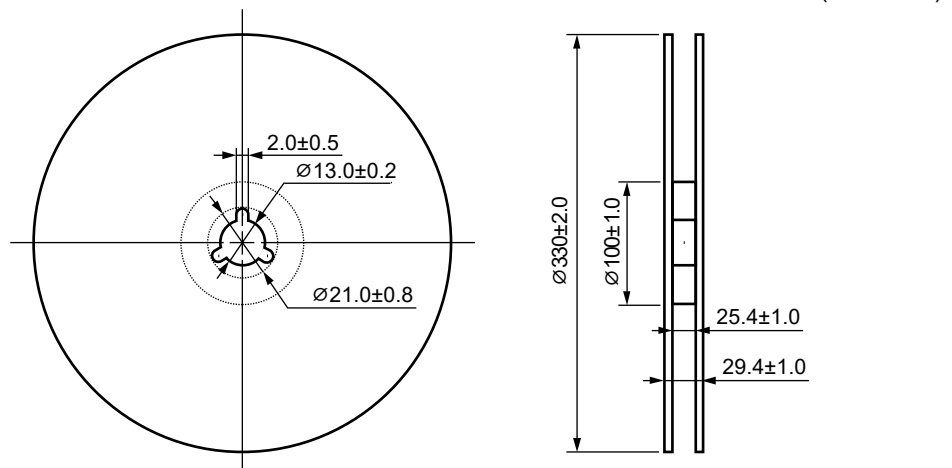
Tape Direction



Outline and Dimensions (Tape)

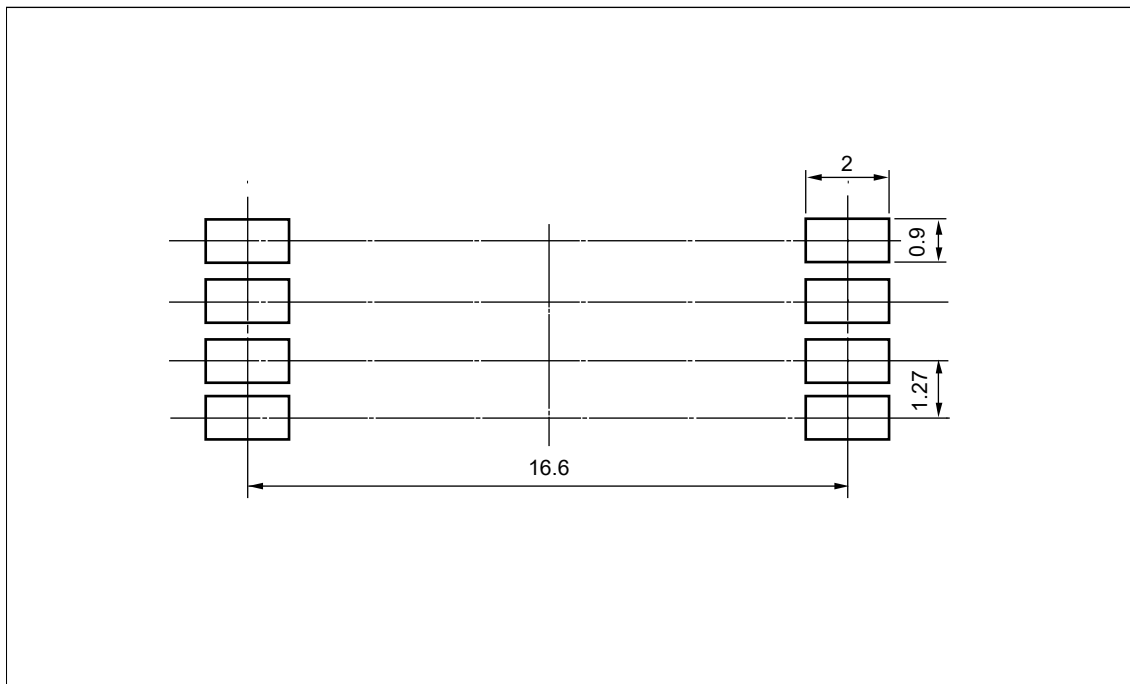


Outline and Dimensions (Reel)



包装数量: 1 000個/リール

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)



Remark All dimensions in this figure must be evaluated before use.

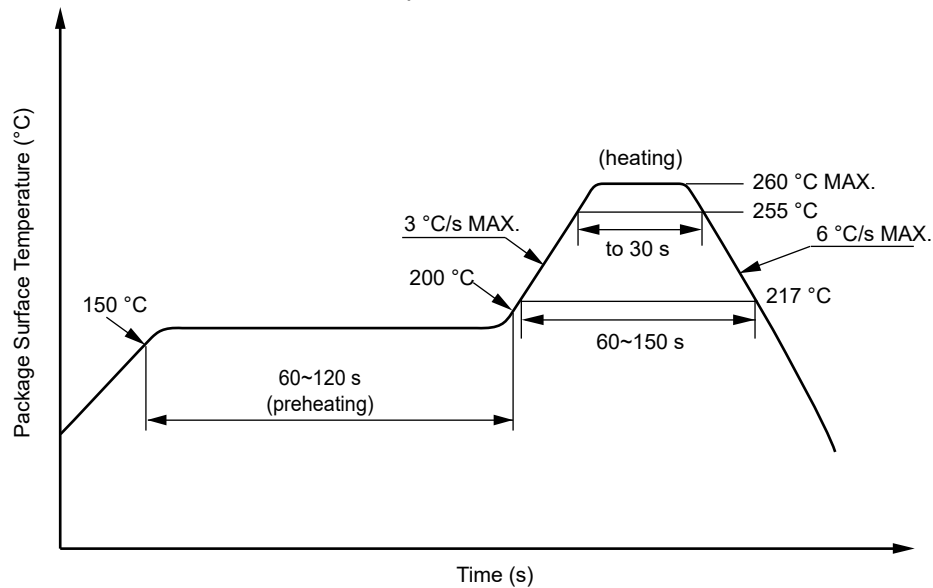
## NOTES ON HANDLING

## 1. Recommended soldering conditions

## (1) Infrared reflow soldering

- Peak reflow temperature 260 °C or below (package surface temperature)
- Time of peak reflow temperature -5 °C (255 °C) 30 s or less
- Time of temperature higher than 217 °C 60 to 150 seconds
- Time to preheat temperature from 150 to 200 °C 60 to 120 seconds
- Number of reflows Three
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

Recommended Temperature Profile of Infrared Reflow



JEDEC J-STD-020F compliant soldering conditions

## (2) Wave soldering

- Temperature 260 °C or below (molten solder temperature)
- Time 10 s or less
- Preheating conditions 120 °C or below (package surface temperature)
- Number of times One (Allowed to be dipped in solder including plastic mold portion.)
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

## (3) Soldering by Soldering Iron

- Peak temperature (lead part temperature) 350 °C or below
- Time (per one side) 3 s or less
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt % is recommended.)
- Place 1.5 to 2.0 mm or more away from the root of the lead

## (4) Cautions

- Flux cleaning Avoid cleaning with Freon- or halogen-based (chlorinated etc.) solvents.
- Fixing/Coating Do not use fixing agents or coatings containing halogen-based substances.

2. Cautions regarding noise

Be aware that when voltage is applied suddenly between the photocoupler's input and output at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

## USAGE CAUTIONS

1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.

2. Board designing

(1) A 10  $\mu$ F ceramic capacitor is required between  $V_{CC}$  and GND /  $V_E$  and GND as a bypass capacitor.

Since the circuit operates with high current and high-speed switching, place the photocoupler and the bypass capacitor as close together as possible to reduce parasitic inductance and minimize noise effects.

It is recommended to make the GND pattern as wide as possible and to mount the photocoupler and the bypass capacitor on the same side of the board.

(2) In the board artwork, ensure that the patterns of the IGBT collector/emitter or the MOSFET source/drain do not come close to the input of this product.

Coupling between the above patterns may allow transients from the IGBT/MOSFET side to enter the LED input of this product, which could cause malfunction or performance degradation.

(If it is necessary to route the patterns close to each other, design the input drive circuit so that the LED remains reverse-biased when off, preventing the LED from turning on due to transient coupling.)

(3) Pin 1, 4 (which is an NC\*1 pin) can either be connected directly to the GND pin on the LED side or left open. Unconnected pins should not be used as a bypass for signals or for any other similar purpose because this may degrade the internal noise environment of the device.

Note: \*1. NC: Non-Connection (No Connection)

3. Make sure the rise/fall time of the forward current is 0.5  $\mu$ s or less.

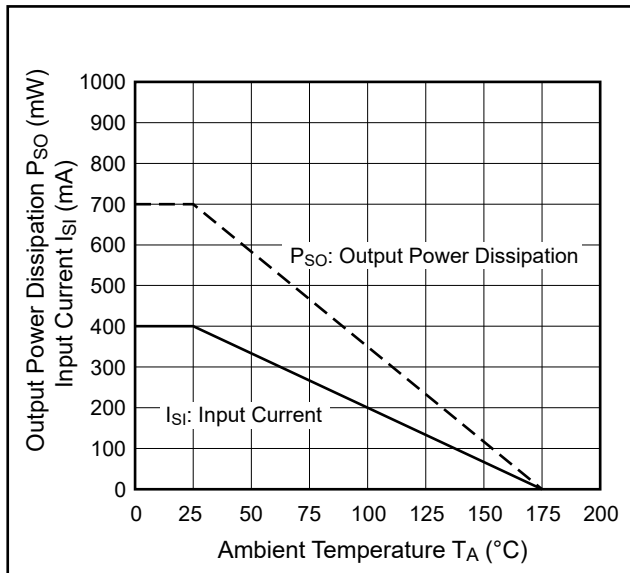
4. In order to avoid malfunctions, make sure the rise/fall slope of the supply voltage is 3 V/ $\mu$ s or less.

5. Avoid storage at a high temperature and high humidity.

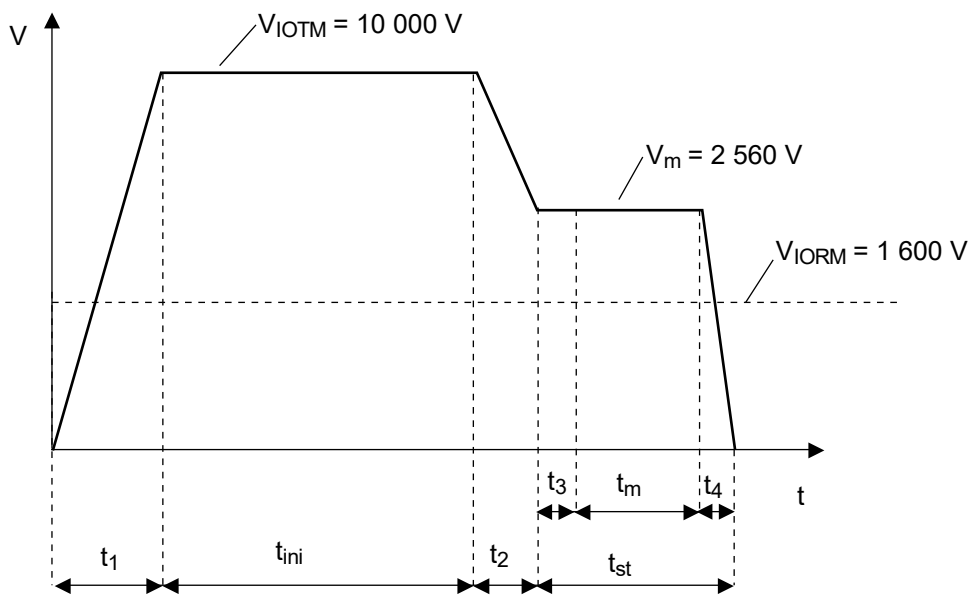
SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Rating	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/125/21	
Dielectric strength			
maximum operating isolation voltage	$V_{IORM}$	1 600	$V_{peak}$
Test voltage (partial discharge test, procedure a for type test and random test) $V_m = 1.6 \times V_{IORM}, q_{pd} < 5 \text{ pC}$	$V_m$	2 560	$V_{peak}$
Test voltage (partial discharge test, procedure b for all devices) $V_m = 1.875 \times V_{IORM}, q_{pd} < 5 \text{ pC}$	$V_m$	3 000	$V_{peak}$
Highest permissible overvoltage	$V_{IOTM}$	10 000	$V_{peak}$
Degree of pollution (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1))		2	
Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303-11))	CTI	175	
Material group (IEC 60664-1/DIN EN 60664-1 (VDE 0110-1))		III a	
Storage temperature range	$T_{stg}$	-40 to +150	°C
Operating temperature range	$T_A$	-40 to +125	°C
Isolation resistance, minimum value $V_{I-O} = 500 \text{ V dc}, T_A = 25 \text{ °C}$	$R_{I-O \text{ MIN.}}$	$10^{12}$	$\Omega$
$V_{I-O} = 500 \text{ V dc}, T_A = \text{maximum temperature of rating, at least } 100 \text{ °C}$	$R_{I-O \text{ MIN.}}$	$10^{11}$	$\Omega$
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve)			
Maximum ambient temperature	$T_S$	175	°C
Maximum input current	$I_{SI}$	400	mA
Maximum output power dissipation	$P_{SO}$	700	mW
Isolation resistance, minimum value at $V_{I-O} = 500 \text{ V dc}, T_A = T_S$	$R_{I-O \text{ MIN.}}$	$10^9$	$\Omega$

Dependence of maximum safety ratings on ambient temperature

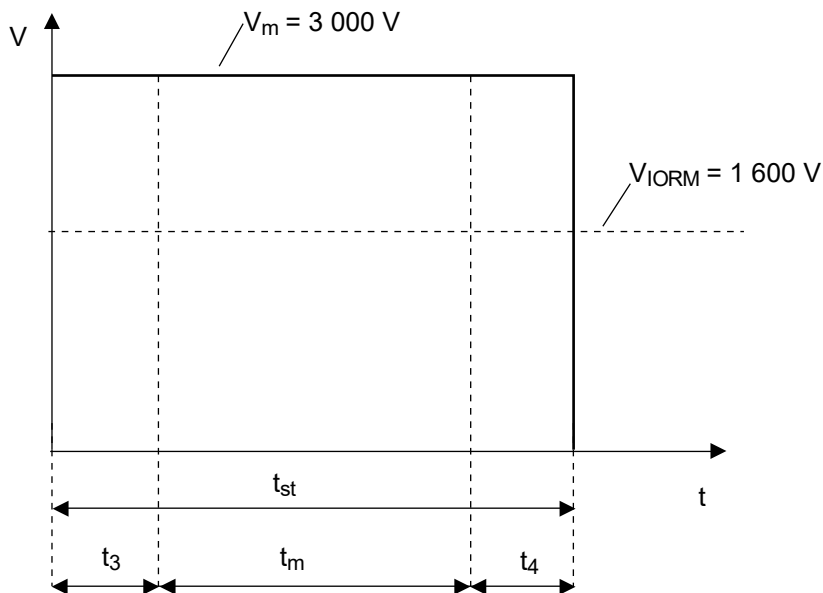


Method a) Destructive Test, Type and Sample Test



$t_1, t_2 = 1 \text{ to } 10 \text{ sec}$   
 $t_3, t_4 = 1 \text{ sec}$   
 $t_m = 10 \text{ sec}$   
 $t_{st} = 12 \text{ sec}$   
 $t_{ini} = 60 \text{ sec}$

Method b) Non-destructive Test, 100% Production Test



$t_3, t_4 = 0.1 \text{ sec}$   
 $t_m = 1.0 \text{ sec}$   
 $t_{st} = 1.2 \text{ sec}$

<p><b>Caution</b> GaAs Products</p>	<p>This product uses gallium arsenide (GaAs). GaAs vapor and powder are hazardous to human health if inhaled or ingested, so please observe the following points.</p> <ul style="list-style-type: none"><li>• Follow related laws and ordinances when disposing of the product. If there are no applicable laws and/or ordinances, dispose of the product as recommended below.<ol style="list-style-type: none"><li>1. Commission a disposal company able to (with a license to) collect, transport and dispose of materials that contain arsenic and other such industrial waste materials.</li><li>2. Exclude the product from general industrial waste and household garbage, and ensure that the product is controlled (as industrial waste subject to special control) up until final disposal.</li></ol></li><li>• Do not burn, destroy, cut, crush, or chemically dissolve the product.</li><li>• Do not lick the product or in any way allow it to enter the mouth.</li></ul>
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