

PS9113

1 Mbps, OPEN COLLECTOR OUTPUT

R08DS0124EJ0301

Rev.3.01

Oct 29, 2018

HIGH CMR, INTELLIGENT POWER MODULE DRIVE 5-PIN SOP (SO-5) PHOTOCOUPLER

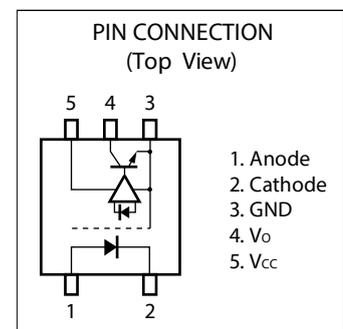
DESCRIPTION

The PS9113 is an optically coupled isolator containing an AlGaAs LED on the input side and a photo diode and a signal processing circuit on the output side on one chip.

The PS9113 is specified high CMR, high CTR and pulse width distortion with operating temperature. It is suitable for IPM drive.

FEATURES

- High instantaneous common mode rejection voltage ($CM_H, CM_L = \pm 15 \text{ kV}/\mu\text{s MIN.}$)
- Small package (SO-5)
- High-speed response ($t_{PHL} = 500 \text{ ns MAX.}, t_{PLH} = 750 \text{ ns MAX.}$)
- Propagation Delay Difference ($t_{PLH} - t_{PHL} = 270 \text{ ns TYP.}$)
- Pulse width distortion ($|t_{PHL} - t_{PLH}| = 270 \text{ ns TYP.}$)
- High isolation voltage ($BV = 3\,750 \text{ Vr.m.s.}$)
- Open collector output
- Ordering number of taping product: PS9113-F3: 2 500 pcs/reel
- Pb-Free product
- Safety standards
 - UL approved: UL1577, Single protection
 - CSA approved: CAN/CSA-C22.2 No. 62368-1, Basic insulation
 - VDE approved: DIN EN 60747-5-5 (Option)



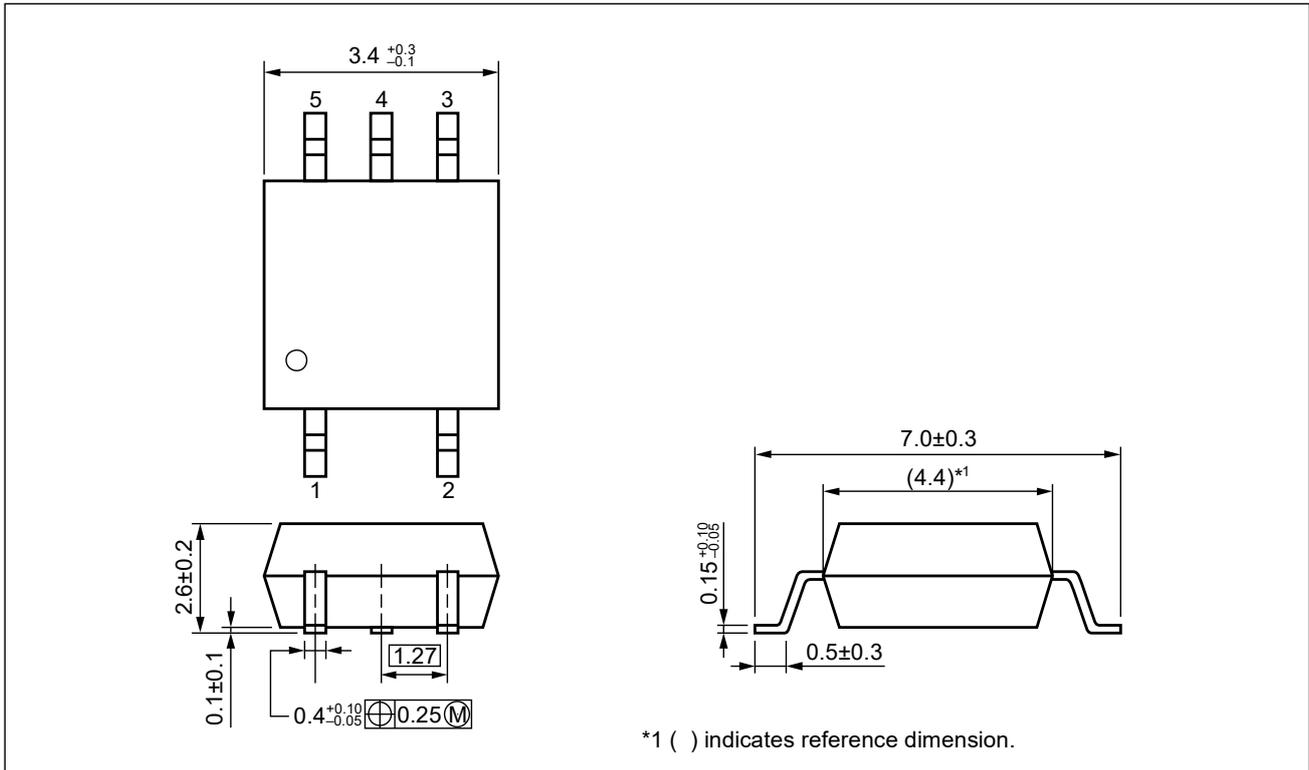
APPLICATIONS

- IPM Driver
- General purpose inverter

Start of mass production

Jan.2003

PACKAGE DIMENSIONS (UNIT: mm)

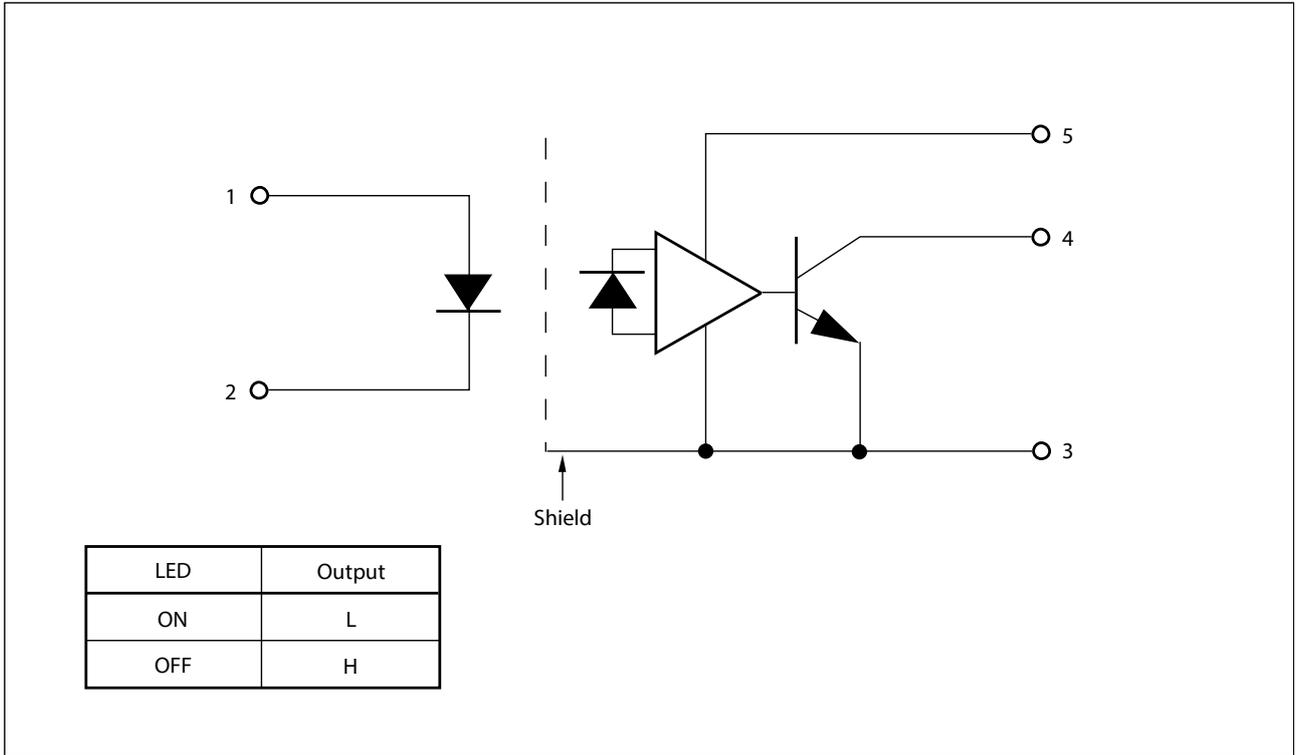


Weight: 0.08g (typ.)

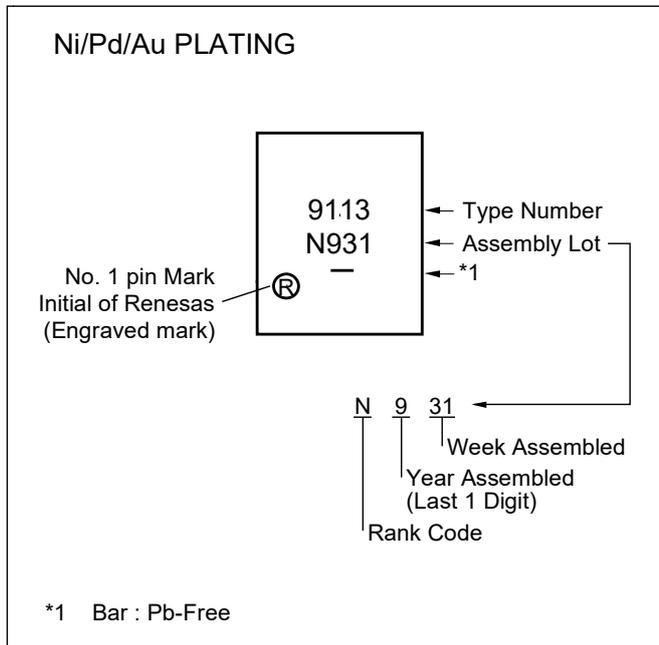
PHOTOCOUPLER CONSTRUCTION

Parameter	PS9113
Air Distance (MIN.)	4.2 mm
Creepage Distance (MIN.)	4.2 mm
Isolation Distance (MIN.)	0.2 mm

FUNCTIONAL DIAGRAM



MARKING EXAMPLE



ORDERING INFORMATION

Part Number	Order Number	Solder Plating Specification	Packing Style	Safety Standard Approval	Application Part Number ^{*1}
PS9113	PS9113-AX	Pb-Free (Ni/Pd/Au)	20 pcs (Tape 20 pcs cut)	Standard products (UL, CSA approved)	PS9113
PS9113-F3	PS9113-F3-AX		Embossed Tape 2500 pcs/reel		
PS9113-V	PS9113-V-AX		20 pcs (Tape 20 pcs cut)	UL, CSA, DIN EN 60747-5-5 approved	
PS9113-V-F3	PS9113-V-F3-AX		Embossed Tape 2 500 pcs/reel		

Notes*: 1. For the application of the Safety Standard, following part number should be used.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C, unless otherwise specified)

Parameter		Symbol	Ratings	Unit
Diode	Forward Current ^{*1}	I _F	25	mA
	Reverse Voltage	V _R	5	V
Detector	Supply Voltage	V _{CC}	-0.5 to +25	V
	Output Voltage	V _O	-0.5 to +25	V
	Output Current	I _O	15	mA
	Power Dissipation ^{*2}	P _C	100	mW
Isolation Voltage ^{*3}		BV	3 750	Vr.m.s.
Operating Ambient Temperature		T _A	-40 to +100	°C
Storage Temperature		T _{stg}	-55 to +125	°C

- Notes*: 1. Reduced to 0.33 mA/°C at T_A = 70°C or more.
 2. Reduced to 1.9 mW/°C at T_A = 70°C or more.
 3. AC voltage for 1 minute at T_A = 25°C, RH = 60% between input and output.
 Pins 1-2 shorted together, 3-5 shorted together.

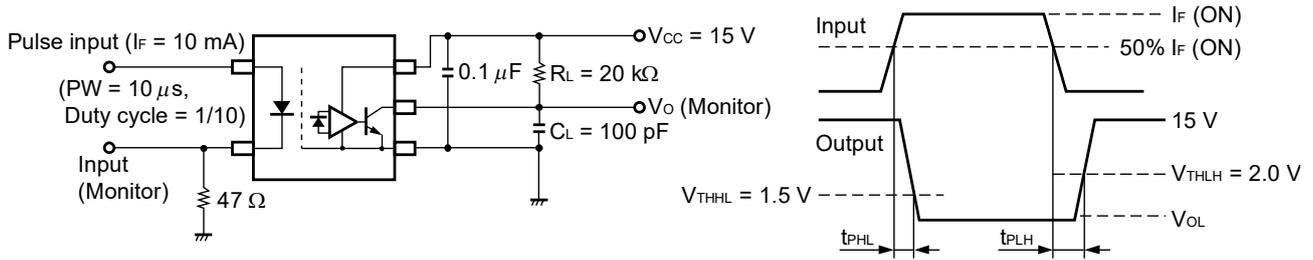
RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
High Level Input Current	I_{FH}	10		20	mA
Output Voltage	V_O	0		20	V
Supply Voltage	V_{CC}	4.5	15	20	V
LED Off Voltage	V_F	0		0.8	V

ELECTRICAL CHARACTERISTICS ($T_A = -40$ to $+100^\circ\text{C}$, $V_{CC} = 15$ V, unless otherwise specified)

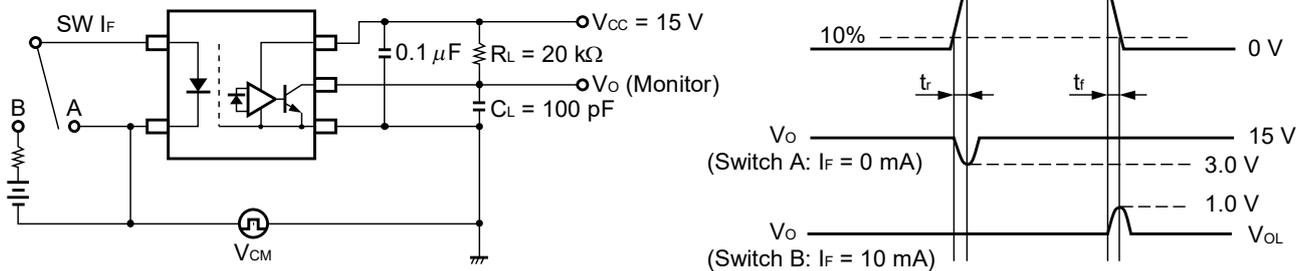
Parameter		Symbol	Conditions	MIN.	TYP.*1	MAX.	Unit	
Diode	Forward Voltage	V_F	$I_F = 10$ mA	1.3	1.65	2.1	V	
	Reverse Current	I_R	$V_R = 3$ V			200	μA	
	Terminal Capacitance	C_t	$V = 0$ V, $f = 1$ MHz, $T_A = 25^\circ\text{C}$		30		pF	
Detector	Low Level Output Voltage	V_{OL}	$I_F = 10$ mA, $I_{OL} = 2.4$ mA		0.13	0.6	V	
	High Level Output Current	I_{OH}	$V_{CC} = V_O = 20$ V, $V_F = 0.8$ V		0.01	50	μA	
	High Level Supply Current	I_{CCH}	$V_{CC} = 20$ V, $V_F = 0.8$ V, $V_O = \text{open}$		1.0	1.3	mA	
	Low Level Supply Current	I_{CCL}	$V_{CC} = 20$ V, $I_F = 10$ mA, $V_O = \text{open}$		1.0	1.3	mA	
Coupled	Threshold Input Current (H \rightarrow L)	I_{FHL}	$V_O = 0.8$ V, $I_O = 0.75$ mA		1.5	5.0	mA	
	Current Transfer Ratio (I_C/I_F)	CTR	$I_F = 10$ mA, $V_O = 0.6$ V	44	110		%	
	Isolation Resistance	R_{I-O}	$V_{I-O} = 1$ kV _{DC} , RH = 40 to 60%, $T_A = 25^\circ\text{C}$	10^{11}			Ω	
	Isolation Capacitance	C_{I-O}	$V = 0$ V, $f = 1$ MHz, $T_A = 25^\circ\text{C}$		0.6		pF	
	Propagation Delay Time (H \rightarrow L)*2	t_{PHL}	$V_{THHL} = 1.5$ V, $V_{THLH} = 2.0$ V		250	500	ns	
	Propagation Delay Time (L \rightarrow H)*2	t_{PLH}			520	750		
	Propagation Delay Difference Between Any 2 Parts	$t_{PLH} - t_{PHL}$			-200	270		650
	Pulse Width Distortion (PWD)*2	$ t_{PHL} - t_{PLH} $				270		650
Common Mode Transient Immunity at High Level Output*3	CM_H	$T_A = 25^\circ\text{C}$, $I_F = 0$ mA, $V_O > 3.0$ V, $V_{CM} = 1.5$ kV, $R_L = 20$ k Ω , $C_L = 100$ pF		15		kV/ μs		
Common Mode Transient Immunity at Low Level Output*3	CM_L	$T_A = 25^\circ\text{C}$, $I_F = 10$ mA, $V_O < 1.0$ V, $V_{CM} = 1.5$ kV, $R_L = 20$ k Ω , $C_L = 100$ pF		-15		kV/ μs		

- Notes*: 1. Typical values at $T_A = 25^\circ\text{C}$.
 2. Test circuit for propagation delay time



C_L includes probe and stray wiring capacitance.

3. Test circuit for common mode transient immunity



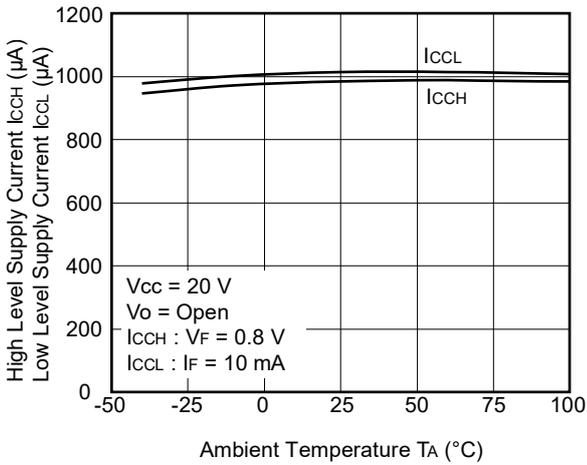
C_L includes probe and stray wiring capacitance.

USAGE CAUTIONS

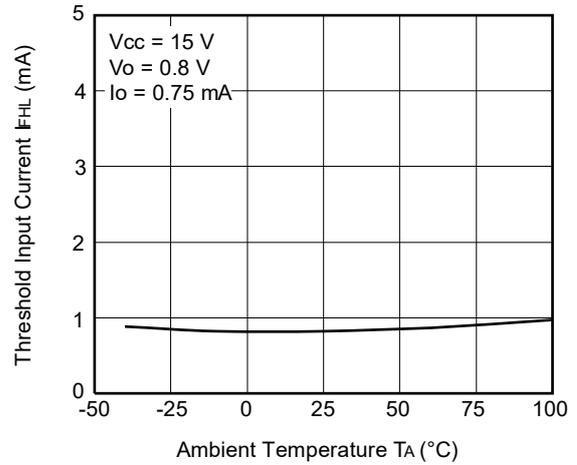
1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of $0.1 \mu\text{F}$ is used between V_{CC} and GND near device. Also, ensure that the distance between the leads of the photocopier and capacitor is no more than 10 mm.
3. Avoid storage at a high temperature and high humidity.
4. Do not use adhesives or coating materials including halogens to fix this device.

TYPICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified)

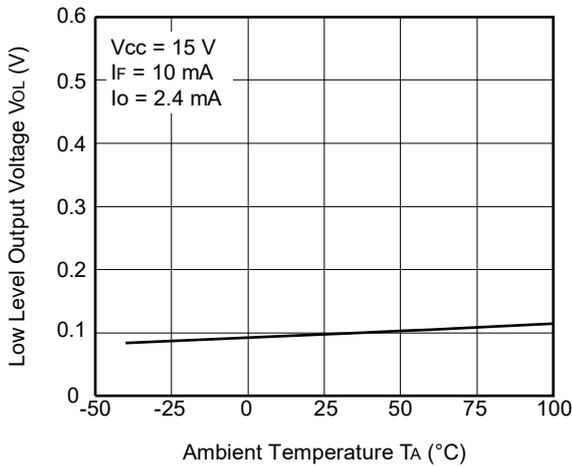
SUPPLY CURRENT vs. AMBIENT TEMPERATURE



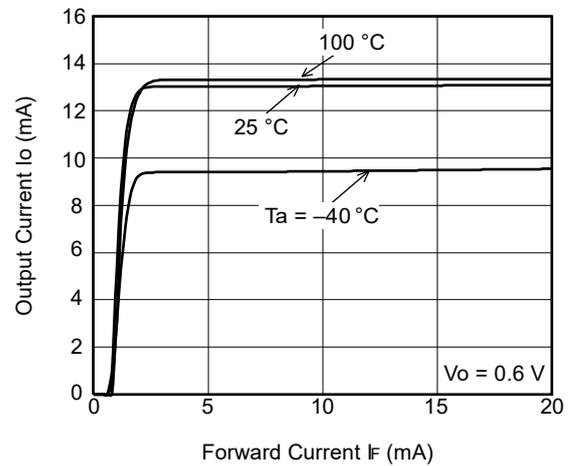
THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE



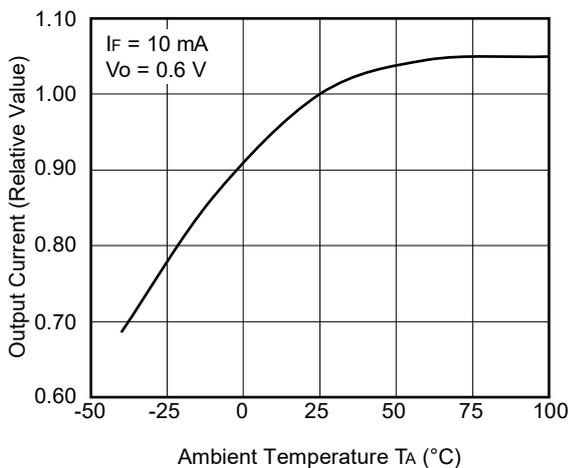
LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



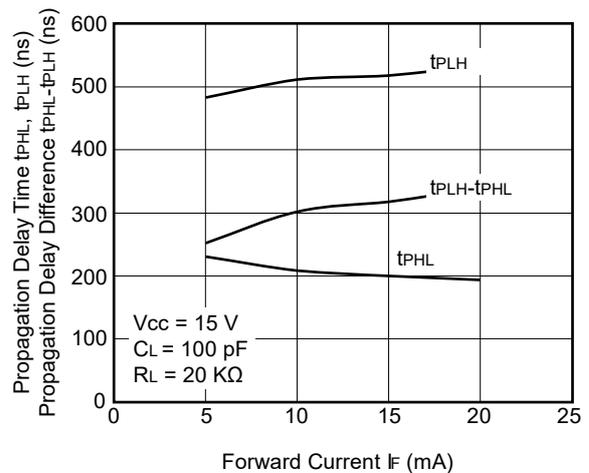
OUTPUT CURRENT vs. FORWARD CURRENT



OUTPUT CURRENT vs. AMBIENT TEMPERATURE

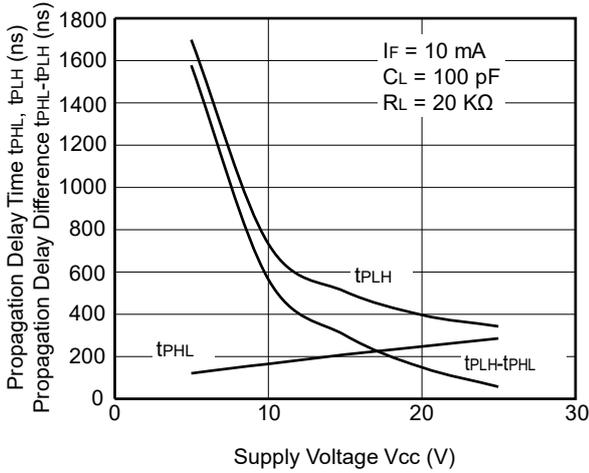


PROPAGATION DELAY TIME, PROPAGATION DELAY DIFFERENCE vs. FORWARD CURRENT

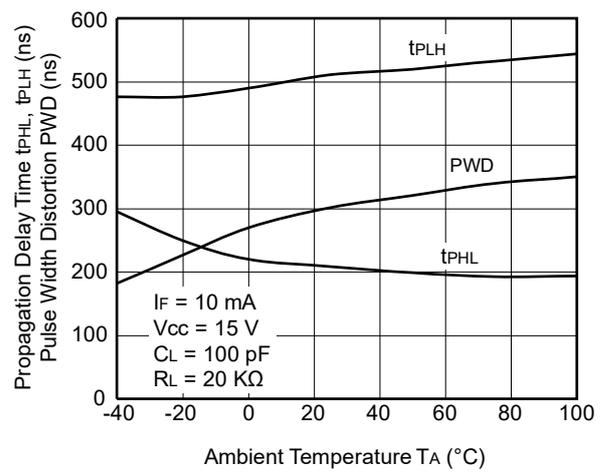


Remark The graphs indicate nominal characteristics.

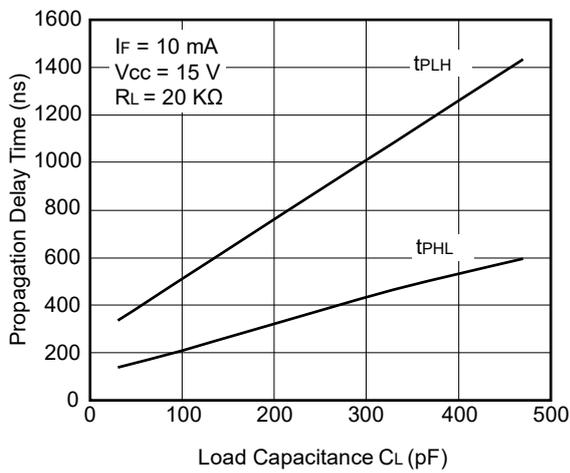
PROPAGATION DELAY TIME,
PROPAGATION DELAY DIFFERENCE
vs. SUPPLY VOLTAGE



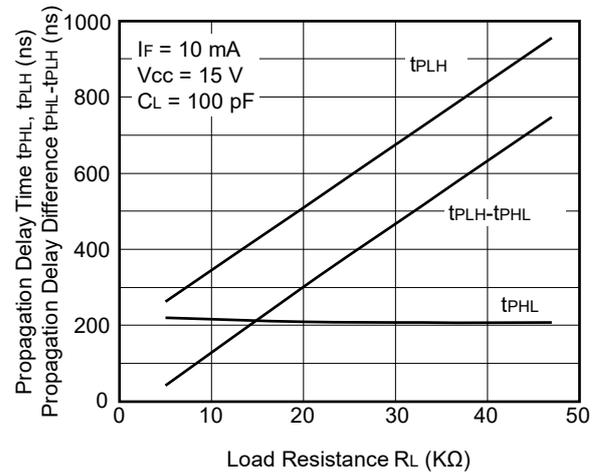
PROPAGATION DELAY TIME,
PULSE WIDTH DISTORTION
vs. AMBIENT TEMPERATURE



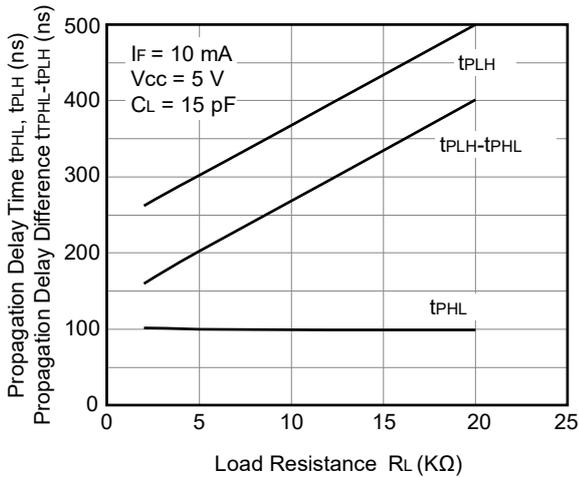
PROPAGATION DELAY TIME
vs. LOAD CAPACITANCE



PROPAGATION DELAY TIME,
PROPAGATION DELAY DIFFERENCE
vs. LOAD RESISTANCE



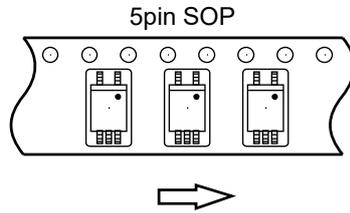
PROPAGATION DELAY TIME,
PROPAGATION DELAY DIFFERENCE
vs. LOAD RESISTANCE



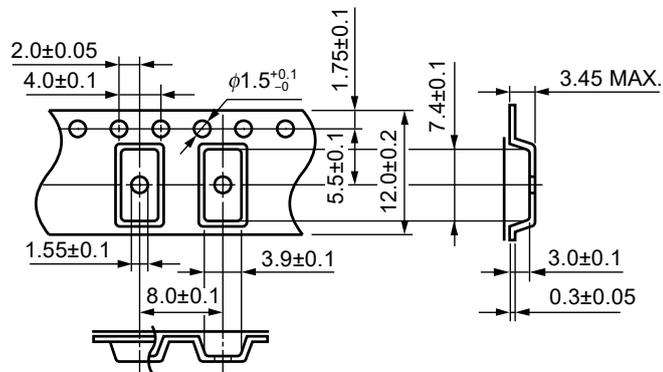
Remark The graphs indicate nominal characteristics.

TAPING SPECIFICATIONS (UNIT: mm)

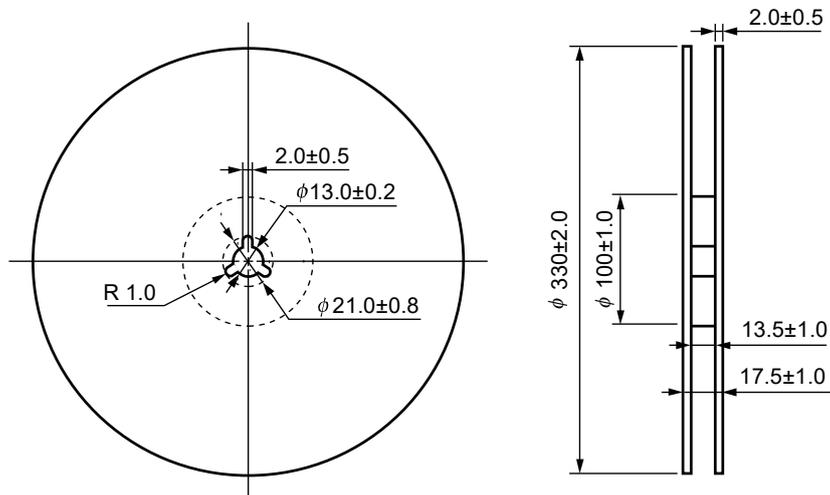
Tape Direction



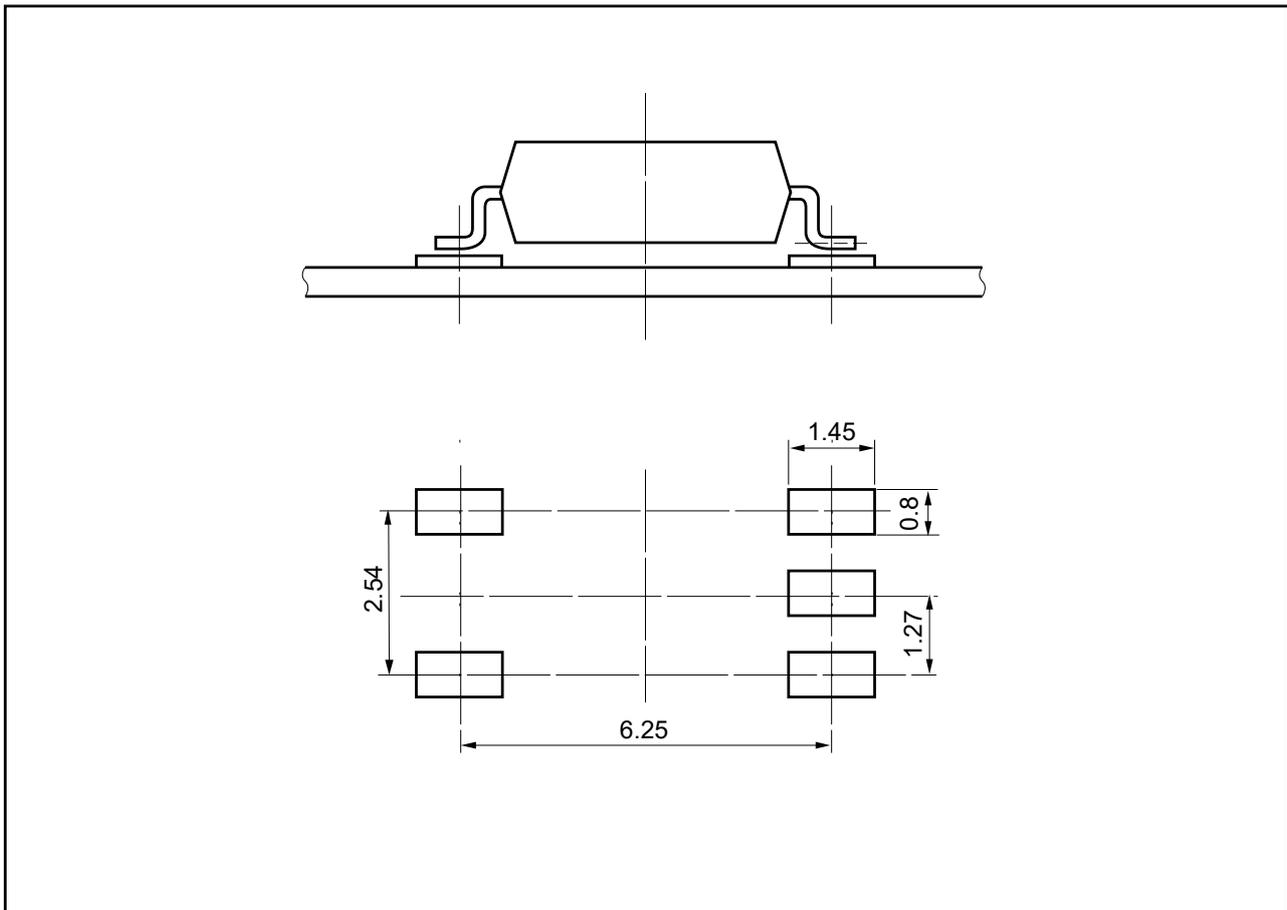
Outline and Dimensions (Tape)



Outline and Dimensions (Reel)



Packing: 2 500 pcs/reel

RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)

【5pin SOP】

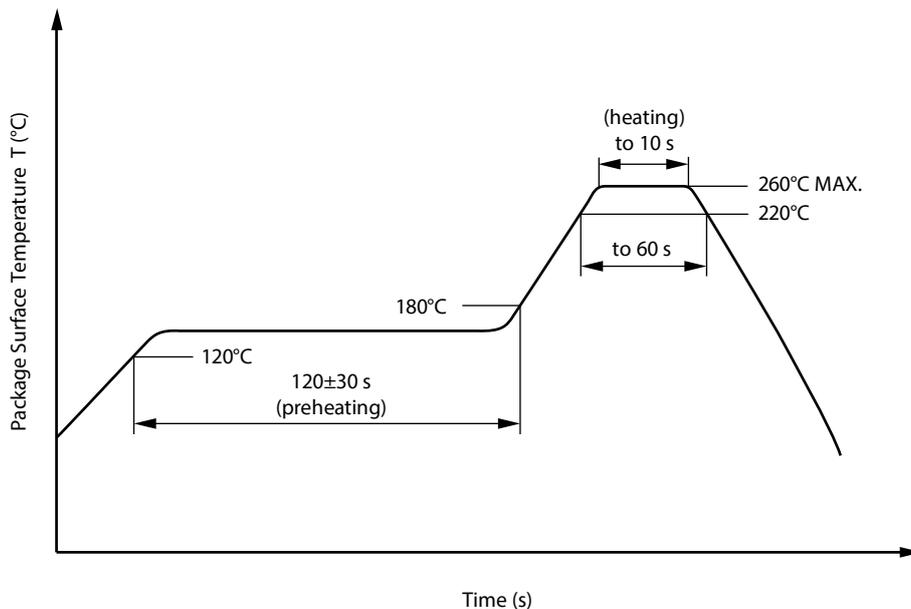
NOTES ON HANDLING

1. Recommended soldering conditions

(1) Infrared reflow soldering

- Peak reflow temperature 260°C or below (package surface temperature)
- Time of peak reflow temperature 10 seconds or less
- Time of temperature higher than 220°C 60 seconds or less
- Time to preheat temperature from 120 to 180°C 120±30 s
- 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



(2) Wave soldering

- Temperature 260°C or below (molten solder temperature)
- Time 10 seconds 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 (each pins) 3 seconds or less
- Flux Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.)

(a) Soldering of leads should be made at the point 1.5 to 2.0 mm from the root of the lead

(b) Please be sure that the temperature of the package would not be heated over 100°C

(4) Cautions

Fluxes

Avoid removing the residual flux with freon-based and halogens-based (chlorine-based) cleaning solvent .

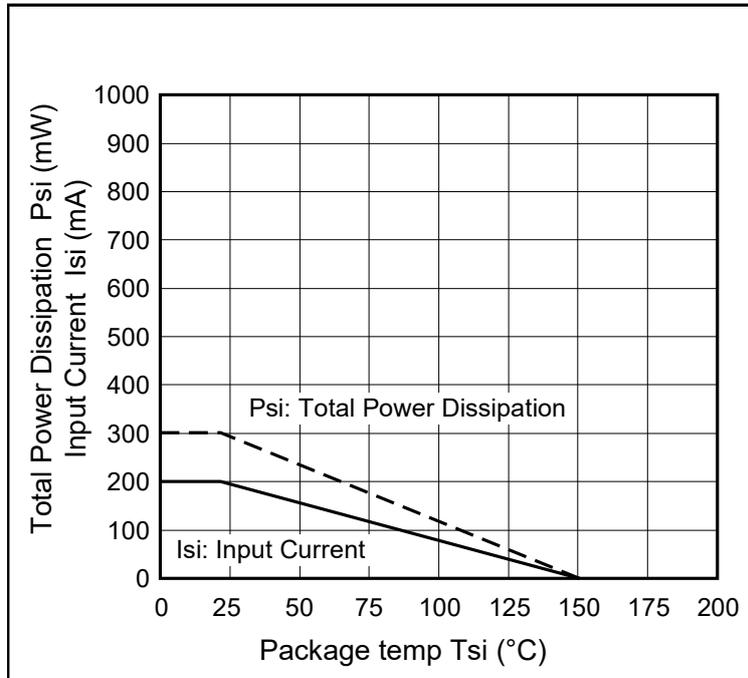
2. Cautions regarding noise

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

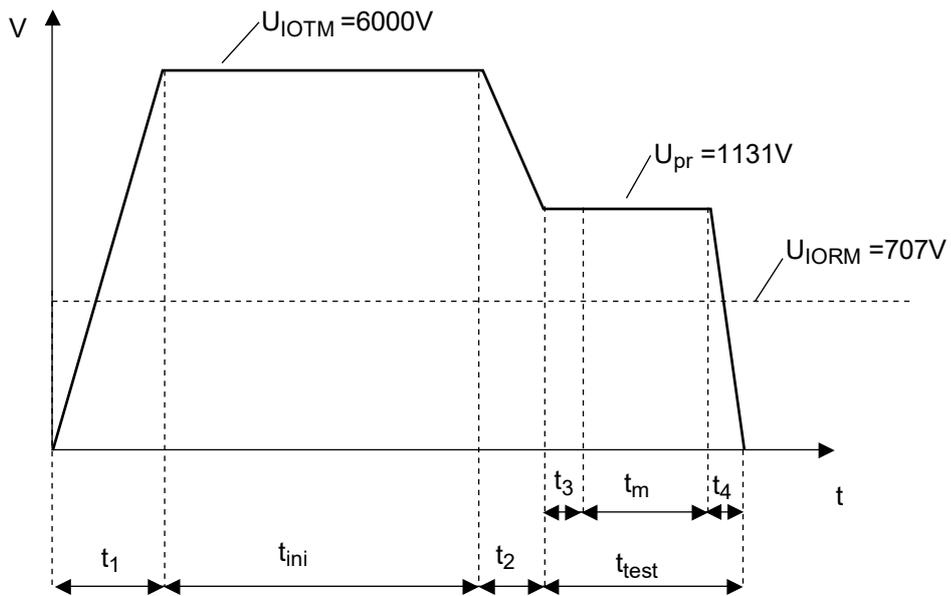
SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

Parameter	Symbol	Rating	Unit
Climatic test class (IEC 60068-1/DIN EN 60068-1)		40/100/21	
Dielectric strength maximum operating isolation voltage Test voltage (partial discharge test, procedure a for type test and random test) $U_{pr} = 1.6 \times U_{IORM}, Pd < 5 \text{ pC}$	U_{IORM} U_{pr}	707 1131	V_{peak} V_{peak}
Test voltage (partial discharge test, procedure b for all devices) $U_{pr} = 1.875 \times U_{IORM}, Pd < 5 \text{ pC}$	U_{pr}	1 326	V_{peak}
Highest permissible overvoltage	U_{IOTM}	6 000	V_{peak}
Degree of pollution (DIN EN 60664-1 VDE 0110 Part 1)		2	
Comparative tracking index ((IEC 60112/DIN EN 60112 (VDE 0303 Part 11))	CTI	175	
Material group (DIN EN 60664-1 VDE 0110 Part 1)		III a	
Storage temperature range	Tstg	-55 to +125	°C
Operating temperature range	T_A	-40 to +100	°C
Isolation resistance, minimum value $V_{IO} = 500 \text{ V dc at } T_A = 25^\circ\text{C}$ $V_{IO} = 500 \text{ V dc at } T_A \text{ MAX. at least } 100^\circ\text{C}$	Ris MIN. Ris MIN.	10^{12} 10^{11}	Ω Ω
Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve) Package temperature Current (input current I_F , $\Psi_i = 0$) Power (output or total power dissipation) Isolation resistance $V_{IO} = 500 \text{ V dc at } T_A = T_{si}$	T_{si} I_{si} Ψ_i Ris MIN.	150 200 300 10^9	°C mA mW Ω

Dependence of maximum safety ratings with package temperature

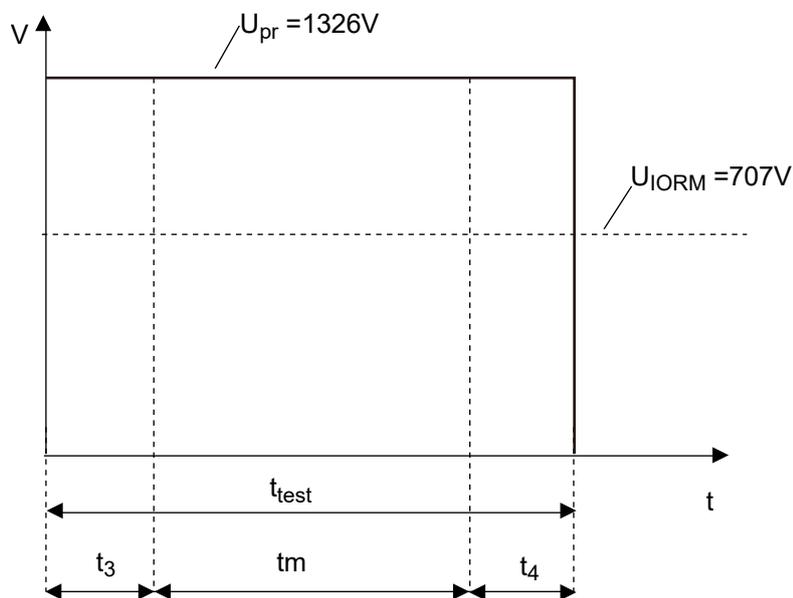


Method a) Destructive Test, Type and Sample Test



$t_1, t_2 = 1 \text{ to } 10 \text{ sec}$
 $t_3, t_4 = 1 \text{ sec}$
 $t_m(\text{PARTIAL DISCHARGE}) = 10 \text{ sec}$
 $t_{\text{test}} = 12 \text{ sec}$
 $t_{\text{ini}} = 60 \text{ sec}$

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



$t_3, t_4 = 0.1 \text{ sec}$
 $t_m(\text{PARTIAL DISCHARGE}) = 1.0 \text{ sec}$
 $t_{\text{test}} = 1.2 \text{ sec}$

Caution	GaAs Products	<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">• 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">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.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.• Do not burn, destroy, cut, crush, or chemically dissolve the product.• Do not lick the product or in any way allow it to enter the mouth.
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(Rev.4.0-1 November 2017)



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California Eastern Laboratories, Inc.

4590 Patrick Henry Drive, Santa Clara, California 95054-1817, U.S.A.
Tel: +1-408-919-2500, Fax: +1-408-988-0279

Renesas Electronics Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-651-700, Fax: +44-1628-651-804

Renesas Electronics Europe GmbH

Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.

Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.

Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited

Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.

13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

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80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

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Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.

No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.

17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338