



# Photocoupler

## Product Data Sheet

### LTV-0601

Spec No.: DS70-2013-0015

Effective Date: 07/06/2016

Revision: C

**LITE-ON DCC**

**RELEASE**

BNS-OD-FC001/A4

## Photocoupler LTV-0601 series

### 1. DESCRIPTION

The LTV-0601 consists of a high efficient AlGaAs Light Emitting Diode and a high speed optical detector. This design provides excellent AC and DC isolation between the input and output sides of the Optocoupler. The output of the optical detector features an open collector Schottky clamped transistor. The enable function allows the optical detector to be strobed. A guaranteed common mode transient immunity is up to 10kV/ $\mu$ s at 3.3V.

The Optocoupler operational parameters are guaranteed over the temperature range from -40°C ~ +85°C.

#### 1.1 Features

- 3.3V / 5V Dual Supply Voltages
- Low power consumption
- High speed – 15MBd typical
- 10kV/ $\mu$ s minimum Common Mode Rejection (CMR) at  $V_{CM} = 1000V$
- Guaranteed AC and DC performance over temperature -40°C ~ +85°C.
- LVTTTL/LVCMOS Compatible.
- Strobable output.
- Safety approval

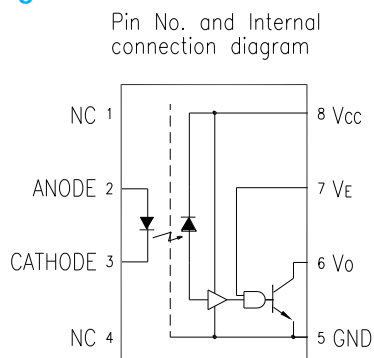
UL/ cUL 1577, 3750 Vrms/1 min

VDE DIN EN60747-5-5,  $V_{IORM} = 567 V_{peak}$

#### 1.2 Applications

- Isolation in line receivers
- Digital isolation for A/D, D/A conversion
- Ground loop elimination
- Feedback Element in Switching Mode Power Supplier
- Pulse transformer replacement
- Power transistor isolation in motor drives
- Interface between Microprocessor system, computer and their peripheral

#### 1.3 Functional Diagram



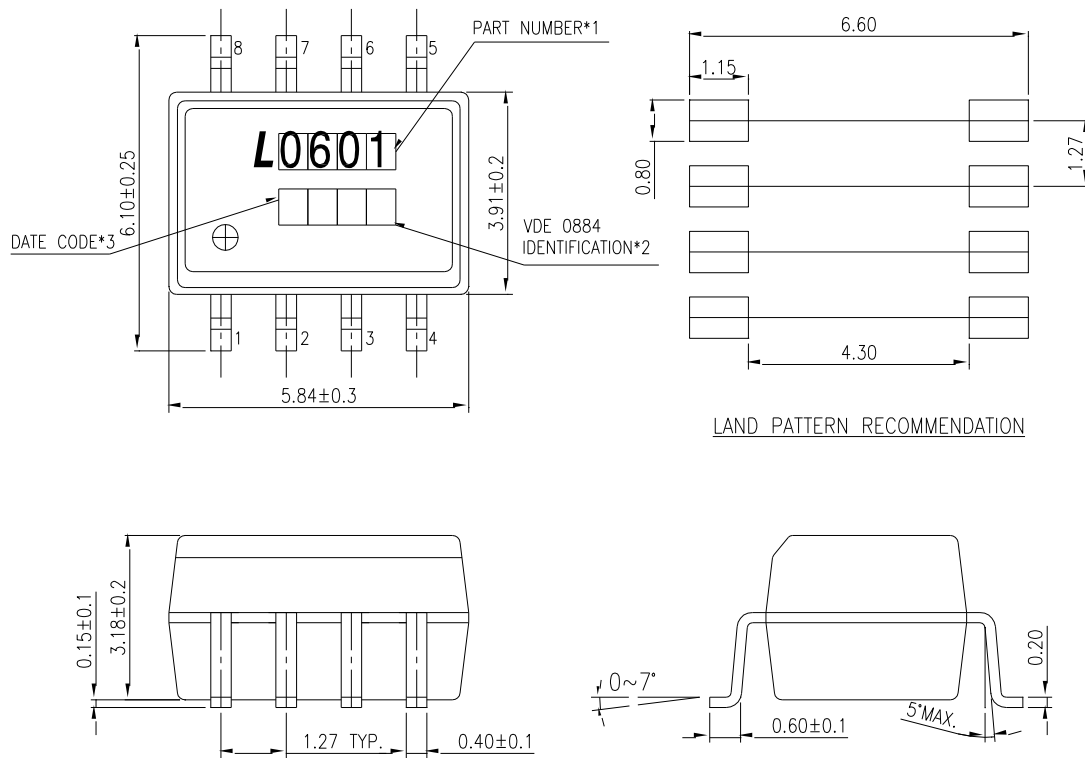
A 0.1 $\mu$ F bypass Capacitor must be connected between Pin8 and Pin5

Truth Table (Positive Logic)

LED	ENABLE	OUT
ON	H	L
OFF	H	H
ON	L	H
OFF	L	H
ON	NC	L
OFF	NC	H

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## 2. PACKAGE DIMENSIONS



Part No : LTV-0601

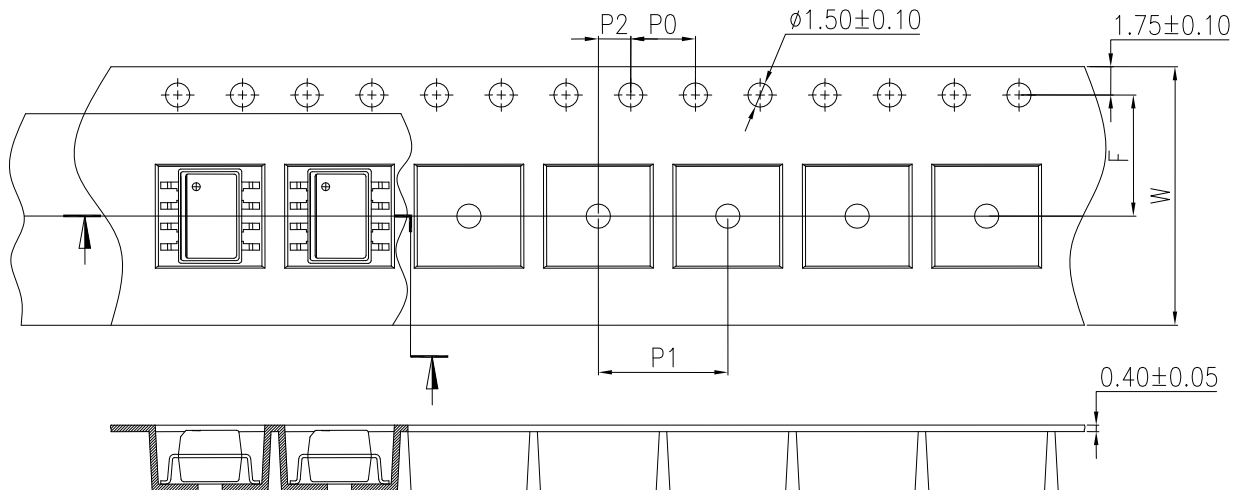
**Notes :**

1. Date code
  2. "V" to represent VDE0884
  3. 1st digit year code, 2nd and 3rd digit work week code
- Dimensions are all in Millimeters.

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**3. TAPING DIMENSIONS**

**3.1 LTV-0601**



Description	Symbol	Dimension in mm (inch)
Tape wide	W	16±0.3 (0.63)
Pitch of sprocket holes	$P_0$	4±0.1 (0.157)
Distance of compartment	F	7.5±0.1 (0.295)
	$P_2$	2±0.1 (0.079)
Distance of compartment to compartment	$P_1$	12±0.1 (0.472)

**3.2 Quantities Per Reel**

Package Type	LTV-0601
Quantities (pcs)	2000

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### 4. RATING AND CHARACTERISTICS

#### 4.1 Absolute Maximum Ratings at Ta=25°C \*

	Parameter	Symbol	Rating	Unit	Note
Input	Average Forward Input Current	$I_F$	20	mA	2
	Reverse Input Voltage	$V_R$	5	V	
	Power Dissipation	$P_I$	40	mW	
	Enable Input Voltage	$V_E$	V <sub>CC</sub> +0.5	V	
	Enable Input current	$I_E$	5	mA	
Output	Output Collector Current	$I_O$	50	mA	
	Output Collector Voltage	$V_O$	7	V	
	Output Collector Power Dissipation	$P_O$	85	mW	
	Isolation Voltage	$V_{iso}$	3750	V <sub>rms</sub>	
	Supply Voltage	$V_{CC}$	7	V	
	Operating Temperature	$T_{opr}$	-40 ~ +85	°C	
	Storage Temperature	$T_{stg}$	-55 ~ +125	°C	
	Lead Solder Temperature **	$T_{sol}$	260	°C	

\* Ambient temperature = 25°C, unless otherwise specified. Stresses exceeding the absolute maximum ratings can cause permanent damage to the device. Exposure to absolute maximum ratings for long periods of time can adversely affect reliability.

\*\* 260°C for 10 seconds. Refer to Lead Free Reflow Profile.

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**4.2 Recommended Operating Conditions**

Parameter	Symbol	Min	Max	Unit
Operating Temperature	$T_A$	-40	85	°C
Supply Voltage	$V_{CC}$	2.7	3.6	V
		4.5	5.5	
Low Level Input Current	$I_{FL}$	0	250	μA
High Level Input Current	$I_{FH}$	5	15	mA
Low Level Enable Voltage	$V_{EL}$	0	0.8	V
High Level Enable Voltage	$V_{EH}$	2	$V_{CC}$	V
Output Pull-up Resistor	$R_L$	330	4k	Ω
Fan Out (at $R_L=1k\Omega$ per channel)	N	—	5	TTL Loads

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### 4.3 ELECTRICAL OPTICAL CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Fig	Note
<b>Input</b>								
Input Forward Voltage	$V_F$	—	1.38	1.70	V	$I_F = 10\text{mA}$	8	
Input Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta T$	—	-1.5	—	mV/°C	$I_F = 10\text{mA}$		
Input Reverse Voltage	$BV_R$	5.0	—	—	V	$I_R = 10\mu\text{A}$		
Input Threshold Current	$I_{TH}$	—	1.5	5	mA	$V_E = 2\text{V}, V_{CC} = 3.3\text{V}, V_O = 0.6\text{V}, I_{OL} (\text{sinking}) = 13\text{mA}$	5	11
Input Capacitance	$C_{IN}$	—	34	—	pF	$f = 1\text{MHz}, V_F = 0\text{V}$		
<b>Detector</b>								
High Level Supply Current	$I_{CCH}$	—	3.8	7	mA	$V_E = 0.5\text{V}, V_{CC} = 3.3\text{V}, I_F = 0\text{mA}$		
Low Level Supply Current	$I_{CCL}$	—	5.8	10	mA	$V_E = 0.5\text{V}, V_{CC} = 3.3\text{V}, I_F = 10\text{mA}$		
High Level Enable Current	$I_{EH}$	—	-0.2	-1.6	mA	$V_{CC} = 3.3\text{V}, V_E = 2\text{V}$		
Low Level Enable Current	$I_{EL}$	—	-0.4	-1.6	mA	$V_{CC} = 3.3\text{V}, V_E = 0.5\text{V}$		
High Level Enable Voltage	$V_{EH}$	2	—	—	V			11
Low Level Enable Voltage	$V_{EL}$	—	—	0.8	V			
High Level Output Current	$I_{OH}$	—	5	100	$\mu\text{A}$	$V_E = 2\text{V}, V_{CC} = 3.3\text{V}, V_O = 3.3\text{V}, I_F = 250\mu\text{A}$	4	11
Low Level Output Voltage	$V_{OL}$	—	0.3	0.60	V	$V_E = 2\text{V}, V_{CC} = 3.3\text{V}, I_F = 5\text{mA}, I_{OL} (\text{sinking}) = 13\text{mA}$	6	11

Specified over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $2.7\text{V} \leq V_{CC} \leq 3.6\text{V}$ ),  $I_F = 7.5\text{mA}$  unless otherwise specified. All typicals at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V}$ .

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Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Fig.	Note
<b>Input</b>								
Input Forward Voltage	$V_F$	—	1.38	1.70	V	$I_F = 10\text{mA}$	8	
Input Forward Voltage Temperature Coefficient	$\Delta V_F / \Delta T$	—	-1.5	—	mV/°C	$I_F = 10\text{mA}$		
Input Reverse Voltage	$BV_R$	5.0	—	—	V	$I_R = 10\mu\text{A}$		
Input Threshold Current	$I_{TH}$	—	1.35	5	mA	$V_E = 2\text{V}, V_{CC} = 5.5\text{V}, V_O = 0.6\text{V}, I_{OL}(\text{sinking}) = 13\text{mA}$	5	11
Input Capacitance	$C_{IN}$	—	34	—	pF	$f = 1\text{MHz}, V_F = 0\text{V}$		
<b>Detector</b>								
High Level Supply Current	$I_{CCH}$	—	6.1	10	mA	$V_E = 0.5\text{V}, V_{CC} = 5.5\text{V}, I_F = 0\text{mA}$		
Low Level Supply Current	$I_{CCL}$	—	8.3	13	mA	$V_E = 0.5\text{V}, V_{CC} = 5.5\text{V}, I_F = 10\text{mA}$		
High Level Enable Current	$I_{EH}$	—	-0.6	-1.6	mA	$V_{CC} = 5.5\text{V}, V_E = 2\text{V}$		
Low Level Enable Current	$I_{EL}$	—	-0.9	-1.6	mA	$V_{CC} = 5.5\text{V}, V_E = 0.5\text{V}$		
High Level Enable Voltage	$V_{EH}$	2	—	—	V			11
Low Level Enable Voltage	$V_{EL}$	—	—	0.8	V			
High Level Output Current	$I_{OH}$	—	0.9	100	$\mu\text{A}$	$V_E = 2\text{V}, V_{CC} = 5.5\text{V}, V_O = 5.5\text{V}, I_F = 250\mu\text{A}$	4	11
Low Level Output Voltage	$V_{OL}$	—	0.4	0.60	V	$V_{CC} = 5.5\text{V}, I_F = 5\text{mA}, I_{OL}(\text{sinking}) = 13\text{mA}$	6	11

Specified over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $4.5\text{V} \leq V_{CC} \leq 5.5\text{V}$ ),  $I_F = 7.5\text{mA}$  unless otherwise specified. All typicals at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V}$ .



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### 5. SWITCHING SPECIFICATION

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Fig	Note
Propagation Delay Time to High Output Level	$t_{PLH}$	25	48	90	ns	$R_L = 350\Omega, C_L = 15pF$	1, 9	3, 11
Propagation Delay Time to Low Output Level	$t_{PHL}$	25	35	75	ns			4, 11
Pulse Width Distortion	$ t_{PLH} - t_{PHL} $	—	13	—	ns		10	11
Propagation Delay Skew	$t_{PSK}$	—	—	40	—		—	11, 12
Output Rise Time (10 to 90%)	$t_r$	—	21	—	ns		—	11
Output Fall Time (90 to 10%)	$t_f$	—	6.6	—	ns		—	11
Propagation Delay Time of Enable from $V_{EH}$ to $V_{EL}$	$t_{ELH}$	—	27	—	ns	$R_L = 350\Omega, C_L = 15pF, V_{EL} = 0V, V_{EH} = 3V$	2	5, 11
Propagation Delay Time of Enable from $V_{EL}$ to $V_{EH}$	$t_{EHL}$	—	9	—	ns	$R_L = 350\Omega, C_L = 15pF, V_{EL} = 0V, V_{EH} = 3V$		6, 11

Specified over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $2.7V \leq V_{CC} \leq 3.6V$ ),  $I_F = 7.5\text{mA}$  unless otherwise specified. All typicals at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3V$ .

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Fig	Note	
Propagation Delay Time to High Output Level	$t_{PLH}$	25	40	75	ns	$T_A = 25^\circ\text{C}$ $R_L = 350\Omega, C_L = 15pF$	1,9	3, 11	
		—	—	100					
Propagation Delay Time to Low Output Level	$t_{PHL}$	25	32	75	ns	$T_A = 25^\circ\text{C}$ $R_L = 350\Omega, C_L = 15pF$	1,9	4, 11	
		—	—	100					
Pulse Width Distortion	$ t_{PLH} - t_{PHL} $	—	8	—	ns	$R_L = 350\Omega, C_L = 15pF$	10	11	
Propagation Delay Skew	$t_{PSK}$	—	—	40	—		11, 12		
Output Rise Time (10 to 90%)	$t_r$	—	22	—	ns		11		
Output Fall Time (90 to 10%)	$t_f$	—	6.9	—	ns		11		
Propagation Delay Time of Enable from $V_{EH}$ to $V_{EL}$	$t_{ELH}$	—	28	—	ns		$R_L = 350\Omega, C_L = 15pF, V_{EL} = 0V, V_{EH} = 3V$	2	5, 11
Propagation Delay Time of Enable from $V_{EL}$ to $V_{EH}$	$t_{EHL}$	—	12	—	ns		$R_L = 350\Omega, C_L = 15pF, V_{EL} = 0V, V_{EH} = 3V$		6, 11

Specified over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $4.5V \leq V_{CC} \leq 5.5V$ ),  $I_F = 7.5\text{mA}$  unless otherwise specified. All typicals at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5.0V$ .

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Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Fig	Note
Logic High Common Mode Transient Immunity	CM <sub>H</sub>	10	15	—	kV/μs	V <sub>CC</sub> = 3.3V V <sub>CM</sub> = 1000V R <sub>L</sub> = 350Ω I <sub>F</sub> = 0mA T <sub>A</sub> = 25°C	2	7
		10	15	—		V <sub>CC</sub> = 5V V <sub>CM</sub> = 1000V R <sub>L</sub> = 350Ω I <sub>F</sub> = 0mA T <sub>A</sub> = 25°C		
Logic Low Common Mode Transient Immunity	CM <sub>L</sub>	10	15	—	kV/μs	V <sub>CC</sub> = 3.3V V <sub>CM</sub> = 1000V R <sub>L</sub> = 350Ω I <sub>F</sub> = 10.0mA T <sub>A</sub> = 25°C	2	8
		10	15	—		V <sub>CC</sub> = 5V V <sub>CM</sub> = 1000V R <sub>L</sub> = 350Ω I <sub>F</sub> = 10.0mA T <sub>A</sub> = 25°C		

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### 6. ISOLATION CHARACTERISTIC

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Note
Input-Output Insulation Leakage Current	$I_{I-O}$	—	—	1.0	$\mu\text{A}$	45% RH, $t = 5\text{s}$ , $V_{I-O} = 3\text{kV DC}$ , $T_A = 25^\circ\text{C}$	9
Withstand Insulation Test Voltage	$V_{ISO}$	3750	—	—	$V_{RMS}$	RH $\leq 50\%$ , $t = 1\text{min}$ , $T_A = 25^\circ\text{C}$	9, 10
Input-Output Resistance	$R_{I-O}$	—	$10^{12}$	—	$\Omega$	$V_{I-O} = 500\text{V DC}$	9,
Input-Output Capacitance	$C_{I-O}$	—	1.0	—	$\text{pF}$	$f = 1\text{MHz}$ , $T_A = 25^\circ\text{C}$	9,

Specified over recommended temperature ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ) unless otherwise specified. Typical values applies to  $T_A = 25^\circ\text{C}$

#### Note:

1. A  $0.1\mu\text{F}$  or bigger bypass capacitor for  $V_{CC}$  is needed.
2. Peaking driving circuit may be used to speed up the LED. The peak drive current of LED may go up to 50mA and maximum pulse width 50ns, as long as average current doesn't exceed 20mA.
3.  $t_{PLH}$  (propagation delay) is measured from the 3.75 mA point on the falling edge of the input pulse to the 1.5 V point on the rising edge of the output pulse.
4.  $t_{PHL}$  (propagation delay) is measured from the 3.75 mA point on the rising edge of the input pulse to the 1.5 V point on the falling edge of the output pulse.
5. The  $t_{ELH}$  enable propagation delay is measured from the 1.5 V point on the falling edge of the enable input pulse to the 1.5 V point on the rising edge of the output pulse.
6. The  $t_{EHL}$  enable propagation delay is measured from the 1.5 V point on the rising edge of the enable input pulse to the 1.5 V point on the falling edge of the output pulse.
7.  $CM_H$  is the maximum tolerable rate of rise of the common mode voltage to assure that the output will remain in a high logic state (i.e.,  $V_O > 2.0\text{V}$ ).
8.  $CM_L$  is the maximum tolerable rate of fall of the common mode voltage to assure that the output will remain in a low logic state (i.e.,  $V_O < 0.8\text{V}$ ).
9. Device is considered a two-terminal device: pins 1, 2, 3 and 4 shorted together, and pins 5, 6, 7 and 8 shorted together.
10. In accordance with UL1577, each optocoupler is proof tested by applying an insulation test voltage 4500Vrms for one second (leakage current less than  $10\mu\text{A}$ ). This test is performed before the 100% production test for partial discharge
11. No external pull up is required for a high logic state on the enable input. If the  $V_E$  pin is not used, tying  $V_E$  to  $V_{CC}$  will result in improved CMR performance.
12.  $t_{PSK}$  is equal to the worst case difference in  $t_{PHL}$  and/or  $t_{PLH}$  that will be seen between units at any given temperature and specified test conditions.

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## 7. SWITCHING TIME TEST CIRCUIT

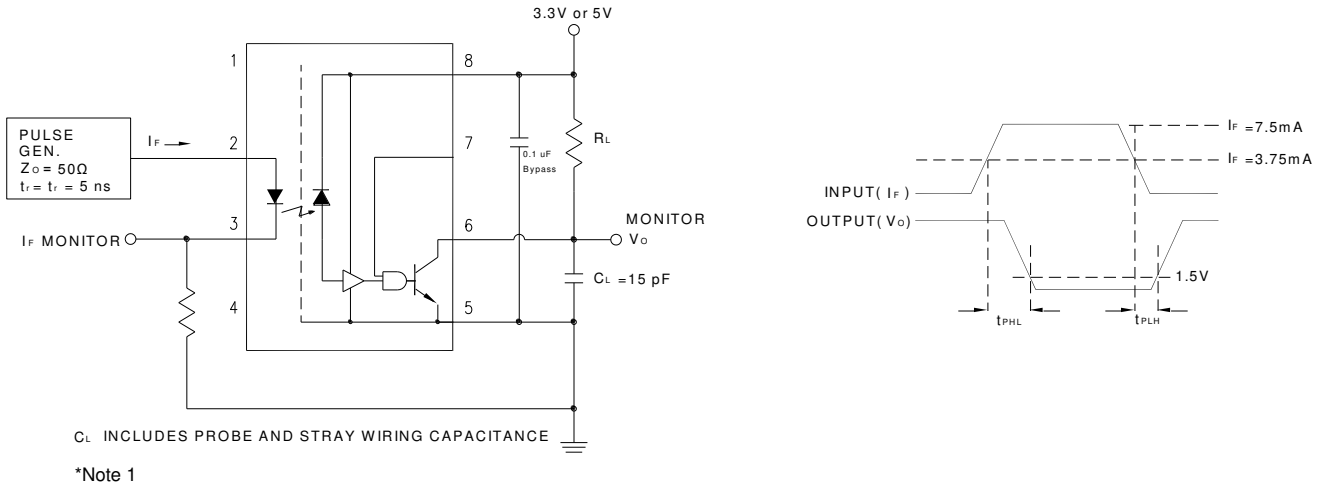


Figure 1: Test Circuit for  $t_{PHL}$  and  $t_{PLH}$

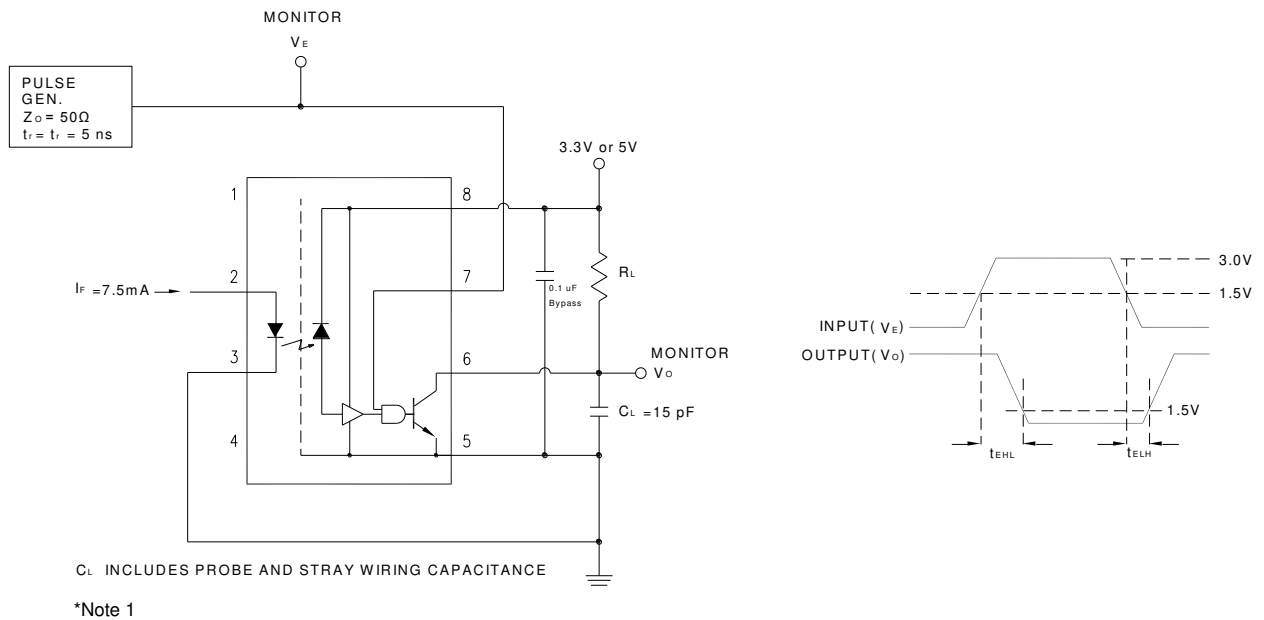
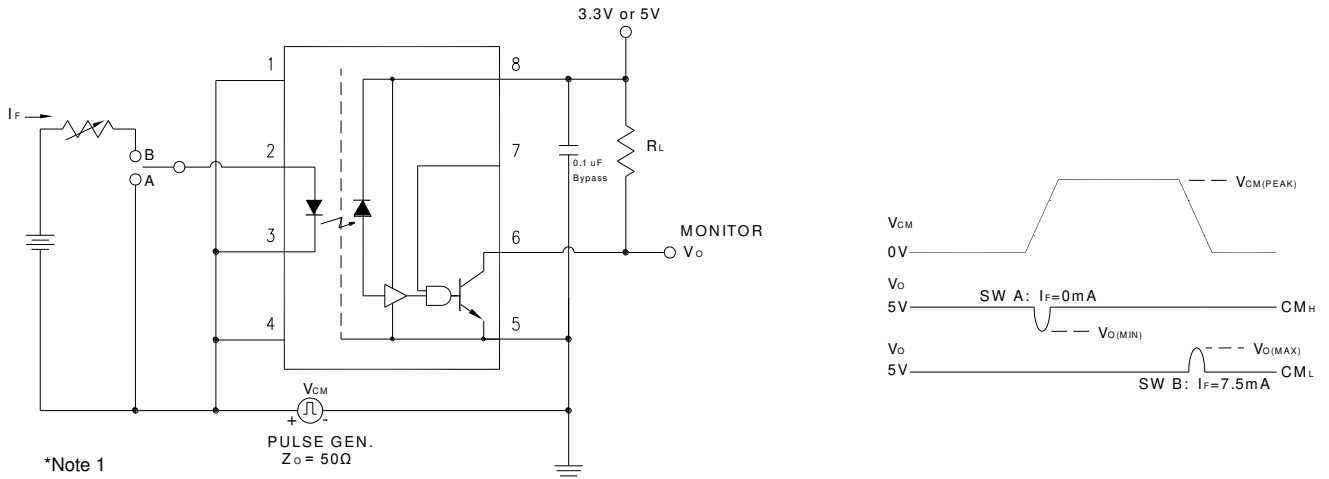


Figure 2: Test Circuit for  $t_{EHL}$  and  $t_{ELH}$

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**Figure 3: Single Channel Test Circuit for Common Mode Transient Immunity**

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8. CHARACTERISTIC CURVES

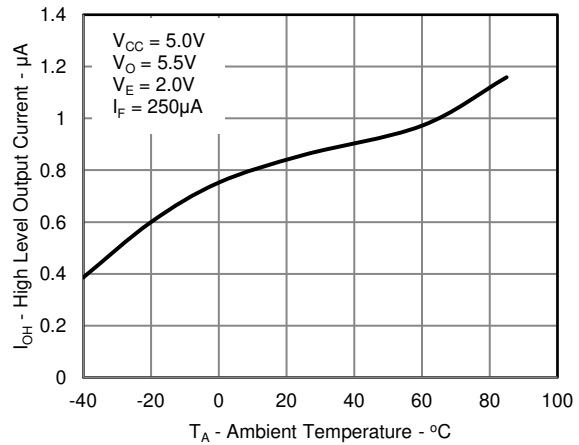
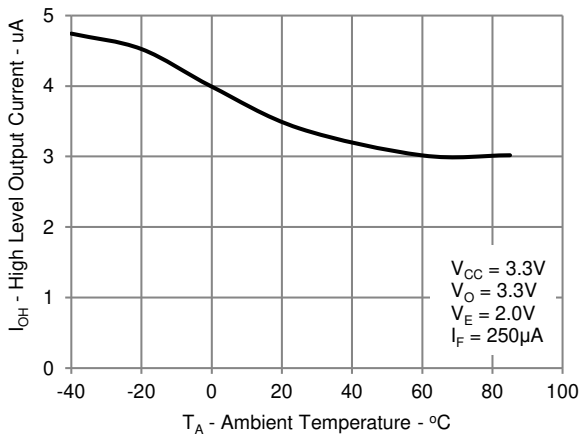


Figure 4: Typical High Level Output Current vs. Ambient Temperature

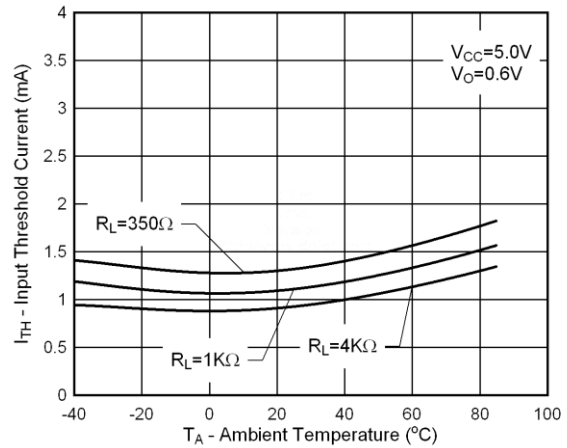
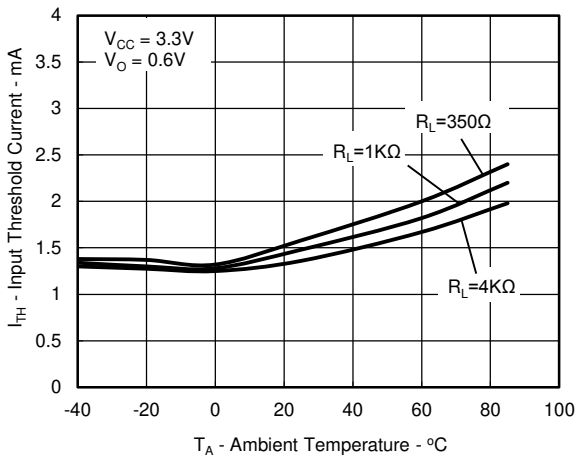


Figure 5: Typical Input Diode Threshold Current vs. Ambient Temperature

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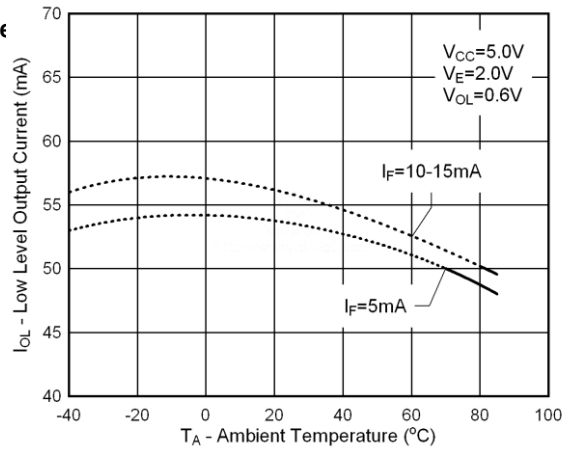
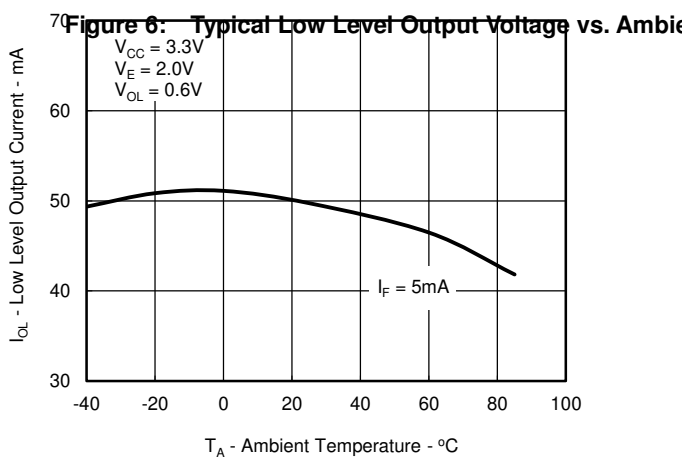
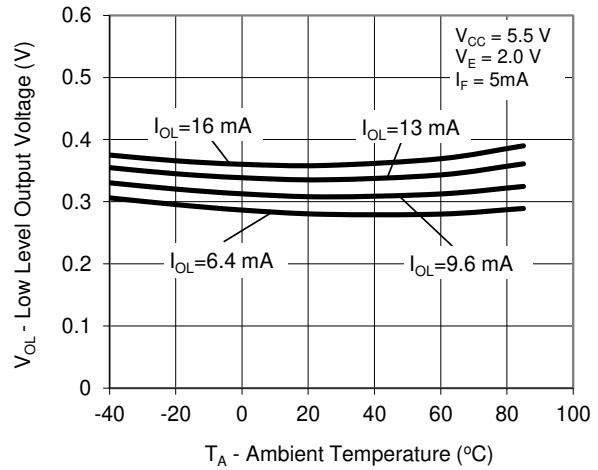
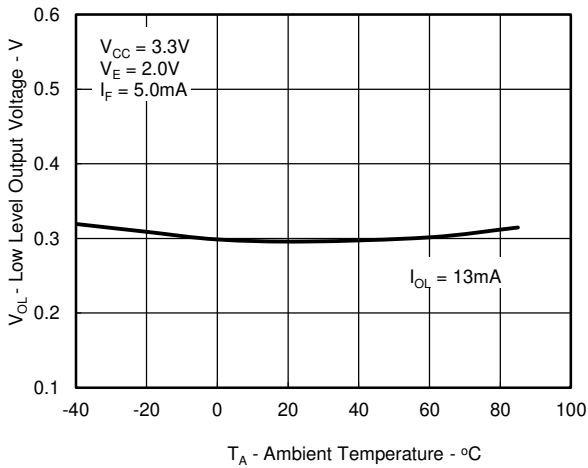
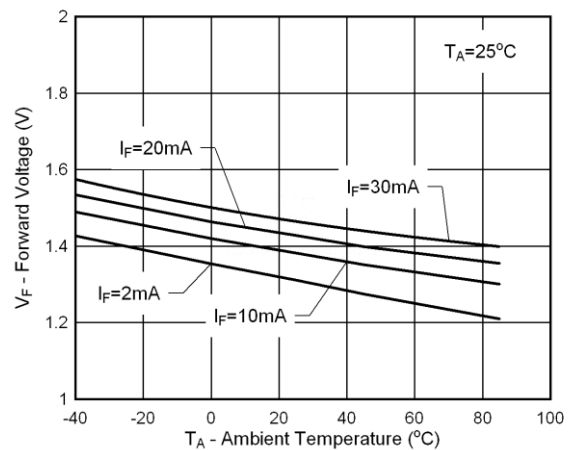
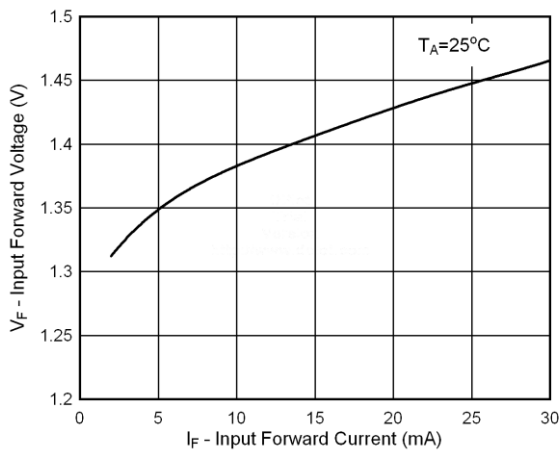


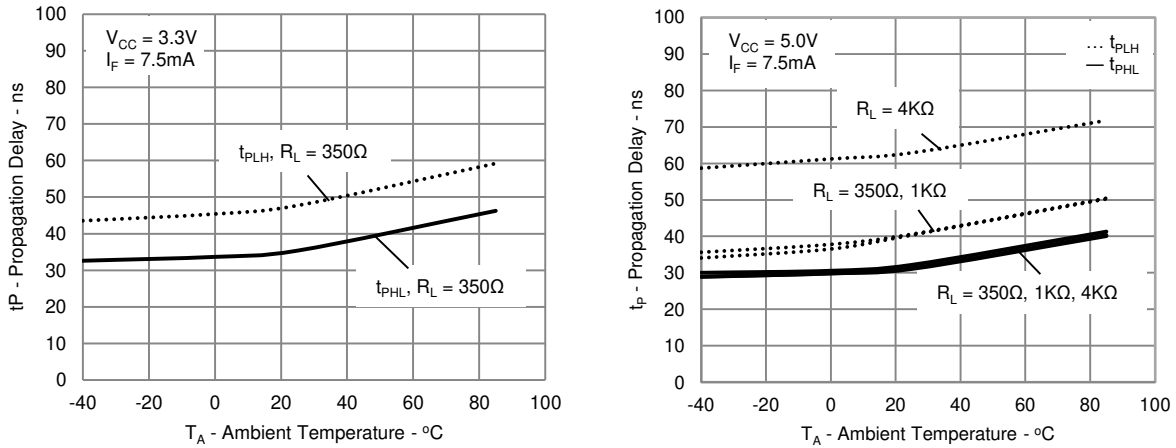
Figure 6: Typical Low Level Output Voltage vs. Ambient Temperature

Figure 7: Typical Low Level Output Current vs. temperature

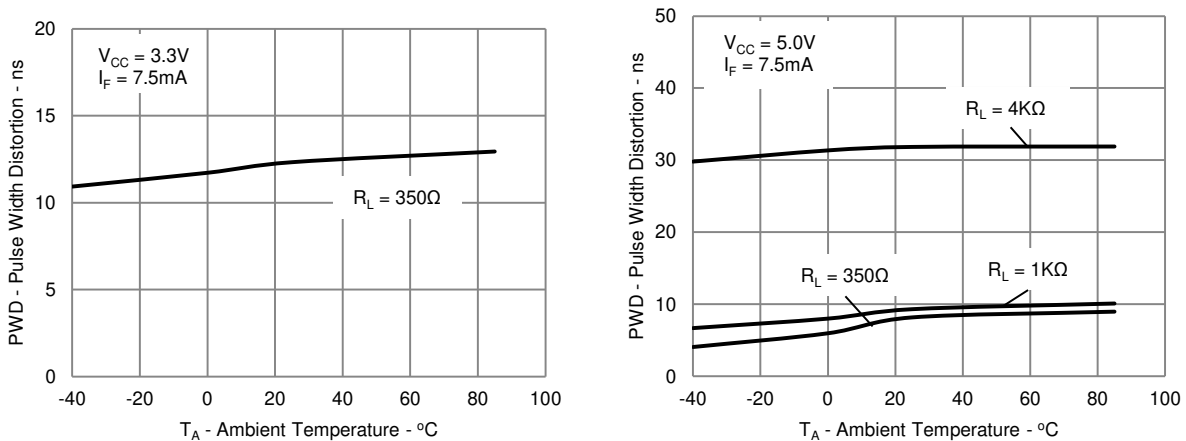


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**Figure 8: Typical Input Diode Forward Characteristic**



**Figure 9: Typical Propagation Delay vs. Ambient Temperature**



**Figure 10: Typical Pulse Width Distortion vs. Ambient Temperature**



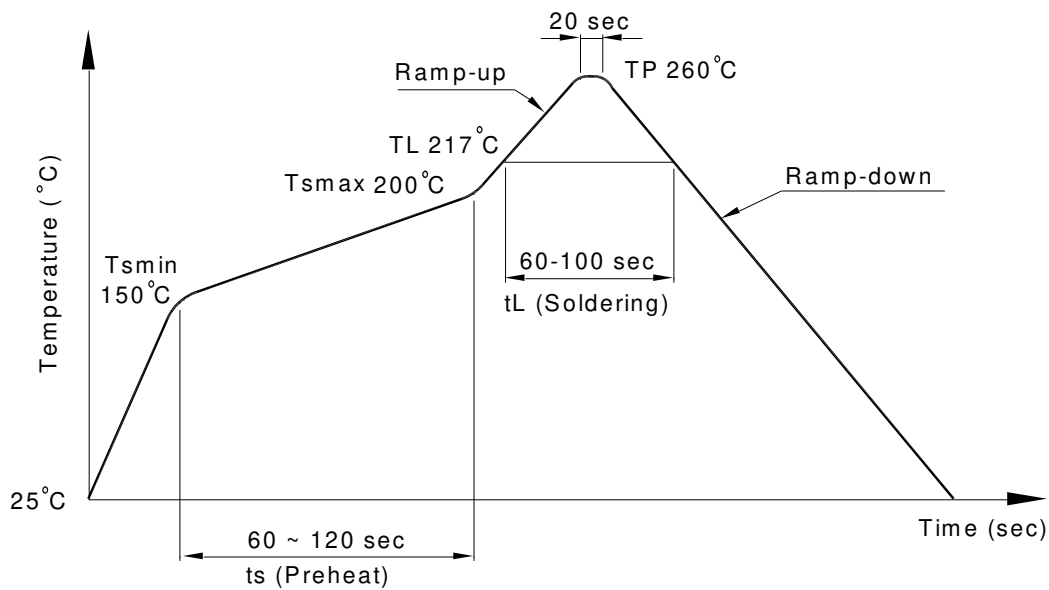
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## 9. TEMPERATURE PROFILE OF SOLDERING

### 9.1 IR Reflow soldering (JEDEC-STD-020C compliant)

One time soldering reflow is recommended within the condition of temperature and time profile shown below. Do not solder more than three times.

Profile item	Conditions
Preheat	
- Temperature Min ( $T_{Smin}$ )	150°C
- Temperature Max ( $T_{Smax}$ )	200°C
- Time (min to max) (ts)	90±30 sec
Soldering zone	
- Temperature ( $T_L$ )	217°C
- Time ( $t_L$ )	60 ~ 100 sec
Peak Temperature ( $T_P$ )	260°C
Ramp-up rate	3°C / sec max.
Ramp-down rate	3~6°C / sec



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**9.2 Wave soldering (JEDEC22A111 compliant)**

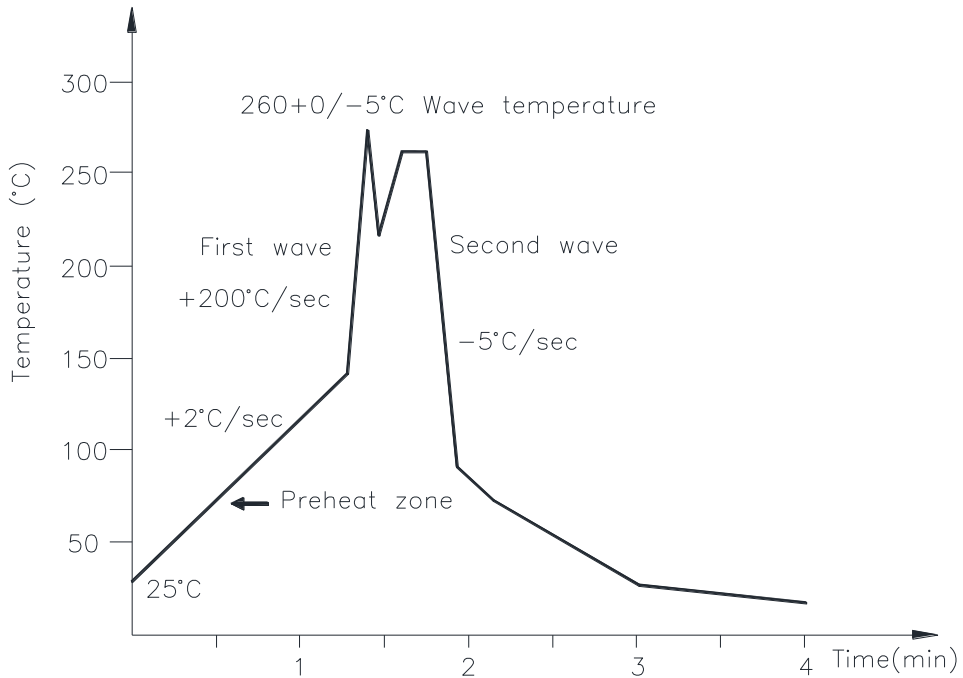
One time soldering is recommended within the condition of temperature.

Temperature:  $260 \pm 0 / -5^{\circ}\text{C}$

Time: 10 sec.

Preheat temperature: 25 to  $140^{\circ}\text{C}$

Preheat time: 30 to 80 sec.



**9.3 Hand soldering by soldering iron**

Allow single lead soldering in every single process. One time soldering is recommended.

Temperature:  $380 \pm 0 / -5^{\circ}\text{C}$

Time: 3 sec max.

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**10. NAMING RULE**

Part Number Options
LTV-0601
LTV0601-V

Definition of Suffix	Remark
"0601"	LiteOn model name
"No Suffix"	Pin 1 location at upper left of the tape
"V"	VDE approved option

**11. NOTES**

LiteOn is continually improving the quality, reliability, function or design and LiteOn reserves the right to make changes without further notices.

The products shown in this publication are designed for the general use in electronic applications such as office automation equipment, communications devices, audio/visual equipment, electrical application and instrumentation.

For equipment/devices where high reliability or safety is required, such as space applications, nuclear power control equipment, medical equipment, etc, please contact our sales representatives.

When requiring a device for any "specific" application, please contact our sales in advice.

If there are any questions about the contents of this publication, please contact us at your convenience.

The contents described herein are subject to change without prior notice.

Immerge unit's body in solder paste is not recommended.