

Photocoupler LTV-M501-3 series

Small Outline, 5Lead, High Speed Optocouplers

1. DESCRIPTION

The LTV-M501-3 series consists of a high efficient AlGaAs Light Emitting Diode and a high speed optical detector. This unique design provides excellent AC and DC isolation between the input and output sides of the Optocoupler. Connection for the bias of the photodiode improves the speed that of a conventional phototransistor coupler by reducing the base-collector capacitances. The internal shield ensures high common mode transient immunity. A guaranteed common mode transient immunity is up to 15kV/μs (Min.).

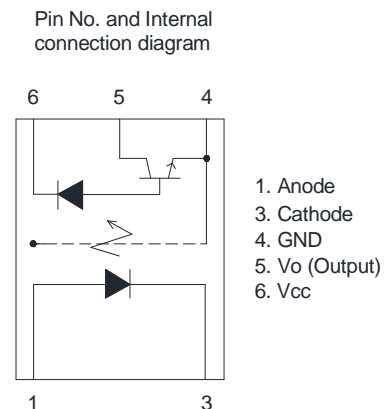
1.1 Features

- Surface mountable
- High speed – 1MBd typical
- Compatible with infrared vapor phase reflow and wave soldering process
- Very high common mode transient immunity: 15K V/μs at $V_{CM} = 1000\text{ V}$ guaranteed
- TTL compatible
- Open collector output
- Lead free option
- MSL Level 1
- Worldwide Safety approval :
UL/ cUL 1577, Cert. No.E113898.
3750 Vrms/1 min
VDE DIN EN60747-5-5, Cert. No. 138213
 $V_{IORM} = 560\text{ V}_{peak}$

1.2 Applications

- Line receivers: High common mode transient immunity (>1000 V/μs) and low input-output capacitance (0.6 pF).
- Ground loop elimination
- Feedback Element in Switching Mode Power Supplier
- High Speed Logic Ground Isolation – TTL/TTL, TTL/LTTL, TTL/CMOS, TTL/LSTTL
- Pulse transformer replacement: save board space and weight
- Analog signal ground isolation: Integrated photon detector provides improved linearity over phototransistor type.

Functional Diagram



Truth Table (Positive Logic)

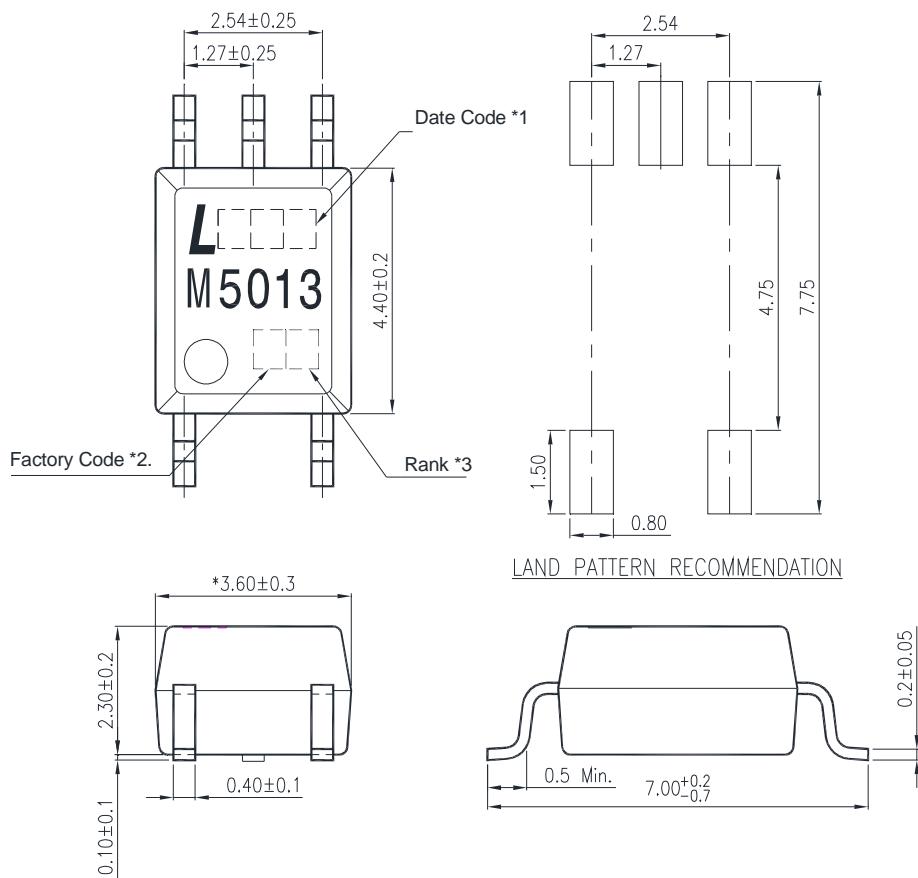
LED	OUT
ON	L
OFF	H

A 0.1μF bypass Capacitor must be connected between Pin4 and Pin6

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2. PACKAGE DIMENSIONS

2.1 LTV-M501-3 series



Notes :

1. The first digit is year date code, second and third digit is work week
2. Factory identification mark (W :China-CZ)
3. VDE option
4. Halogen free option

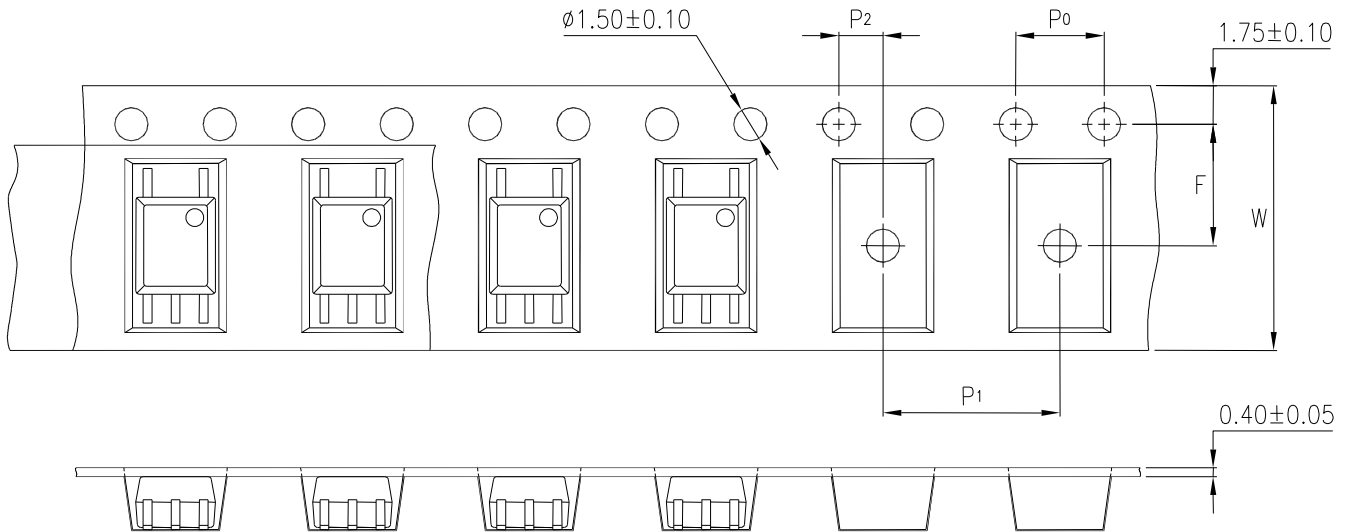
* Dimensions are in Millimeters and (Inches).

* Mold flash on each side is 0.15mm maximum

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3. TAPING DIMENSIONS

3.1 LTV-M501-3



Description	Symbol	Dimension in mm (inch)
Tape wide	W	12 ± 0.3 (.472)
Pitch of sprocket holes	P ₀	4 ± 0.1 (.157)
Distance of compartment	F	5.5 ± 0.1 (.217)
	P ₂	2 ± 0.1 (.079)
Distance of compartment to compartment	P ₁	8 ± 0.1 (.315)

3.3 Quantities Per Reel

Package Type	LTV-M501-3 series
Quantities (pcs)	3000

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4. RATING AND CHARACTERISTICS

4.1 Absolute Maximum Ratings at Ta=25°C *

Parameter	Symbol	Min	Max	Units	Note
Storage Temperature	T _{ST}	-55	125	°C	
Operating Temperature	T _A	-40	100	°C	
Isolation Voltage	V _{ISO}	3750		V _{RMS}	
Supply Voltage	V _{CC}	-0.5	30	V	
Lead Solder Temperature **			260	°C	
Input					
Average Forward Input Current	I _F		20	mA	
Peak Input Current (50% duty cycle, 1 ms pulse width)	I _F		40	mA	
Peak Transient Input Current (1 μs pulse width, 300 pps)	I _F		1.0	A	
Reverse Input Voltage	V _R		5	V	
Input Power Dissipation	P _I		36	mW	
Output					
Output Collector Current	I _O		8	mA	
Peak Output Current	I _O		16	mA	
Output Collector Voltage	V _O	-0.5	20	V	
Output Collector Power Dissipation	P _O		100	mW	

*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 ELECTRICAL OPTICAL CHARACTERISTICS

Parameters	Test Condition	Symbol	Min	Typ	Max	Units	Fig.	Note
Input								
Input Forward Voltage	$I_F = 3\text{mA}$, $T_A = 25^\circ\text{C}$	V_F	1.2	1.4	1.8	V	2	
Input Reverse Voltage	$I_R = 10\mu\text{A}$	BV_R	5			V		
Detector								
Current transfer ratio	$I_F = 3\text{mA}$; $V_{CC} = 3.3\text{V}$ or 5V ; $T_A = 25^\circ\text{C}$; $V_O = 0.4\text{V}$	CTR	90	125	200	%	4,5	2
	$I_F = 3\text{mA}$; $V_{CC} = 3.3\text{V}$ or 5V ; $T_A = 25^\circ\text{C}$; $V_O = 0.5\text{V}$		53					
Logic low output voltage output voltage	$I_F = 3\text{mA}$; $V_{CC} = 3.3\text{V}$ or 5V ; $I_O = 3.0\text{mA}$; $T_A = 25^\circ\text{C}$	V_{OL}		0.25	0.4	V		
	$I_F = 3\text{mA}$; $V_{CC} = 3.3\text{V}$ or 5V ; $I_O = 1.6\text{mA}$; $T_A = 25^\circ\text{C}$			0.25	0.5			
Logic high output current	$I_F = 0\text{mA}$, $V_O = V_{CC} = 5.5\text{V}$, $T_A = 25^\circ\text{C}$	I_{OH}			0.5	μA	7	
	$I_F = 0\text{mA}$, $V_O = 20\text{V}$, $V_{CC} = 30\text{V}$ $T_A = 25^\circ\text{C}$				1			
	$V_O = 20\text{V}$, $V_{CC} = 30\text{V}$				80			
Logic low supply current	$I_F = 3\text{mA}$, $V_O = \text{open}$ ($V_{CC} = 30\text{V}$)	I_{CCL}		60	100			1
Logic high supply current	$I_F = 0\text{mA}$, $V_O = \text{open}$; $T_A = 25^\circ\text{C}$ ($V_{CC} = 30\text{V}$)	I_{CCH}			2			1

*Over recommended temperature ($T_A = -40^\circ\text{C}$ to 105°C), $I_F = 3\text{mA}$, ($2.7\text{V} \leq V_{CC} \leq 24\text{V}$), unless otherwise specified.

*All Typical at $T_A = 25^\circ\text{C}$

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5. SWITCHING SPECIFICATION

Parameters	Test Condition	Symbol	Min	Typ	Max	Units	Fig.	Note
Propagation Delay Time to Low Output Level	Pulse: f = 10kHz, Duty cycle = 50%, $I_F = 3\text{mA}$, $V_{CC} = 3.3\text{V}$, $R_L = 1.8\text{K}\Omega$, $C_L = 15\text{pF}$, $V_{THHL} = 1.5\text{V}$	t_{PHL}		0.3	1	μs	3.6,9	3, 4
	Pulse: f = 10kHz, Duty cycle = 50%, $I_F = 3\text{mA}$, $V_{CC} = 5.0\text{V}$, $R_L = 2.9\text{K}\Omega$, $C_L = 15\text{pF}$, $V_{THHL} = 1.5\text{V}$			0.3	1			
Propagation Delay Time to High Output Level	Pulse: f = 10kHz, Duty cycle = 50%, $I_F = 3\text{mA}$, $V_{CC} = 3.3\text{V}$, $R_L = 1.8\text{K}\Omega$, $C_L = 15\text{pF}$, $V_{THLH} = 2\text{V}$	t_{PLH}		0.4	1.4		3.6,9	3, 4
	Pulse: f = 10kHz, Duty cycle = 50%, $I_F = 3\text{mA}$, $V_{CC} = 5.0\text{V}$, $R_L = 2.9\text{K}\Omega$, $C_L = 15\text{pF}$, $V_{THLH} = 2\text{V}$			0.4	1			
Logic High Common Mode Transient Immunity	$I_F = 0\text{mA}$, $V_{CM} = 1000\text{Vp-p}$; $V_{CC} = 3.3\text{V}$ or 5V , $T_A = 25^\circ\text{C}$, $R_L = 1.8\text{K}\Omega$ or $2.9\text{K}\Omega$	$ CM_H $	15			kV/ μs	10	3, 4
Logic Low Common Mode Transient Immunity	$I_F = 3\text{mA}$; $V_{CM} = 1000\text{Vp-p}$ $V_{CC} = 3.3\text{V}$ or 5V , $T_A = 25^\circ\text{C}$, $R_L = 1.8\text{K}\Omega$ or $2.9\text{K}\Omega$	$ CM_L $	15			kV/ μs	10	3, 4

*Over recommended temperature ($T_A = 0^\circ\text{C}$ to 70°C) $V_{CC} = 5\text{V}$, $I_F = 16\text{mA}$ unless otherwise specified.

*All Typical at $T_A = 25^\circ\text{C}$

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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	μA	45% RH, $t = 5s$, $V_{I-O} = 3kV$ DC, $T_A = 25^\circ C$	5
Withstand Insulation Test Voltage	V_{ISO}	3750			V_{RMS}	RH $\leq 50\%$, $t = 1min$, $T_A = 25^\circ C$	5, 6
Input-Output Resistance	R_{I-O}		10^{12}		Ω	$V_{I-O} = 500V$ DC	5

Typical values applies to $T_A = 25^\circ C$

Note

1. Use of a 0.1 μf bypass capacitor connected between pins 4 and 6 is recommended.
2. Current Transfer Ratio is defined as the ratio of output collector current I_o , to the forward LED input current I_F , times 100.
3. The 1.9K Ω load represents 1TTL unit load of 1.6mA and the 5.6K Ω pull-up resistor.
4. The 4.1K Ω load represents 1LSTTL unit load of 0.36mA and the 6.1K Ω pull-up resistor.
5. Device considered a two-terminal device: Pins 1 and 3 shorted together and Pins 4, 5 and 6 shorted together.
6. In accordance with UL1577, each optocoupler is proof tested by applying an insulation test voltage 4500Vrms for one second (leakage current less than 10 μA). This test is performed before the 100% production test for partial discharge

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7. TYPICAL PERFORMANCE CURVES

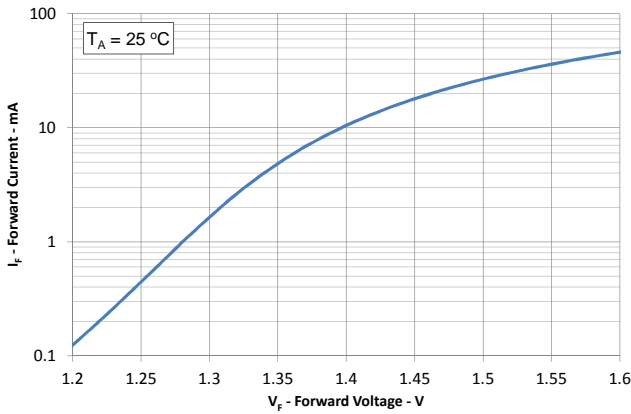


Figure 1. Input Current vs. Forward Voltage

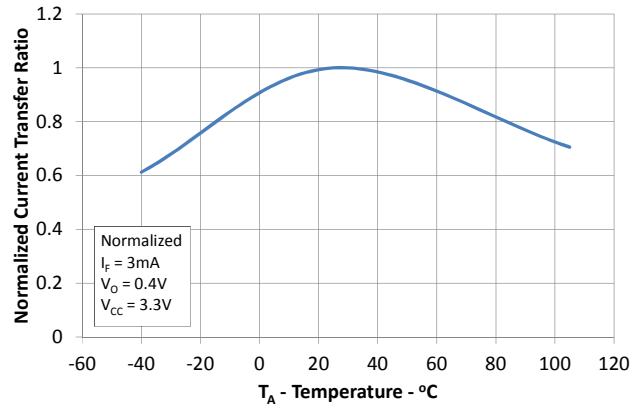


Figure 2. Typical Current Transfer Ratio vs. Temperature

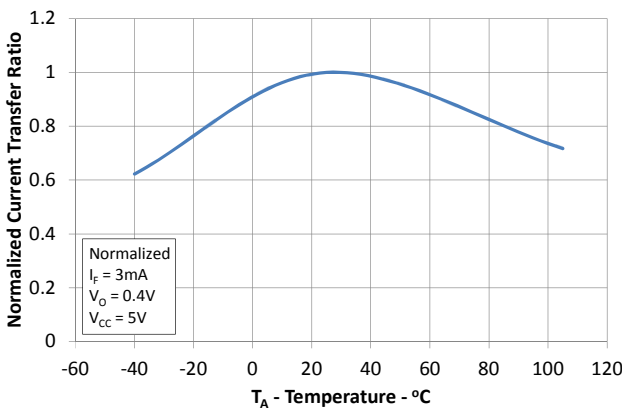


Figure 3. Typical Current Transfer Ratio vs. Temperature

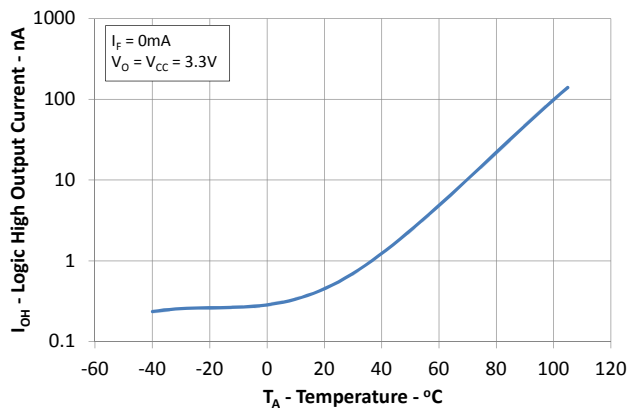


Figure 4. Typical Logic High Output Current vs. Temperature

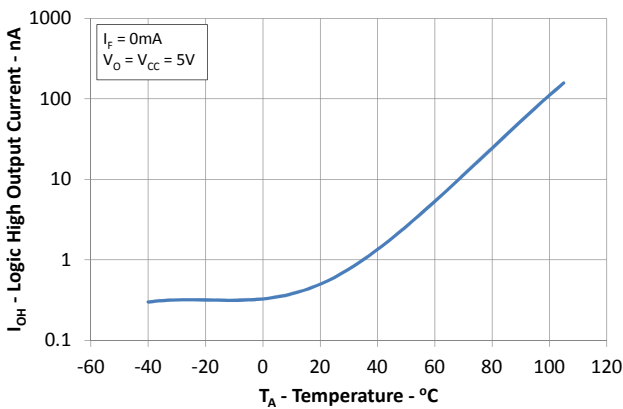


Figure 5. Typical Logic High Output Current vs. Temperature

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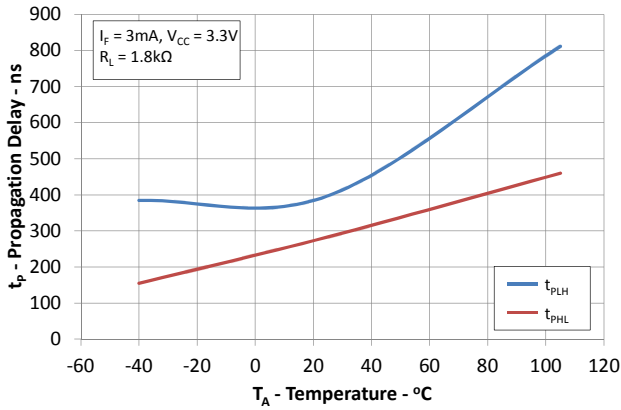


Figure 6. Typical Propagation Delay vs. Temperature

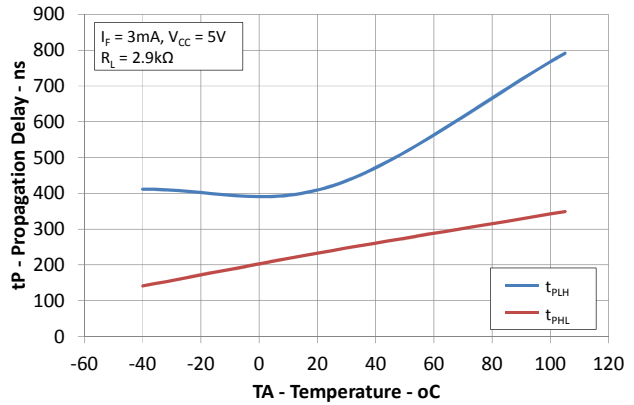


Figure 7. Typical Propagation Delay vs. Temperature

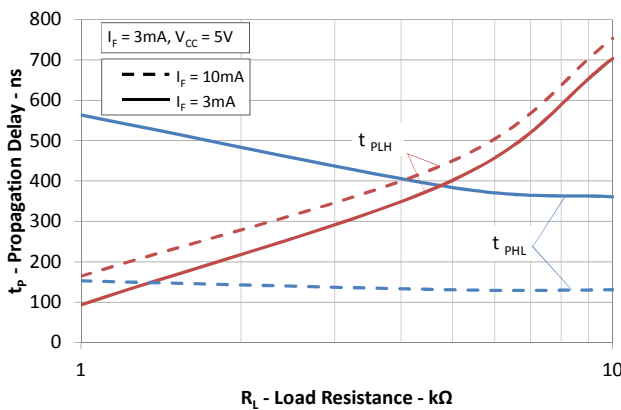


Figure 8. Typical Propagation Delay vs. Load Resistance

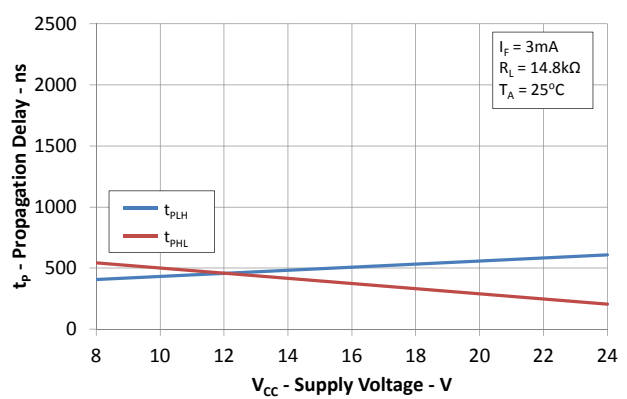


Figure 9. Typical Propagation Delay vs. Supply Voltage

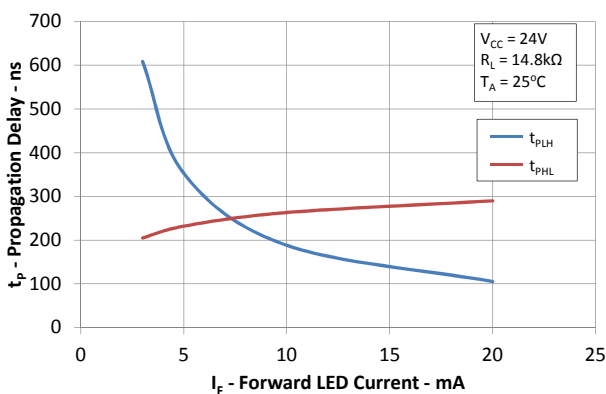


Figure 10. Typical Propagation Delay vs. Supply Current

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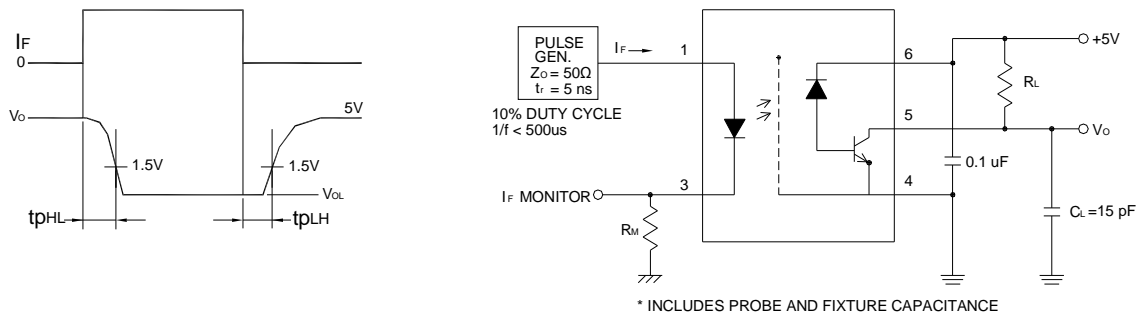


Figure 11: Switching Test Circuit.

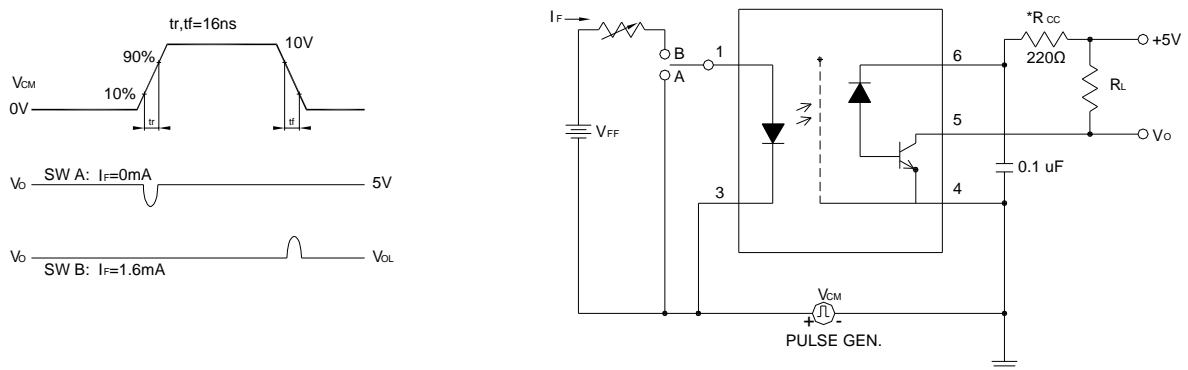


Figure 12: Test Circuit for Transient Immunity and Typical Waveforms.

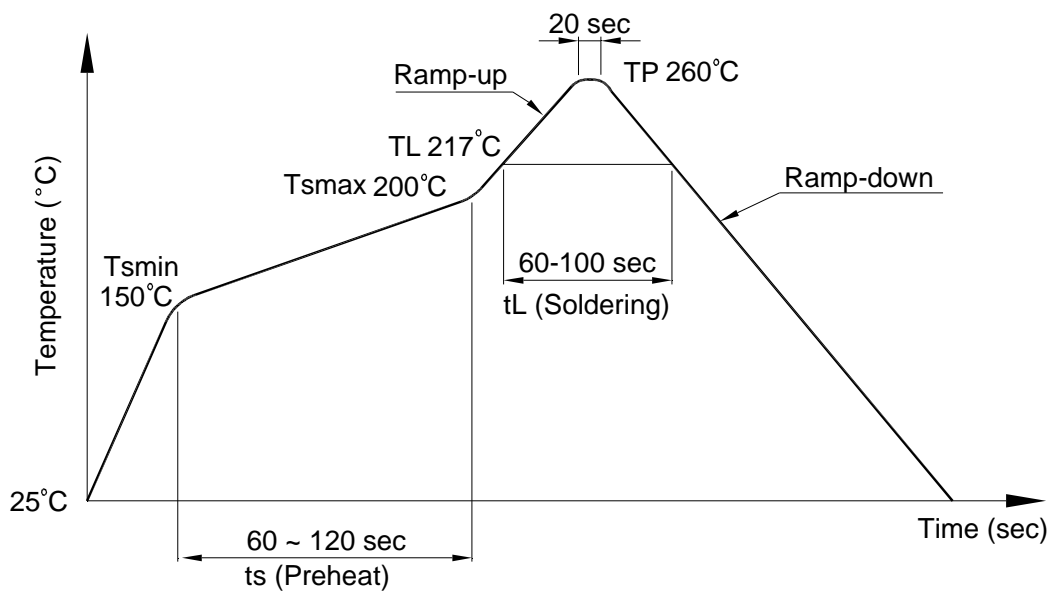
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8. TEMPERATURE PROFILE OF SOLDERING

8.1 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 ~ 100sec
Peak Temperature (T_P)	260°C
Ramp-up rate	3°C / sec max.
Ramp-down rate	3~6°C / sec



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8.2 Wave soldering (JEDEC22A111 compliant)

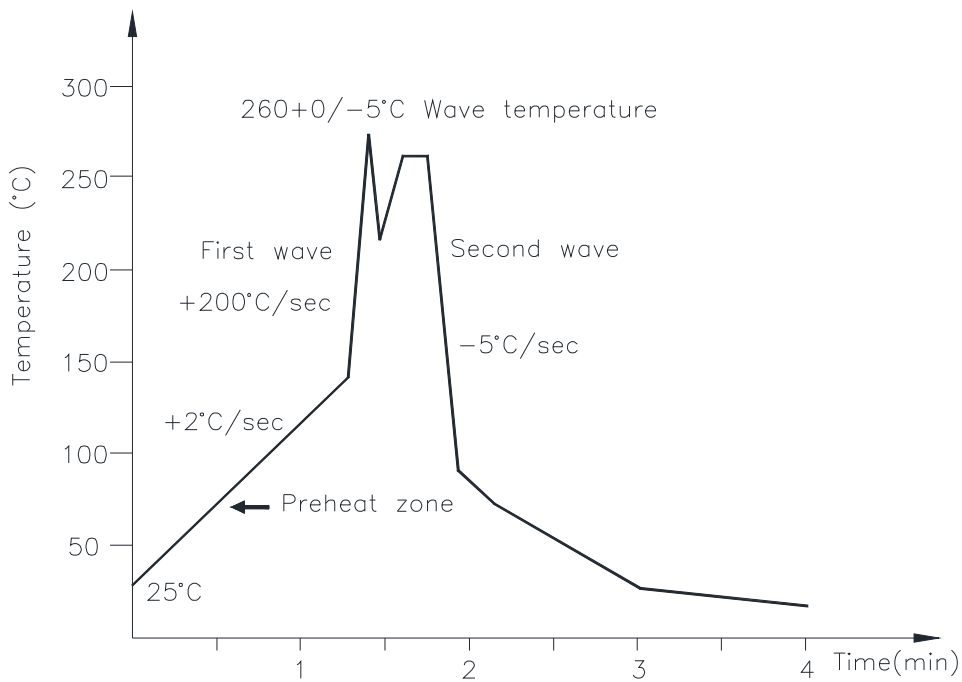
One time soldering is recommended within the condition of temperature.

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

Time: 10 sec.

Preheat temperature: 25 to 140°C

Preheat time: 30 to 80 sec.



8.3 Hand soldering by soldering iron

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

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

Time: 3 sec max.

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9. NAMING RULE

Part Number Options
LTV-M501-3
LTV-M501-3-G
LTVM5013G-V

Definition of Suffix	Remark
"M501-3"	LiteOn model name
"no suffix"	Pin 1 location at upper right of the tape
"V"	VDE approved option
"G"	Halogen free option

10. 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.

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