

Photocouplers LTV-7840 series

LTV-7840 series

Fully Differential Optical Coupled Isolation Amplifier

1. DESCRIPTION

The LTV-7840 is an optically-coupled high-precision analog isolation amplifier. Its input consists of a GaAlAs light-emitting-diode and a highly accurate sigma-delta A/D converter while its output has a highly accurate D/A converter with a differential output. This optocoupler is ideally suited for current sensing in motor drives.

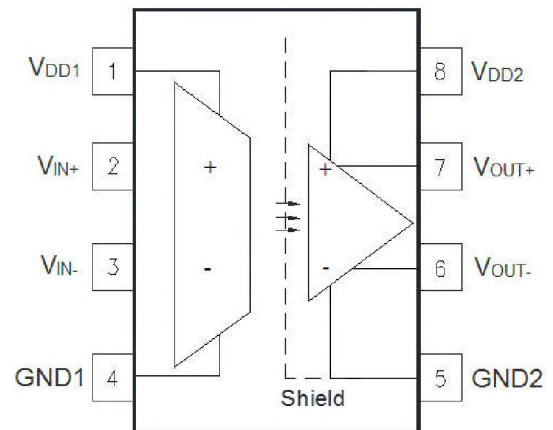
1.1 Features

- 0.3mV Input Offset Voltage
- 0.00025V/V/°C Gain drift vs. Temperature
- 0.004% Non-linearity (NL200 = 0.35% Max)
- Advanced Sigma-Delta ($\Sigma\Delta$) A/D Converter Technology
- Fully Differential Circuit Topology
- 100 kHz Bandwidth
- 10 kV/ μ s minimum Common Mode Rejection (CMR) at $V_{CM} = 1000$ V
- Guaranteed performance over temperature -40°C ~ +100°C.
- MSL Level 1
- Safety approval:
 - UL/ cUL Recognized 5000 V_{RMS}/1 min
 - IEC/EN/DIN EN 60747-5-5 V_{IORM} = 891 V_{peak}

1.2 Applications

- General Purpose Analog Signal Isolation
- General Purpose Current Sensing and Monitoring
- Switched Mode Power Supply Signal Isolation
- Inverter Current Sensing
- Motor Phase and Rail Current Sensing

Functional Diagram

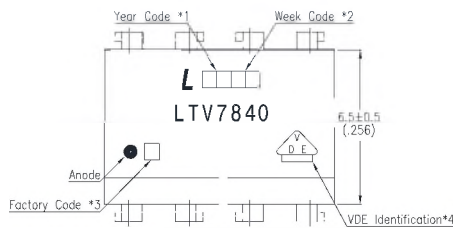


A 0.1 μ F bypass Capacitor must be connected between pin 1 and pin 4 and between pin 5 and pin 8.

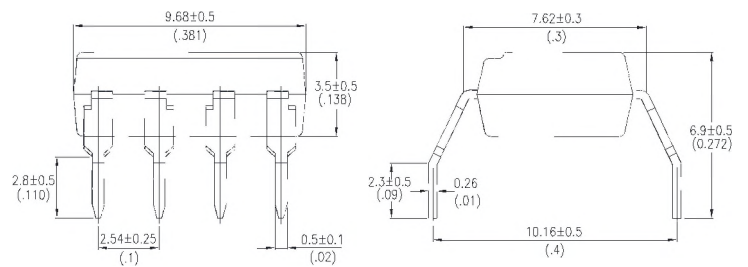
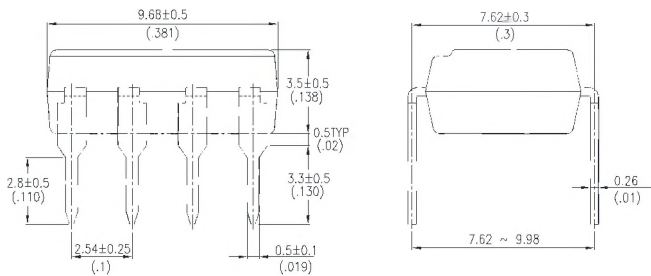
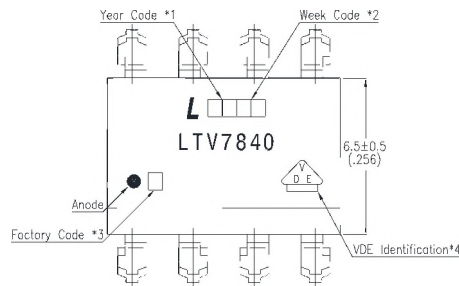
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2. PACKAGE DIMENSIONS

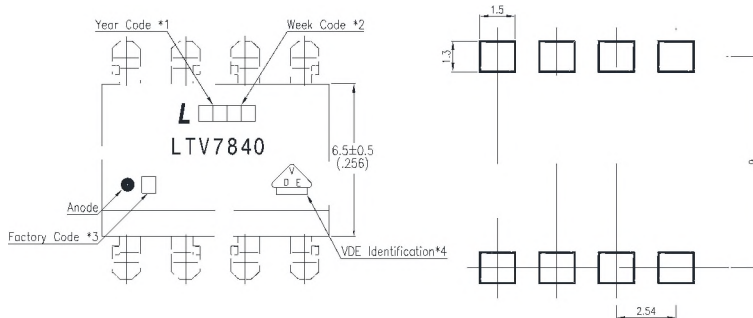
2.1 LTV-7840



2.2 LTV-7840M



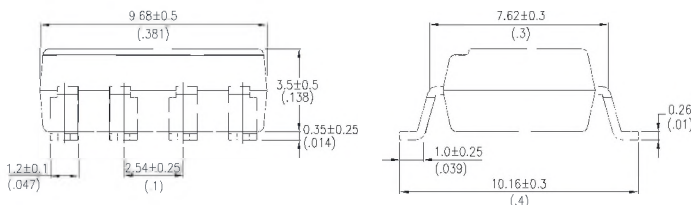
2.3 LTV-7840S



Notes :

- *1. Year date code.
- *2. 2-digit work week.
- *3. Factory identification mark
(Y : Thailand).

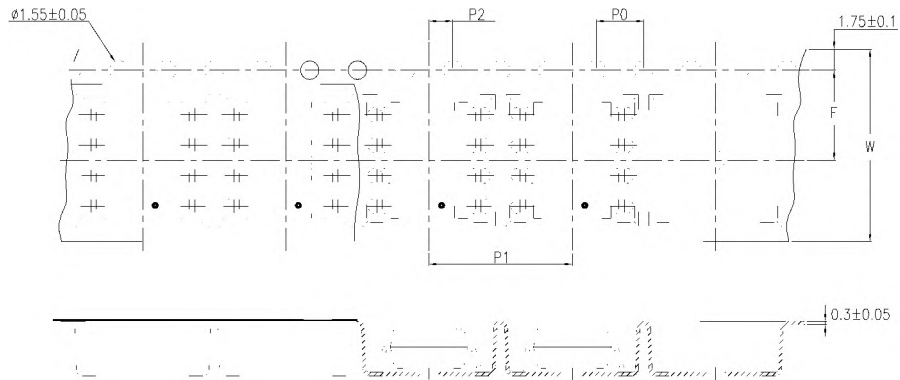
Dimensions are in Millimeters and (Inches).



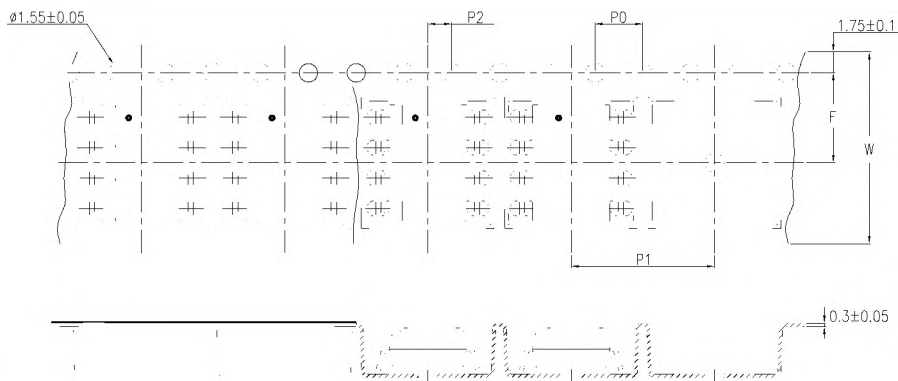
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3. TAPING DIMENSIONS

3.1 LTV-7840S-TA



3.2 LTV-7840S-TA1



Description	Symbol	Dimension in mm (inch)
Tape wide	W	16±0.3 (0.63)
Pitch of sprocket holes	P ₀	4±0.1 (0.15)
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 (0.47)

3.3 Quantities Per Reel

Package Type	LTV-7840
Quantities (pcs)	1000

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4. IEC/EN/DIN EN 60747-5-5 Insulation Characteristics

Isolation characteristics are guaranteed only within the safety maximum ratings which must be ensured by protective circuits in application.

Description	Symbol	Characteristics	Unit
Installation classification per DIN VDE 0110, Table 1 for rated mains voltage $\leq 150 V_{rms}$ for rated mains voltage $\leq 300 V_{rms}$ for rated mains voltage $\leq 450 V_{rms}$		I-IV I-IV I-III	
Climatic Classification		55/115/21	
Pollution Degree (DIN VDE 0110/39)		2	
Maximum Working Insulation Voltage	V_{IORM}	1230	V_{peak}
Input-to-Output Test Voltage, Method b *a $V_{IORM} \times 1.875 = V_{PR}$, 100% Production Test with $t_m = 1$ sec, Partial Discharge < 5 pC	V_{PR}	2306	V_{peak}
Input-to-Output Test Voltage, Method a *a $V_{IORM} \times 1.6 = V_{PR}$, Type and Sample Test, $t_m = 10$ sec, Partial Discharge < 5 pC	V_{PR}	1968	V_{peak}
Highest Allowable Overvoltage (Transient Overvoltage, $t_{ini} = 60$ sec)	V_{IOTM}	8000	V_{peak}
Safety Limiting Values (Maximum values allowed in the event of a failure)			
Case Temperature	T_S	175	$^{\circ}C$
Input Current *b	$I_{S, INPUT}$	400	mA
Output Power *b	$P_{S, OUTPUT}$	600	mW
Insulation Resistance at T_S , $V_{IO} = 500$ V	R_S	$\geq 10^9$	Ω

*a. Refer to the front of the optocoupler section of the current catalog, under Product Safety Regulations section, IEC/EN/DIN EN 60747-5-5, for a detailed description.

*b. Ratings apply to all devices except otherwise noted in the Package column.

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5. Insulation and Safety Related Specifications

Part number	Symbol	LTV-7840	Units	Conditions
Minimum External Air Gap (External Clearance)	L(101)	7.4	mm	Measured from input terminals to output terminals, shortest distance through air.
Minimum External Tracking (External Creepage)	L(102)	8.0*	mm	Measured from input terminals to output terminals, shortest distance path along body.
Minimum Internal Plastic Gap (Internal Clearance)		0.4	mm	Through insulation distance, conductor to conductor, usually the direct distance between the photoemitter and photodetector inside the optocoupler cavity.
Tracking Resistance (Comparative Tracking Index)	CTI	> 175	V	DIN IEC 112/VDE 0303 Part 1
Isolation Group		IIIa		Material Group (DIN VDE 0110, 1/89, Table 1)

*Note : Only with Wide lead option

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6. RATING AND CHARACTERISTICS

6.1 Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit	Note
Storage Temperature	T_{stg}	-55	+125	°C	—
Operating Temperature	T_{opr}	-40	+100	°C	—
Output IC Junction Temperature	T_J	—	125	°C	—
Supply Voltage	V_{DD1}, V_{DD2}	0	5.5	V	—
Steady State Input Voltage	V_{IN+}, V_{IN-}	-2.0	$V_{DD1}+0.5$	V	—
2 Second Transient Input Voltage	V_{IN+}, V_{IN-}	-6.0	$V_{DD1}+0.5$	V	—
Output Voltage	V_{OUT+}, V_{OUT-}	-0.5	$V_{DD2}+0.5$	V	—
Input Power Dissipation	P_D	—	70	mW	—
Output Power Dissipation	P_O	—	60	mW	—
Lead Solder Temperature (10s)	T_{sol}	—	260	°C	—

Note: 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.

Note: Note: A ceramic capacitor (0.1 μ F) should be connected between pin 1 and pin 4, between pin 8 and pin 5 to stabilize the operation of a high gain linear amplifier. Otherwise, this Photocoupler may not switch properly. The bypass capacitor should be placed within 1 cm of each pin.

6.2 Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Operating Temperature	T_A	-40	85	°C
Supply Voltage	V_{DD1}, V_{DD2}	4.5	5.5	V
Input Voltage (accurate and linear)	V_{IN+}, V_{IN-}	-200	200	mV
Input Voltage (functional)	V_{IN+}, V_{IN-}	-2	2	V

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6.3 ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Figure	Note
Input Offset Voltage	V_{OS}	-2.0 -3.0	0.78	2.0 3.0	mV	$T_A = 25^\circ\text{C}$ $-40^\circ\text{C} < T_A < +85^\circ\text{C}$		
Magnitude of Input Offset Change vs. Temperature	$ \Delta V_{OS}/\Delta T_A $		4.0	10.0	$\mu\text{V}/^\circ\text{C}$	$+25^\circ\text{C} < T_A < +85^\circ\text{C}$ (KIV)		
Gain ($\pm 5\%$ tolerance)	G	7.6	8.0	8.4	V/V	$-200\text{ mV} < V_{IN+} < 200\text{ mV}$, $T_A = 25^\circ\text{C}$		
Magnitude of V_{OUT} Gain Change vs. Temperature	$ \Delta G/\Delta T_A $		0.0006		$\text{V/V}/^\circ\text{C}$			
V_{OUT} 200 mV Nonlinearity	NL ₂₀₀		0.0295	0.35	%	$-200\text{ mV} < V_{IN+} < 200\text{ mV}$		
Magnitude of V_{OUT} 200 mV Nonlinearity Change vs. Temperature	$ \Delta \text{NL}_{200}/\Delta T_A $		0.0009		$\%/^\circ\text{C}$			
V_{OUT} 100 mV Nonlinearity	NL ₁₀₀		0.0233	0.2	%	$-100\text{ mV} < V_{IN+} < 100\text{ mV}$		
Magnitude Input Voltage before V_{OUT} Clipping	$ V_{IN+} _{\text{MAX}}$		320		mV			
Input Supply Current	I_{DD1}		7.08	15.5	mA	$V_{IN+} = +400\text{ mV}$		
Output Supply Current	I_{DD2}		3.60	15.5	mA	$V_{IN+} = -400\text{ mV}$		
Input Current	I_{IN+}		-0.4	5.0	μA			
Magnitude of Input Bias Current vs. Temperature	$ \Delta I_{IN+}/\Delta T_A $		0.27		$\text{nA}/^\circ\text{C}$			
Low level output voltage	V_{OL}		1.29		V			
High level output voltage	V_{OH}		3.80		V			
Output Common-Mode Voltage	V_{OCM}	2.2		2.8	V			
Output Short-Circuit Current	$ I_{OSC} $		13		mA			
Equivalent Input Impedance	R_{IN}		594		k Ω			
V_{OUT} Output Resistance	R_{OUT}		9.9		Ω			
Input DC Common-Mode Rejection Ratio	CMRR _{IN}		80		dB			

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All Typical values at $T_A = 25^\circ\text{C}$, $V_{IN+} = V_{IN-} = 0\text{ V}$ and $V_{DD1} = V_{DD2} = 5\text{ V}$, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition. (Refer to [6.2](#))

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7. SWITCHING SPECIFICATION

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Figure	Note
V_{OUT} Bandwidth (-3dB) sine wave	BW	50	100		kHz	$V_{IN+} = 200 \text{ mV}_{pk-pk}$		
V_{OUT} Noise	N_{OUT}		30		mV_{rms}	$V_{IN+} = 0 \text{ V}$		
V_{IN} to V_{OUT} Signal Delay (50 to 10%)	t_{PD10}		2.25	3.3	μs	$V_{IN+} = 0 \text{ mV to } 150 \text{ mV}$ step. Measured at output of OPA132 on Figure 3.		
V_{IN} to V_{OUT} Signal Delay (50 to 50%)	t_{PD50}		4.40	5.6				
V_{IN} to V_{OUT} Signal Delay (50 to 90%)	t_{PD90}		6.83	9.9				
V_{OUT} Rise/Fall Time (10 to 90%)	$t_{R/F}$			6.6				
Common Mode transient Immunity	CMTI	10	15		$\text{kV}/\mu\text{s}$	$T_A = 25^\circ\text{C}$, $V_{CM} = 1000 \text{ V}$		
Power Supply Rejection	PSR		170		mV_{rms}	With recommended application circuit		

All Typical values at $T_A = 25^\circ\text{C}$, $V_{IN+} = V_{IN-} = 0 \text{ V}$ and $V_{DD1} = V_{DD2} = 5 \text{ V}$, unless otherwise specified; all minimum and maximum specifications are at recommended operating condition. (Refer to 6.2)

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8. ISOLATION CHARACTERISTIC

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	Note
Withstand Insulation Test Voltage	V_{ISO}	5000	—	—	V	$RH \leq 40-60\%$, $t = 1\text{min}$, $T_A = 25^\circ\text{C}$,	1, 2
Input-Output Resistance	R_{I-O}	—	10^{12}	—	Ω	$V_{I-O} = 500\text{V DC}$	1
Input-Output Capacitance	C_{I-O}	—	0.90	—	pF	$f = 1\text{MHz}$, $T_A = 25^\circ\text{C}$	1

All Typical values at $T_A = 25^\circ\text{C}$ unless otherwise specified. All minimum and maximum specifications are at recommended operating condition. (Refer to 6.2)

Note 1: Device is considered a two-terminal device: pins 1, 2, 3 and 4 are shorted together and pins 5, 6, 7 and 8 are shorted together.

Note 2: According to UL1577, each Photocoupler is tested by applying an insulation test voltage $6000V_{RMS}$ for one second (leakage current less than $10\mu\text{A}$). This test is performed before the 100% production test for partial discharge.

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9. TYPICAL PERFORMANCE CURVES & TEST CIRCUITS : Pending

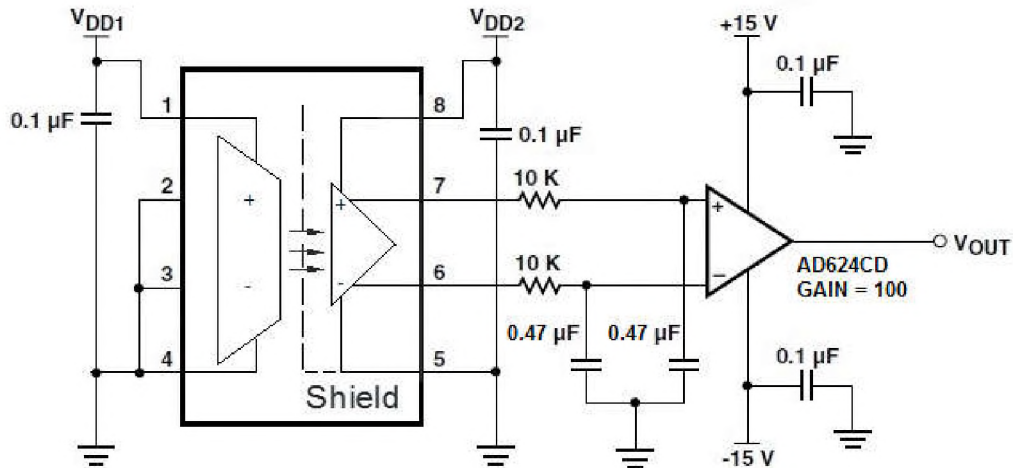


Figure 1. Input Voltage Test Circuit

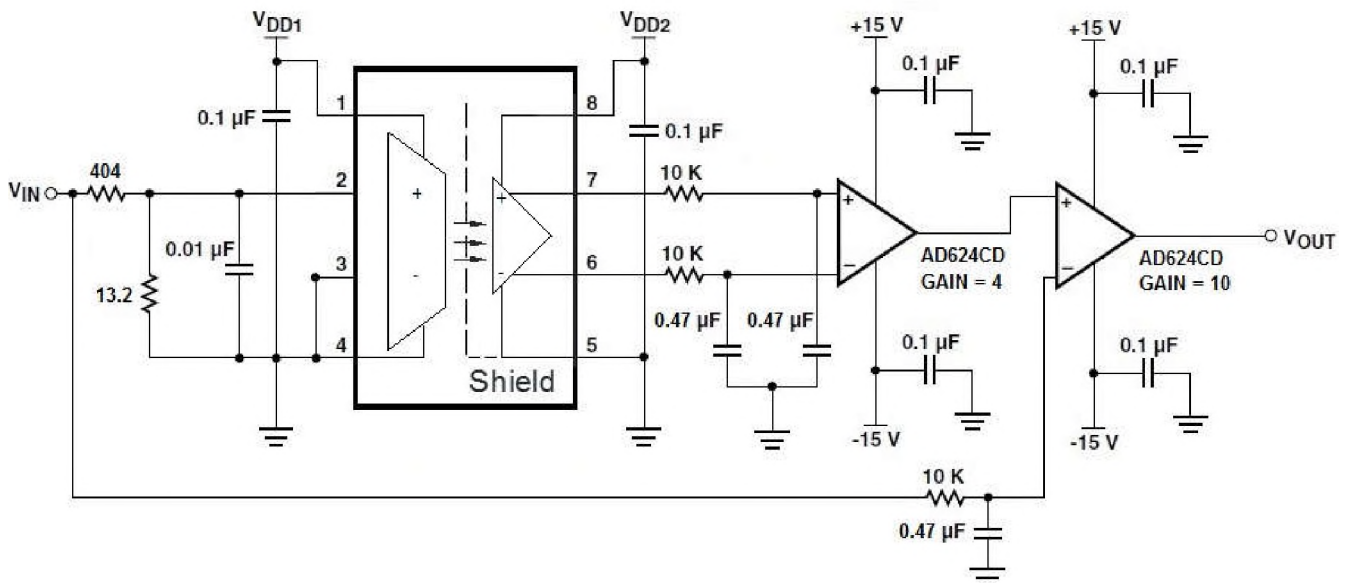


Figure 2. Gain and Nonlinearity Test Circuit

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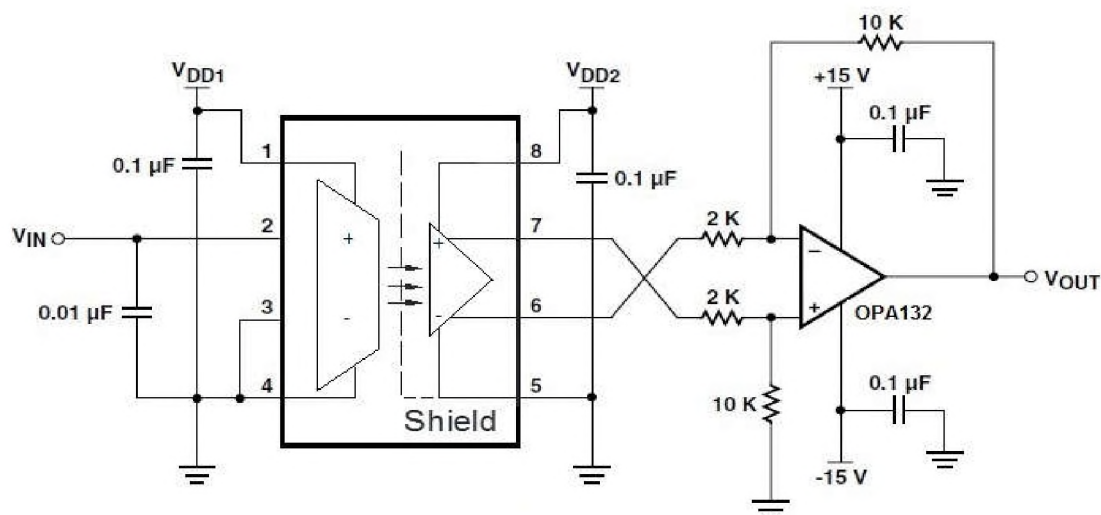
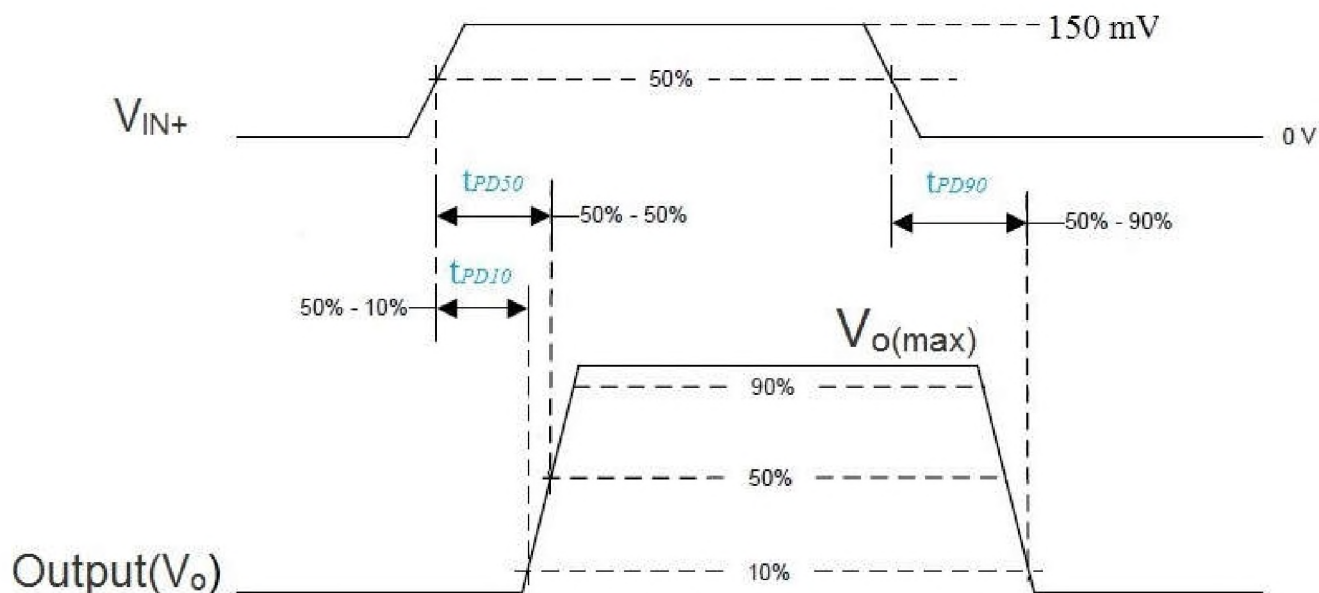


Figure 3. Propagation Delay Test Circuit



Delay Time Test Waveforms

Figure 4. Propagation Delay Waveforms

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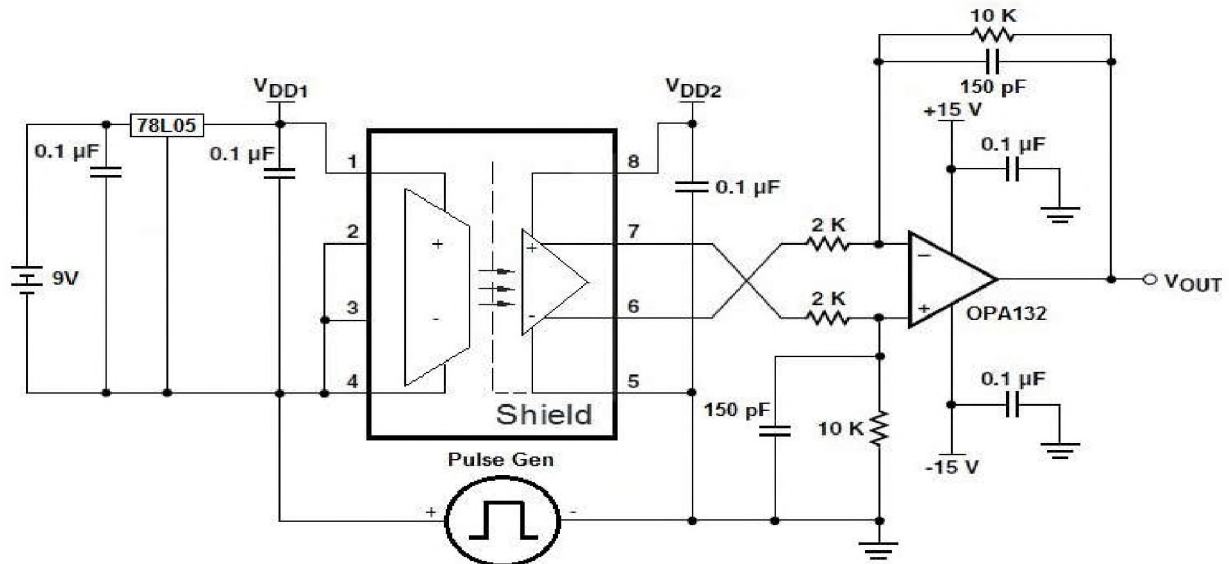


Figure 5. CMTI Test Circuit

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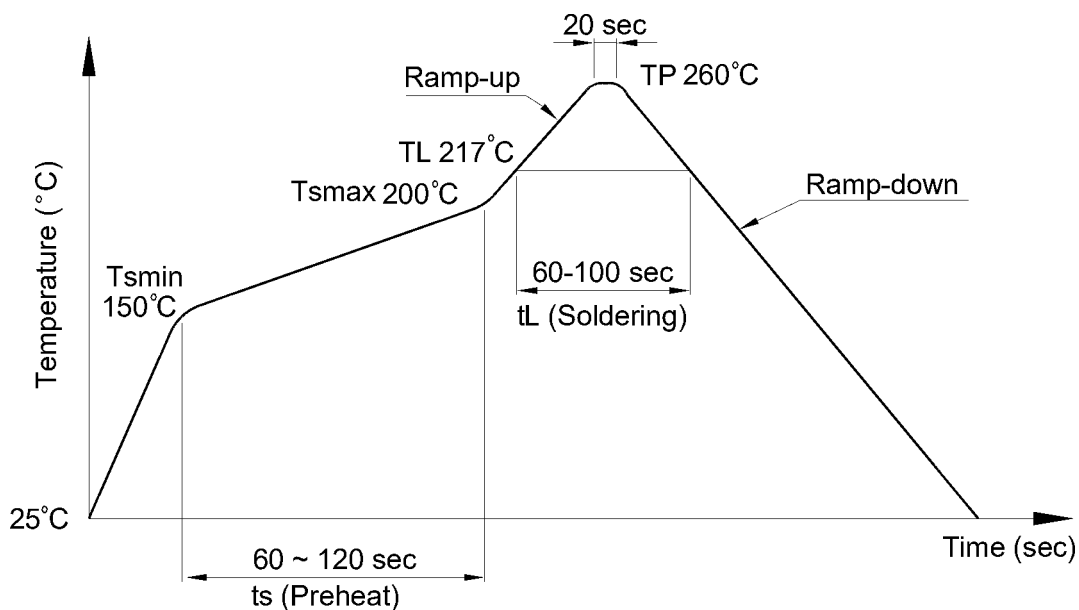
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TEMPERATURE PROFILE OF SOLDERING

10.1 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) (t_s)	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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10.2 Wave soldering (JEDEC22A111 compliant)

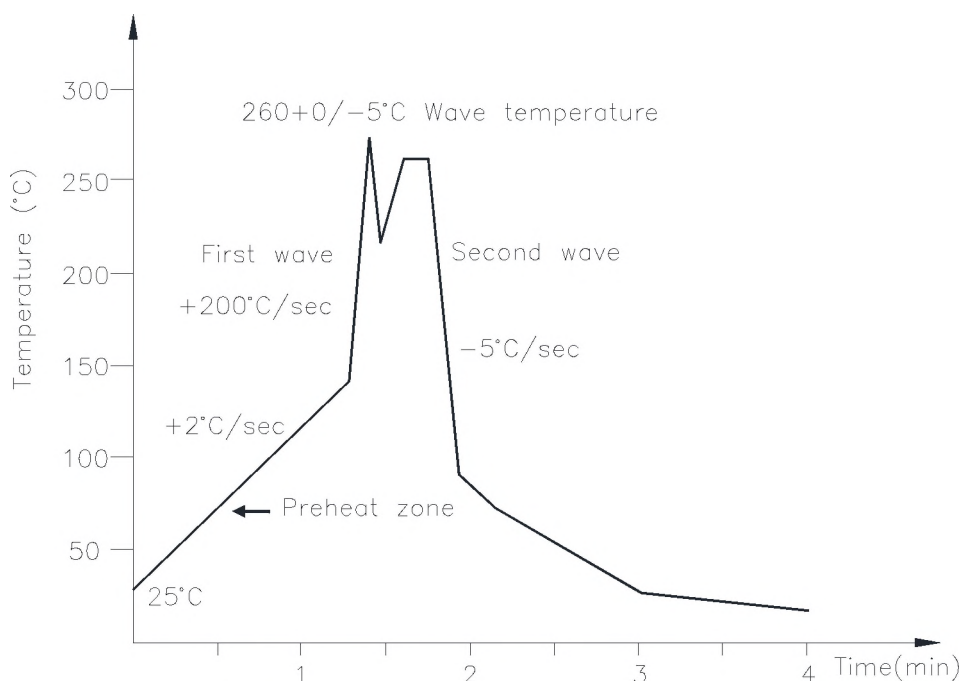
One time soldering is recommended within the condition of temperature.

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

Time: 10 sec.

Preheat temperature: 25 to 140°C

Preheat time: 30 to 80 sec.



10.3 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-7840	
LTV-7840M	
LTV-7840S	
LTV-7840S-TA	
LTV-7840S-TA1	
LTV7840-V	
LTV7840M-V	
LTV7840S-V	
LTV7840STA-V	
LTV7840STA1-V	
Definition of Suffix	Remark
"7840"	LiteOn model name
"No Suffix"	Dual-in-Line package clearance distance 7 mm typical
"M"	Wide lead spacing package clearance distance 8 mm min.
"S"	Surface mounting package clearance distance 8 mm min.
"TA"	Pin 1 location at lower right of the tape
"TA1"	Pin 1 location at upper left of the tape
"V"	VDE approved option

12. Notes:

Specifications of the products displayed herein are subject to change without notice.

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 instrumentation and application. 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.