Features

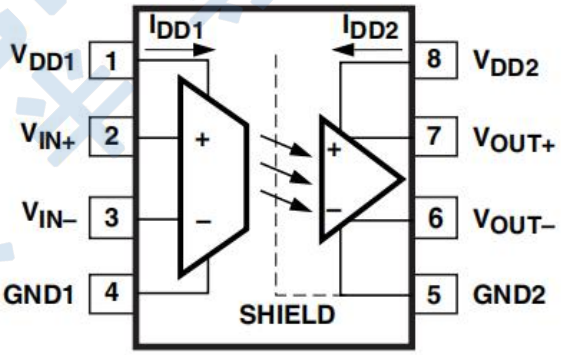
- 15 kV/μs common-mode rejection at V_{CM} = 1000 V
- 0.00025 V/V/°C gain drift vs. temperature
- 0.3 mV input off set voltage
- 100 kHz bandwidth
- 0.004% nonlinearity
- Advanced Sigma-Delta (∑-Δ) A/D converter technology
- Fully diff erential circuit topology
- CMOS IC technology
- REACH & RoHS compliance
- Halogen free
- Regulatory Approvals
  - UL - UL1577
  - VDE - EN60747-5-5(VDE0884-5)
  - CQC - GB4943.1

Description

The ICPL-7840 isolation amplifi er family was designed for current sensing in electronic motor drives. In a typical implementation, motor currents flow through an external resistor and the resulting analog voltage drop is sensed by the ICPL-7840. A diff erential output voltage is created on the other side of the ICPL-7840 optical isolation barrier.

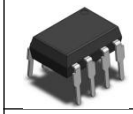
Applications

- Motor phase and rail current sensing
- Inverter current sensing
- Switched mode power supply signal isolation
- General purpose current sensing and monitoring
- General purpose analog signal isolation



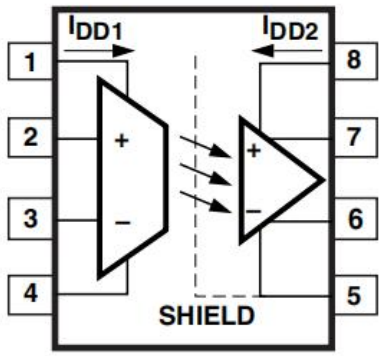
* 0.1 μF bypass capacitor must be connected between pins 1 and 4 and between pins 5 and 8.

ORDERING INFORMATION

Outline	Part Number	Package	Marking	Packing	Packing Size	Quantity
	ICPL-7840-000E	DIP8	ICPL 7840 /YYWW E	Tube	500mm	40
	ICPL-7840-500E	DIP8-SL		Reel	13 "	1000

CONTENTS

PIN CONFIGURATION AND FUNCTIONS



Pin	Name
1	V_{DD1}
2	V_{IN+}
3	V_{IN-}
4	GND1
5	GND2
6	V_{OUT-}
7	V_{OUT+}
8	V_{DD2}

RECOMMENDED OPERATION 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	mA
Input Voltage (functional)	V_{IN+}, V_{IN-}	-2	2	V

recommends operation with V_{IN-} = 0V (tied to GND1). Limiting V_{IN+} to 100mV will improve DC nonlinearity and nonlinearity drift. If V_{IN-} is brought above V_{DD1} – 2V, an internal test mode may be activated. This test mode is for testing LED coupling and is not intended for customer use.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Storage Temperature	T_S	-55	125	℃
Operating Temperature	T_a	-40	100	℃
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		-6.0	V_{DD1} +0.5	
Output Voltage	V_{OUT}	-0.5	V_{DD2} +0.5	V

DC Electrical Specifi cations

*Unless otherwise noted, all typicals and fi gures are at the nominal operating conditions of V_{IN+} = 0, V_{IN-} = 0 V, V_{DD1} = V_{DD2} = 5 V and T_A = 25°C; all Min./Max. specifi cations are within the Recommended Operating Conditions.

Parameter	Symbol	Condition	Min	Typ	Max.	Unit	Note
Input Off set Voltage	V_{OS}	T_A = 25°C	-2.0	0.3	2.0	mV	
		T_A = -40°C to +85°C	-3.0	-	3.0	mV	
Magnitude of Input Off set Change vs. Temperature	$\|\Delta V_{OS}/\Delta T_A\|$		-	3.0	10.0	µV/°C	1
Gain (± 5% Tol.)	G	-200 mV < V_{IN+} < 200 mV, T_A = 25°C	7.60	8.00	8.40	V/V	2
Magnitude of V_{OUT} Gain Change vs. Temperature	$\|\Delta G/\Delta T_A\|$		-	0.00025	-	V/V/°C	3
V_{OUT} 200 mV Nonlinearity	NL_{200}	-200 mV < V_{IN+} < 200 mV	-	0.0037	0.35	%	4
Magnitude of V_{OUT} 200 mV Nonlinearity Change vs. Temperature	$\|dNL_{200}/dT\|$		-	0.0002	-	% / °C	
V_{OUT} 100 mV Nonlinearity	NL_{100}	-100 mV < V_{IN+} < 100 mV		0.0027	0.2	%	5
Maximum Input Voltage before V_{OUT} Clipping	$\|V_{IN+}\|$ MAX		-	308.0	-	mV	
Input Supply Current	I_{DD1}	V_{IN+} = 400 mV	-	10.86	15.5	mA	6
Output Supply Current	I_{DD2}	V_{IN+} = -400 mV		11.56	15.5	mA	7
Input Current	I_{IN+}			-0.5	5.0	µA	8
Magnitude of Input Bias Current vs. Temperature Coeffi cient	$\|dI_{IN}/dT\|$		-	+0.45	-	nA/°C	
Output Low Voltage	V_{OL}		-	1.29	-	V	9
Output High Voltage	V_{OH}		-	3.80	-	V	9
Output Common-Mode Voltage	V_{OCM}		2.2	2.545	2.8	V	
Output Short-Circuit Current	$\|I_{OSC}\|$		-	18.6	-	mA	10
Equivalent Input Impedance	R_{IN}		-	500	-	kΩ	
VOUT Output Resistance	R_{OUT}		-	15	-	Ω	

Input DC Common-Mode Rejection Ratio	$CMRR_{IN}$		-	76.1	-	dB	11

1、This is the Absolute Value of Input Off set Change vs. Temperature.

2、Gain is defi ned as the slope of the best-fi t line of diff erential output voltage (V_{OUT+}–V_{OUT-}) vs. diff erential input voltage (V_{IN+}–V_{IN-}) over the specifi ed input range.

3、This is the Absolute Value of Gain Change vs. Temperature.

4、Nonlinearity is defi ned as half of the peak-to-peak output deviation from the best-fi t gain line, expressed as a percentage of the full-scale diff erential output voltage.

5、NL_{100} is the nonlinearity specifi ed over an input voltage range of ±100 mV.

6、The input supply current decreases as the diff erential input voltage (V_{IN+}–V_{IN-}) decreases.

7、The maximum specifi ed output supply current occurs when the diff erential input voltage (V_{IN+}–V_{IN-}) = -200 mV, the maximum recommended operat-ing input voltage. However, the out-put supply current will continue to rise for diff erential input voltages up to approximately -300 mV, beyond which the output supply current remains constant.

8、Because of the switched-capacitor nature of the input sigma-delta con-verter, time-averaged values are shown.

9、When the diff erential input signal exceeds approximately 308 mV, the outputs will limit at the typical values shown.

10、Short circuit current is the amount of output current generated when either output is shorted to V_{DD2} or ground.

11、CMRR is defined as the ratio of the differential signal gain (signal applied differentially between pins 2 and 3) to the common-mode gain (input pins tied together and the signal applied to both inputs at the same time), expressed in dB.

AC Electrical Specifi cations

*Unless otherwise noted, all typicals and fi gures are at the nominal operating conditions of V_{IN+}=0, V_{IN-}=0V, V_{DD1}= V_{DD2}=5V and T_A= 25°C; all Min./Max. specifi cations are within the Recommended Operating Conditions.

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units	Note
V_{OUT} Bandwidth (-3 dB)	BW	V_{IN+} = 200 mV_{pk-pk} sine wave.	50	100	-	kHz	
V_{OUT} Noise	N_{OUT}	V_{IN+} = 0.0 V	-	31.5	-	mVrms	12
V_{IN} to V_{OUT} Signal Delay (50 – 10%)	t_{PD10}	Measured at output of MC34081 on Figure 15. V_{IN+} = 0 mV to 150 mV step	-	2.03	3.3	μs	
V_{IN} to V_{OUT} Signal Delay (50 – 50%)	t_{PD50}		-	3.47	5.6		
V_{IN} to V_{OUT} Signal Delay (50 – 90%)	t_{PD90}		-	4.99	9.9		
V_{OUT} Rise/Fall Time (10 – 90%)	$t_{R/F}$		-	2.96	6.6		
Common Mode Transient Immunity	CMTI	V_{CM} = 1 kV, T_A = 25°C	10.0	15.0	-	kV/μs	13
Power Supply Rejection	PSR	With recommended application circuit.	-	170	-	mVrms	14

12、Output noise comes from two primary sources: chopper noise and sigma-delta quantization noise. Chopper noise results from chopper stabilization of the output op-amps. It occurs at a specific frequency (typically 400 kHz at room temperature), and is not at tenuated by the internal output fi lter. A fi lter circuit can be easily added to the external post-amplifi er to reduce the total rms output noise. The internal output fi lter does eliminate most, but not all, of the sigma-delta quantization noise. The magnitude of the output quantization noise is very small at lower frequencies (below 10 kHz) and increases with increasing frequency.

13、CMTI (Common Mode Transient Immunity or CMR, Common Mode Rejection) is tested by applying an exponentially rising/falling voltage step on pin 4 (GND1) with respect to pin 5 (GND2). The rise time of the test waveform is set to approximately 50 ns. The amplitude of the step is adjusted until the diff erential output (V_{OUT+}–V_{OUT-}) exhibits more than a 200 mV deviation from the average output voltage for more than 1μs. The ICPL-7840 will continue to func-tion if more than 10 kV/μs common mode slopes are applied, as long as the breakdown voltage limitations are observed.

14、Data sheet value is the diff erential amplitude of the transient at the output of the ICPL-7840 when a 1 V_{pk-pk}, 1 MHz square wave with 40 ns rise and fall times is applied to both V_{DD1} and V_{DD2}.

Package Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units	Note
Input-Output Momentary Withstand Voltage	V_{ISO}	RH < 50%, t = 1 min., T_A = 25°C	3750	-	-	Vrms	
Resistance (Input-Output)	R_{I-O}	V_{I-O} = 500 VDC		>10^9		Ω	
Capacitance (Input-Output)	C_{I-O}	F = 1 MHz		1.2		pF	

CHARACTERISTIC CURVES

Fig.1 Input off set voltage vs. temperature

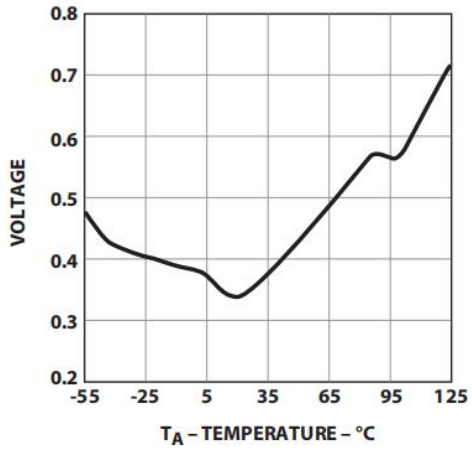


Fig.2 Input off set vs. supply

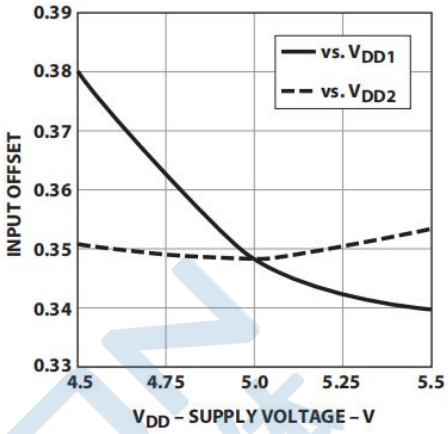


Fig.3 Gain vs. temperature

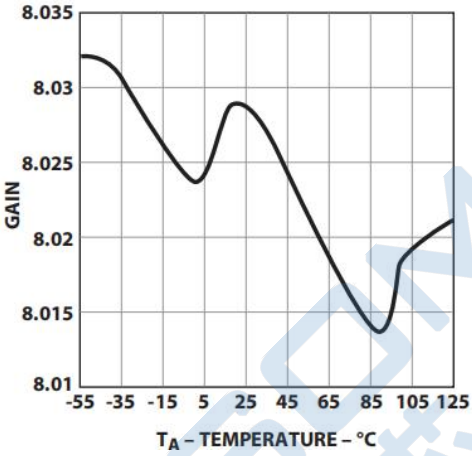


Fig.4 Gain vs. supply

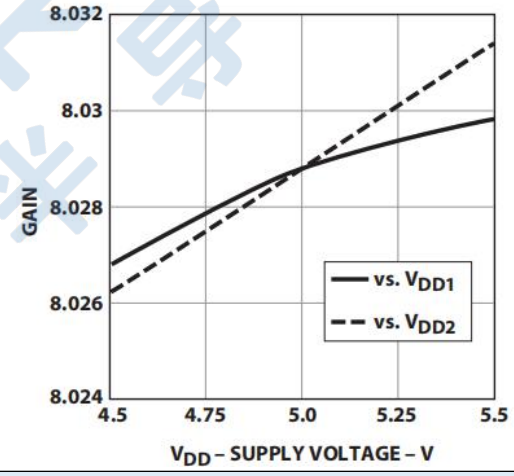


Fig.5 Nonlinearity vs. temperature

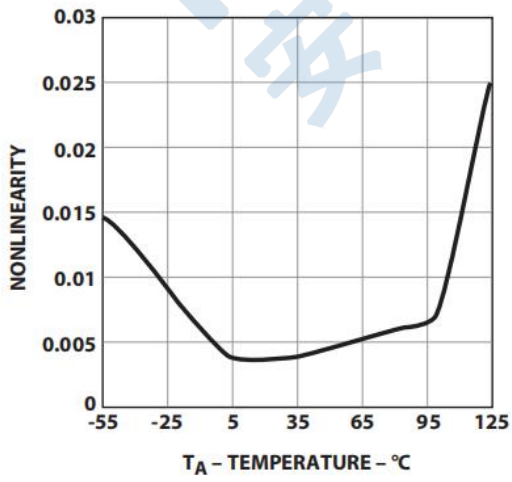


Fig.6 Nonlinearity vs. supply

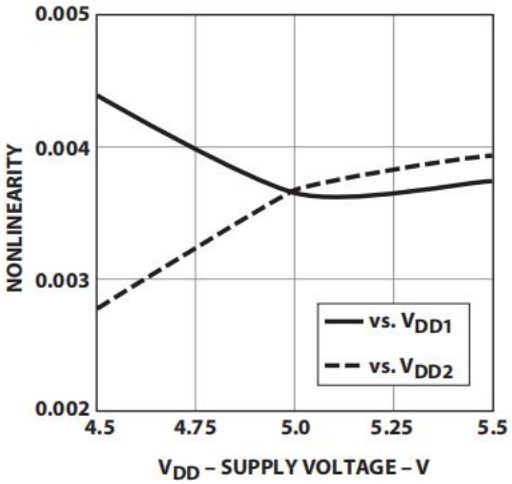


Fig.7 Output voltage vs. input voltage	Fig.8 Supply current vs. input voltage

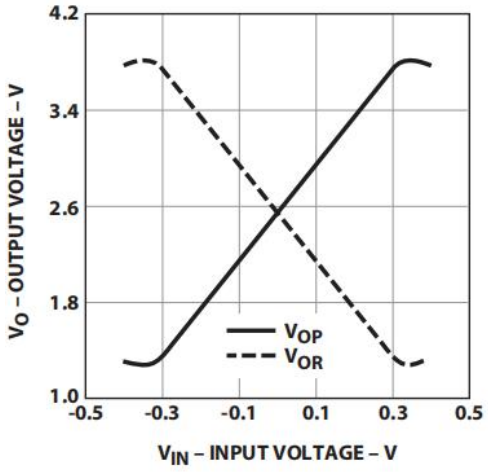
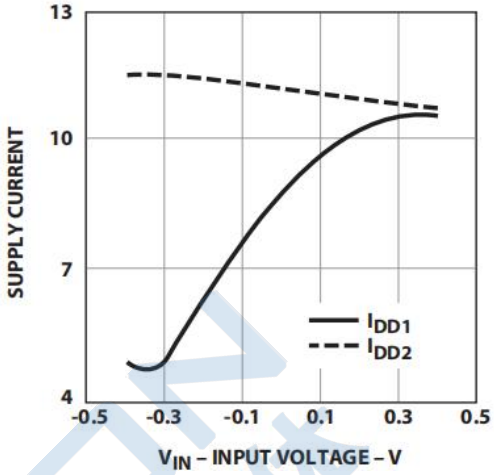

	

Fig.9 Input current vs. input voltage	**Fig.10 Gain vs. frequency**

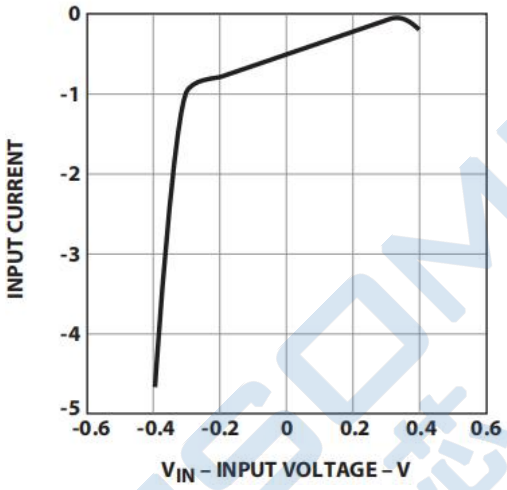
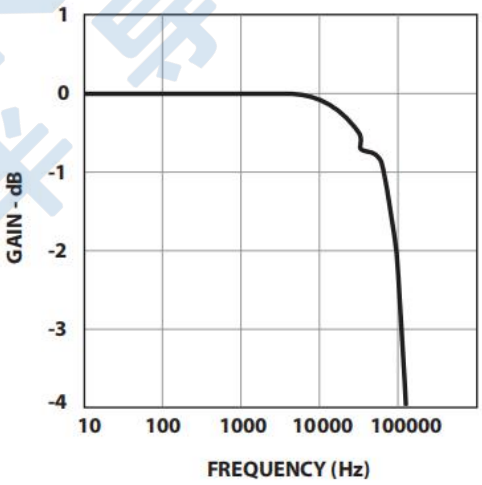
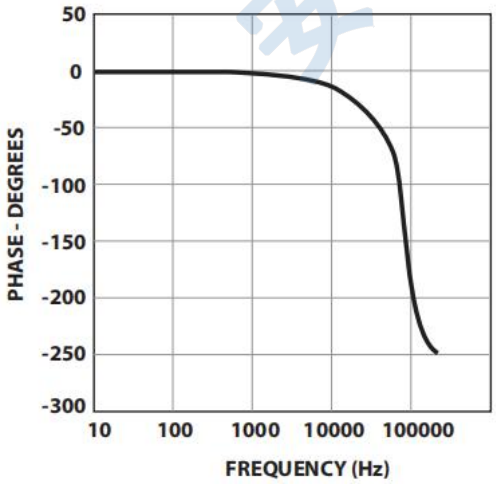
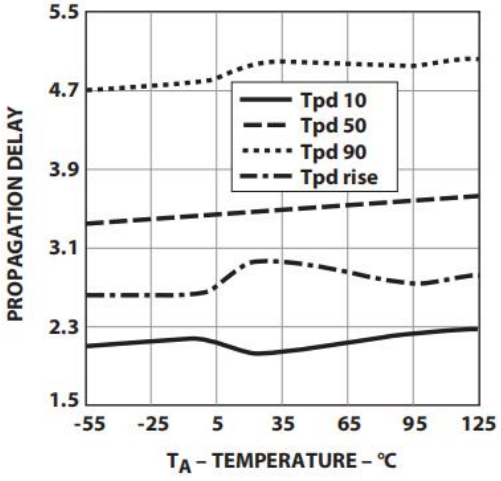

	

Fig.11 Phase vs. frequency	**Fig.12 Propagation delay vs. temperature**
	

TEST CIRCUITS

Fig.13 Input off set voltage test circuit

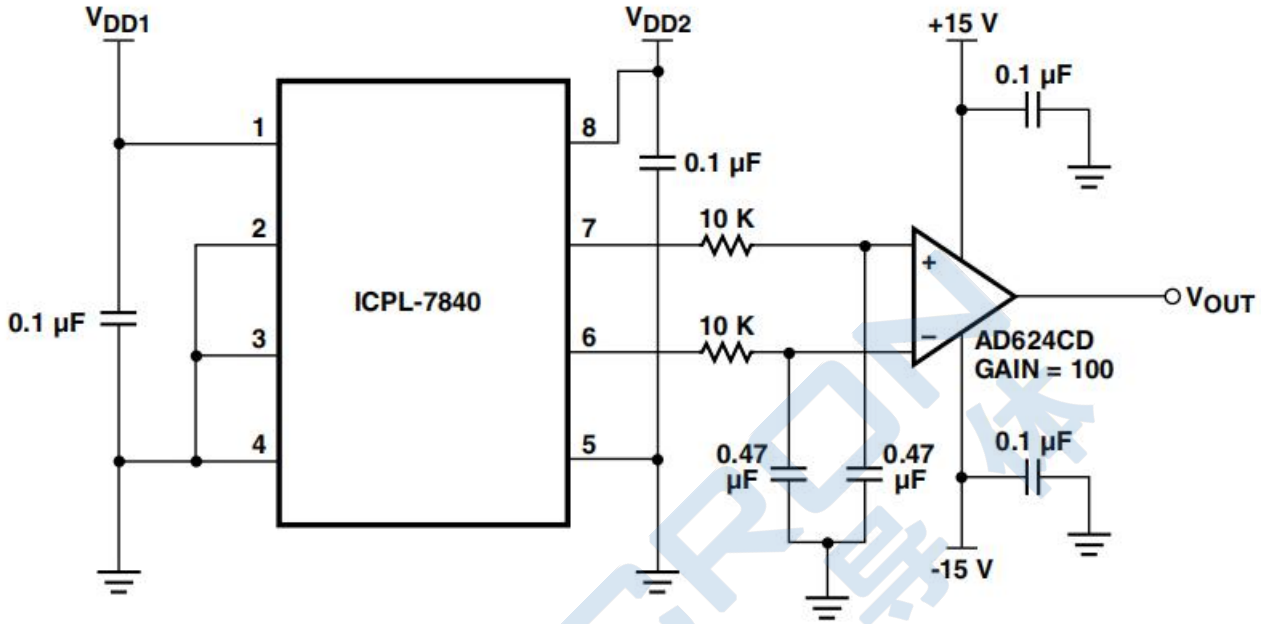
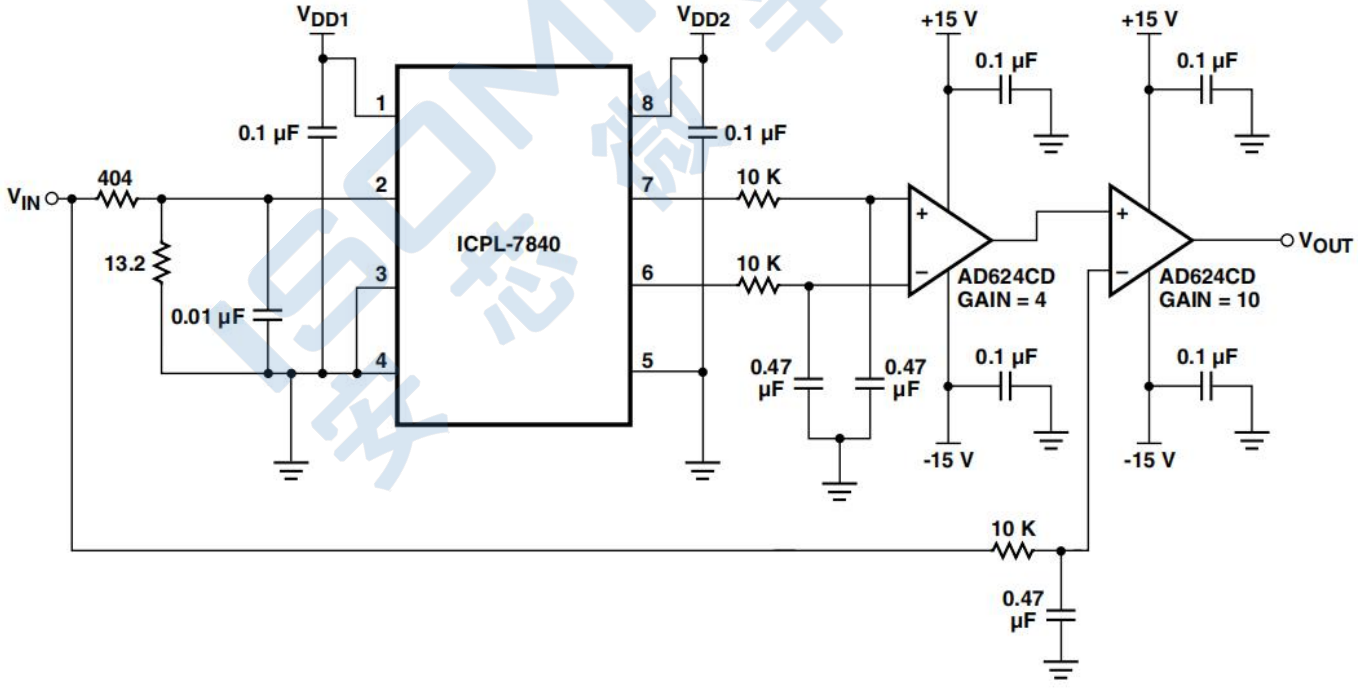
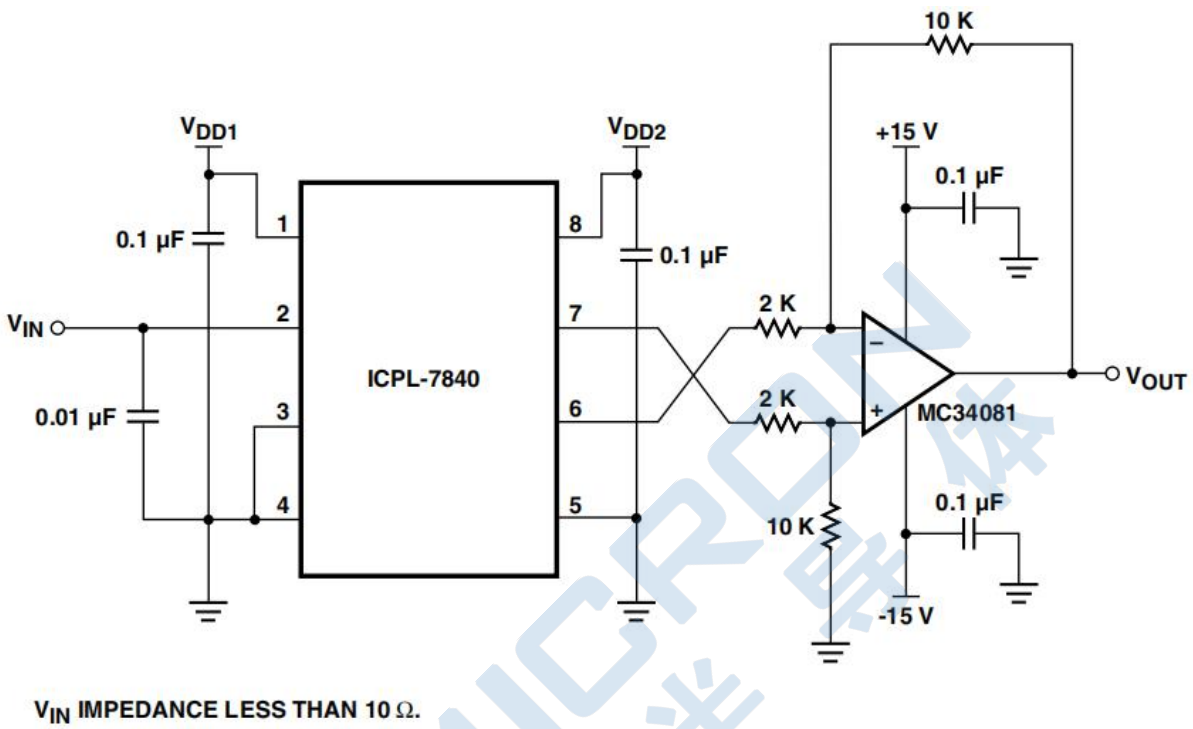


Fig.14 Gain and nonlinearity test circuit



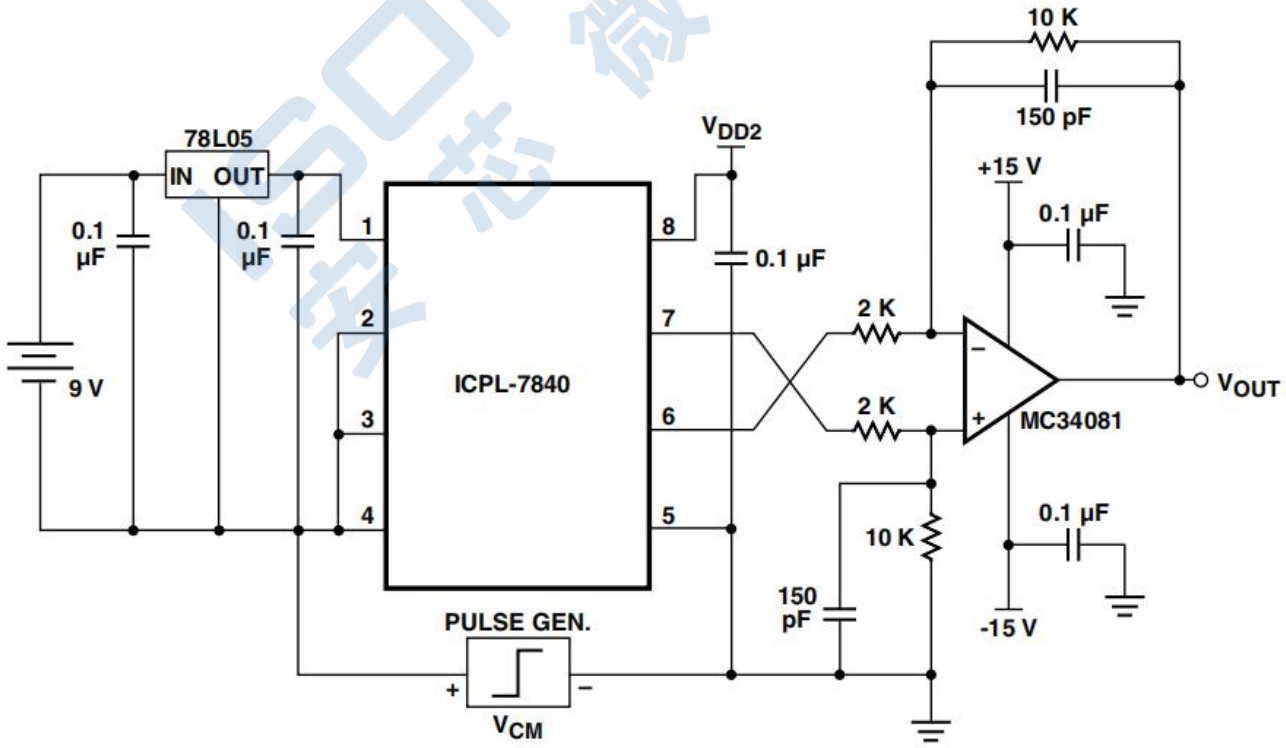
TEST CIRCUITS

Fig.15 Propagation delay test circuits



V_{IN} IMPEDANCE LESS THAN 10 Ω.

Fig.16 CMTI test circuits



APPLICATION INFORMATION

Fig.17 Recommended supply and sense resistor connections

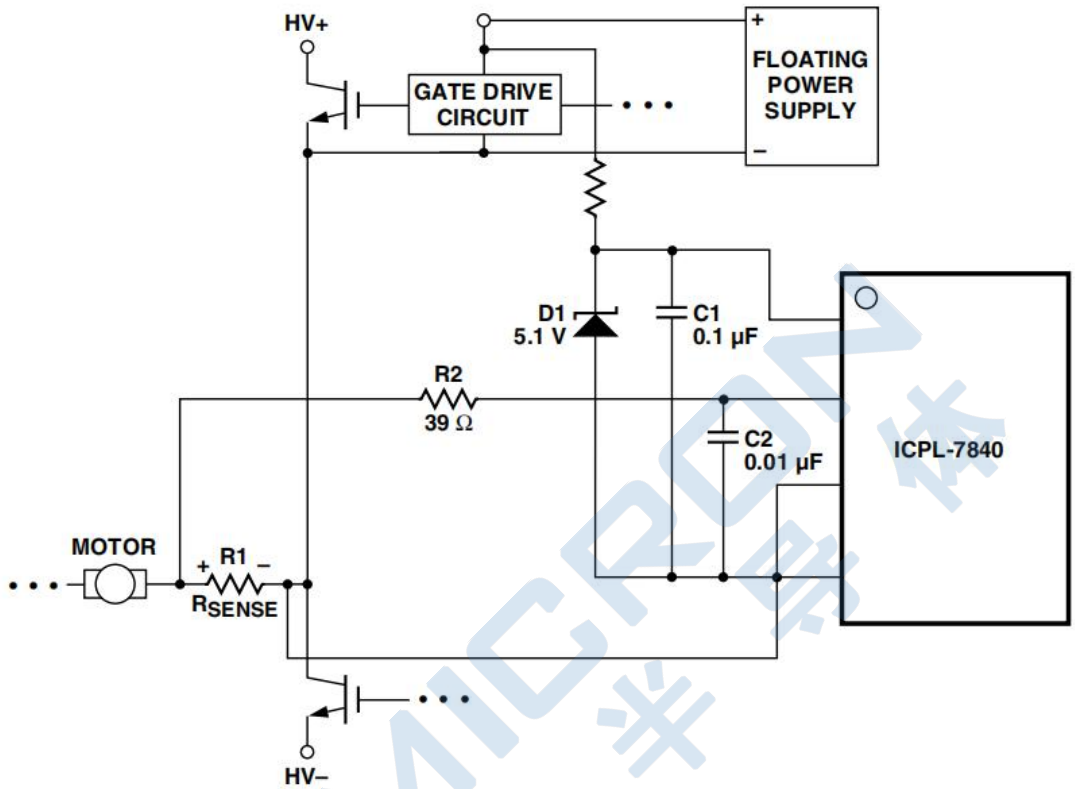
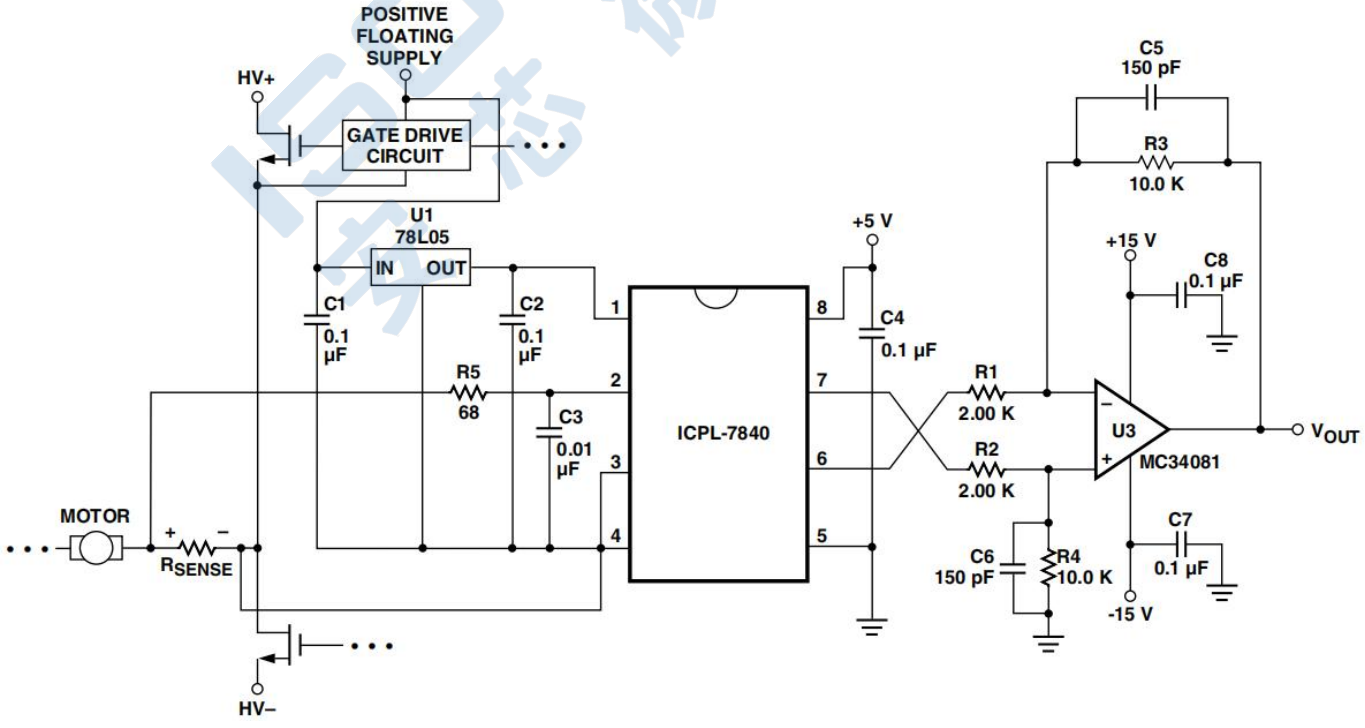
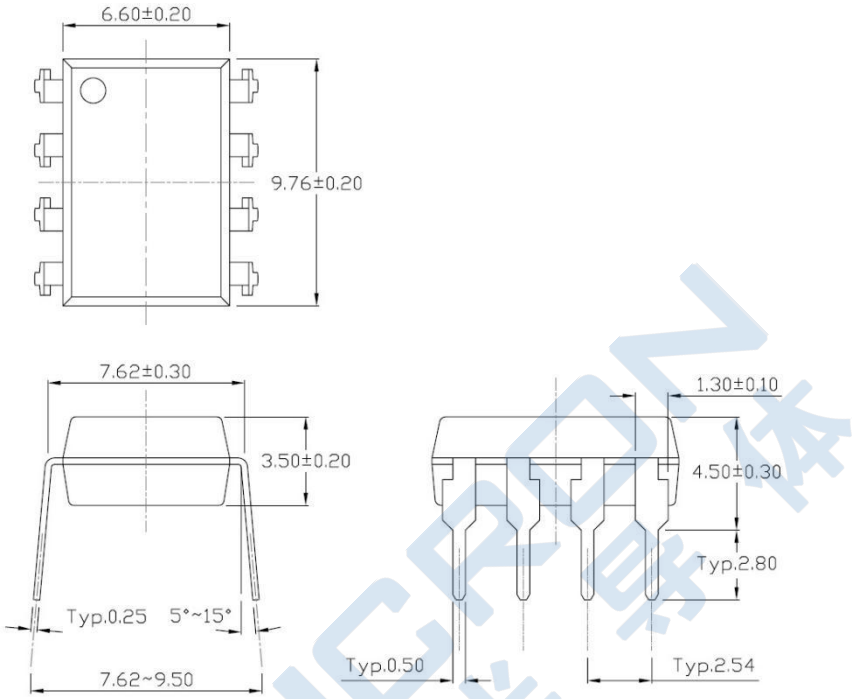


Fig.18 Recommended application circuit

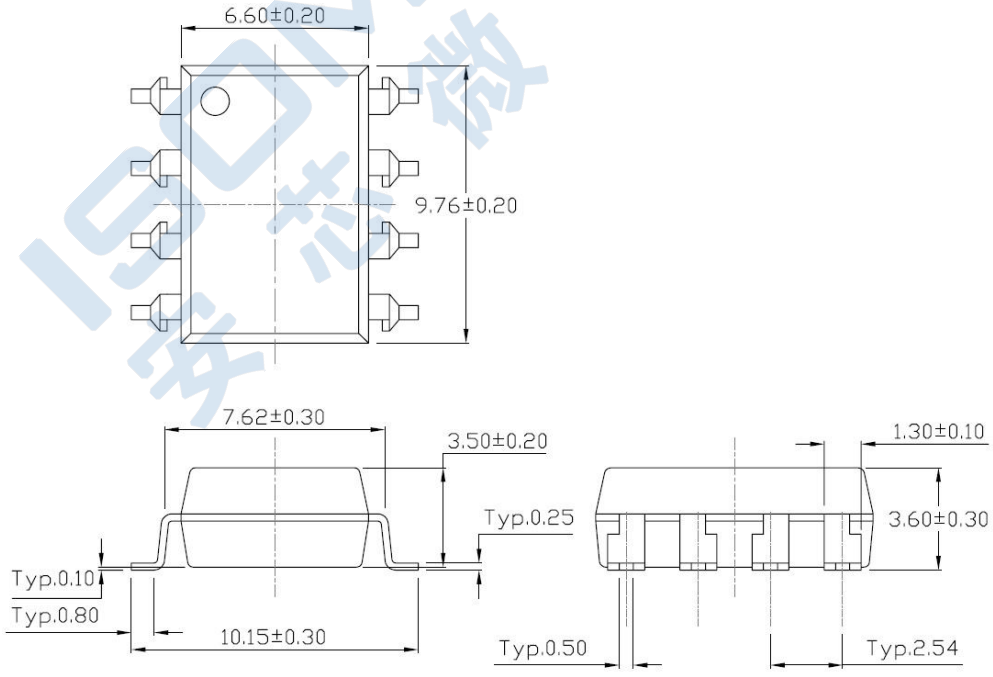


PACKAGE DIMENSIONS

Standard DIP – Through Hole (DIP Type)



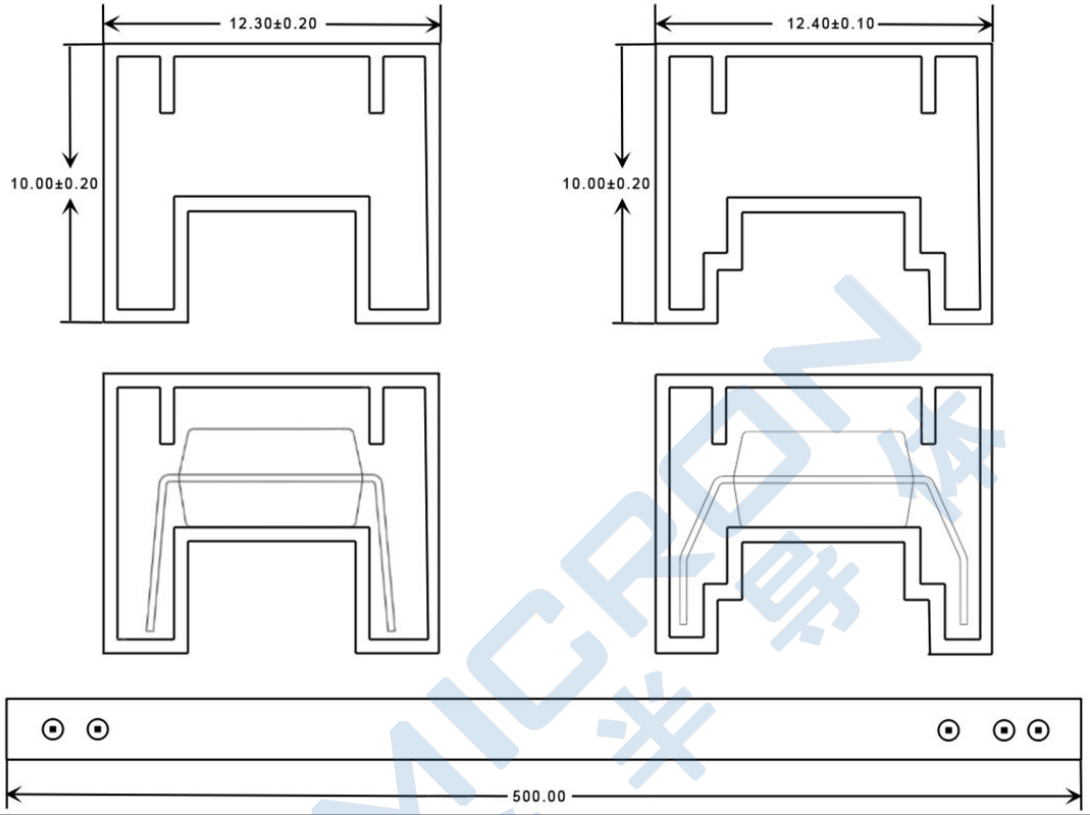
Surface Mount (Low Profile) Lead Forming (SL Type)



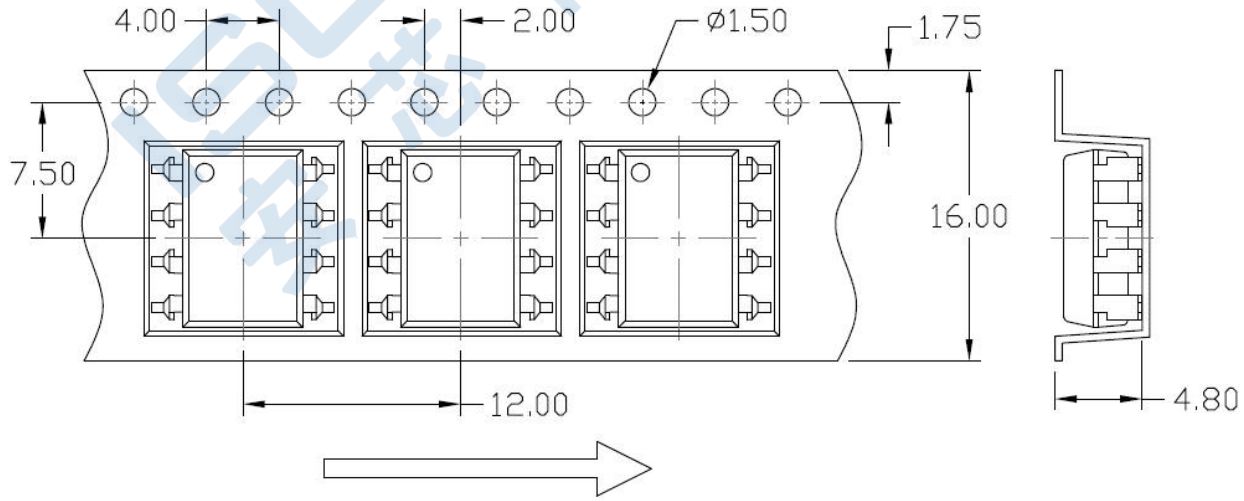
- **Dimensions in mm unless otherwise stated**

Carrier Tape Specifications

Option DIP-Standard



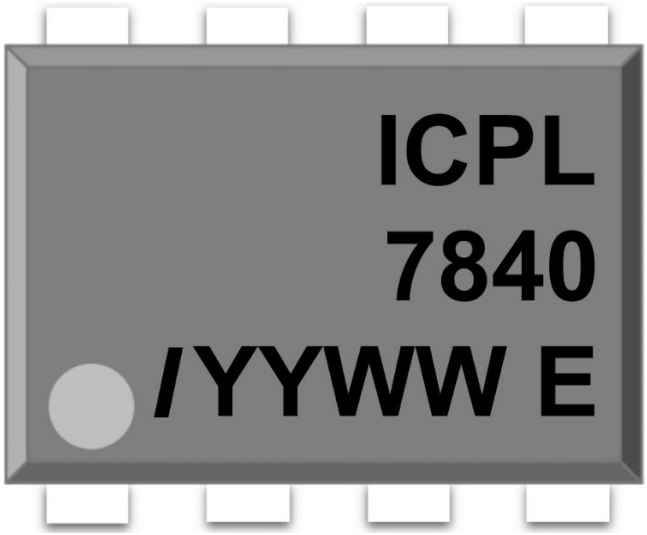
Option SM-SL



- **Dimensions in mm unless otherwise stated**

ORDERING AND MARKING INFORMATION

Marking Information



ICPL	:	Company Abbr.
7840	:	Part Number
/	:	ISOMICRON
YY	:	Fiscal Year
WW	:	Work Week
E	:	Manufacturing Code

Order Code

ICPL – 7840 - 5 0 0 E

Company Abbr.

Part Number

Lead Forming
0: DIP-Standard
5: SM-SL

Halogen Free
E: Halogen-free,Lead-free
Z: Halogen, Lead-free

None

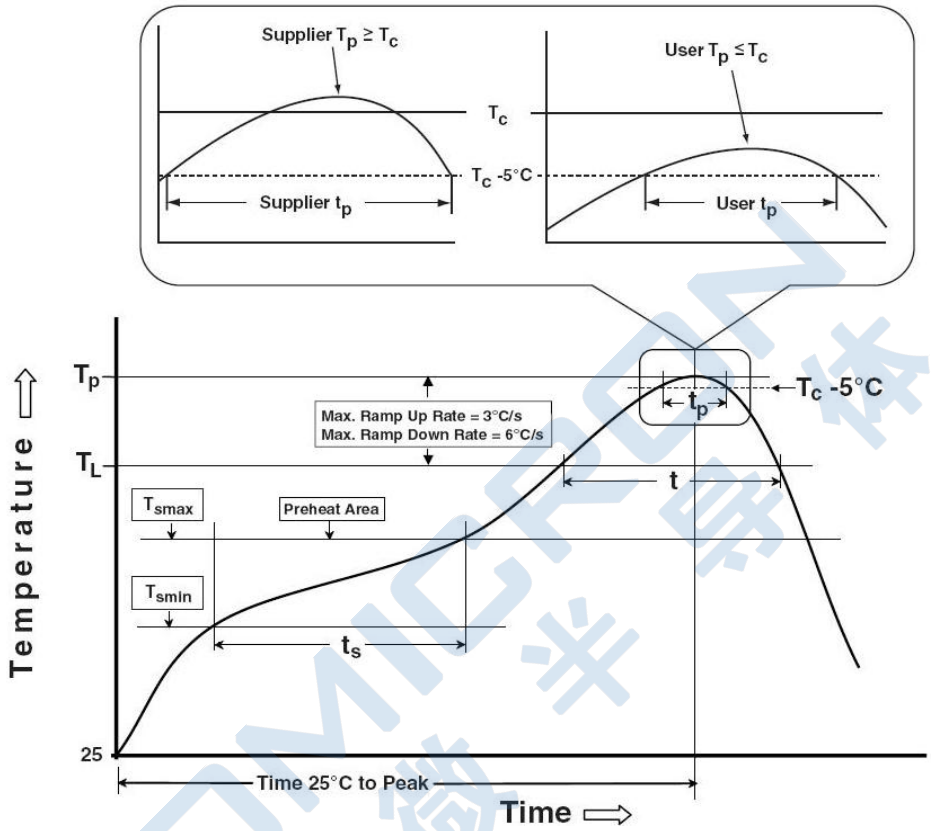
Performance
0: Normal
1: Enhanced

Packing Quantity

Option	Quantity	Quantity – Inner box	Quantity – Outer box
DIP-Standard	40 Units/Tube	25 Tubes/Inner box	6 Inner box/Outer box = 6k Units
SM-SL	1000 Units/Reel	2 Reels/Inner box	5 Inner box/Outer box = 10k Units

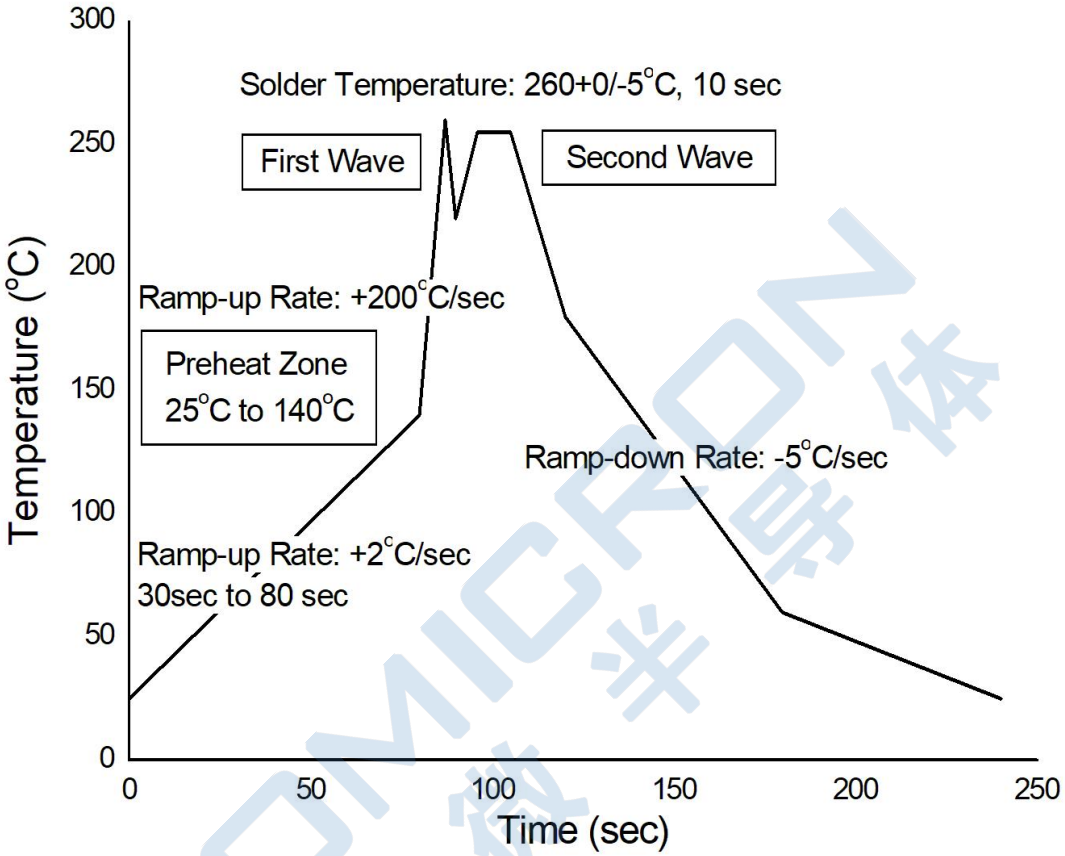
REFLOW INFORMATION

Reflow Profile



Profile Feature	Sn-Pb Assembly Profile	Pb-Free Assembly Profile
Temperature Min. (Tsmin)	100	150°C
Temperature Max. (Tsmax)	150	200°C
Time (ts) from (Tsmin to Tsmax)	60-120 seconds	60-120 seconds
Ramp-up Rate (tL to tP)	3°C/second max.	3°C/second max.
Liquidous Temperature (TL)	183°C	217°C
Time (tL) Maintained Above (TL)	60 – 150 seconds	60 – 150 seconds
Peak Body Package Temperature	235°C +0°C / -5°C	260°C +0°C / -5°C
Time (tP) within 5°C of 260°C	20 seconds	30 seconds
Ramp-down Rate (TP to TL)	6°C/second max	6°C/second max
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

TEMPERATURE PROFILE OF SOLDERING

Wave Soldering (JESD22-A111 Compliant)


Hand Soldering By Soldering Iron	
Soldering Temperature	380+0/-5°C
Soldering Time	3 sec max.

- **One time soldering is recommended for all soldering method.**
- **Do not solder more than three times for IR reflow soldering.**

DISCLAIMER

- ISOMICRON is continually improving the quality, reliability, function and design. ISOMICRON reserves the right to make changes without further notices.
- The characteristic curves shown in this datasheet are representing typical performance which are not guaranteed.
- ISOMICRON makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, ISOMICRON disclaims (a) any and all liability arising out of the application or use of any product, (b) any and all liability, including without limitation special, consequential or incidental damages, and (c) any and all implied warranties, including warranties of fitness for particular
- 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 purpose, non-infringement and merchantability.
- This product is not intended to be used for military, aircraft, automotive, medical, life sustaining or lifesaving applications or any other application which can result in human injury or death.
- Please contact ISOMICRON sales agent for special application request.
- Immerge unit's body in solder paste is not recommended.
- Parameters provided in datasheets may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated in each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify ISOMICRON's terms and conditions of purchase, including but not limited to the warranty expressed therein.
- Discoloration might be occurred on the package surface after soldering, reflow or long-time use. It neither impacts the performance nor reliability.