36-V, Low Power Comparators with Open Drain Output

Features

- Power Supply Voltage: 2.5 V to 36 V
- Low Supply Current: 150 μA per channel
- High-to-Low Propagation Delay: 300 ns
- Offset Voltage: ±4.5 mV
- Input Common-Mode Range Includes Ground
- Open-Drain Output for Maximum Flexibility
- −40°C to 125°C Operation Range

Applications

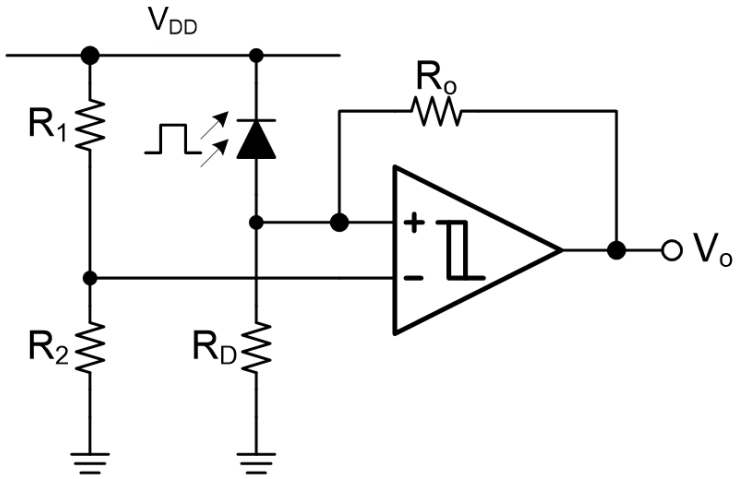
- Peak and Zero-crossing Detectors
- Threshold Detectors/Discriminators
- Sensing at the Ground or Supply Line
- Logic Level Shifting or Translation
- Window Comparators
- IR Receivers

Description

The devices in this series consist of two comparators on a single monolithic substrate. The common-mode input voltage range includes ground and power even when operated from a single supply, and the low power supply current drain makes these comparators suitable for battery operation. The devices are designed to directly interface with TTL and CMOS, the outputs can be connected to other open-collector or open-drain outputs to achieve wired-AND relationships.

The devices are specified for the temperature range from −40°C to +125°C.

Typical Application Circuit



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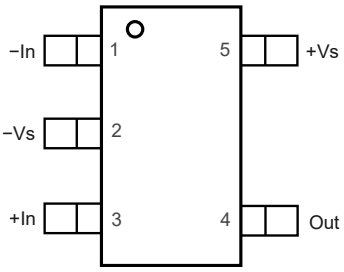
Revision History

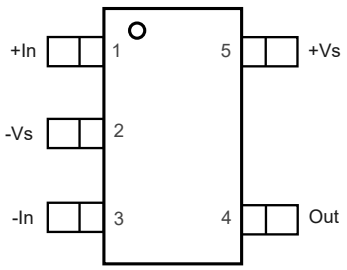
Date	Revision	Notes
2024-04-07	Rev.A.0	Initial version
2024-06-09	Rev.A.1	The following updates are all about the new datasheet formats or typo, the actual product remains unchanged. Updated the figure 5 and figure 6, the actual product remains unchanged.

Pin Configuration and Functions

TPCMP761Y
SOT23-5 Package
Top View



TPCMP761U
SOT23-5 Package
Top View



TPCMP761W
SOT23-5 Package
Top View

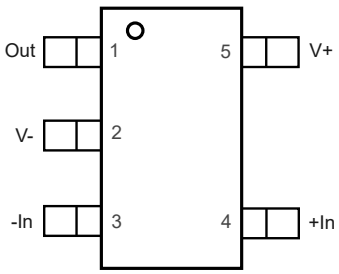
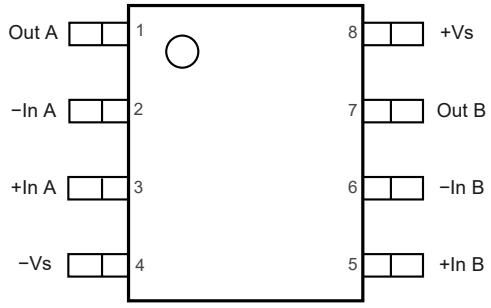


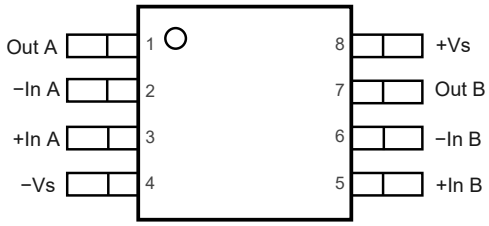
Table 1. Pin Functions: TPCMP761Y, TPCMP761U, TPCMP761W

Pin No.			Name	I/O	Description
TPCMP761W	TPCMP761U	TPCMP761Y			
1	4	4	Out	O	Output
2	2	2	$-V_S$	-	Negative power supply
3	3	1	−In	I	Inverting input
4	1	3	+In	I	Noninverting input
5	5	5	$+V_S$	-	Positive power supply

TPCMP762
SOP8 Package
Top View



TPCMP762
MSOP8 Package
Top View



TPCMP762
TSSOP8 Package
Top View

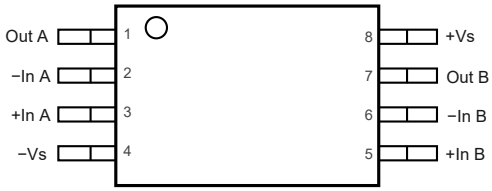
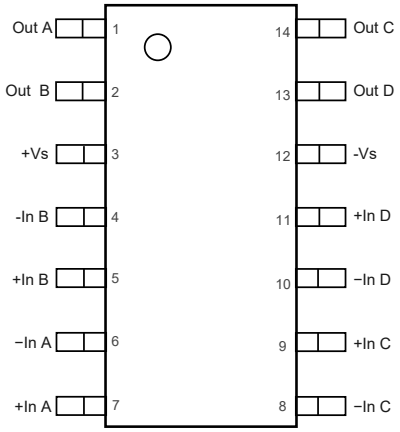


Table 2. Pin Functions: TPCMP762

Pin No.	Name	I/O	Description
1	Out A	O	Output
2	−In A	I	Inverting input
3	+In A	I	Noninverting input
4	$-V_S$	-	Negative power supply
5	+In B	I	Noninverting input
6	−In B	I	Inverting input
7	Out B	O	Output
8	$+V_S$		Positive power supply

TPCMP764
SOP14 Package
Top View



TPCMP764
TSSOP14 Package
Top View

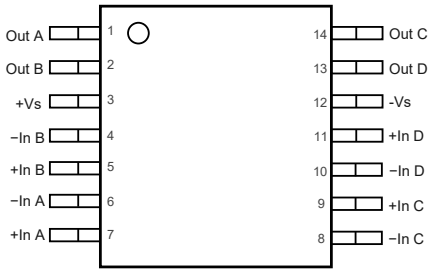


Table 3. Pin Functions: TPCMP764

Pin No.	Name	I/O	Description
1	Out A	Output	Output
6	−In A	Input	Inverting input
7	+In A	Input	Noninverting input
3	$+V_S$		Positive power supply
2	+In B	Input	Noninverting input
4	−In B	Input	Inverting input
5	Out B	Output	Output
14	Out C	Output	Output
8	−In C	Input	Inverting input
9	+In C	Input	Noninverting input
12	$-V_S$		Negative power supply
11	+In D	Input	Noninverting input
10	−In D	Input	Inverting input
13	Out D	Output	Output

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
	Supply Voltage, $(+V_S) – (-V_S)$		40	V
	Input Voltage: +IN, −IN	$(-V_S) – 0.3$	$(+V_S) + 0.3$	V
	Input Current: +IN, −IN (2)	−20	+20	mA
	Output Voltage: OUT	$(-V_S) – 0.3$	36	V
	Output Current: OUT	−20	+20	mA
	Output Short-Circuit Duration (3)		Infinite	
	Current at Supply Pins	−60	60	mA
T_J	Maximum Junction Temperature		150	°C
T_A	Operating Temperature Range	−40	125	°C
T_{STG}	Storage Temperature Range	–65	150	°C
T_L	Lead Temperature (Soldering 10 sec)		260	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.
(2) The inputs are protected by ESD protection diodes to each power supply. If the input extends more than 500 mV beyond the negative power supply, the input current should be limited to less than 10 mA.
(3) A heat sink may be required to keep the junction temperature below the absolute maximum. This depends on the power supply voltage and how many comparators are shorted. Thermal resistance varies with the amount of PC board metal connected to the package. The specified values are for short traces connected to the leads.

ESD, Electrostatic Discharge Protection

Parameter		Condition	Level	Unit
HBM	Human Body Model ESD	ANSI/ESDA/JEDEC JS-001 (1)	0.5	kV
CDM	Charged Device Model ESD	ANSI/ESDA/JEDEC JS-002 (2)	1	kV

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

Recommended Operating Conditions

Parameter			Min	Typ	Max	Unit
V_S	Supply Voltage	Single Supply	2.5		36	V
		Dual Supply	±1.25		±18	V
T_A	Operating Temperature Range		−40		125	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOT23-5	250	81	°C/W
SOP8	158	43	°C/W
TSSOP8	191	50	°C/W
MSOP8	210	45	°C/W
SOP14	120	36	°C/W
TSSOP14	180	35	°C/W

Electrical Characteristics

All test conditions: V_S = 5 V, $R_{PULL-UP}$ = 5.1k, C_L = 15pF, T_A = 25°C, unless otherwise noted.

Parameter		Conditions		Min	Typ	Max	Unit
Power Supply							
I_Q	Quiescent Current per Comparator	For TPCMP761, V_{CC} = 5 V			200	250	µA
		For TPCMP761, V_{CC} = 36 V			300	350	µA
		For TPCMP762/764, V_{CC} = 5 V			100	125	µA
		For TPCMP762/764, V_{CC} = 36 V			150	175	µA
Input Characteristics							
V_{OS}	Input Offset Voltage (1)	V_{CC} = 5 V to 36 V, V_{CM} = 0 V, T_A = −40°C to 125°C		-4.5	±0.5	4.5	mV
I_B	Input Bias Current (2)	V_{DM} = 0 V, V_{CM} = 0 V		-50	±0.2	50	nA
		V_{DM} = 0 V, V_{CM} = 0 V, T_A = −40°C to 125°C		-150	1	150	nA
I_{OS}	Input Offset Current (2)	V_{DM} = 0 V, V_{CM} = 0 V		-50	±0.2	50	nA
		V_{DM} = 0 V, V_{CM} = 0 V, T_A = −40°C to 125°C		-150	1	150	nA
C_{IN}	Input Capacitance	T_A = 25°C	Differential		1.5		pF
			Common Mode		2		
V_{CM}	Common-mode Input Voltage Range			(−V_S)		(+V_S) − 1.5	V
		T_A = −40°C to 125°C		(−V_S)		(+V_S) − 2	V
A_{VD}	Large-signal Differential voltage Amplification (4)	V_{CC}= 15 V, V_O = 1.4 V to 11.4 V, R_L ≥ 15 kΩ to V_{CC}		50	400		V/mV
Output Characteristics							
I_{OH}	High-level Output Current	V_{OH} = 5 V, V_{ID} = 1 V			20	50	nA
		V_{CC} = 36 V, V_{OH} = 36 V, V_{ID} = 1 V, T_A= −40°C to 125°C				150	nA
V_{OL}	Low-Level Output Voltage	I_{OL} = 4 mA, V_{ID} = −1 V			200	250	mV
		I_{OL} = 4 mA, V_{ID} = −1 V, T_A = −40°C to 125°C				350	mV
I_{OL}	Low-level Output Current	V_{OL} = 1.5 V, V_{ID} = −1 V		15			mA
Switching Characteristics, T_A = −40°C to 125°C (3)							
T_{PLH}	Propagation delay time, low-to-high	ΔV_{IN} = 0.1 V, V_{CM} = 0 V, 100mV overdrive, C_L = 15pF (2)			300	440	ns
		ΔV_{IN} = 0.1 V, V_{CM} = 0 V, 20mV overdrive, C_L = 15pF (2)			490	700	ns
		ΔV_{IN} = 0.1 V, V_{CM} = 0 V, 5mV overdrive, C_L = 15pF (2)			790	1130	ns
T_{PHL}	Propagation delay time, high-to-low	ΔV_{IN} = 0.1 V, V_{CM} = 0 V, 100mV overdrive, C_L = 15 pF (2)			300	470	ns
		ΔV_{IN} = 0.1 V, V_{CM} = 0 V, 20mV overdrive, C_L = 15 pF (2)			490	750	ns

Parameter		Conditions	Min	Typ	Max	Unit
		ΔV_{IN} = 0.1 V, V_{CM} = 0 V, 5mV overdrive, C_L = 15 pF (2)		870	1230	ns

(1) The input offset voltage is the average of the input-referred trip points.
(2) Provided by bench test and design simulation.
(3) Delay time is measured from input to mid-point of output.
(4) Provided by design simulation.

Typical Performance Characteristics

All test conditions: V_S = 5 V, V_{CM} = 0 V, $R_{pull-up}$ = 5.1 K, C_L = 15 pF, unless otherwise noted.

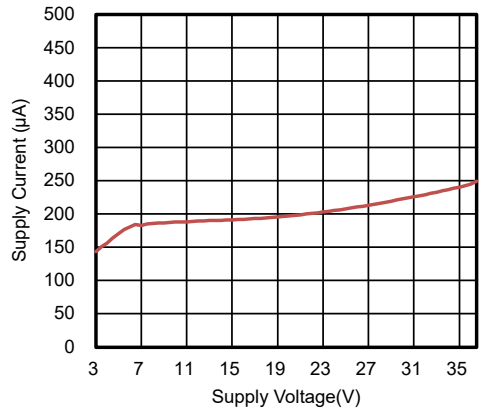


Figure 1. Supply Current vs Supply Voltage (Dual channel)

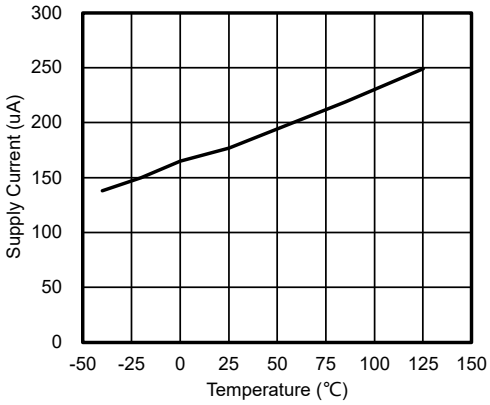


Figure 2. Supply Current vs Temperature (Dual channel)

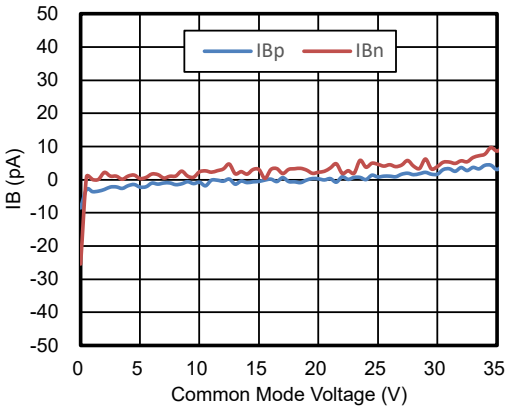


Figure 3. I_B vs V_{CM}, V_S=36V

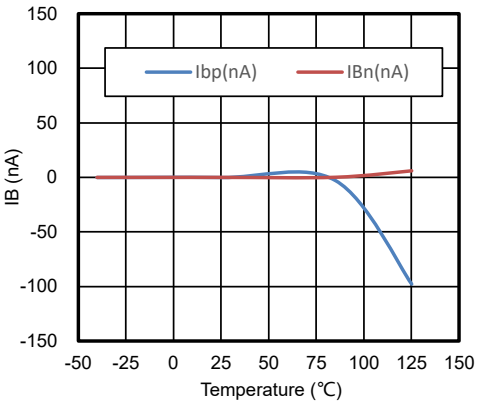


Figure 4. I_B vs Temperature

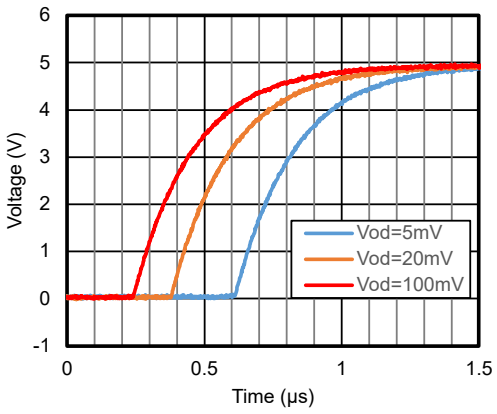


Figure 5. Propagation Delay, Low to High

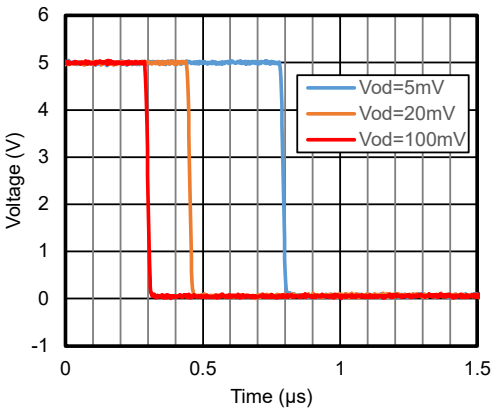


Figure 6. Propagation Delay, High to Low

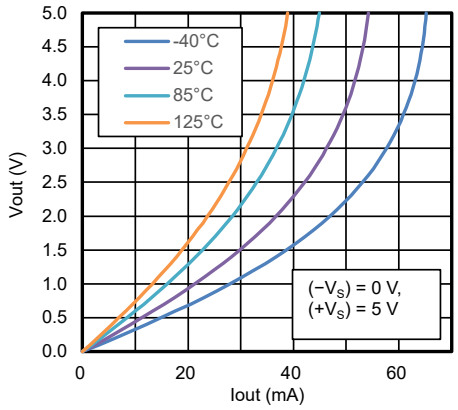


Figure 7. V_{OUT} vs I_{OUT}, Sink

Detailed Description

Overview

The TPCMP76x series of comparators can operate from 2.5 V to 36 V, and also have a very low Iq and fast response.

The open-drain output allows the logic high voltage of the output to be configured or used in the AND functionality.

Functional Block Diagram

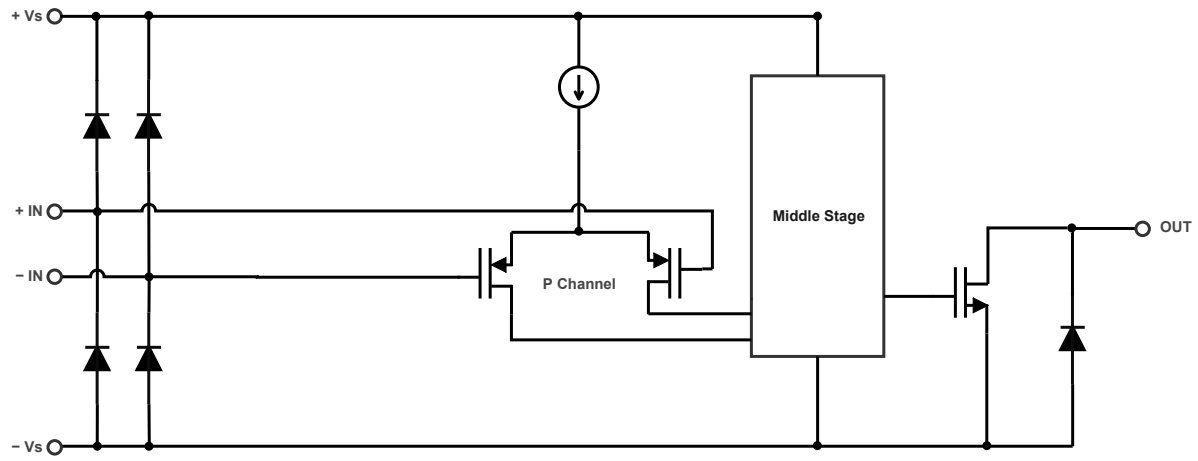


Figure 8. Functional Block Diagram

Feature Description

Operating Voltage

The devices are designed for single supply operation from 2.5 V to 36 V or dual supply operation from ±1.25 V to ±18 V.

The recommended operating voltage conditions are as follows:

Power supply voltage ($+V_S$) - ($-V_S$): 2.5 V to 36 V. The power supply voltage can support the following three scenarios:

- Single supply

- Dual supplies with equal voltage values

- Various voltage configurations, as long as the voltage range of ($+V_S$) - ($-V_S$) is within 2.5 V to 36 V

For example, if operating with a single supply, ($-V_S$) = 0 V, then ($+V_S$) can support 2.5 V to 36 V. If using dual supplies with equal absolute values, the minimum voltage would be ±1.25 V and the maximum voltage would be ±18 V. It can even support other voltage configurations, such as ($-V_S$) = 100 V, ($+V_S$) = 136 V, or ($-V_S$) = -6 V, ($+V_S$) = 30 V, and so on.

No ESD Diode between the Output Pin and the +Vs Pin

There is no ESD diode between the output pins and the (+Vs) pin, so the voltage at the output pins can be applied from 0 V to 36 V regardless of the voltage at the (+Vs) pin. The feature supports setting output logic as a high level to a voltage higher than the voltage at the (+Vs) pin.

Application and Implementation

Note

Information in the following application sections is not part of the 3PEAK's component specification and 3PEAK does not warrant its accuracy or completeness. 3PEAK's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

Power Supply Layout and Bypass

The power supply pin of the TPCMP23x family is supposed to have a local bypass capacitor (i.e., 0.01 μF to 0.1 μF) within 2 mm for good high-frequency performance. It can also use a bulk capacitor (i.e., 1 μF or larger) within 100 mm to provide large and slow currents. This bulk capacitor can be shared with other analog parts.

A good ground layout improves performance by decreasing the amount of stray capacitance and noise at the inputs and outputs of the comparator. To decrease stray capacitance, minimize PCB lengths and resistor leads, and place external components as close to the comparator pins as possible.

Operation Outside of the Common Input Voltage Range

The following is a list of input voltage situation and their outcomes:

1. When both −IN and +IN are within the common-mode range:
   a. If the voltage at the −IN pin is higher than the voltage at the +IN pin and the offset voltage, the output is low, and the output MOSFET is sinking current.
   b. If the voltage at the −IN pin is lower than the voltage at the +IN pin and the offset voltage, the output is high and output MOSFET is sourcing current.
2. When the voltage at the −IN pin is higher than the common-mode voltage range and the voltage at the +IN pin is within the common-mode voltage range, the output is low, and the output MOSFET is sinking current.
3. When the voltage at the +IN pin is higher than the common-mode voltage range and the voltage at the −IN pin is within the common-mode voltage range, the output is high impedance.
4. When the voltage at the −IN and +IN pins are both higher than the common-mode voltage range, the output is in an uncertain state.

Typical Application

IR Receiver

The device is an ideal candidate to be used as an infrared receiver shown in Figure 9. The infrared photo diode creates a current relative to the amount of infrared light present. The current creates a voltage across RD. When this voltage level crosses the voltage applied by the voltage divider to the inverting input, the output transitions. Optional Ro provides additional hysteresis for noise immunity.

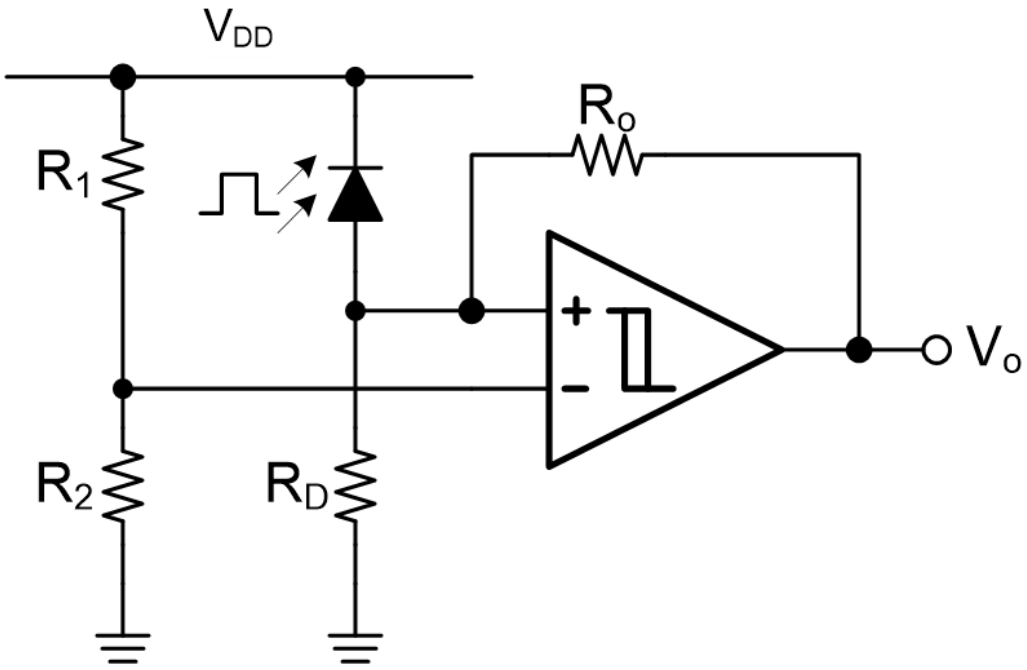
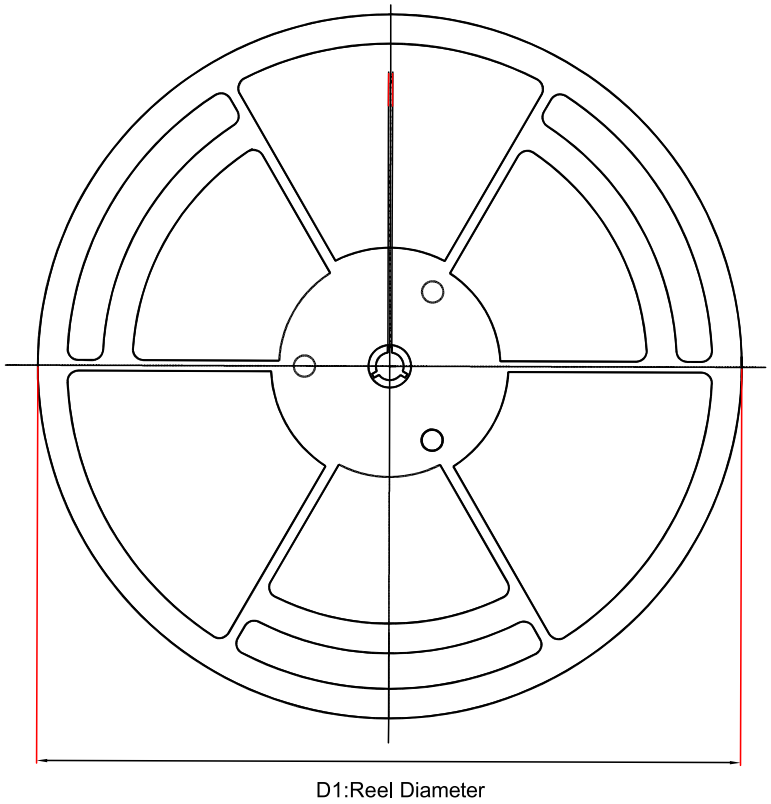
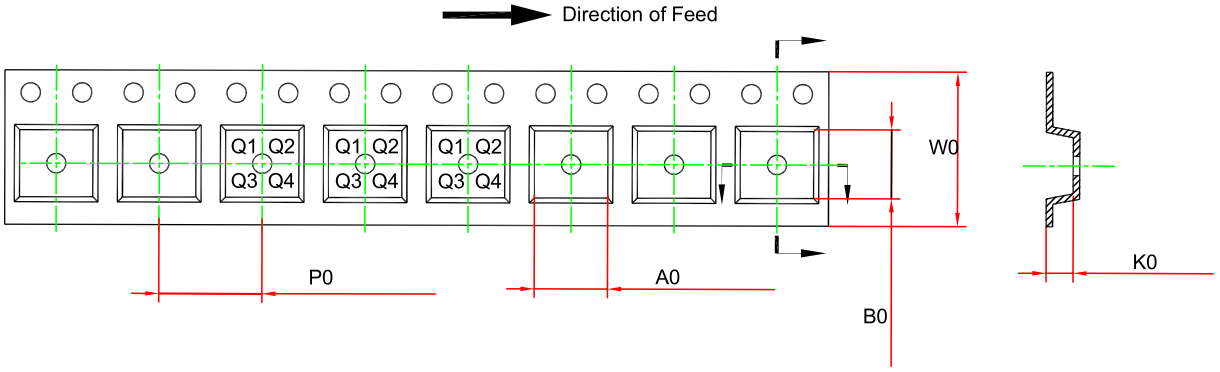


Figure 9. Typical Application Circuit

Tape and Reel Information





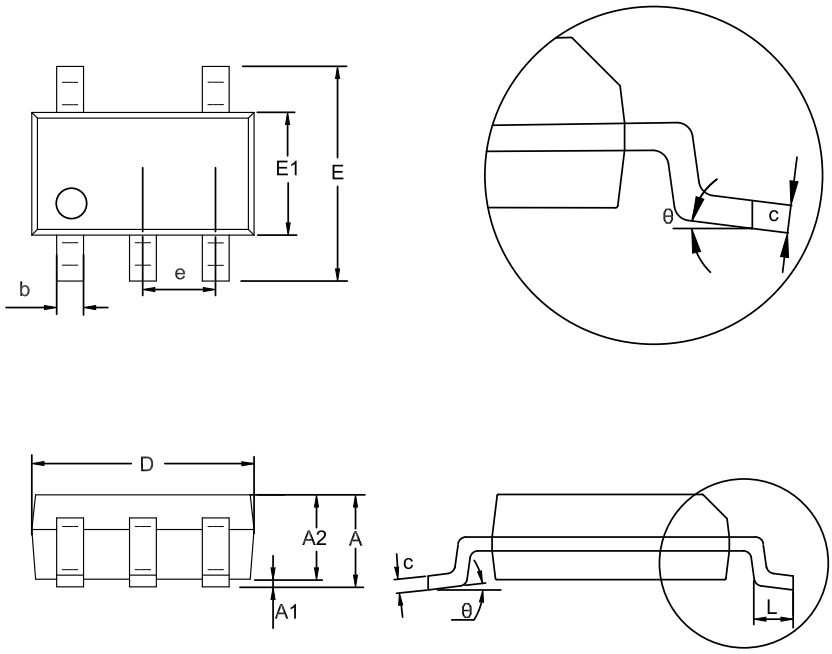
Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPCMP762-SO1R	SOP-8	330	17.6	6.5	5.4	2	8	12	Q1
TPCMP762-TS1R	TSSOP-8	330	17.6	6.8	3.4	1.8	8	12	Q1
TPCMP762-VS1R	MSOP-8	330	17.6	5.3	3.4	1.3	8	12	Q1
TPCMP764-SO2R	SOP-14	330	21.6	6.6	9.15	1.8	8	16	Q1
TPCMP764-TS2R	TSSOP-14	330	17.6	6.8	5.5	1.3	8	12	Q1
TPCMP761U-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3

Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPCMP761W-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3
TPCMP761Y-S5TR	SOT23-5	180	12	3.3	3.25	1.4	4	8	Q3

Package Outline Dimensions

SOT23-5

Package Outline Dimensions S5T(SOT23-5-A)



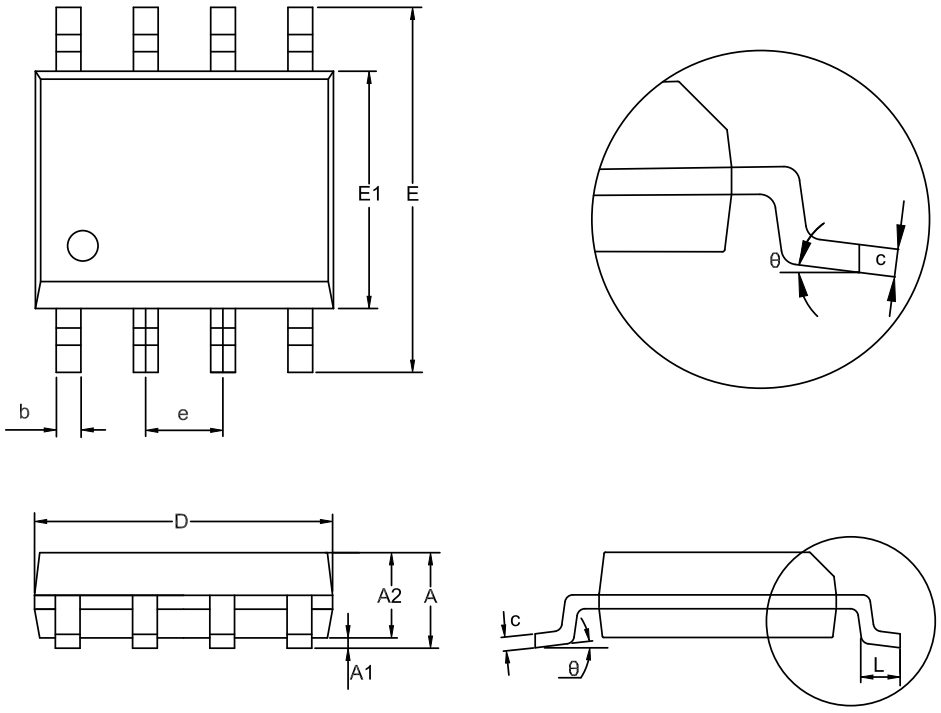
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.150	0.000	0.006
A2	1.000	1.200	0.039	0.047
b	0.280	0.500	0.011	0.020
c	0.100	0.230	0.004	0.009
D	2.820	3.020	0.111	0.119
E	2.600	3.000	0.102	0.118
E1	1.500	1.720	0.059	0.068
e	0.950 BSC		0.037 BSC	
L	0.300	0.600	0.012	0.024
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

SOP8

Package Outline Dimensions SO1(SOP-8-A)



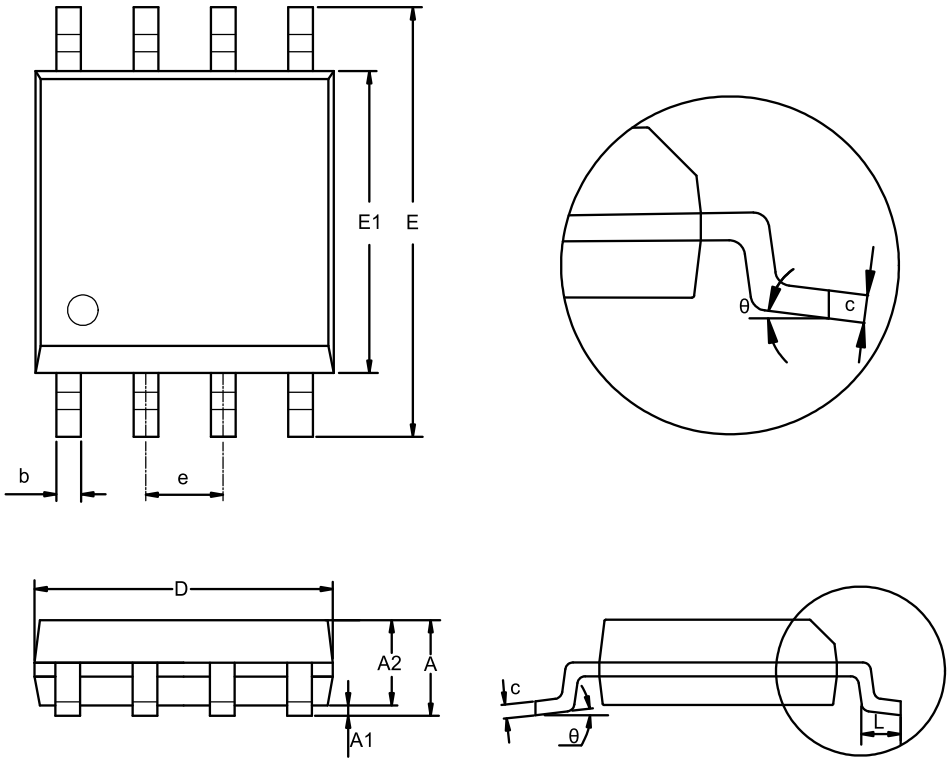
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.550	0.049	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.000	0.016	0.039
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

MSOP8

Package Outline Dimensions VS1(MSOP-8-A)



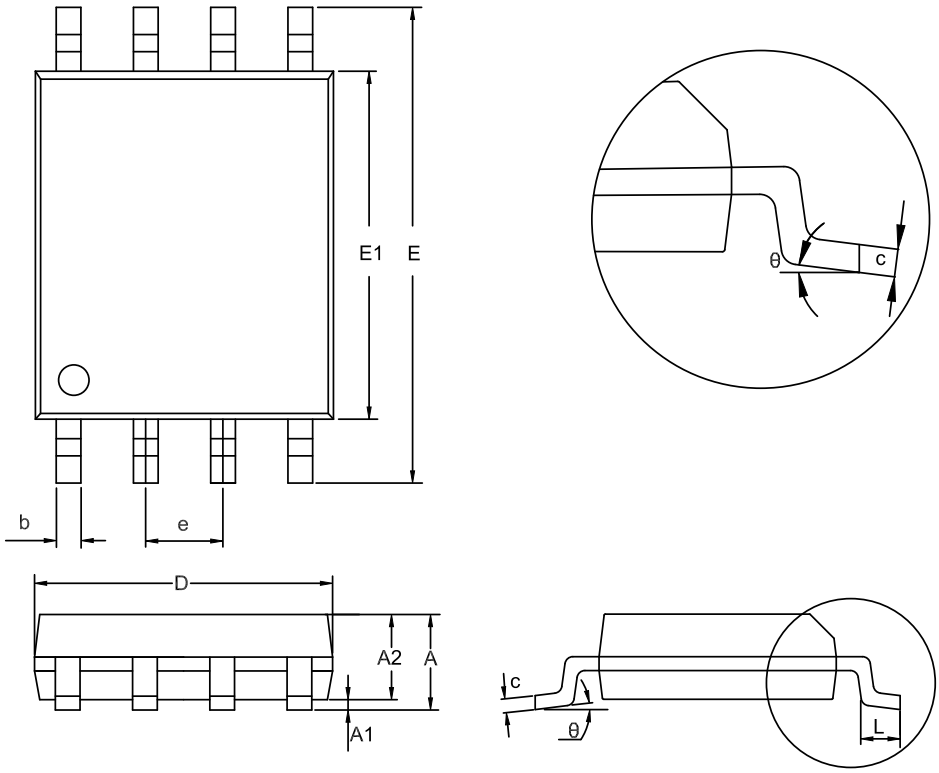
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.800	1.100	0.031	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	4.700	5.100	0.185	0.201
E1	2.900	3.100	0.114	0.122
e	0.650 BSC		0.026 BSC	
L	0.400	0.800	0.016	0.031
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

TSSOP8

Package Outline Dimensions TS1(TSSOP-8-A)



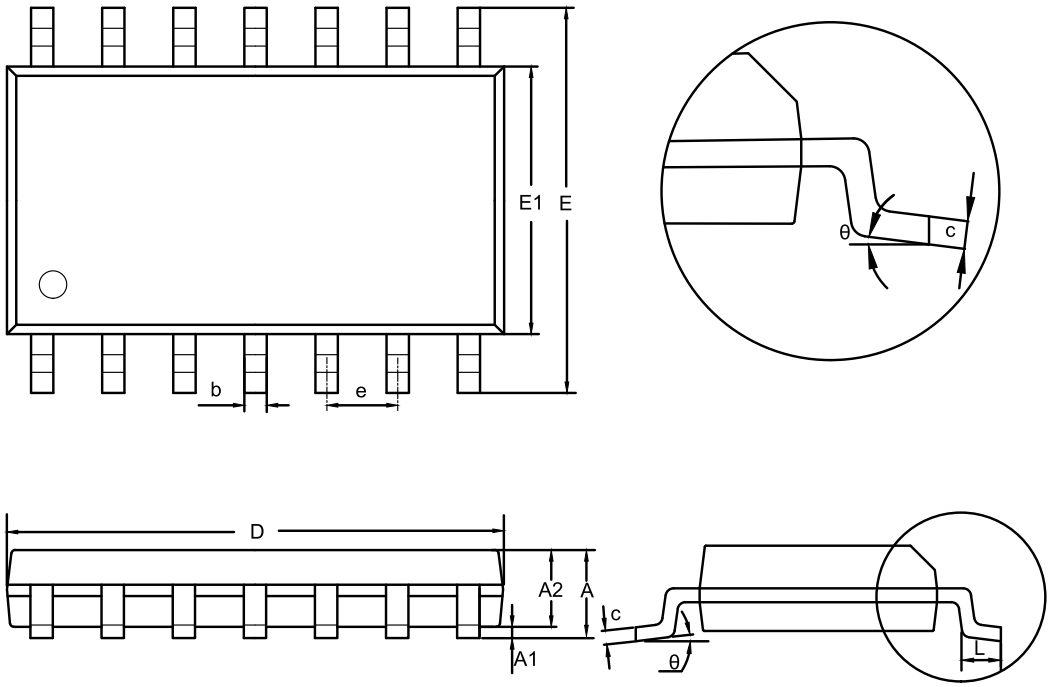
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026 BSC	
L	0.450	0.750	0.018	0.030
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

SOP14

Package Outline Dimensions SO2(SOP-14-A)



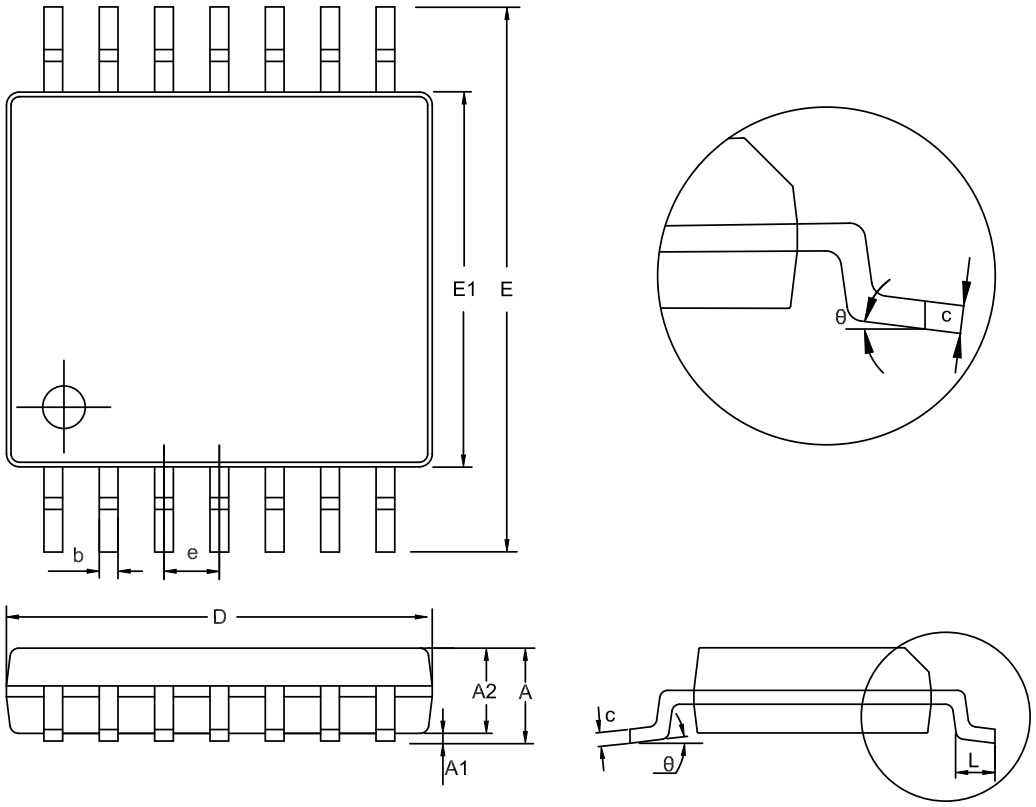
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

TSSOP14

Package Outline Dimensions — TS2(TSSOP-14-A)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.200	0.035	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	6.200	6.600	0.244	0.260
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026 BSC	
L	0.450	0.750	0.018	0.030
θ	0	8°	0	8°

NOTES

1. Do not include mold flash or protrusion.
2. This drawing is subject to change without notice.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPCMP761U-S5TR (1)	−40 to 125°C	SOT23-5	76U	MSL3	Tape and Reel,3000	Green
TPCMP761W-S5TR	−40 to 125°C	SOT23-5	76W	MSL3	Tape and Reel,3000	Green
TPCMP761Y-S5TR (1)	−40 to 125°C	SOT23-5	76Y	MSL3	Tape and Reel,3000	Green
TPCMP762-SO1R	−40 to 125°C	SOP-8	CM762	MSL3	Tape and Reel,4000	Green
TPCMP762-TS1R (1)	−40 to 125°C	TSSOP-8	CM762	MSL3	Tape and Reel,3000	Green
TPCMP762-VS1R (1)	−40 to 125°C	MSOP-8	CM762	MSL3	Tape and Reel,3000	Green
TPCMP764-SO2R	−40 to 125°C	SOP-14	CM764	MSL3	Tape and Reel,2500	Green
TPCMP764-TS2R	−40 to 125°C	TSSOP-14	CM764	MSL3	Tape and Reel,3000	Green

(1) For future products, contact the 3PEAK factory for more information and samples.

Green: Defines "Green" to mean RoHS compatible and free of halogen substances.

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