

Dual-Channel, Micropower Comparator with Integrated Reference**Features**

- Single-Supply Voltage Range: +2.5 V to +5.5 V
- Low Supply Current: 48 μ A
- Two-channel Detectors in Small Packages
- 390 ns Propagation Delay for 100 mV Overdrive Voltage
- Rail-to-Rail Inputs
- Operation Range: -40°C to 125°C
- Push-pull Output

Applications

- Precision Battery Management
- Window Comparators
- Level Translators
- Digital Line Receivers

Description

The TPCMP512B is a family of high-accuracy, dual-channel comparators featuring low power and small solution size. The INA and INB inputs include hysteresis to reject brief glitches, thus ensuring stable output operation without false triggering. The TPCMP512B has adjustable INx inputs that can be configured by an external resistor divider pair. When the voltage at the INA or INB input goes below the falling threshold, OUTA or OUTB is driven low, respectively. When INA or INB rises above the rising threshold, OUTA or OUTB goes high, respectively. The TPCMP512B operates from 2.5 V to 5.5 V, over the -40°C to $+125^{\circ}\text{C}$ temperature range. The propagation delay of TPCMP512B is 390 ns for 100 mV overdrive voltage.

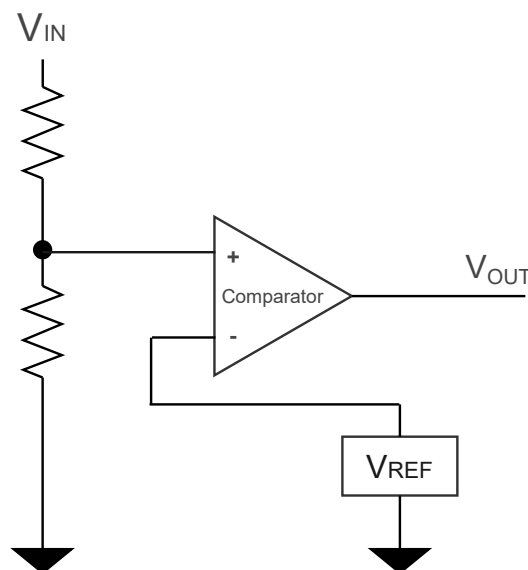
Typical Application Circuit

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Revision History

Date	Revision	Notes
2026-03-24	Rev.A.0	Initial version.

Pin Configuration and Functions

TPCMP512B-DFNR

DFN1.5X1-6

Top View

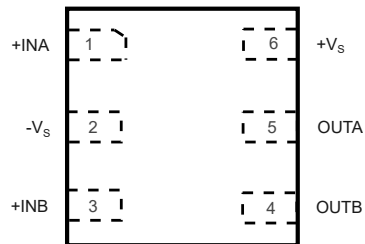


Table 1. Pin Functions: TPCMP512B-DFNR

Pin No.	Name	I/O	Description
1	+INA	I	Non-inverting input.
2	-Vs	-	Negative power supply.
3	+INB	I	Non-inverting input.
4	OUTB	O	Output.
5	OUTA	O	Output.
6	+Vs	-	Positive power supply.

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Specifications

Absolute Maximum Ratings ⁽¹⁾

Parameter		Min	Max	Unit
	Supply Voltage, (+V _S) – (–V _S)	–0.3	6	V
	Input Voltage	(–V _S) – 0.3	(+V _S) + 0.3	V
	Input Current: +IN, –IN ⁽²⁾	–10	10	mA
	Output Voltage	(–V _S) – 0.3	(+V _S) + 0.3	V
	Comparator Output Short-Circuit Duration ⁽³⁾		Indefinite	
	Reference Output Short-Circuit Duration ⁽³⁾		Indefinite	
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 the positive and negative power supply. If the input extends more than 500 mV beyond the positive or 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⁾	2	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, (+V _S) – (–V _S)	2.5		5.5	V

Dual-Channel, Micropower Comparator with Integrated Reference**Thermal Information**

Package Type	θ_{JA}	θ_{JC}	Unit
DFN1.5X1-6	229.4	250.5	°C/W

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Electrical Characteristics

All test conditions: $V_S = 5\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply						
I _Q	Quiescent Current	V _S = 3.3 V, No Load, Output High, +VIN = +V _S		48		μA
		V _S = 3.3 V, No Load, Output High, +VIN = +V _S , T _A = −40°C to 125°C			56	μA
		V _S = 3.3 V, No Load, Output Low, +VIN = −V _S		52		μA
		V _S = 3.3 V, No Load, Output Low, +VIN = −V _S , T _A = −40°C to 125°C			61	μA
		V _S = 5.5 V, No Load, Output High, +VIN = +V _S		50		μA
		V _S = 5.5 V, No Load, Output High, +VIN = +V _S , T _A = −40°C to 125°C			58	μA
		V _S = 5.5 V, No Load, Output Low, +VIN = −V _S		55		μA
		V _S = 5.5 V, No Load, Output Low, +VIN = −V _S , T _A = −40°C to 125°C			63	μA
V _{POR}	Power On Reset Voltage	V _{OL} (max) = 0.2 V, I _{OL} = 15 μA			0.85	V
		V _{OL} (max) = 0.2 V, I _{OL} = 15 μA, T _A = −40°C to 125°C			0.95	V
Input Characteristics						
V _{IT+}	Positive-going (rising) Input Threshold Voltage	V _{IN} rising	1.2182	1.2312	1.2442	V
		V _{IN} rising, T _A = −40°C to 125°C	1.2124		1.2526	V
V _{IT−}	Negative-going (falling) Input Threshold Voltage	V _{IN} falling	1.217	1.23	1.243	V
		V _{IN} falling, T _A = −40°C to 125°C	1.2112		1.2514	V
V _{HYST}	Input Built Hysteresis	V _S = 5.5 V		2		mV
I _B	Input Bias Current	V _S = 5.5 V, +VIN = +V _S		15		pA
		V _S = 5.5 V, +VIN = +V _S , T _A = −40°C to 125°C	−10000		10000	pA
		V _S = 5.5 V, +VIN = −V _S		15		pA
		V _S = 5.5 V, +VIN = −V _S , T _A = −40°C to 125°C	−10000		10000	pA
V _{CM}	Common-mode Input Voltage Range	V _S = 5 V	−0.25		5.25	V
		V _S = 5 V, T _A = −40°C to 125°C	0		5	V
Output						

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{OL}	Output Voltage Swing from Negative Rail	V _S = 2.7 V, I _{SINK} = 2 mA		80		mV
		V _S = 2.7 V, I _{SINK} = 2 mA, T _A = −40°C to 125°C			100	mV
		V _S = 4.5 V, I _{SINK} = 3.2 mA		109		mV
		V _S = 4.5 V, I _{SINK} = 3.2 mA, T _A = −40°C to 125°C			135	mV
V _{OH}	Output Voltage Swing from Positive Rail	V _S = 2.7 V, I _{SOURCE} = 1 mA		27		mV
		V _S = 2.7 V, I _{SOURCE} = 1 mA, T _A = −40°C to 125°C			38	mV
		V _S = 4.5 V, I _{SOURCE} = 2.5 mA		44		mV
		V _S = 4.5 V, I _{SOURCE} = 2.5 mA, T _A = −40°C to 125°C			57	mV
Switching Characteristics ⁽¹⁾⁽²⁾						
T _{PLH}	Propagation Delay Time, Low to High	V _S = 3.3 V, +VIN transitions between 0 V and 1.3 V		530		ns
		V _S = 3.3 V, 50-mV Overdrive		450		ns
		V _S = 3.3 V, 100-mV Overdrive		390		ns
T _{PHL}	Propagation Delay Time, High to Low	V _S = 3.3 V, +VIN transitions between 0 V and 1.3 V		340		ns
		V _S = 3.3 V, 50-mV Overdrive		470		ns
		V _S = 3.3 V, 100-mV Overdrive		400		ns
T _{SD}	Startup Delay	V _S = 3.3 V, +VIN = 1.4 V, The time between +V _S exceeding V _S (min) and the output is in a valid logic state.		89		μs

(1) Provided by bench tests and design simulation.

(2) Delay time is measured from the mid-point of the input to the mid-point of the output.

(3) Provided by design simulation.

Dual-Channel, Micropower Comparator with Integrated Reference

Typical Performance Characteristics

All test conditions: $V_S = 5\text{ V}$, $V_{CM} = 2.5\text{ V}$, unless otherwise noted.

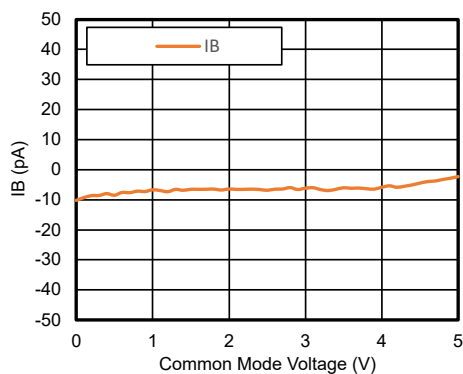


Figure 1. IB vs. Common-Mode Voltage

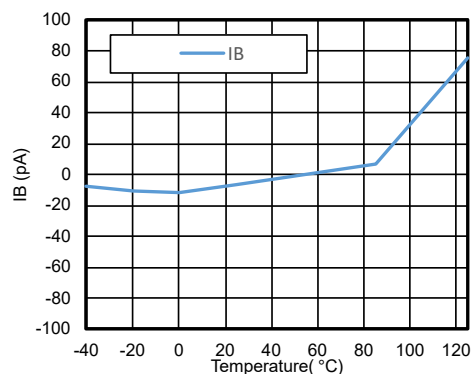


Figure 2. IB vs. Temperature

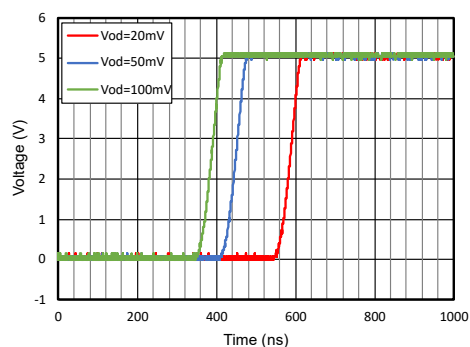


Figure 3. Propagation Delay, Low to High, 5 V

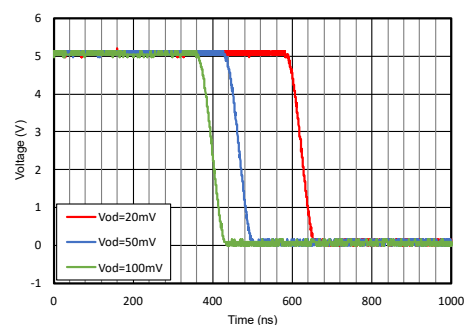


Figure 4. Propagation Delay, High to Low, 5 V

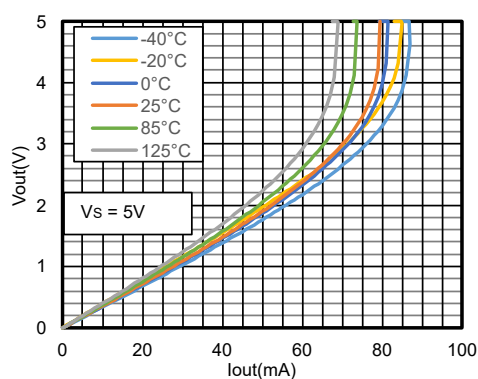


Figure 5. Output Voltage vs. Output Sinking Current, 5 V

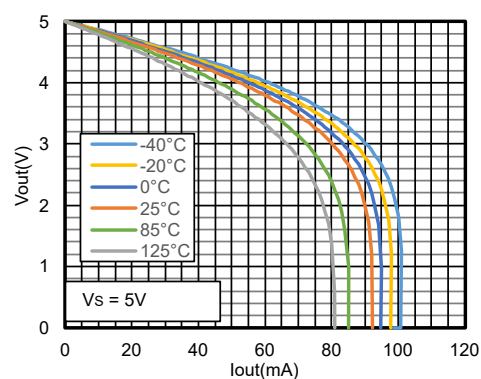


Figure 6. Output Voltage vs. Output Sourcing Current, 5 V

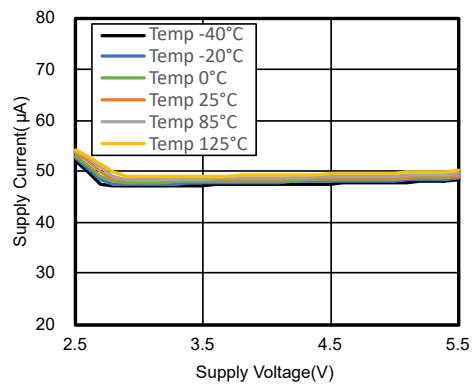
Dual-Channel, Micropower Comparator with Integrated Reference


Figure 7. Supply Current vs. Supply Voltage

Detailed Description

Overview

The TPCMP512B is a family of high-accuracy, dual-channel comparators featuring low power and small solution size. The INA and INB inputs include hysteresis to reject brief glitches, thus ensuring stable output operation without false triggering. The TPCMP512B has adjustable INx inputs that can be configured by an external resistor divider pair. When the voltage at the INA or INB input goes below the falling threshold, OUTA or OUTB is driven low, respectively. When INA or INB rises above the rising threshold, OUTA or OUTB goes high, respectively. The TPCMP512B operates from 2.5 V to 5.5 V, over the -40°C to $+125^{\circ}\text{C}$ temperature range. The propagation delay of the TPCMP512B is 390 ns for 100-mV overdrive voltage.

Functional Block Diagram

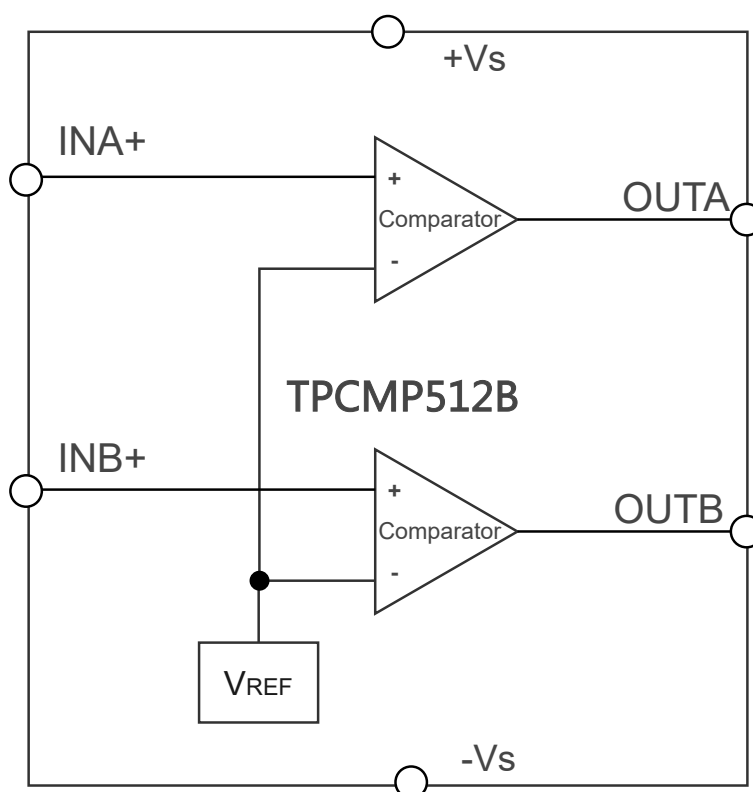


Figure 8. Functional Block Diagram

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 TPCMP511 should have local bypass capacitors (i.e., 0.01 μF to 0.1 μF) within 2 mm for high-frequency performance. They 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 to the pins of the comparator as close as possible.

Operation Outside of the Common Input Voltage Range

A list of input voltage situations and the corresponding outcomes are as follows:

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 impedance.
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 voltages at the $-IN$ and $+IN$ pins are both higher than the common-mode voltage range, the output is in an uncertain state.

Typical Application

Over-voltage Detection

The device is an ideal candidate to be used as over-voltage detection, as shown in [Figure 9](#). The input signal is compared with the reference voltage through a resistor divider to generate a comparator logic output. When the divided input voltage exceeds the reference voltage, the comparator output goes high to indicate an over-voltage fault.

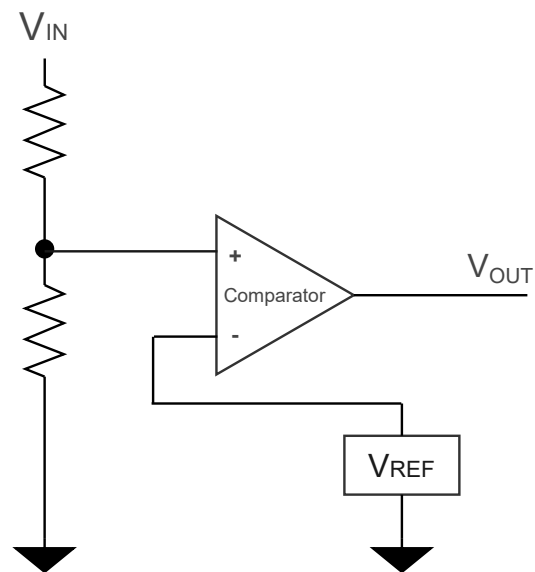
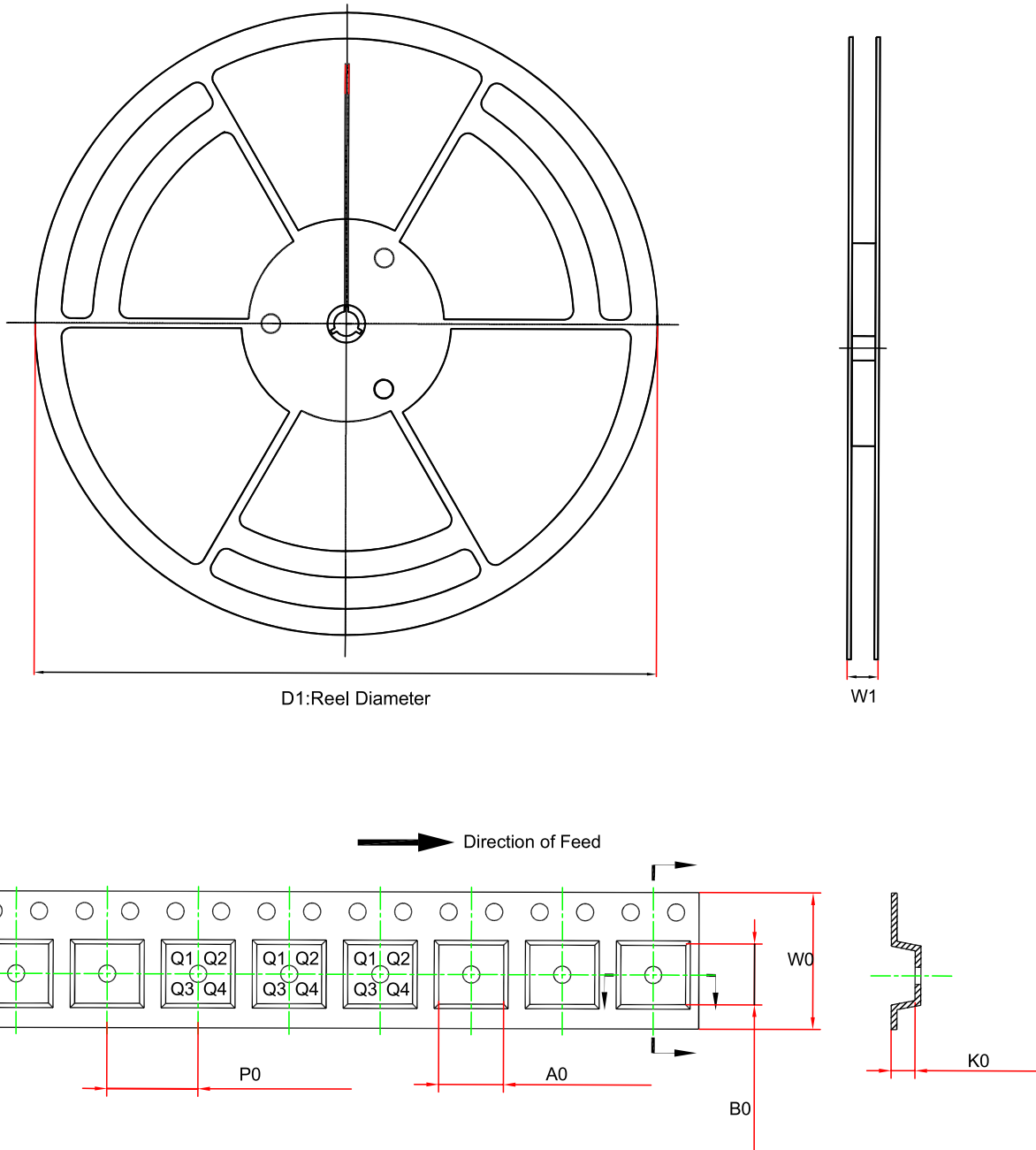


Figure 9. Typical Application Circuit

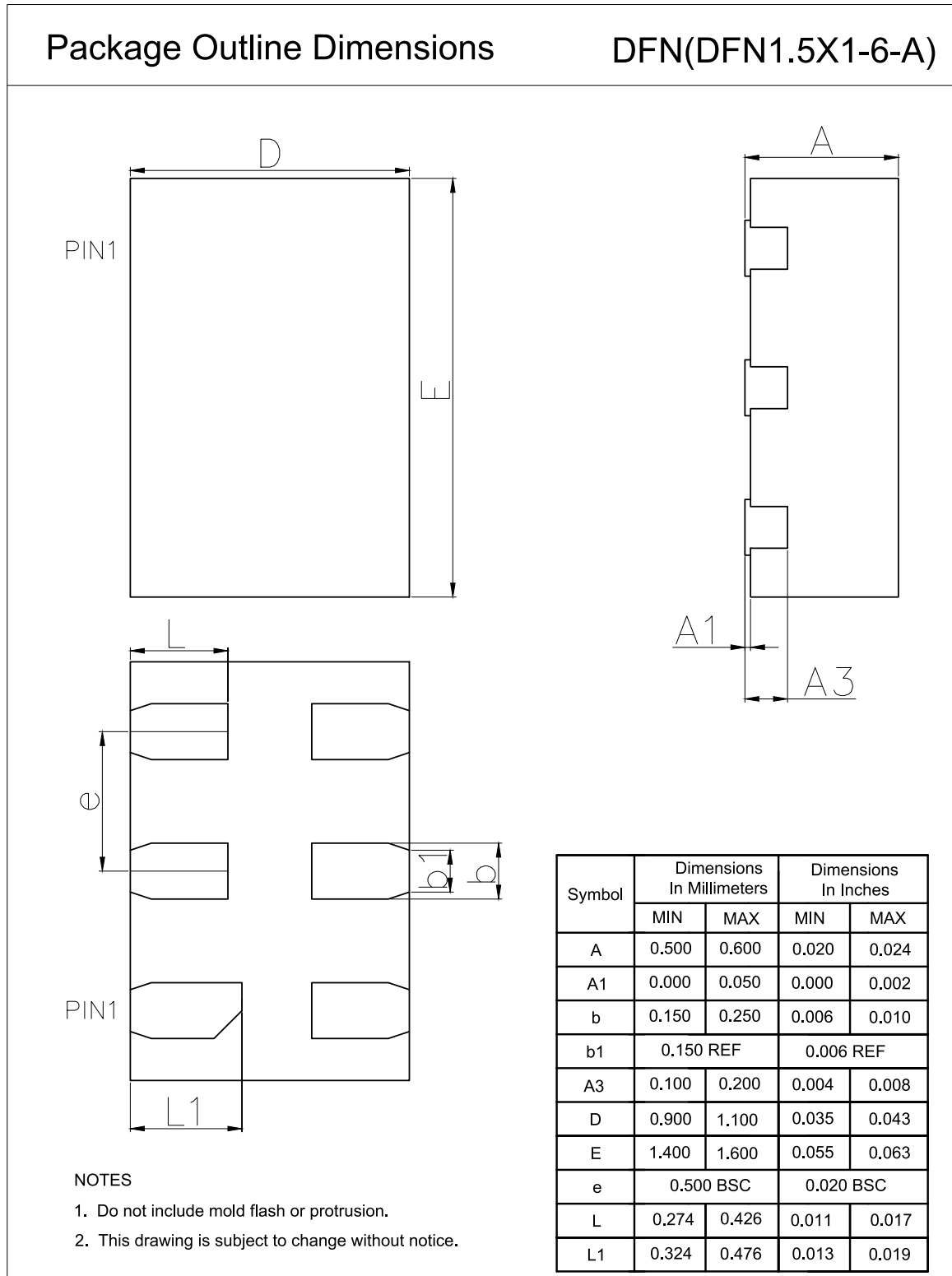
Tape and Reel Information



Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm) ⁽¹⁾	B0 (mm) ⁽¹⁾	K0 (mm) ⁽¹⁾	P0 (mm)	W0 (mm)	Pin1 Quadrant
TPCMP512B-DFNR	DFN1.5X1-6	180	13.1	1.15	1.72	0.70	4	8	Q1

(1) The value is for reference only. Contact the 3PEAK factory for more information.

Package Outline Dimensions

DFN1.5X1-6


Dual-Channel, Micropower Comparator with Integrated Reference**Order Information**

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
TPCMP512B-DFNR	-40 to 125°C	DFN1.5X1-6	C52	MSL1	Tape and Reel,4000	Green

Green: 3PEAK defines "Green" to mean RoHS compatible and free of halogen substances.

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