36-V Dual Comparators

Features

- Wide Power Supply Range: +3 V to +36 V or ±1.5 V to ±18 V
- Low Supply Current: 1 mA
- Low Input Bias Current: 25 nA Typical
- Low Offset Voltage: ±7 mV Max
- Input Common-mode Voltage Range Includes Ground
- Internal Differential Input Voltage Range Equal to the Supply Voltage
- AEC-Q100 Qualified for Automotive Applications, Grade 1: −40°C to 125°C Ambient Operating Temperature Range

Applications

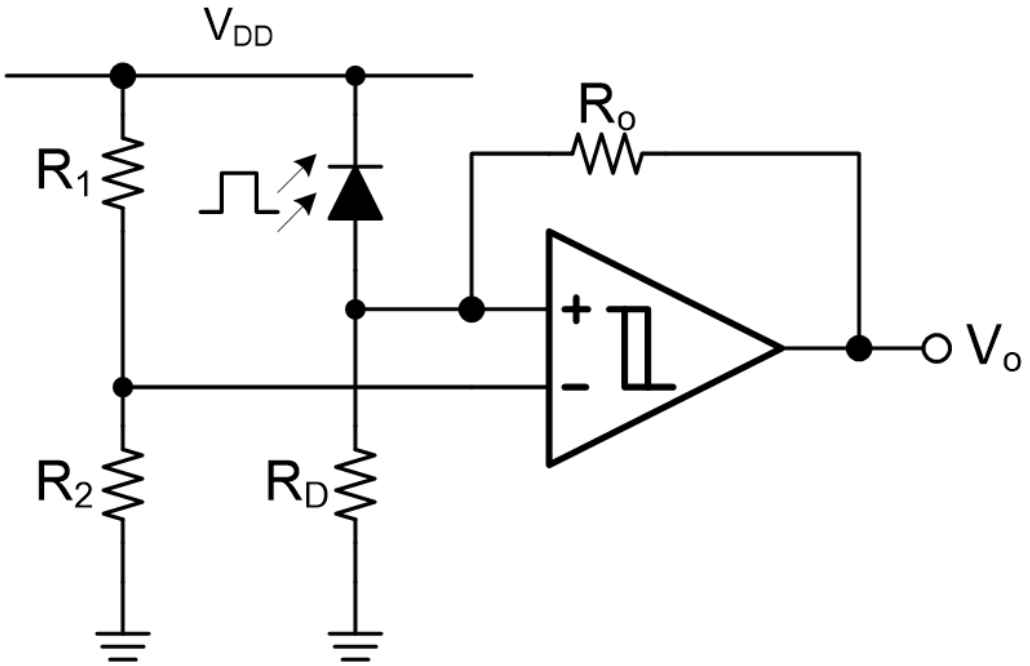
- High-Speed Sampling Circuits
- Peak and Zero-crossing Detectors
- Threshold Detectors/Discriminators
- Sensing at Ground or Supply Line

Description

The LM2903DQ consists of dual comparators on a single monolithic substrate. The common-mode input voltage range includes ground even when the LM2903DQ is operated from a single supply. The low power supply current drain makes these comparators suitable for battery operation. These types are designed to directly interface with TTL and CMOS. The current drain is independent of the supply voltage. The outputs can be connected to other open-collector or open-drain outputs to achieve wired-AND relationships.

The LM2903DQ is a dual-channel version available in an 8-pin SOP package. The LM2903DQ is specified for the temperature range from −40°C to +125°C.

Typical Application Circuit



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Revision History

Date	Revision	Notes
2022-11-10	Rev.A.0	Initial Version

Pin Configuration and Functions

LM2903DQ-SO1R-S
SOP8 Package
Top View

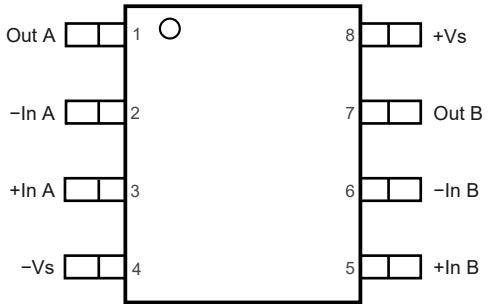


Table 1. Pin Functions: LM2903DQ

Pin		I/O	Description
No.	Name		
1	Out A	O	Output of channel A.
2	−In A	I	Inverting Input of the channel A.
3	+In A	I	Non-Inverting Input of the channel A.
4	−Vs	I	Negative power supply.
5	+In B	I	Non-Inverting Input of the channel B.
6	−In B	I	Inverting Input of the channel B.
7	Out B	O	Output of channel B.
8	+Vs	I	Positive power supply.

Specifications

Absolute Maximum Ratings (1)

Parameter		Min	Max	Unit
	Supply Voltage: (+Vs) – (−Vs)		40	V
	Input Voltage	(−Vs) − 0.3	40	V
	Input Current: +IN, −IN (2)	−10	10	mA
	Differential Input Voltage	−40	40	V
	Output Current: OUT (2)	−10	10	mA
	Output Sink Current (3)		50	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 and outputs are protected by ESD protection diodes to negative power supply. If the input or output extends more than 300 mV beyond the negative power supply, the 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

Symbol	Parameter	Condition	Minimum Level	Unit
HBM	Human Body Model ESD	AEC-Q100-002	1.5	kV
CDM	Charged Device Model ESD	AEC-Q100-011	1	kV
LU	Latch Up	AEC-Q100-004, 25°C	300	mA
		AEC-Q100-004, 125°C	100	mA

Recommended Operating Conditions

Parameter		Min	Typ	Max	Unit
Vs	Supply Voltage, (+Vs) – (−Vs)	3 (±1.5)		36 (±18)	V
T_A	Operating Temperature Range	−40		125	°C

Thermal Information

Package Type	θ_{JA}	θ_{JC}	Unit
SOP8	158	43	°C/W

Electrical Characteristics

All test condition: T_A = 25°C, V_S = 5 V, V_{CM} = 0 V, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_S	Supply Voltage		3		36	V
V_{OS}	Input Offset Voltage (1)	V_S= 5 V to 36 V, V_{CM} = 0 V to +Vs – 2 V	−7	1	7	mV
		V_S= 5 V to 36 V, V_{CM} = 0 V to +Vs – 2 V, T_A= −40 to 125°C	−10		10	mV
I_B	Input Bias Current			25	250	nA
		T_A= −40 to 125°C			400	nA
I_{OS}	Input Offset Current			10	50	nA
		T_A= −40 to 125°C			150	nA
V_{CM}	Common-mode Input Voltage Range		0		(+Vs) −1.5	V
		T_A= −40°C to +125°C	0		(+Vs) − 2	V
	Differential Input Voltage			±V_S		V
A_{VD}	Large Signal Voltage Gain	V_{CC} = 15 V, R_L ≥ 15 kΩ to V_{CC}		200		V/mV
I_{OH}	High Level Output Current	V_{OH} = 5 V, V_{ID} = 1 V		25	100	nA
		V_{OH} = 36 V, V_{ID} = 1 V, T_A = −40°C to +125°C			200	nA
V_{OL}	Low Level Output Voltage	I_{OL} = 4 mA, V_{ID} = −1 V		150	350	mV
		I_{OL} = 4 mA, V_{ID} = −1 V, T_A = −40°C to +125°C			400	mV
I_{OL}	Low Level Output Current	V_{OL} = 1.5 V, V_{ID} = −1 V	25	40		mA
		V_{OL} = 1.5 V, V_{ID} = −1 V, T_A = −40°C to +125°C	10			
I_Q	Quiescent Current, 2ch Comparator	V_{CC} = 5 V		0.7	1	mA
		V_{CC} = 36 V, T_A = −40°C to +125°C		0.8	1.2	mA
t_{RT}	Response Time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF (2)(3) — 100-mV input step with 5-mV overdrive		1.6		µs

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t_{RT}	Response Time	R_L connected to 5 V through 5.1 kΩ, C_L = 15 pF (2)(3)	TTL-level input step, low to high		0.6	1	
			TTL-level input step, high to low		0.3	0.5	

(1) The input offset voltage is the average of the input-referred trip points.
(2) C_L includes probe and jig capacitance.
(3) The response time specified is the interval between the input step function and the instant of output:

- Output low to high transition: when the output crosses 10% of the high-level output voltage.
- Output high to low transition: when the output crosses 90% of the high-level output voltage.

Typical Performance Characteristics

All test condition: V_{IN} =5 V, V_A =+ 25°C, unless otherwise noted.

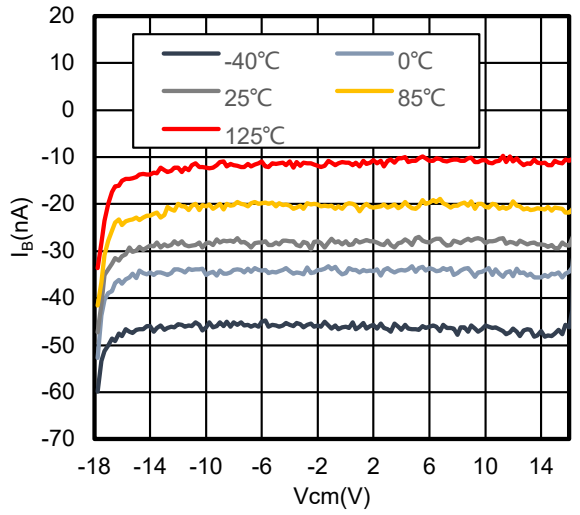


Figure 1. I_B vs. V_{CM}, (+Vs) = 18 V, (−Vs) = −18 V

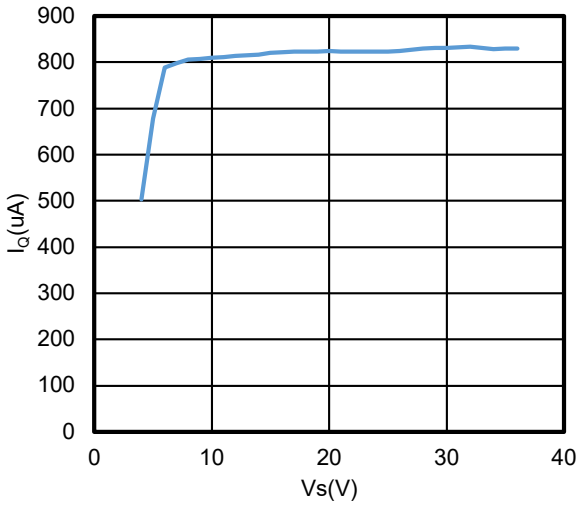


Figure 2. Supply Current vs. Supply Voltage

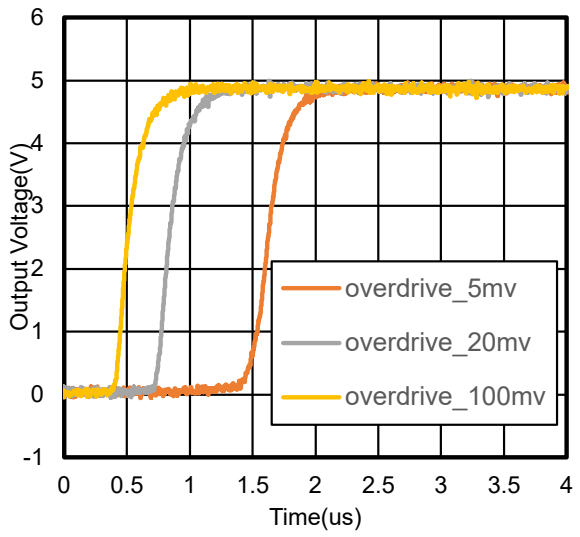


Figure 3. Response Time for Various Input Overdrives, Positive Transition

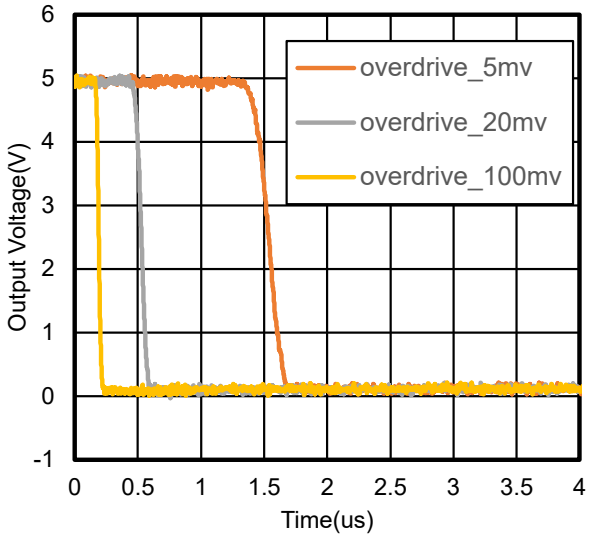


Figure 4. Response Time For Various Input Overdrives, Negative Transition

Detailed Description

Overview

The LM2903DQ comparator has the ability to operate from 3 V to 36 V on the supply pin, and also has 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

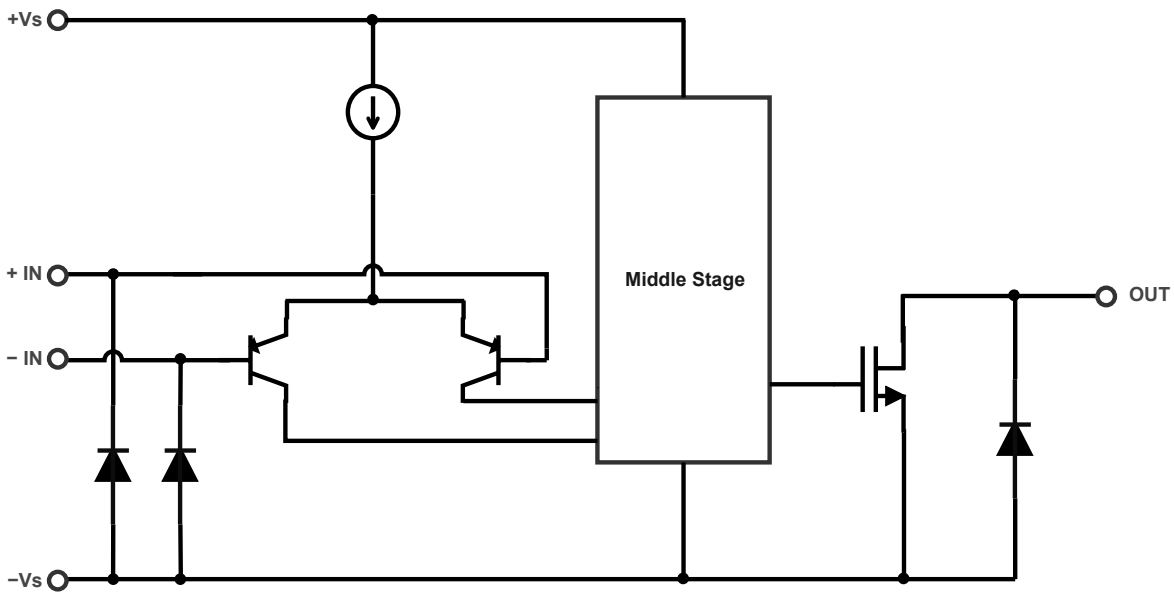


Figure 5. Functional Block Diagram

Feature Description

Operating Voltage

The LM2903DQ is designed for single supply operation from 3 V to 36 V or dual supply operation from ±1.5 V to ±18 V.

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

There is no ESD diode between the input pins and the (+Vs) pin, so the voltage at the input pins can be applied from 0 V to 36 V regardless of the voltage at the (+Vs) pin. The feature provides isolation when the device is powered off and the signal still exists at the input pin.

There is no ESD diode between the input 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 to set output logic as 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 LM2903DQ should 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.

Good ground layout improves performance by decreasing the amount of stray capacitance and noise at the comparator's inputs and outputs. 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 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 voltage at the −IN and +IN pins are both higher than the common-mode voltage range, the output is in uncertain state.

Typical Application

IR Receiver

The LM2903DQ is an ideal candidate to be used as an infrared receiver shown in Figure 6 . 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.

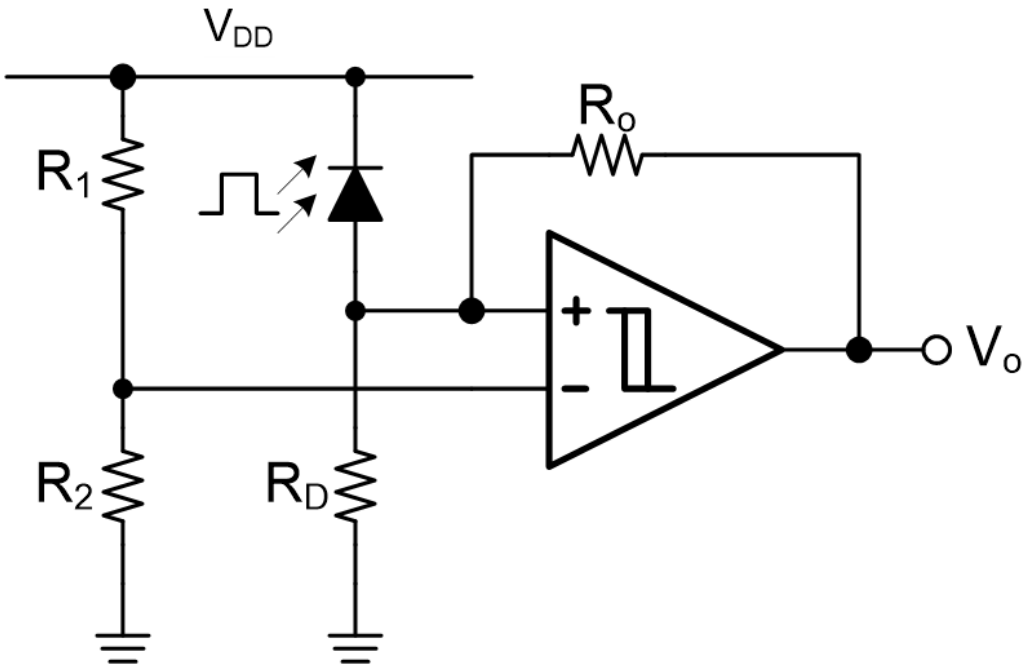
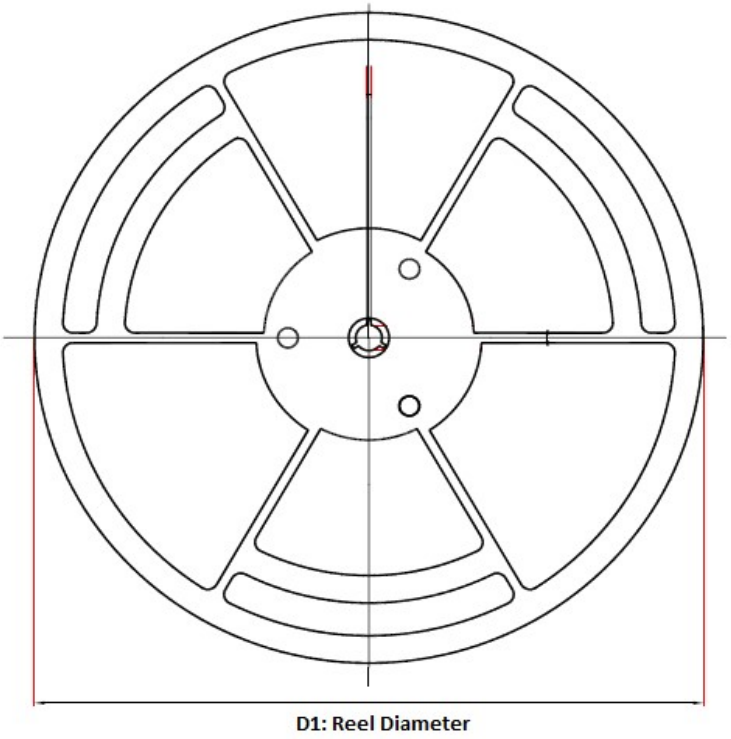
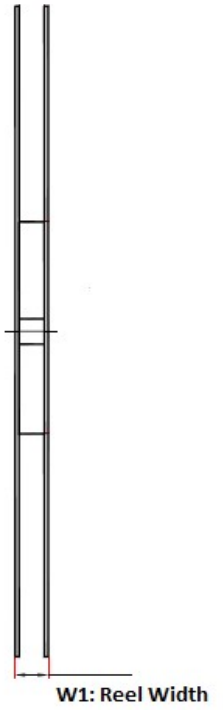
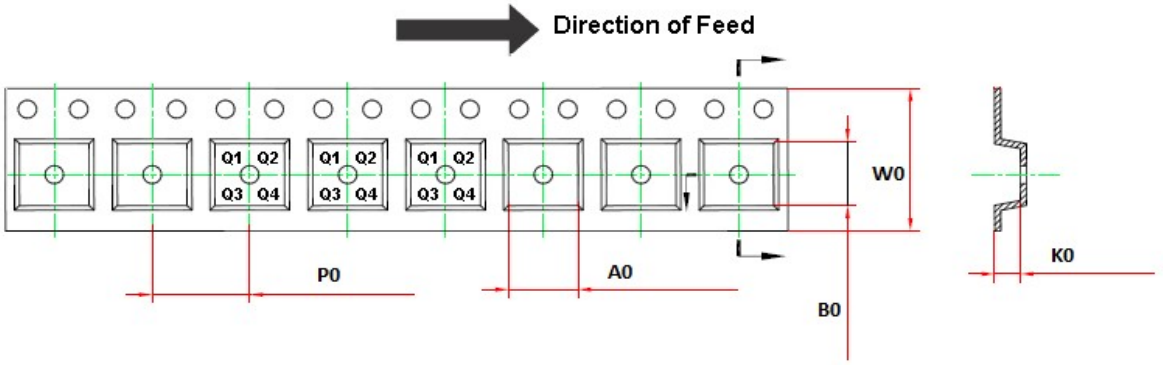


Figure 6. Typical Application Circuit

Tape and Reel Information





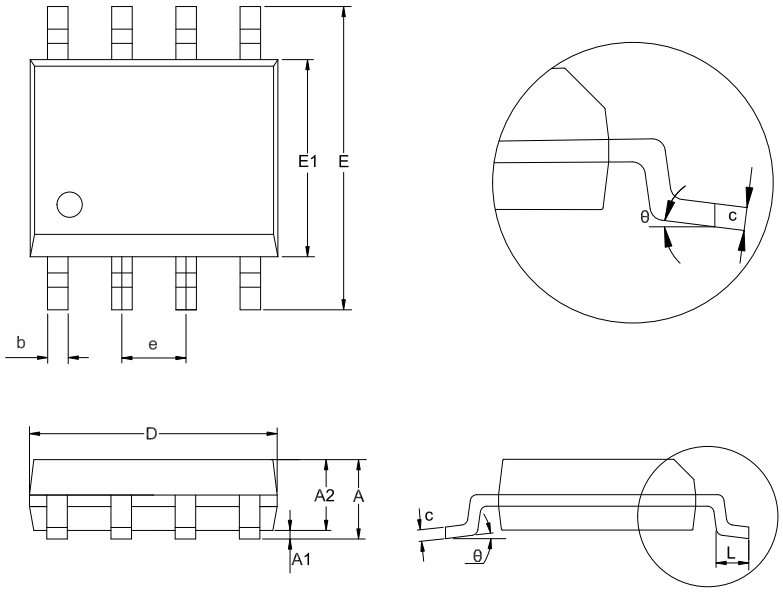


Order Number	Package	D1 (mm)	W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	W0 (mm)	Pin1 Quadrant
LM2903DQ-SO1R-S	SOP8	330.0	17.6	6.4	5.4	2.1	8.0	12.0	Q1

Package Outline Dimensions

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.

Order Information

Order Number	Operating Temperature Range	Package	Marking Information	MSL	Transport Media, Quantity	Eco Plan
LM2903DQ-SO1R-S	−40 to 125°C	SOP8	2903Q	MSL3	Tape and Reel, 4000	Green

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

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

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