

2:1,3-Channel CMOS ANALOG SIGNAL MULTIPLEXERS/DEMULTIPLEXERS

General Description

The QM4053 is a CMOS analog IC configured as a 2:1,3-channel multiplexer with the low-power consumption. The QM4053 can operate from 2.5V to 5.5V single supplies. And each switch can handle rail-to-rail analog signals. It also guarantees an On-Resistance 48Ω (TYP) with 5V supply.

The QM4053 features a low On-Resistance flatness (15Ω TYP) and low On-Resistance matching between channels (0.5Ω TYP). The off-leakage current is less than 1nA (TYP) at +25°C.

It is capable of operating over an ambient temperature range of -40°C to +125°C. The QM4053 is available in Green SOP16 and TSSOP16 packages.

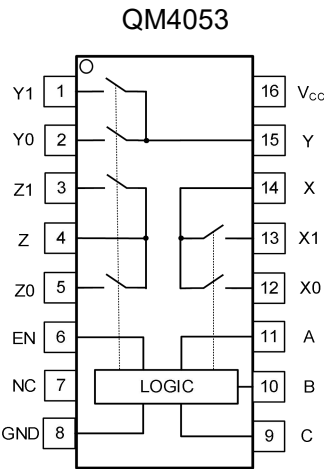
Features and Benefits

- Fast Switching and Propagation Speeds
- Low On-Resistance: 48Ω (TYP)
- Low On-Resistance Match Between Channels
- 2.5V to 5.5V Single Supply Operation
- Low power consumption
- 1.8V Logic Compatible
- Rail-to-Rail Signal Handling
- Break-Before-Make Switching
- High Channel Off Feedthrough: -90dB
- Operating Temperature Range: -40°C to +125°C
- Enhanced ESD Protection on All Inputs/Outputs
- These are Pb-Free Devices

Applications

- Automotive
- Sensor
- Communications Circuits
- Audio and Video Signal Routing
- Low-Voltage Data-Acquisition Systems
- Battery-Operated Equipment
- Appliances
- Signal Gating
- Factory Automation

Function Diagram



Function Description

QM4053 Control Inputs				ON Channels
EN	Select			
	C	B	A	
L	X	X	L	X0
L	X	X	H	X1
L	X	L	X	Y0
L	X	H	X	Y1
L	L	X	X	Z0
L	H	X	X	Z1
H	X	X	X	NONE

X = Don't Care

Recommended Operating Conditions

Parameter	Min	Max	Unit
Supply Voltage Range	2.5	5.5	V
Operating Temperature Range	-40	125	°C

Ordering Information

Model	Part Number	Package	Container, Pack Qty
QM4053	QM4053D	SOP16	Reel, 4000
QM4053	QM4053PW	TSSOP16	Reel, 4000

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) ⁽¹⁾

Parameter	Min	Max	Unit
V _{CC} to GND	-0.3	6	V
Voltage into Any Terminal	-0.3	V _{CC} + 0.3	V
Junction Temperature		150	°C
Storage Temperature Range	-65	150	°C
Lead Temperature (Soldering, 10s)		260	°C
ESD Susceptibility HBM		± 6000	V
ESD Susceptibility CDM		± 2000	V
Continuous Current into Any Terminal	-20	+20	mA
Peak Current, X ₁ (Pulsed at 1ms, 10% Duty Cycle)	-40	+40	mA

- (1) Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD CAUTION



ESD (electrostatic discharge) sensitive device

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid

Electrical Characteristics:

Boldface limits apply over the specified temperature range, $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$.

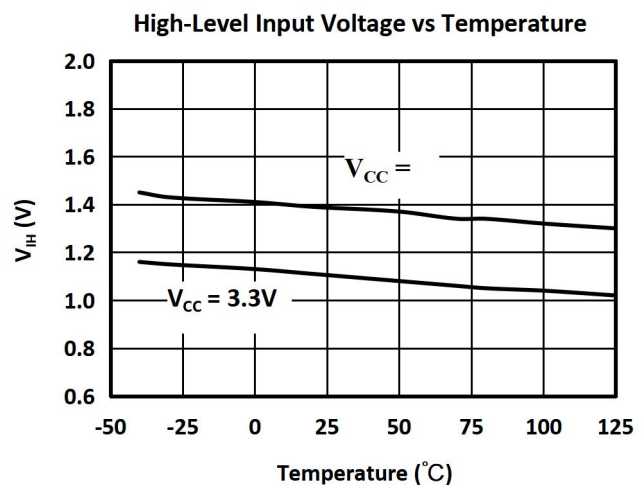
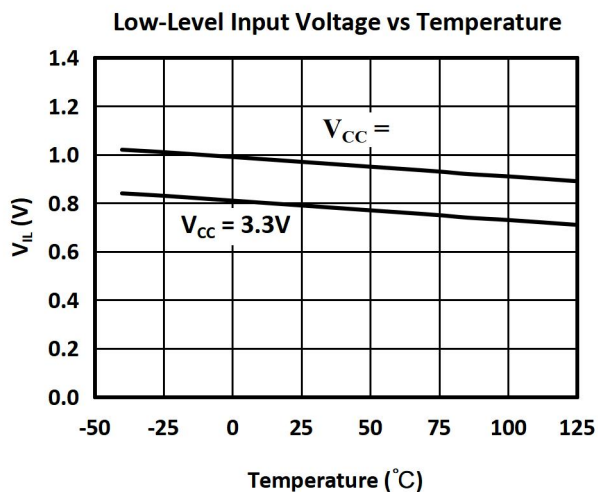
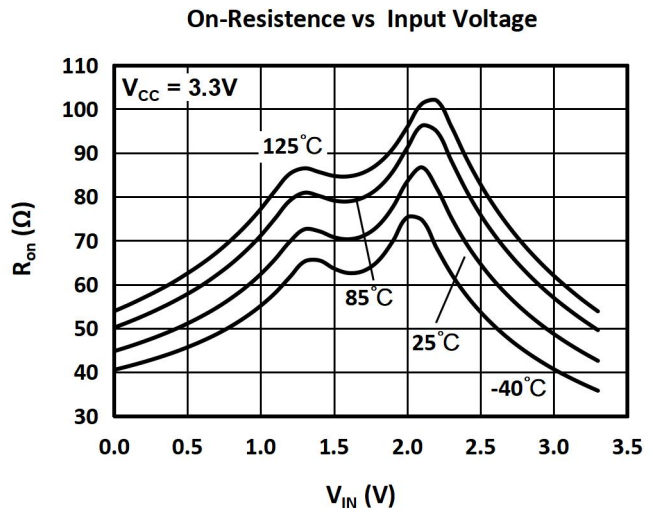
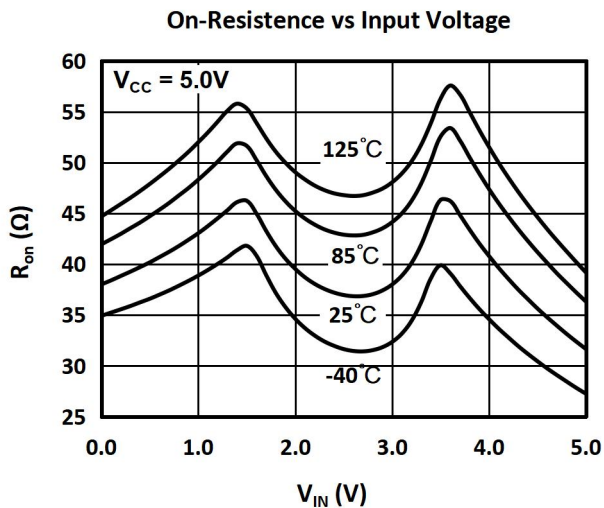
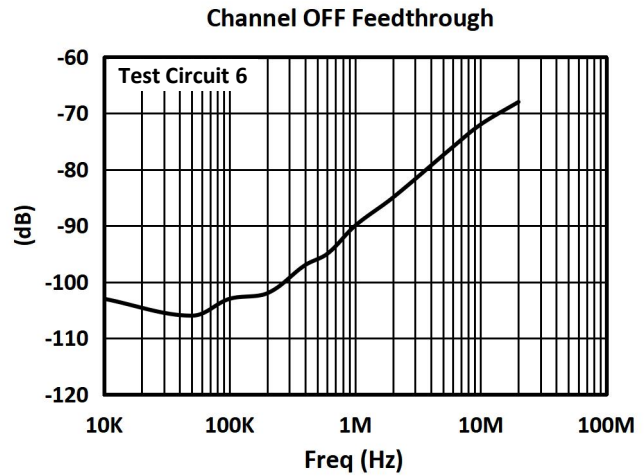
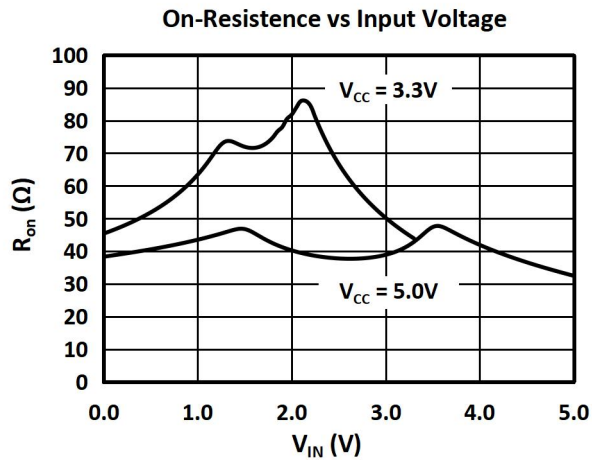
At $T_A = +25^{\circ}\text{C}$, $V_{CC} = 5.0\text{V}$ (unless otherwise noted)

Parameter		Test Conditions	Min	Typ	Max	Unit
Power Supply						
V _{CC}	Power Supply Range	T _A = -40°C to +125°C	2.5		5.5	V
I _{CC}	Power Supply Current	V _{CC} = 5.0V, V _A , V _B , V _C , V _{EN} = V _{CC} or 0V		0.001	6	μA
		V _{CC} = 3.3V, V _A , V _B , V _C , V _{EN} = V _{CC} or 0V			4	μA
Analog Switch						
V _X , V _{X_}	Analog Signal Range		GND		V _{CC}	V
R _{ON}	On-Resistance	V _{CC} = 5.0V, I _X = 1mA		48	60	Ω
		T _A = -40°C to +125°C			70	Ω
		V _{CC} = 3.3V, I _X = 1mA		85	110	Ω
		T _A = -40°C to +125°C			125	Ω
ΔR _{ON}	On-Resistance Match Between Channels	I _X = 1mA		0.5	4	Ω
		T _A = -40°C to +125°C			5	Ω
R _{FLAT(ON)}	On-Resistance Flatness	I _X = 1mA		15	22	Ω
		T _A = -40°C to +125°C			28	Ω
I _{X(OFF)}	X_ Off Leakage Current	V _{X_} = 4.5V or 0V, V _X = 4.5V or 0V		±0.001	±1	μA
I _{X(OFF)}	X Off Leakage Current	V _{X_} = 4.5V or 0V, V _X = 4.5V or 0V		±0.001	±1	μA
I _{X(ON)}	X On Leakage Current	V _X = 4.5V or 0V		±0.001	±1	μA
Digital I/O						
V _{IH}	High-level input voltage		1.7			V
V _{IL}	Low-level input voltage				0.5	V
I _{AH} , I _{BH} , I _{CH} , I _{EN}	Input-Current High	V _A , V _B , V _C , V _{EN} = V _{CC}		0.001	1	μA
I _{AL} , I _{BL} , I _{CL} , I _{EN}	Input-Current Low	V _A , V _B , V _C , V _{EN} = 0V		0.001	1	μA
Dynamic Characteristics						
t _{TRANS}	Address Transition Time	V _{X_} = V _{CC} or 0V, R _L = 300Ω, C _L = 35pF		55		ns
t _{ON}	EN Turn-On Time	V _{X_} = V _{CC} or 0V, R _L = 300Ω, C _L = 35pF		30		ns
t _{OFF}	EN Turn-Off Time	V _{X_} = V _{CC} or 0V, R _L = 300Ω, C _L = 35pF		40		ns
t _{pd}	Analog channel signal delay	R _L = 300Ω, C _L = 35pF		2		ns
t _D	Break-Before-Make Time Delay	V _{X_} = V _{CC} , R _L = 300Ω, C _L = 35pF, Test Circuit 4		50		ns
Q	Charge Injection	C _L = 1nF, Test Circuit 3		5		pC
	Channel Off Feedthrough	R _L = 50Ω, C _L = 10pF, f = 1MHz, Test Circuit 6		-90		dB
C _{X(OFF)}	X_ Off-Capacitance	V _{X_} = 0V, f = 1MHz, Test Circuit 1		3		pF
C _{X(OFF)}	X Off-Capacitance	V _{X_} = 0V, f = 1MHz, Test Circuit 1		3		pF

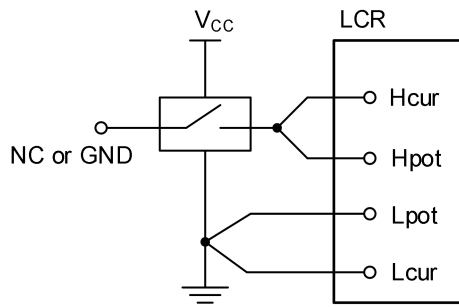
C _{X(ON)}	X On-Capacitance	V _{X_Other} = 0V, f = 1MHz, Test Circuit 1		7		pF
BW	-3dB Bandwidth	R _L = 50Ω		220		MHz
	Feedthrough Noise	R _L = 600Ω, C _L = 50pF, Test Circuit 2		140		mV _{PP}
		R _L = 10kΩ, C _L = 10pF, Test Circuit 2		160		mV _{PP}
THD	Total Harmonic Distortion	R _L = 600Ω, 5V _{P-P} , 1kHz, sine, Test Circuit 5		0.1		%

Typical Characteristics:

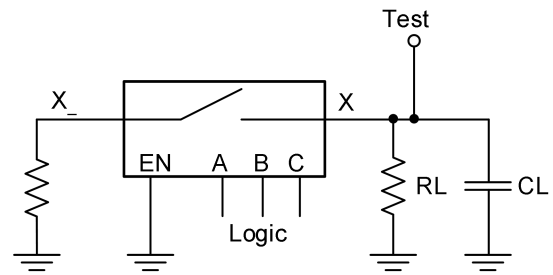
At $T_A = 25^\circ\text{C}$, $V_{CC} = 5.0\text{V}$ (unless otherwise noted)



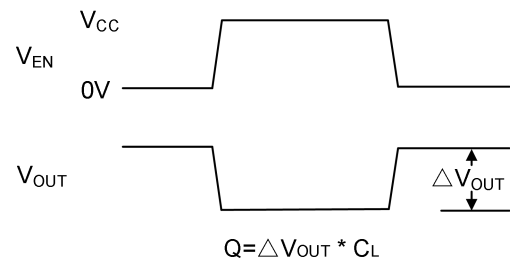
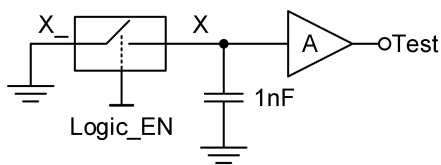
Test Circuit



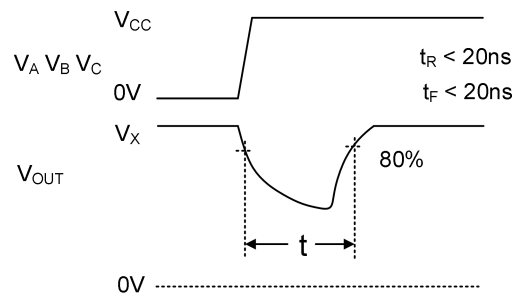
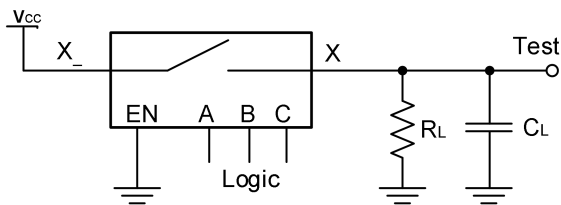
Test Circuit 1. Capacitance



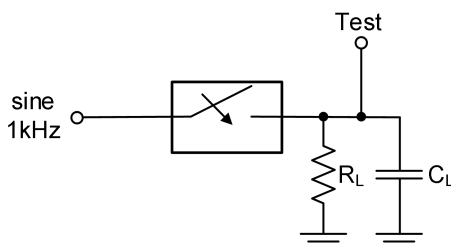
Test Circuit 2. Feedthrough Noise



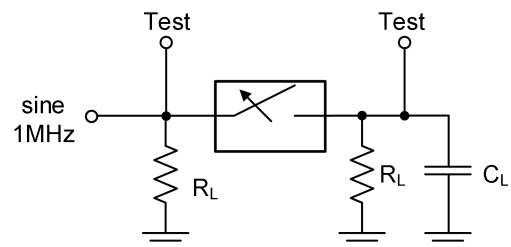
Test Circuit 3. Charge Injection



Test Circuit 4. Break-Before-Make time delay



Test Circuit 5. THD



Test Circuit 6. Channel Off Feedthrough

Application Notes & Additional Details

● On-Resistance

The block diagram of a unit inside the device is shown in Figure 1. The device uses PMOS and NMOS in parallel to reduce the on-resistance and improve the flatness index of the on-resistance. When a single PMOS or NMOS is used as a switch, its on-resistance varies when the signal voltage changes. The variation of on-resistance can be reduced by parallel connection. Figure 2 is a plot of the on-resistance change vs. the signal voltage when two devices are used separately as a switch and in parallel connection.

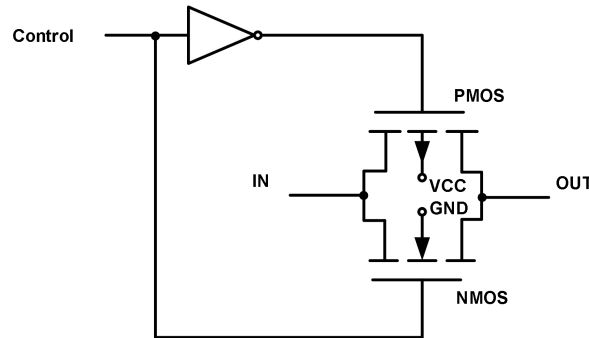


Figure 1. Schematic Diagram of Single Unit of Analog Switch

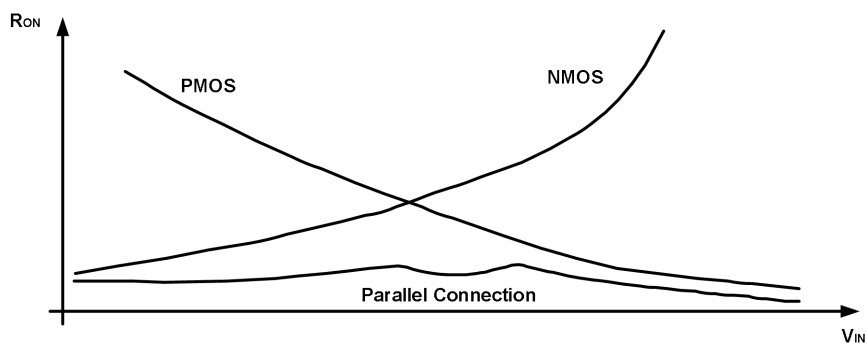


Figure 2. Relationship between On-Resistance and Signal Voltage

● Break-Before-Make Time Delay

The function of "Break-Before-Make Time Delay" is to ensure that the two channels will never be in the state of on at the same time when the multiplexer switches from one channel to another. This is a safety function. When channels switch, the current channel turns off first, then another channel turns on after a certain delay to prevent short circuit. When connecting the input of both channels to V_X and pulling down the output of the channel to GND, the behavior shown in figure 3 happens when one channel switches to another.

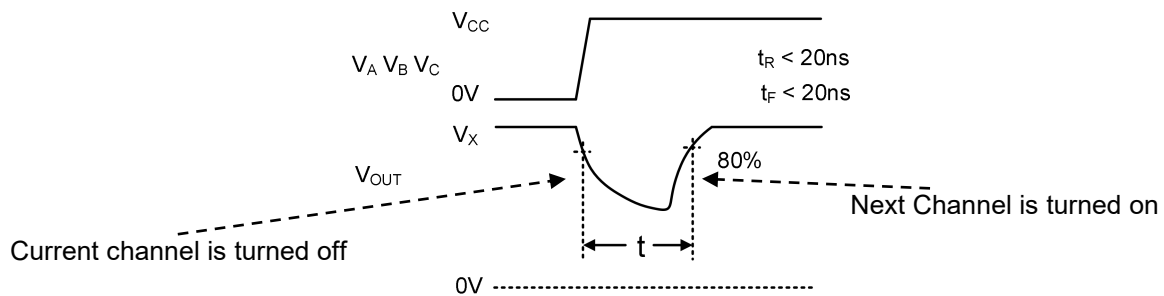
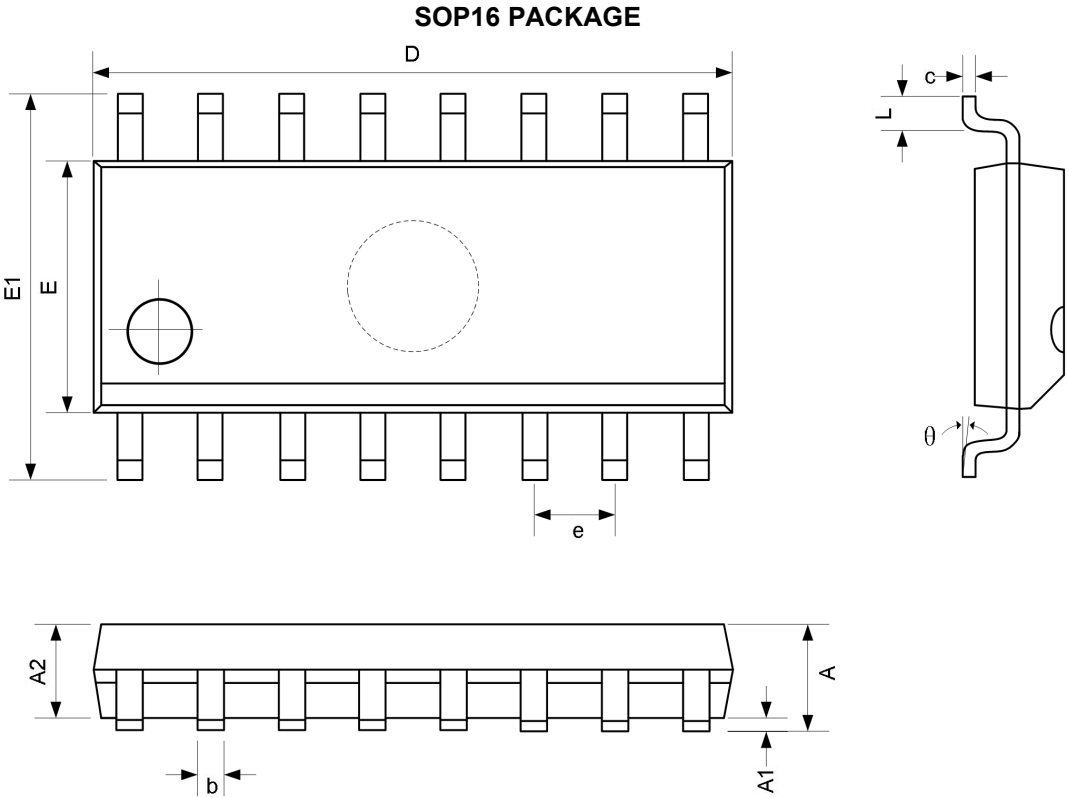


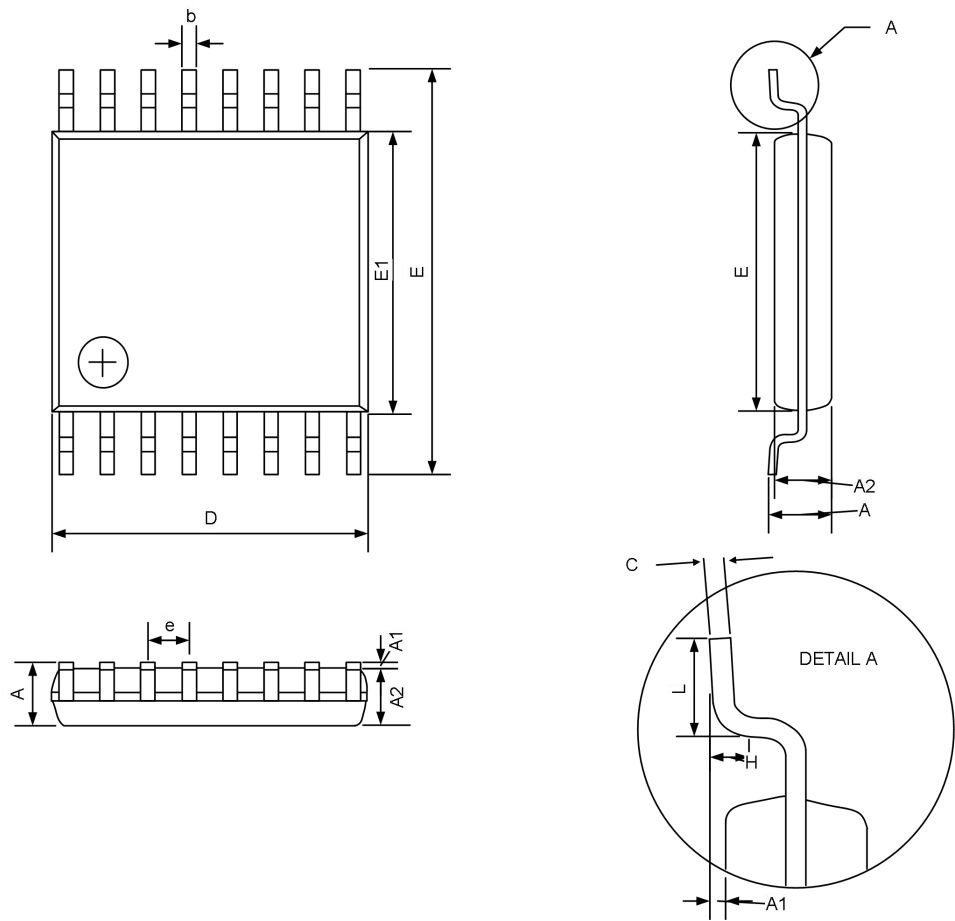
Figure 3. Break-Before-Make Time Delay

Package Outline



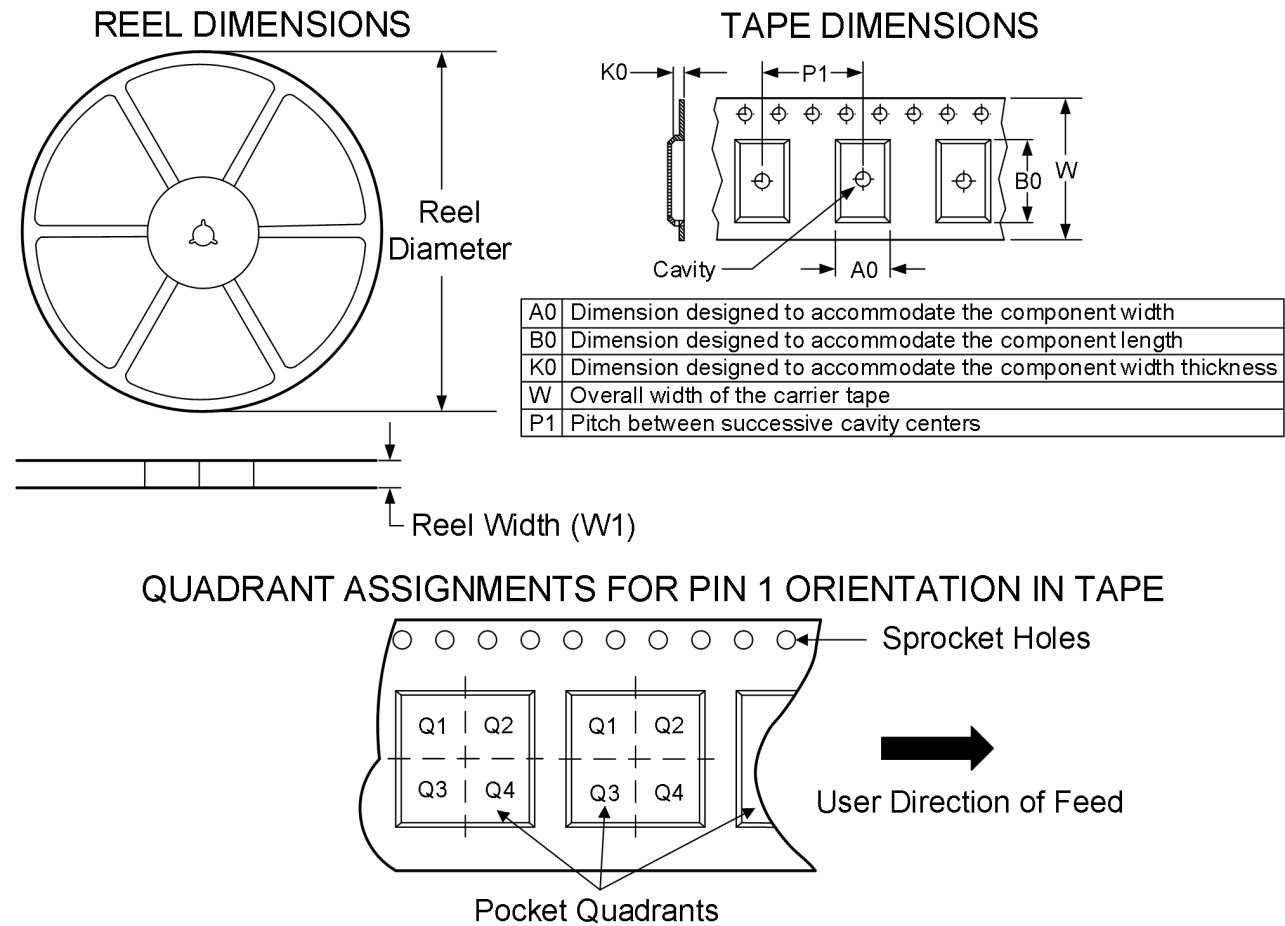
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.150	0.250	0.006	0.010
A2	1.400	1.500	0.055	0.059
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	9.800	10.000	0.386	0.394
E	3.800	4.000	0.150	0.157
E1	5.900	6.100	0.232	0.240
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TSSOP16 PACKAGE



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
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	6.250	6.550	0.246	0.258
E1	4.300	4.500	0.169	0.177
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.250(TYP)		0.010(TYP)	
θ	1°	7°	1°	7°

Tape and Reel Information



Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
QM4053D	SOP16	16	4000	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
QM4053PW	TSSOP16	16	4000	330.0	15.4	6.8	5.4	1.3	8.0	12.0	Q1

Revision History

Revision	Date	Description
0.5	2024.09	Preliminary Version
1.0	2025.02	Add ESD Susceptibility CDM, update electrical characteristics
1.1	2026.06	Updated Ordering Information
1.2	2026.07	Updated Feature information