



SGM4516

11 Ω , High Voltage, Rail-to-Rail, Dual, SPDT Analog Switch

GENERAL DESCRIPTION

The SGM4516 is a high voltage, rail-to-rail signal passing, dual single-pole/double-throw (SPDT) analog switch that is designed to operate for single power supply or dual power supply. Targeted applications include battery powered equipment that benefit from the SGM4516's low 11 Ω (TYP) on-resistance, high off-isolation, very low crosstalk and fast switching speeds.

The SGM4516 is a committed dual single-pole/double-throw (SPDT) switches that consist of two normally open (NO) and two normally closed (NC) switches. This configuration can be used as a dual 2-to-1 multiplexer.

The SGM4516 can pass V_{EE} to V_{CC} wide range rail-to-rail signals with very low distortion.

The SGM4516 is available in Green TQFN-2.6 $\times$ 1.8-16L and SOIC-16 packages. It operates over an ambient temperature range of -40 $^{\circ}$ C to +85 $^{\circ}$ C.

FEATURES

- **Dual Supply Range:** $\pm 2.7V$ to $\pm 12V$
- **Single Supply Range:** 2.7V to 24V
- **On-Resistance for Switches:** 11 Ω (TYP)
- **V_{EE} to V_{CC} Rail-to-Rail Low Distortion Signal Passing**
- **V_{EE} Can be Connected to Negative Power Supply or GND**
- **Fast Switching Times**
- **High Off-Isolation**
- **Very Low Crosstalk**
- **1.8V Logic Compatible Control Pin**
- **Break-Before-Make Switching**
- **-40 $^{\circ}$ C to +85 $^{\circ}$ C Operating Temperature Range**
- **Available in Green TQFN-2.6 $\times$ 1.8-16L and SOIC-16 Packages**

APPLICATIONS

Portable Instrumentation
Battery-Operated Equipment

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM4516	TQFN-2.6×1.8-16L	-40°C to +85°C	SGM4516YTQA16G/TR	4516 XXXXX	Tape and Reel, 3000
	SOIC-16	-40°C to +85°C	SGM4516YS16G/TR	SGM4516YS16 XXXXX	Tape and Reel, 2500

NOTE: XXXXX = Date Code and Vendor Code.

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS

V_{CC} to V_{EE} 0V to 26.4V
 IN_1 , IN_2 , EN to GND 0V to 6V
 Analog Voltage Range ⁽¹⁾ ($V_{EE} - 0.3V$) to ($V_{CC} + 0.3V$)
 Continuous Current from NO to COM ±50mA
 Continuous Current from NC to COM ±50mA
 Peak Current from NO to COM ±80mA
 Peak Current from NC to COM ±80mA
 I/O Clamp Current ($V_I < 0$) -30mA
 Junction Temperature +150°C
 Storage Temperature Range -65°C to +150°C
 Lead Temperature (Soldering, 10s) +260°C
 ESD Susceptibility
 HBM 7000V
 MM 300V
 CDM 1000V

NOTE:

1. Signals on NC, NO, or COM exceeding V_{CC} will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

RECOMMENDED OPERATING CONDITIONS

Dual Supply Range ±2.7V to ±12V
 Single Supply Range 2.7V to 24V
 Operating Temperature Range -40°C to +85°C

OVERSTRESS CAUTION

Stresses beyond those listed may cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational section of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

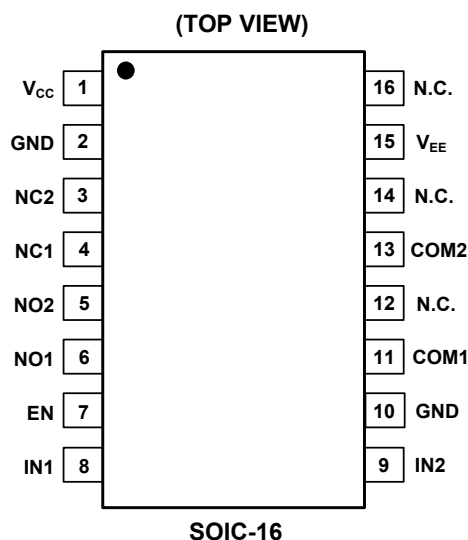
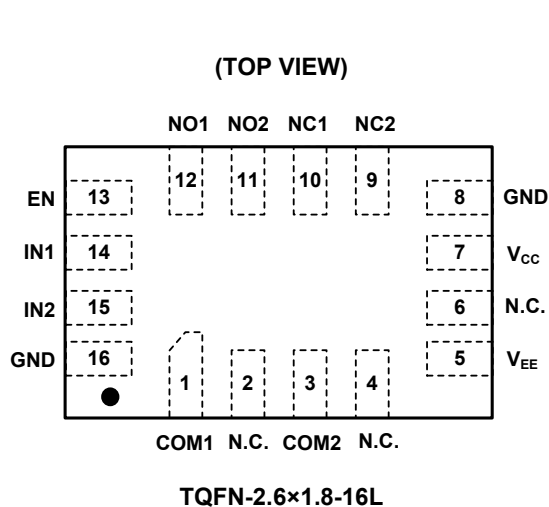
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time.

PIN CONFIGURATIONS



PIN DESCRIPTION

PIN		NAME	FUNCTION
TQFN-2.6×1.8-16L	SOIC-16		
1	11	COM1	Common Terminal.
2, 4, 6	12, 14, 16	N.C.	No Connection.
3	13	COM2	Common Terminal.
5	15	V _{EE}	The Low Side Power Supply of the SGM4516. Connect it to negative power supply for dual power supply application or connect it to GND for single power supply application.
7	1	V _{CC}	Power Supply.
8, 16	2, 10	GND	Ground.
9	3	NC2	Normally-Closed Terminal.
10	4	NC1	Normally-Closed Terminal.
11	5	NO2	Normally-Open Terminal.
12	6	NO1	Normally-Open Terminal.
13	7	EN	Enable Control. When EN = "Low", both NC and NO will be disconnected with COM, and the SGM4516 will be in shutdown state. When EN = "High", the SGM4516 will be in working state, and NC or NO will be connected with COM depending on the logical state of IN.
14	8	IN1	Digital Control Pin to Connect the COM Terminal to the NO or NC Terminal.
15	9	IN2	Digital Control Pin to Connect the COM Terminal to the NO or NC Terminal.

NOTE: NO, NC and COM terminals may be an input or output.

FUNCTION TABLE

Table 1. Function Table of Switch 1:

EN	IN1	COM1
0	X	COM1 is disconnected with NO1 and NC1
1	0	COM1 = NC1
1	1	COM1 = NO1

Table 2. Function Table of Switch 2:

EN	IN2	COM2
0	X	COM2 is disconnected with NO2 and NC2
1	0	COM2 = NC2
1	1	COM2 = NO2

ELECTRICAL CHARACTERISTICS

(V_{CC} = 5.0V, V_{EE} = -5.0V, GND = 0V, Full = -40°C to +85°C. Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH								
Analog Signal Range	V _{NO} , V _{NC} , V _{COM}			Full	V _{EE}		V _{CC}	V
On-Resistance	R _{ON}	V _{EE} + 3V ≤ V _{NO} , V _{NC} ≤ V _{CC} - 3V, I _{COM} = -10mA, Test Circuit 1		+25°C		11	13	Ω
				Full			18	
On-Resistance Match Between Channels	ΔR _{ON}	V _{EE} + 3V ≤ V _{NO} or V _{NC} ≤ V _{CC} - 3V, I _{COM} = -10mA, Test Circuit 1		+25°C		0.3	0.6	Ω
				Full			0.65	
On-Resistance Flatness	R _{FLAT(ON)}	V _{EE} + 3V ≤ V _{NO} or V _{NC} ≤ V _{CC} - 3V, I _{COM} = -10mA, Test Circuit 1		+25°C		0.15	0.5	Ω
				Full			0.55	
Source OFF Leakage Current	I _{NC(OFF)} , I _{NO(OFF)}	V _{NO} or V _{NC} = -4.5V, 4.5V, V _{COM} = 4.5V, -4.5V		+25°C		0.01	0.4	μA
				Full			1	
Channel ON Leakage Current	I _{NC(ON)} , I _{NO(ON)} , I _{COM(ON)}	V _{NO} or V _{NC} = -4.5V, 4.5V, V _{COM} = floating, or V _{NO} or V _{NC} = floating, V _{COM} = -4.5V, 4.5V		+25°C		0.01	0.4	μA
				Full			1	
DIGITAL INPUTS								
Input High Voltage	V _{INH}			Full	1.4			V
Input Low Voltage	V _{INL}			Full			0.4	V
Pull Down Resistor	R _{PULL DOWN}			+25°C		600		kΩ
DYNAMIC CHARACTERISTICS								
Turn-On Time	t _{ON}	V _{NO} or V _{NC} = 1.0V, R _L = 50Ω, C _L = 35pF, Test Circuit 2		+25°C		200		ns
Turn-Off Time	t _{OFF}	V _{NO} or V _{NC} = 1.0V, R _L = 50Ω, C _L = 35pF, Test Circuit 2		+25°C		60		ns
Break-Before-Make Time Delay	t _D	V _{NO1} or V _{NC1} = V _{NO2} or V _{NC2} = 1.0V, R _L = 50Ω, C _L = 35pF, Test Circuit 3		+25°C		100		ns
Off Isolation	O _{ISO}	f = 1kHz, R _L = 32Ω, Signal = 0dBm, Test Circuit 4		+25°C		-130		dB
		f = 1MHz, R _L = 50Ω, C _L = 5pF, Signal = 0dBm, Test Circuit 4				-90		
Channel-to-Channel Crosstalk	X _{TALK}	f = 1kHz, R _L = 32Ω, Signal = 0dBm, Test Circuit 5		+25°C		-110		dB
		f = 1MHz, R _L = 50Ω, C _L = 5pF, Signal = 0dBm, Test Circuit 5				-75		
-3dB Bandwidth	BW	Signal = 0dBm, R _L = 50Ω, C _L = 5pF, Test Circuit 6		+25°C		300		MHz
Channel ON Capacitance	C _{ON}			+25°C		30		pF
Charge Injection	Q	V _G = GND, R _G = 0Ω, C _L = 1.0nF, Test Circuit 7		+25°C		80		pC
Total Harmonic Distortion	THD	A-Weighting, Test Circuit 8	V _{NO} , V _{NC} = 2V _{PP} , R _L = 600Ω	+25°C		-113		dB
			V _{NO} , V _{NC} = 2V _{PP} , R _L = 32Ω			-93		
			V _{NO} , V _{NC} = 1V _{PP} , R _L = 600Ω			-110		
			V _{NO} , V _{NC} = 1V _{PP} , R _L = 32Ω			-103		
			V _{NO} , V _{NC} = 0.5V _{PP} , R _L = 600Ω			-106		
			V _{NO} , V _{NC} = 0.5V _{PP} , R _L = 32Ω			-102		

ELECTRICAL CHARACTERISTICS (continued)(V_{CC} = 5.0V, V_{EE} = -5.0V, GND = 0V, Full = -40°C to +85°C. Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
POWER REQUIREMENTS							
Power Supply Current	I _{CC}	V _{IN} = 0V or 1.6V, V _{EN} = 1.6V	+25°C		70	82	μA
			Full			85	
	I _{EE}		+25°C		-40	-49	
			Full			-60	
Power Supply Current in Shutdown State	I _{CC}	V _{IN} = 0V or 1.6V, V _{EN} = 0V	+25°C		0.3	0.8	μA
			Full			1.2	

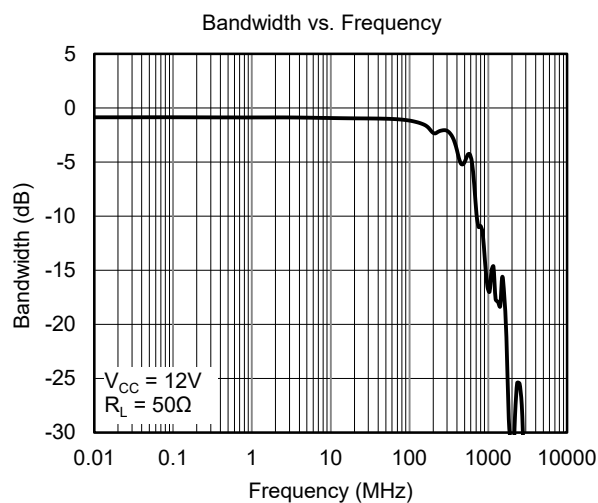
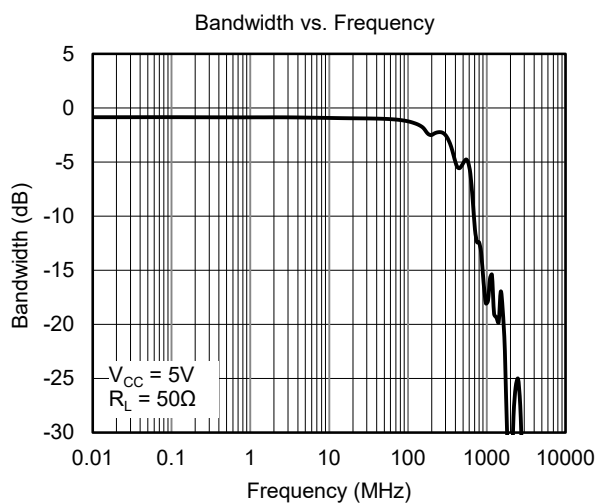
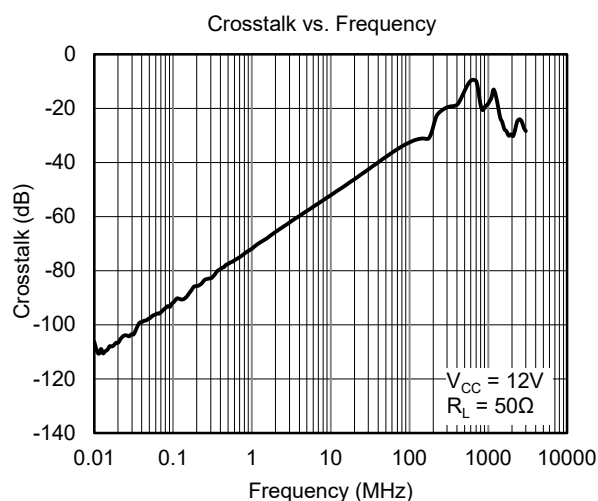
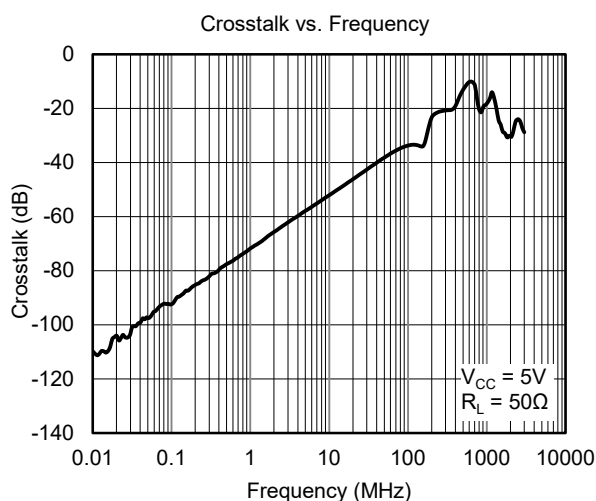
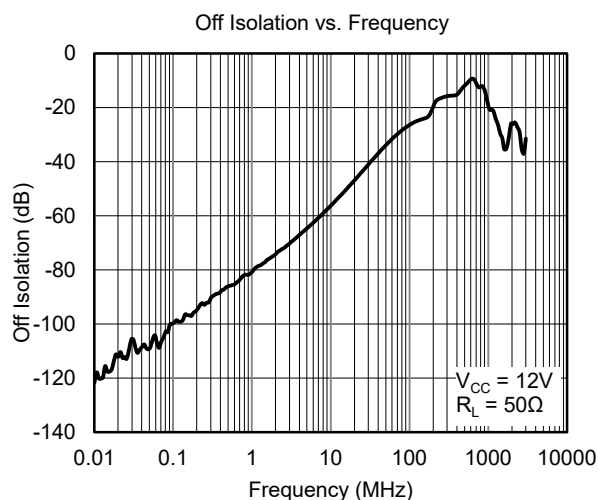
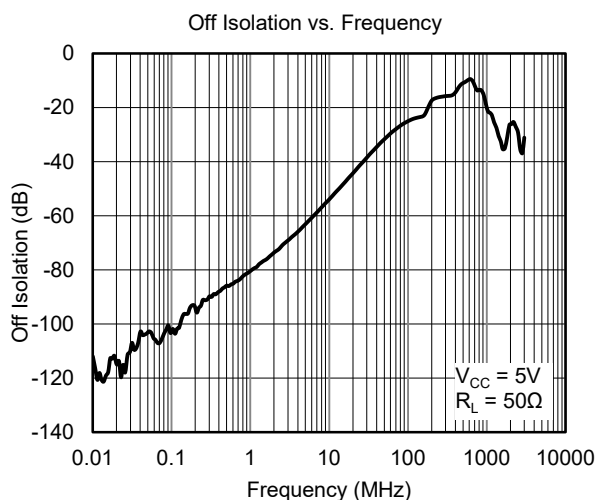
ELECTRICAL CHARACTERISTICS (continued)(V_{CC} = 12V, V_{EE} = -12V, GND = 0V, Full = -40°C to +85°C. Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V _{NO} , V _{NC} , V _{COM}		Full	V _{EE}		V _{CC}	V
On-Resistance	R _{ON}	V _{EE} + 3V ≤ V _{NO} , V _{NC} ≤ V _{CC} - 3V, I _{COM} = -10mA, Test Circuit 1	+25°C		11	13	Ω
			Full			18	
On-Resistance Match Between Channels	ΔR _{ON}	V _{EE} + 3V ≤ V _{NO} or V _{NC} ≤ V _{CC} - 3V, I _{COM} = -10mA, Test Circuit 1	+25°C		0.3	0.6	Ω
			Full			0.65	
On-Resistance Flatness	R _{FLAT(ON)}	V _{EE} + 3V ≤ V _{NO} or V _{NC} ≤ V _{CC} - 3V, I _{COM} = -10mA, Test Circuit 1	+25°C		0.15	0.5	Ω
			Full			0.55	
Source OFF Leakage Current	I _{NC(OFF)} , I _{NO(OFF)}	V _{NO} or V _{NC} = -11.5V, 11.5V, V _{COM} = 11.5V, -11.5V	+25°C		0.05	1	μA
			Full			3	
Channel ON Leakage Current	I _{NC(ON)} , I _{NO(ON)} , I _{COM(ON)}	V _{NO} or V _{NC} = -11.5V, 11.5V, V _{COM} = floating, or V _{NO} or V _{NC} = floating, V _{COM} = -11.5V, 11.5V	+25°C		0.05	1	μA
			Full			3	
DIGITAL INPUTS							
Input High Voltage	V _{INH}		Full	1.4			V
Input Low Voltage	V _{INL}		Full			0.4	V
Pull Down Resistor	R _{PULL DOWN}		+25°C		600		kΩ
DYNAMIC CHARACTERISTICS							
Turn-On Time	t _{ON}	V _{NO} or V _{NC} = 1.0V, R _L = 50Ω, C _L = 35pF, Test Circuit 2	+25°C		200		ns
Turn-Off Time	t _{OFF}	V _{NO} or V _{NC} = 1.0V, R _L = 50Ω, C _L = 35pF, Test Circuit 2	+25°C		60		ns
Break-Before-Make Time Delay	t _D	V _{NO1} or V _{NC1} = V _{NO2} or V _{NC2} = 1.0V, R _L = 50Ω, C _L = 35pF, Test Circuit 3	+25°C		100		ns
Off Isolation	O _{ISO}	f = 1kHz, R _L = 32Ω, Signal = 0dBm, Test Circuit 4	+25°C		-130		dB
		f = 1MHz, R _L = 50Ω, C _L = 5pF, Signal = 0dBm, Test Circuit 4			-90		
Channel-to-Channel Crosstalk	X _{TALK}	f = 1kHz, R _L = 32Ω, Signal = 0dBm, Test Circuit 5	+25°C		-110		dB
		f = 1MHz, R _L = 50Ω, C _L = 5pF, Signal = 0dBm, Test Circuit 5			-75		
-3dB Bandwidth	BW	Signal = 0dBm, R _L = 50Ω, C _L = 5pF, Test Circuit 6	+25°C		300		MHz
Channel ON Capacitance	C _{ON}		+25°C		30		pF
Charge Injection	Q	V _G = GND, R _G = 0Ω, C _L = 1.0nF, Test Circuit 7	+25°C		100		pC
Total Harmonic Distortion	THD	A-Weighting, Test Circuit 8	+25°C		-113		dB
					-93		
					-110		
					-103		
					-106		
					-102		

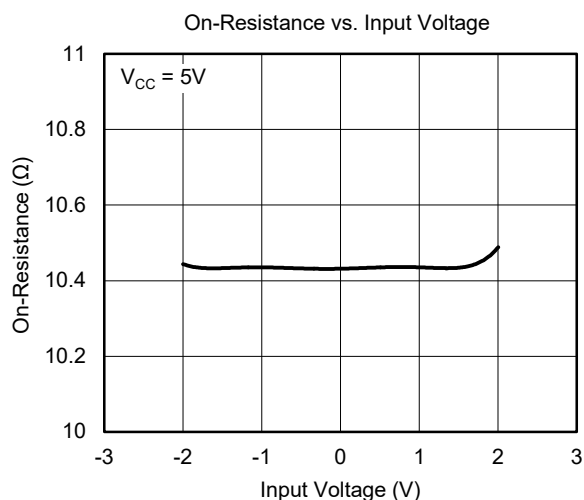
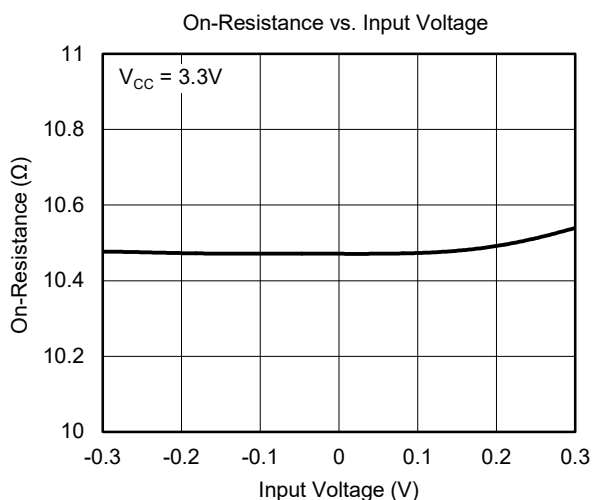
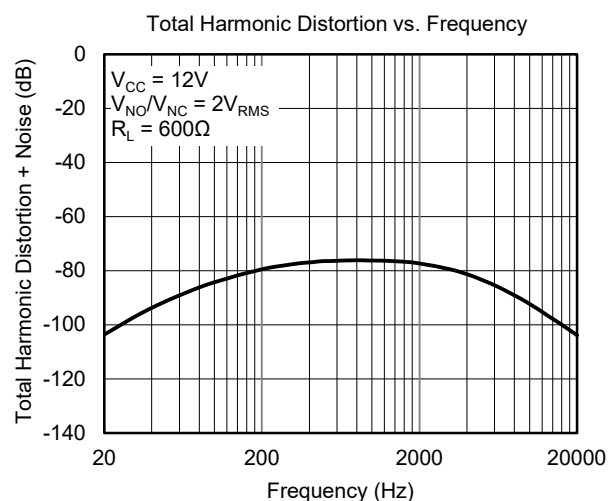
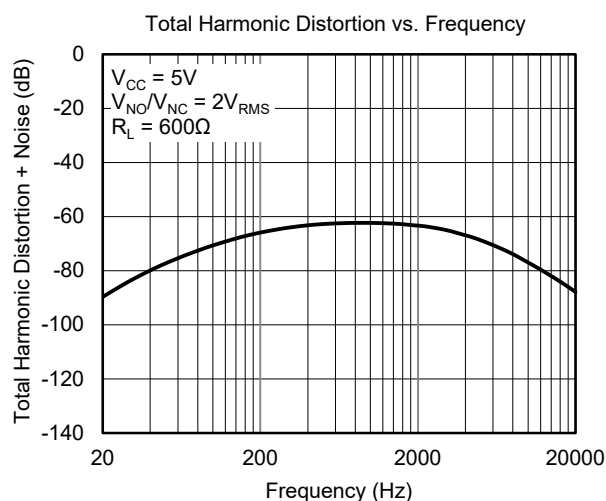
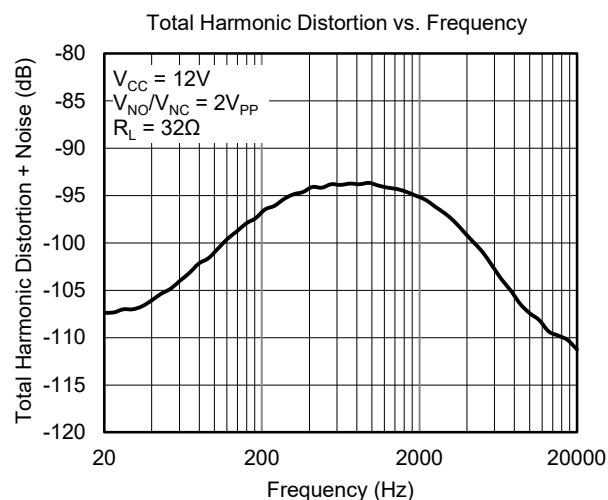
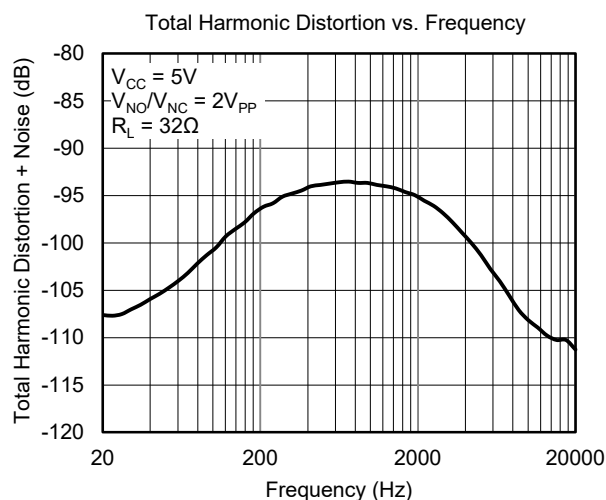
ELECTRICAL CHARACTERISTICS (continued)(V_{CC} = 12V, V_{EE} = -12V, GND = 0V, Full = -40°C to +85°C. Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
POWER REQUIREMENTS							
Power Supply Current	I _{CC}	V _{IN} = 0V or 1.6V, V _{EN} = 1.6V	+25°C		70	85	μA
			Full			90	
	I _{EE}		+25°C		-40	-49	
			Full			-60	
Power Supply Current in Shutdown State	I _{CC}	V _{IN} = 0V or 1.6V, V _{EN} = 0V	+25°C		0.5	1.2	μA
			Full			1.5	

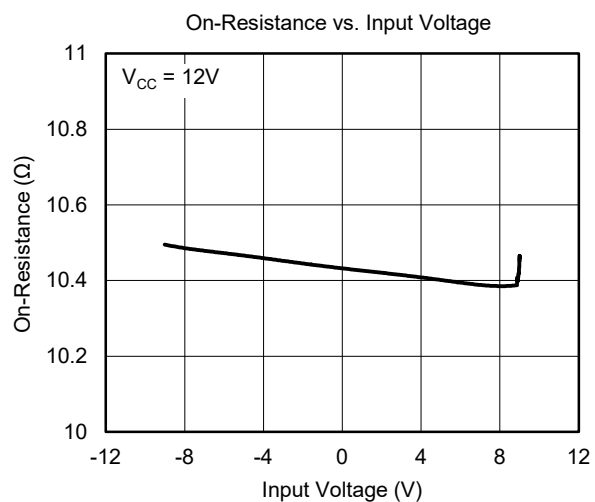
TYPICAL PERFORMANCE CHARACTERISTICS

 $T_A = +25^\circ\text{C}$, unless otherwise noted.

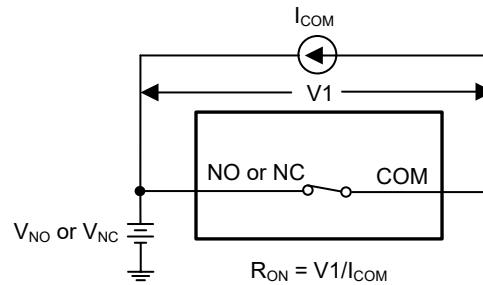
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

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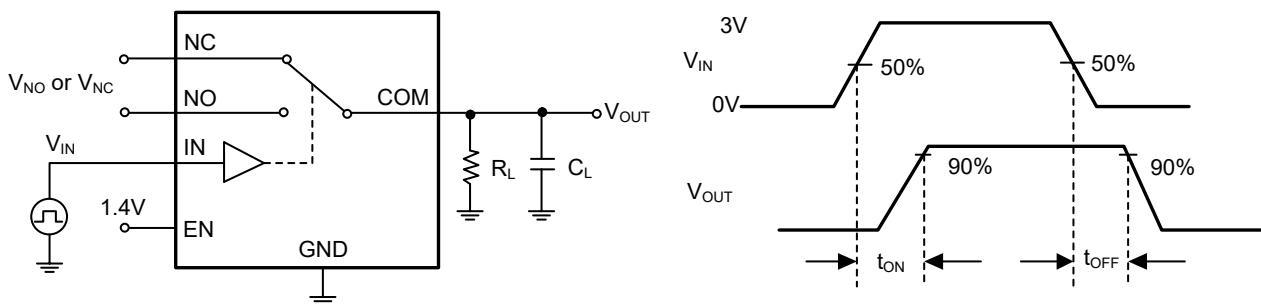
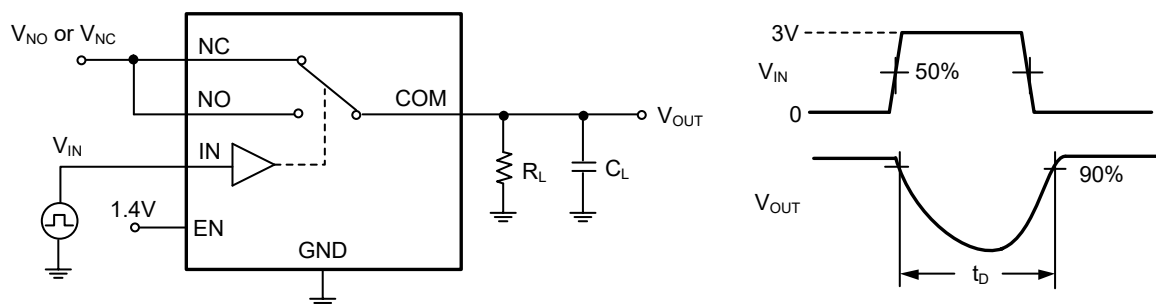
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

 $T_A = +25^\circ\text{C}$, unless otherwise noted.

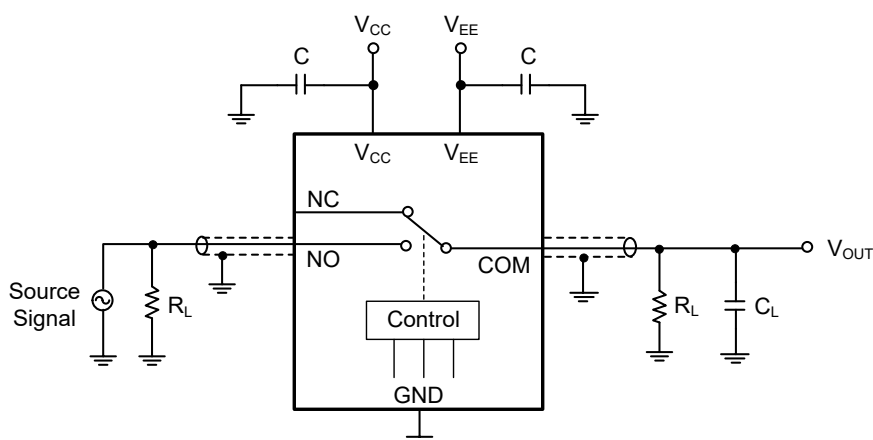
TEST CIRCUITS



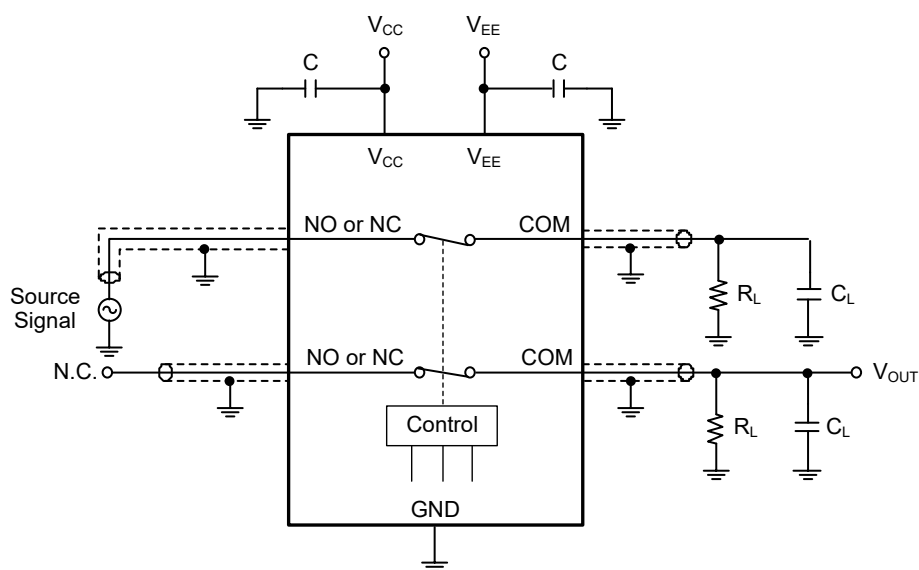
Test Circuit 1. On-Resistance

Test Circuit 2. Switching Times (t_{ON} , t_{OFF})Test Circuit 3. Break-Before-Make Time Delay (t_D)

TEST CIRCUITS (continued)



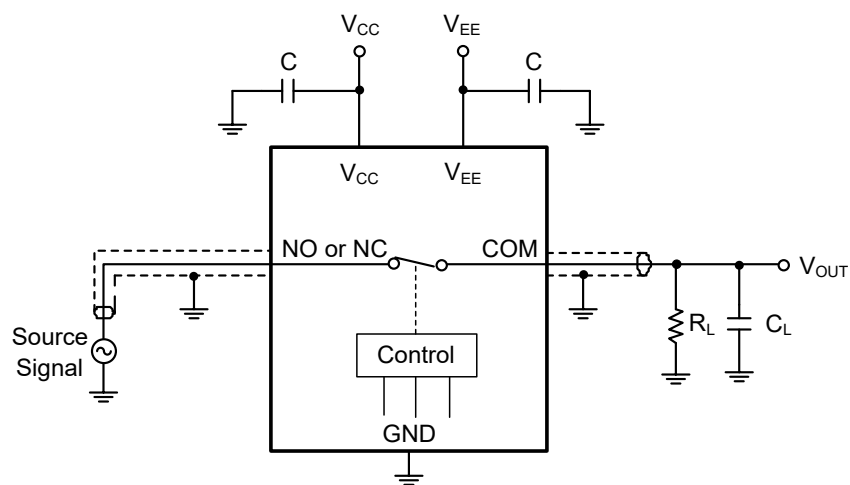
Test Circuit 4. Off Isolation



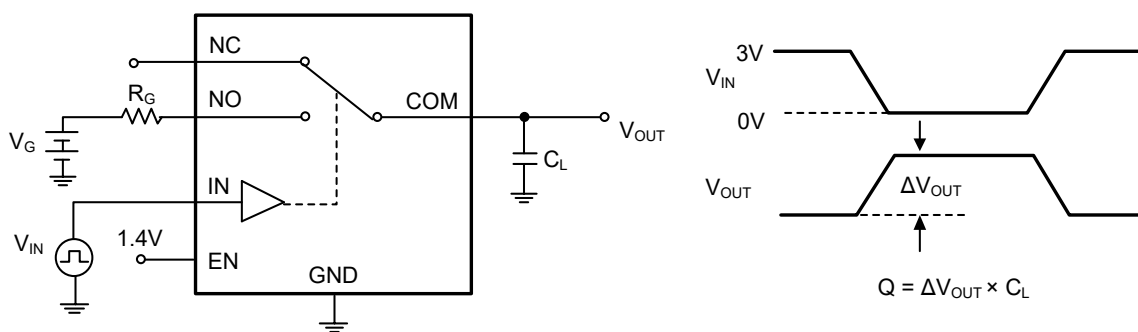
$$\text{Channel-to-Channel Crosstalk} = -20 \times \log \frac{V_{NO \text{ or } V_{NC}}}{V_{OUT}}$$

Test Circuit 5. Channel-to-Channel Crosstalk

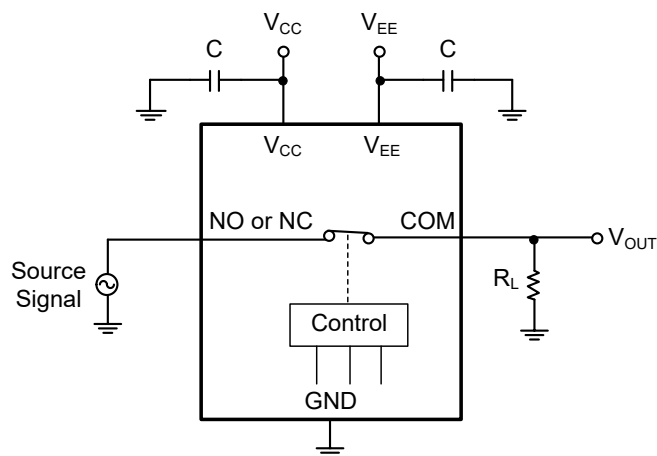
TEST CIRCUITS (continued)



Test Circuit 6. -3dB Bandwidth



Test Circuit 7. Charge Injection (Q)



Test Circuit 8. Total Harmonic Distortion (THD)

APPLICATION INFORMATION

The schematic in Figure 1 is for dual power supply application which can pass negative to positive analog signal. The schematic in Figure 2 is for single power supply application which can pass positive analog signal.

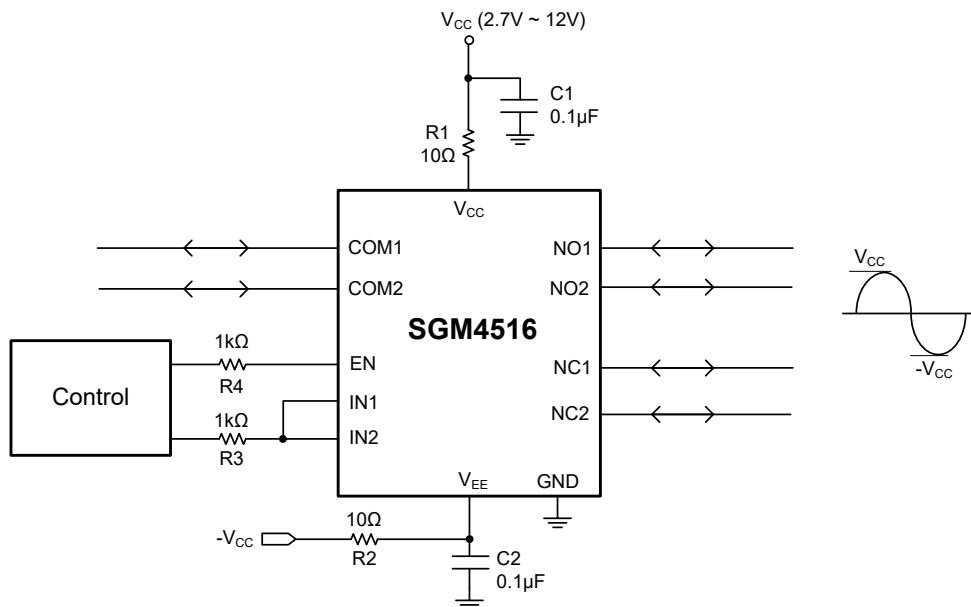


Figure 1. Application Circuit for Dual Power Supply

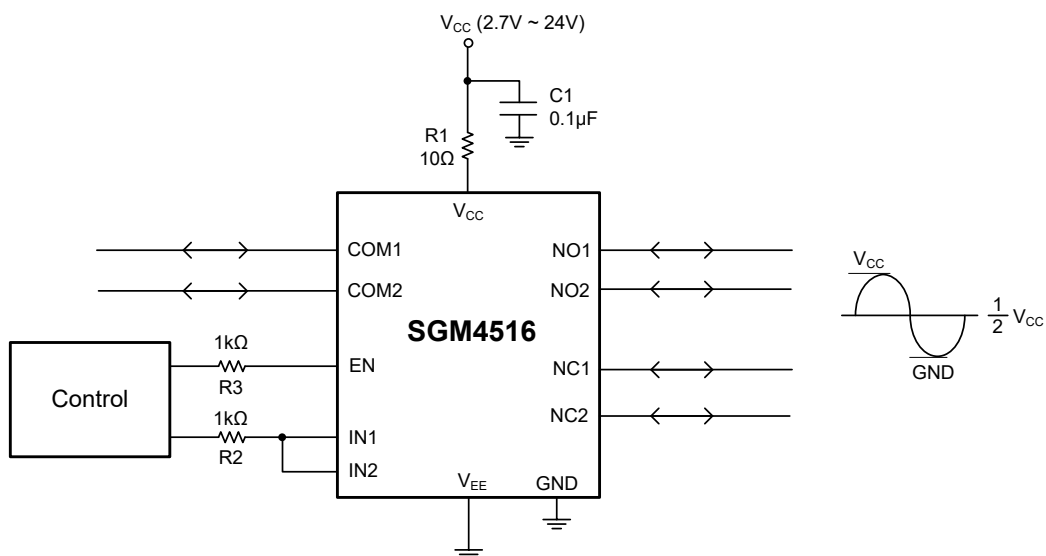


Figure 2. Application Circuit for Single Power Supply

REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DECEMBER 2017 – REV.A.1 to REV.A.2

Added Typical Performance Characteristics section	9~10
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NOVEMBER 2016 – REV.A to REV.A.1

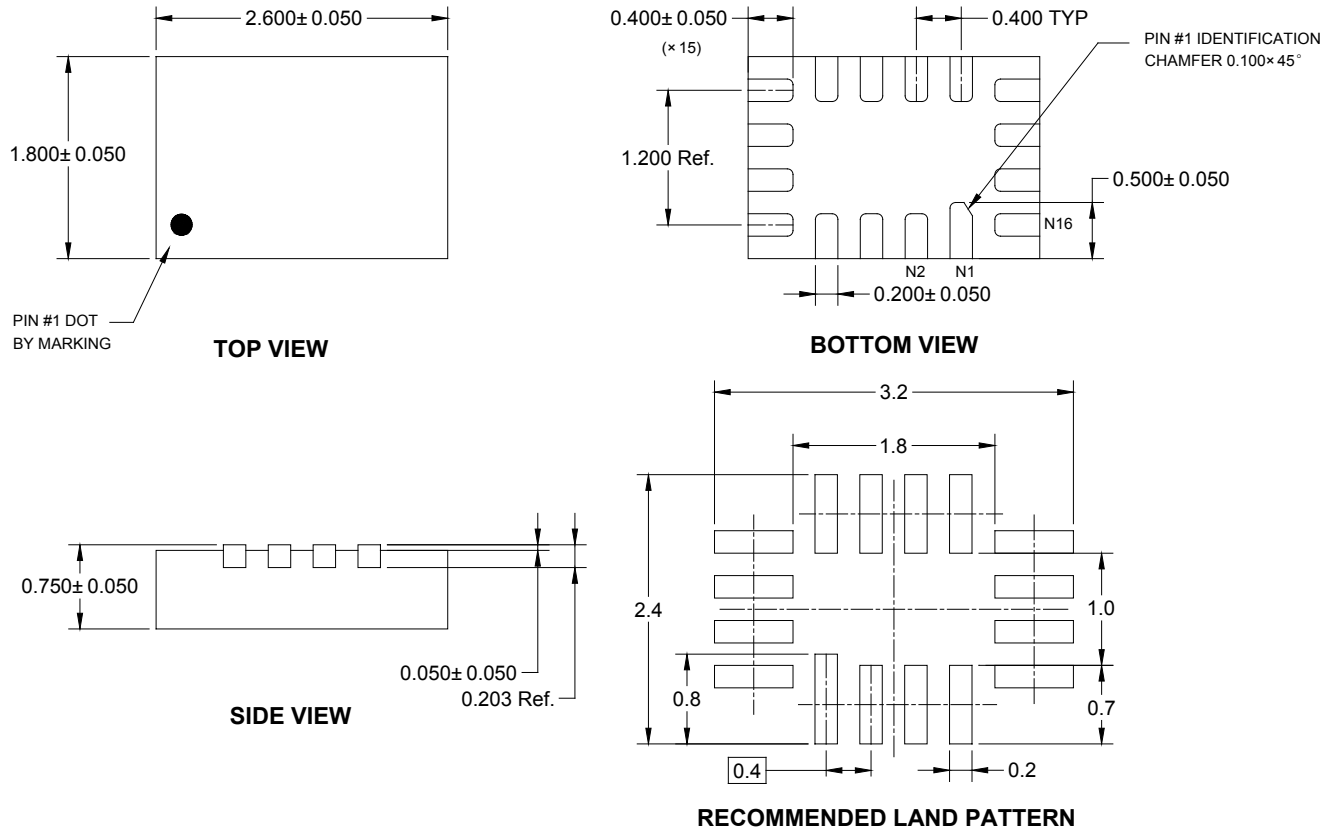
Changed Electrical Characteristics section	4~7
Changed Test Circuits section	11~12

Changes from Original (AUGUST 2016) to REV.A

Changed from product preview to production data	All
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PACKAGE OUTLINE DIMENSIONS

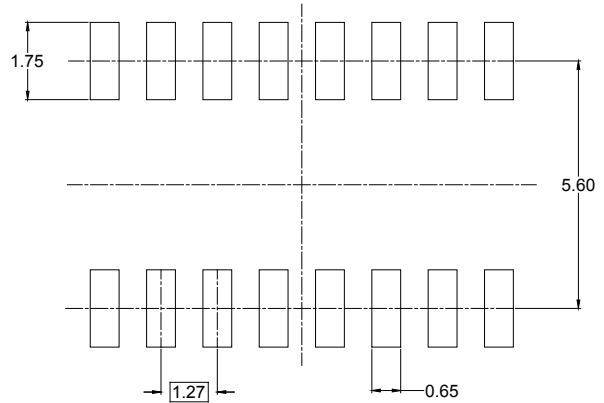
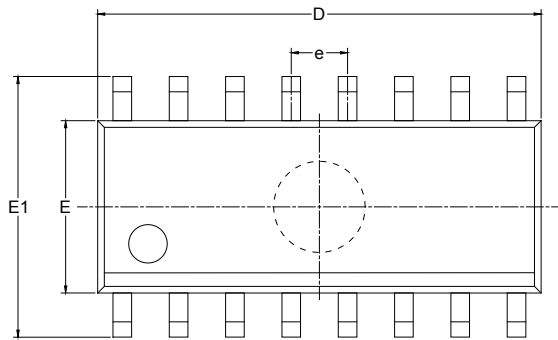
TQFN-2.6×1.8-16L



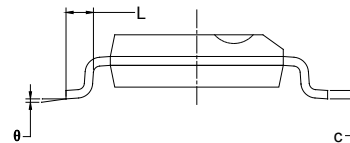
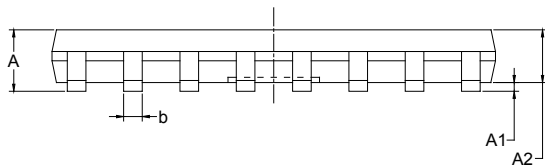
NOTE: All linear dimensions are in millimeters.

PACKAGE OUTLINE DIMENSIONS

SOIC-16



RECOMMENDED LAND PATTERN (Unit: mm)

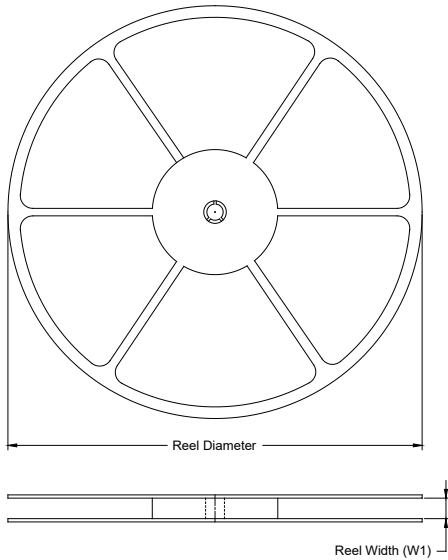


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	9.800	10.200	0.386	0.402
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

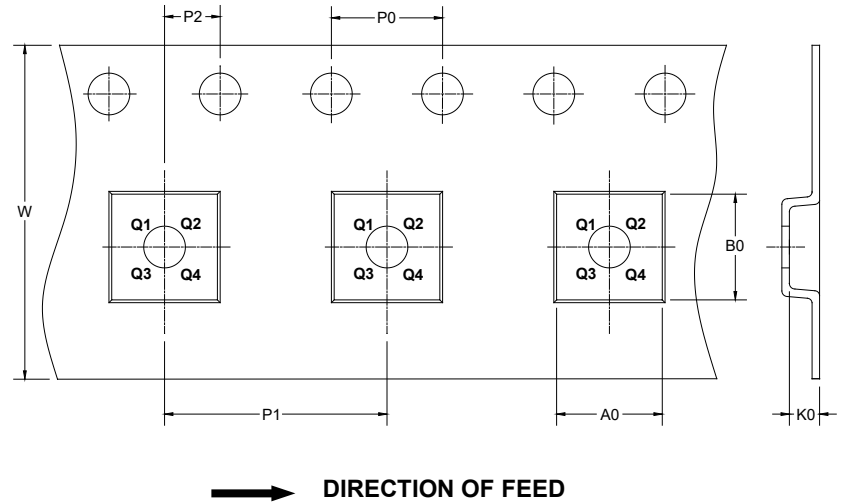
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

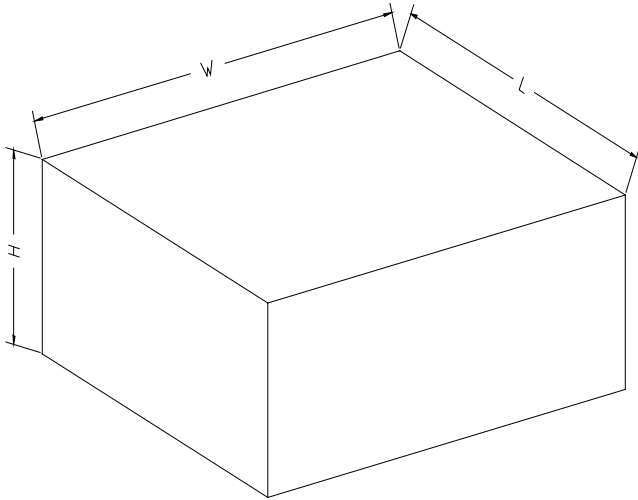
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TQFN-2.6×1.8-16L	7"	9.0	2.01	2.81	0.93	4.0	4.0	2.0	8.0	Q1
SOIC-16	13"	16.4	6.50	10.30	2.10	4.0	8.0	2.0	16.0	Q1

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PACKAGE INFORMATION

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7" (Option)	368	227	224	8
7"	442	410	224	18
13"	386	280	370	5

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