



# SGM3713

## 0.18Ω, High Voltage, Rail-to-Rail Negative Signal Passing, Dual, SPST Analog Switch

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### GENERAL DESCRIPTION

The SGM3713 is a high voltage, dual SPST (single-pole/single-throw) analog switch. It operates from a 2.7V to 9V single power supply and allows rail-to-rail negative signal passing with low distortion.

In addition, the SGM3713 can be used as a dual 2-to-1 multiplexer, two single signals or one differential signal switch and power switches because it has two single-pole/single-throw switches.

The SGM3713 features low on-resistance, high off-isolation and fast switching times. The high performances make it very suitable for multiple applications.

The SGM3713 is available in Green TQFN-3×3-16L and WLCSP-1.62×1.23-12B packages. It operates over an operating temperature range of -40°C to +85°C.

### FEATURES

- **Single Supply Voltage Range: 2.7V to 9V**
- **Ultra-Low On-Resistance: 0.18Ω (TYP)**
- **-V<sub>CC</sub> to +V<sub>CC</sub> Rail-to-Rail Low Distortion Positive and Negative Signal Passing**
- **Fast Switching Times**
- **High Off-Isolation: -125dB at 20kHz**
- **Low Crosstalk: -110dB at 20kHz**
- **Low Input Leakage Current**
- **Rail-to-Rail Input and Output Operation**
- **1.8V Logic Compatible Control Pin**
- **-40°C to +85°C Operating Temperature Range**
- **Available in Green TQFN-3×3-16L and WLCSP-1.62×1.23-12B Packages**

### APPLICATIONS

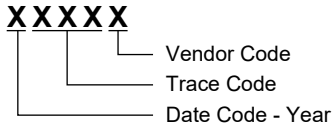
HiFi Audio Switch  
Portable Equipment  
Battery-Powered Systems

**PACKAGE/ORDERING INFORMATION**

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3713	TQFN-3x3-16L	-40°C to +85°C	SGM3713YTQ16G/TR	3713TQ XXXXX	Tape and Reel, 4000
	WLCSP-1.62x1.23-12B	-40°C to +85°C	SGM3713YG/TR	XXXXX 3713	Tape and Reel, 3000

**MARKING INFORMATION**

NOTE: XXXXX = Date Code, Trace 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<sub>CC</sub> to GND .....0V to 10V
- IN1, IN2, EN to GND .....0V to 6V
- Analog Voltage Range <sup>(1)</sup> .....(-V<sub>CC</sub> - 0.3V) to (V<sub>CC</sub> + 0.3V)
- Continuous Current from Sx to Dx .....±800mA
- Peak Current from Sx to Dx .....±1000mA
- I/O Clamp Current (V<sub>I</sub> < 0) .....-30mA
- Junction Temperature .....+150°C
- Storage Temperature Range .....-65°C to +150°C
- Lead Temperature (Soldering, 10s) .....+260°C
- ESD Susceptibility
- HBM ..... 8000V
- CDM ..... 1000V

NOTE:

1. Internal diodes will clamp voltages at Sx and Dx that exceed V<sub>CC</sub> or GND. Limit the current through the forward diode to the maximum ratings.

**RECOMMENDED OPERATING CONDITIONS**

- Supply Voltage Range .....2.7V to 9V
- Operating Temperature Range .....-40°C to +85°C

**OVERSTRESS CAUTION**

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

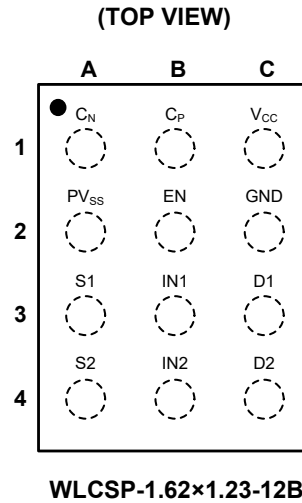
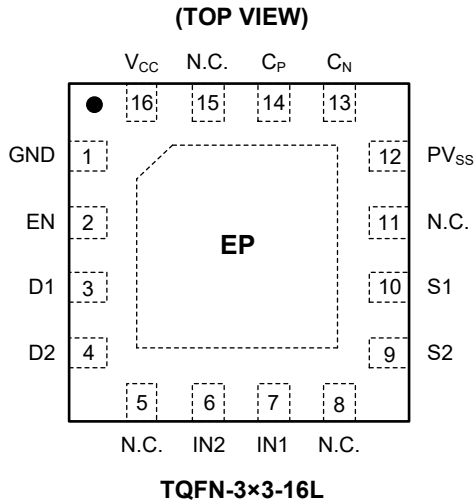
**ESD SENSITIVITY CAUTION**

This integrated circuit can be damaged if ESD protections are not considered carefully. 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 even small parametric changes could cause the device not to meet the published specifications.

**DISCLAIMER**

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATIONS



PIN DESCRIPTION

PIN		NAME	FUNCTION
TQFN-3×3-16L	WLCSP-1.62×1.23-12B		
1	C2	GND	Ground.
2	B2	EN	Enable Control Pin. When EN = "Low", both Sx and Dx are disconnected, negative charge pump does not work and the SGM3713 is in shutdown state. When EN = "High", negative charge pump works, the SGM3713 is in working state, and Sx or Dx is connected or disconnected depending on the logical state of INx.
3	C3	D1	Drain Pin 1.
4	C4	D2	Drain Pin 2.
5, 8, 11, 15	—	N.C.	No Connection.
6	B4	IN2	Digital Control Pin of Switch 2. When IN2 = "Low", switch 2 is turned off, and S2 and D2 are disconnected. When IN2 = "High", switch 2 is turned on, and S2 and D2 are connected.
7	B3	IN1	Digital Control Pin of Switch 1. When IN1 = "Low", switch 1 is turned off, and S1 and D1 are disconnected. When IN1 = "High", switch 1 is turned on, and S1 and D1 are connected.
9	A4	S2	Source Pin 2.
10	A3	S1	Source Pin 1.
12	A2	PV <sub>SS</sub>	Negative Supply Voltage Output. Connect a 0.1μF ceramic capacitor from PV <sub>SS</sub> to GND pins.
13	A1	C <sub>N</sub>	Charge Pump Flying Capacitor Negative Pin.
14	B1	C <sub>P</sub>	Charge Pump Flying Capacitor Positive Pin.
16	C1	V <sub>CC</sub>	Power Supply Pin.
Exposed Pad	—	EP	No Connection.

NOTE: S1 and D1 pins may be an input or an output of switch 1. S2 and D2 pins may be an input or an output of switch 2.

**FUNCTION TABLE**

Table 1. Function Table of Switch 1:

EN	IN1	S1 and D1	Negative Charge Pump
0	X	Disconnected	Turn off
1	0	Disconnected	Turn on
1	1	Connected (S1 = D1)	Turn on

Table 2. Function Table of Switch 2:

EN	IN2	S2 and D2	Negative Charge Pump
0	X	Disconnected	Turn off
1	0	Disconnected	Turn on
1	1	Connected (S2 = D2)	Turn on

## ELECTRICAL CHARACTERISTICS

(V<sub>CC</sub> = 5V, Full = -40°C to +85°C, typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)

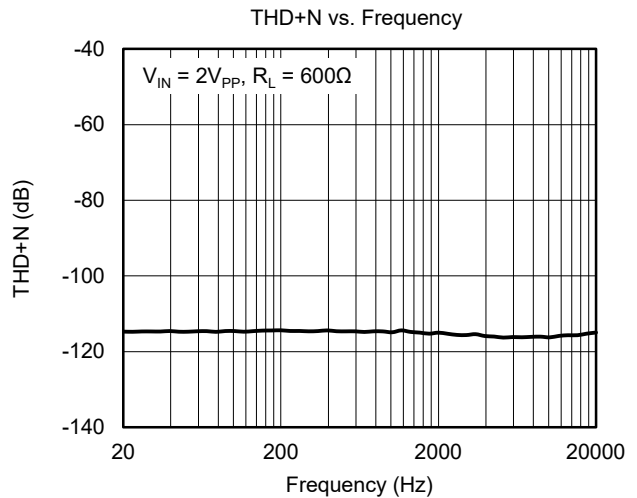
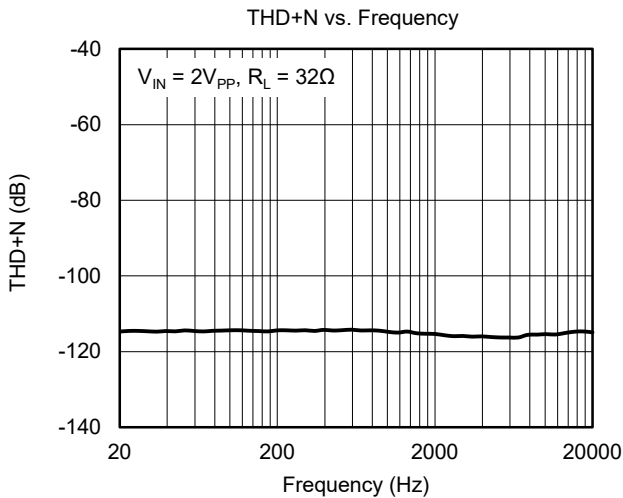
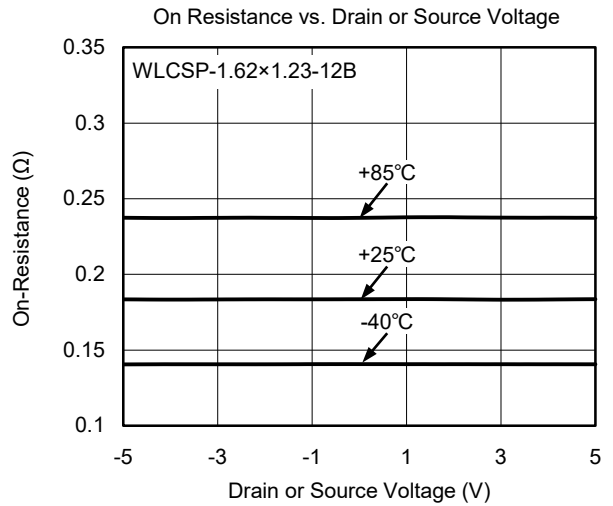
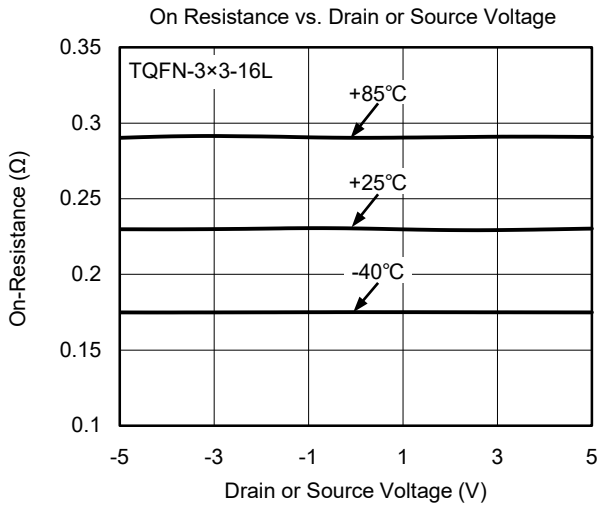
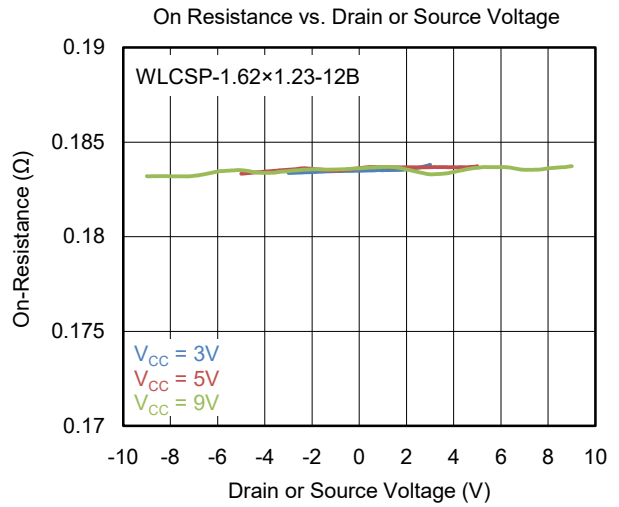
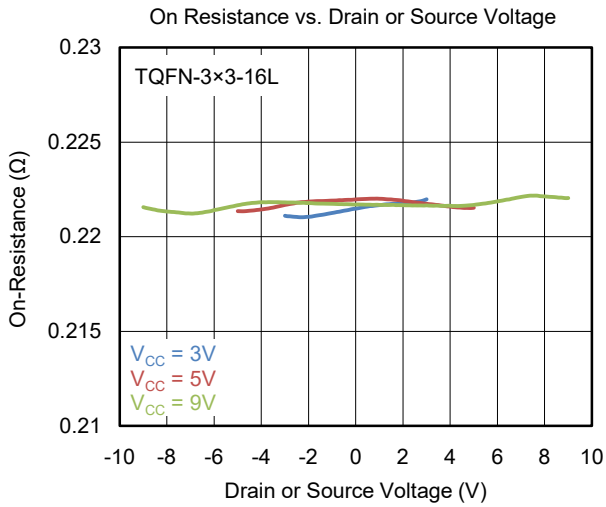
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
<b>Analog Switch</b>							
Analog Signal Range	V <sub>ANALOG</sub>		+25°C	-V <sub>CC</sub>		+V <sub>CC</sub>	V
On-Resistance	R <sub>ON</sub>	-V <sub>CC</sub> ≤ V <sub>D</sub> ≤ +V <sub>CC</sub> , I <sub>S</sub> = 200mA	TQFN-3×3-16L	Full	0.22	0.34	Ω
			WLCSP-1.62×1.23-12B	Full	0.18	0.3	
On-Resistance Match between Channels	ΔR <sub>ON</sub>	-V <sub>CC</sub> ≤ V <sub>D</sub> ≤ +V <sub>CC</sub> , I <sub>S</sub> = 200mA	Full		0.001	0.016	Ω
On-Resistance Flatness	R <sub>FLAT(ON)</sub>	-V <sub>CC</sub> ≤ V <sub>D</sub> ≤ +V <sub>CC</sub> , I <sub>S</sub> = 200mA	Full		0.001	0.005	Ω
Source Off Leakage Current	I <sub>S(OFF)</sub>	V <sub>S</sub> = -4.5V/4.5V, V <sub>D</sub> = 4.5V/-4.5V	Full		0.01	0.3	μA
Channel On Leakage Current	I <sub>S(ON)</sub> , I <sub>D(ON)</sub>	V <sub>S</sub> = -4.5V/4.5V, V <sub>D</sub> = floating, or V <sub>S</sub> = floating, V <sub>D</sub> = -4.5V/4.5V	Full		0.01	0.3	μA
<b>Digital Inputs</b>							
Input High Voltage	V <sub>INH</sub>	V <sub>CC</sub> = 2.7V to 9V	Full	1.6			V
Input Low Voltage	V <sub>INL</sub>	V <sub>CC</sub> = 2.7V to 9V	Full			0.4	V
Pull Down Resistor	R <sub>PULLDOWN</sub>		+25°C		600		kΩ
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>S</sub> = 2V, V <sub>IH</sub> = 1.6V, V <sub>IL</sub> = 0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Test Circuit 1	+25°C		175		ns
Turn-Off Time	t <sub>OFF</sub>	V <sub>S</sub> = 2V, V <sub>IH</sub> = 1.6V, V <sub>IL</sub> = 0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Test Circuit 1	+25°C		520		ns
Off-Isolation	O <sub>ISO</sub>	f = 1kHz, R <sub>L</sub> = 32Ω, Signal = 0dBm, Test Circuit 2	+25°C		-140		dB
		f = 1MHz, R <sub>L</sub> = 50Ω, Signal = 0dBm, C <sub>L</sub> = 5pF, Test Circuit 2			-72		
Channel-to-Channel Crosstalk	X <sub>TALK</sub>	f = 1kHz, R <sub>L</sub> = 32Ω, Signal = 0dBm, Test Circuit 3	+25°C		-116		dB
		f = 1MHz, R <sub>L</sub> = 50Ω, Signal = 0dBm, C <sub>L</sub> = 5pF, Test Circuit 3			-75		
-3dB Bandwidth	BW	Signal = 0dBm, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 4	+25°C		220		MHz
Channel On Capacitance	C <sub>ON</sub>		+25°C		30		pF
Charge Injection Select Input to Common I/O	Q	V <sub>G</sub> = GND, R <sub>G</sub> = 0Ω, C <sub>L</sub> = 1nF, Test Circuit 5	+25°C		320		pC
Total Harmonic Distortion + Noise	THD+N	A-Weighting, Test Circuit 6	+25°C	V <sub>S</sub> = 2V <sub>RMS</sub> , R <sub>L</sub> = 600Ω		-116	dB
				V <sub>S</sub> = 2V <sub>PP</sub> , R <sub>L</sub> = 600Ω		-114	
				V <sub>S</sub> = 2V <sub>PP</sub> , R <sub>L</sub> = 32Ω		-114	
				V <sub>S</sub> = 1V <sub>PP</sub> , R <sub>L</sub> = 600Ω		-112	
				V <sub>S</sub> = 1V <sub>PP</sub> , R <sub>L</sub> = 32Ω		-110	
Start Up Time	t <sub>START</sub>	Switch V <sub>EN</sub> = 0V to V <sub>EN</sub> = 1.6V	+25°C		350		μs
<b>Power Requirements</b>							
Power Supply Current	I <sub>CC</sub>	V <sub>IN</sub> = 0V or 1.6V, V <sub>EN</sub> = 1.6V	Full		375	480	μA
Power Supply Current in Shutdown State	I <sub>CC</sub>	V <sub>IN</sub> = 0V or 1.6V, V <sub>EN</sub> = 0V	Full		0.75	2	μA

**ELECTRICAL CHARACTERISTICS (continued)**(V<sub>CC</sub> = 9V, Full = -40°C to +85°C, typical values are at T<sub>A</sub> = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
<b>Analog Switch</b>							
Analog Signal Range	V <sub>ANALOG</sub>		+25°C	-V <sub>CC</sub>		+V <sub>CC</sub>	V
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On-Resistance Match between Channels	ΔR <sub>ON</sub>	-V <sub>CC</sub> ≤ V <sub>D</sub> ≤ +V <sub>CC</sub> , I <sub>S</sub> = 200mA	Full		0.001	0.016	Ω
On-Resistance Flatness	R <sub>FLAT(ON)</sub>	-V <sub>CC</sub> ≤ V <sub>D</sub> ≤ +V <sub>CC</sub> , I <sub>S</sub> = 200mA	Full		0.001	0.005	Ω
Source Off Leakage Current	I <sub>S(OFF)</sub>	V <sub>S</sub> = -8.5V/8.5V, V <sub>D</sub> = 8.5V/-8.5V	Full		0.01	0.3	μA
Channel On Leakage Current	I <sub>S(ON)</sub> , I <sub>D(ON)</sub>	V <sub>S</sub> = -8.5V/8.5V, V <sub>D</sub> = floating, or V <sub>S</sub> = floating, V <sub>D</sub> = -8.5V/8.5V	Full		0.01	0.3	μA
<b>Digital Inputs</b>							
Input High Voltage	V <sub>INH</sub>	V <sub>CC</sub> = 2.7V to 9V	Full	1.6			V
Input Low Voltage	V <sub>INL</sub>	V <sub>CC</sub> = 2.7V to 9V	Full			0.4	V
Pull Down Resistor	R <sub>PULLDOWN</sub>		+25°C		600		kΩ
<b>Dynamic Characteristics</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>S</sub> = 2V, V <sub>IH</sub> = 1.6V, V <sub>IL</sub> = 0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Test Circuit 1	+25°C		165		ns
Turn-Off Time	t <sub>OFF</sub>	V <sub>S</sub> = 2V, V <sub>IH</sub> = 1.6V, V <sub>IL</sub> = 0V, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 35pF, Test Circuit 1	+25°C		355		ns
Off-Isolation	O <sub>ISO</sub>	f = 1kHz, R <sub>L</sub> = 32Ω, Signal = 0dBm, Test Circuit 2	+25°C		-140		dB
		f = 1MHz, R <sub>L</sub> = 50Ω, Signal = 0dBm, C <sub>L</sub> = 5pF, Test Circuit 2			-75		
Channel-to-Channel Crosstalk	X <sub>TALK</sub>	f = 1kHz, R <sub>L</sub> = 32Ω, Signal = 0dBm, Test Circuit 3	+25°C		-116		dB
		f = 1MHz, R <sub>L</sub> = 50Ω, Signal = 0dBm, C <sub>L</sub> = 5pF, Test Circuit 3			-75		
-3dB Bandwidth	BW	Signal = 0dBm, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 4	+25°C		270		MHz
Channel On Capacitance	C <sub>ON</sub>		+25°C		26		pF
Charge Injection Select Input to Common I/O	Q	V <sub>G</sub> = GND, R <sub>G</sub> = 0Ω, C <sub>L</sub> = 1nF, Test Circuit 5	+25°C		460		pC
Total Harmonic Distortion + Noise	THD+N	A-Weighting, Test Circuit 6	+25°C	V <sub>S</sub> = 2V <sub>RMS</sub> , R <sub>L</sub> = 600Ω		-116	dB
				V <sub>S</sub> = 2V <sub>PP</sub> , R <sub>L</sub> = 600Ω		-114	
				V <sub>S</sub> = 2V <sub>PP</sub> , R <sub>L</sub> = 32Ω		-114	
				V <sub>S</sub> = 1V <sub>PP</sub> , R <sub>L</sub> = 600Ω		-112	
				V <sub>S</sub> = 1V <sub>PP</sub> , R <sub>L</sub> = 32Ω		-110	
Start Up Time	t <sub>START</sub>	Switch V <sub>EN</sub> = 0V to V <sub>EN</sub> = 1.6V	+25°C		350		μs
<b>Power Requirements</b>							
Power Supply Current	I <sub>CC</sub>	V <sub>IN</sub> = 0V or 1.6V, V <sub>EN</sub> = 1.6V	Full		415	520	μA
Power Supply Current in Shutdown State	I <sub>CC</sub>	V <sub>IN</sub> = 0V or 1.6V, V <sub>EN</sub> = 0V	Full		0.8	2	μA

TYPICAL PERFORMANCE CHARACTERISTICS

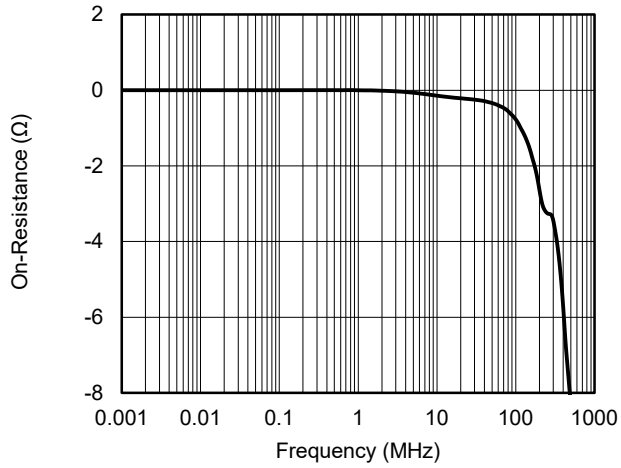
T<sub>A</sub> = +25°C, V<sub>CC</sub> = 5V, unless otherwise noted.



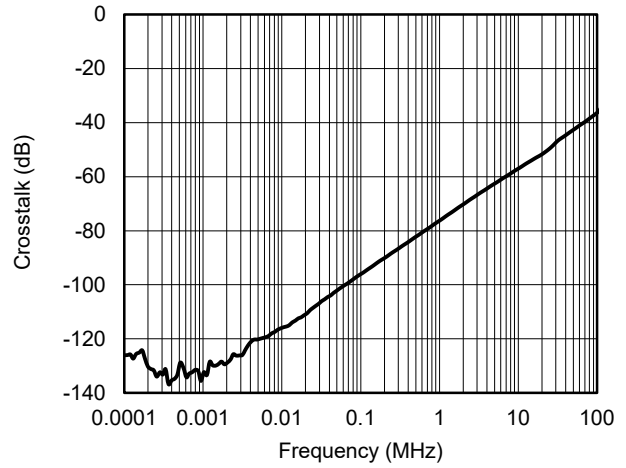
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

T<sub>A</sub> = +25°C, V<sub>CC</sub> = 5V, unless otherwise noted.

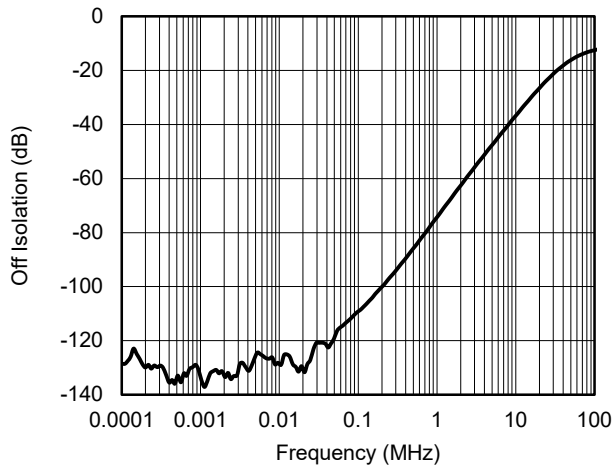
On Response vs. Frequency



Crosstalk vs. Frequency

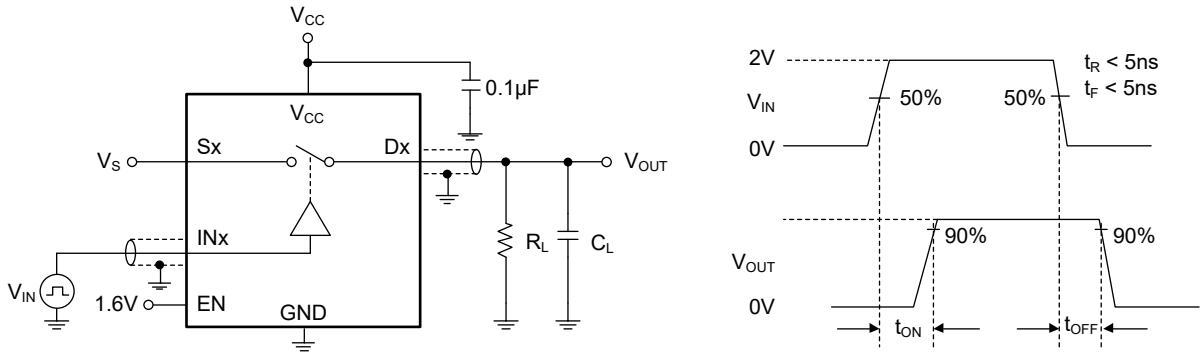


Off Isolation vs. Frequency

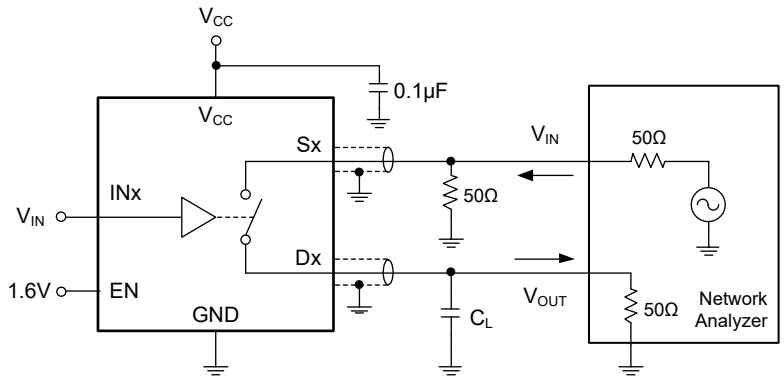




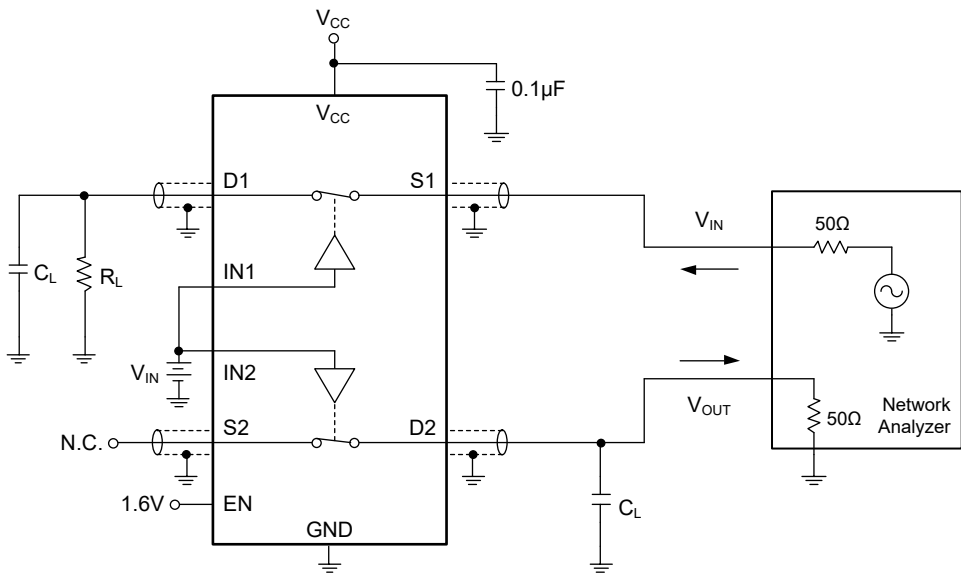
TEST CIRCUITS



Test Circuit 1. Switching Times ( $t_{ON}$ ,  $t_{OFF}$ )



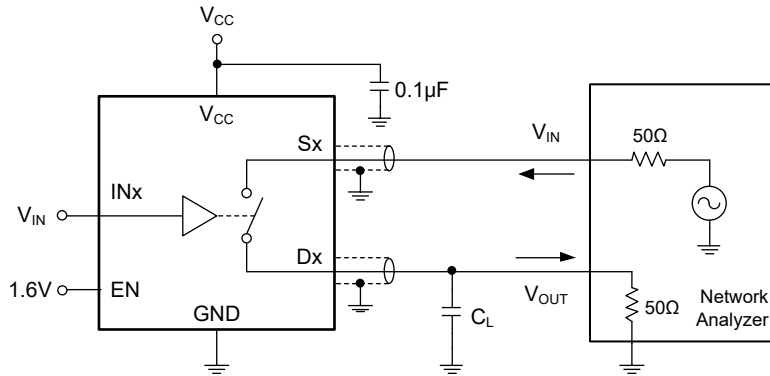
Test Circuit 2. Off-Isolation



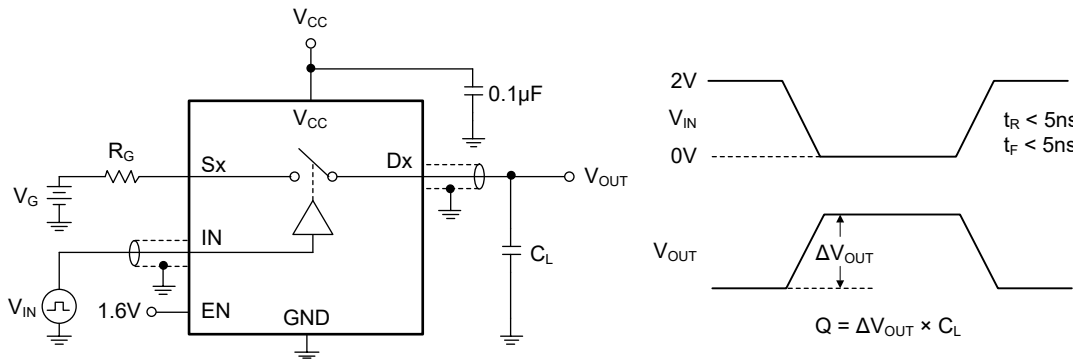
$$\text{Channel-to-Channel Crosstalk} = -20\log(V_{IN}/V_{OUT})$$

Test Circuit 3. Channel-to-Channel Crosstalk

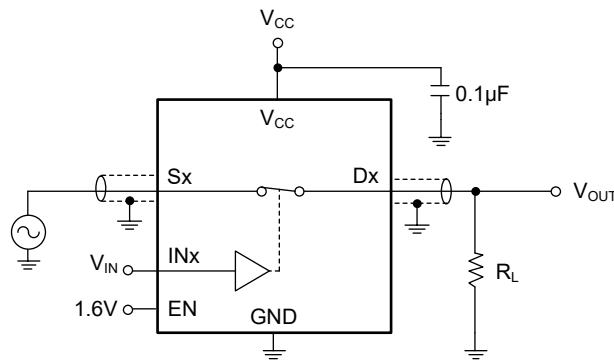
TEST CIRCUITS (continued)



Test Circuit 4. -3dB Bandwidth



Test Circuit 5. Charge Injection (Q)



Test Circuit 6. Total Harmonic Distortion + Noise (THD+N)

APPLICATION INFORMATION

The combination of Speaker and Receiver is always used in portable devices, and high voltage class D speaker driver (smart audio PA) is used to drive speaker in order to provide high audio volume. But the high output voltage of class D speaker driver will damage the receiver driver because receiver driver is designed using low voltage technology. The SGM3713

can solve this design issue by providing the safe isolation between receiver driver and high voltage class D speaker driver. The SGM3713 provides low  $R_{ON}$  channels to pass the positive and negative signals from capless receiver driver and smart audio PA. The circuit is shown in Figure 1.

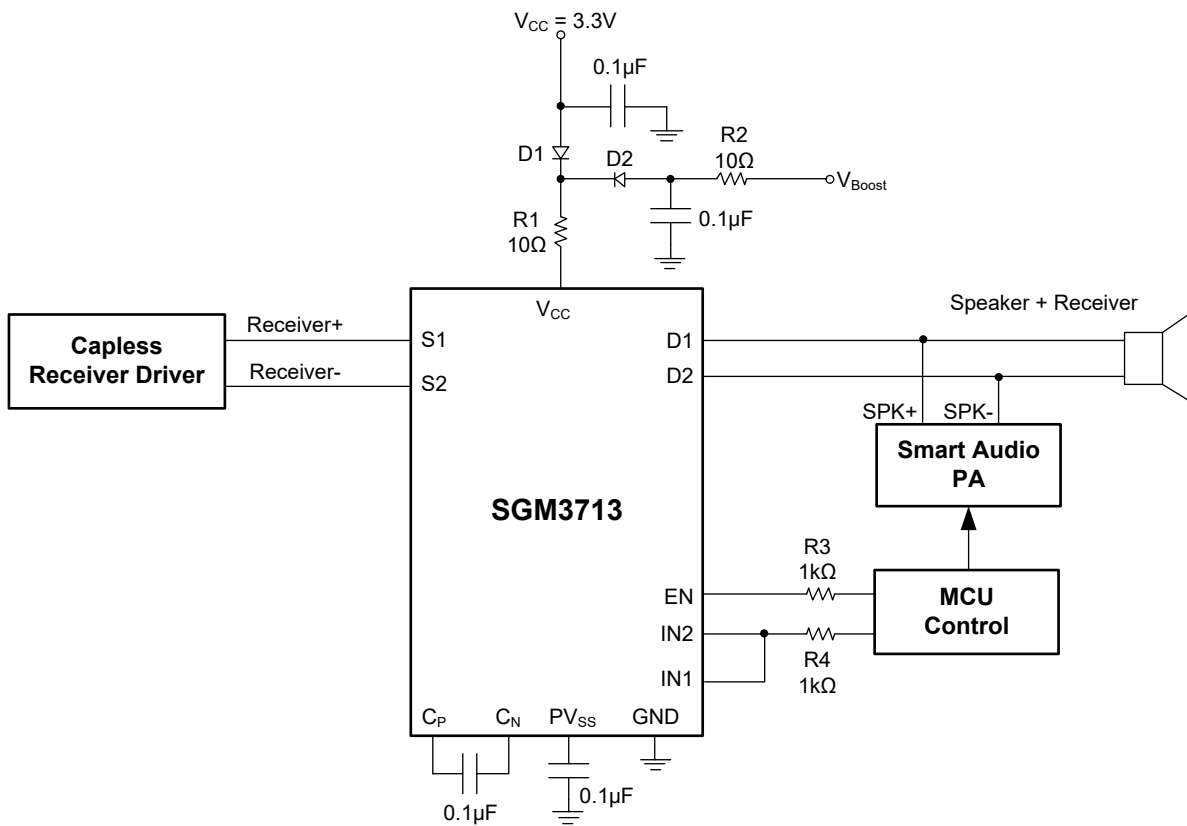


Figure 1. Typical Application Circuit for Speaker + Receiver

APPLICATION INFORMATION (continued)

In order to improve audio performance of portable devices, external speaker power amplifier is always selected to replace the internal integrated speaker power amplifier. Because the audio signal quality of audio line-out or headset driver is better than that of the integrated speaker power amplifier, the audio signal of

line-out or headset driver which is selected as the high performance audio signal source for external speaker power amplifier. High performance SGM3713 is used as the 1-to-2 HiFi signal switch in this application. The circuit is shown in Figure 2, and a stable 3.3V power supply is required in this circuit.

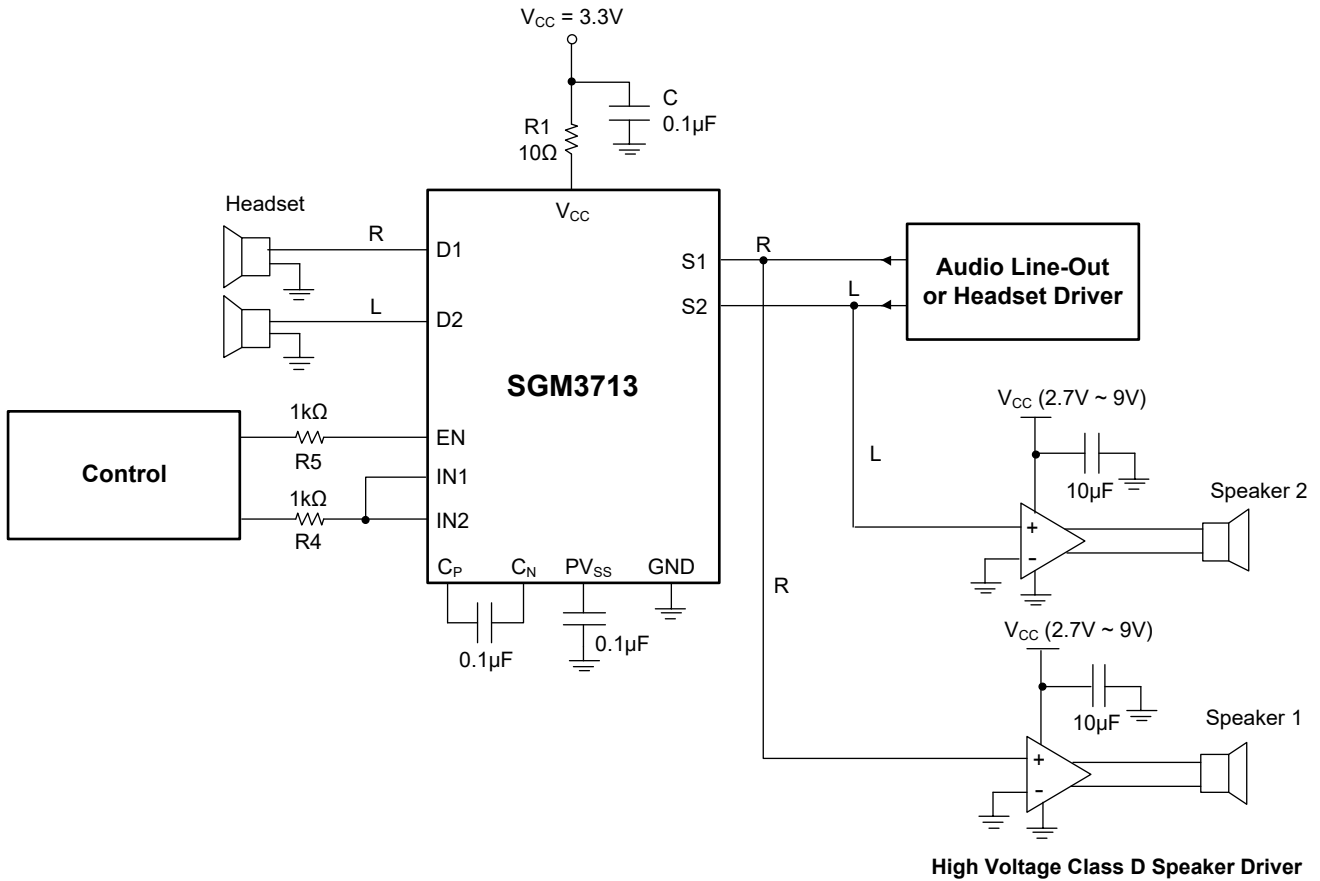


Figure 2. Typical Application Circuit for 1-to-2 HiFi Audio Signal Switch

REVISION HISTORY

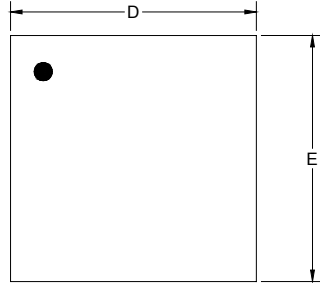
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

NOVEMBER 2020 – REV.A to REV.A.1	Page
Updated Package Outline Dimensions.....	14
Changes from Original (JULY 2020) to REV.A	Page
Changed from product preview to production data.....	All

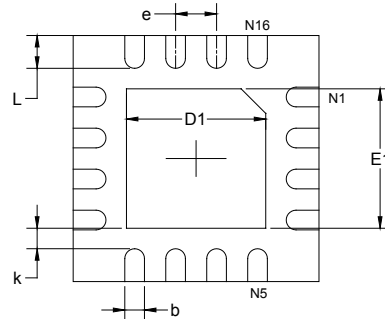
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

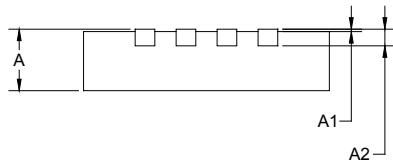
### TQFN-3×3-16L



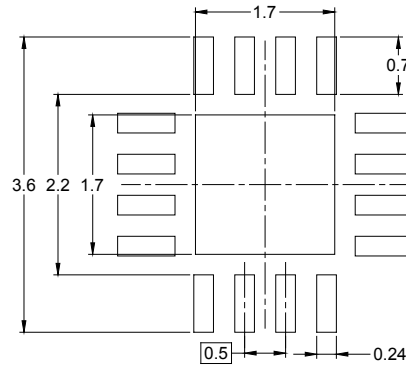
TOP VIEW



BOTTOM VIEW



SIDE VIEW

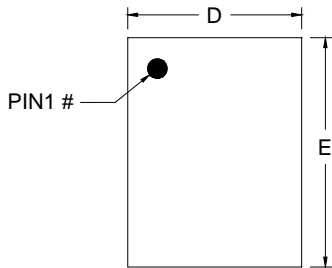


RECOMMENDED LAND PATTERN (Unit: mm)

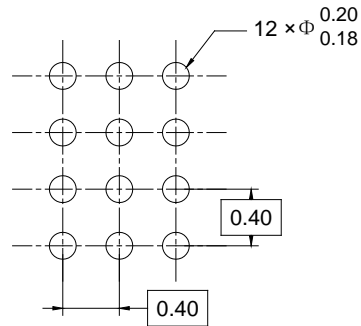
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 REF		0.008 REF	
D	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
k	0.200 MIN		0.008 MIN	
b	0.180	0.300	0.007	0.012
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

PACKAGE OUTLINE DIMENSIONS

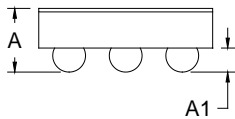
WLCSP-1.62x1.23-12B



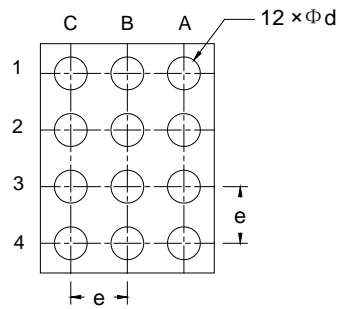
TOP VIEW



RECOMMENDED LAND PATTERN (Unit: mm)



SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	0.400	0.450	0.500
A1	0.150	0.170	0.190
D	1.215	1.230	1.245
E	1.605	1.620	1.635
d	0.212	0.232	0.252
e	0.400 BSC		

NOTE: This drawing is subject to change without notice.

# 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-3×3-16L	13"	12.4	3.35	3.35	1.13	4.0	8.0	2.0	12.0	Q2
WLCSP-1.62×1.23-12B	7"	9.0	1.35	1.75	0.70	4.0	4.0	2.0	8.0	Q1

DD0001

# 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

DD0002