SGM3715
0.8Ω, High Voltage, Rail-to-Rail Negative Signal Passing, Dual, SPDT Analog Switch

GENERAL DESCRIPTION

The SGM3715 is a high voltage, $-V_{CC}$ to $+V_{CC}$ wide range positive and negative signal passing dual single-pole/double-throw (SPDT) analog switch that is designed to operate from a single 2.7V to 12V power supply. Targeted applications include battery powered equipment that benefit from the SGM3715's low 0.8Ω (TYP) on-resistance for dual NO to COM switches and dual NC to COM switches and fast switching speeds.

The SGM3715 has excellent on-resistance matching (0.01Ω TYP) between switches and guarantees excellent on-resistance flatness over all signal range. This ensures excellent linearity and low distortion when switching audio signals.

The SGM3715 is a committed dual single-pole/double-throw (SPDT) 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 SGM3715 can pass $-V_{CC}$ to $+V_{CC}$ wide range positive and negative signals with very low distortion.

The SGM3715 is available in Green WLCSP-1.27×2.13-15B package. It operates over an ambient temperature range of -40℃ to +85℃.

FEATURES

- **Wide Voltage Operation: 2.7V to 12V**
- **On-Resistance for Switches: 0.8Ω (TYP)**
- **$-V_{CC}$ to $+V_{CC}$ Rail-to-Rail Low Distortion Positive and Negative Signal Passing**
- **High Off-Isolation**
- **Very Low Crosstalk**
- **1.8V Logic Compatible Control Pin**
- **Break-Before-Make Switching**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green WLCSP-1.27×2.13-15B Package**

APPLICATIONS

Portable Instrumentation
Battery-Operated Equipment

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM3715	WLCSP-1.27×2.13-15B	-40℃ to +85℃	SGM3715YG/TR	XXXXX 3715	Tape and Reel, 3000

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 GND ..... 0V to 13.2V
IN1, IN2, EN to GND ..... 0V to 6V
Analog Voltage Range (1) ..... ($-V_{CC}$ - 0.3V) to (V_{CC} + 0.3V)
Continuous Current from NO to COM ..... ±350mA
Continuous Current from NC to COM ..... ±350mA
Peak Current from NO to COM ..... ±400mA
Peak Current from NC to COM ..... ±400mA
I/O Clamp Current (V_I < 0) ..... -30mA
Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 8000V
MM 400V
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

Supply Voltage Range ..... 2.7V to 12V
Operating Temperature Range ..... -40℃ to +85℃

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

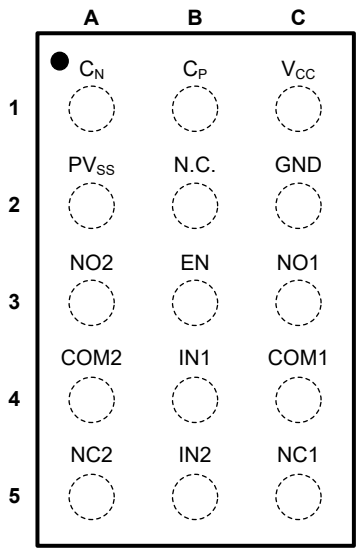
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance 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 CONFIGURATION

(TOP VIEW)



WLCSP-1.27×2.13-15B

PIN DESCRIPTION

PIN	NAME	FUNCTION
A1	C_N	Charge Pump Flying Capacitor Negative Terminal.
B1	C_P	Charge Pump Flying Capacitor Positive Terminal.
C1	V_{CC}	Power Supply.
A2	PV_{SS}	Negative Supply Voltage Output. Connect one 0.1μF ceramic capacitor from PV_{SS} to GND.
B2	N.C.	No Connection.
C2	GND	Ground.
A3	NO2	Normally-Open Terminal.
B3	EN	Enable Control. When EN = “Low”, both NC and NO will be disconnected with COM, negative charge pump doesn’t work and the SGM3715 will be in shutdown state. When EN = “High”, negative charge pump will work, the SGM3715 will be in working state, and NC or NO will be connected with COM depending on the logical state of IN.
C3	NO1	Normally-Open Terminal.
A4	COM2	Common Terminal.
B4	IN1	Digital Control Pin to Connect the COM Terminal to the NO or NC Terminal.
C4	COM1	Common Terminal.
A5	NC2	Normally-Closed Terminal.
B5	IN2	Digital Control Pin to Connect the COM Terminal to the NO or NC Terminal.
C5	NC1	Normally-Closed 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	NEGATIVE CHARGE PUMP
0	X	COM1 is disconnected with NO1 and NC1	Turn off
1	0	COM1 = NC1	Turn on
1	1	COM1 = NO1	Turn on

Table 2. Function Table of Switch 2:

EN	IN2	COM2	NEGATIVE CHARGE PUMP
0	X	COM2 is disconnected with NO2 and NC2	Turn off
1	0	COM2 = NC2	Turn on
1	1	COM2 = NO2	Turn on

ELECTRICAL CHARACTERISTICS

(V_{CC} = 3.3V, Full = -40℃ to +85℃. Typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}		Full	$-V_{CC}$		$+V_{CC}$	V
On-Resistance	R_{ON}	$-V_{CC} \le V_{NO}$, $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.8	1.1	Ω
			Full			1.7	
On-Resistance Match Between Channels	ΔR_{ON}	$-V_{CC} \le V_{NO}$ or $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.01	0.15	Ω
			Full			0.25	
On-Resistance Flatness	$R_{FLAT(ON)}$	$-V_{CC} \le V_{NO}$ or $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.05	0.15	Ω
			Full			0.2	
Source Off Leakage Current	$I_{NC(OFF)}$, $I_{NO(OFF)}$	V_{NO} or V_{NC} = -2.8V, 2.8V, V_{COM} = 2.8V, -2.8V	+25℃	-0.5	0.01	0.5	μA
			Full			1	
Channel On Leakage Current	$I_{NC(ON)}$, $I_{NO(ON)}$, $I_{COM(ON)}$	V_{NO} or V_{NC} = -2.8V, 2.8V, V_{COM} = floating, or V_{NO} or V_{NC} = floating, V_{COM} = -2.8V, 2.8V	+25℃	-0.5	0.01	0.5	μA
			Full			1	
DIGITAL INPUTS							
Input High Voltage	V_{INH}	V_{CC} = 2.7V to 12V	Full	1.5		5.5	V
Input Low Voltage	V_{INL}	V_{CC} = 2.7V to 12V	Full	0		0.5	V
Pull Down Resistor	$R_{PULL\ DOWN}$		+25℃		600		kΩ
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 2	+25℃		820		μs
Turn-Off Time	t_{OFF}	V_{NO} or V_{NC} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 2	+25℃		180		μs
Break-Before-Make Time Delay	t_D	V_{NO1} or V_{NC1} = V_{NO2} or V_{NC2} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 3	+25℃		680		μs
Off Isolation	O_{ISO}	f = 1kHz, R_L = 32Ω, Signal = 0dBm, Test Circuit 4	+25℃		-130		dB
		f = 1MHz, R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 4			-50		
Channel-to-Channel Crosstalk	X_{TALK}	f = 1kHz, R_L = 32Ω, Signal = 0dBm, Test Circuit 5	+25℃		-120		dB
		f = 1MHz, R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 5			-60		
-3dB Bandwidth	BW	R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 6	+25℃		100		MHz
Channel On Capacitance	C_{ON}		+25℃		60		pF
Charge Injection	Q	V_G = GND, R_G = 0Ω, C_L = 1nF, Test Circuit 7	+25℃		1000		pC
Total Harmonic Distortion	THD	A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{RMS}$, R_L = 600Ω	+25℃		-113		dB
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{PP}$, R_L = 600Ω			-115		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{PP}$, R_L = 32Ω			-113		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $1V_{PP}$, R_L = 600Ω			-112		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $1V_{PP}$, R_L = 32Ω			-110		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $0.5V_{PP}$, R_L = 600Ω			-108		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $0.5V_{PP}$, R_L = 32Ω			-104		
Start Up Time	t_{START}	Switch V_{EN} = 0V to V_{EN} = 1.5V	+25℃		0.5		ms

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = 5V, Full = -40℃ to +85℃. Typical values are at T_A = +25℃, unless otherwise noted.)

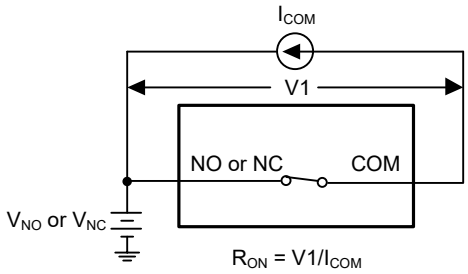
PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}		Full	$-V_{CC}$		$+V_{CC}$	V
On-Resistance	R_{ON}	$-V_{CC} \le V_{NO}$, $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.8	1.1	Ω
			Full			1.7	
On-Resistance Match Between Channels	ΔR_{ON}	$-V_{CC} \le V_{NO}$ or $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.01	0.15	Ω
			Full			0.25	
On-Resistance Flatness	$R_{FLAT(ON)}$	$-V_{CC} \le V_{NO}$ or $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.01	0.15	Ω
			Full			0.2	
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℃	-0.5	0.01	0.5	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℃	-0.5	0.01	0.5	μA
			Full			1	
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 2	+25℃		880		μs
Turn-Off Time	t_{OFF}	V_{NO} or V_{NC} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 2	+25℃		190		μs
Break-Before-Make Time Delay	t_D	V_{NO1} or V_{NC1} = V_{NO2} or V_{NC2} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 3	+25℃		720		μs
Off Isolation	O_{ISO}	f = 1kHz, R_L = 32Ω, Signal = 0dBm, Test Circuit 4	+25℃		-130		dB
		f = 1MHz, R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 4			-50		
Channel-to-Channel Crosstalk	X_{TALK}	f = 1kHz, R_L = 32Ω, Signal = 0dBm, Test Circuit 5	+25℃		-120		dB
		f = 1MHz, R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 5			-60		
-3dB Bandwidth	BW	R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 6	+25℃		100		MHz
Channel On Capacitance	C_{ON}		+25℃		60		pF
Charge Injection	Q	V_G = GND, R_G = 0Ω, C_L = 1nF, Test Circuit 7	+25℃		1000		pC
Total Harmonic Distortion	THD	A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{RMS}$, R_L = 600Ω	+25℃		-117		dB
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{PP}$, R_L = 600Ω			-115		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{PP}$, R_L = 32Ω			-113		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $1V_{PP}$, R_L = 600Ω			-112		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $1V_{PP}$, R_L = 32Ω			-110		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $0.5V_{PP}$, R_L = 600Ω			-108		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $0.5V_{PP}$, R_L = 32Ω			-104		
Start Up Time	t_{START}	Switch V_{EN} = 0V to V_{EN} = 1.5V	+25℃		0.5		ms
POWER REQUIREMENTS							
Power Supply Current	I_{CC}	V_{IN} = 0V or 1.5V, V_{EN} = 1.5V	+25℃		520	650	μA
			Full			680	
Power Supply Current in Shutdown State	I_{CC}	V_{IN} = 0V or 1.5V, V_{EN} = 0V	+25℃		0.4	1	μA
			Full			1.5	

ELECTRICAL CHARACTERISTICS (continued)

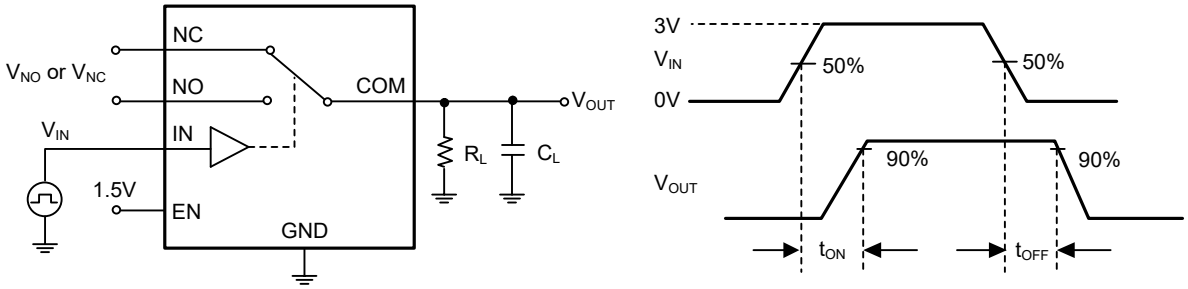
(V_{CC} = 12V, Full = -40℃ to +85℃. Typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TYP	MAX	UNITS
ANALOG SWITCH							
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}		Full	$-V_{CC}$		$+V_{CC}$	V
On-Resistance	R_{ON}	$-V_{CC} \le V_{NO}$, $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.8	1.1	Ω
			Full			1.7	
On-Resistance Match Between Channels	ΔR_{ON}	$-V_{CC} \le V_{NO}$ or $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.01	0.15	Ω
			Full			0.25	
On-Resistance Flatness	$R_{FLAT(ON)}$	$-V_{CC} \le V_{NO}$ or $V_{NC} \le V_{CC}$, I_{COM} = -50mA, Test Circuit 1	+25℃		0.01	0.15	Ω
			Full			0.2	
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℃	-1.5	0.05	1.5	μA
			Full			9	
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℃	-1.5	0.05	1.5	μA
			Full			9	
DYNAMIC CHARACTERISTICS							
Turn-On Time	t_{ON}	V_{NO} or V_{NC} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 2	+25℃		1100		μs
Turn-Off Time	t_{OFF}	V_{NO} or V_{NC} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 2	+25℃		200		μs
Break-Before-Make Time Delay	t_D	V_{NO1} or V_{NC1} = V_{NO2} or V_{NC2} = 1V, R_L = 50Ω, C_L = 35pF, Test Circuit 3	+25℃		950		μs
Off Isolation	O_{ISO}	f = 1kHz, R_L = 32Ω, Signal = 0dBm, Test Circuit 4	+25℃		-130		dB
		f = 1MHz, R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 4			-50		
Channel-to-Channel Crosstalk	X_{TALK}	f = 1kHz, R_L = 32Ω, Signal = 0dBm, Test Circuit 5	+25℃		-120		dB
		f = 1MHz, R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 5			-60		
-3dB Bandwidth	BW	R_L = 50Ω, C_L = 5pF, Signal = 0dBm, Test Circuit 6	+25℃		100		MHz
Channel On Capacitance	C_{ON}		+25℃		60		pF
Charge Injection	Q	V_G = GND, R_G = 0Ω, C_L = 1nF, Test Circuit 7	+25℃		1100		pC
Total Harmonic Distortion	THD	A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{RMS}$, R_L = 600Ω	+25℃		-117		dB
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{PP}$, R_L = 600Ω			-115		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $2V_{PP}$, R_L = 32Ω			-113		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $1V_{PP}$, R_L = 600Ω			-112		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $1V_{PP}$, R_L = 32Ω			-110		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $0.5V_{PP}$, R_L = 600Ω			-108		
		A-Weighting, Test Circuit 8; V_{NO}, V_{NC} = $0.5V_{PP}$, R_L = 32Ω			-104		
Start Up Time	t_{START}	Switch V_{EN} = 0V to V_{EN} = 1.5V	+25℃		0.5		ms
POWER REQUIREMENTS							
Power Supply Current	I_{CC}	V_{IN} = 0V or 1.5V, V_{EN} = 1.5V	+25℃		620	780	μA
			Full			800	
Power Supply Current in Shutdown State	I_{CC}	V_{IN} = 0V or 1.5V, V_{EN} = 0V	+25℃		0.5	1.5	μA
			Full			2	

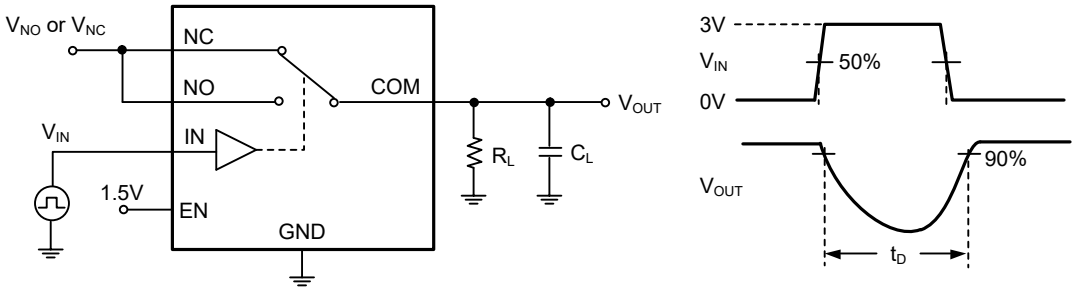
TEST CIRCUITS



Test Circuit 1. On-Resistance

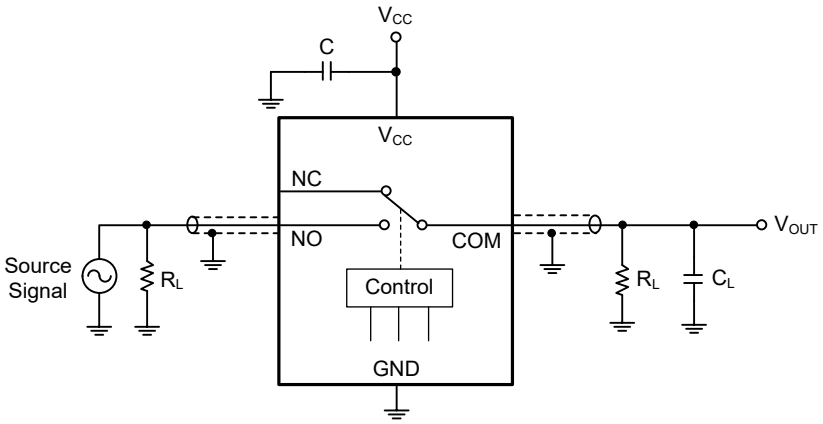


Test Circuit 2. Switching Times (t_{ON}, t_{OFF})

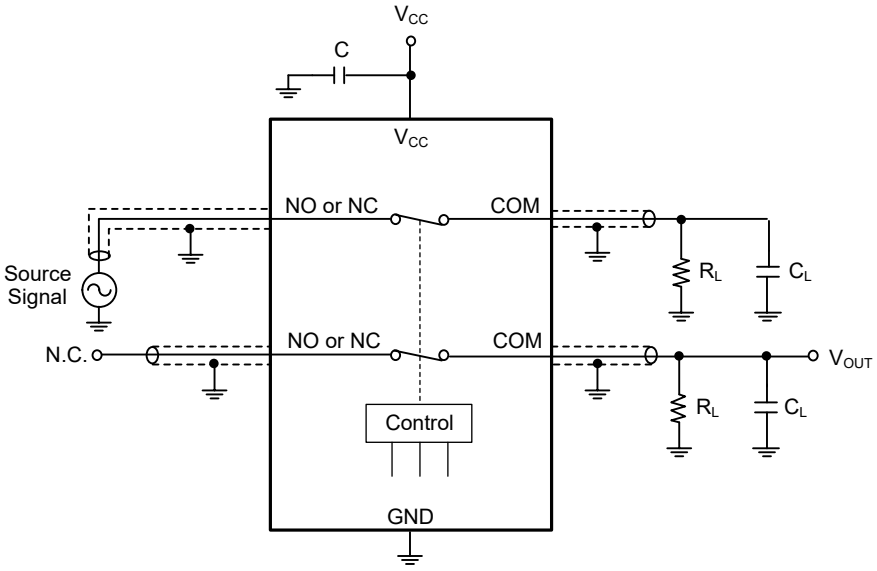


Test Circuit 3. Break-Before-Make Time Delay (t_D)

TEST CIRCUITS (continued)

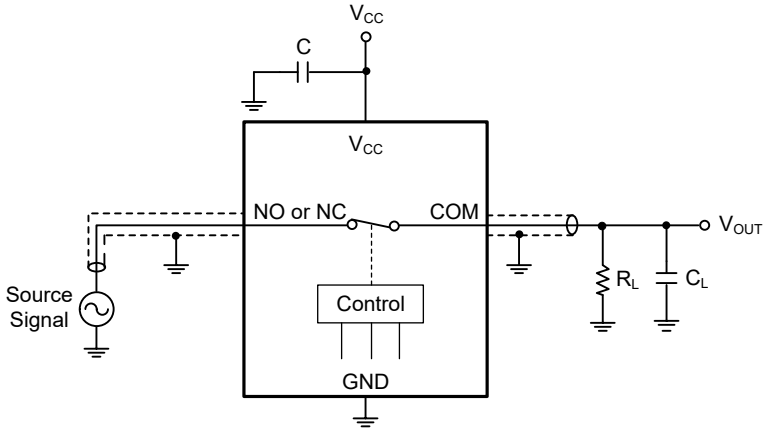


Test Circuit 4. Off Isolation



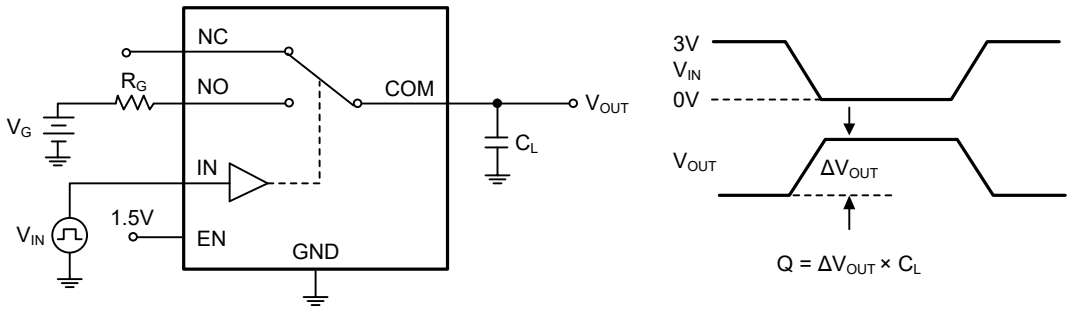
$$\text{Channel-to-Channel Crosstalk} = -20 \times \log \frac{V_{NO} \text{ or } V_{NC}}{V_{OUT}}$$

Test Circuit 5. Channel-to-Channel Crosstalk

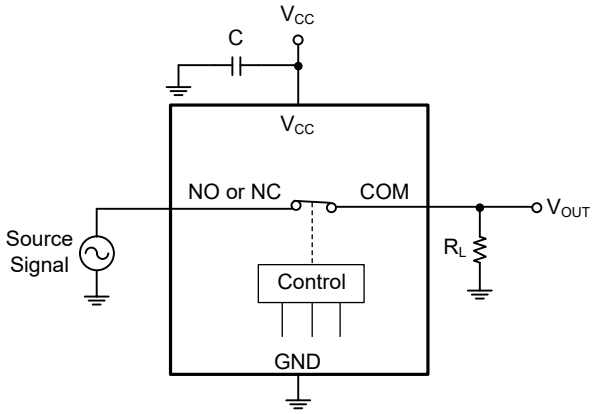


Test Circuit 6. -3dB Bandwidth

TEST CIRCUITS (continued)



Test Circuit 7. Charge Injection (Q)



Test Circuit 8. Total Harmonic Distortion (THD)

APPLICATION INFORMATION

Speaker + Receiver is always used in portable devices, and high voltage class D speaker driver 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. The SGM3715 provides the safe isolation between receiver driver and high voltage class D speaker driver. The SGM3715 provides low R_{ON} channels to pass the positive and negative signals from capless receiver driver. The circuit is shown in Figure 1.

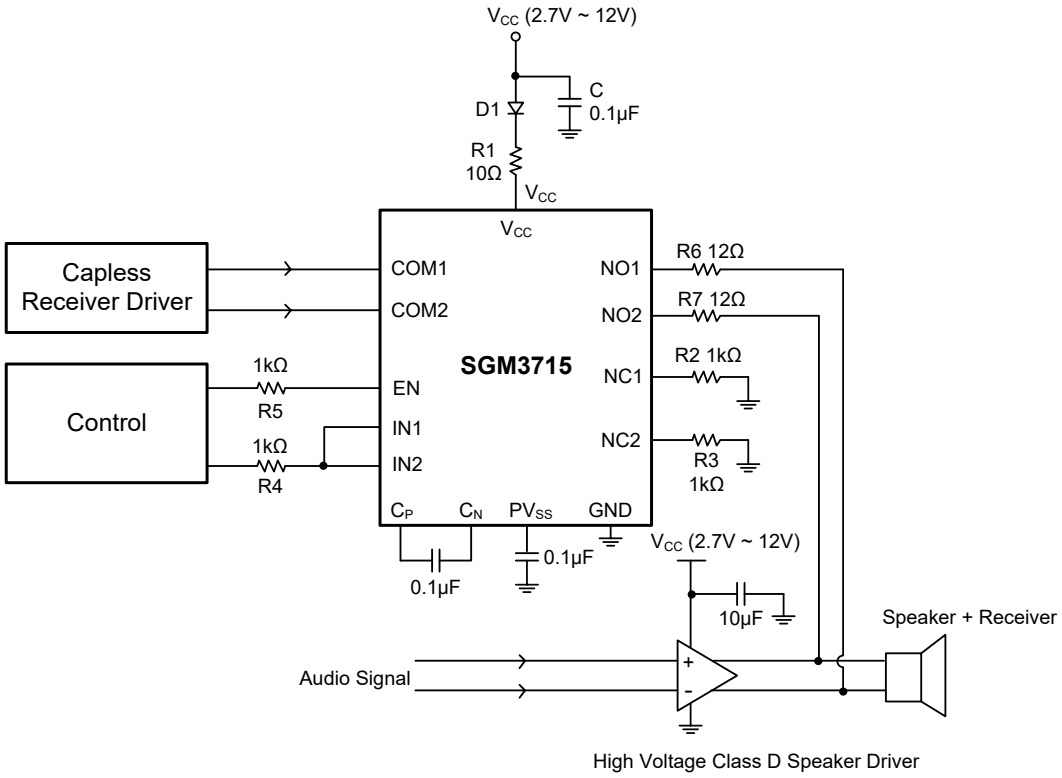


Figure 1. Typical Application Circuit for Speaker + Receiver

APPLICATION INFORMATION (continued)

In order to improve audio performance of portable equipment, 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 the integrated speaker power amplifier, the audio signal of line out or headset driver is selected as the high performance audio signal source for external speaker power amplifier. High performance SGM3715 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.

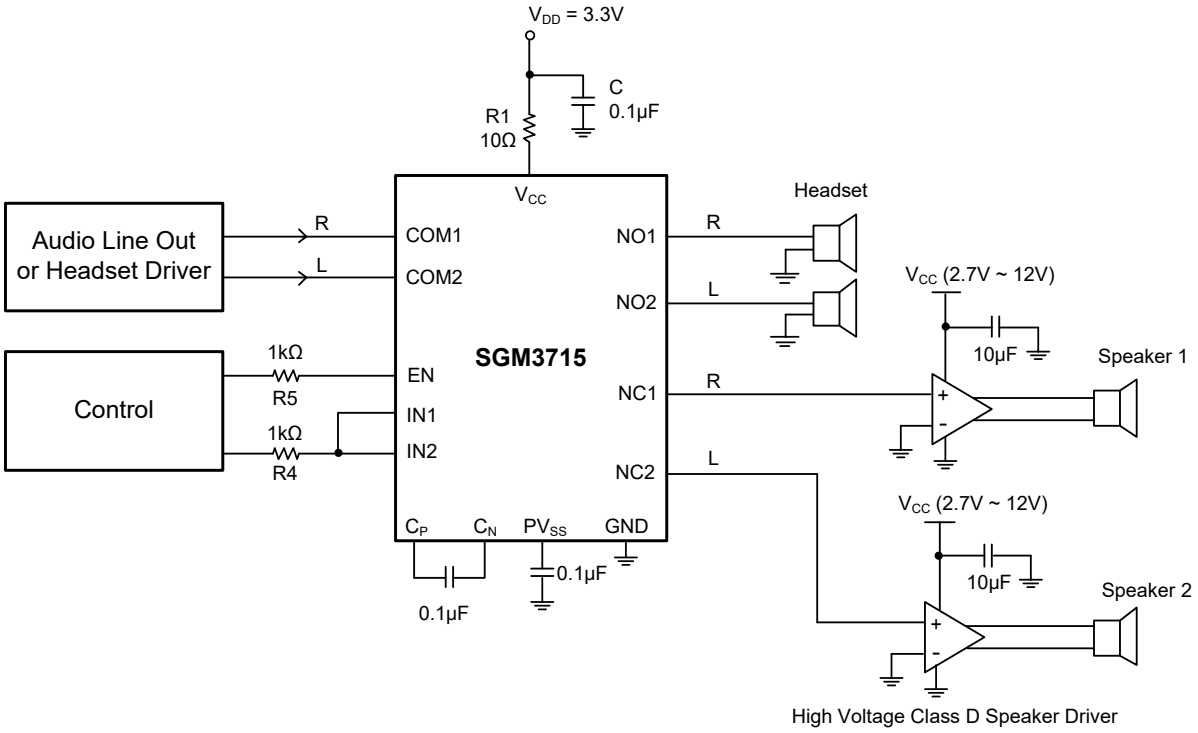


Figure 2. Typical Application Circuit for 1-to-2 HiFi Audio Signal Switch

REVISION HISTORY

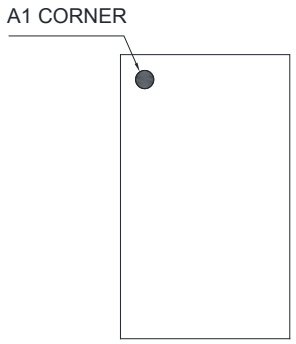
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (NOVEMBER 2017) to REV.A

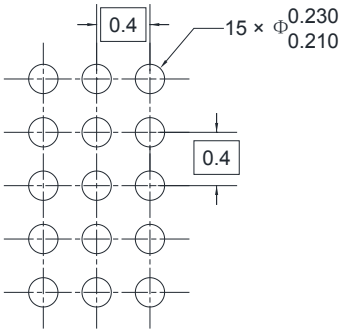
Changed from product preview to production data	All

PACKAGE OUTLINE DIMENSIONS

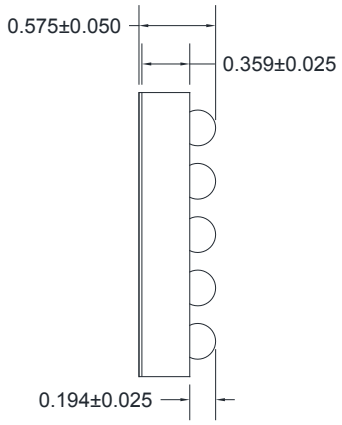
WLCSP-1.27×2.13-15B



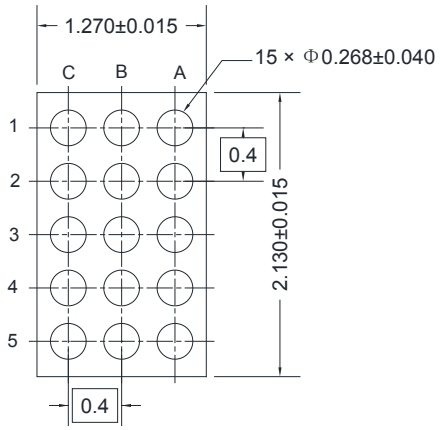
TOP VIEW



RECOMMENDED LAND PATTERN



SIDE VIEW

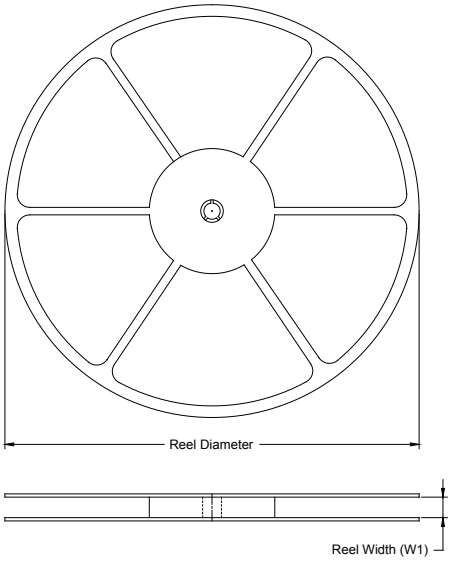


BOTTOM VIEW

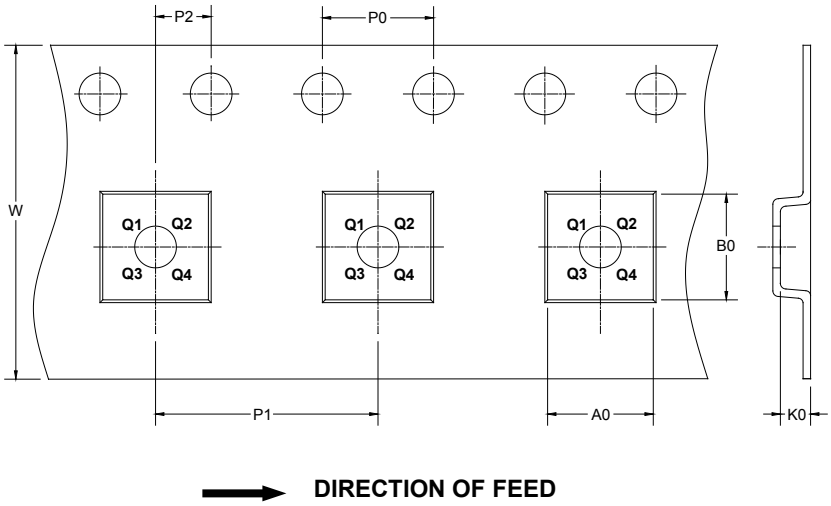
NOTE: All linear dimensions are in millimeters.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



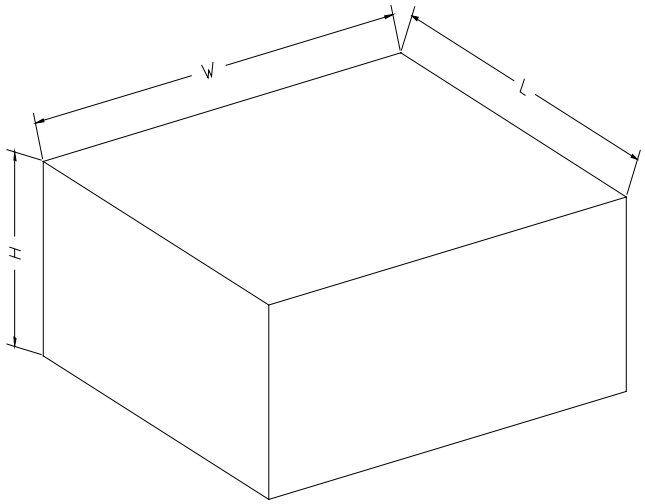
NOTE: The picture is only for reference. Please make the object as the standard.

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
WLCSP-1.27×2.13-15B	7″	9.5	1.47	2.37	0.78	4.0	4.0	2.0	8.0	Q1

DD0001

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

DD0002