

# SGM3158

# 4.5Ω Dual SPDT Analog Switch in 12-pin TDFN

## GENERAL DESCRIPTION

The SGM3158 is a dual, bidirectional, single-pole/double-throw (SPDT) CMOS analog switches designed to operate from a single +1.8V to +5.5V supply. It features high-bandwidth (300MHz) and low ON-resistance (4.5Ω typ), Targeted applications for audio switching.

SGM3158 features guaranteed on-resistance matching (0.3Ω max) between switches and guaranteed on-resistance flatness over the signal range (2.3Ω TYP). This ensures excellent linearity and low distortion when switching audio signals.

SGM3158 is available in a TDFN-12 package.

## APPLICATIONS

Portable Instrumentation  
 Battery-Operated Equipment  
 Computer Peripherals  
 Cell Phones  
 PDAs  
 MP3s

## PIN DESCRIPTION

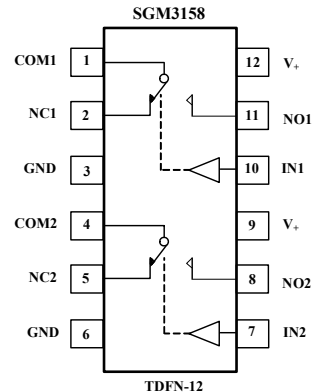
NAME	FUNCTION
NO1, NO2	Normally-open terminal
GND	ground
NC1, NC2	Normally-closed terminal
COM1, COM2	Common terminal
V <sub>+</sub>	Power supply
IN1, IN2	Digital control pin to connect the COM terminal to the NO or NC terminals

Note: NO1 or NO2, NC1 or NC2, and COM1 or COM2 terminal may be an input or output.

## FEATURES

- Voltage Operation : 1.8 V to 5.5 V
- On-Resistance: 4.5Ω (typ) at 5.0V
- Fast Switching Time
  - t<sub>ON</sub> 20 ns
  - t<sub>OFF</sub> 15 ns
- High Bandwidth: 300 MHz
- High Off-Isolation: 51dB at 10MHz
- Rail-to-Rail Operation
- TTL/CMOS Compatible
- Break-Before-Make Switching
- Extended Industrial Temperature Range:
  - 40°C to 85°C
- Lead (Pb) Free TDFN-12 Package

## PIN CONFIGURATIONS (TOP VIEW)



## FUNCTION TABLE

LOGIC	NO	NC
0	OFF	ON
1	ON	OFF

Switches Shown For Logic "0" Input



# ELECTRICAL CHARACTERISTICS

( $V_+ = +2.7V$  to  $+3.6V$ ,  $V_{IH} = +1.4V$ ,  $V_{IL} = +0.5V$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , Typical values are at  $V_+ = 3.0V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TPY	MAX	UNITS
<b>ANALOG SWITCH</b>							
Analog Signal Range	$V_{NO}, V_{NC}, V_{COM}$		-40°C to +85°C	0		$V_+$	V
On-Resistance	$R_{ON}$	$V_+ = 2.7V, V_{NO}$ or $V_{NC} = 1.5V,$ $I_{COM} = -10$ mA, Test Circuit 1	+25°C		7	10	$\Omega$
			-40°C to +85°C			10.5	$\Omega$
On-Resistance Match Between Channels	$\Delta R_{ON}$	$V_+ = 2.7V, V_{NO}$ or $V_{NC} = 1.5V,$ $I_{COM} = -10$ mA, Test Circuit 1	+25°C		0.15	0.3	$\Omega$
			-40°C to +85°C			0.4	$\Omega$
On-Resistance Flatness	$R_{FLAT(ON)}$	$V_+ = 2.7V, V_{NO}$ or $V_{NC} = 1.0V, 1.5V,$ $2.0V, I_{COM} = -10$ mA, Test Circuit 1	+25°C		3	4	$\Omega$
			-40°C to +85°C			4.3	$\Omega$
Source OFF Leakage current	$I_{NC(OFF)}, I_{NO(OFF)}$	$V_+ = 3.6V, V_{NO}$ or $V_{NC} = 0.3V, 3.3V,$ $V_{COM} = 0.3V, 3.3V,$	-40°C to +85°C			1	$\mu A$
Channel ON Leakage current	$I_{NC(ON)}, I_{NO(ON)},$ $I_{COM(ON)}$	$V_+ = 3.6V, V_{COM} = 0.3V, 3.3V,$ $V_{NO}$ or $V_{NC} = 0.3V, 3.3V,$ or floating	-40°C to +85°C			1	$\mu A$
<b>DIGITAL INPUTS</b>							
Input High Voltage	$V_{INH}$		-40°C to +85°C	1			V
Input Low Voltage	$V_{INL}$		-40°C to +85°C			0.5	V
Input Leakage Current	$I_{IN}$	$V_+ = +3.6V, V_{IN} = 0$ or $5.5V$	-40°C to +85°C			1	$\mu A$
<b>DYNAMIC CHARACTERISTICS</b>							
Turn-On Time	$t_{ON}$	$V_{NO}$ or $V_{NC} = 1.5V,$ $R_L = 300\Omega, C_L = 35pF,$ Test Circuit 2; $V_{IH} = 1.5V, V_{IL} = 0V$	+25°C		30		ns
Turn-Off Time	$t_{OFF}$	$V_{NO}$ or $V_{NC} = 1.5V,$ $R_L = 300\Omega, C_L = 35pF,$ Test Circuit 2; $V_{IH} = 1.5V, V_{IL} = 0V$	+25°C		25		ns
Break-Before-Make Time Delay	$t_D$	$V_{NO1}$ or $V_{NC1} = V_{NO2}$ or $V_{NC2} = 3V,$ $R_L = 300\Omega, C_L = 35pF,$ Test Circuit 4	+25°C		8		ns
Skew	$t_{SKEW}$	$R_S = 39\Omega, C_L = 50pF,$ Test Circuit 5	+25°C		2		ns
Off Isolation	$O_{ISO}$	$R_L = 50\Omega, C_L = 5pF,$ Signal = 0dBm, Test Circuit 6	f = 10MHz	+25°C		-51	dB
			f = 1MHz	+25°C		-72	dB
Bandwidth -3 dB	BW	Signal = 0dBm, $R_L = 50\Omega, C_L = 5pF,$ Test Circuit 7	+25°C		300		MHz
Source OFF Capacitance	$C_{NC(OFF)}, C_{NO(OFF)}$	f = 1MHz	+25°C		5.5		pF
Channel ON Capacitance	$C_{NC(ON)}, C_{NO(ON)},$ $C_{COM(ON)}$	f = 1MHz	+25°C		15.5		pF
<b>POWER REQUIREMENTS</b>							
Power Supply Range	$V_+$		-40°C to +85°C	1.8		5.5	V
Power Supply Current	$I_+$	$V_+ = +5.5V, V_{IN} = 0V$ or $V_+$	-40°C to +85°C			5	$\mu A$

Specifications subject to change without notice.

# ELECTRICAL CHARACTERISTICS

(V<sub>+</sub> = +4.5V to +5.5V, V<sub>IH</sub> = +2.0 V, V<sub>IL</sub> = +0.8V, T<sub>A</sub> = - 40°C to +85°C, Typical values are at V<sub>+</sub> = 5.0V, T<sub>A</sub> = + 25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN	TPY	MAX	UNITS
<b>ANALOG SWITCH</b>							
Analog Signal Range	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>		- 40°C to +85°C	0		V <sub>+</sub>	V
On-Resistance	R <sub>ON</sub>	V <sub>+</sub> = 4.5V, V <sub>NO</sub> or V <sub>NC</sub> = 3.5V, I <sub>COM</sub> = -10 mA, Test Circuit 1	+25°C		4.5	8	Ω
			- 40°C to +85°C				8.5
On-Resistance Match Between Channels	ΔR <sub>ON</sub>	V <sub>+</sub> = 4.5V, V <sub>NO</sub> or V <sub>NC</sub> = 3.5V, I <sub>COM</sub> = -10 mA, Test Circuit 1	+25°C		0.15	0.3	Ω
			- 40°C to +85°C				0.4
On-Resistance Flatness	R <sub>FLAT(ON)</sub>	V <sub>+</sub> = 4.5V, V <sub>NO</sub> or V <sub>NC</sub> = 1.0V, 2.0V, 3.5V, I <sub>COM</sub> = -10 mA, Test Circuit 1	+25°C		2.3	3.3	Ω
			- 40°C to +85°C				3.7
Source OFF Leakage current	I <sub>NC(OFF)</sub> , I <sub>NO(OFF)</sub>	V <sub>+</sub> = 5.5V, V <sub>NO</sub> or V <sub>NC</sub> = 1.0V, 4.5V, V <sub>COM</sub> = 1.0V, 4.5V,	- 40°C to +85°C			1	μA
Channel ON Leakage current	I <sub>NC(ON)</sub> , I <sub>NO(ON)</sub> , I <sub>COM(ON)</sub>	V <sub>+</sub> = 5.5V, V <sub>COM</sub> = 1.0V, 4.5V, V <sub>NO</sub> or V <sub>NC</sub> = 1.0V, 4.5V, or floating	- 40°C to +85°C			1	μA
<b>DIGITAL INPUTS</b>							
Input High Voltage	V <sub>IH</sub>		- 40°C to +85°C	1.5			V
Input Low Voltage	V <sub>IL</sub>		- 40°C to +85°C			0.6	V
Input Leakage Current	I <sub>IN</sub>	V <sub>+</sub> = +5.5V, V <sub>IN</sub> = 0 or 5.5V	- 40°C to +85°C			1	μA
<b>DYNAMIC CHARACTERISTICS</b>							
Turn-On Time	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 3.0V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 2; V <sub>IH</sub> = 1.5V, V <sub>IL</sub> = 0V	+25°C		20		ns
Turn-Off Time	t <sub>OFF</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 3.0V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 2; V <sub>IH</sub> = 1.5V, V <sub>IL</sub> = 0V	+25°C		15		ns
Break-Before-Make Time Delay	t <sub>d</sub>	V <sub>NO1</sub> or V <sub>NC1</sub> = V <sub>NO2</sub> or V <sub>NC2</sub> = 3V, R <sub>L</sub> = 300Ω, C <sub>L</sub> = 35pF, Test Circuit 4	+25°C		5		ns
Skew	t <sub>SKEW</sub>	R <sub>S</sub> = 39Ω, C <sub>L</sub> = 50pF, Test Circuit 5	+25°C		5		ns
Off Isolation	O <sub>ISO</sub>	R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Signal = 0dBm, Test Circuit 6	f = 10MHz	+25°C		-51	dB
			f = 1MHz	+25°C		-72	dB
Bandwidth -3 dB	BW	Signal = 0dBm, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 5pF, Test Circuit 7	+25°C		300		MHz
Source OFF Capacitance	C <sub>NC(OFF)</sub> , C <sub>NO(OFF)</sub>	f = 1MHz	+25°C		5.5		pF
Channel ON Capacitance	C <sub>NC(ON)</sub> , C <sub>NO(ON)</sub> , C <sub>COM(ON)</sub>	f = 1MHz	+25°C		15.5		pF
<b>POWER REQUIREMENTS</b>							
Power Supply Range	V <sub>+</sub>		- 40°C to +85°C	1.8		5.5	V
Power Supply Current	I <sub>+</sub>	V <sub>+</sub> = +5.5V, V <sub>IN</sub> = 0V or V <sub>+</sub>	- 40°C to +85°C			5	μA

Specifications subject to change without notice.

## ORDERING INFORMATION

MODEL	PIN-PACKAGE	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKAGE OPTION
SGM3158	TDFN-12	- 40°C to +85°C	SGM3158YD	3158	Tape and Reel, 3000

## ABSOLUTE MAXIMUM RATINGS

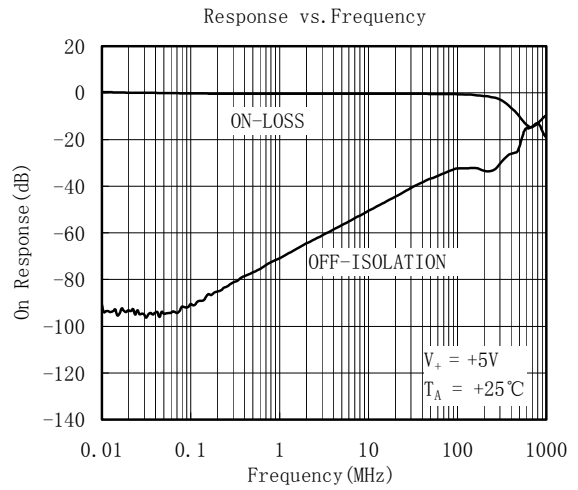
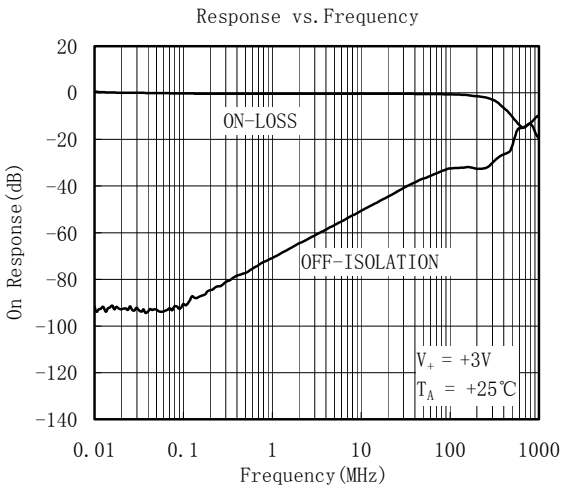
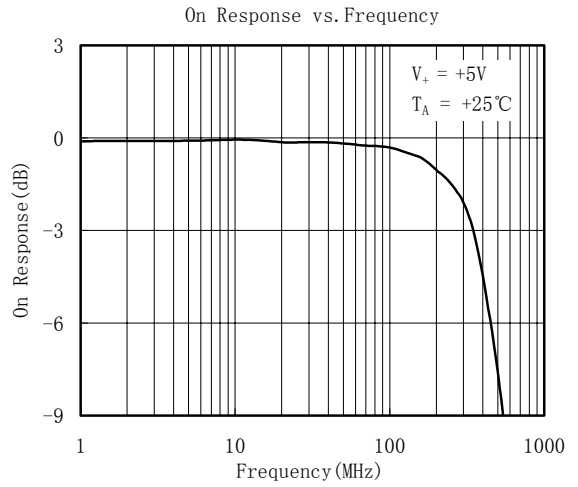
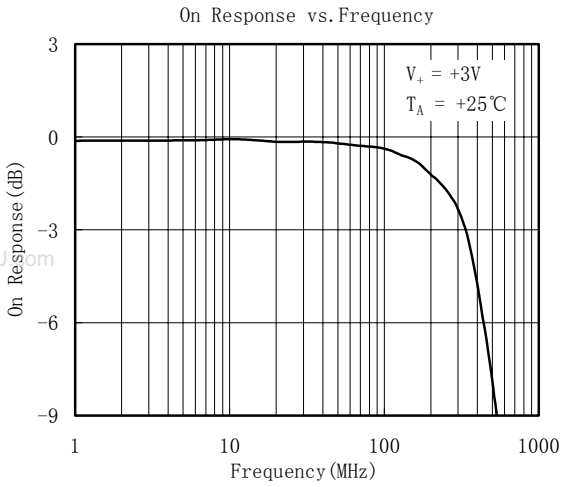
V<sub>+</sub>, IN to GND..... - 0.3V to +6V  
 Analog, Digital voltage range(1)..... - 0.3V to (V<sub>+</sub> + 0.3V)  
 Continuous Current NO, NC, or COM..... ±200mA  
 Peak Current NO, NC, or COM..... ±300mA  
 Operating Temperature Range..... - 40°C to +85°C

Junction Temperature.....+150°C  
 Storage Temperature..... - 65°C to +150°C  
 Lead Temperature (soldering, 10s).....+260°C  
 ESD(HBM).....2000V

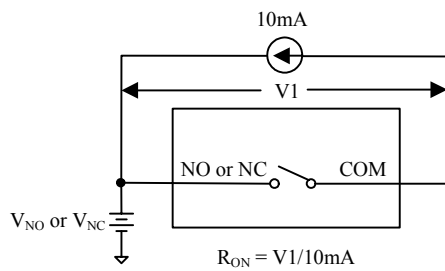
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

(1) Signals on NC, NO, or COM or IN exceeding V<sub>+</sub> will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

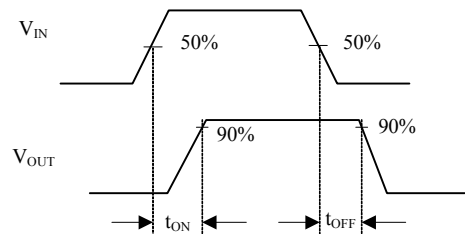
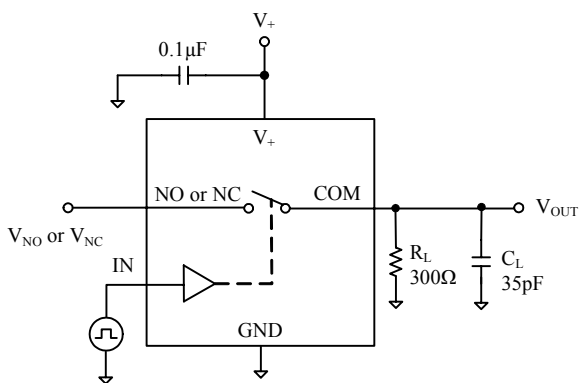
# TYPICAL PERFORMANCE CHARACTERISTICS



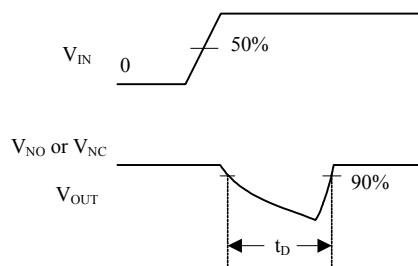
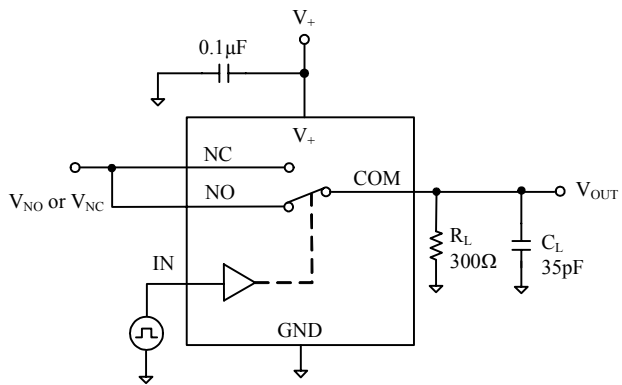
# TEST CIRCUITS



Test Circuit 1. On Resistance

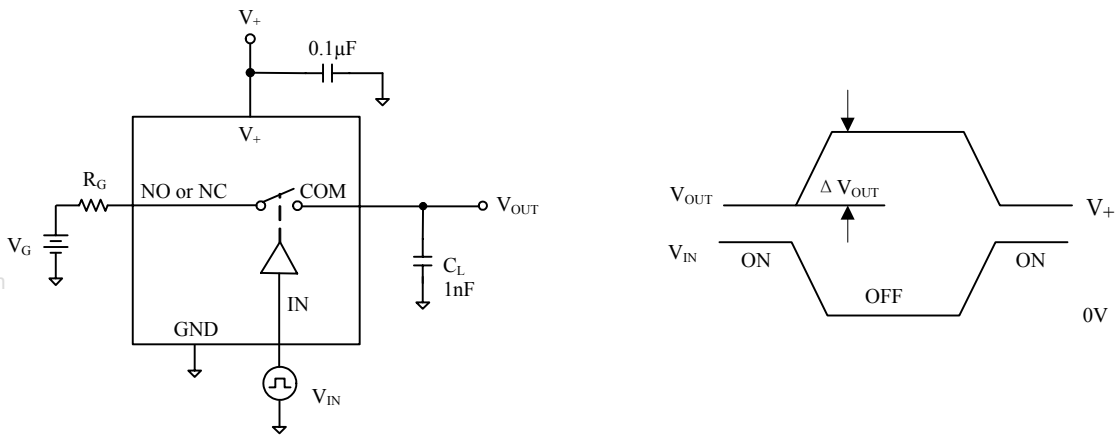


Test Circuit 2. Switching Times

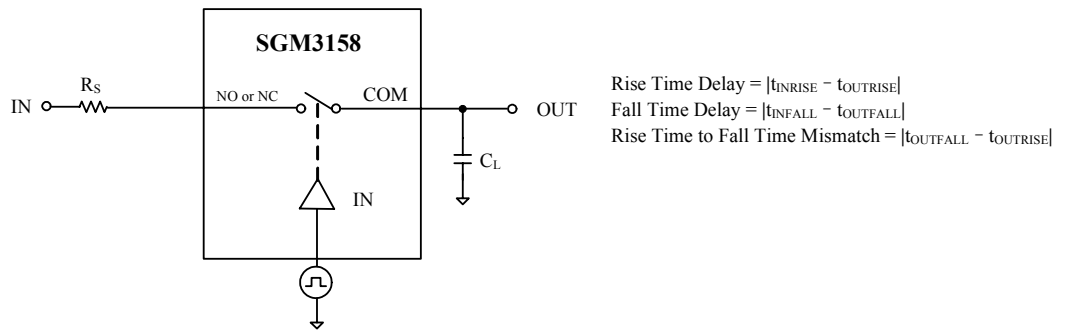


Test Circuit 3. Break-Before-Make Time Delay,  $t_D$

# TEST CIRCUITS (Cont.)



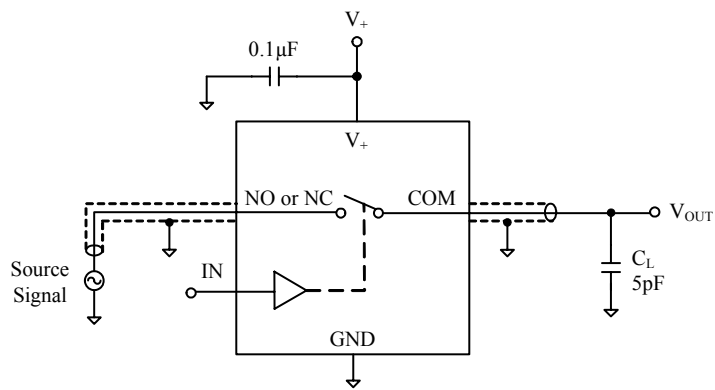
Test Circuit 4. Charge Injection



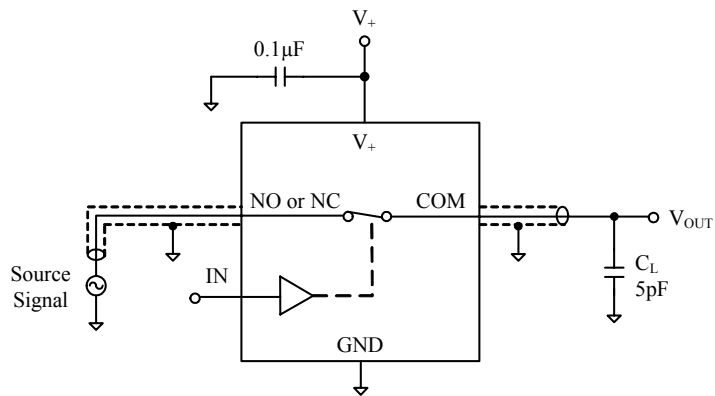
$Rise\ Time\ Delay = |t_{INRISE} - t_{OUTRISE}|$   
 $Fall\ Time\ Delay = |t_{INFALL} - t_{OUTFALL}|$   
 $Rise\ Time\ to\ Fall\ Time\ Mismatch = |t_{OUTFALL} - t_{OUTRISE}|$

Test Circuit 5. Output Signal Skew

## TEST CIRCUITS (Cont.)



Test Circuit 6. Off Isolation

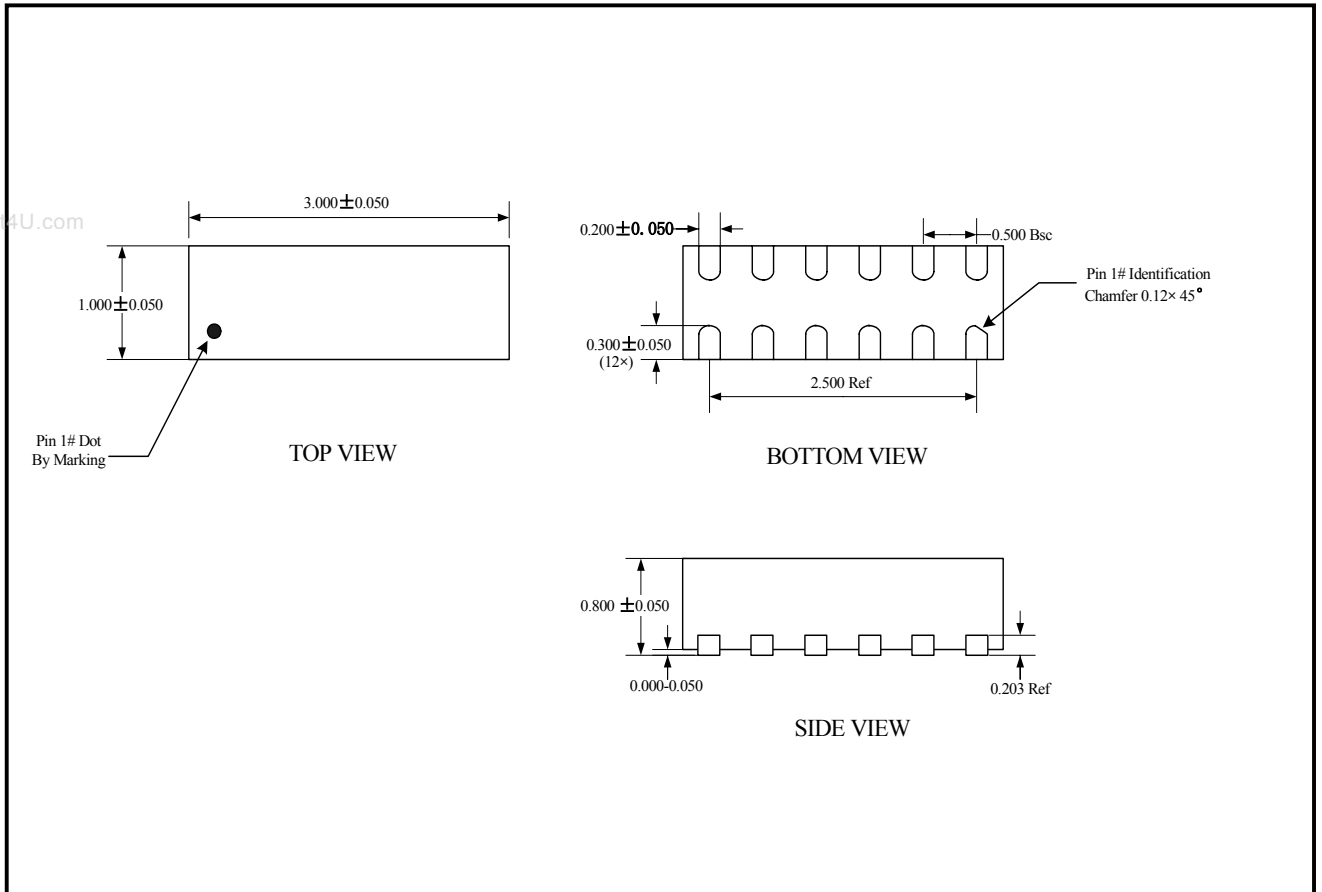


Test Circuit 7. Bandwidth



# PACKAGE OUTLINE DIMENSIONS

## TDFN-12



### NOTES:

All linear dimensions are in millimeters.

## REVISION HISTORY

Location	Page
<b>05/07— Data Sheet REV.A</b>	
<b>10/07— Data Sheet changed from REV.A to REV.B</b>	
Changes to TYPICAL PERFORMANCE CHARACTERISTICS .....	5

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