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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
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Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Ultra-Low-THD Dual-SPDT (0.35Ω) Analog Switch with Negative Signal Handling Capability

Features

- CMOS Technology for Bus and Analog Applications
- Negative Signal Handling Capability at all Ports
- Low On-Resistance: 0.35Ω at 1.8V Supply
- On-Resistance Flatness 0.001Ω
- Wide VDD Range: 1.65V to 4.3V
- 2.0Vrms analog signal range
- Programmable soft-start and soft-stop time
- -3dB Bandwidth: 255MHz
- High Off Isolation: -85dB @ 30kHz
- Low THD: 0.0003% from 20Hz to 20kHz, 0.5VRMS
- Crosstalk Rejection Reduces Signal Distortion: -85dB @ 30kHz
- High-impedance mode when VDD not applied
- ESD：4kV for HBM mode, 1kV for CDM mode
- Extended Industrial Temperature Range: –40°C to 85°C
- Packaging (Pb-free & Green): –10-contact UQFN (ZM10)

Applications

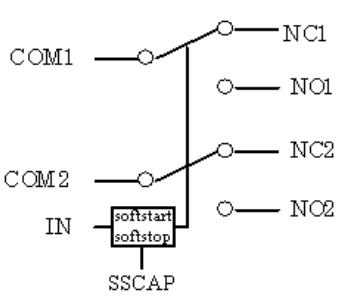
- Cell Phones, PDAs, MP3 Players
- Portable Instrumentation
- Computer Peripherals
- Speaker Headset Switching
- Power Routing
- Relay Replacement
- Audio and Video Signal Routing
- PCMCIA Cards
- Modems

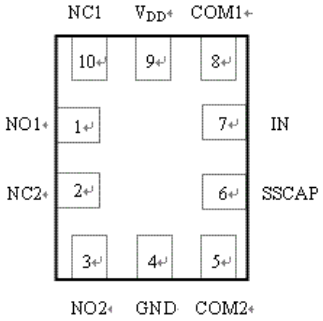
Description

PI3A288 is a dual, single-pole double throw (SPDT) CMOS switch with negative signal handling capability at all ports. It can be used as an analog switch or as a low-delay bus switch. Operating over a wide power supply voltage ranges from 1.65V to 4.3V, PI3A288 processes a low on-resistance and distortion. The ultra-low THD performance enables PI3A288 to apply in high-quality audio applications.

PI3A288 has also a soft-start and soft-stop feature so as to minimize signal disruption during channel switching

Functional Block Diagram





Pin Description

Pin	Name	Description
1, 3	NO_X	Data Ports (Normally open)
4	GND	Ground
2, 10	NC_X	Data Ports (Normally closed)
5, 8	COM_X	Common Output / Data Ports
9	V_{DD}	Positive Power Supply
7	IN	Logic Control Pins
6	SSCAP	Slew Rate Control Pin

Logic Function Table

Logic Input (IN)	Function
0	NC1 Connected to COM1 NC2 Connected to COM2
1	NO1 Connected to COM1 NO2 Connected to COM2

Maximum Ratings

Storage Temperature…….. -65℃ to +150℃
Ambient Temperature with Power Applied.....-40℃ to +85℃
Supply Voltage V_{DD}……..-0.5Vto +4.6V
Control Input Voltage V_{INx}……-0.5Vto +4.6V
DC Input Voltage V_{INPUT}…….. V_{DD} – 6.0V and -3.1V to +3.1V
Continuous Current NO_NC_COM_……..……±350mA
Peak Current NO_NC_COM_
(pulsed at 1ms 50% duty cycle) ……..…….. ±400mA
Peak Current NO_NC_COM_
(pulsed at 1ms 10% duty cycle) ……..…….. ±500mA
ESD HBM mode…… 4kV
CDM mode…… 1kV

Note:
Stresses greater than those listed under 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 above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
Control input must be held HIGH or LOW; it must not float.

Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{DD}	Operating Voltage	-	1.65	-	4.3	V
V_{IN}	Control Input Voltage	-	0	-	4.3	V
V_{INPUT}	Switch Input Voltage	V_{DD} =< 2.3V		2.0		V_{RMS}
		V_{DD} > 2.3V		1.8		
T_A	Operating Temperature	-	-40	25	85	°C

Electrical Characteristics

(T_A = –40°C to 85°C, unless otherwise noted. Typical values are at 1.8V and +25°C.)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
ANALOG SWITCH						
Analog Signal Range	V_{NO}, V_{NC}, V_{COM}	V_{DD} =< 2.3V		2.0		V_{RMS}
		V_{DD} > 2.3V		1.8		
On-Resistance	R_{ON}	V_{DD} = 1.8V, V_{COM} = 0V Test Circuit Figure 1	-	0.35	-	Ω
On-Resistance Match Between Channels	ΔR_{ON}	V_{DD} = 1.8V, V_{COM} = 0V between same NC_ and NO_ channel Test Circuit Figure 1	-	0.005	0.05	Ω
On-Resistance Flatness	R_{ONF}	V_{DD} = 1.8V, V_{COM} = -2.5V to +2.5V Test Circuit Figure 1 (NOTE1)		0.001	0.01	Ω
Supply Current	I_{CC}	V_{DD} =1.8V	-	70	110	µA
DIGITAL INPUTS						
Input Logic High	V_{IH}		1.4			V
Input Logic Low	V_{IL}				0.325	
IN Input Leakage Current	I_{IN}	V_{DD} = 1.8V, V_{IN}=0 or 1.8V	-0.5	-	0.5	µA
DYNAMIC CHARACTERISTICS						
Turn-Off Time	t_{OFF}	$V_{NO\_}$ or $V_{NC\_}$ = 3V, R_L = 32Ω SSCAP=float		65		µs
Turn-On Time	t_{ON}	$V_{NO\_}$ or $V_{NC\_}$ = 3V, R_L = 32Ω SSCAP=float		270		µs
Soft-Start Time	t_{START}	SSCAP=0.01uF $V_{NC\_}$ = 0.1V, 10% to 90%		5		ms
Soft-Stop Time	t_{STOP}	SSCAP=0.01uF $V_{NC\_}$ = 0.1V, 90% to 10%		5		ms
NC-NO and COM-NC/NO Off-Isolation	O_{ISO}	V_{BIAS}=0V, V_{IN}=0dBm *See Test Circuit Figure 2 and Figure 3* 30kHz	-	-85	-	dB
Channel-to-Channel Crosstalk	X_{TALKD}	V_{BIAS}=0V, V_{IN}=0dBm *See Test Circuit Figure 4* 30kHz	-	-85	-	dB
-3dB Bandwidth	f_{3dB}	V_{BIAS}=0V, V_{IN}=0dBm *See Test Circuit Figure 5*	-	255	-	MHz
Total Harmonic Distortion	THD+N	f=20Hz to 20kHz, R_L=32Ω, V_{IN}=0.5V_{RMS}, V_{BIAS}=0V (NOTE2)	-	-110	-	dB

Note 1 and Note 2 ： These parameters are measured on TA=25°C

Capacitance

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Control Pin Input Capacitance	C_{IN}	V_{DD}=0V, f=1MHz,	-	6	-	pF
NC Off Capacitance	$C_{NC\ (OFF)}$	V_{DD}=1.8V, f = 1MHz, See Test Circuit Figure 6.	-	14	-	
NO Off Capacitance	$C_{NO\ (OFF)}$	V_{DD}=1.8V, f = 1MHz, See Test Circuit Figure 6.	-	14	-	
NC On Capacitance	$C_{NC\ (ON)}$	V_{DD}=1.8V, f = 1MHz, See Test Circuit Figure 7.	-	35	-	
NO On Capacitance	$C_{NO\ (ON)}$	V_{DD}=1.8V, f = 1MHz, See Test Circuit Figure 7.	-	35	-	

Test Circuits and Timing Diagrams

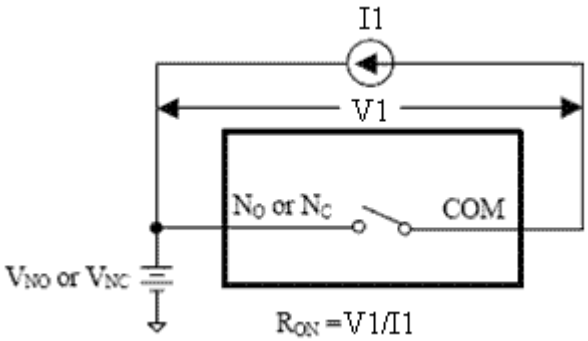


Figure 1, On Resistance

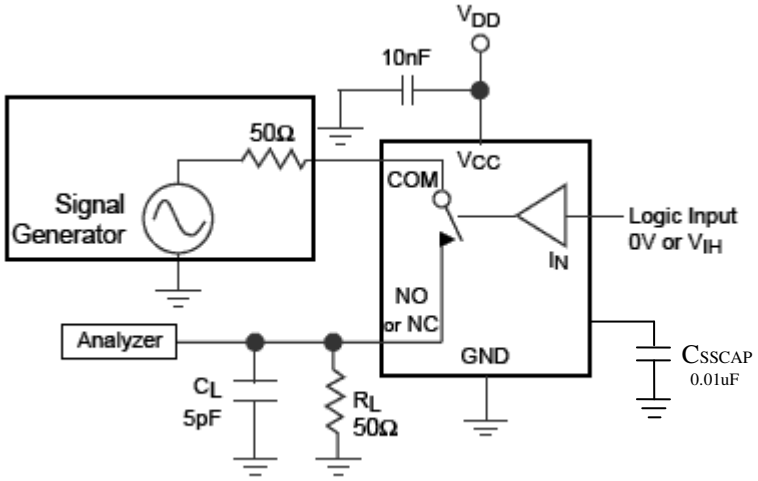


Figure 2, COM-NC/NO Isolation

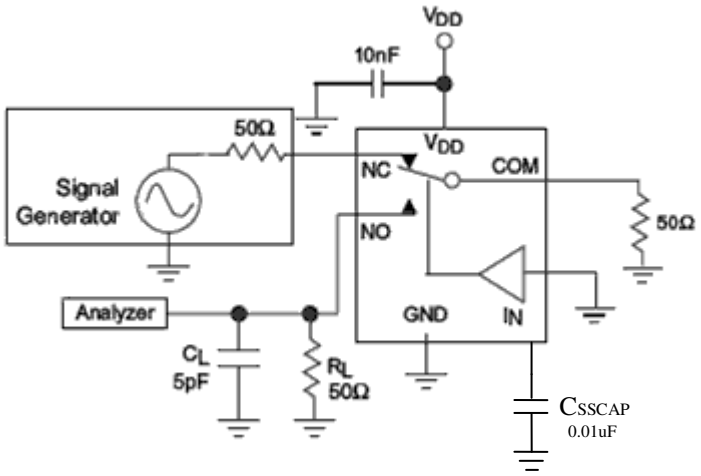


Figure 3, NC-NO Isolation

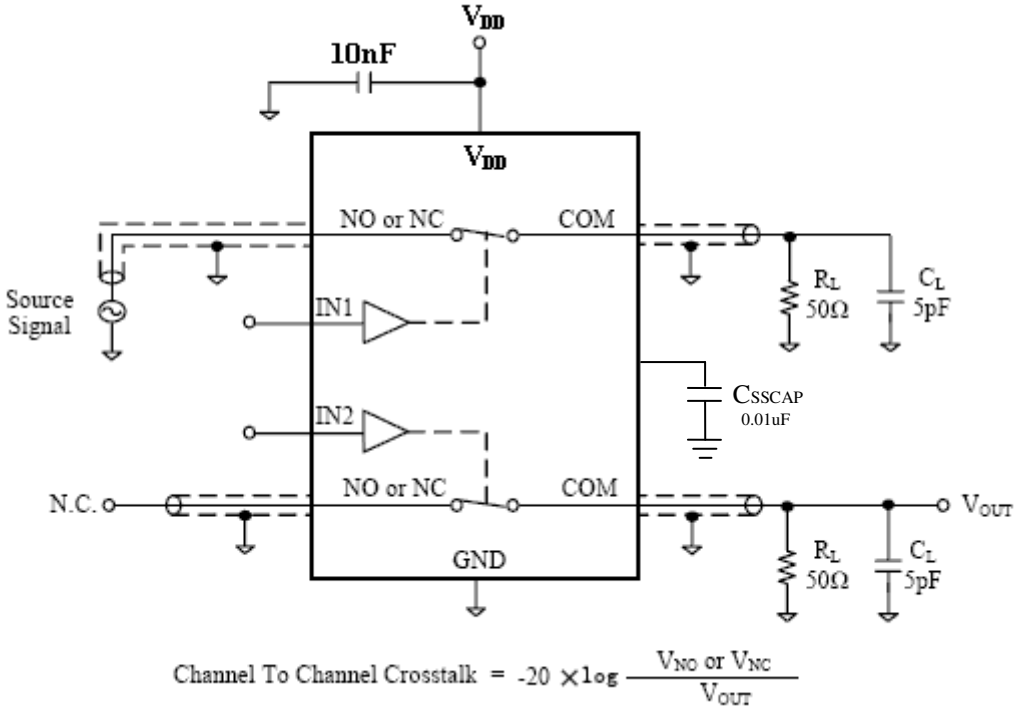


Figure 4, Channel-to-Channel Crosstalk

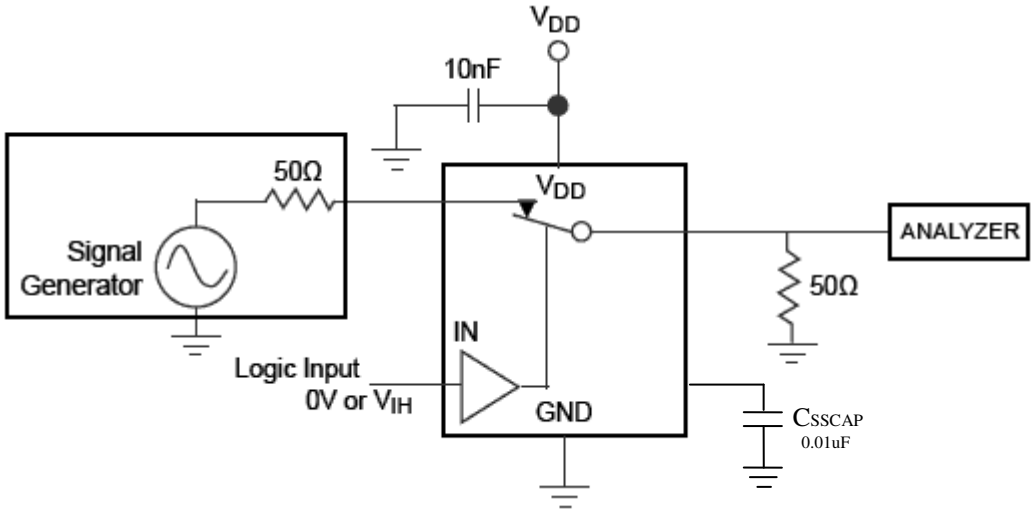


Figure 5, Bandwidth

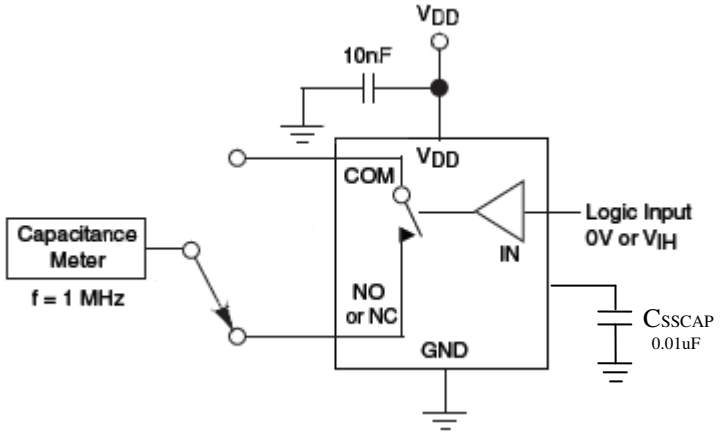


Figure 6, Channel Off Capacitance

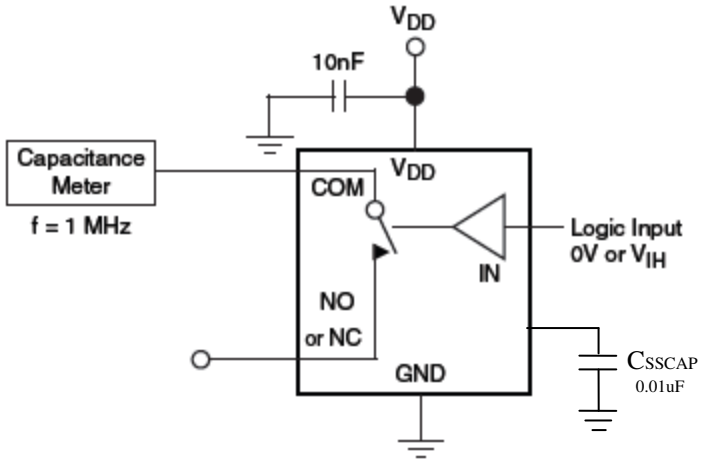


Figure 7, Channel On Capacitance

TYPICAL CHARACTERISTICS

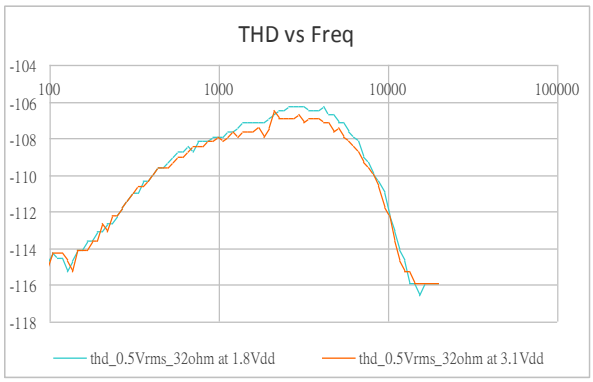


Figure 8, THD vs signal frequency

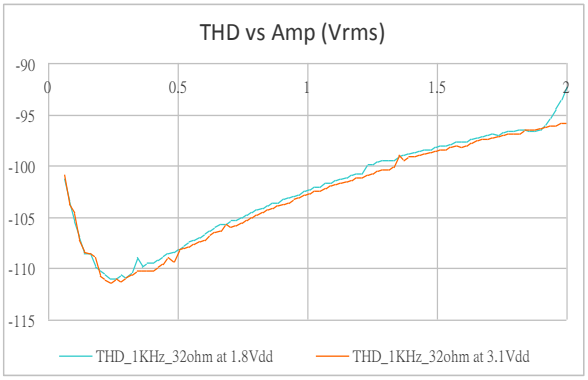


Figure 9, THD vs signal amplitude

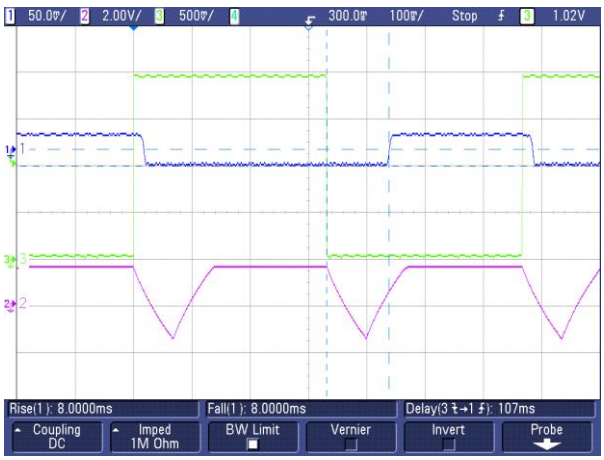


Figure 10, Soft-start with C_{SSCAP} = 10nF, VNC = + 50mV, VNO = 0V
Channel 1 = COM
Channel 2 = SSCAP
Channel 3 = IN

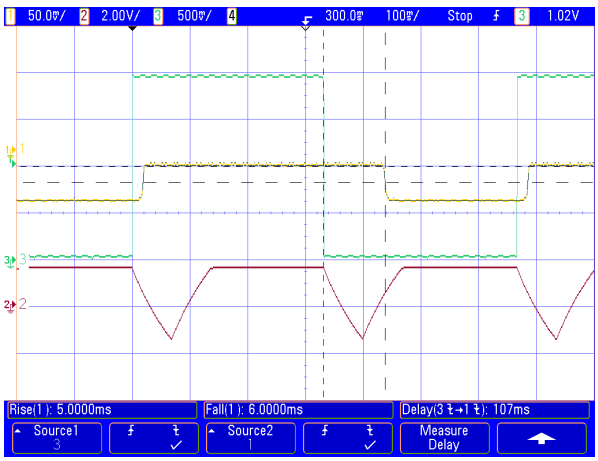


Figure 11, Soft-start with C_{SSCAP} = 10nF, VNC = - 50mV, VNO = 0V
Channel 1 = COM
Channel 2 = SSCAP
Channel 3 = IN

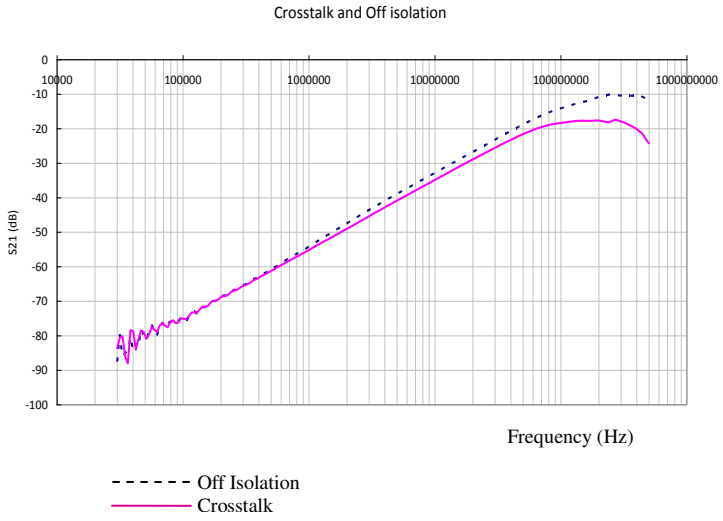


Figure12, Crosstalk and Isolation

Typical Application Circuit

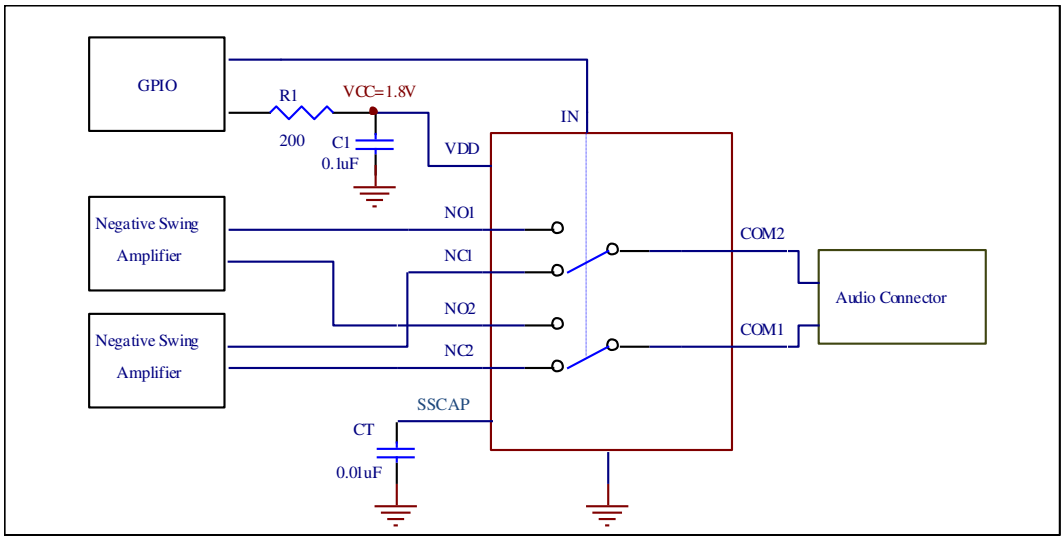


Figure12, Crosstalk and Isolation

Function Description

The PI3A288 is an ultra-small, ultra-low THD , low on-resistance, high ESD-protected DPDT switch that operates from a +1.65V to 4.3V supply. These switches feature the low on-resistance (RON) necessary for high-performance switching applications. The Beyond-the-Rails signal capability of the PI3A288 allows signals below ground and above VCC to pass without distortion.

Analog Signal Levels

The topology of the switches allows the signal to drop below ground without the need of an external negative voltage supply. The devices can also withstand analog signal levels of 2Vrms. in the case of lower V_{DD} voltage.

Digital Control Input

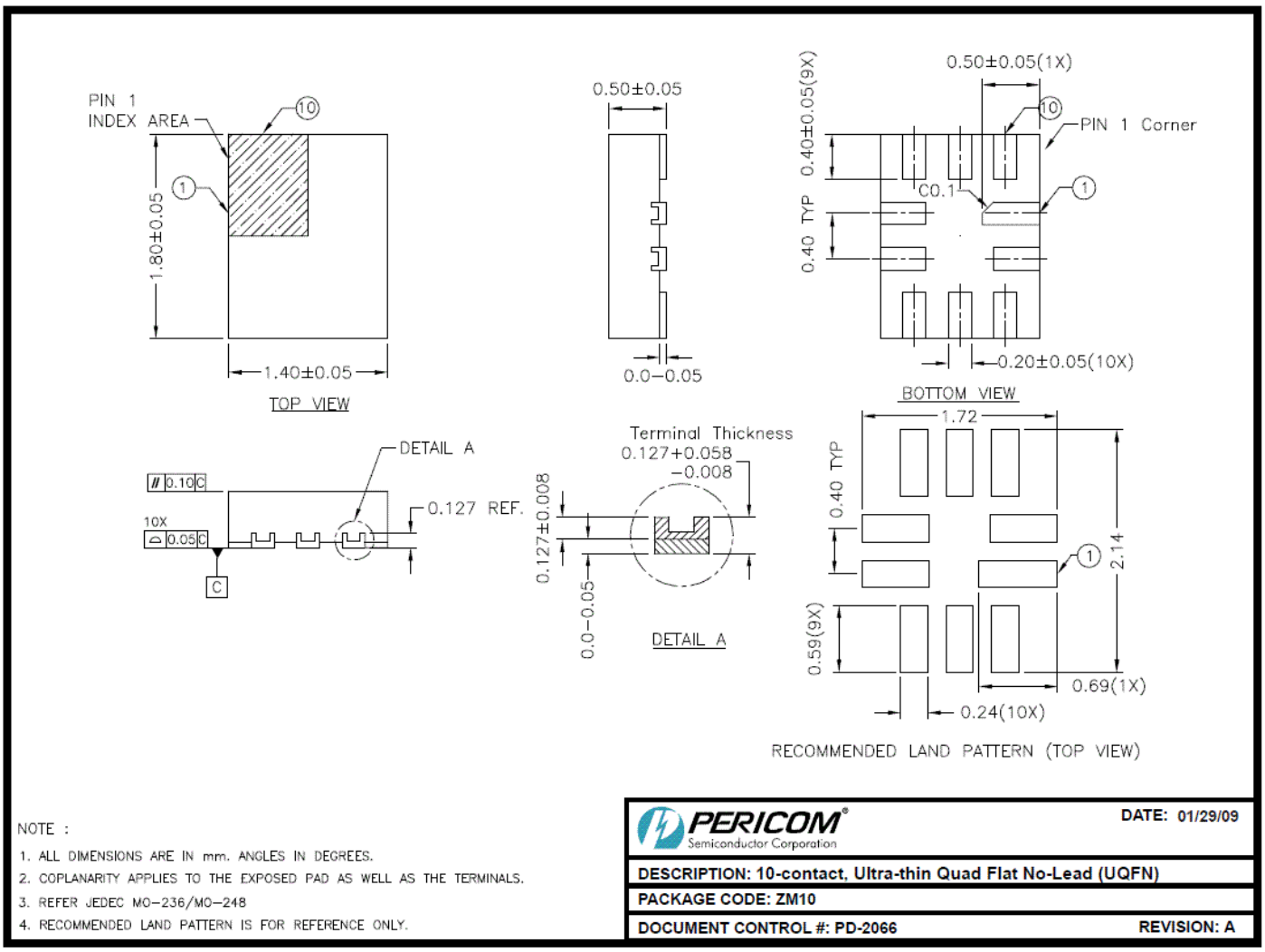
The PI3A288 provides a single-bit control logic input, IN. IN controls the switch position. The logic control inputs can be driven up to +4.3V regardless of the supply voltage. For example, given a +3.3V supply, the output enables or select pins may be driven to low to 0V and high to 4.3V.

Click and Pop Operation

The PI3A288 can pass ground referenced audio signals which allows it to be directly connected to audio drivers that output ground referenced audio signals, eliminating the need for a DC blocking capacitor. Audio drivers that swing around ground, however, do generate some DC offset, from a few millivolts to tens of millivolts. When switching between audio channels or muting the audio signal, these small DC offset levels of the drivers can lead to a voltage step across the speaker loads and create unwanted clicks and pops.

The PI3A288 has a special soft-start feature that slowly ramps the DC offset voltage from the audio driver to the speaker load when turning on a switch channel. The ramp rate at the load is determined by the capacitor value connected at the SSCAP pin. A soft-start capacitor value of 0.01µF provides obvious effect of eliminating pop-click noise and is recommended.

Mechanical Information 10-pin UQFN (ZM10)



Ordering Information

Part No.	Package Code	Package
PI3A288ZMEX	ZM	Lead free and Green 10-pin UQFN1.8x1.4 Tape & reel

Note:
- E = Pb-free and Green
- Adding X Suffix= Tape/Reel