

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

### 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)

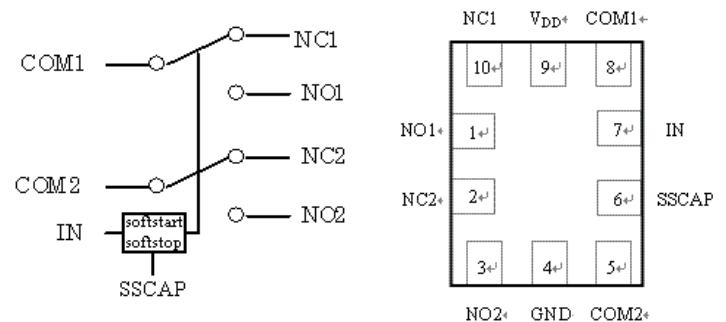
### Applications

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

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 <sub>X</sub>	Data Ports (Normally open)
4	GND	Ground
2, 10	NC <sub>X</sub>	Data Ports (Normally closed)
5, 8	COM <sub>X</sub>	Common Output / Data Ports
9	V <sub>DD</sub>	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°C to +150°C
Ambient Temperature with Power Applied.....	-40°C to +85°C
Supply Voltage $V_{DD}$ .....	-0.5V to +4.6V
Control Input Voltage $V_{INx}$ .....	-0.5V to +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	$V_{DD} \leq 2.3V$		2.0		$V_{RMS}$
		$V_{DD} > 2.3V$		1.8		
$T_A$	Operating Temperature	-	-40	25	85	°C

## Electrical Characteristics

(T<sub>A</sub> = -40 °C to 85 °C, unless otherwise noted. Typical values are at 1.8V and +25 °C.)

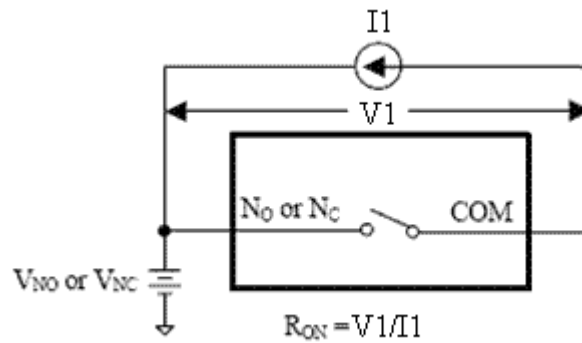
Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
ANALOG SWITCH							
Analog Signal Range	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>	V <sub>DD</sub> =< 2.3V			2.0		V <sub>RMS</sub>
		V <sub>DD</sub> > 2.3V			1.8		
On-Resistance	R <sub>ON</sub>	V <sub>DD</sub> = 1.8V, V <sub>COM</sub>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

Note 1 and Note 2 : These parameters are measured on T<sub>A</sub>=25 °C

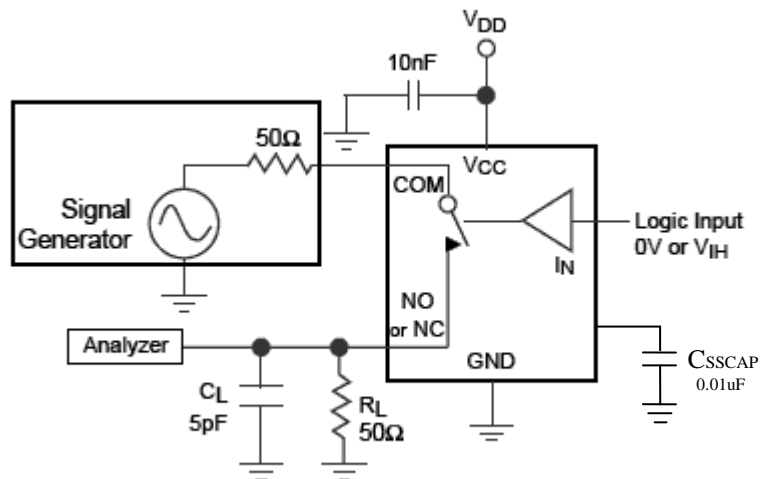
## Capacitance

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Control Pin Input Capacitance	C <sub>IN</sub>	V <sub>DD</sub> =0V, f=1MHz,	-	6	-	pF
NC Off Capacitance	C <sub>NC (OFF)</sub>	V <sub>DD</sub> =1.8V, f = 1MHz, See Test Circuit Figure 6.	-	14	-	
NO Off Capacitance	C <sub>NO (OFF)</sub>	V <sub>DD</sub> =1.8V, f = 1MHz, See Test Circuit Figure 6.	-	14	-	
NC On Capacitance	C <sub>NC (ON)</sub>	V <sub>DD</sub> =1.8V, f = 1MHz, See Test Circuit Figure 7.	-	35	-	
NO On Capacitance	C <sub>NO (ON)</sub>	V <sub>DD</sub> =1.8V, f = 1MHz, See Test Circuit Figure 7.	-	35	-	

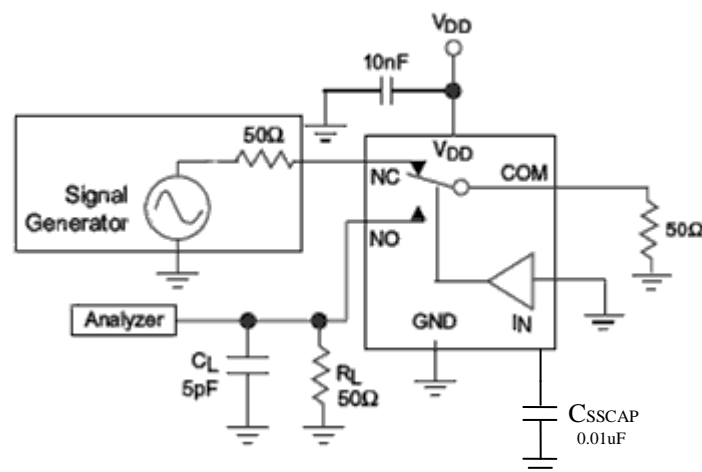
## Test Circuits and Timing Diagrams



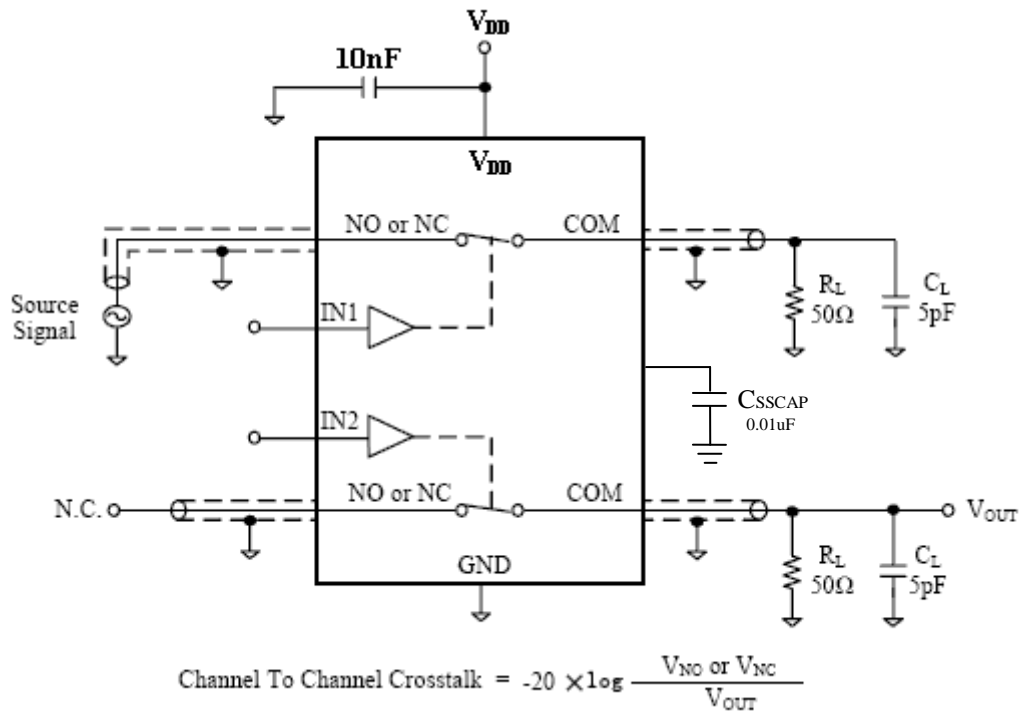
**Figure 1, On Resistance**



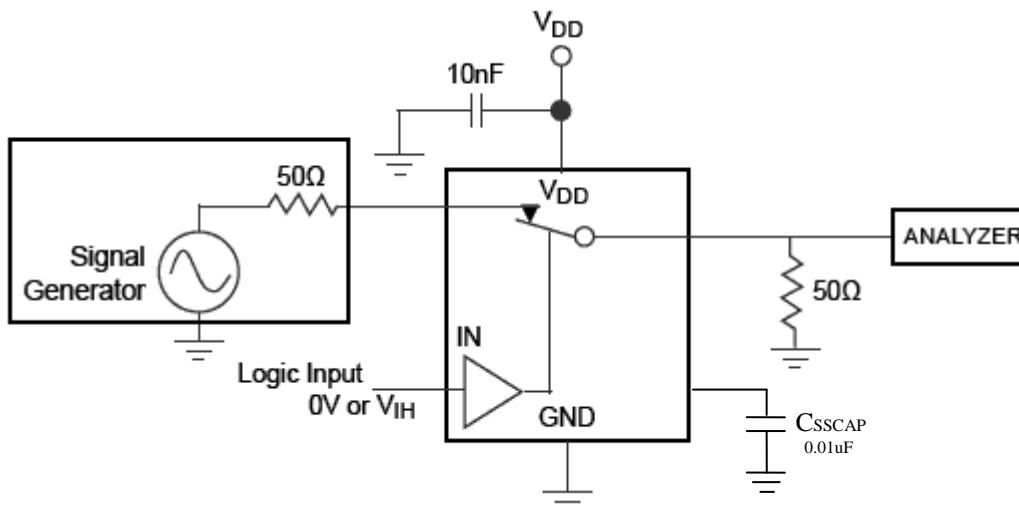
**Figure 2, COM-NC/NO Isolation**



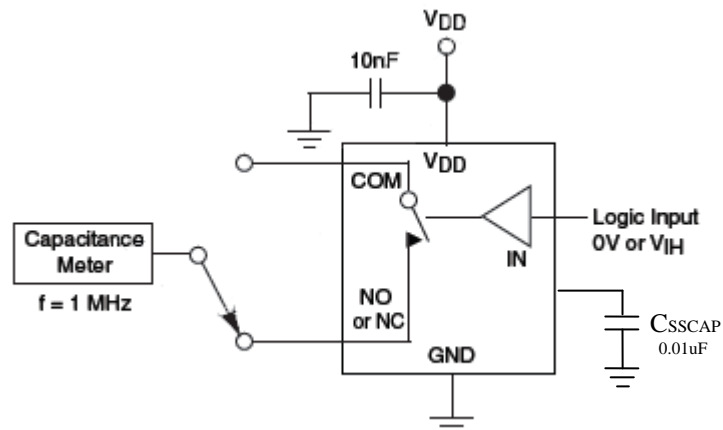
**Figure 3, NC-NO Isolation**



**Figure 4, Channel-to-Channel Crosstalk**



**Figure 5, Bandwidth**



**Figure 6, Channel Off Capacitance**

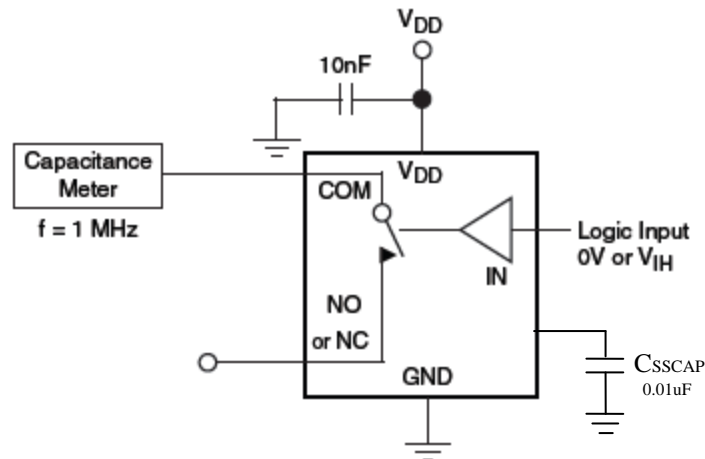


Figure 7, Channel On Capacitance

## TYPICAL CHARACTERISTICS

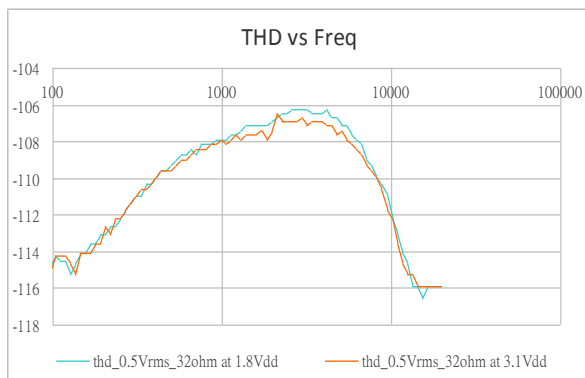


Figure 8, THD vs signal frequency

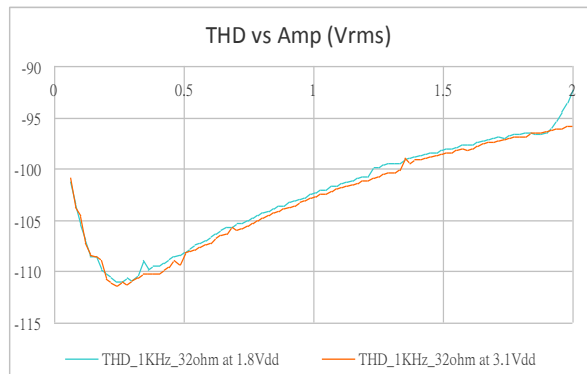


Figure 9, THD vs signal amplitude



Figure 10, Soft-start with  $C_{SSCAP} = 10\text{nF}$ ,  $V_{NC} = +50\text{mV}$ ,  $V_{NO} = 0\text{V}$   
Channel 1 = COM  
Channel 2 = SSCAP  
Channel 3 = IN

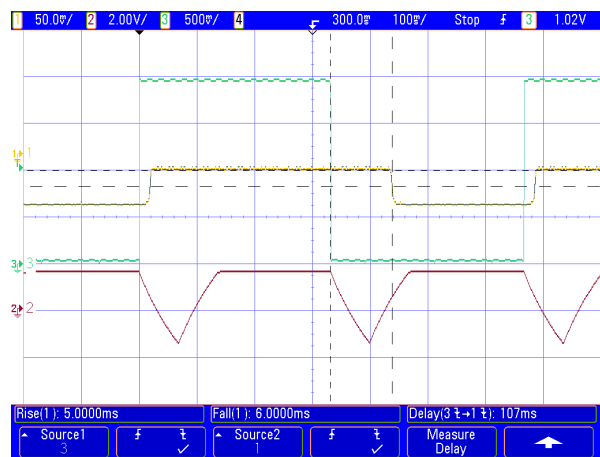
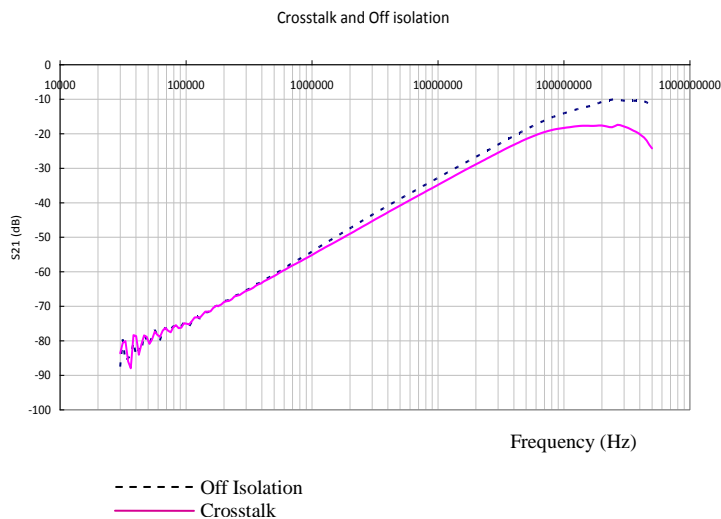
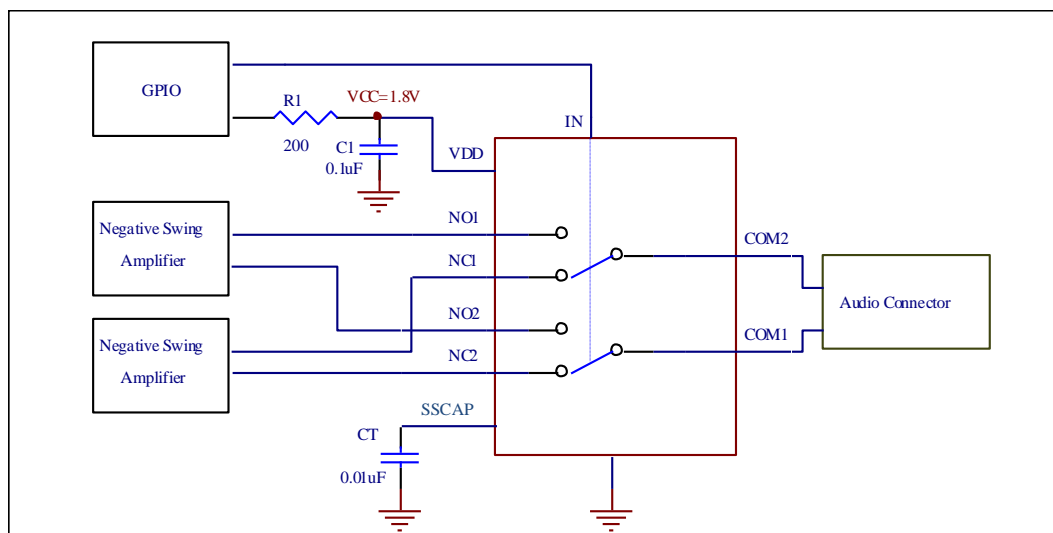


Figure 11, Soft-start with  $C_{SSCAP} = 10\text{nF}$ ,  $V_{NC} = -50\text{mV}$ ,  $V_{NO} = 0\text{V}$   
Channel 1 = COM  
Channel 2 = SSCAP  
Channel 3 = IN



**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 ( $R_{ON}$ ) 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  $2V_{rms}$  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.

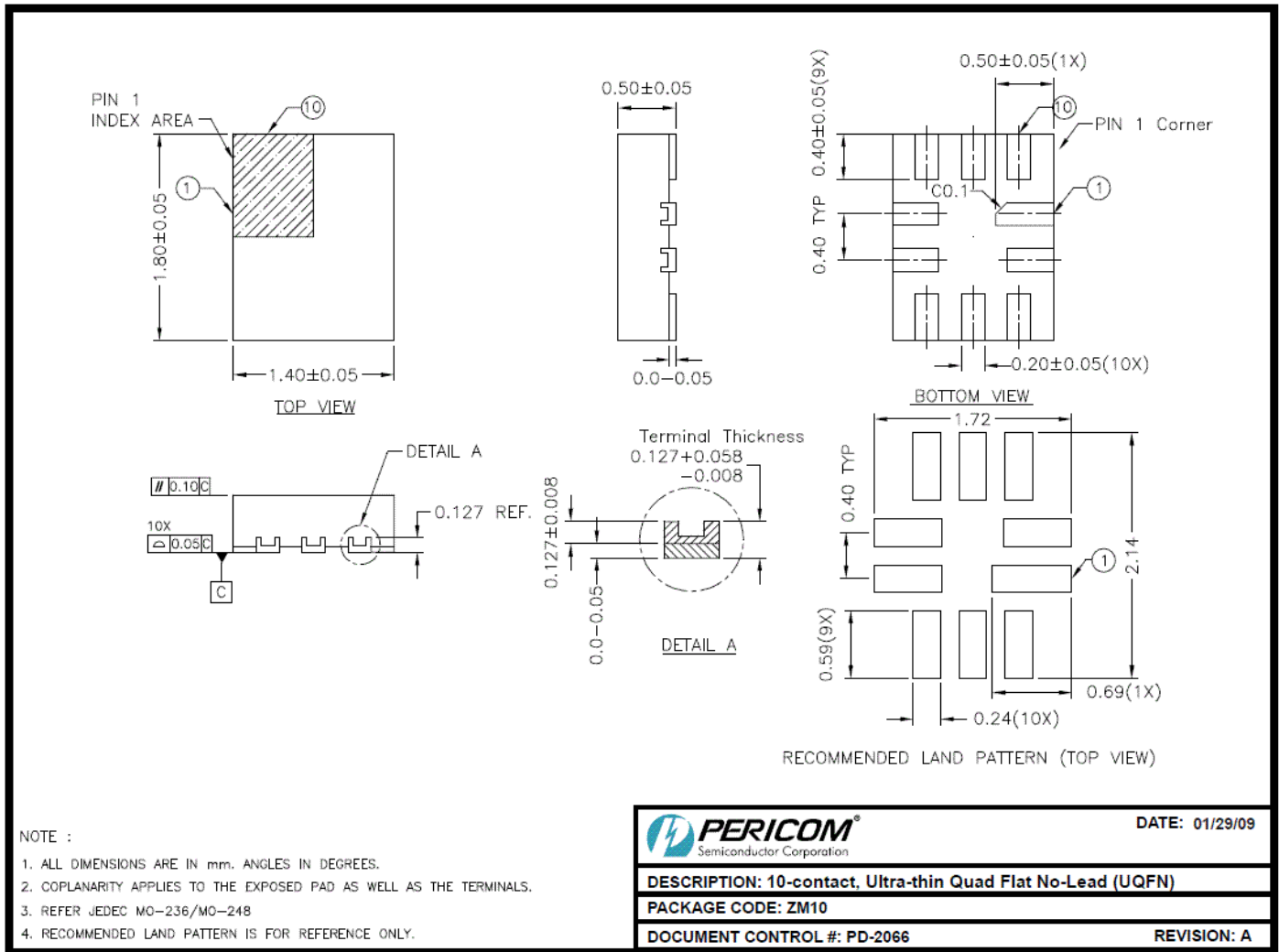
## **Click and Pop Operation**

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

Pericom Semiconductor Corporation • 1-800-435-2336 • [www.pericom.com](http://www.pericom.com)

Pericom reserves the right to make changes to its products or specifications at any time, without notice, in order to improve design or performance and to supply the best possible product. Pericom does not assume any responsibility for use of any circuitry described other than the circuitry embodied in Pericom product. The company makes no representations that circuitry described herein is free from patent infringement or other rights, of Pericom.