Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

General Description

The HTS3005 is a dual, low on-resistance, low voltage, bidirectional, single-pole/double-throw (SPDT) CMOS analog switch designed to operate from a single 1.8V to 5.5V power supply. Targeted applications include battery powered equipment that benefit from low R_{ON} (0.5Ω) and fast switching speeds (t_{ON} = 50ns, t_{OFF} = 15ns).

The on resistance profile is very flat over the full analog signal range. This ensures excellent linearity and low distortion when switching audio signals.

The HTS3005 is a committed dual single-pole/double- throw (SPDT) that consist of two normally open (NO) and two normally close (NC) switches. This configuration can be used as a dual 2-to-1 multiplexer.

HTS3005 is available in Green TDFN-3×3-10L and MSOP-10 packages.

Features

- Low Voltage Operation: 1.8V to 5.5V
- Low On-Resistance: 0.5Ω (TYP)
- Low On-Resistance Flatness
- -3dB Bandwidth: 15MHz
- Fast Switching Times:
  - t_{ON} 50ns
  - t_{OFF} 15ns
- Rail-to-Rail Operation
- Typical Power Consumption (<0.01μW)
- TTL/CMOS Compatible
- Microsize Packages

Application

- Battery-powered, Handheld, and Portable Equipment
  - Cellular/Mobile Phones
  - Laptops, Notebooks, Palmtops
- Communication Systems
- Sample-and-Hold Circuits
- Audio Signal Routing
- Audio and Video Switching
- Portable Test and Measurement
- Medical Equipment

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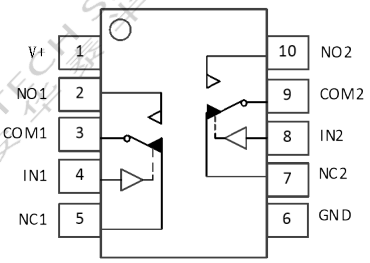
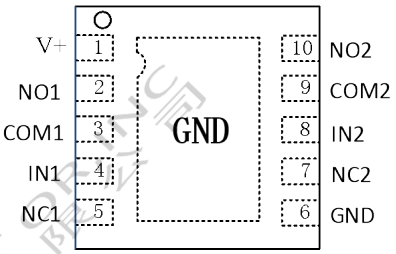
Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Pin Configurations

HTS3005
MSOP10



HTS3005
TDFN-3×3-10L



Pin Description

Symbol	Description
V+	Power supply.
GND	Ground.
IN1, IN2	Digital control pin to connect the COM terminal to the NO or NC terminals.
COM1, COM2	Common terminal.
NO1, NO2	Normally-open terminal.
NC1, NC2	Normally-closed terminal.

Ordering Information

Type Number	Package Name	Package Quantity	Marking Code
HTS3005XV10/R6	MSOP10	Tape and Reel,3000	C3005X
HTS3005XF10/R6	TDFN-3×3-10	Tape and Reel,3000	C3005X

Recommended Operating Conditions

- Operating voltage range: 1.8V to 5.5V
- Specified temperature range: -40℃ to 125℃

Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Absolute Maximum Ratings

Attention: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Parameter	Symbol	Absolute Maximum Rating	**Unit**
	V+ to GND	-0.3V to 6V	V
	Analog, Digital voltage range (1)	-0.3V to (V+) + 0.3V	V
	Continuous Current NO, NC, or COM	±300mA	mA
	Peak Current NO, NC, or COM	±500mA	mA
	Operating Temperature Range	-40°C to +125°C	°C
Temperature	Storage	--65°C to +150°C	°C
	Junction	150°C	°C
Package Thermal Resistance @ TA = 25°C	TDFN-3×3-10L, θJA	33°C/W	°C/W
	MSOP-10, θJA	205°C/W	°C/W
	Lead Temperature (soldering, 10s)	260°C	°C
ESD Susceptibility	HBM	2000V	V
	MM	400V	V

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

(2) 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.

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Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Electrical Characteristics

V+ = +5V, GND = 0V, TA = -40℃ to +125℃, typical values are at TA = + 25℃, unless otherwise noted

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
ANALOG SWITCH						
V_{NO}, V_{NC}, V_{COM}	Analog Signal Range	T_A=-40°C to + 125°C	0		V_+	V
R_{ON}	On-Resistance	0 V_{NO} or V_{NC} V_+, I_{COM} = -10mA, Test Circuit 1		0.5	0.9	Ω
		T_A=-40°C to + 125°C			1.1	Ω
R_{ON}	On-Resistance Match Between Channels	0 V_{NO} or V_{NC} V_+, I_{COM} = -10mA, Test Circuit 1		0.05	0.09	Ω
		T_A=-40°C to + 125°C			0.12	Ω
$R_{FLAT(ON)}$	On-Resistance Flatness	0 V_{NO} or V_{NC} V_+, I_{COM} = -10mA, Test Circuit 1		0.25	0.3	Ω
		T_A=-40°C to + 125°C			0.4	Ω
LEAKAGE CURRENTS						
$I_{NC(OFF)}$, $I_{NO(OFF)}$	Source OFF Leakage Current	V_{NO} or V_{NC} = 4.5V/1V, V_{COM} = 1V/4.5V, V_+ = +5.5V, Test Circuit 2		±4	±10	nA
		T_A=-40°C to + 125°C			±1000	nA
$I_{NC(ON)}$, $I_{NO(ON)}$, $I_{COM(ON)}$,	Channel ON Leakage Current	V_{NO} or V_{NC} = V_{COM} = 1V or 4.5V, V_+ = +5.5V, Test Circuit 3		±4	±10	nA
		T_A=-40°C to + 125°C			±1000	nA
DIGITAL INPUTS						
V_{INH}	Input High Voltage	T_A=-40°C to + 125°C	2.4			V
V_{INL}	Input Low Voltage	T_A=-40°C to + 125°C			0.8	V
I_{INL} or I_{INH}	Input Current	V_{IN} = V_{INH} or V_{INL}		±0.01	±0.1	μA
		T_A=-40°C to + 125°C			±1	μA
DYNAMIC CHARACTERISTICS						
t_{ON}	Turn-On Time	V_{NO} or V_{NC} = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 4		50		nS
t_{OFF}	Turn-Off Time	V_{NO} or V_{NC} = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 4		15		nS
Q	Charge Injection	C_L = 1.0nF, V_G = 0V, R_G = 0Ω, Test Circuit 5		20		pC
t_D	Break-Before-Make Time Delay	V_{NO1} or V_{NC1} = V_{NO2} or V_{NC2} = 3V, R_L = 300Ω, C_L = 35pF, Test Circuit 6		10		nS
O_{ISO}	Off Isolation	R_L=50Ω, C_L = 5pF, Test Circuit 7, f = 100kHz		-70		dB
		R_L=50Ω, C_L = 5pF, Test Circuit 7, f = 10kHz		-85		dB

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Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Electrical Characteristics

V+ = +5V, GND = 0V, TA = -40℃ to +125℃, typical values are at TA = + 25℃, unless otherwise noted

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
X_{TALK}	Channel-to-Channel Crosstalk	R_L = 50Ω, C_L = 5pF, Test Circuit 8	f = 100kHz		-90		dB
			f = 10kHz		-105		dB
THD	Total Harmonic Distortion	f = 20Hz to 20kHz, V_{COM} = 3.5V_{P-P}, R_L = 600Ω, C_L = 50pF			0.065		%
BW	-3dB Bandwidth	R_L = 50Ω, C_L = 5pF, Test Circuit 9			15		MHZ
$C_{NC(OFF)}$, $C_{NO(OFF)}$	Source off Capacitance				80		pF
$C_{NC(ON)}$, $C_{NO(ON)}$, $C_{COM(ON)}$	Channel on Capacitance				380		pF
POWER REQUIREMENTS							
I_+	Power Supply Current	V_+ = +5.5V, V_{IN} = 0V or 5V			0.001		μA
		T_A=-40°C to + 125°C				1	μA

Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Electrical Characteristics

V+ = +3V, GND = 0V, TA = -40℃ to +125℃, typical values are at TA = + 25℃, unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
ANALOG SWITCH						
V_{NO}, V_{NC}, V_{COM}	Analog Signal Range	T_A=-40°C to + 125°C	0		V_+	V
R_{ON}	On-Resistance	0 V_{NO} or V_{NC} V_+, I_{COM} = -10mA, Test Circuit 1		0.6	1.0	Ω
		T_A=-40°C to + 125°C			1.3	Ω
R_{ON}	On-Resistance Match Between Channels	0 V_{NO} or V_{NC} V_+, I_{COM} = -10mA, Test Circuit 1		0.05	0.1	Ω
		T_A=-40°C to + 125°C			0.13	Ω
$R_{FLAT(ON)}$	On-Resistance Flatness	0 V_{NO} or V_{NC} V_+, I_{COM} = -10mA, Test Circuit 1		0.25	0.3	Ω
		T_A=-40°C to + 125°C			0.4	Ω
LEAKAGE CURRENTS						
$I_{NC(OFF)}$, $I_{NO(OFF)}$	Source OFF Leakage Current	V_{NO} or V_{NC} =3V/1V, V_{COM} = 1V/3V, V_+ = +3.3V, Test Circuit 2		±5	±11	nA
		T_A=-40°C to + 125°C			±1000	nA
$I_{NC(ON)}$, $I_{NO(ON)}$, $I_{COM(ON)}$,	Channel ON Leakage Current	V_{NO} or V_{NC} = V_{COM} = 1V or 3V, V_+ = +3.3V, Test Circuit 3		±5	±11	nA
		T_A=-40°C to + 125°C			±1000	nA
DIGITAL INPUTS						
V_{INH}	Input High Voltage	T_A=-40°C to + 125°C	2.0			V
V_{INL}	Input Low Voltage	T_A=-40°C to + 125°C			0.4	V
I_{INL} *or* I_{INH}	Input Current	V_{IN} = V_{INH} or V_{INL}		±0.01	±0.1	μA
		T_A=-40°C to + 125°C			±1	μA
DYNAMIC CHARACTERISTICS						
t_{ON}	Turn-On Time	V_{NO} or V_{NC} = 2V, R_L = 300Ω, C_L = 35pF, Test Circuit 4		50		nS
t_{OFF}	Turn-Off Time	V_{NO} or V_{NC} = 2V, R_L = 300Ω, C_L = 35pF, Test Circuit 4		17		nS
Q	Charge Injection	C_L = 1.0nF, V_G = 0V, R_G = 0Ω, Test Circuit 5		25		pC
t_D	Break-Before-Make Time Delay	V_{NO1} or V_{NC1} = V_{NO2} or V_{NC2} = 2V, R_L = 300Ω, C_L = 35pF, Test Circuit 6		11		nS
O_{ISO}	Off Isolation	R_L=50Ω, C_L = 5pF, Test Circuit 7, f = 100kHz		-70		dB
		R_L=50Ω, C_L = 5pF, Test Circuit 7, f = 10kHz		-85		dB

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Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Electrical Characteristics

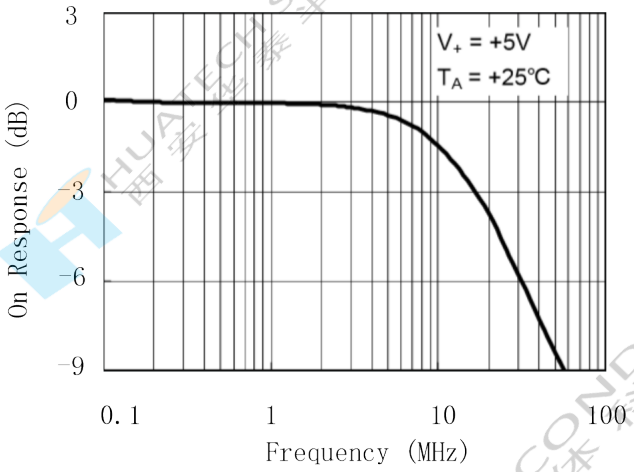
V+ = +5V, GND = 0V, TA = -40℃ to +125℃, typical values are at TA = + 25℃, unless otherwise noted

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
X_{TALK}	Channel-to-Channel Crosstalk	R_L = 50Ω, C_L = 5pF, Test Circuit 8	f = 100kHz		-90		dB
			f = 10kHz		-105		dB
THD	Total Harmonic Distortion	f = 20Hz to 20kHz, V_{COM} = 2VP-P, R_L = 600Ω, C_L = 50pF			0.06		%
BW	-3dB Bandwidth	R_L = 50Ω, C_L = 5pF, Test Circuit 9			15		MHZ
$C_{NC(OFF)}$, $C_{NO(OFF)}$	Source off Capacitance				80		pF
$C_{NC(ON)}$, $C_{NO(ON)}$, $C_{COM(ON)}$	Channel on Capacitance				380		pF
POWER REQUIREMENTS							
I_+	Power Supply Current	V_+ = +3.3V, V_{IN} = 0V or 5V			0.001		μA
		TA=-40°C to + 125°C				1	μA

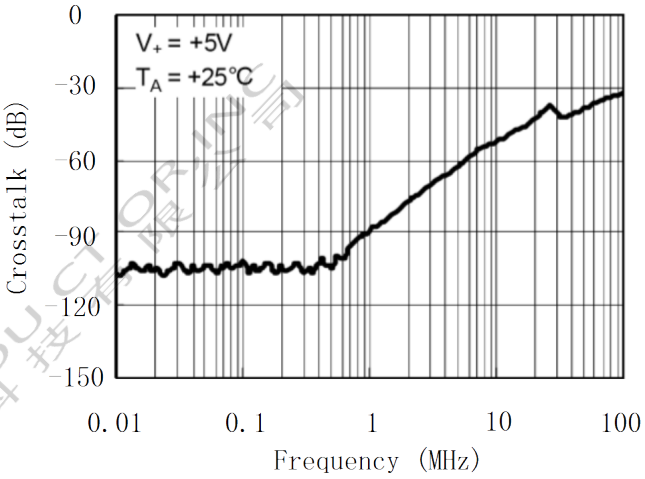
Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Type Performance Characteristics

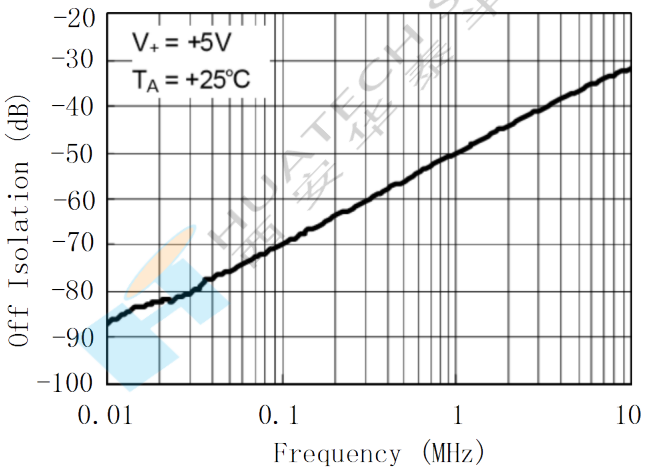
On Response vs. Frequency



Crosstalk vs. Frequency



Off Isolation vs. Frequency



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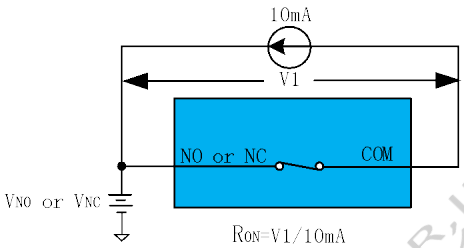
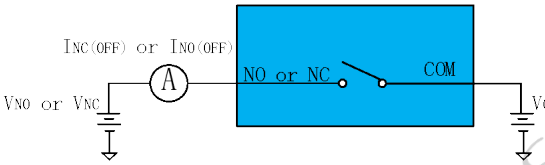
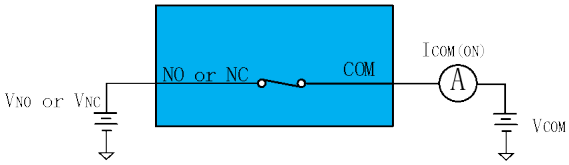
Application Notes



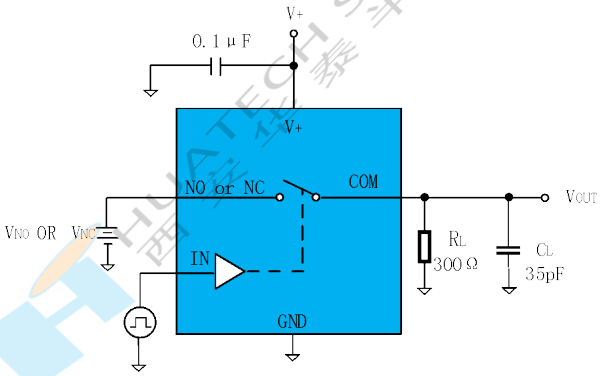
Test Circuit 1. On Resistance

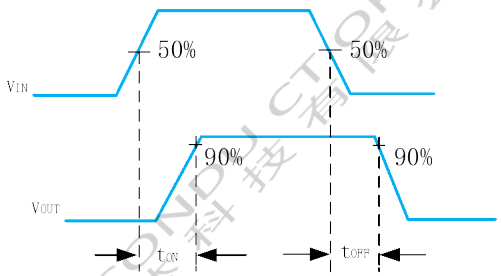


Test Circuit 2. Off Leakage

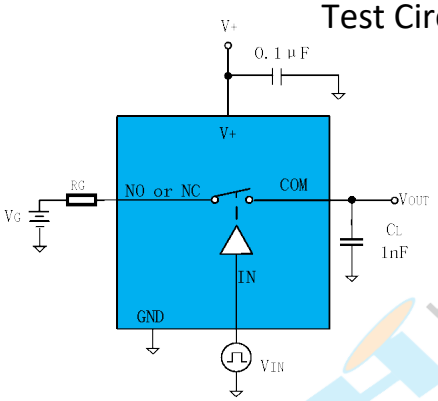


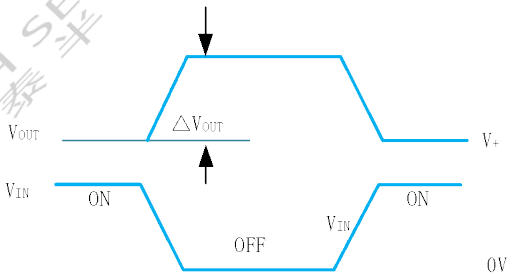
Test Circuit 3. On Leakage





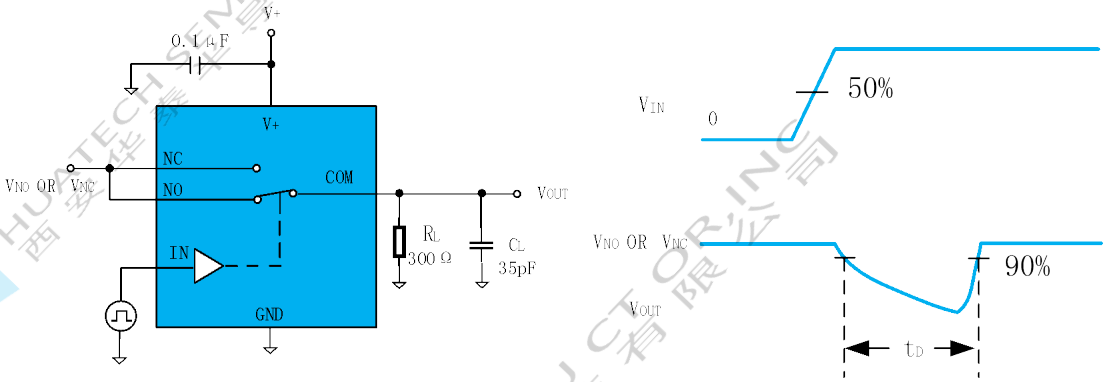
Test Circuit 4. Switching Times



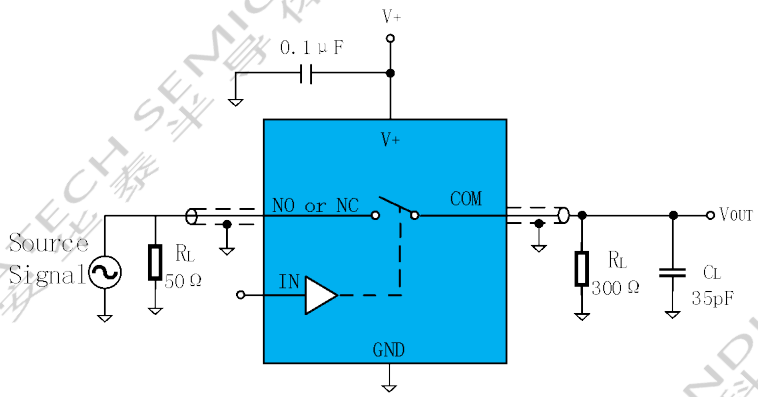


Test Circuit 5. Charge Injection

Application Notes



Test Circuit 6. Break-Before-Make Time Delay, tD



Test Circuit 7. Off Isolation

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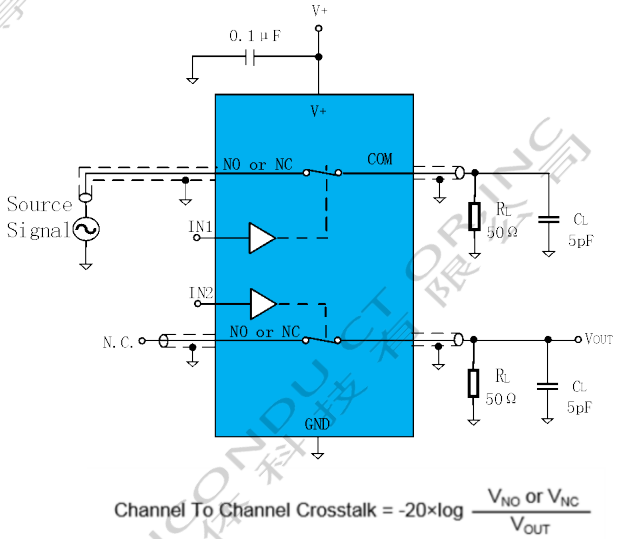
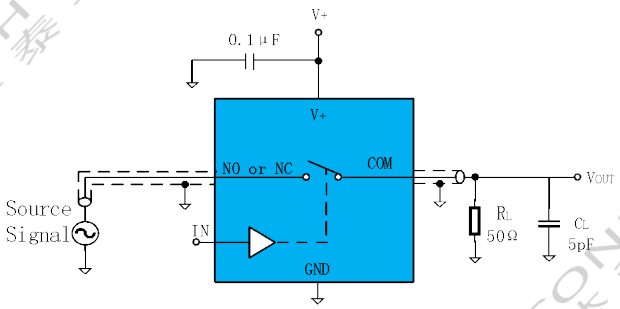
Application Notes



Test Circuit 8. Channel-to-Channel Crosstalk

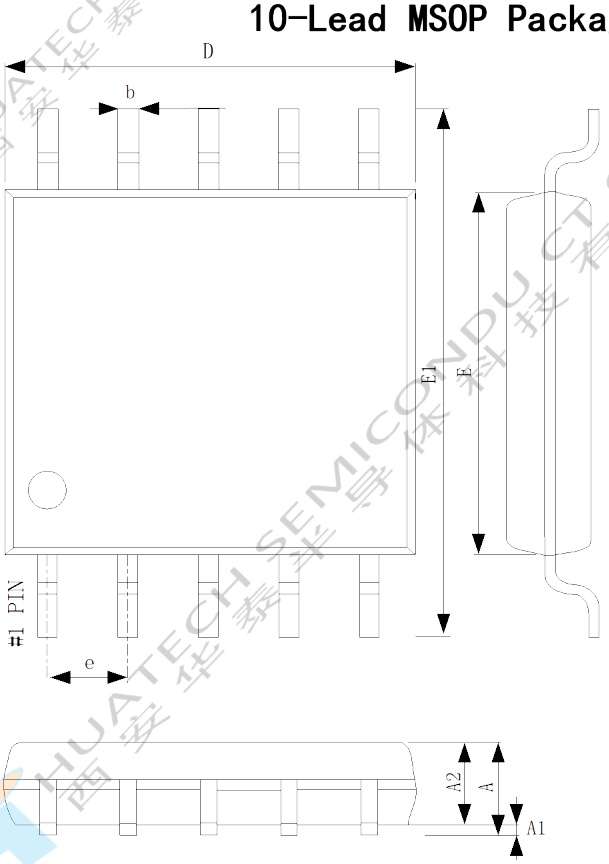


Test Circuit 9. -3dB Bandwidth

Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Package Outlines

MSOP-10



COMMON DIMENSIONS

(UNITS OF MEASURE=MILLIMETER)

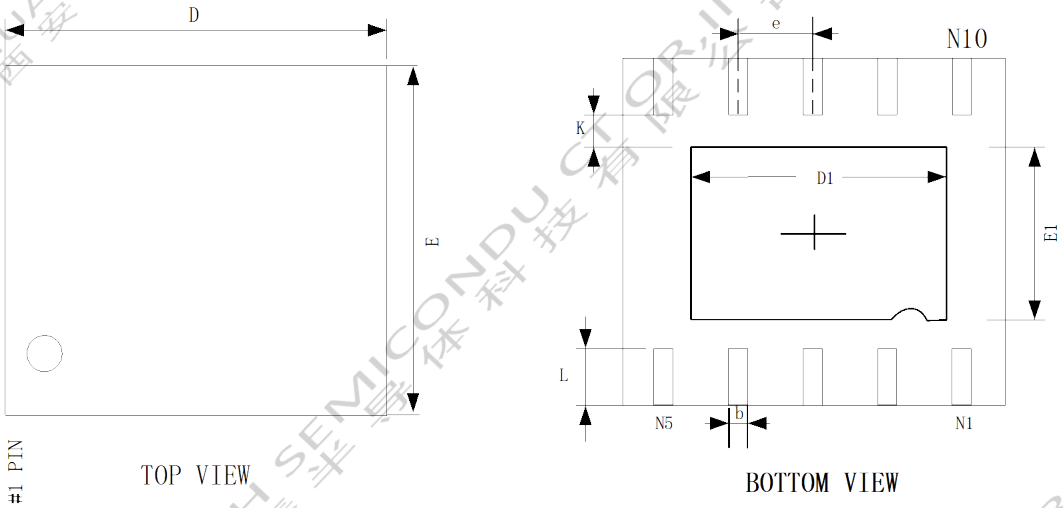
SYMBOL	MIN	MAX
A	0.820	1.100
A1	0.020	0.150
A2	0.750	0.950
b	0.180	0.280
c	0.090	0.230
D	2.900	3.100
E	2.900	3.100
E1	4.750	5.050
e	0.500BSC	
L	0.400	0.800
θ	0°	6°

Ultra Low ON-Resistance, Low Voltage, Dual, SPDT Analog Switch

Package Outlines

TDFN-3×3-10L

TDFN-3×3-10L Package Outline Diagram



COMMON DIMENSIONS

(UNITS OF MEASURE-MILLIMETER)

SYMBOL	MIN	MAX
A	0.700	0.800
A1	0.000	0.050
A2	0.203 REF	
D	2.900	3.100
D1	2.300	2.500
E	2.900	3.100
E1	1.600	1.800
K	0.200MIN	
b	0.180	0.300
e	0.500TYP	
L	0.300	0.500