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3, 2009 FN6584.1

Negative Signal Swing, High Off-Isolation, Dual SPST Single Supply Switch

The Intersil ISL54066 device is a low ON-resistance, high off-isolation, low voltage, dual single-pole/single-throw (SPST) analog switch. It was designed to operate from a single +1.8V to +6.5V supply and can pass signals that swing down to 6.5V below the positive supply rail. Targeted applications include battery powered equipment that benefit from low r_{ON} (1Ω), high off-isolation (80dB) and fast switching speeds (t_{ON} = 40ns, t_{OFF} = 30ns). The digital logic input is 1.8V logic-compatible when using a single +3V supply.

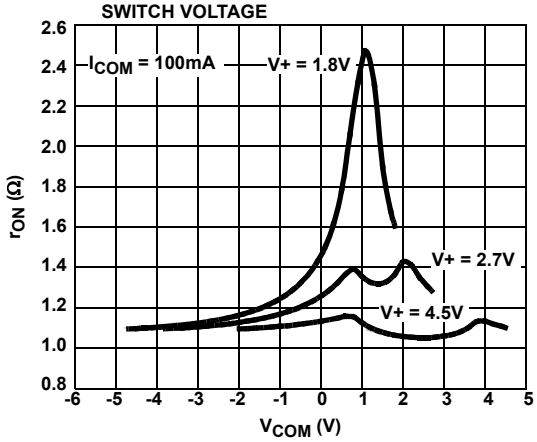
The ISL54066 incorporates a T-switch architecture. This approach results in excellent signal off-isolation while retaining a low impedance signal path when switches are ON. The ISL54066 is offered in small form factor packages, alleviating board space limitations. The ISL54066 is available in 10Ld µTQFN and TDFN packages.

The ISL54066 is a dual single-pole/single-throw (SPST) normally open (NO) switch with independent logic control.

TABLE 1. FEATURES AT A GLANCE

ISL54066	
Number of Switches	2
Switch Type	SPST NO
4.3V r_{ON}	1Ω
4.3V t_{ON}/t_{OFF}	40ns/30ns
2.7V r_{ON}	1.5Ω
2.7V t_{ON}/t_{OFF}	60ns/30ns
1.8V r_{ON}	3Ω
1.8V t_{ON}/t_{OFF}	180ns/44ns
Packages	10 Ld µTQFN, 10 Ld TDFN

ON-RESISTANCE vs SUPPLY VOLTAGE vs SWITCH VOLTAGE



Features

- Pb-free (RoHS Compliant)
- Negative Signal Swing (Max 6.5V Below V+)
- T-switch Architecture
- ON-Resistance (r_{ON})
  - V+ = +4.5V 1Ω
  - V+ = +4.3V 1Ω
  - V+ = +2.7V 1.5Ω
  - V+ = +1.8V 3Ω
- r_{ON} Matching Between Channels 10mΩ
- r_{ON} Flatness Across Signal Range 0.2Ω
- Single Supply Operation . . . . . +1.8V to +6.5V
- Low Power Consumption @ 3V (P_D). 60nW
- Fast Switching Action (V+ = +4.3V)
  - t_{ON} 40ns
  - t_{OFF} 30ns
- ESD HBM Rating . . . . . >6kV
- 1.8V Logic Compatible (+3V Supply)
- Low I+ Current when VinH is not at the V+ Rail
- Available in 10 Ld µTQFN and 10 Ld 3x3 TDFN

Applications

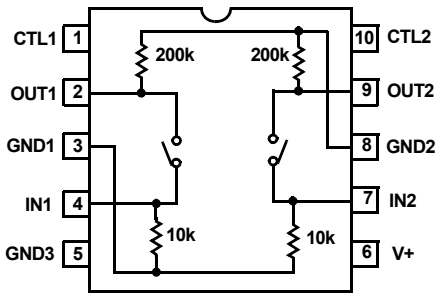
- Battery powered, Handheld, and Portable Equipment
  - Cellular/mobile Phones
  - Pagers
  - Laptops, Notebooks, Palmtops
- Portable Test and Measurement
- Medical Equipment
- Audio and Video Switching

Related Literature

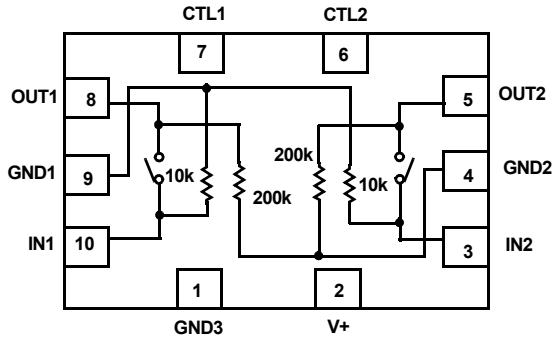
- Technical Brief TB363 “Guidelines for Handling and Processing Moisture Sensitive Surface Mount Devices (SMDs)”
- Application Note AN557 “Recommended Test Procedures for Analog Switches”

Pinouts (Note 1)

ISL54066
(10 LD TDFN)
TOP VIEW



ISL54066
(10 LD µTQFN)
TOP VIEW



NOTE:

1. Switches Shown for CTLx = Logic “0”. Logic “0” ≤0.5V. Logic “1” ≥1.4V with a 3V supply.

Truth Table

CTLx	INx/OUTx
0	OPEN
1	CLOSED

NOTE: Logic “0” ≤0.5V. Logic “1” ≥1.4V with a 3V supply.

Pin Descriptions

PIN	FUNCTION
V+	System Power Supply Input (+1.8V to +6.5V)
GND1	10kΩ Input Shunt Ground
GND2	200kΩ Output Shunt Ground
GND3	IC Ground Connection
CTLx	Digital Control Input
INx	Switch x Input
OUTx	Switch x Output

Ordering Information

PART NUMBER	PART MARKING	TEMP. RANGE (°C)	PACKAGE (Pb-free)	PKG. DWG. #
ISL54066IRZ (Note 3)	4066	-40 to +85	10 Ld 3x3 TDFN	L10.3x3A
ISL54066IRZ-T (Notes 2, 3)	4066	-40 to +85	10 Ld 3x3 TDFN (Tape and Reel)	L10.3x3A
ISL54066IRUZ-T (Notes 2, 4)	9	-40 to +85	10 Ld µTQFN (Tape and Reel)	L10.1.8x1.4A

NOTES:

2. Please refer to TB347 for details on reel specifications.
3. These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
4. These Intersil Pb-free plastic packaged products employ special Pb-free material sets; molding compounds/die attach materials and NiPdAu plate - e4 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations. Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

Absolute Maximum Ratings

V+ to GND . . . . . -0.5 to 7.0V
Input Voltages
INx (Note 5) . . . . . (V+ - 7V) to ((V+) + 0.5V)
CNTLx (Note 5) . . . . . -0.5 to ((V+) + 0.5V)
Output Voltages
OUTx (Note 5) . . . . . (V+ - 7V) to ((V+) + 0.5V)
Continuous Current INx or OUTx. . . . . ±300mA
Peak Current INx or OUTx
(Pulsed 1ms, 10% Duty Cycle, Max) . . . . . ±500mA
ESD Rating:
Human Body Model . . . . . >6kV
Machine Model. . . . . >400V
Charged Device Model. . . . . >1.5kV

Thermal Information

Thermal Resistance (Typical)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
10 Ld 3x3 TDFN Package (Notes 6, 8)	55	18
10 Ld µTQFN Package (Note 7)	155	N/A

Maximum Junction Temperature (Plastic Package). . . . . +150°C
Maximum Storage Temperature Range . . . . . -65°C to +150°C
Pb-Free Reflow Profile. . . . . .see link below
http://www.intersil.com/pbfree/Pb-FreeReflow.asp)

Operating Conditions

Temperature Range. . . . . -40°C to +85°C
Power Supply Range. . . . . +1.8V to +6.5V

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

NOTES:

5. Signals on NC, NO, IN, or COM exceeding V+ or GND by specified amount are clamped by internal diodes. Limit forward diode current to maximum current ratings.
6. θ_{JA} is measured in free air with the component mounted on a high effective thermal conductivity test board with “direct attach” features. See Tech Brief TB379.
7. θ_{JA} is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.
8. For θ_{JC}, the “case temp” location is the center of the exposed metal pad on the package underside.

Electrical Specifications - 5V Supply

Test Conditions: V+ = +4.5V to +5.5V, GND = 0V, V_{CTL_H} = 2.4V, V_{CTL_L} = 0.8V (Note 9), Unless Otherwise Specified.

PARAMETER	TEST CONDITIONS	TEMP (°C)	MIN (Notes 10, 11)	TYP	MAX (Notes 10, 11)	UNITS
ANALOG SWITCH CHARACTERISTICS						
ON-Resistance, r_{ON}	V+ = 4.5V, I_{OUT} = 100mA, V_{IN} = (V+ - 6.5) to V+, (See Figure 4)	25	-	1	-	Ω
		Full	-	1.2	-	Ω
r_{ON} Matching Between Channels, Δr_{ON}	V+ = 4.5V, I_{OUT} = 100mA, V_{IN} = Voltage at max r_{ON}, (Note 13)	25	-	5	-	mΩ
		Full	-	10	-	mΩ
r_{ON} Flatness, $R_{FLAT(ON)}$	V+ = 4.5V, I_{OUT} = 100mA, V_{IN} = (V+ - 6.5) to V+, (Note 12)	25	-	0.21	-	Ω
		Full	-	0.27	-	Ω
DYNAMIC CHARACTERISTICS						
Turn-ON Time, t_{ON}	V+ = 4.5V, V_{IN} = 3.0V, R_L = 50Ω, C_L = 35pF (See Figure 1)	25	-	39	-	ns
		Full	-	46	-	ns
Turn-OFF Time, t_{OFF}	V+ = 4.5V, V_{IN} = 3.0V, R_L = 50Ω, C_L = 35pF (See Figure 1)	25	-	27	-	ns
		Full	-	33	-	ns
Charge Injection, Q	V_G = 0V, R_G = 0Ω, C_L = 1.0nF (See Figure 2)	25	-	170	-	pC
OFF-Isolation	R_L = 50Ω, C_L = 5pF, f = 1MHz, V_{INx} = $1V_{RMS}$ (See Figure 3)	25	-	70	-	dB
Crosstalk (Channel-to-Channel)	R_L = 50Ω, C_L = 5pF, f = 1MHz, V_{IN1} = $1V_{RMS}$ (See Figure 5)	25	-	-80	-	dB
Total Harmonic Distortion	f = 20Hz to 20kHz, V_{OUT} = $2V_{P-P}$, R_L = 32Ω	25	-	0.015	-	%
-3dB Bandwidth	R_L = 50Ω	25	-	30	-	MHz
INx OFF Capacitance, C_{OFF}	f = 1MHz, GND1 = float (See Figure 6)	25	-	33	-	pF
OUTx ON Capacitance, $C_{OUT(ON)}$	f = 1MHz, GND2 = float (See Figure 6)	25	-	124	-	pF
POWER SUPPLY CHARACTERISTICS						
Positive Supply Current, I+	V+ = +5.5V, V_{CTLx} = 0V or V+	25	-	0.03	0.1	µA
		Full	-	1.64	-	µA

Electrical Specifications - 5V Supply Test Conditions: V+ = +4.5V to +5.5V, GND = 0V, V_{CTL_H} = 2.4V, V_{CTL_L} = 0.8V (Note 9), Unless Otherwise Specified. **(Continued)**

PARAMETER	TEST CONDITIONS	TEMP (°C)	MIN (Notes 10, 11)	TYP	MAX (Notes 10, 11)	UNITS
DIGITAL INPUT CHARACTERISTICS						
Input Voltage Low, V_{CTLx_L}		Full	-	-	0.8	V
Input Voltage High, V_{CTLx_H}		Full	2.4	-	-	V
Input Current, I_{CTLx_H}, I_{CTLx_L}	V+ = 5.5V, V_{CTLx} = 0V or V+	25	-0.1	-	0.1	µA
		Full	-	0.9	-	µA

Electrical Specifications - 4.3V Supply Test Conditions: V+ = +3.9V to +4.5V, GND = 0V, V_{CTL_H} = 1.6V, V_{CTL_L} = 0.5V (Note 9), Unless Otherwise Specified.

PARAMETER	TEST CONDITIONS	TEMP (°C)	MIN (Notes 10, 11)	TYP	MAX (Notes 10, 11)	UNITS
ANALOG SWITCH CHARACTERISTICS						
ON-Resistance, r_{ON}	V+ = 4.3V, I_{OUT} = 100mA, V_{IN} = (V+ - 6.5) to V+, (See Figure 4)	25	-	1	-	Ω
		Full	-	1.2	-	Ω
r_{ON} Matching Between Channels, Δr_{ON}	V+ = 4.3V, I_{OUT} = 100mA, V_{IN} = Voltage at max r_{ON}, (Note 13)	25	-	5	-	mΩ
		Full	-	10	-	mΩ
r_{ON} Flatness, $R_{FLAT(ON)}$	V+ = 4.3V, I_{OUT} = 100mA, V_{IN} = (V+ - 6.5) to V+ (Note 12, 14)	25	-	0.2	-	Ω
		Full	-	0.27	-	Ω
DYNAMIC CHARACTERISTICS						
Turn-ON Time, t_{ON}	V+ = 3.9V, V_{IN} = 3.0V, R_L = 50Ω, C_L = 35pF (See Figure 1)	25	-	40	-	ns
		Full	-	47	-	ns
Turn-OFF Time, t_{OFF}	V+ = 3.9V, V_{IN} = 3.0V, R_L = 50Ω, C_L = 35pF, (See Figure 1)	25	-	31	-	ns
		Full	-	34	-	ns
Charge Injection, Q	C_L = 1.0nF, V_G = 0V, R_G = 0Ω, (See Figure 2)	25	-	200	-	pC
OFF-Isolation	R_L = 50Ω, C_L = 5pF, f = 1MHz, V_{INx} = $1V_{RMS}$ (See Figure 3)	25	-	70	-	dB
Crosstalk (Channel-to-Channel)	R_L = 50Ω, C_L = 5pF, f = 1MHz, V_{IN1} = $1V_{RMS}$ (See Figure 5)	25	-	-80	-	dB
Total Harmonic Distortion	f = 20Hz to 20kHz, V_{COM} = $2V_{P-P}$, R_L = 32Ω	25	-	0.02	-	%
INx OFF Capacitance, C_{OFF}	f = 1MHz, GND1 = float (See Figure 6)	25	-	33	-	pF
OUTx ON Capacitance, $C_{OUT(ON)}$	f = 1MHz, GND2 = float (See Figure 6)	25	-	124	-	pF
POWER SUPPLY CHARACTERISTICS						
Positive Supply Current, I+	V+ = +4.5V, V_{CTLx} = 0V or V+	25	-	0.02	0.1	µA
		Full	-	1.76	-	µA
Positive Supply Current, I+	V+ = +4.2V, V_{CTL1} = V_{CTL2} = 2.85V	25	-	0.95	12	µA
DIGITAL INPUT CHARACTERISTICS						
Input Voltage Low, V_{CTLx_L}		Full	-	-	0.5	V
Input Voltage High, V_{CTLx_H}		Full	1.6	-	-	V
Input Current, I_{CTLx_H}, I_{CTLx_L}	V+ = 4.5V, V_{CTLx} = 0V or V+	25	-0.5	-	0.5	µA
		Full	-	0.63	-	µA

Electrical Specifications - 3V Supply

Test Conditions: V+ = +2.7V to +3.3V, GND = 0V, V_{CTL_H} = 1.4V, V_{CTL_L} = 0.5V (Note 9), Unless Otherwise Specified.

PARAMETER	TEST CONDITIONS	TEMP (°C)	MIN (Notes 10, 11)	TYP	MAX (Notes 10, 11)	UNITS
ANALOG SWITCH CHARACTERISTICS						
ON-Resistance, r_{ON}	V+ = 2.7V, I_{OUT} = 100mA, V_{IN} = (V+ - 6.5) to V+ (See Figure 4)	25	-	1.5	-	Ω
		Full	-	1.9	-	Ω
r_{ON} Matching Between Channels, Δr_{ON}	V+ = 2.7V, I_{OUT} = 100mA, V_{IN} = Voltage at max r_{ON}, (Note 13)	25	-	10	-	mΩ
		Full	-	10	-	mΩ
r_{ON} Flatness, $R_{FLAT(ON)}$	V+ = 2.7V, I_{OUT} = 100mA, V_{IN} = (V+ - 6.5) to V+ (Notes 12, 14)	25	-	0.63	1	Ω
		Full	-	0.68	1.35	Ω
DYNAMIC CHARACTERISTICS						
Turn-ON Time, t_{ON}	V+ = 2.7V, V_{IN} = 1.5V, R_L = 50Ω, C_L = 35pF (See Figure 1)	25	-	60	-	ns
		Full	-	68	-	ns
Turn-OFF Time, t_{OFF}	V+ = 2.7V, V_{IN} = 1.5V, R_L = 50Ω, C_L = 35pF (See Figure 1)	25	-	31	-	ns
		Full	-	35	-	ns
Charge Injection, Q	C_L = 1.0nF, V_G = 0V, R_G = 0Ω, (See Figure 2)	25	-	150	-	pC
OFF-Isolation	R_L = 50Ω, C_L = 5pF, f = 1MHz, V_{INx} = $1V_{RMS}$ (See Figure 3)	25	-	70	-	dB
Crosstalk (Channel-to-Channel)	R_L = 50Ω, C_L = 5pF, f = 1MHz, V_{IN1} = $1V_{RMS}$ (See Figure 5)	25	-	-80	-	dB
Total Harmonic Distortion	f = 20Hz to 20kHz, V_{OUT} = $2V_{P-P}$, R_L = 32Ω	25	-	0.04	-	%
INx OFF Capacitance, C_{OFF}	f = 1MHz, GND1 = float (See Figure 6)	25	-	33	-	pF
OUTx ON Capacitance, $C_{OUT(ON)}$	f = 1MHz, GND2 = float (See Figure 6)	25	-	124	-	pF
POWER SUPPLY CHARACTERISTICS						
Positive Supply Current, I+	V+ = +3.6V, V_{CTLx} = 0V or V+	25	-	0.02	-	µA
		Full	-	1.76	-	µA
DIGITAL INPUT CHARACTERISTICS						
Input Voltage Low, V_{CTLx_L}		25	-	-	0.5	V
Input Voltage High, V_{CTLx_H}		25	1.4	-	-	V
Input Current, I_{CTLx_H}, I_{CTLx_L}	V+ = 3.3V, $V_{CTL\ x}$ = 0V or V+	25	-0.5	-	0.5	µA
		Full	-	0.55	-	µA

Electrical Specifications - 1.8V Supply

Test Conditions: V+ = +1.8V, GND = 0V, V_{CTL_H} = 1.0V, V_{CTL_L} = 0.4V (Note 9), Unless Otherwise Specified.

PARAMETER	TEST CONDITIONS	TEMP (°C)	MIN (Notes 10, 11)	TYP	MAX (Notes 10, 11)	UNITS
ANALOG SWITCH CHARACTERISTICS						
ON-Resistance, r_{ON}	V+ = 1.8V, I_{OUT} = 100mA, V_{IN} = (V+ - 6.5V) to V+, (See Figure 4)	25	-	3	-	Ω
		Full	-	3.2	-	Ω
r_{ON} Matching Between Channels, ΔR_{ON}	V+ = 1.8V, I_{OUT} = 100mA, V_{IN} = Voltage at max r_{ON}, (Note 13)	25	-	20	-	mΩ
		Full	-	20	-	mΩ
r_{ON} Flatness, $R_{FLAT(ON)}$	V+ = 1.8V, I_{OUT} = 100mA, V_{IN} = (V+ - 6.5) to V+, (Note 12)	25	-	2.3	-	Ω
		Full	-	2.5	-	Ω

Electrical Specifications - 1.8V Supply Test Conditions: V+ = +1.8V, GND = 0V, V_{CTL_H} = 1.0V, V_{CTL_L} = 0.4V (Note 9), Unless Otherwise Specified. **(Continued)**

PARAMETER	TEST CONDITIONS	TEMP (°C)	MIN (Notes 10, 11)	TYP	MAX (Notes 10, 11)	UNITS
DYNAMIC CHARACTERISTICS						
Turn-ON Time, t_{ON}	V+ = 1.8V, V_{IN} = 1.8V, R_L = 50Ω, C_L = 35pF (See Figure 1)	25	-	180	-	ns
Turn-OFF Time, t_{OFF}	V+ = 1.8V, V_{IN} = 1.8V, R_L = 50Ω, C_L = 35pF (See Figure 1)	25	-	44	-	ns
Charge Injection, Q	C_L = 1.0nF, V_G = 0V, R_G = 0Ω, (See Figure 2)	25	-	40	-	pC
-3dB Bandwidth	V_{COM} = $1V_{RMS}$, R_L = 50Ω, C_L = 5pF	25	-	30	-	MHz
INx OFF Capacitance, C_{OFF}	f = 1MHz, GND1 = float (See Figure 6)	25	-	33	-	pF
OUTx ON Capacitance, $C_{OUT(ON)}$	f = 1MHz, GND2 = float (See Figure 6)	25	-	124	-	pF
DIGITAL INPUT CHARACTERISTICS						
Input Voltage Low, V_{CTLx_L}		25	-	-	0.4	V
Input Voltage High, V_{CTLx_H}		25	1.0	-	-	V
Input Current, I_{CTLx_H}, I_{CTLx_L}	V+ = 2.0V, V_{CTLx} = 0V or V+	25	-0.5	-	-	µA
		Full	-	0.5	-	µA

NOTES:

9. V_{CTL_x} = input voltage to perform proper function.
10. The algebraic convention, whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
11. Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested.
12. Flatness is defined as the difference between maximum and minimum value of ON-resistance over the specified analog signal range.
13. r_{ON} matching between channels is calculated by subtracting the channel with the highest max r_{ON} value from the channel with lowest max r_{ON} value, between IN1 and IN2.
14. Limits established by characterization and are not production tested.

Test Circuits and Waveforms

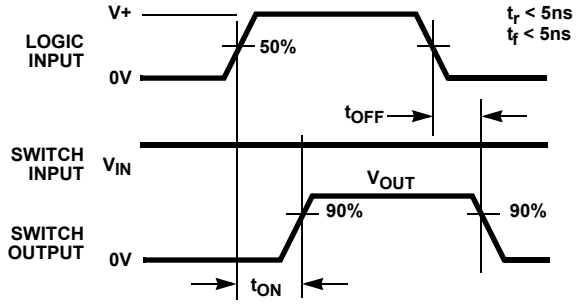
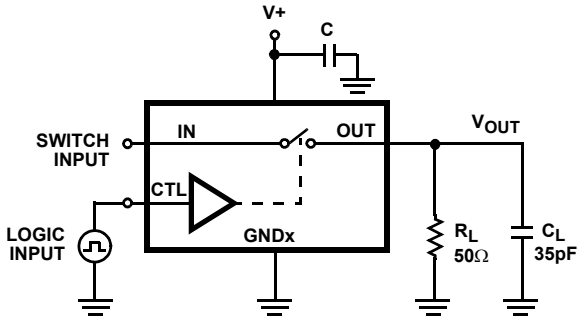


FIGURE 1A. MEASUREMENT POINTS



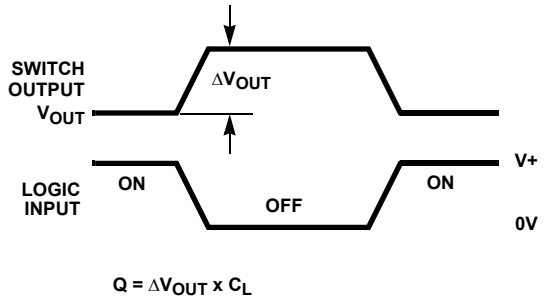
Repeat test for all switches. C_L includes fixture and stray capacitance.

$$V_{OUT} = V_{(IN)} \frac{R_L}{R_L + r_{ON}}$$

FIGURE 1B. TEST CIRCUIT

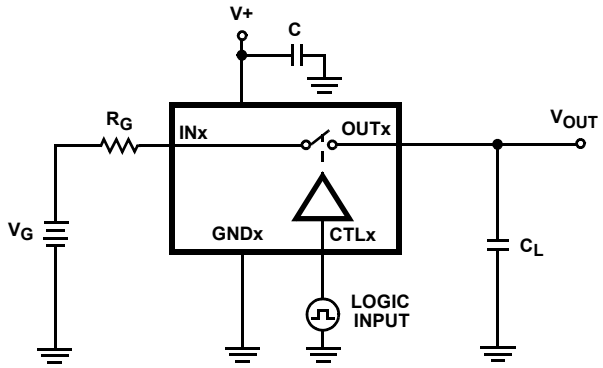
FIGURE 1. SWITCHING TIMES

Test Circuits and Waveforms (Continued)



$Q = \Delta V_{OUT} \times C_L$

FIGURE 2A. MEASUREMENT POINTS



Repeat test for all switches.

FIGURE 2B. TEST CIRCUIT

FIGURE 2. CHARGE INJECTION

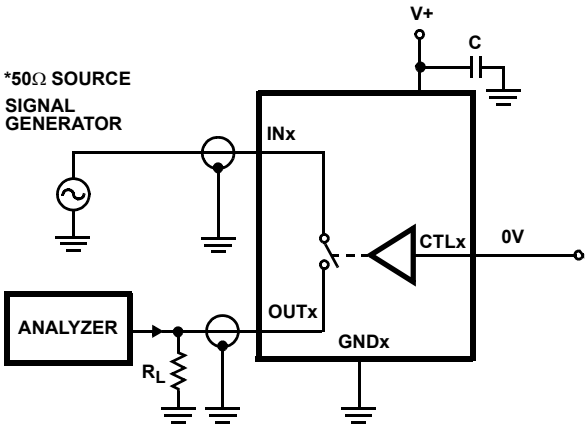
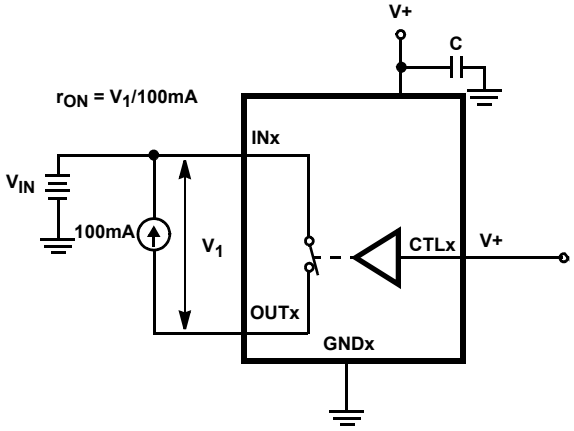


FIGURE 3. OFF-ISOLATION TEST CIRCUIT



Repeat test for all switches.

FIGURE 4. r_{ON} TEST CIRCUIT

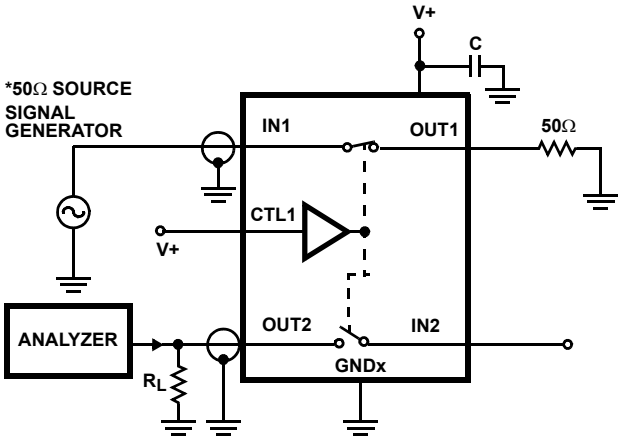
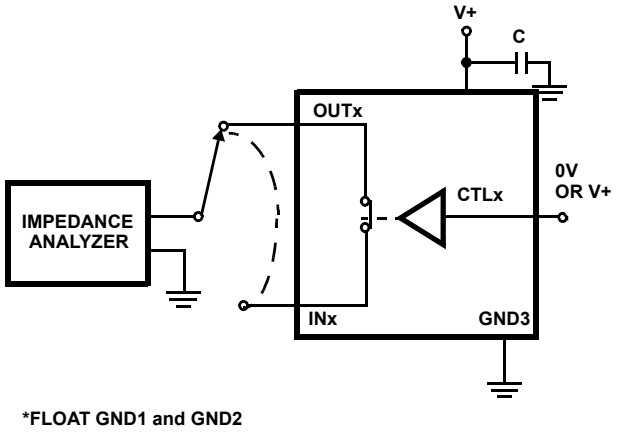


FIGURE 5. CROSSTALK TEST CIRCUIT



*FLOAT GND1 and GND2

FIGURE 6. CAPACITANCE TEST CIRCUIT

The ISL54066 is a dual single pole-single throw (SPST) analog switch that offers precise switching from a single 1.8V to 6.5V supply with low ON-resistance (1.5Ω), high off-isolation, high speed operation (t_{ON} = 60ns, t_{OFF} = 30ns) and negative signal swing capability. The device is especially well suited for portable battery powered equipment due to its low operating supply voltage (1.8V), low power consumption (30nA), and a tiny 1.8mmx1.4mm µTQFN package or a 3mmx3mm TDFN package. The low r_{ON} resistance and r_{ON} flatness provide very low insertion loss and signal distortion for applications that require signal switching with minimal interference by the switch. In additon, the ISL54066 uses a T-switch architecture to achieve superior off-isolation from the input to output of the switch.

Input/Output Shunt Resistors

The ISL54066 contains input and output shunts resistors on the switch terminals. On the INx pins, there are 10kΩ shunts to the GND1 pin. On the OUTx pins, there are 200kΩ shunts to the GND2 pin. The input shunts are designed to discharge voltage that may be built up on the input pins, such as DC offsets due to AC-coupled signals. The output shunts are designed to bleed off any charge that may accumulate on the output pins when the switch is turned off.

To have the shunt resistors enabled, connect the GND1 and GND2 pins to GND3. The GND3 pin is the main ground of the ISL54066 IC. The shunt resistors can be disconnected from the IC by floating the appropriate GND1 and GND2 pin.

Grounding Considerations

For maximum off-isolation performance, it is recommended to follow a star ground configuration of the GNDx pins (see Figure 7). Grounding the GND1, GND2 and GND3 pins to a star ground ensures there are no cross conduction of ground currents between the ground pins, which effect the off-isolation capability of the switch.

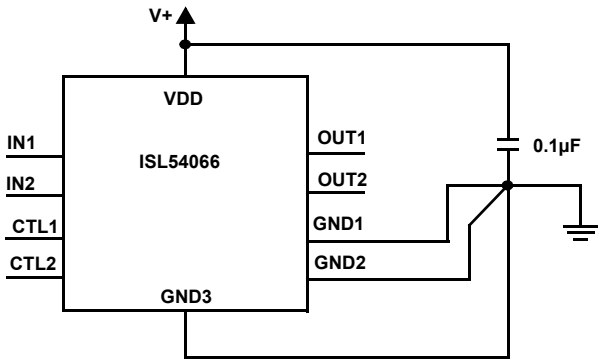


FIGURE 7. STAR GROUNDING CONFIGURATION

Supply Sequencing and Overvoltage Protection

With any CMOS device, proper power supply sequencing is required to protect the device from excessive input currents which might permanently damage the IC. All I/O pins contain ESD protection diodes from the pin to V+ and to GND (see Figure 8). To prevent forward biasing these diodes, V+ must be applied before any input signals, and the input signal voltages must remain between (V_+ - 6.5V) and V+.

If these conditions cannot be guaranteed, then precautions must be implemented to prohibit the current and voltage at the logic pin and signal pins from exceeding the maximum ratings of the switch. The following two methods can be used to provided additional protection to limit the current in the event that the voltage at a logic pin or switch terminal goes above the V+ rail.

Logic inputs can be protected by adding a 1kΩ resistor in series with the logic input (see Figure 8). The resistor limits the input current below the threshold that produces permanent damage.

This method is not acceptable for the signal path inputs. Adding a series resistor to the switch input defeats the purpose of using a low r_{ON} switch. Alternatively, connecting external Schottky diodes from the V+ rail to the signal pins will shunt the fault current through the Schottky diode instead of through the internal ESD diodes, thereby protecting the switch. These Schottky diodes must be sized to handle the expected fault current..

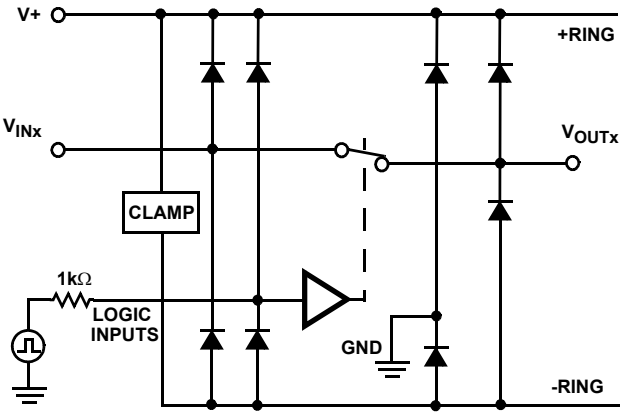


FIGURE 8. OVERVOLTAGE PROTECTION

Power-Supply Considerations

The ISL54066 construction is typical of most single supply CMOS analog switches which have two supply pins: V+ and GND. V+ and GND provide the CMOS switch bias and sets their analog voltage limits. Unlike switches with a 5.5V maximum supply voltage, the ISL54066 have a 6.5V maximum supply voltage providing plenty of head room for the 10% tolerance of 5V supplies due to overshoot and noise spikes.

The minimum recommended supply voltage is +1.8V. It is important to note that the input signal range, switching times, and on-resistance degrade at lower supply voltages. Refer to the “Electrical Specifications” tables, beginning on page 3 and “Typical Performance Curves”, beginning on page 10 for details.

V+ and GND also power the internal logic and level shifters. The level shifters convert the input logic levels to V+ and GND signals levels to drive the analog switch gate terminals. A high frequency decoupling capacitor placed as close to the V+ and GND pin as possible is recommended for proper operation of the switch. A value of 0.1µF is highly recommended.

Negative Signal Swing Capability

The ISL54066 contains circuitry that allows the analog switch signal to swing below ground. The device has an analog signal range of 6.5V below V+ up to the V+ rail (see Figure 14) while maintaining low r_{ON} performance. For example, if V+ = 5V, then the analog input signal range is from -1.5V to +5V. If V+ = 2.7V then the range is from -3.8V to +2.7V.

Logic-Level Thresholds

This switch family is 1.8V CMOS compatible (0.45V V_{OLMAX} and 1.35V V_{OHMIN}) over a supply range of 1.8V to 3.3V (see Figure 16). At 3.3V the V_{IL} level is 0.5V maximum. This is still below the 1.8V CMOS guaranteed low output maximum level of 0.45V, but noise margin is reduced. At 3.3V the V_{IH} level is 1.4V minimum. While this is above the 1.8V CMOS guaranteed high output minimum of 1.35V under most operating conditions the switch will recognize this as a valid logic high.

The digital input stages draw supply current whenever the digital input voltage is not at one of the supply rails. Driving the digital input signals from GND to V+ with a fast transition time minimizes power dissipation. The ISL54066 has been designed to minimize the supply current whenever the digital input voltage is not driven to the supply rails (0V to V+). For example, driving the device with 2.85V logic high while operating with a 4.2V supply, the device draws only 1µA of current.

High-Frequency Performance

In 50Ω systems, the ISL54066 has a -3dB bandwidth of 30MHz (see Figure 19). The frequency response is very consistent over a wide V+ range and for varying analog signal levels.

An OFF switch acts like a capacitor and passes higher frequencies with less attenuation, resulting in signal feedthrough from a switch's input to its output. Off-Isolation is the resistance to this feed-through, while Crosstalk indicates the amount of feedthrough from one switch to another. Figure 20 details the high Off-Isolation and Crosstalk rejection provided by this part. At 1MHz, Off-Isolation is approximately 70dB in 50Ω systems, decreasing approximately 40dB per decade as frequency increases. Crosstalk is approximately -80dB at 1MHz in 50Ω systems.

Leakage Considerations

Reverse ESD protection diodes are internally connected between each analog-signal pin, V+ and GND. One of these diodes conducts if any analog signal exceeds the recommended analog signal range.

Virtually all the analog switch leakage current comes from the ESD diodes and reversed biased junctions in the switch cell. Although the ESD diodes on a given signal pin are identical and therefore fairly well balanced, they are reverse biased differently. Each is biased to either the +Ring or -Ring and the analog input signal. This means their leakages will vary as the signal varies. The difference in the two diode leakages to the +Ring or -Ring and the reverse biased junctions at the internal switch cell constitutes the analog-signal-path leakage current.

Typical Performance Curves T_A = +25°C, Unless Otherwise Specified

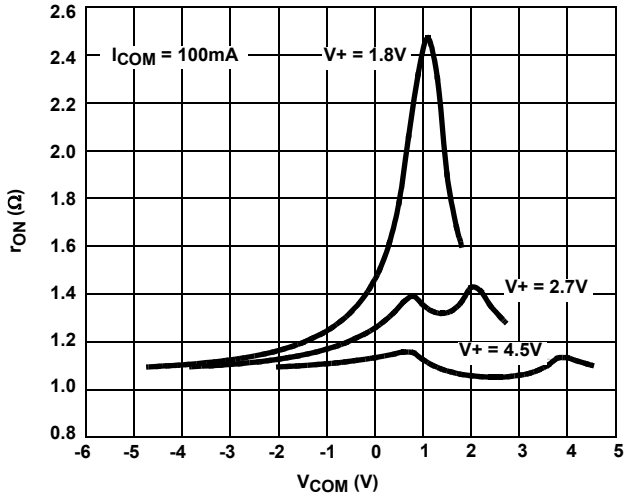


FIGURE 9. ON-RESISTANCE vs SUPPLY VOLTAGE vs SWITCH VOLTAGE

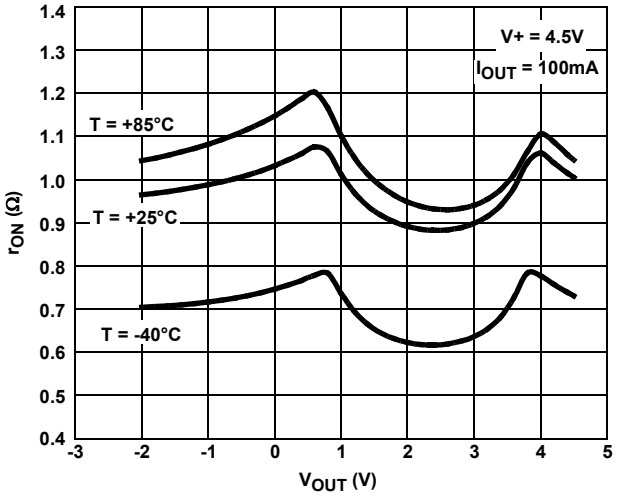


FIGURE 10. ON-RESISTANCE vs SWITCH VOLTAGE

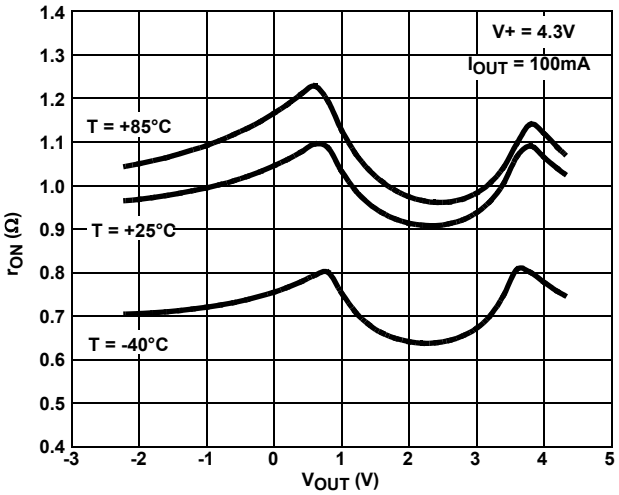


FIGURE 11. ON-RESISTANCE vs SWITCH VOLTAGE

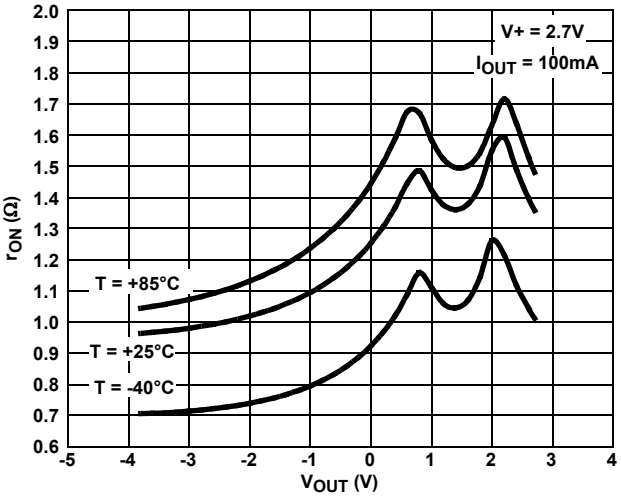


FIGURE 12. ON-RESISTANCE vs SWITCH VOLTAGE

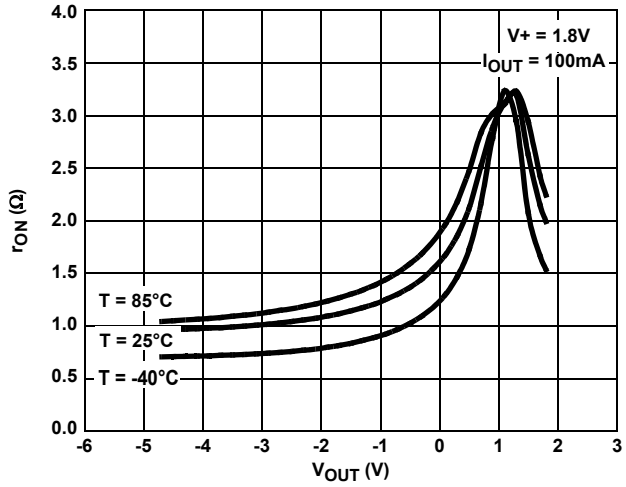


FIGURE 13. ON-RESISTANCE vs SWITCH VOLTAGE

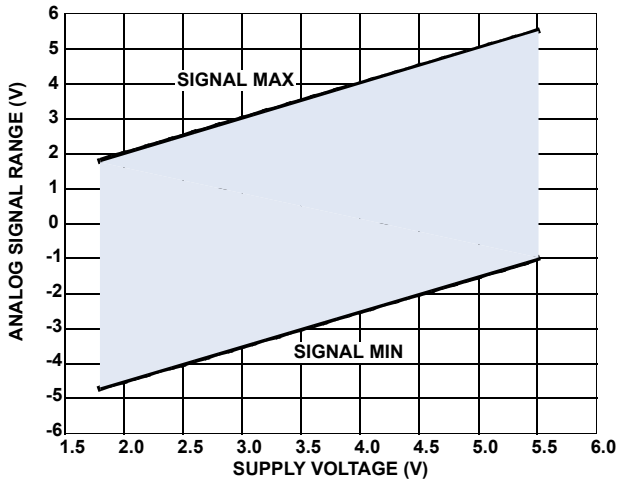


FIGURE 14. ANALOG SIGNAL RANGE vs SUPPLY VOLTAGE

Typical Performance Curves T_A = +25°C, Unless Otherwise Specified **(Continued)**

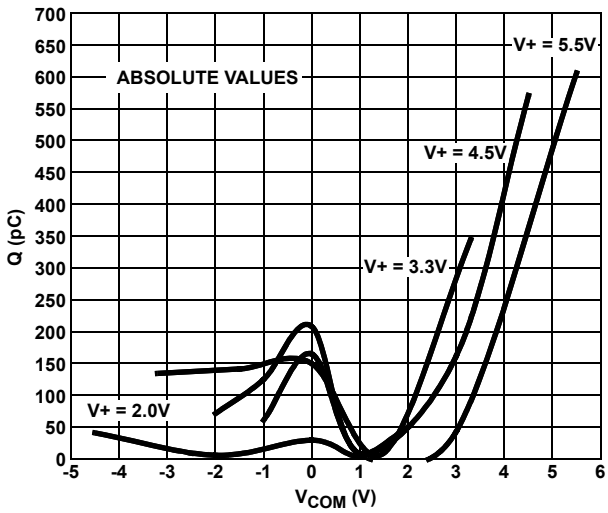


FIGURE 15. CHARGE INJECTION vs SWITCH VOLTAGE

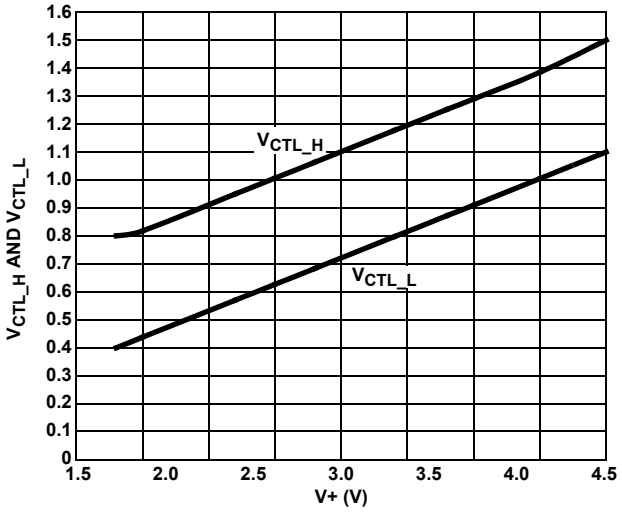


FIGURE 16. DIGITAL SWITCHING POINT vs SUPPLY VOLTAGE

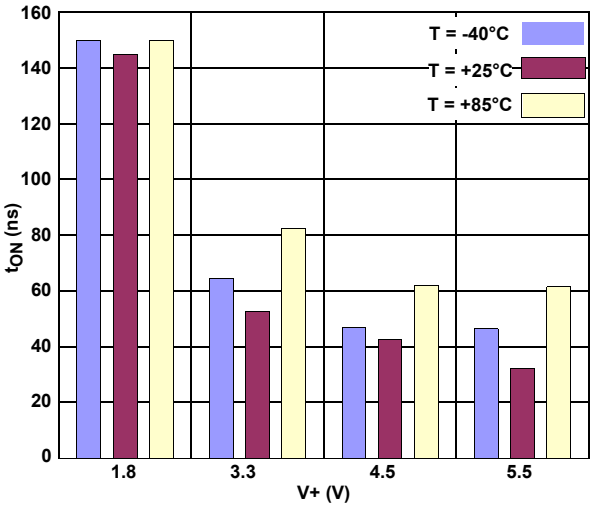


FIGURE 17. TURN-ON TIME vs SUPPLY VOLTAGE

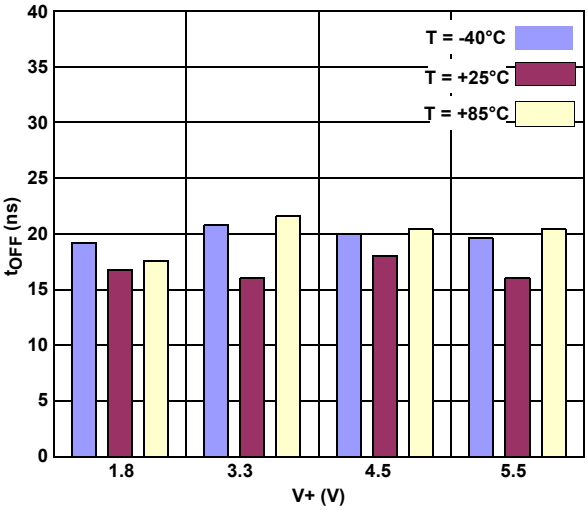


FIGURE 18. TURN-OFF TIME vs SUPPLY VOLTAGE

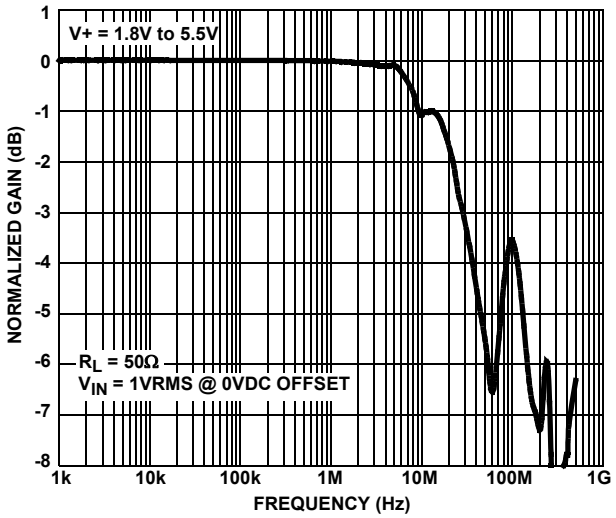


FIGURE 19. FREQUENCY RESPONSE

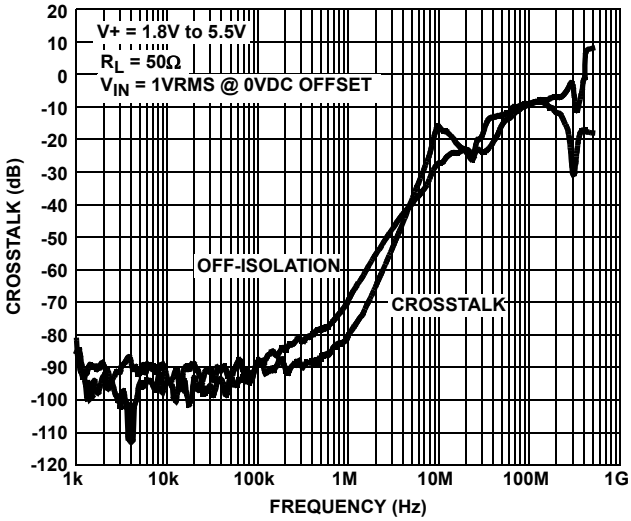


FIGURE 20. CROSSTALK AND OFF-ISOLATION

Typical Performance Curves T_A = +25°C, Unless Otherwise Specified **(Continued)**

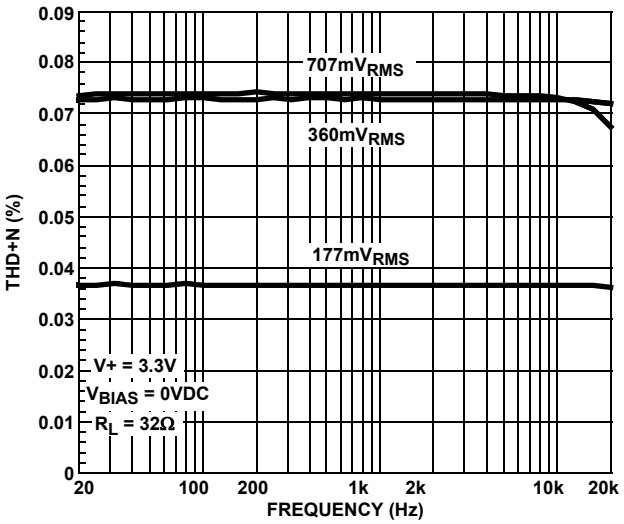


FIGURE 21. TOTAL HARMONIC DISTORTION vs FREQUENCY

Die Characteristics

SUBSTRATE POTENTIAL (POWERED UP):

GND (DFN Paddle Connection: Tie to GND or Float)

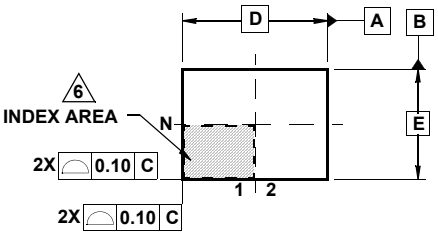
TRANSISTOR COUNT:

432

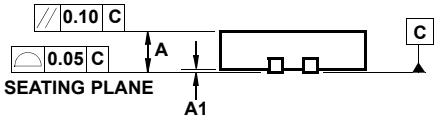
PROCESS:

Submicron CMOS

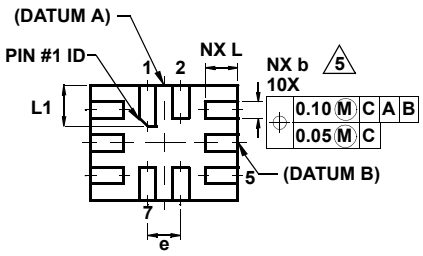
Ultra Thin Quad Flat No-Lead Plastic Package (UTQFN)



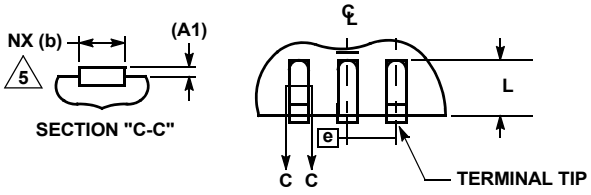
TOP VIEW

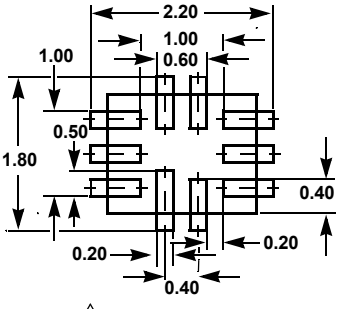


SIDE VIEW



BOTTOM VIEW





L10.1.8x1.4A

10 LEAD ULTRA THIN QUAD FLAT NO-LEAD PLASTIC PACKAGE

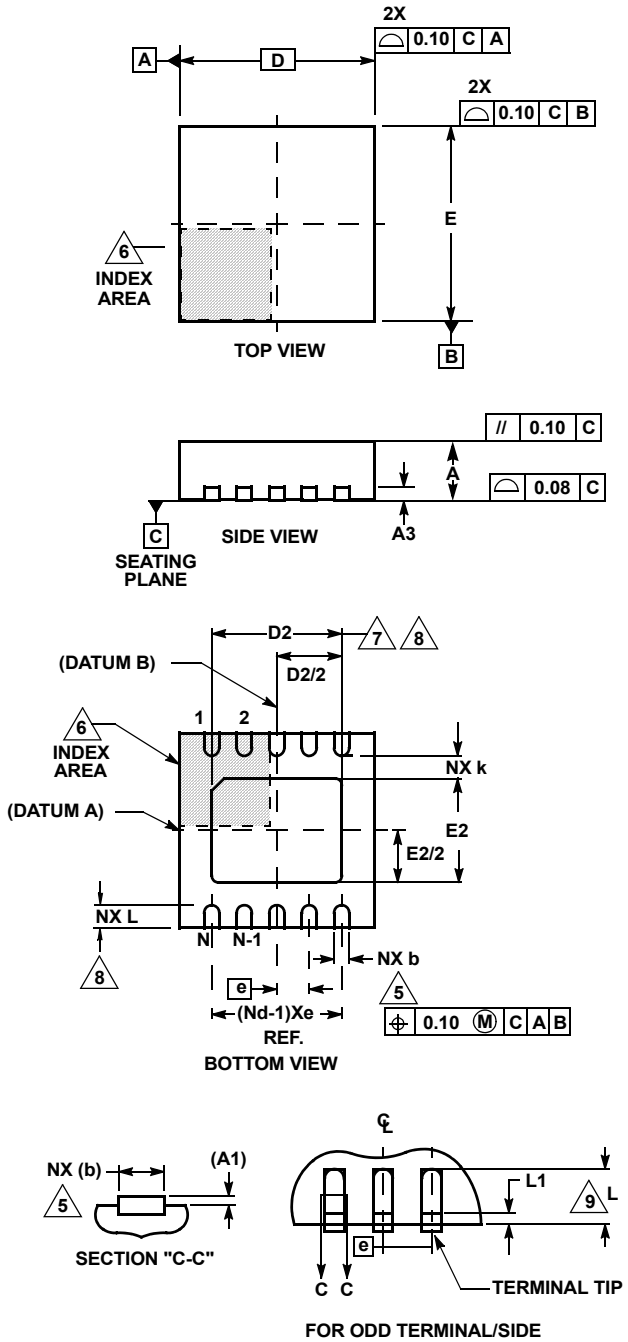
SYMBOL	MILLIMETERS			NOTES
	MIN	NOMINAL	MAX	
A	0.45	0.50	0.55	-
A1	-	-	0.05	-
A3		0.127 REF		-
b	0.15	0.20	0.25	5
D	1.75	1.80	1.85	-
E	1.35	1.40	1.45	-
e		0.40 BSC		-
L	0.35	0.40	0.45	-
L1	0.45	0.50	0.55	-
N		10		2
Nd		2		3
Ne		3		3
θ	0	-	12	4

Rev. 3 6/06

NOTES:

1. Dimensioning and tolerancing conform to ASME Y14.5-1994.
2. N is the number of terminals.
3. Nd and Ne refer to the number of terminals on D and E side, respectively.
4. All dimensions are in millimeters. Angles are in degrees.
5. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 identifier may be either a mold or mark feature.
7. Maximum package warpage is 0.05mm.
8. Maximum allowable burrs is 0.076mm in all directions.
9. JEDEC Reference MO-255.
10. For additional information, to assist with the PCB Land Pattern Design effort, see Intersil Technical Brief TB389.

Thin Dual Flat No-Lead Plastic Package (TDFN)



L10.3x3A

10 LEAD THIN DUAL FLAT NO-LEAD PLASTIC PACKAGE

SYMBOL	MILLIMETERS			NOTES
	MIN	NOMINAL	MAX	
A	0.70	0.75	0.80	-
A1	-	-	0.05	-
A3		0.20 REF		-
b	0.20	0.25	0.30	5, 8
D	2.95	3.0	3.05	-
D2	2.25	2.30	2.35	7, 8
E	2.95	3.0	3.05	-
E2	1.45	1.50	1.55	7, 8
e		0.50 BSC		-
k	0.25	-	-	-
L	0.25	0.30	0.35	8
N		10		2
Nd		5		3

Rev. 3 3/06

NOTES:

1. Dimensioning and tolerancing conform to ASME Y14.5-1994.
2. N is the number of terminals.
3. Nd refers to the number of terminals on D.
4. All dimensions are in millimeters. Angles are in degrees.
5. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 identifier may be either a mold or mark feature.
7. Dimensions D2 and E2 are for the exposed pads which provide improved electrical and thermal performance.
8. Nominal dimensions are provided to assist with PCB Land Pattern Design efforts, see Intersil Technical Brief TB389.
9. Compliant to JEDEC MO-229-WEED-3 except for D2 dimensions.