ISL54207

Low Voltage, Dual SPDT, USB/CVBS/ Audio Switches, with Negative Signal Capability

FN6403
Rev 0.00
December 5, 2006

The Intersil ISL54207 dual SPDT (Single Pole/Double Throw) switches combine low distortion audio/video and accurate USB 2.0 high speed (480Mbps) data signal switching in the same low voltage device. When operated with a 2.7V to 3.6V single supply, these analog switches allow audio/video signal swings below-ground, allowing the use of a common USB and audio/video connector in digital cameras, camcorders and other portable battery powered Personal Media Player devices.

The ISL54207 incorporates circuitry for detection of the USB V_{BUS} voltage, which is used to switch between the audio/video and USB signal sources in the portable device. The part has a control pin to open all the switches and put the part in a low power down state.

The ISL54207 is available in a small 10 Ld 2.1mm x 1.6mm ultra-thin µTQFN package and a 10Ld 3mm x 3mm TDFN package. It operates over a temperature range of -40 to +85°C.

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”

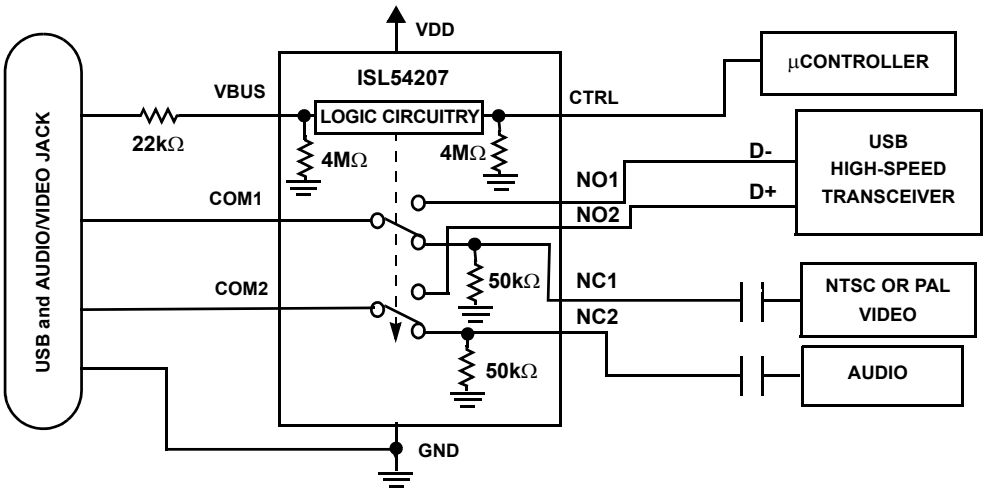
Features

- High Speed (480Mbps) Signaling Capability per USB 2.0
- Low Distortion Negative Signal Capability
- Detection of V_{BUS} Voltage on USB Cable
- Control Pin to Open all Switches and Enter Low Power State
- Low Distortion Mono Audio Signal
  - THD+N at 20mW into 32Ω Load . . . . . <0.1%
- Low Distortion Color Video Signal
  - Differential Gain 0.28%
  - Differential Phase 0.04deg
- Cross-talk (4MHz) . . . . . -78dB
- Single Supply Operation (V_{DD}) . . . . . 2.7V to 3.6V
- -3dB Bandwidth USB Switch 630MHz
- Available in µTQFN and TDFN Packages
- Pb-Free Plus Anneal Available (RoHS Compliant)
- Compliant with USB 2.0 Short Circuit Requirements Without Additional External Components

Applications

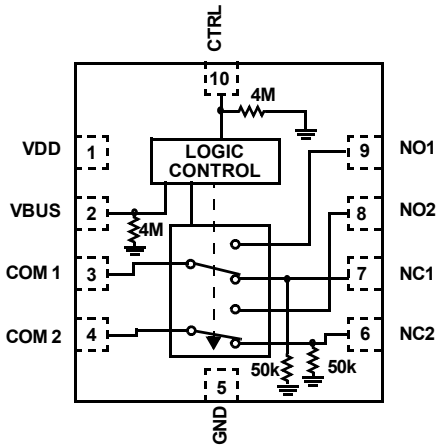
- Digital Camera and Camcorders
- Video MP3 and other Personal Media Players
- Cellular/Mobile Phones
- PDAs
- Audio/Video/USB Switching

Application Block Diagram

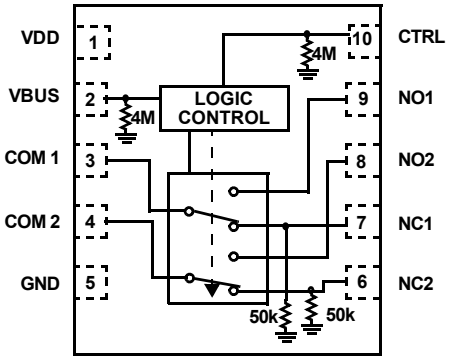


Pinouts (Note 1)

ISL54207
(10 LD μTQFN)
TOP VIEW



ISL54207
(10 LD TDFN)
TOP VIEW



NOTE:

1. ISL54207 Switches shown for V_{BUS} = Logic “0” and CTRL = Logic “1”.

Truth Table

ISL54207			
VBUS	**CTRL**	**NC1, NC2**	**NO1, NO2**
0	0	OFF	OFF
0	1	ON	OFF
1	X	OFF	ON

CTRL: Logic “0” when ≤ 0.5V, Logic “1” when ≥ 1.4V
V_{BUS}: Logic “0” when ≤ V_{DD} + 0.2V or Floating, Logic “1” when ≥V_{DD} + 0.8V

Pin Descriptions

ISL54207		
PIN NO.	**NAME**	**FUNCTION**
1	VDD	Power Supply
2	VBUS	Digital Control Input
3	COM1	Voice/Video and USB Common Pin
4	COM2	Voice/Video and USB Common Pin
5	GND	Ground Connection
6	NC2	Audio or Video Input
7	NC1	Audio or Video Input
8	NO2	USB Differential Input
9	NO1	USB Differential Input
10	CTRL	Digital Control Input (Audio Enable)

Ordering Information

PART NUMBER (Note)	PART MARKING	TEMP. RANGE (°C)	PACKAGE (Pb-Free)	PKG. DWG. #
ISL54207IRUZ-T	FP	-40 to +85	10 Ld 2.1 x 1.6mm μTQFN Tape and Reel	L10.2.1x1.6A
ISL54207IRZ-T	207Z	-40 to +85	10 Ld 3mm x 3mm TDFN Tape and Reel	L10.3x3A
ISL54207IRZ	207Z	-40 to +85	10 Ld 3mm x 3mm TDFN	L10.3x3A

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate or NiPdAu termination finish, which are 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

VDD to GND . . . . . -0.3 to 6.0V
Input Voltages
NCx, NOx(Note 2) . . . . . - 2V to ((V_{DD}) + 0.3V)
VBUS (Note 2). . . . . -2V to 5.5V
CTRL (Note 2) . . . . . -0.3 to ((V_{DD}) + 0.3V)
Output Voltages
COMx (Note 2) . . . . . -2V to ((V_{DD}) + 0.3V)
Continuous Current (NCx, COMx) . . . . . ±150mA
Peak Current (NCx, COMx)
(Pulsed 1ms, 10% Duty Cycle, Max). . . . . ±300mA
Continuous Current (NOx) . . . . . ±40mA
Peak Current (NOx)
(Pulsed 1ms, 10% Duty Cycle, Max) . . . . . ±100mA
ESD Rating:
HBM . . . . . >7kV
MM . . . . . >450V
CDM . . . . . >2kV

Thermal Information

Thermal Resistance (Typical, Note 3)	θ_{JA} (°C/W)
10 Ld μTQFN Package	130
10 Ld 3x3 TDFN Package	110

Maximum Junction Temperature (Plastic Package) . . . . . +150°C
Maximum Storage Temperature Range. . . . . -65°C to +150°C

Operating Conditions

Temperature Range
ISL54207IRUZ and ISL54207IRZ. . . . . -40°C to +85°C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTES:

2. Signals on NOx, NCx, COMx, CTRL, VBUS exceeding V_{DD} or GND by specified amount are clamped. Limit current to maximum current ratings.
3. 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.

Electrical Specifications - 2.7V to 3.6V Supply

Test Conditions: V_{DD} = +3.0V, GND = 0V, V_{BUSH} = 3.8V, V_{BUSL} = 3.2V, V_{CTRLH} = 1.4V, V_{CTRLL} = 0.5V, (Notes 4, 6), unless otherwise specified.

PARAMETER	TEST CONDITIONS	TEMP (°C)	(NOTE 5) MIN	TYP	(NOTE 5) MAX	UNITS
ANALOG SWITCH CHARACTERISTICS						
Audio/Video Switches (NC1, NC2)						
Analog Signal Range, V_{ANALOG}	V_{DD} = 3.0V, V_{BUS} = float, CTRL = 1.4V	Full	-1.5	-	1.5	V
ON Resistance, r_{ON}	V_{DD} = 3.0V, V_{BUS} = float, CTRL = 1.4V, I_{COMx} = 100mA, V_{NCx} = -0.85V to 0.85V, (See Figure 3)	25	-	2.65	4	Ω
		Full	-	-	5.5	Ω
r_{ON} Matching Between Channels, Δr_{ON}	V_{DD} = 3.0V, V_{BUS} = float, CTRL = 1.4V, I_{COMx} = 100mA, V_{NCx} = Voltage at max r_{ON} over signal range of -0.85V to 0.85V, (Note 8)	25	-	0.02	0.13	Ω
		Full	-	-	0.16	Ω
r_{ON} Flatness, $r_{FLAT(ON)}$	V_{DD} = 3.0V, V_{BUS} = float, CTRL = 1.4V, I_{COMx} = 100mA, V_{NCx} = -0.85V to 0.85V, (Note 7)	25	-	0.03	0.05	Ω
		Full	-	-	0.07	Ω
Discharge Pull-Down Resistance, R_{NC1}, R_{NC2}	V_{DD} = 3.6V, V_{BUS} = float, CTRL = 1.4V, V_{COM-} or V_{COM+} = -0.85V, 0.85V, V_{NCx} = -0.85V, 0.85V, V_{NOx} = floating, Measure current through the discharge pull-down resistor and calculate resistance value.	25	-	50	-	kΩ
USB Switches (NO1, NO2)						
Analog Signal Range, V_{ANALOG}	V_{DD} = 3.0V, V_{BUS} = 5.0V, CTRL = 0V or 3V	Full	0	-	V_{DD}	V
ON Resistance, r_{ON}	V_{DD} = 3.6V, V_{BUS} = 4.4V, CTRL = 0V or 3.6V, I_{COMx} = 40mA, V_{NOx} = 0V to 400mV (See Figure 4)	25	-	4.6	5	Ω
		Full	-	-	6.5	Ω
r_{ON} Matching Between Channels, ΔR_{ON}	V_{DD} = 3.6V, V_{BUS} = 4.4V, CTRL = 0V or 3.6V, I_{COMx} = 40mA, V_{NOx} = Voltage at max r_{ON}, (Note 8)	25	-	0.06	0.5	Ω
		Full	-	-	0.55	Ω
r_{ON} Flatness, $r_{FLAT(ON)}$	V_{DD} = 3.6V, V_{BUS} = 4.4V, CTRL = 0V or 3.6V, I_{COMx} = 40mA, V_{NOx} = 0V to 400mV, (Note 7)	25	-	0.4	0.6	Ω
		Full	-	-	1.0	Ω

Electrical Specifications - 2.7V to 3.6V Supply Test Conditions: V_{DD} = +3.0V, GND = 0V, V_{BUSH} = 3.8V, V_{BUSL} = 3.2V, V_{CTRLH} = 1.4V, V_{CTRLL} = 0.5V, (Notes 4, 6), unless otherwise specified. **(Continued)**

PARAMETER	TEST CONDITIONS	TEMP (°C)	(NOTE 5) MIN	TYP	(NOTE 5) MAX	UNITS
OFF Leakage Current, $I_{D+(OFF)}$ or $I_{D-(OFF)}$	V_{DD} = 3.6V, V_{BUS} = 0V, CTRL = 3.6V, V_{COMx} = 0.5V, 0V, V_{NOx} = 0V, 0.5V, V_{NCx} = float	25	-10	-	10	nA
		Full	-70	-	70	nA
ON Leakage Current, I_{Dx}	V_{DD} = 3.3V, V_{BUS} = 5.25V, CTRL = 0V or 3.6V, V_{NOx} = 2.0V, V_{COMx}, V_{NCx} = float	25	-10	2	10	nA
		Full	-75	-	75	nA
DYNAMIC CHARACTERISTICS						
Turn-ON Time, t_{ON}	V_{DD} = 2.7V, R_L = 50Ω, C_L = 10pF, (See Figure 1)	25	-	67	-	ns
Turn-OFF Time, t_{OFF}	V_{DD} = 2.7V, R_L = 50Ω, C_L = 10pF, (See Figure 1)	25	-	48	-	ns
Break-Before-Make Time Delay, t_D	V_{DD} = 2.7V, R_L = 50Ω, C_L = 10pF, (See Figure 2)	25	-	18	-	ns
Skew, t_{SKEW}	V_{DD} = 3.0V, V_{BUS} = 5.0V, CTRL = 0V or 3V, R_L = 45Ω, C_L = 10pF, t_R = t_F = 720ps at 480Mbps, (Duty Cycle = 50%) (See Figure 7)	25	-	50	-	ps
Total Jitter, t_J	V_{DD} = 3.0V, V_{BUS} = 5.0V, CTRL = 0V or 3V, R_L = 45Ω, C_L = 10pF, t_R = t_F = 750ps at 480Mbps	25	-	210	-	ps
Propagation Delay, t_{PD}	V_{DD} = 3.0V, V_{BUS} = 5.0V, CTRL = 0V or 3V, R_L = 45Ω, C_L = 10pF, (See Figure 7)	25	-	250	-	ps
Crosstalk (Channel-to-Channel), NC2 to COM1, NC1 to COM2	V_{DD} = 3.0V, V_{BUS} = float, CTRL = 3.0V, R_L = 75Ω, f = 4MHz, V_{NCx} = 300mV_{P-P} , (See Figure 6)	25	-	-78	-	dB
Differential Gain	V_{IN} = 300mV_{P-P}, V_{OFFSET} = 0V to 0.7V, f = 3.58MHz, R_L = 75	25	-	0.28	-	%
Differential Phase	V_{IN} = 300mVp-p, V_{OFFSET} = 0V to 0.7V, f = 3.58MHz, R_L = 75	25	-	0.04	-	°
Total Harmonic Distortion	f = 20Hz to 20kHz, V_{DD} = 3.0V, V_{BUS} = float, CTRL = 3.0V, V_{NCx} = 0.707V_{RMS} (2V_{P-P}), R_L = 32Ω	25	-	0.06	-	%
NCx (Audio/Video) Switch -3dB Bandwidth	Signal = 8dBm, R_L = 75Ω, C_L = 5pF	25	-	338	-	MHz
NOx (USB) Switch -3dB Bandwidth	Signal = 0dBm, 0.2V_{DC} offset, R_L = 50Ω, C_L = 5pF	25	-	630	-	MHz
NOx OFF Capacitance, $C_{NOx(OFF)}$	f = 1MHz, V_{DD} = 3.0V, V_{BUS} = float, CTRL = 3.0V, V_{D-} or V_{D+} = V_{COMx} = 0V, (See Figure 5)	25	-	6	-	pF
NCx OFF Capacitance, $C_{NCx(OFF)}$	f = 1MHz, V_{DD} = 3.0V, V_{BUS} = 5.0V, CTRL = 0V or 3V, V_L or V_R = V_{COMx} = 0V, (See Figure 5)	25	-	9	-	pF
COMx ON Capacitance, $C_{COMx(ON)}$	f = 1MHz, V_{DD} = 3.0V, V_{BUS} = 5.0V, CTRL = 0V or 3V, V_{D-} or V_{D+} = V_{COMx} = 0V, (See Figure 5)	25	-	10	-	pF
POWER SUPPLY CHARACTERISTICS						
Power Supply Range, V_{DD}		Full	2.7		3.6	V
Positive Supply Current, I_{DD}	V_{DD} = 3.6V, V_{BUS} = float or 5.25V, CTRL = 1.4V	25	-	6	8	µA
		Full	-	-	10	µA
Positive Supply Current, I_{DD} (Low Power State)	V_{DD} = 3.6V, V_{BUS} = 0V or float, CTRL = 0V or float	25	-	1	7	nA
		Full	-	-	140	nA
DIGITAL INPUT CHARACTERISTICS						
V_{BUS} Voltage Low, V_{BUSL}	V_{DD} = 2.7V to 3.6V	Full	-	-	V_{DD} + 0.2	V
V_{BUS} Voltage High, V_{BUSH}	V_{DD} = 2.7V to 3.6V	Full	V_{DD} + 0.8	-	-	V
CTRL Voltage Low, V_{CTRLL}	V_{DD} = 2.7V to 3.6V	Full	-	-	0.5	V

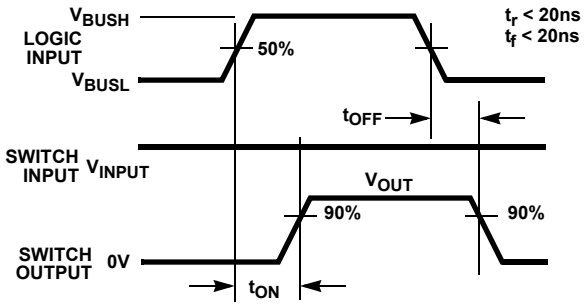
Electrical Specifications - 2.7V to 3.6V Supply Test Conditions: V_{DD} = +3.0V, GND = 0V, V_{BUSH} = 3.8V, V_{BUSL} = 3.2V, V_{CTRLH} = 1.4V, V_{CTRLL} = 0.5V, (Notes 4, 6), unless otherwise specified. **(Continued)**

PARAMETER	TEST CONDITIONS	TEMP (°C)	(NOTE 5) MIN	TYP	(NOTE 5) MAX	UNITS
CTRL Voltage High, V_{CTRLH}	V_{DD} = 2.7V to 3.6V	Full	1.4	-	-	V
Input Current, I_{BUSL}, I_{CTRLL}	V_{DD} = 3.6V, V_{BUS} = 0V or float, CTRL = 0V or float	Full	-50	20	50	nA
Input Current, I_{BUSH}	V_{DD} = 3.6V, V_{BUS} = 5.25V, CTRL = 0V or float	Full	-2	1.1	2	µA
Input Current, I_{CTRLH}	V_{DD} = 3.6V, V_{BUS} = 0V or float, CTRL = 3.6V	Full	-2	1.1	-2	µA
V_{BUS} Pull-Down Resistor, R_{VBUS}	V_{DD} = 3.6V, V_{BUS} = 5.25V, CTRL = 0V or float	Full	-	4	-	MΩ
CTRL Pull-Down Resistor, R_{CTRL}	V_{DD} = 3.6V, V_{BUS} = 0V or float, CTRL = 3.6V	Full	-	4	-	MΩ

NOTES:

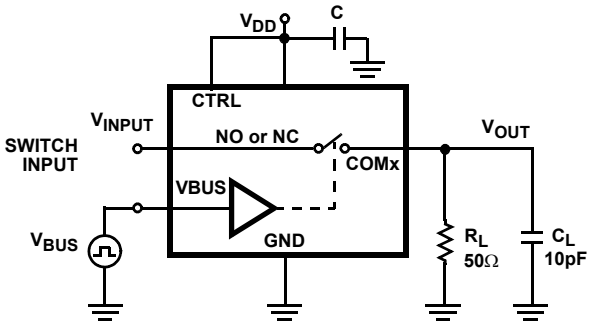
4. V_{LOGIC} = Input voltage to perform proper function.
5. The algebraic convention, whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
6. Parts are 100% tested at +25°C. Limits across the full temperature range are guaranteed by design and correlation.
7. Flatness is defined as the difference between maximum and minimum value of on-resistance over the specified analog signal range.
8. 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 NC1 and NC2 or between NO1 and NO2.

Test Circuits and Waveforms



Logic input waveform is inverted for switches that have the opposite logic sense.

FIGURE 1A. MEASUREMENT POINTS



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

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

FIGURE 1B. TEST CIRCUIT

FIGURE 1. SWITCHING TIMES

Test Circuits and Waveforms (Continued)

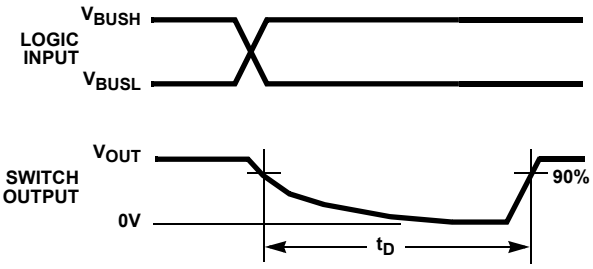
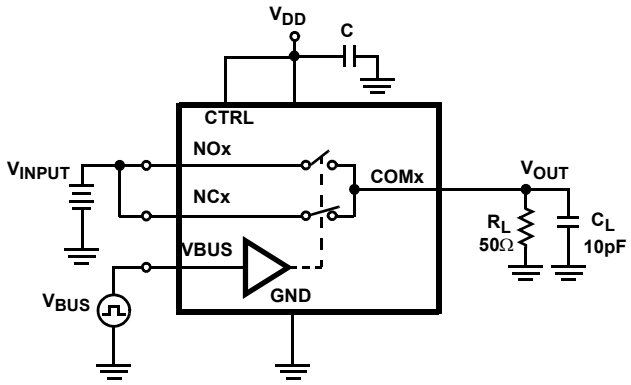


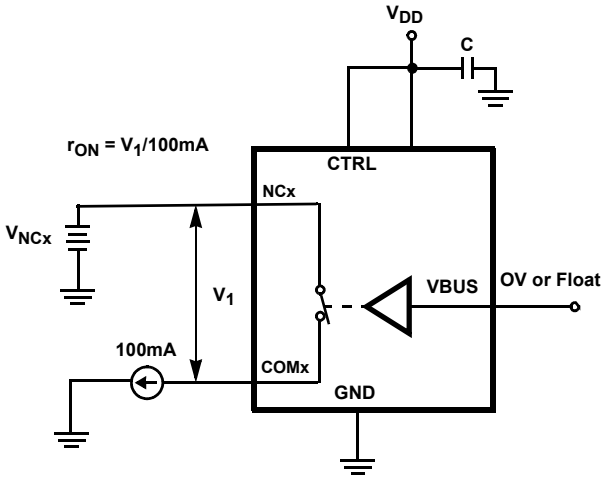
FIGURE 2A. MEASUREMENT POINTS



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

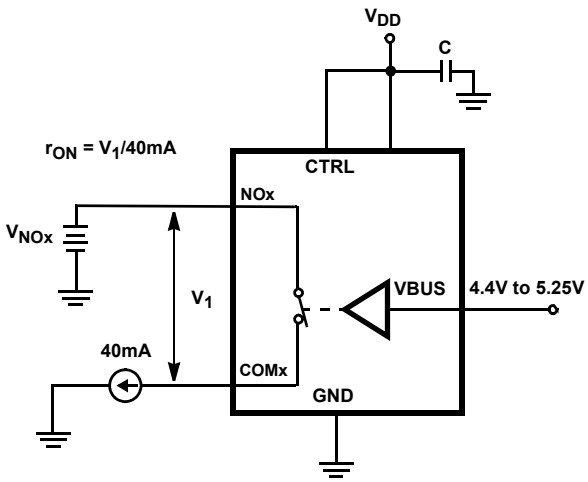
FIGURE 2B. TEST CIRCUIT

FIGURE 2. BREAK-BEFORE-MAKE TIME



Repeat test for all switches.

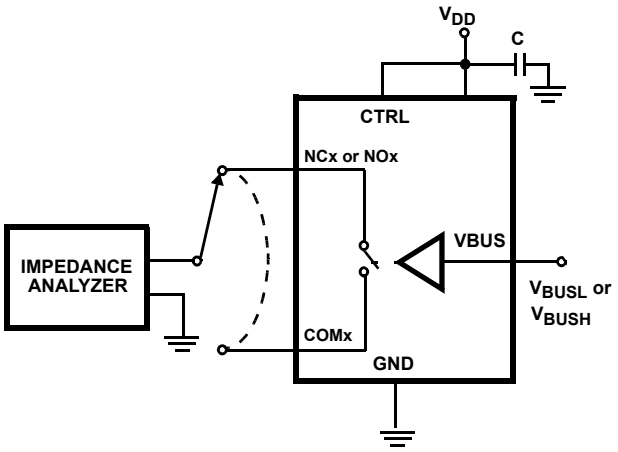
FIGURE 3. AUDIO r_{ON} TEST CIRCUIT



Repeat test for all switches.

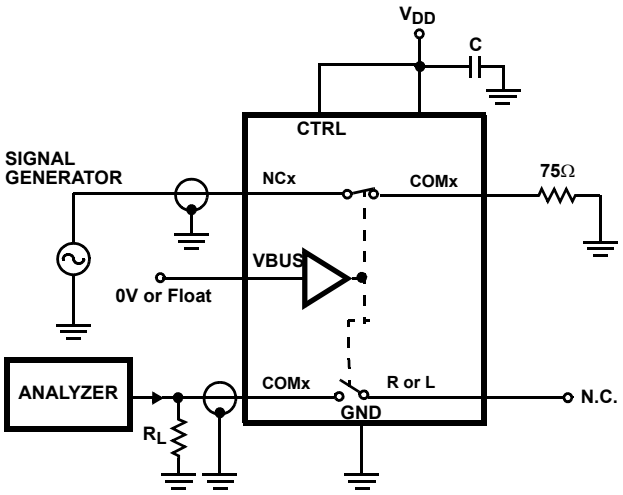
FIGURE 4. USB r_{ON} TEST CIRCUIT

Test Circuits and Waveforms (Continued)



Repeat test for all switches.

FIGURE 5. CAPACITANCE TEST CIRCUIT



Signal direction through switch is reversed, worst case values are recorded. Repeat test for all switches

FIGURE 6. AUDIO CROSSTALK TEST CIRCUIT

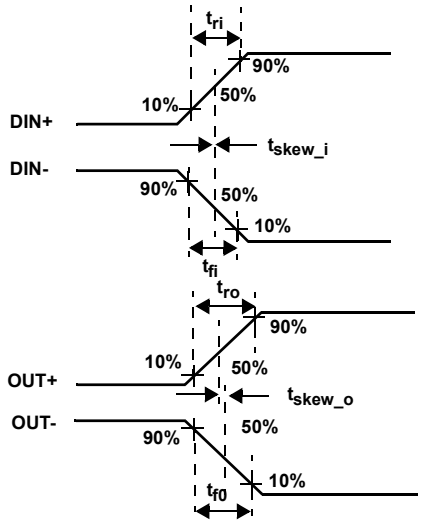
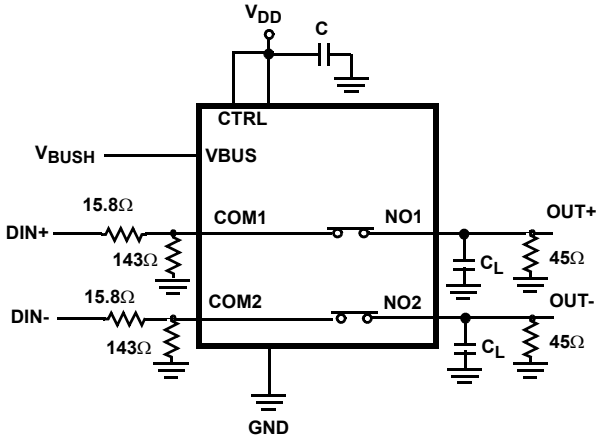


FIGURE 7A. MEASUREMENT POINTS



|tro - tri| Delay Due to Switch for Rising Input and Rising Output Signals.

|tfo - tfi| Delay Due to Switch for Falling Input and Falling Output Signals.

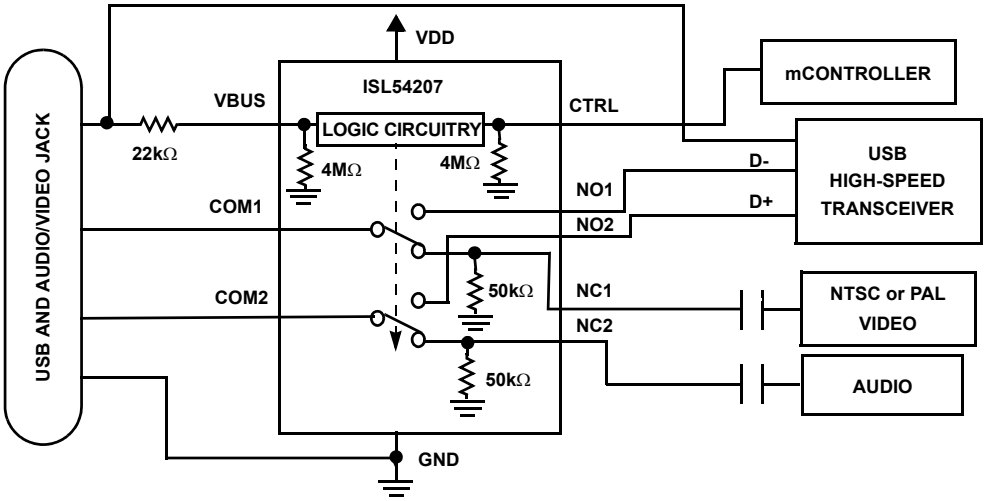
|tskew_0| Change in Skew through the Switch for Output Signals.

|tskew_i| Change in Skew through the Switch for Input Signals.

FIGURE 7B. TEST CIRCUIT

FIGURE 7. SKEW TEST

Application Block Diagram



Detailed Description

The ISL54207 device is a dual single pole/double throw (SPDT) analog switch device that operates from a single DC power supply in the range of 2.7V to 3.6V. It was designed to function as a dual 2 to 1 multiplexer to select between USB differential data signals and mono audio/composite video baseband signals (CVBS). It comes in tiny μTQFN and TDFN packages for use in cameras, camcorders, video MP3 players, PDAs, cell phones, and other personal media players.

The part consists of two 3Ω audio/video switches and two 5Ω USB switches. The audio/video switches can accept signals that swing below ground. They were designed to pass ground reference audio or dc restored with synch composite video signals with minimal distortion. The USB switches were designed to pass high-speed USB differential data signals with minimal edge and phase distortion.

The ISL54207 was specifically designed for digital cameras, camcorders, MP3 players, cell phones and other personal media player applications that need to combine the audio/video jacks and the USB data connector into a single shared connector, thereby saving space and component cost. A typical application block diagram of this functionality is shown above.

The ISL54207 incorporates circuitry for the detection of the USB V_{BUS} voltage, which is used to switch between the audio/video drivers and USB transceiver of the media player. The ISL54207 contains a logic control pin (CTRL) that when driven Low while VBUS is Low, opens all switches and puts the part into a low power state, drawing typically 1nA of I_{DD} current.

A detailed description of the two types of switches is provided in the following sections. The USB transmission and audio/video playback are intended to be mutually exclusive operations.

NC1 and NC2 Audio/Video Switches

The two NC (normally closed) audio/video switches (NC1, NC2) are 3Ω switches that can pass signals that swing below ground by as much as 1.5V. They were designed to pass ground reference audio signals and DC restored composite base-band signals (CVBS), including negative synchronizing pulse with minimal insertion loss and very low distortion and degradation.

The -3dB bandwidth into 75Ω is 338MHz (Figure 17). Crosstalk between NC1 and NC2 @ 4MHz is -78dB (Figure 16), which allows composite video to be routed through one switch and mono-audio through the other switch with little interference.

The recommended maximum signal range is from -1.5V to 1.5V. You can apply positive signals greater than 1.5V but the r_{ON} resistance of the switch increases rapidly above 1.5V. The signal should not be allowed to exceed the V_{DD} rail or swing more negative than -1.5V.

Over a signal range of ±1V (0.707Vrms) with V_{DD} > 2.7V, these switches have an extremely low r_{ON} resistance variation. They can pass a ground referenced audio signal with very low distortion (<0.06% THD+N) when delivering 15.6mW into a 32Ω headphone speaker load. See Figures 10, 11, 12, and 13 THD+N performance curves.

Figure 8 and 9 shows the vector scope plots of a standard NTSC color bar signal at both the input (Figure 8) and output (Figure 9) of the ISL54207. The plots show that except for a little attenuation due to switch r_{ON} and test fixture cabling, there is virtually no degradation of the video waveform through the switch.

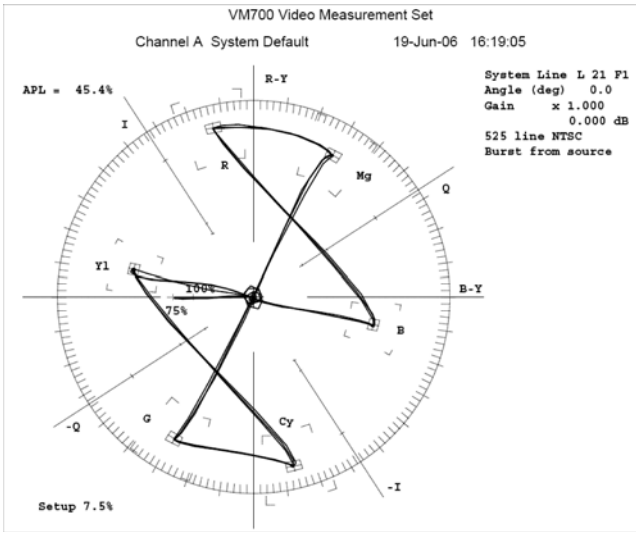


FIGURE 8. VECTOR-SCOPE PLOT BEFORE SWITCH

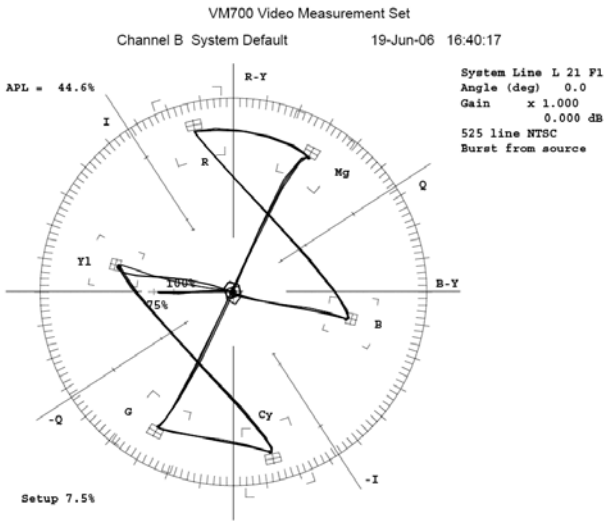


FIGURE 9. VECTOR-SCOPE PLOT AFTER SWITCH

Figure 18 shows the differential gain (DG) and differential phase (DP) plots at the output of the switch using an actual NTSC composite video signal and a VM700A Video Measurement Test Set. DG = 0.28% and DP = 0.04°.

These NC switches are uni-directional switches. The audio/video sources should be connected at the NC side of the switch (pins 7 and 8) and the speaker load and video receiver should be connected at the COM side of the switch (pins 3 and 4).

The NC switches are active (turned ON) whenever the V_{BUS} voltage is ≤ to V_{DD} + 0.2V or floating and the CTRL voltage ≥ to 1.4V.

Note: Whenever the NC switches are ON the USB transceivers need to be in the high impedance state or static high or low state.

NO1 and NO2 USB Switches

The two NO (normally open) USB switches (NO1, NO2) are 5Ω bidirectional switches that are designed to pass high-speed USB differential signals in the range of ±0V to 400mV. The switches have low capacitance and high bandwidth to pass USB high-speed signals (480Mbps) with minimum edge and phase distortion to meet USB 2.0 signal quality specifications. See Figure 14 for High-speed Eye Pattern taken with switch in the signal path.

The maximum signal range for the USB switches is from -1.5V to V_{DD}. The signal voltage at NO1 and NO2 should not be allowed to exceed the V_{DD} voltage rail or go below ground by more than -1.5V.

The NO switches are active (turned ON) whenever the V_{BUS} voltage is ≥ to V_{DD} + 0.8V. VBUS is internally pulled low, so when VBUS is floating, the USB switches are OFF.

Note: Whenever the NO switches are ON, the audio and video drivers need to be at AC or DC ground or floating to keep from interfering with the data transmission.

ISL54207 Operation

The discussion that follows will discuss using the ISL54207 in the typical application shown in the block diagram on page 8.

LOGIC CONTROL

The state of the ISL54207 device is determined by the voltage at the VBUS pin (pin 2) and the CTRL pin (pin 10). Refer to truth-table on page 2 of the data sheet.

The VBUS pin and CTRL pin are internally pulled low through 4MΩ resistors to ground and can be left floating. The CTRL control pin is only active when VBUS is logic “0”.

Logic control voltage levels:

VBUS = Logic “0” (Low) when VBUS ≤ V_{DD} + 0.2V or Floating.
VBUS = Logic “1” (High) when VBUS ≥ V_{DD} + 0.8V
CTRL = Logic “0” (Low) when ≤ 0.5V or floating.
CTRL = Logic “1” (High) when ≥ 1.4V

Audio/Video Mode

If the VBUS pin = Logic “0” and CTRL pin = Logic “1,” the part will be in the Audio/Video mode. In Audio/Video mode the NC1 and NC2 3Ω audio/video switches are ON and the NO1 and NO2 5Ω USB switches are OFF (high impedance). In a typical application, V_{DD} will be in the range of 2.7V to 3.6V and will be connected to the battery or LDO of the media player. When a audio/video jack is plugged into the common connector, nothing gets connected at the VBUS pin (it is floating) and as long as the CTRL = Logic “1,” the ISL54207 part remains in the audio/video mode and the media player audio and video drivers can drive the speaker and video display.

USB Mode

If the VBUS pin = Logic “1” and CTRL pin = Logic “0” or Logic “1,” the part will go into USB mode. In USB mode, the NO1 and NO2 5Ω switches are ON and the NC1 and NC2 3Ω audio switches are OFF (high impedance). When a USB cable from a computer or USB hub is connected at the common connector, the voltage at the VBUS pin will be driven to be in the range of 4.4V to 5.25V. The ISL54207 part will go into the USB mode. In USB mode, the computer or USB hub transceiver and the media player USB transceiver are connected and digital data will be able to be transmitted back and forth.

When the USB cable is disconnected, the ISL54207 automatically turns the NO1 and NO2 switches OFF.

Low Power Mode

If the VBUS pin = Logic “0” and CTRL pin = Logic “0,” the part will be in the Low Power mode. In the Low Power mode, the NCx switches and the NOx switches are OFF (high impedance). In this state, the device draws typically 1nA of current.

EXTERNAL V_{BUS} SERIES RESISTOR

The ISL54207 contains a clamp circuit between VBUS and VDD. Whenever the V_{BUS} voltage is greater than the V_{DD} voltage by more than 2.55V, current will flow through this clamp circuitry into the V_{DD} power supply bus.

During normal USB operation, V_{DD} is in the range of 2.7V to 3.6V and V_{BUS} is in the range of 4.4V to 5.25V. The clamp circuit is not active and no current will flow through the clamp into the V_{DD} supply.

In a USB application, the situation can exist where the V_{BUS} voltage from the computer could be applied at the VBUS pin before the V_{DD} voltage is up to its normal operating voltage range and current will flow through the clamp into the V_{DD} power supply bus. This current could be quite high when V_{DD} is OFF or at 0V and could potentially damage other components connected in the circuit. In the application circuit, a 22kΩ resistor has been put in series with the VBUS pin to limit the current to a safe level during this situation.

It is recommended that a current limiting resistor in the range of 10kΩ to 50kΩ be connected in series with the VBUS pin. It will have minimal impact on the logic level at the VBUS pin during normal USB operation and protect the circuit during the time V_{BUS} is present before V_{DD} is up to its normal operating voltage.

Note: No external resistor is required in applications where V_{BUS} will not exceed V_{DD} by more than 2.55V.

POWER

The power supply connected at VDD (pin 1) provides power to the ISL54207 part. Its voltage should be kept in the range of 2.7V to 3.6V when used in a USB/Audio/Video application to ensure you get proper switching when the V_{BUS} voltage is at its lower limit of 4.4V.

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

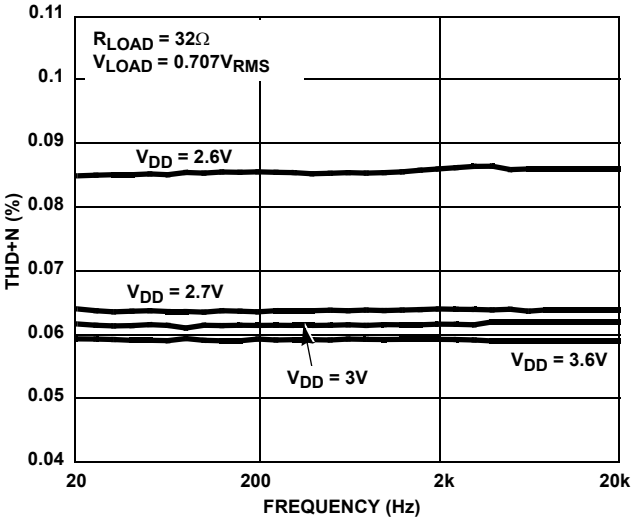


FIGURE 10. THD+N vs SUPPLY VOLTAGE vs FREQUENCY

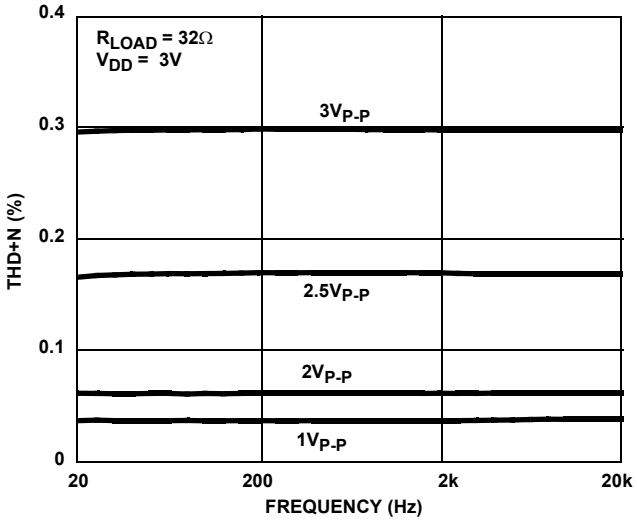


FIGURE 11. THD+N vs SIGNAL LEVELS vs FREQUENCY

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

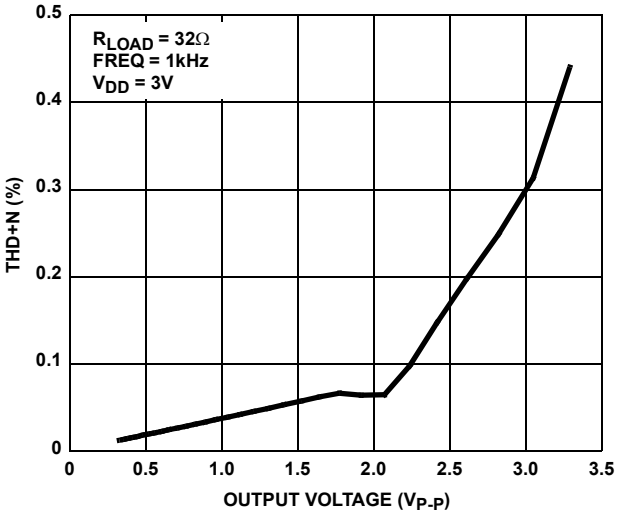


FIGURE 12. THD+N vs OUTPUT VOLTAGE

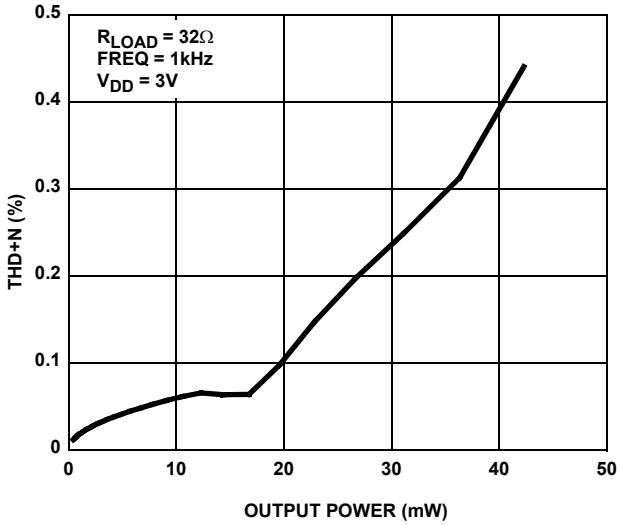


FIGURE 13. THD+N vs OUTPUT POWER

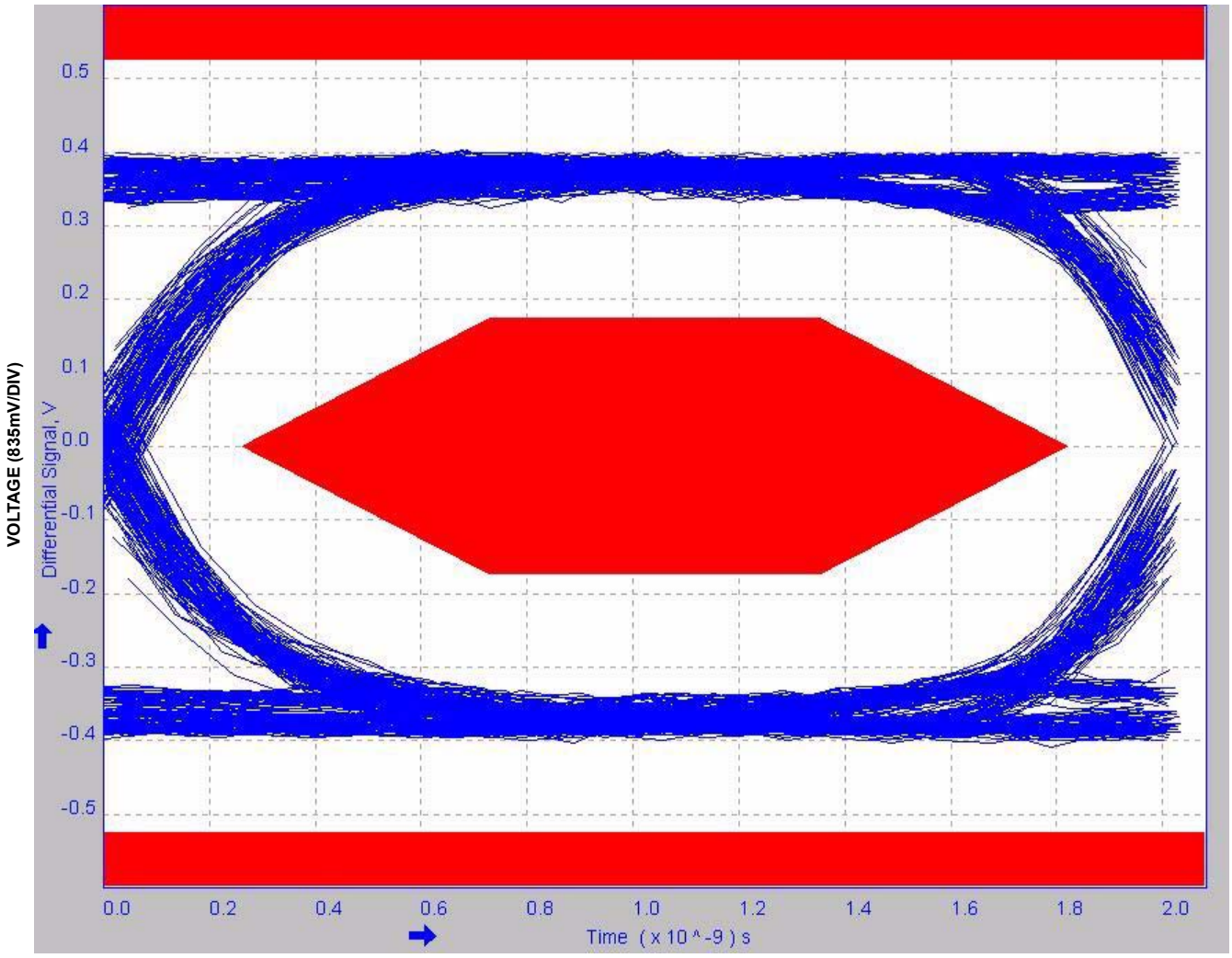


FIGURE 14. EYE PATTERN: 480Mbps WITH NOx SWITCHES IN THE SIGNAL PATH

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

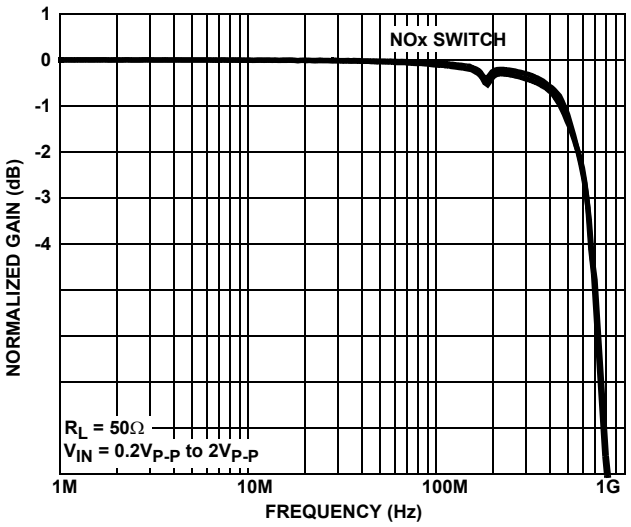


FIGURE 15. FREQUENCY RESPONSE

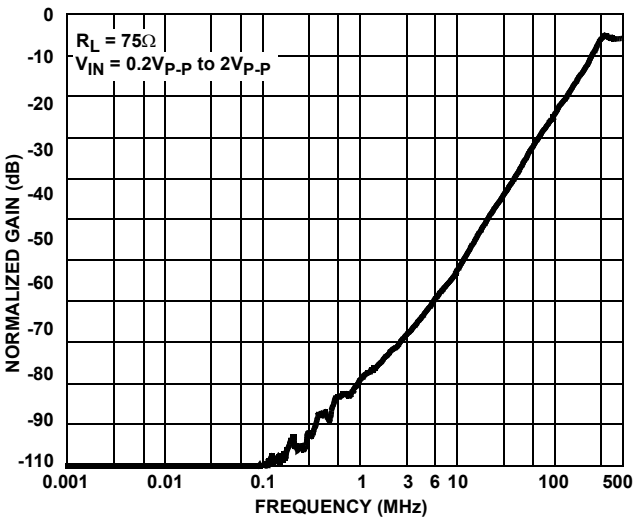


FIGURE 16. VIDEO TO AUDIO CROSSTALK

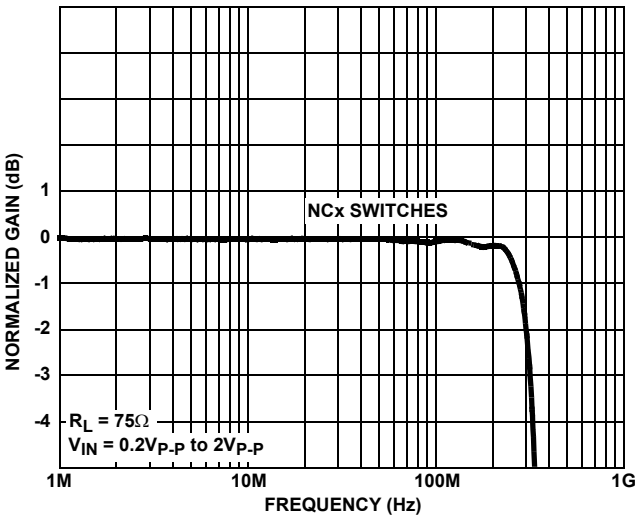


FIGURE 17. FREQUENCY RESPONSE

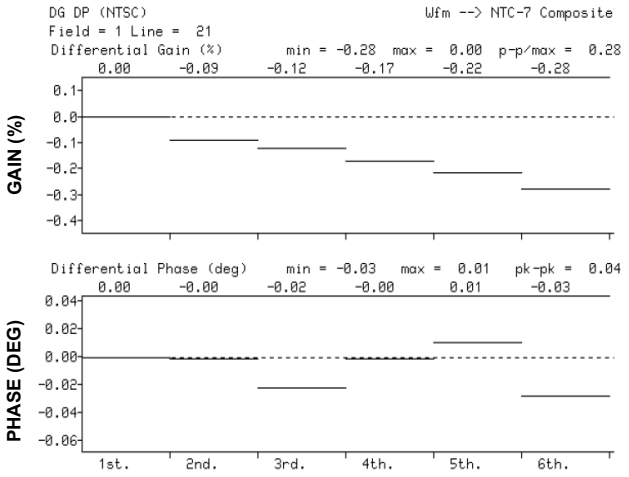


FIGURE 18. DIFFERENTIAL PHASE AND DIFFERENTIAL GAIN

Die Characteristics

SUBSTRATE POTENTIAL (POWERED UP):

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

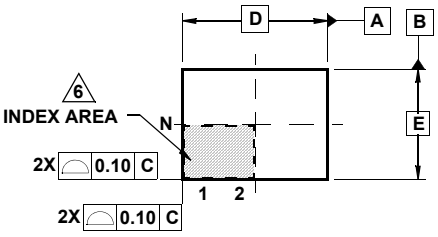
TRANSISTOR COUNT:

98

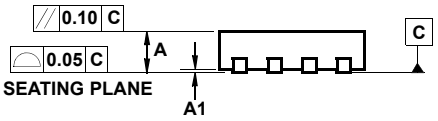
PROCESS:

Submicron CMOS

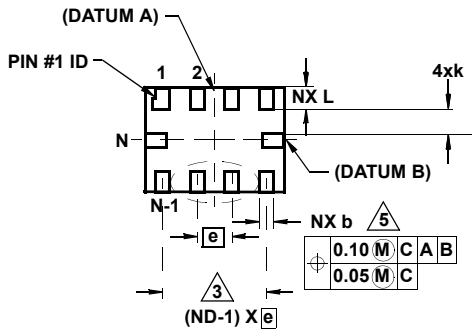
Ultra Thin Quad Flat No-Lead Plastic Package (UTQFN)



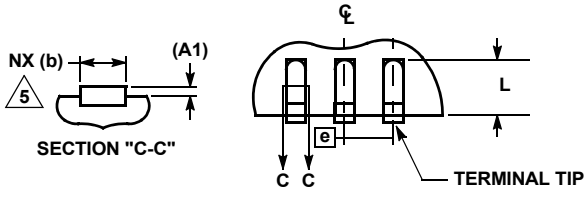
TOP VIEW



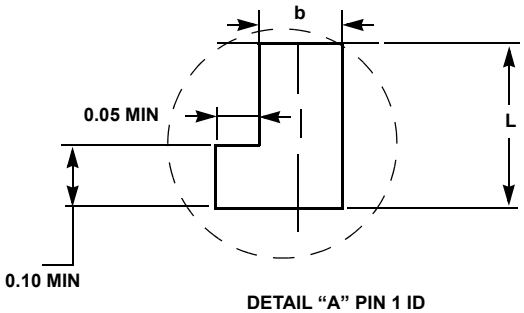
SIDE VIEW



BOTTOM VIEW



FOR ODD TERMINAL/SIDE



DETAIL “A” PIN 1 ID

L10.2.1x1.6A

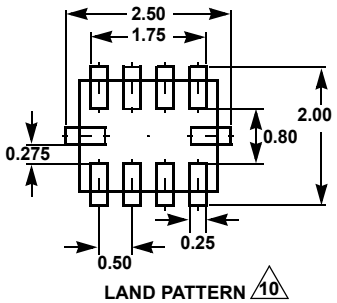
10 LEAD ULTRA THIN QUAD FLAT NO-LEAD PLASTIC PACKAGE

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	2.05	2.10	2.15	-
E	1.55	1.60	1.65	-
e		0.50 BSC		-
k	0.20	-	-	-
L	0.35	0.40	0.45	-
N		10		2
Nd		4		3
Ne		1		3
θ	0	-	12	4

Rev. 3 6/06

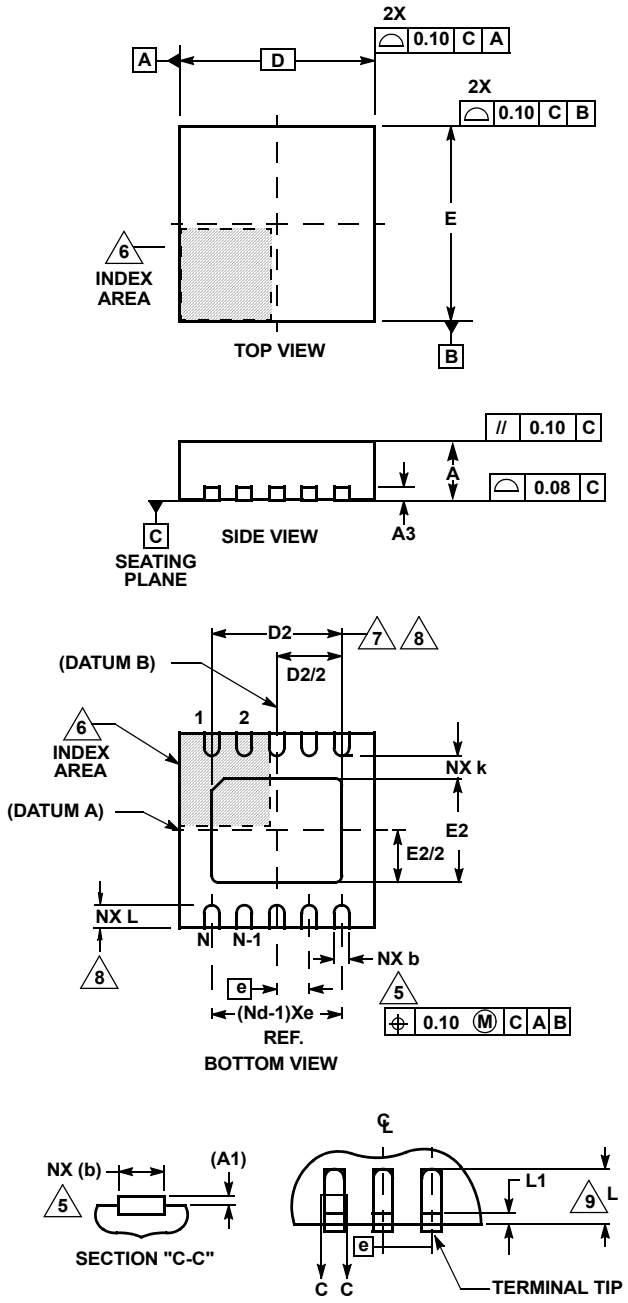
NOTES:

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. Same as JEDEC MO-255UABD except:
   No lead-pull-back, "A" MIN dimension = 0.45 not 0.50mm
   "L" MAX dimension = 0.45 not 0.42mm.
10. For additional information, to assist with the PCB Land Pattern Design effort, see Intersil Technical Brief TB389.



LAND PATTERN 10

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.