Low-Voltage SPDT Analog Switch

UM3156 *SC70-6/SC88/SOT363*

General Description

The UM3156 is an advanced CMOS analog switch fabricated with silicon gate CMOS technology. It achieves very low propagation delay and $R_{DS(ON)}$ resistances while maintaining CMOS low power dissipation. These make it ideal for portable and battery power applications.
The switch conducts signals within power rails equally well in both directions when on, and blocks up to the power supply level when off. Break-before-make is guaranteed.
The select pin has over-voltage protection that allows voltages above V_{CC}, up to 6.5V to be present on the pin without damage or disruption of operation of the part, regardless of the operating voltage.
The UM3156 can maintain low power consumption for rail-to-rail signaling as long as the control signal input is held at a level that is greater than V_{IH} minimum and less than V_{IL} maximum by improving the control circuitry input buffer. so the part can be used in mixed voltage rail environments, especially services the mobile handset applications very well allowing for the direct interface with baseband processor general purpose I/Os, and it is no longer necessary to have the control input equal to V_{CC} to maintain low power consumption

Applications

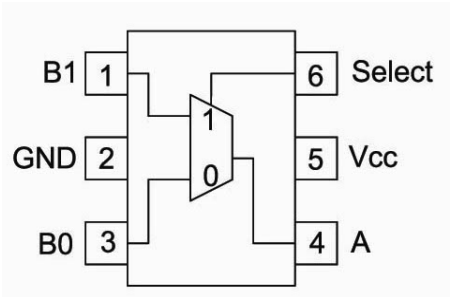
- Sample-and-Hold Circuits
- Battery-Powered Equipment
- Audio and Video Signal Routing
- Communication Circuits

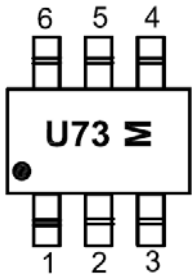
Features

- Control Inputs are 5V Tolerant
- Low Charge Injection
- Excellent ON-State Resistance Matching
- Low Total Harmonic Distortion (THD)
- 1.65V to 5.5V Single-Supply Operation
- ESD Performance:
  Human Body Model>2kV
  Machine Model>200V
- SC70-6/SC88/SOT363 Package
- Pb-Free Package

Pin Configurations

Top View





M: Month Code
UM3156
SC70-6/SC88/SOT363

Ordering Information

Part Number	Packaging Type	Marking Code	Shipping Qty
UM3156	SC70-6/SC88/SOT363	U73	3000pcs/7 Inch Tape & Reel

Function Table

Select Input	Function
L	B0 Connected to A
H	B1 Connected to A

Absolute Maximum Ratings

Symbol	Parameter	Limit	Unit
V_{CC}	Supply Voltage	-0.5 to +6.5	V
V_S	DC Switch Voltage (Note 1)	-0.5 to (V_{CC}+0.5)	
V_{IN}	DC IN Voltage (Note 1)	-0.5 to +6.5	
I_{IK}	DC Input Diode Current @ V_{IN}<0V	-50	mA
I_{OUT}	DC Output Current	128	
I_{CC}/I_{GND}	DC V_{CC} or Ground Current	+100	
T_J	Junction Temperature Under Bias	+150	°C
T_{STG}	Storage Temperature	-65 to +150	
T_L	Junction Lead Temperature (Soldering, 10 Seconds)	260	
θ_{JA}	Thermal Resistance	350	°C/W
P_D	Power Dissipation @ +85°C	180	mW

Note 1: The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

Recommended Ratings (Note 2)

Symbol	Parameter	Limit	Unit
V_{CC}	Supply Voltage Operating	1.65 to 5.5	V
V_{IN}	Switch Input Voltage	0 to V_{CC}	
V_{IN}	Select Input Voltage	0 to V_{CC}	
V_{OUT}	Output Voltage	0 to V_{CC}	
T_A	Operating Temperature	-55 to +125	°C
t_r, t_f	Input Rise and Fall Time Control Input V_{CC}=2.3V to 3.6V Control Input V_{CC}=4.5V to 5.5V	 0 to 10 0 to 5.0	ns/V

Note 2: Select input must be held HIGH or LOW, it must not float.

Electrical Characteristics

Symbol	Parameter	Test Conditions	V_{CC} (V)	Temp	Limits (-40°C to 85°C)			Unit
					Min	Typ	Max	
DC Electrical Characteristics								
	Analog Signal Range		V_{CC}	Full	0		V_{CC}	V
I_{IN}	Input Leakage Current	$0 \le V_{IN} \le 5.5V$	0 to 5.5	Room Full		±0.05	±0.1 ±1	μA
I_{OFF}	OFF State Leakage Current	$0 \le A, B \le V_{CC}$	1.65 to 5.5	Room Full		±0.05	±0.1 ±1	μA
V_{IH}	Input High Voltage		1.65 to 2.3	Full	1.1			V
			2.3 to 2.7		1.4			
			2.7 to 3.6		1.8			
			3.6 to 4.3		2.1			
			4.3 to 5.5		2.6			
V_{IL}	Input Low Voltage		1.65 to 2.3	Full			0.4	V
			2.3 to 2.7				0.7	
			2.7 to 3.6				1.0	
			3.6 to 4.3				1.3	
			4.3 to 5.5				1.5	
I_{CC}	Quiescent Supply Current	$V_{IN}=V_{CC}$ or GND $I_O=0$	5.5	Room Full			1.0 10	μA
R_{ON}	On-Resistance (Note 3)	$V_{IN}=0V$, $I_O=30mA$ $V_{IN}=2.4V$, $I_O=-30mA$ $V_{IN}=4.5V$, $I_O=-30mA$	4.5	Full		3.0 4.0 4.5	7.0 12 15	Ω
		$V_{IN}=0V$, $I_O=24mA$ $V_{IN}=3V$, $I_O=-24mA$	3.0	Full		4.0 6.0	9.0 20	
		$V_{IN}=0V$, $I_O=8mA$ $V_{IN}=2.3V$, $I_O=-8mA$	2.3	Full		5.0 8.0	12 30	
		$V_{IN}=0V$, $I_O=4mA$ $V_{IN}=1.65V$, $I_O=-4mA$	1.65	Full		6.5 15	20 50	
R_{RANGE}	On Resistance Over Signal Range (Note 3, 7)	$I_A=-30mA$ $0 \le V_{Bn} \le V_{CC}$	4.5	Full			25	Ω
		$I_A=-24mA$ $0 \le V_{Bn} \le V_{CC}$	3.0	Full			50	
		$I_A=-8mA$, $0 \le V_{Bn} \le V_{CC}$	2.3	Full			100	
		$I_A=-4mA$, $0 \le V_{Bn} \le V_{CC}$	1.65	Full			300	
ΔR_{ON}	On Resistance Match Between Channels (Note 3, 4, 5)	$I_A=-30mA$, $V_{Bn}=3.15V$	4.5	Room		0.15		Ω
		$I_A=-24mA$, $V_{Bn}=2.1V$	3.0	Room		0.2		
		$I_A=-8mA$, $V_{Bn}=1.6V$	2.3	Room		0.5		
		$I_A=-4mA$, $V_{Bn}=1.15V$	1.65	Room		0.5		
R_{FLAT}	On Resistance Flatness (Note 3, 4, 6)	$I_A=-30mA$, $0 \le V_{Bn} \le V_{CC}$	5.0	Room		6.0		Ω
		$I_A=-24mA$, $0 \le V_{Bn} \le V_{CC}$	3.3	Room		12		
		$I_A=-8mA$, $0 \le V_{Bn} \le V_{CC}$	2.5	Room		28		
		$I_A=-4mA$, $0 \le V_{Bn} \le V_{CC}$	1.8	Room		125		

Electrical Characteristics (Continued)

Symbol	Parameter	Test Conditions	V_{CC} (V)	Temp	Limits (-40°C to 85°C)			Unit
					Min	Typ	Max	
AC Electrical Characteristics								
t_{PHL} t_{PLH}	Propagation Delay Bus to Bus (Note 9)	V_I=OPEN	1.65 to1.95 2.3 to 2.7 3.0 to 3.6 4.5 to 5.5	Full			1.5 1.0 0.8	ns
t_{PZL} t_{PZH}	Output Enable Time Turn On Time (A to Bn)	V_I=2×V_{CC} for t_{PZL} V_I=0V for t_{PZH}	1.65 to1.95 2.3 to 2.7 3.0 to 3.6 4.5 to 5.5	Full	7.0 3.5 2.5 1.5		26 15 8.6 6.2	ns
t_{PLZ} t_{PHZ}	Output Disable Time Turn Off Time (A Port to B Port)	V_I=2×V_{CC} for t_{PLZ} V_I=0V for t_{PHZ}	1.65 to1.95 2.3 to 2.7 3.0 to 3.6 4.5 to 5.5	Full	3.0 2.0 1.7 0.8		13 7.5 5.3 3.8	ns
t_D	Break Before Make Time (Note 8)		1.65 to1.95 2.3 to 2.7 3.0 to 3.6 4.5 to 5.5	Full	0.5 0.5 0.5 0.5			ns
Q_{INJ}	Charge Injection (Note 8)	C_L=0.1nF, V_{GEN}=0V, R_{GEN}=0Ω	5.0 3.3	Room		9.0 4.0		pC
O_{IRR}	Off Isolation (Note 10)	R_L=50Ω, f=10MHz	1.65 to 5.5	Room		-60		dB
Xtalk	Crosstalk	R_L=50Ω, f=10MHz	1.65 to 5.5	Room		-54		dB
BW	-3 dB Bandwidth	R_L=50Ω	1.65 to 5.5	Room		230		MHz
THD	Total Harmonic Distortion (Note 8)	R_L=600Ω 0.5V_{P-P} f=600Hz to 20kHz	5.0	Room		0.011		%
Capacitance								
C_{IN}	IN Pin Input Capacitance (Note 11)	V_{CC}=0V				2.5		pF
C_{IO-B}	B Port Off Capacitance (Note 11)	V_{CC}=5.0V				7.5		pF
C_{IOA-ON}	A Port Capacitance when Switch is Enabled (Note 11)	V_{CC}=5.0V				20.1		pF

Note 3: Measured by the voltage drop between A and B pins at the indicated current through the switch. On Resistance is determined by the lower of the voltages on the two (A or B Ports).

Note 4: Parameter is characterized but not tested in production.

Note 5: $\Delta R_{ON} = | R_{ON(B0)} - R_{ON(B1)} |$ measured at identical V_{CC}, temperature and voltage levels.

Note 6: Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of conditions.

Note 7: Guaranteed by design.

Note 8: Guaranteed by design.

Note 9: This parameter is guaranteed by design but not tested. The bus switch contributes no propagation delay other than the RC delay of the On Resistance of the switch and the 50 pF load capacitance, when driven by an ideal voltage source (zero output impedance).

Note 10: Off Isolation=20log10 [V_A/V_{Bn}].

Note 11: T_A=+25°C, f=1MHz. Capacitance is characterized but not tested in production.

Test Circuits/Timing Diagrams

NOTE: Input driven by 50 Ω source terminated in 50 Ω
NOTE: C_L includes load and stray capacitance
NOTE: Input PRR = 1.0 MHz; t_W = 500 ns

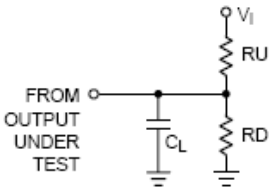


Figure 1. AC Test Circuit

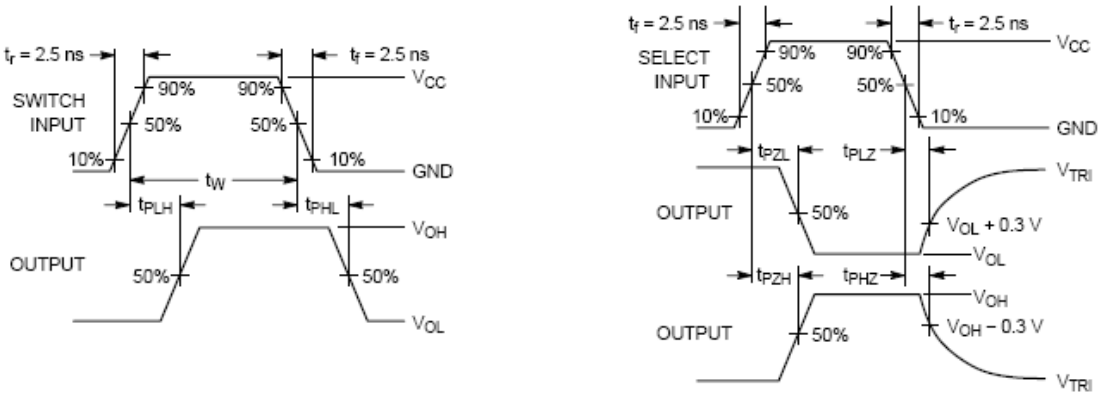
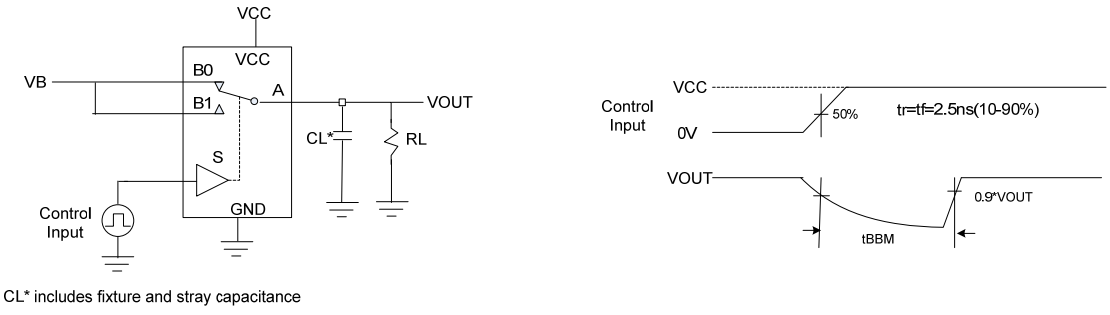


Figure 2. AC Waveforms

Figure 3. Break Before Make Interval Timing



CL* includes fixture and stray capacitance

Figure 4. Break-Before-Make Timing

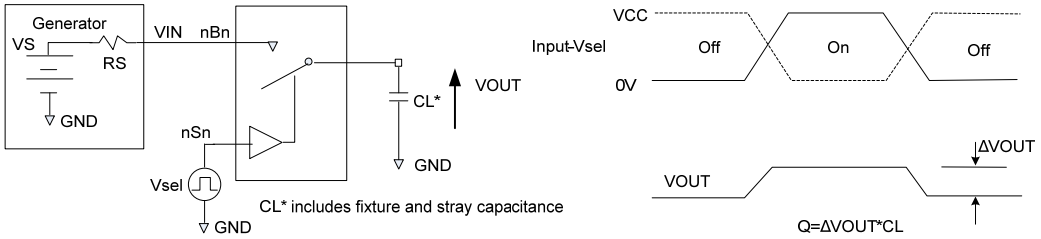


Figure 5. Charge Injection Test

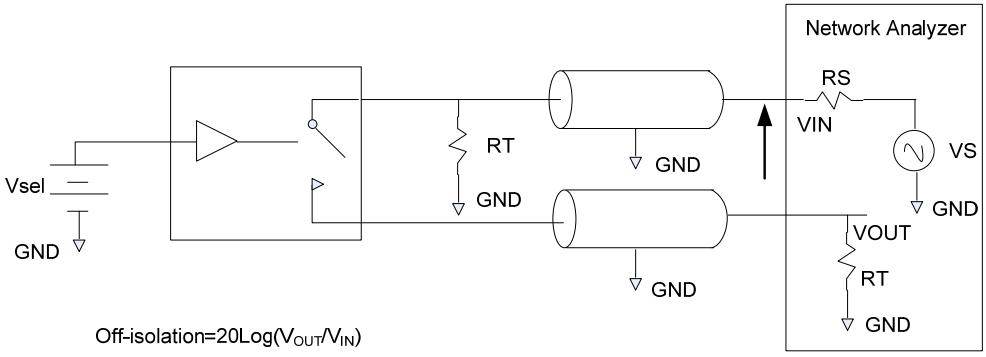


Figure 6. Off-Isolation

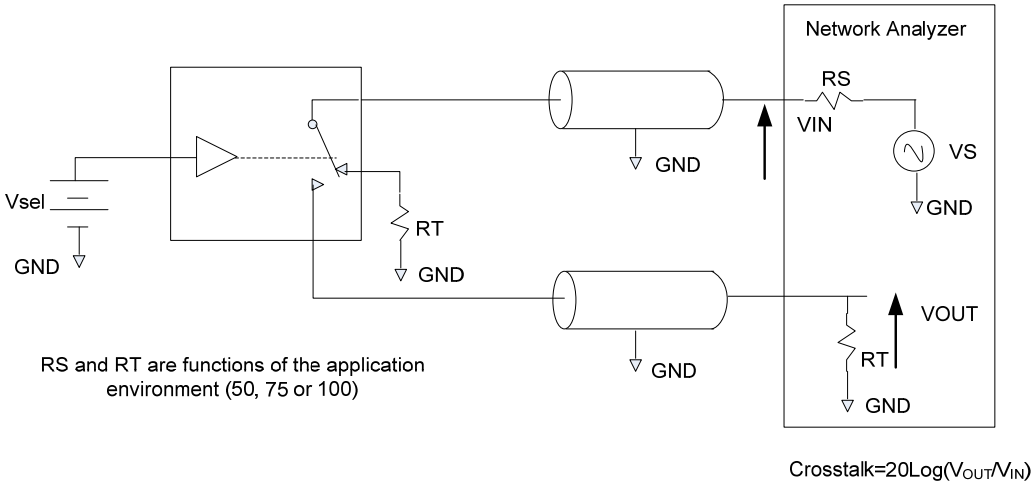


Figure 7. Non-Adjacent Channel-to-Channel Crosstalk

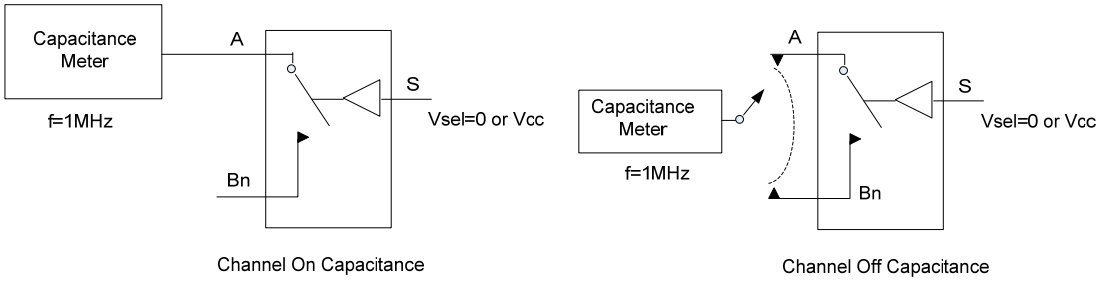


Figure 8. On/Off Capacitance Measurement Setup

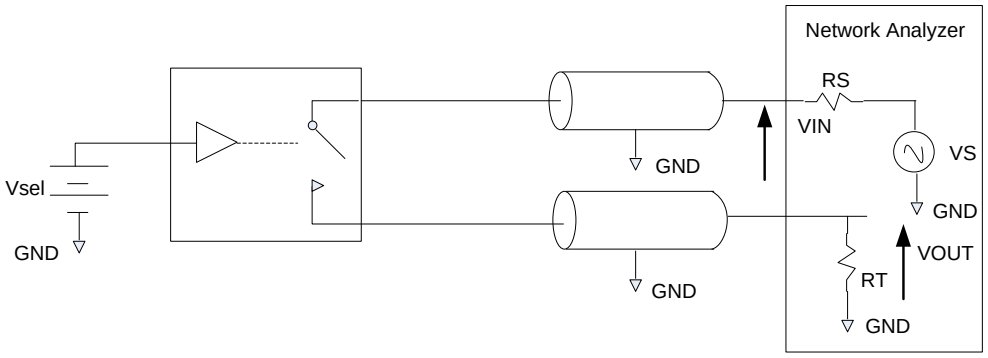
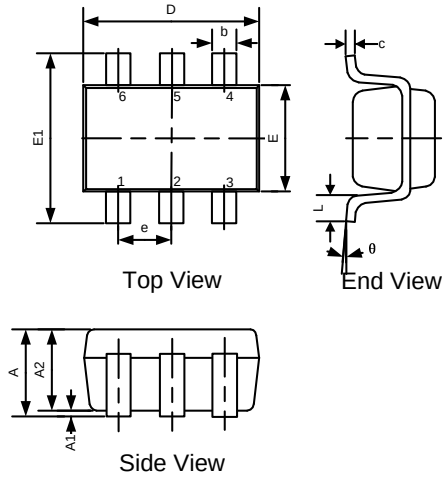


Figure 9. Bandwidth

Package Information

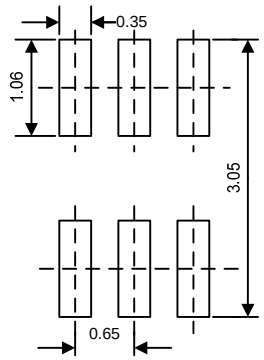
UM3156 SC70-6/SC88/SOT363

Outline Drawing



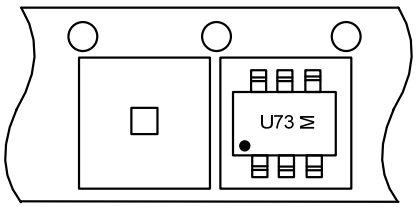
DIMENSIONS						
Symbol	MILLIMETERS			INCHES		
	Min	Typ	Max	Min	Typ	Max
A	0.90	-	1.10	0.035	-	0.043
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	0.90	-	1.00	0.035	-	0.039
b	0.10	0.25	0.35	0.004	0.010	0.014
c	0.08	0.11	0.22	0.003	0.004	0.009
D	1.80	2.15	2.20	0.071	0.085	0.087
E	1.15	1.30	1.35	0.045	0.051	0.053
E1	2.00	-	2.45	0.079	-	0.096
e	0.65BSC			0.026BSC		
L	0.25	-	0.46	0.010	-	0.018
θ	0°	-	8°	0°	-	8°

Land Pattern



NOTES:
1. Compound dimension: 2.15×1.30;
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

Tape and Reel Orientation



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