

4.5Ω 300MHz Bandwidth Dual SPDT Analog Switch

UM4258Q QFN10 1.80×1.40

General Description

The UM4258Q low-voltage, low on-resistance (R_{ON}), dual single-pole/double-throw (SPDT) analog switch operates from a single +1.8V to +5.5V supply. The device is designed for USB 1.1/2.0 and audio switching applications.

The UM4258Q features two 4.5Ω $R_{ON(max)}$ SPDT switches with 1.2Ω flatness and 0.3Ω matching between channels. The switch offers break-before-make switching (1ns) with $t_{ON}<80ns$ and $t_{OFF}<40ns$ at +2.7V. The digital logic inputs are +1.8V logic compatible with a +2.7V to +3.6V supply.

The UM4258Q is packaged in a 1.80mm×1.40mm QFN10 package, which significantly reducing the required PC board area.

Applications

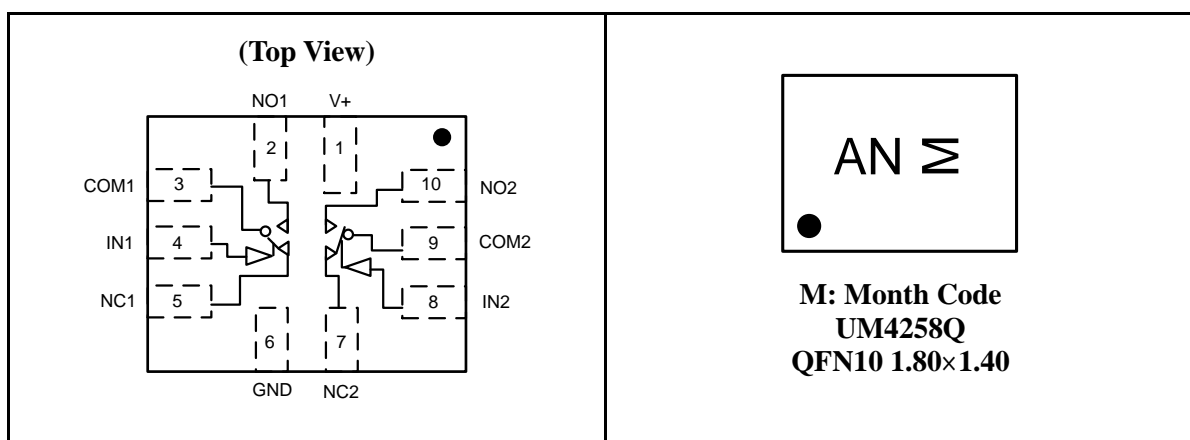
- USB 1.1/2.0 Signal Switching Circuits
- Battery-Operated Equipment
- Audio/Video-Signal Routing
- Headphone Switching
- Low-Voltage Data-Acquisition Systems
- Sample-and-Hold Circuits
- Cell Phones
- PDAs

Features

- 2ns (Max) Differential Skew
- -3dB Bandwidth: 300MHz
- Low 15pF On-Channel Capacitance
- Single-Supply Operation from +1.8V to +5.5V
- 4.5Ω R_{ON} (Max) Switches
- 0.3Ω (Max) R_{ON} Match (+3.0V Supply)
- 1.2Ω (Max) Flatness (+3.0V Supply)
- Rail-to-Rail Signal Handling
- High Off-Isolation: -55dB (10MHz)
- Low Crosstalk: -80dB (10MHz)
- Low Distortion: 0.03%
- +1.8V CMOS-Logic Compatible
- < 0.5nA Leakage Current at +25°C

Pin Configurations

Top View



Pin Description

Pin Number	Name	Function
7	NC2	Analog Switch 2-Normally Closed Terminal
8	IN2	Analog Switch 2-Digital Control Input
9	COM2	Analog Switch 2-Common Terminal
10	NO2	Analog Switch 2-Normally Open Terminal
6	GND	Ground Connection
1	V ₊	Positive Supply Voltage
5	NC1	Analog Switch 1-Normally Closed Terminal
4	IN1	Analog Switch 1-Digital Control Input
3	COM1	Analog Switch 1-Common Terminal
2	NO1	Analog Switch 1-Normally Open Terminal

Ordering Information

Part Number	Packaging Type	Marking Code	Shipping Qty
UM4258Q	QFN10 1.80×1.40	AN	3000pcs/7 Inch Tape & Reel

Function Table

IN __	NO __	NC __
0	OFF	ON
1	ON	OFF

Absolute Maximum Ratings

Symbol	Parameter	Limit	Unit
V ₊	Supply Voltage	-0.3 to +6.0	V
V _S	DC Switch Voltage (Note 1)	-0.3 to (V ₊ +0.3)	
IN __	DC IN Voltage	-0.3 to +6.0	
I _o	Continuous Current (COM __ , NO __ , NC __)	±100	mA
I _p	Peak Current (Pulsed at 1ms, 10% Duty Cycle)	±200	
T _O	Operating Temperature Range	-40 to +85	°C
T _J	Junction Temperature	+150	
T _{STG}	Storage Temperature Range	-65 to +150	
T _L	Junction Lead Temperature (Soldering, 10 Seconds)	+300	
T _{Bump}	Bump Temperature (Soldering)	Infrared (15s)	
		Vapor Phase (60s)	+215
P _D	Continuous Power Dissipation @ +70°C	909	mW
ESD	ESD Method 3015.7	>2000	V

Note 1: Signals on COM_{_}, NO_{_}, or NC_{_} exceeding V₊ or GND are clamped by internal diodes. Limit forward-diode current to maximum current rating.

DC Electrical Characteristics (Single +3V Supply)

($V_+ = +2.7V$ to $+3.6V$, $V_{IH} = +1.4V$, $V_{IL} = +0.5V$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $V_+ = +3.0V$, $T_A = +25^\circ C$) (Note 2, 3)

Symbol	Parameter	Test Conditions	Temp	Limits (-40°C to 85°C)			Unit
				Min	Typ	Max	
DC Electrical Characteristics							
$V_{COM_}$ $V_{NO_}$ V_{NC}	Analog Signal Range		Full	0		V_+	V
V_+	Power Supply Range		Full	1.8		5.5	V
I_+	Supply Current	$V_+ = +5.5V$, $V_{IN_} = 0V$ or V_+	Full			1	μA
$I_{COM_ (ON)}$	COM_On Leakage Current (Note 7)	$V_+ = +3.6V$, $V_{COM_} = 0.3V, 3.3V$; $V_{NO_}$ or $V_{NC_} = 0.3V, 3.3V$, or Floating	Room Full	-1 -2	+0.01	+1 +2	nA
I_{OFF}	OFF State Leakage Current (Note 7)	$V_+ = +3.6V$, $V_{COM_} = 0.3V, 3.3V$; $V_{NO_}$ or $V_{NC_} = 3.3V, 0.3V$	Room Full	-0.5 -1	+0.01	+0.5 +1	nA
V_{IH}	Input High Voltage		Full	1.4			V
V_{IL}	Input Low Voltage		Full			0.5	V
I_{IN}	Input Leakage Current	$V_+ = +3.6V$, $V_{IN_} = 0$ or $5.5V$	Full	-100		+100	nA
R_{ON}	On-Resistance (Note 4)	$V_+ = +2.7V$, $I_{COM_} = 10mA$; $V_{NO_}$ or $V_{NC_} = 1.5V$	Room		3.0	4.5	Ω
			Full			5	
ΔR_{ON}	On Resistance Match Between Channels (Note 4, 5)	$V_+ = +2.7V$, $I_{COM_} = 10mA$; $V_{NO_}$ or $V_{NC_} = 1.5V$	Room		0.1	0.3	Ω
			Full			0.4	
R_{FLAT}	On Resistance Flatness (Note 6)	$V_+ = +2.7V$, $I_{COM_} = 10mA$; $V_{NO_}$ or $V_{NC_} = 1.0V, 1.5V,$ $2.0V$	Room		0.6	1.2	Ω
			Full			1.5	

AC Electrical Characteristics (Single +3V Supply)

($V_+ = +2.7V$ to $+3.6V$, $V_{IH} = +1.4V$, $V_{IL} = +0.5V$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $V_+ = +3.0V$, $T_A = +25^\circ C$) (Note 2, 3)

Symbol	Parameter	Test Conditions	Temp	Limits (-40°C to 85°C)			Unit
				Min	Typ	Max	
AC Electrical Characteristics							
t_{ON}	Turn-On Time	$V_{NO_}, V_{NC_} = 1.5V$; $R_L = 300\Omega$, $C_L = 35pF$, Figure 1; $V_{IH} = 1.5V$, $V_{IL} = 0V$	Room Full		40	80 100	ns
t_{OFF}	Turn-Off Time	$V_{NO_}, V_{NC_} = 1.5V$; $R_L = 300\Omega$, $C_L = 35pF$, Figure 1; $V_{IH} = 1.5V$, $V_{IL} = 0V$	Room Full		20	40 50	ns
t_{BBM}	Break Before Make Time (Note 7)	$V_{NO_}, V_{NC_} = 1.5V$; $R_L = 300\Omega$, $C_L = 35pF$, Figure 2	Room Full	1	8		ns
t_{SKEW}	Skew (Note 7)	$R_S = 39\Omega$, $C_L = 50pF$, Figure 3	Full		0.15	2	ns
Q_{INJ}	Charge Injection	$C_L = 1.0nF$, Figure 4 $V_{GEN} = 1.5V$, $R_{GEN} = 0\Omega$	Room		5		pC
V_{ISO}	Off Isolation	$f = 10MHz$; $V_{NO_}, V_{NC_} = 1V_{P-P}$; $R_L = 50\Omega$, $C_L = 5pF$, Figure 5	Room		-55		dB
		$f = 1MHz$; $V_{NO_}, V_{NC_} = 1V_{P-P}$; $R_L = 50\Omega$, $C_L = 5pF$, Figure 5			-80		
V_{CT}	Crosstalk (Note 8)	$f = 10MHz$; $V_{NO_}, V_{NC_} = 1V_{P-P}$; $R_L = 50\Omega$, $C_L = 5pF$, Figure 5	Room		-80		dB
		$f = 1MHz$; $V_{NO_}, V_{NC_} = 1V_{P-P}$; $R_L = 50\Omega$, $C_L = 5pF$, Figure 5			-110		
BW	-3dB Bandwidth	Signal=0dBm, $R_L = 50\Omega$, $C_L = 5pF$, Figure 5	Room		300		MHz
THD	Total Harmonic Distortion	$R_L = 600\Omega$, $V_{COM} = 2V_{P-P}$	Room		0.03		%
Capacitance							
$C_{NO_ (OFF)}$ $C_{NC_ (OFF)}$	NO_, NC_ Off Capacitance	$f = 1MHz$, Figure 6	Room		9		pF
$C_{(ON)}$	Switch On Capacitance	$f = 1MHz$, Figure 6	Room		15		pF

DC Electrical Characteristics (Single +5V Supply)

($V_+ = +4.2V$ to $+5.5V$, $V_{IH} = +2.0V$, $V_{IL} = +0.8V$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $V_+ = +5.0V$, $T_A = +25^\circ C$) (Note 2, 3)

Symbol	Parameter	Test Conditions	Temp	Limits (-40°C to 85°C)			Unit
				Min	Typ	Max	
DC Electrical Characteristics							
$V_{COM_}$ $V_{NO_}$ $V_{NC_}$	Analog Signal Range		Full	0		V_+	V
V_+	Power Supply Range		Full	1.8		5.5	V
I_+	Supply Current	$V_+ = +5.5V$, $V_{IN_} = 0V$ or V_+	Full			1	μA
$I_{COM_ (ON)}$	COM_On Leakage Current (Note 7)	$V_+ = +5.5V$, $V_{COM_} = 1.0V$, $4.5V$; $V_{NO_}$ or $V_{NC_} = 1.0V$, $4.5V$, or Floating	Room Full	-1 -2	+0.01	+1 +2	nA
I_{OFF}	OFF State Leakage Current (Note 7)	$V_+ = +5.5V$, $V_{COM_} = 1.0V$, $4.5V$; $V_{NO_}$ or $V_{NC_} = 1.0V$, $4.5V$	Room Full	-0.5 -1	+0.01	+0.5 +1	nA
V_{IH}	Input High Voltage		Full	2.0			V
V_{IL}	Input Low Voltage		Full			0.8	V
I_{IN}	Input Leakage Current	$V_+ = +5.5V$, $V_{IN_} = 0$ or V_+	Full	-100		+100	nA
R_{ON}	On-Resistance (Note 4)	$V_+ = +4.2V$, $I_{COM_} = 10mA$; $V_{NO_}$ or $V_{NC_} = 3.5V$	Room		1.7	3	Ω
			Full			3.5	
ΔR_{ON}	On Resistance Match Between Channels (Note 4, 5)	$V_+ = +4.2V$, $I_{COM_} = 10mA$; $V_{NO_}$ or $V_{NC_} = 3.5V$	Room		0.1	0.3	Ω
			Full			0.4	
R_{FLAT}	On Resistance Flatness (Note 6)	$V_+ = +4.2V$, $I_{COM_} = 10mA$; $V_{NO_}$ or $V_{NC_} = 1.0V$, $2.0V$, $3.5V$	Room		0.4	1.2	Ω
			Full			1.5	

AC Electrical Characteristics (Single +5V Supply)

($V_+ = +4.2V$ to $+5.5V$, $V_{IH} = +2.0V$, $V_{IL} = +0.8V$, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $V_+ = +5.0V$, $T_A = +25^\circ C$) (Note 2, 3)

Symbol	Parameter	Test Conditions	Temp	Limits (-40°C to 85°C)			Unit
				Min	Typ	Max	
AC Electrical Characteristics							
t_{ON}	Turn-On Time	$V_{NO_}, V_{NC_} = 3.0V$; $R_L = 300\Omega$, $C_L = 35pF$, Figure 1;	Room Full		30	80 100	ns
t_{OFF}	Turn-Off Time	$V_{NO_}, V_{NC_} = 3.0V$; $R_L = 300\Omega$, $C_L = 35pF$, Figure 1;	Room Full		20	40 50	ns
t_{BBM}	Break Before Make Time (Note 7)	$V_{NO_}, V_{NC_} = 3.0V$; $R_L = 300\Omega$, $C_L = 35pF$, Figure 2	Room Full	1	8		ns
t_{SKEW}	Skew (Note 7)	$R_S = 39\Omega$, $C_L = 50pF$, Figure 3	Full		0.15	2	ns
Q_{INJ}	Charge Injection	$C_L = 1.0nF$, Figure 4 $V_{GEN} = 1.5V$, $R_{GEN} = 0\Omega$	Room		9		pC
V_{ISO}	Off Isolation	$f = 10MHz$; $V_{NO_}, V_{NC_} = 1V_{P-P}$; $R_L = 50\Omega$, $C_L = 5pF$, Figure 5	Room		-55		dB
		$f = 1MHz$; $V_{NO_}, V_{NC_} = 1V_{P-P}$; $R_L = 50\Omega$, $C_L = 5pF$, Figure 5			-80		
V_{CT}	Crosstalk (Note 8)	$f = 10MHz$; $V_{NO_}, V_{NC_} = 1V_{P-P}$; $R_L = 50\Omega$, $C_L = 5pF$, Figure 5	Room		-80		dB
		$f = 1MHz$; $V_{NO_}, V_{NC_} = 1V_{P-P}$; $R_L = 50\Omega$, $C_L = 5pF$, Figure 5			-110		
BW	-3dB Bandwidth	Signal=0dBm, $R_L = 50\Omega$, $C_L = 5pF$, Figure 5	Room		300		MHz
THD	Total Harmonic Distortion	$R_L = 600\Omega$, $V_{COM} = 2V_{P-P}$	Room		0.03		%
Capacitance							
$C_{NO_ (OFF)}$ $C_{NC_ (OFF)}$	NO_, NC_ Off Capacitance	$f = 1MHz$, Figure 6	Room		9		pF
$C_{(ON)}$	Switch On Capacitance	$f = 1MHz$, Figure 6	Room		15		pF

Note 2: The parts are 100% tested at $+25^\circ C$ only, and guaranteed by design over the specified temperature range.

Note 3: The algebraic convention used in this data sheet is where the most negative value is a minimum and the most positive value is a maximum.

Note 4: Guaranteed by design.

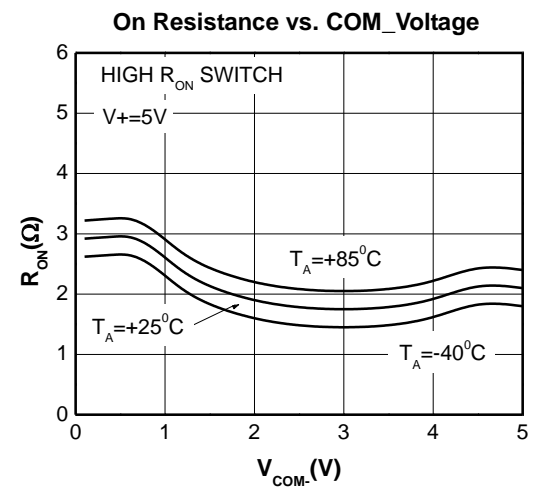
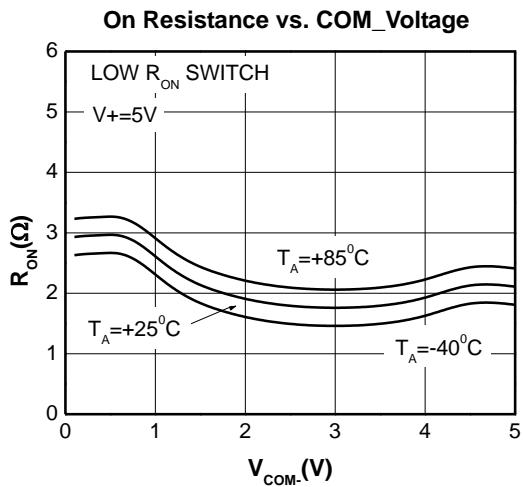
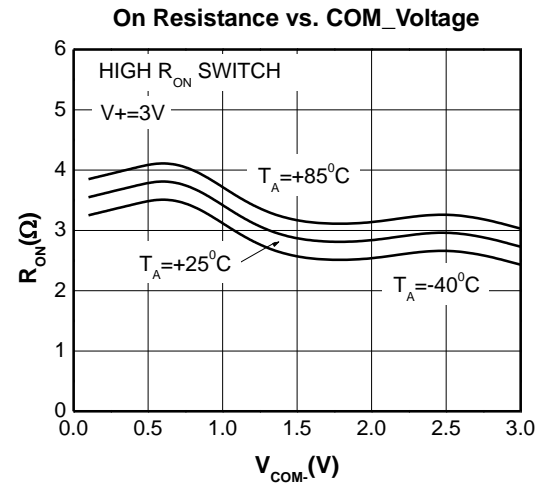
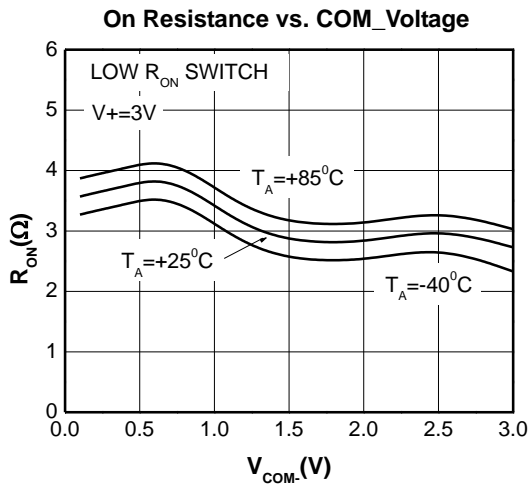
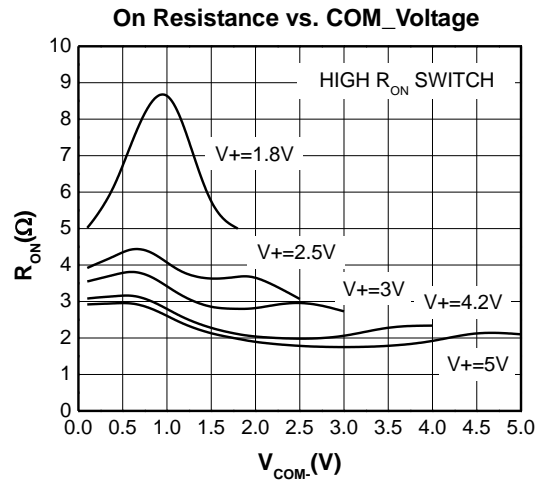
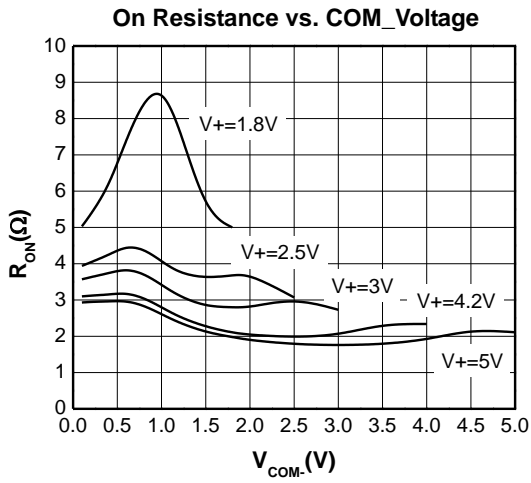
Note 5: $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.

Note 6: Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal ranges.

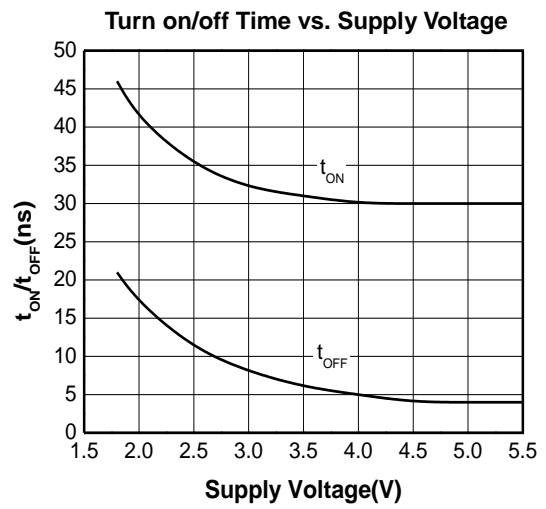
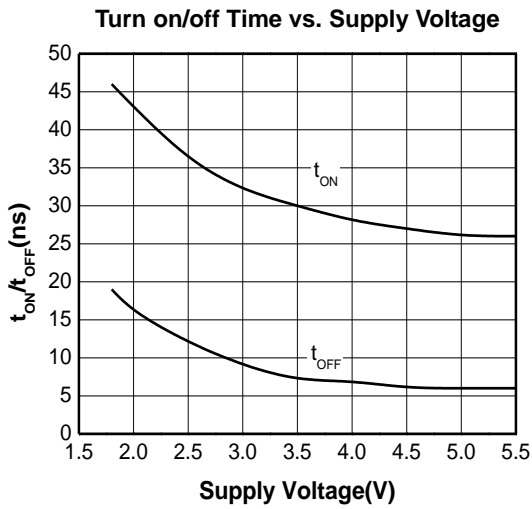
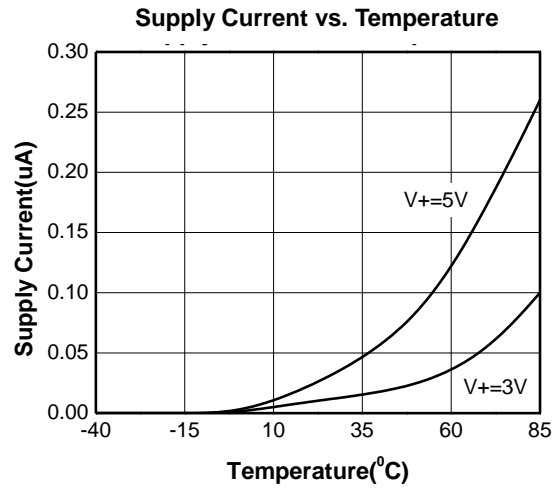
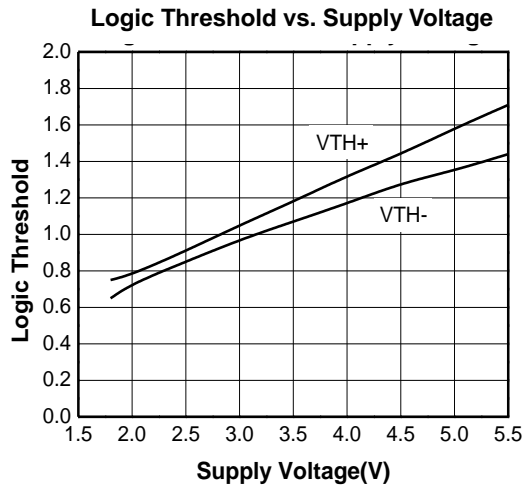
Note 7: Guaranteed by design.

Note 8: Between any two switches.

Typical Operating Characteristics

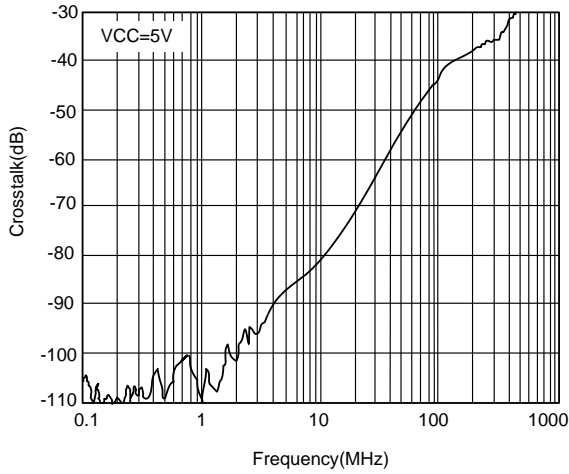


Typical Operating Characteristics (Continued)

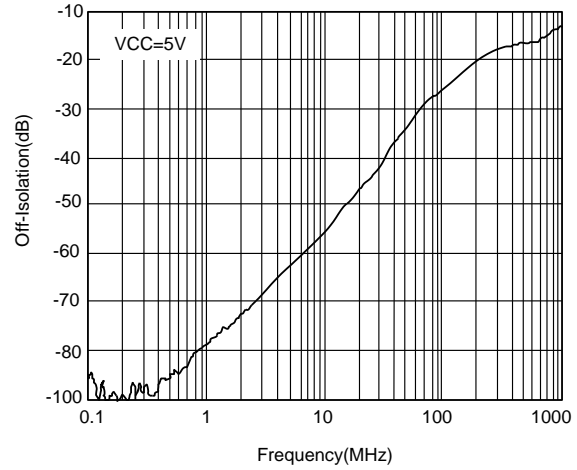


Typical Operating Characteristics (Continued)

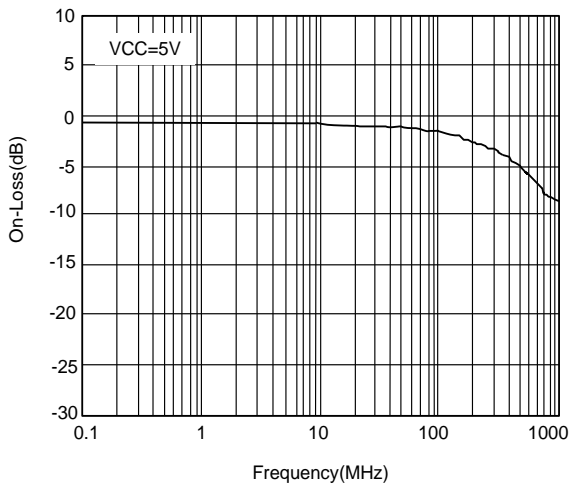
Crosstalk vs. Frequency



Off-Isolation vs. Frequency



On-Loss vs. Frequency



Detailed Description

The UM4258Q high-speed, low-voltage, low on-resistance (R_{ON}), dual SPDT analog switch operates from a single +1.8V to +5.5V supply. The switch features break-before-make switching operation and fast switching speeds ($t_{ON}=80ns$ (max), $t_{OFF}=40ns$ (max)).

The switch has low 15pF on-channel capacitance, which allows for 12Mbps switching of the data signals for USB 1.0/1.1 applications. The UM4258Q is designed to switch D_+ and D_- USB signals with a guaranteed skew of less than 2ns (see Figure 4) as measured from 50% of the input signal to 50% of the output signal.

Applications Information

Digital Control Inputs

The UM4258Q logic inputs accept up to +5.5V regardless of supply voltage. For example, with a +3.3V supply, IN_- can be driven low to GND and high to +5.5V allowing for mixing of logic levels in a system. Driving the control logic inputs rail-to-rail minimizes power consumption. For a +3V supply voltage, the logic thresholds are 0.5V (low) and 1.4V (high); for a +5V supply voltage, the logic thresholds are 0.8V (low) and 2.0V (high).

Analog Signal Levels

The on-resistance of the UM4258Q changes very little for analog input signals across the entire supply voltage range (see the Typical Operating Characteristics). The switches are bidirectional, so the NO_- , NC_- , and COM_- pins can be either inputs or outputs.

Power-Supply Sequencing and Over-Voltage Protection

Proper power-supply sequencing is recommended for all CMOS devices. Always apply V_+ before applying analog signals, especially if the analog signal is not current-limited.

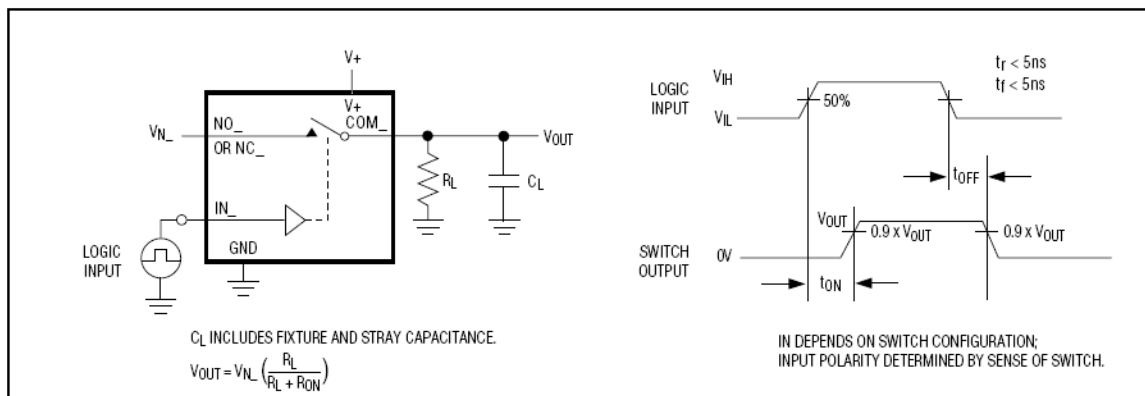


Figure 1. Switching Time

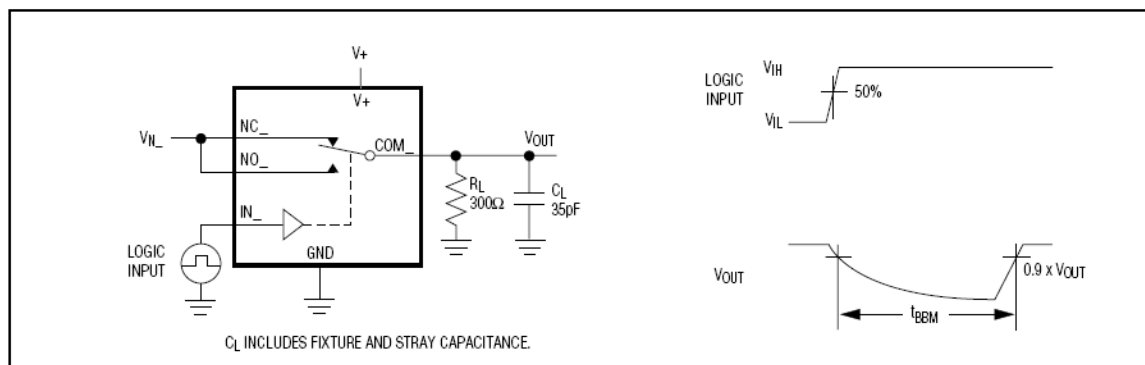


Figure 2. Break-Before-Make Interval

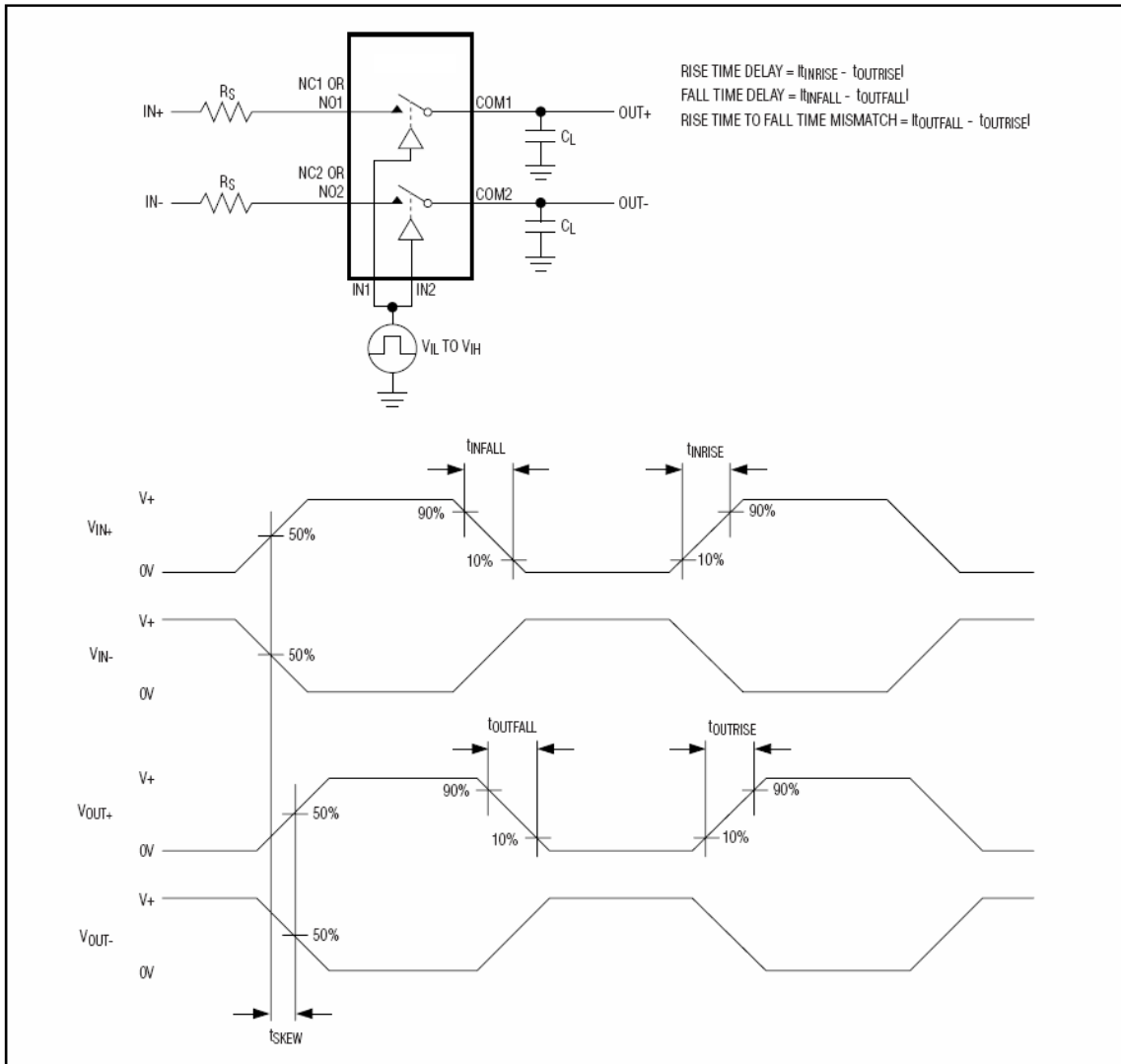


Figure 3. Output Signal Skew

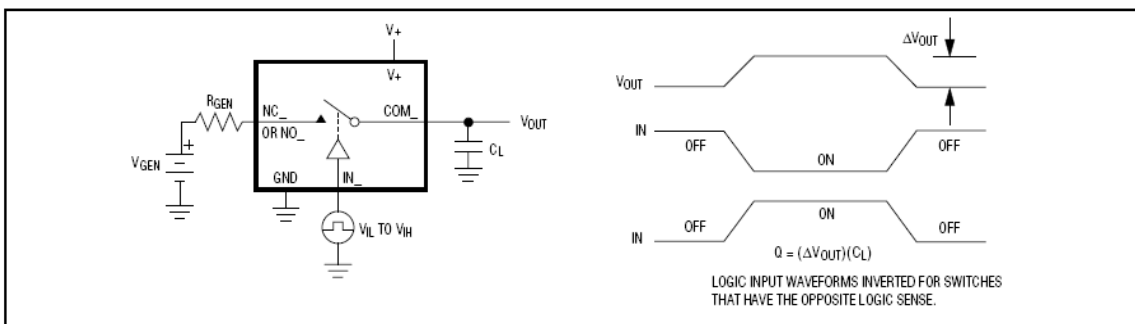


Figure 4. Charge Injection

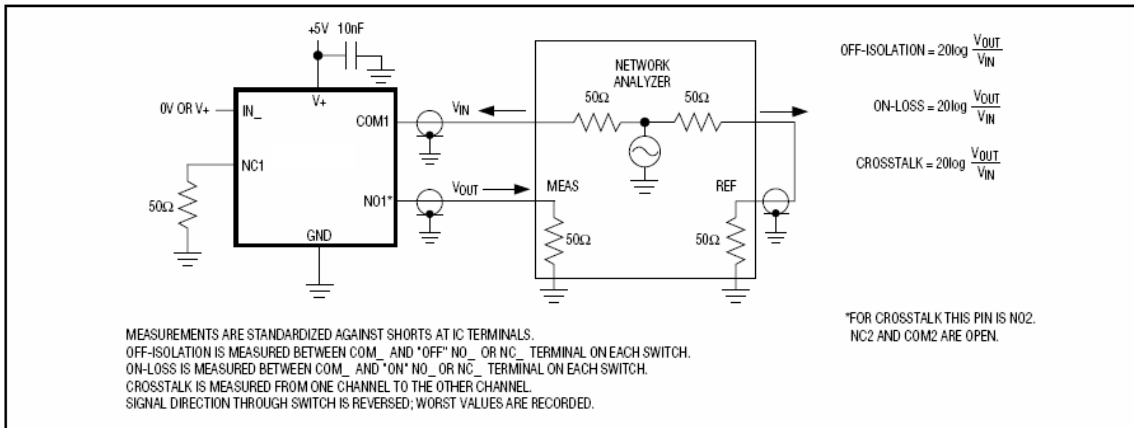


Figure 5. On-Loss, Off-Isolation, and Crosstalk

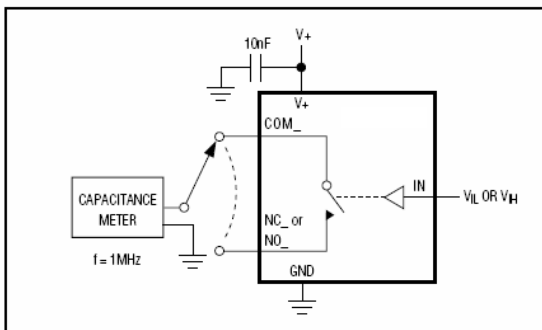
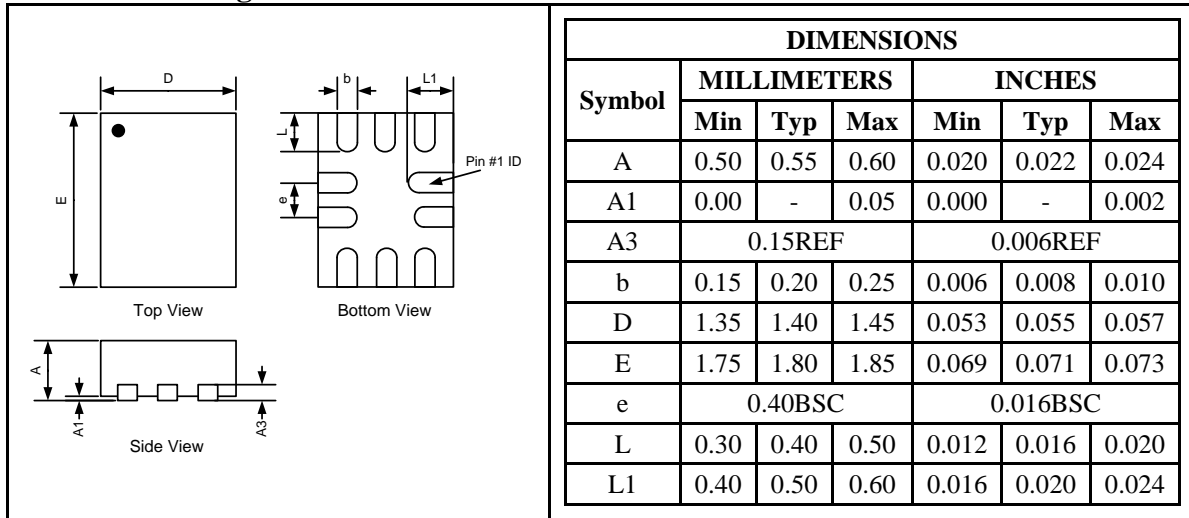


Figure 6. Channel Off/On-Capacitance

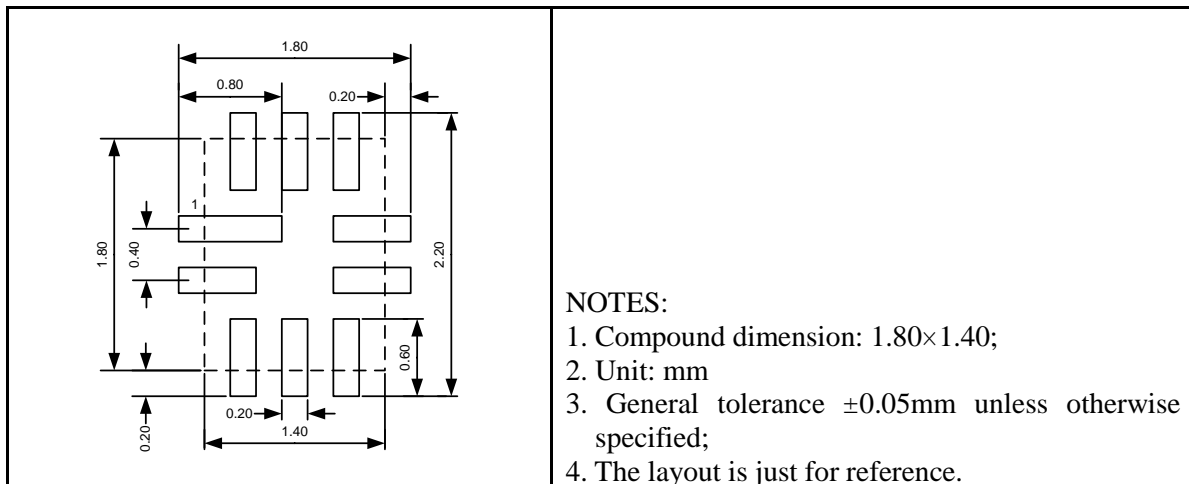
Package Information

UM4258Q: QFN10 1.80×1.40

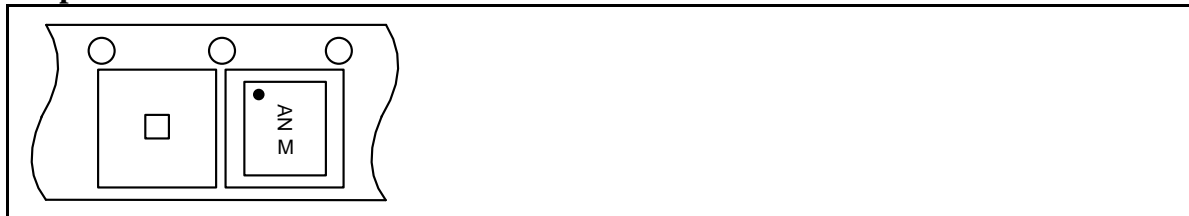
Outline Drawing



Land Pattern



Tape and Reel Orientation



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