

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

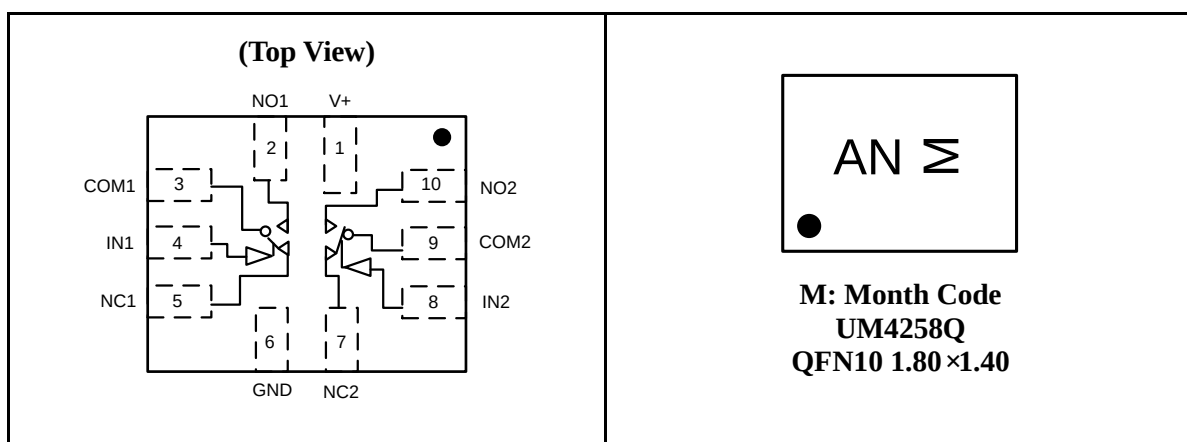
- USB 1.1/2.0 Signal Switching Circuits
- Battery-Operated Equipment
- Audio/Video-Signal Routing
- Headphone Switching
- Low-Voltage Data-Acquisition Systems
- Sample-and-Hold Circuits
- Cell Phones
- PDAs

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	℃
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)	+220	
		Vapor Phase (60s)	+215	
P _D	Continuous Power Dissipation @ +70 ℃		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 =300Ω, 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 =300Ω, 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 =300Ω, C _L =35pF, Figure 2	Room Full	1	8		ns
t _{SKEW}	Skew (Note 7)	R _S =39Ω, 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} =0Ω	Room		5		pC
V _{ISO}	Off Isolation	f=10MHz; V _{NO_} , V _{NC_} =1V _{P-P} ; R _L =50Ω, C _L =5pF, Figure 5	Room		-55		dB
		f=1MHz; V _{NO_} , V _{NC_} =1V _{P-P} ; R _L =50Ω, C _L =5pF, Figure 5			-80		
V _{CT}	Crosstalk (Note 8)	f=10MHz; V _{NO_} , V _{NC_} =1V _{P-P} ; R _L =50Ω, C _L =5pF, Figure 5	Room		-80		dB
		f=1MHz; V _{NO_} , V _{NC_} =1V _{P-P} ; R _L =50Ω, C _L =5pF, Figure 5			-110		
BW	-3dB Bandwidth	Signal=0dBm, R _L =50Ω, C _L =5pF, Figure 5	Room		300		MHz
THD	Total Harmonic Distortion	R _L =600Ω, 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 =300Ω, C _L =35pF, Figure 1;	Room Full		30	80 100	ns
t _{OFF}	Turn-Off Time	V _{NO_} , V _{NC_} =3.0V; R _L =300Ω, 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 =300Ω, C _L =35pF, Figure 2	Room Full	1	8		ns
t _{SKEW}	Skew (Note 7)	R _S =39Ω, 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} =0Ω	Room		9		pC
V _{ISO}	Off Isolation	f=10MHz; V _{NO_} , V _{NC_} =1V _{P-P} ; R _L =50Ω, C _L =5pF, Figure 5	Room		-55		dB
		f=1MHz; V _{NO_} , V _{NC_} =1V _{P-P} ; R _L =50Ω, C _L =5pF, Figure 5			-80		
V _{CT}	Crosstalk (Note 8)	f=10MHz; V _{NO_} , V _{NC_} =1V _{P-P} ; R _L =50Ω, C _L =5pF, Figure 5	Room		-80		dB
		f=1MHz; V _{NO_} , V _{NC_} =1V _{P-P} ; R _L =50Ω, C _L =5pF, Figure 5			-110		
BW	-3dB Bandwidth	Signal=0dBm, R _L =50Ω, C _L =5pF, Figure 5	Room		300		MHz
THD	Total Harmonic Distortion	R _L =600Ω, 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.

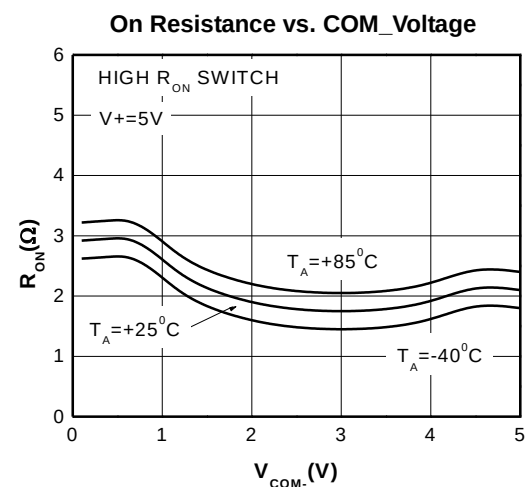
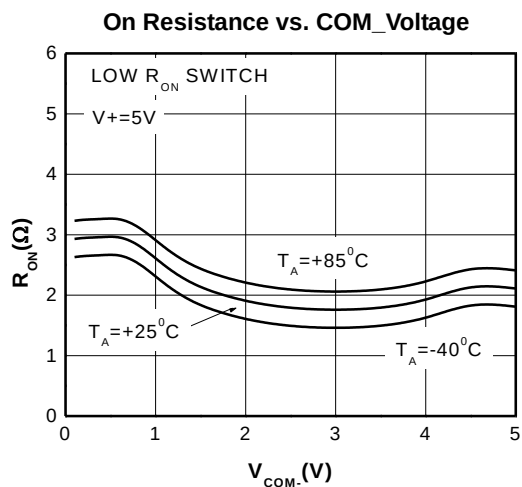
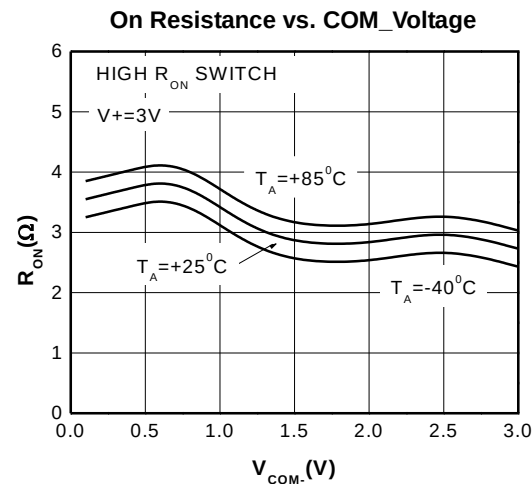
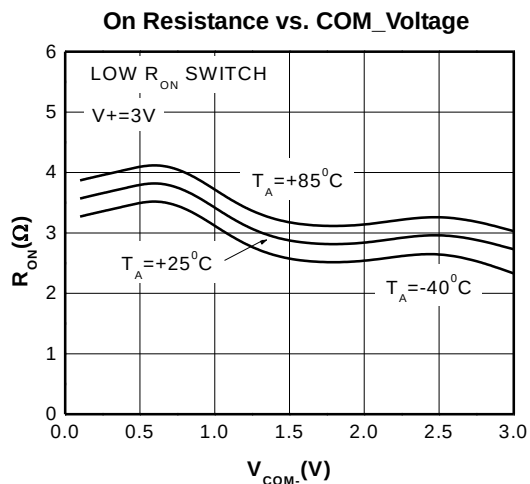
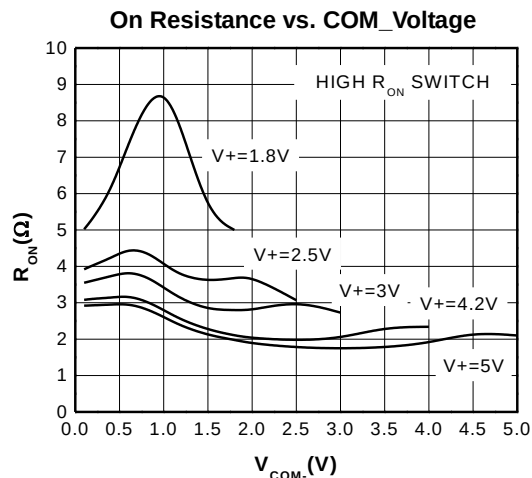
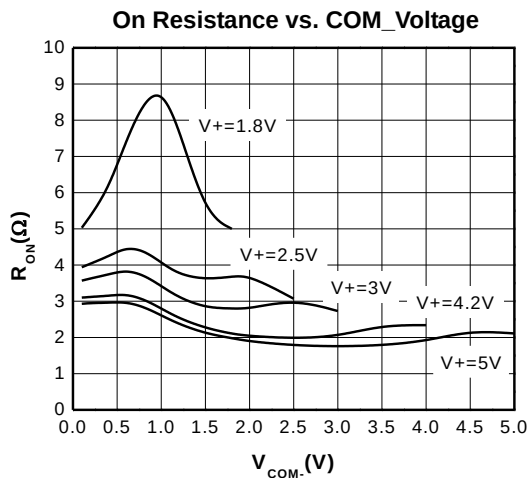
Note 5: $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.

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.

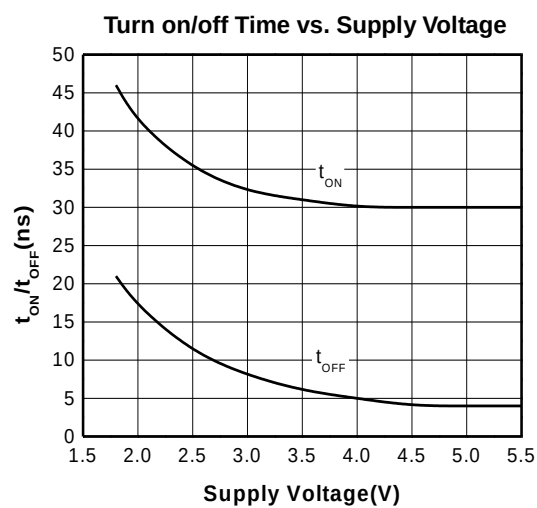
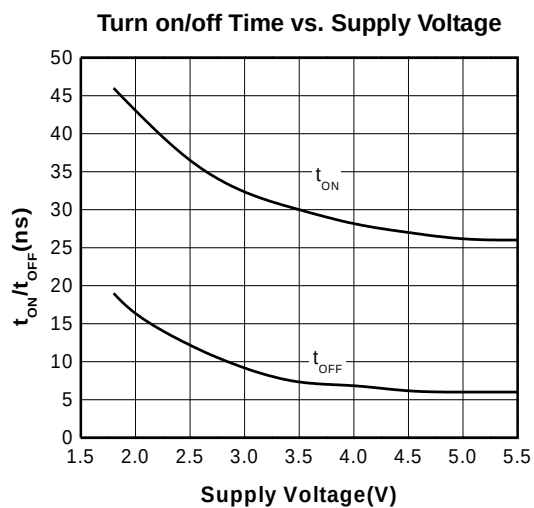
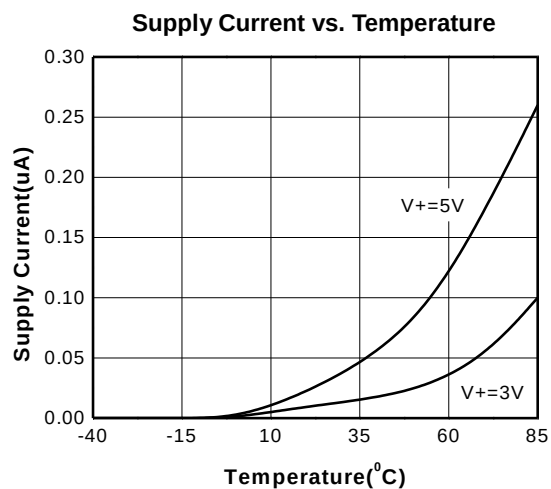
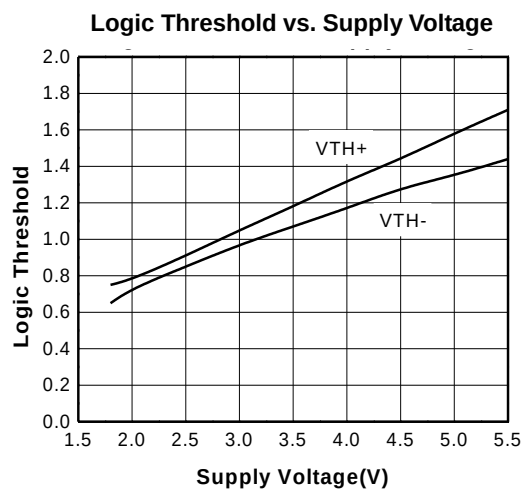
Note 7: Guaranteed by design.

Note 8: Between any two switches.

Typical Operating Characteristics

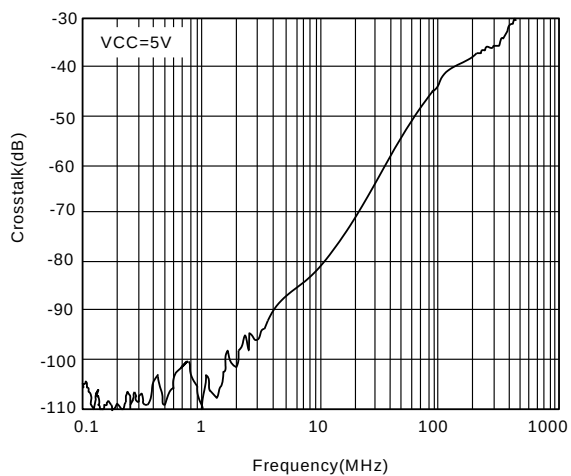


Typical Operating Characteristics (Continued)

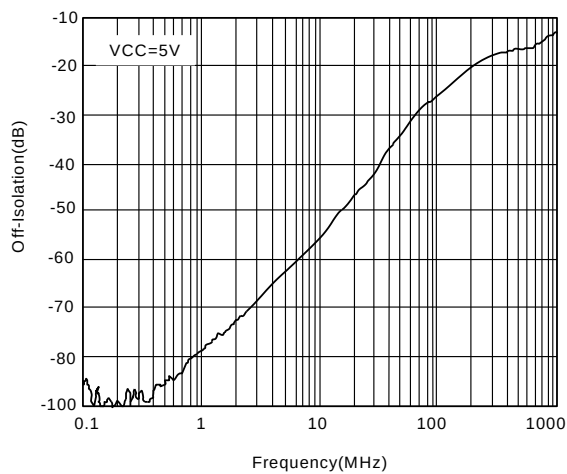


Typical Operating Characteristics (Continued)

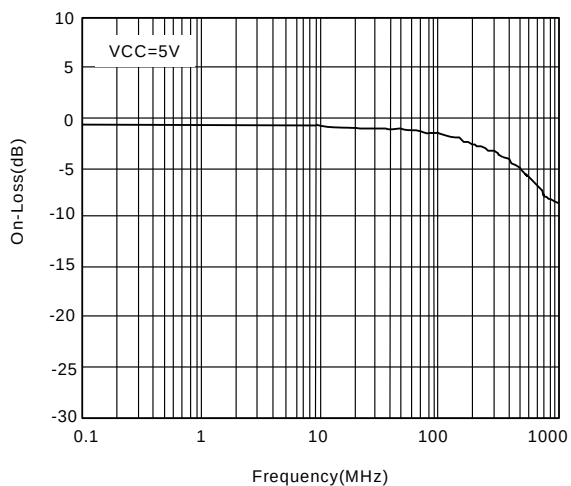
Crosstalk vs. Frequency



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 ($t_{ON}=80\text{ns}$ (max), $t_{OFF}=40\text{ns}$ (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.

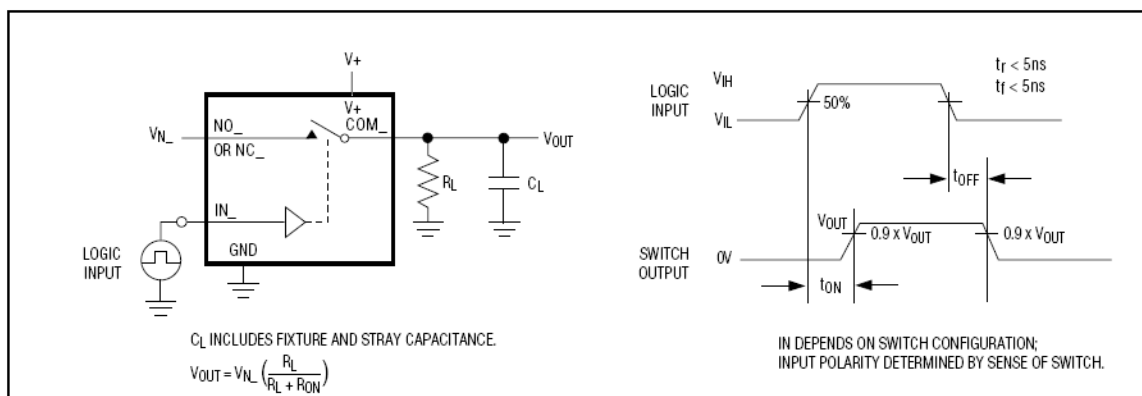


Figure 1. Switching Time

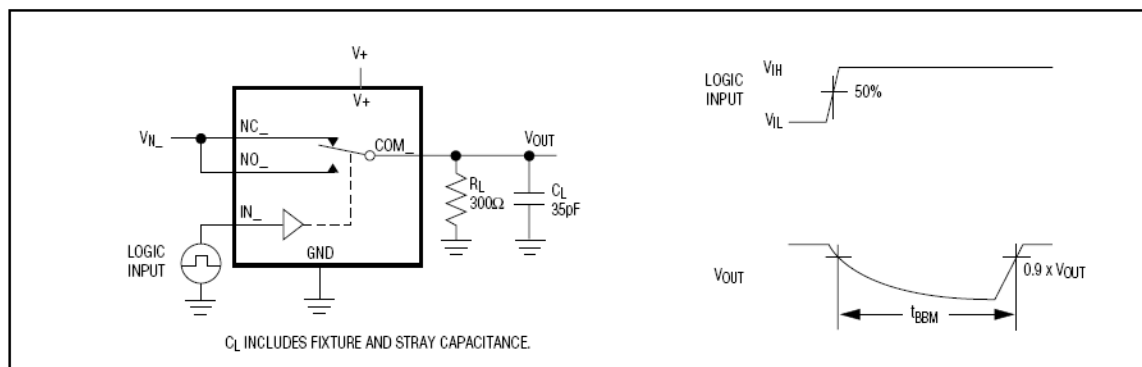
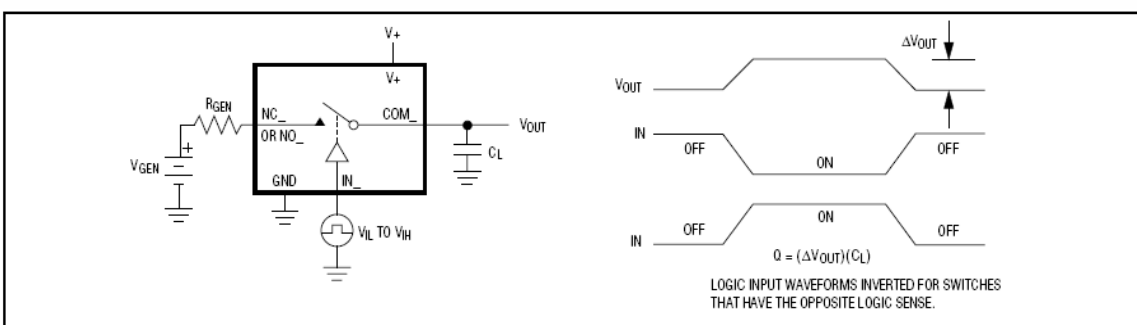
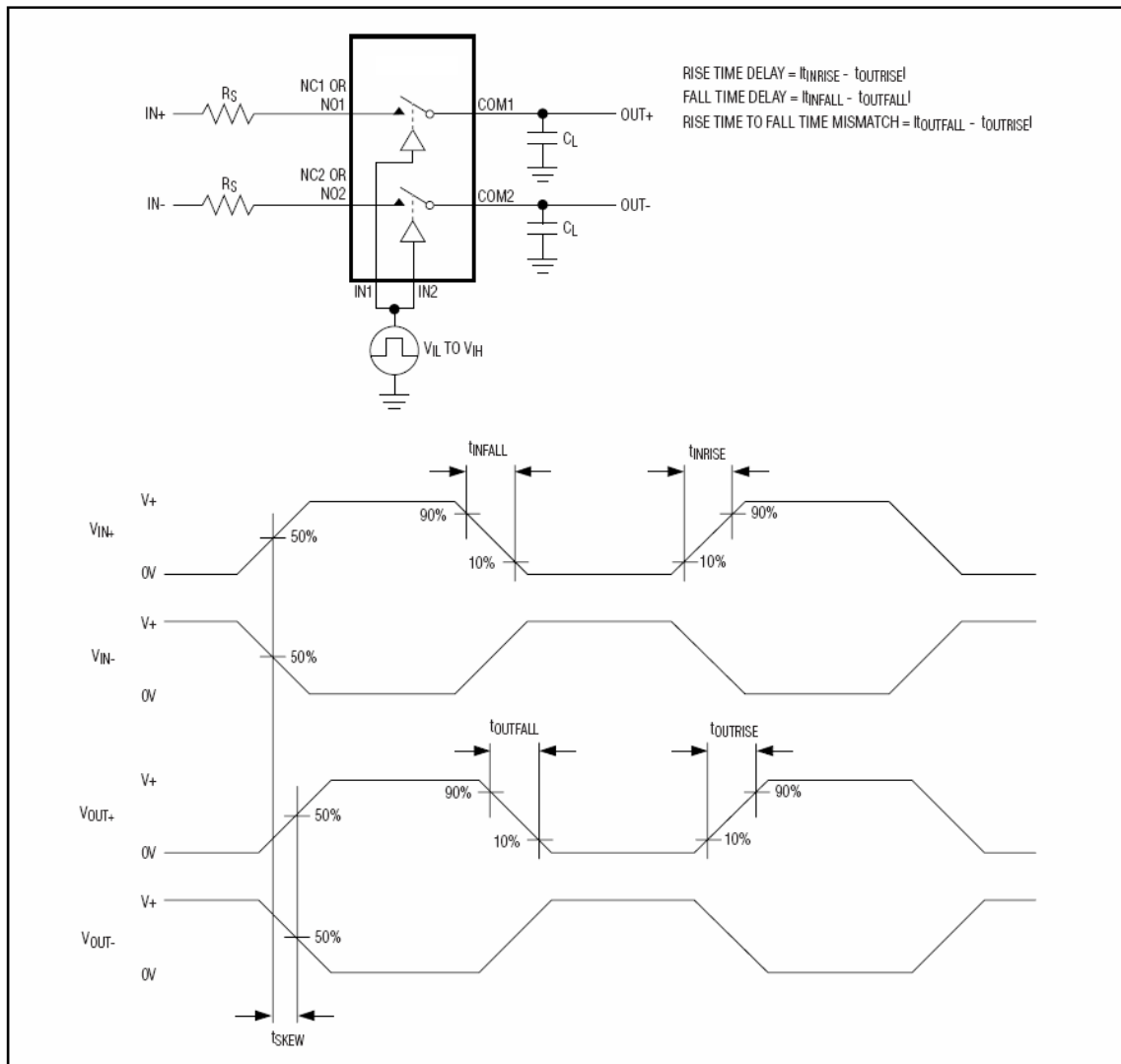


Figure 2. Break-Before-Make Interval



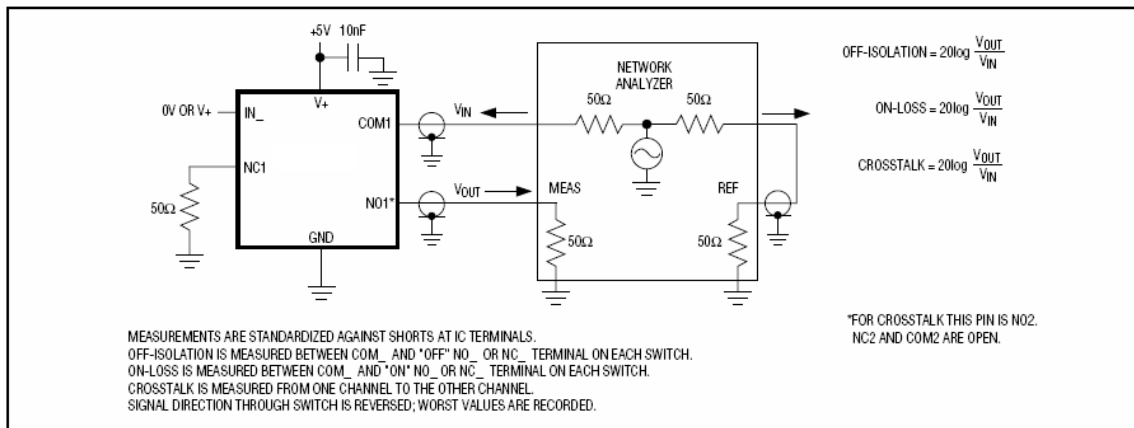


Figure 5. On-Loss, Off-Isolation, and Crosstalk

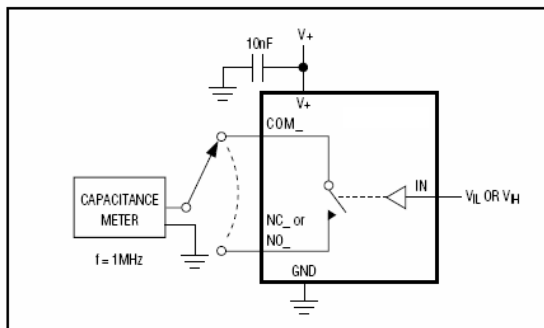
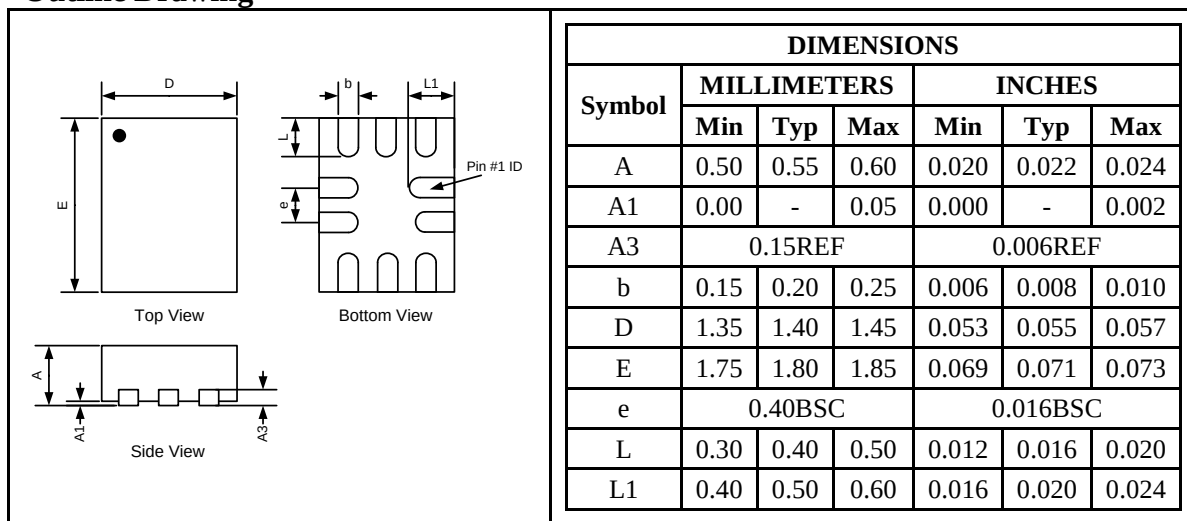


Figure 6. Channel Off/On-Capacitance

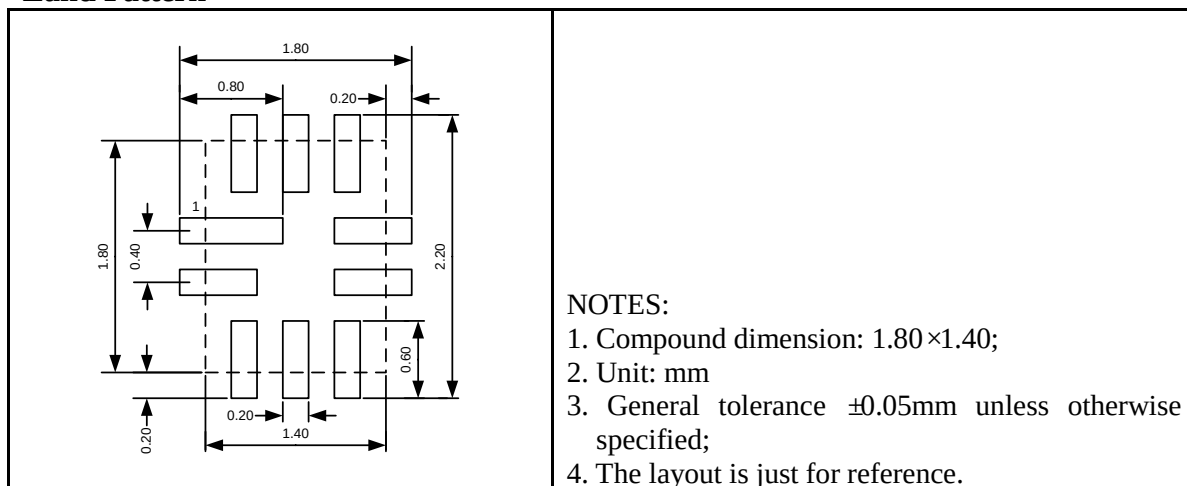
Package Information

UM4258Q: QFN10 1.80×1.40

Outline Drawing



Land Pattern



Tape and Reel Orientation



GREEN COMPLIANCE

Union Semiconductor is committed to environmental excellence in all aspects of its operations including meeting or exceeding regulatory requirements with respect to the use of hazardous substances. Numerous successful programs have been implemented to reduce the use of hazardous substances and/or emissions.

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