

1. General Description

The EMS4735 is a bidirectional low-power dual port, high-speed, USB 2.0 analog switch with integrated protection for USB Type-C™ systems. The device is configured as a dual 4:1 or 1:4 switch. It is optimized for use with the USB 2.0 DP/DM lines in a USB Type-C™ system.

The device has low bit-to-bit skew and high channel-to-channel noise isolation, and is compatible with various standards, such as high-speed USB 2.0 (480Mbps). Each switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. Its bandwidth is wide enough to pass high-speed USB 2.0 differential signals (480 Mb/s) with good signal integrity.

The GPIO control of SEL is 1.8V logic compatible. EMS4735 is available in QFN 1.8x2.6-16L with Pb-free and Halogen-free making it a perfect candidate for mobile and space constrained applications.

2. Features and Benefits

- Low On-resistance, $R_{ON} = 3\ \Omega$ when $V_{CC} = 5\ V$
- High Bandwidth (-3 dB @ 800 MHz) Suitable For USB2.0 High-Speed Routing
- Low Quiescent Current (< 2 μA) With Very Wide Supply Range (1.5V ~ 5.5V)
- 1.8 V Logic Compatible Control Pin
- High Off-Isolation: -100 dB @ 100 kHz
- Low Channel-to-Channel Crosstalk: -97 dB @ 100 kHz
- ESD protection: HBM ESDA/JEDEC JS-001 Class 3A exceeds 4000 V

3. Applications

- Mobile Phones, Tablets and Notebooks
- USB port devices

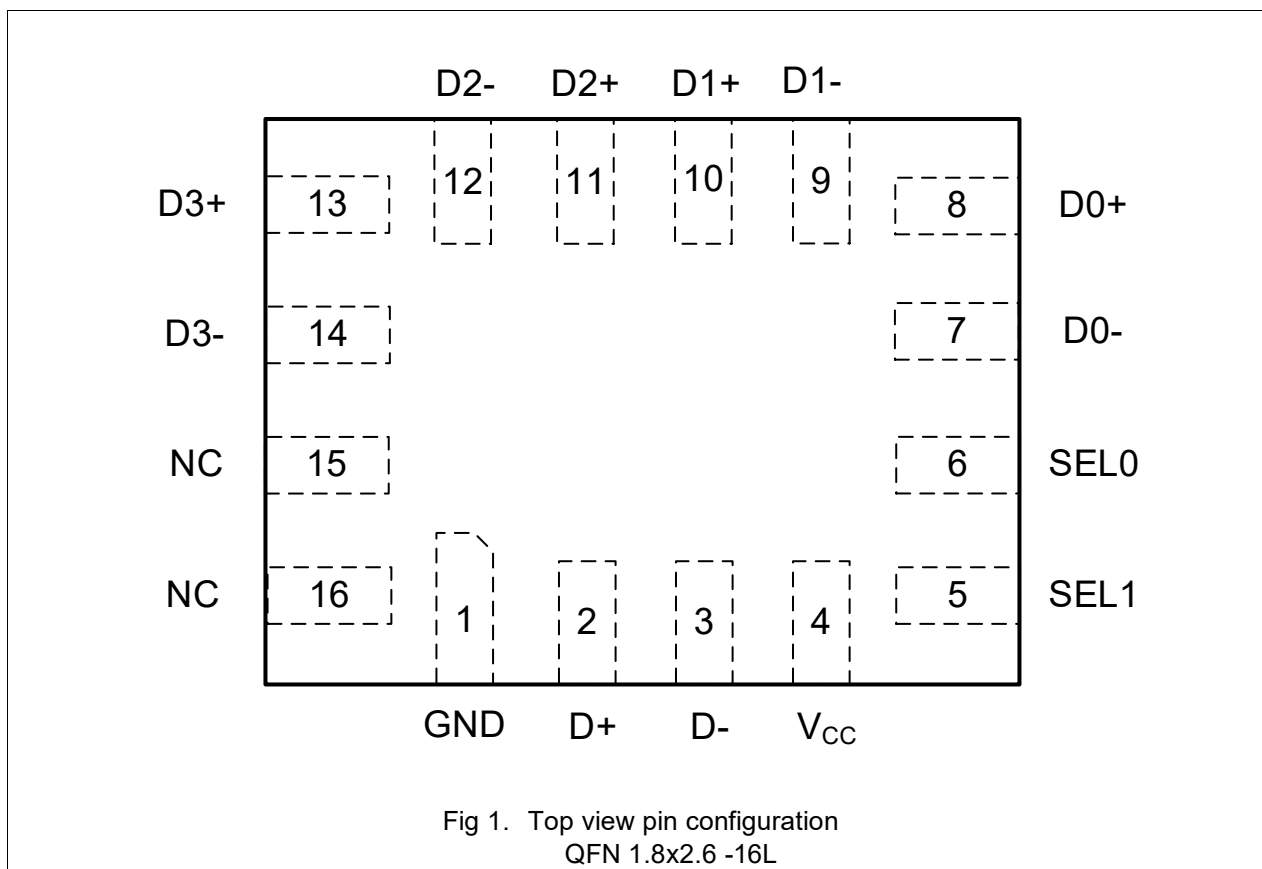
4. Ordering Information

Table 1. Ordering information

Type number	Topside marking	Package		
		Name	Description	Quantity
EMS4735Q	A26 GYW	QFN1.8×2.6-16L	QFN package, 16 pins 1.8 mm × 2.6 mm; 0.6 mm (Max) height	3000

5. Pinning Information

5.1. Pin map



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
GND	1	Ground
D+	2	D+ Common Port (HS or FS USB)
D-	3	D- Common Port (HS or FS USB)
V _{CC}	4	Power Supply
SEL1	5	Path Selection Control Input (See Table Below)
SELO	6	Path Selection Control Input (See Table Below)
D0-	7	D- From the 1st Source Path (HS or FS USB)
D0+	8	D+ From the 1st Source Path (HS or FS USB)
D1-	9	D- From the 2nd Source Path (HS or FS USB)
D1+	10	D+ From the 2nd Source Path (HS or FS USB)
D2+	11	D+ From the 3rd Source Path (HS or FS USB)
D2-	12	D- From the 3rd Source Path (HS or FS USB)
D3+	13	D+ From the 4th Source Path (HS or FS USB)
D3-	14	D- From the 4th Source Path (HS or FS USB)
NC	15,16	No Connect

6. Functional Description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level.

Input SEL1	Input SELO	Switch
L	L	D+ to D0+, D- to D0-
L	H	D+ to D1+, D- to D1-
H	L	D+ to D2+, D- to D2-
H	H	D+ to D3+, D- to D3-

7. Typical Application

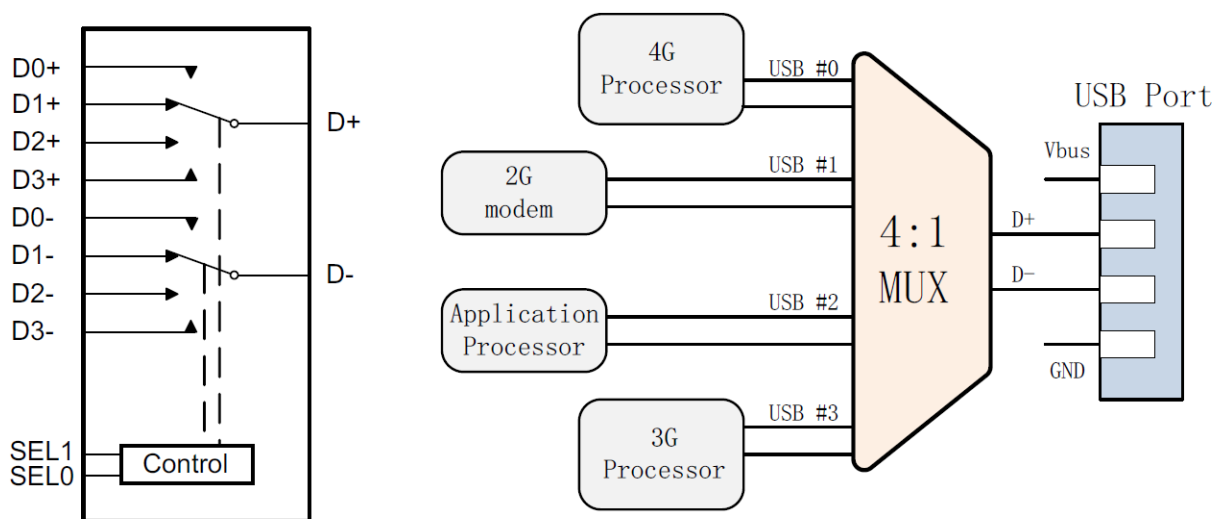


Fig 2. Mobile Phone

8. Absolute Maximum Ratings

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 beyond those indicated in the operational sections of this specification is not implied.

Table 4. Absolute Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		-0.3	6.5	V
V _{IN}	control input voltage		-0.3	6.5	V
I _C	continuous current through Dx+/- and D+/-			±100	mA
I _P	peak current through Dx+/- and D+/- (pulsed at 1ms 50% duty cycle)			±200	mA
P _D	power dissipation			250	mW
T _{stg}	storage temperature		-55	150	°C
T _J	junction temperature under bias			125	°C
T _L	lead temperature (soldering, 10 seconds)			260	°C

9. Recommended Operating Conditions

Table 5. Recommend operating ratings

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	supply voltage operating		1.5		5.5	V
V _{SW}	switch voltage		0		5.5	V
V _{IN}	control input voltage		0		5.5	V
T _A	operating temperature		-40		125	°C
R _{θJA}	thermal Resistance			360		°C/W

10. Electrical Characteristics

Table 6. Static characteristics
 $T_A = 25^\circ\text{C}$, $V_{CC} = 3.3\text{V}$, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DC Characteristics						
V_{IH}	input logic high level	$V_{CC} = 3.4\text{ V to } 5.5\text{ V}$	1.6			V
		$V_{CC} = 1.5\text{ V to } 3.3\text{ V}$	1.4			V
V_{IL}	input logic low level	$V_{CC} = 3.4\text{ V to } 5.5\text{ V}$			0.6	V
		$V_{CC} = 1.5\text{ V to } 3.3\text{ V}$			0.4	V
I_{CC}	supply quiescent current	$I_{COM} = 0$, $V_{IN} = 0$ or $V_{IN} = V_{CC}$			1.0	μA
ΔI_{CC}	increase in I_{CC} per input	$I_{COM}=0$, $V_{CC}=4.5\text{V}$ $V_{IN}>1.8$ or $V_{IN}<0.5$			1.0	μA
I_{COMx}	off state leakage from COMx to NCx (or NOx)	$V_{COM} = 5\text{ V}$, $V_{NC(or NO)} = 0\text{ V}$			± 2.0	μA
R_{ON}	on-resistance	$V_{COM}=0 \sim 0.5\text{V}$, $I_{COM}=30\text{mA}$		6.2	7.2	Ω
		$V_{COM}=0.5 \sim 2.0\text{V}$, $I_{COM}=30\text{mA}$		7.2	7.9	Ω
		$V_{COM}=2.0 \sim 4.0\text{V}$, $I_{COM}=30\text{mA}$		5.2	7.2	Ω
		$V_{COM}=4.0 \sim 5.5\text{V}$, $I_{COM}=30\text{mA}$		3.3	3.8	Ω
R_{FLAT}	on-resistance flatness	$V_{COM}=0 \sim 0.5\text{V}$, $I_{COM}=30\text{mA}$		1.4		Ω
		$V_{COM}=0.5 \sim 2.0\text{V}$, $I_{COM}=30\text{mA}$		1.0		Ω
		$V_{COM}=2.0 \sim 4.0\text{V}$, $I_{COM}=30\text{mA}$		3.2		Ω
		$V_{COM}=4.0 \sim 5.5\text{V}$, $I_{COM}=30\text{mA}$		0.6		Ω
ΔR_{ON}	on-resistance matching between channels	$V_{COM}=0 \sim 5.5\text{V}$, $I_{COM}=30\text{mA}$		0.2	0.4	Ω

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
AC Characteristics						
C_{ON}	on capacitance	$f = 100 \text{ kHz}$		7		pF
C_{OFF}	off capacitance	$f = 100 \text{ kHz}$		5		pF
OIRR	off isolation	$f = 1 \text{ kHz}$		-81		dB
		$f = 10 \text{ kHz}$		-80		dB
X_{TALK}	crosstalk	$f = 1 \text{ kHz}$		-83		dB
		$f = 10 \text{ kHz}$		-82		dB
BW	-3dB bandwidth	$C_L = 0 \text{ pF}$		800		MHz
t_{BBM}	break-before-make time	$V_{COM} = 1.5 \text{ V}, C_L = 35 \text{ pF}, R_L = 50 \Omega$		500		ns
t_{ON}	turn-on time	$V_{COM} = 1.5 \text{ V}, C_L = 35 \text{ pF}, R_L = 50 \Omega$		200		ns
t_{OFF}	turn-off time	$V_{COM} = 1.5 \text{ V}, C_L = 35 \text{ pF}, R_L = 50 \Omega$		200		ns
THD	total harmonic distortion	$f = 20 \text{ Hz to } 20 \text{ KHz}, V_{COM} = 600 \text{ mVpp}, R_L = 32 \Omega$		-80		dB

11. Typical Performance Curves

$T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.3\text{ V}$, unless otherwise noted

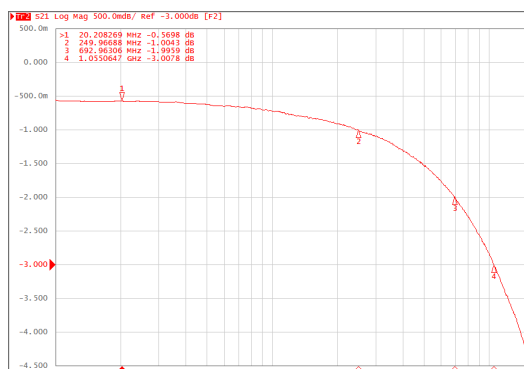


Fig 3. Bandwidth

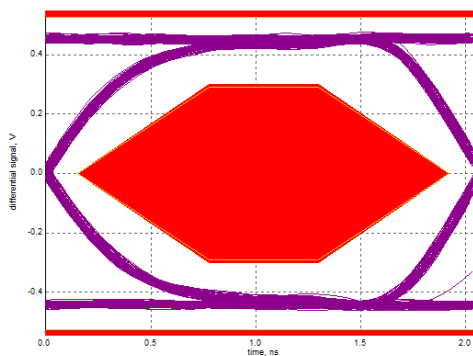


Fig 4. Eye Diagram (480Mbps)

12. Test Circuits

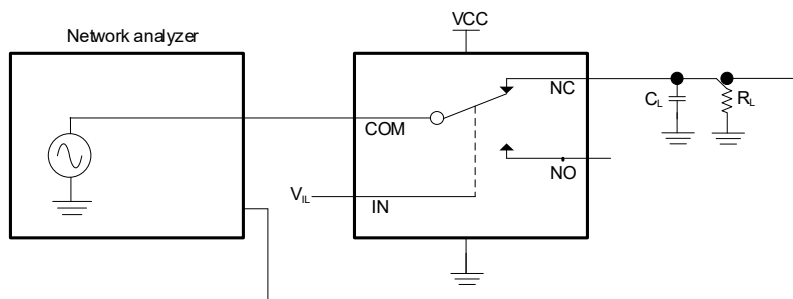


Fig 5. Bandwidth

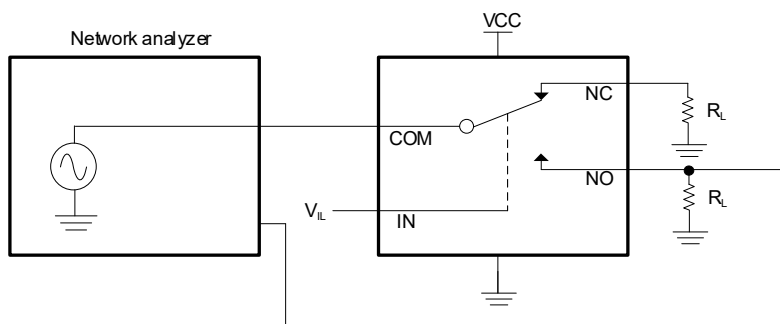


Fig 6. Off isolation

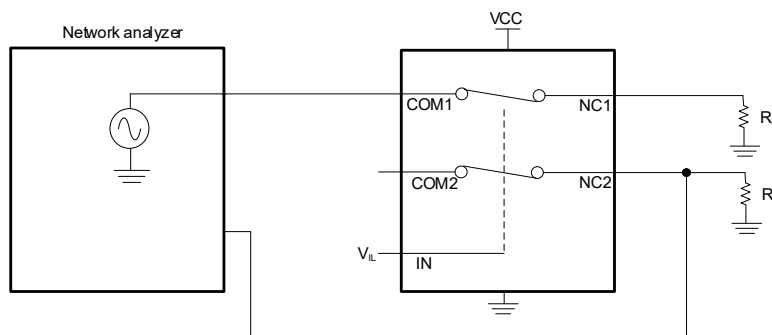
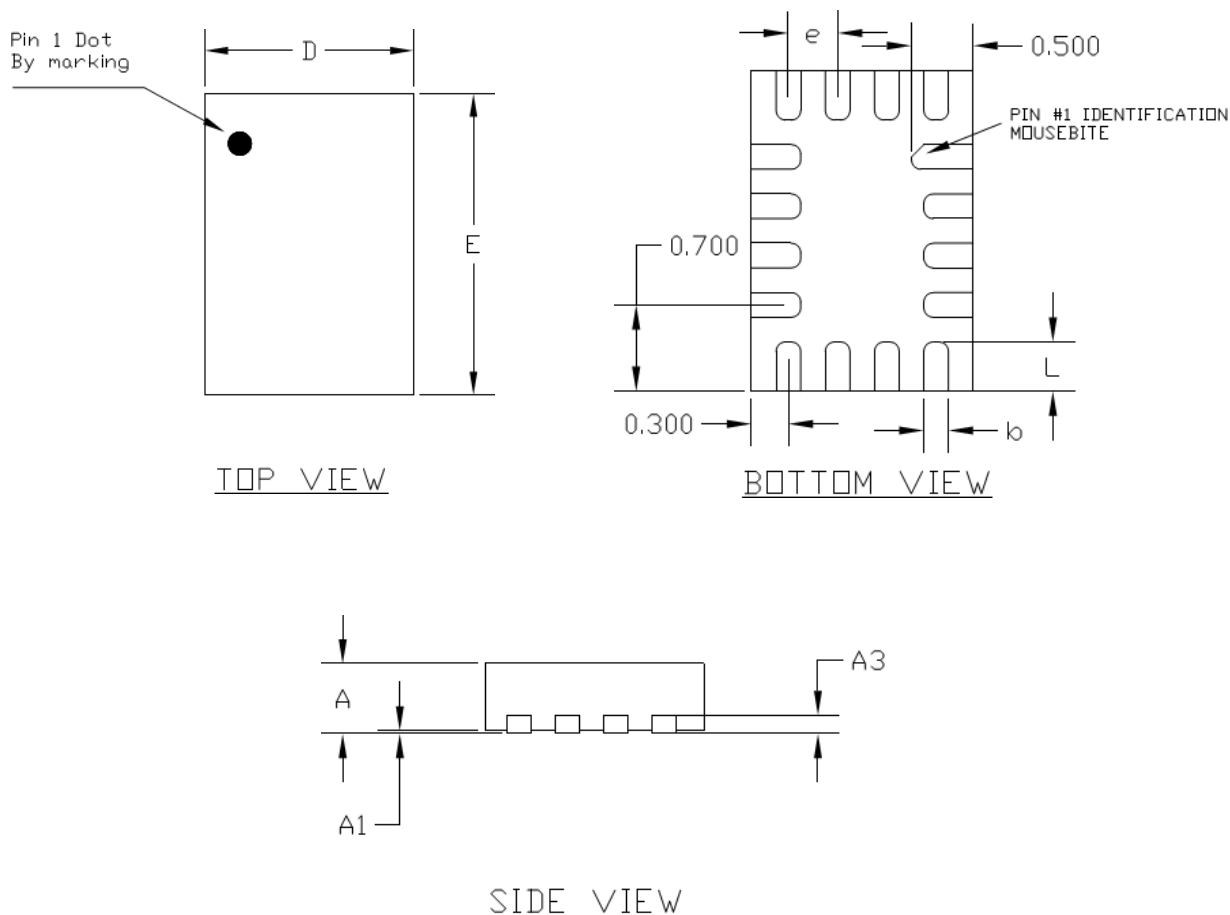


Fig 7. Crosstalk

13. Package Outline

QFN 1.8x2.6 -16L



Symbol	Dimension in Millimeters		
	Min.	Typ.	Max.
A	0.50	0.55	0.60
A1	0.00	-	0.05
A3	0.15 Typ.		
D	1.75	1.80	1.85
E	2.55	2.60	2.65
L	0.30	0.40	0.50
b	0.15	0.20	0.25
e	0.40 Typ.		

14. Revision History

Table 7. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EMS4735 Rev. 1.0	June 30, 2024	Product datasheet		