

1. General Description

The EMS3902 is a bidirectional low-power dual port, high-speed, USB 2.0 analog switch. The device is configured as a dual 2:1 or 1:2 switch. It is optimized for use with the USB 2.0 DP/DM data lines.

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. EMS3902 is available in QFN 1.4x1.8-10L and MSOP-10L with Pb-free and Halogen-free making it a perfect candidate for mobile and space constrained applications.

2. Features and Benefits

- Low On-resistance, $R_{ON} = 1.9 \Omega$ when $V_{CC} = 5.5 V$
- 12 pF typical ON capacitance
- High Bandwidth (-3 dB @ 800 MHz) Suitable For USB2.0 High-Speed Routing
- Low Quiescent Current ($< 1 \mu A$) when $V_{CC} = 3.3 V$
- 1.8 V Logic Compatible Control Pin
- High Off-Isolation: -80 dB @ 10 KHz
- Low Channel-to-Channel Crosstalk: -82 dB @ 10 KHz
- ESD protection: HBM ESDA/JEDEC JS-001 Class 2 exceeds 2000 V

3. Applications

- Mobile Phones, Tablets and Notebooks
- USB port devices

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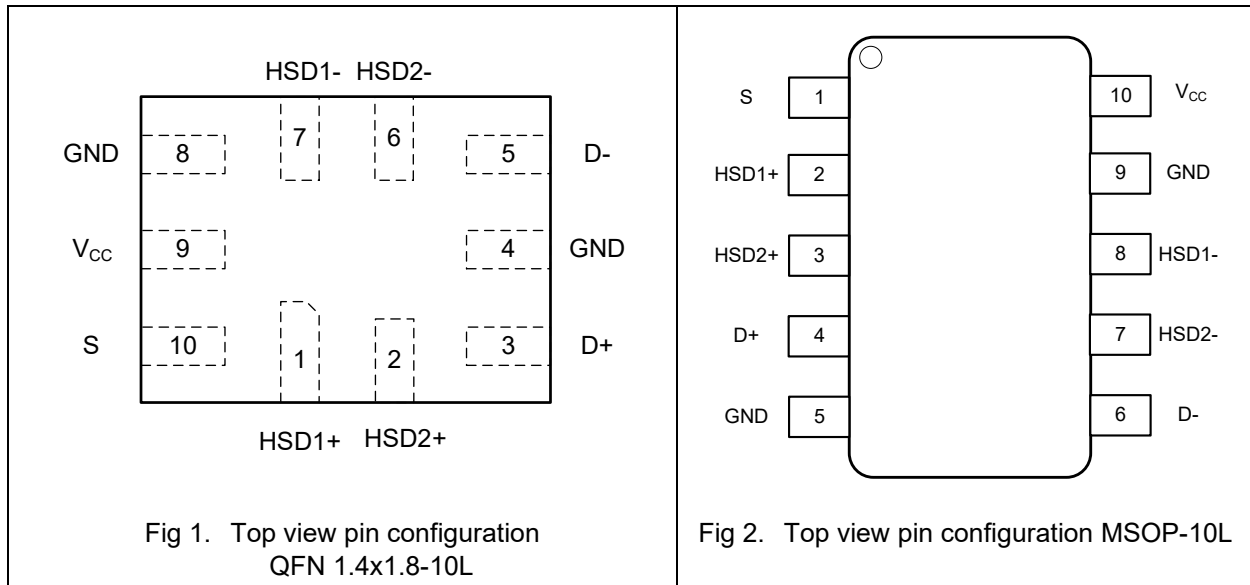
4. Ordering Information

Table 1. Ordering information

Type number	Topside marking	Package Name	Description	Quantity
EMS3902RSW	22Q	QFN1.4×1.8-10L	QFN package, 10 pins 1.4 mm × 1.8 mm; 0.55 mm (Max) height	3000
EMS3902MS	22M	MSOP-10L	MSOP package, 10 pins 3.0mm × 3.0mm; 1.1 mm (Max) height	3000

5. Pinning Information

5.1. Pin map



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5.2. Pin description

Table 2. Pin description

Symbol	Pin		Description
	QFN 1.4x1.8-10L	MSOP-10L	
V _{CC}	9	10	Single Power Supply
HSD2-, HSD2+	6, 7	7, 3	Analog/Digital Signal Ports
D+, D-	1, 2	4, 6	Common Signal Ports
HSD1-, HSD1+	4, 5	8, 2	Analog/Digital Signal Ports
GND	3, 8	5, 9	Ground
S	10	1	Selection Logic Control

6. Functional Description

Table 3. Function table

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

Input S	Switch
L	HSD1+ to D+, HSD1- to D-
H	HSD2+ to D+, HSD2- to D-

7. Typical Application

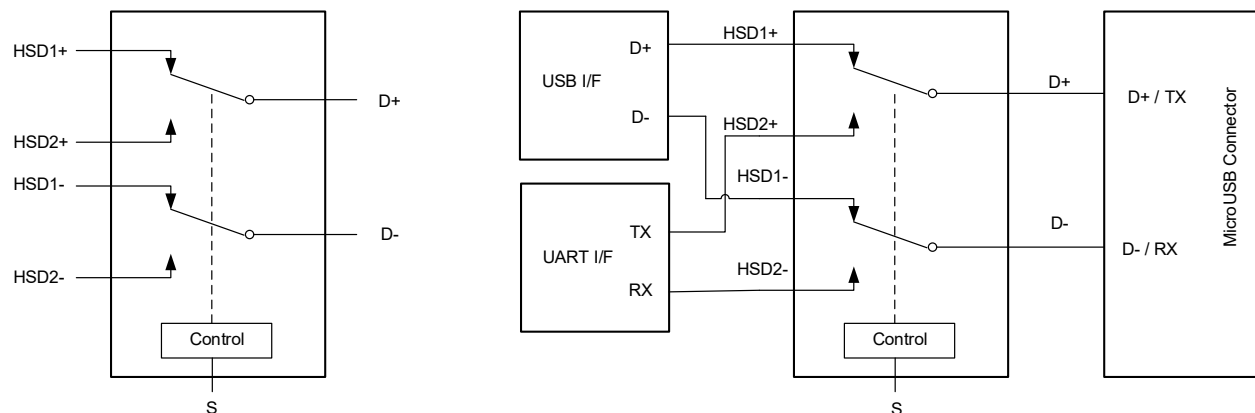


Fig 3. USB2.0 Switch

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 _{SW}	switch voltage		-0.3	6.5	V
V _{IN}	control input voltage		-0.3	6.5	V
I _C	continuous current HSDn or Dn			±100	mA
I _P	peak current HSDn or Dn(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	Max	Unit
V _{CC}	supply voltage operating		1.5	5.5	V
V _{SW}	switch voltage		0	V _{CC}	V
V _{IN}	control input voltage		0	5.5	V
T _A	operating temperature		-40	125	°C

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	$I_D = 0$, $V_{IN} = 0$ or $V_{IN} = V_{CC}$			1.0	μA
ΔI_{CC}	increase in I_{CC} per input	$I_D = 0$, $V_{CC} = 2.5\text{ V or } 4.2\text{ V}$ $V_{IN} = 1.6\text{ V}$			3.0	μA
I_{OFF}	off state leakage from Dn to HSDn	$V_{CC} = 5.5\text{ V}$, $V_{Dn} = 5\text{ V}$, $V_{HSDn} = 0\text{ V}$			± 2.0	μA
R_{ON}	on-resistance	$V_{CC} = 3.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.0\text{ V}$, $I_D = 10\text{ mA}$		3.4	4.0	Ω
		$V_{CC} = 4.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.3\text{ V}$, $I_D = 10\text{ mA}$		2.4	3.0	Ω
		$V_{CC} = 5.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.6\text{ V}$, $I_D = 10\text{ mA}$		1.9	2.5	Ω
R_{FLAT}	on-resistance flatness	$V_{CC} = 3.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.0\text{ V}$, $I_D = 10\text{ mA}$		0.2	0.4	Ω
		$V_{CC} = 4.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.3\text{ V}$, $I_D = 10\text{ mA}$		0.25	0.45	Ω
		$V_{CC} = 5.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.6\text{ V}$, $I_D = 10\text{ mA}$		0.3	0.5	Ω
ΔR_{ON}	on-resistance matching between channels	$V_{CC} = 3.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.0\text{ V}$, $I_D = 10\text{ mA}$		0.1	0.2	Ω
		$V_{CC} = 4.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.3\text{ V}$, $I_D = 10\text{ mA}$		0.1	0.2	Ω
		$V_{CC} = 5.5\text{ V}$, $V_{SW} = 0.8\text{ V to } 2.6\text{ V}$, $I_D = 10\text{ mA}$		0.1	0.2	Ω

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
AC Characteristics						
C_{ON}	on capacitance	$f = 100 \text{ kHz}$		12		pF
C_{OFF}	off capacitance	$f = 100 \text{ kHz}$		4		pF
OIRR	off isolation	$f = 10 \text{ kHz}$		-80		dB
		$f = 240 \text{ MHz}$		-31		dB
X_{TALK}	crosstalk	$f = 10 \text{ kHz}$		-82		dB
		$f = 240 \text{ MHz}$		-26		dB
BW	-3dB bandwidth	$C_L = 0 \text{ pF}$		800		MHz
t_{BBM}	break-before-make time	$V_{SW} = 1.5 \text{ V}, C_L = 50 \text{ pF}, R_L = 50 \Omega$		600		ns
t_{ON}	turn-on time	$V_{SW} = 1.5 \text{ V}, C_L = 50 \text{ pF}, R_L = 50 \Omega$		470		ns
t_{OFF}	turn-off time	$V_{SW} = 1.5 \text{ V}, C_L = 50 \text{ pF}, R_L = 50 \Omega$		120		ns
THD	total harmonic distortion	$f = 20 \text{ Hz to } 20 \text{ KHz}, V_{SW} = 600 \text{ mVpp}, R_L = 32 \Omega$		-80		dB

11. Typical Performance Curves

$T_A = 25\text{ }^{\circ}\text{C}$, $V_{CC} = 3.0\text{ V}$, unless otherwise noted

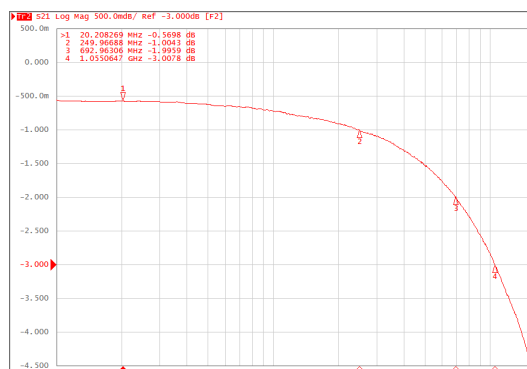


Fig 4. Bandwidth

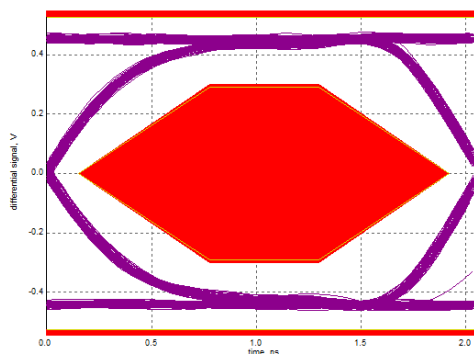


Fig 5. Eye Diagram (480Mbps)

12. Test Circuits

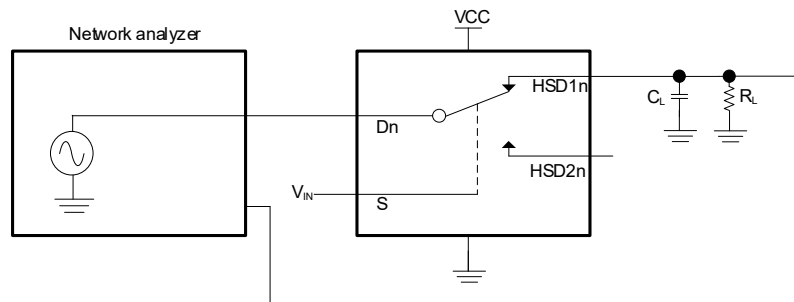


Fig 6. Bandwidth

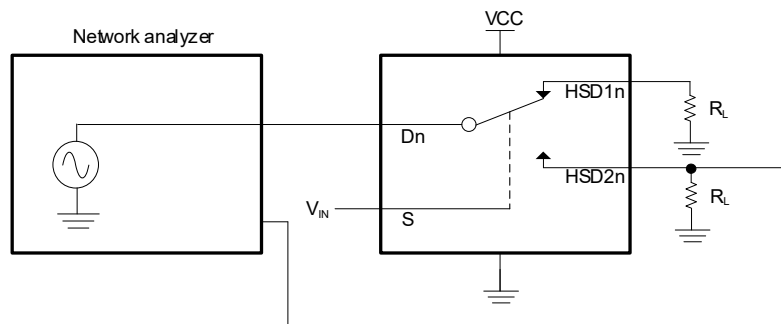


Fig 7. Off isolation

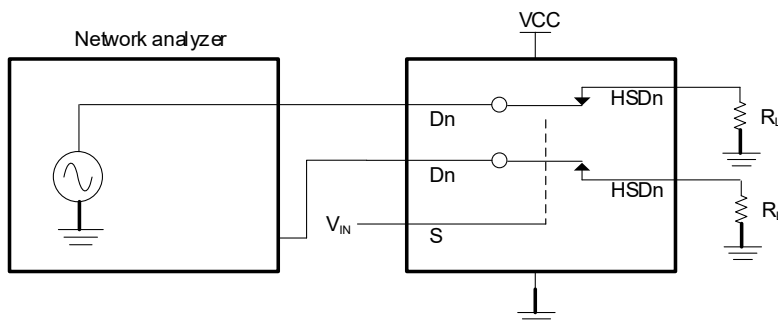
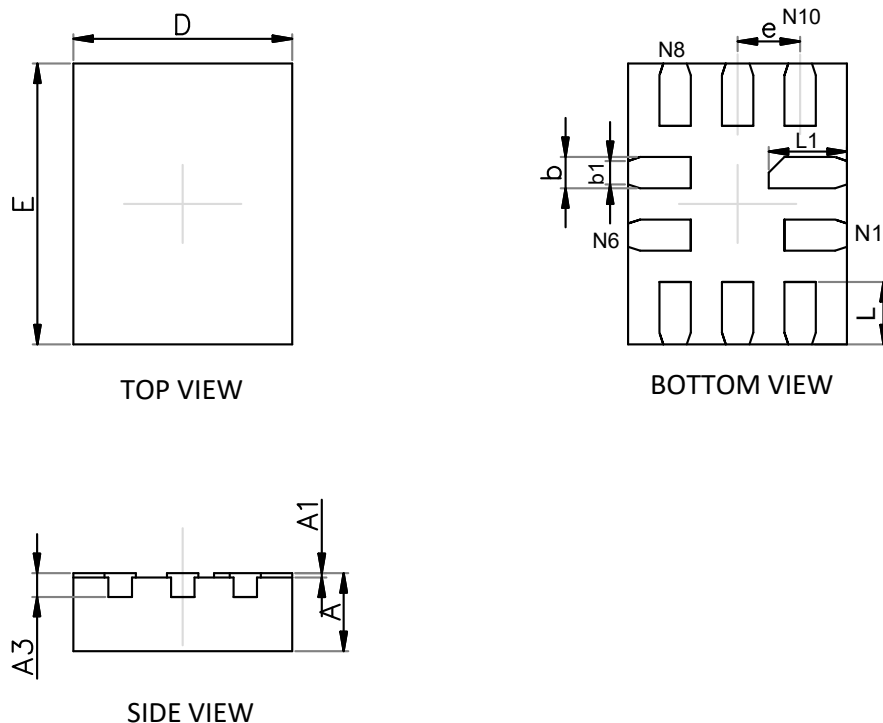


Fig 8. Crosstalk

13. Package Outline

QFN 1.4x1.8 -10L

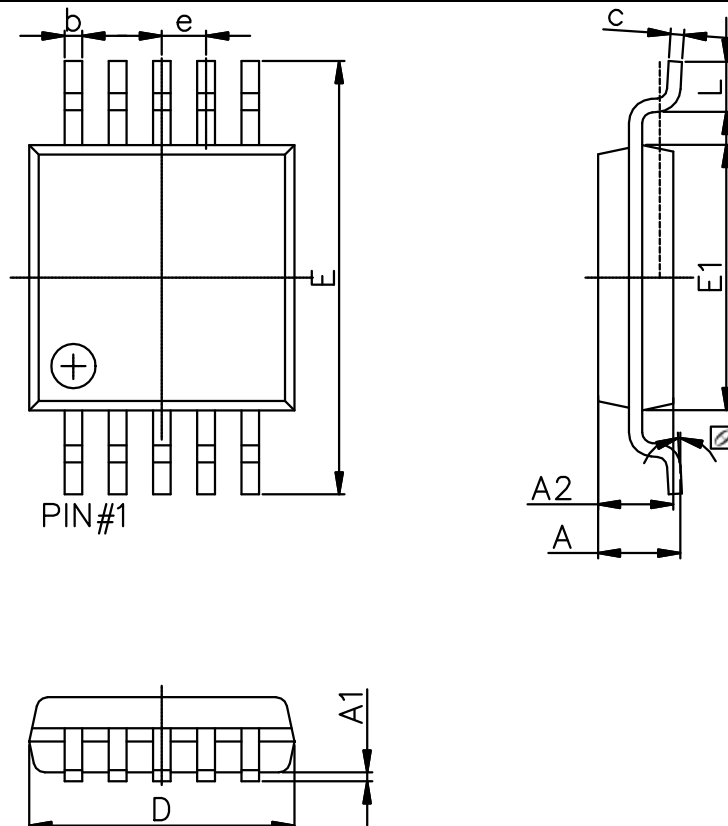


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.450	0.550	0.018	0.022
A1	0.000	0.050	0.000	0.002
A3	0.152REF.		0.006REF.	
D	1.350	1.450	0.053	0.057
E	1.750	1.850	0.069	0.073
b	0.150	0.250	0.006	0.010
b1	0.100	0.200	0.004	0.008
e	0.400TYP.		0.016TYP.	
L	0.350	0.450	0.014	0.018
L1	0.450	0.550	0.018	0.022

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MSOP - 10L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	---	1.100	---	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.330	0.007	0.013
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.500(BSC)		0.020(BSC)	
E	4.750	5.050	0.187	0.199
E1	2.900	3.100	0.114	0.122
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

14. Revision History

Table 7. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EMS3902 Rev. 1.0	Jun 09, 2025	Product datasheet		