

1. General Description

The EMS3900 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. EMS3900 is available in QFN 1.4x1.8-10L 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

EMS3900

Dual high-speed USB 2.0 double-pole double-throw analog switch

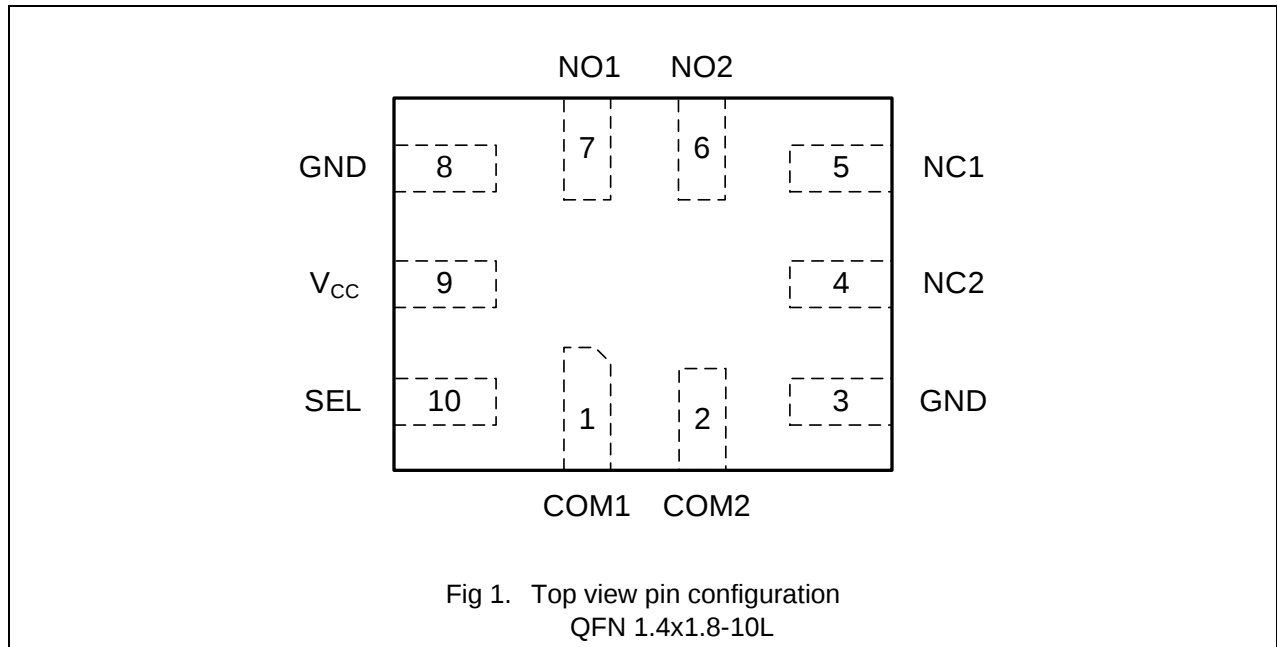
4. Ordering Information

Table 1. Ordering information

Type number	Topside marking	Package		Quantity
		Name	Description	
EMS3900RSW	3900 YYWW	QFN1.4×1.8-10L	QFN package, 10 pins 1.4 mm × 1.8 mm; 0.55 mm (Max) height	3000

5. Pinning Information

5.1. Pin map



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
V _{CC}	9	Single Power Supply
NOx	6,7	Analog/Digital Signal Ports
COMx	1, 2	Common Signal Ports
NCx	4, 5	Analog/Digital Signal Ports
GND	3, 8	Ground
SEL	10	Selection Logic Control

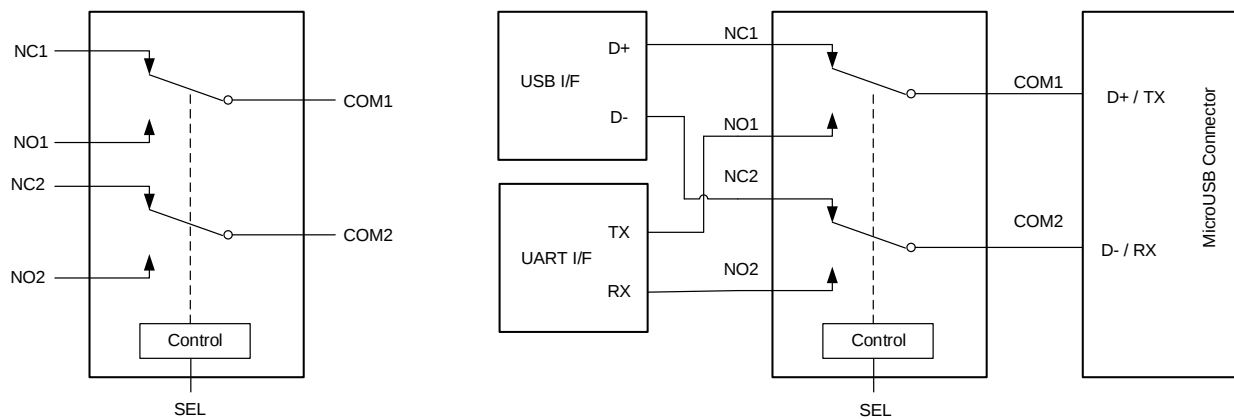
6.Functional Description

Table 3. Function table

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

Input SEL	Switch
L	NC1 to COM1, NC2 to COM2
H	NO1 to COM1, NO2 to COM2

7. Typical Application


Fig 2. 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 _{COM}	switch voltage		-0.3	6.5	V
V _{IN}	control input voltage		-0.3	6.5	V
I _C	continuous current through NO, NC, COM			±100	mA
I _P	peak current through NO, NC, COM (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 _{COM}	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	$I_{COM} = 0$, $V_{IN} = 0$ or $V_{IN} = V_{CC}$			1.0	μA
ΔI_{CC}	increase in I_{CC} per input	$I_{COM} = 0$, $V_{CC} = 2.5\text{ V or } 4.2\text{ V}$ $V_{IN} = 1.6\text{ V}$			3.0	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	$V_{CC} = 3.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.0\text{ V}$, $I_{COM} = 10\text{ mA}$		3.4	4.0	Ω
		$V_{CC} = 4.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.3\text{ V}$, $I_{COM} = 10\text{ mA}$		2.4	3.0	Ω
		$V_{CC} = 5.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.6\text{ V}$, $I_{COM} = 10\text{ mA}$		1.9	2.5	Ω
R_{FLAT}	on-resistance flatness	$V_{CC} = 3.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.0\text{ V}$, $I_{COM} = 10\text{ mA}$		0.2	0.4	Ω
		$V_{CC} = 4.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.3\text{ V}$, $I_{COM} = 10\text{ mA}$		0.25	0.45	Ω
		$V_{CC} = 5.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.6\text{ V}$, $I_{COM} = 10\text{ mA}$		0.3	0.5	Ω
ΔR_{ON}	on-resistance matching between channels	$V_{CC} = 3.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.0\text{ V}$, $I_{COM} = 10\text{ mA}$		0.1	0.2	Ω
		$V_{CC} = 4.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.3\text{ V}$, $I_{COM} = 10\text{ mA}$		0.1	0.2	Ω
		$V_{CC} = 5.5\text{ V}$, $V_{COM} = 0.8\text{ V to } 2.6\text{ V}$, $I_{COM} = 10\text{ mA}$		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	$V_{COM} = 1.5 \text{ V}$, $C_L = 50 \text{ pF}$, $R_L = 50 \Omega$		600		ns
t_{ON}	turn-on time	$V_{COM} = 1.5 \text{ V}$, $C_L = 50 \text{ pF}$, $R_L = 50 \Omega$		470		ns
t_{OFF}	turn-off time	$V_{COM} = 1.5 \text{ V}$, $C_L = 50 \text{ pF}$, $R_L = 50 \Omega$		120		ns
THD	total harmonic distortion	$f = 20 \text{ Hz to } 20 \text{ KHz}$, $V_{COM} = 600 \text{ mVpp}$, $R_L = 32 \Omega$		-80		dB

11. Typical Performance Curves

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

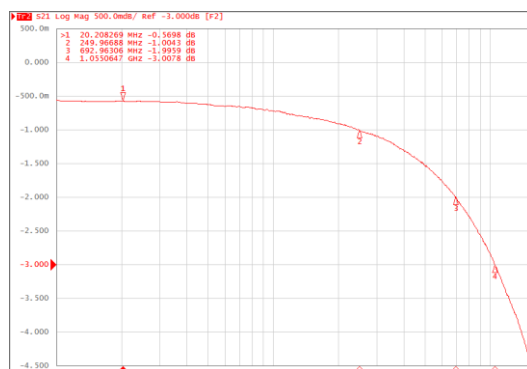


Fig 3. Bandwidth

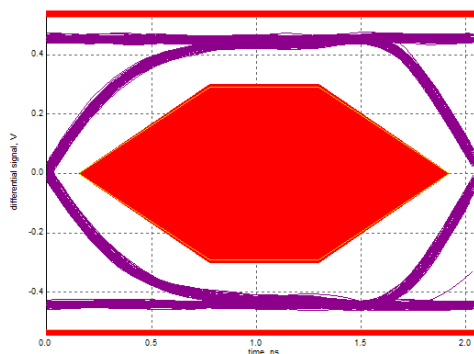


Fig 4. Eye Diagram (480Mbps)

12. Test Circuits

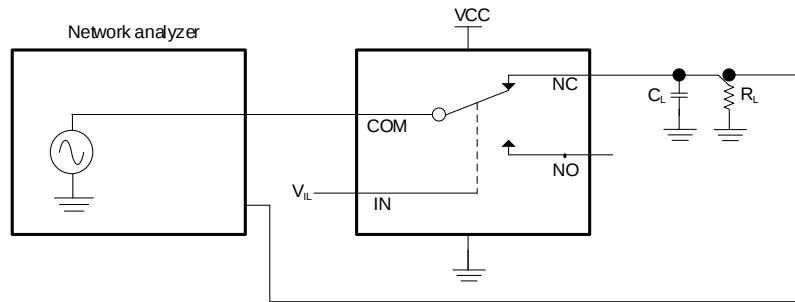


Fig 5. Bandwidth

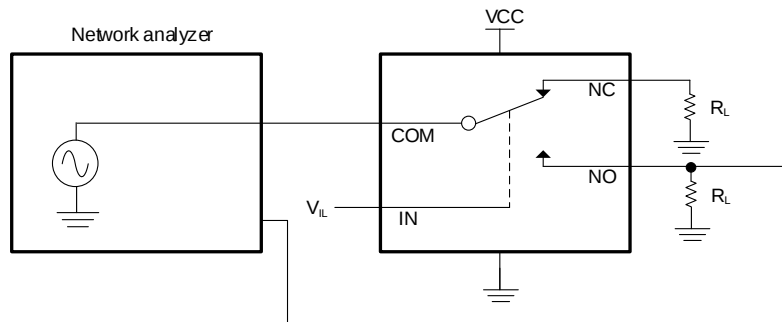


Fig 6. Off isolation

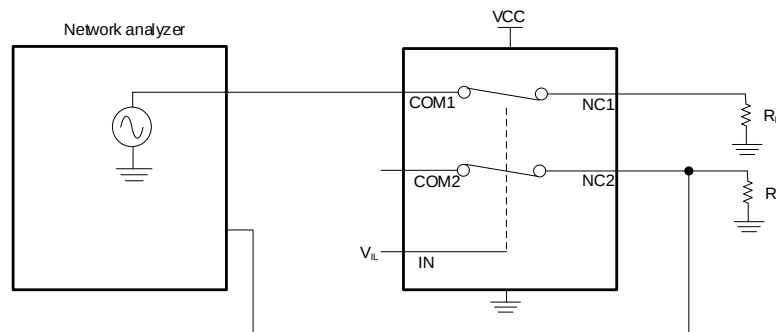
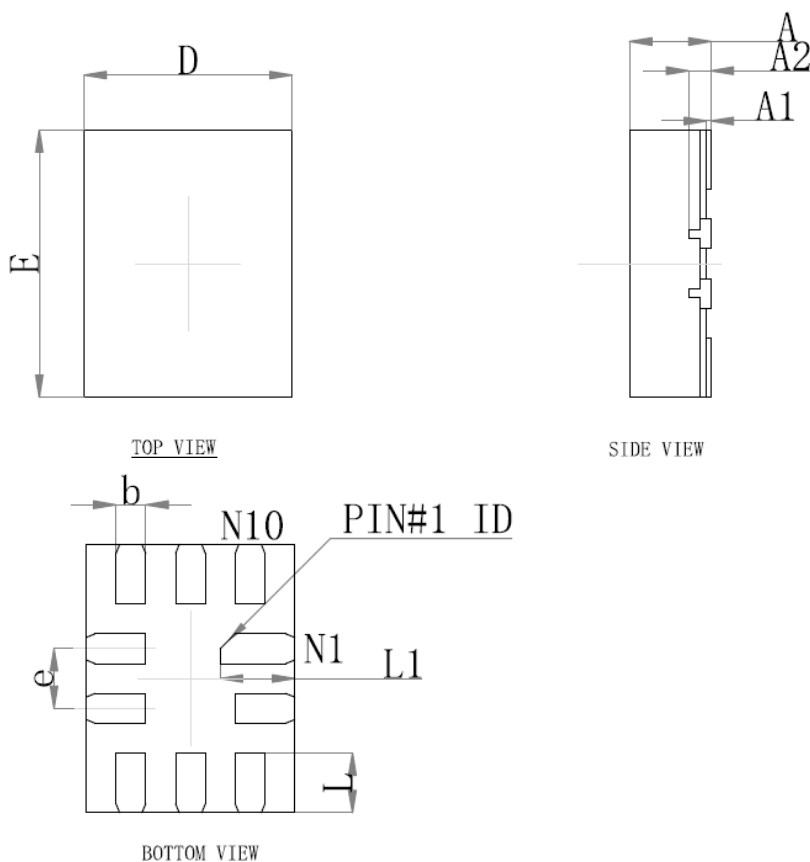


Fig 7. Crosstalk

13. Package Outline

QFN 1.4x1.8 -10L



Symbol	Dimension in Millimeters		
	Min.	NOM.	Max.
A	0.500	0.550	0.600
A1	0.000	--	0.050
A2	0.152 Ref.		
D	1.324	1.400	1.476
E	1.724	1.800	1.876
b	0.150	0.200	0.250
e	0.400 Typ.		
L	0.350	0.400	0.450
L1	0.450	0.500	0.550

14. Revision History

Table 7. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EMS3900 Rev. 1.4	Mar 31, 2025	Product datasheet		EMS3900 Rev. 1.3
Modifications:	- Features and Benefits: HBM updated. - Table6: OIRR and X_{TALK} updated.			
EMS3900 Rev. 1.3	Feb 13, 2025	Product datasheet		EMS3900 Rev. 1.2
Modifications:	Table 6: The specification of R_{FLAT} updated.			
EMS3900 Rev. 1.2	Jan 6, 2025	Product datasheet		EMS3900 Rev. 1.1
Modifications:	- Table 6: The condition of ΔI_{CC} and R_{ON} updated. - QFN package outline drawings updated. - Topside marking updated.			
EMS3900 Rev. 1.1	Nov 8, 2024	Product datasheet		EMS3900 Rev. 1.0
Modifications:	Table 6: I_{CCT} and AC Characteristics updated.			
EMS3900 Rev. 1.0	June 30, 2024	Product datasheet		