

1. General Description

The EMS3905 is a dual SPDT low on-resistance analog switch. It can operate from 1.5V to 5.5V power supply. The device offers low ON-state resistance and excellent ON-state resistance matching with break-before-make feature, to prevent signal distortion during the transferring of a signal from one channel to another. The device is capable of truly isolation. Even when A overrides V_{CC} , very little current will flow back to the supply.

2. Features and Benefits

- Wide Supply Range from 1.5 V to 5.5 V
- Low ON-state resistance, typically $1.9\ \Omega$ ($V_{CC}=5.5\text{ V}$)
- 1.8 V Compatible Control Logic Inputs
- High Off-Isolation: -80 dB @ 10 kHz
- Low Channel-to-Channel Crosstalk: -82 dB @ 10 kHz
- High Bandwidth (-3dB @ 800MHz) Suitable For USB2.0 High-Speed Routing
- Low Quiescent Current ($< 1\mu\text{A}$) when $V_{CC} = 3.3\text{ V}$

3. Applications

- Audio, Video, UART, USB2.0 Signal and Supply Routing
- Cell phones and TWS headset

EMS3905

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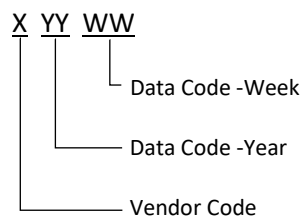
4. Ordering Information

Table 1. Ordering information

Type number	Topside marking	Package		
		Name	Description	Quantity
EMS3905MS	3905 XYWW	MSOP-10L	MSOP package, 10 pins 3.0mm × 3.0mm; 1.1 mm (Max) height	3000
EMS3905DRC	3905 XYWW	DFN3x3-10L	DFN package, 10 pins 3.0 mm × 3.0 mm; 0.8 mm (Max) height	3000
EMS3905RSW	3905 XYWW	QFN1.4x1.8-10L	QFN package, 10 pins 1.4 mm × 1.8 mm; 0.55 mm (Max) height	3000

MARKING INFORMATION

NOTE: XYWW = Vendor Code and Data Code.



5. Pinning Information

5.1. Pin map

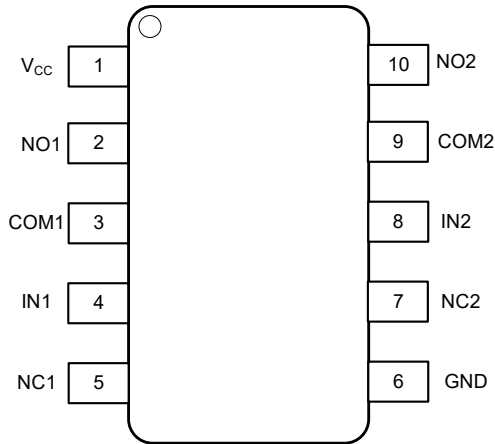


Fig 1. Top view pin configuration MSOP-10L

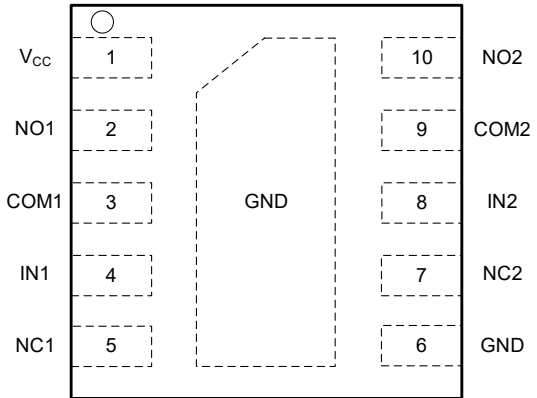


Fig 2. Top view pin configuration DFN3x3-10L

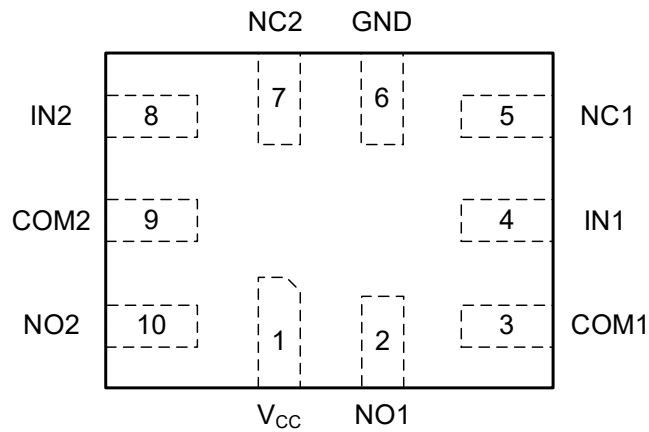


Fig 3. Top view pin configuration QFN1.4x1.8-10L

EMS3905

Low Voltage and High Speed Dual SPDT Analog Switch with True Isolation

5.2. Pin description

Table 2. Pin description

Symbol	Pin		Description
	MSOP-10L/DFN3x3-10L	QFN1.4x1.8-10L	
IN1	1	4	Select pin for switch 1
NO1	2	2	Normally open I/O for switch 1
GND	3	6	Ground
NO2	4	10	Normally open I/O for switch 2
IN2	5	8	Select pin for switch 2
COM2	6	9	Common I/O for switch 2
NC2	7	7	Normally closed I/O for switch 2
V _{CC}	8	1	Power supply pin
NC1	9	5	Normally closed I/O for switch 1
COM1	10	3	Common I/O for switch 1

6. Functional Description

Table 3. Function table

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

IN	NC TO COM, COM TO NC	NO TO COM, COM TO NO
L	ON	OFF
H	OFF	ON

7. Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Table 4. Absolute Maximum Ratings

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND.

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
V _A	signal input voltage		-0.3	6.5	V
I _A	continuous Current Through COM, NC, NO			±100	mA
	peak Current Through COM, NC, NO (pulsed at 1ms 50% duty cycle)			±200	mA
T _J	junction Temperature under Bias			150	°C
T _L	lead Temperature (Soldering, 10 seconds)			260	°C
R _{θJA}	thermal resistance			350	°C/W

8. Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. EnergyMath does not recommend exceeding them or designing to Absolute Maximum Ratings.

Table 5. Recommended Operating Conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V _{CC}	supply voltage		1.5	5.5	V
V _{IN}	control input voltage		0	5.5	V
V _A	signal input voltage		0	V _{CC}	V
T _{amb}	ambient temperature		-40	125	°C

9. Electrical Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DC Electrical 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 current	$I_A = 0$, $V_{SEL} = 0$ or $V_{SEL} = V_{CC}$			1.0	μA
ΔI_{CC}	additional supply current	$I_A = 0$, $V_{CC} = 2.5\text{ V or }4.2\text{ V}$ $V_{SEL} = 1.6\text{ V}$			3.0	μA
I_{off}	OFF-state switch leakage current from COM to NC (or NO)	$V_A = 5\text{ V}$, V_{NC} or $V_{NO} = 0\text{ V}$			± 2.0	μA
R_{ON}	on-resistance	$V_{CC} = 3.5\text{ V}$, $V_A = 0.8\text{ V to }2.0\text{ V}$, $I_A = 10\text{ mA}$		3.4	4.0	Ω
		$V_{CC} = 4.5\text{ V}$, $V_A = 0.8\text{ V to }2.3\text{ V}$, $I_A = 10\text{ mA}$		2.4	3.0	Ω
		$V_{CC} = 5.5\text{ V}$, $V_A = 0.8\text{ V to }2.6\text{ V}$, $I_A = 10\text{ mA}$		1.9	2.5	Ω
R_{FLAT}	on-resistance flatness	$V_{CC} = 3.5\text{ V}$, $V_A = 0.8\text{ V to }2.0\text{ V}$, $I_A = 10\text{ mA}$		0.2	0.4	Ω
		$V_{CC} = 4.5\text{ V}$, $V_A = 0.8\text{ V to }2.3\text{ V}$, $I_A = 10\text{ mA}$		0.25	0.45	Ω
		$V_{CC} = 5.5\text{ V}$, $V_A = 0.8\text{ V to }2.6\text{ V}$, $I_A = 10\text{ mA}$		0.3	0.5	Ω
ΔR_{ON}	on-resistance matching between channels	$V_{CC} = 3.5\text{ V}$, $V_A = 0.8\text{ V to }2.0\text{ V}$, $I_A = 10\text{ mA}$		0.1	0.2	Ω
		$V_{CC} = 4.5\text{ V}$, $V_A = 0.8\text{ V to }2.3\text{ V}$, $I_A = 10\text{ mA}$		0.1	0.2	Ω
		$V_{CC} = 5.5\text{ V}$, $V_A = 0.8\text{ V to }2.6\text{ V}$, $I_A = 10\text{ mA}$		0.1	0.2	Ω

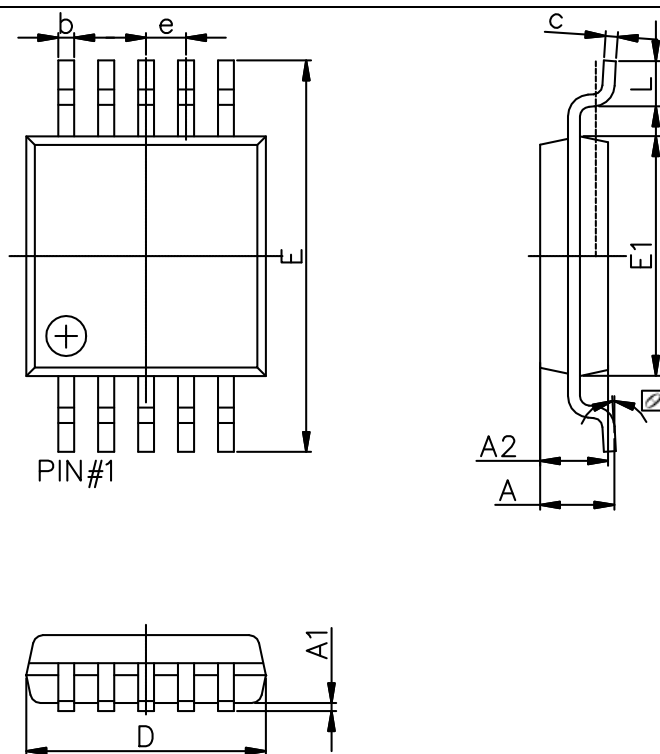
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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
AC Electronics Characteristics						
t_{ON}	turn-On Time	$V_A=1.5V, C_L=50pF, R_L=50\Omega$		470		ns
t_{OFF}	turn-Off Time	$V_A=1.5V, C_L=50pF, R_L=50\Omega$		120		ns
t_{BBM}	break-before-make time	$V_A=1.5V, C_L=50pF, R_L=50\Omega$		600		ns
BW	-3dB Bandwidth	$C_L=0pF$		800		MHz
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
THD	total harmonic distortion	$f=20\text{Hz to } 20\text{KHz}$ $V_A=600\text{mVpp}, R_L=32\Omega$		-80		dB
Capacitance						
C_{ON}	On Capacitance	$f=100\text{KHz}$		12		pF
C_{OFF}	Off Capacitance	$f=100\text{KHz}$		4		pF

10. Package Outline

MSOP-10L

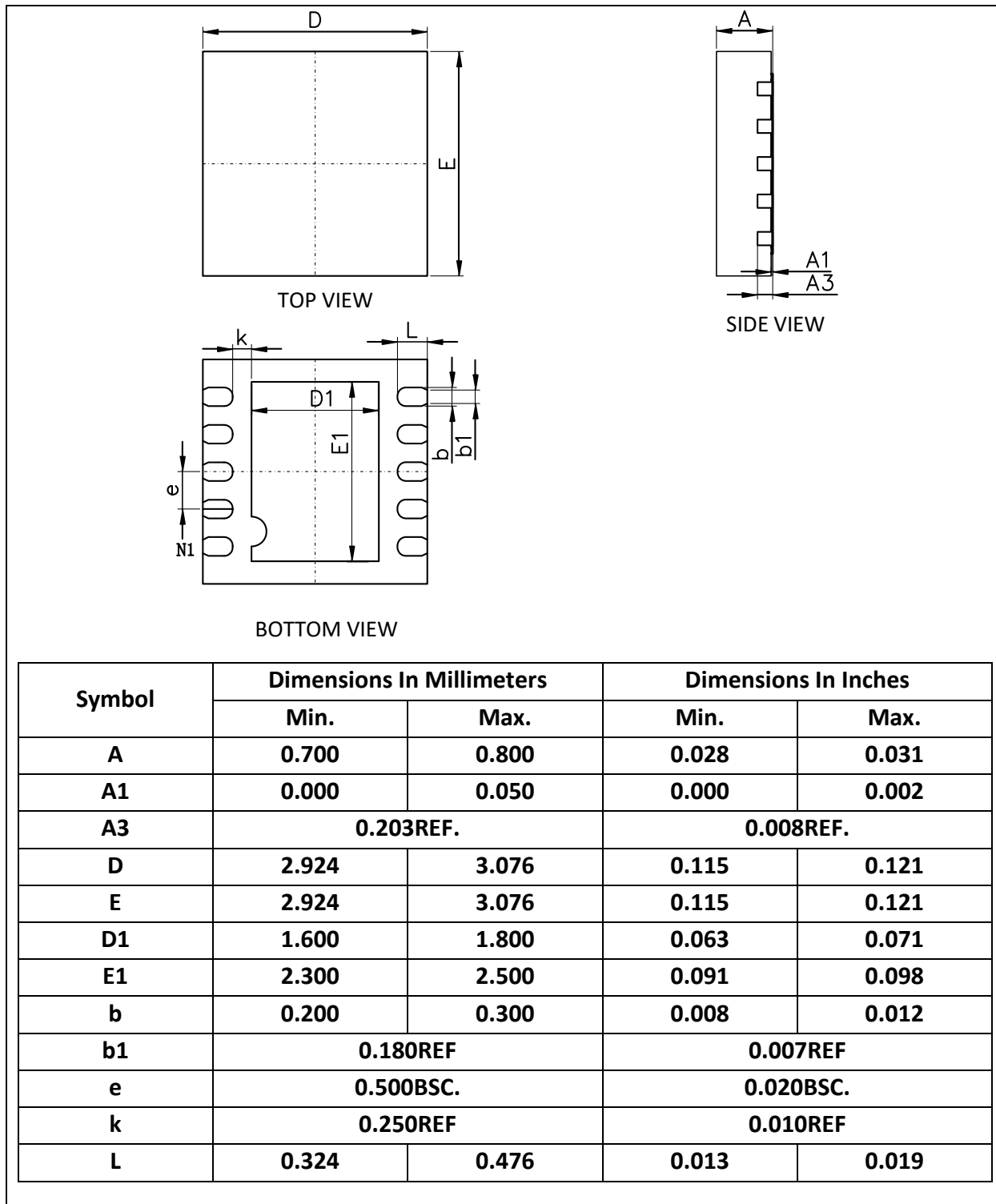


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	---	1.100	---	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.330	0.007	0.013
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.500(BSC)		0.020(BSC)	
E	4.750	5.050	0.187	0.199
E1	2.900	3.100	0.114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

EMS3905

Low Voltage and High Speed Dual SPDT Analog Switch with True Isolation

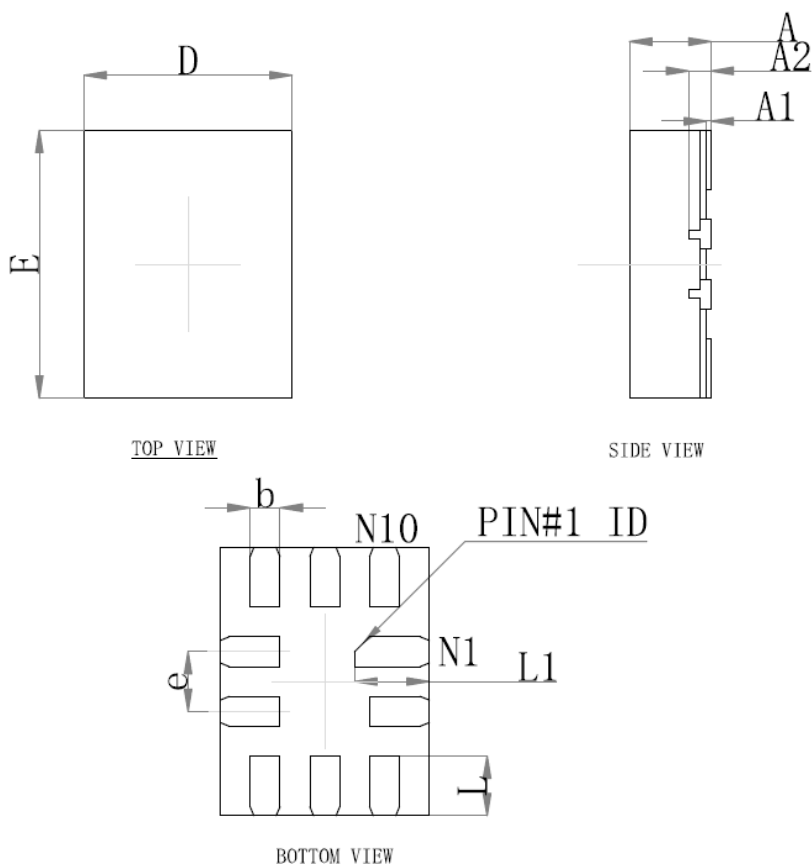
DFN 3x3 -10L



EMS3905

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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

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11. Revision History

Table 7. Revision history

Document ID	Release Date	Data sheet status	Change notice	Supersedes
EMS3905 Rev. 1.1	Apr 10, 2024	Product datasheet		EMS3905 Rev. 1.0
Modifications:	Added the QFN package outline.			
EMS3905 Rev. 1.0	Feb 13, 2024	Product datasheet		