



MMIC SURFACE MOUNT

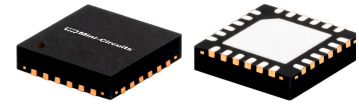
# SP4T RF Switch

**M4SWA4-34DR+**

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

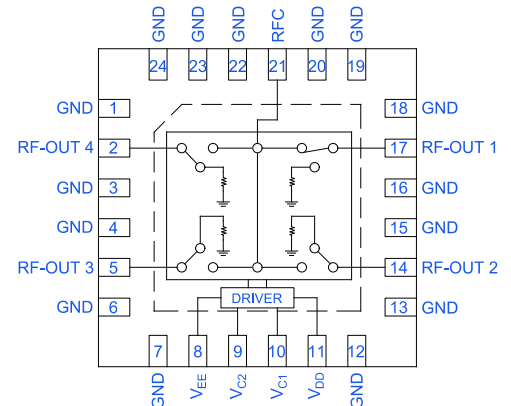
## THE BIG DEAL

- Wideband, DC to 30 GHz
- Low Insertion Loss, Typ. 1.8 dB
- High Isolation, Typ. 47 dB
- High Input IP3, Typ. +46 dBm
- Fast Rise/Fall Time, Typ. 23.1 ns/6.4 ns
- 4x4 mm, 24-Lead QFN-Style Package



Generic photo used for illustration purposes only

## FUNCTIONAL DIAGRAM



## APPLICATIONS

- Radar, EW, and ECM Defense Systems
- Communication Infrastructure
- Test and Measurement Equipment

## PRODUCT OVERVIEW

Mini-Circuits' M4SWA4-34DR+ is a GaAs MMIC SP4T absorptive switch with an internal driver designed for wideband operation from DC to 30 GHz. This switch enables fast, nano-second switching across a wide frequency range with minimal gate lag effects. This model provides excellent isolation, high linearity, and is capable of withstanding +24 dBm RF input power. It is packaged in a small 4x4 mm QFN-Style package for ease of integration in compact assemblies.

## KEY FEATURES

Features	Advantages
Absorptive Design	Absorptive switch design enables excellent return loss on all ports, minimizing reflection at the unselected ports.
High Isolation: <ul style="list-style-type: none"> <li>• 47 dB Typ. RFC to RF-OUT 1/2/3/4</li> <li>• 45 dB Typ. Between RF-OUT 1/2/3/4</li> </ul>	High isolation significantly reduces leakage of power into OFF ports.
High Linearity and Input Power: <ul style="list-style-type: none"> <li>• Input Power at P1dB, +28.9 dBm Typ.</li> <li>• Input IP3, +46 dBm Typ.</li> <li>• Max RF Input Power, +24 dBm CW</li> </ul>	High linearity minimizes unwanted intermodulation products which are difficult or impossible to filter in multi-carrier environments, or in the presence of strong interfering signals from adjacent circuitry. High RF input power tolerance protects the device from damage due to unexpected spikes in signal level.
Fast RF Switching Time: <ul style="list-style-type: none"> <li>• Rise/Fall Time, Typ. 23.1 ns/6.4 ns</li> <li>• On/Off Time, Typ. 67 ns/37 ns</li> <li>• Settling to 0.05 dB, Typ. 104 ns</li> </ul>	Fast switching makes this model suitable for applications where extremely fast transition between ports is required, such as automated switching networks.
Compact Size, 4x4 mm	Small footprint saves space in dense layouts, while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB. Industry standard packaging allows for ease of assembly in high volume manufacturing processes.



MMIC SURFACE MOUNT

## SP4T RF Switch

M4SWA4-34DR+

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

ELECTRICAL SPECIFICATIONS<sup>1,2,3</sup> AT +25° C,  $V_{DD} = +3.3$  V,  $V_{EE} = -3.3$  V, UNLESS NOTED OTHERWISE

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units
Frequency Range		DC		30	GHz
Insertion Loss	0.01		0.9	1.4	dB
	0.1		0.9	1.4	
	1.0		1.1	1.6	
	10		1.8	2.5	
	20		2.4	3.2	
	30		3.3	4.8	
Isolation Between Ports, RF-OUT 1/2/3/4	0.01	65	76		dB
	0.1	63	74		
	1.0	52	61		
	10	40	45		
	20	42	52		
	30	36	42		
Isolation Between RFC & RF-OUT 1/2/3/4 Ports	0.01	65	75		dB
	0.1	64	75		
	1.0	54	62		
	10	40	47		
	20	37	43		
	30	34	40		
Return Loss - RFC	0.01		22		dB
	0.1		22		
	1.0		18		
	10		15		
	20		19		
	30		15		
Return Loss – RF-OUT 1/2/3/4 (On & Off State)	0.01		15		dB
	0.1		16		
	1.0		17		
	10		17		
	20		15		
	30		17		
Input IP3 ( $P_{IN} = +5$ dBm/Tone)	0.01		+33		dBm
	0.1		+44		
	1.0		+45		
	10		+46		
	20		+45		
	30		+37		
Input Power at P1dB Compression	0.01		+19.3		dBm
	0.1		+24.3		
	1.0		+27.4		
	10		+28.9		
	20		+28.2		
	30		+28.3		
Input Power at P0.1dB Compression	0.01		+13.5		dBm
	0.1		+21.0		
	1.0		+24.0		
	10		+25.2		
	20		+25.2		
	30		+24.7		

1. Tested on Mini-Circuits Characterization Test Board TB-M4SWA434DRC+. See Figure 2.

2. Bi-directional, refer to S-Parameters for actual performance.

3. All RF-ports must be DC blocked or held at 0 V DC.





MMIC SURFACE MOUNT

## SP4T RF Switch

M4SWA4-34DR+

Mini-Circuits

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## DC ELECTRICAL SPECIFICATIONS

Parameter	Min.	Typ.	Max.	Units
Positive Supply Voltage, $V_{DD}$	+3.2	+3.3	+3.4	V
Negative Supply Voltage, $V_{EE}$	-3.4	-3.3	-3.2	V
Positive Supply Current, $I_{DD}$		1.2	1.8	mA
Negative Supply Current, $I_{EE}$		0.8	1.4	mA
Control Voltage Low		0	+0.8	V
Control Voltage High	+1.6	+2	$V_{DD}$	V
Control Current ( $I_{C1}$ ) Low		0		nA
Control Current ( $I_{C1}$ ) High		9	21	nA
Control Current ( $I_{C2}$ ) Low		0		nA
Control Current ( $I_{C2}$ ) High		7	16	nA

## SWITCHING SPECIFICATIONS

Parameter	Condition	Min.	Typ.	Max.	Units
ON Time, 50% Control to 90% RF output	RF $P_{IN}$ at RFC = 0 dBm RF Frequency = 150 MHz Control Frequency = 1 kHz Control High = +2 V Control Low = 0 V		67		ns
OFF Time, 50% Control to 10% RF output			37		ns
Video Leakage			+4.5		mV
Rise Time, 10% to 90% of RF output			23.1		ns
Fall Time, 90% to 10% of RF output			6.7		ns
Settling time, 50% VCTRL to 0.05 dB of final RF output			104		ns
Settling time, 50% VCTRL to 0.02 dB of final RF output			446		ns

## TRUTH TABLE

State of $V_{C1}$	State of $V_{C2}$	RFC to RF-OUT 1	RFC to RF-OUT 2	RFC to RF-OUT 3	RFC to RF-OUT 4
Low	Low	ON	OFF	OFF	OFF
High	Low	OFF	ON	OFF	OFF
Low	High	OFF	OFF	ON	OFF
High	High	OFF	OFF	OFF	ON



MMIC SURFACE MOUNT

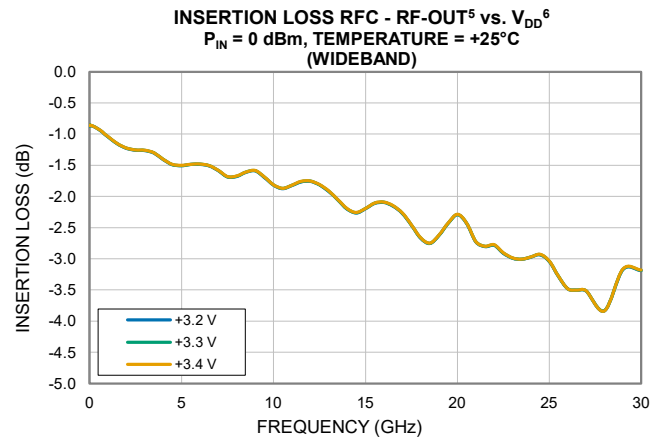
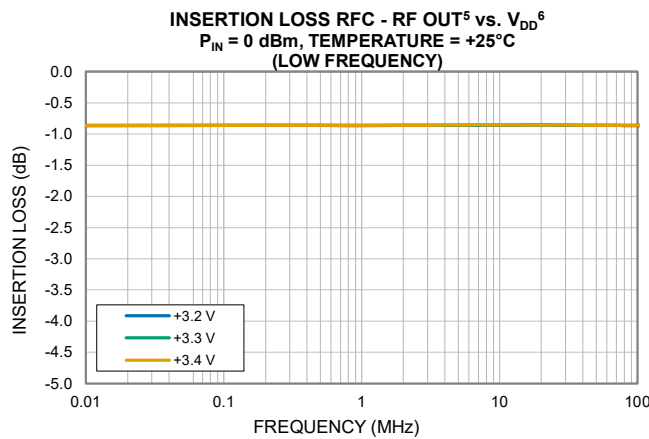
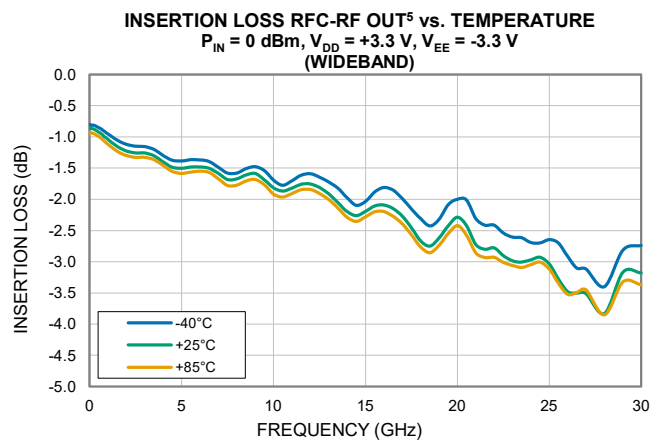
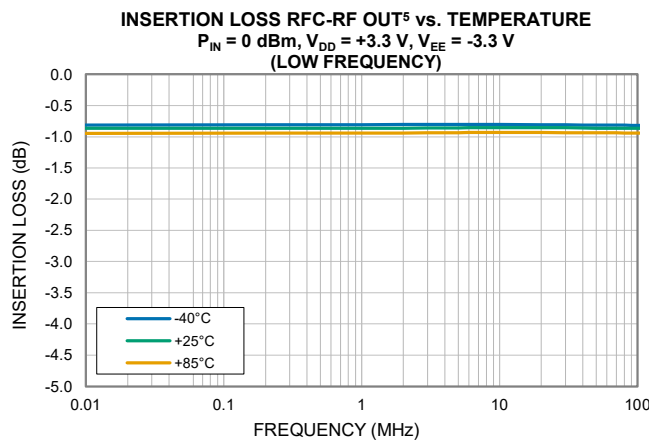
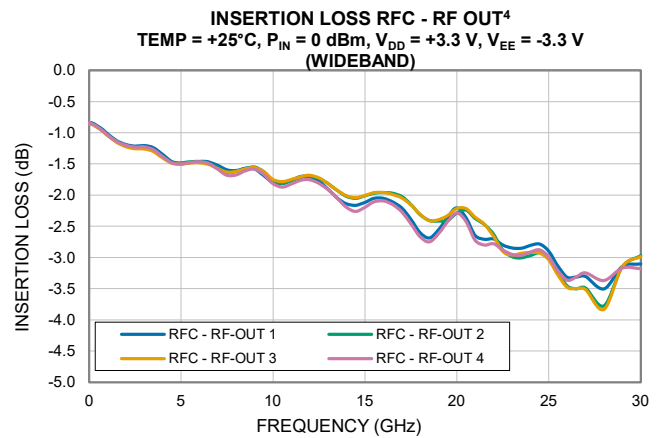
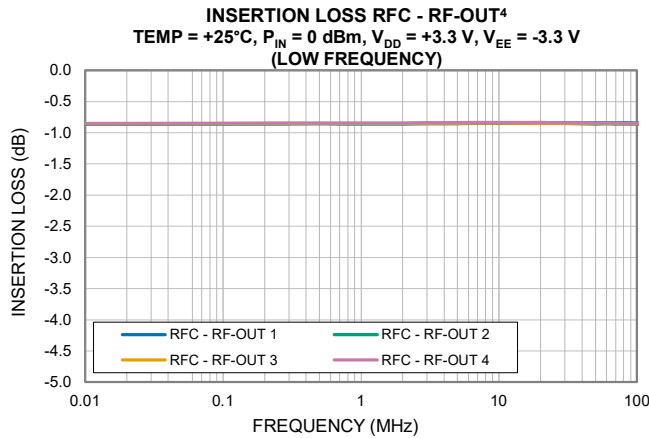
# SP4T RF Switch

**M4SWA4-34DR+**

Mini-Circuits

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## TYPICAL PERFORMANCE GRAPHS



4. RF-OUT defined as either RF-OUT 1 (ON), RF-OUT 2 (ON), RF-OUT 3 (ON), or RF-OUT 4 (ON)

5. RF-OUT defined as the worst of RFC to RF-OUT 1 (ON), RF-OUT 2 (ON), RF-OUT 3 (ON), or RF-OUT 4 (ON)

6. V<sub>EE</sub> is the negative equivalent value to V<sub>DD</sub>. Both V<sub>DD</sub> and V<sub>EE</sub> are varied.



MMIC SURFACE MOUNT

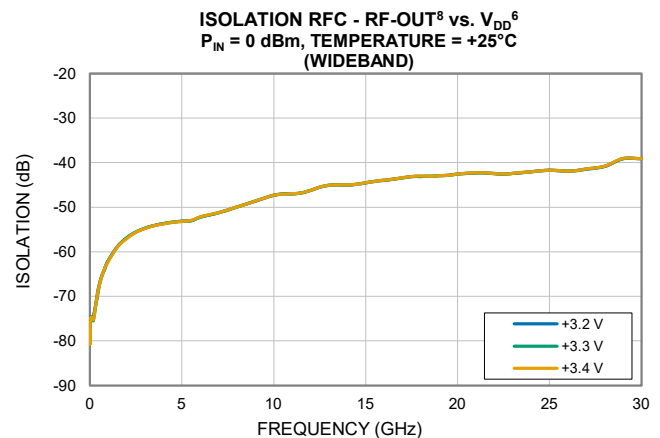
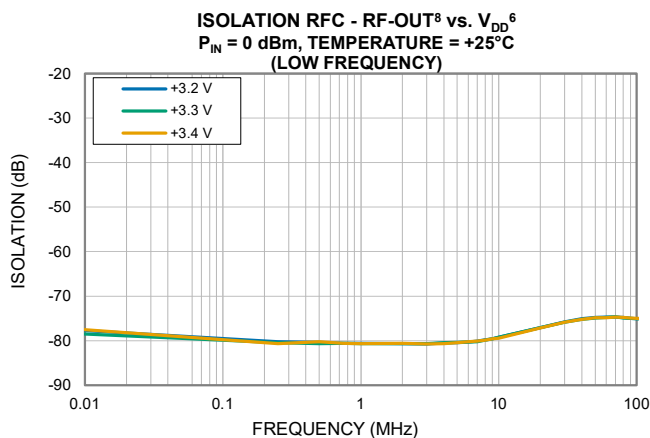
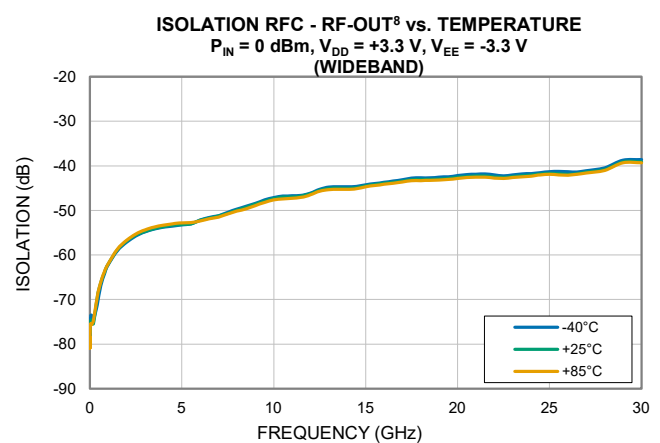
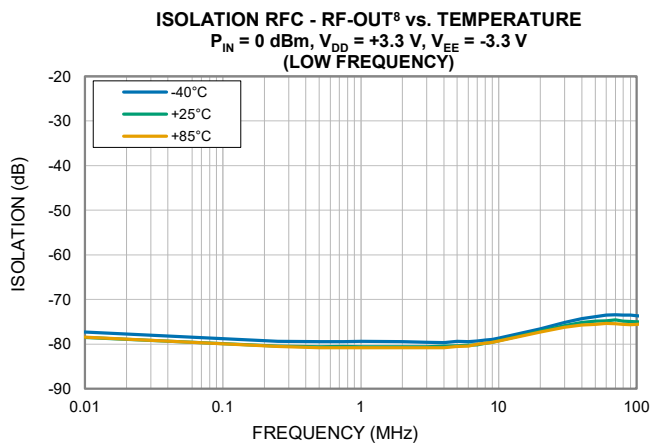
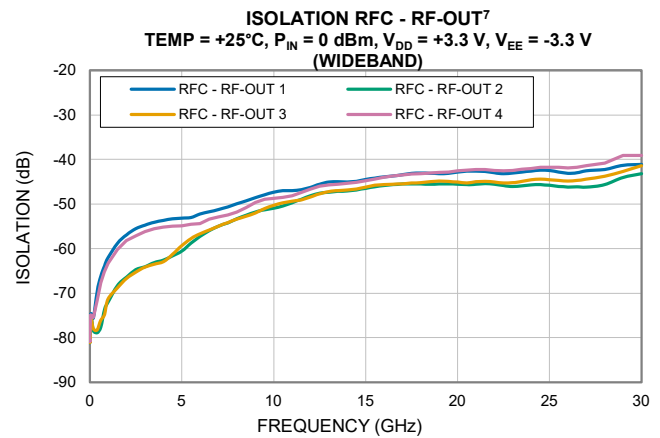
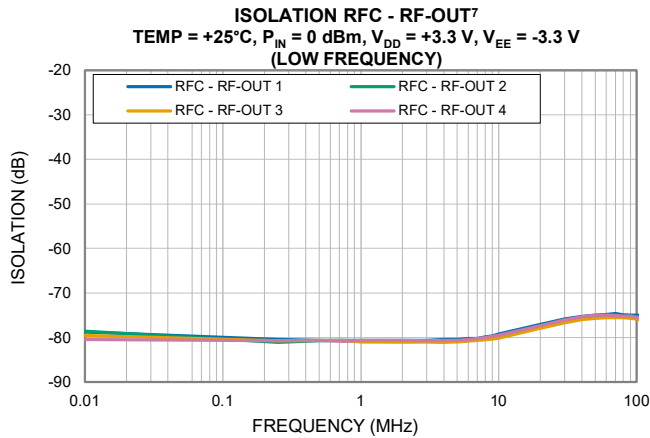
# SP4T RF Switch

**M4SWA4-34DR+**

Mini-Circuits

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## TYPICAL PERFORMANCE GRAPHS



6. V<sub>EE</sub> is the negative equivalent value to V<sub>DD</sub>. Both V<sub>DD</sub> and V<sub>EE</sub> are varied.

7. RF-OUT defined as either RF-OUT 1 (OFF), RF-OUT 2 (OFF), RF-OUT 3 (OFF), or RF-OUT 4 (OFF)

8. RF-OUT defined as the worst of RFC to RF-OUT 1 (OFF), RF-OUT 2 (OFF), RF-OUT 3 (OFF), or RF-OUT 4 (OFF)

Mini-Circuits



MMIC SURFACE MOUNT

# SP4T RF Switch

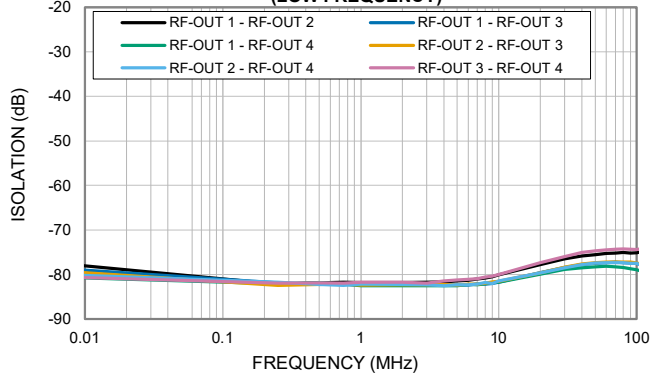
**M4SWA4-34DR+**

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## TYPICAL PERFORMANCE GRAPHS

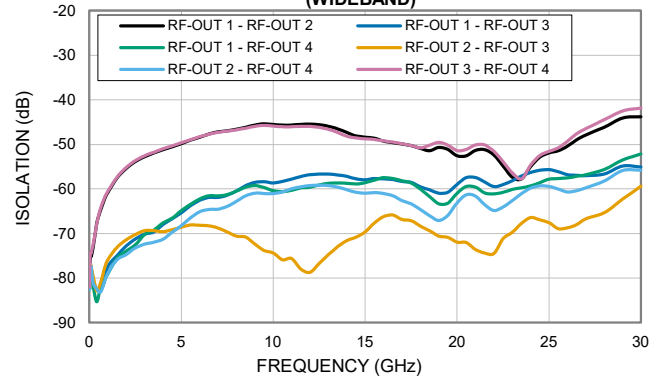
### ISOLATION BETWEEN RF OUTPUTS

TEMP = +25°C,  $P_{IN} = 0$  dBm,  $V_{DD} = +3.3$  V,  $V_{EE} = -3.3$  V  
(LOW FREQUENCY)



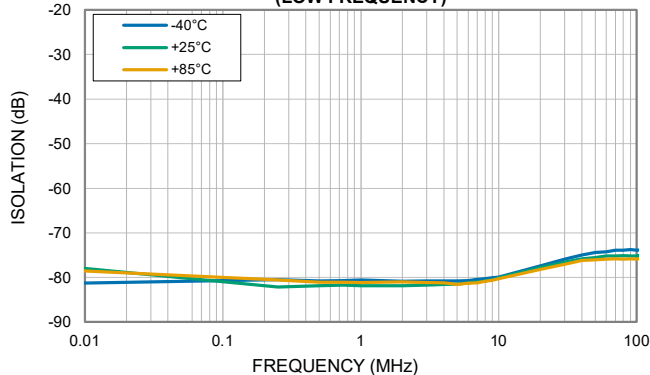
### ISOLATION BETWEEN RF OUTPUTS

TEMP = +25°C,  $P_{IN} = 0$  dBm,  $V_{DD} = +3.3$  V,  $V_{EE} = -3.3$  V  
(WIDEBAND)



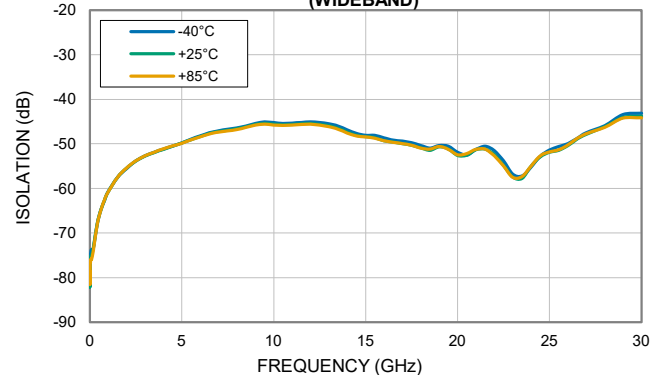
### ISOLATION RF-OUT 1 - RF-OUT 2 vs. TEMPERATURE

$P_{IN} = 0$  dBm,  $V_{DD} = +3.3$  V,  $V_{EE} = -3.3$  V  
(LOW FREQUENCY)



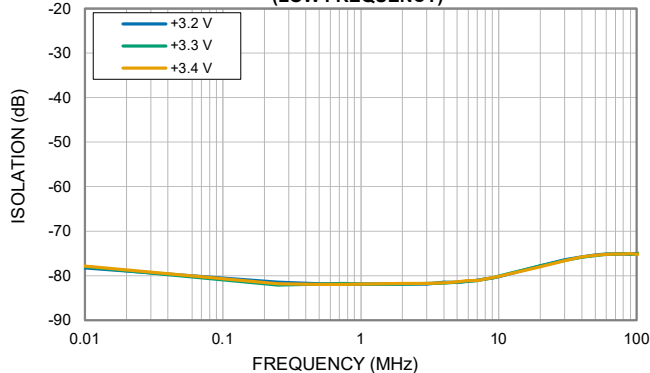
### ISOLATION RF-OUT 1 - RF-OUT 2 vs. TEMPERATURE

$P_{IN} = 0$  dBm,  $V_{DD} = +3.3$  V,  $V_{EE} = -3.3$  V  
(WIDEBAND)



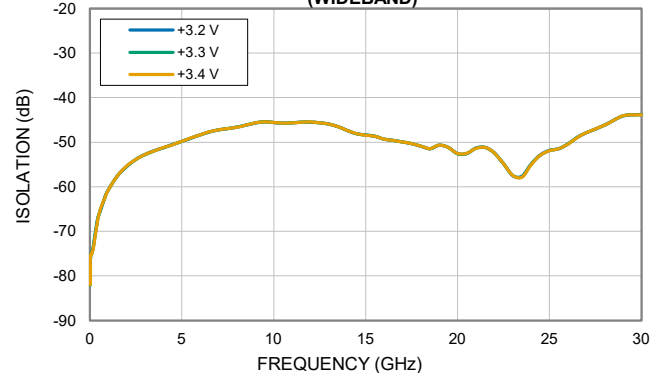
### ISOLATION RF-OUT 1 - RF-OUT 2 vs. $V_{DD}$ <sup>6</sup>

$P_{IN} = 0$  dBm, TEMPERATURE = +25°C  
(LOW FREQUENCY)



### ISOLATION RF-OUT 1 - RF-OUT 2 vs. $V_{DD}$ <sup>6</sup>

$P_{IN} = 0$  dBm, TEMPERATURE = +25°C  
(WIDEBAND)



6.  $V_{EE}$  is the negative equivalent value to  $V_{DD}$ . Both  $V_{DD}$  and  $V_{EE}$  are varied.



MMIC SURFACE MOUNT

# SP4T RF Switch

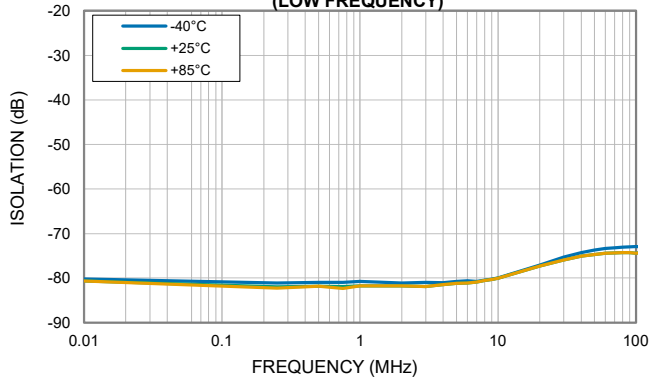
**M4SWA4-34DR+**

Mini-Circuits

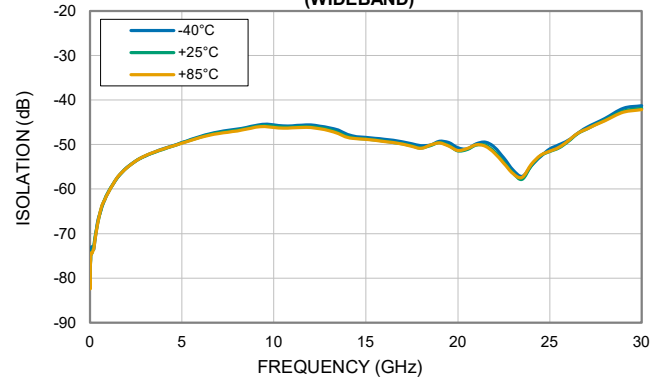
50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## TYPICAL PERFORMANCE GRAPHS

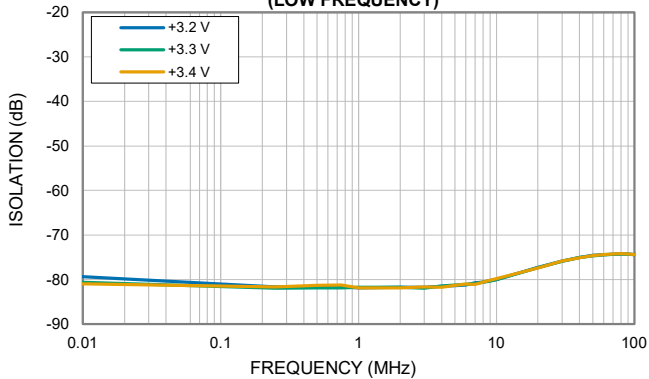
ISOLATION RF-OUT 3 - RF-OUT 4 vs. TEMPERATURE  
 $P_{IN} = 0 \text{ dBm}$ ,  $V_{DD} = +3.3 \text{ V}$ ,  $V_{EE} = -3.3 \text{ V}$   
(LOW FREQUENCY)



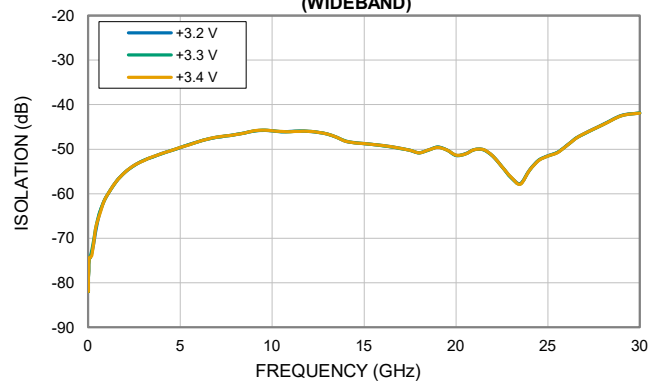
ISOLATION RF-OUT 3 - RF-OUT 4 vs. TEMPERATURE  
 $P_{IN} = 0 \text{ dBm}$ ,  $V_{DD} = +3.3 \text{ V}$ ,  $V_{EE} = -3.3 \text{ V}$   
(WIDEBAND)



ISOLATION RF-OUT 3 - RF-OUT 4 vs.  $V_{DD}$ <sup>6</sup>  
 $P_{IN} = 0 \text{ dBm}$ , TEMPERATURE = +25°C  
(LOW FREQUENCY)



ISOLATION RF-OUT 3 - RF-OUT 4 vs.  $V_{DD}$ <sup>6</sup>  
 $P_{IN} = 0 \text{ dBm}$ , TEMPERATURE = +25°C  
(WIDEBAND)



6.  $V_{EE}$  is the negative equivalent value to  $V_{DD}$ . Both  $V_{DD}$  and  $V_{EE}$  are varied.



MMIC SURFACE MOUNT

# SP4T RF Switch

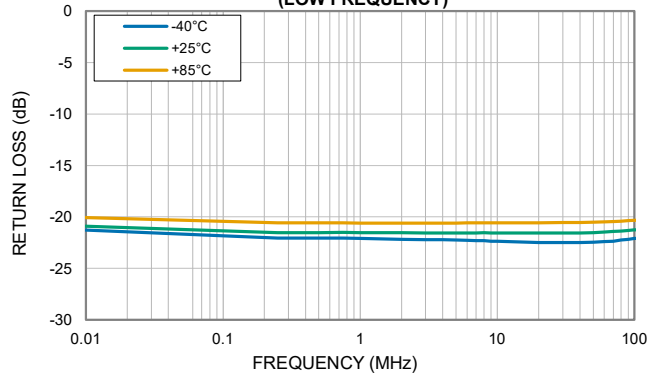
**M4SWA4-34DR+**

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## TYPICAL PERFORMANCE GRAPHS

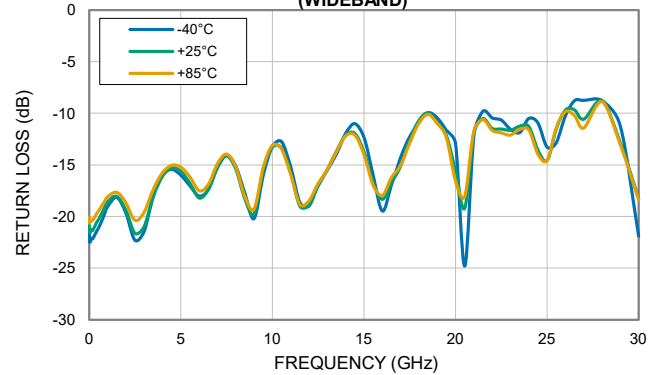
**RFC INPUT RETURN LOSS vs. TEMPERATURE**

$P_{IN} = 0 \text{ dBm}$ ,  $V_{DD} = +3.3 \text{ V}$ ,  $V_{EE} = -3.3 \text{ V}$   
(LOW FREQUENCY)

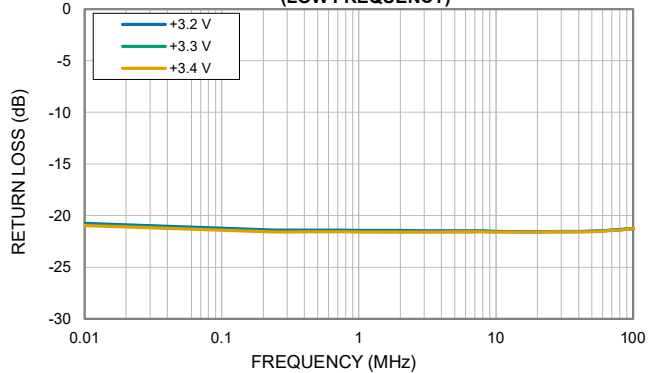


**RFC INPUT RETURN LOSS vs. TEMPERATURE**

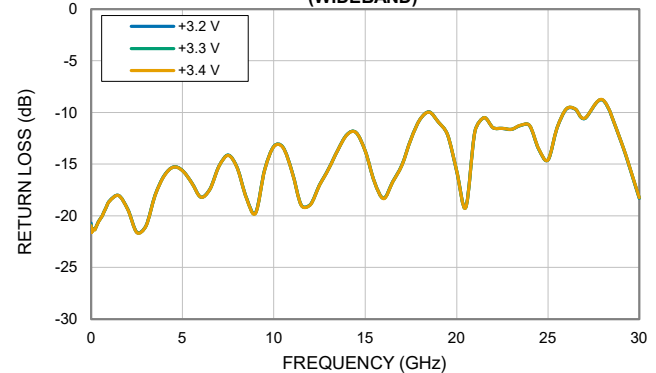
$P_{IN} = 0 \text{ dBm}$ ,  $V_{DD} = +3.3 \text{ V}$ ,  $V_{EE} = -3.3 \text{ V}$   
(WIDEBAND)



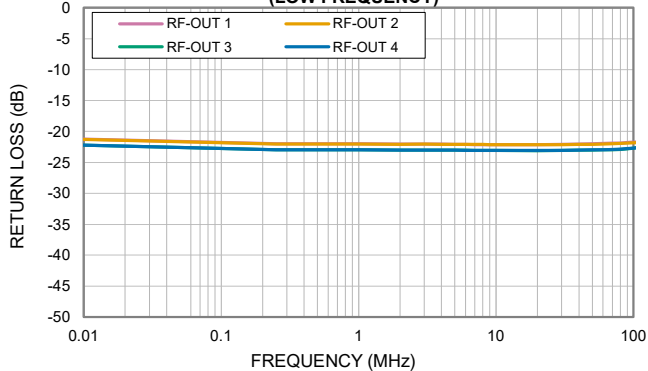
**RFC INPUT RETURN LOSS vs.  $V_{DD}$ <sup>6</sup>**  
 $P_{IN} = 0 \text{ dBm}$ , TEMPERATURE = +25°C  
(LOW FREQUENCY)



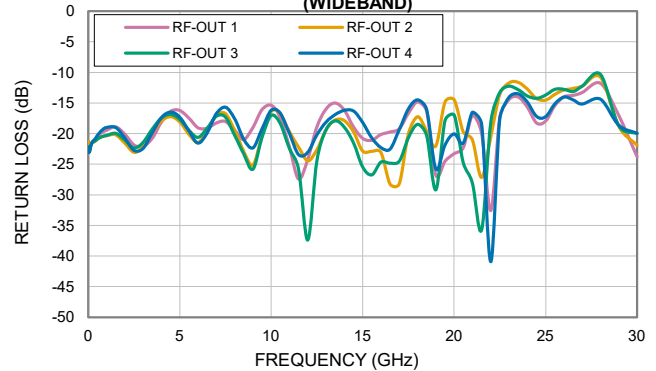
**RFC INPUT RETURN LOSS vs.  $V_{DD}$ <sup>6</sup>**  
 $P_{IN} = 0 \text{ dBm}$ , TEMPERATURE = +25°C  
(WIDEBAND)



**RF (ON) OUTPUT RETURN LOSS**  
TEMP = +25°C,  $P_{IN} = 0 \text{ dBm}$ ,  $V_{DD} = +3.3 \text{ V}$ ,  $V_{EE} = -3.3 \text{ V}$   
(LOW FREQUENCY)



**RF (ON) OUTPUT RETURN LOSS**  
TEMP = +25°C,  $P_{IN} = 0 \text{ dBm}$ ,  $V_{DD} = +3.3 \text{ V}$ ,  $V_{EE} = -3.3 \text{ V}$   
(WIDEBAND)



6.  $V_{EE}$  is the negative equivalent value to  $V_{DD}$ . Both  $V_{DD}$  and  $V_{EE}$  are varied.





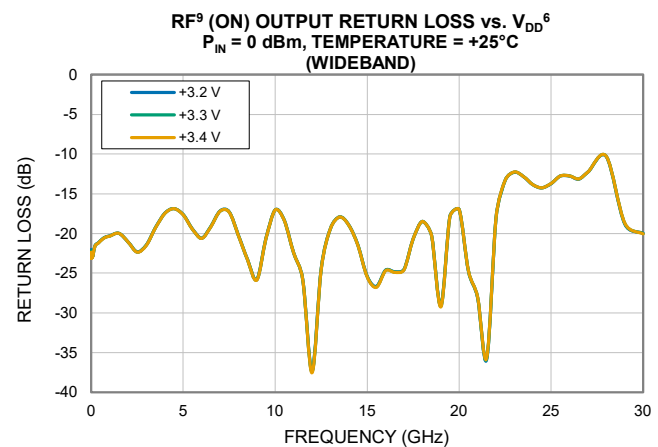
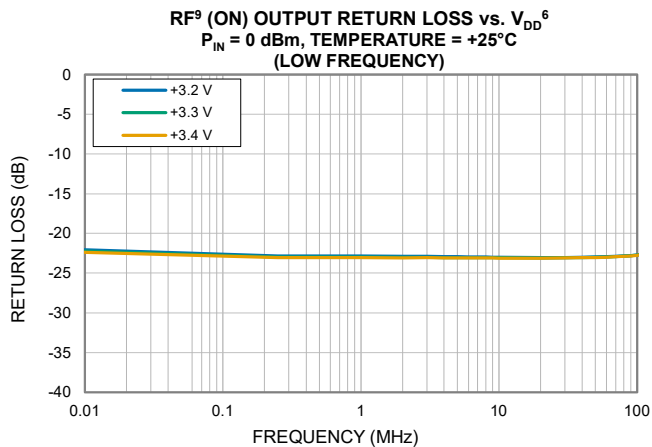
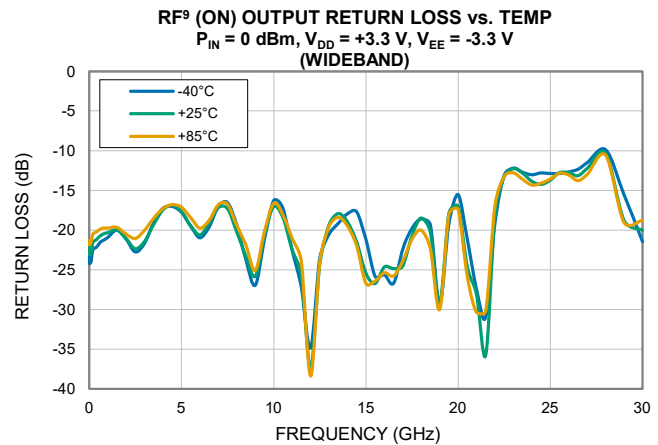
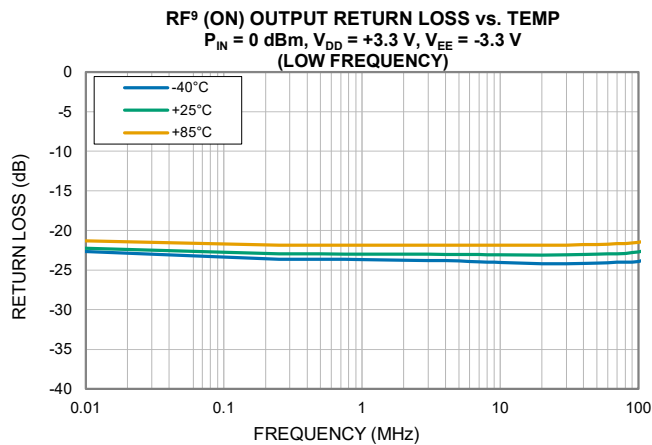
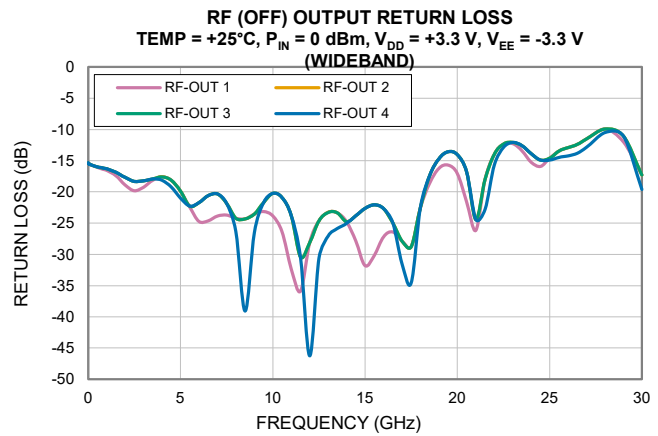
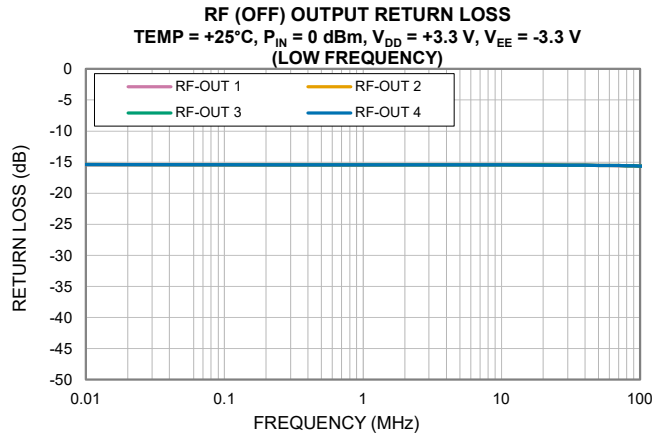
MMIC SURFACE MOUNT

# SP4T RF Switch

**M4SWA4-34DR+**

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## TYPICAL PERFORMANCE GRAPHS



6.  $V_{EE}$  is the negative equivalent value to  $V_{DD}$ . Both  $V_{DD}$  and  $V_{EE}$  are varied.

9. RF-OUT defined as the worst of RF-OUT 1 (ON), RF-OUT 2 (ON), RF-OUT 3 (ON), or RF-OUT 4 (ON)



MMIC SURFACE MOUNT

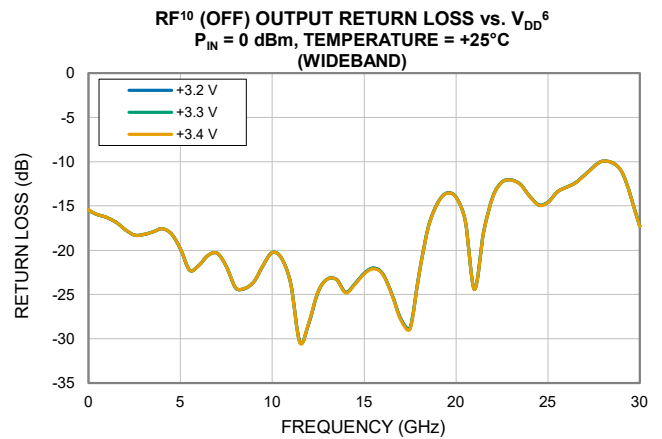
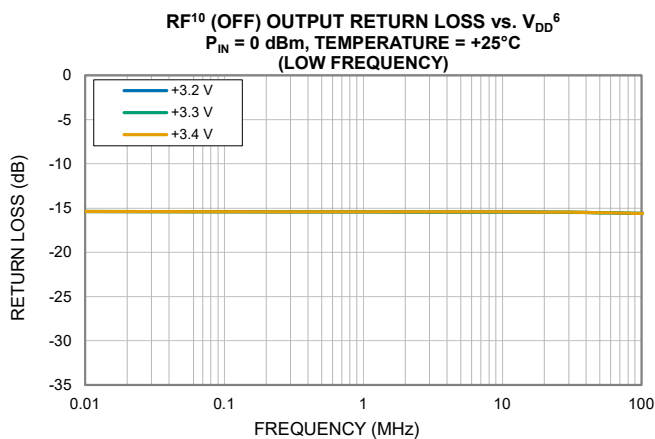
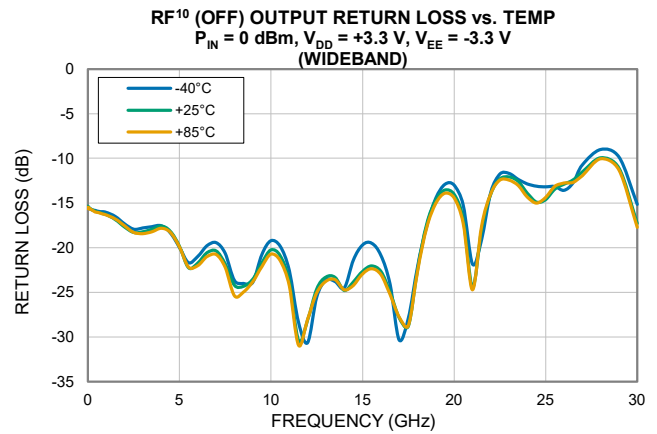
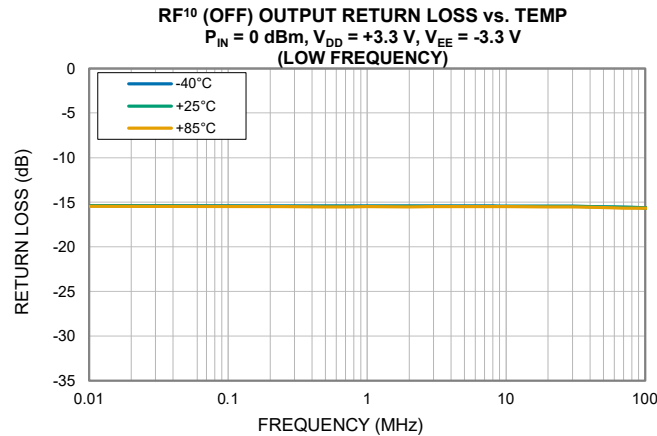
# SP4T RF Switch

**M4SWA4-34DR+**

Mini-Circuits

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## TYPICAL PERFORMANCE GRAPHS



6.  $V_{EE}$  is the negative equivalent value to  $V_{DD}$ . Both  $V_{DD}$  and  $V_{EE}$  are varied.

10. RF-OUT defined as the worst of RF-OUT 1 (OFF), RF-OUT 2 (OFF), RF-OUT 3 (OFF), or RF-OUT 4 (OFF)



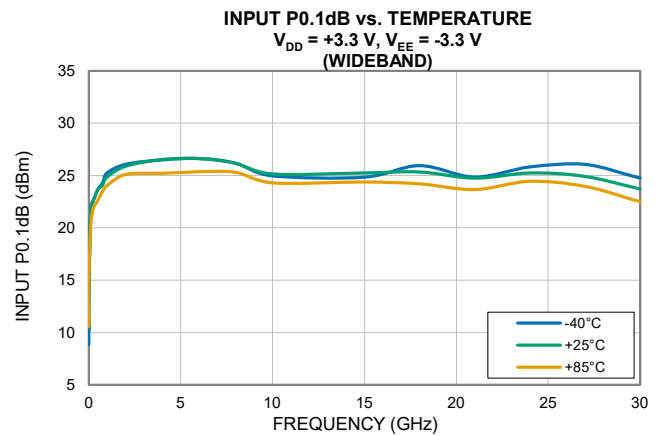
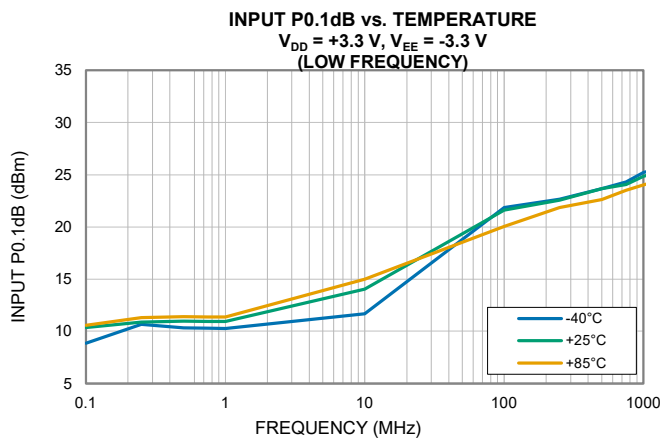
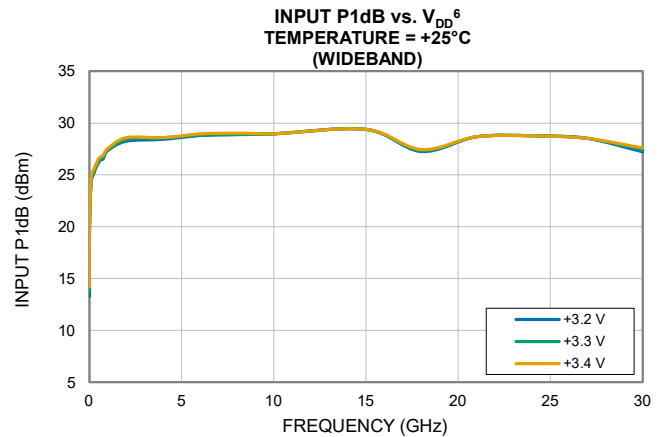
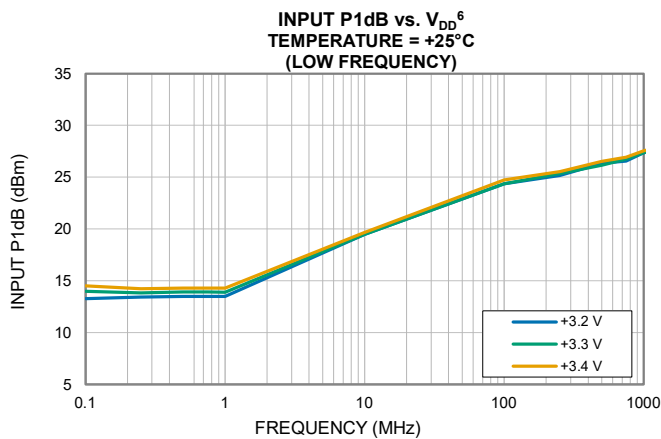
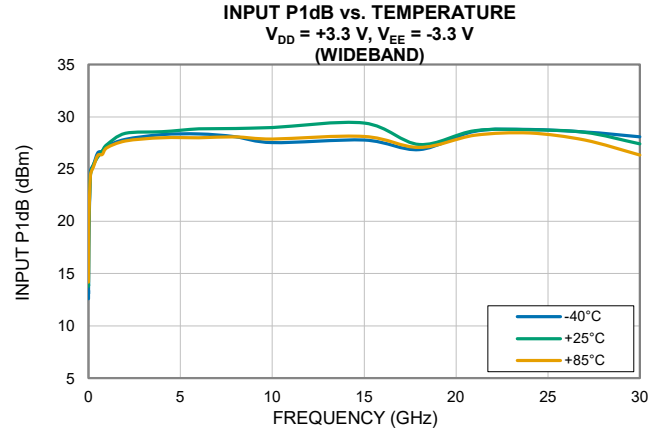
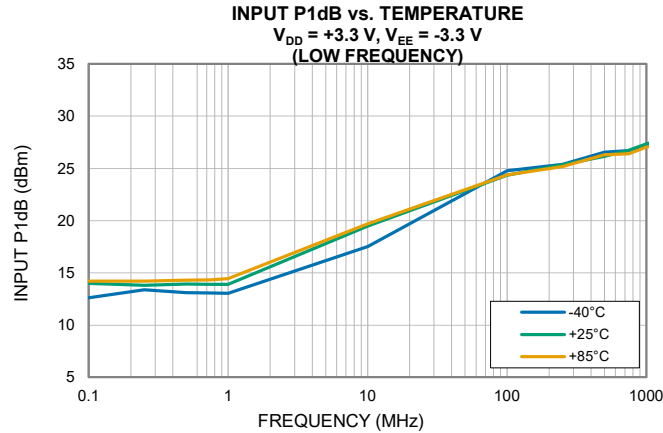
MMIC SURFACE MOUNT

# SP4T RF Switch

**M4SWA4-34DR+**

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

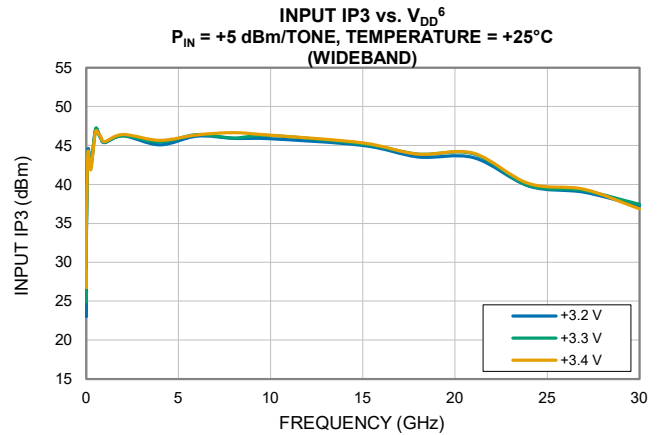
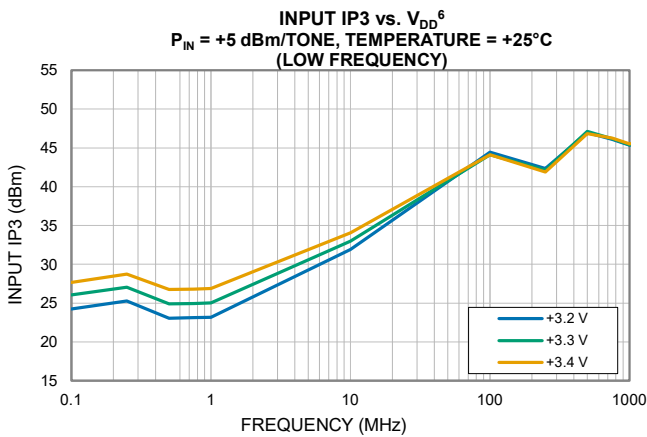
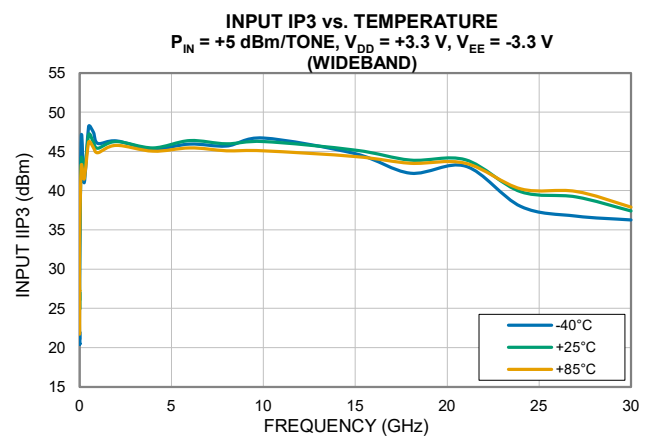
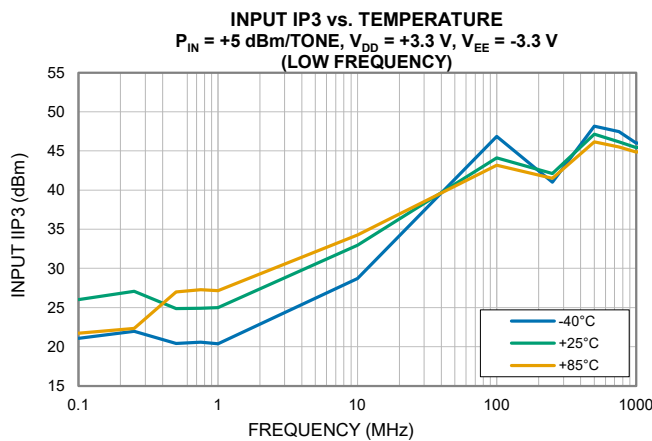
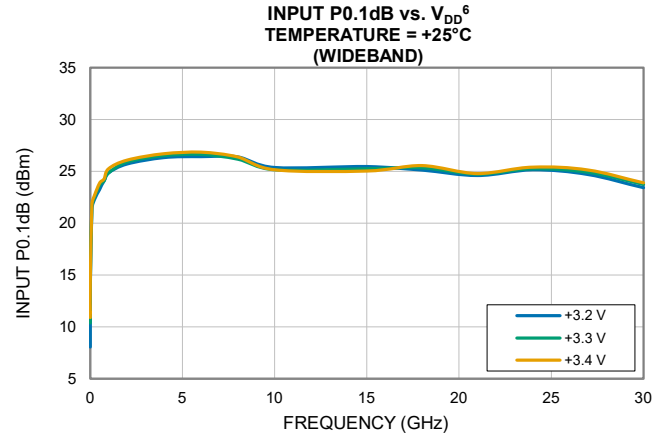
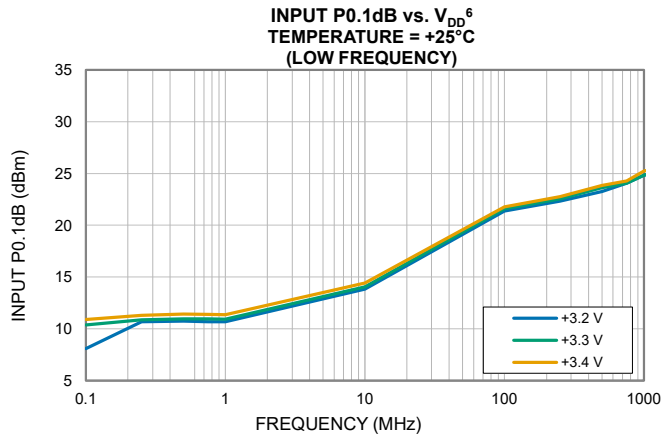
## TYPICAL PERFORMANCE GRAPHS



6.  $V_{EE}$  is the negative equivalent value to  $V_{DD}$ . Both  $V_{DD}$  and  $V_{EE}$  are varied.



## TYPICAL PERFORMANCE GRAPHS



6.  $V_{EE}$  is the negative equivalent value to  $V_{DD}$ . Both  $V_{DD}$  and  $V_{EE}$  are varied.



MMIC SURFACE MOUNT

# SP4T RF Switch

**M4SWA4-34DR+**

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## ABSOLUTE MAXIMUM RATINGS<sup>11</sup>

Parameter	Ratings
Operating Temperature (ground lead)	-40°C to +85°C
Storage Temperature	-65°C to +150°C
Junction Temperature <sup>12</sup>	+150°C
Total Power Dissipation	0.33 W
Through Path @ +85°C: Input Power at RFC (CW), (V <sub>DD</sub> = +3.3 V, V <sub>EE</sub> = -3.3 V)	+24 dBm
Input Power at RF-OUT 1/2/3/4 (CW), RF Applied to one of the Unselected Ports (V <sub>DD</sub> = +3.3 V, V <sub>EE</sub> = -3.3 V)	+24 dBm
Input Power at RF-OUT 1/2/3/4 (CW), RF Applied to the Selected Port (V <sub>DD</sub> = +3.3 V, V <sub>EE</sub> = -3.3 V)	+24 dBm

11. Permanent damage may occur if any of these limits are exceeded. Maximum ratings are not intended for continuous normal operation.

12. Peak temperature on top of Die.

## THERMAL RESISTANCE

Parameter	Condition	Ratings
Thermal Resistance (Θ <sub>JC</sub> ) <sup>13</sup>	Through Path RFC to RF-OUT 1	86.9°C/W
	Through Path RF-OUT 1 to RFC	55.7°C/W
	Termination Path	77.1°C/W

13. Θ<sub>JC</sub> = (Hot Spot Temperature on Die - Temperature at Ground Lead)/Dissipated Power

## ESD RATING

	Class	Voltage Range	Reference Standard
HBM	1B	500 V to < 1000 V	ANSI/ESDA/JEDEC JS-001-2023



ESD HANDLING PRECAUTION: This device is designed to be Class 1B for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

## MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E/JEDEC J-STD-033C





MMIC SURFACE MOUNT

# SP4T RF Switch

**M4SWA4-34DR+**

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

## FUNCTIONAL DIAGRAM (TOP VIEW)

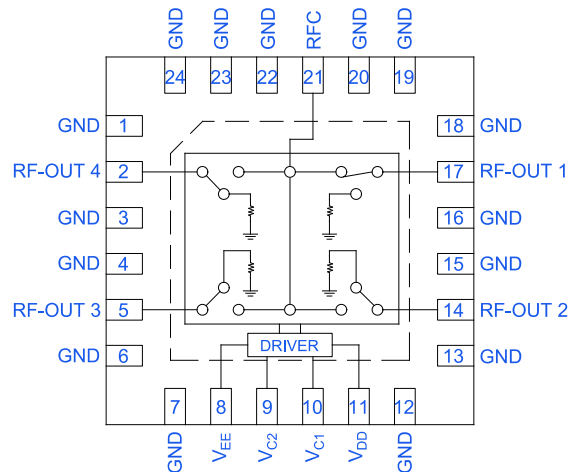
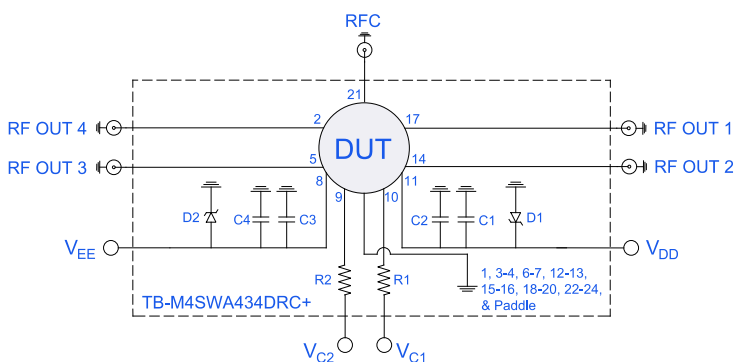


Figure 1. M4SWA4-34DR+ Functional Diagram

## PAD DESCRIPTION

Function	Pad Number	Application Description (Refer to Fig 2)
RFC	21	RFC Pad connects to RF Input port.
RF-OUT 1	17	RF-OUT 1 Pad connects to RF Output port 1.
RF-OUT 2	14	RF-OUT 2 Pad connects to RF Output port 2.
RF-OUT 3	5	RF-OUT 3 Pad connects to RF Output port 3.
RF-OUT 4	2	RF-OUT 4 Pad connects to RF Output port 4.
V <sub>DD</sub>	11	V <sub>DD</sub> Pad connects to positive DC Input.
V <sub>EE</sub>	8	V <sub>EE</sub> Pad connects to negative DC Input.
V <sub>C1</sub>	10	V <sub>C1</sub> Pad connects to switch control voltage input 1.
V <sub>C2</sub>	9	V <sub>C2</sub> Pad connects to switch control voltage input 2.
GND	1, 3-4, 6-7, 12-13, 15-16, 18-20, 22-24, & Paddle	Connects to ground.

## CHARACTERIZATION TEST BOARD<sup>14</sup>



### Electrical Parameters and Conditions

Insertion Loss, Isolation, Return Loss, Input Power at 1dB Compression (P1dB), and Input IP3 tested using PNA-X N5247B microwave network analyzer and P5022A vector network analyzer.

### Conditions:

1. Insertion Loss, Isolation, and Return Loss: P<sub>IN</sub> = 0 dBm
2. Input IP3 (IIP3): Two tones, spaced 1 MHz apart, +5 dBm/Tone at input.

Figure 2. M4SWA4-34DR+ Characterization and Application Circuit

14. Support components are included on the evaluation board for filtering and protection of the device. Support circuitry may vary based on the user's application and may not be required in all cases if clean, known voltages are supplied.

Component	Value	Size	Part Number	Manufacturer
C2, C3	100 pF	0402	GRM1555C1H101JA01D	Murata
C1, C4	0.1 uF	0402	GRM155R71C104KA88D	Murata
R1, R2	100 Ω	0402	RK73H1ETTP1000F	KOA Speer
D1, D2	V <sub>Z</sub> = +5.1 V	SOD-123	MMSZ5231BT1G	ON Semiconductor





MMIC SURFACE MOUNT

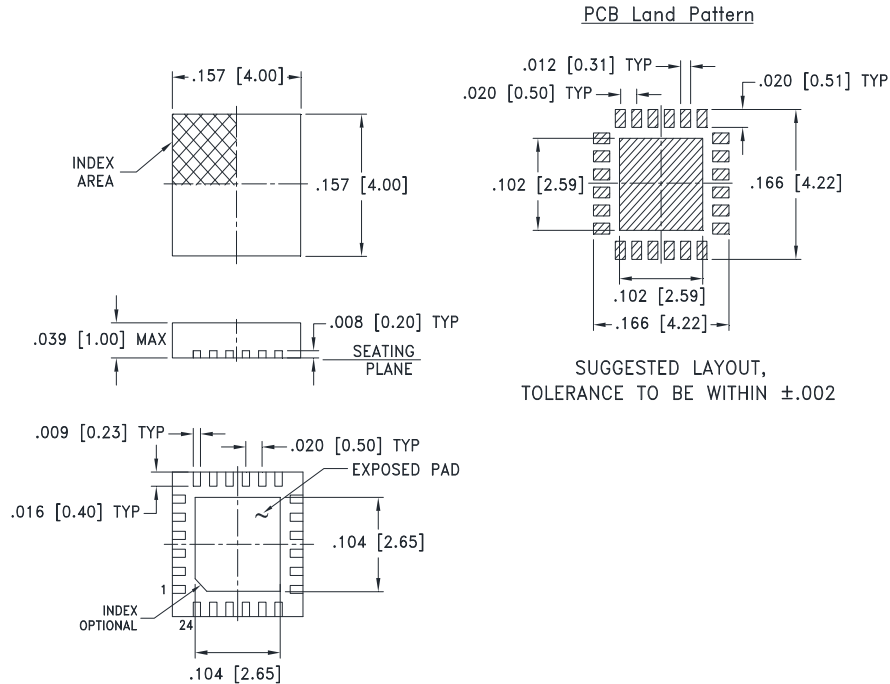
# SP4T RF Switch

**M4SWA4-34DR+**

Mini-Circuits

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

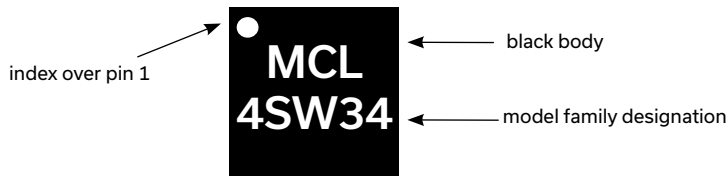
## CASE STYLE DRAWING



Weight: .04 Grams

Dimensions are in inches [mm]. Tolerances in inches: 2 Pl.  $\pm .01$ ; 3 Pl.  $\pm .005$  inches

## PRODUCT MARKING



Marking may contain other features or characters for internal lot control

Mini-Circuits



MMIC SURFACE MOUNT

# SP4T RF Switch

## M4SWA4-34DR+

50Ω DC to 30 GHz Absorptive RF Switch with Internal Driver

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD [CLICK HERE](#)

Performance Data & Graphs	Data
	Graphs
	S-Parameter (S5P Files) Data Set (.zip file)
Case Style	DG1847. Plastic package, exposed paddle, Lead Finish: Matte-Tin
RoHS Status	Compliant
Tape & Reel Standard quantities available on reel	F68 7" reels with 20, 50, 100, 200, 500, or 1000 devices 13" reels with 2000, 3000, or 4000 devices
Suggested Layout for PCB Design	PL-830
Evaluation Board	TB-M4SWA434DRC+
	Gerber File
Environmental Ratings	ENV08T1

#### NOTES

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at [www.minicircuits.com/terms/viewterm.html](http://www.minicircuits.com/terms/viewterm.html)

