MMIC DIE

SPDT RF Switch M3SWA2-34DR-D+

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

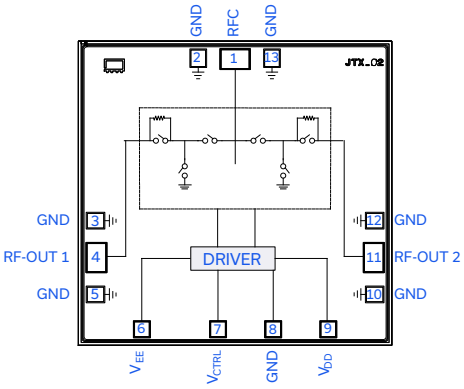
THE BIG DEAL

- Wideband, DC to 30 GHz
- Low Insertion Loss, Typ. 1.1 dB
- High Isolation RF1-RF2, Typ. 67 dB
- High Input IP3, Typ. +48 dBm
- Fast Rise/Fall Time, Typ. 6.9 ns/7.1 ns

APPLICATIONS

- Radar, EW and ECM Defense Systems
- Communication Infrastructure
- Test and Measurements

FUNCTIONAL DIAGRAM



SEE ORDERING INFORMATION ON THE LAST PAGE

PRODUCT OVERVIEW

Mini-Circuits' M3SWA2-34DR-D+ is a GaAs MMIC SPDT 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 no gate lag effects. This model provides excellent isolation, high linearity and is capable of withstanding +27 dBm RF input power. The M3SWA2-34DR-D+ die is suitable for chip and wire assemblies.

KEY FEATURES

Features	Advantages
Absorptive Design	Absorptive switch design enables excellent return loss on all ports, minimizing reflection at the unselected port.
High Isolation: • 62 dB Typ. RFC to RF1/RF2 • 67 dB Typ. RF1 to RF2	High isolation significantly reduces leakage of power into OFF ports.
High linearity and Input Power: • Input Power at P1dB, 25.2 dBm Typ. • Input IP3, +48 dBm Typ. • Max RF Input Power, +27 dBm CW	High linearity minimizes unwanted intermodulation products which are difficult or impossible to filter in multi-carrier environments, or in the presence of strong interfering signal from adjacent circuitry. High RF input power tolerance protects the device from damage due to unexpected spikes in signal level.
Fast RF Switching Time: • Rise/Fall Time, Typ. 6.9 ns/7.1 ns • On/Off Time, Typ. 23.3 ns/16.5 ns • Settling to 0.05 dB, Typ. 29 ns	Fast switching makes this model suitable for applications where extremely fast transition between ports is required, such as automated switching networks.
Unpackaged Die	Suitable for chip and wire hybrid assemblies

REV. OR
ECO-020350
M3SWA2-34DR-D+
MCL NY
231220

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ELECTRICAL SPECIFICATIONS[1,2,3] 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		0.5		dB
	0.1		0.6		
	1.0		0.6		
	10		0.9		
	20		1.8		
	30		2.4		
Isolation Between Ports, RF1 & RF2	0.01		83		dB
	0.1		80		
	1.0		69		
	10		64		
	20		52		
	30		51		
Isolation Between RFC & RF1/RF2 Ports	0.01		81		dB
	0.1		79		
	1.0		67		
	10		51		
	20		48		
	30		46		
Return Loss - RFC	0.01		19		dB
	0.1		22		
	1.0		22		
	10		18		
	20		11		
	30		11		
Return Loss - RF1 & RF2 (On & Off State)	0.01		19		dB
	0.1		22		
	1.0		22		
	10		18		
	20		11		
	30		11		
Input Power at P1dB	0.01		+19.8		dBm
	0.1		+24.7		
	1.0		+26.4		
	10		+27.3		
	20		+27.8		
	30		+25.1		
Input Power at P0.1 dB	0.01		+17.8		dBm
	0.1		+21.3		
	1.0		+23.6		
	10		+25.6		
	20		+27.0		
	30		+23.9		
Input IP3 (P_{IN} = +5 dBm/Tone)	0.01		+46		dBm
	0.1		+49		
	1.0		+52		
	10		+49		
	20		+48		
	30		+43		

1. Tested on Mini-Circuits Die Characterization Test Board. See Figure 3.
2. Bi-directional, refer to S-Parameters for actual performance.
3. All RF-ports must be DC blocked or held at 0 V DC.

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DC ELECTRICAL SPECIFICATIONS[4]

Parameter	Min.	Typ.	Max.	Units
Positive Supply Voltage, V_{DD}	+3.3		+3.6	V
Negative Supply Voltage, V_{EE}	-3.6		-3.3	V
Positive Supply Current, I_{DD}		2.7	2.9	mA
Negative Supply Current, I_{EE}		1.6	1.8	mA
Control Voltage Low		0	+0.8	V
Control Voltage High	+1.8	+2	+3.6	V
Control Current Low		0.01	1	µA
Control Current High		5	9	mA

4. DC electrical performance was measured on packaged model M3SWA2-34DR+ on its Mini-Circuits Characterization Test Board TB-M3SWA234DRC+.

SWITCHING SPECIFICATIONS[5]

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		23		ns
OFF Time, 50% Control to 10% RF output			17		ns
Video Leakage			+5.4		mV
Rise Time, 10% to 90% of RF output			6.9		ns
Fall Time, 90% to 10% of RF output			7.1		ns
Settling time (50% VCTRL to 0.05 dB of final RF output)			29		ns

5. Switching specifications were measured on packaged model M3SWA2-34DR+ on its Mini-Circuits Characterization Test Board TB-M3SWA234DRC+.

TRUTH TABLE

State of Control Voltage	RFC to RF1	RFC to RF2
Low	ON	OFF
High	OFF	ON

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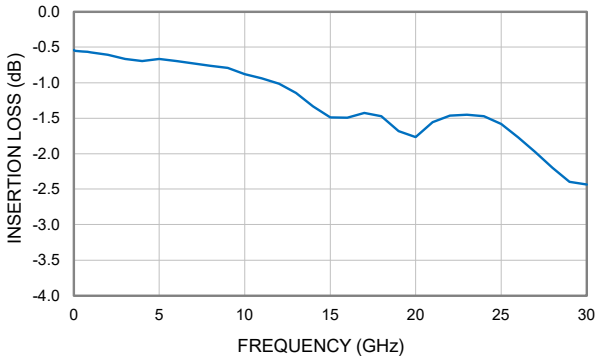
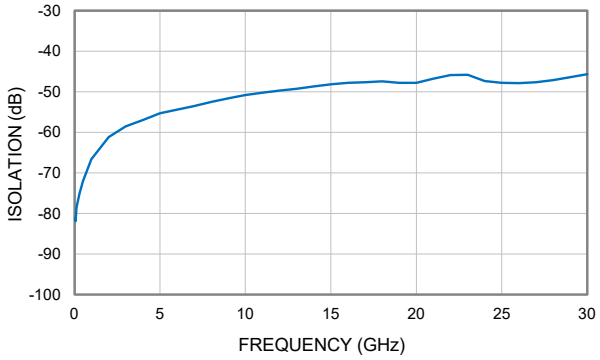
TYPICAL PERFORMANCE GRAPHS

Temperature = +25° C, V_{DD} = +3.3 V, V_{EE} = -3.3 V

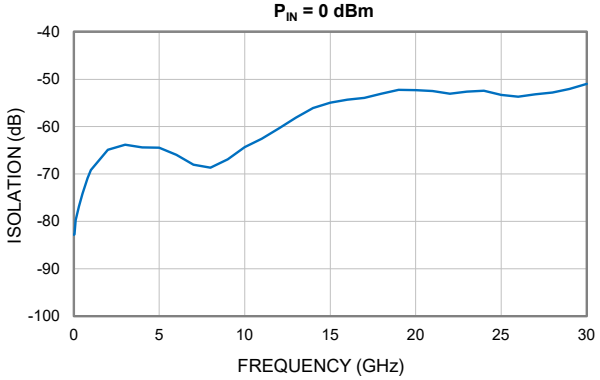
INSERTION LOSS RFC-RF OUT[6], P_{IN} = 0 dBm



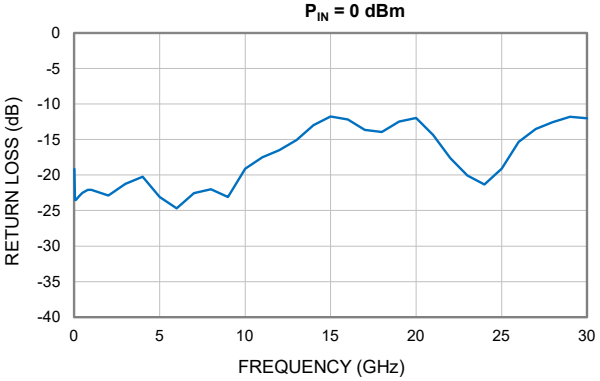
ISOLATION RFC-RF OUT[7], P_{IN} = 0 dBm



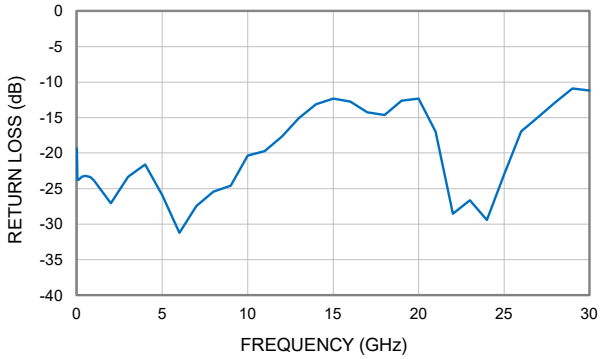
ISOLATION RF1 - RF2, P_{IN} = 0 dBm



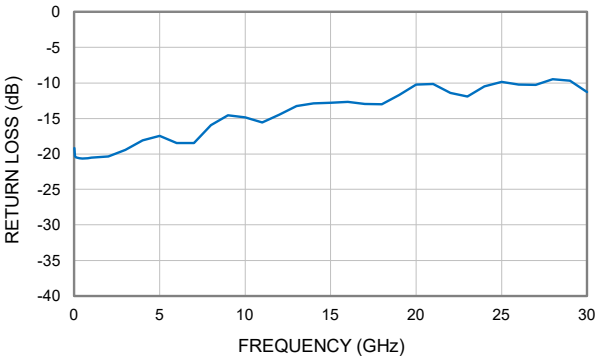
RFC INPUT RETURN LOSS, P_{IN} = 0 dBm



RF1 (ON) OUTPUT RETURN LOSS, P_{IN} = 0 dBm



RF1 (OFF) OUTPUT RETURN LOSS, P_{IN} = 0 dBm

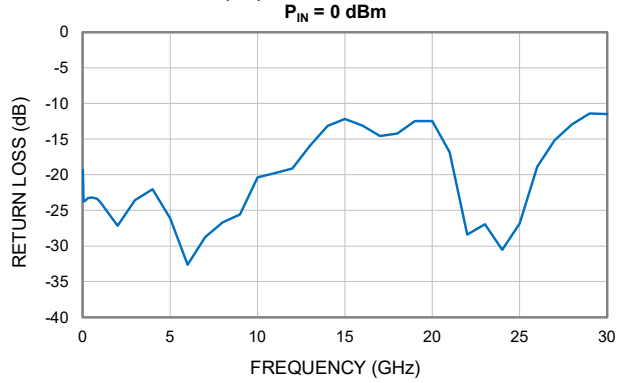


6. RF OUT is defined as either RF1 (ON) or RF2 (ON)
7. RF OUT is defined as either RF1 (OFF) or RF2 (OFF)

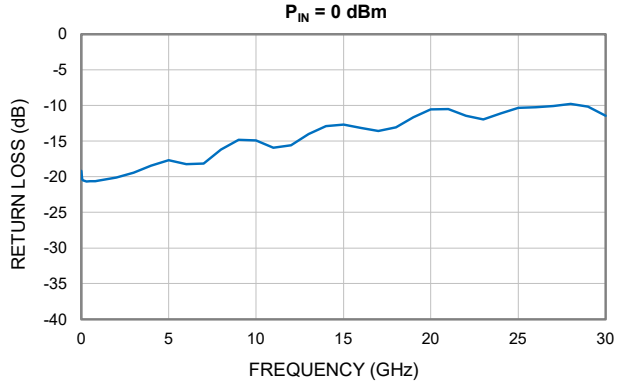
TYPICAL PERFORMANCE GRAPHS

Temperature = +25° C, V_{DD}= +3.3 V, V_{EE}= -3.3 V

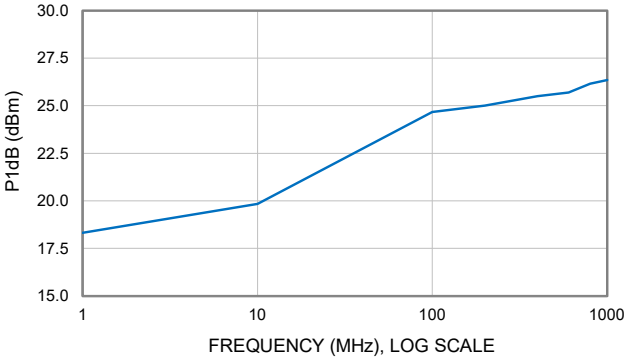
RF2 (ON) OUTPUT RETURN LOSS, P_{IN} = 0 dBm



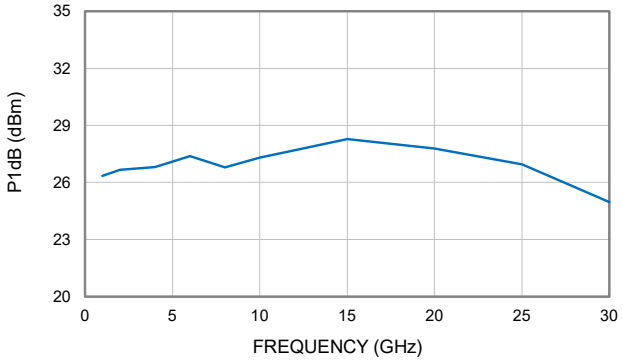
RF2 (OFF) OUTPUT RETURN LOSS , P_{IN} = 0 dBm



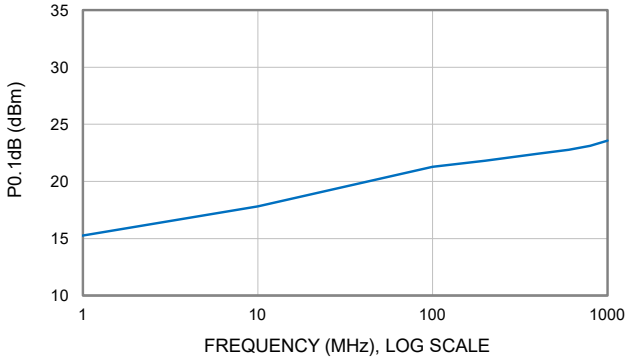
INPUT P1dB



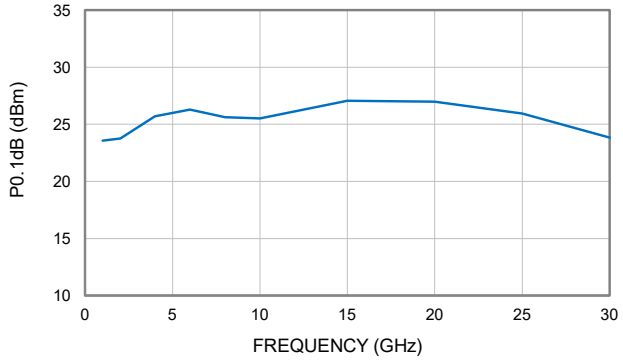
INPUT P1dB



INPUT P0.1dB



INPUT P0.1dB

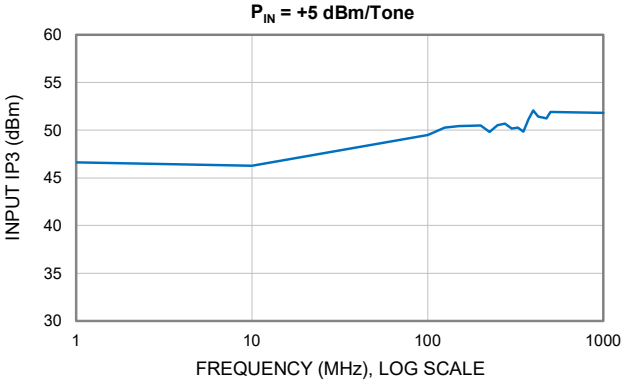


6. RF OUT is defined as either RF1 (ON) or RF2 (ON)
7. RF OUT is defined as either RF1 (OFF) or RF2 (OFF)

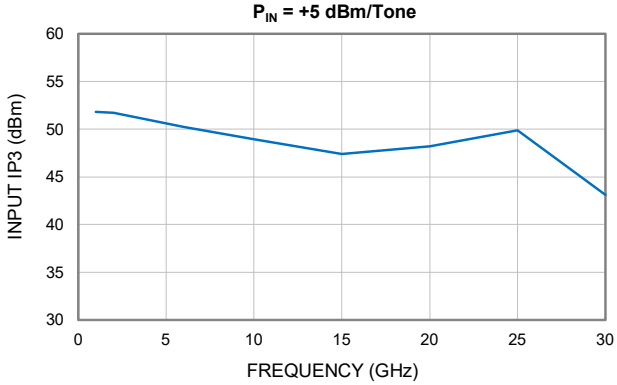
TYPICAL PERFORMANCE GRAPHS

Temperature = +25° C, V_{DD}= +3.3 V, V_{EE}= -3.3 V

INPUT IP3, P_{IN} = +5 dBm/Tone



INPUT IP3, P_{IN} = +5 dBm/Tone



ABSOLUTE MAXIMUM RATINGS[9]

Parameter	Ratings
Operating Temperature[10]	-55°C to +105°C
Storage Temperature (for Die)[11]	-65°C to +150°C
Junction Temperature[12]	+150°C
Total Power Dissipation	0.43 W
Input Power at RFC (CW), (V_{DD} = +3.5 V, V_{EE} = -3.5 V)	+29 dBm
Input Power at RF1/RF2 (CW), (V_{DD} = +3.5 V, V_{EE} = -3.5 V)	+27 dBm
DC Voltage (V_{DD})	0 V to +5 V
DC Voltage (V_{EE})	-5 V to 0 V

9. Permanent damage may occur if any of these limits are exceeded. Maximum ratings are not intended for continuous normal operation.
10. Bottom of Die.
11. For die shipped in Gel-Pak see ENV-80 (limited by packaging)
12. Peak temperature on top of Die.

THERMAL RESISTANCE

Parameter	Ratings
Thermal Resistance (Θ_{jc})[13]	363°C/W

13. Θ_{jc}= (Hot Spot Temperature on Die - Temperature at Ground Lead)/Dissipated Power

ESD RATING[14]

	Class	Voltage Range	Reference Standard
HBM	1A	250 V to < 500 V	ANSI/ESDA/JEDEC JS-001-2017
CDM	C3	≥ 1000 V	JESD22-C101F

ESD HANDLING PRECAUTION: This device is designed to be Class 1A 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.

14. Tested in 3x3 mm 16-Lead QFN style package.

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FUNCTIONAL DIAGRAM

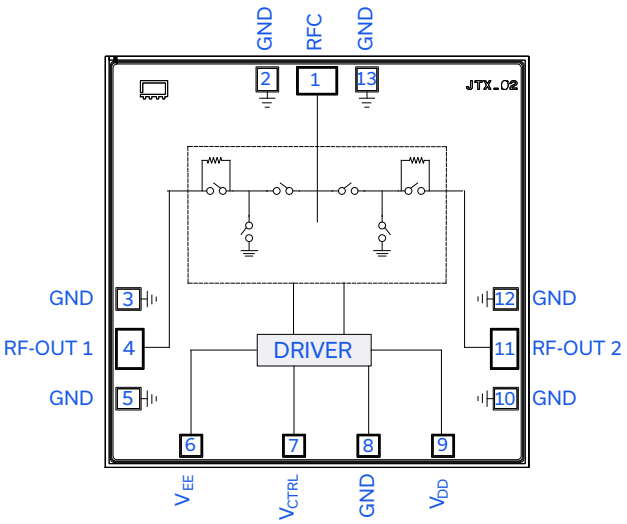

Figure 1. M3SWA2-34DR-D+ Functional Diagram

PAD DESCRIPTION

Function	Pad Number	Application Description (Refer to Fig 2)
RFC	1	RF Input Port.
RF-OUT 1	4	RF Output Port 1.
RF-OUT 2	11	RF Output Port 2.
V_{EE}	6	Negative DC Input Port.
V_{CTRL}	7	Switch control DC Input Port.
V_{DD}	9	Positive DC Input Port.
GND	2,3,5,8,10,12, & 13	Connected to die backside through vias. Bond wires to ground are optional.

DIE OUTLINE: inches [mm], Typical

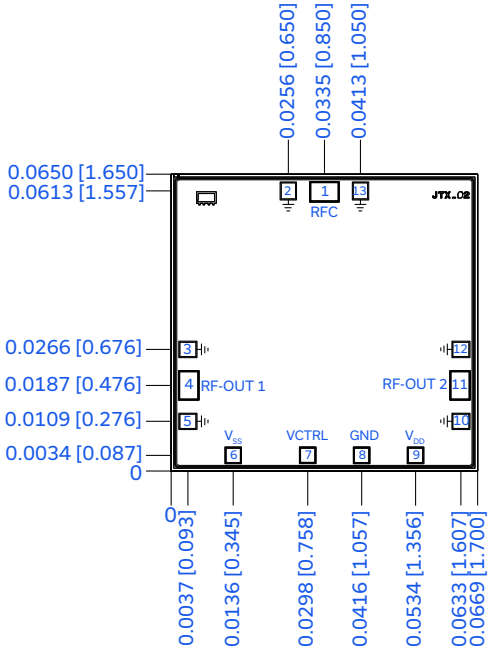

Figure 2. M3SWA2-34DR-D+ Die Outline

DIMENSIONS: inches [mm], Typical

Die Size	0.0669 x 0.0650 [1.700 x 1.650]
Die Thickness	0.0040 [0.100]
Bond Pad Sizes:	
Pads 1	0.0060 x 0.0040 [0.152 x 0.102]
Pad 4 & 11	0.0040 x 0.0060 [0.102 x 0.152]
Pads 2 & 13	0.0031 x 0.0035 [0.080 x 0.090]
Pads 3, 5, 10 & 12	0.0035 x 0.0031 [0.090 x 0.080]
Pads 6, 7, 8 & 9	0.0031 x 0.0031 [0.080 x 0.080]
Plating (Pads & Bottom of Die)	Gold

CHARACTERIZATION AND APPLICATION CIRCUIT

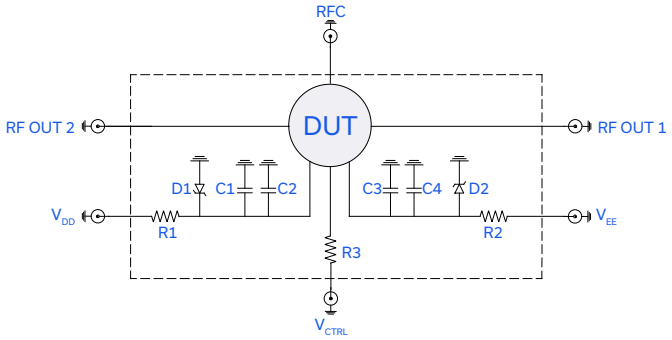

Figure 3. M3SWA2-34DR-D+ Characterization and Application Circuit

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

Conditions:
1. Insertion Loss, Isolation, & Return Loss: P_{IN} = 0 dBm
2. Input IP3(IIP3): Two tones, spaced 1 MHz apart, +5 dBm/Tone at input

Component	Value	Size	Part Number	Manufacturer
C2, C3	100 pF	0402	GRM1555C1H101JAO1D	Murata
C1, C4	0.1 uF	0402	GRM155R71C104KA88D	Murata
R1, R2	11.5 Ω	0402	RP73PF1E11R5BTDF	TE Connectivity
R3	100 Ω	0402	RK73H1ETTP1000F	KOA
D1, D2	V_Z = +5.6 V	SOD-123	SZMMSZ5232BT1G	ON Semiconductor

ASSEMBLY DIAGRAM

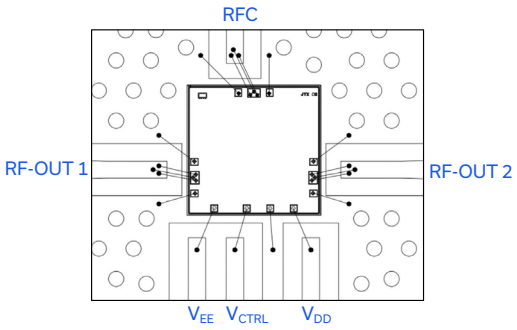

Figure 4. M3SWA2-34DR-D+ Assembly Diagram

- Refer to the table in Figure 3 for more details on the passive components
- Bond wire diameter: 1 mil
- Bond wire lengths from Die Pad to PCB at:
  - RFC & V_{CTRL} ports: 24 ± 2 mils
  - RF-OUT ports: 22 ± 2 mils
  - V_{DD} & V_{EE} ports: 25 ± 2 mils
- Typical Gap from Die edge to PCB edge: 3 mils
- PCB thickness and material: 6.6 mil Rogers RO4350B (Thickness: 1 oz copper on each side)

ASSEMBLY AND HANDLING PROCEDURE

1. Storage
   Die should be stored in a dry nitrogen purged desiccator or equivalent.
2. ESD Precautions
   MMIC die are susceptible to electrostatic and mechanical damage. Die are supplied in anti-static protected material, which should be opened only in clean room conditions at an appropriately grounded anti-static workstation.
3. Die Handling and Attachment
   Devices require careful handling using tools appropriate for manipulating semiconductor chips. It is recommended to handle the chips along the edges with a custom designed collet. The surface of the chips have exposed air bridges and should not be touched with a vacuum collet, tweezers or fingers.
   The die mounting surface must be clean and flat. Using conductive silver-filled epoxy, apply sufficient adhesive to meet the required bond line thickness, fillet height and coverage around the total periphery of the device. The recommended epoxy is Ablestik 84-1 LMISR4 or equivalent. Parts should be cured in a nitrogen-filled atmosphere per manufacturer's recommended cure profile.
4. Wire Bonding
   Openings in the surface passivation above the gold bond pads are provided to allow wire bonding to the die. Thermosonic bonding is recommended with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. The suggested interconnect is pure gold, 1 mil diameter wire. Bonds are recommended to be made from the bond pads on the die to the package or substrate. All bond wire length and bond wire height should be kept as short as possible, unless specified by design, to minimize performance degradation due to undesirable series inductance.

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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD CLICK HERE

Performance Data & Graphs	Data Graphs S-Parameter (S3P Files) Data Set (.zip file)	
Case Style	Die	
RoHS Status	Compliant	
Die Ordering and Packaging Information	Quantity, Package	Model No.
	Gel - Pak: 5, 10, 50, or 100 KGD*	M3SWA2-34DR-DG+
	Medium†, Partial wafer: KGD* <729	M3SWA2-34DR-DP+
	+ Full wafer†	M3SWA2-34DR-DF+
	†Available upon request contact sales representative. Refer to AN-60-067	
Die Marking	JTX_02	
Environmental Ratings	ENV-80	

* Known Good Die ("KGD") means that the die in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such die fall within a predefined range. While DC testing is not definitive, it does provide a high degree of confidence that die are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

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-Circuits' 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 there in. For a full statement of the standard. Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/MCLStore/terms.jsp

D. Mini-Circuits does not warrant the accuracy or completeness of the information, text, graphics and other items contained within this document and same are provided as an accommodation and on an As is basis, with all faults.

E. Purchasers of this part are solely responsible for proper storing, handling, assembly and processing of known good die (KGD) (including, without limitation, proper ESD preventative measures, die preparation, die attach, wire bonding and related assembly and test activities), and Mini-Circuits assumes no responsibility therefor or for environmental effects on KGD.