High Power Reflective SPDT PIN Diode Switch 6 - 20 GHz

MASW-011196
Rev. V1

Features

- Broadband Performance, 6 to 20 GHz
- Low Loss: 0.8 dB @ 12 GHz
- High Isolation: >42 dB @ 18 GHz
- Switching Speed: <118 ns
- Up to 41.5 dBm CW Power @ +85°C
- Lead Free 6.5 mm 40-Lead QFN Package
- RoHS* Compliant

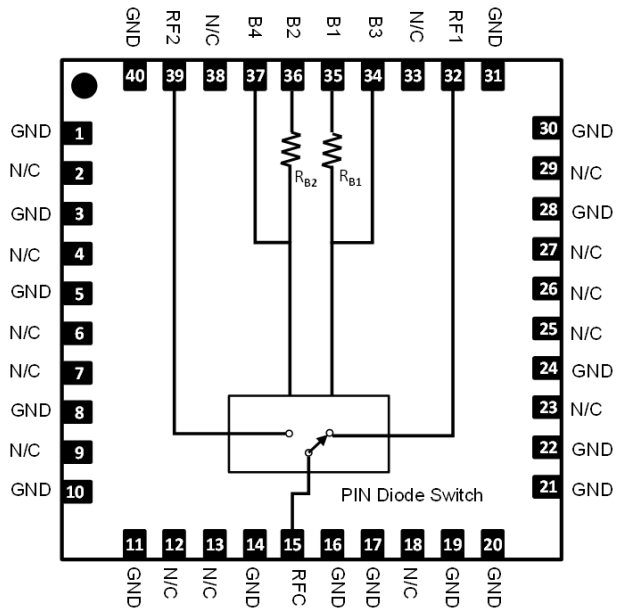
Applications

- Test & Measurement
- Point to Point Communications
- Radar Systems
- Radiometers
- High Frequency Applications

Description

The MASW-011196 is a high power symmetrical SPDT PIN diode switch in a 6.5 mm AQFN package. This broadband, reflective, high linearity, switch was developed for 6 - 20 GHz applications that require up to 14 W of power handling while maintaining low insertion loss and high isolation.

Functional Schematic



Pin Configuration[2]

Pin #	Function
1, 3, 5, 8,10, 11, 14, 16, 17, 19, 20, 21,22, 24, 28, 30,	GND
2, 4, 6, 7, 9, 12,13, 18, 23, 25, 26, 27, 29, 33, 38	N/C
15	RFC
32	RF1
34	Bias B3 - Bypass R_{B1}
35	Bias B1 - with R_{B1}
36	Bias B2 - with R_{B2}
37	Bias B4 - Bypass R_{B2}
39	RF2

Ordering Information[1]

Part Number	Package
MASW-011196-TR0250	250 piece reel
MASW-011196-000SMB	Sample Board

1. Reference Application Note M513 for reel size information.

2. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Electrical Specifications: T_A = 25°C, V_F[3] = 5 V (I_F = 10 mA), V_R[4] = -15 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss (RF_{COMMON} to RFx ON state)	6 GHz 11 GHz 18 GHz	dB	—	1.0 0.7 1.1	1.3 1.2 1.6
Isolation (RF_{COMMON} to RFx OFF state)	6 GHz 11 GHz 18 GHz	dB	38 40 35	42 45 42	—
Return Loss (RF_{COMMON})	6 GHz 11 GHz 18 GHz	dB	—	13 18 22	—
Return Loss (RF1, RF2 ON state)	6 GHz 11 GHz 18 GHz	dB	—	14 18 24	—
CW Power Handling (ON state)	6 GHz, +85°C @ V_R = -15 V V_F = 5 V (10 mA) 6 GHz, +85°C @ V_R = -33 V V_F = 8 V (35 mA)	dBm / W	—	39.0 / 8 41.5 / 14	—
Switching Speed[5] T_{ON} / T_{OFF} T_{RISE} / T_{FALL}	18 GHz, 100 kHz 50% DC to 90% RF / 50% DC to 10% RF 10% to 90% RF / 90% to 10% RF	ns	—	118 / 17 88 / 13	—
Reverse Bias Leakage Current	-32 V	nA	—	50	—

3. Forward bias current (I_F) is set to 10mA @ 5V with internal bias resistors R_{B1} = R_{B2} at Pin 35 (B1) and 36 (B2). The Bias Control Pin # 34 (B3) and 37 (B4) bypasses the internal resistors and it requires a current source to control the switch forward bias current I_F. For more details, refer to p. 6 and p. 7.
4. Reverse bias voltage (V_R) should be determined based on working conditions. For example, -33 V @ 41.46 dBm input power. For lower power applications, a less negative voltage can be used. R. Caverly and G. Hiller, "Establishing the Minimum Reverse Bias for a PIN Diode in a High Power Switch," IEEE Transactions on Microwave Theory and Techniques, Vol.38, No.12, December 1990.
5. Switching Speed is measured with a MACOM driver.

Absolute Maximum Ratings[6,7]

Parameter	Absolute Maximum
DC Reverse Bias Voltage + RF Peak Voltage	-50 V
Forward Bias Current	40 mA
CW Incident RF Power	42 dBm @ +85°C, 6 GHz
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. MACOM does not recommend sustained operation near these survivability limits.

Handling Procedures

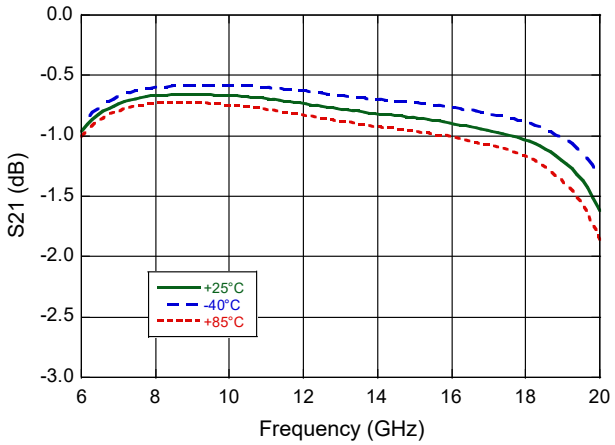
Please observe the following precautions to avoid damage:

Static Sensitivity

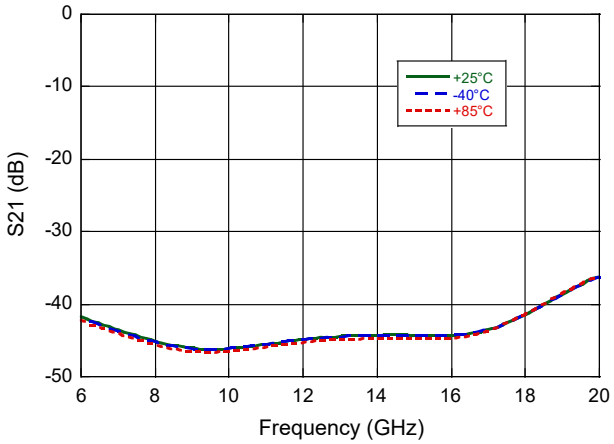
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM class 1A and CDM class C5 devices.

Typical Performance Curves: V_F = 5 V (I_F = 10 mA), V_R = -15 V.

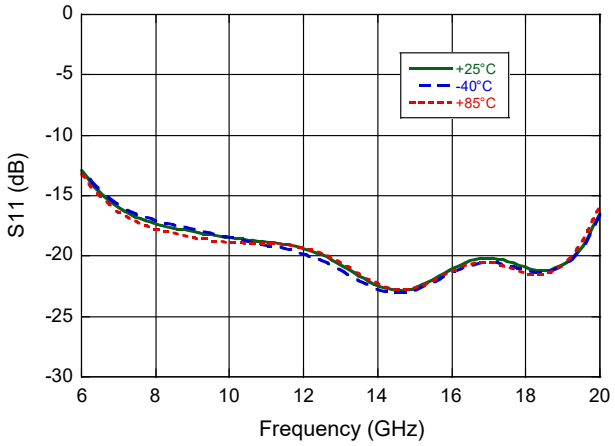
Insertion Loss over Temp



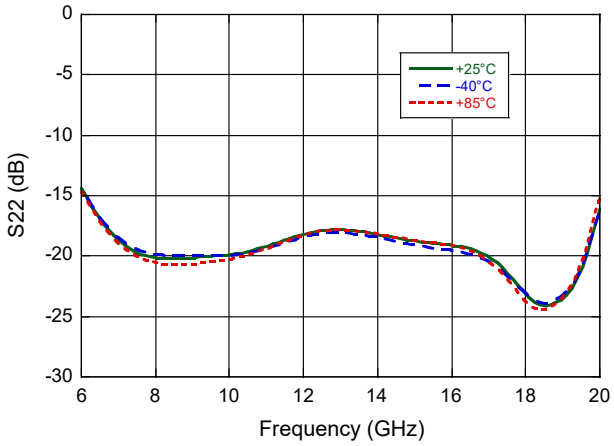
Isolation over Temp



Input Return Loss over Temp

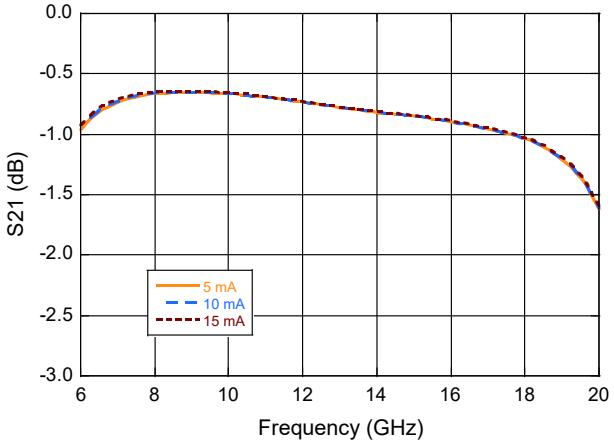


Output Return Loss over Temp

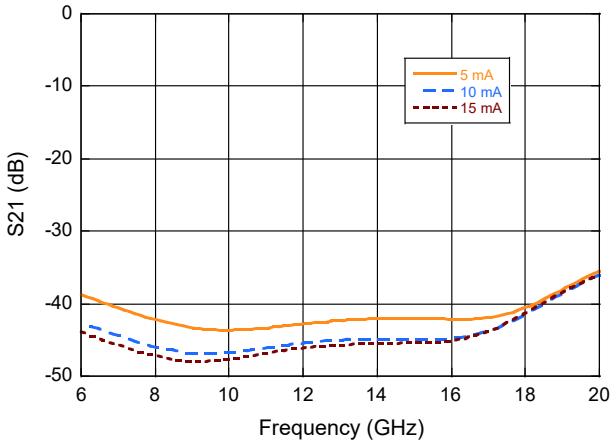


Typical Performance Curves: T_A = 25°C, V_R = -15 V.

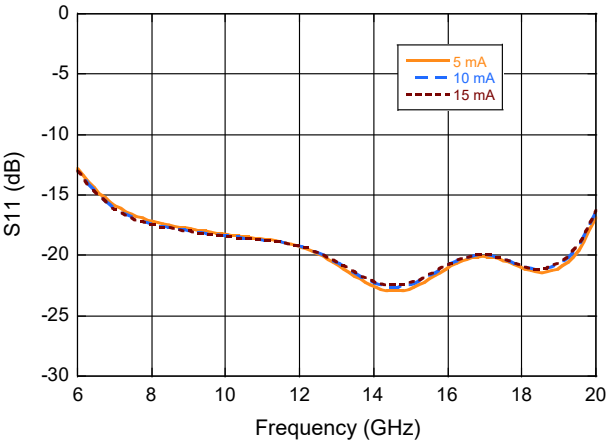
Insertion Loss over Forward Bias Current I_F



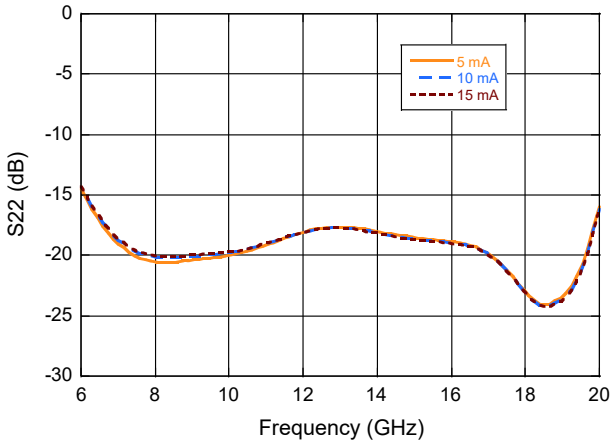
Isolation over Forward Bias Current I_F



Input Return Loss over Forward Bias Current I_F

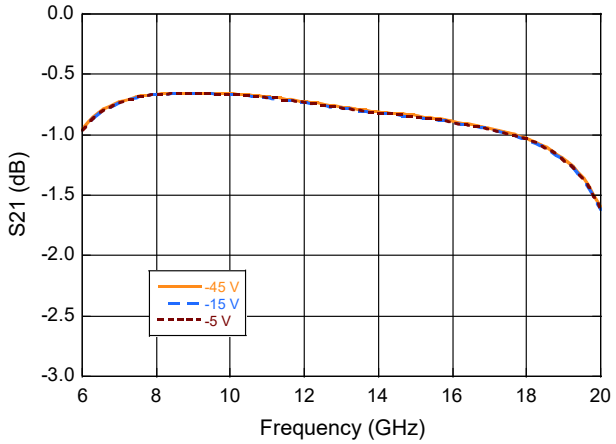


Output Return Loss Forward Bias Over Current I_F

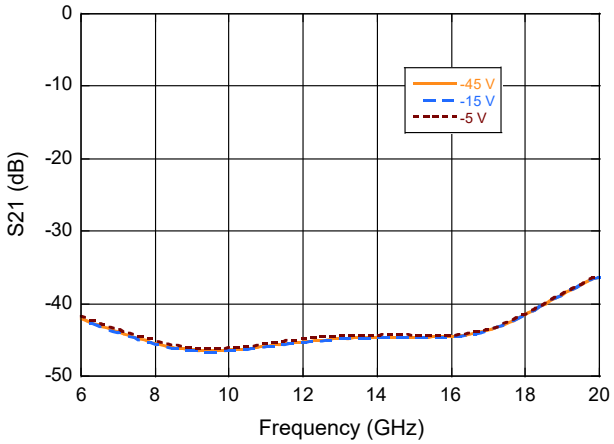


Typical Performance Curves: T_A = 25°C, V_F = 5 V (I_F = 10 mA).

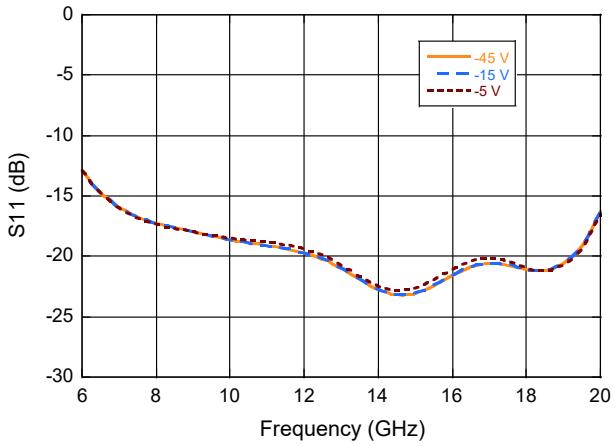
Insertion Loss over Reverse Bias Voltage V_R



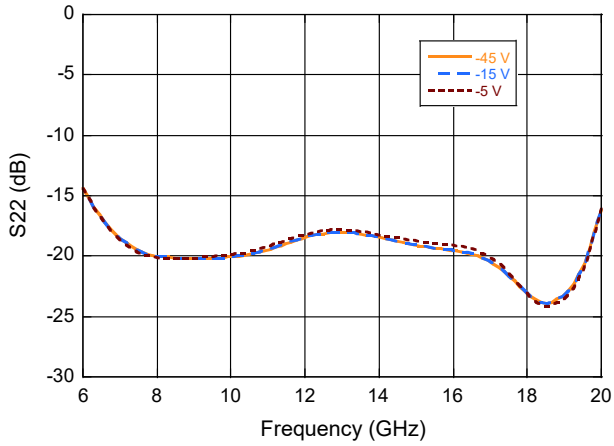
Isolation over Reverse Bias Voltage V_R



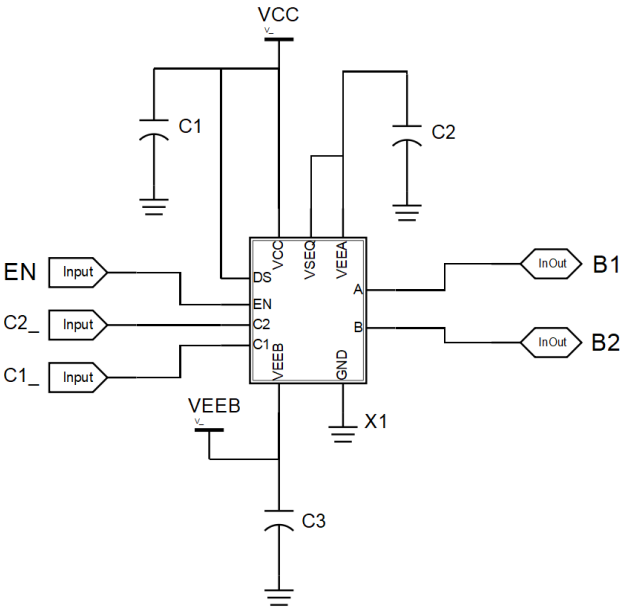
Input Return Loss over Reverse Bias Voltage V_R

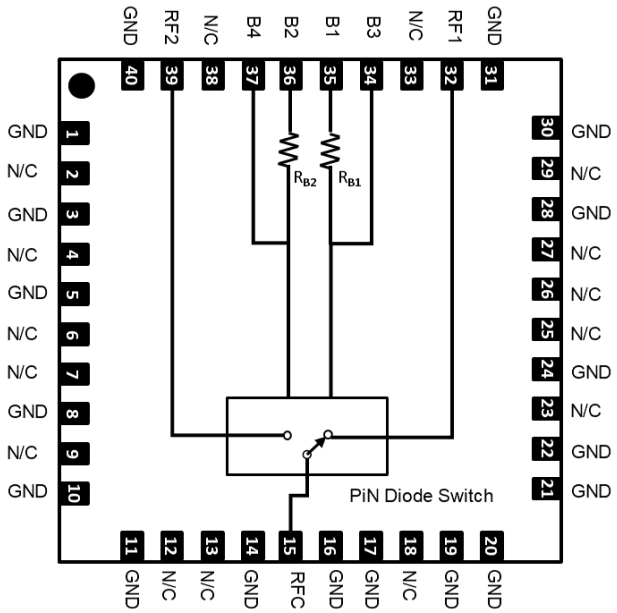


Output Return Loss Over Reverse Bias Voltage V_R



MASW-011196 with MADR-011022 / MADR-011020[8] Driver Application Schematic - The Driver Connected to Bias B1/B2 with Internal Resistors R_{B1} / R_{B2}





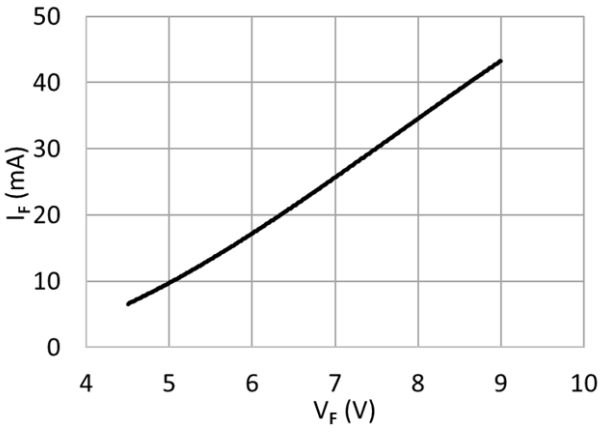
Parts List

Parameter	Value	Parameter	Value
C1, C3	0.1 µF	V_{CC} [9] / V_F	5.4 / 5.0 V
C2	47 pF	V_{EEA} , V_{EEB} [10]	-15 V

An Example of the Logic Truth Table of MADR-011022 / MADR-011020

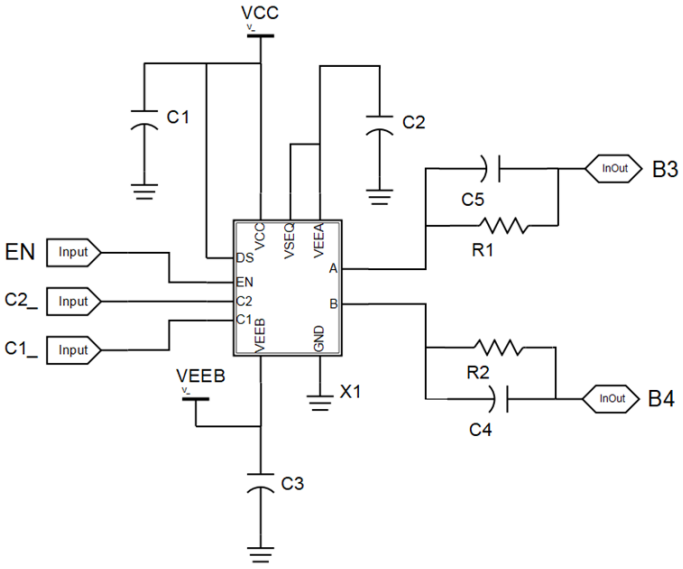
Inputs			Outputs		RF OUTPUT
EN1	C2	C1	A1	B1	
1	X	X	H	H	ALL OFF
0	0	0	L	H	RF1 - ON
0	0	1	H	L	RF2 - ON

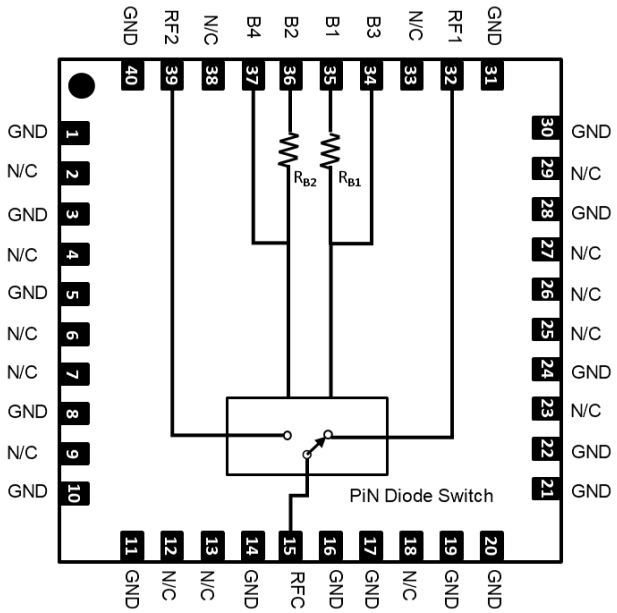
Forward Bias Current vs Forward Bias Voltage at B1 and B2 with internal resistors R_{B1} and R_{B2}



8. The application details of the MADR-011022 / MADR-011020 driver are in their Data Sheets.
9. V_{CC} at the driver should be 0.4 V higher than the required forward bias voltage V_F at the bias driver output A & B (V_F > 4.3V).
10. V_{EEA} , V_{EEB} - Exemplary voltage. For details see Data Sheet of the used driver.

MASW-011196 with MADR-011022 / MADR-011020 Driver Application Schematic - The Driver Connected to Bias B3/B4.





Parts List

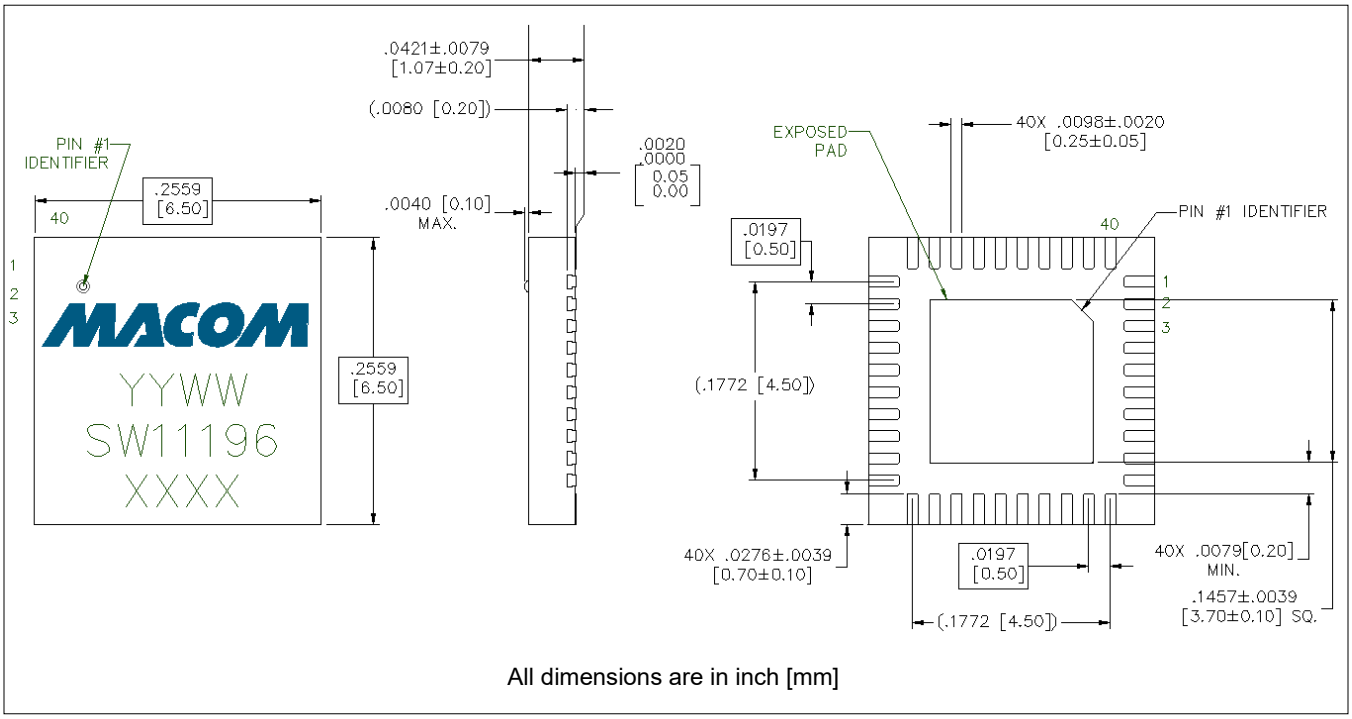
Parameter	Value	Parameter	Value
C1, C3	0.1 µF	R1, R2 [12]	330 Ω
C2	47 pF	V_{CC} [9] / V_F	5.4 / 5.0 V
C4, C5 [11]	250 pF	V_{EEA} , V_{EEB} [10]	-15 V

An Example of the Logic Truth Table of MADR-011022 / MADR-011020

Inputs			Outputs		RF OUTPUT
EN1	C2	C1	A1	B1	
1	X	X	H	H	ALL OFF
0	0	0	L	H	RF1 - ON
0	0	1	H	L	RF2 - ON

11. Exemplary value. Use of spik capacitors C4 / C5 is optional. The capacitor value is adjusted to desired T = RC time constant which may be used to decrease the switch switching time.
12. Exemplary value. The R1 = R2 value is defined by the desired forward bias current $I_F = (V_F - 3.96V) / R1$.

Lead-Free 6.5 mm AQFN 40-LD Package†



All dimensions are in inch [mm]

† This is not a JEDEC standard package
Reference Application Note M538 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 3 requirements.
Plating is NiPdAu