

Monolithic Pin Diode Switches with Integrated Bias Network

MA4SW210B-1, MA4SW310B-1

Features

- Broad Bandwidth Specified up to 18 GHz
- Usable up to 26 GHz
- Integrated Bias Network
- Low Insertion Loss / High Isolation
- Rugged, Fully Monolithic, Glass Encapsulated Construction

Description

The MA4SW210B-1 and MA4SW310B-1 devices are SP2T and SP3T broad band switches with integrated bias networks utilizing M/A-COM's HMIC™ (Heterolithic Microwave Integrated Circuit) Process, US Patent 5,268,310. This process allows the incorporation of silicon pedestals that form series and shunt diodes or vias by imbedding them in low loss, low dispersion glass. By using small spacing between elements, this combination of silicon and glass gives HMIC devices low loss and high isolation performance with exceptional repeatability through low millimeter frequencies.

Large bond pads facilitate the use of low inductance ribbon bonds, while gold backside metalization allows for manual or automatic chip bonding via 80Au/20Sn, Sn62/Pb36/Ag2 solders or electrically conductive silver epoxy.

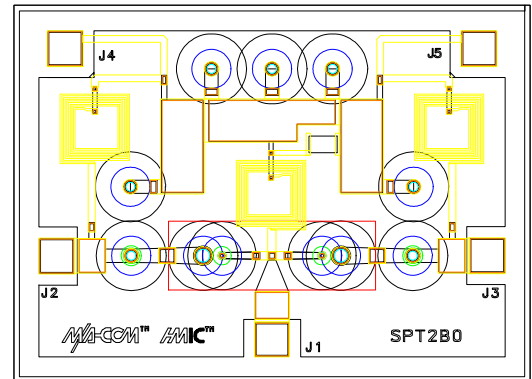
Absolute Maximum Ratings¹ @T_A = 25 °C (unless otherwise specified)

Parameter	Absolute Maximum
Operating Temperature	-65 °C to +125 °C
Storage Temperature	65 °C to +150 °C
RF C.W. Incident Power @ +/- 20mA	+30 dBm
D.C. Bias Current	+/- 40 mA

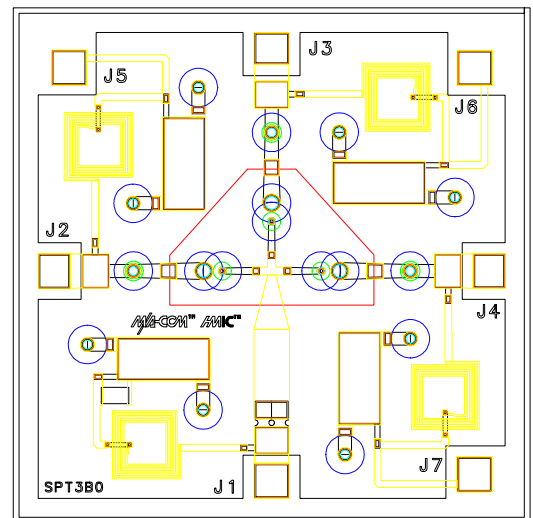
1. Exceeding any one or combination of these limits may cause permanent damage.

Chip Layout

MA4SW210B-1



MA4SW310B-1



MA4SW210B-1 (SP2T)**Electrical Specifications @ $T_A = +25\text{ }^\circ\text{C}$, +/- 20 mA Bias Current**

Parameter	Frequency	Minimum	Nominal	Maximum	Units
Insertion Loss	6 GHz		0.60	1.0	dB
	12 GHz		0.80	1.1	dB
	18 GHz		1.25	2.25	dB
Isolation	6 GHz	47.5	51.4		dB
	12 GHz	41.4	45.1		dB
	18 GHz	36.2	40.4		dB
Input Return Loss	6 GHz	18.5	20.5		dB
	12 GHz	12.9	18.2		dB
	18 GHz	19.0	14.0		dB
Switching Speed ¹	-		50.0		ns

MA4SW310B-1 (SP3T)**Electrical Specifications @ $T_A = +25\text{ }^\circ\text{C}$, +/- 20 mA Bias Current**

Parameter	Frequency	Minimum	Nominal	Maximum	Units
Insertion Loss	6 GHz		0.58	1.16	dB
	12 GHz		0.76	1.38	dB
	18 GHz		1.04	1.81	dB
Isolation	6 GHz	49.0	58.6		dB
	12 GHz	41.4	48.5		dB
	18 GHz	36.0	42.5		dB
Input Return Loss	6 GHz	16.3	19.9		dB
	12 GHz	13.0	19.4		dB
	18 GHz	10.9	17.3		dB
Switching Speed ¹	-		50.0		ns

¹ Typical Switching Speed measured from 10% to 90% of detected RF signal driven by TTL compatible drivers using RC Output Spiking Network, R = 50 – 200 Ω , C = 390 – 560 pF.

Operation of the MA4SW 210B-1 and 310B-1

Operation of the MA4SW210B-1 and MA4SW 310B-1 PIN Switches is achieved by simultaneous application of DC currents to the bias pads. The required levels for the different states are shown in the tables below.

The control currents should be supplied by constant current sources. The nominal 40 Ω - 60 Ω pull-up resistor voltage @ J4 and J5 for -20 mA is usually -1V for +20 mA is usually +1 V.

Driver Connections MA4SW210B-1

Control Level (DC Current) at		Condition of RF Output	Condition of RF Output
J4	J5	J1 - J2	J1 - J3
-20 mA	+20 mA	Low Loss	Isolation
+20 mA	-20 mA	Isolation	Low Loss

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Driver Connections MA4SW310B-1

Control Level (DC Current) at			Condition of RF Output	Condition of RF Output	Condition of RF Output
J5	J6	J7	J1 - J2	J1 - J3	J1 - J4
-20 mA	+20 mA	+20 mA	Low Loss	Isolation	Isolation
+20 mA	-20 mA	+20 mA	Isolation	Low Loss	Isolation
+20 mA	+20 mA	-20 mA	Isolation	Isolation	Low Loss

Handling Considerations

Cleanliness

These chips should be handled in a clean environment. Do not attempt to clean chips after installation.

Electro-Static Sensitivity

The MA4SW210B-1 and MA4SW310B-1 Series PIN Diode Switches are ESD, Class 1 sensitive. The proper ESD handling procedures should be used.

Wire Bonding

Thermosonic wedge wire bonding using 0.003" x 0.00025" ribbon or 0.001" diameter gold wire is recommended. A stage temperature of 150 °C and a force of 18 to 22 grams should be used. Ultrasonic energy should be adjusted to the minimum required. RF bonds should be as short as possible.

Mounting

These chips have TiPtAu back metal. They can be die mounted with a gold-tin eutectic solder preform or conductive epoxy. Mounting surface must be clean and flat.

Eutectic Die Attachment

An 80/20 gold-tin eutectic solder preform is recommended with a work surface temperature of 255 °C and a tool tip temperature of 265°C. When hot gas is applied, the tool tip temperature should be 290 °C. The chip should not be exposed to temperatures greater than 320 °C for more than 20 seconds. No more than three seconds should be required for attachment.

Electrically Conductive Epoxy Die Attachment

Assembly should be preheated to 125-150 °C. A minimum amount of epoxy should be used, approximately 1 to 2 mils thickness. A thin epoxy fillet should be visible around the perimeter of the chip after placement. Cure epoxy per manufacturer's schedule time-temperature schedule.

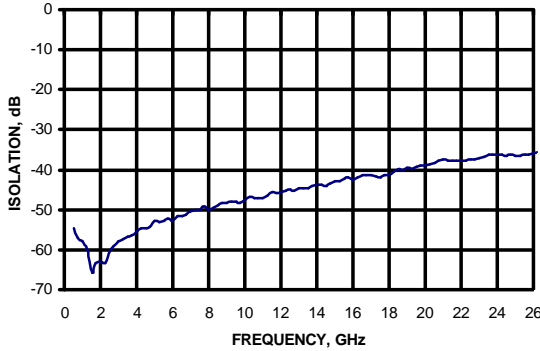
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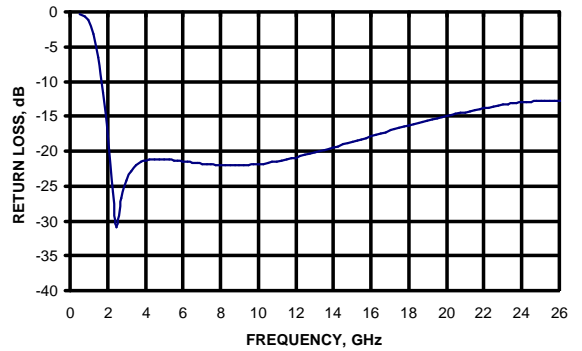
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Typical Performance Curves - MA4SW210B-1

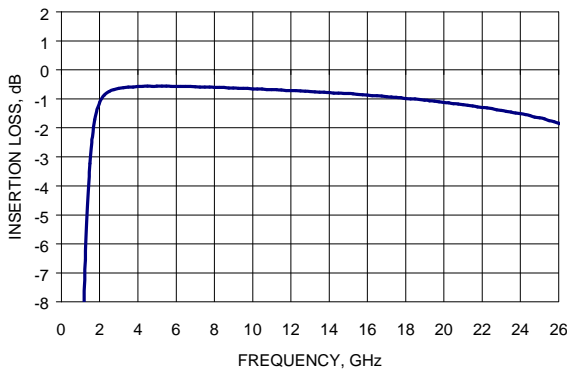
Isolation vs. Frequency



Return Loss vs. Frequency



Insertion Loss vs. Frequency



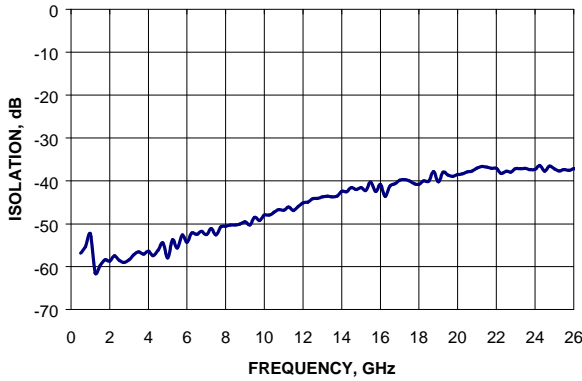
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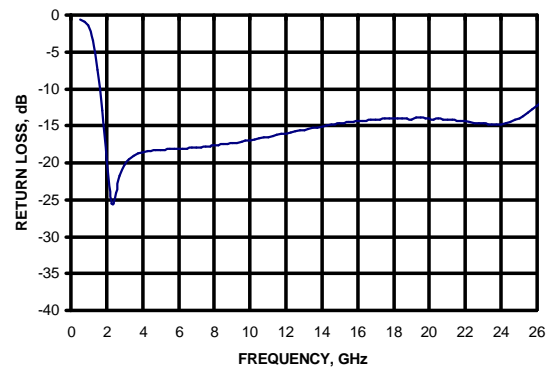
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Typical Performance Curves - MA4SW310B-1

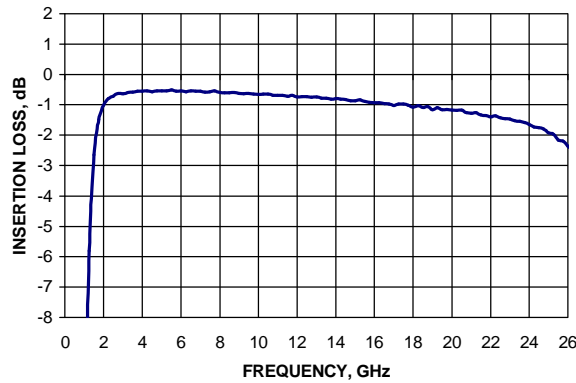
Isolation vs. Frequency



Return Loss vs. Frequency



Insertion Loss vs. Frequency

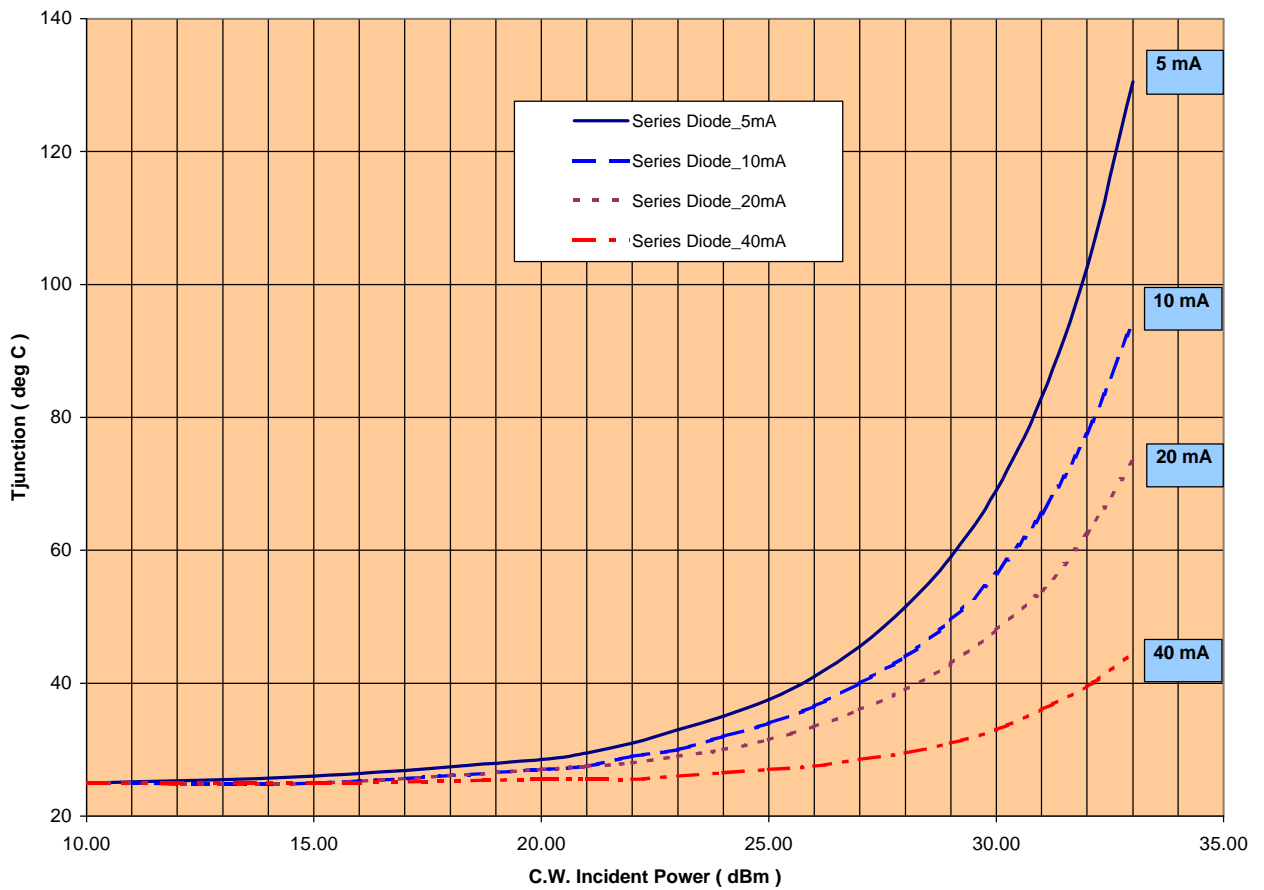


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MA4SW210B-1 Series Diode Junction Temperature vs Incident Power at 8 GHz



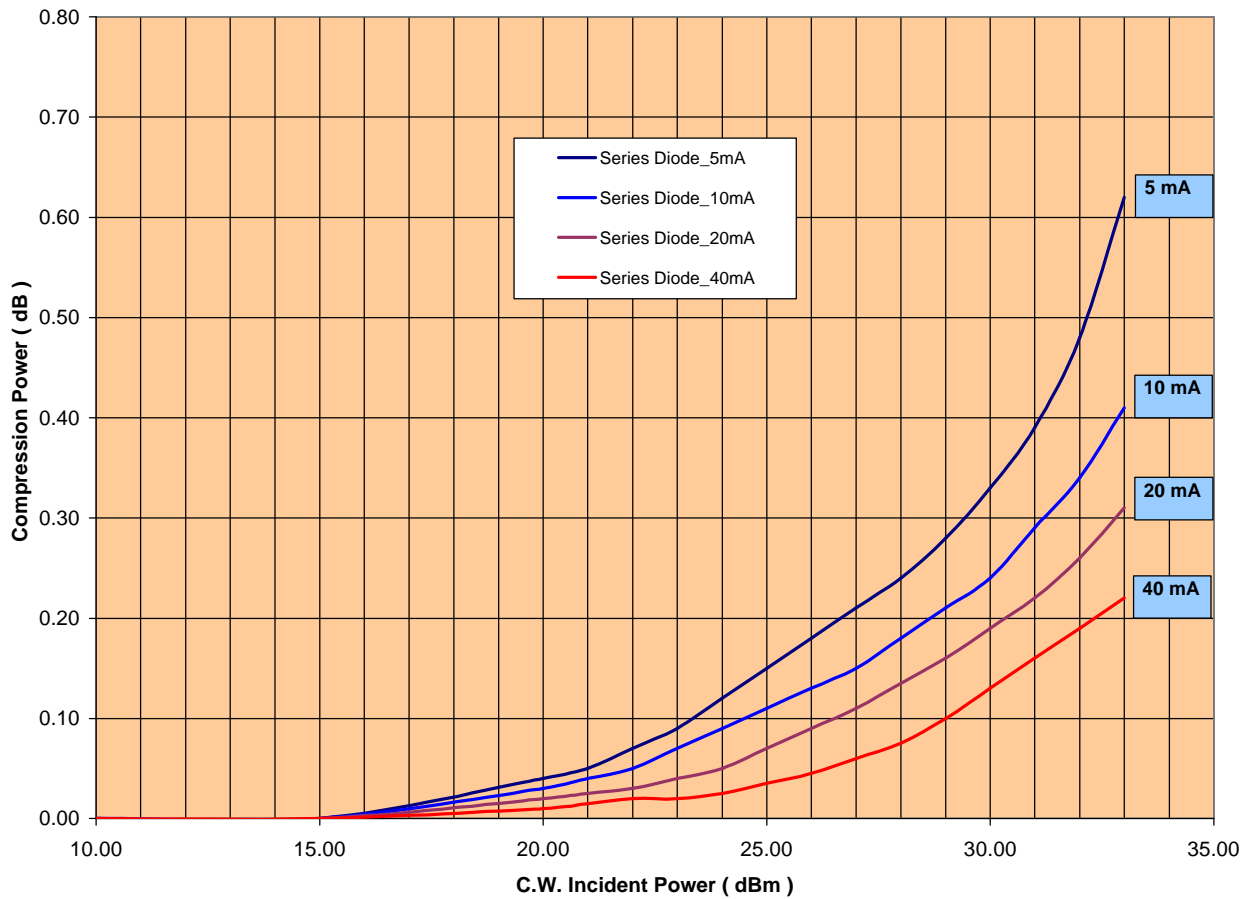
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MA4SW210B-1 Compression Power vs Incident Power at 8 GHz



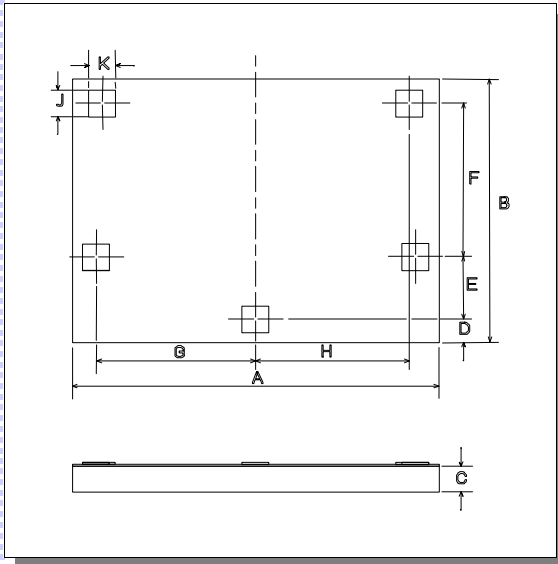
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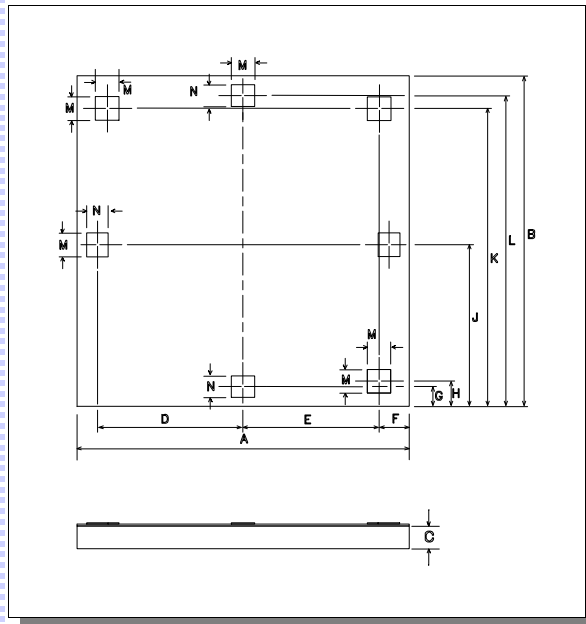


MA4SW210B-1



DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.0661	0.0700	1.68	1.78
B	0.0484	0.0524	1.23	1.33
C	0.0039	0.0059	0.100	0.150
D	0.0035	0.0055	0.090	0.140
E	0.0115	0.0125	0.292	0.317
F	0.0289	0.0299	0.735	0.760
G	0.0301	0.0311	0.766	0.791
H	0.0288	0.0298	0.732	0.757
J	0.0051 REF.		0.129 REF.	
K	0.0051 REF.		0.129 REF.	

MA4SW310B-1



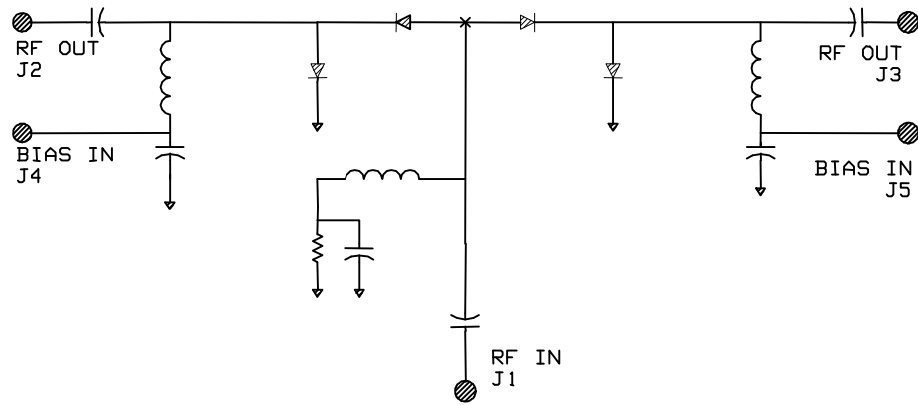
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.0697	0.0736	1.77	1.87
B	0.0693	0.0732	1.76	1.86
C	0.0039	0.0059	0.100	0.150
D	0.0310	0.0319	0.787	0.812
E	0.0289	0.0299	0.734	0.759
F	0.0055	0.0075	0.140	0.190
G	0.0035	0.0055	0.089	0.139
H	0.0044	0.0064	0.113	0.163
J	0.0338	0.0358	0.859	0.909
K	0.0632	0.0652	1.61	1.66
L	0.0660	0.0680	1.68	1.73
M	0.0051 REF.		0.129 REF.	
N	0.0046 REF.		0.118 REF.	

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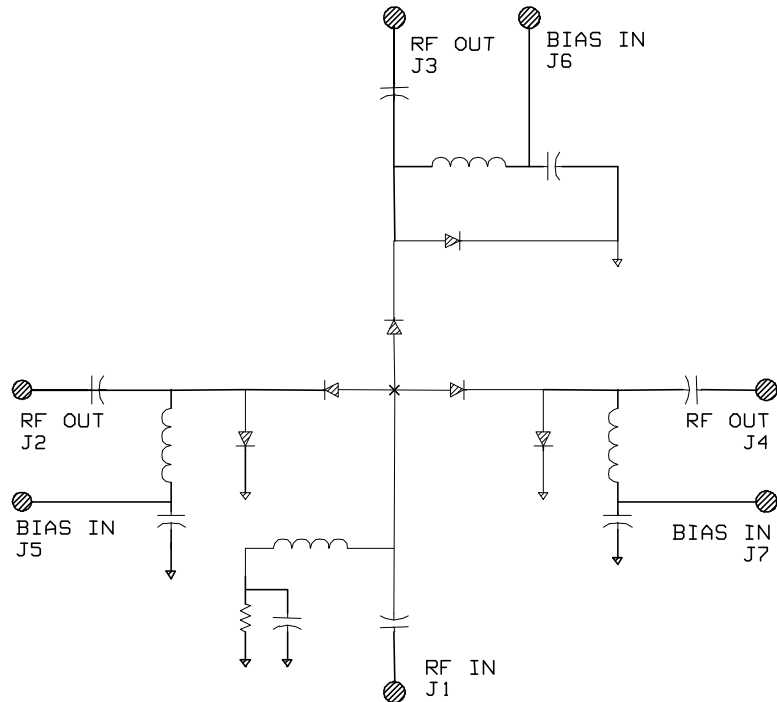
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Equivalent Circuit MA4SW210B-1



Equivalent Circuit MA4SW310B-1



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