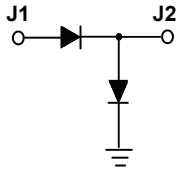
MA4SW110
MA4SW210
MA4SW310

HMIC™ Silicon PIN Diode Switches
RoHS Compliant

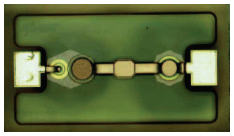
V8

Features

- Broad Bandwidth
- Specified from 50 MHz to 20 GHz
- Usable from 50 MHz to 26.5 GHz
- Lower Insertion Loss and Higher Isolation than Comparable pHEMT/Discrete Component Designs
- Rugged Design Fully Monolithic
- Glass Encapsulated Chip with Polymer Protective Coating
- Up to +30dBm C.W. Power Handling @ +25°C
- 50 nS Switching Speed



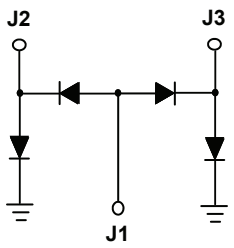
MA4SW110



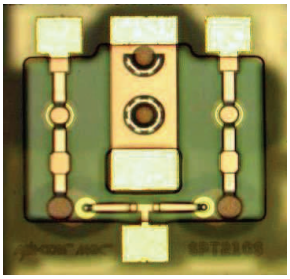
Description

The MA4SW110, MA4SW210 and MA4SW310 are series-shunt, broadband, PIN diode switches made with M/A-COM Tech's HMIC™ (Heterolithic Microwave Integrated Circuit) process. This process allows the silicon pedestals which form the series - shunt diodes and vias to be embedded into low loss, low dispersion glass. By also incorporating small spacing between circuit elements, the result is an HMIC chip with low insertion loss and high isolation at frequencies up to 26.5GHz. They are designed for use as moderate power, high performance switches and provide superior performance when compared to similar designs that use discrete components.

The top side of the chip is protected by a polymer coating for manual or automatic handling and large gold bond pads help facilitate connection of low inductance ribbons. The gold metallization on the backside of the chip allows for attachment via 80/20, gold/tin solder or conductive silver epoxy.



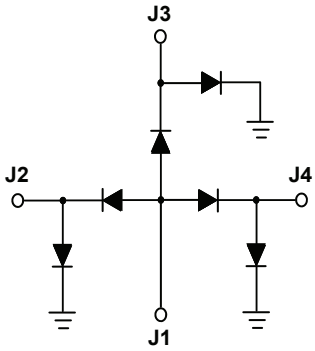
MA4SW210



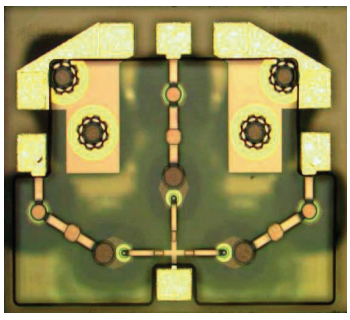
Absolute Maximum Ratings
T_{AMB} = +25°C (Unless Otherwise Specified)

Parameter	Absolute Maximum
Operating Temperature	-65°C to +125°C
Storage Temperature	-65°C to +150°C
Junction Temperature	+175°C
Applied Reverse Voltage	- 50V
RF C.W. Incident Power	+30dBm C.W.
Bias Current Per Port	± 50mA

Max. operating conditions for a combination of RF power, D.C. bias and temperature:
+30dBm CW @ 15mA (per diode) @+85°C



MA4SW310



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MA4SW110
MA4SW210
MA4SW310

HMIC™ Silicon PIN Diode Switches
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V8

MA4SW110 (SPST)
Electrical Specifications @ T_A = +25°C, 20mA

Parameter	Frequency	Minimum	Nominal	Maximum	Units
	6GHz	-	0.4	0.7	dB
Insertion Loss	13GHz	-	0.5	0.9	dB
	20GHz	-	0.7	1.2	dB
	6GHz	46	55	-	dB
Isolation	13GHz	39	47	-	dB
	20GHz	34	42	-	dB
	6GHz	22	31	-	dB
Input Return Loss	13GHz	15	33	-	dB
	20GHz	14	27	-	dB
Switching Speed[1]	-	-	20	-	ns
Voltage Rating[2]	-	-	-	50	V
Signal Compression (500mW)	1GHz	-	0.2	-	dB

1.) Typical Switching Speed measured from 10 % to 90 % of detected RF signal driven by TTL compatible drivers.
2.) Maximum reverse leakage current in either the shunt or series PIN diodes shall be 10µA maximum at -50 volts.

MA4SW210 (SPDT)
Electrical Specifications @ T_A = +25°C, 20mA

Parameter	Frequency	Minimum	Nominal	Maximum	Units
	6GHz	-	0.4	0.7	dB
Insertion Loss	13GHz	-	0.5	1.0	dB
	20GHz	-	0.7	1.2	dB
	6GHz	48	63	-	dB
Isolation	13GHz	40	50	-	dB
	20GHz	34	42	-	dB
	6GHz	20	27	-	dB
Input Return Loss	13GHz	18	25	-	dB
	20GHz	15	25	-	dB
Switching Speed[1]	-	-	20	-	ns
Voltage Rating[2]	-	-	-	50	V
Signal Compression (500mW)	1GHz	-	0.2	-	dB

1.) Typical Switching Speed measured from 10 % to 90 % of detected RF signal driven by TTL compatible drivers.
2.) Maximum reverse leakage current in either the shunt or series PIN diodes shall be 10µA maximum at -50 volts.

MA4SW310 (SP3T)
Electrical Specifications @ T_A = +25°C, 20mA

Parameter	Frequency	Minimum	Nominal	Maximum	Units
	6GHz	-	0.5	0.8	dB
Insertion Loss	13GHz	-	0.7	1.1	dB
	20GHz	-	0.9	1.5	dB
	6GHz	49	57	-	dB
Isolation	13GHz	42	48	-	dB
	20GHz	33	42	-	dB
	6GHz	20	24	-	dB
Input Return Loss	13GHz	14	22	-	dB
	20GHz	11	21	-	dB
Switching Speed[1]	-	-	20	-	ns
Voltage Rating[2]	-	-	-	50	V
Signal Compression (500mW)	1GHz	-	0.2	-	dB

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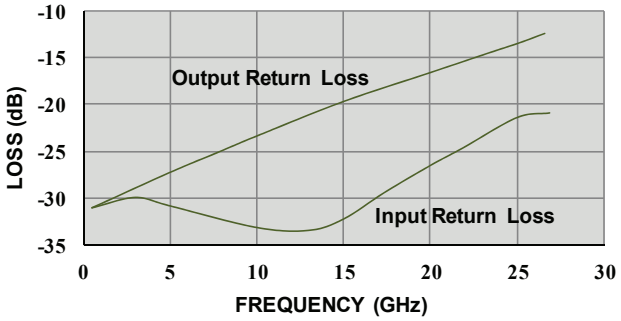
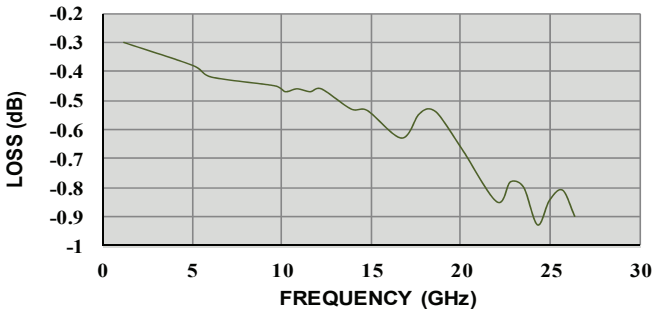
Typical Performance Curves at T_A = +25°C, 20mA Bias Current

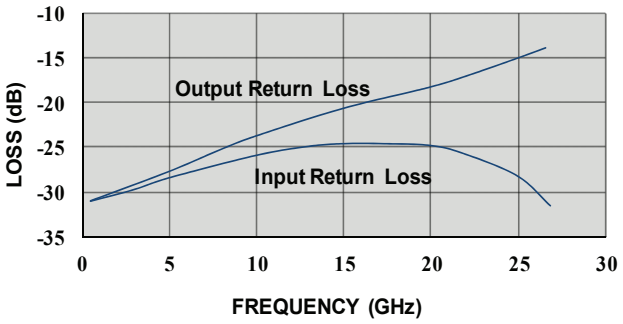
MA4SW110
RETURN LOSS vs. FREQUENCY



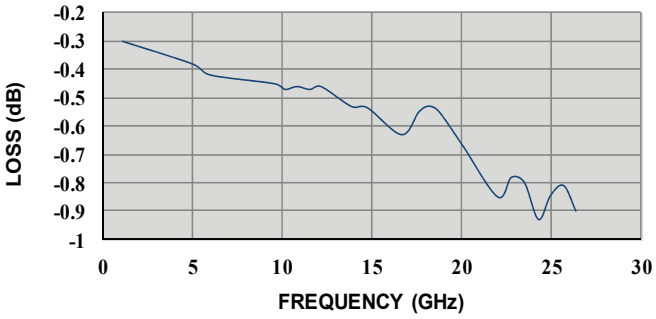
MASW110
INSERTION LOSS vs. FREQUENCY



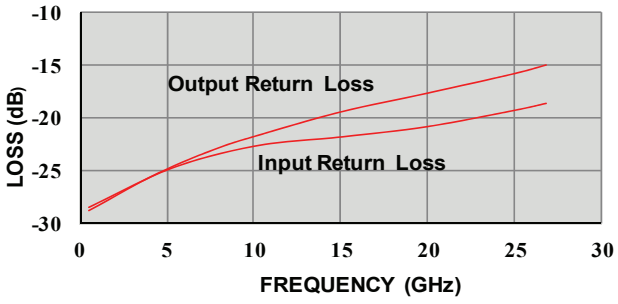
MA4SW210



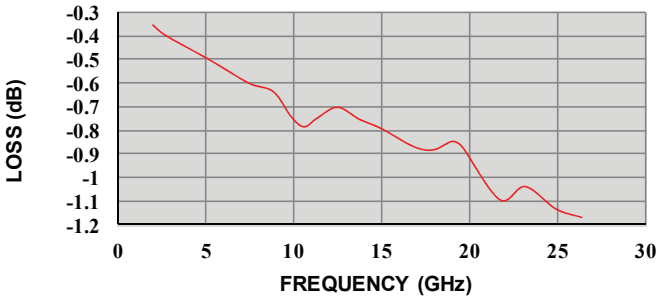
MA4SW210
INSERTION LOSS vs. FREQUENCY



MA4SW310



MA4SW310
INSERTION LOSS vs. FREQUENCY



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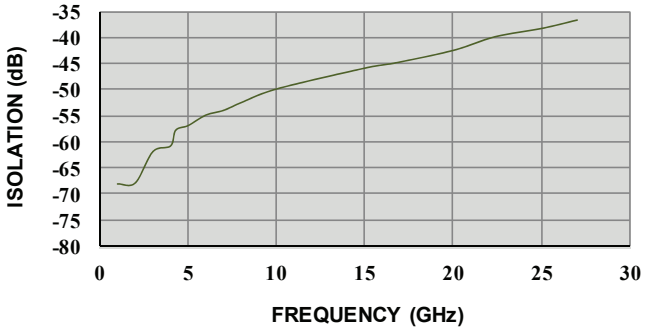
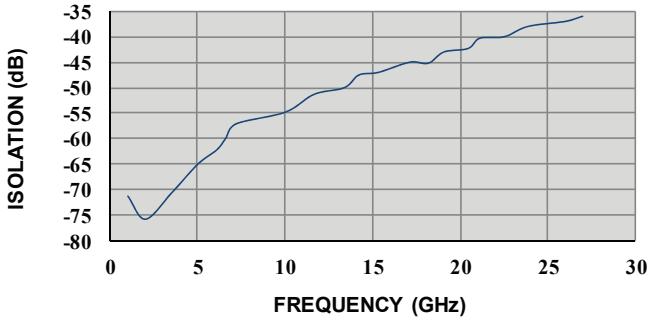
Typical Performance Curves @ TA = +25°C, 20mA Bias Current

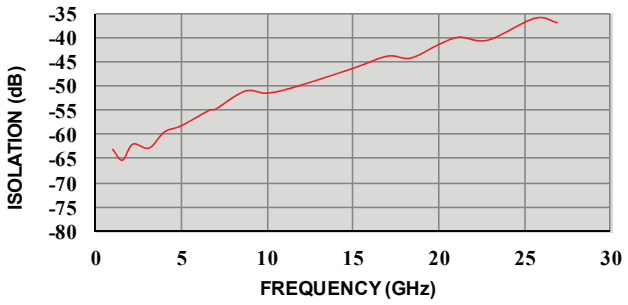
MA4SW110
ISOLATION vs. FREQUENCY



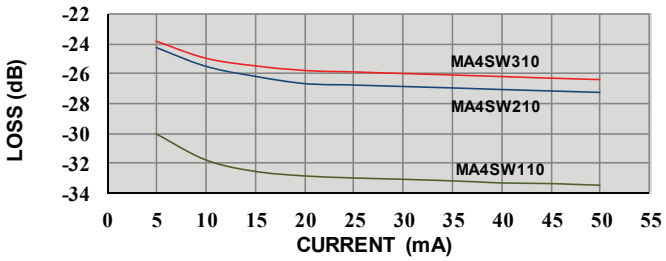
MA4SW210
ISOLATION vs. FREQUENCY



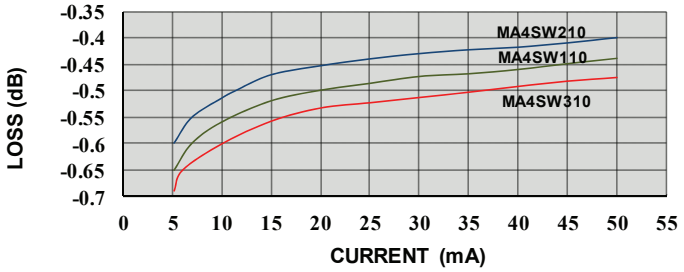
MA4SW310
ISOLATION vs. FREQUENCY



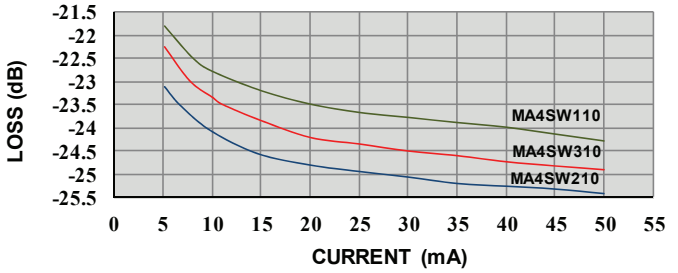
INPUT RETURN LOSS vs. BIAS CURRENT @ 10 GHz



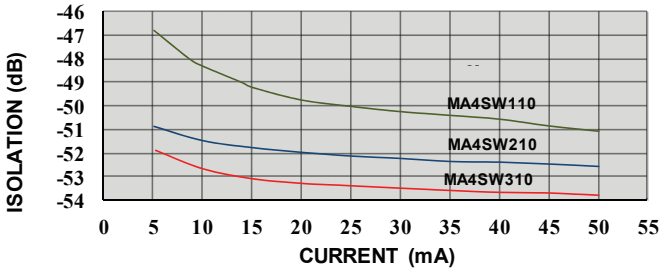
INSERTION LOSS vs. BIAS CURRENT @ 10 GHz



OUTPUT RETURN LOSS vs. BIAS CURRENT@ 10 GHz



ISOLATION vs. BIAS CURRENT @ 10 GHz



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Operation of the MA4SW Series Switches

The simultaneous application of a negative DC current to the low loss port and positive DC current to the isolated port is required for proper operation of the MA4SW series of PIN switches. The backside area of the die is the RF and DC ground return and the DC return is through the common Port J1. A constant current source should be used to supply the DC control currents. The control voltages at these points will not exceed ±1.5 volts for supply currents up to ± 20mA. In the low loss state, the series diode must be forward biased and the shunt diode reverse biased. On all isolated ports, the shunt diode is forward biased and the series diode is reverse biased.

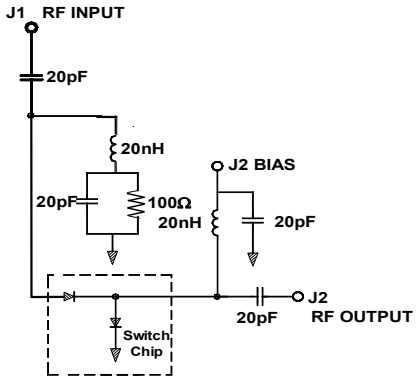
Driver Connections and Drivers

MA4SW110	
DC Control Current	**RF Output State**
J2	**J1-J2**
-20mA	Low Loss
+20mA	Isolation
Compatible M/A-COM Tech Driver MADR-007097-000100	

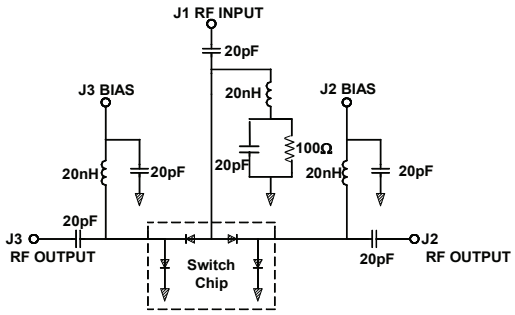
MA4SW210			
DC Control Current		**RF Output State**	**RF Output State**
J2	**J3**	**J1-J2**	**J1-J3**
-20mA	+20mA	Low Loss	Isolation
+20mA	-20mA	Isolation	Low Loss
Compatible M/A-COM Tech Driver MADR-007097-000100			

MA4SW310					
DC Control Current			**RF Output State**	**RF Output State**	**RF Output State**
J2	**J3**	**J4**	**J1-J2**	**J1-J3**	**J1-J4**
-20mA	+20mA	+20mA	Low Loss	Isolation	Isolation
+20mA	-20mA	+20mA	Isolation	Low Loss	Isolation
+20mA	+20mA	-20mA	Isolation	Isolation	Low Loss
Compatible M/A-COM Tech Driver MADR-009190-000100					

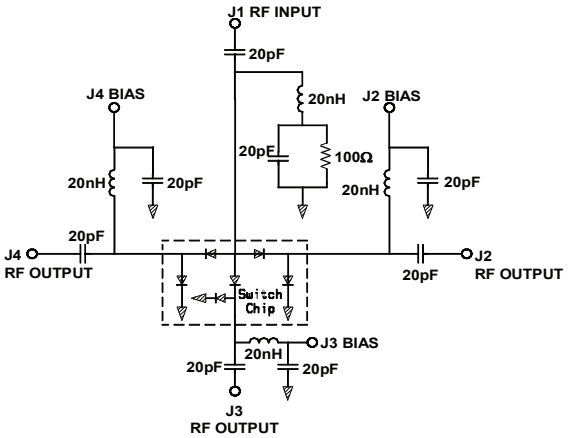
MA4SW110 and Bias Connections[1]



MA4SW210 and Bias Connections[1]



MA4SW310 and Bias Connections[1]



Notes:
1. RLC values are for an operation frequency of 2-18GHz and bias current of ± 20mA per port..

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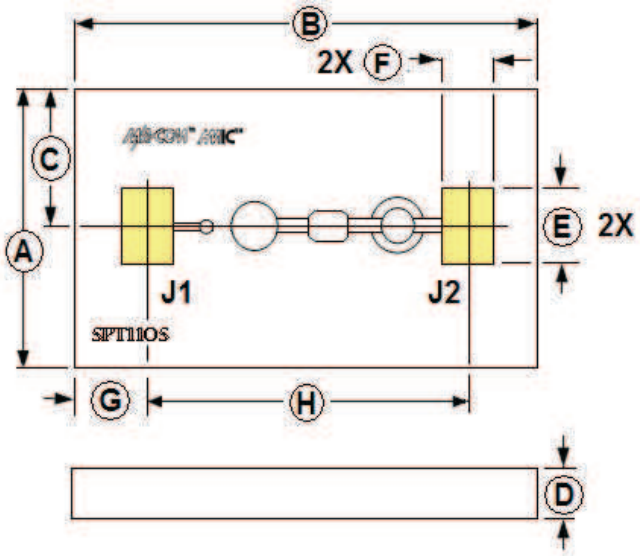
MA4SW110 Chip Outline Drawing[1,2]



DIM	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
A	0.014	0.018	0.35	0.45
B	0.025	0.029	0.64	0.74
C	0.008 REF		0.20 REF	
D	0.004	0.006	0.10	0.15
E	0.004 REF		0.10 REF	
F	0.003 REF		0.08 REF	
G	0.003 REF		0.08 REF	
H	0.020 REF		0.52 REF	

Notes:

1. Topside and backside metallization is gold , 2.5µm thick typical.
2. Yellow areas indicate ribbon/wire bonding pads

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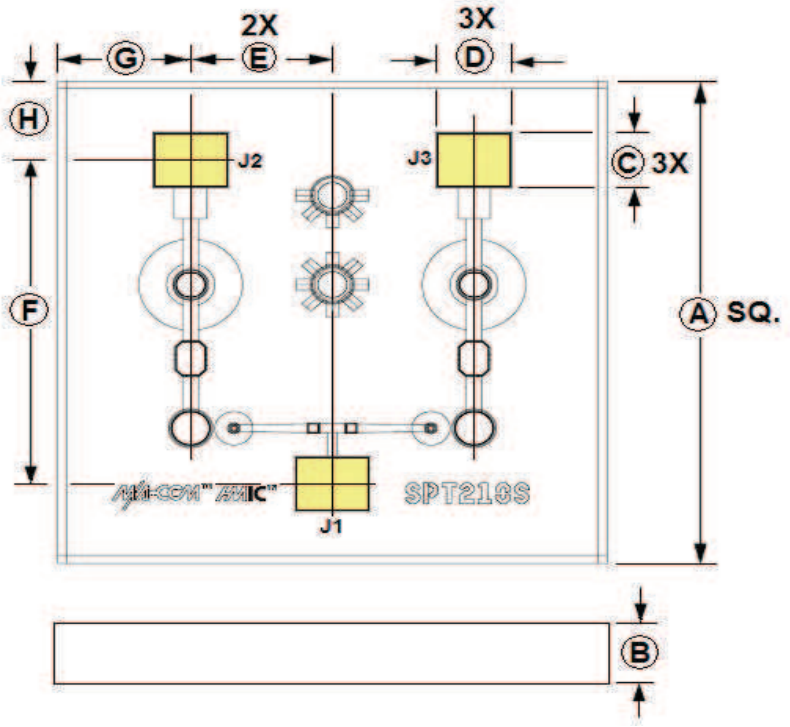
MA4SW210 Chip Outline Drawing[1,2]



DIM	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
A	0.029	0.033	0.73	0.83
B	0.004	0.006	0.10	0.15
C	0.004 REF		0.10 REF	
D	0.005 REF		0.13 REF	
E	0.009 REF		0.23 REF	
F	0.023 REF		0.58 REF	
G	0.007 REF		0.17 REF	
H	0.004 REF		0.10 REF	

Notes:

1. Topside and backside metallization is gold , 2.5µm thick typical.
2. Yellow areas indicate ribbon/wire bonding pads

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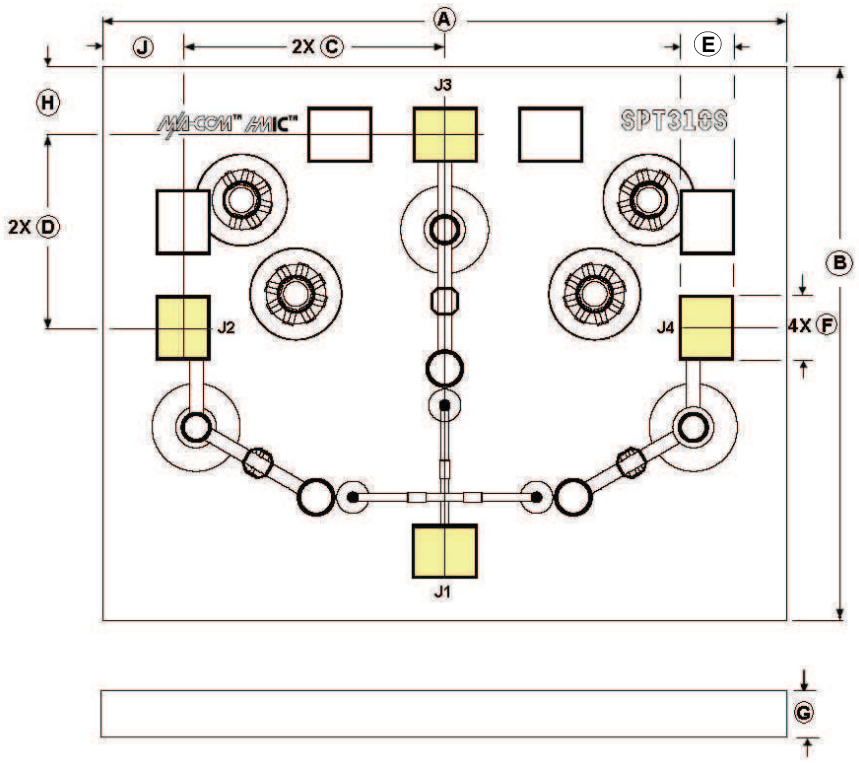
MA4SW310 Chip Outline Drawing [1, 2]



DIM	INCHES		MM	
	MIN.	MAX.	MIN.	MAX.
A	0.046	0.050	1.16	1.26
B	0.036	0.040	0.92	1.02
C	0.019 REF		0.48 REF	
D	0.014 REF		0.36 REF	
E	0.004 REF		0.10 REF	
F	0.005 REF		0.13 REF	
G	0.004	0.006	0.10	0.15
H	0.005 REF		0.12 REF	
J	0.004 REF		0.10 REF	

Notes:

1. Topside and backside metallization is gold , 2.5µm thick typical.
2. Yellow areas indicate ribbon/wire bonding pads

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ASSEMBLY INSTRUCTIONS

Cleanliness: The chips should be handled in a clean environment free of dust and organic contamination.

Electro-Static Sensitivity: The MA4SW series of PIN diode switches are ESD sensitive and proper precautions should be taken to avoid damaging the chip. ESD rating is Class 0 (HBM) and Class C1 (CDM).

Wire / Ribbon Bonding: Thermosonic wedge bonding using 0.003" x 0.00025" ribbon or 0.001" diameter gold wire is recommended. A work stage temperature of 150°C – 200°C, tool tip temperature of 120°C –150°C and a downward force of 18 to 22 grams should be used. If ultrasonic energy is necessary, it should be adjusted to the minimum level required to achieve a good bond. Excessive power or force will fracture the silicon beneath the bond pad causing it to lift. RF bond wires and ribbons should be kept as short as possible for optimum RF performance.

Chip Mounting: HMIC switches have Ti-Pt-Au backside metallization and can be mounted using a gold-tin eutectic solder or conductive epoxy. Mounting surface must be free of contamination and flat.

Eutectic Die Attachment: 80/20, gold-tin, solder is recommended. A re-flow oven or hot gas die bonder with a temperature setting of 290°C is normally used to melt the solder. The chip should not be exposed to temperatures greater than 320°C for more than 20 seconds. Typically no more than three seconds at peak temperature is required for attachment. RoHS compliant solders may also be used but solders rich in tin should be avoided as they will scavenge the backside gold and/or cause gold embrittlement.

Epoxy Die Attachment: A minimum amount of epoxy, 1–2 mils thick, should be used to attach chip. A thin epoxy fillet should be visible around the outer perimeter of the chip after placement. Epoxy cure time is typically 1 hour at 150°C.

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