tyco / Electronics M/A-COM

Broadband Monolithic Silicon PIN Diode Switches
Rev 2.0

MASW-001100-1190
MASW-002100-1191
MASW-003100-1192

Features
- Broad Bandwidth
  Specified from 50MHz to 20GHz
  Usable from 50MHz to 26.5GHz
- Lower Insertion Loss / Higher Isolation than pHempt
- Rugged, Fully Monolithic, Glass Encapsulated Construction
- Up to +33dBm C.W. Power Handling @ + 25°C

Description
The MASW-001100, MASW-002100 and MASW-003100 are broadband monolithic switches using series and shunt connected silicon PIN diodes. They are designed for use as moderate signal, high performance switches in applications up to 26.5GHz. They provide performance levels superior to those realized by hybrid MIC designs incorporating beam lead and PIN chip diodes that require chip and wire assembly.

These switches are fabricated using M/A-COM's patented 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 through low millimeter frequencies.

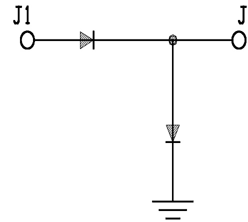
Large bond pads facilitate the use of low inductance ribbon leads, while gold backside metallization allows for manual or automatic chip bonding via 80/20 AuSn solder or conductive Ag epoxy.

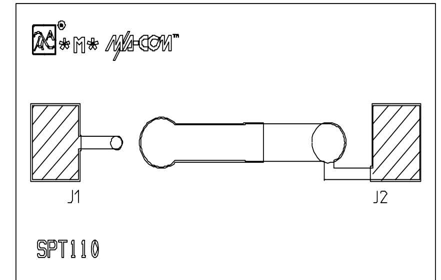
Absolute Maximum Ratings @ +25°C

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	+33dBm C.W.
Bias Current +25°C	±20mA

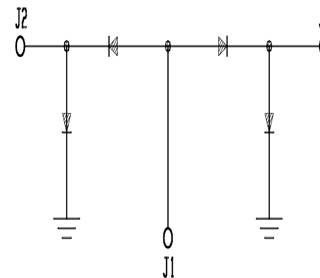
Maximum Operating Conditions for Combination of RF Power, D.C. Bias, and Temperature: +30dBm C.W. @ 15 mA (per Diode) @ +85 °C.

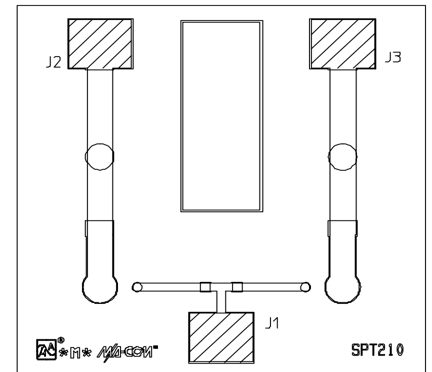
MASW-001100-1190



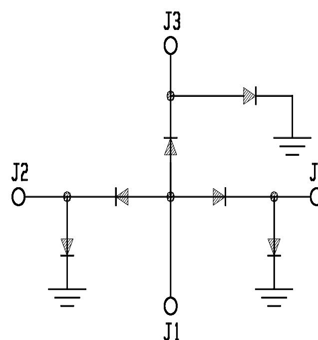


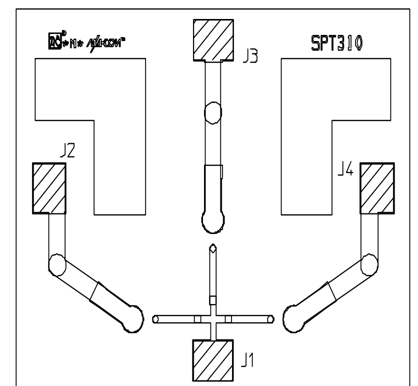
MASW-002100-1191





MASW-003100-1192





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MASW-001100-1190 (SPST)

Electrical Specifications @ T_A = +25°C, 20mA Bias Current

Parameter	Frequency	Minimum	Nominal	Maximum	Units
Insertion Loss	6GHz	-	0.4	0.7	dB
	13GHz	-	0.5	0.9	dB
	20GHz	-	0.7	1.2	dB
Isolation	6GHz	46	55	-	dB
	13GHz	39	47	-	dB
	20GHz	34	42	-	dB
Input Return Loss	6GHz	22	31	-	dB
	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

MASW-002100-1191 (SPDT)

Electrical Specifications @ T_A = +25°C, 20mA Bias Current

Parameter	Frequency	Minimum	Nominal	Maximum	Units
Insertion Loss	6GHz	-	0.4	0.7	dB
	13GHz	-	0.5	1.0	dB
	20GHz	-	0.7	1.2	dB
Isolation	6GHz	48	63	-	dB
	13GHz	40	50	-	dB
	20GHz	34	42	-	dB
Input Return Loss	6GHz	20	27	-	dB
	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

MASW-003100-1192 (SP3T)

Electrical Specifications @ T_A = +25°C, 20mA Bias Current

Parameter	Frequency	Minimum	Nominal	Maximum	Units
Insertion Loss	6GHz	-	0.5	0.8	dB
	13GHz	-	0.7	1.1	dB
	20GHz	-	0.9	1.5	dB
Isolation	6GHz	49	57	-	dB
	13GHz	42	48	-	dB
	20GHz	33	42	-	dB
Input Return Loss	6GHz	20	24	-	dB
	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

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.

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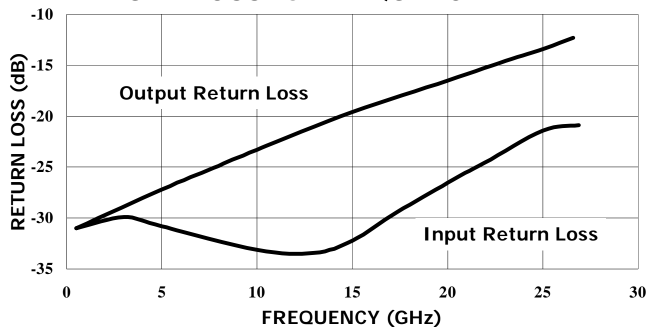
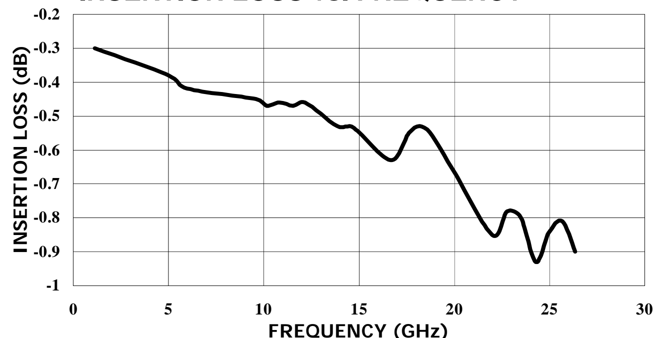
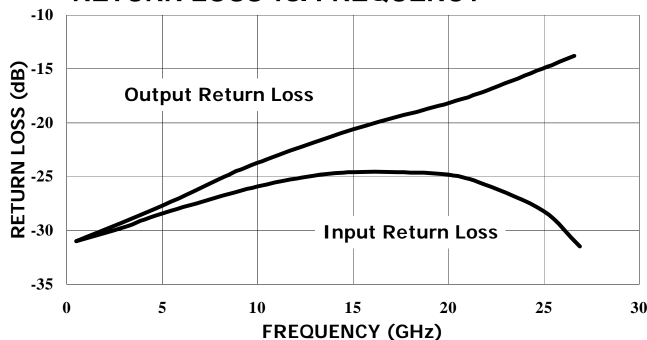
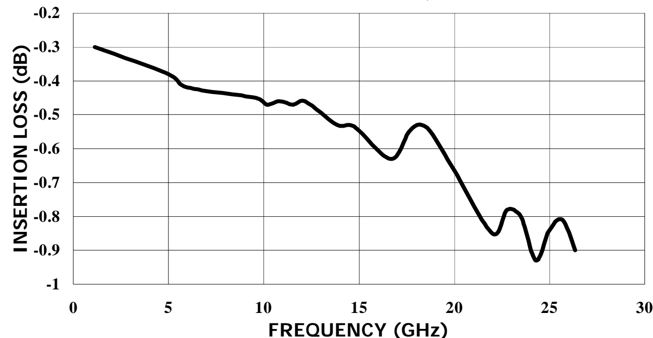
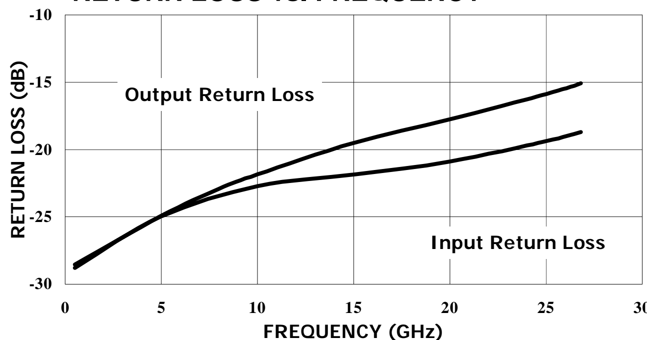
Typical Performance Curves @ T_A = +25°C, 20mA Bias Current

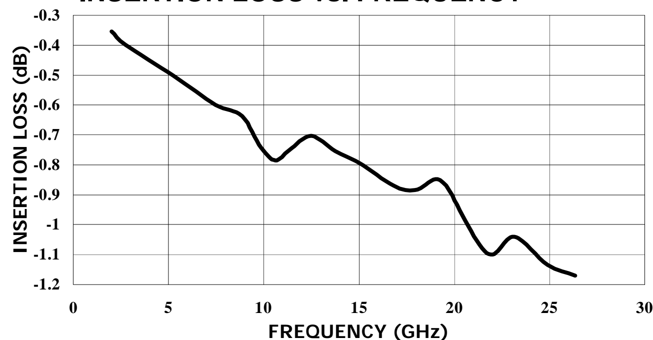












S-Parameters: S-Parameter data for these devices are available upon request.

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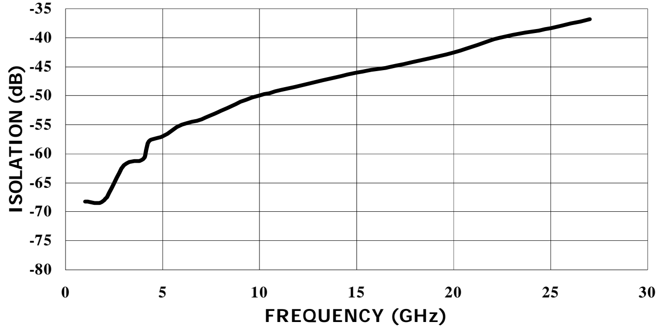
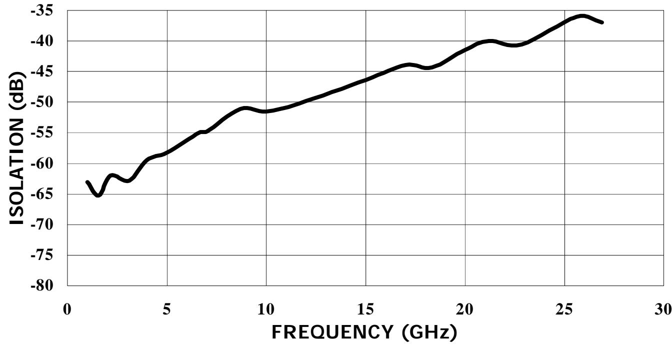
Typical Performance Curves @ T_A = +25°C, 20mA Bias Current

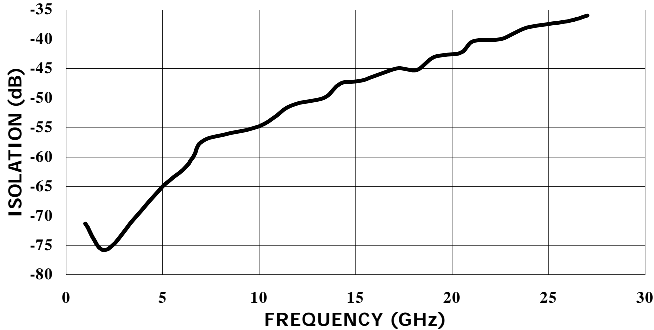
MASW-001100-1190 ISOLATION vs. FREQUENCY



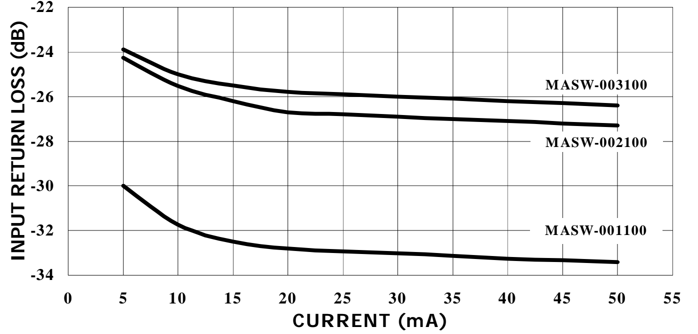
MASW-003100-1192 ISOLATION vs. FREQUENCY



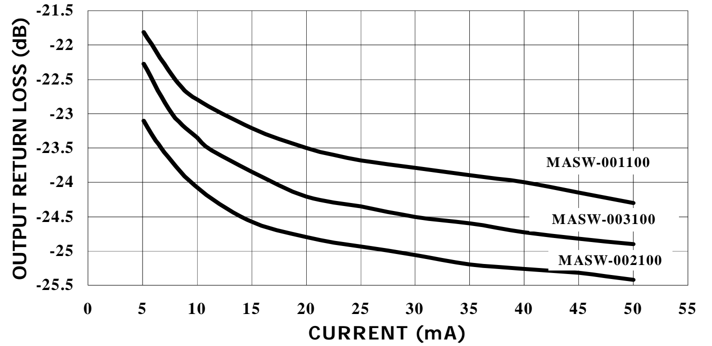
MASW-002100-1191 ISOLATION vs. FREQUENCY



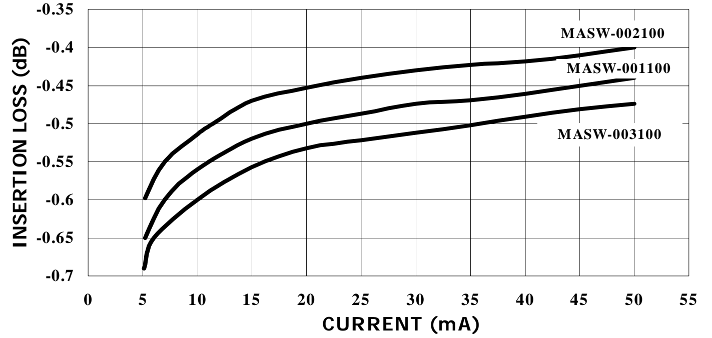
INPUT RETURN LOSS vs. BIAS CURRENT @ 10 GHz



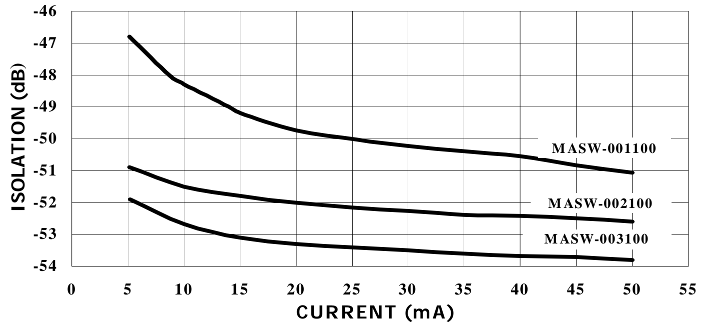
OUTPUT RETURN LOSS vs. BIAS CURRENT@ 10 GHz



INSERTION LOSS vs. BIAS CURRENT @ 10 GHz



ISOLATION vs. BIAS CURRENT @ 10 GHz



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Operation of the MASW Series Switches

Operation of the MASW series of PIN Switches is achieved by simultaneous application of negative DC current to the low loss switching arm J1, J2, or J3, and positive DC current to the remaining switching arms as shown in the Bias Connection circuits. DC return is achieved via J1. The control currents should be supplied by constant current sources. The voltages at these points will not exceed ±1.5 volts (1.2 volts typical) at currents up to ± 20mA. In the Low Loss state, the series diode must be forward biased and the shunt diode reverse biased. In the isolated arm, the shunt diode is forward biased and the series diode is reverse biased.

Driver Connections

MASW-001100-1190

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

MASW-002100-1191

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

MASW-003100-1192

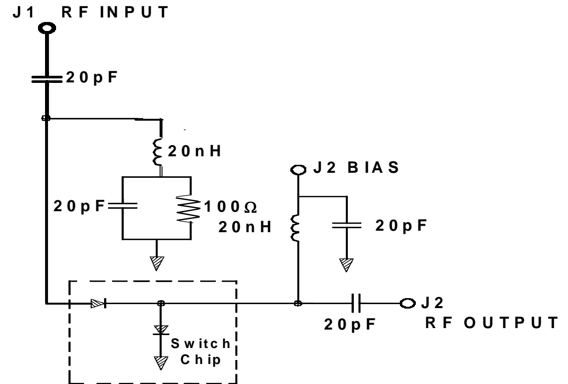
Control Level (DC Current) at			Condition of RF Output	Conditio n of RF Output	Condition of RF Output
J2	J3	J4	J1-J2	J1-J3	J1-J4
-20 mA	+20 mA	+20 mA	Low Loss	Isolation	Isolation
+20 mA	-20 mA	+20 mA	Isolation	Low Loss	Isolation
+20 mA	+20 mA	-20 mA	Isolation	Isolation	Low Loss

Handling Considerations

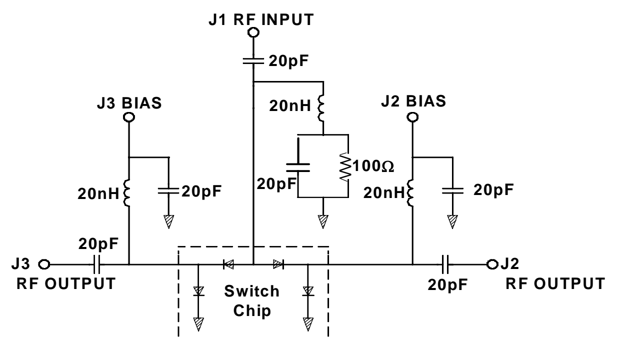
Cleanliness: These chips should be handled in a clean environment. Do not attempt to clean chips after installation.

Electro-Static Sensitivity: The MASW Series PIN switches are ESD, Class 1A sensitive (HBM). The proper ESD handling procedures should be used.

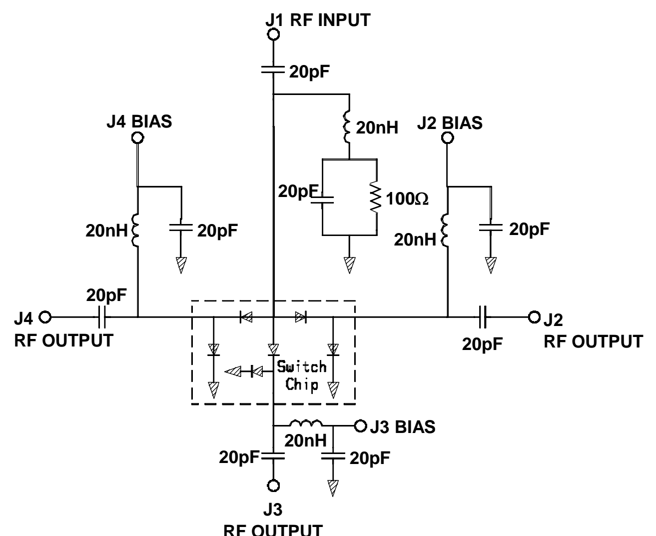
MASW-001100-1190 and Bias Connections[1]



MASW-002100-1191 and Bias Connections[1]



MASW-003100-1192 and Bias Connections[1]



Notes:
1. RLC values are for a typical operating frequency of 2 - 18GHz and Bias Current of ± 20mA per diode.

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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 to achieve a good bond. RF bond wires should be kept as short as possible.

Mounting

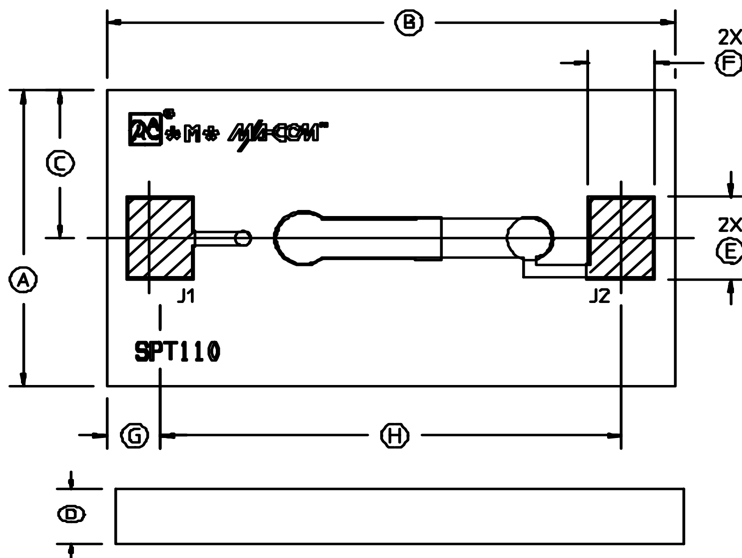
The HMIC switches have TiPtAu back metal. They can be die mounted with a gold-tin eutectic solder preform or conductive epoxy. Mounting surface must be clean and flat.

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. Solders containing tin should not be used.

Epoxy Die Attachment: Surface of assembly should be preheated to 125-150°C. A minimum amount of epoxy should be used. A thin epoxy fillet should be visible around the perimeter of the chip after placement. Cure epoxy per manufacturer’s schedule.

Chip Outline Drawings[1, 2]

MASW-001100-1190



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 metallization is gold 2.5µm thick typical. Backside metallization is gold, 1.0µm thick typical.
2. Hatched areas indicate wire bonding pads.

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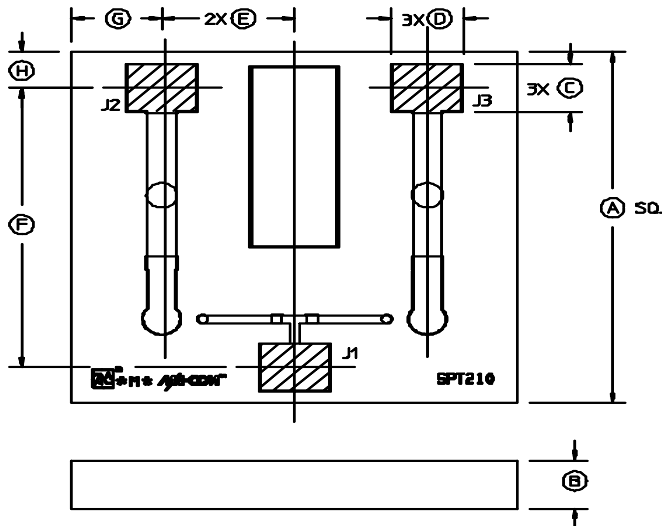
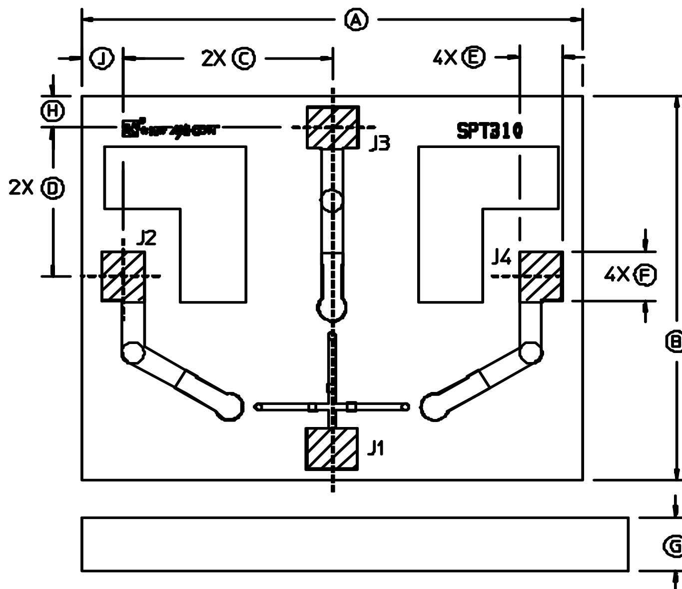
Chip Outline Drawings[1, 2]

MASW-002100-1191



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	

MASW-003100-1192



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 metallization is gold 2.5µm thick typical. Backside metallization is gold, 1.0µm thick typical.
2. Hatched areas indicate wire bonding pads.

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Ordering Information

Part Number	Package
MASW-001100-11900W	Waffle Pack
MASW-002100-11910W	Waffle Pack
MASW-003100-11920W	Waffle Pack

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