

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 pHEMT
- 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.

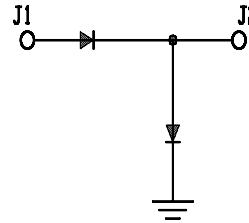
These switches are fabricated using M/A-COM's patented HMIC™ (Heterolithic Microwave Integrated Circuit) process, US Patent 5,268,310. This process allows the incorporation of silicon pedestals that form series and shunt diodes or vias by imbedding them in low loss, low dispersion glass. By using small 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.

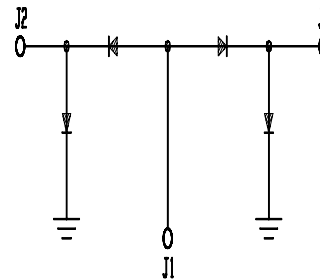
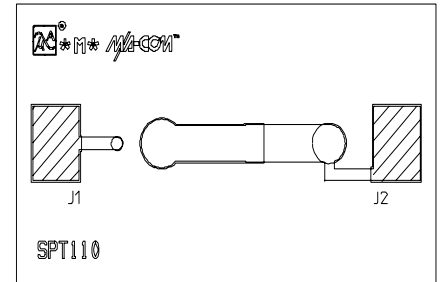
Absolute Maximum Ratings @ +25°C

| 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 |

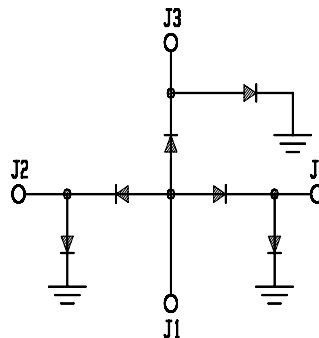
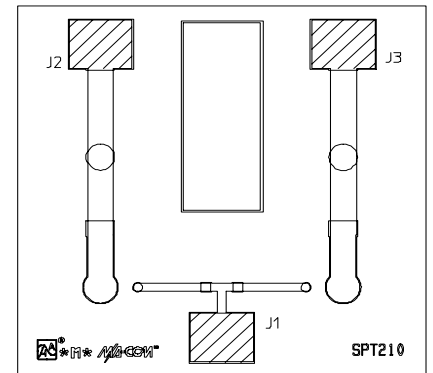
Maximum Operating Conditions for Combination of RF Power, D.C. Bias, and Temperature:
+30dBm C.W. @ 15 mA (per Diode) @ +85 °C.



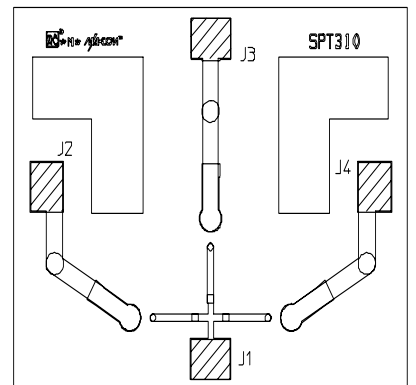
MASW-001100-1190



MASW-002100-1191



MASW-003100-1192



Specification Subject to Change Without Notice

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MASW-001100-1190, MASW-002100-1191, MASW-003100-1192**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 |

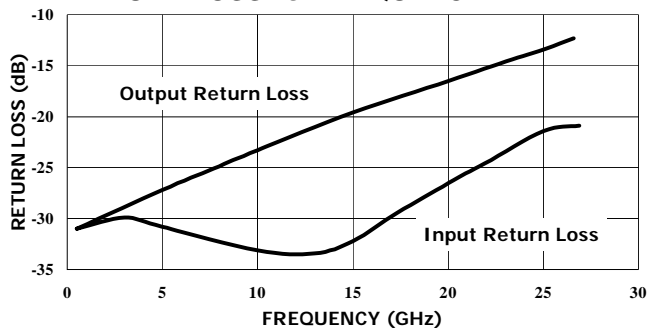
- 1.) Typical Switching Speed measured from 10 % to 90 % of detected RF signal driven by TTL compatible drivers.
- 2.) Maximum reverse leakage current in either the shunt or series PIN diodes shall be 10µA maximum at -50 volts.

Specification Subject to Change Without Notice

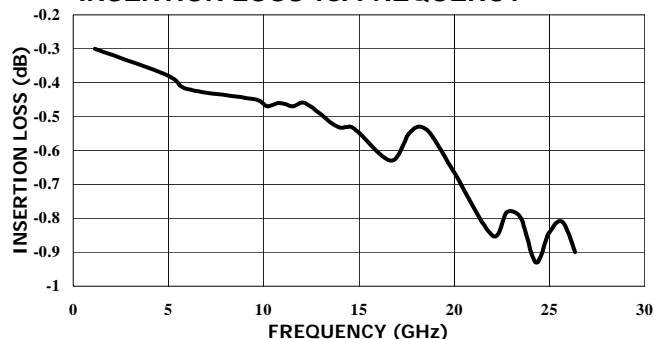
MASW-001100-1190, MASW-002100-1191, MASW-003100-1192

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

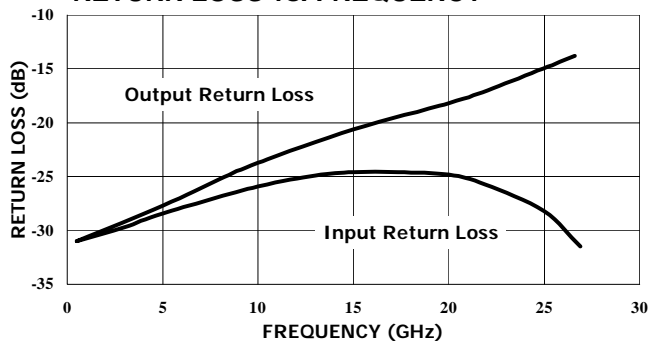
MASW-001100-1190
RETURN LOSS vs. FREQUENCY



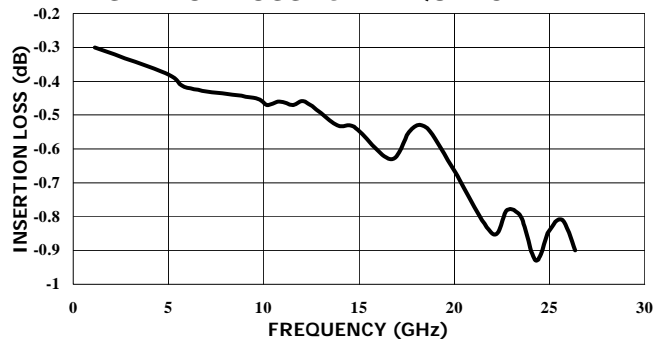
MASW-001100-1190
INSERTION LOSS vs. FREQUENCY



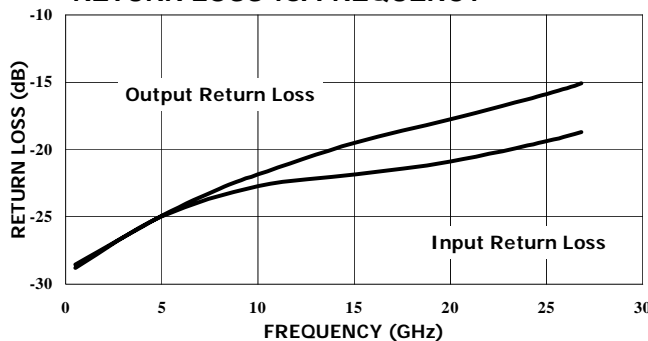
MASW-002100-1191
RETURN LOSS vs. FREQUENCY



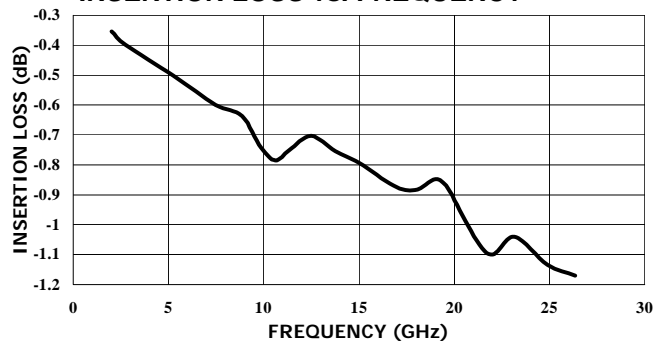
MASW-002100-1191
INSERTION LOSS vs. FREQUENCY



MASW-003100-1192
RETURN LOSS vs. FREQUENCY



MASW-003100-1192
INSERTION LOSS vs. FREQUENCY

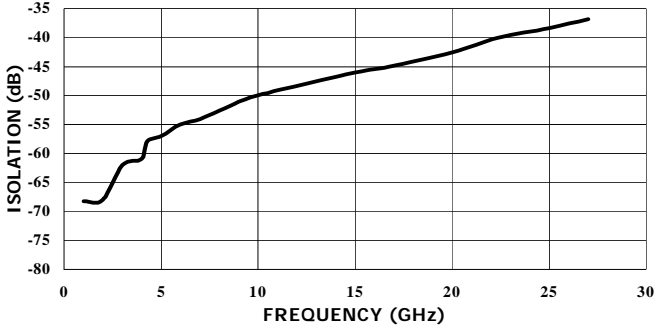


S-Parameters: S-Parameter data for these devices are available upon request.

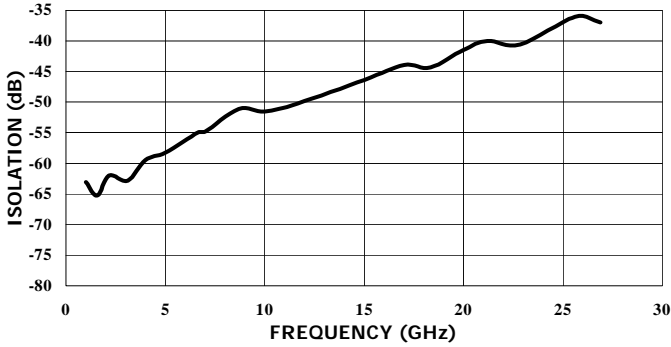
Specification Subject to Change Without Notice

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

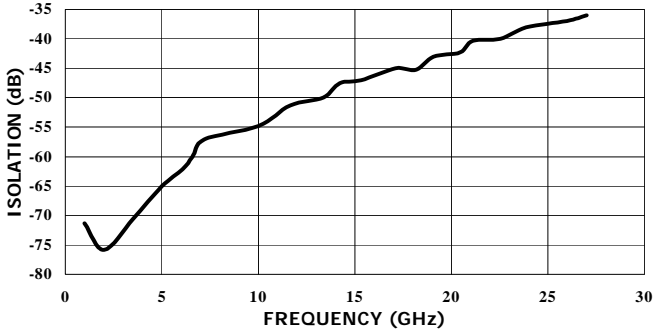
MASW-001100-1190
ISOLATION vs. FREQUENCY



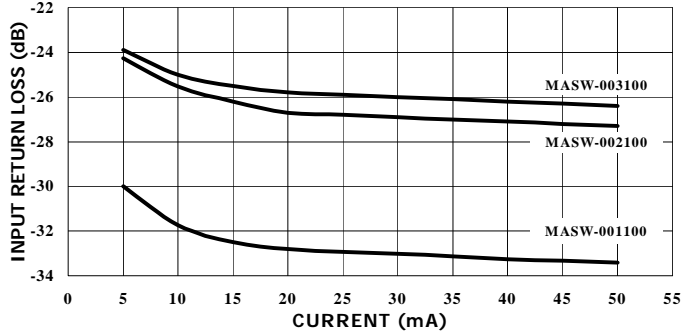
MASW-003100-1192
ISOLATION vs. FREQUENCY



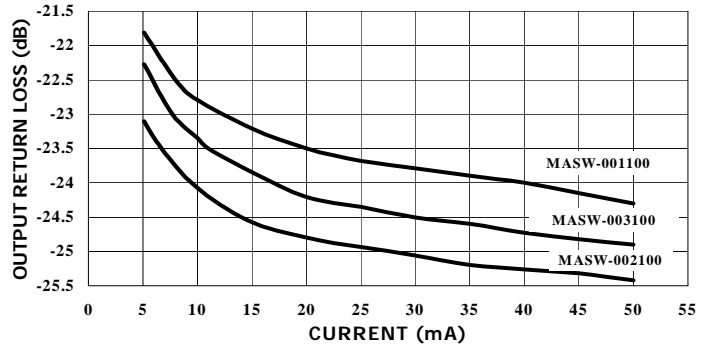
MASW-002100-1191
ISOLATION vs. FREQUENCY



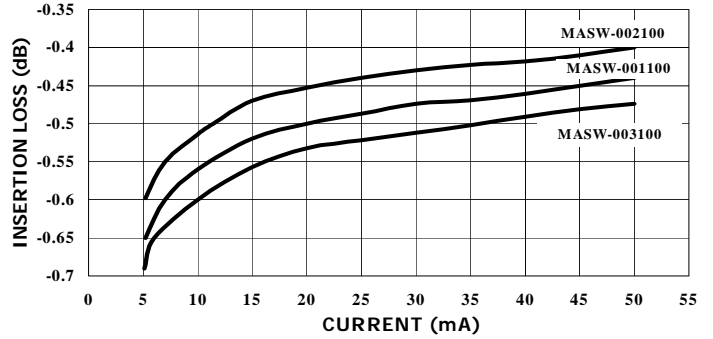
INPUT RETURN LOSS vs. BIAS CURRENT @ 10 GHz



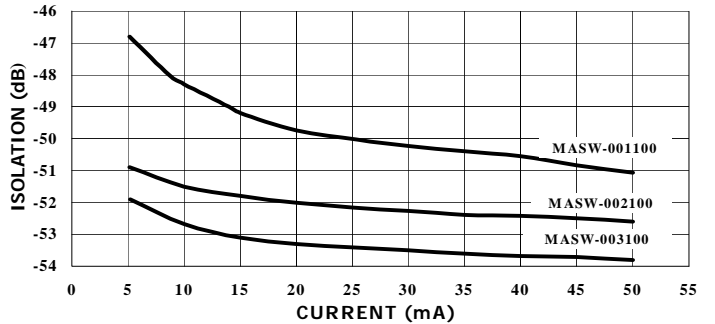
OUTPUT RETURN LOSS vs. BIAS CURRENT @ 10 GHz



INSERTION LOSS vs. BIAS CURRENT @ 10 GHz



ISOLATION vs. BIAS CURRENT @ 10 GHz



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

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 ± 20 mA. 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

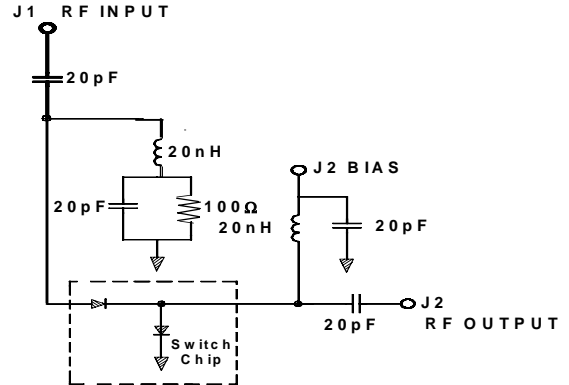
| Control Level (DC Current) at | | | Condition of RF Output | Condition of RF Output | Condition of RF Output |
|-------------------------------|--------|--------|------------------------|------------------------|------------------------|
| J2 | J3 | J4 | J1-J2 | J1-J3 | J1-J4 |
| -20 mA | +20 mA | +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

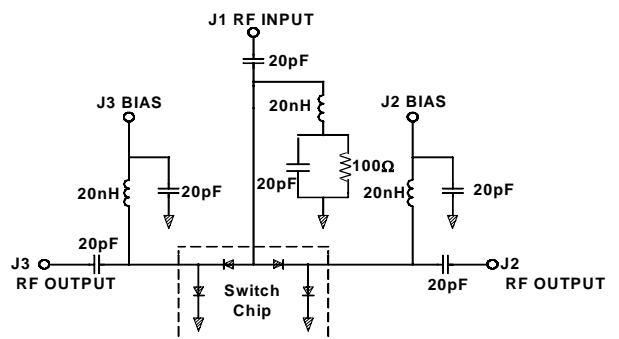
Cleanliness: These chips should be handled in a clean environment. Do not attempt to clean chips after installation.

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

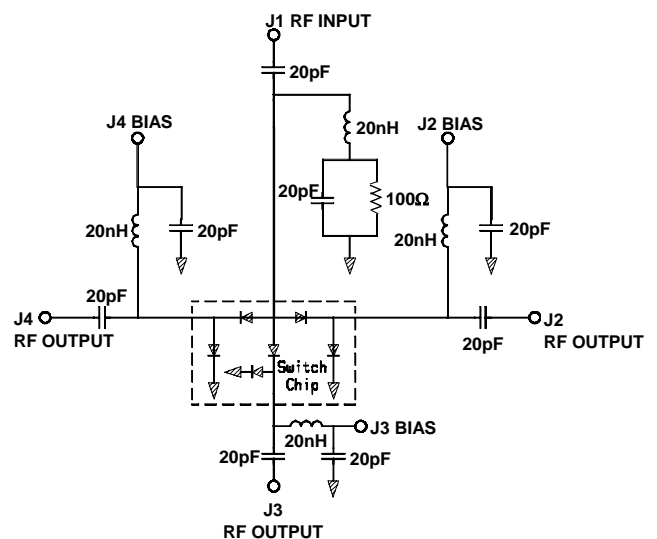
MASW-001100-1190 and Bias Connections¹



MASW-002100-1191 and Bias Connections¹



MASW-003100-1192 and Bias Connections¹



Notes:

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

Specification Subject to Change Without Notice

M/A-COM, Inc.

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

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

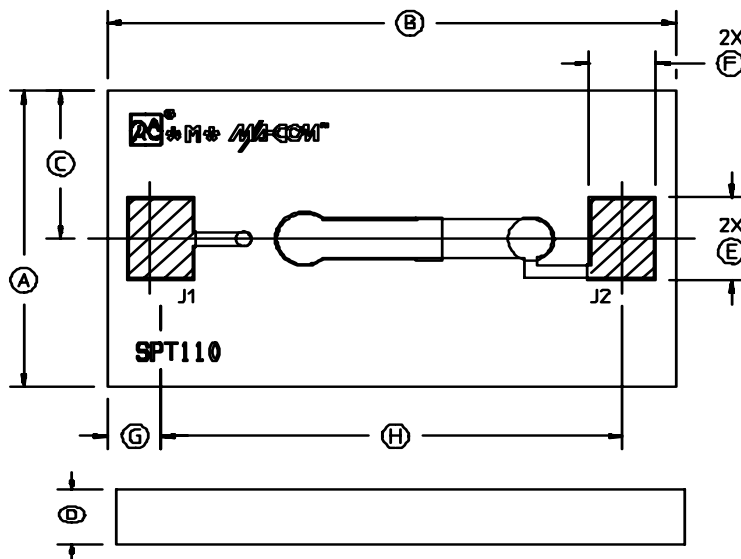
The HMIC switches have TiPtAu back metal. They can be die mounted with a gold-tin eutectic solder preform or conductive epoxy. Mounting surface must be clean and flat.

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



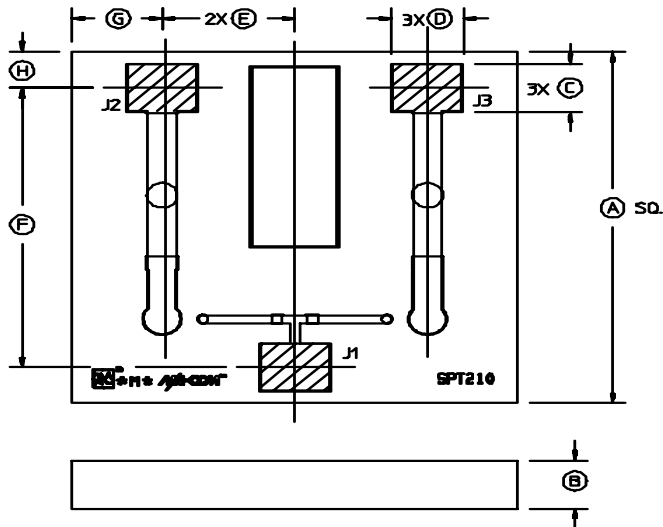
| DIM | INCHES | | MM | |
|-----|-----------|-------|----------|------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.014 | 0.018 | 0.35 | 0.45 |
| B | 0.025 | 0.029 | 0.64 | 0.74 |
| C | 0.008 REF | | 0.20 REF | |
| D | 0.004 | 0.006 | 0.10 | 0.15 |
| E | 0.004 REF | | 0.10 REF | |
| F | 0.003 REF | | 0.08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

Specification Subject to Change Without Notice

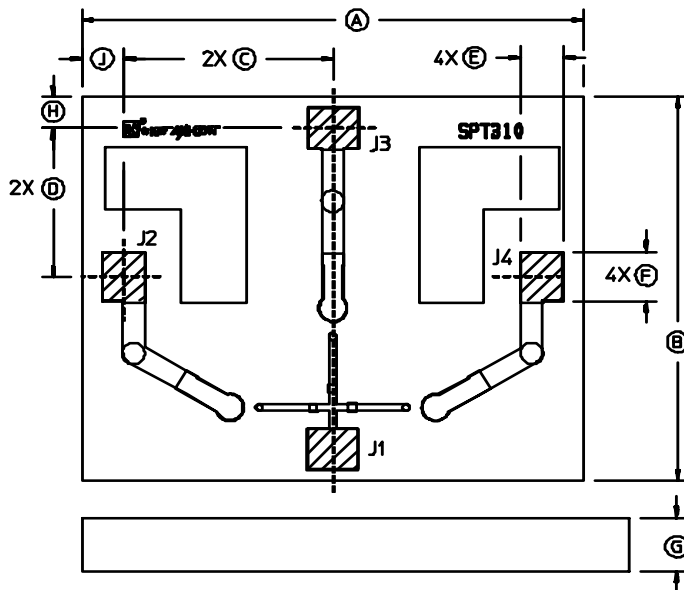
Chip Outline Drawings^{1,2}

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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