

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.

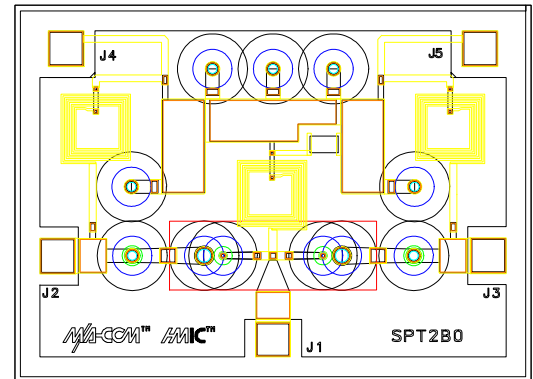
Absolute Maximum Ratings¹ @T_A = 25 °C (unless otherwise specified)

| 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 |

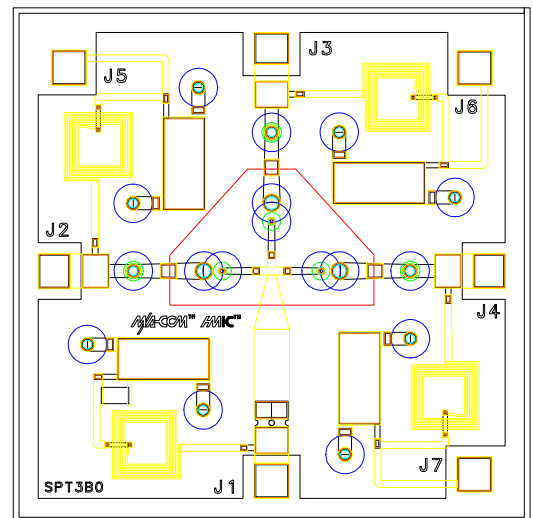
1. Exceeding any one or combination of these limits may cause permanent damage.

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 |

M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. M/A-COM makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does M/A-COM assume any liability whatsoever arising out of the use or application of any product(s) or information.

Visit www.macom.com for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020



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.

M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. M/A-COM makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does M/A-COM assume any liability whatsoever arising out of the use or application of any product(s) or information.

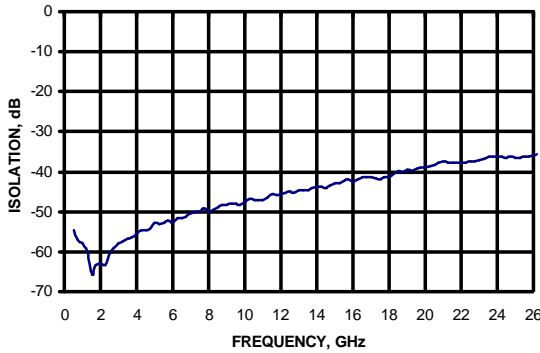
Visit www.macom.com for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020

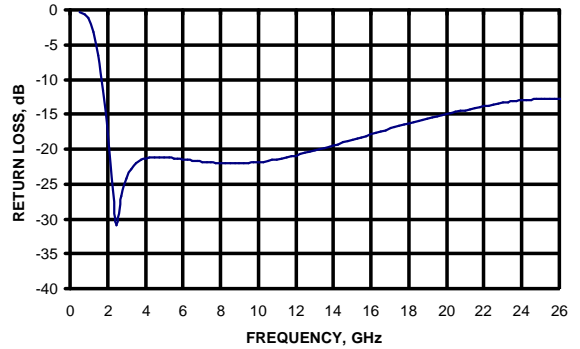
tyco / Electronics 

Typical Performance Curves - MA4SW210B-1

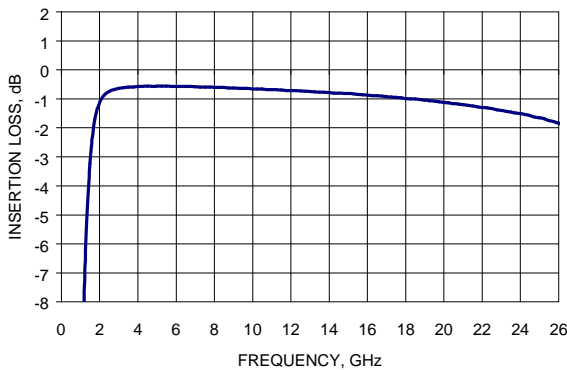
Isolation vs. Frequency



Return Loss vs. Frequency



Insertion Loss vs. Frequency



M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. M/A-COM makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does M/A-COM assume any liability whatsoever arising out of the use or application of any product(s) or information.

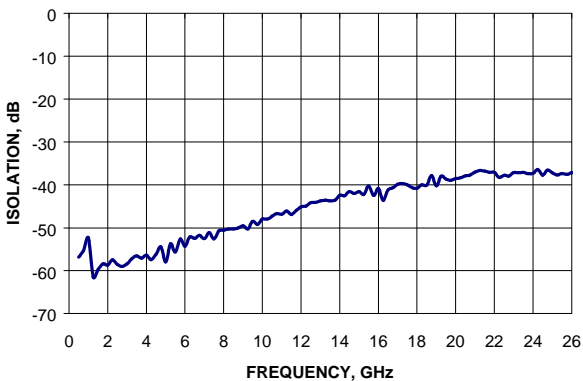
Visit www.macom.com for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020

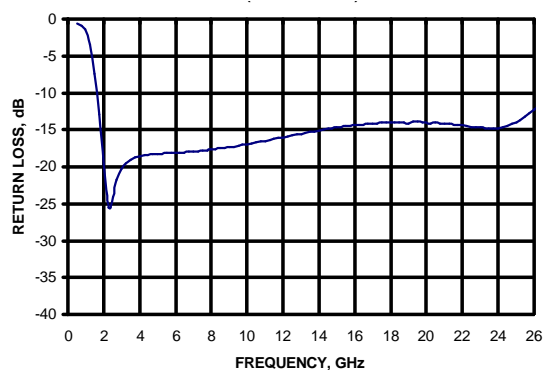


Typical Performance Curves - MA4SW310B-1

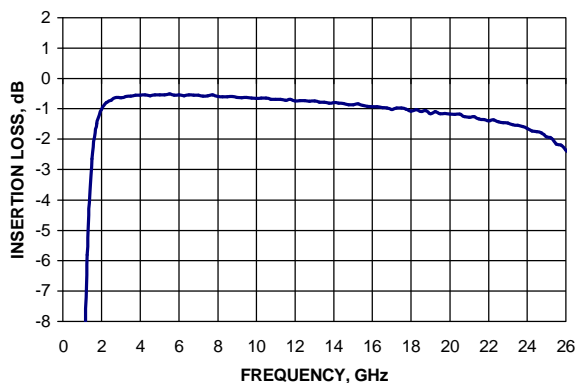
Isolation vs. Frequency



Return Loss vs. Frequency



Insertion Loss vs. Frequency



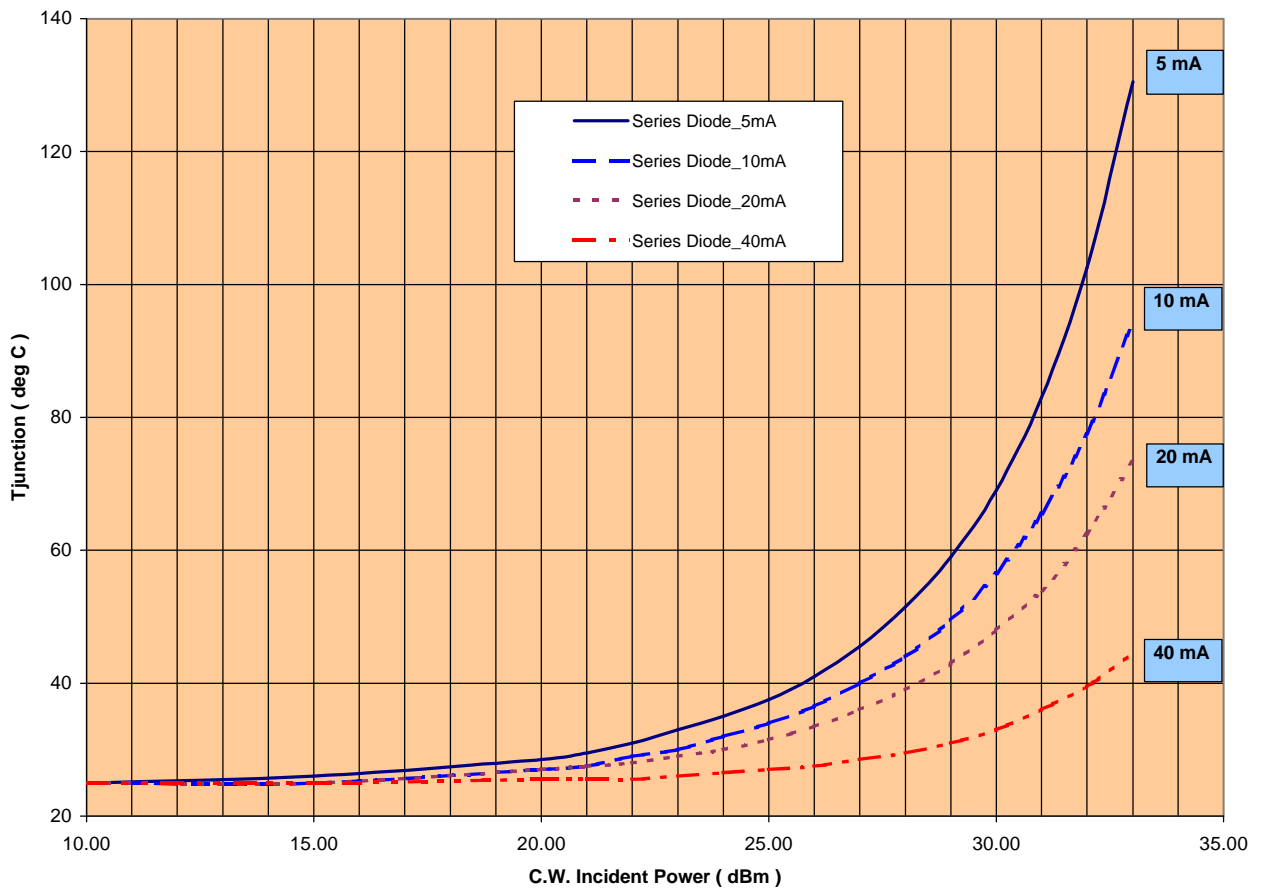
M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. M/A-COM makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does M/A-COM assume any liability whatsoever arising out of the use or application of any product(s) or information.

Visit www.macom.com for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020



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



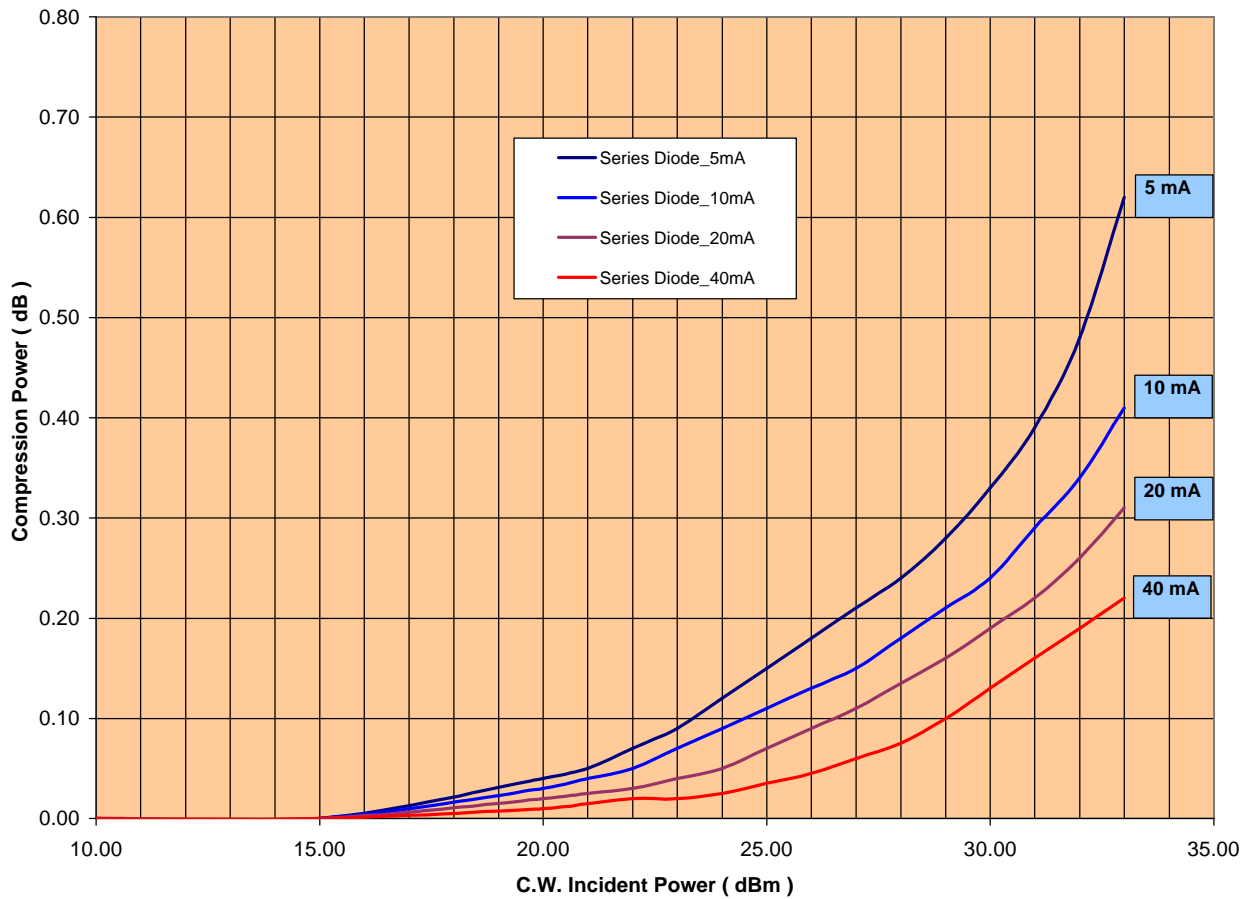
M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. M/A-COM makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does M/A-COM assume any liability whatsoever arising out of the use or application of any product(s) or information.

Visit www.macom.com for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020



MA4SW210B-1 Compression Power vs Incident Power at 8 GHz



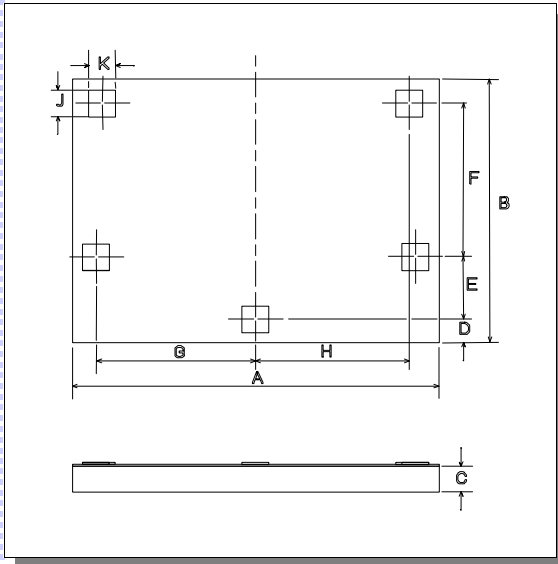
M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. M/A-COM makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does M/A-COM assume any liability whatsoever arising out of the use or application of any product(s) or information.

Visit www.macom.com for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel.+81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020

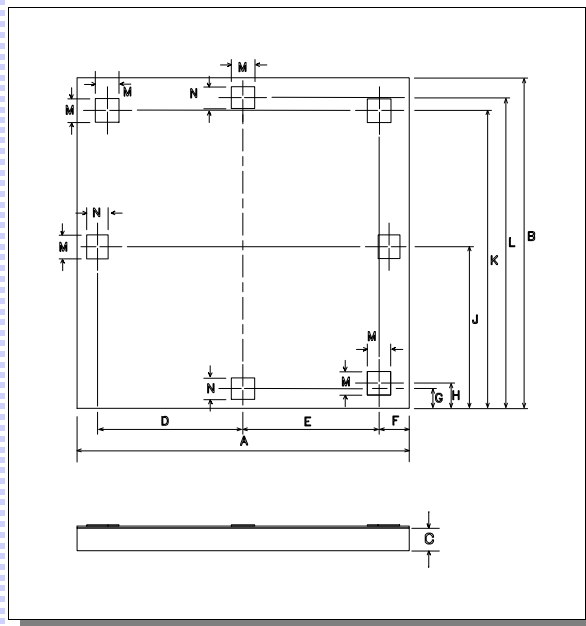


MA4SW210B-1



| 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. | |

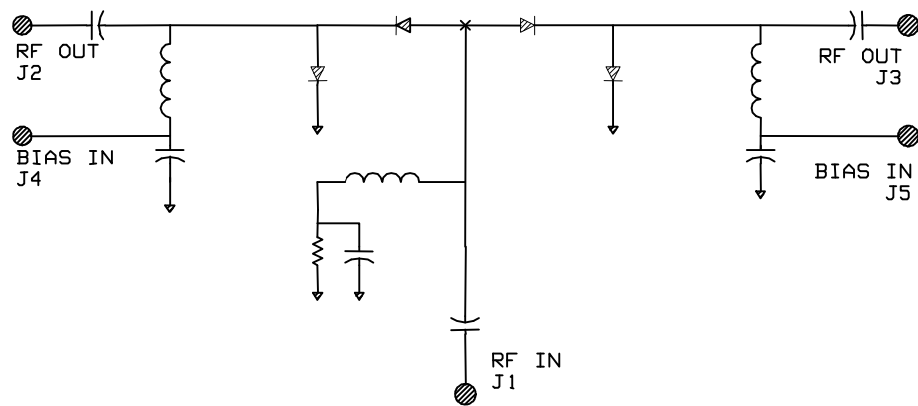
M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. M/A-COM makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does M/A-COM assume any liability whatsoever arising out of the use or application of any product(s) or information.

Visit www.macom.com for additional data sheets and product information.

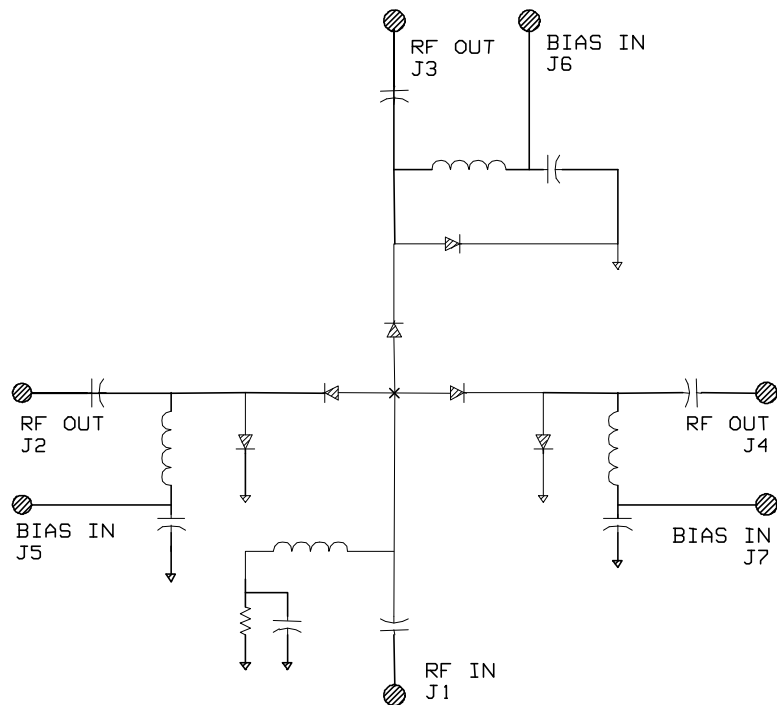
- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel. +81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020



Equivalent Circuit MA4SW210B-1



Equivalent Circuit MA4SW310B-1



M/A-COM Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice. M/A-COM makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does M/A-COM assume any liability whatsoever arising out of the use or application of any product(s) or information.

Visit www.macom.com for additional data sheets and product information.

- North America: Tel. (800) 366-2266
- Asia/Pacific: Tel. +81-44-844-8296, Fax +81-44-844-8298
- Europe: Tel. +44 (1344) 869 595, Fax +44 (1344) 300 020

