General MM7100 Evaluation Board Information

The MM7100 is designed for applications with up to 400V standoff, yet has less than 0.5 Ohm DC on-resistance. To achieve the voltage rating the MM7100 contains two 200V switch elements connected in series with a common node for both gate electrodes. The MM7100 is a symmetrical, bidirectional device. It can be used for both large and small signal DC and AC.

The Evaluation Board is set up as an in-line/series switch that may also be configured as a shunt switch element with the help of the included shorted BNC type plug.

The MM7100 is non-magnetic and suitable for MRI and NMR applications. The current version of the evaluation board is not designed to be non-magnetic.

In its current form the MM7100 Evaluation board supports and may be used for:

- **DC On state resistance measurement**
- **DC Resistance repeatability measurement**
- **Actuation and de-actuation timing & switching speed measurements**
- **Electrical performance over temperature**
- **Limited switching with current on (within specified limits)**
- **Off state DC isolation and voltage standoff (with R4 and R5 removed)**
- **Limited testing in application circuits with DC, AC, and low frequency RF signals (using BNC connectors)**

This version of the evaluation board is not intended to facilitate RF testing or S-parameter measurements.

About the Midpoint Pin and Isolation

With the two switches in series, configured back to back, the midpoint pin becomes an isolated island when the switch is not actuated (“off” state). When the switch is actuated (“on” state), the MIDPOINT pin is now part of the circuit between the INPUT pins and the OUTPUT pins. The GATE pin always remains DC isolated.

On Biasing of the MIDPOINT Pin.

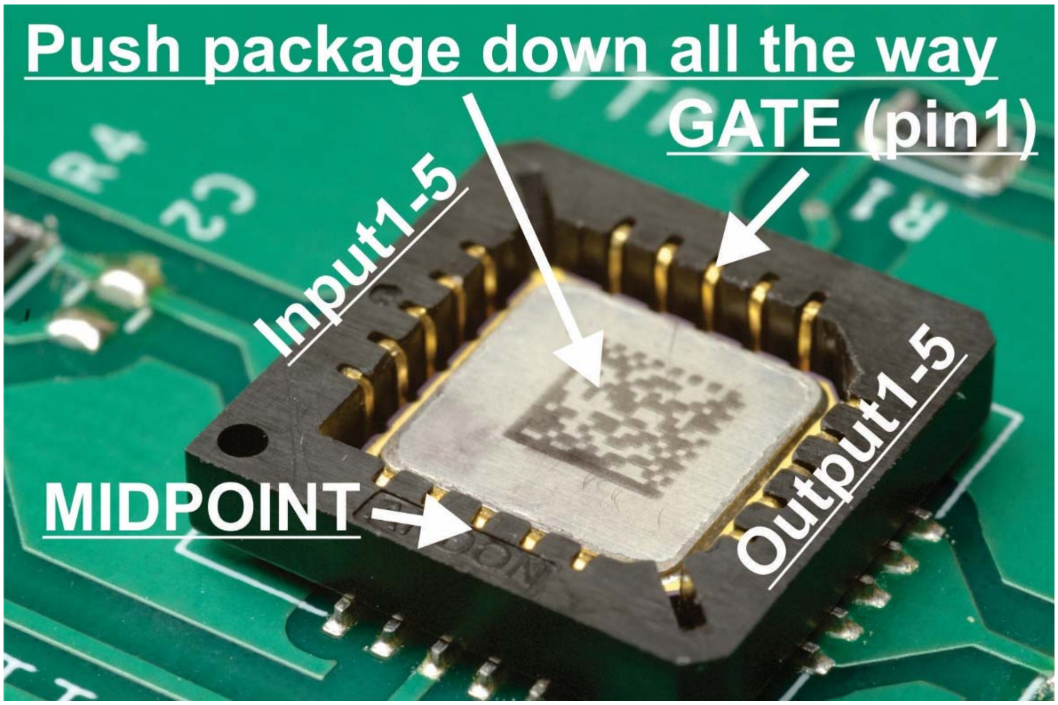
The evaluation board has a voltage division network (R4 and R5) with two 100kΩ resistors that will bias the midpoint pin to the average voltage of the input and output terminals. This ensures that voltage across the INPUT and OUTPUT pins is evenly divided over the two switch elements.

R4 and R5 need to be removed for isolation and standoff measurements. With J2 installed, the midpoint pin is tied to the BNC shield and PCB GND (over Resistor R6).

Correct Orientation of the Device in Socket

Proper seating of the device – push in with a blunt instrument, the top surface of the part needs to be well below the surface of the socket. When you receive the board, the device should be installed properly, but it is always good to check.

When oriented correctly, the longer pin #1 (GATE pin) is oriented at 12:00 when the connector J3 is at 09:00 and J4 at 15:00. When viewed from above with the GATE pin at 12:00, INPUT1-5 pins are located on the left side and Output 1-5 on the right.



Removing Device from Socket

Due to the risk of socket damage it is not recommended to remove the device from the socket. Should you still want to remove or change the part, carefully push on the bottom of the device (through the drilled hole in the middle of the board and socket) using a blunt instrument. Always maintain proper ESD precautions when working with the board and loose devices. Proceed with caution and don't hurt yourself when the device releases from the socket.

Note: the yellow plastic/Kapton film at the bottom of the socket is intended to guard against contact between bottom pads and the GND layer under the solder mask. Make sure it stays in the correct place.

Standoff Voltage Testing

The MM7100 is rated for 400V standoff voltage. On this evaluation board, a voltage standoff test with the bias resistor network will draw a current of about 2 mA when biased at 400V. This can be tolerated only for short periods of time due to the resistors heating. Note that the 400 V standoff has not yet been tested, and we recommend not performing this test until we can confirm the evaluation board can withstand the voltage.

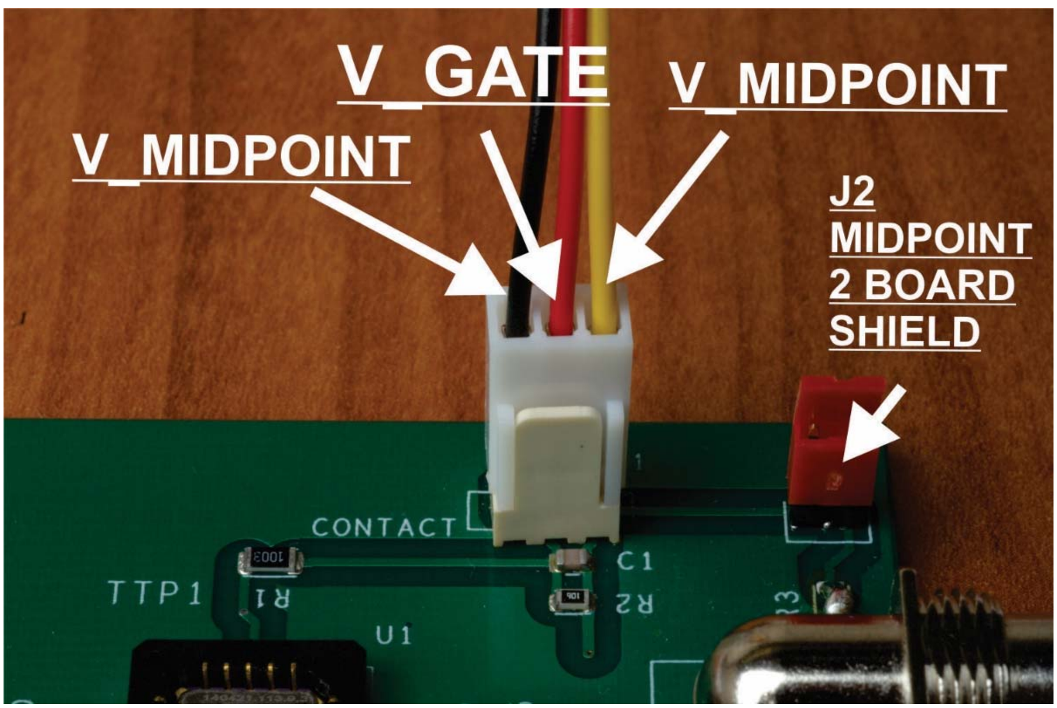
Actuating the MM7100

The actuation process requires that 77.5 V is applied to the GATE pin referenced to the MIDPOINT pin. For the purpose of testing, keep jumper J2 in place and keep the midpoint tied to ground potential of the BNC connectors. We recommend cold-switching the MM7100 during evaluation. This means that during the actuation event, there should be no voltage between the IN1-5 pins and OUT1-5 pins. The MM7100 is specified for hot-switching for voltage levels < 1.0 V for a 100Ω source impedance, so if you leave the DMM connected during actuation, it will not cause any issue.

The hot switching limitation also applies to the bias of the MIDPOINT pin which must be within 0.5 V of <u>both</u> the Input and output pins at the time of actuation.

Note that the device can be actuated equally well using a negative voltage (-77.5 V).

The supplied biasing cable connects to connector J1 and your power supply, which should be capable of the 77.5 V bias.



It is a good practice to monitor the current flowing into the GATE pin (J1-2) on the board. It is determined by the 10 MΩ resistor (R2) in parallel with the pin. Therefore, you should see 7.8 uA or close to this value, independent of whether the device is in the socket or not. This indicates that no current is flowing into the VGATE pin of the MM7100 device, showing that the device is operating properly.

Measure Closing and Opening Gate Voltage

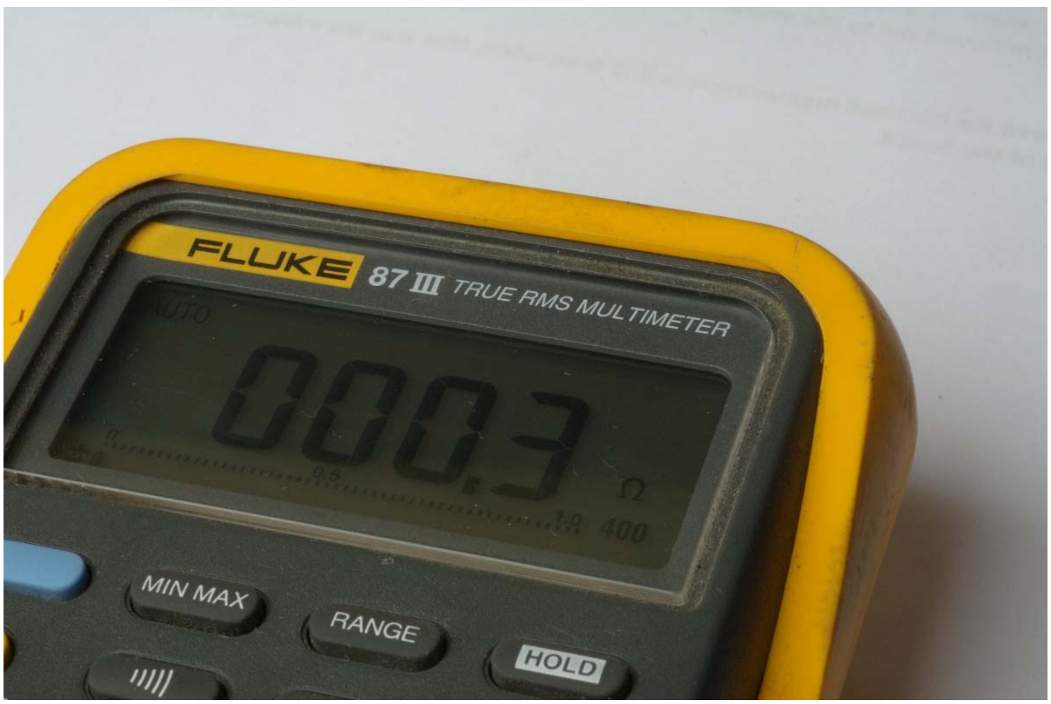
Clearly outside scope of normal operation but still interesting is to test the actuation and de-actuation voltages. With an adjustable power supply, it is possible to ramp the voltage slowly to the point of actuation and see the transition from switch ON state to switch OFF state.

Note that there is significant hysteresis in the OFF-ON-OFF cycle, where the de-actuation voltage, once actuated, is significantly lower than the starting actuation voltage when ramping the voltage up.

The only allowable operation points that guarantees specification compliance are 0V GATE voltage and 77.5 V GATE voltage.

On Resistance Tests in Series and Shunt Mode

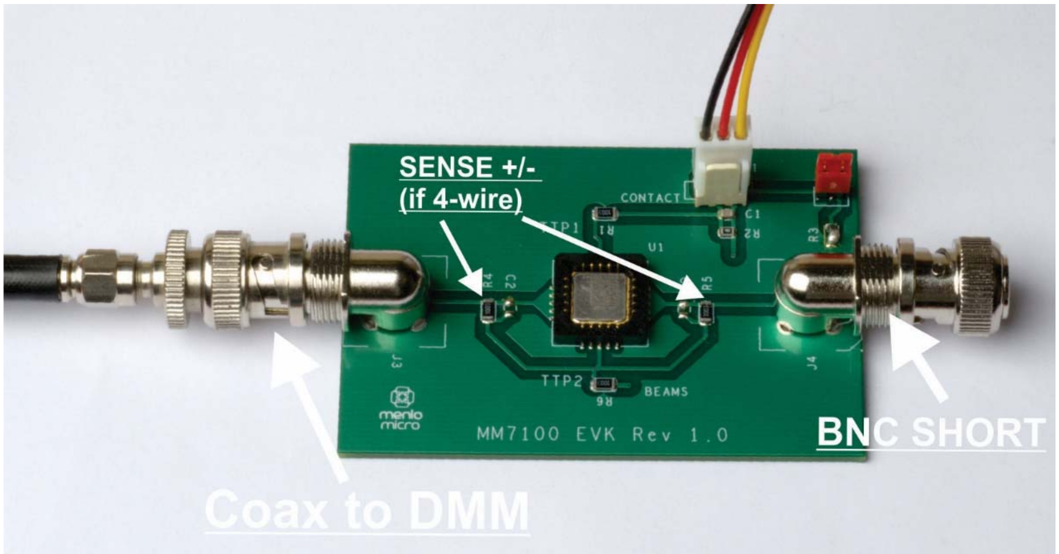
The most interesting tests to perform with this board is an on-resistance test. There is a 200kΩ path in parallel but with an on-resistance in the sub 1 Ohm range, this is of little significance. Expected value is 0.5 Ω or below.



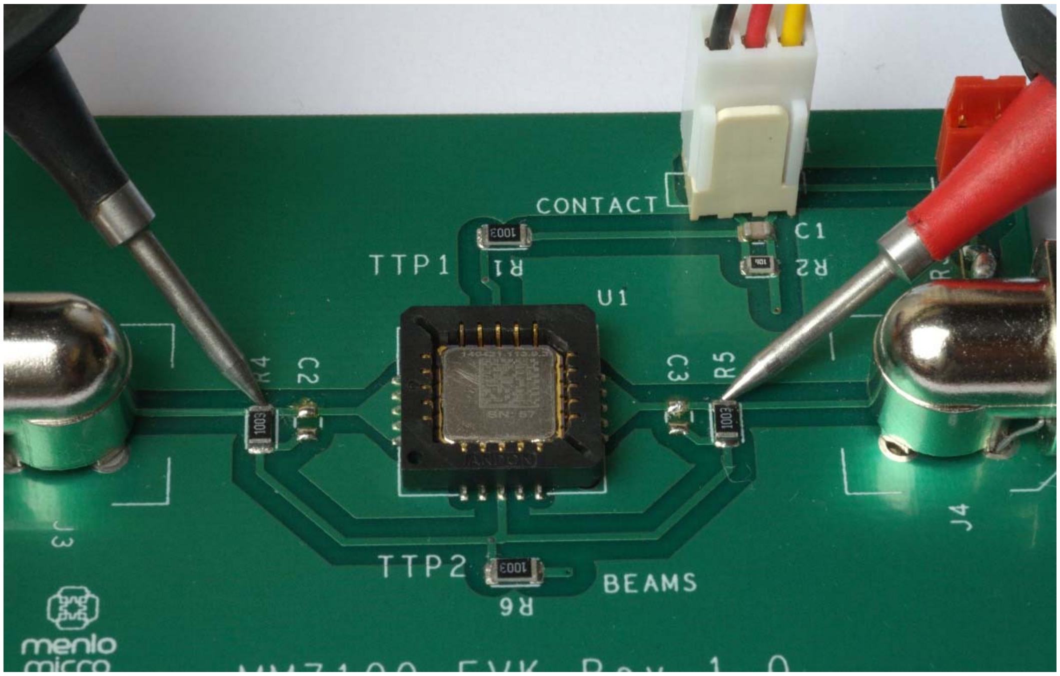
The following values have been measured for the evaluation board and can be used for de-embedding the resistance of the PCB traces and connectors:

J3 -> INPUT 1-5	**35 mΩ**
J4 -> OUTPUT 1-5	**35 mΩ**
GND J3 –> GND J4	**10 mΩ**

As an alternative to measuring inline series resistance between connector J3 and J4, you may measure round trip resistance by connecting a short to J4 and the Ohm-meter to J3 via a BNC and coax. This allow you to connect a multimeter via BNC coax cable. When using this method, the reading needs to be corrected by subtracting (35 mΩ + 35 mΩ+ 10 mΩ) = 80 mΩ. Alternatively this method may be used for the FORCE wires in a 4-wire measurement with the SENSE lines connected to R3 & R4 top pads.



One the other hand, it is also possible to measure DC resistance using a multimeter by placing the probes on the input and output traces, next to the device, as shown in the picture below. If you zero out the multimeter test leads, you will get a good direct reading of the devices DC resistance, just a tiny bit on the high side of the correct value. R3 & R4 are also a good place to attach the SENSE lines for a 4-wire resistance measurement.



Connectors on the Board and Their Function

J1 GATE Voltage Connector

Pin 2 (the middle pin) is where the 77.5 V for the GATE pin is applied.

Use the included cable for this purpose.

Pin 1 & 3 are both connected to the MIDPOINT pin (normally at GND potential when the J2 jumper is in place), and either pin is fine to use.

J2 Jumper

J2 connects the MIDPOINT pin through a 100K Ohm resistor to board shield (same as GND for the BNC connectors)

In general, it is a good idea to have J2 in place and connect shields of J3 and J4 to measurement setup GND reference. That way it is easy to ensure 0V over the contacts when actuating the device.

Note that J2 needs to be in place if R4 and R5 are removed. Otherwise the MIDPOINT pin will float and it will be uncertain if the correct bias is applied.

J3 Input 1-5

The J3 center conductor connects to all five the INPUT pins of the MM7100 (left side of the device). The connector shield is connected to the board shield, which connects only to the J2 jumper and J4 shield.

J4 Output 1-5

The J4 center conductor connects to all five the OUTPUT pins of the MM7100 (right side of the device). The connector shield is connected to the board shield, which connects only to the J2 jumper and J3 shield.