

MM7100 – High-Voltage SPST Digital-Micro-Switch

Product Overview

Features:

- Frequency Range: DC to 750 MHz
- Low On-State Resistance < 0.30Ω (typ.)
- Rated Voltage (AC or DC): 400V
- Rated Current (AC or DC): 2A
- Switching Time: 8 us (close or open operation)
- High Switching Reliability: > 3 Billion Operations
- Non-Magnetic LCC Package

Applications:

- High Voltage RF Signal Switching
- RF Power Amplifier Impedance Matching
- Tunable Filters and Antennas
- RF Coil Frequency Tuning

Markets:

- Aerospace and Defense
- Medical and Scientific
- Test and Measurement

Description:

The MM7100 is a high-voltage SPST micro-mechanical switch, utilizing Menlo Micro’s Digital-Micro-Switch (DMS) fabrication process. The innovative DMS technology enables highly reliable micro-mechanical switches capable of carrying high voltage and high current in a small SMT form factor. The MM7100 provides ultra-low on-state resistance and high off-state isolation, with greater than 3 billion switching cycles guaranteed at +85°C. Because of its long lifetime, extremely low current consumption, and small form factor, the MM7100 is an ideal solution for replacing electromechanical relays, as well as pin diode switches where size, weight, power and thermal management are critical system-level design parameters.

The MM7100 device is non-polarized and can flow current in both directions between INPUT and OUTPUT. The internal dual gates are controlled via the common GATE pin and requires a 77.5 V voltage in relation to the MIDPOINT pin to close the two contacts.

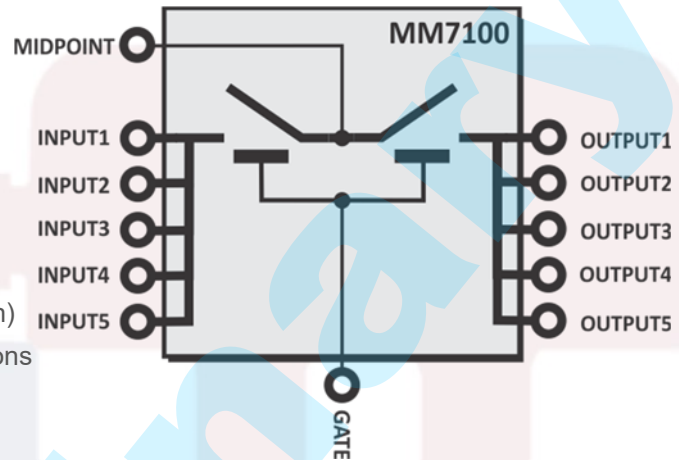


Figure 1: Functional Diagram



Figure 2: Non-Magnetic 20-Pin LCC Package

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Operating Characteristics

Absolute Maximum Ratings

Exceeding the maximum ratings as listed in Table 1 below may reduce the reliability of the device or cause permanent damage. Operation of the MM7100 should be restricted to the limits indicated in Table 2 recommended operating conditions listed below.

Electrostatic Discharge (ESD) Safeguards

When handling the MM7100, observe the same precautions as with any other ESD sensitive devices. Even though the MM7100 is protected from ESD damage, precautions must be taken to avoid exceeding the ratings specified in Table 1 below.

Susceptibility to Latch-Up

The MM7100 digital micro switch device is generally not susceptible to switch latch-up condition, which can occur in some semiconductor devices.

Table 1: Absolute Maximum Ratings

Parameter	Minimum	Maximum	Unit
High Voltage Gate, GATE		250	Volt
RF Input Power, 50Ω Impedance, 750 MHz ⁽¹⁾		100	W
Operating Frequency Range ⁽²⁾		750	MHz
Voltage ⁽³⁾	-425	+425	V (DC)
Current	-2	2	A (DC)
ESD Voltage All Pins ⁽⁴⁾		250	Volt
Storage Temperature Range	-70	+150	°C

Notes:

- 1) All parameters must be within recommended operating conditions. Maximum DC and RF power can only be applied during the on-state condition (cold-switched condition).
- 2) For various RF/microwave applications the high frequency performance can be improved by using external matching.
- 3) Requires MIDPOINT pin biased to the average voltage between the INPUT and the OUTPUT pins.
- 4) Machine model JEDEC Standard JESD22 A115.

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Detailed Electrical Characteristics

Table 2: Recommended Operating Conditions

Parameter	Minimum	Typical	Maximum	Unit
Frequency Range			750	MHz
RF Input Power, 50Ω Impedance, 750 MHz ⁽¹⁾			100	W
Pulsed Power (10% Duty Cycle, Input -			TBD	W (Peak)
On-State Resistance		300	500	mΩ
Off-State Capacitance		TBD		fF
On/Off Isolation @ 250MHz		TBD		dB
DC Standoff Voltage ⁽²⁾			+/-400	V
Steady State DC Current			2000	mA
Transient Current ⁽³⁾			TBD	mA
High Voltage Gate Bias (GATE)	75	77.5	80	V
GATE Pin Leakage Current @ 200 Volts		< 25		pA
Third-Order Output Intercept (OIP3)		>85		dBm
Second Order Harmonic (H2)		TBD		dBm
Switching Time (close or open operation) ⁽⁴⁾		8	10	μsec
Full Cycle Frequency			10	kHz
Switching Reliability (close + open cycle)	3x10 ⁹			Cycles
Hot Switching Current @ 1 Volt ⁽⁵⁾			10	mA
Operating Temperature Range	-20		+85	°C

Notes:

- 1) All parameters must be within recommended operating conditions. Maximum DC and RF power can only be applied during the on-state condition (cold-switched condition).
- 2) Requires MIDPOINT pin biased to the average voltage between the INPUT and the OUTPUT pins.
- 3) TBD
- 4) Requires 1.0 us GATE pin voltage rise time (10% - 90%)
- 5) This requirement is equivalent to switching the device with an inline 100 Ω resistor and 1 V applied across the resistor and switch combination.

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Typical Application

INPUT Pins

The MM7100 has 5 input pins named INPUT1 – INPUT5. They are internally connected inside the package, however, they shall be externally connected in the application, as close as possible to the package.

OUTPUT Pins

The 5 output pins are named OUTPUT1 – OUTPUT5. Like the INPUT pins, they are internally connected inside the package and shall also be externally connected in the application, as close as possible to the package.

GATE Pin

This pin is connected to the electrostatic actuation electrode used to close the two switch elements. The counter electrode is connected to the MIDPOINT pin that serves as the reference voltage for the actuation voltage applied at the GATE pin. The allowable voltages on the GATE pin are 0V and 77.5V (nominal, for min. and max., refer to Table 2).

MIDPOINT Pin

To ensure that the MIDPOINT pin operates at the correct DC voltage based on the INPUT and OUTPUT pin DC voltages, it is recommended to use a resistive divider as shown in Figure 3 . This ensures that the DC voltage applied to the MIDPOINT pin is correct for the open/OFF state, as well as for proper switch actuation and ON state closure.

Operation in Static Magnetic Fields

The MM7100 is designed to operate in environments with 1.5 T and 3.0 T static magnetic fields.

Magnetic Compatibility

The MM7100 is non-magnetic and B0 compatible.

Galvanic Isolation

The MM7100 provides galvanic isolation between control signals and contact path.

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Test and Evaluation Board

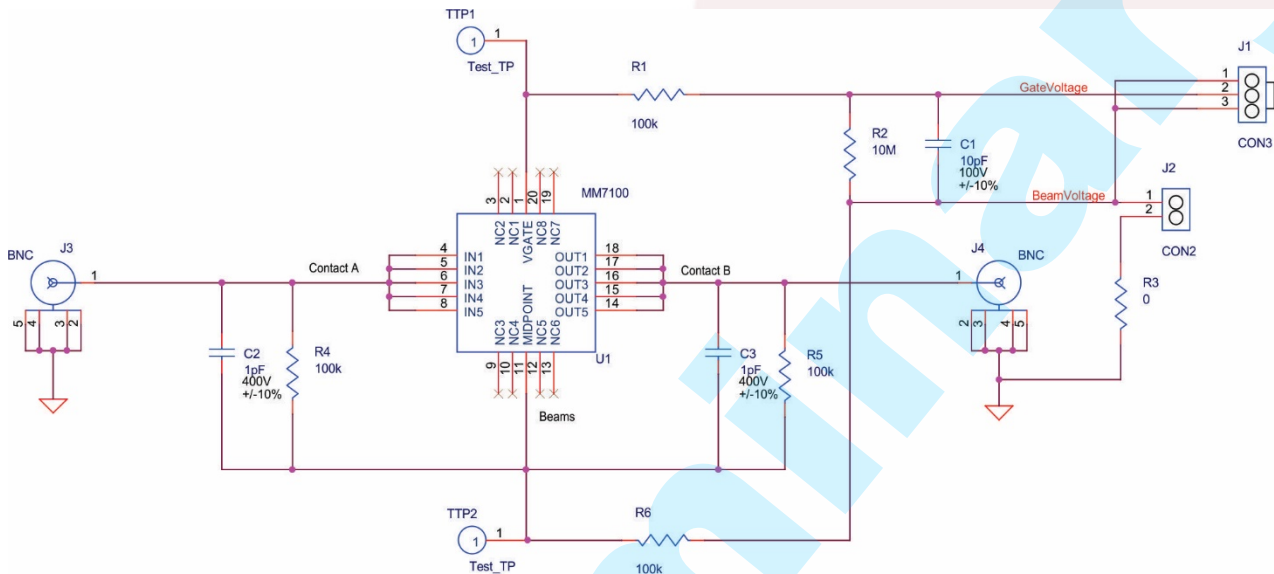


Figure 3: MM7100 evaluation board schematic. Note the resistive divider for the MIDPOINT pin and the 1 pF (400V) capacitors in parallel with the resistors.

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Device Pin Information

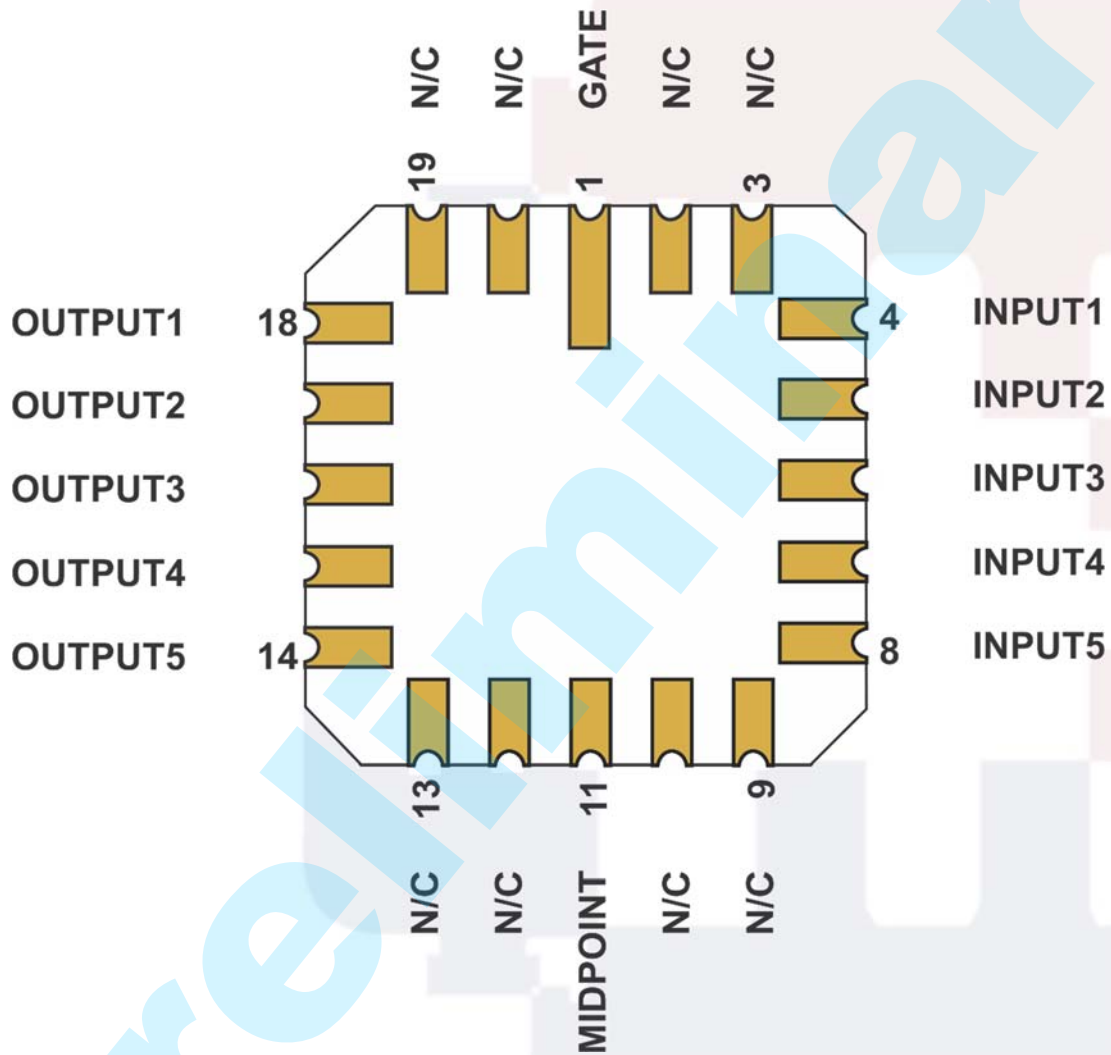


Figure 4: MM7100 20-Pin LCC Pinout (Bottom View)

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Device Pin Information

Table 3: Detailed Pin Description

Pin #	Pin Name	Description
1	GATE	Gate control to turn switch on/off, referenced to MIDPOINT pin.
2	N/C	Do Not Connect (Float)
3	N/C	Do Not Connect (Float)
4	INPUT1	Switch Input Pin
5	INPUT2	Switch Input Pin
6	INPUT3	Switch Input Pin
7	INPUT4	Switch Input Pin
8	INPUT5	Switch Input Pin
9	N/C	Do Not Connect (Float)
10	N/C	Do Not Connect (Float)
11	MIDPOINT	Beams Reference
12	N/C	Do Not Connect (Float)
13	N/C	Do Not Connect (Float)
14	OUTPUT1	Switch Output Pin
15	OUTPUT2	Switch Output Pin
16	OUTPUT3	Switch Output Pin
17	OUTPUT4	Switch Output Pin
18	OUTPUT5	Switch Output Pin
19	N/C	Do Not Connect (Float)
20	N/C	Do Not Connect (Float)

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Package Information

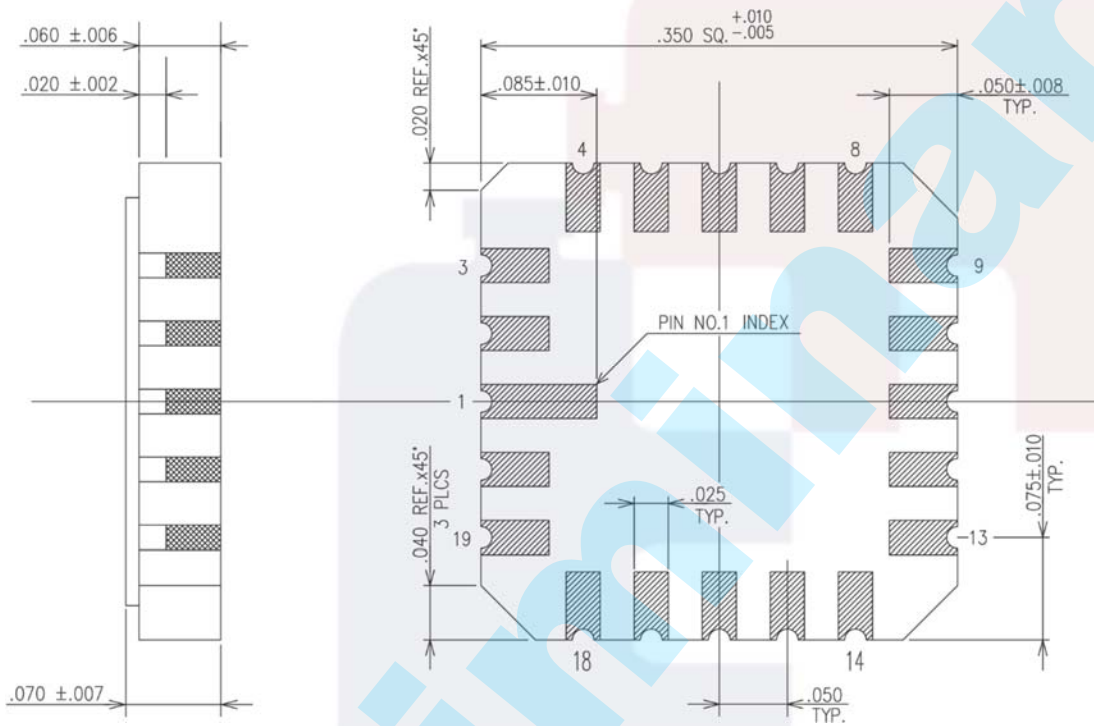


Figure 5: MM7100 Package Dimensions

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Package Marking Information

The MM7100 has a 18x18 2D barcode with a unique part identifier, as described in Figure 6 below.

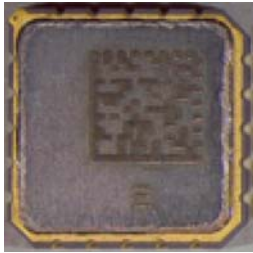


Figure 6: Package Markings

PER ECC200 FOR 35 ALPHANUMERIC CHARACTERS. THE CONTENT OF THE BARCODE IS:

CHARACTERS 1-6: PART NUMBER "MM7100,"
CHARACTERS 7-10: REVISION NUMBER OF PART "RXX,"
CHARACTERS 11-19: DATE "DDMMYYYY,"
CHARACTERS 20-27: LOT NUMBER "MRFXXXX,"
CHARACTERS 28-31: WAFER NUMBER "WXX,"
CHARACTERS 32-35: SERIAL NUMBER SERIES "XXXX"

Moisture Sensitivity Level (MSL)

The MM7100 as specified in this datasheet is MSL 3.

Shipping Information

The MM7100 is shipped in tape and reel.

Ordering Information

The MM7100 ordering part number is MM7100-00

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Important Information

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