

Advance Product Overview

Features

- DC to 12GHz Frequency Range
- 25 Watt (CW), 150W (Pulsed) Max Power Handling
- Low On-State Insertion Loss < 0.35 dB @ 6GHz
- High-linearity, IIP3 > 85dBm
- -25dB Isolation @ 6GHz
- Maximum voltage (AC or DC): +150 Volt on RF Input
- High Reliability > 3 Billion Switching Operations
- Integrated Analog Gate Control with HV Boost
- 4mm x 4mm 28 Lead LGA Package

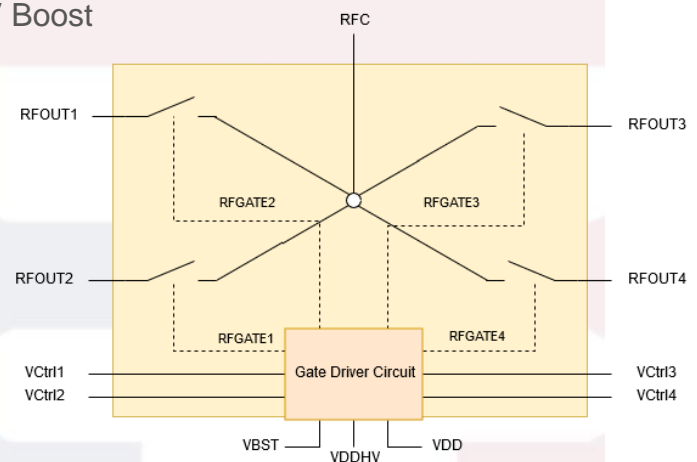


Applications

- Switched filter banks and tunable filters
- High power RF front ends
- Low-loss switch matrices
- RF EM relay replacement

Markets

- Defense and Aerospace
- Test and Measurement Systems
- Wireless Infrastructure



Functional Block Diagram

Description

The MM5120 device is a high power SP4T micro-mechanical switch offered by Menlo Micro. Menlo Micro has developed a new Digital-Micro-Switch (DMS) fabrication process and applied it to DC and wideband RF/microwave switch applications. This innovative DMS technology enables robust and highly reliable switches capable of greater than 25 watts. The MM5120 provides ultra-low insertion loss and superior linearity from 12GHz down to DC, with greater than 3 billion switching cycles guaranteed at elevated +85°C temperatures. An integrated analog gate driver allows the user to provide the required high-voltage gate signal externally, or to generate it internally. The MM5120 is an ideal solution for replacing large RF electromechanical relays, as well as RF/microwave solid-state switches where linearity and insertion loss are critical parameters.

Advance Electrical Characteristics

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 MM5120 should be restricted to the limits indicated in Table 2 recommended operating conditions listed below.

Electrostatic Discharge (ESD) Safeguards

When handling the MM5120, observe the same precautions as with any other ESD sensitive devices. Even though the MM5120 is protected from ESD damage, precautions must be taken to avoid exceeding the ratings specified in Table 1 below.

Susceptibility to Latch-Up

The MM5120 digital micro switch device is generally not susceptible to switch latch-up condition, which can occur in some semiconductor or MMIC type switch devices used in RF/microwave applications.

Table 1 Maximum Ratings¹

Parameter	Minimum	Maximum	Unit
Total CW Input Power / Switch		25	W
DC Voltage Rating / Switch (Input to Output)		+/-150	V
DC Current Rating / Switch		500	mA
Operating Temperature Range	-40	+85	°C
ESD Voltage All Pins ²		250	V
Storage Temperature Range	-70	+150	°C
DC Supply Voltage (V _{DD})	-0.3	4.0	V
Input Control Voltage	-0.3	V _{DD} +0.3	V

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 Per Human-Body Model

Table 2 Recommended Operating Conditions

Parameter	Minimum	Typical	Maximum	Unit
Operating Frequency Range	0	6	12	GHz
CW Power / Channel @ 6GHz ³			25	W
Peak Power / Channel @ 10% Duty Cycle ⁴			150	W
Insertion Loss @ 6GHz		0.35		dB
Insertion Loss @ 12GHz		0.75		dB
Input / Output Return Loss @ 6GHz		17		dB
Input / Output Return Loss @ 12GHz		11		dB
On / Off Isolation @ 6GHz		30		dB
On / Off Isolation @ 12GHz		28		dB
Channel to Channel Isolation @ 6GHz		25		dB
Third-Order Output Intercept (OIP3)		> 85		dBm
Second-Order Output Intercept (OIP2)		> 125		dBm
Max Rated Voltage			+/-150	VDC
Off / Open State Switch Rated Voltage (Input to Output) ⁵			+/- 150	V _{DC}
On / Closed State Switch Rated Voltage (Input to Output) ⁶			+/- 45	V _{DC}
Full Cycle Frequency			10	KHz
On / Off Switch Operations	3x10 ⁹			Cycles
Steady State Carry Current			500	mA

³ Maximum allowable Continuous Wave Power below 2MHz is 1W.

⁴ Duty Cycle based on 10 us period.

⁵ The voltage difference between RF Output (Beam) pin and Supply Voltage Return (V_{SS}) pin must be ±2.5V.

⁶ This rating applies for Frequencies below 10MHz. For frequencies above 10MHz, see *CW Power / Channel* and *Peak Power / Channel* specifications.

Table 2 Recommended Operating Conditions (Continued)

Parameter	Minimum	Typical	Maximum	Unit
Hot Switching Current @ 1 Volt			10	mA
Input to Output Leakage Current @ 150 V		< 19		pA
On-State Resistance		500	750	mΩ
High Voltage Gate Bias (V_{BB})	67.5	70	72.5	V_{DC}
High Voltage Gate Bias Current			TBD	uA
Low Voltage Supply (V_{DD})	3.0	3.3	3.6	V_{DC}
Low Voltage Ground (V_{SS})		0		V_{DC}
Input Control Voltage (V_{CTRL}) Logic High		V_{DD}		V_{DC}
Input Control Voltage (V_{CTRL}) Logic Low		0		V_{DC}
Operating Temperature Range	-40		+85	°C
Video Feedthrough ⁷		16		mV _{Peak}
Internal Oscillator Frequency		5		MHz
Internal Oscillator Feedthrough ^{8,9}		-110		dBm

⁷ Performed with 1 MΩ termination

⁸ The MM5120 has an internal oscillator. This oscillator drives the charge pump circuitry that provides the actuation voltage for each of the switch gate electrodes when enabled.

⁹ Internal Oscillator Feedthrough can be removed by operating in EXTERNAL HV DRIVE mode, see modes of operation.

Advance Package / Pinout Information

Figure 1 MM5120 4mm x 4mm package and pinout (Top View)

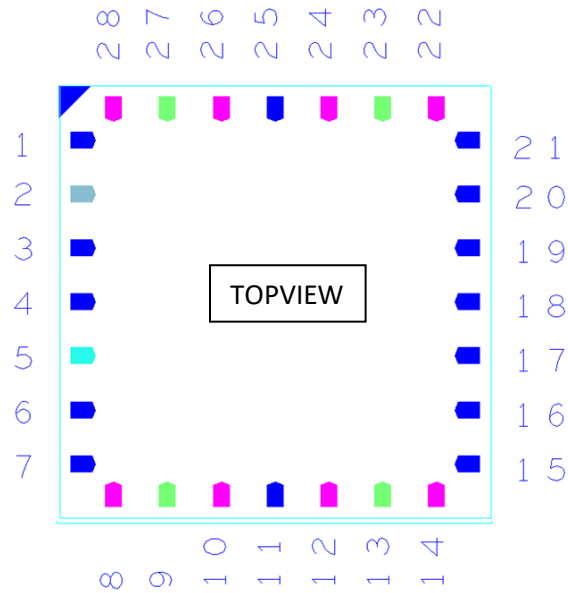


Table 3 Detailed Pin Description

Pin #	Function	Description
1,6,7,19,20,21,25	DNC	Do Not Connect
8,10,12,14,22,24,26,28	GND	RF Ground
2	V _{SS}	Digital Ground
3	V _{DDHV}	External High Voltage Supply
4	V _{BST}	Internally Generated High
5	V _{DD}	Low Voltage Bias Supply
9	RFOUT1	RF Output 1 (Contact)
11	RFC	RF Common Input (Contact)
13	RFOUT4	RF Output 4 (Contact)
15	V _{Ctrl4}	Gate Actuation Control RF4
16	V _{Ctrl3}	Gate Actuation Control RF3
17	V _{Ctrl2}	Gate Actuation Control RF2
18	V _{Ctrl1}	Gate Actuation Control RF1
23	RFOUT3	RF Output 3 (Contact)
27	RFOUT2	RF Output 2 (Contact)

Table 4 Voltage Control Truth Table when Logic levels are applied, 1 is High, 0 is Low

VCtrl4	VCtrl3	VCtrl2	VCtrl1	RFC – RF4	RFC – RF3	RFC – RF2	RFC – RF1
0	0	0	1	Off	Off	Off	On
0	0	1	0	Off	Off	On	Off
0	1	0	0	Off	On	Off	Off
1	0	0	0	On	Off	Off	Off

Modes of Operation

The MM5120 allows the user to provide the 70V gate bias required to drive the switch externally, or to have the MM5120 create the 70V gate bias internally through a dedicated boost circuit.

Modes of Operation

EXTERNAL HV DRIVE

If using external 70V:

V_{DDHV} = high voltage supply 70V max

V_{BST} = DO NOT CONNECT

V_{DD} = 3.3V

INTERNAL HV BOOST

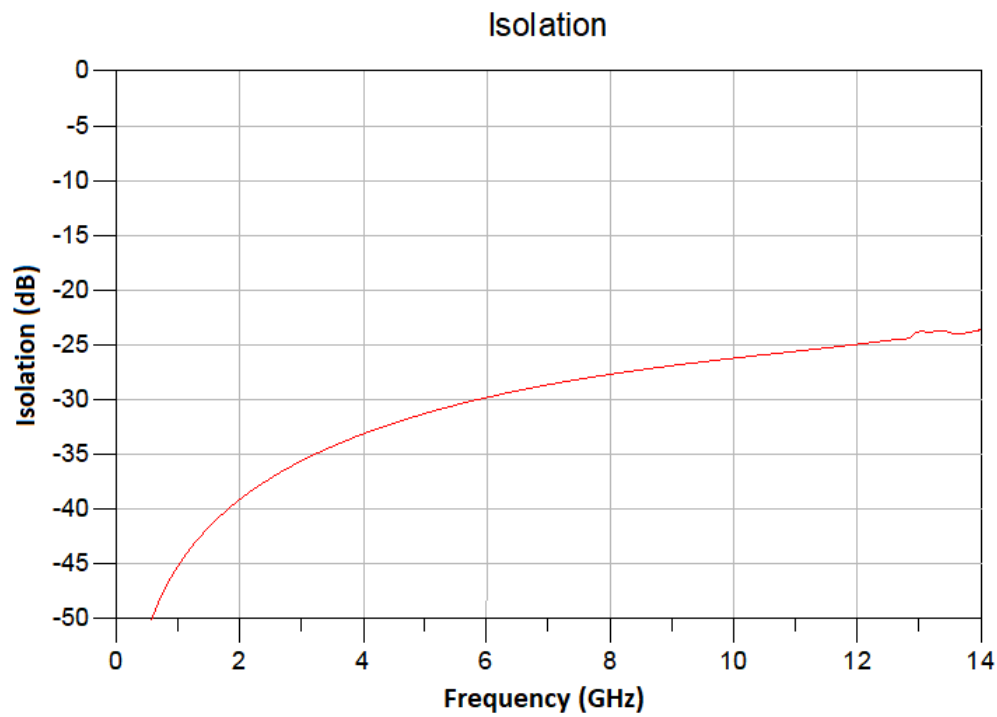
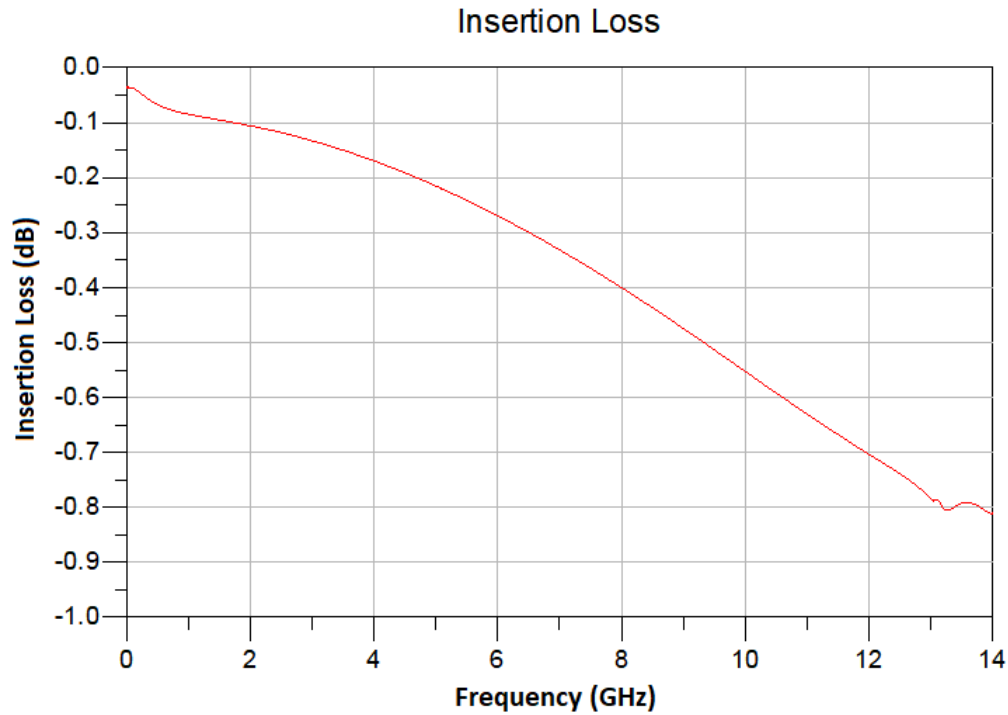
If using internal 70V:

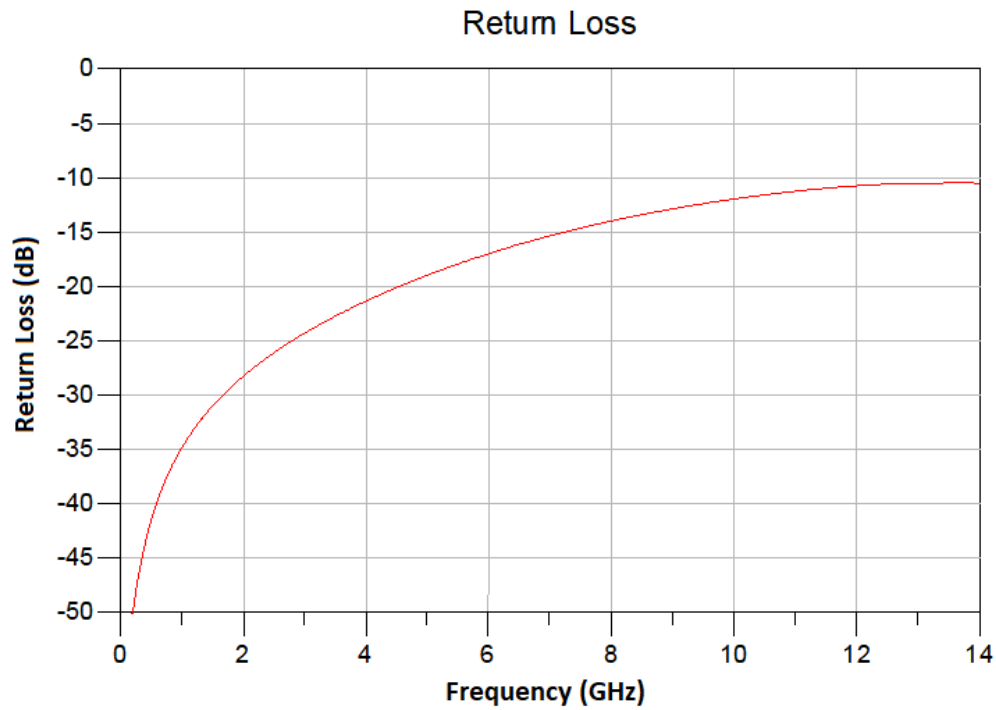
V_{DDHV} = DO NOT CONNECT

V_{BST} = inductor between V_{BST} and V_{DD}

V_{DD} = 3.3V (inductor between V_{BST} and V_{DD})

Advance RF Performance (3D simulated)





Important Information

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