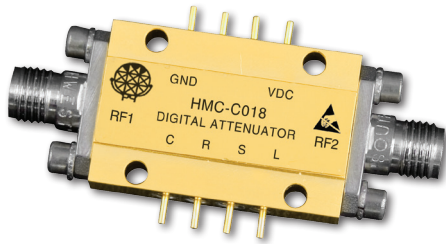


## 0.5dB LSB GaAs MMIC 6-BIT DIGITAL SERIAL CONTROL ATTENUATOR MODULE, DC - 13 GHz



### Features

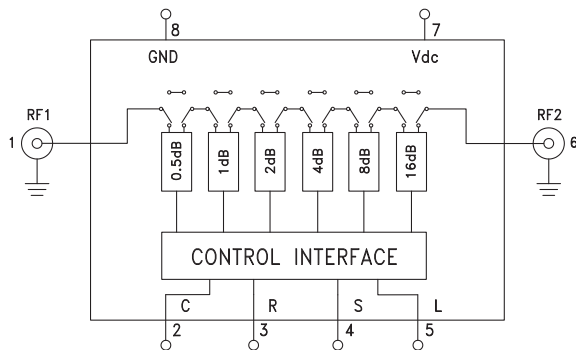
- 0.5 dB LSB Steps to 31.5 dB
- CMOS Compatible Serial Data Interface
- Typical Bit Error:  $\pm 0.3$  dB
- Hermetically Sealed Module
- Field Replaceable SMA Connectors
- 55 °C to +85 °C Operating Temperature

### Typical Applications

The HMC-C018 is ideal for:

- Telecom Infrastructure
- Military Radio, Radar & ECM
- Space Systems
- Test Instrumentation

### Functional Diagram



### General Description

The HMC-C018 is a DC to 13 GHz 6-bit GaAs IC Digital Serial Control Attenuator housed in a miniature hermetic module. This wideband attenuator features 3.6 dB typical insertion loss, +38 dBm input IP3, and bit values of 0.5 (LSB), 1, 2, 4, 8, and 16 dB for a total attenuation of 31.5 dB. Attenuation accuracy is excellent with  $\pm 0.3$  dB typical step error. A six bit CMOS compatible serial control word is used to select each attenuation state and a single Vdc bias of -5V allows operation at frequencies down to DC. Removable SMA connectors can be detached to allow direct connection of the module's I/O pins to a microstrip or coplanar circuit.

### Electrical Specifications, $T_A = +25$ °C, with Vdc = -5V and 0/+5V CMOS Control

Parameter	Frequency (GHz)	Min.	Typ.	Max.	Units
Insertion Loss	DC - 4.0 GHz		3.2	3.7	dB
	4.0 - 8.0 GHz		3.6	4.1	dB
	8.0 - 13.0 GHz		5.0	6.0	dB
Attenuation Range	DC - 13.0 GHz		31.5		dB
Return Loss (RF1 & RF2, All Atten. States)	DC - 8.0 GHz		15		dB
	8.0 - 13.0 GHz		10		dB
Attenuation Accuracy: (Referenced to Insertion Loss) All States 0.5 - 27.5 dB 28.0 - 31.5 dB All States	DC - 3.0 GHz	$\pm (0.2 + 3\% \text{ of Atten. Setting}) \text{ Max}$			dB
	3.0 - 10.0 GHz	$\pm (0.4 + 3\% \text{ of Atten. Setting}) \text{ Max}$			dB
	3.0 - 10.0 GHz	$\pm (0.5 + 6\% \text{ of Atten. Setting}) \text{ Max}$			dB
	10.0 - 13.0 GHz	$\pm (0.6 + 6\% \text{ of Atten. Setting}) \text{ Max}$			dB
Input Power for 0.1 dB Compression	1.0 - 13.0 GHz		22		dBm
Input Third Order Intercept Point (Two-Tone Input Power= 0 dBm Each Tone)	1.0 - 13.0 GHz	REF State	46		dBm
		All Other States	32		dBm
Switching Characteristics	DC - 13.0 GHz				
tRISE, tFALL (10/90% RF)			600		ns
tON/tOFF (50% CTL to 10/90% RF)			700		ns

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Application Support: Phone: 1-800-ANALOG-D

# HMC-C018\* PRODUCT PAGE QUICK LINKS

Last Content Update: 02/23/2017

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## COMPARABLE PARTS

View a parametric search of comparable parts.

## DOCUMENTATION

### Data Sheet

- HMC-C018 Data Sheet

## TOOLS AND SIMULATIONS

- HMC-C018 S-Parameter

## REFERENCE MATERIALS

### Technical Articles

- Hittite's Connectorized Modules Extend HMC-T2000 Synthesizer Performance

## DESIGN RESOURCES

- HMC-C018 Material Declaration
- PCN-PDN Information
- Quality And Reliability
- Symbols and Footprints

## DISCUSSIONS

View all HMC-C018 EngineerZone Discussions.

## SAMPLE AND BUY

Visit the product page to see pricing options.

## TECHNICAL SUPPORT

Submit a technical question or find your regional support number.

## DOCUMENT FEEDBACK

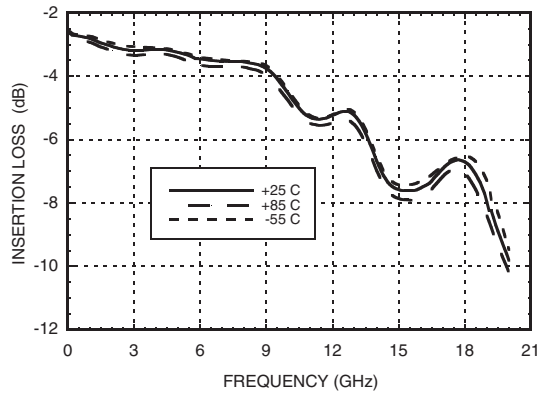
Submit feedback for this data sheet.

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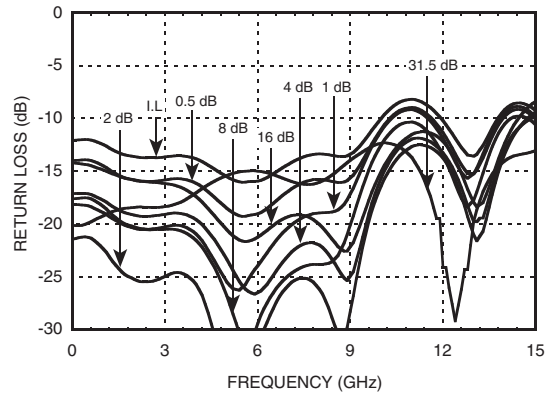


**0.5dB LSB GaAs MMIC 6-BIT DIGITAL SERIAL CONTROL ATTENUATOR MODULE, DC - 13 GHz**

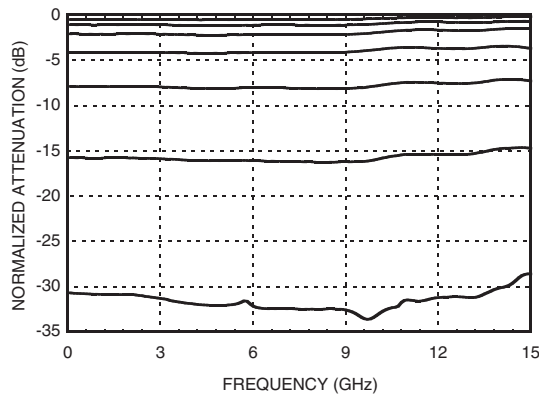
**Insertion Loss**



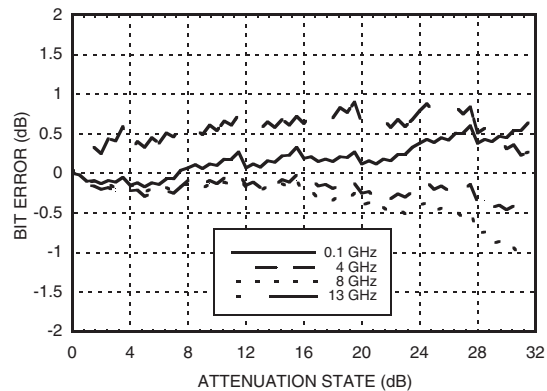
**Return Loss RF1, RF2**  
(Only Major States are Shown)



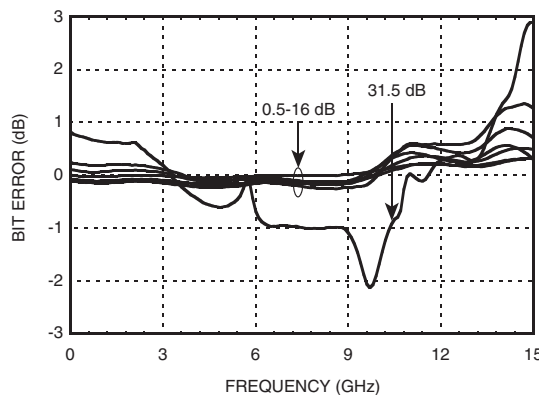
**Normalized Attenuation**  
(Only Major States are Shown)



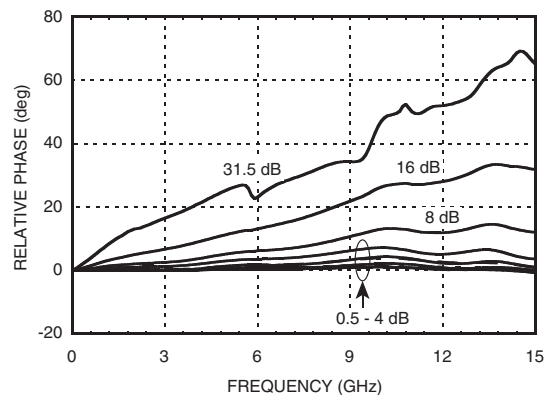
**Bit Error vs. Attenuation State**



**Bit Error vs. Frequency**  
(Only Major States are Shown)



**Relative Phase vs. Frequency**  
(Only Major States are Shown)



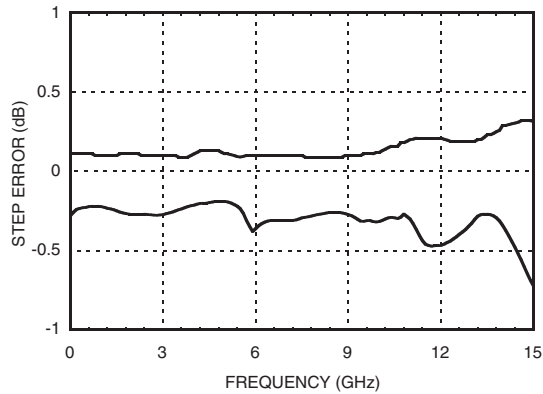
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## 0.5dB LSB GaAs MMIC 6-BIT DIGITAL SERIAL CONTROL ATTENUATOR MODULE, DC - 13 GHz



### Worst Case Step Error Between Successive Attenuation States



### Absolute Maximum Ratings

Digital Inputs (Reset, Shift Clock, Latch Enable & Serial Input)	-0.5V to +5.5V
Bias Voltage (VDC)	-7.0 Vdc
Storage Temperature	-65 to + 150 °C
Operating Temperature	-55 to +85 °C
RF Input Power (0.5 - 13.0 GHz)	+25 dBm



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

### Bias Voltage & Current

VDC Range= -5.0 Vdc ± 10%		
VDC	Idc (Typ.) (mA)	Idc (Max.) (mA)
-5.0	5	9

### CMOS Control Voltages

State	Bias Condition
Low	0 to +1.3V
High	+3.5 to +5.0V

### Serial Input Truth Table

Latch Enable	Shift Clock	Reset	Function
X	X	L	Shift register cleared
X	↑	H	Shift register clocked
↑	X	H	Contents of shift register transferred to Digital Attenuator

### Truth Table

Serial Control Input						Attenuation Settings RF1 - RF2
C0.5	C1	C2	C4	C8	C16	
H	H	H	H	H	H	Reference I.L.
L	H	H	H	H	H	0.5 dB
H	L	H	H	H	H	1 dB
H	H	L	H	H	H	2 dB
H	H	H	L	H	H	4 dB
H	H	H	H	L	H	8 dB
H	H	H	H	H	L	16 dB
L	L	L	L	L	L	31.5 dB

Any combination of the above states will provide an attenuation approximately equal to the sum of the bits selected.

## 0.5dB LSB GaAs MMIC 6-BIT DIGITAL SERIAL CONTROL ATTENUATOR MODULE, DC - 13 GHz

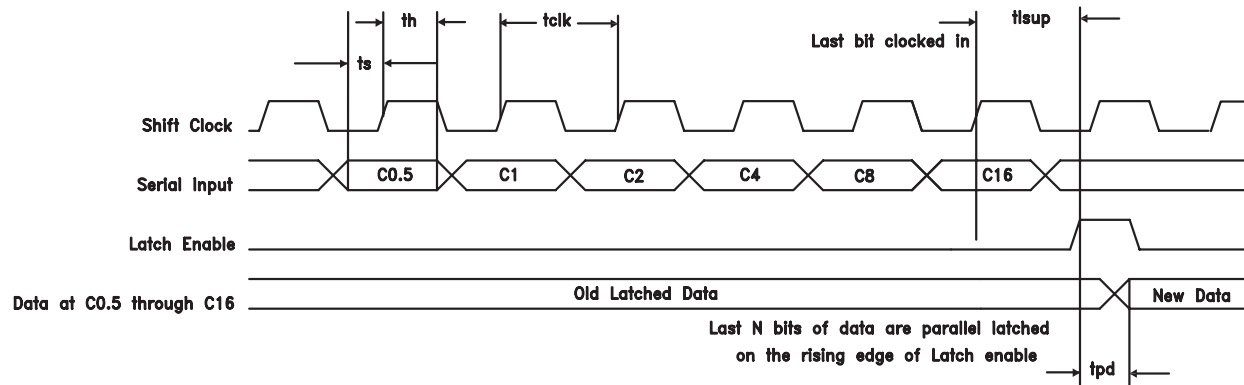


### Timing

Parameter	Symbol	Min.	Max.	Units
Serial Input Setup Time	ts	20	-	ns
Hold time from Serial Input to Shift Clock	th	0	-	ns
Setup time from Shift Clock to Latch Enable	tisup	40	-	ns
Propagation delay, Latch Enable to C0.5 through C8	tpd	-	30	ns
Setup time from Reset to Shift Clock	-	20	-	ns
Clock Frequency (1/tclk)	fclk	-	30	MHz

### Timing Diagram

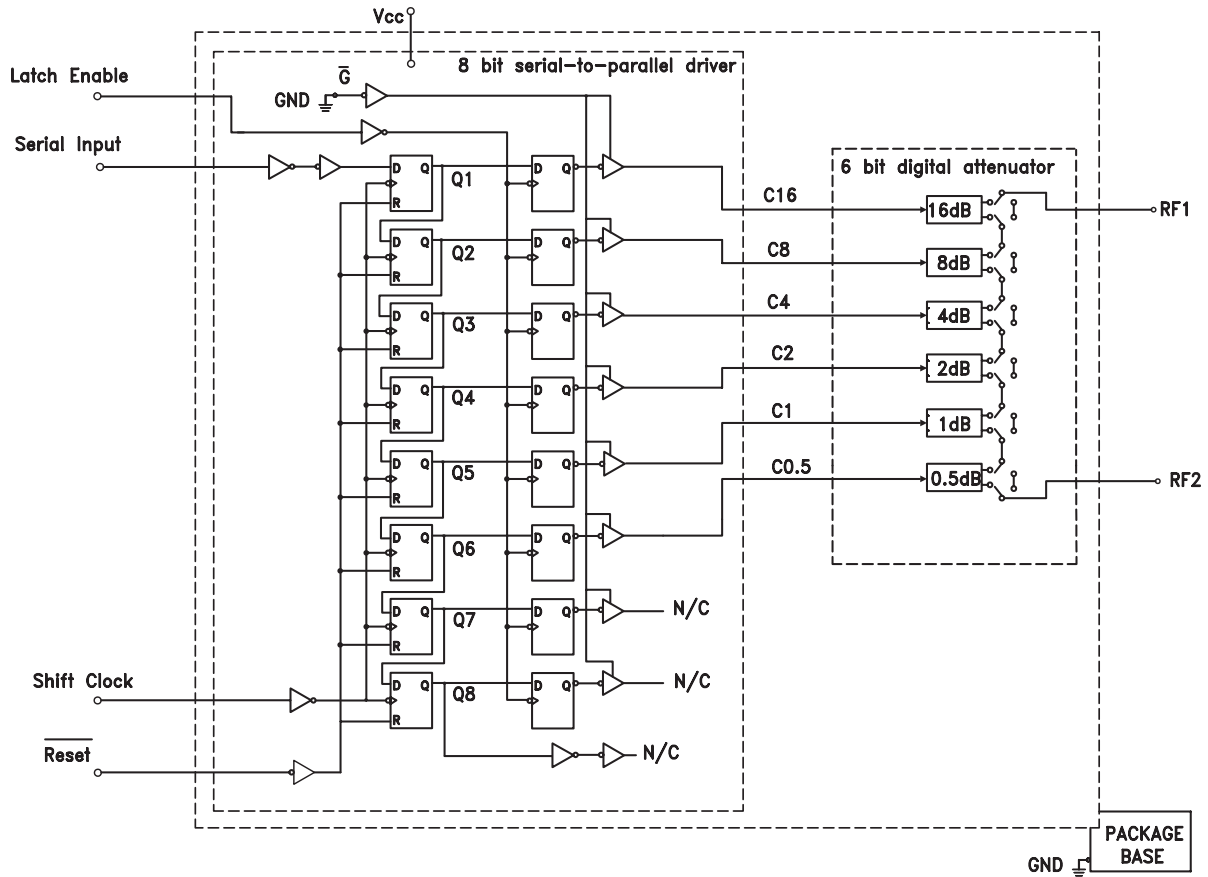
Serial data is shifted in on the rising edge of the Shift Clock, LSB first, and is latched on the rising edge of Latch Enable.





**0.5dB LSB GaAs MMIC 6-BIT DIGITAL  
SERIAL CONTROL ATTENUATOR MODULE, DC - 13 GHz**

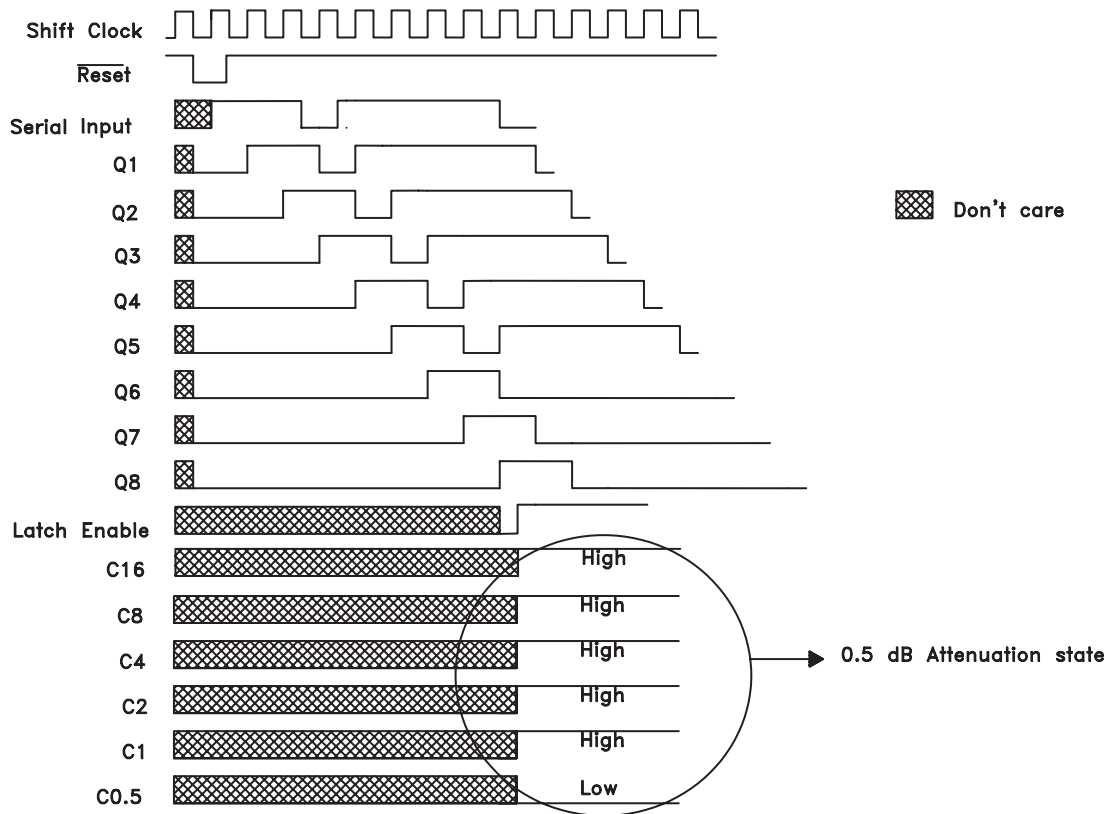
**Logic / Functional Diagram**





**0.5dB LSB GaAs MMIC 6-BIT DIGITAL  
SERIAL CONTROL ATTENUATOR MODULE, DC - 13 GHz**

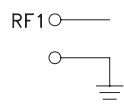
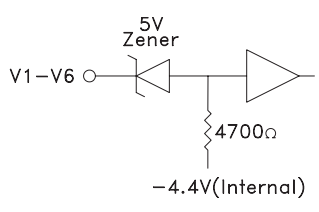
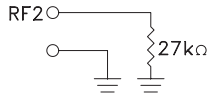
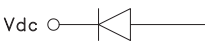

**Programming Example to Select 0.5 dB Attenuation State**



## 0.5dB LSB GaAs MMIC 6-BIT DIGITAL SERIAL CONTROL ATTENUATOR MODULE, DC - 13 GHz



### Pin Description

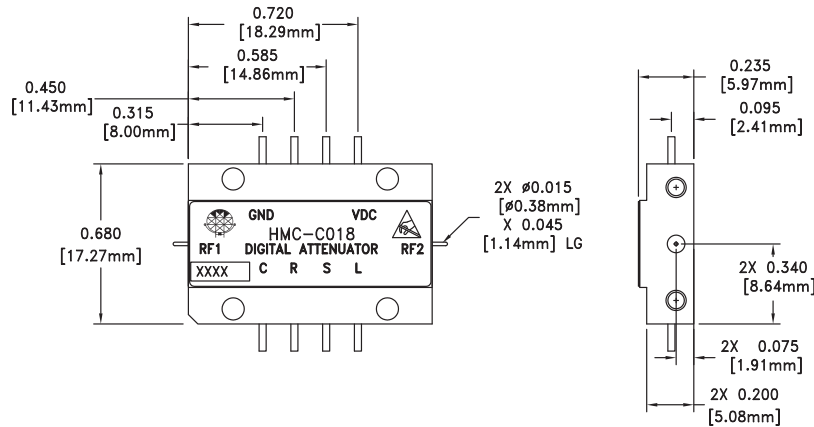
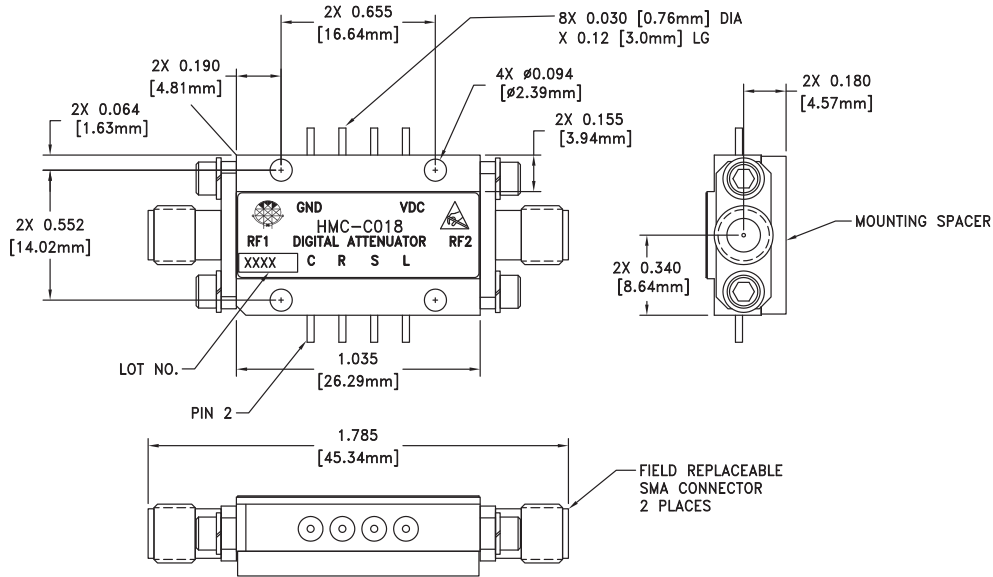
Pin Number	Function	Description	Interface Schematic
1	RF1	This pin is DC coupled and matched to 50 Ohms. Blocking capacitors are required if RF line potential is not equal to 0 Vdc.	
2	C	Shift Clock	
3	R	Reset	
4	S	Serial Input	
5	L	Latch Enable	
6	RF2	This pin is DC coupled and matched to 50 Ohms. Blocking capacitors are required if RF line potential is not equal to 0 Vdc.	
7	Vdc	Supply voltage: -5 Vdc ±10%. (Internal diode for reverse bias protection)	
8	GND	Power Supply Ground	



**0.5dB LSB GaAs MMIC 6-BIT DIGITAL SERIAL CONTROL ATTENUATOR MODULE, DC - 13 GHz**



**Outline Drawing**



VIEW SHOWN WITH CONNECTORS REMOVED

**Package Information**

Package Type	C-6
Package Weight [1]	17.4 gms [2]
Spacer Weight	3 gms [2]

[1] Includes the connectors

[2] ±1 gms Tolerance

**NOTES:**

1. PACKAGE, LEADS, COVER MATERIAL: KOVAR™
2. PLATING: ELECTROLYTIC GOLD 50 MICROINCHES MIN., OVER ELECTROLYTIC NICKEL 75 MICROINCHES MIN
3. MOUNTING SPACER: NICKEL PLATED ALUMINUM
4. ALL DIMENSIONS ARE IN INCHES [MILLIMETERS]
5. TOLERANCES ±0.010 [0.25] UNLESS OTHERWISE SPECIFIED
6. FIELD REPLACEABLE SMA CONNECTORS TENSOLITE 5602 - 5CCSF OR EQUIVALENT
7. TO MOUNT MODULE TO SYSTEM PLATFORM REPLACE 0 -80 HARDWARE WITH DESIRED MOUNTING SCREWS

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