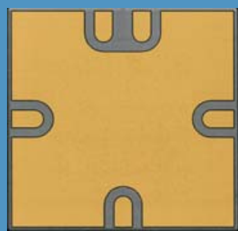
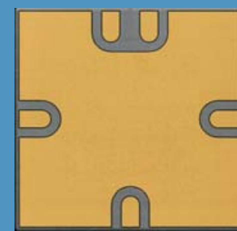
Series InP1012

SPDT DC - 20GHz Active RF Switch



SURFACE MOUNT HIGH FREQUENCY, ACTIVE RF SWITCH SPDT



SERIES	SWITCH TYPE
InP1012	Solid State, InP-HEMT Active RF Switch

DESCRIPTION

The InP1012-20 is a highly compact, reflective SPDT Active RF switch, manufactured using Teledyne's high-speed, low-loss InP HEMT process. The switch die is packaged in a low-loss, surface mount package, with a small form factor: 3mm (L) × 3mm (W) × 1mm (H). It supports a wide frequency range from DC to 20 GHz, and delivers low insertion loss, fast switching time, and good isolation—making this switch ideal for test and measurement, microwave communications, and radar applications. The InP1012-20 can also tolerate up to 100 krads of radiation, allowing it to be used in space applications.

The InP1012-20 features:

- Broad frequency bandwidth, greater than 20 GHz
- Small form factor, 3mm X 3mm X 1mm
- Low insertion loss
- Very High linearity
- Wide operating temperature
- Radiation tolerant up to 100 krads
- Very fast switching time of less than 100 ns
- RoHS Compliant

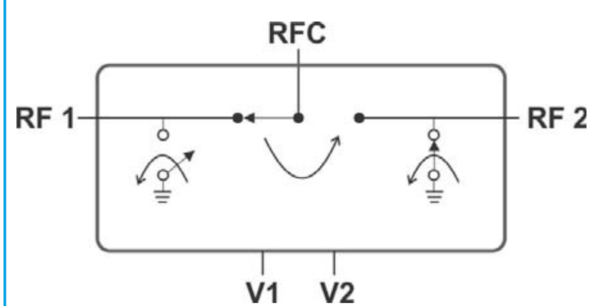
The following unique construction features and manufacturing techniques provide excellent robustness to environmental extremes and overall high reliability:

- Monolithic solid-state switch with no mechanical wear
- Flip-chip packaging provides shock & vibration resistance
- ENEPIG surface finish for solder bonding
- Low loss package with organic overmold
- Test board with K-connectors can be provided

ENVIRONMENTAL AND PHYSICAL SPECIFICATIONS

Temperature (Ambient)	**Storage**	–65°C to +125°C
	Operating	–65°C to +125°C
Enclosure		Low-Loss Surface Mount Package
ESD Sensitivity (HBM)		Class 1
MSL Sensitivity		TBD
Radiation Tolerance		100krads

INTERNAL CONSTRUCTION



Teledyne Part Numbering System for InP1012

InP1012 - 20 / TR

- **Relay Series**: InP1012
- **Frequency (GHz)**: 20
- **Packaging Option**: TR = Tape & Reel

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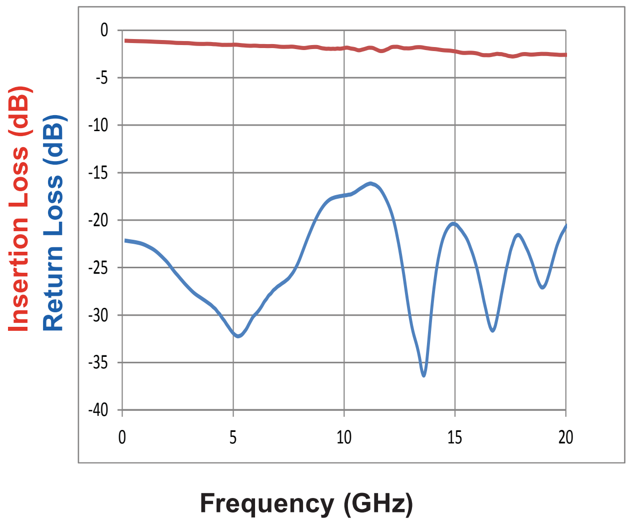
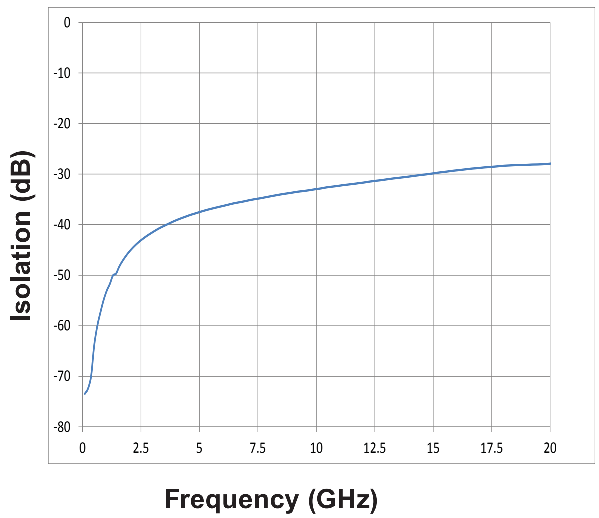
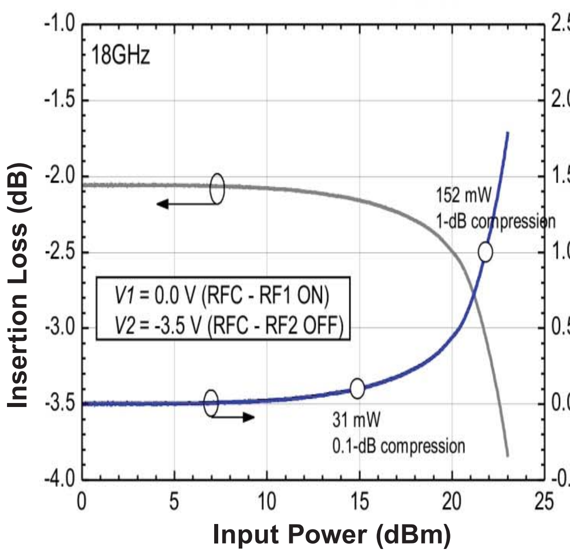
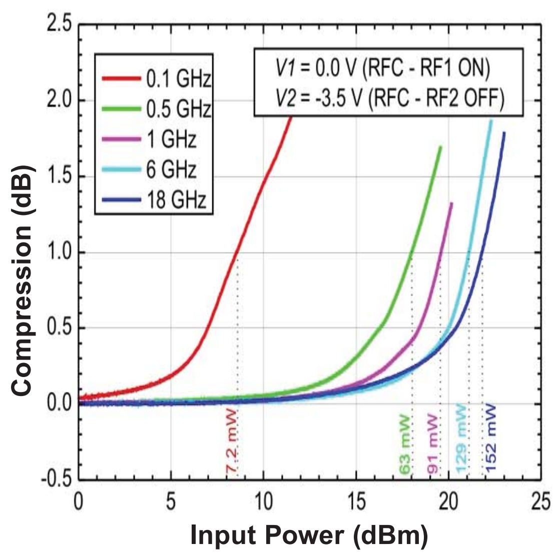
InP1012-20
TYPICAL RF CHARACTERISTICS (See RF Notes)





TYPICAL POWER HANDLING CHACTERISTICS





RF NOTES

1. Test conditions:
   a. Fixture: .020” RO4350B, ENIG plated, with 2.4 mm connectors. (Trademark of Rogers Corporation.)
   b. RF ground pad is soldered to PCB RF ground plane.
   c. Room ambient temperature.
   d. Terminals not tested were terminated with 50-ohm load.
   e. Contact signal level: –10 dBm.
   f. No. of test samples: 1.
2. Data presented herein represents typical characteristics and is not intended for use as specification limits.

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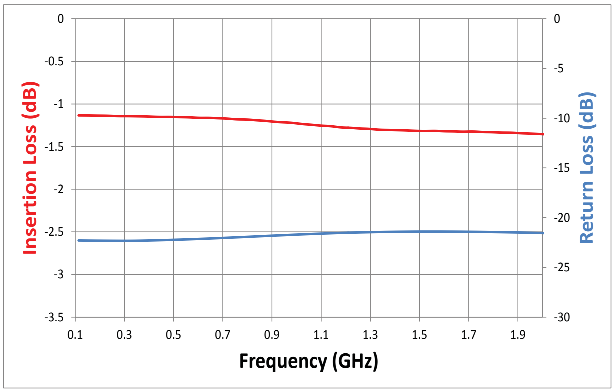
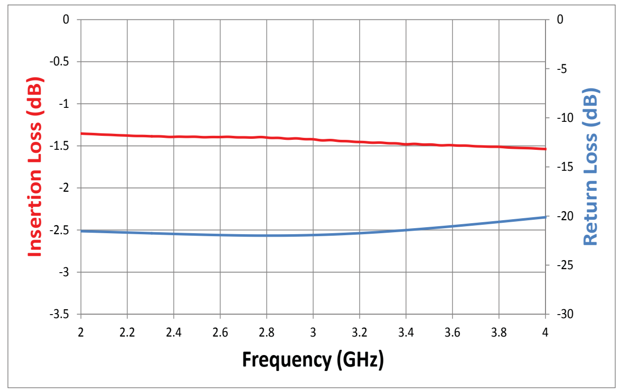
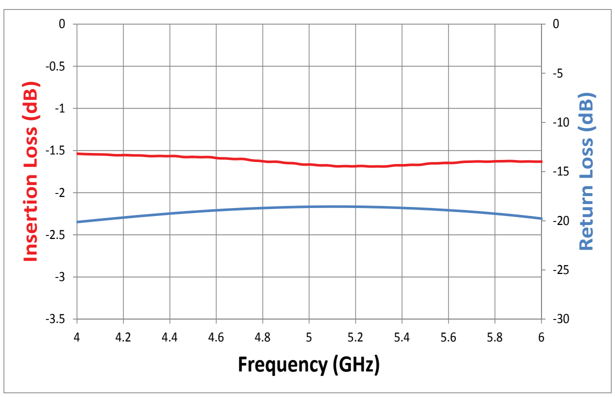
NARROWBAND INSERTION LOSS AND RETURN LOSS PLOTS



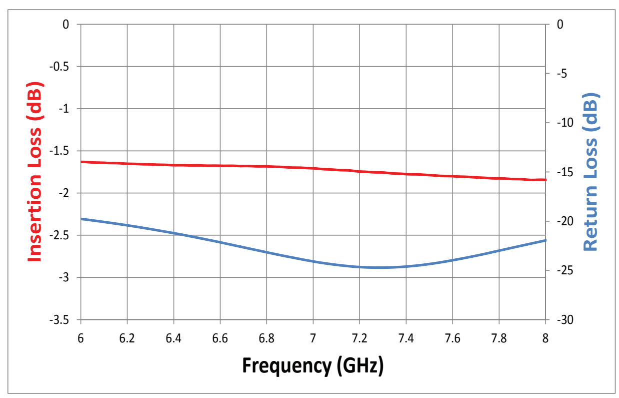
0.1 - 2 GHz



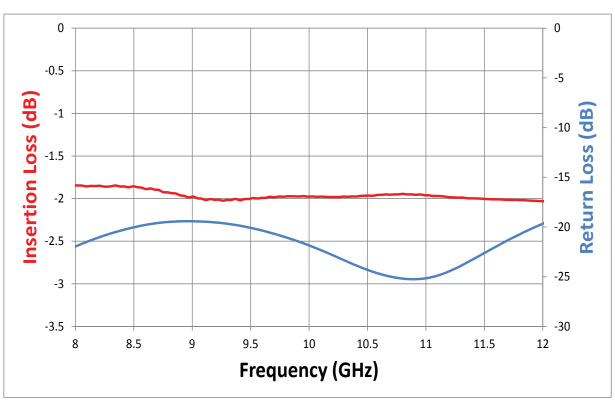
2 - 4 GHz



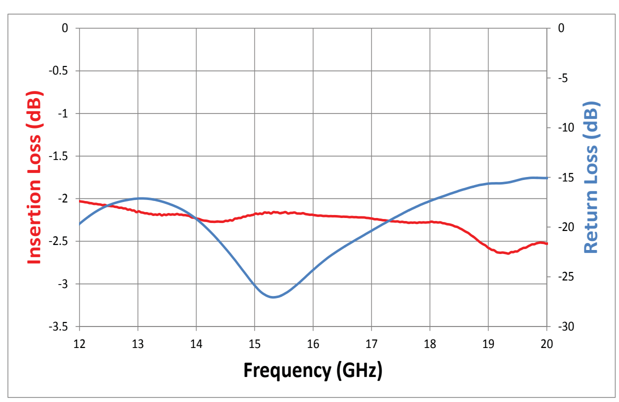
4 - 6 GHz



6 - 8 GHz



8 - 12 GHz



12 - 20 GHz

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TYPICAL ELECTRICAL SPECIFICATIONS (@25°C, V1 = ON, V2 = OFF OR V1 = OFF, V2 = ON, $Z_S = Z_L$ = 50 Ω)
OPERATING FREQUENCY: DC - 20GHz

Parameter/Condition	Path	Condition	Typical	Unit
Insertion Loss	RFC-RFX	DC (20mV - 200mV)* 10 kHz 100 MHz 2 GHz 4 GHz 6 GHz 8 GHz 12 GHz 16 GHz 20 GHz	2.0 0.9 1.2 1.4 1.5 1.8 1.7 1.9 2.3 2.5	dB dB dB dB dB dB dB dB dB dB
Isolation	RFC-RFX	10 kHz 100 MHz 2 GHz 4 GHz 6 GHz 8 GHz 12 GHz 16 GHz 20 GHz	67 60 43 40 36 34 31 29 26	dB dB dB dB dB dB dB dB dB
Isolation	RF1-RF2	100 MHz 100 MHz - 20 GHz	69 32	dB dB
Return Loss (active port)	RFC-RFX	100 MHz 2 GHz 4 GHz 6 GHz 8 GHz 12 GHz 16 GHz 20 GHz	23 22 20 20 20 20 24 15	dB dB dB dB dB dB dB dB
Input 0.1dB compression point		100 MHz 6 GHz 18 GHz	3.1 15.7 14.9	dBm dBm dBm
Input 1dB compression point		100 MHz 6 GHz 18 GHz	8.6 21.1 21.8	dBm dBm dBm
Input 3rd Order Intercept (IIP3)		10GHz	37.5	dBm

* Insertion loss increases with a higher DC offset, up to the 2.5Vdc Max.

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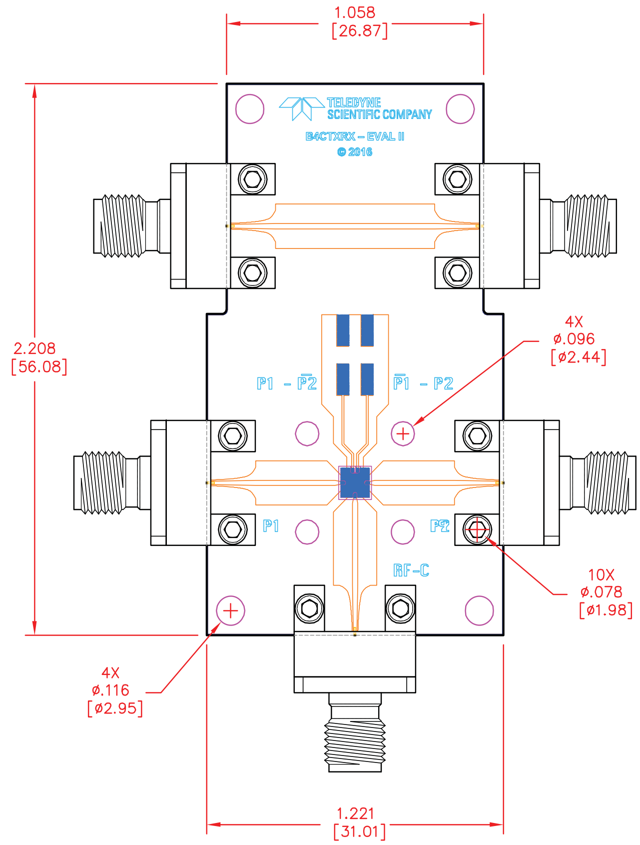
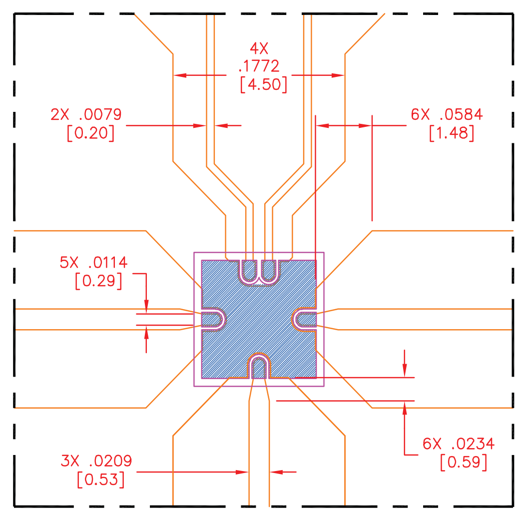
Evaluation Board





Note: RF and Signal Integrity measurements were made using the custom-built test board shown above.
Fixture: .020" RO4350B, ENIG plated, with SMA connectors (Trademark of Rogers Corporation.)
RF ground pad is soldered to PCB RF ground plane.

To order the Evaluation Board, please use the following part number:

InP1012 - 20 / K

- InP1012 — **Relay Series** InP1012
- 20 — **Frequency (GHz)**
- K — **Evaluation Board**

GENERAL ELECTRICAL SPECIFICATIONS (@25°C)

Contact Arrangement	1 Form C (SPDT)
Rated Duty	Continuous
Operating Power	1-2 mW
Switching Time	60-100 ns

Note: Use DC blocking capacitors at RF ports.

RECOMMENDED OPERATING CONDITIONS

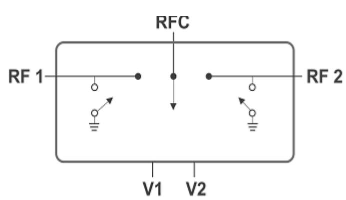
Parameter	MIN	TYPICAL	MAX	UNIT
Control ON (V1,V2)	-0.3	0	+0.3	V
Control OFF (V1,V2)	-2.0	-2.5	-3.0	V
Control Current		200	700	µA

Note: Operation between -0.3V and -2.0V is not recommended.

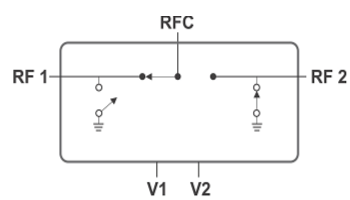
SWITCH STATES

V1	V2	RF1	RF2	STATE
-2.5V	-2.5V	OFF	OFF	1
-2.5V	0V	OFF	ON	2
0V	-2.5V	ON	OFF	3
0V	0V	ON	ON	4

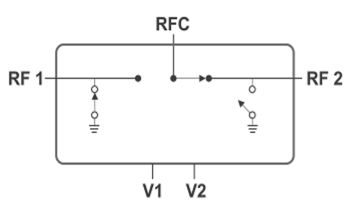
State 1



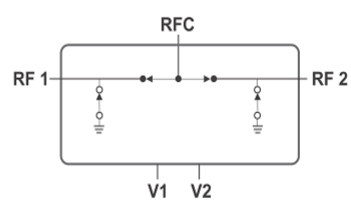
State 3



State 2



State 4



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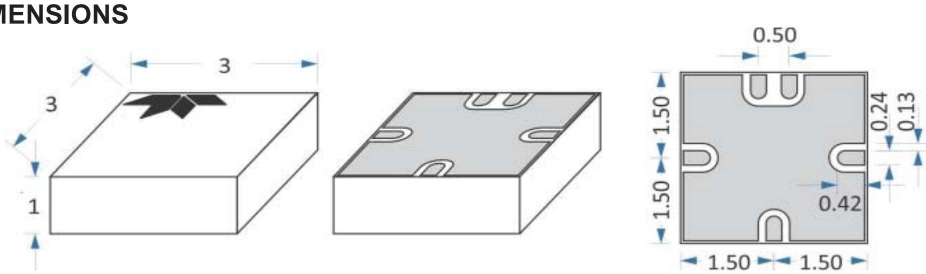
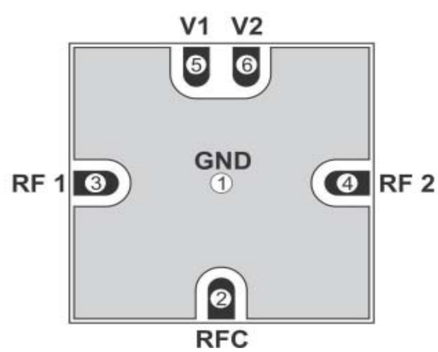
ABSOLUTE RATINGS

Parameter/Condition	MIN	MAX	UNIT
Control Voltage (V1,V2)	-3.0	+0.3	V
RF Input Power P1.0 dB (RFC-RFX, 50Ω)		8.6 @ 100 MHz 21.1 @ 6 GHz 21.8 @ 18 GHz	dBm dBm dBm
RF Contact Maximum DC Offset		2.5	V
Maximum Junction Temperature*		+180 (est.)	°C
Storage Temperature Range*	-65	+180 (est.)	°C

*InP die: 200°C for 30hours, BCB cure temperature: 250°C for 1hour, PbSn solder reflow temperature: 250°C for 1min, Pb37/Sn63 solder melting point: 183°C, MEG-TRON 6 substrate: 260°C, Sumitomo G770 epoxy overmold: 260°C

InP1012-20
OUTLINE DIMENSIONS

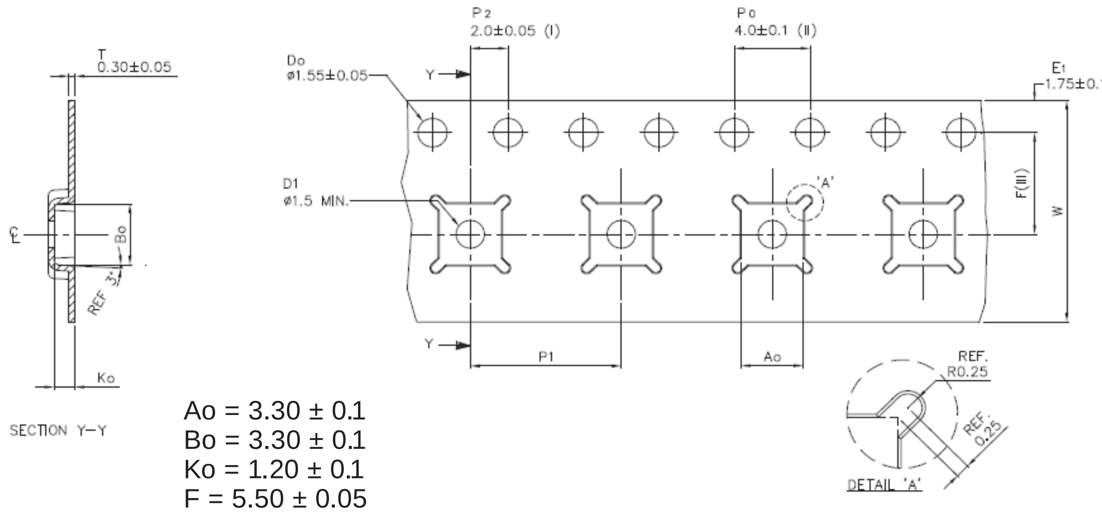




Note: Dimensions are in metric (mm).

Pad No.	Pad Name	Description
1	GND	Ground
2	RFC	RF Common Port
3	RF1	RF Port 1
4	RF2	RF Port 2
5	V1	Control Input 1
6	V2	Control Input 2

TAPE AND REEL PACKAGING OPTIONS



Ao = 3.30 ± 0.1
Bo = 3.30 ± 0.1
Ko = 1.20 ± 0.1
F = 5.50 ± 0.05
P1 = 8.00 ± 0.1
W = 12.00 ± 0.3

Notes:

1) **Cumulative Tolerance for 10 Sprocket Holes ± 0.2mm**
2) **Ao and Bo measured from a plane 0.3mm above bottom of pocket**
3) **Pocket position relative to sprocket hole and true positon of pocket**
4) **Tape Engineered to comply with ANSI/EIA 481 B (July 2002)**
5) **Material does not contain heavy metals**
6) **Camber in compliance with ANSI/EIA 481 B (July 2002)**

DIE INFORMATION

PARAMETER	MIN	TYP	MAX	UNIT	TEST CONDITION
Die Size, Singulated (x,y)	820 x 950	830 x 960	840 x 970	µm	Including excess InP, maximum tolerance = ±10 µm
Wafer Thickness	615	625	635	µm	
Bump Pitch	150			µm	
Bump Height	50	60	70	µm	
Bump Diameter		79		µm	
UBM Diameter	65	69	74	µm	

Contact factory for die RF performance and additional information.

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Handling Guidelines for HEMT RF Switches (InP Series)

1. Do not drop, throw, or in any way mishandle individual switches or cartons containing switches.
2. Store switches in a humidity-controlled, shock- and vibration-free environment. Storage temperature range limits are –65°C to +125°C, however, when possible, switches should be stored in an ambient environment.
3. Do not expose switches to humid condition such that condensation may be formed due to sudden drop in temperature. Switches shall be stored in condensation free condition.
4. Do not stack heavy objects directly onto switches.
5. Active RF switches shall be treated as Electrostatic Discharge (ESD) sensitive and shall be handled accordingly. Always work in ESD protected station and wear wrist strap before handling the device.
6. When removing switches from packs, do so with extreme care. Do not allow the switches to fall onto any hard surface during unpacking. Do not "pour" the switches from the packing. Do not allow switches to fall onto the floor.
7. When transferring switches to a production area after unpacking, do so only in a suitable container, transport the devices in anti-static container, taking care not to drop the switches into the container, or to drop, throw or mishandle the container in any way.
8. For either metal-cover switches that are hermetically sealed or plastic switches that are not hermetically sealed, any damage to the casing, leads, or connector may compromise the relay's performance and reliability.
9. Never subject switches to ultrasonic cleaning environment.
10. Do not submerge plastic switches, which are not hermetically sealed, in cleaning solution or spray aqueous cleaning solution directly onto switches.
11. For plastic switches, which are not hermetically sealed, switches should be baked before use. After bake, switches must be mounted within 8 hours. Switches must be baked again if this 8 hour time period is exceeded. The recommended bake profile is 125°C for 1 hour.
12. After the reflow/mounting process, switches should be baked again after cleaning, prior to a second reflow, or prior to conformal coating.
13. Unless otherwise specified, do not subject switches and relay terminals to reflow solder temperatures above 245°C, 6 seconds maximum. If hand soldering is used, the solder iron tip shall be properly grounded. Observe IPC J-HDBK- 001, paragraph 6.1.0.1 guidelines for heat sensitive components when hand soldering switches.
14. If reshipping product do so in original packaging from factory.
15. Switches should not be exposed to any process or environment that exceeds any limits within this guideline or any published specification that applies to the relay.