United Monolithic Semiconductors

CHT3091-FAB

DC-14GHz Attenuator

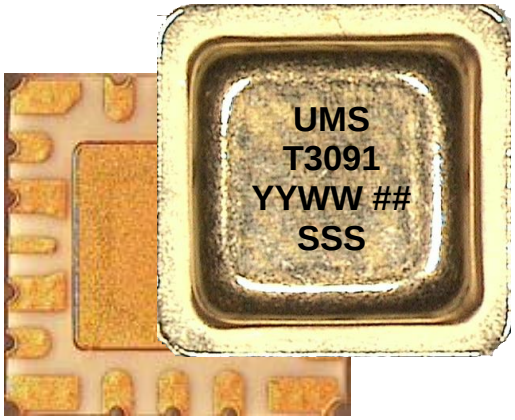
GaAs Monolithic Microwave IC in SMD leadless package

Description

The CHT3091-FAB is a variable DC-14GHz attenuator designed for a wide range of applications, from space, military to commercial communication systems.

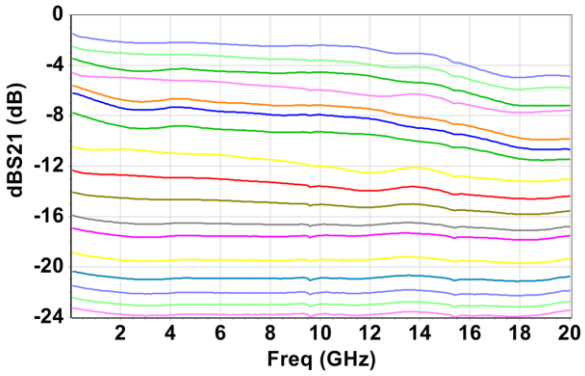
It is proposed in leadless surface mount hermetic metal ceramic 6x6mm² package. The circuit is manufactured with a MESFET process, 0.7µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.

It is supplied in RoHS compliant SMD package.



Main Features

- Broadband performances: DC-14GHz
- 15dBm typical input @1dB compression point (any attenuation, 1-14GHz)
- DC bias: -5V<V_S<0V ; -5V<V_P<0V
- 6x6mm² hermetic metal ceramic package



Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
F_{in}	Input frequency range	DC		14	GHz
Min Att.	Minimum attenuation |S21| (V_S=0V;V_P=-5V)		2.5		dB
Max Att.	Maximum attenuation |S21|(V_S=-5V;V_P=0V)	20	23		dB
P_{in}1dB	Input 1dB comp. point (any Att., F_{in} > 1GHz)		15		dBm

ESD Protection: Electrostatic discharge sensitive device. Observe handling precautions!

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Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
F_{in}	Input frequency range	DC		14	GHz
Min Att.	Minimum attenuation |S21| (V_S=0V;V_P=-5V)		2.5	4.0	dB
Max Att.	Maximum attenuation |S21| (V_S=-5V;V_P=0V)	20	23		dB
$VSWR_{in}$	Input VSWR (any attenuation)		2:1		
$VSWR_{out}$	Output VSWR (any attenuation)		2:1		
P_{in}1dB	Input 1dB compression point (any attenuation, 1 – 14GHz)		15		dBm

These values are representative of on board measurements as defined on the drawing 503566 (see below).

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Absolute Maximum Ratings (1)

Tamb.= +25°C

Symbol	Parameter	Values	Unit
V_S	V_S control voltage	-6V to +0.6V	V
V_P	V_P control voltage	-6V to +0.6V	V
Tj	Junction temperature	175	°C
P_{in}	RF input power	20	dBm

(1) Operation of this device above anyone of these parameters may cause permanent damage.

Temperature Range

Ta	Operating temperature range	-40 to +85	°C
Tstg	Storage temperature range	-50 to +150	°C

Typical Bias Conditions

Tamb.= +25°C

Symbol	Pad Nº	Parameter	Values	Unit
V_S	2	V_S control voltage	0 to -5	V
V_P	4	V_P control voltage	-5 to 0	V

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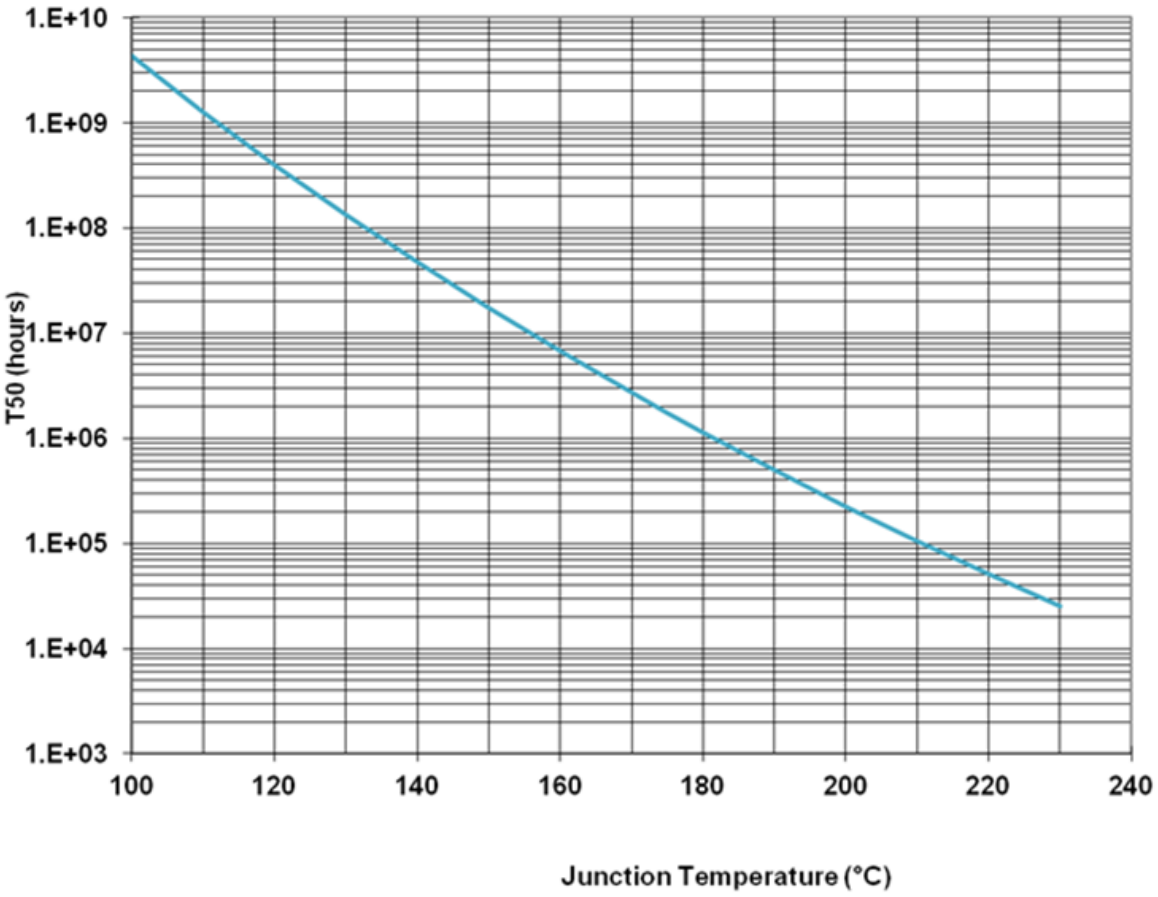
Device thermal performances

All the figures given in this section are obtained assuming that the packaged device is only cooled down by conduction through the package thermal pad (no convection mode considered).
The temperature is monitored at the package back-side interface (Tcase).
The system maximum temperature must be adjusted in order to guarantee that Tjunction remains below the maximum value specified in the Absolute Maximum Ratings table.
So, the system PCB must be designed to comply with this requirement.

Parameter	Biasing conditions	Tjunction (°C)	R_{TH} (°C/W)	T50 (hours)
R_{TH} (1) Thermal Resistance (Junction to Case)	Vs=0V, Vp=-5V(2) Pin = 20dBm Pdiss = 0.1W	114	292	7.0E+8

(1) Assuming 85°C Tcase
(2) Worst case for Tj



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Typical Package Sij parameters

Tamb.= +25°C, V_S = 0V, V_P = -5V

Freq (GHz)	S11 (dB)	PhS11 (°)	S21 (dB)	PhS21 (°)	S12 (dB)	PhS12 (°)	S22 (dB)	PhS22 (°)
1.00	-16.16	-28.84	-2.03	-29.87	-2.10	-30.02	-15.75	-21.39
1.50	-16.45	-42.30	-2.07	-44.25	-2.14	-44.39	-15.66	-31.36
2.00	-16.82	-55.39	-2.09	-58.66	-2.16	-58.82	-15.48	-41.56
2.50	-17.30	-69.15	-2.11	-73.11	-2.18	-73.31	-15.28	-52.66
3.00	-17.93	-82.44	-2.13	-87.60	-2.19	-87.77	-15.05	-63.67
3.50	-18.65	-95.85	-2.14	-102.10	-2.21	-102.27	-14.76	-75.46
4.00	-19.67	-109.78	-2.15	-116.64	-2.22	-116.80	-14.52	-87.87
4.50	-20.85	-123.08	-2.16	-131.18	-2.23	-131.35	-14.23	-100.39
5.00	-22.48	-136.77	-2.18	-145.77	-2.24	-145.91	-13.98	-113.70
5.50	-24.72	-149.06	-2.19	-160.34	-2.25	-160.56	-13.75	-127.01
6.00	-28.31	-160.94	-2.20	-174.97	-2.26	-175.22	-13.57	-140.81
6.50	-32.91	-179.30	-2.24	170.31	-2.31	170.10	-13.21	-154.87
7.00	-46.97	-158.86	-2.26	155.63	-2.33	155.42	-13.05	-168.64
7.50	-35.51	-42.60	-2.29	140.90	-2.36	140.69	-12.91	176.97
8.00	-28.26	-51.14	-2.33	126.16	-2.40	125.96	-12.83	162.56
8.50	-24.46	-63.20	-2.37	111.39	-2.43	111.18	-12.73	147.52
9.00	-21.64	-74.27	-2.41	96.57	-2.48	96.36	-12.73	131.66
9.50	-19.43	-86.96	-2.46	81.74	-2.53	81.52	-12.82	115.42
10.00	-17.64	-99.45	-2.54	67.20	-2.61	67.01	-12.98	99.59
10.50	-16.10	-111.79	-2.59	52.31	-2.65	52.10	-13.10	81.76
11.00	-14.79	-123.85	-2.66	37.47	-2.73	37.28	-13.33	63.43
11.50	-13.58	-135.08	-2.73	22.62	-2.80	22.42	-13.66	43.78
12.00	-12.48	-146.79	-2.81	7.81	-2.88	7.61	-14.05	23.16
12.50	-11.60	-158.57	-2.90	-7.00	-2.97	-7.23	-14.32	1.45
13.00	-10.76	-170.08	-3.01	-21.79	-3.07	-21.99	-14.29	-20.87
13.50	-10.04	178.10	-3.13	-36.54	-3.20	-36.75	-14.07	-44.69
14.00	-9.53	166.02	-3.25	-51.16	-3.32	-51.39	-13.92	-66.70
14.50	-9.15	154.14	-3.39	-65.61	-3.47	-65.82	-13.34	-88.44
15.00	-8.69	141.69	-3.46	-80.18	-3.53	-80.40	-13.05	-108.80
15.50	-8.51	129.28	-3.56	-94.70	-3.63	-94.93	-12.49	-126.20
16.00	-8.43	115.80	-3.66	-109.08	-3.74	-109.29	-11.98	-142.75
16.50	-8.61	102.30	-3.71	-123.44	-3.78	-123.68	-11.64	-157.94
17.00	-8.90	88.06	-3.73	-137.91	-3.80	-138.14	-11.35	-169.67
17.50	-9.36	73.27	-3.75	-152.79	-3.82	-153.02	-10.94	177.70
18.00	-10.13	56.46	-3.76	-167.74	-3.84	-168.01	-10.85	167.92
18.50	-11.18	37.39	-3.79	177.03	-3.86	176.82	-10.59	158.76
19.00	-12.53	13.70	-3.81	161.52	-3.88	161.29	-10.50	150.90
19.50	-14.28	-14.64	-3.83	145.82	-3.90	145.53	-10.01	145.32
20.00	-15.23	-51.79	-3.92	129.60	-4.00	129.32	-9.44	138.51
20.50	-14.70	-95.25	-4.07	113.11	-4.15	112.91	-8.91	132.81
21.00	-12.74	-130.86	-4.33	96.84	-4.40	96.60	-8.18	126.28

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Typical Package Sij parameters

Tamb.= +25°C, V_S = -5V, V_P = 0V

Freq (GHz)	S11 (dB)	PhS11 (°)	S21 (dB)	PhS21 (°)	S12 (dB)	PhS12 (°)	S22 (dB)	PhS22 (°)
1.00	-17.28	-17.86	-23.36	-26.05	-23.43	-26.21	-17.27	-15.63
1.50	-17.26	-28.85	-23.40	-38.55	-23.47	-38.68	-17.20	-25.44
2.00	-17.30	-39.43	-23.43	-51.03	-23.49	-51.22	-17.16	-34.96
2.50	-17.41	-50.21	-23.44	-63.54	-23.51	-63.82	-17.17	-44.84
3.00	-17.57	-60.32	-23.45	-76.17	-23.52	-76.35	-17.20	-54.01
3.50	-17.72	-70.48	-23.46	-88.75	-23.53	-88.92	-17.19	-63.53
4.00	-17.99	-80.27	-23.47	-101.37	-23.54	-101.52	-17.29	-72.90
4.50	-18.19	-89.79	-23.47	-113.95	-23.54	-114.11	-17.31	-82.17
5.00	-18.49	-99.09	-23.48	-126.55	-23.54	-126.66	-17.38	-91.61
5.50	-18.81	-107.02	-23.48	-139.10	-23.54	-139.31	-17.49	-100.10
6.00	-19.17	-113.51	-23.48	-151.75	-23.54	-151.96	-17.64	-107.57
6.50	-19.46	-128.20	-23.48	-164.39	-23.55	-164.62	-17.12	-120.18
7.00	-19.69	-135.86	-23.47	-177.06	-23.54	-177.28	-17.12	-128.84
7.50	-19.94	-143.47	-23.46	170.24	-23.52	170.02	-17.13	-137.87
8.00	-20.13	-149.43	-23.44	157.58	-23.51	157.38	-17.09	-146.00
8.50	-20.24	-155.50	-23.44	144.87	-23.51	144.67	-17.07	-154.59
9.00	-20.43	-160.49	-23.42	132.22	-23.48	132.02	-17.14	-163.07
9.50	-20.38	-164.96	-23.39	119.47	-23.46	119.25	-17.22	-170.69
10.00	-20.19	-167.63	-23.43	107.00	-23.50	106.79	-17.15	-176.87
10.50	-19.89	-172.40	-23.37	94.26	-23.44	94.05	-17.16	174.95
11.00	-19.48	-176.65	-23.34	81.71	-23.41	81.47	-17.15	167.73
11.50	-19.28	179.96	-23.30	68.83	-23.37	68.64	-17.31	161.56
12.00	-18.73	175.87	-23.26	56.35	-23.32	56.16	-17.20	156.58
12.50	-18.31	170.78	-23.21	43.88	-23.28	43.69	-17.18	150.94
13.00	-18.00	166.85	-23.15	31.05	-23.21	30.84	-17.34	144.65
13.50	-17.60	162.09	-23.08	18.64	-23.14	18.45	-17.50	140.91
14.00	-17.39	157.06	-22.98	5.69	-23.05	5.48	-17.48	135.59
14.50	-17.28	153.24	-22.97	-7.36	-23.05	-7.58	-17.58	133.80
15.00	-16.81	148.28	-22.85	-19.76	-22.92	-19.98	-17.20	128.28
15.50	-16.70	144.45	-22.78	-32.46	-22.86	-32.69	-17.38	124.43
16.00	-16.59	139.58	-22.61	-45.31	-22.69	-45.53	-17.35	122.60
16.50	-16.76	136.53	-22.48	-58.97	-22.55	-59.20	-17.05	119.21
17.00	-16.66	134.90	-22.39	-72.84	-22.46	-73.10	-17.19	116.61
17.50	-16.44	133.05	-22.52	-86.49	-22.59	-86.72	-16.66	115.19
18.00	-16.27	131.63	-22.48	-99.14	-22.56	-99.44	-16.52	111.60
18.50	-16.12	130.70	-22.51	-112.24	-22.58	-112.47	-16.06	108.64
19.00	-15.87	130.02	-22.31	-125.73	-22.39	-125.94	-15.79	103.59
19.50	-14.93	129.86	-22.40	-139.04	-22.47	-139.29	-15.38	102.67
20.00	-14.41	126.82	-22.36	-153.16	-22.43	-153.43	-14.74	98.44
20.50	-13.54	124.97	-22.43	-166.42	-22.51	-166.62	-14.49	93.19
21.00	-12.80	121.53	-22.46	-179.90	-22.53	179.82	-14.21	88.37

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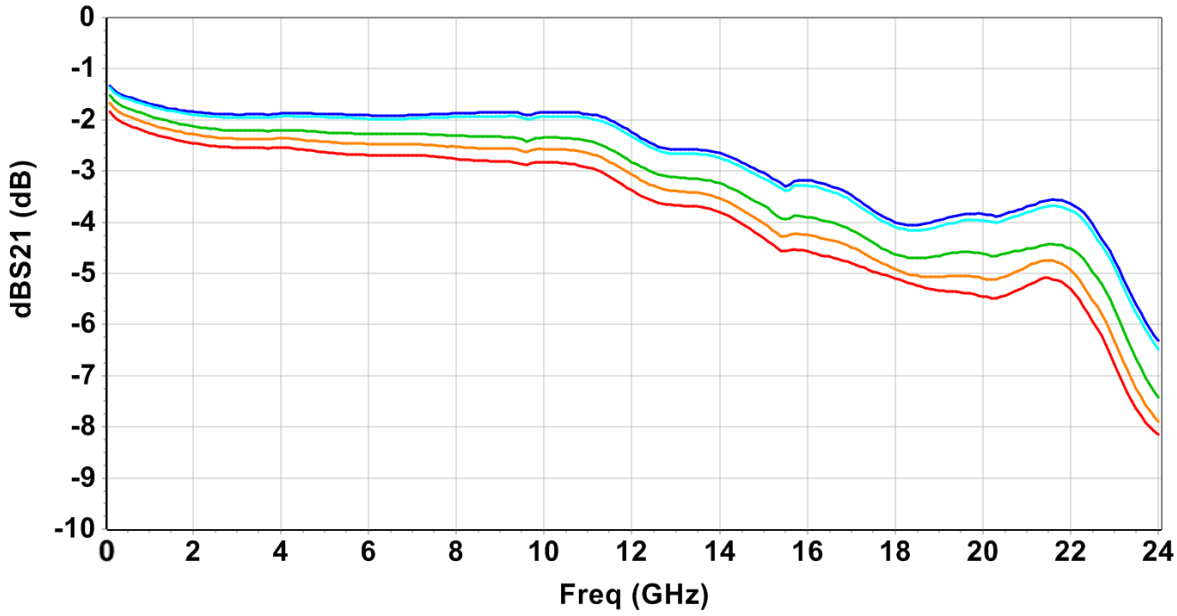
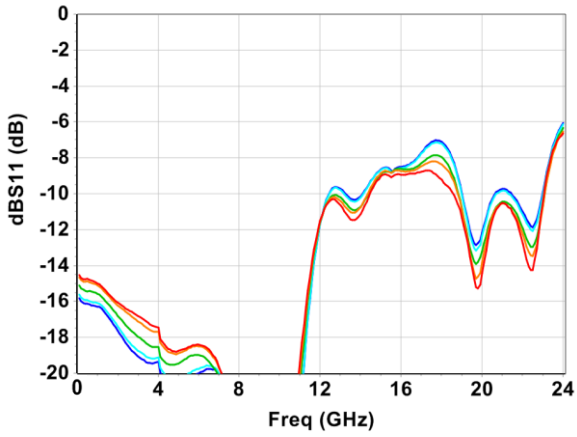
Typical Board Measurements

Min attenuation V_S = 0V; V_P = -5V Temperature : -55, -40, +25, +85, +125°C

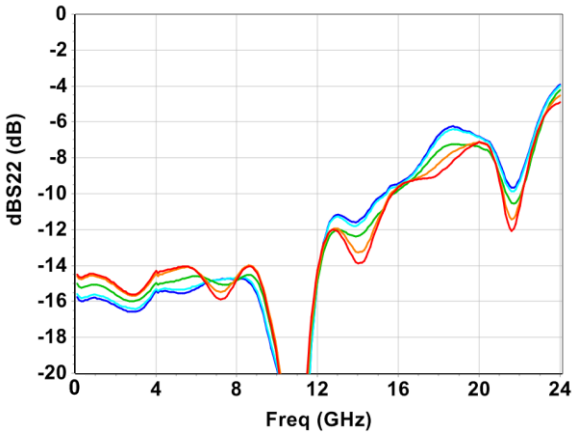
Gain versus Frequency and Temperature



Input Return Loss versus Frequency and Temperature



Output Return Loss versus Frequency and Temperature



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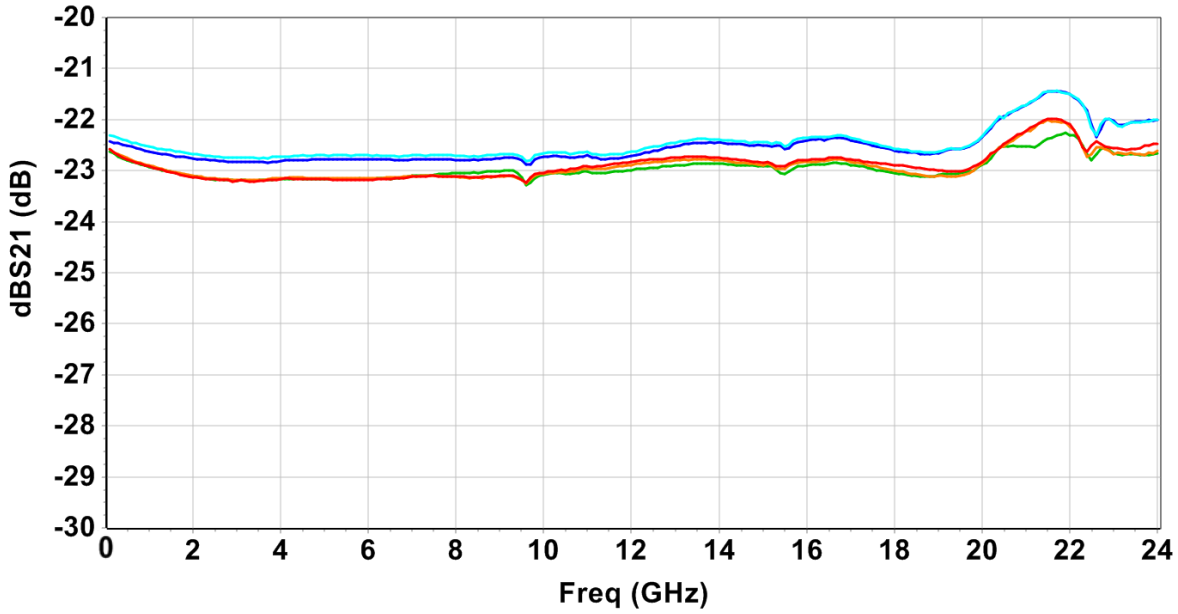
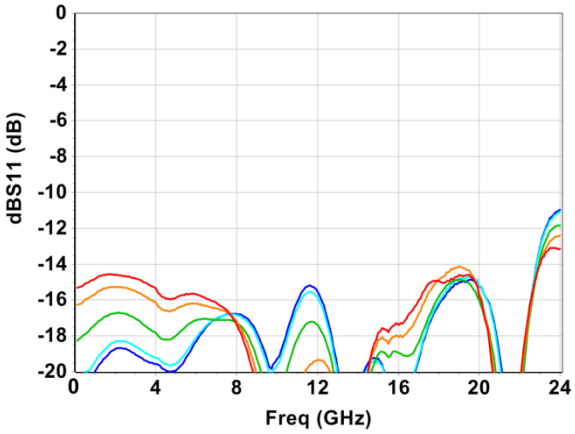
Typical Board Measurements

Max attenuation V_S = -5V; V_P = 0V Temperature : -55, -40, +25, +85, +125°C

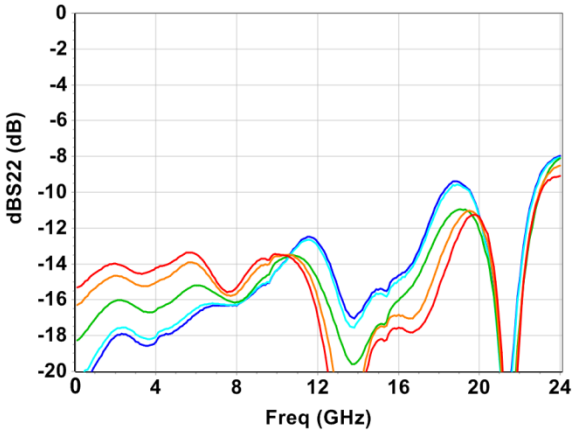
Gain versus Frequency and Temperature



Input Return Loss versus Frequency and Temperature



Output Return Loss versus Frequency and Temperature



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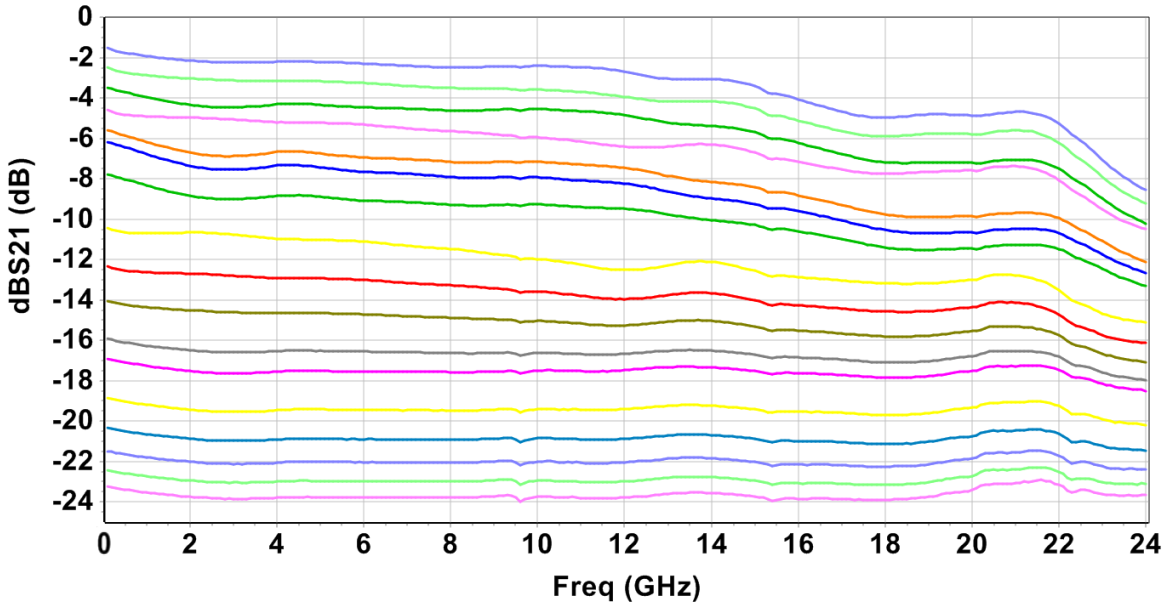
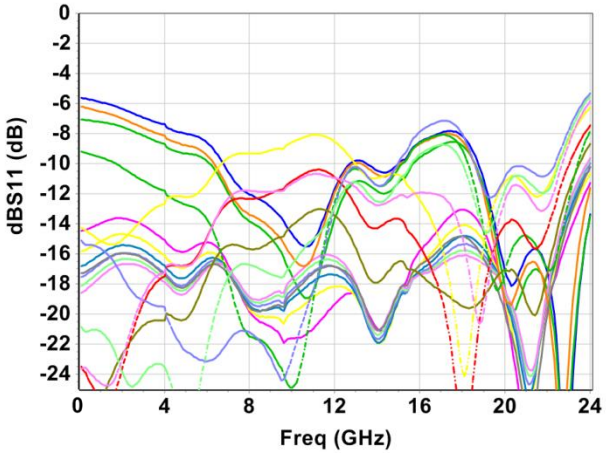
Typical Board Measurements

Tamb.= +25°C

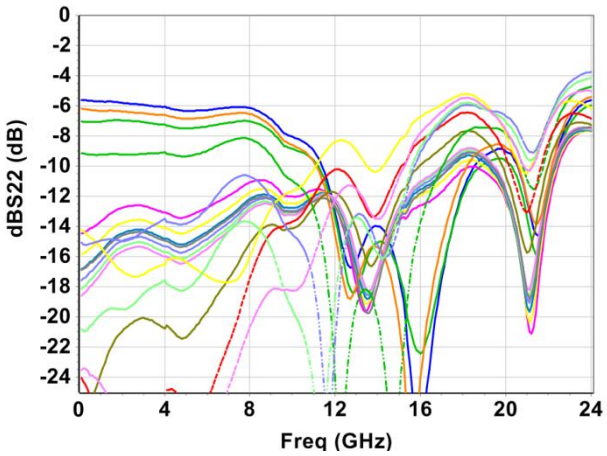
Gain versus Frequency and Gain Control Voltage



Input Return Loss versus Frequency and Gain Control Voltage



Output Return Loss versus Frequency and Gain Control Voltage



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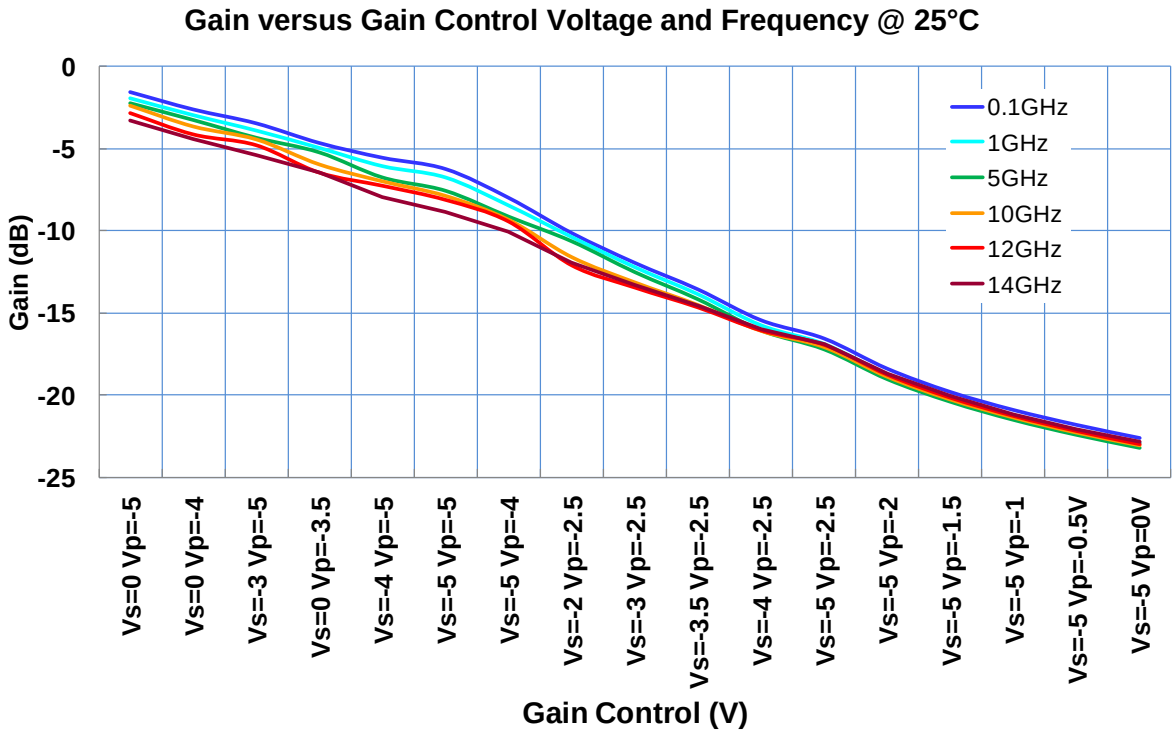
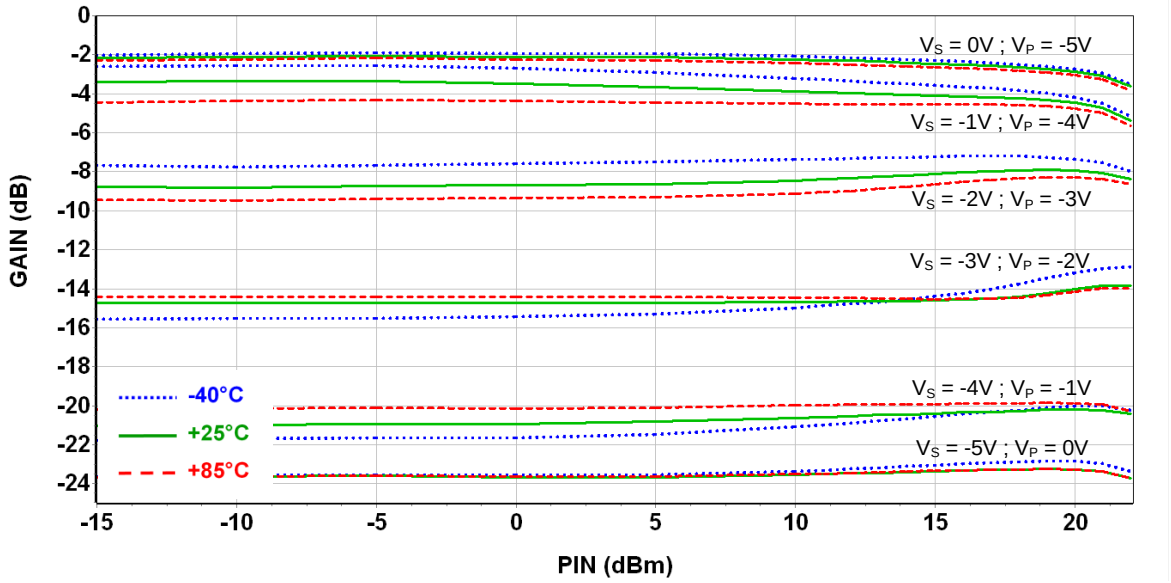
Typical Board Measurements



Gain versus Input Power and Gain Control Voltage

Frequency = 1GHz ; Temperature : -40, +25, +85°C



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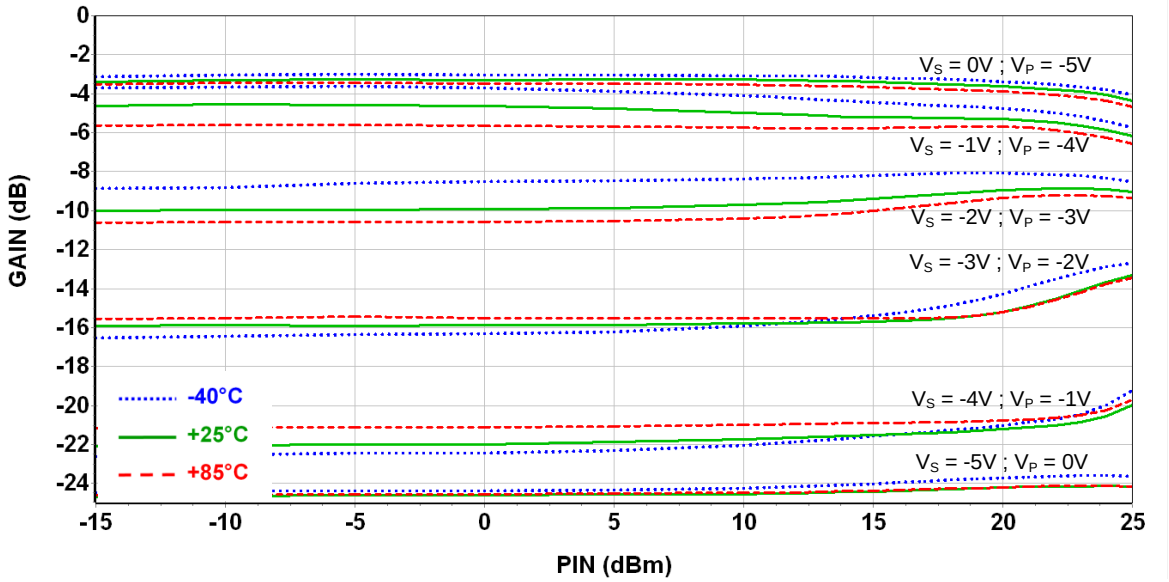
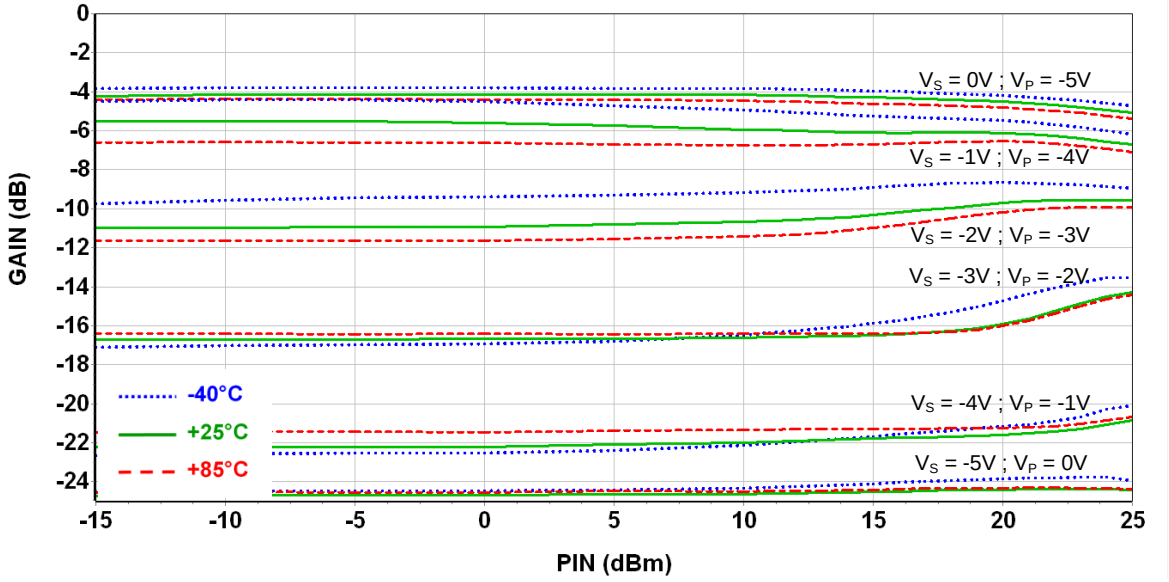
Typical Board Measurements

Gain versus Input Power and Gain Control Voltage
Frequency = 7GHz ; Temperature : -40, +25, +85°C



Gain versus Input Power and Gain Control Voltage
Frequency = 13GHz ; Temperature : -40, +25, +85°C



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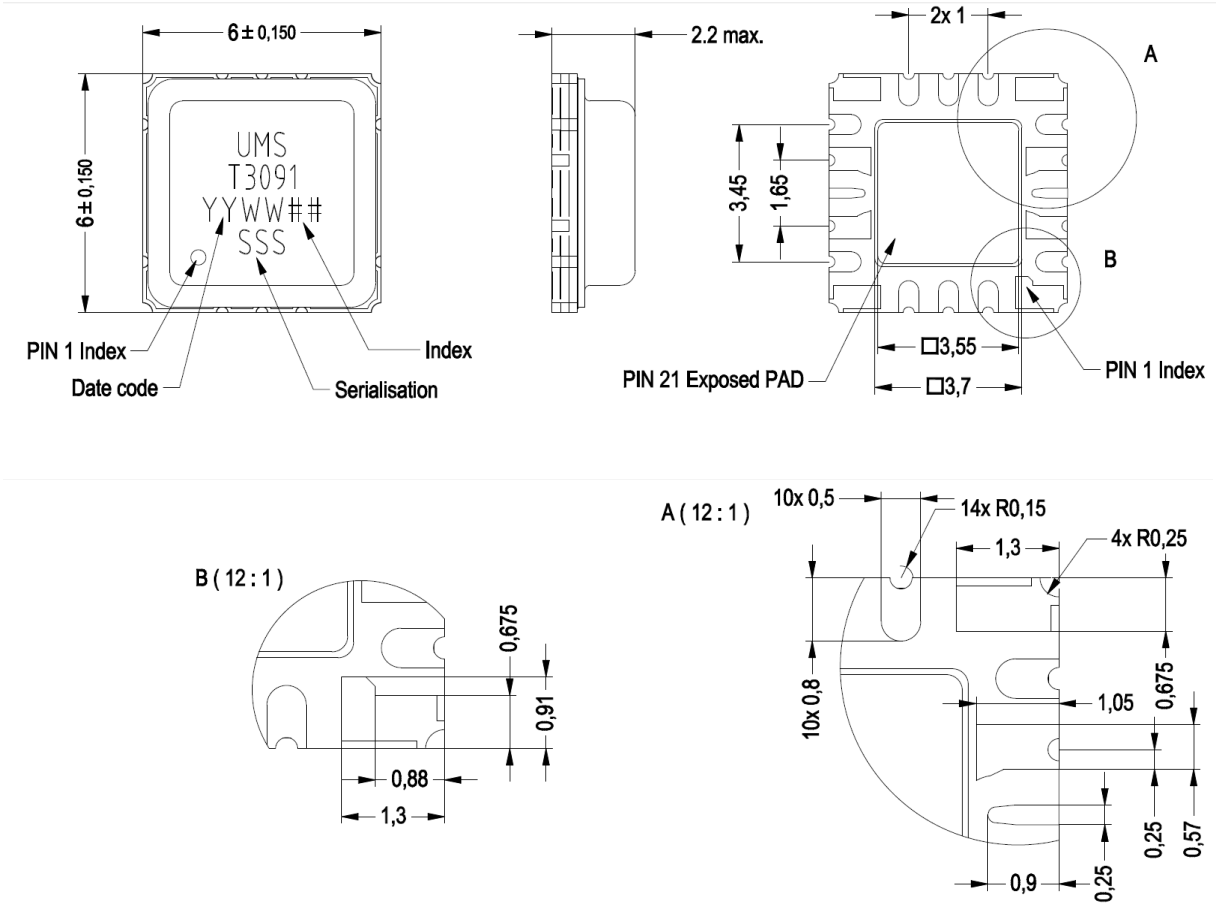
Package outline (1)



1- GND	8- RF OUT	15- GND
2- VS	9- GND	16- Nc
3- Nc	10- Nc	17- GND
4- VP	11- GND	18- RF IN
5- GND	12- Nc	19- GND
6- nc	13- Nc	20- Nc
7- GND	14- Nc	21- GND

All dimensions are in mm

It is strongly recommended to ground all pins marked “GND” through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.

(1) The package outline drawing included in this data-sheet is given for indication. Refer to the application note AN0024 (https://www.ums-rf.com) for exact package dimensions.

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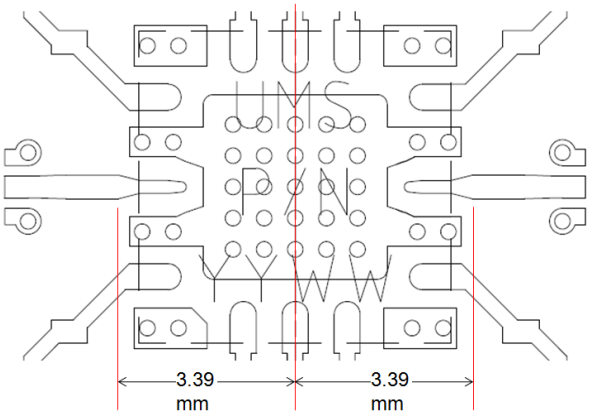
Definition of the Sij reference planes

The reference planes used for Sij measurements given above are symmetrical from the symmetrical axis of the package (see drawing beside). The input and output reference planes are located at 3.39mm offset (input wise and output wise respectively) from this axis. Then, the given Sij parameters incorporate the land pattern of the evaluation motherboard recommended in paragraph "Evaluation board description".



Package Information

Parameter	Value
Package body material	RoHS-compliant
Lead finish	Gold
Hermetic sealing (fine leak compliant Mil-Std-883 Method 1014.10 Condition A4, tracer gas He at 1atm)	$1x10^{-8}$ ccHe/s/atm

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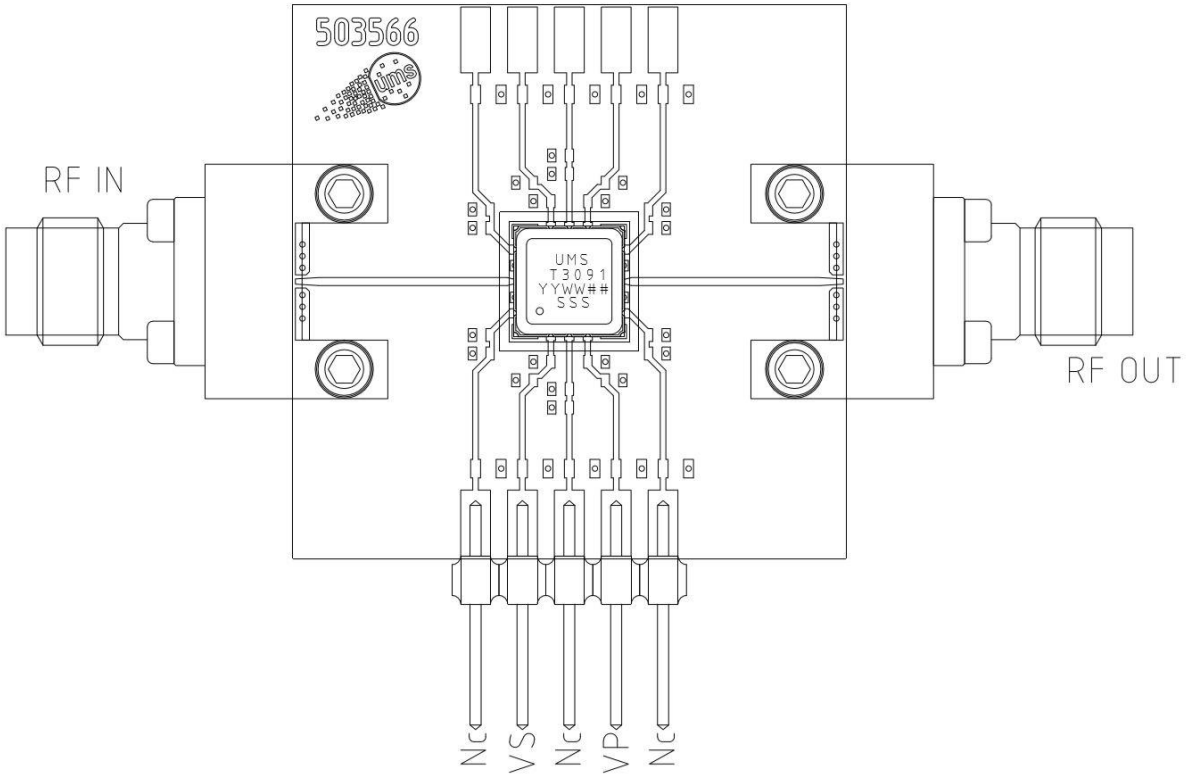
Evaluation board description

- Compatible with the proposed footprint.
- Based on typically Ro4003 / 8mils or equivalent.
- Using a micro-strip to coplanar transition to access the package.
- Recommended for the implementation of this product on a module board.



Note: All board measurements are performed using shielded cables, even for DC bias, to ensure safe operation.

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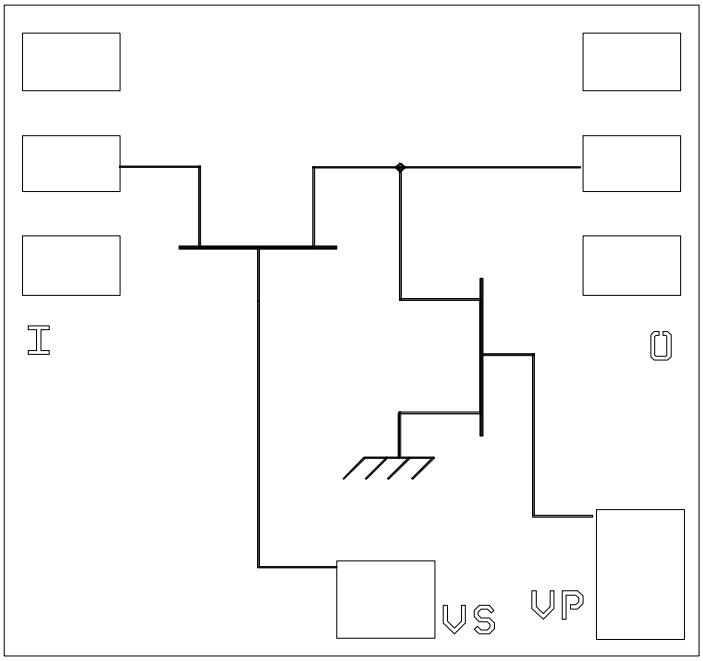
Block Diagram

Block diagram of the circuit



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SMD mounting procedure

For the mounting process standard techniques involving solder paste and a suitable reflow process can be used. For further details, see application note AN0017 available at https://www.ums-rf.com.

Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at https://www.ums-rf.com.

Recommended ESD management

Refer to the application note AN0020 available at https://www.ums-rf.com for ESD sensitivity and handling recommendations for the UMS package products.

FAB Type Surface Mount Hermetic Package

Refer to the application note AN0024 available at https://www.ums-rf.com for assembly recommendations for the UMS FAB package products.

Ordering Information

Leadless hermetic package:	CHT3091-FAB/XY
	Waffle pack: XY = 24

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