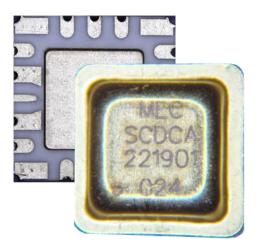
27 - 31 GHz to 1 – 5.5 GHz DownConverter





Product Description

MECSCDCA is a Ka band to IF band frequency converter. It is based on a 0.25 μ m GaAs pHEMT space evaluated process.

The MECSCDCA integrates in a single chip 8 dB of continuous gain variation in the conversion chain, as well as 9 dB of continuous gain variation of the LO buffer amplifier. They can be changed either statically or dynamically by means of two different control voltages. The gain variation features allow great flexibility in its integration within different systems requiring different conversion gain and LO input power.

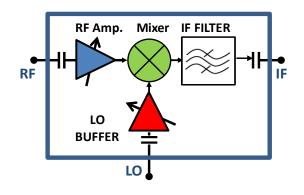
The MECSCDCA offers a conversion gain in the range 4 dB to 12 dB, LOW-GAIN and HIGH-GAIN state respectively. Its performances remain quite uniform as a function of the LO input power from -7 to +2 dBm.

The MMIC is assembled in a hermetically sealed SMT ceramic package suitable for space applications.

Main Features

- 0.25µm GaAs pHEMT space evaluated process
- Full performance in the frequency bands:
 - o RF: 27 31 GHz
 - o LO: 11.5 14.5 GHz
 - o IF: 1 5.5 GHz
- +4 to +12 dB minimum Conversion Gain
- 8 dB Conversion Gain variation
- -7 to +2 dBm of LO input power with same conversion performance
- Fixed Bias: VDD = 3V, Idq = 104 mA
- Conversion Gain control: VC1 = -5 to 0 V
- LO power control: VC2 = -5 to 0 V
- Fully matched to 50 Ω, with integrated RF to DC decoupling
- Assembled in a hermetically sealed SMT ceramic package

Functional Block Diagram



Applications

- Radar
- Defence
- Space
- Itar-free

- 1/15 -





Nominal Operating Conditions

Parameter	Min	Тур.	Max	Units
Temperature	-40	+25	+85	°C
Range	10			
VD1		3		V
ID1		55		mA
VG1		-0.4		V
IG1		0		mA
VC1	-5		0	V
IC1		0		mA
VD2		3		V
ID2		49		mA
VG2		-0.4		V
IG2		0		mA
VC2	-4.4	-2.6	-0.8	V
IC2		0		mA
PDC_RF			165	mW
PDC_LO			147	mW
PDC			312	mW
P_RF_state1	-45		-35	dBm
P_RF_state2	-35		-25	dBm
P_LO	-7		+2	dBm

- When operates under these recommended conditions, the device is compliant with ESA space-derating rules.
- Electrical specifications are measured at specified test conditions.
- Control voltages configuration:
 - VC1 (RF gain control):
 5 V for High Gain; 0 V for Low-Gain
- VC2 (To equalize performance Vs. P_LO variation):
 -4.4 V @ P_LO [-7÷-4] dBm
 -2.6 V @ P_LO [-3÷-1] dBm
 -0.8 V @ P_LO [0÷+2] dBm
- The continuous gain variation features can be achieved by applying a continuous variation to VC1.

Absolute Maximum Rating

Parameter	Rating
VD	4 V
VG	-1.5 to 0 V
Channel temperature, TJ	175 °C
PDC (T = 85 °C; VD = 4V)	540 mW
RF Input Power @ High-Gain	8 dBm
RF Input Power @ Low-Gain	10 dBm
LO Input Power	10 dBm
Mounting Temperature (<30 sec)	260 °C
Storage Temperature	-55 to +150 °C

These parameters are carried out from specific stress test analysis.

Operation of this device outside of these ranges may cause permanent damage.

Thermal and Reliability Information

Conditions	Parameter	Value
Worst case operating conditions:	Equivalent Thermal Resistance	117 °C/W
VD1 = 3 V, ID1 = 55 mA VD2 = 3 V, ID2 = 59 mA VC1 = -1.4 V VC2 = -1.2 V	Channel Temperature	125 °C
P_RF = -25 dBm P_LO = +2 dBm Pdiss = 340 mW Tbase = 85 °C	Mean Time Failure	> 2E+7 hrs

27 - 31 GHz to 1 – 5.5 GHz DownConverter



Electrical Characteristics

Test conditions unless otherwise noted: Tbase = 25°C, VD1 = 3 V, VG1 = - 0.4 V, ID1 = 55 mA, VD2 = 3 V, VG2 = - 0.4 V, ID2 = 49 mA, VC2 = -2.6 V, P_LO = -3 dBm.

Parameter	Min.	Тур	Max	Units
Input Frequency Range (RF)	27		31	GHz
Output Frequency Range (IF)	1		5.5	GHz
LO Frequency Range (LO)	11.5		14.5	GHz
RF Input Power Range				
High-Gain Low-Gain	-45 -35		-35 -25	dBm
LO Input Power Range	-7	-3	+2	dBm
Conversion Gain High-Gain Low-Gain		+12 +4		dB dB
Conversion gain difference between states		8 ± 1		dB
Conversion Gain Flatness			1	dBpp
Conversion Gain Variation with LO Drive Level			1	dBpp
Noise Figure (SSB) High-Gain Low-Gain	3 5		4	dB
Output P1dB High-Gain Low-Gain		2		dBm dBm
Output IP3 level High-Gain Low-Gain	-1 -3		+6 +5	dBm dBm
LO to IF Isolation		13		dB
Input Return Loss	13			dB
Output Return Loss	10			dB
LO Input Return Loss	10			dBc
In-band Mixing Spurious Levels	50			dBc
Close to In-band Mixing Spurious Levels (IF bandwidth of 5.5 GHz to 7 GHz)	50			dBc
5LO x -2RF Spurious	30			dBc
IF Spurious Harmonic Level	50			dBc
Power Consumption			0.33	W
Packaged Size Body Dimensions Package Height		6 x 6 2.5		mm² mm

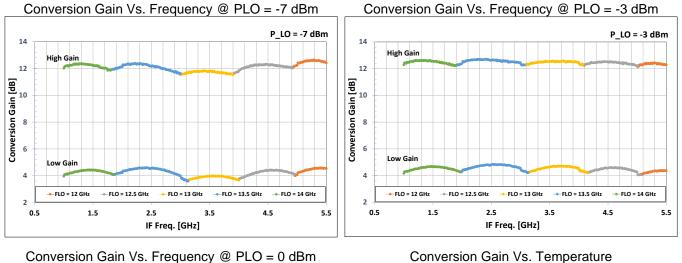


27 - 31 GHz to 1 – 5.5 GHz DownConverter

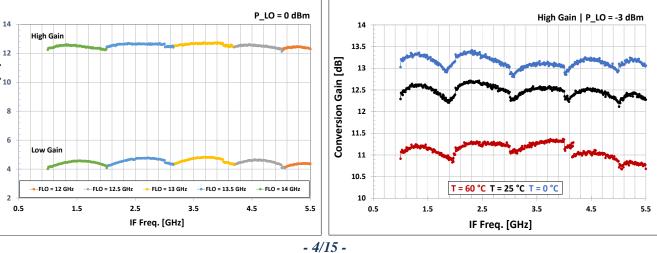
Main Performance – Conversion Gain

Test conditions unless otherwise noted: Tbase = 25°C, VD1 = 3 V, VG1 = - 0.4 V, ID1 = 55 mA, VD2 = 3 V, VG2 = - 0.4 V, ID2 = 49 mA. VC1 = -5 V (High-Gain) and 0 V (Low-Gain); VC2 = -4.4 V (P_LO = -7 dBm), -2.6 V (P_LO = -3 dBm) and -0.8 $V (P_LO = 0 dBm)$

Specific Conversion Scheme								
LO freq	11.5	12.0	12.5	13.0	13.5	14.0	14.5	GHz
Syn. #	1	2	3	4	5	6	7	
RF freq				IF freq				
27.0	4.0	3.0	2.0	1.0	0.0	-1.0	-2.0	
27.5	4.5	3.5	2.5	1.5	0.5	-0.5	-1.5	
28.0	5.0	4.0	3.0	2.0	1.0	0.0	-1.0	
28.5	5.5	4.5	3.5	2.5	1.5	0.5	-0.5	
29.0	6.0	5.0	4.0	3.0	2.0	1.0	0.0	
29.5	6.5	5.5	4.5	3.5	2.5	1.5	0.5	
30.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0	
30.5	7.5	6.5	5.5	4.5	3.5	2.5	1.5	
31.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	
GHz	GHz	GHz	GHz	GHz	GHz	GHz	GHz	
·		•					•	



Conversion Gain Vs. Frequency @ PLO = 0 dBm

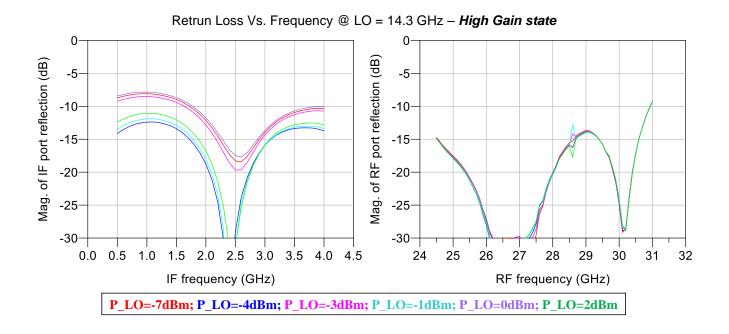


Conversion Gain [dB]

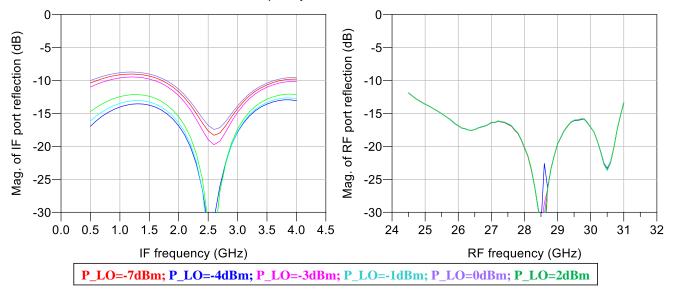


Main Performance – Return Loss

Test conditions unless otherwise noted: Tbase = 25° C, VD1 = 3 V, VG1 = - 0.4 V, ID1 = 55 mA, VD2 = 3 V, VG2 = - 0.4 V, ID2 = 49 mA. VC1 = -5 V (High-Gain) and 0 V (Low-Gain); VC2 = -4.4 V (P_LO = -7, -4 dBm), -2.6 V (P_LO = -3, -1 dBm) and -0.8 V (P_LO = 0, 2 dBm)



Retrun Loss Vs. Frequency @ LO = 14.3 GHz - Low Gain state



27 - 31 GHz to 1 – 5.5 GHz DownConverter

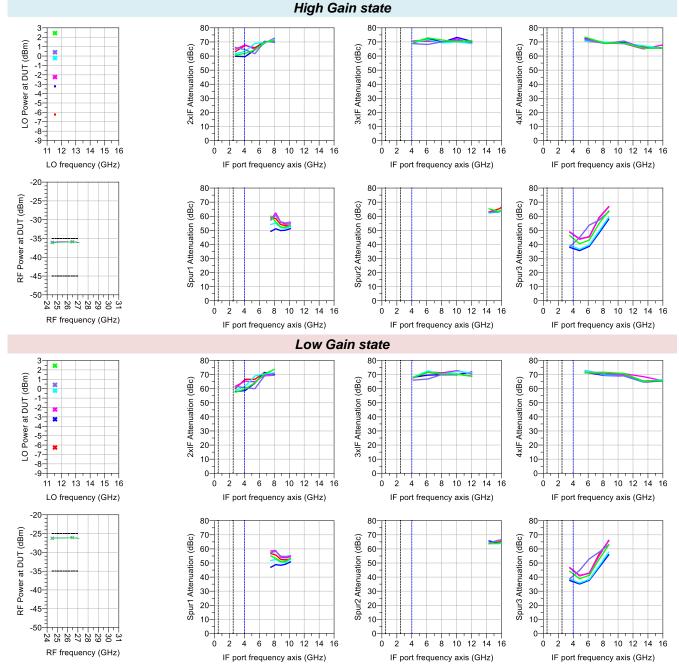


Main Performance – IF harmonics and Spurious tones (F_LO = 11.55 GHz)

Test conditions unless otherwise noted: Tbase = 25°C, VD1 = 3 V, VG1 = - 0.4 V, ID1 = 55 mA, VD2 = 3 V, VG2 = - 0.4 V, ID2 = 49 mA. VC1 = -5 V (High-Gain) and 0 V (Low-Gain); VC2 = -4.4 V (P_LO = -7, -4 dBm), -2.6 V (P_LO = -3, -1 dBm) and -0.8 V (P_LO = 0, 2 dBm)

F_LO = 11.55 GHz





- 6/15 -



Main Performance – IF harmonics and Spurious tones (F_LO = 12.45 GHz)

F LO = 12.45 GHz P_LO=-7dBm; P_LO=-4dBm; P_LO=-3dBm; P_LO=-1dBm; P_LO=0dBm; P_LO=2dBm; Spur1: (3,-1); Spur2: (3,-2); Spur3: (5,-2) High Gain state 80 80 80 2 1 -1 -2 -3 -4 -5 -7 -8 70 70 70 LO Power at DUT (dBm) (dBc) 2xIF Attenuation (dBc) 4xIF Attenuation (dBc) 60 60-60 ž 50-50-**3xIF Attenuation** 50-* 40 40-40 30 30 30 20-20-20 -10-10 10 -9 0 0 0-11 12 13 14 15 16 10 12 14 16 8 6 8 ò ż 4 6 8 ò 2 4 6 10 12 14 16 2 4 10 12 14 16 Ó LO frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) -20 80 80 80 RF Power at DUT (dBm) -25-70 70 70 Spur1 Attenuation (dBc) (dBc) Spur3 Attenuation (dBc) 60-60-60--30-Attenuation 50-50-50--35-40-40-40 -40-30-30-30-Spur2 / 20 20 20--45-10 10 10 -50 -24 -25 -24 0 6 8 10 12 14 16 8 10 12 14 16 6 8 10 12 14 16 Ó 2 4 Ó 2 à 6 Ó 2 4 RF frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) Low Gain state 80 80 80 2 1 -1 -2 -3 -4 -5 -6 -7 70 70 70 LO Power at DUT (dBm) 2xIF Attenuation (dBc) (dBc) Attenuation (dBc) ž 60-60-60 50-Attenuation 50-50-40 40-40 * 30-30-30-20 4×IF / 3xIF 20-20 . 10-10 10 -8--9-0-0-0 11 12 13 14 15 16 6 8 10 12 14 16 ż 4 6 8 10 12 14 16 2 4 6 8 10 12 14 16 2 4 0 0 IF port frequency axis (GHz) IF port frequency axis (GHz) LO frequency (GHz) IF port frequency axis (GHz) -20 80 80 80 RF Power at DUT (dBm) -25-70 70-70 (dBc) Spur1 Attenuation (dBc) Spur3 Attenuation (dBc) 60-60-60 -30-Spur2 Attenuation 50 50-50 -35-40 40 40 -40-30 30-30-20 20-20 -45-10 10-10 -50 0 -29 -27 -27 -27 -25 10 12 14 16 8 10 12 14 16 6 8 8 10 12 14 16 à 6 Ó 2 à. Ó 2 à. 6 Ó 2 RF frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz)

- 7/15 -



Main Performance – IF harmonics and Spurious tones (F_LO = 13.35 GHz)

F LO = 13.35 GHz P_LO=-7dBm; P_LO=-4dBm; P_LO=-3dBm; P_LO=-1dBm; P_LO=0dBm; P_LO=2dBm; Spur1: (3,-1); Spur2: (3,-2); Spur3: (5,-2) High Gain state 80 80 80 2-1--2--3--4--5--6--7--8--9-70 70-70 LO Power at DUT (dBm) (dBc) 2xIF Attenuation (dBc) 4xIF Attenuation (dBc) 60 60-60 * 50 50-**3xIF Attenuation** 50-40 40-40-. 30 30 30 20 20-20-10-10 10 0 0-0 11 12 13 14 15 16 10 12 14 16 8 ò 2 4 6 8 ò ż 4 6 10 12 14 16 ż 4 6 8 10 12 14 16 Ó LO frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) -20-80 80 80 RF Power at DUT (dBm) -25-70 70 70 Spur1 Attenuation (dBc) (dBc) Spur3 Attenuation (dBc) 60-60-60--30-Attenuation 50-50-50--35-40 40-40--40-30-30-30-Spur2 / 20 20-20--45 10 10 10 -50--26 0 0 6 8 10 12 14 16 8 10 12 14 16 ò 2 4 ò ż 4 6 ò ż 4 6 8 10 12 14 16 RF frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) Low Gain state 80 80 3 80 2-1--1--2--3--4--5--6--7-70 70 70 LO Power at DUT (dBm) 2xIF Attenuation (dBc) Attenuation (dBc) 4xIF Attenuation (dBc) 60-60-60 50-50-50-40-40-40-30-30-30-3XIF / 20-20-20-* 10 10-10--8-0--9-0-0-11 12 13 14 15 16 2 4 6 8 10 12 14 16 2 4 6 8 10 12 14 16 2 4 6 8 10 12 14 16 ò 0 LO frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) -20 80 80 80-RF Power at DUT (dBm) -25-70-70-70-(dBc) (dBc) Spur1 Attenuation (dBc) 60-60-60--30 Spur2 Attenuation Spur3 Attenuation 50-50-50--35-40-40-40--40 30 30 30 20-20 20--45 10 10 10 -50 0 0-0 -231 -225 -225 8 10 12 14 16 8 10 12 14 8 10 12 14 16 ò ż 6 ò 2 6 16 ò 2 4 6 4 4 RF frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz)

- 8/15 -



Main Performance – IF harmonics and Spurious tones (F_LO = 14.30 GHz)

F LO = 14.30 GHz P_LO=-7dBm; P_LO=-4dBm; P_LO=-3dBm; P_LO=-1dBm; P_LO=0dBm; P_LO=2dBm; Spur1: (3,-1); Spur2: (3,-2); Spur3: (5,-2) High Gain state 80 80 80 2-1--1--2--3--4--5--6--7--8-70 70 70 LO Power at DUT (dBm) (dBc) 4xIF Attenuation (dBc) 2xIF Attenuation (dBc) 60-60-60 50-50-**3xIF** Attenuation 50-40-40-40-30 30-30-20 20-20-10 10-10--9-0 0. 0-11 12 13 14 15 16 10 12 14 16 8 8 ò ż 4 6 8 ò 2 4 6 10 12 14 16 ò ż 4 6 10 12 14 16 LO frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) -20 80 80 80 RF Power at DUT (dBm) -25-70 70 70 Spur1 Attenuation (dBc) Spur3 Attenuation (dBc) Attenuation (dBc) 60-60-60--30-50-50-50--35-40-40-40--40-30-30-30-Spur2 / 20-20 20--45 10-10 10--50 0 0 -266 8 10 12 14 16 8 8 ò ż 4 ò 2 4 6 10 12 14 16 ò ż 4 6 10 12 14 16 RF frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) Low Gain state 80 80 3 80 2-1--1--2--3--4--5--6--7-70 70 70 LO Power at DUT (dBm) 2xIF Attenuation (dBc) Attenuation (dBc) 4xIF Attenuation (dBc) 60-60-60 50-50-50-40-40-40-30-30-30-3XIF / 20-20-20-* 10 10-10--8-0--9-0-0-11 12 13 14 15 16 2 4 6 8 10 12 14 16 2 4 6 8 10 12 14 16 2 4 6 8 10 12 14 16 ò 0 LO frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) -20 80 80 80-RF Power at DUT (dBm) -25-70-70-70-(dBc) (dBc) Spur1 Attenuation (dBc) . 60-60-60--30 Spur2 Attenuation Spur3 Attenuation 50-50-50--35-40-40-40--40 30 30 30 20-20 20--45 10 10 10 -50 0 0-0 -231 -225 -225 8 10 12 14 16 8 10 12 14 8 10 12 14 16 ò ż 6 ò 2 4 6 16 ò 2 4 6 4 RF frequency (GHz)

- 9/15 -

IF port frequency axis (GHz)

MEC – Microwave Electronics for Communications www.mec-mmic.com

IF port frequency axis (GHz)

IF port frequency axis (GHz)



Main Performance – IF harmonics and Spurious tones (F_LO = 15.20 GHz)

F LO = 15.20 GHz P_LO=-7dBm; P_LO=-4dBm; P_LO=-3dBm; P_LO=-1dBm; P_LO=0dBm; P_LO=2dBm; Spur1: (3,-1); Spur2: (3,-2); Spur3: (5,-2) High Gain state 80 80 2-1--1--2--3--4--5--6--7--8-70-70 70 LO Power at DUT (dBm) (dBc) 2xIF Attenuation (dBc) 4xIF Attenuation (dBc) 60 60 60 50 **3xIF** Attenuation 50-50-40 40-40-30 30 30 20 20-20-10 10-10 -9-0 0-0 11 12 13 14 15 16 ò 2 4 6 8 10 12 14 ò ż 6 8 10 12 14 16 ż 6 8 10 12 14 16 4 Ó 4 LO frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) -20 80 80 80 RF Power at DUT (dBm) -25-70 70 70 Spur1 Attenuation (dBc) Spur2 Attenuation (dBc) Spur3 Attenuation (dBc) 60-60-60--30-50-50-50--35-40 40 40--40-30 30-30-20 20-20--45 10 10-10--50 0 0 -26 -26 -26 -26 -26 -26 -26 -26 -26 -24 -26 -24 -266 8 10 12 14 16 8 10 12 14 16 ò 2 4 ò ż 4 6 ò ż 4 6 8 10 12 14 16 RF frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) Low Gain state 80 80 80 2 1 -1 -2 -3 -4 -5 -6 -7 70 70-70 LO Power at DUT (dBm) 2xIF Attenuation (dBc) 3xIF Attenuation (dBc) 4xIF Attenuation (dBc) 60-60-60 50-50-50-40 40-40-30 30-30-20 20-20-10-10 10 -8-0+ 0+ -9-0+ 4 6 8 10 12 4 4 6 4 N N 12 14 15 Ň ÷ LO frequency (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) IF port frequency axis (GHz) -20 80 80 80 RF Power at DUT (dBm) -25-70-70-70-Spur1 Attenuation (dBc) Spur2 Attenuation (dBc) Spur3 Attenuation (dBc) 60-60-60--30-50-50-50--35-40 40-40--40-30 30-30 20 20-20--45 10 10 10 0-0 -230 -225 -255 -24 0-4 6 0 -10 Ň 8 -10 -12 -14 'n 4 6 8 -12 6 å -10 -12 -14 Ň 6 6 4 6 RF frequency (GHz)

- 10/15 -

IF port frequency axis (GHz)

IF port frequency axis (GHz)

MEC – Microwave Electronics for Communications www.mec-mmic.com IF port frequency axis (GHz)

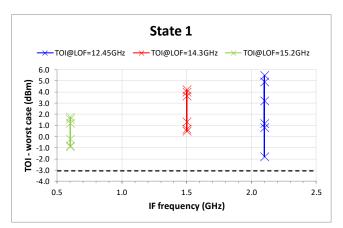
27 - 31 GHz to 1 – 5.5 GHz DownConverter



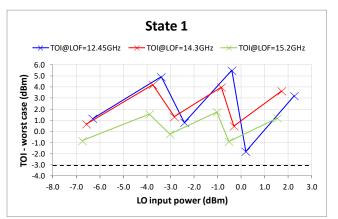
Main Performance – Third Order Intercept Point

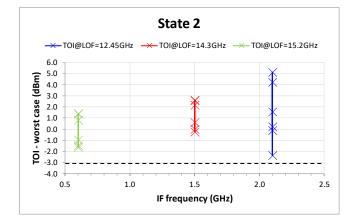
Test conditions unless otherwise noted: Tbase = 25° C, VD1 = 3 V, VG1 = - 0.4 V, ID1 = 55 mA, VD2 = 3 V, VG2 = - 0.4 V, ID2 = 49 mA. VC1 = -5 V (High-Gain) and 0 V (Low-Gain); VC2 = -4.4 V (P_LO = -7, -4 dBm), -2.6 V (P_LO = -3, -1 dBm) and -0.8 V (P_LO = 0, 2 dBm). RF frequencies = 27, 30.1, 31 GHz.

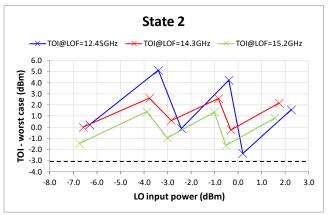
Worst Case TOI as a function of the IF frequency. P_RF (DCL) = -35 dBm (*High Gain – State 1*) P_RF (DCL) = -25 dBm (*Low Gain – State 2*)



Worst Case TOI as a function of the P_LO power P_RF (DCL) = -35 dBm (*High Gain – State 1*) P_RF (DCL) = -25 dBm (*Low Gain – State 2*)



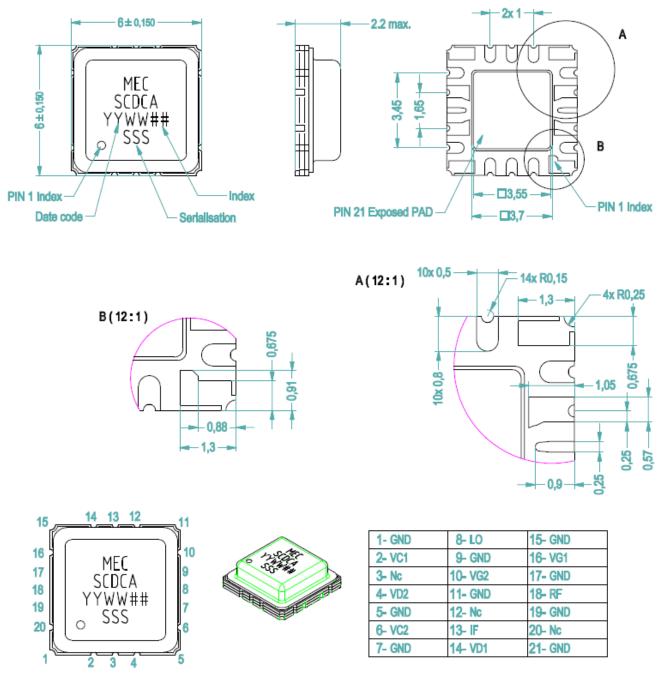






27 - 31 GHz to 1 – 5.5 GHz DownConverter

Package Outline and PIN configuration



All dimensions are in mm.

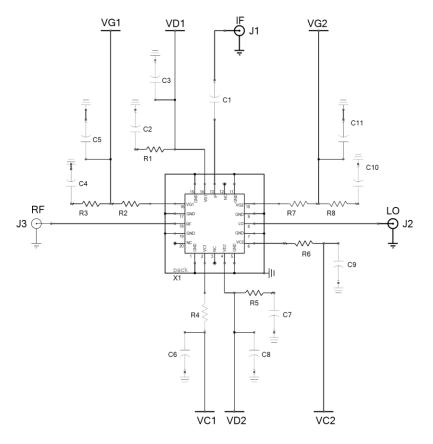
It is strongly recommended to ground all pins marked "GND" through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.

Detailed package dimensions and characteristics are available upon request at <u>contact.mec@mec-</u> <u>mmic.com</u>

- 12/15 -







Ref.	Component	Value	Description
C1	SMT 0402 RF Capacitor	100 nF	Ultrabroadband Decoupling Capacitor
C2, C4, C6, C7, C9, C10	SMT 0402 Capacitor	100 pF	Low Frequency Bypass Capacitor
C3, C5, C8, C11	SMT 0402 Capacitor	1 µF	Low Frequency Bypass Capacitor
R1, R2, R4, R5, R6, R7	SMT 0402 Resistor	1 Ω	Low power Resistor
R3, R8	SMT 0402 Resistor	5 Ω	Low power Resistor

Bias-up Procedure

- 1. VG set to -1.5 V.
- 2. VD set to +3 V.
- Adjust VG until quiescent ld is 104 mA (Vg = -0.4 V Typical).
- 4. Apply RF signals.

Bias-down Procedure

- 1. Turn off RF signals.
- 2. Reduce VG to -1.5 V (Id0 \approx 0 mA).
- 3. Set Vd to 0 V.
- 4. Set Vg to 0 V.

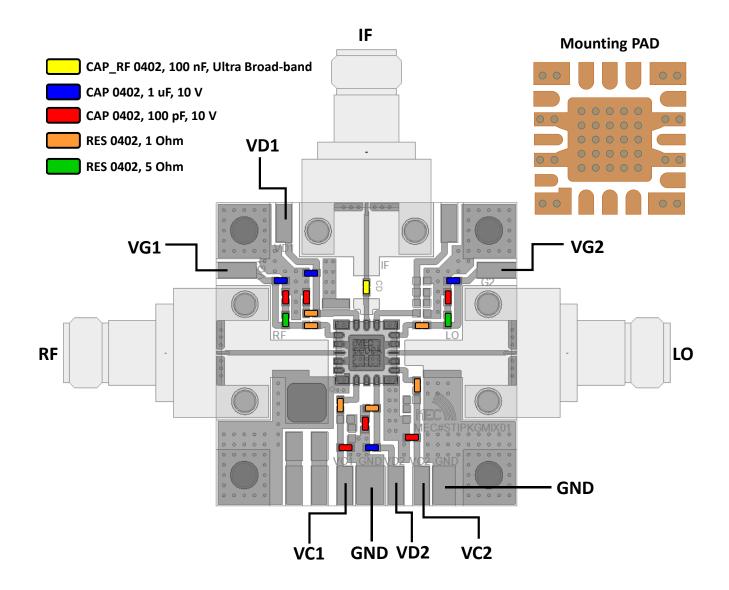
- 13/15 -



27 - 31 GHz to 1 – 5.5 GHz DownConverter



Evaluation Board and Assembly



0.008" thick Rogers Corp. RO4003C ($\mathcal{E}r = 3.35$). Metal layers 0.5 oz. copper cladding. Microstrip to Coplanar transition optimized to access the package. Microstrip to coplanar transition for connector interface optimized for the Southwest Microwave end launch 1492-04A-5.

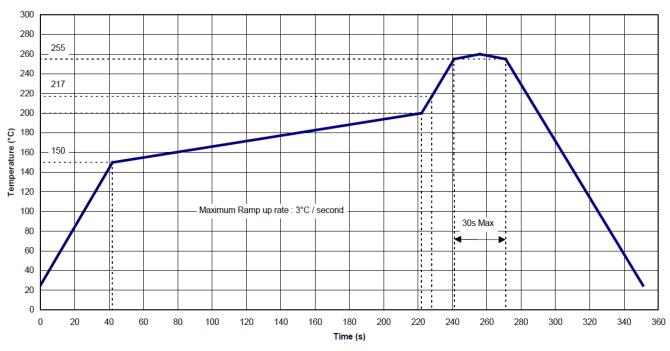
- 14/15 -

27 - 31 GHz to 1 – 5.5 GHz DownConverter



Solderability and Recommended Soldering Temperature Profile

The package complies with standard surface mount assembly processes (J-STD-020). Peak reflow temperature of 260 °C. Leaded (SnPn) or RoHS leadless solder pasts (SnAgCu) can be used, having gold platted terminations with 0.8 µm minimum of gold (Au)



MAXIMUM RECOMMENDED REFLOW PROFILE for LEADFREE SMT ASSEMBLY PRODUCTS

RoHS Compliance

The product is compliant with the 2011/65/EU RoHS directive 2015/863/EU and REACH N° 1907/2006.

Contact Information

For additional technical Information and Requirements: contact.mec@mec-mmic.com

Notice

The furbished information is believed to be reliable. However, performances and specifications contained herein are based on preliminary characterizations and then susceptible to possible variations. On the basis of customer requirements, the product can be tested and characterized in specific operating conditions and, if needed, tuned to meet custom specifications.

The contents of this document are under the copyright of MEC srl. It is released by MEC srl on condition that it shall not be copied in whole, in part or otherwise reproduced (whether by photographic, reprographic, or any other method) and the contents thereof shall not be divulged to any person other than inside the company at which has been provided by MEC.

- 15/15 -