ECP053

½ Watt, High Linearity InGaP HBT Amplifier

Product Features

- 2300 – 2700 MHz
- 13 dB Gain @ 2450 MHz
- +28 dBm P1dB
- +43 dBm Output IP3
- Single Positive Supply (+5V)
- Lead-free/green/RoHS-compliant 16pin 4mm QFN and SOIC-8 packages

Applications

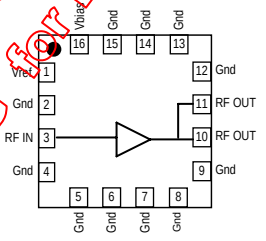
- WLAN / WiBro
- RFID
- DMB
- Fixed Wireless

Product Description

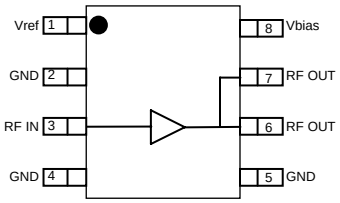
The ECP053 is a high dynamic range driver amplifier in a low-cost surface mount package. The InGaP/GaAs HBT is able to achieve high performance for various narrowband-tuned application circuits with up to +43 dBm OIP3 and +28 dBm of compressed 1dB power. It is housed in a Lead-free/green/RoHS-compliant SOIC-8 and 16-pin 4x4 mm QFN SMT packages. All devices are 100% RF and DC tested.

The ECP053 is targeted for use as a driver amplifier in wireless infrastructure where high linearity and medium power is required. An internal active bias allows the ECP053 to maintain high linearity over temperature and operate directly off a single +5V supply. This combination makes the device an excellent candidate for driver amplifier stages in wireless-LAN, digital multimedia broadcast, or fixed wireless applications. The device can also be used in next generation RFID readers.

Functional Diagram



ECP053D



ECP053G

Specifications (1)

Parameter	Units	Min	Typ	Max
Operational Bandwidth	MHz	2300		2700
Test Frequency	MHz		2450	
Gain	dB	10.5	13	
Input Return Loss	dB		12.5	
Output Return Loss	dB		13	
Output P1dB	dBm	+25.5	+28	
Output IP3 (2)	dBm	+40.5	+43	
Noise Figure	dB		5.3	
Test Frequency	MHz		2650	
Gain	dB		12.5	
Input Return Loss	dB		10.5	
Output Return Loss	dB		22	
Output P1dB	dBm		+27.5	
Output IP3 (2)	dBm		+42	
Operating Current Range, Icc (3)	mA	200	250	300
Device Voltage, Vcc	V		+5	

1. Test conditions unless otherwise noted. T = 25 ºC, Vsupply = +5 V in tuned application circuit.
2. 3OIP measured with two tones at an output power of +11 dBm/tone separated by 1 MHz. The suppression on the largest IM3 product is used to calculate the 3OIP using a 2:1 rule.
3. This corresponds to the quiescent current or operating current under small-signal conditions into the Vbias and RF out pins. It is expected that the current can increase by an additional 50 mA at P1dB. Pin 1 is used as a reference voltage for the internal biasing circuitry. It is expected that Pin 1 will pull 12mA of current when used with a series bias resistor of R1=100Ω. (ie. total device current typically will be 262 mA.)

Typical Performance (4)

Parameter	Units	Typical		
Frequency	MHz	2350	2450	2650
S21 – Gain	dB	13.5	13	12.5
S11	dB	-9.5	-12.5	-20
S22	dB	-14	-13	-10.5
Output P1dB	dBm	+28	+28	+27.5
Output IP3	dBm	+43	+43	+42
Noise Figure	dB	5.3	5.3	5.3
Supply Bias (3)		+5 V @ 250 mA		

4. Typical parameters reflect performance in a tuned application circuit at +25 °C.

Absolute Maximum Rating

Parameter	Rating
Storage Temperature	-65 to +150 °C
RF Input Power (continuous)	+22 dBm
Device Voltage	+8 V
Device Current	400 mA
Device Power	2 W
Thermal Resistance, Rth	60°C/W
Junction Temperature	+200°C

Operation of this device above any of these parameters may cause permanent damage.

Ordering Information

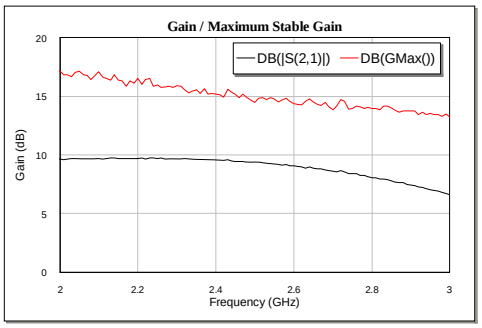
Part No.	Description
ECP053D-G	½ Watt InGaP HBT Amplifier (lead-free/green/RoHS-compliant 4x4 mm QFN Package)
ECP053G-G	½ Watt InGaP HBT Amplifier (lead-free/green/RoHS-compliant SOIC-8 Package)

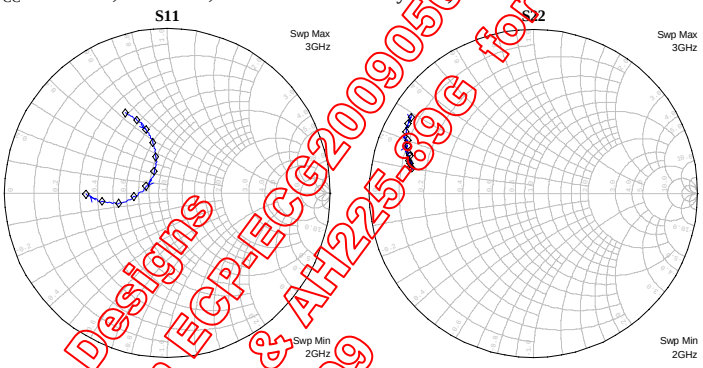
Standard tape / reel size = 500 pieces on a 7” reel

Specifications and information are subject to change without notice

Typical Device Data (QFN 4 X 4mm)

S-Parameters (V_{CC} = +5 V, I_{CC} = 250 mA, T = 25 °C, unmatched 50 ohm system)



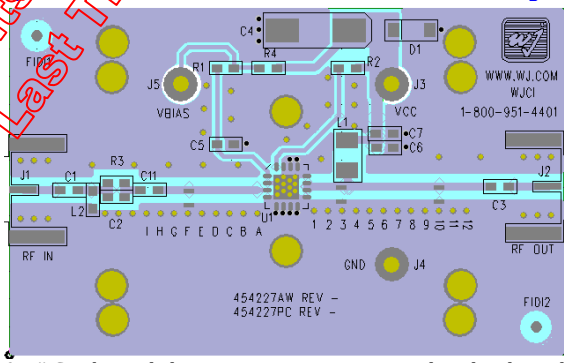


Notes:
The gain for the unmatched device in 50 ohm system is shown as the trace in black color. For a tuned circuit for a particular frequency, it is expected that actual gain will be higher, up to the maximum stable gain. The maximum stable gain is shown in the dashed red line. The impedance plots are shown from 2 – 3 GHz, with markers placed at 2 – 3.0 GHz in 0.1 GHz increments.

S-Parameters (V_{CC} = +5 V, I_{CC} = 250 mA, T = 25 °C, unmatched 50 ohm system, calibrated to device leads)

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
2	-5.19	117.90	9.66	24.93	-29.05	-59.39	-2.44	168.21
2.1	-6.36	112.97	9.72	17.21	-28.52	-70.26	-2.32	168.14
2.2	-7.80	108.77	9.71	8.78	-28.05	-78.03	-2.25	166.38
2.3	-9.91	106.37	9.66	-0.23	-28.09	-83.20	-2.09	165.22
2.4	-12.75	108.17	9.57	-9.80	-27.51	-94.92	-2.08	163.14
2.5	-16.19	122.03	9.38	-19.69	-27.85	-102.45	-2.00	162.20
2.6	-17.22	162.78	9.10	-30.16	-27.56	-114.98	-1.73	159.28
2.7	-13.72	-173.95	8.62	-40.79	-27.79	-126.32	-1.61	157.01
2.8	-10.32	-168.26	8.08	-51.38	-28.17	-136.65	-1.30	154.15
2.9	-7.89	172.69	7.45	-61.77	-28.71	-144.45	-1.18	150.88
3	-6.93	-179.07	6.60	-71.90	-29.04	-156.57	-1.14	148.06

Application Circuit PC Board Layout



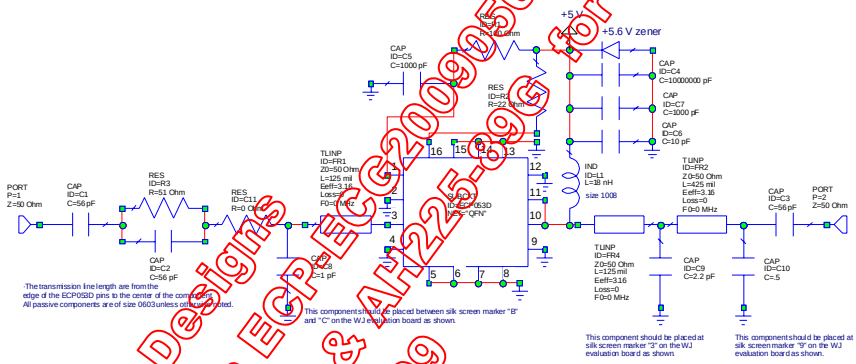
Circuit Board Material: .014” Getek, single layer, 1 oz copper, Microstrip line details: width = .026”, spacing = .026”
The silk screen markers ‘A’, ‘B’, ‘C’, etc. and ‘1’, ‘2’, ‘3’, etc. are used as placemarkers for the input and output tuning shunt capacitors – C8, C9 and C10. The markers and vias are spaced in .050” increments.

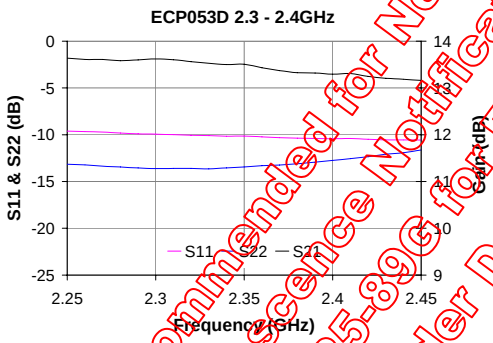
2350 MHz Reference Design

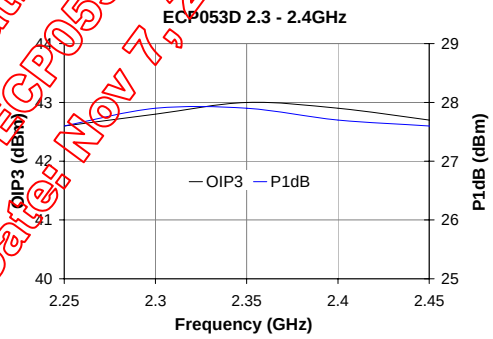
Typical RF Performance at 25 °C

Frequency	2350 MHz
S21 – Gain	13.5 dB
S11 – Input Return Loss	-9.5 dB
S22 – Output Return Loss	-14 dB
Output P1dB	+28 dBm
Output IP3 (+11 dBm / tone, 1 MHz spacing)	+43 dBm
Noise Figure	5.3 dB
Device / Supply Voltage	+5 V
Quiescent Current (1)	250 mA

1. This corresponds to the quiescent current or operating current under small-signal conditions into pins 10, 11, and 16.





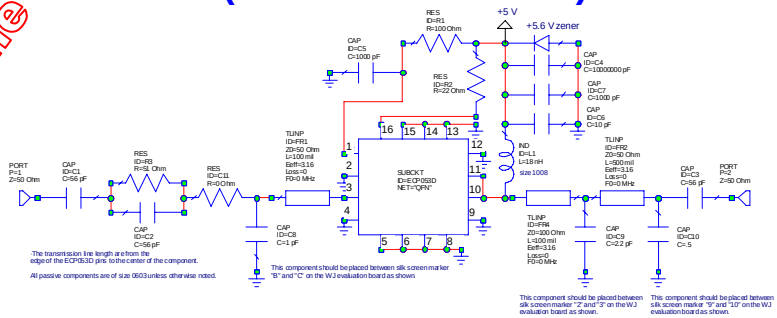


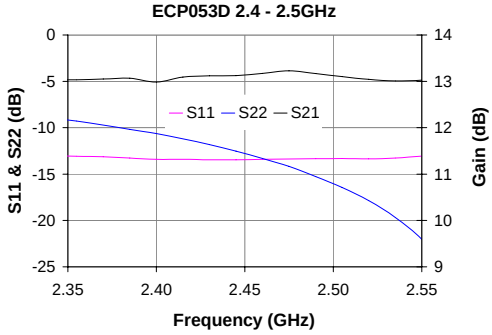
2450 MHz Application Circuit (ECP053D-PCB2450)

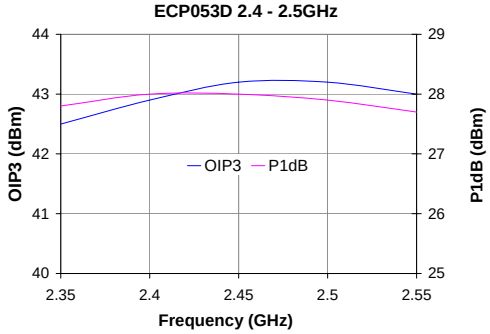
Typical RF Performance at 25 °C

Frequency	2450 MHz
S21 – Gain	13 dB
S11 – Input Return Loss	12.5 dB
S22 – Output Return Loss	-13 dB
Output P1dB	+28 dBm
Output IP3 (+11 dBm / tone, 1 MHz spacing)	+43 dBm
Noise Figure	5.3 dB
Device / Supply Voltage	+5 V
Quiescent Current (1)	250 mA

1. This corresponds to the quiescent current or operating current under small-signal conditions into pins 10, 11, and 16.





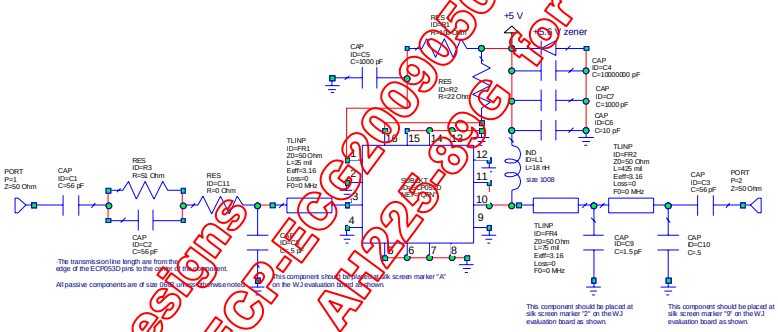


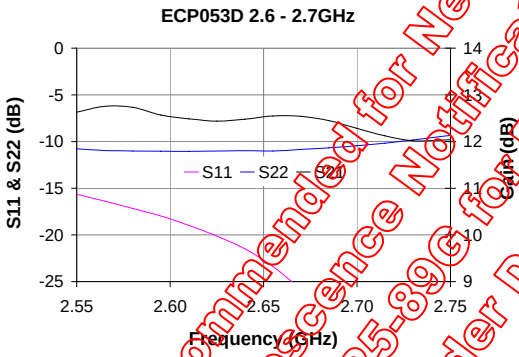
2650 MHz Application Circuit (ECP053D-PCB2650)

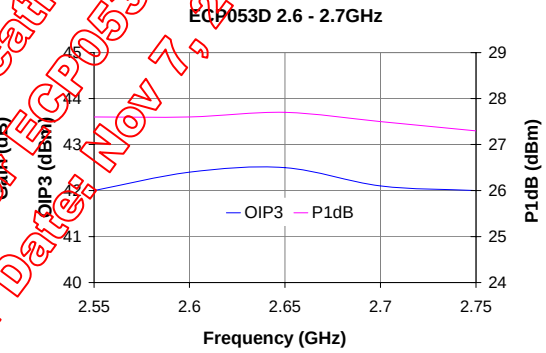
Typical RF Performance at 25 °C

Frequency	2650 MHz
S21 – Gain	12.5 dB
S11 – Input Return Loss	-20 dB
S22 – Output Return Loss	-10.5 dB
Output P1dB	+27.5 dBm
Output IP3 (+11 dBm / tone, 1 MHz spacing)	+42 dBm
Noise Figure	5.3 dB
Device / Supply Voltage	+5 V
Quiescent Current (1)	250 mA

1. This corresponds to the quiescent current or operating current under small-signal conditions into pins 10, 11, and 16.

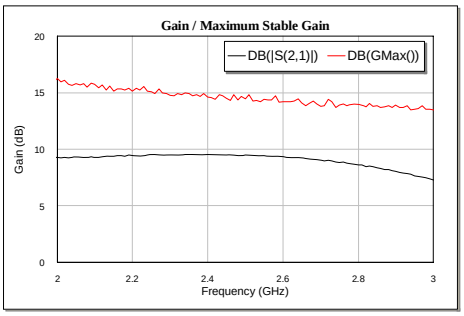


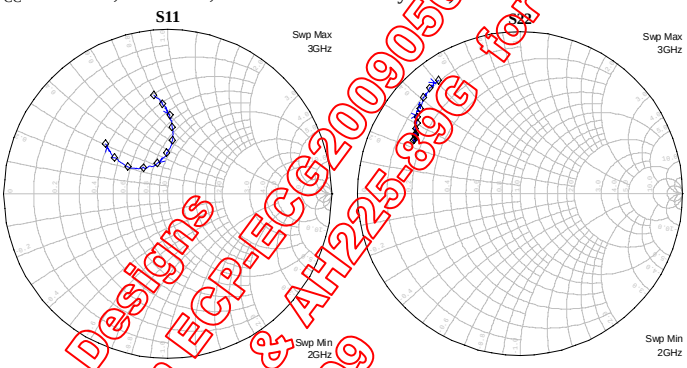




Typical Device Data (SOIC-8)

S-Parameters (V_{CC} = +5 V, I_{CC} = 250 mA, T = 25 °C, unmatched 50 ohm system)



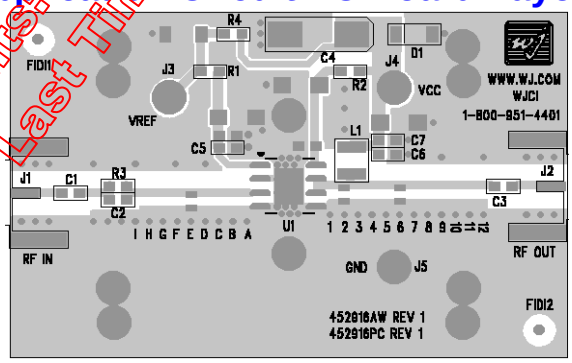


Notes:
The gain for the unmatched device in 50 ohm system is shown as the trace in black color. For a tuned circuit for a particular frequency, it is expected that actual gain will be higher, up to the maximum stable gain. The maximum stable gain is shown in the dashed red line. The impedance plots are shown from 2 – 3 GHz, with markers placed at 2 – 3.0 GHz in 0.1 GHz increments.

S-Parameters (V_{CC} = +5 V, I_{CC} = 250 mA, T = 25 °C, unmatched 50 ohm system, calibrated to device leads)

Freq (GHz)	S11 (dB)	S11 (ang)	S21 (dB)	S21 (ang)	S12 (dB)	S12 (ang)	S22 (dB)	S22 (ang)
2	-4.32	98.01	9.28	172	-29.98	-69.43	-2.68	153.43
2.1	-5.19	93.40	9.30	-0.49	-29.24	-77.01	-2.73	152.75
2.2	-6.37	88.45	9.41	-8.84	-29.95	-85.66	-2.64	151.06
2.3	-7.77	86.25	9.48	-18.28	-29.73	-97.77	-2.61	150.21
2.4	-9.66	85.14	9.53	-28.78	-29.40	-107.36	-2.41	148.05
2.5	-11.95	91.55	9.48	-39.21	-28.25	-117.61	-2.29	145.47
2.6	-14.01	108.83	9.35	-50.77	-28.48	-129.89	-2.06	143.26
2.7	-13.24	132.73	9.05	-62.97	-29.29	-154.29	-1.86	139.45
2.8	-10.59	145.74	8.61	-74.99	-29.93	-164.37	-1.51	134.98
2.9	-8.11	145.70	8.06	-86.88	-30.48	-176.10	-1.34	130.45
3	-6.22	141.12	7.29	-99.32	-29.85	168.90	-1.30	125.67

Application Circuit PC Board Layout



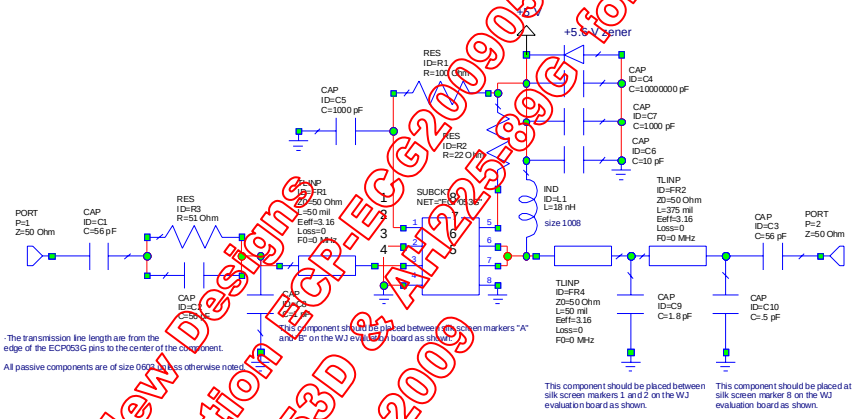
Circuit Board Material: Top RF layer is .014” Getek, 4 total layers (0.062” thick) for mechanical rigidity
1 oz copper, Microstrip line details: width = .026”, spacing = .026”
The silk screen markers ‘A’, ‘B’, ‘C’, etc. and ‘1’, ‘2’, ‘3’, etc. are used as placemarkers for the input and output tuning shunt capacitors – C8 and C9. The markers and vias are spaced in .050” increments.

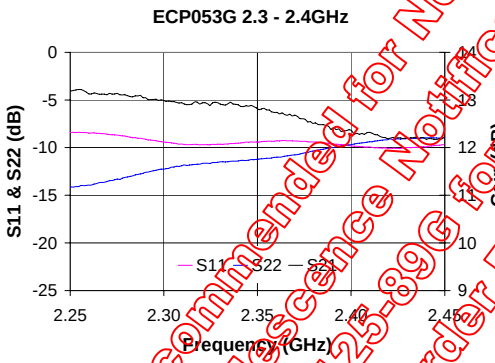
2350 MHz Reference Design

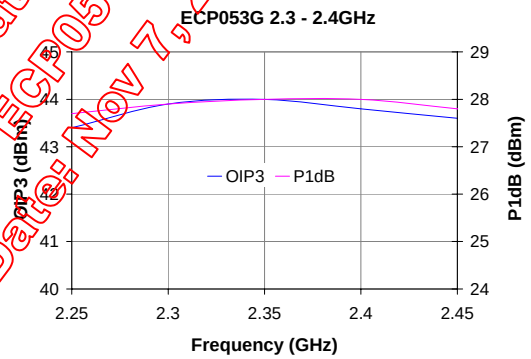
Typical RF Performance at 25 °C

Frequency	2350 MHz
S21 – Gain	13 dB
S11 – Input Return Loss	-9.5 dB
S22 – Output Return Loss	-11.5 dB
Output P1dB	+28 dBm
Output IP3 (+11 dBm / tone, 1 MHz spacing)	+44 dBm
Noise Figure	5.3 dB
Device / Supply Voltage	+5 V
Quiescent Current (1)	250 mA

1. This corresponds to the quiescent current or operating current under small-signal conditions into pins 6, 7, and 8.





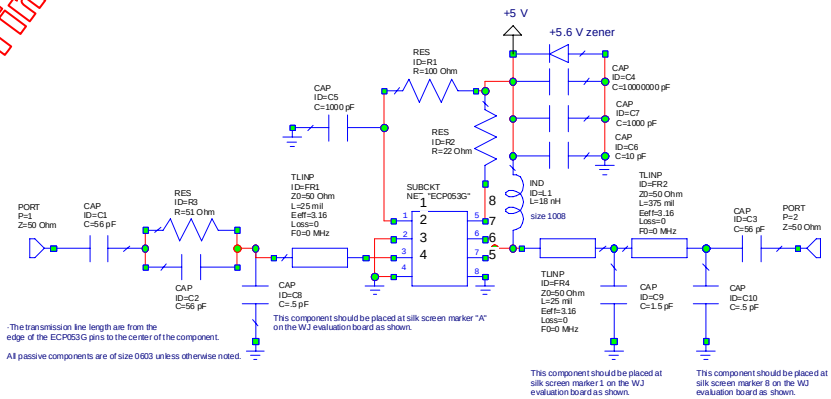


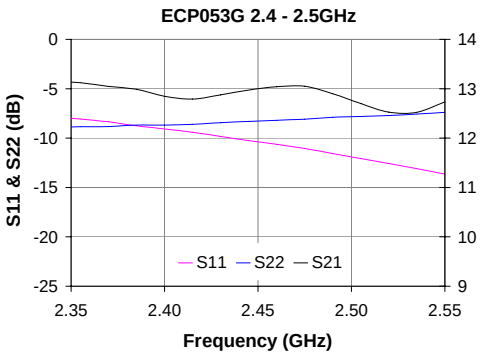
2450 MHz Application Circuit (ECP053G-PCB2450)

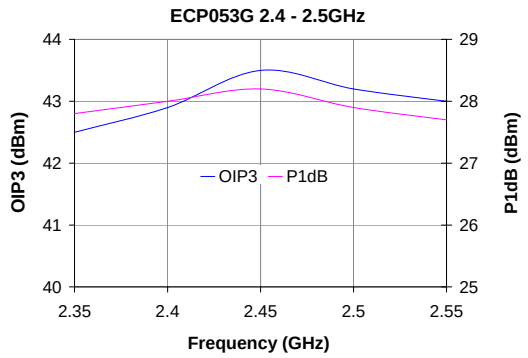
Typical RF Performance at 25 °C

Frequency	2450 MHz
S21 – Gain	12 dB
S11 – Input Return Loss	8 dB
S22 – Output Return Loss	-10 dB
Output P1dB	+28 dBm
Output IP3 (+11 dBm / tone, 1 MHz spacing)	+43 dBm
Noise Figure	5.3 dB
Device / Supply Voltage	+5 V
Quiescent Current (1)	250 mA

1. This corresponds to the quiescent current or operating current under small-signal conditions into pins 6, 7, and 8.







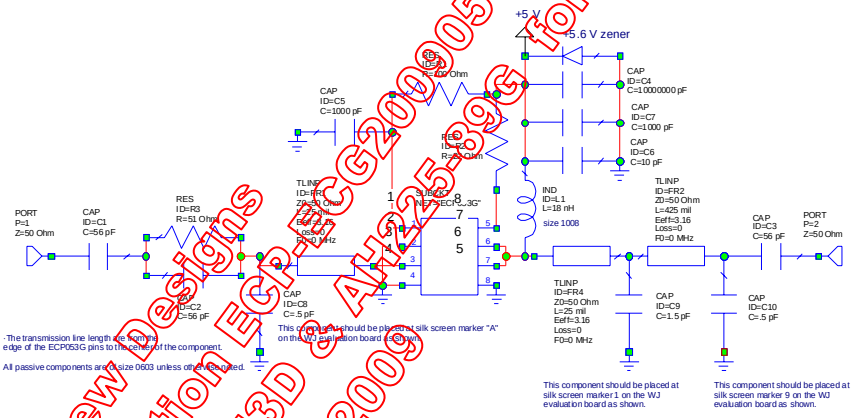
Specifications and information are subject to change without notice

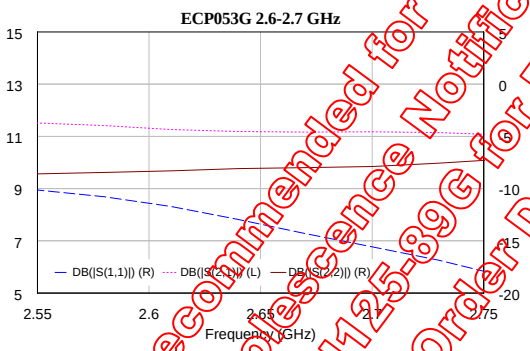
2650 MHz Application Circuit (ECP053G-PCB2650)

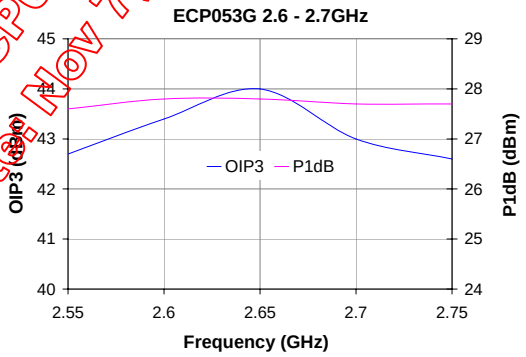
Typical RF Performance at 25 °C

Frequency	2650 MHz
S21 – Gain	11.5 dB
S11 – Input Return Loss	-12 dB
S22 – Output Return Loss	-7 dB
Output P1dB	+27.5 dBm
Output IP3 (+11 dBm / tone, 1 MHz spacing)	+44 dBm
Noise Figure	5.3 dB
Device / Supply Voltage	+5 V
Quiescent Current (1)	250 mA

1. This corresponds to the quiescent current or operating current under small-signal conditions into pins 6, 7, and 8.



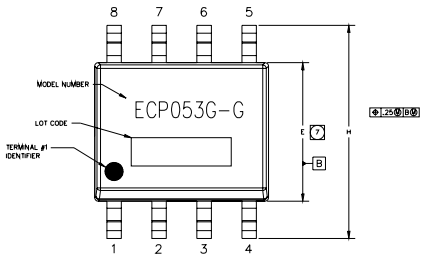




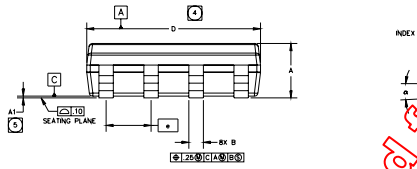
ECP053G-G Mechanical Information

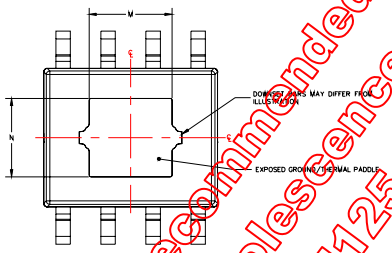
This package is lead-free/green/RoHS-compliant. The plating material on the leads is NiPdAu. It is compatible with both lead-free (maximum 260 °C reflow temperature) and leaded (maximum 245 °C reflow temperature) soldering processes.

Outline Drawing



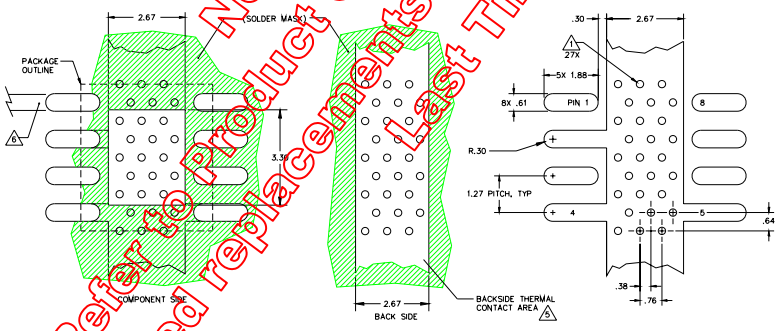
NOTES:
1. EXCEPT WHERE NOTED, THIS PART OUTLINE CONFORMS TO JEDEC STANDARD MS-012, ISSUE C FOR SMALL OUTLINE (SO) PERIPHERAL TERMINALS 3.75mm BODY WIDTH (PLASTIC).
2. DIMENSIONING & TOLERANCING CONFORM TO ANSI Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES). ANGLES ARE IN DEGREES.
4. DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS, WHICH SHALL NOT EXCEED .15mm (.006in) PER SIDE.
5. DEVIATION FROM JEDEC MS-012 STANDARD.
6. LENGTH OF TERMINAL FOR SOLDERING TO A SUBSTRATE.
7. DOES NOT INCLUDE INTER-LEAD FLASH OR PROTRUSIONS, WHICH SHALL NOT EXCEED .25mm (.010in) PER SIDE.





SYMBOL	MILLIMETERS MIN	NOM	MAX	INCHES MIN	NOM	MAX
5 A	1.40	1.52	1.62	.055	.060	.064
5 A1	.00	.05	.10	.000	.002	.004
5 b	.38	.41	.43	.015	.016	.017
c	.19	.20	.25	.007	.008	.010
D	4.80	4.90	5.00	.189	.193	.197
E	3.80	3.90	4.00	.150	.154	.157
e	1.27 BSC			.050 BSC		
H	5.80	6.00	6.20	.228	.236	.244
h	.25	.33	.50	.01	.013	.02
L	.40	.64	1.27	.016	.033	.050
5 M	2.21	2.34	2.47	.087	.092	.097
5 N	2.08	2.21	2.34	.082	.087	.092
α	4°8	8°8		0	4°8	8°8

Mounting Configuration / Land Pattern



Product Marking

The component will be marked with an "ECP053G-G" designator with an alphanumeric lot code on the top surface of the package. The obsolete tin-lead package is marked with an "ECP053G" designator followed by an alphanumeric lot code.

Tape and reel specifications for this part are located on the website in the "Application Notes" section.

ESD / MSL Information

Caution! ESD sensitive device.

ESD Rating:	Class 1B
Value:	Passes between 500 and 1000V
Test:	Human Body Model (HBM)
Standard:	JEDEC Standard JESD22-A114
MSL Rating:	Level 2 at +260 °C convection reflow
Standard:	JEDEC Standard J-STD-020

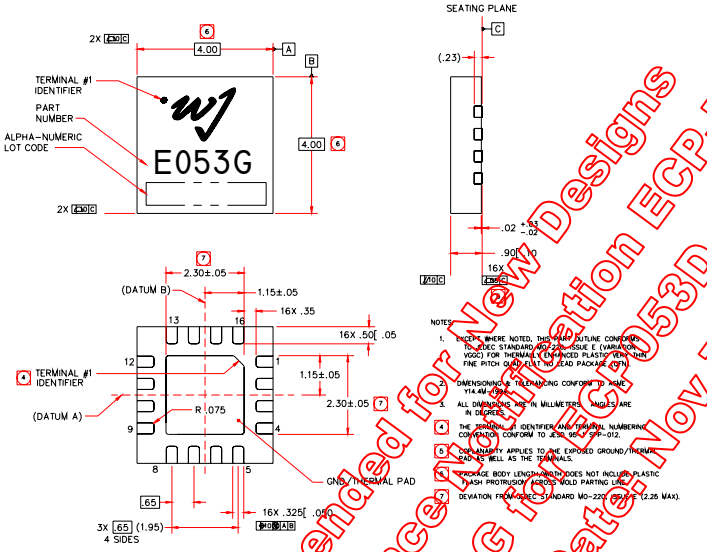
Mounting Config. Notes

1. A heatsink underneath the area of the PCB for the mounted device is strictly required for proper thermal operation. Damage to the device can occur without the use of one.
2. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm (#80 / .0135") diameter drill and have a final plated thru diameter of .25 mm (.010").
3. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.
4. Mounting screws can be added near the part to fasten the board to a heatsink. Ensure that the ground / thermal via region contacts the heatsink.
5. Do not put solder mask on the backside of the PC board in the region where the board contacts the heatsink.
6. RF trace width depends upon the PC board material and construction.
7. Use 1 oz. Copper minimum.
8. All dimensions are in millimeters (inches). Angles are in degrees.

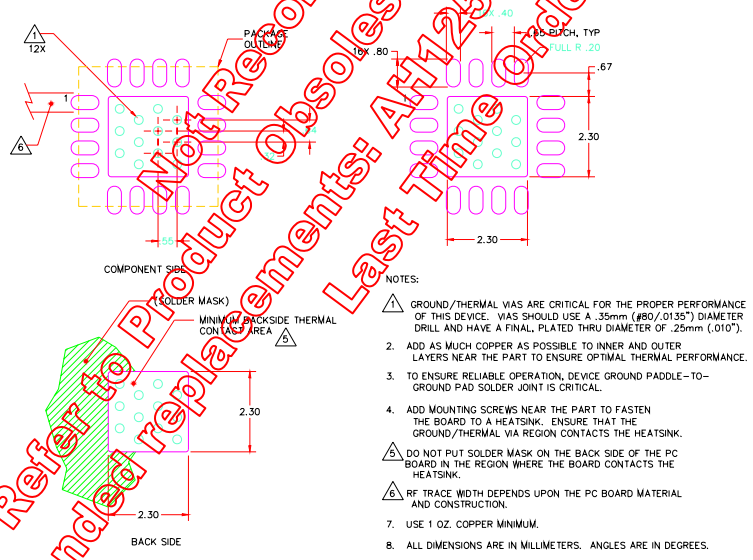
ECP053D-G Mechanical Information

This package is lead-free/Green/RoHS-compliant. The plating material on the pins is annealed matte tin over copper. It is compatible with both lead-free (maximum 260 °C reflow temperature) and leaded (maximum 245 °C reflow temperature) soldering processes.

Outline Drawing



Land Pattern



Product Marking

The component will be marked with an "E053G" designator with an alphanumeric lot code on the top surface of the package. The obsolete tin-lead package is marked with an "E053" designator followed by an alphanumeric lot code.

Tape and reel specifications for this part are located on the website in the "Application Notes" section.

ESD / MSL Information

Caution! ESD sensitive device.

ESD Rating:	Class 1B
Value:	Passes between 500 and 1000V
Test:	Human Body Model (HBM)
Standard:	JEDEC Standard JESD22-A114
MSL Rating:	Level 2 at +260 °C convection reflow
Standard:	JEDEC Standard J-STD-020

Mounting Config. Notes

1. A heatsink underneath the area of the PCB for the mounted device is recommended for proper thermal operation. Damage to the device can occur without the use of one.
2. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm (#80 / .0135") diameter drill and have a final plated thru diameter of .25 mm (.010").
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8 All dimensions are in millimeters. Angles are in degrees.