

## DATA SHEET

# CX77107: PA Module for CDMA / PCS (1850–1910 MHz)

### APPLICATIONS

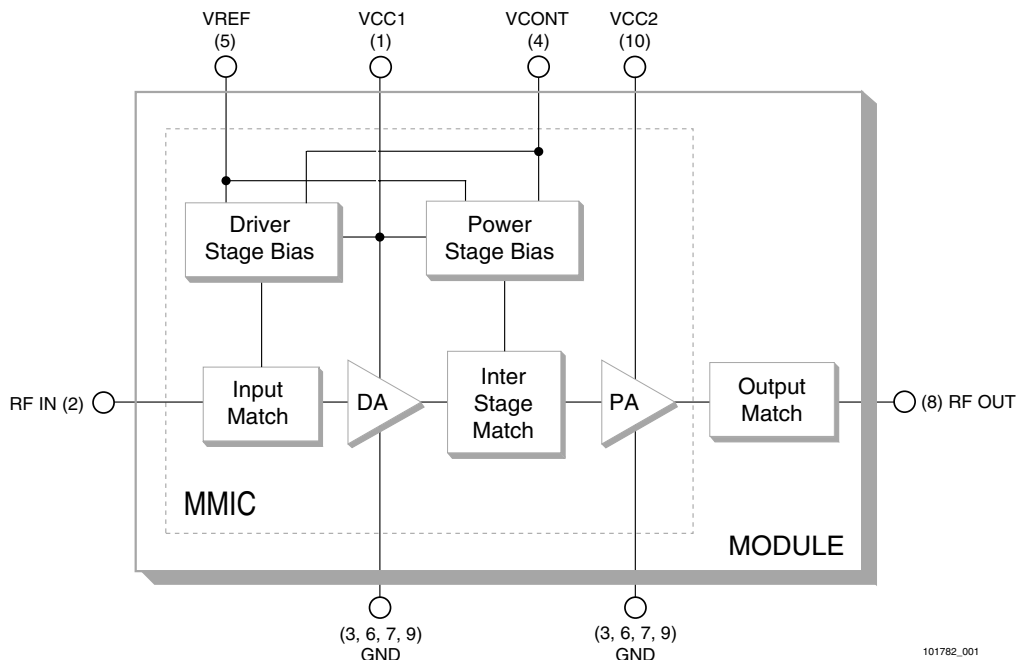
- Personal Communications Services (PCS)
- Wireless local loop (WLL)

### DISTINGUISHING FEATURES

- Low voltage positive bias supply (3.2 V to 4.2 V)
- Good linearity
- High efficiency
- Large dynamic range
- 10-pin package  
4 mm x 4 mm x 1.5 mm
- Power down control
- Low power-state control
- InGaP
- IS95/CDMA2000
- Full U.S. PCS coverage

The CX77107 Power Amplifier Module (PAM) is a fully matched 10-pin surface mount module developed for Personal Communications Service (PCS) and Wireless Local Loop (WLL) applications. This small and efficient Power Amplifier packs full 1850–1910 MHz bandwidth coverage into a single compact package. The CX77107 meets the stringent spectral linearity requirements of Code Division Multiple Access (CDMA) PCS transmission, with high power added efficiency for power output of up to 28 dBm. A low current (VCONT) pin is provided to improve efficiency for the low RF power range of operation.

The single Gallium Arsenide (GaAs) Microwave Monolithic Integrated Circuit (MMIC) contains all active circuitry in the module. The MMIC contains on-board bias circuitry, as well as input and interstage matching circuits. The output match is realized off-chip within the module package to optimize efficiency and power performance into a 50  $\Omega$  load. This device is manufactured with Skyworks' GaAs Heterojunction Bipolar Transistor (HBT) process that provides for all positive voltage DC supply operation while maintaining high efficiency and good linearity. Primary bias to the CX77107 is supplied directly from a three-cell nickel cadmium, a single-cell lithium ion, or other suitable battery with an output in the 3 to 4 volt range. Power down is accomplished by setting the voltage on the low current reference pin to zero volts. No external supply side switch is needed as typical "off" leakage is a few microamperes with full primary voltage supplied from the battery.



101782\_001

Figure 1. Functional Block Diagram

## Electrical Specifications

The following tables list the electrical characteristics of the CX77107 Power Amplifier. [Table 1](#) lists the absolute maximum ratings, while [Table 2](#) shows the recommended operating

conditions to achieve the performance characteristics listed in [Table 4](#). [Table 3](#) presents a truth table for the power ranges.

**Table 1. Absolute Maximum Ratings <sup>(1)</sup>**

| Parameter   | Symbol           | Minimum | Nominal | Maximum | Unit  |
|---|------------------|---------|---------|---------|-------|
| RF Input Power  | P <sub>IN</sub>  | —       | 0.0     | 7.0     | dBm   |
| Supply Voltage  | V <sub>CC</sub>  | —       | 3.4     | 6.0     | Volts |
| Reference Voltage   | V <sub>REF</sub> | —       | 3.0     | 3.1     | Volts |
| Case Operating Temperature  | T <sub>C</sub>   | –30     | 25      | +110    | °C    |
| Storage Temperature   | T <sub>STG</sub> | –55     | —       | +125    | °C    |
| <sup>(1)</sup> No damage assuming only one parameter is set at limit at a time with all other parameters set at or below nominal value. |                  |         |         |         |       |

**Table 2. Recommended Operating Conditions**

| Parameter                  | Symbol                      | Minimum | Nominal | Maximum | Unit  |
|----------------------------|-----------------------------|---------|---------|---------|-------|
| Supply Voltage             | V <sub>CC</sub>             | 3.2     | 3.4     | 4.2     | Volts |
| Reference Voltage          | V <sub>REF</sub>            | 2.95    | 3.0     | 3.05    | Volts |
| Control voltage            | Low Mode V <sub>CONT</sub>  | 2.5     | —       | 3.0     | Volts |
|                            | High Mode V <sub>CONT</sub> | 0.0     | —       | 0.5     | Volts |
| Operating Frequency        | F <sub>0</sub>              | 1850.0  | 1880.0  | 1910.0  | MHz   |
| Case Operating Temperature | T <sub>C</sub>              | –30     | +25     | +85     | °C    |

**Table 3. Power Range Truth Table**

| Power Mode | V <sub>REF</sub> | V <sub>CONT</sub> | Range         |
|------------|------------------|-------------------|---------------|
| High Power | 3.0 V            | 0.0 V–0.5 V       | 16 dBm–28 dBm |
| Low Power  | 3.0 V            | 2.5 V–3.0 V       | ≤ 16 dBm      |
| Shut Down  | 0.0 V            | 0.0 V             | —             |

**Table 4. Electrical Specifications for CDMA Nominal Operating Conditions <sup>(1)</sup>**

| Characteristics                           | Symbol               | Condition  | Min.   | Typical | Max.   | Unit   |
|---|----------------------|--|--|---------|--------|--------|
| Gain conditions      Digital Mode         | G <sub>LOW</sub>     | V <sub>CONT</sub> ≥ 2.5 V<br>P <sub>0</sub> = 16 dBm | 22.0   | 24.0    | 26.5   | dB     |
|   | G <sub>HIGH</sub>    | V <sub>CONT</sub> ≤ 0.5 V<br>P <sub>0</sub> = 28 dBm | 26.5   | 28.0    | 30.0   |        |
| Power Added Efficiency      Digital Mode  | PAE <sub>LOW</sub>   | V <sub>CONT</sub> ≥ 2.5 V<br>P <sub>0</sub> = 16 dBm | 7.5  | 9.0     | —      | %      |
|   | PAE <sub>HIGH</sub>  | V <sub>CONT</sub> ≤ 0.5 V<br>P <sub>0</sub> = 28 dBm | 37.0   | 39.0    | —      |        |
| Total Supply current                      | I <sub>CC_LOW</sub>  | P <sub>0</sub> = 16 dBm                              | —  | 125     | 150    | mA     |
|   | I <sub>CC_HIGH</sub> | P <sub>0</sub> = 28 dBm                              | —  | 475     | 500    |        |
| Quiescent current                         | I <sub>Q_LOW</sub>   | V <sub>CONT</sub> ≥ 2.5 V                            | —  | 50      | —      | mA     |
|   | I <sub>Q_HIGH</sub>  | V <sub>CONT</sub> ≤ 0.5 V                            | —  | 90      | —      |        |
| Reference Current                         | I <sub>REF</sub>     | —  | —  | 6.0     | —      | mA     |
| Control Current                           | I <sub>CTRL</sub>    | V <sub>CONT</sub> = 2.5 V                            | —  | 140     | —      | mA     |
| Total Supply current in Power-down Mode   | I <sub>PD</sub>      | V <sub>CC</sub> = 3.4V<br>V <sub>REF</sub> = 0 V     | —  | 3.0     | 5.0    | mA     |
| Adjacent Channel Power <sup>(2) (3)</sup> | 1.25 MHz offset      | ACP1 <sub>LOW</sub>                                  | V <sub>CONT</sub> ≥ 2.5 V<br>P <sub>0</sub> ≤ 16 dBm | —       | –48.0  | dBc    |
|   |                      | ACP1 <sub>HIGH</sub>                                 | V <sub>CONT</sub> ≤ 0.5 V<br>P <sub>0</sub> ≤ 28 dBm | —       | –50.0  |        |
|   | 2.25 MHz offset      | ACP3 <sub>LOW</sub>                                  | V <sub>CONT</sub> ≥ 2.5 V<br>P <sub>0</sub> ≤ 16 dBm | —       | –73.0  |        |
|   |                      | ACP3 <sub>HIGH</sub>                                 | V <sub>CONT</sub> ≤ 0.5 V<br>P <sub>0</sub> ≤ 28 dBm | —       | –58.5  |        |
| Harmonic Suppression                      | Second               | F <sub>02</sub>                                      | P <sub>0</sub> ≤ 28 dBm                              | —       | –40.0  | dBc    |
|   | Third                | F <sub>03</sub>                                      | P <sub>0</sub> ≤ 28 dBm                              | —       | –55.0  |        |
| Noise Power in RX Band 1930-1990 MHz      | RxBN                 | P <sub>0</sub> ≤ 28 dBm                              | —  | –138.0  | –137.0 | dBm/Hz |
| Noise Figure                              | NF                   | —  | —  | 4.0     | 5.0    | dB     |
| Input Voltage Standing Wave Ratio (VSWR)  | VSWR                 | —  | —  | —       | 2.0:1  | —      |
| Stability (Spurious output)               | S                    | 5:1 VSWR All phases                                  | —  | —       | –70.0  | dBc    |
| Ruggedness – No damage <sup>(4)</sup>     | Ru                   | P <sub>0</sub> ≤ 28 dBm                              | 10:1   | —       | —      | VSWR   |

<sup>(1)</sup> V<sub>CC</sub> = +3.4 V, V<sub>REF</sub> = +3.0 V, Freq = 1880 MHz, T<sub>c</sub> = 25 °C, unless otherwise specified  
<sup>(2)</sup> ACP is specified per IS95 as the ratio of the total in-band power (1.23 MHz BW) to adjacent power in a 30 kHz BW.  
<sup>(3)</sup> CDMA2000 is configured as DCCH = 9600, SCH0 = 9600, PCH (Walsh 0) = –3.75 dB, and Peak-to-Average Ratio (CCDF = 1%) = 4.5 dB. For CDMA2000, 0.5 dB back-off in output power is required.  
<sup>(4)</sup> All phases, time = 10 seconds.

**Table 5. Electrical Specifications for CDMA Recommended Operating Conditions <sup>(1)</sup>**

| Characteristics   | Symbol            | Condition  | Minimum  | Maximum | Unit   |
|---|-------------------|--|--|---------|--------|
| Gain conditions      Digital Mode   | G <sub>LOW</sub>  | V <sub>CONT</sub> ≥ 2.5 V<br>P <sub>0</sub> = 16 dBm | 21.0   | 29.5    | dB     |
|   | G <sub>HIGH</sub> | V <sub>CONT</sub> ≤ 0.5 V<br>P <sub>0</sub> = 28 dBm | 24.5   | 33.0    |        |
| Adjacent Channel Power <sup>(2) (3) (4)</sup>   | 1.25 MHz offset   | ACP1 <sub>LOW</sub>                                  | V <sub>CONT</sub> ≥ 2.5 V<br>P <sub>0</sub> ≤ 16 dBm | —       | dBc    |
|   |                   | ACP1 <sub>HIGH</sub>                                 | V <sub>CONT</sub> ≤ 0.5 V<br>P <sub>0</sub> ≤ 28 dBm | —       |        |
|   | 2.25 MHz offset   | ACP3 <sub>LOW</sub>                                  | V <sub>CONT</sub> ≥ 2.5 V<br>P <sub>0</sub> ≤ 16 dBm | —       |        |
|   |                   | ACP3 <sub>HIGH</sub>                                 | V <sub>CONT</sub> ≤ 0.5 V<br>P <sub>0</sub> ≤ 28 dBm | —       |        |
| Harmonic Suppression  | Second            | F <sub>02</sub>                                      | P <sub>0</sub> ≤ 28 dBm                              | —       | dBc    |
|   | Third             | F <sub>03</sub>                                      | P <sub>0</sub> ≤ 28 dBm                              | —       |        |
| Noise Power in RX Band 1840-1895 MHz  | RxBN              | P <sub>0</sub> ≤ 28 dBm                              | —  | –136.0  | dBm/Hz |
| Noise Figure  | NF                | —  | —  | 7.0     | dB     |
| Input Voltage Standing Wave Ratio (VSWR)  | VSWR              | —  | —  | 2.5:1   | —      |
| Stability (Spurious output)   | S                 | 5:1 VSWR<br>All phases                               | —  | –70.0   | dBc    |
| Ruggedness – No damage <sup>(5)</sup>   | Ru                | P <sub>0</sub> ≤ 28 dBm                              | 10:1   | —       | VSWR   |
| <sup>(1)</sup> Per Table 2, unless otherwise specified.<br><sup>(2)</sup> ACP is specified per IS95 as the ratio of the total in-band power (1.23 MHz BW) to adjacent power in a 30 kHz BW.<br><sup>(3)</sup> CDMA2000 is configured as DCCH = 9600, SCH0 = 9600, PCH (Walsh 0) = –3.75 dB, and Peak-to-Average Ratio (CCDF = 1%) = 4.5 dB. For CDMA2000, 0.5 dB back-off in output power is required.<br><sup>(4)</sup> Worst case ACPR is –43dBc at +85 °C, V <sub>CC</sub> = 3.2 V.<br><sup>(5)</sup> All phases, time = 10 seconds. |                   |  |  |         |        |

## Characterization Data

The graphs from Figure 2 through Figure 10 illustrate the characteristics of a typical CX77107 power amplifier designed for operation in the PCS frequency band (1850–1910 MHz). This amplifier was selected by characterizing a group of devices and choosing a part with average electrical performance for both nominal and the full range of recommended operating conditions, including worst case limits.

The graphs illustrate the digital signal characteristics of the CX77107. Shown are power sweep characteristics for key performance parameters over temperature and frequency, up to 28.5 dBm output power. The data was taken up to and including 16 dBm output power with the bias mode control pin setting of  $V_{\text{CONT}} = 2.5$  volts. Beyond 16 dBm output power, the  $V_{\text{CONT}}$  was set to 0 volts.

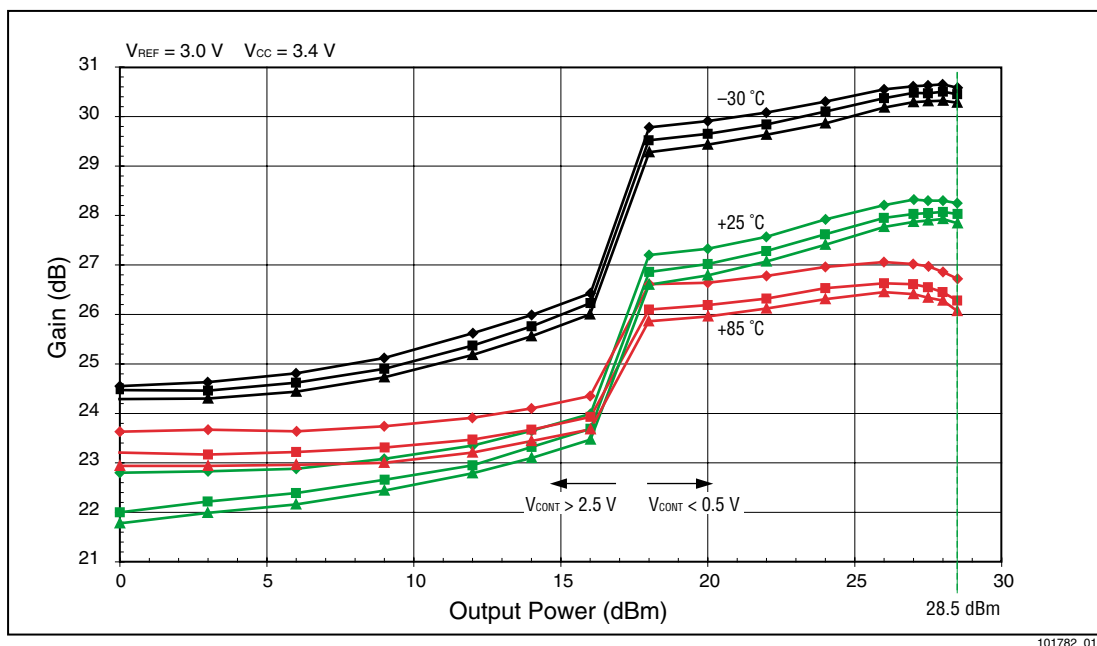
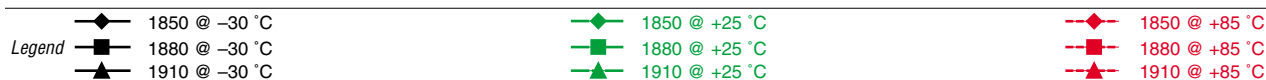


Figure 2. Digital Mode Gain vs. Output Power



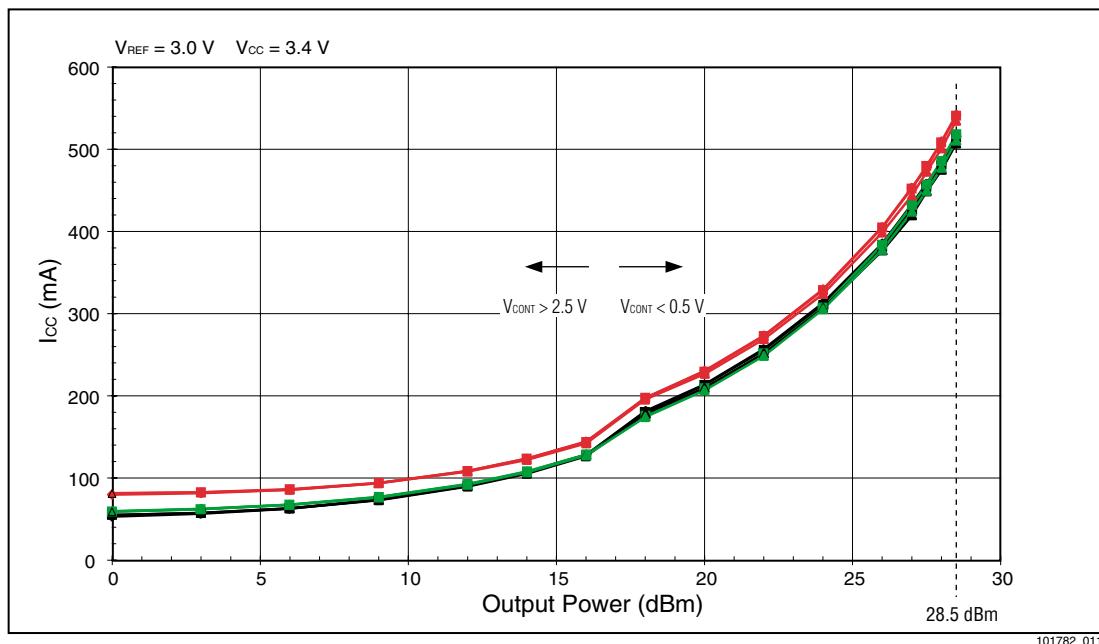


Figure 3. Primary Bias Current vs. Output Power

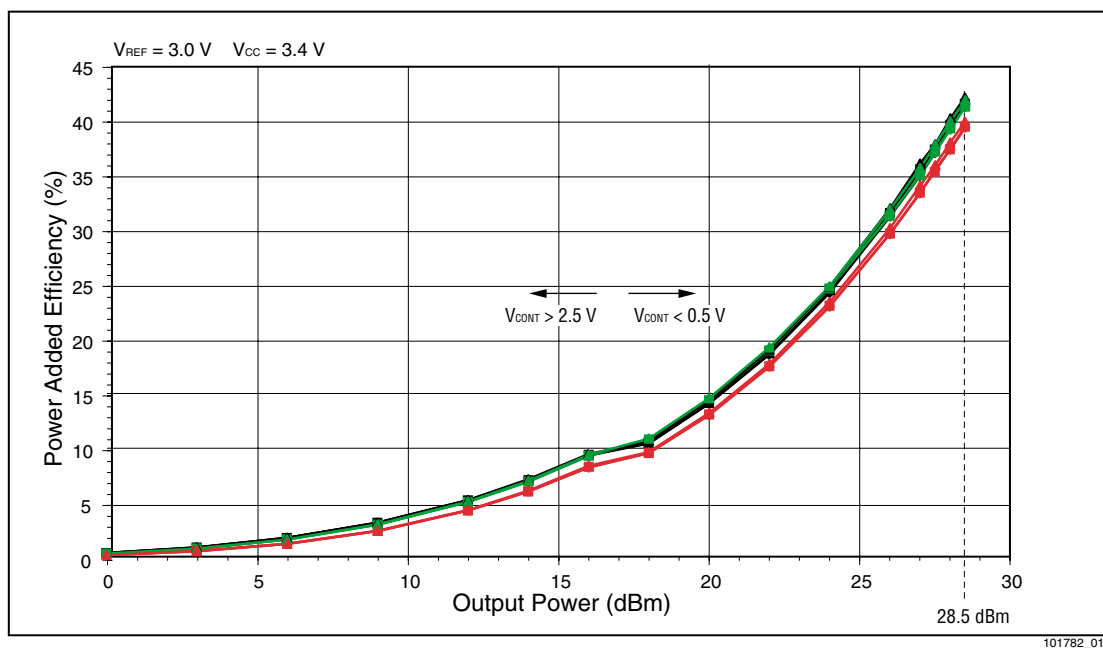


Figure 4. Power Added Efficiency vs. Output Power

Legend

- ◆ 1850 @ -30 °C
- 1880 @ -30 °C
- ▲ 1910 @ -30 °C

- ◆ 1850 @ +25 °C
- 1880 @ +25 °C
- ▲ 1910 @ +25 °C

- ◆ 1850 @ +85 °C
- 1880 @ +85 °C
- ▲ 1910 @ +85 °C

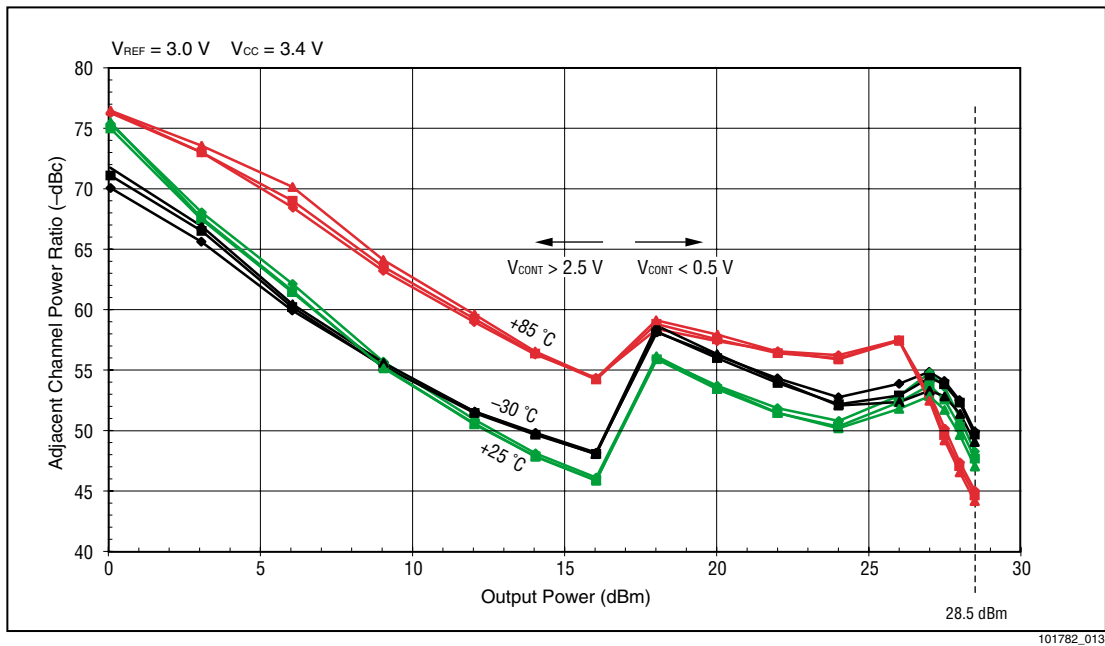


Figure 5. ACP for 1.25 MHz Offset vs. Output Power

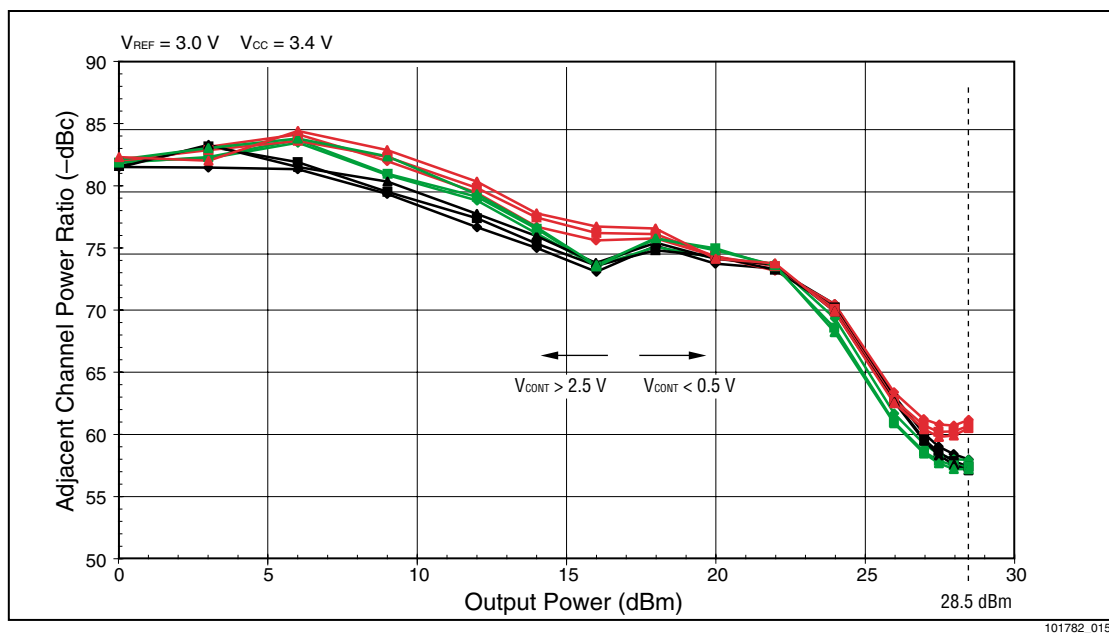
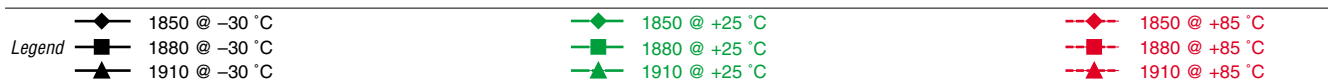


Figure 6. ACP for 2.25 MHz Offset vs. Output Power



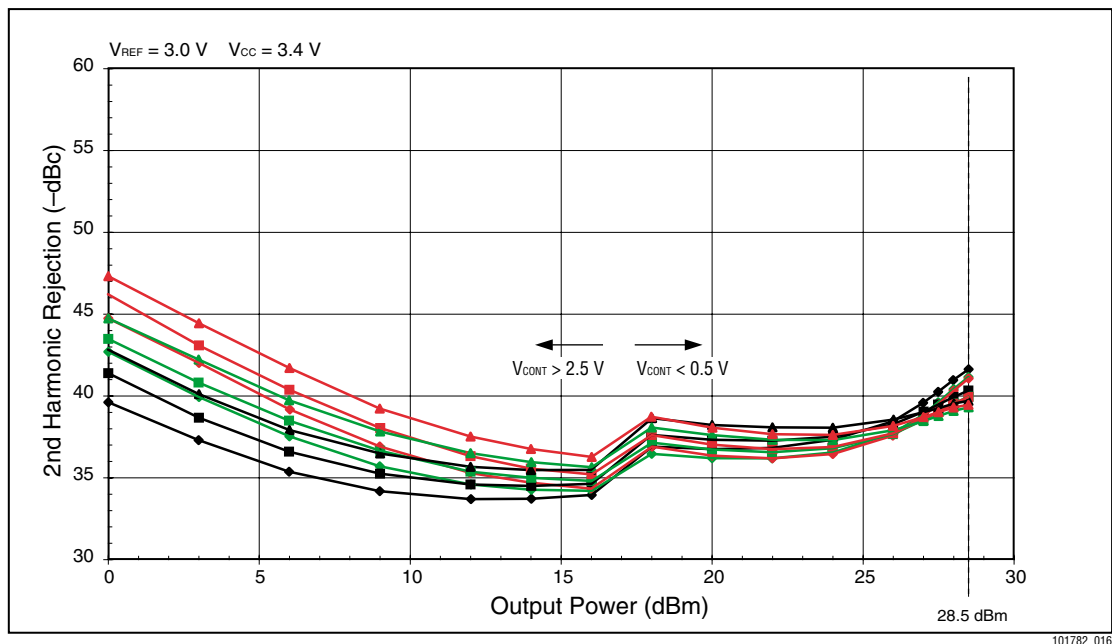


Figure 7. Second Harmonic Rejection vs. Output Power

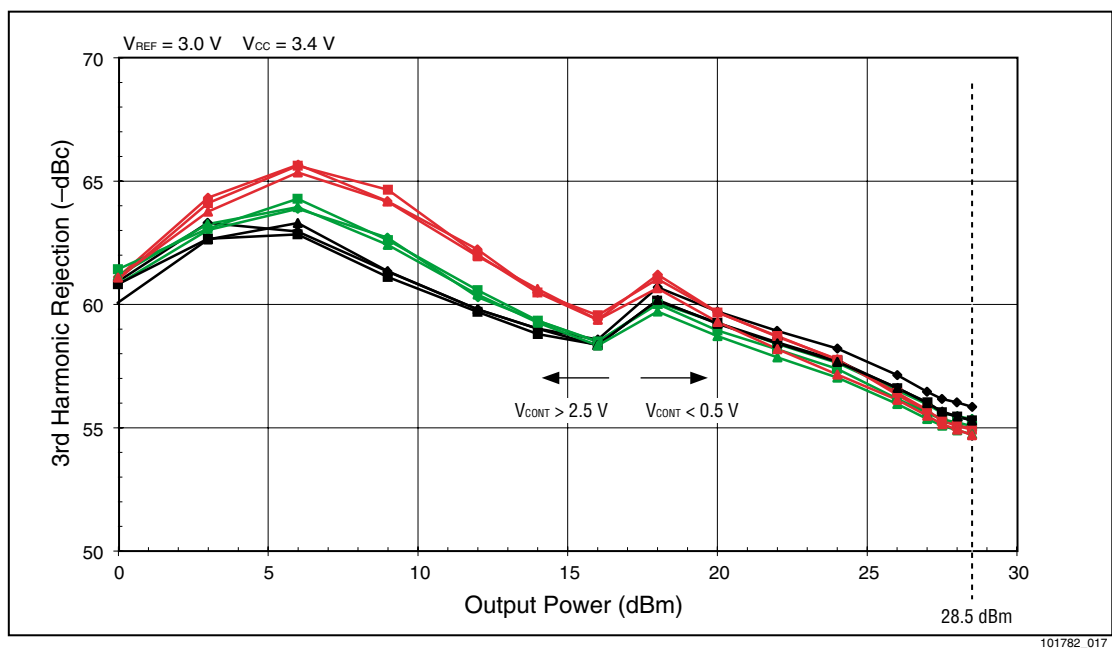


Figure 8. Third Harmonic Rejection vs. Output Power

|        |                 |                 |                 |
|--------|-----------------|-----------------|-----------------|
| Legend | ◆ 1850 @ -30 °C | ◆ 1850 @ +25 °C | ◆ 1850 @ +85 °C |
|        | ■ 1880 @ -30 °C | ■ 1880 @ +25 °C | ■ 1880 @ +85 °C |
|        | ▲ 1910 @ -30 °C | ▲ 1910 @ +25 °C | ▲ 1910 @ +85 °C |



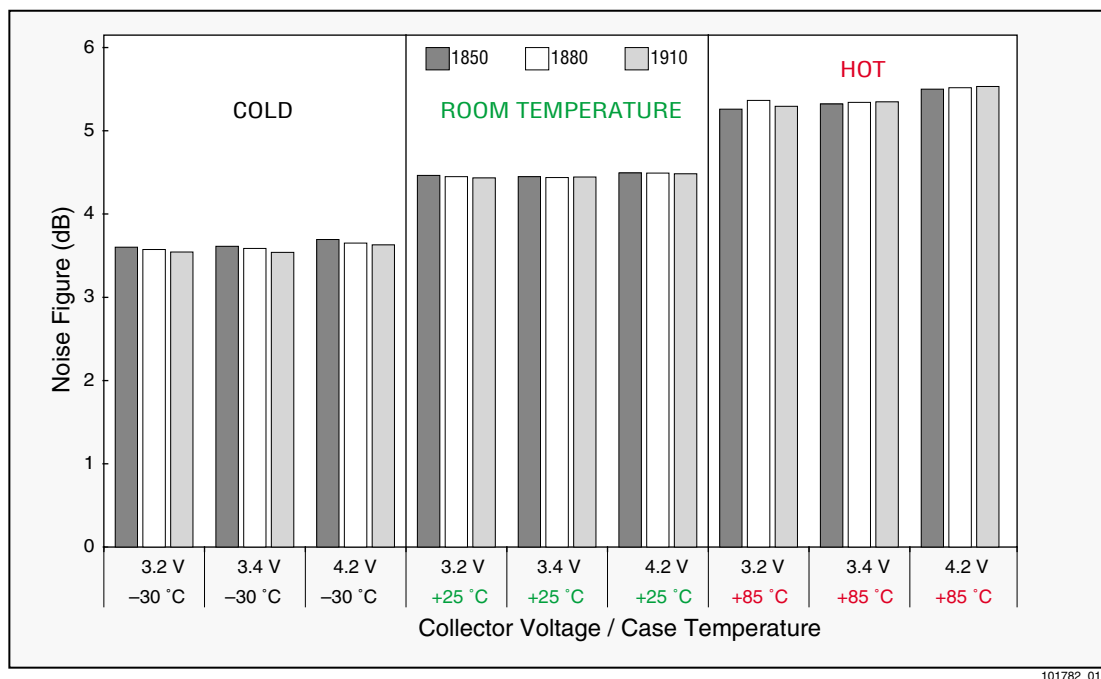


Figure 9. Noise Figure as Function of Operating Conditions

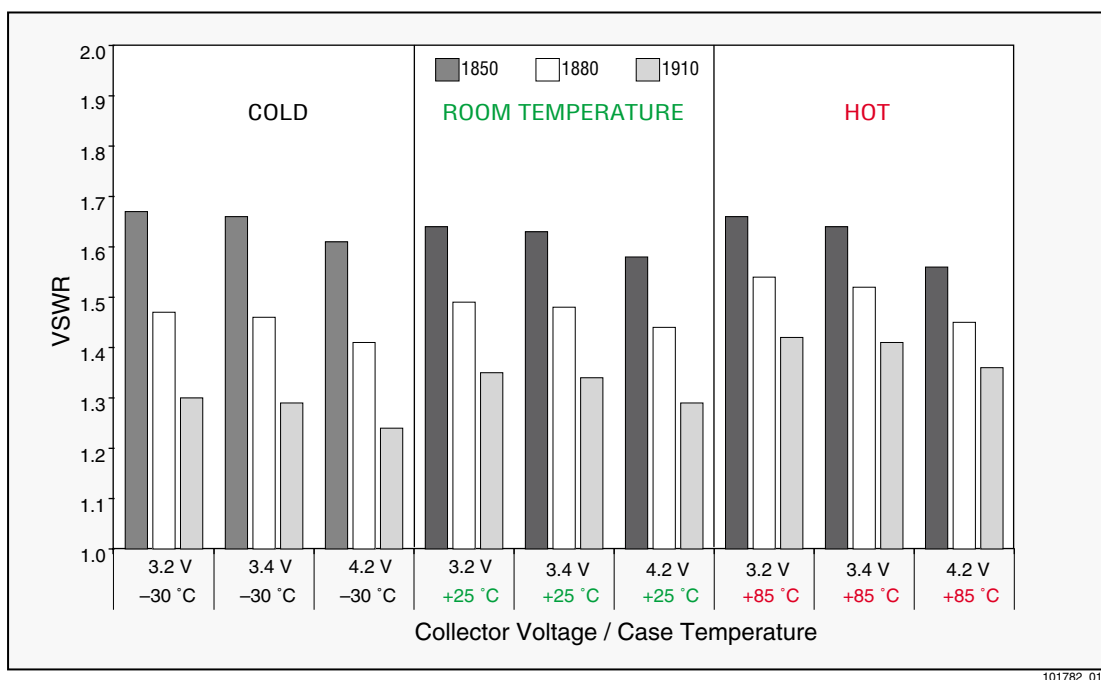
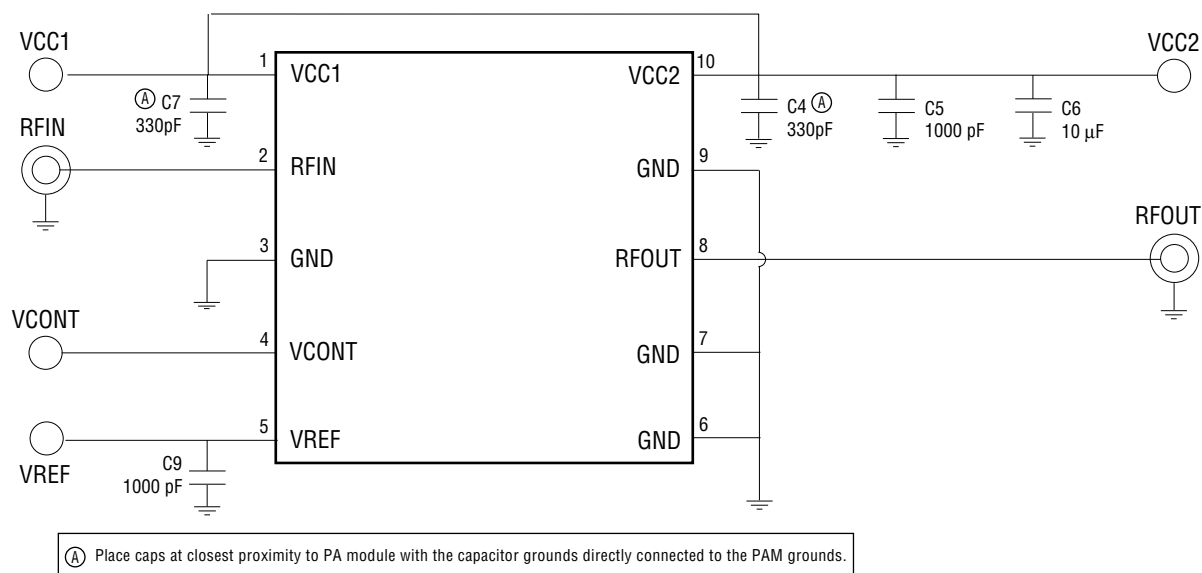


Figure 10. Input VSWR as Function of Operating Conditions

## Evaluation Board Description

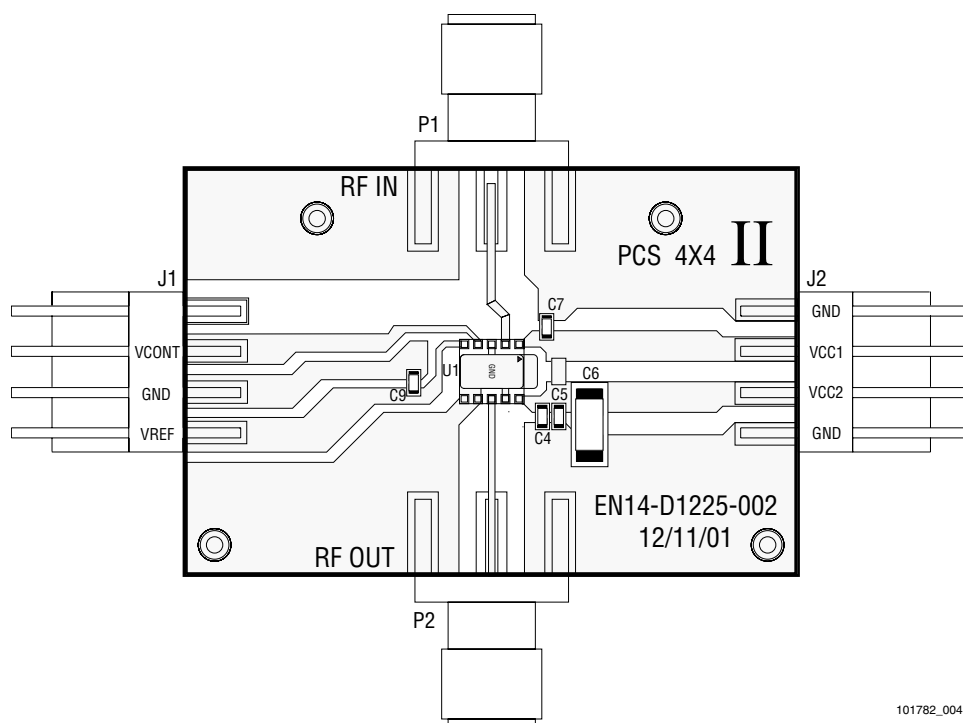
The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the CX77107, the evaluation board schematic and diagrams are

included for preliminary analysis and design. [Figure 11](#) is the basic schematic of the board for the 1850 MHz to 1910 MHz range and [Figure 12](#) is a diagram of the board assembly.



101782\_002

Figure 11. Evaluation Board Schematic



101782\_004

Figure 12. Evaluation Board Assembly Diagram

## Package Dimensions and Pin Descriptions

The CX77107 is a multi-layer laminate base, overmold encapsulated modular package designed for surface mount solder attachment to a printed circuit board. Figure 13 is a mechanical drawing of the pad layout for this package and Figure

14 illustrates typical case markings. The pin numbering convention, as shown in Figure 15, starts with pin 1 in the upper left and increments counter-clockwise around the package. Table 6 lists each pin function and description.

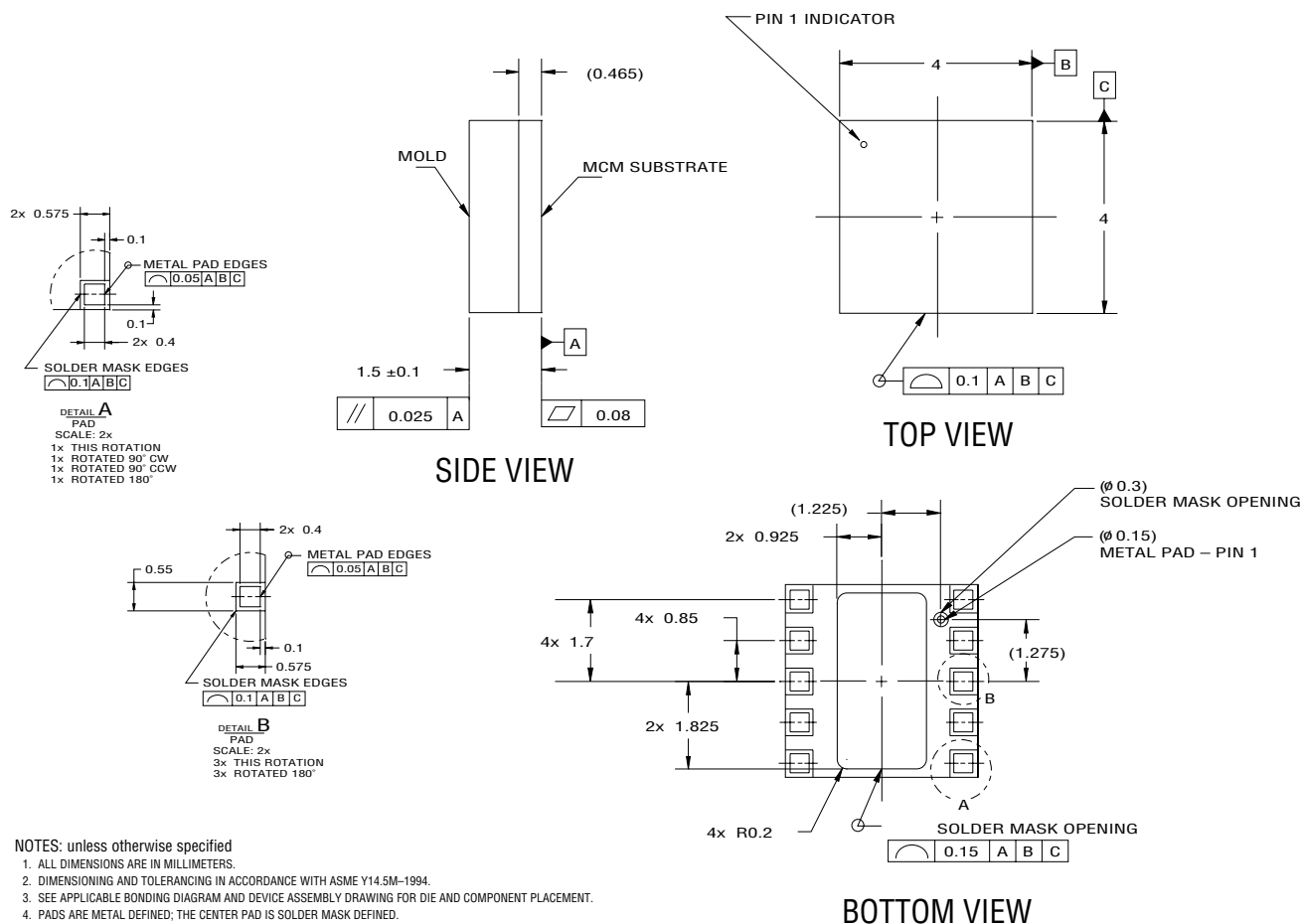


Figure 13. CX77107 Package Drawing

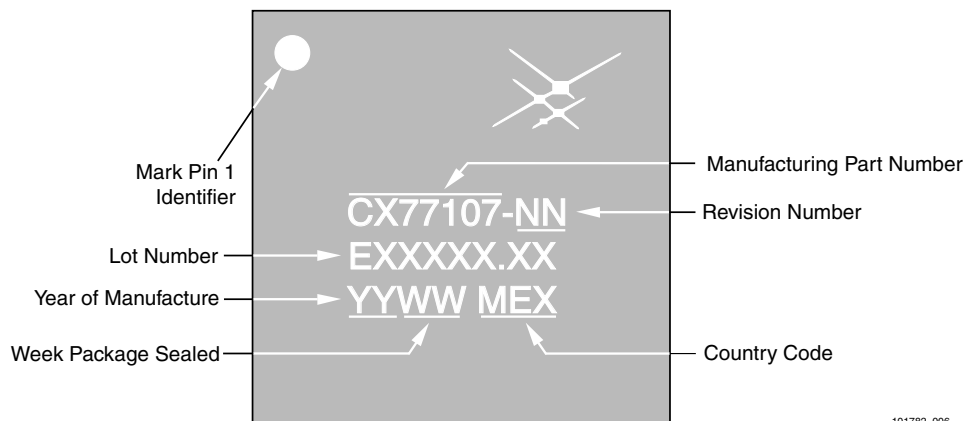
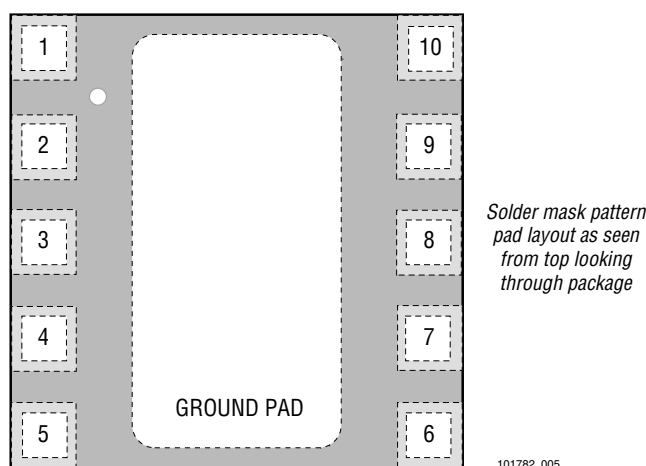


Figure 14 Typical Case Markings (Top View)

**Table 6. Pin Names and Descriptions**

| PIN Number  | Function | Description                        |
|---|----------|------------------------------------|
| 1 <sup>(1)</sup>  | VCC1     | Connect to battery or DC supply    |
| 2   | RF IN    | RF Input                           |
| 3   | GND      | Ground                             |
| 4   | VCONT    | Control voltage                    |
| 5   | VREF     | Reference voltage                  |
| 6   | GND      | Ground                             |
| 7   | GND      | Ground                             |
| 8   | RF OUT   | RF Output                          |
| 9   | GND      | Ground                             |
| 10 <sup>(1)</sup>   | VCC2     | Connect to battery or DC supply    |
| GND PAD <sup>(2)</sup>  | GND      | Ground pad on underside of package |
| <sup>(1)</sup> All supply pins may be connected together at the supply.<br><sup>(2)</sup> Package underside is GND PAD. |          |                                    |

**Figure 15. Pin Configuration**

## Package and Handling Information

Because of its sensitivity to moisture absorption, this device package is baked and vacuum packed prior to shipment. Instructions on the shipping container label must be followed regarding exposure to moisture after the container seal is broken, otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The CX77107 is capable of withstanding an MSL 3/240 °C solder reflow. Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. If the part is attached in a reflow oven, the temperature ramp rate should not exceed 5 °C per second; maximum temperature

should not exceed 240 °C. If the part is manually attached, precaution should be taken to insure that the part is not subjected to temperatures exceeding 240 °C for more than 10 seconds. For details on both attachment techniques, precautions, and handling procedures recommended by Skyworks, please refer to *Application Note: PCB Design and SMT Assembly/Rework, Document Number 101752*. Additional information on standard SMT reflow profiles can also be found in the *JEDEC Standard J-STD-020B*.

Production quantities of this product are shipped in the standard tape-and-reel format. For packaging details, refer to *Application Note: Tape and Reel, Document Number 101568*.

Electrostatic Discharge Sensitivity

The CX77107 is a Class I device. lists the Electrostatic Discharge (ESD) immunity level for each pin of the CX77107 product. The numbers in specify the ESD threshold level for each pin where the I-V curve between the pin and ground starts to show degradation.

The ESD testing was performed in compliance with MIL-STD-883E Method 3015.7 using the Human Body Model. If ESD damage threshold magnitude is found to consistently exceed 2000 volts on a given pin, this so is indicated. If ESD damage threshold below 2000 volts is measured for either polarity, numbers are indicated that represent worst case values observed in product characterization.

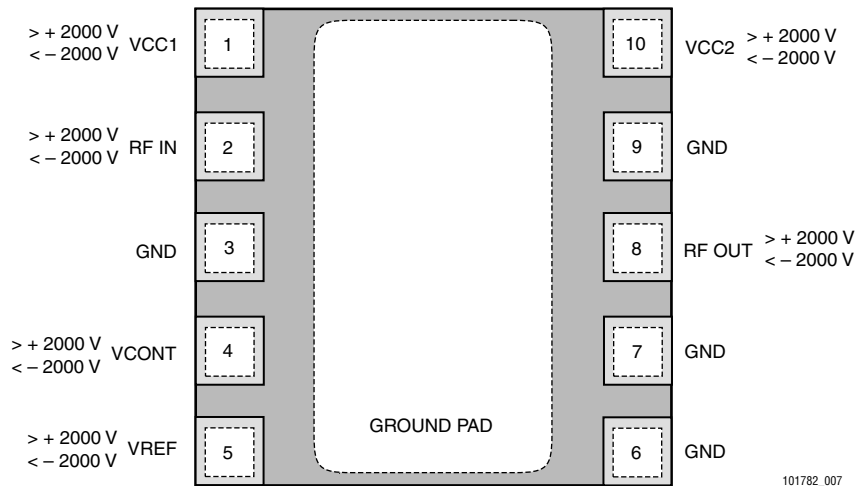


Figure 16. ESD Sensitivity Areas (Top View)

Various failure criteria can be utilized when performing ESD testing. Many vendors employ relaxed ESD failure standards which fail devices only after “the pin fails the electrical specification limits” or “the pin becomes completely non-functional”. Skyworks employs most stringent criteria; fails devices as soon as the pin begins to show any degradation on a curve tracer. To avoid ESD damage, both latent and visible, it is very important that the product assembly and test areas follow the Class-1 ESD handling precautions listed in Table 7.

Table 7. Precautions for Handling GaAs IC-based Products to Avoid Induced Damage

| Personnel Grounding  | Facility  |
|--|---|
| Wrist Straps<br>Conductive Smocks, Gloves and Finger Cots<br>Antistatic ID Badges  | Relative Humidity Control and Air Ionizers<br>Dissipative Floors (less than 10 <sup>9</sup> Ω to GND)   |
| Protective Workstation   | Protective Packaging & Transportation   |
| Dissipative Table Tops<br>Protective Test Equipment (Properly Grounded)<br>Grounded Tip Soldering Irons<br>Conductive Solder Suckers<br>Static Sensors | Bags and Pouches (Faraday Shield)<br>Protective Tote Boxes (Conductive Static Shielding)<br>Protective Trays<br>Grounded Carts<br>Protective Work Order Holders |

## Ordering Information

| Model Number | Manufacturing Part Number | Product Revision | Package  | Operating Temperature |
|--------------|---------------------------|------------------|----------|-----------------------|
| CX77107      | CX77107                   |                  | 4x4LM-10 | -30 °C to +85 °C      |

## Revision History

| Revision | Level | Date         | Description     |
|----------|-------|--------------|-----------------|
| A        |       | July 3, 2003 | Initial Release |

## References

Application Note: PCB Design and SMT Assembly/Rework, Document Number 101752.

Application Note: Tape and Reel, Document Number 101568

Standard SMT Reflow Profiles: JEDEC Standard J-STD-020B.

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