DATA SHEET

CX77105 Power Amplifier Module for CDMA/AMPS (824–849 MHz)

Applications

- Digital cellular (CDMA)
- Analog cellular (AMPS)
- Wireless local loop (WLL)

Features

- Low voltage positive bias supply
  - 3.2 V to 4.2 V, typical
- Good linearity
- High efficiency
- Dual mode operation
- Large dynamic range
- 10-pad package
  - 4 x 4 x 1.5 mm
- Power down control
- Low power-state control
- InGaP
- IS 95/CDMA2000

Description

The CX77105, a dual-mode, Code Division Multiple Access (CDMA) / Advanced Mobile Phone Service (AMPS) Power Amplifier Module (PAM), is a fully matched, 10-pad surface mount module developed for cellular handsets and wireless local loop applications. This small and efficient power amplifier module packs a full 824–849 MHz bandwidth coverage into a single compact package. The device meets the stringent IS95 CDMA linearity requirements to and exceeding 28 dBm output power, and can be driven to levels beyond 31 dBm for high efficiency in FM mode operation. A low current digital pad (VCONT) provides improved 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. Output match into a 50 Ω load is realized off-chip and within the module package to optimize efficiency and power performance. 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 CX77105 is supplied directly from a three-cell Ni-Cd, a single-cell Li-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 pad 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.

NEW Skyworks offers lead (Pb)-free "environmentally friendly" packaging that is RoHS compliant (European Parliament for the Restriction of Hazardous Substances).

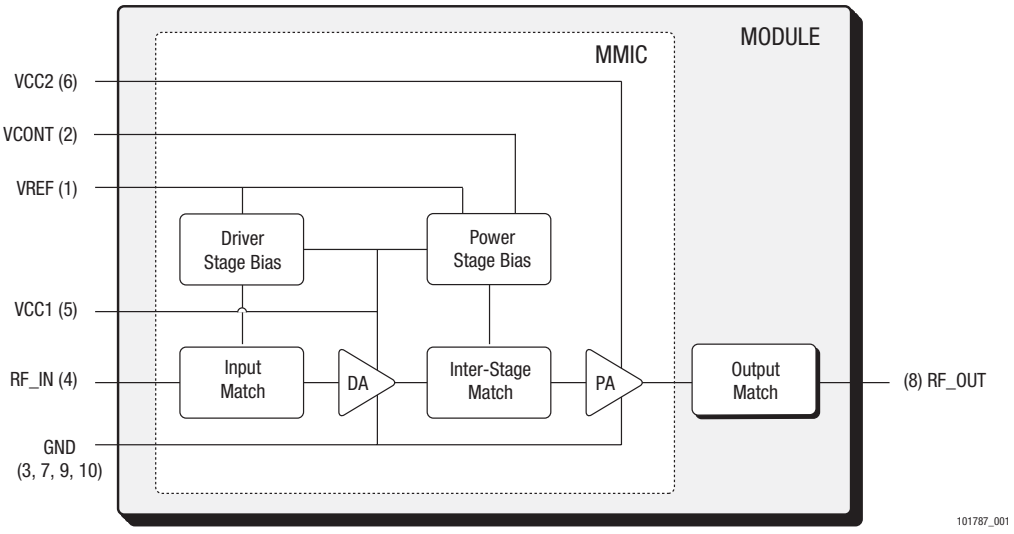


Figure 1. CX77105 Functional Block Diagram

Electrical Specifications

The following tables list the electrical characteristics of the CX77105 Power Amplifier. Table 1 lists the absolute maximum ratings and Table 2 lists the recommended operating conditions for achieving the electrical performance listed in Table 4. Table 3 is a truth table for the CX77105 Power Amplifier.

Table 1. Absolute Maximum Ratings [1]

Parameter		Symbol	Minimum	Nominal	Maximum	Unit
RF Input Power		P_{IN}	—	4.0	7.0	dBm
Supply Voltage		V_{CC}	—	3.4	6.0	Volts
Reference Voltage		V_{REF}	—	3.0	3.1	Volts
Case Temperatures	Operating	T_C	–30	25	+110	°C
	Storage	T_{STG}	–55	—	+125	°C

[1] No damage assuming only one parameter is set at limit at a time with all other parameters set at nominal value.

Table 2. Recommended Operating Conditions

Parameter		Symbol	Minimum	Nominal	Maximum	Unit
Supply Voltage		V_{CC}	3.2	3.4	4.2	Volts
Reference Voltage	PA On	V_{REF}	2.95	3.0	3.05	Volts
	PA Off		—	—	0.5	
Mode Input Impedance >2.5 kW	High Bias	V_{CONT}	0.0	—	0.5	Volts
	Low Bias	V_{CONT}	2.5	—	3.0	
Operating Frequency		F_O	824.0	836.5	849.0	MHz
Case Operating Temperature		T_C	–30	—	+85	°C

Table 3. Power Range Truth Table

Power Mode	V_{REF}	V_{CONT}	Range
High Power	3.0 V	0.0–0.5 V	16 dBm–31 dBm
Low Power	3.0 V	2.5–3.0 V	≤ 16 dBm
Shut Down	0.0 V	0.0 V	—

Table 4. Electrical Specifications for CDMA / AMPS Nominal Operating Conditions [1]

Characteristics		Symbol	Condition	Minimum	Typical	Maximum	Unit
Gain conditions	Digital Mode	G_{LOW}	$V_{CONT} \geq 2.5$ V $P_O = 16$ dBm	25.0	27.0	28.0	dB
		G_{HIGH}	$V_{CONT} \leq 0.5$ V $P_O = 28$ dBm	28.5	29.0	31.0	
	Analog Mode	G_P	$V_{CONT} \leq 0.5$ V $P_O = 31$ dBm	27.5	29.0	31.0	
Power Added Efficiency	Digital Mode	PAE_{LOW}	$V_{CONT} \geq 2.5$ V $P_O = 16$ dBm	7.6	8.5	—	%
		PAE_{HIGH}	$V_{CONT} \leq 0.5$ V $P_O = 28$ dBm	37.0	40.0	—	
	Analog Mode	PAE_A	$V_{CONT} \leq 0.5$ V $P_O = 31$ dBm	48.0	55.0	—	
Total Supply Current		I_{CC_LOW}	$P_O = 16$ dBm	—	137	153	mA
		I_{CC_HIGH}	$P_O = 28$ dBm	—	490	500	
Quiescent Current		I_{Q_LOW}	$V_{CONT} \geq 2.5$ V	40			mA
		I_{Q_HIGH}	$V_{CONT} \leq 0.5$ V	60	55	75	
Reference Current		I_{REF}	—	—	2.5	5.0	mA
Control Current		I_{CTRL}	$V_{CONT} = 2.5$ V	200	235	500	µA
Total Supply current in Power-down Mode		I_{PD}	$V_{CC} = 3.4$ V $V_{REF} = 0$ V	—	3.0	5.0	µA
Adjacent Channel Power [2,3]	885 kHz offset	$ACP1_{LOW}$	$V_{CONT} \geq 2.5$ V $P_O \leq 16$ dBm	—	–49.0	–47.3	dBc
		$ACP1_{HIGH}$	$V_{CONT} \leq 0.5$ V $P_O \leq 28$ dBm	—	–50.0	–47.0	
	1.98 MHz offset	$ACP2_{LOW}$	$V_{CONT} \geq 2.5$ V $P_O \leq 16$ dBm	—	–65.0	–59.0	
		$ACP2_{HIGH}$	$V_{CONT} \leq 0.5$ V $P_O \leq 28$ dBm	—	–60.0	–57.4	
Harmonic Suppression	Second	$f_0 2$	$P_O \leq 28$ dBm	—	–38.0	–35.0	dBc
	Third	$f_0 3$	$P_O \leq 28$ dBm	—	–59.0	–45.0	
Noise Power in RX Band 869-894 MHz		RxBN	$P_O \leq 28$ dBm	—	–137	—	dBm/Hz
Noise Figure		NF	—	—	4.6	5.0	dB
Input Voltage Standing Wave Ratio		VSWR	—	—	—	1.9:1	—
Stability (Spurious output)		S	5:1 VSWR all phases	—	—	–60.0	dBc
Ruggedness—No damage4		Ru	$P_O \leq 28$ dBm	10:1	—	—	VSWR

[1] VCC = +3.4 V, VREF = +3.0 V, Freq = 836.5 MHz, TC = 25 °C, unless otherwise specified.

[2] 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.

[3] 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.

[4] All phases, time = 10 seconds.

Table 5. Electrical Specifications for CDMA / AMPS Recommended Operating Conditions [1]

Characteristics		Symbol	Condition	Minimum	Maximum	Unit
Gain conditions	Digital Mode	G_{LOW}	$V_{CONT} \geq 2.5$ V $P_O = 16$ dBm	24.0	28.5	dB
		G_{HIGH}	$V_{CONT} \leq 0.5$ V $P_O = 28$ dBm	27.1	32.4	
	Analog Mode	G_P	$V_{CONT} \leq 0.5$ V $P_O = 31$ dBm	24.0	33.0	
Adjacent Channel Power [2,3]	1.25 MHz offset	$ACP1_{LOW}$	$V_{CONT} \geq 2.5$ V $P_O \leq 16$ dBm	—	–44	dBc
		$ACP1_{HIGH}$	$V_{CONT} \leq 0.5$ V $P_O \leq 28$ dBm	—	–44	
	1.98 MHz offset	$ACP2_{LOW}$	$V_{CONT} \geq 2.5$ V $P_O \leq 16$ dBm	—	–56	
		$ACP2_{HIGH}$	$V_{CONT} \leq 0.5$ V $P_O \leq 28$ dBm	—	–56	
Harmonic Suppression	Second	f_O2	$P_O \leq 28$ dBm	—	–30	dBc
	Third	f_O3	$P_O \leq 28$ dBm	—	–40	
Noise Power in RX Band 869-894 MHz		RxBN	$P_O \leq 28$ dBm	—	–134.0	dBm/Hz
Noise Figure		NF	—	—	7.0	dB
Input Voltage Standing Wave Ratio (VSWR)		VSWR	—	—	2.0:1	—
Stability (Spurious output)		S	5:1 VSWR All phases	—	–60.0	dBc
Ruggedness – No damage [4]		Ru	$P_O \leq 28$dBm	10:1	—	VSWR

1 Per Table 2, unless otherwise specified.

2 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.

3 CDMA2000 is configured as DCCH = 9600, SCHO = 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.

4 All phases, time = 10 seconds.

Characterization Data

The following graphs illustrate the characteristics of a typical CX77105 power amplifier designed for operation in the cellular frequency band (824–849 MHz). This amplifier was selected by characterizing a group of devices and then selecting a part with average electrical performance for both nominal and the full range of recommended operating conditions, including worst case limits. Figure 2 through Figure 8 illustrate the digital signal characteristics of the CX77105. 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 pad setting of V_{CONT} = 2.5 volts. Beyond 16 dBm output power, the V_{CONT} was set to zero volts.

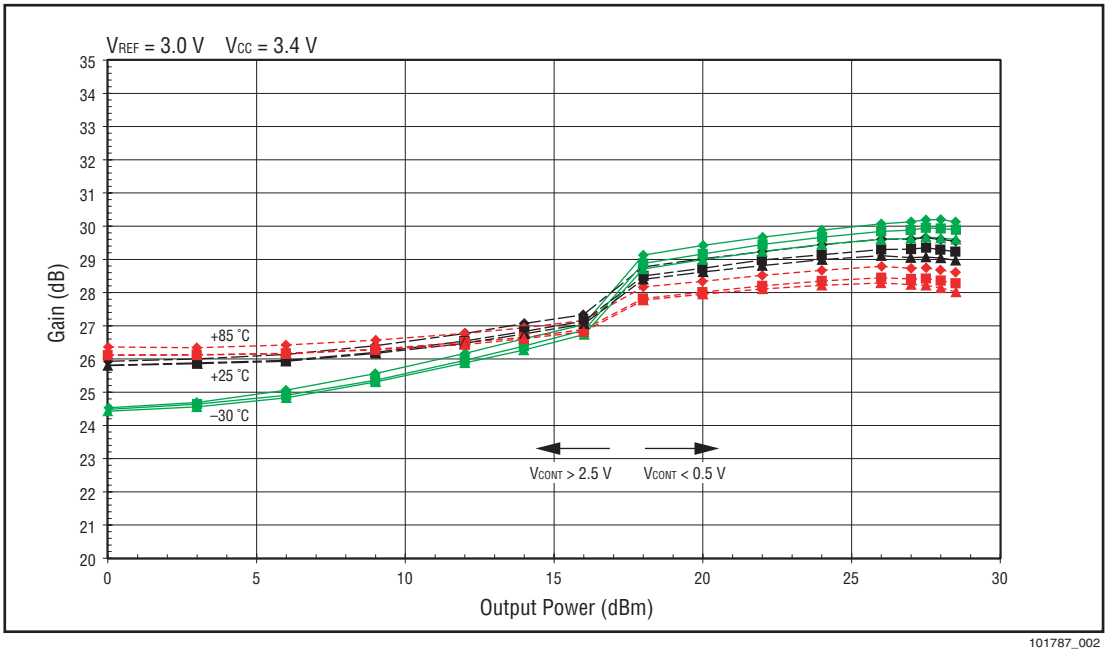
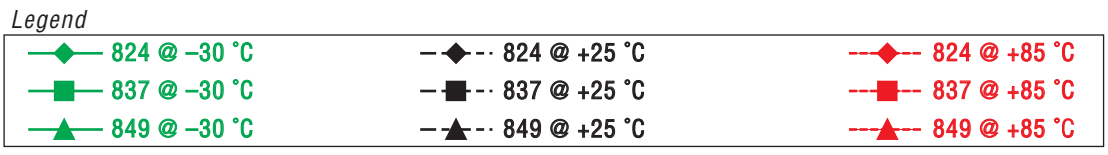


Figure 2. Digital Mode Gain vs. Output Power



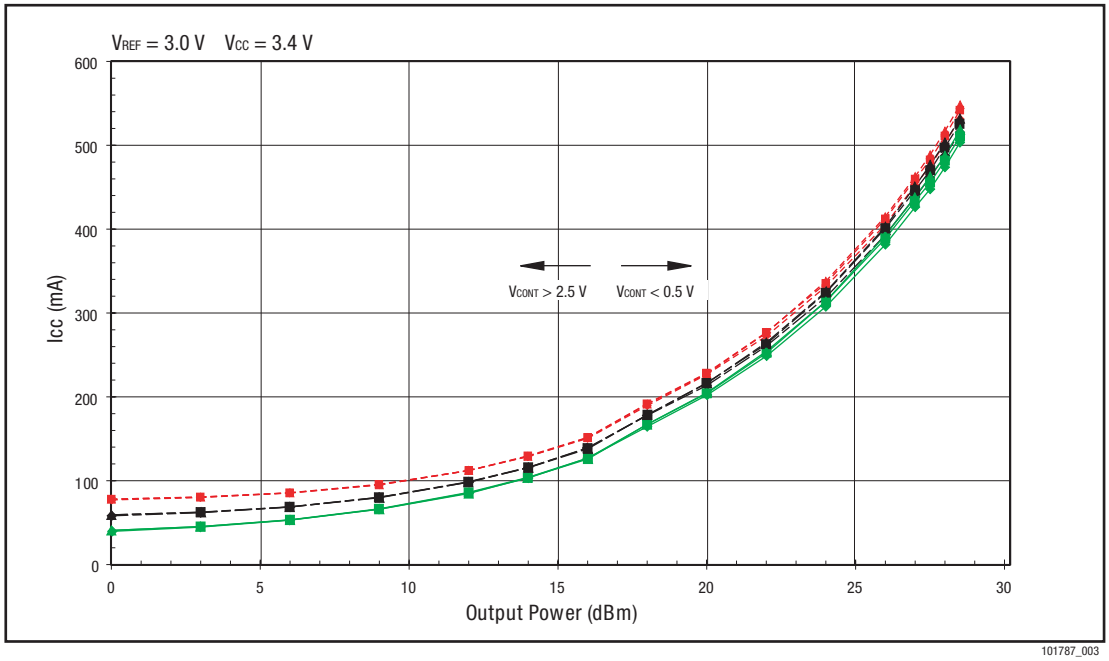


Figure 3. Primary Bias Current vs. Output Power

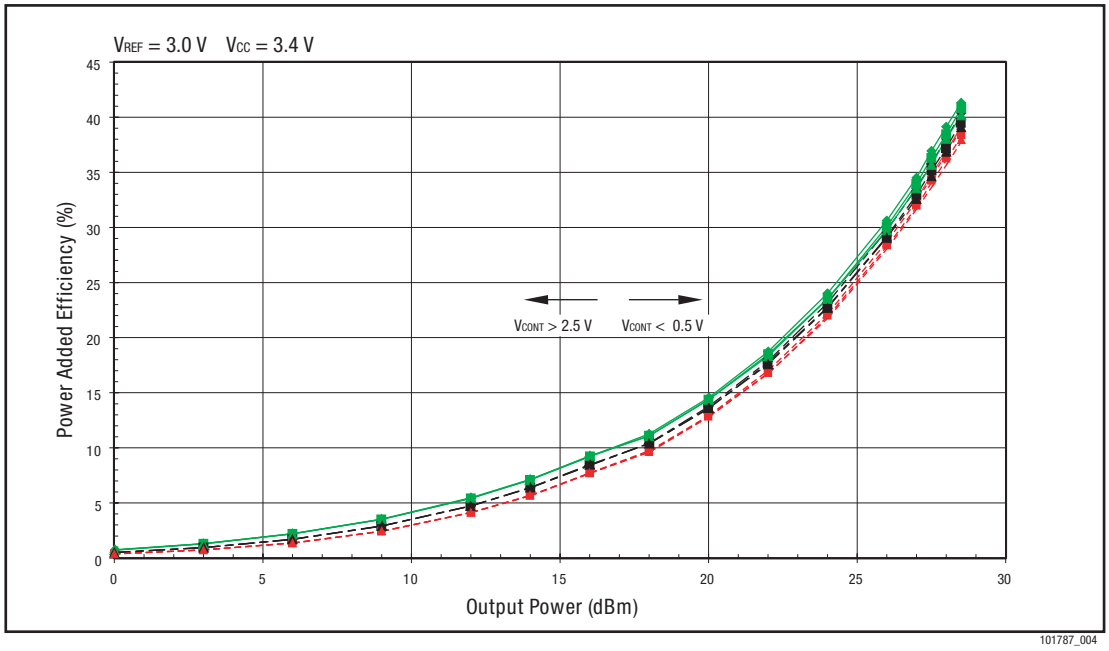


Figure 4. Power Added Efficiency vs. Output Power

Legend

824 @ –30 °C	824 @ +25 °C	824 @ +85 °C
837 @ –30 °C	837 @ +25 °C	837 @ +85 °C
849 @ –30 °C	849 @ +25 °C	849 @ +85 °C

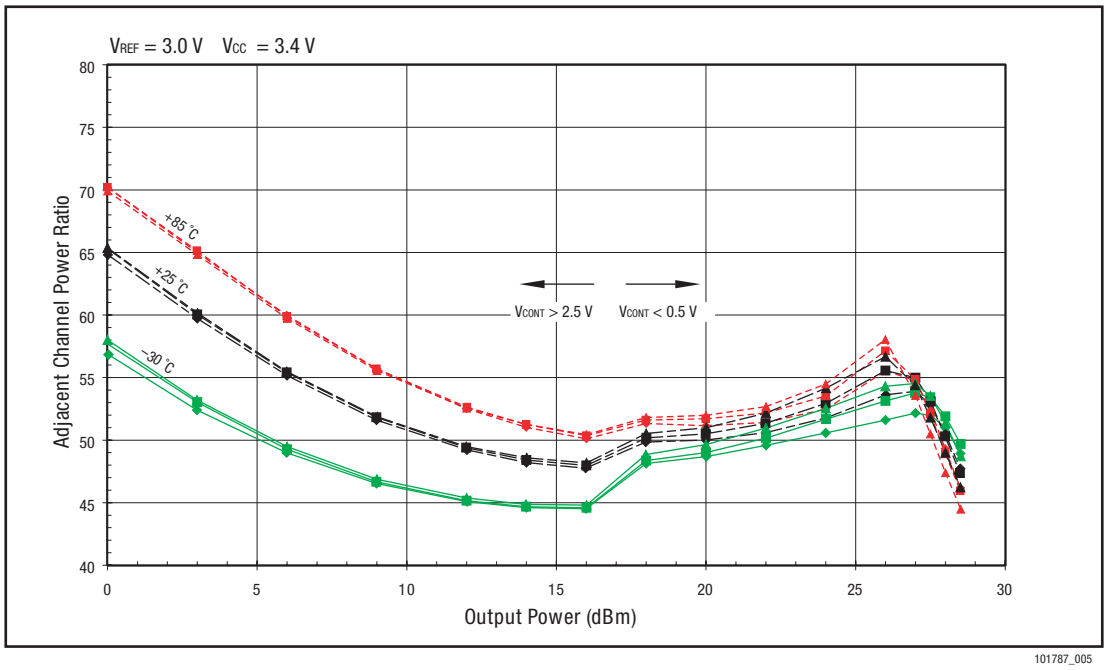


Figure 5. Channel Power for 885 kHz Offset Current vs. Output Power

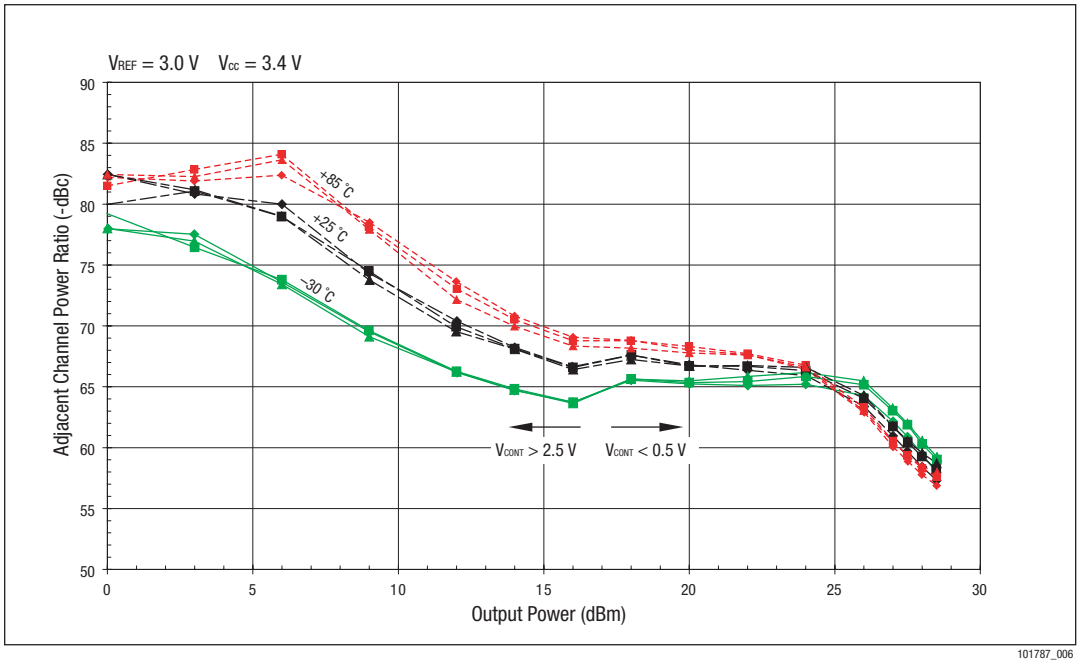


Figure 6. Adjacent Channel Power for 1.98 MHz Offset vs. Output Power

Legend

824 @ –30 °C	824 @ +25 °C	824 @ +85 °C
837 @ –30 °C	837 @ +25 °C	837 @ +85 °C
849 @ –30 °C	849 @ +25 °C	849 @ +85 °C

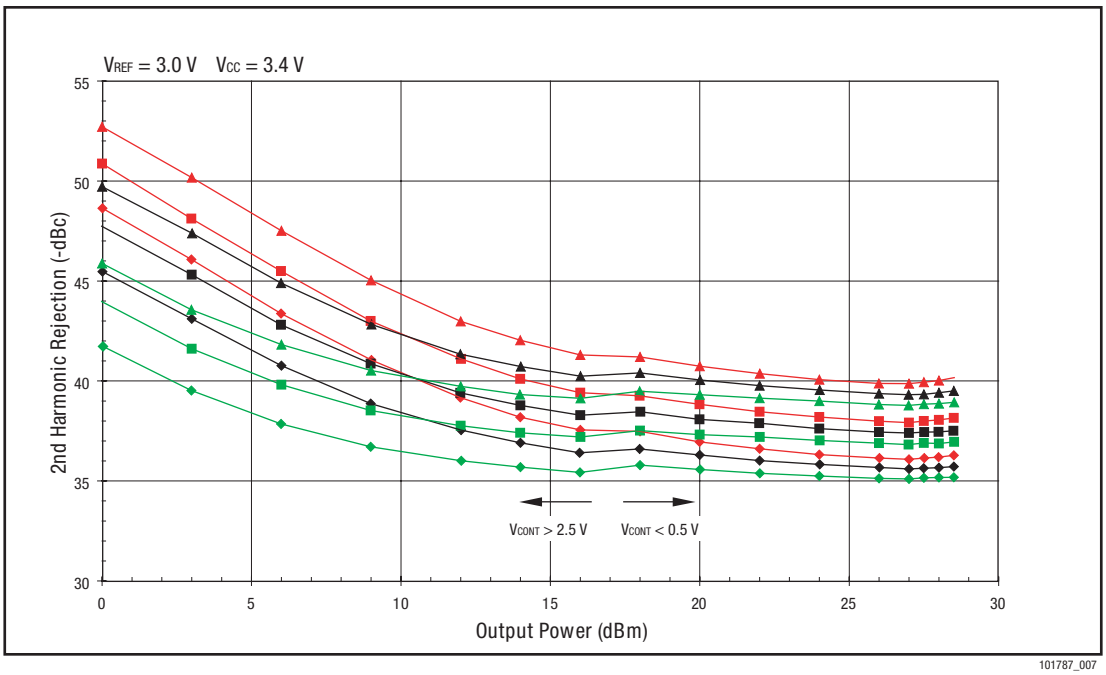


Figure 7. Second Harmonic Rejection vs. Output Power

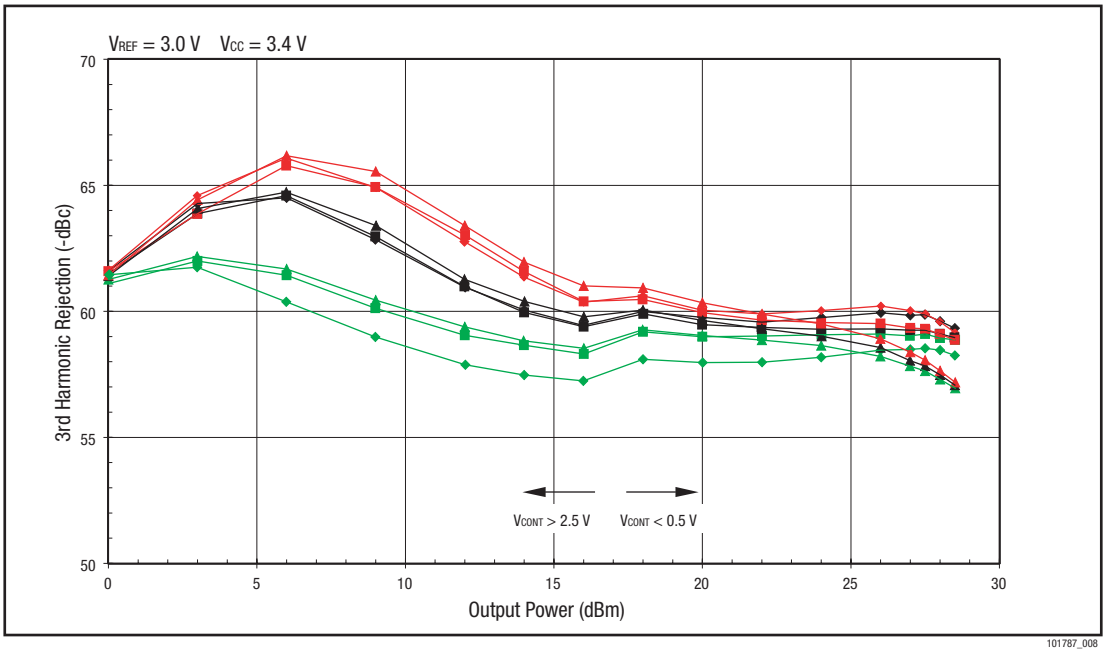


Figure 8. Third Harmonic Rejection vs. Output Power

Legend

824 @ –30 °C	824 @ +25 °C	824 @ +85 °C
837 @ –30 °C	837 @ +25 °C	837 @ +85 °C
849 @ –30 °C	849 @ +25 °C	849 @ +85 °C

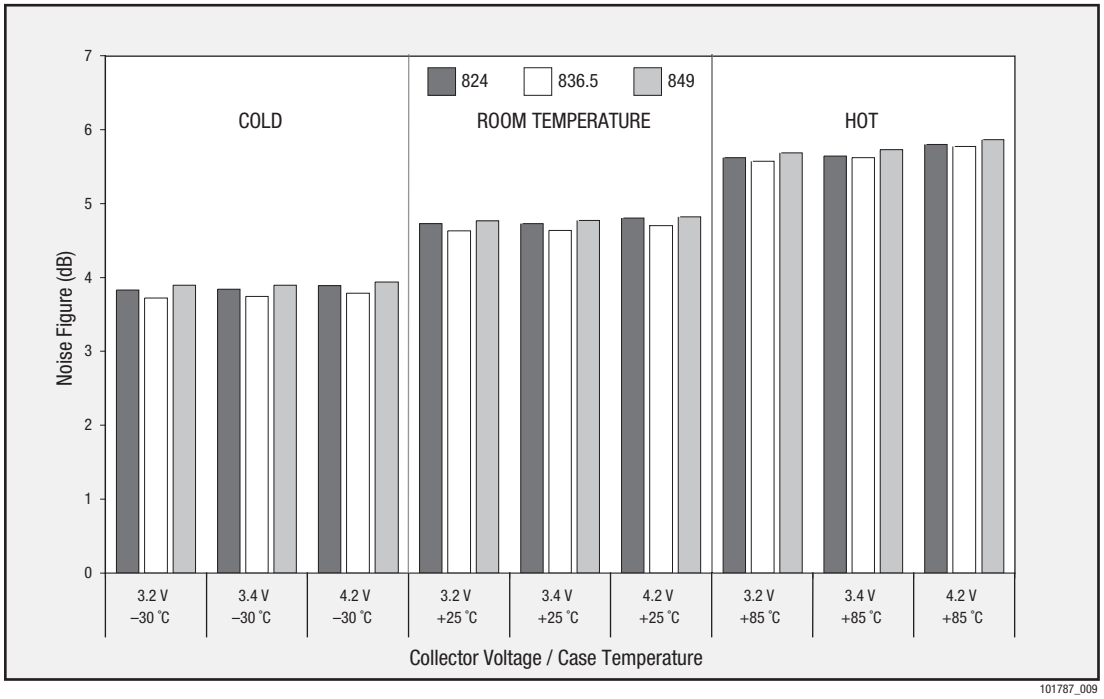


Figure 9. Noise Figure as Function of Operating Conditions

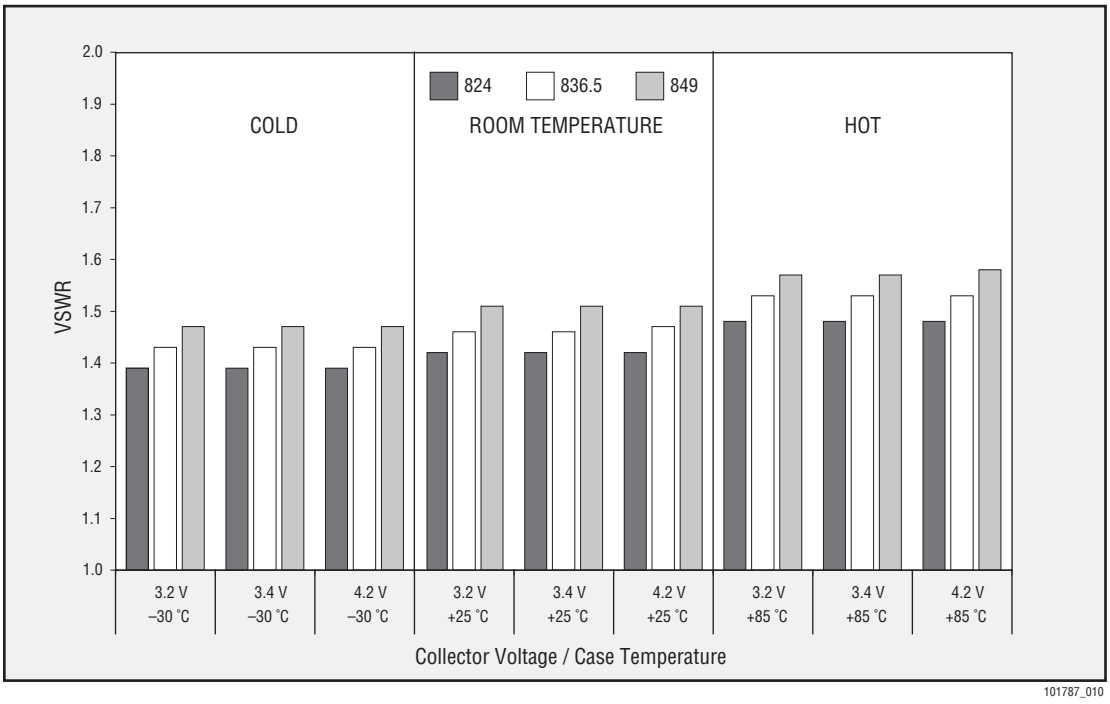


Figure 10. Input VSWR as Function of Operating Conditions

Evaluation Board Description

The evaluation board is a platform for testing and interfacing design circuitry. To accommodate the interface testing of the CX77105, the evaluation board schematic and diagrams are included for preliminary analysis and design. Figure 11 shows the basic schematic of the board for the 824 MHz to 849 MHz range.

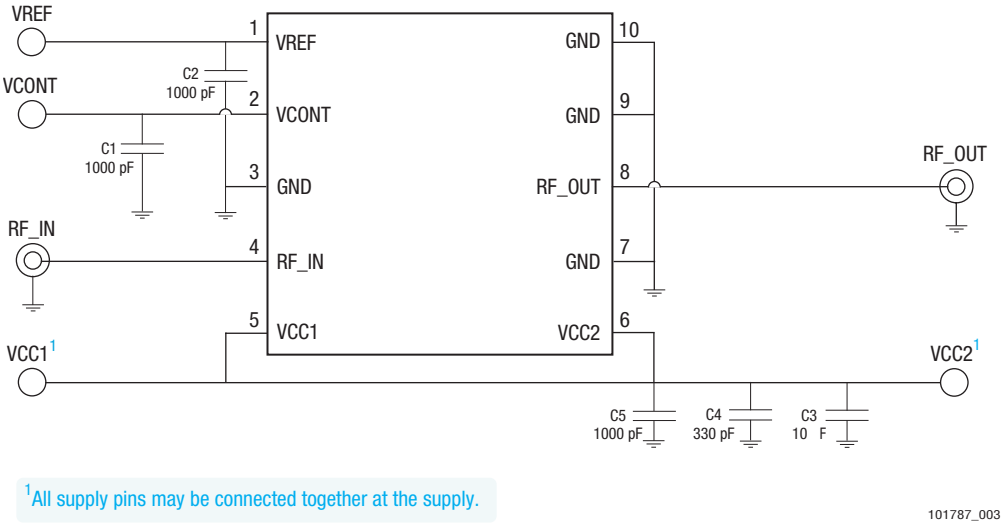


Figure 11. CX77105 Evaluation Board Schematic

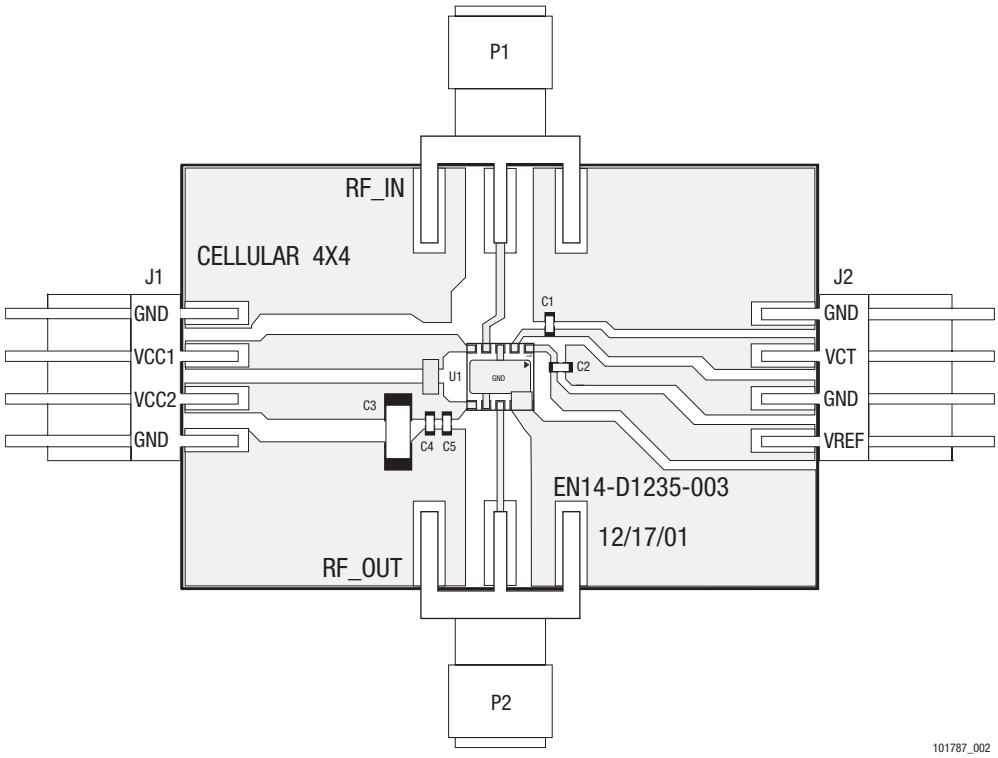
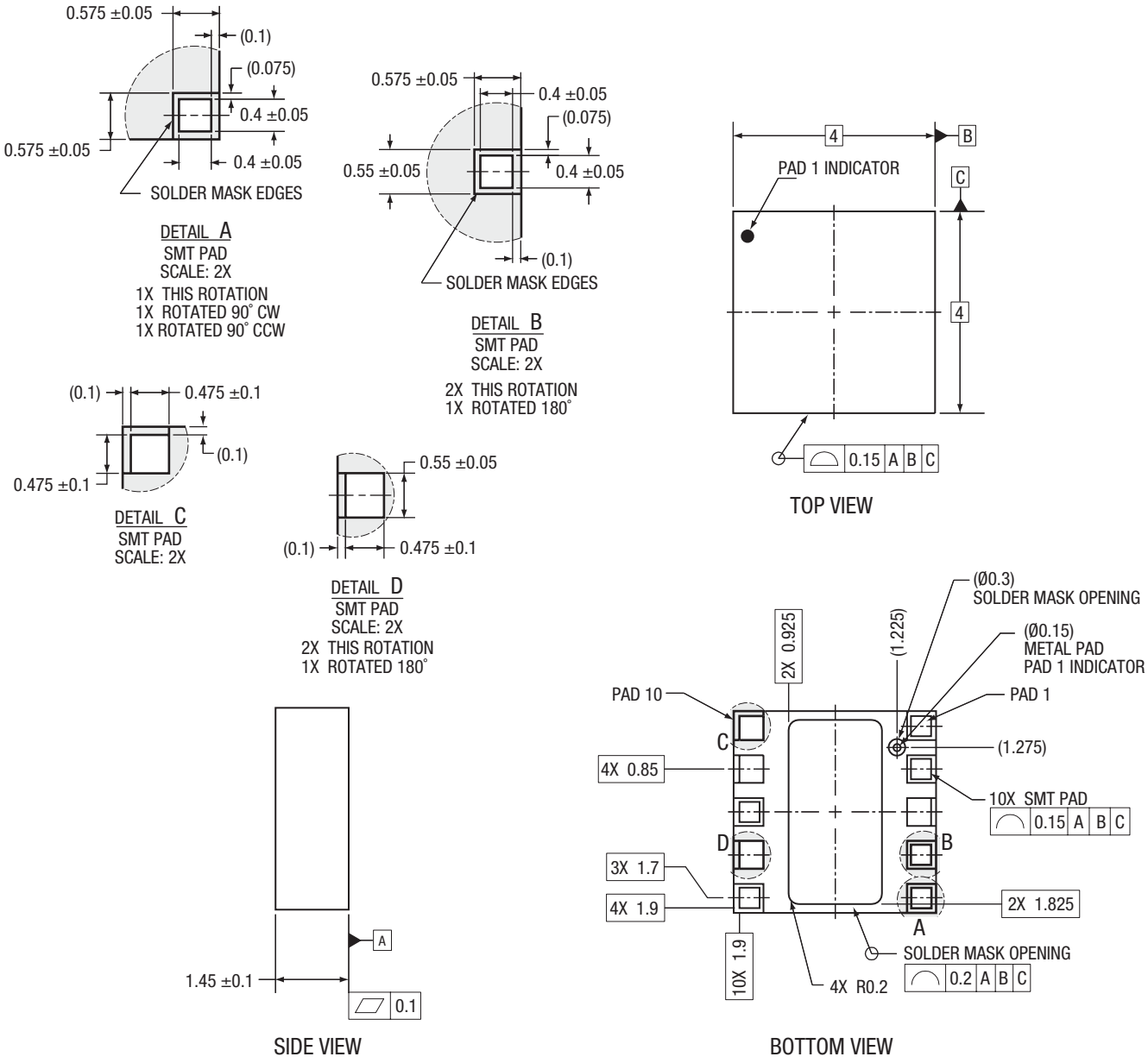


Figure 12. Evaluation Board Assembly Diagram

Package Dimensions and Pin Descriptions

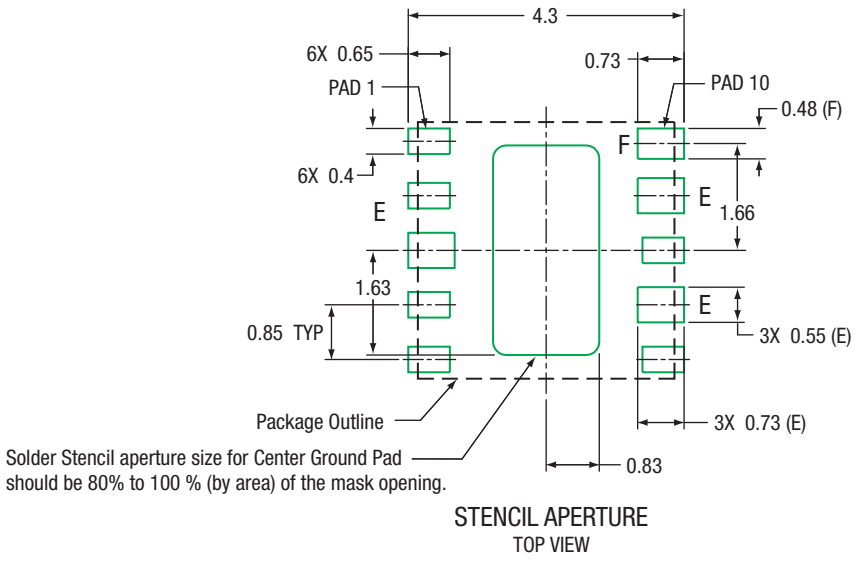
The CX77105 is a multi-layer laminate base, overmold encapsulated modular package designed for surface mount solder attachment to a printed circuit board. Figure 13 is a mechanical drawing of the pad layout for this package. Figure 14 provides a recommended phone board layout footprint for the PAM to help the designer attain optimum thermal conductivity, good grounding, and minimum RF discontinuity for the 50-ohm terminals. The pad numbering convention starts with pad 1 in the upper left, as indicated in Figure 15, and increments counter-clockwise around the package. Figure 16 illustrates typical case markings.



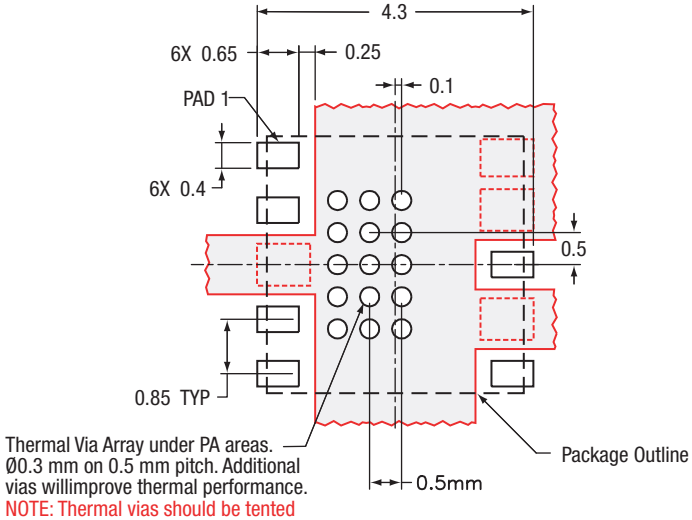
NOTES: UNLESS OTHERWISE SPECIFIED.
1. Dimensioning and Tolerancing in accordance with ASME Y14.5M-1994.
2. All dimensions are in millimeters.
3. Pads are solder mask and metal defined.

101787_013

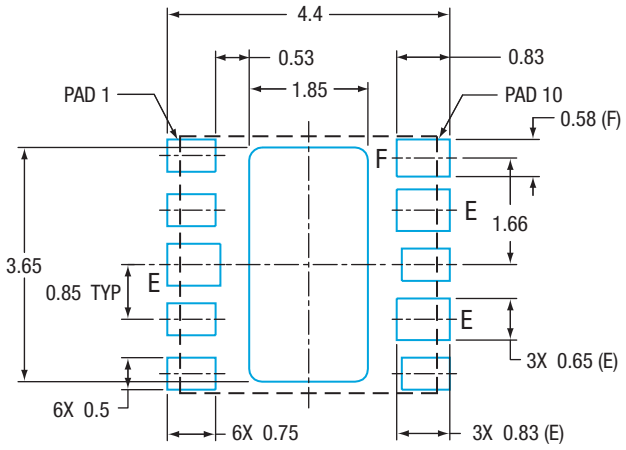
Figure 13. Dimensional Drawing for 4 x 4 x 1.5 mm, 10-Pad Package – CX77105 Specific



STENCIL APERTURE
TOP VIEW



METALLIZATION
TOP VIEW



SOLDER MASK OPENING
TOP VIEW

The shaded area represents the merger of the Center Ground Pad and 4 individual I/O pads thus reducing the number of places dimensioned.

101787_014

Figure 14. Phone PCB Layout Footprint for 4 mm x 4 mm, 10-Pin Package – CX77105 Specific

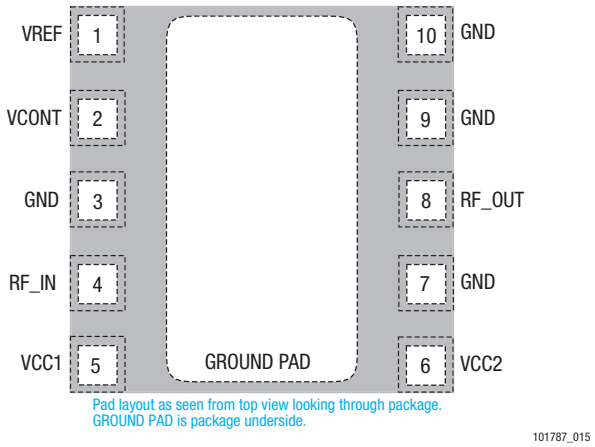


Figure 15. CX77105 Pin Configuration (Top View)

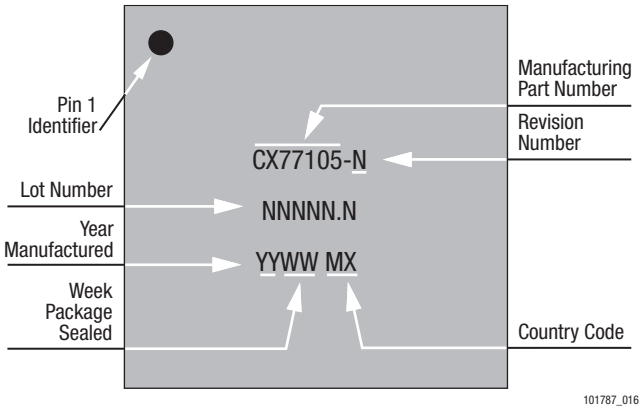


Figure 16. Typical Case Markings (Top View)

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 CX77105 is capable of withstanding an MSL3/240 °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 3 °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 Skyworks 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–020*.

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

Electrostatic Discharge Sensitivity

The CX77105 is a Class I device. Figure 17 lists the Electrostatic Discharge (ESD) immunity level for each non-ground pad of the CX77105 product. The numbers in Figure 17 specify the ESD threshold level for each pad where the I-V curve between the pad 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 pad, 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.

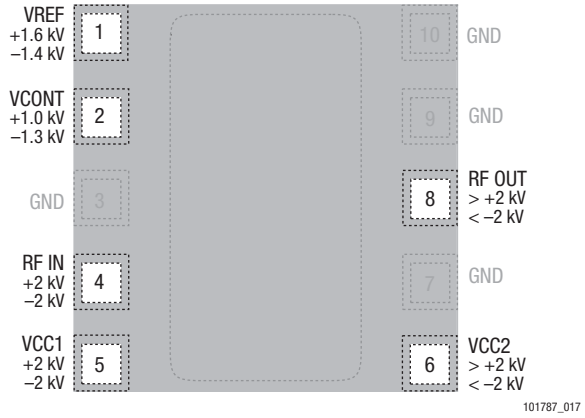


Figure 17. ESD Sensitivity Areas (Top View)

Various failure criteria can be utilized when performing ESD testing. Many vendors employ relaxed ESD failure standards, which fail devices only after “the pad fails the electrical specification limits” or “the pad becomes completely non-functional”. Skyworks employs most stringent criteria and fails devices as soon as the pad 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 6

Table 6. Precautions for Handling GaAs IC-based Products to Avoid Induced Damage

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

Ordering Information

Model Number	Manufacturing Part Number	Product Revision	Package	Operating Temperature
CX77105	CX77105-16P	16	MCM 4x4LM-10	–30 °C to +85 °C

Revision History

Revision	Level	Date	Description
A		December 10, 2002	Initial Release
B		April 20, 2005	Revise: Figure 1, 11, 12; Table 1 Add: Figure 14
C		January 6, 2006	Add: Lead-free statement (p1) Revise: Figures 13, 14; section Package and Handling Information: changes solder flow temperature ramp rate to 3 °C/sec

References

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

Application Note: Tape and Reel Information – RF Modules, Document Number 101568

JEDEC Standard J–STD–020.

Copyright © 2002-2006, Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. (“Skyworks”) products. These materials are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials. Skyworks may make changes to its documentation, products, specifications and product descriptions at any time, without notice. Skyworks makes no commitment to update the information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from future changes to its documentation, products, specifications and product descriptions.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by or under this document. Except as may be provided in Skyworks’ Terms and Conditions of Sale for such products, Skyworks assumes no liability whatsoever in association with its documentation, products, specifications and product descriptions.

THESE MATERIALS ARE PROVIDED “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED OR OTHERWISE, RELATING TO SALE AND/OR USE OF SKYWORKS PRODUCTS INCLUDING WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. SKYWORKS FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THESE MATERIALS WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications. Skyworks’ customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

The following are trademarks of Skyworks Solutions, Inc.: Skyworks™, the Skyworks logo, and Breakthrough Simplicity™. Product names or services listed in this publication are for identification purposes only, and may be trademarks of Skyworks or other third parties. Third-party brands and names are the property of their respective owners. Additional information, posted at www.skyworksinc.com, is incorporated by reference.