

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).

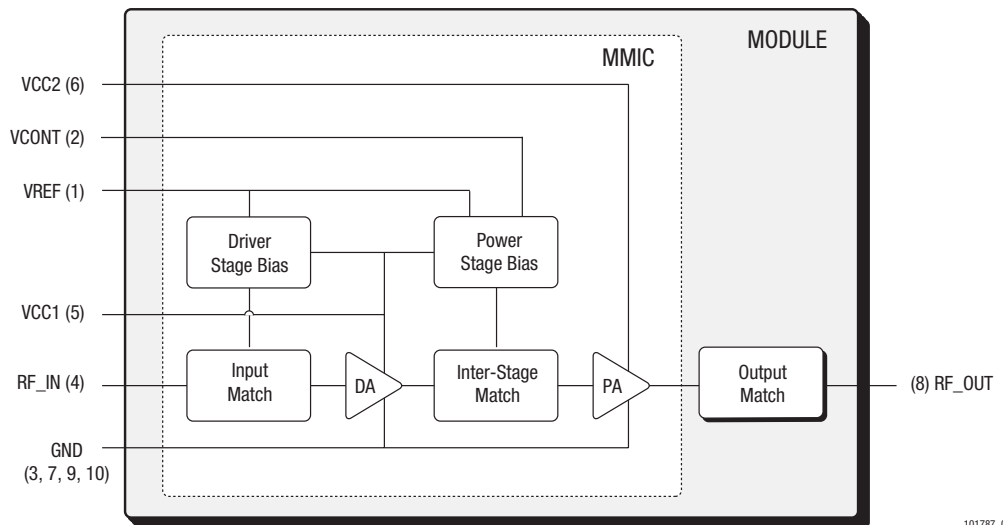



Figure 1. CX77105 Functional Block Diagram

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 Ratings¹

Parameter	Symbol	Minimum	Nominal	Maximum	Unit	
RF Input Power	PIN	—	4.0	7.0	dBm	
Supply Voltage	VCC	—	3.4	6.0	Volts	
Reference Voltage	VREF	—	3.0	3.1	Volts	
Case Temperatures	Operating	Tc	-30	25	+110	°C
	Storage	TSTG	-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	VCC	3.2	3.4	4.2	Volts	
Reference Voltage	PA On	VREF	2.95	3.0	3.05	Volts
	PA Off	—	—	0.5		
Mode Input Impedance >2.5 kW	High Bias	VCONT	0.0	—	0.5	Volts
	Low Bias	VCONT	2.5	—	3.0	
Operating Frequency	Fo	824.0	836.5	849.0	MHz	
Case Operating Temperature	Tc	-30	—	+85	°C	

Table 3. Power Range Truth Table

Power Mode	VREF	VCONT	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	GLOW $V_{CONT} \geq 2.5 V$ $P_o = 16 \text{ dBm}$	25.0	27.0	28.0	dB
		GHIGH $V_{CONT} \leq 0.5 V$ $P_o = 28 \text{ dBm}$	28.5	29.0	31.0	
	Analog Mode	GP $V_{CONT} \leq 0.5 V$ $P_o = 31 \text{ dBm}$	27.5	29.0	31.0	
Power Added Efficiency	Digital Mode	PAELOW $V_{CONT} \geq 2.5 V$ $P_o = 16 \text{ dBm}$	7.6	8.5	—	%
		PAEHIGH $V_{CONT} \leq 0.5 V$ $P_o = 28 \text{ dBm}$	37.0	40.0	—	
	Analog Mode	PAEA $V_{CONT} \leq 0.5 V$ $P_o = 31 \text{ dBm}$	48.0	55.0	—	
Total Supply Current	ICC_LOW	$P_o = 16 \text{ dBm}$	—	137	153	mA
	ICC_HIGH	$P_o = 28 \text{ dBm}$	—	490	500	
Quiescent Current	IQ_LOW	$V_{CONT} \geq 2.5 V$	40	—	—	mA
	IQ_HIGH	$V_{CONT} \leq 0.5 V$	60	55	75	
Reference Current	IREF	—	—	2.5	5.0	mA
Control Current	ICTRL	$V_{CONT} = 2.5 V$	200	235	500	μA
Total Supply current in Power-down Mode	IPD	$V_{CC} = 3.4 V$ $V_{REF} = 0 V$	—	3.0	5.0	μA
Adjacent Channel Power ^{2,3}	885 kHz offset	ACP1LOW $V_{CONT} \geq 2.5 V$ $P_o \leq 16 \text{ dBm}$	—	-49.0	-47.3	dBc
		ACP1HIGH $V_{CONT} \leq 0.5 V$ $P_o \leq 28 \text{ dBm}$	—	-50.0	-47.0	
	1.98 MHz offset	ACP2LOW $V_{CONT} \geq 2.5 V$ $P_o \leq 16 \text{ dBm}$	—	-65.0	-59.0	
		ACP2HIGH $V_{CONT} \leq 0.5 V$ $P_o \leq 28 \text{ dBm}$	—	-60.0	-57.4	
Harmonic Suppression	Second	f ₀₂ $P_o \leq 28 \text{ dBm}$	—	-38.0	-35.0	dBc
	Third	f ₀₃ $P_o \leq 28 \text{ dBm}$	—	-59.0	-45.0	
Noise Power in RX Band 869-894 MHz	RxBN	$P_o \leq 28 \text{ dBm}$	—	-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 damage ⁴	Ru	$P_o \leq 28 \text{ dBm}$	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, 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.

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} ≥ 2.5 V P ₀ = 16 dBm	24.0	28.5	dB
		G _{HIGH}	V _{CONT} ≤ 0.5 V P ₀ = 28 dBm	27.1	32.4	
	Analog Mode	G _P	V _{CONT} ≤ 0.5 V P ₀ = 31 dBm	24.0	33.0	
Adjacent Channel Power ^{2,3}	1.25 MHz offset	ACP1 _{LOW}	V _{CONT} ≥ 2.5 V P ₀ ≤ 16 dBm	—	–44	dBc
		ACP1 _{HIGH}	V _{CONT} ≤ 0.5 V P ₀ ≤ 28 dBm	—	–44	
	1.98 MHz offset	ACP2 _{LOW}	V _{CONT} ≥ 2.5 V P ₀ ≤ 16 dBm	—	–56	
		ACP2 _{HIGH}	V _{CONT} ≤ 0.5 V P ₀ ≤ 28 dBm	—	–56	
Harmonic Suppression	Second	f ₀₂	P ₀ ≤ 28 dBm	—	–30	dBc
	Third	f ₀₃	P ₀ ≤ 28 dBm	—	–40	
Noise Power in RX Band 869-894 MHz	RxBN	P ₀ ≤ 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 ₀ ≤ 28dBm	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.

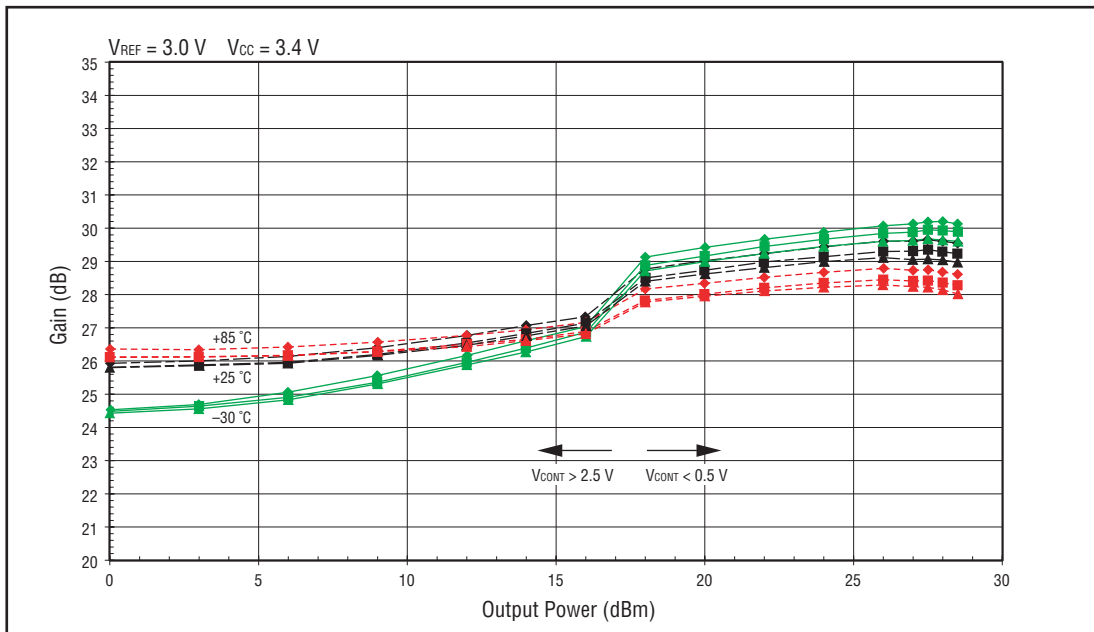
³ CDMA2000 is configured as DCCH = 9600, SCHO = 9600, PCH (Walsh 0) = –3.75 dB, and Peak-to-Average Ratio (CCDF = 1%) = 4.5 dB. For CDMA2000, 0.5 dB back-off in output power is required.

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.

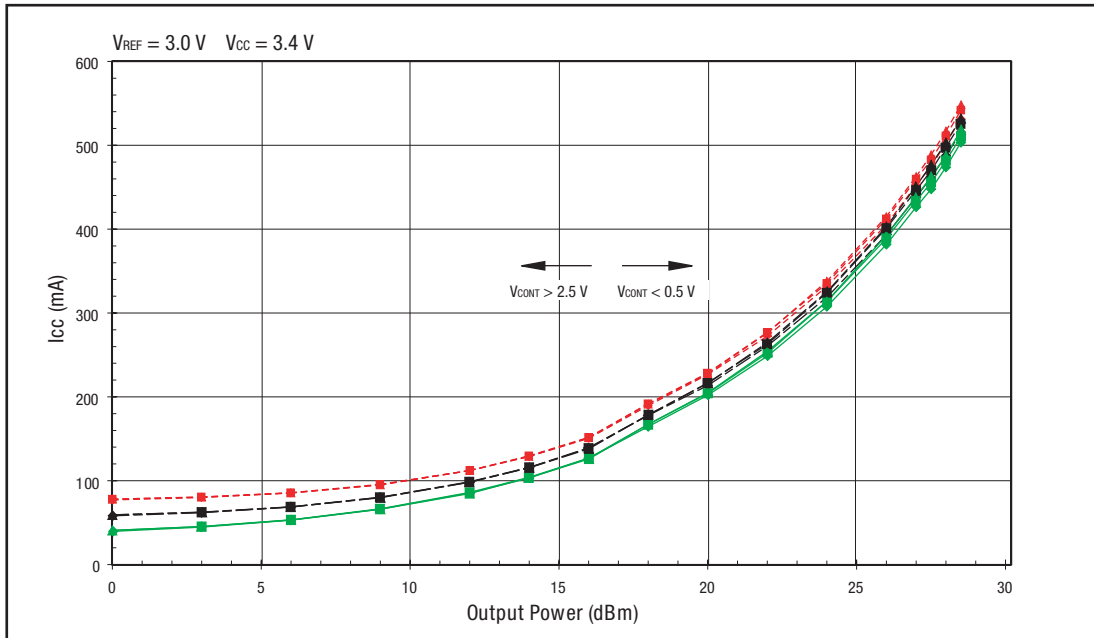


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Figure 2. Digital Mode Gain vs. Output Power

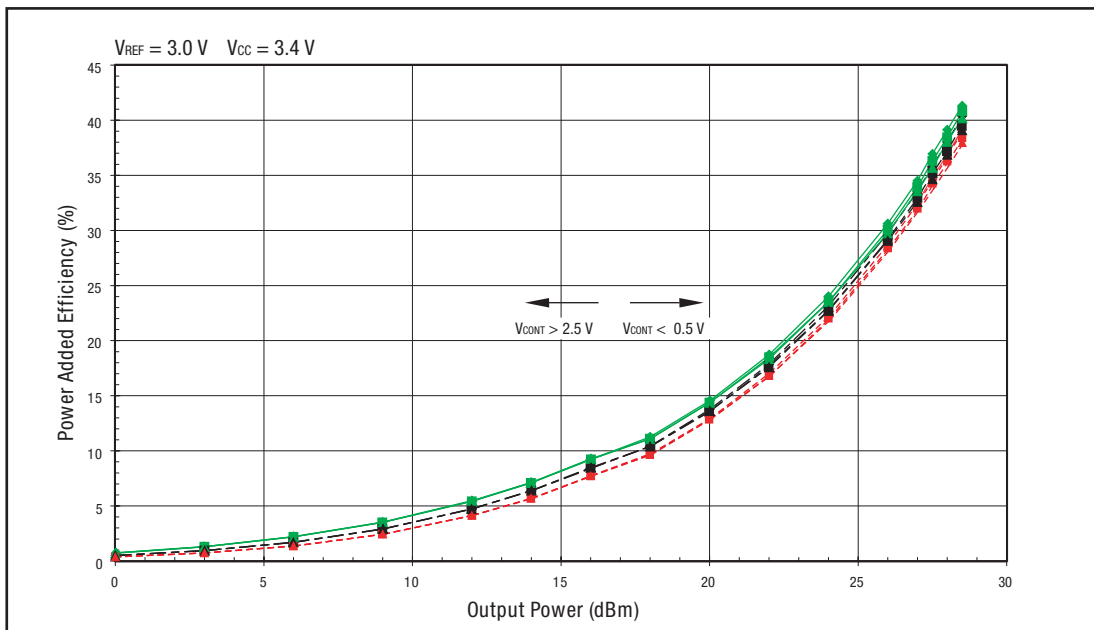
Legend

—◆— 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



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Figure 3. Primary Bias Current vs. Output Power



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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

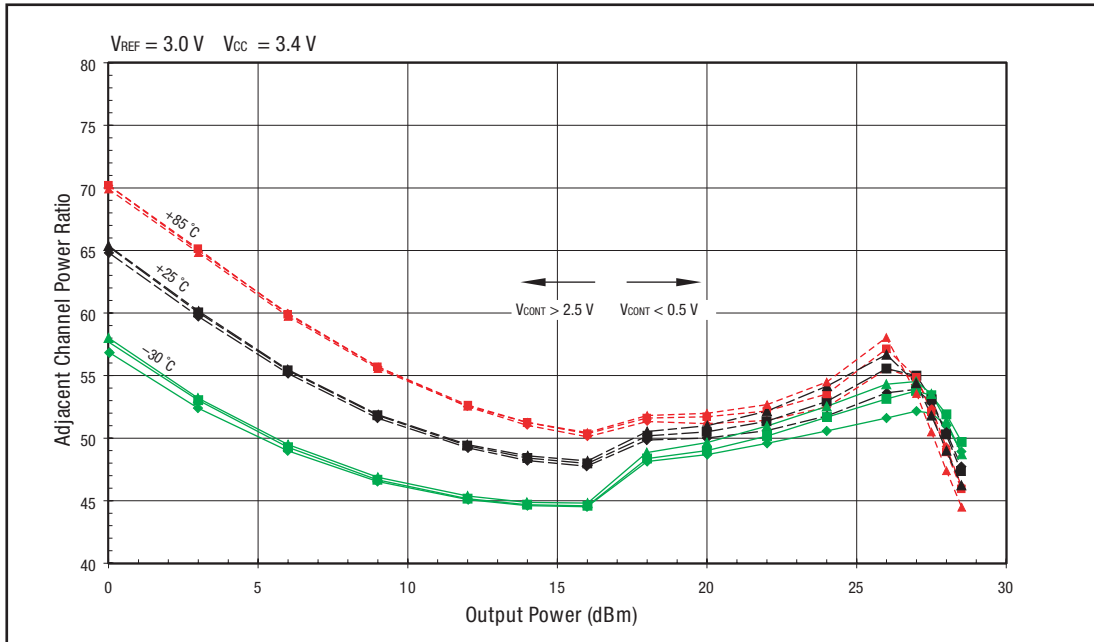


Figure 5. Channel Power for 885 kHz Offset Current vs. Output Power

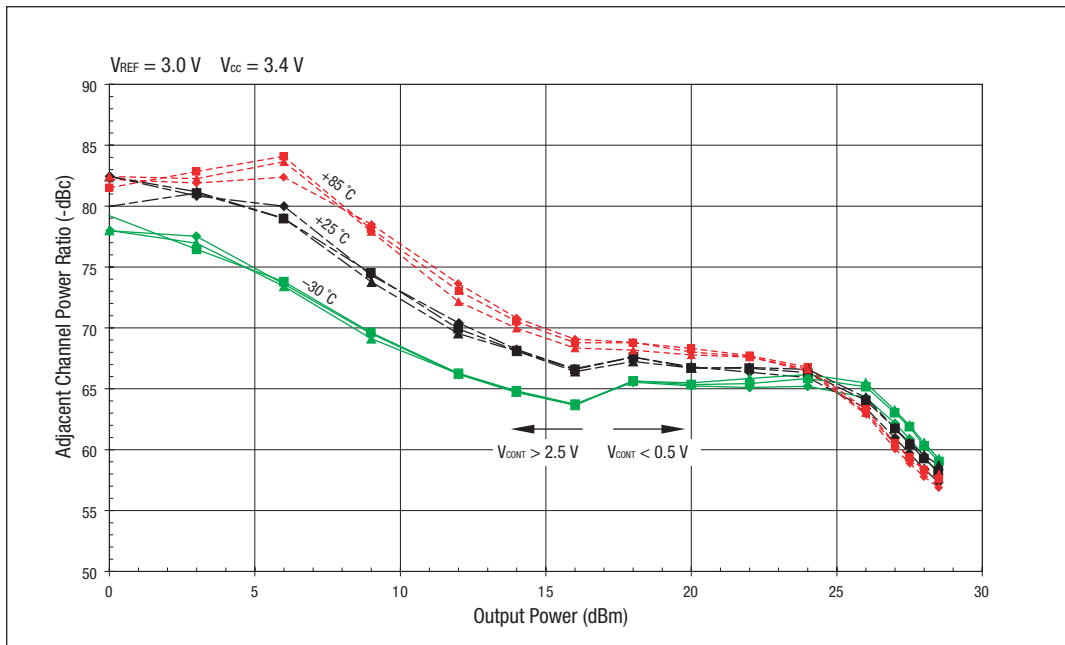


Figure 6. Adjacent Channel Power for 1.98 MHz Offset vs. Output Power

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

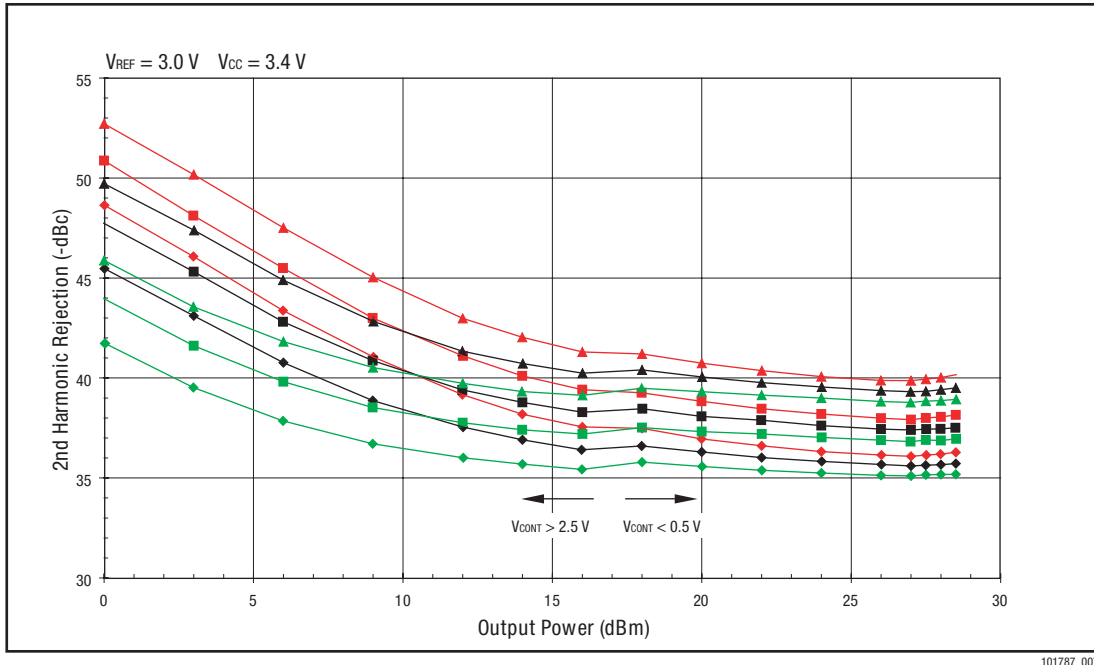


Figure 7. Second Harmonic Rejection vs. Output Power

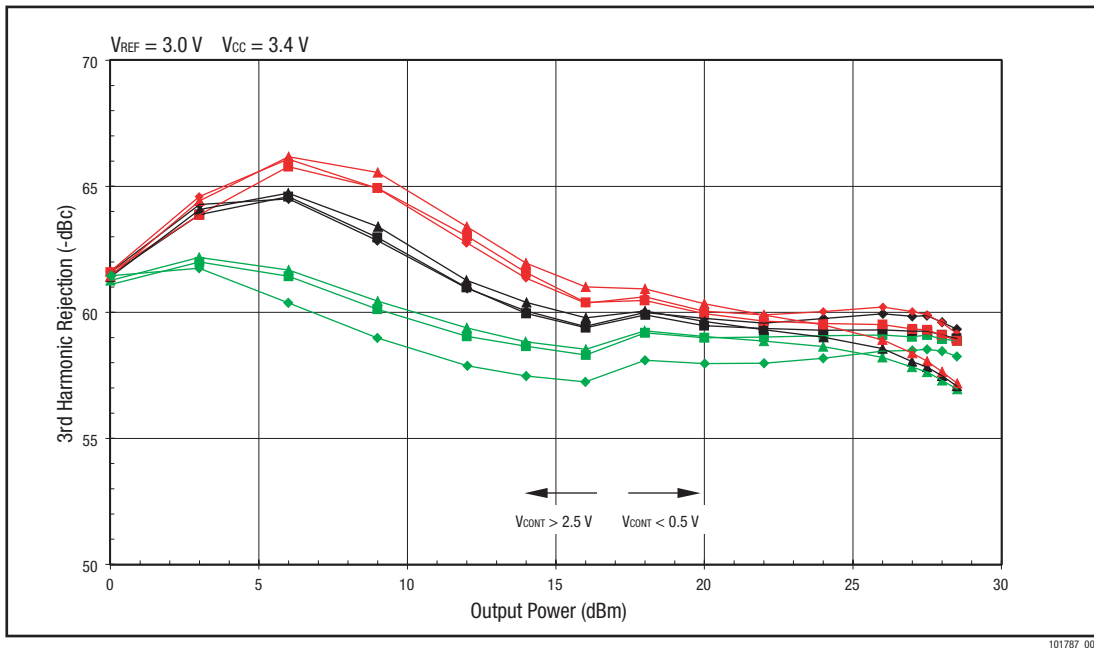
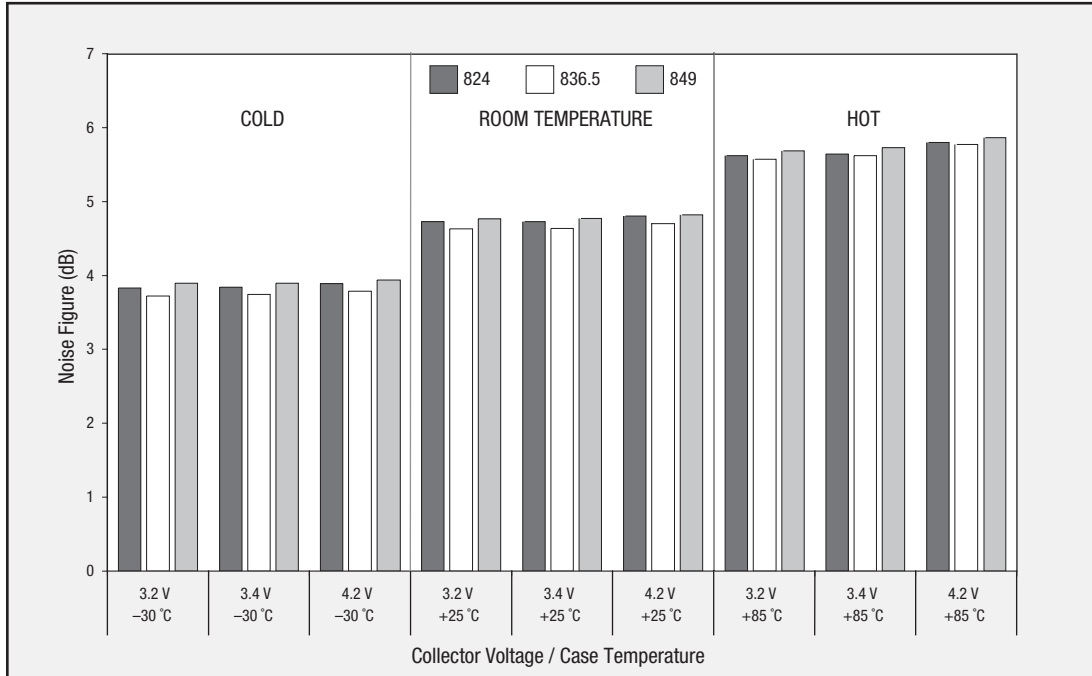


Figure 8. Third Harmonic Rejection vs. Output Power

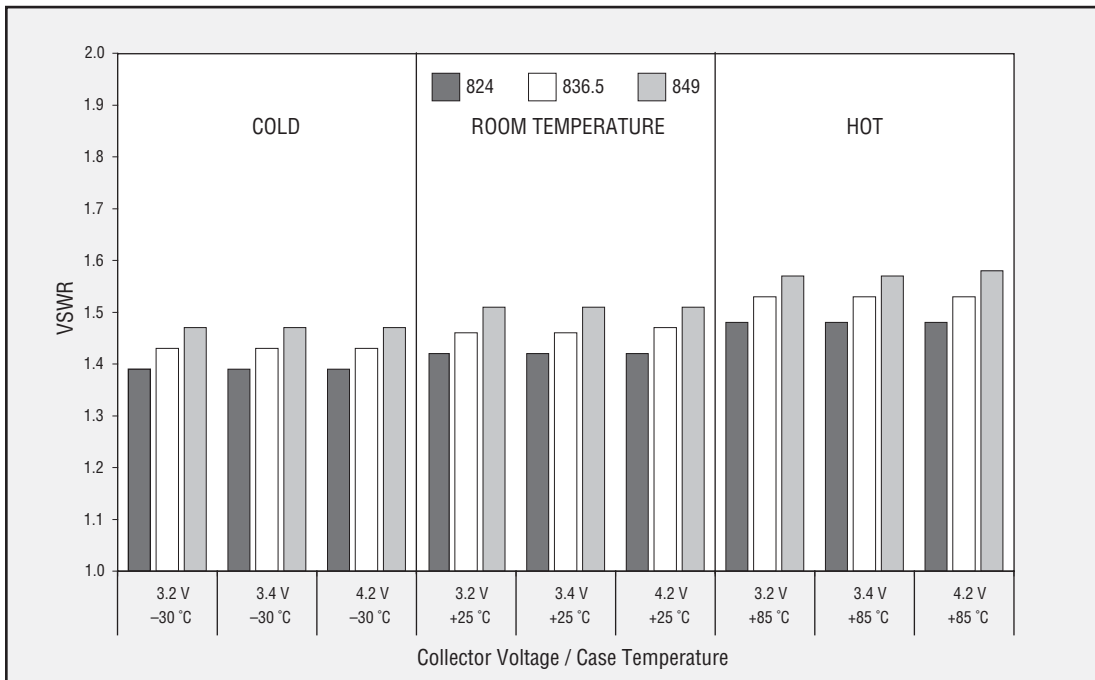
Legend

—◆— 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



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Figure 9. Noise Figure as Function of Operating Conditions



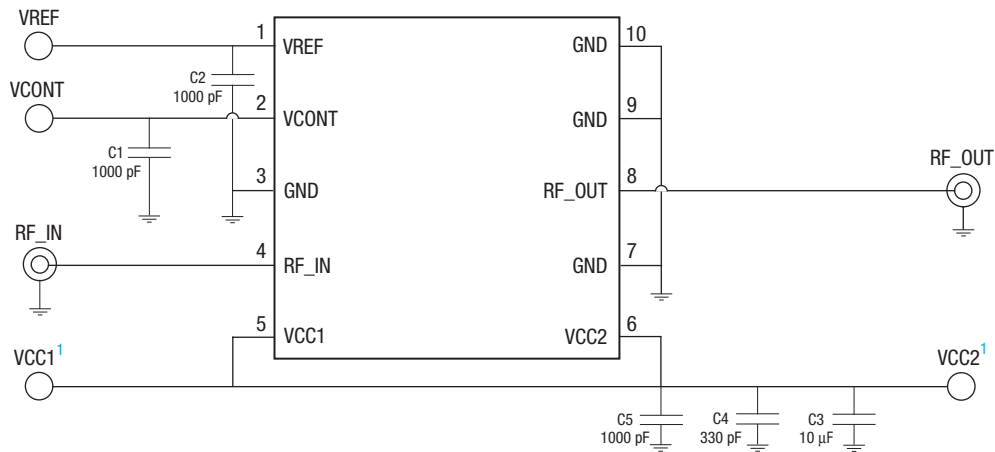
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Figure 10. Input VSWR as Function of Operating Conditions

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

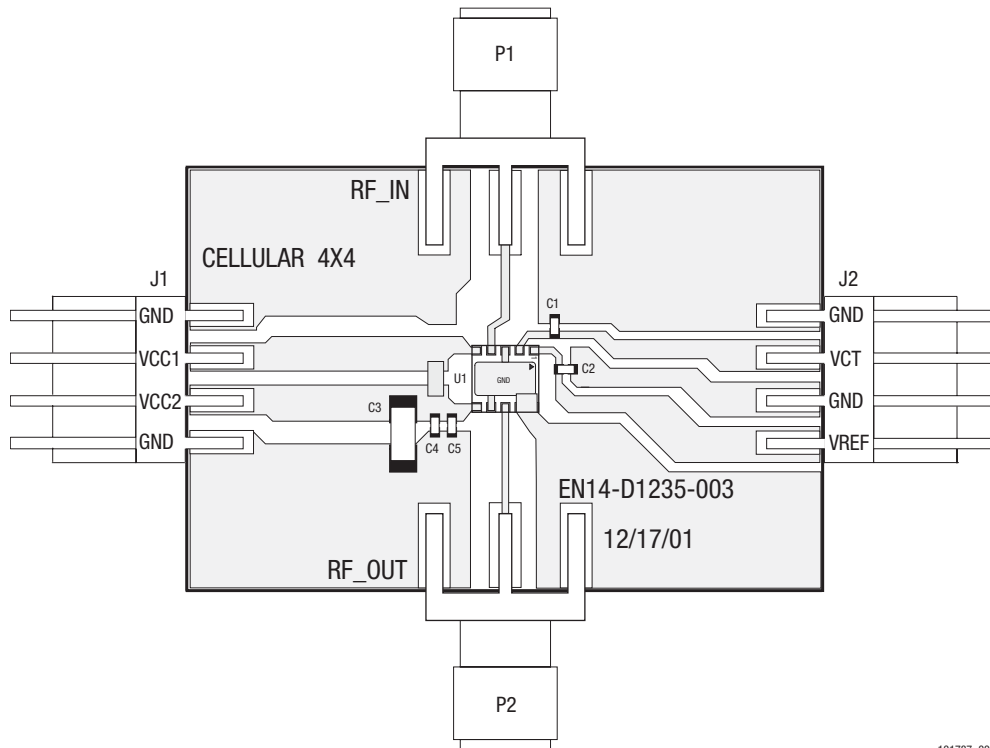
included for preliminary analysis and design. Figure 11 shows the basic schematic of the board for the 824 MHz to 849 MHz range.



¹All supply pins may be connected together at the supply.

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Figure 11. CX77105 Evaluation Board Schematic



101787_002

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.

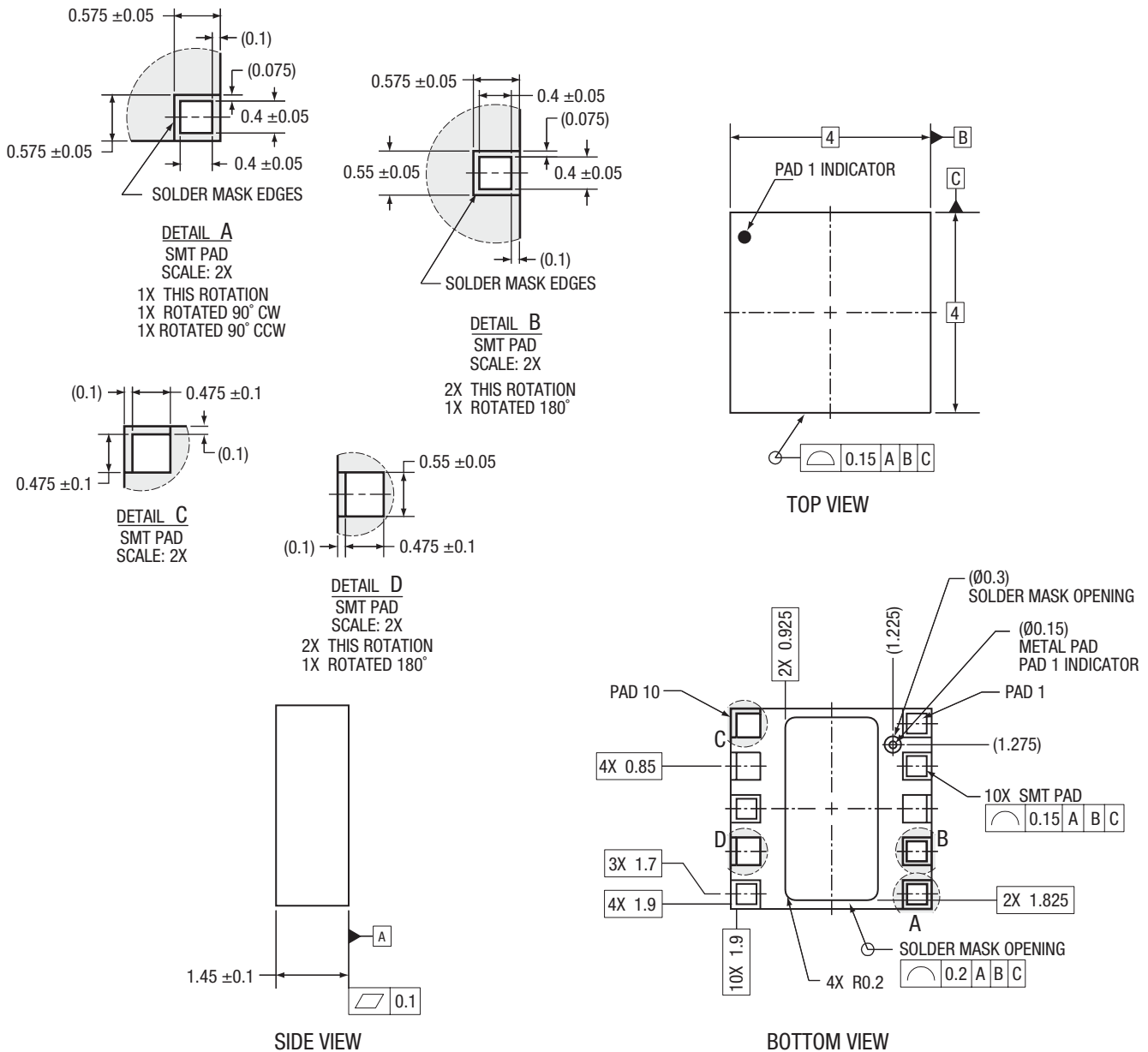
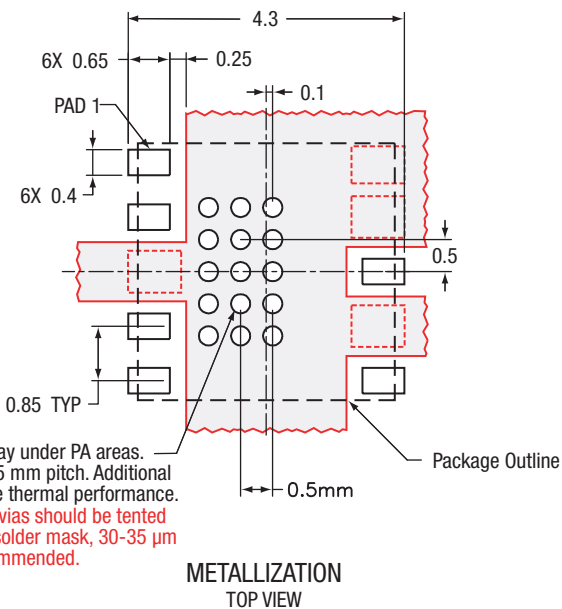
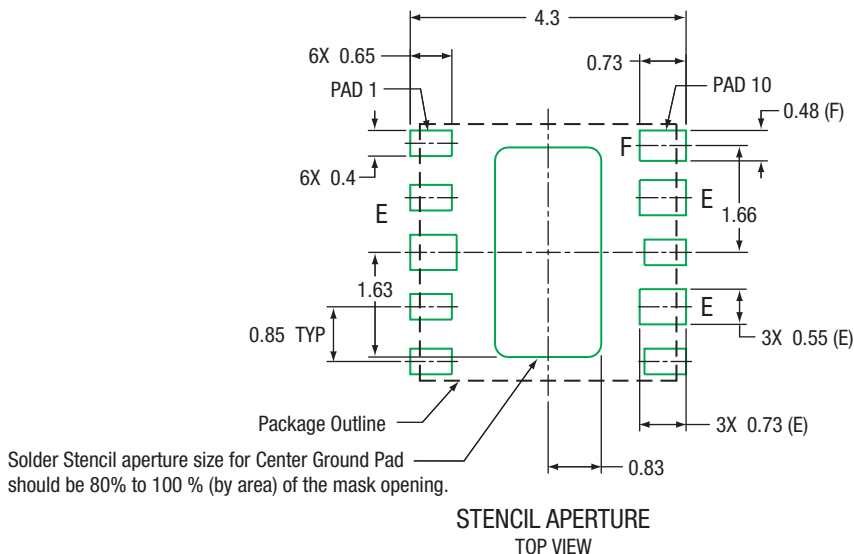


Figure 13. Dimensional Drawing for 4 x 4 x 1.5 mm, 10-Pad Package – CX77105 Specific



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

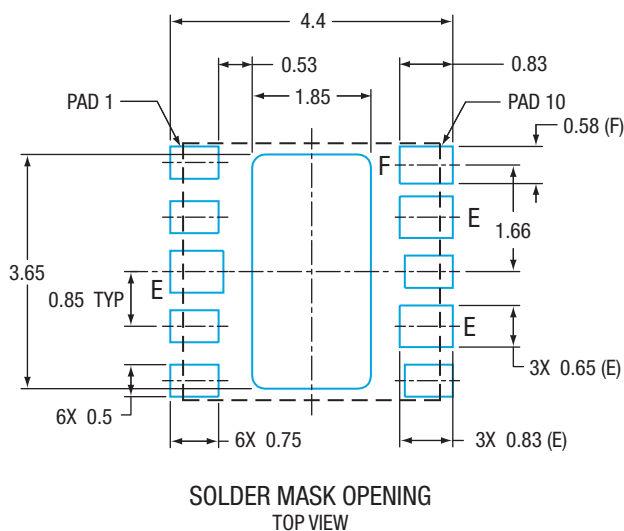


Figure 14. Phone PCB Layout Footprint for 4 mm x 4 mm, 10-Pin Package – CX77105 Specific

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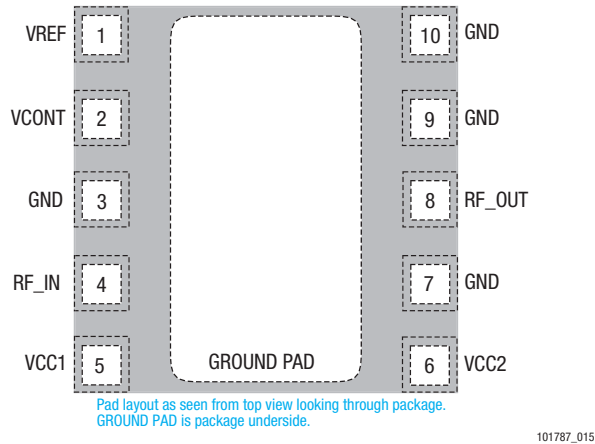


Figure 15. CX77105 Pin Configuration (Top View)

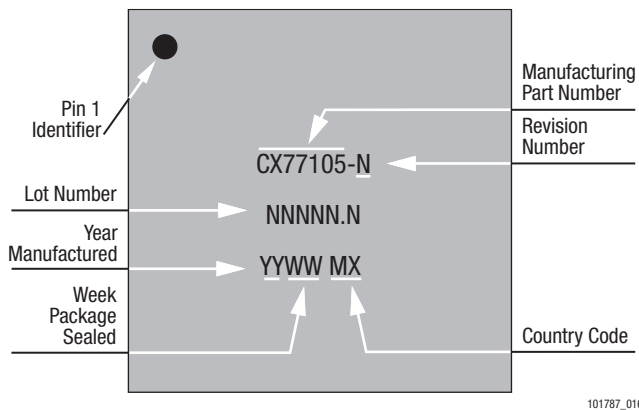


Figure 16. Typical Case Markings (Top View)

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.

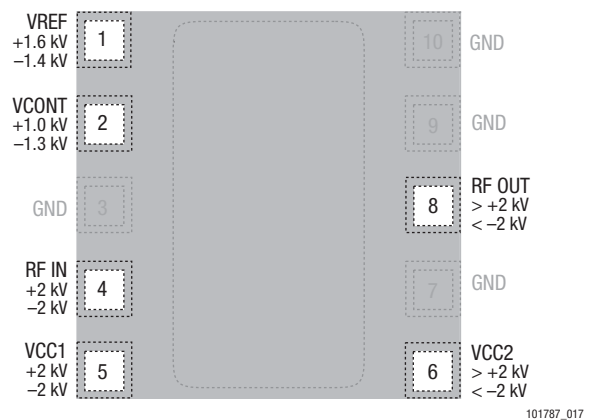


Figure 17. ESD Sensitivity Areas (Top View)

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 $10^9 \Omega$ 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.

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