RF25F

Tx ASIC for CDMA/AMPS and PCS Applications

The RF25F Transmit Application-Specific Integrated Circuit (ASIC) is a tri-mode, dual-band upconverter and driver amplifier in a 5x5 mm LGA package designed for transmitter application in portable phones. The RF25F can be used in both cellular and Personal Communications System (PCS) bands and, in dual-mode, can be used in both Code Division Multiple Access (CDMA) mode and Advanced Mobile Phone System (AMPS) mode.

The RF25F device includes the following functional blocks:

- Cellular and PCS upconverters with RF gain control.
- Cellular and PCS power amplifier drivers.

The device package and pin-outs are shown in Figure 1. A block diagram of the RF25F is shown in Figure 2.

Features

- Supports tri-mode, dual-band applications
- Optional 14 dB mixer RF adjustable gain
- Low DC power dissipation
- Dual drivers for cellular and PCS bands
- 32-pin Land Grid Array (LGA) 5x5 mm package

Applications

- Cellular and PCS band phones
- CDMA and AMPS modes in the cellular band including:
  - CDMA-US
  - CDMA-J
- CDMA mode in the PCS band including:
  - US-PCS
  - K-PCS

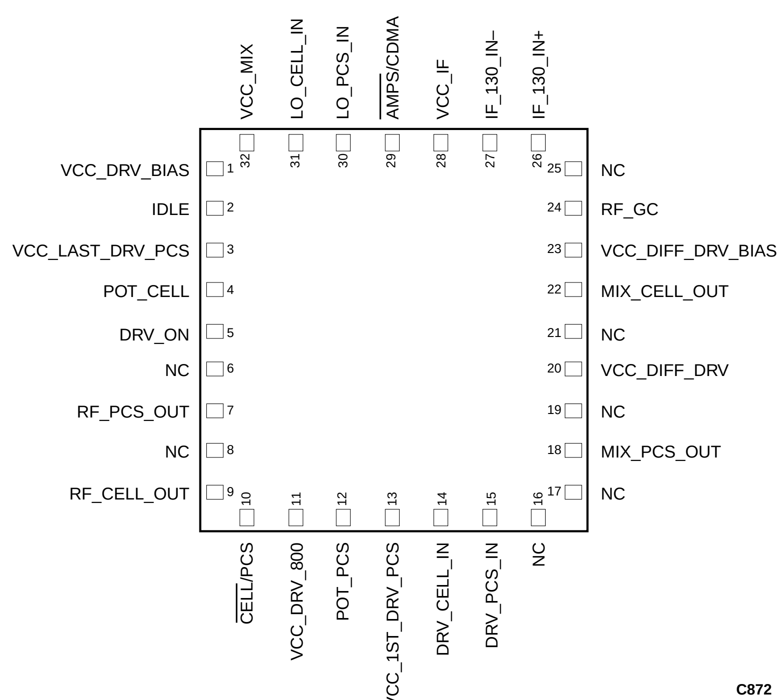


Figure 1. RF25F Pinout – 32-Pin LGA (Top View)

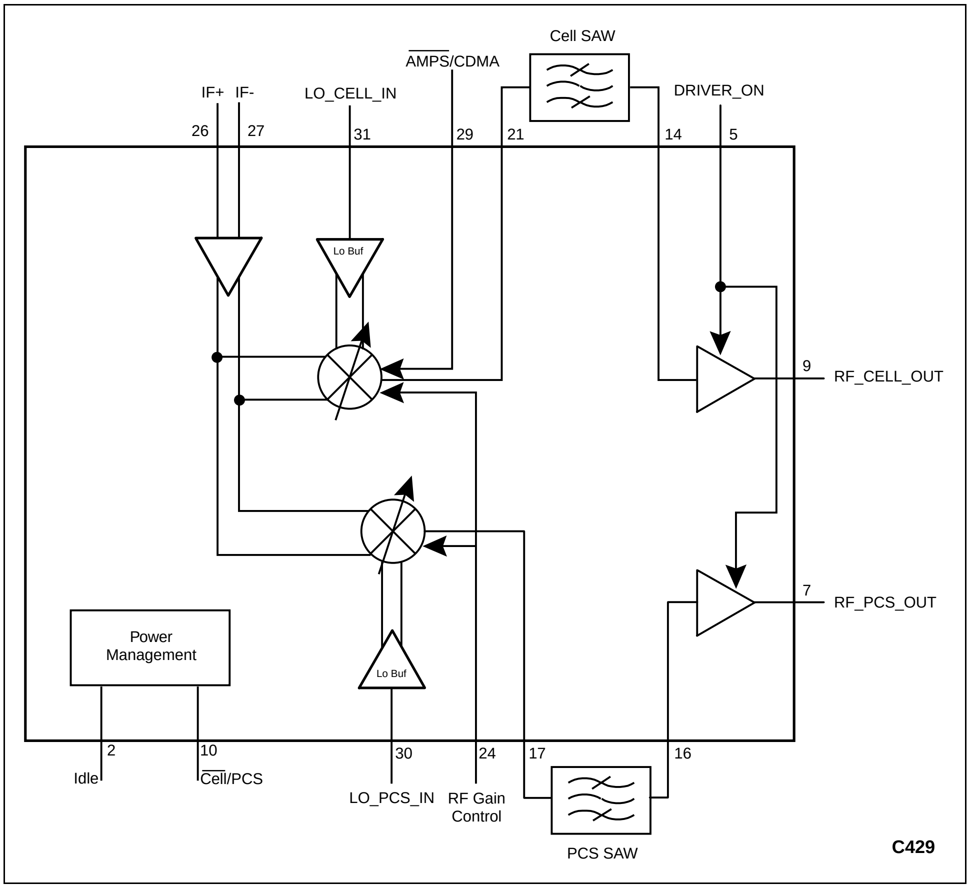


Figure 2. RF25F Tx ASIC Block Diagram

Technical Description

The RF25F is an upconverter and driver amplifier used by the CDMA transmitter section in the cellular and PCS bands. Its function can also be used in AMPS mode. A band select command chooses between the cellular and the PCS band. A mode select command chooses between CDMA and AMPS mode in the cellular band. The ASIC consists of two variable gain upconverters and two power amplifier drivers for the cellular and PCS bands.

Upconverters. The cellular and PCS variable gain upconverters receive the IF signal. Each upconverter uses an external Local Oscillator (LO) controlled by an external Phase Locked Loop (PLL). Upconverter conversion gain control can be used to calibrate out part-to-part and temperature gain variations in the transmit path. A band select command switches between the cellular and PCS bands. The DRIVER_ON command deactivates the driver during no transmission status. The output RF signal is sent to an output pin to be filtered before driver amplification.

Power Amplifier Drivers. Two power amplifier drivers are included, the cellular driver and the PCS driver.

Each driver takes its input from the upconverter after passing through an image reject filter. The drivers amplify the signal and send it to an external power amplifier.

The DRIVER_ON command is used during gated output power mode to deactivate the drivers in periods of no transmission. A Surface Acoustic Wave (SAW) filter for noise and image rejection should be placed between the driver and the external power amplifier.

Electrical and Mechanical Specifications

Signal pin assignments and functional pin descriptions are described in Table 1. The absolute maximum ratings of the RF25F are provided in Table 2. The recommended operating conditions are specified in Table 3 and electrical specifications are provided in Table 4.

Typical performance characteristics of the RF25F are illustrated in Figures 3 through 26. Figure 27 provides a typical application schematic diagram. Figure 28 shows the package dimensions for the 32-pin LGA and Figure 29 provides the tape and reel dimensions.

Electrostatic Discharge (ESD) Sensitivity

The RF25F is a Class 1 device. The following extreme Electrostatic Discharge (ESD) precautions are required according to the Human Body Model (HBM):

- Protective outer garments.
- Handle device in ESD safeguarded work area.
- Transport device in ESD shielded containers.
- Monitor and test all ESD protection equipment.

The HBM ESD withstand threshold value, with respect to ground, is ±2.5 kV. The HBM ESD withstand threshold value, with respect to VDD (the positive power supply terminal) is also ±2.5 kV.

Table 1. RF25F Signal Descriptions (1 of 2)

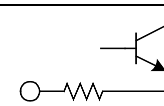
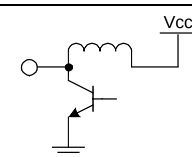
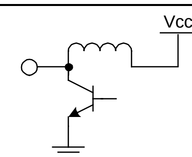
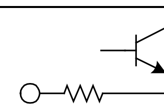
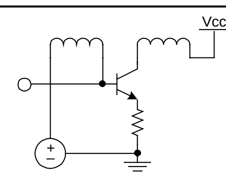
Pin #	Name	Description	
1	VCC_DRV_BIAS	Supply voltage for bias circuit of cellular driver and last stage of PCS driver.	
2	IDLE	Upconverter enable signal. When the input is low, the chip is disabled. When the input is high, the chip is enabled.	
3	VCC_LAST_DRV_PCS	Supply voltage for the PCS driver amplifier. This pin can be used to turn the last driver on and off for a 24 dB gain step.	
4	POT_CELL	This pin is connected to an external resistor. The value of the resistor sets the bias current of the cellular driver, which affects gain and Adjacent Channel Power Rejection(ACPR).	
5	DRV_ON	This is the driver control signal. When the pin is low, the driver is deactivated during no transmission. During transmission the pin should be high to enable the driver.	
6	NC	No connection.	
7	RF_PCS_OUT	This is the output pin for the PCS RF signal. The pin is connected to the output of the PCS driver amplifier. Impedance matching is required.	
8	NC	No connection.	
9	RF_CELL_OUT	This is the output pin for the cellular RF signal. The pin is connected to the output of the cellular driver amplifier. Impedance matching is required.	
10	$\overline{\text{CELL}}$/PCS	This is a control signal input pin that selects between the cellular band and PCS band. When the input is low, the cellular band is chosen. When the input is high, the PCS band is chosen.	
11	VCC_DRV_800	Supply voltage for the driver of the cellular band.	
12	POT_PCS	This pin is connected to an external resistor. The value of the resistor sets the bias current of the PCS driver, which affects gain and ACPR.	
13	VCC_1ST_DRV_PCS	Supply voltage for the first amplifier in the PCS driver block.	
14	DRV_CELL_IN	The cellular driver input pin connected to the RF input of the cellular band driver. The input signal should pass through a SAW filter before being connected to the driver. Impedance matching is required.	
15	DRV_PCS_IN	The PCS driver input pin connected to the RF input of the PCS band driver. The input signal should pass through a SAW filter before being connected to the driver. Impedance matching is required.	
16	NC	No connection.	

Table 1. RF25F Pin Assignments and Signal Descriptions (2 of 2)

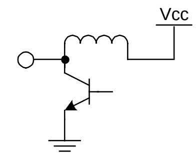
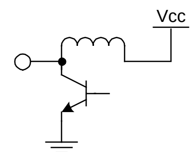
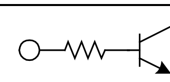
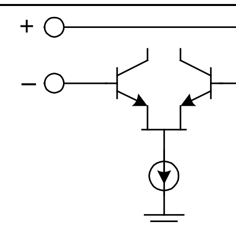
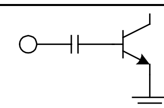
Pin #	Name	Description	
17	NC	No connection.	
18	MIX_PCS_OUT	This pin is connected to the RF output of the PCS upconverter. This pin needs impedance matching. The RF output signal should be routed through an image rejection filter before being connected to the driver input.	
19	NC	No connection.	
20	VCC_DIFF_DRV	Supply voltage for a differential amplifier in the upconverter block.	
21	NC	No connection.	
22	MIX_CELL_OUT	This pin is connected to the RF output of the cellular upconverter. The RF output signal should be routed through an image rejection filter before being connected to the cellular driver input.	
23	VCC_DIFF_DRV_BIAS	Supply voltage for the bias circuit of both upconverters' differential drivers.	
24	RF_GC	The gain control pin for both RF upconverters.	
25	NC	No connection.	
26	IF130_IN+	The IF input pin for the upconverter block. DC bias is set internally.	
27	IF130_IN–	Same as pin 26, except a complementary input.	
28	VCC_IF	Supply voltage for the IF mux and bias circuitry.	
29	$\overline{\text{AMPS}}$/CDMA	This is the cellular mode control signal input. When the input is low, the AMPS mode is selected. If the input is high, CDMA mode is selected.	
30	LO_PCS_IN	This is the input pin for the PCS band local oscillator. A typical –10 dBm LO power is needed.	
31	LO_CELL_IN	This is the input pin for the cellular band local oscillator. A typical –10 dBm LO power is needed.	
32	VCC_MIX	Supply voltage for the mixer and LO buffer of the upconverter block.	

Table 2. Absolute Maximum Ratings

Parameter	Minimum	Maximum	Units
Supply voltage (VCC)	–0.3	+5.0	V
Input voltage range	–0.3	VCC	V
Power dissipation		600	mW
Operating temperature	–30	+80	°C
Storage temperature	–40	+125	°C

Table 3. Recommended Operating Conditions

Parameter	Minimum	Typical	Maximum	Units
Supply voltage (Note 1)	2.85	3.0	3.3	V
Logic level high	Vcc – 0.5			V
Logic level low			0.5	V
Supply current in 800 MHz CDMA @ 7 dBm		62	71	mA
Supply current in 800 MHz CDMA @ 0 dBm		52	59	mA
Supply current in 800 MHz AMPS @ 11 dBm		75	85	mA
Supply current in 800 MHz (driver on = off)		43	49	mA
Supply current in 1900 MHz CDMA @ 8 dBm		74	84	mA
Supply current in 1900 MHz CDMA @ 0 dBm		57	65	mA
Supply current in 1900 MHz CDMA (driver on = off)		42	48	mA
Supply current in sleep mode (chip enable = off, driver on = off)		20		μA
Required LO Level	–12	–10	–8	dBm
Note 1: The RF25F works at lower than 3.0 V VCC, but with some performance degradation.				

Table 4. RF25F Electrical Characteristics (1 of 2)
(T_A = 25° C, Vcc = 3.0 V, PLO = –10 dBm, input externally matched)

Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Units
Cellular Variable Gain Upconverter						
LO frequency range			700		1100	MHz
LO input return loss (reference to 50 Ω)		External match		–15		dB
Terminating resistor across IF inputs			485	510	535	Ω
Output frequency			824		925	MHz
CDMA mode conversion gain, maximum				20		dB
CDMA mode conversion gain, minimum				–10		dB
ACPR in 30 KHz at 885 KHz offset @ –4 dBm output				–54	–53	dBc
ACPR in 30 KHz at 1.98 MHz offset @ –4 dBm output					–62	dBc
FM mode conversion gain, maximum				22		dB
FM mode conversion gain, minimum				–6		dB
FM mode output P1dB			5	6		dBm
Noise figure @ 21 dB gain CDMA/21 dB gain FM				8	9	dB
Noise figure @ 12 dB gain CDMA/14 dB gain FM				16	18	dB
LO to RF leakage @ maximum gain, LO = –10 dBm				–35		dBm
PCS Variable-Gain Upconverter						
LO frequency range			1600		2200	MHz
LO input return loss (reference to 50 Ω)		External match		–15		dB
Terminating resistor across IF inputs			485	510	535	Ω
Output frequency			1700		1910	MHz
Maximum conversion gain				19		dB
Minimum conversion gain				–6		dB
Output power at maximum gain				–3		dBm
ACPR in 30 KHz at 1.25 MHz offset @ –6 dBm output				–56	–54	dBc
ACPR in 1 MHz at 2.75 MHz offset @ –6 dBm output				–56	–54	dBc
Noise figure at maximum gain				9	10	dB
Noise figure @ 13 dB gain				13		dB
LO to RF leakage @ maximum gain, LO = –10 dBm				–30		dBm
Cellular PA Driver						
Input return loss (reference to 50 Ω)		External match		–15		dB
Output frequency			824		925	MHz
Gain (@ POT_CELL = 330 Ω)				14		dB
Output power level at maximum gain			7	8		dBm
Saturated output power level (FM)			12	14		dBm
ACPR in 30 KHz band at 885 KHz offset @ 7 dBm output				–54	–53	dBc
ACPR in 30 KHz band at 1.98 MHz offset @ 7 dBm output				–67	–66	dBc
Noise figure				6	8	dB

Table 4. RF25F Electrical Characteristics (2 of 2)
(T_A = 25° C, Vcc = 3.0 V, PLO = –10 dBm, input externally matched)

Parameter	Symbol	Test Condition	Minimum	Typical	Maximum	Units
PCS PA Driver						
Input return loss (reference to 50 Ω)		External match		–15		dB
Output frequency			1700		1910	MHz
Gain (@ POT_PCS = 100 Ω)				16		dB
Output power level with 1800 MHz mixer @ maximum gain			8	9		dBm
ACPR in 30 KHz band at 1.25 MHz offset @ 8 dBm output				–52	–51	dBc
ACPR in 1 MHz band at 2.75 MHz offset @ 8 dBm output				–52	–51	dBc
Noise figure				9	10	dB

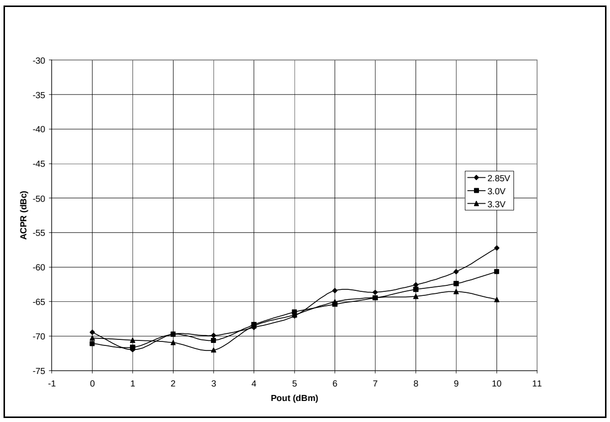


Figure 3. PCS Driver ACPR vs. Pout Over Vcc

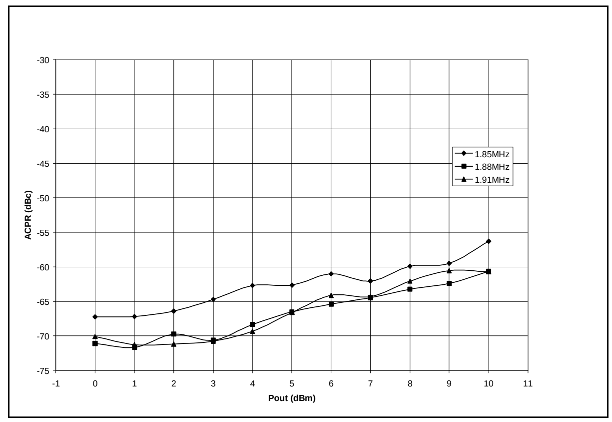


Figure 5. PCS Driver ACPR vs. Pout Over Frequency

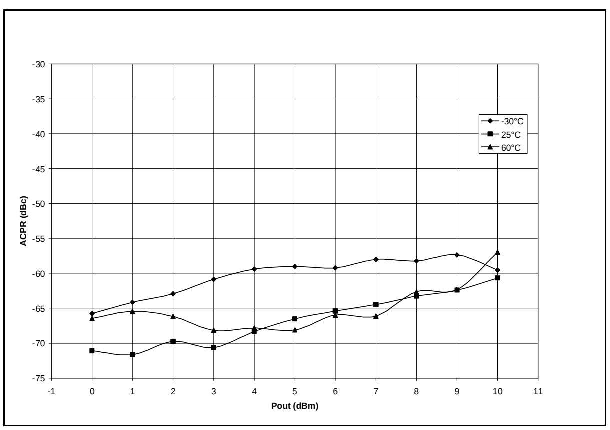


Figure 4. PCS Driver ACPR vs. Pout Over Temperature

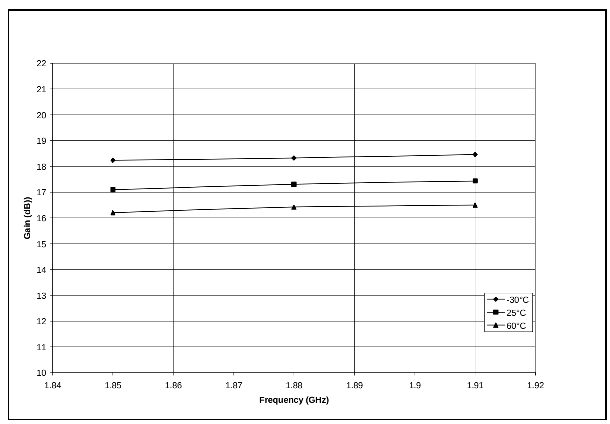


Figure 6. PCS Driver Gain vs. Frequency Over Temperature (Po = +8 dBm)

Note: Unless otherwise specified, all graphs depict testing at the following parameters: For CDMA: Fc = 836.5 MHz, ΔF = ±0.885 MHz, 25 °C, 3.0 V; For PCS: Fc = 1.88 GHz, ΔF = ±1.25 MHz, 25 °C, 3.0 V

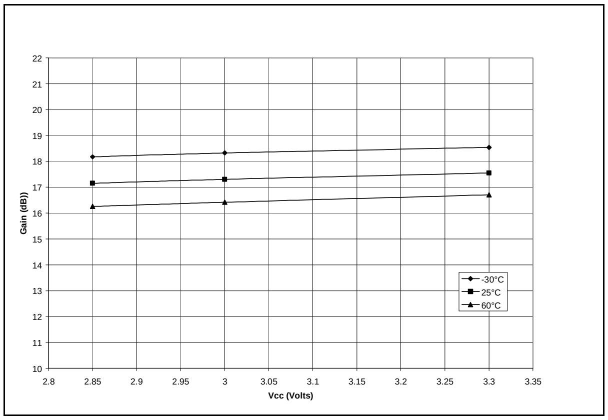


Figure 7. PCS Driver Gain vs. Vcc Over Temperature (Po = +8 dBm)

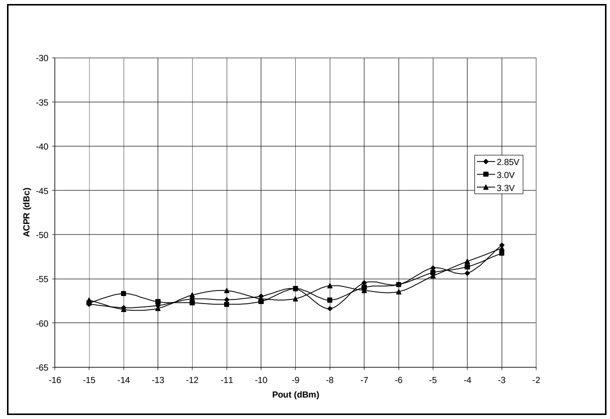


Figure 8. PCS Mixer ACPR vs. Pout Over Vcc

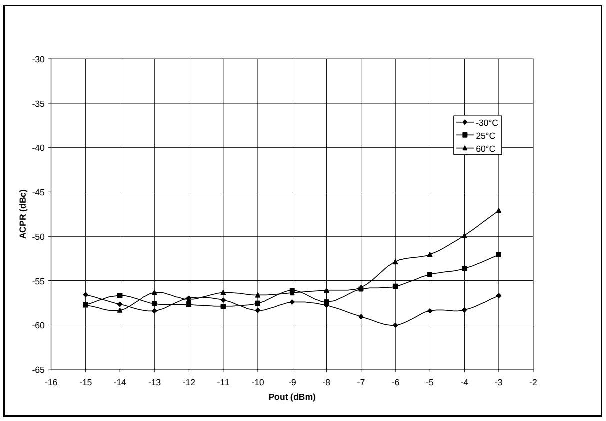


Figure 9. PCS Mixer ACPR vs. Pout Over Temperature

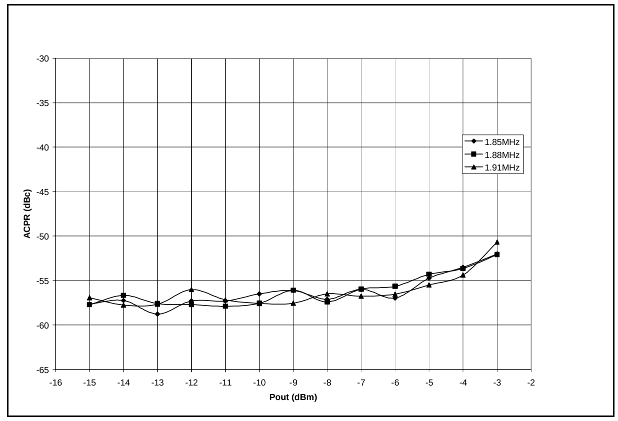


Figure 10. PCS Mixer ACPR vs Pout Over Frequency

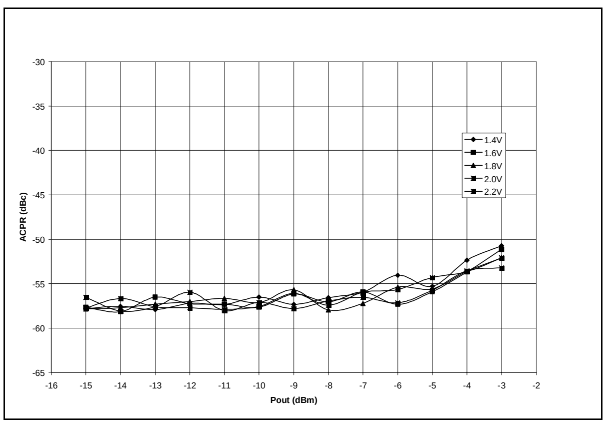


Figure 11. PCS Mixer ACPR vs. Pout Over RFGC Voltage (Pout = -6 dBm)

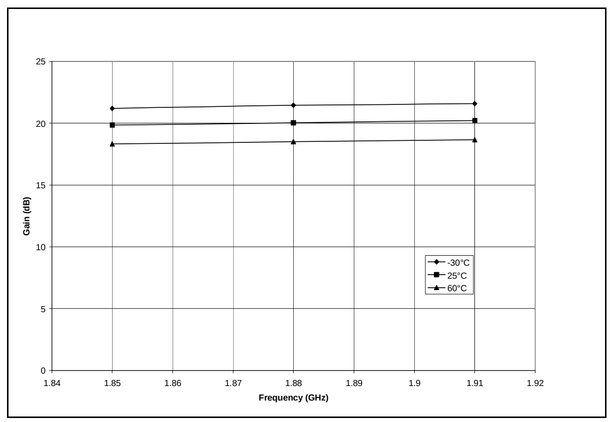


Figure 12. PCS Mixer Gain vs. Frequency Over Temperature (Pout = -6 dBm)

Note: Unless otherwise specified, all graphs depict testing at the following parameters: For CDMA: Fc = 836.5 MHz, ΔF = ±0.885 MHz, 25 °C, 3.0 V; For PCS: Fc = 1.88 GHz, ΔF = ±1.25 MHz, 25 °C, 3.0 V

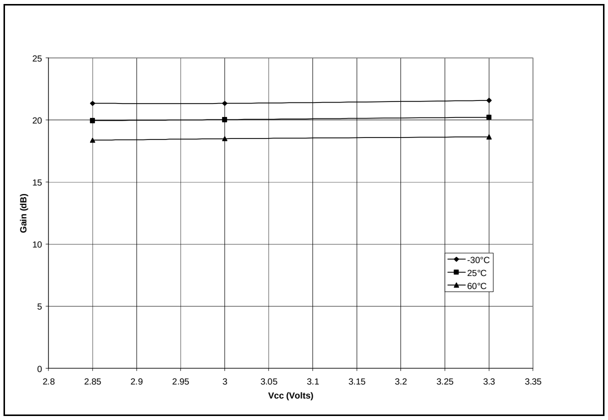


Figure 13. PCS Mixer Gain vs. Vcc Over Temperature (Pout = -6 dBm)

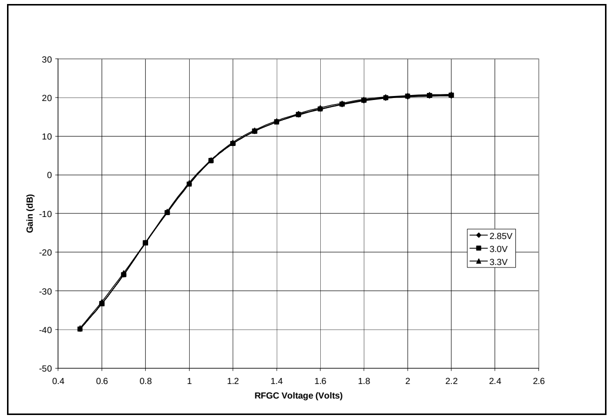


Figure 14. PCS Mixer Gain vs. RFGC Voltage Over Vcc

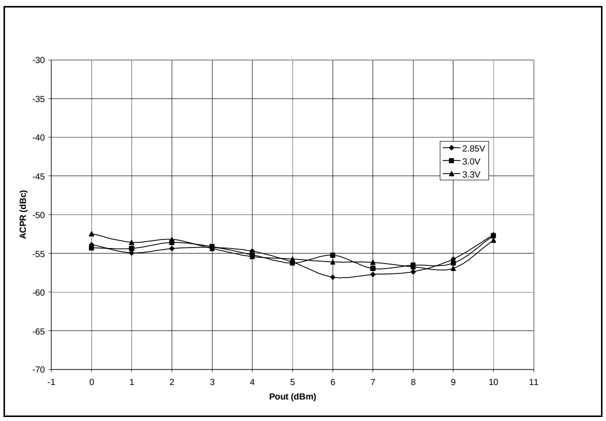


Figure 15. Cellular Driver ACPR vs. Pout Over Vcc

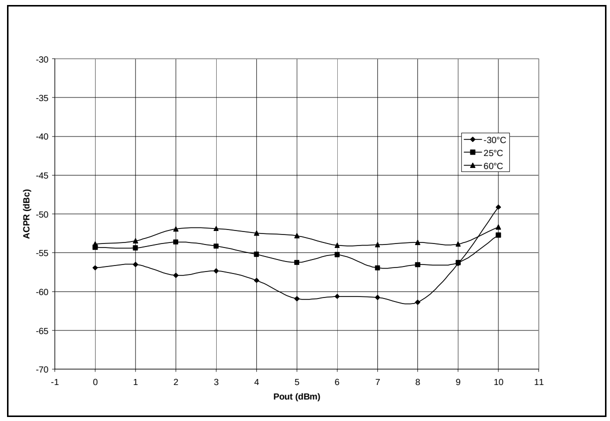


Figure 16. Cellular Driver ACPR vs. Pout Over Temperature

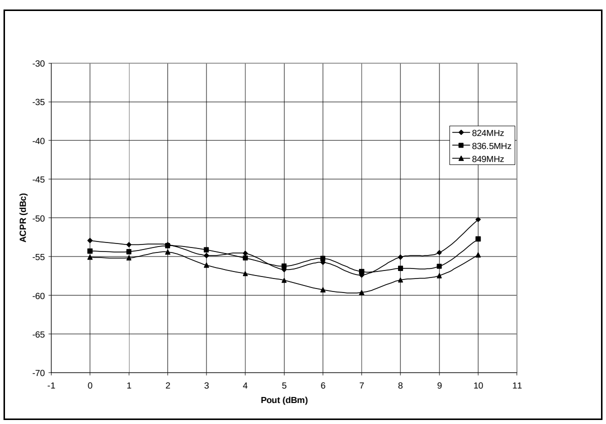


Figure 17. Cellular Driver ACPR vs. Pout Over Frequency

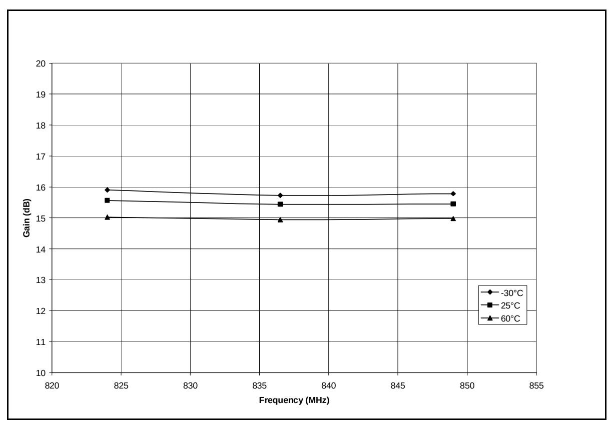


Figure 18. Cellular Driver Gain vs. Frequency Over Temperature (Pout = +7 dBm)

Note: Unless otherwise specified, all graphs depict testing at the following parameters: For CDMA: Fc = 836.5 MHz, ΔF = ±0.885 MHz, 25 °C, 3.0 V; For PCS: Fc = 1.88 GHz, ΔF = ±1.25 MHz, 25 °C, 3.0 V

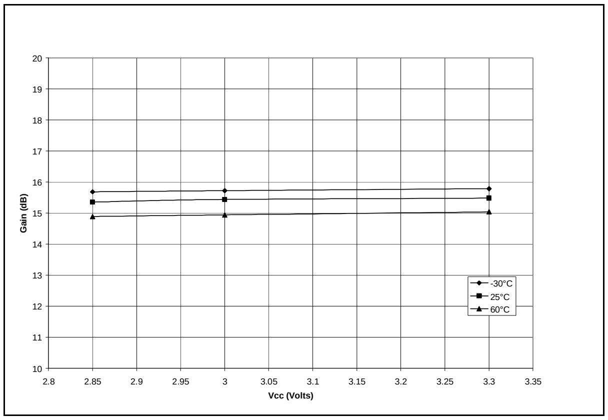


Figure 19. Cellular Driver Gain vs. Vcc Over Temperature (Pout = +7 dBm)

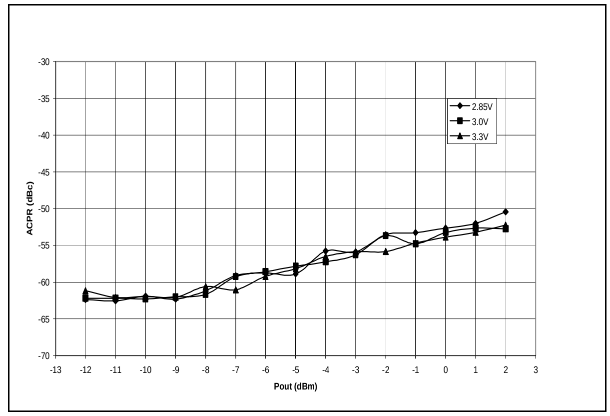


Figure 20. Cellular Mixer ACPR vs. Pout Over Vcc

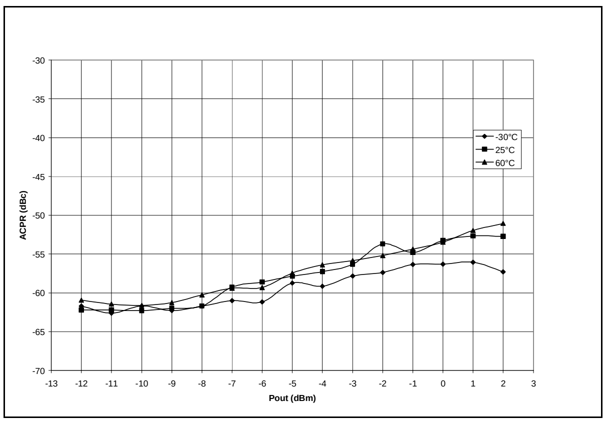


Figure 21. Cellular Mixer ACPR vs. Pout Over Temperature

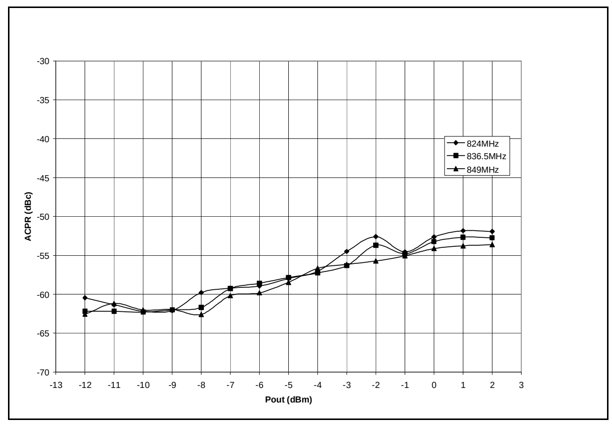


Figure 22. Cellular Mixer ACPR vs. Pout Over Frequency

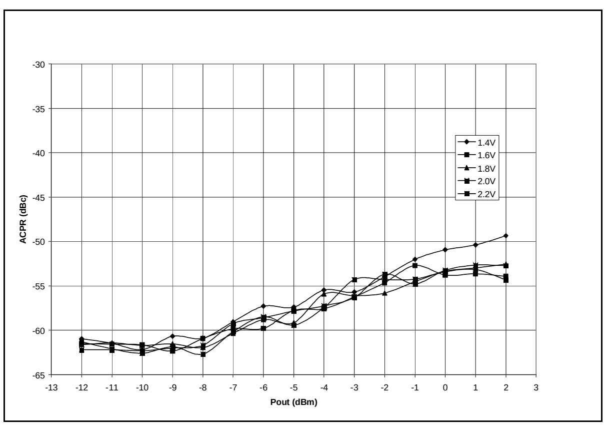


Figure 23. Cellular Mixer ACPR vs. Pout Over RFGC Voltage

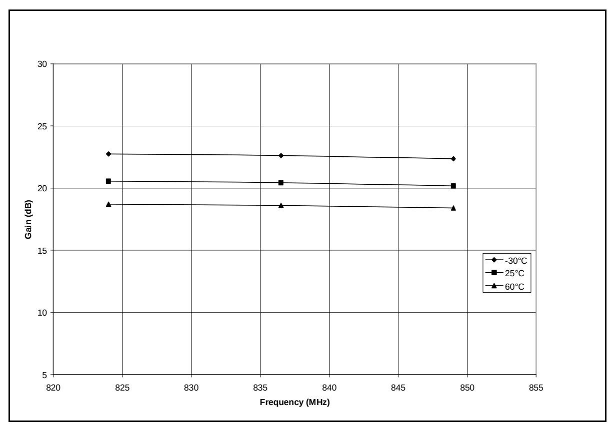


Figure 24. Cellular Mixer Gain vs. Frequency Over Temperature (Pout = -6 dBm)

Note: Unless otherwise specified, all graphs depict testing at the following parameters: For CDMA: Fc = 836.5 MHz, ΔF = ±0.885 MHz, 25 °C, 3.0 V; For PCS: Fc = 1.88 GHz, ΔF = ±1.25 MHz, 25 °C, 3.0 V

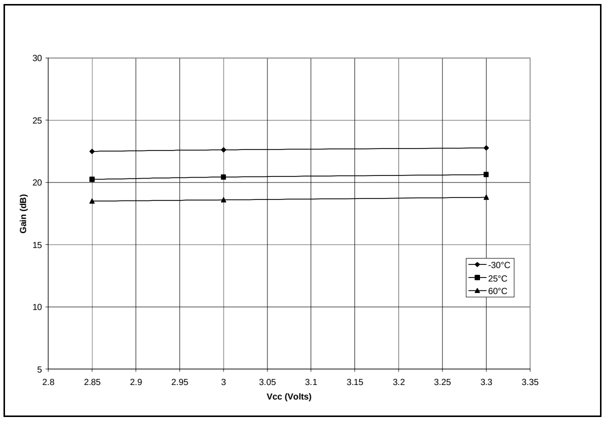


Figure 25. Cellular Mixer Gain vs. Vcc Over Temperature (Pout = -6 dBm)

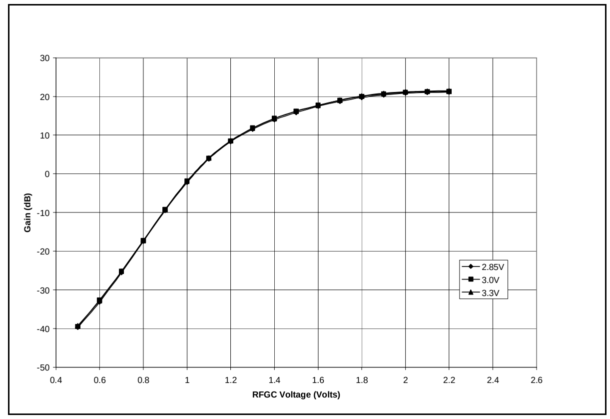


Figure 26. Cellular Mixer Gain vs. RFGC Voltage Over Vcc

Note: Unless otherwise specified, all graphs depict testing at the following parameters: For CDMA: Fc = 836.5 MHz, ΔF = ±0.885 MHz, 25 °C, 3.0 V; For PCS: Fc = 1.88 GHz, ΔF = ±1.25 MHz, 25 °C, 3.0 V

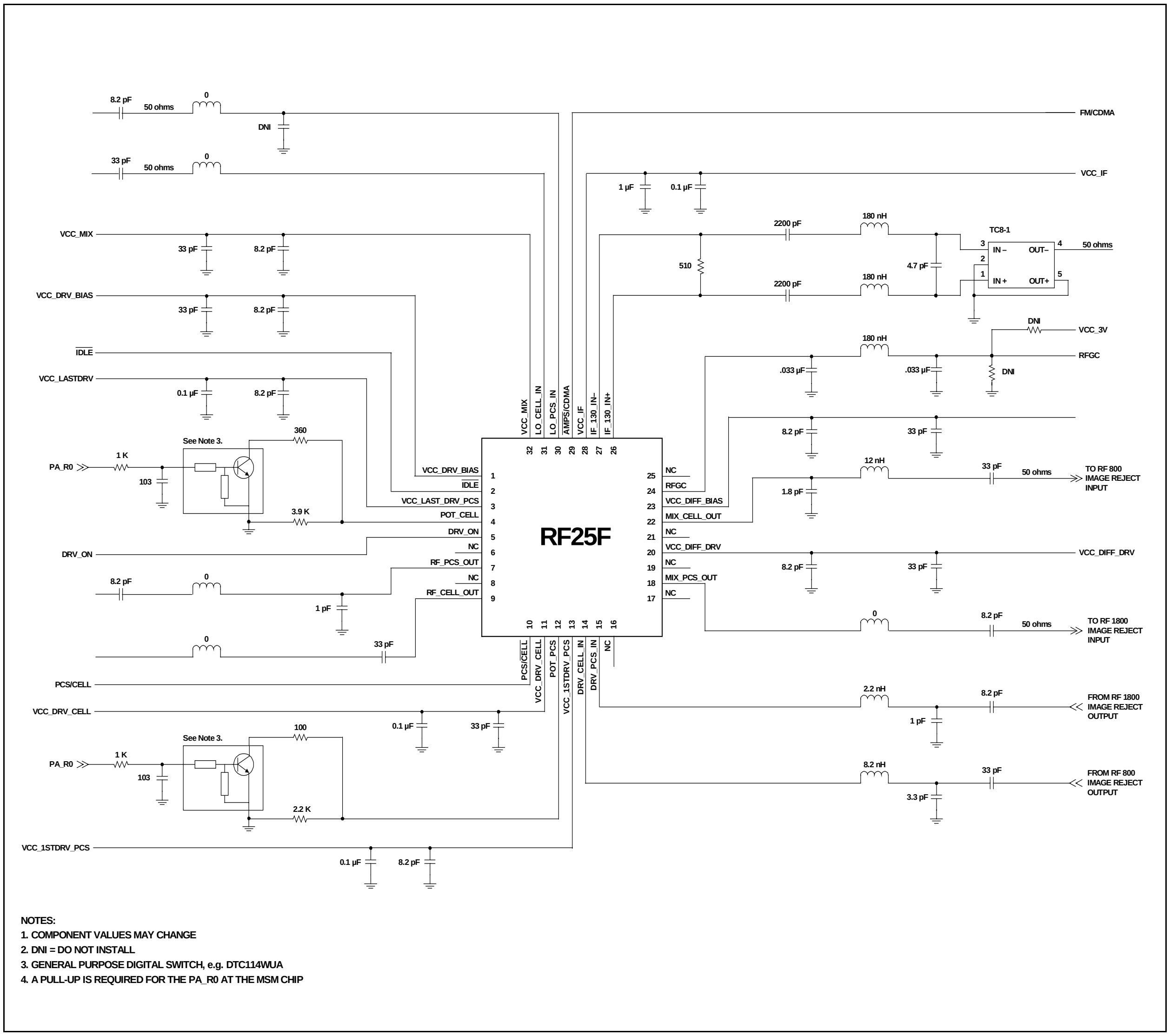


Figure 27. RF25F Schematic Diagram

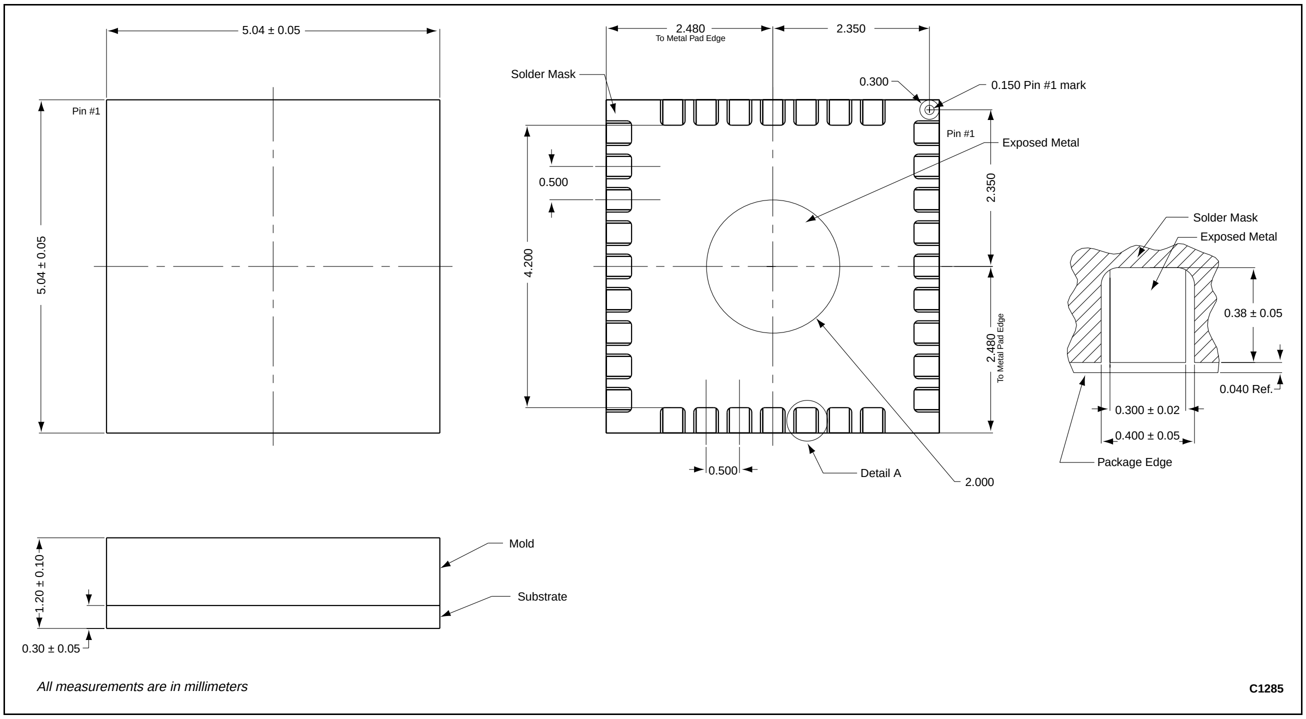


Figure 28. RF25F 32-Pin LGA Package Dimensions

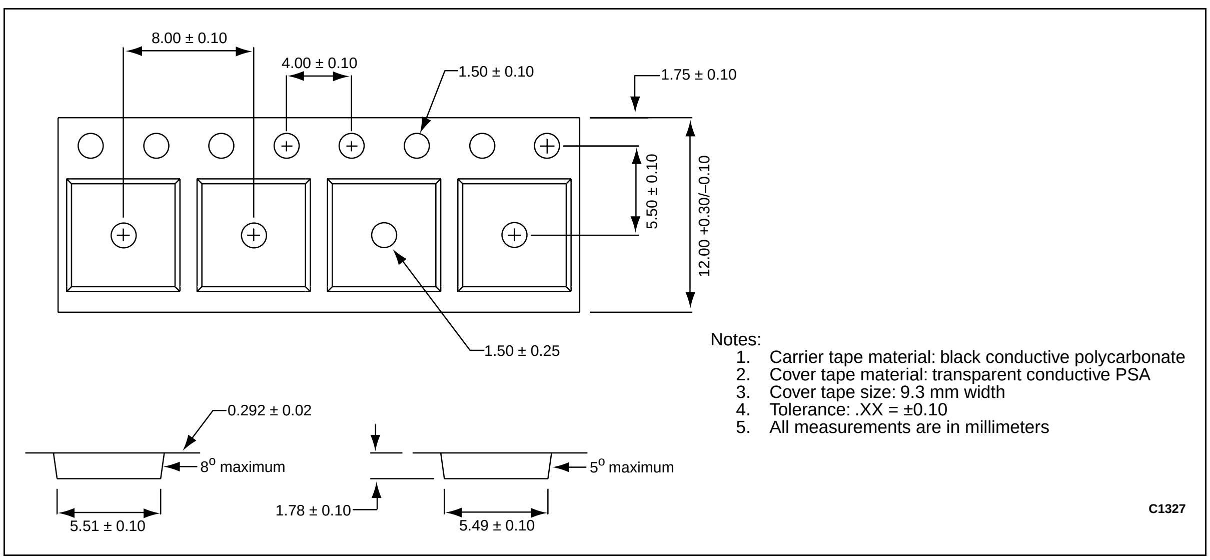


Figure 29. 32-pin LGA Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Product Revision
Tx ASIC	RF25F-12	

General Information:

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