

RMPA0963 *i-Lo*™ Cellular CDMA, CDMA2000-1X and WCDMA Power Amplifier Module

Features

- 38% CDMA/WCDMA efficiency at +28 dBm Pout
- 14% CDMAA/WCDMA efficiency (80 mA total current) at +16 dBm Pout
- Linear operation in low-power mode up to +19 dBm
- 50% AMPS mode efficiency at +31 dBm Pout
- Low quiescent current (Iccq): 20 mA in low-power mode
- Single positive-supply operation with low power and shutdown modes
 - 3.4V typical Vcc operation
 - Low Vref (2.85V) compatible with advanced handset chipsets
- Compact Lead-free compliant LCC package – (4.0 X 4.0 x 1.5 mm nominal)
- Industry standard pinout
- Internally matched to 50 Ohms and DC blocked RF input/output
- Meets IS-95/CDMA2000-1XR/T/WCDMA performance requirements

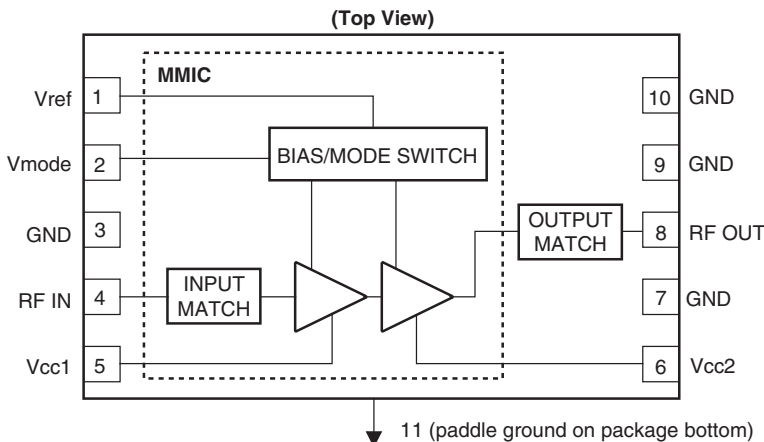
General Description

The RMPA0963 Power Amplifier Module (PAM) is Fairchild's latest innovation in 50 Ohm matched, surface mount modules targeting Cellular CDMA/WCDMA, AMPS and Wireless Local Loop (WLL) applications. Answering the call for ultra-low DC power consumption and extended battery life in portable electronics, the RMPA0963 uses novel proprietary circuitry to dramatically reduce amplifier current at low to medium RF output power levels ($\leq +16$ dBm), where the handset most often operates. A simple two-state Vmode control is all that is needed to reduce operating current by more than 50% at 16 dBm output power, and quiescent current (Iccq) by as much as 70% compared to traditional power-saving methods. No additional circuitry, such as DC-to-DC converters, are required to achieve this remarkable improvement in amplifier efficiency. Further, the 4x4x1.5 mm LCC package is pin-compatible and a drop-in replacement for last generation 4x4 mm PAMs widely used today, minimizing the design time to apply this performance-enhancing technology. The multi-stage GaAs Microwave Monolithic Integrated Circuit (MMIC) is manufactured using Fairchild RF's InGaP Heterojunction Bipolar Transistor (HBT) process.

Device



Functional Block Diagram



Absolute Maximum Ratings¹

| Symbol | Parameter | Value | Units |
|------------|-----------------------|-------------|-------|
| Vcc1, Vcc2 | Supply Voltages | 5.0 | V |
| Vref | Reference Voltage | 2.6 to 3.5 | V |
| Vmode | Power Control Voltage | 3.5 | V |
| Pin | RF Input Power | +10 | dBm |
| Tstg | Storage Temperature | -55 to +150 | °C |

Note:

1. No permanent damage with one parameter set at extreme limit. Other parameters set to typical values.

Electrical Characteristics¹

| Symbol | Parameter | Min | Typ | Max | Units | Comments |
|--------------------------------|--|----------|------------|-------|------------|--|
| f | Operating Frequency | 824 | | 849 | MHz | |
| CDMA/WCDMA Operation | | | | | | |
| Gp | Power Gain | | 30 20 | | dB dB | Po=+28 dBm; Vmode=0V Po=+16 dBm; Vmode≥2.0V |
| Po | Linear Output Power | 28 16 | | | dBm dBm | Vmode=0V Vmode≥2.0V |
| PAEd | PAEd (digital) @ +28 dBm | | 38 | | % | Vmode=0V |
| | PAEd (digital) @ +16 dBm | | 14 | | % | Vmode≥2.0V |
| Itot | High Power Total Current | | 480 | | mA | Po=+28 dBm, Vmode=0V |
| | Low Power Total Current | | 80 | | mA | Po=+16 dBm, Vmode=2.0V |
| CDMA | Adjacent Channel Power Ratio | | | | | IS-95 A/B Modulation |
| ACPR1 | ±885 KHz Offset | | -50 -55 | | dBc dBc | Po=+28 dBm; Vmode=0V Po=+16 dBm; Vmode≥2.0V |
| ACPR2 | ±1.98 MHz Offset | | -60 -65 | | dBc dBc | Po=+28 dBm; Vmode=0V Po=+16 dBm; Vmode≥2.0V |
| WCDMA | Adjacent Channel Leakage Ratio | | | | | IS-95 A/B Modulation |
| ACLR1 | ±5 MHz Offset | | -40 -45 | | dBc dBc | Po=+28 dBm; Vmode=0V Po=+16 dBm; Vmode≥2.0V |
| ACLR2 | ±10 MHz Offset | | -53 -60 | | dBc dBc | Po=+28 dBm; Vmode=0V Po=+16 dBm; Vmode≥2.0V |
| AMPS Operation | | | | | | |
| Gp | Power Gain | | 29 | | dB | Po=+31 dBm |
| PAEa | Power-Added Efficiency (analog) | | 50 | | % | Po=+31 dBm |
| General Characteristics | | | | | | |
| VSWR | Input Impedance | | 2.0:1 | 2.5:1 | | |
| NF | Noise Figure | | 4 | | dB | |
| Rx No | Receive Band Noise Power | | -134 | | dBm/Hz | Po<+28 dBm; 869 to 894MHz |
| 2fo-5fo | Harmonic Suppression ³ | | | -30 | dBc | Po≤+28 dBm |
| S | Spurious Outputs ^{2,3} | | | -60 | dBc | Load VSWR ≤ 5.0:1 |
| | Ruggedness w/ Load Mismatch ³ | | | 10:1 | | No permanent damage. |
| Tc | Case Operating Temperature | -30 | | 85 | ±C | |
| DC Characteristics | | | | | | |
| Iccq | Quiescent Current | | 20 | | mA | Vmode≥2.0V |
| Iref | Reference Current | | 2 | | mA | Po≤+28 dBm |
| Icc(off) | Shutdown Leakage Current | | 1 | 5 | µA | No applied RF signal |

Notes:

1. All parameters met at Tc = +25°C, Vcc = +3.4V, Vref = 2.85V and load VSWR≤1.2:1, unless otherwise noted.
2. All phase angles.
3. Guaranteed by design.

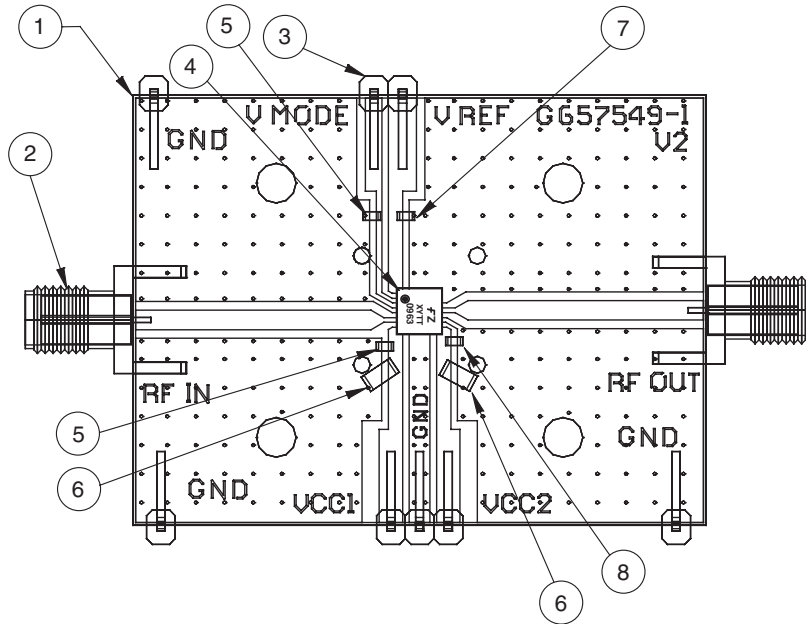
Recommended Operating Conditions

| Symbol | Parameter | Min | Typ | Max | Units |
|------------|---|-----|------|-----|-------|
| f | Operating Frequency | 824 | | 849 | MHz |
| Vcc1, Vcc2 | Supply Voltage | 3.0 | 3.4 | 4.2 | V |
| Vref | Reference Voltage (Operating) (Shutdown) | 2.7 | 2.85 | 3.1 | V |
| | | 0 | | 0.5 | V |
| Vmode | Bias Control Voltage (Low-Power) (High-Power) | 1.8 | 2.0 | 3.0 | V |
| | | 0 | | 0.5 | V |
| Pout | Linear Output Power (High-Power) (Low-Power) | | +16 | +28 | dBm |
| | | | | +19 | dBm |
| Tc | Case Operating Temperature | -30 | | +85 | °C |

DC Turn-On Sequence

- 1) Vcc1 = Vcc2 = 3.4V (typical)
- 2) Vref = 2.85V (typical)
- 3) High-Power: Vmode = 0V (Pout > 16 dBm)
 Low-Power: Vmode = 2V (Pout < 16 dBm)

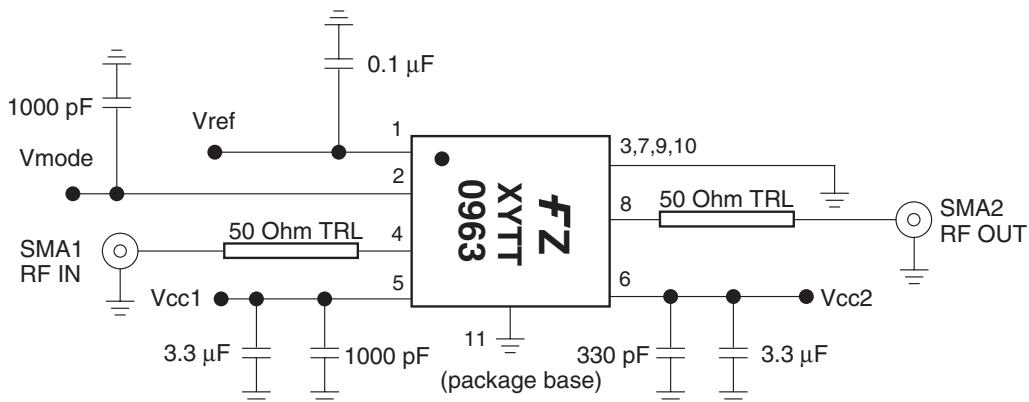
Evaluation Board Layout



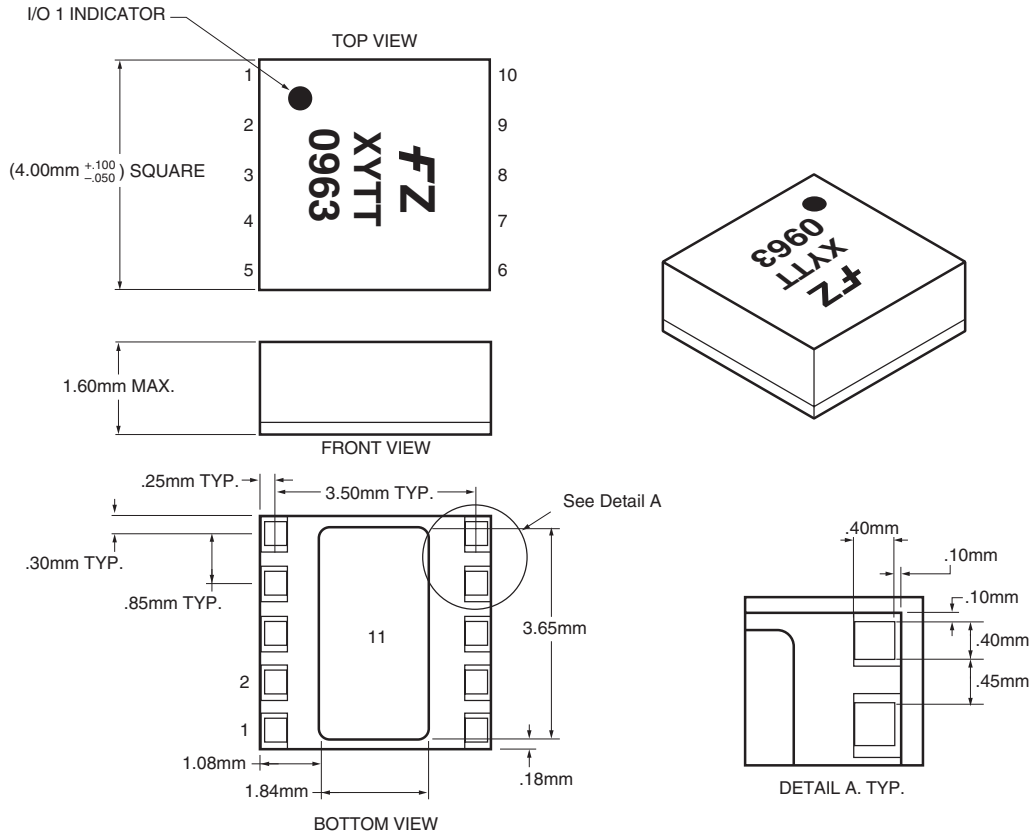
Materials List

| Qty | Item No. | Part Number | Description | Vendor |
|-----|----------|-----------------|-------------------------|--------------|
| 1 | 1 | G657549-1 V2 | PC Board | Fairchild |
| | 2 | #142-0701-841 | SMA Connector | Johnson |
| | 3 | #2340-5211TN | Terminals | 3M |
| Ref | 4 | G657583 | Assembly, RMPA0963 | Fairchild |
| 2 | 5 | GRM39X7R102K50V | 1000pF Capacitor (0603) | Murata |
| 2 | 5 (Alt) | ECJ-1VB1H102K | 1000pF Capacitor (0603) | Panasonic |
| 2 | 6 | C3216X5R1A335M | 3.3µF Capacitor (1206) | TDK |
| 1 | 7 | GRM39Y5V104Z16V | 0.1µF Capacitor (0603) | Murata |
| 1 | 7 (Alt) | ECJ-1VB1C104K | 0.1µF Capacitor (0603) | Panasonic |
| 1 | 8 | GRM39X7R331K50V | 330pF Capacitor (0603) | Murata |
| A/R | 9 | SN63 | Solder Paste | Indium Corp. |
| A/R | 10 | SN96 | Solder Paste | Indium Corp. |

Evaluation Board Schematic



Package Outline



Signal Descriptions

| Pin # | Signal Name | Description |
|-------|-------------|-----------------------------------|
| 1 | Vref | Supply Voltage to Input Stage |
| 2 | Vmode | RF Input Signal |
| 3 | GND | Ground |
| 4 | RF In | High Power/Low Power Mode Control |
| 5 | Vcc1 | Reference Voltage |
| 6 | Vcc2 | Supply Voltage to Output Stage |
| 7 | GND | Ground |
| 8 | RF Out | RF Output Signal |
| 9 | GND | Ground |
| 10 | GND | Ground |
| 11 | GND | Paddle Ground |

Application Information

CAUTION: THIS IS AN ESD SENSITIVE DEVICE

Precautions to Avoid Permanent Device Damage:

- **Cleanliness:** Observe proper handling procedures to ensure clean devices and PCBs. Devices should remain in their original packaging until component placement to ensure no contamination or damage to RF, DC & ground contact areas.
- **Device Cleaning:** Standard board cleaning techniques should not present device problems provided that the boards are properly dried to remove solvents or water residues.
- **Static Sensitivity:** Follow ESD precautions to protect against ESD damage:
 - A properly grounded static-dissipative surface on which to place devices.
 - Static-dissipative floor or mat.
 - A properly grounded conductive wrist strap for each person to wear while handling devices.
- **General Handling:** Handle the package on the top with a vacuum collet or along the edges with a sharp pair of bent tweezers. Avoiding damaging the RF, DC, & ground contacts on the package bottom. Do not apply excessive pressure to the top of the lid.
- **Device Storage:** Devices are supplied in heat-sealed, moisture-barrier bags. In this condition, devices are protected and require no special storage conditions. Once the sealed bag has been opened, devices should be stored in a dry nitrogen environment.

Device Usage:

Fairchild RF recommends the following procedures prior to assembly.

- Dry-bake devices at 125°C for 24 hours minimum. Note: The shipping trays cannot withstand 125°C baking temperature
- Assemble the dry-baked devices within 7 days of removal from the oven.
 - During the 7-day period, the devices must be stored in an environment of less than 60% relative humidity and a maximum temperature of 30°C
 - If the 7-day period or the environmental conditions have been exceeded, then the dry-bake procedure must be repeated.

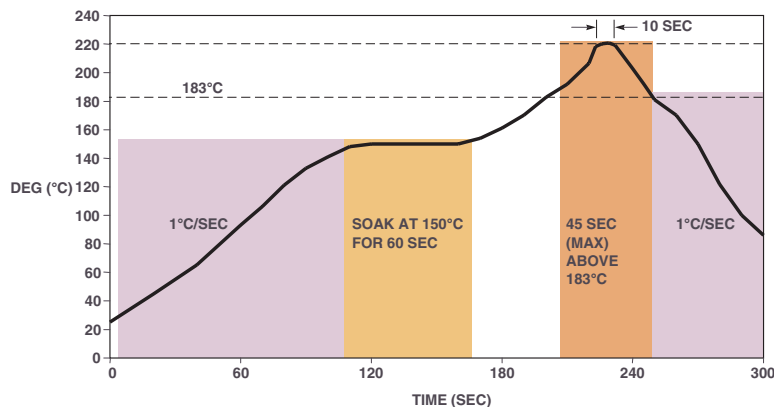
Solder Materials & Temperature Profile:

- Reflow soldering is the preferred method of SMT attachment. Hand soldering is not recommended.

Reflow Profile

- **Ramp-up:** During this stage the solvents are evaporated from the solder paste. Care should be taken to prevent rapid oxidation (or paste slump) and solder bursts caused by violent solvent out-gassing. A typical heating rate is 1-2°C/sec.
- **Pre-heat/soak:** The soak temperature stage serves two purposes; the flux is activated and the board and devices achieve a uniform temperature. The recommended soak condition is: 120-150 seconds at 150°C.
- **Reflow Zone:** If the temperature is too high, then devices may be damaged by mechanical stress due to thermal mismatch or there may be problems due to excessive solder oxidation. Excessive time at temperature can enhance the formation of inter-metallic compounds at the lead/board interface and may lead to early mechanical failure of the joint. Reflow must occur prior to the flux being completely driven off. The duration of peak reflow temperature should not exceed 10 seconds. Maximum soldering temperatures should be in the range 215-220°C, with a maximum limit of 225°C.
- **Cooling Zone:** Steep thermal gradients may give rise to excessive thermal shock. However, rapid cooling promotes a finer grain structure and a more crack-resistant solder joint. The illustration below indicates the recommended soldering profile.
- **Solder Joint Characteristics:** Proper operation of this device depends on a reliable void-free attachment of the heatsink to the PWB. The solder joint should be 95% void-free and be a consistent thickness.
- **Rework Considerations:** Rework of a device attached to a board is limited to reflow of the solder with a heat gun. The device should not be subjected to more than 225°C and reflow solder in the molten state for more than 5 seconds. No more than 2 rework operations should be performed.

Recommended Solder Reflow Profile



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