K&A WIRELESS, LLC

18 February 2013

To Whom It May Concern

Subject: **Modular Approval Request**

Applicant: **K&A Wireless, LLC**
FCC ID: **OPH-MINITX4000**

To Whom It May Concern:

Pursuant to Section 15.212(a)(1) of the FCC rules, the Applicant, request for single modular approval, compliance with the requirements are addressed below.

Single Modular Approval Requirements	Justification
(i) The radio elements of the modular transmitter must have their own shielding. The physical crystal and tuning capacitors may be located external to the shielded radio elements.	Modular transmitter has its own shielding.
(ii) The modular transmitter must have buffered modulation/data inputs (if such inputs are provided) to ensure that the module will comply with part 15 requirements under conditions of excessive data rates or over-modulation.	Modular TX uses Analog Frequency Modulation. It requires the modulation video signal to be limited to 1Vpp. This is clearly noted in the Users Manual.
(iii) The modular transmitter must have its own power supply regulation.	Modular TX contains a power regulator for most of the circuitry. However the RF Power Amplifier receives voltage directly from the input. The input voltage is required to be between 3 and 5Vdc and the RF Pa , would stop operating if 6V or higher are connected to it (Datasheet attached). The operating voltage is clearly noted in the Users Manual.
(iv) The modular transmitter must comply with the antenna and transmission system requirements of §§ 15.203, 15.204(b) and 15.204(c). The antenna must either be permanently attached or employ a ‘‘unique’’ antenna coupler (at all connections between the module and the antenna, including the cable). The ‘‘professional installation’’ provision of § 15.203 is not applicable to modules but can apply to limited modular approvals under paragraph (b) of this section.	This is a part 90 device for OEM integrators.

(v) The modular transmitter must be tested in a stand-alone configuration, *i.e.*, the module must not be inside another device during testing for compliance with part 15 requirements. Unless the transmitter module will be battery powered, it must comply with the AC line conducted requirements found in § 15.207. AC or DC power lines and data input/output lines connected to the module must not contain ferrites, unless they will be marketed with the module (see § 15.27(a)). The length of these lines shall be the length typical of actual use or, if that length is unknown, at least 10 centimeters to insure that there is no coupling between the case of the module and supporting equipment. Any accessories, peripherals, or support equipment connected to the module during testing shall be unmodified and commercially available (see § 15.31(i)).	The modular transmitter was tested in the stand-alone configuration.
(vi) The modular transmitter must be equipped with either a permanently affixed label or must be capable of electronically displaying its FCC identification number. (A) If using a permanently affixed label, the modular transmitter must be labeled with its own FCC identification number, and, if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: ‘‘Contains Transmitter Module FCC ID: XYZMODEL1’’ or ‘‘Contains FCC ID: XYZMODEL1.’’ Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement. In the latter case, a copy of these instructions must be included in the application for equipment authorization. (B) If the modular transmitter uses an electronic display of the FCC identification number, the information must be readily accessible and visible on the modular transmitter or on the device in which it is installed. If the module is installed inside another device, then the outside of the device into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording such as the following: ‘‘Contains FCC certified transmitter module(s).’’ Any similar wording that expresses the same meaning may be used. The user manual must include instructions on how to access the electronic display. A copy of these instructions must be included in the application for equipment authorization.	The modular transmitter is labeled with its FCC identification number. Labeling instructions are provided in the user manual to integrator for proper external label referring to the enclosed module, when FCC ID is not visible.

(vii) The modular transmitter must comply with any specific rules or operating requirements that ordinarily apply to a complete transmitter and the manufacturer must provide adequate instructions along with the module to explain any such requirements. A copy of these instructions must be included in the application for equipment authorization.	A copy of the instructions is provided with the application.
(viii) The modular transmitter must comply with any applicable RF exposure requirements in its final configuration.	Maximum Permissible Exposure (MPE) evaluation was conducted, specific installation and operating instructions for users and installers are provided that ensure that the public is not exposed to radio frequency energy levels in excess of the commissions' guidelines

Regards,

Kamil Agi
President-CEO

FAIRCHILD SEMICONDUCTOR®

January 2005

RMPA2455
2.4–2.5 GHz 1 Watt InGaP HBT Linear Power Amplifier

Features

- 30 dB small signal gain
- 30 dBm output power @ 1 dB compression
- 3% EVM at 22 dBm modulated power out
- 5.0 V positive collector supply operation
- Two power saving shutdown options (bias and logic control)
- Integrated power detector with 20 dB dynamic range
- Low profile 16 pin 3 x 3 x 0.9 mm leadless package
- Internally matched to 50Ω and DC blocked RF input/output
- Optimized for use in 802.11b/g Access Point applications

General Description

The RMPA2455 power amplifier is designed for high performance WLAN access point applications in the 2.4–2.5 GHz frequency band. The low profile 16 pin 3 x 3 x 0.9 mm package with internal matching on both input and output to 50Ω minimizes next level PCB space and allows for simplified integration. The on-chip detector provides power sensing capability while the logic control provides power saving shutdown options. The PA's low power consumption and excellent linearity are achieved using our InGaP Heterojunction Bipolar Transistor (HBT) technology.

Device

Electrical Characteristics[1] 802.11g OFDM Modulation

(with 176 ms burst time, 100 ms idle time) 54 Mbps Data Rate, 16.7 MHz Bandwidth

Parameter	Min	Typ	Max	Units
Frequency	2.4		2.5	GHz
Collector Supply Voltage	4.5	5.0	5.5	V
Mirror Supply Voltage	2.8	3.3	3.6	V
Gain		30		dB
Total Current @ 22dBm P_{OUT}		195		mA
EVM @ 22dBm P_{OUT}[2]		3.0		%
Detector Output @ 22dBm P_{OUT}		960		mV
Detector Threshold[3]		4		dBm

Notes:

1. VC1, VC2 = 5.0 Volts, VM12 = 3.3V, T_A = 25°C, PA is constantly biased, 50Ω system.

2. Percentage includes system noise floor of EVM = 0.8%.

3. P_{OUT} measured at P_{IN} corresponding to power detection threshold.

Electrical Characteristics[1] Single Tone

Parameter	Min	Typ	Max	Units
Frequency	2.4		2.5	GHz
Collector Supply Voltage	4.5	5.0	5.5	V
Mirror Supply Voltage	2.8	3.3	3.6	V
Gain		30		dB
Total Quiescent Current		140		mA
Bias Current at pin VM12[2]		17		mA
P1dB Compression		30		dBm
Standby Current[3]		0.7		mA
Shutdown Current (VM12 = 0V)		<1.0		µA
Input Return Loss		12		dB
Output Return Loss		10		dB
Detector Output at P1dB Comp		4		V
Detector P_{OUT} Threshold[7]		6		dBm
2nd Harmonic Output at P1dB		-40		dBc
3rd Harmonic Output at P1dB		-40		dBc
Logic				
Shutdown Control (V_L):				
Device Off, Logic High Input	2.0	2.4		V
Device On, Logic Low Input		0.0	0.8	V
Logic Current		150		µA
Turn-on Time[4]		<1		µS
Turn-off Time		<1		µS
Spurious (Stability)[5]		-65		dBc

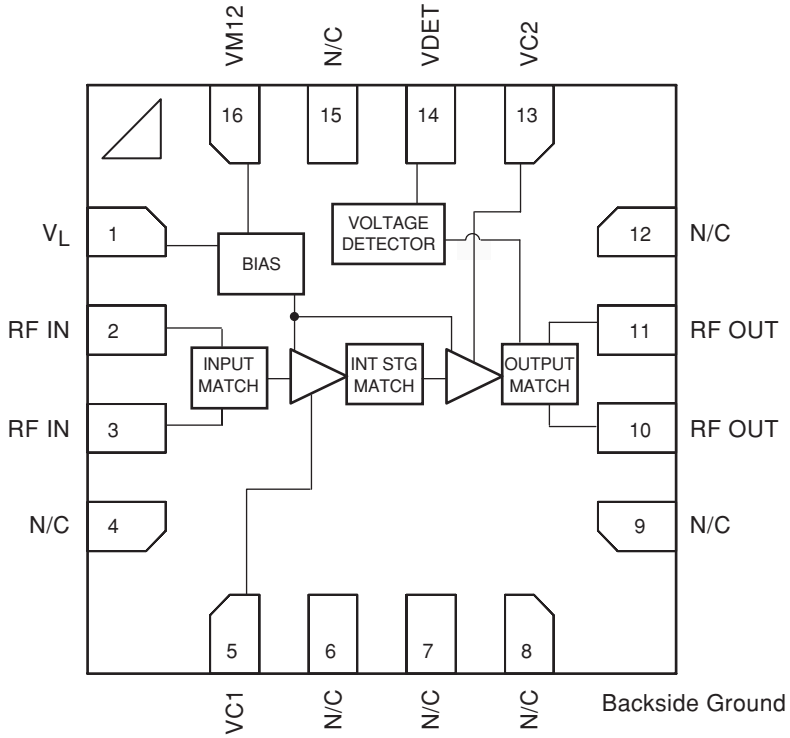
Absolute Ratings[6]

Symbol	Parameter	Ratings	Units
VC1, VC2	Positive Supply Voltage	6	V
IC1, IC2	Supply Current IC1 IC2	 120 700	 mA mA
VM12	Positive Bias Voltage	4.0	V
V_L	Logic Voltage	5	V
P_{IN}	RF Input Power	10	dBm
T_{CASE}	Case Operating Temperature	-40 to +85	°C
T_{STG}	Storage Temperature	-55 to +150	°C

Notes:

1. VC1,VC2 = 5.0V, VM12 = 3.3V, T_C = 25°C, 50Ω system.
2. Mirror bias current is included in the total quiescent current.
3. VL is set to Input Logic Level High for PA Off operation.
4. Measured from Device On signal turn on (Logic Low) to the point where RF P_{OUT} stabilizes to 0.5dB.
5. Load VSWR is set to 8:1 and the angle is varied 360 degrees. P_{OUT} = -30dBm to P1dB.
6. No permanent damage with only one parameter set at extreme limit. Other parameters set to typical values
7. P_{OUT} measured at P_{IN} corresponding to power detection threshold.

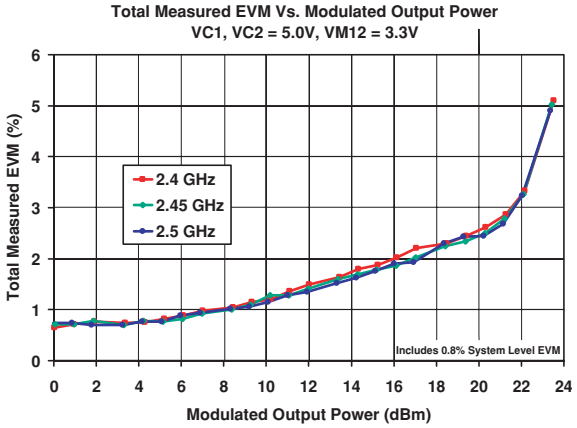
Functional Block Diagram

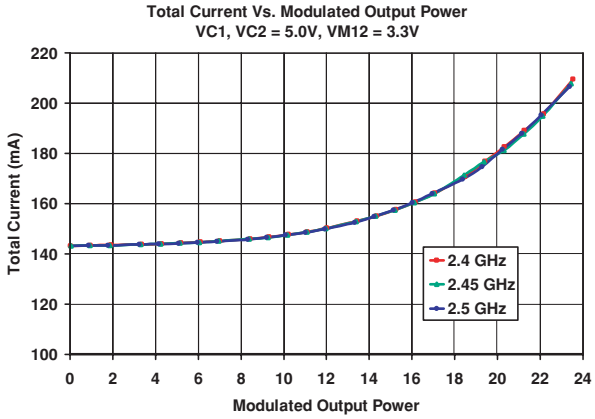


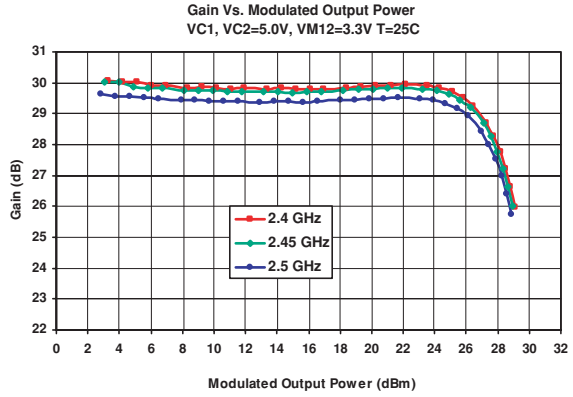
Pin	Description
1	V_L (logic)
2	RF IN
3	RF IN
4	N/C
5	VC1
6	N/C
7	N/C
8	N/C
9	N/C
10	RF OUT
11	RF OUT
12	N/C
13	VC2
14	VDET
15	N/C
16	VM12

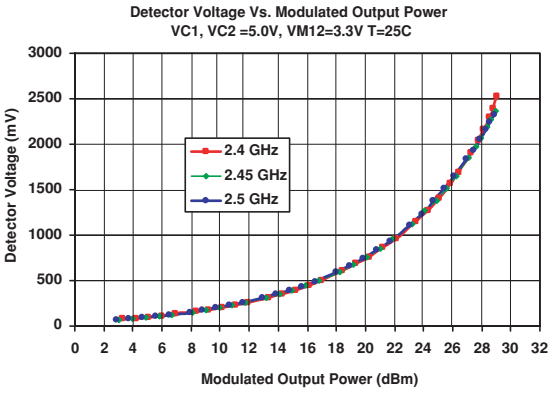
Performance Data 802.11g OFDM

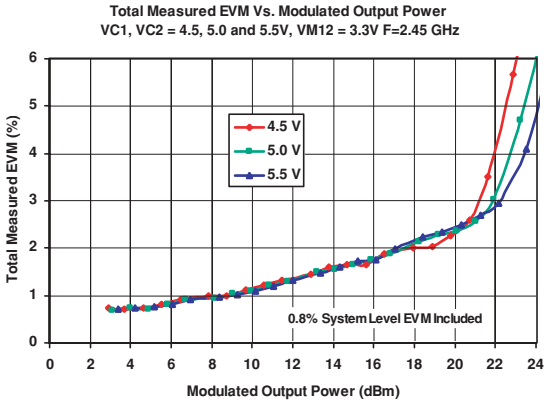
Modulation (with 176 ms burst time, 100 ms idle time) 54 Mbps Data Rate, 16.7 MHz Bandwidth

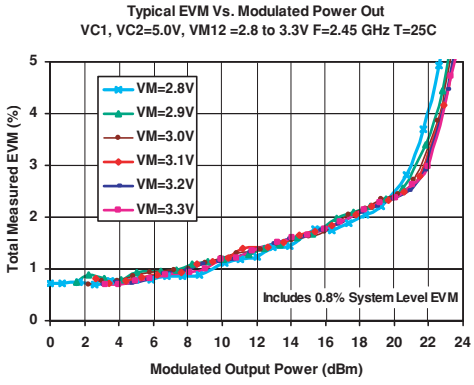












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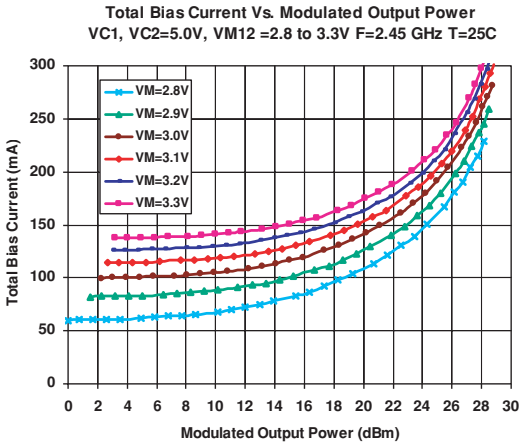
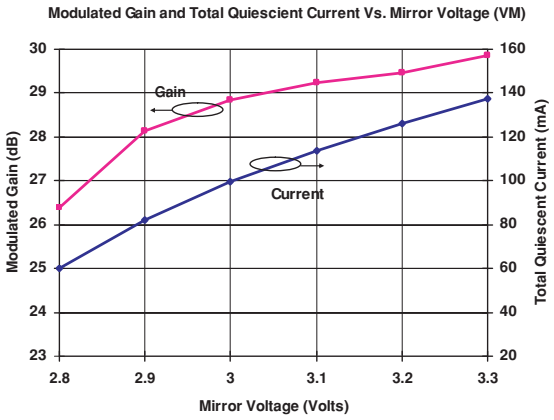
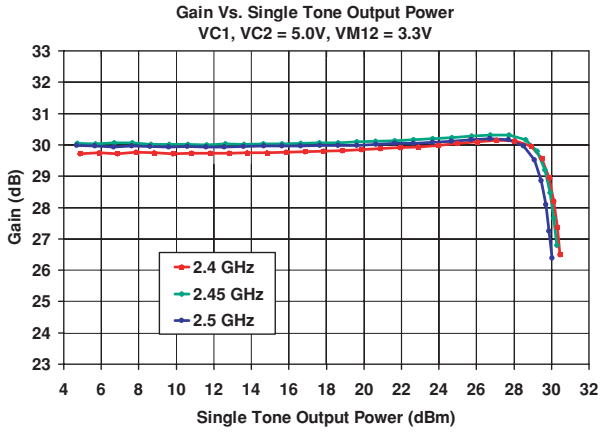
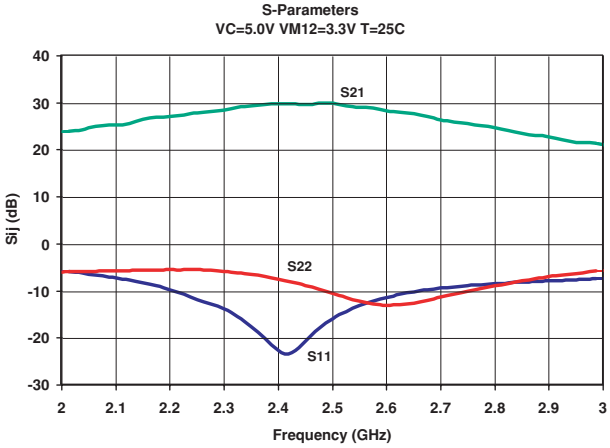


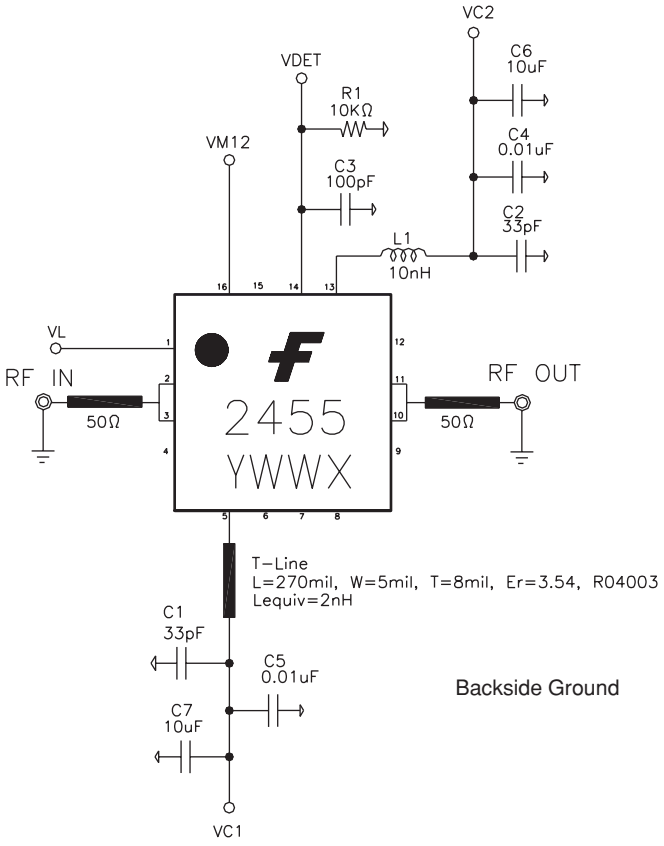


Single Tone

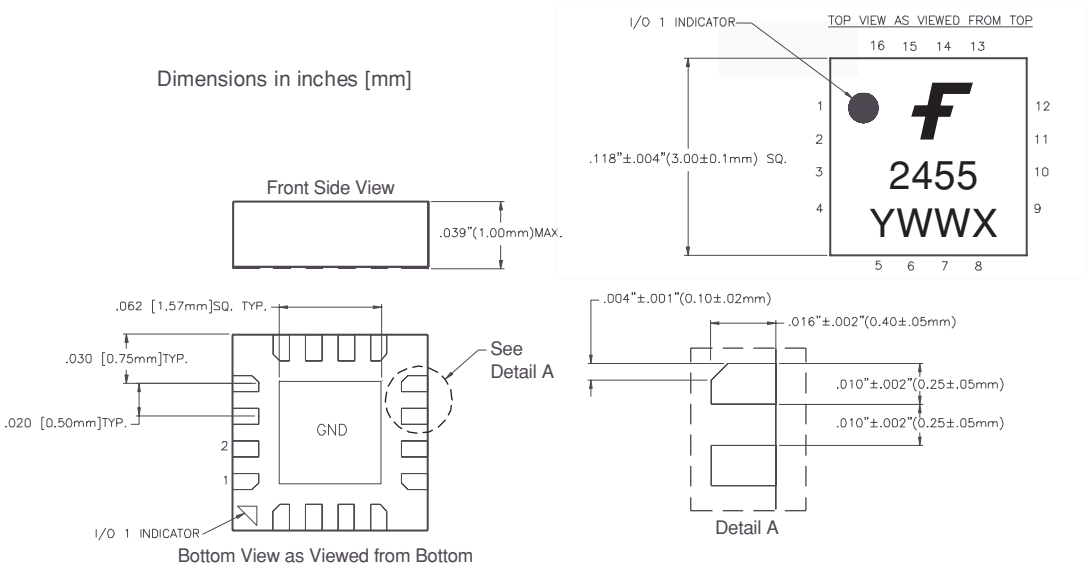




Evaluation Board Schematic



Package Outline



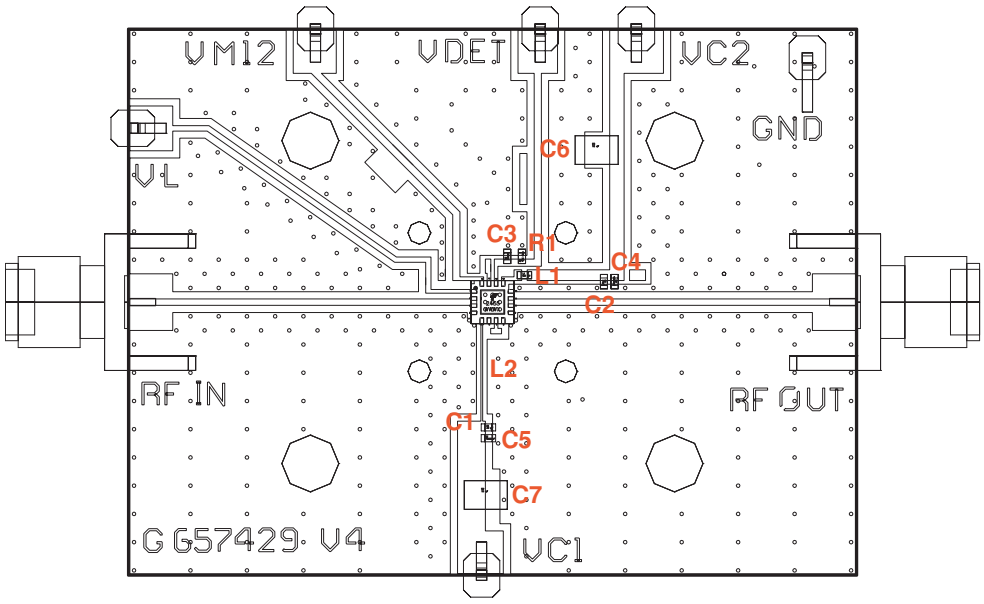
Note: Dimensions do not include protrusions or mold flash. These are not to exceed 0.006" (.155mm) on any side.

Evaluation Board of Materials

MATERIALS LIST

QTY	ITEM NO.	PART NUMBER	DESCRIPTION	VENDOR
1	1	G657429	PC, BOARD	FAIRCHILD
2	2	#142-0701-841	SMA CONNECTOR	JOHNSON
6	3	#S1322-XX-ND	RT ANGLE SGL M HEADER	DIGIKEY
REF	4	F100046	ASSEMBLY, RMPA2455	FAIRCHILD
2	5 (C1&C2)	GRM39C0G330J50V	33 pF CAPACITOR	MURATA
1	6 (C3)	GRM36C0G101J50V	100 pF CAPACITOR	MURATA
2	7 (C4&C5)	GRM39X7R103K50V	.01 uF CAPACITOR	MURATA
2	8 (C6&C7)	CC1206JX5R106M	10 uF CAPACITOR (6.3V)	TDK
1	9 (L1)	LLV1005FB10NJ	10 nH INDUCTOR	TOKO
1	10 (R1)	RCI-0402-1002J	10K OHM RESISTER	IMS
A/R	11	SN63	SOLDER PASTE	INDIUM CORP
A/R	12	SN96	SOLDER PASTE	INDIUM CORP

Evaluation Board Layout



Actual Board Size = 2.0" X 1.5"

Evaluation Board Turn-On Sequence[1]

Recommended turn-on sequence:

1) Connect common ground terminal to the Ground (GND) pin on the board.

2) Apply low voltage 0.0 to +1.0 V to pin V_L.

3) Apply positive supply voltage VC1 (= 5.0V) to pin VC1 (first stage collector).

4) Apply positive supply voltage VC2 (= 5.0V) to pin VC2 (second stage collector).

5) Apply positive bias voltage VM12 (= 3.3V) to pin VM12 (bias networks).

6) At this point, you should expect to observe the following positive currents flowing into the pins:

Pin	Current
VM12	15.0 – 20.0 mA
VC1	45.0 – 65.0 mA
VC2	60.0 – 80.0 mA
V_L	<1 nA

7) Apply input RF power to SMA connector pin RFIN. Currents in pins VC1 and VC2 will vary depending on the input drive level.

8) Vary positive voltage V_L on pin VREG from +0.5V to +2.4V to shut down the amplifier or alter the power level. Shut down current flow into the pins:

Pin	Current
VM12	<0.7 mA
VC1	<1 nA
VC2	<1 nA
V_L	<0.25 mA

Recommended turn-off sequence:

Use reverse order described in the turn-on sequence above.

Note:

1. Turn on sequence is not critical and it is not necessary to sequence power supplies in actual system level design.

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CROSSVOLT™	GlobalOptoisolator™	MicroFET™	PowerTrench®	SuperSOT™-6
DOME™	GTO™	MicroPak™	QFET®	SuperSOT™-8
EcoSPARK™	HiSeC™	MICROWIRE™	QS™	SyncFET™
E²CMOS™	I²C™	MSX™	QT Optoelectronics™	TinyLogic®
EnSigna™	*i-Lo*™	MSXPro™	Quiet Series™	TINYOPTO™
FACT™	ImpliedDisconnect™	OCX™	RapidConfigure™	TruTranslation™
FACT Quiet Series™		OCXPro™	RapidConnect™	UHC™
Across the board. Around the world.™		OPTOLOGIC®	μSerDes™	UltraFET®
The Power Franchise®		OPTOPLANAR™	SILENT SWITCHER®	UniFET™
Programmable Active Droop™		PACMAN™	SMART START™	VCX™

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only.

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