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RF5616

3.0V TO 5.0V, 5GHz LINEAR POWER AMPLIFIER

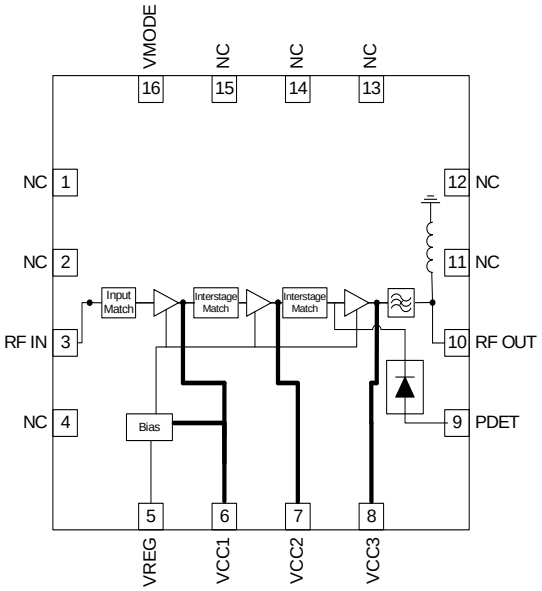
Package Style: QFN, 16-Pin, 3mmx3mmx0.45mm

Features

- Single Supply Voltage 3.0V to 5.0V
- Two Mode Operation
- 29dB Typical Gain Across Band
- P_{OUT}:18dBm at 3.3V Typ. P_{OUT}: 21dBm at 5V Typ.
- Integrated Second and Third Harmonic Filter

Applications

- IEEE802.11a/n and IEEE802.16e Applications
- HyperLAN
- WiFi Systems
- Commercial and Consumer Systems
- Portable Battery-Powered Equipment
- Spread-Spectrum and MMDS Systems



Functional Block Diagram

Product Description

The RF5616 is a linear, medium-power, high-efficiency power amplifier IC designed specifically for battery-powered WiFi applications such as PC cards, mini PCI, and compact flash applications. It is also designed to meet IEEE802.11a, IEEE802.11n, IEEE802.16e (4.9GHz to 5.850GHz only) WiMax, FCC, and ETSI requirements for operation in the 4.9GHz to 5.850GHz band. The device is manufactured on an advanced InGaP GaAs Heterojunction Bipolar Transistor process, and has been designed for use as the final RF amplifier in 5GHz WiFi and other spread-spectrum transmitters. The device is provided in a QFN, 16-pin, 3mmx3mmx0.45mm, leadless chip carrier with backside ground. The RF5616 operates from a single supply and will be easily incorporated into WiFi and other designs with minimal external components.

Ordering Information

RF5616SQ	Standard 25 piece bag
RF5616SR	Standard 100 piece reel
RF5616TR7	Standard 2500 piece reel
RF5616PCK-410	Fully Assembled Evaluation Board with 5-piece Loose Sample Bag

Optimum Technology Matching® Applied

☐ GaAs HBT	☐ SiGe BiCMOS	☐ GaAs pHEMT	☐ GaN HEMT
☐ GaAs MESFET	☐ Si BiCMOS	☐ Si CMOS	☐ BiFET HBT
☑ InGaP HBT	☐ SiGe HBT	☐ Si BJT	☐ LDMOS

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Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage, RF applied	-0.5 to +5.25	V_{DC}
Supply Voltage, no RF applied	-0.5 to +6.0	V_{DC}
Power Control Voltage (V_{REG})	-0.5 to 3.5	V
DC Supply Current	400	mA
Input RF Power (50Ω load)	+5	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C
Moisture sensitivity	JEDEC Level 1	

Caution! ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

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RFMD Green: RoHS compliant per EU Directive 2011/65/EU, halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

Nominal Operating Parameters

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Compliance					T=+25°C; V_{CC}=3.3V and 5.0V; V_{REG}=2.85V; pulsed at 1% to 100% duty cycle; Freq=4.9GHz to 5.85GHz; unless otherwise noted. IEEE802.11a; IEEE802.11n; IEEE802.16e (4.9GHz to 5.85GHz)
Frequency Range	4.9		5.85	MHz	Lower, middle, upper U-NII
Output Power (Mode1)	17	18		dBm	V_{CC}=3.3V, V_{MODE}=Low, using a standard IEEE802.11a waveform, 54 Mbps, 64QAM
EVM		3	4	%	RMS, mean at rated P_{OUT}, V_{CC}=3.3V, V_{REG}=2.85V and temperature= -40°C to +85°C
Output Power (Mode1)	19	20		dBm	V_{CC}=5.0V, V_{MODE}=Low, using a standard IEEE802.11a waveform, 54Mbps, 64QAM, 4.9GHz to 5.15 GHz
EVM		3	4	%	RMS, mean at rated P_{OUT}, V_{CC}=5.0V, V_{REG}=2.85V and temperature= -40°C to +85°C, 4.9GHz to 5.15 GHz
Output Power (Mode1)	20	21		dBm	V_{CC}=5.0V, V_{MODE}=Low, using a standard IEEE802.11a waveform, 54Mbps, 64QAM, 5.15GHz to 5.85 GHz
EVM		3	4	%	RMS, mean at rated P_{OUT}, V_{CC}=5.0V, V_{REG}=2.85V and temperature= -40°C to +85°C, 5.15GHz to 5.85 GHz
Large Signal Gain					At rated P_{OUT}
	25	29		dB	4.9GHz to 5.15GHz
	27	30		dB	5.15GHz to 5.85GHz
Gain Variation			2.5	±dB	4.9GHz to 5.85GHz, -40°C to +85°C
Power Detector					
P_{OUT} at 8dBm	0.3	0.4	0.5	V	Over full frequency range, -40°C to +85°C, V_{CC}=ON, and over full V_{REG} range
P_{OUT} at 21dBm	0.85	1.0	1.2	V	Over full frequency range, -40°C to +85°C, V_{CC}=ON, and over full V_{REG} range
Input Return Loss		-15	-7.0	dB	4.9GHz to 5.1GHz
		-15	-9.0	dB	5.1GHz to 5.85GHz
Turn On/OFF		0.5	1.0	µS	Output stable to within 90% of the final gain
Output VSWR			4:1		Stable and no spurs above -47dBm/MHz

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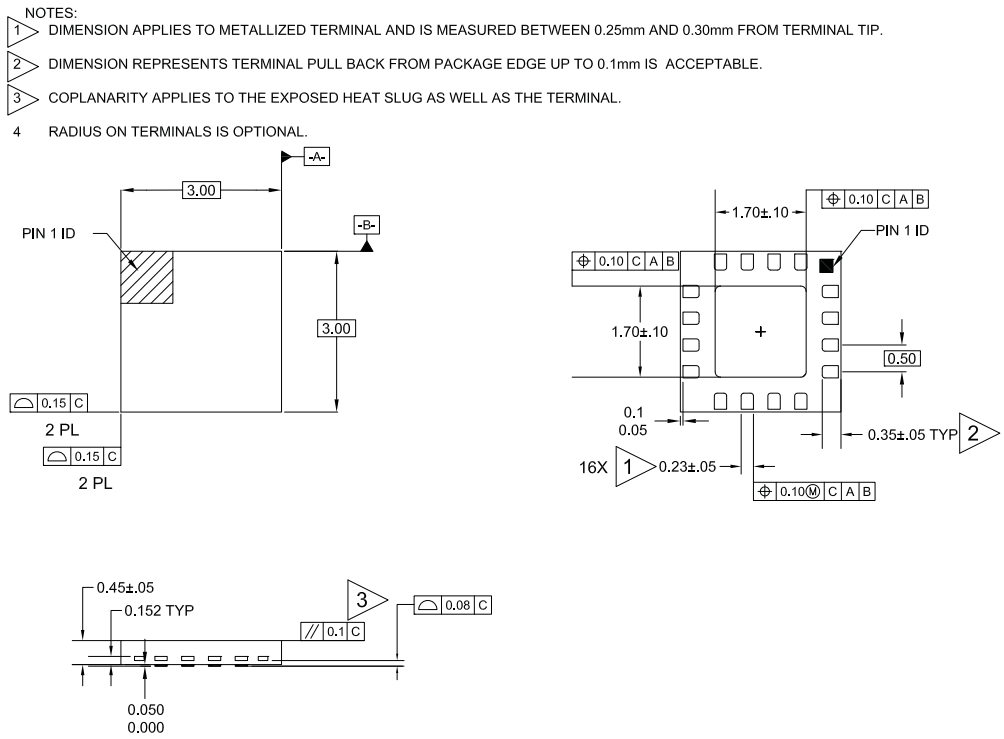
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Second Harmonic		-30	-27	dBm/MHz	CF=4.9GHz to 5.299GHz, at rated power, V_{CC}=On, over V_{REG} range, and over -40°C to +85°C. measured in a 1MHz RBW with 6Mbps 11a signal.
		-50	-45	dBm/MHz	CF=5.3GHz to 5.85GHz, at rated power, V_{CC}=On, over V_{REG} range, and over -40°C to +85°C. Measured in a 1MHz RBW with 6Mbps 11a signal.
Third Harmonic		-38	-27	dBm/MHz	CF=4.9GHz to 5.15GHz and 5.32GHz to 5.85GHz, at rated power, V_{CC}=On, over full V_{REG} range and over -40°C to +85°C. Measured in a 1MHz RBW with 6Mbps 11a signal.
		-40	-38	dBm/MHz	CF=5.15GHz to 5.32GHz at rated power, V_{CC}=on, over full V_{REG} range and over -40°C to +85°C. Measured in a 1MHz RBW with 6Mbps 11a signal.
Operating Current		250	310	mA	V_{CC}=5.0V, V_{MODE}=Low, P_{OUT}=21dBm, over full V_{REG} and temperature=-40°C to +85°C
Quiescent Current		165	180	mA	V_{CC}=5.0V, V_{MODE}=Low, RF=OFF, over full V_{REG} and temperature= -40°C to +85°C
Operating Current		200	240	mA	V_{CC}=3.3V, V_{MODE}=Low, P_{OUT}=18dBm, over full V_{REG} and temperature= -40°C to +85°C
Quiescent Current		140	160	mA	V_{CC}=3.3V, V_{MODE}=Low, RF=OFF, over full V_{REG} and temperature= -40°C to +85°C
I_{REG}		10	15	mA	V_{CC}=ON, over full V_{REG} range and temperature -40°C to +85°C
Leakage (Shutdown) Current		0.5	2.5	µA	V_{CC}=ON, over full V_{REG} range and temperature -40°C to +85°C
Output Power (Mode 2)	8	9		dBm	V_{CC}=ON, V_{MODE}=High, using a standard IEEE802.11a waveform, 54Mbps, 64QAM
EVM		3	4	%	RMS, mean, 54Mbps at rated power (Mode 2), V_{CC}=ON, V_{REG}=2.85V, V_{MODE}=High, temperature= -40°C to +85°C
Gain	24	26		dB	4.9GHz to 5.15GHz
	25	27		dB	5.15GHz to 5.85GHz
Gain Variation			2.5	±dB	4.9GHz to 5.85GHz, -40°C to +85°C
Operating Current		120	150	mA	V_{CC}=ON, V_{MODE}=High, at rated power, temperature= -40°C to +85°C
Quiescent Current		100	120	mA	V_{CC}=ON, V_{MODE}=High, RF=OFF, temperature= -40°C to +85°C
I_{REG}		12	17	mA	V_{CC}=ON, V_{MODE}=High, over full V_{REG} range, at rated power and temperature= -40°C to +85°C
Voltage Supply (V_{CC})	3.0	3.3	5.0	V	
V_{REG} supply	2.75	2.85	2.95	V	
V_{MODE}	2.75	3.3	5.0	V	
V_{MODE} Current		100	500	µA	

Pin Names and Descriptions

Pin	Name	Description
1, 2, 4, 11, 12, 13, 14, 15	N/C	Not internally connected.
3	RFIN	RF Input Pin, Internally matched to 50Ω and DC blocked.
5	VREG	First, second, and third stage bias voltage combined on the die to one external voltage. This Pin requires regulated supply for best performance.
6, 7, 8	VCC	Supply voltage for the PA. Internally decoupled with approximately 100pF.
9	PDETECT	Power detector voltage is proportional to RF output power. May need external decoupling capacitor for module stability. May need external circuitry to bring output voltage to desired level.
10	RF OUT	RF output pin. This pin is matched to 50Ω internally. This pin has a DC blocking cap from the collector side of the final stage but it is an RF short at the RF OUT Pins 10 and 12 therefore an external DC blocking capacitor is needed if DC voltage is presented to the RF OUT pins. See funtional block diagram on the first page for more details.
16	VMODE	This pin will allow the power amplifier to switch between two modes. The first mode is the mode 1, in which this pin needs to be logic low or floating. The second mode is mode 2 which allows the power amplifier to be in a low current and this pin needs to be logic high.
Pkg Base	GND	Ground connection.

Package Drawing

QFN, 16-Pin, 3x3x0.45mm



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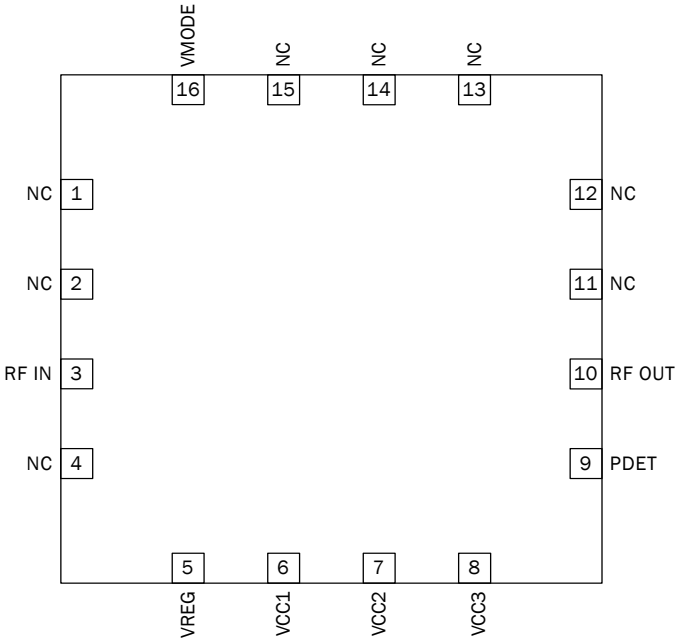
Pin Out


VMODE
NC
NC
NC
16
15
14
13
NC 1
NC 2
RF IN 3
NC 4
12 NC
11 NC
10 RF OUT
9 PDET
5
6
7
8
VREG
VCC1
VCC2
VCC3

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PCB Design Requirements

PCB Surface Finish

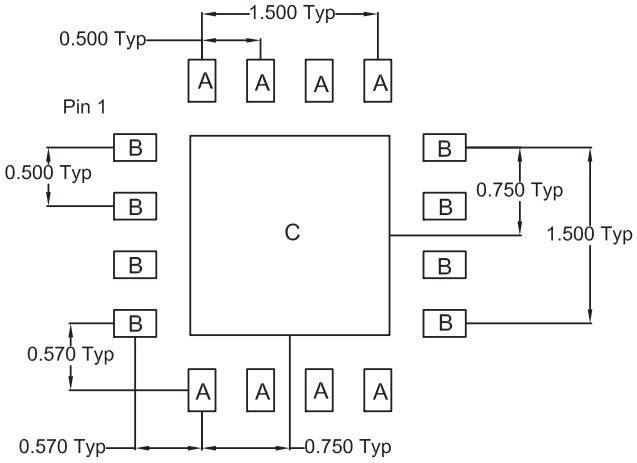
The PCB surface finish used for RFMD's qualification process is electroless nickel, immersion gold. Typical thickness is 3 micro-inch to 8 micro-inch gold over 180 micro-inch nickel.

PCB Land Pattern Recommendation *

PCB land patterns for RFMD components are based on IPC-7351 standards and RFMD empirical data. The pad pattern shown has been developed and tested for optimized assembly at RFMD. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.

PCB Metal Land Pattern

A = 0.230 x 0.360 (mm) Typ
B = 0.360 x 0.230 (mm) Typ
C = 1.700 (mm) Sq



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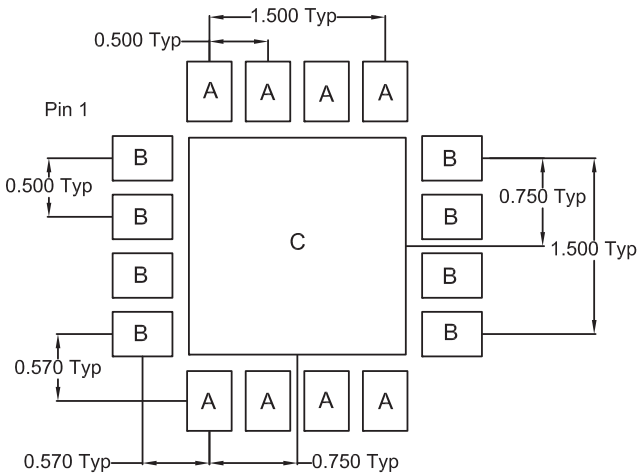
PCB Solder Mask Pattern

Liquid Photo-Imageable (LPI) solder mask is recommended. The solder mask footprint will match what is shown for the PCB metal land pattern with a 2 mil to 3 mil expansion to accommodate solder mask registration clearance around all pads. The center-grounding pad shall also have a solder mask clearance. Expansion of the pads to create solder mask clearance can be provided in the master data or requested from the PCB fabrication supplier.

A = 0.38 x 0.51 (mm) Typ
B = 0.51 x 0.38 (mm) Typ
C = 1.85 (mm) Sq



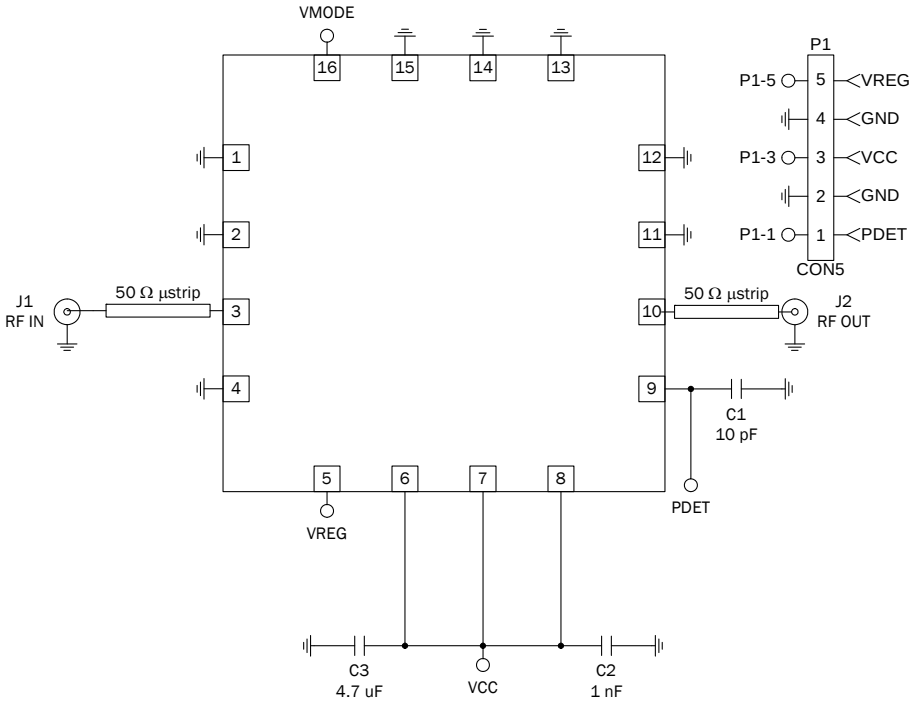
Thermal Pad and Via Design

The PCB land pattern has been designed with a thermal pad that matches the die paddle size on the bottom of the device.

Thermal vias are required in the PCB layout to effectively conduct heat away from the package. The via pattern has been designed to address thermal, power dissipation and electrical requirements of the device as well as accommodating routing strategies.

The via pattern used for the RFMD qualification is based on thru-hole vias with 0.203mm to 0.330mm finished hole size on a 0.5mm to 1.2mm grid pattern with 0.025mm plating on via walls. If micro vias are used in a design, it is suggested that the quantity of vias be increased by a 4:1 ratio to achieve similar results.

Evaluation Board Schematic
RF5616PCBA Evaluation Board (4.9GHz to 5.85GHz)



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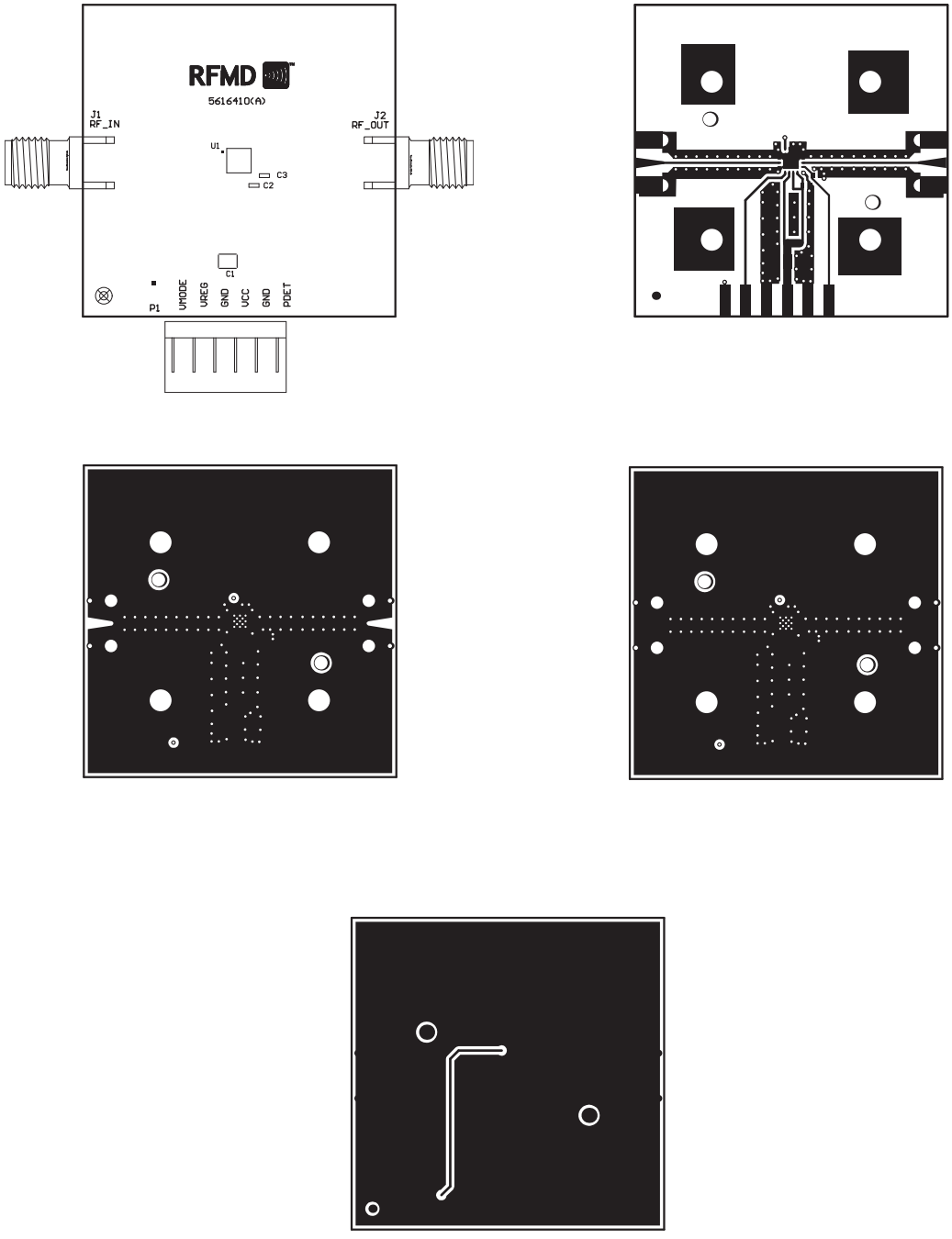
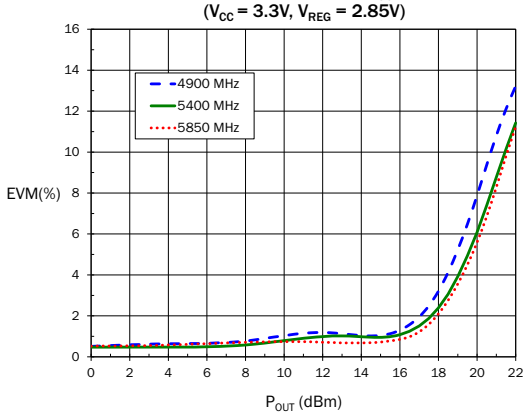
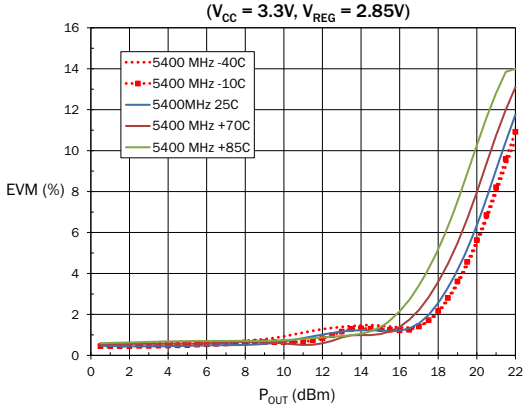
Evaluation Board Layout



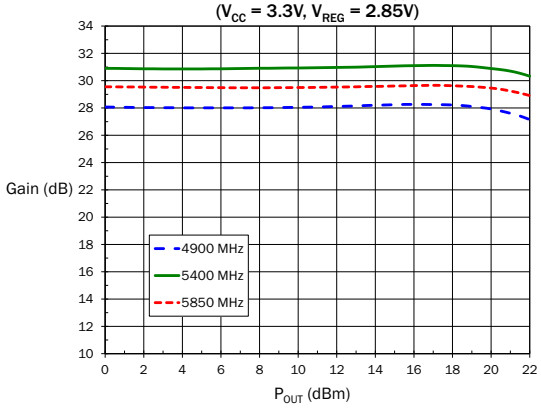
Typical EVM versus P_{OUT}
(V_{CC} = 3.3V, V_{REG} = 2.85V)



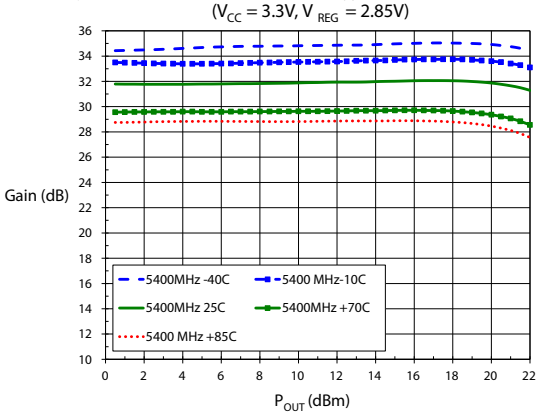
Typical EVM versus P_{OUT} over Temperature -40 TO +85C
(V_{CC} = 3.3V, V_{REG} = 2.85V)



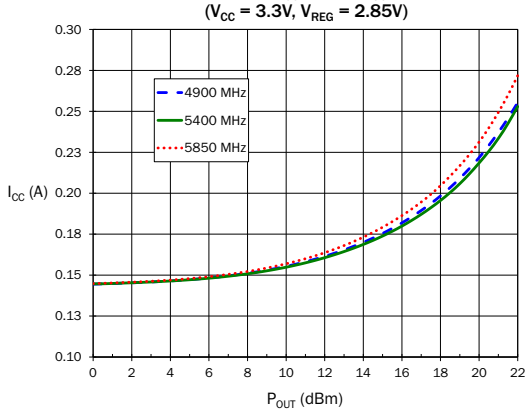
Typical Gain versus P_{OUT}
(V_{CC} = 3.3V, V_{REG} = 2.85V)



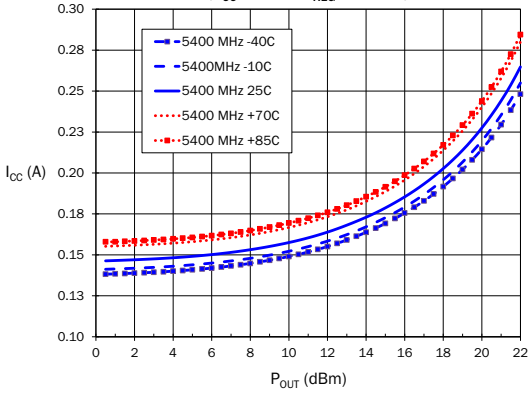
Typical Gain @ 5400MHz versus P_{OUT} over Temp(-40 to +85C)
(V_{CC} = 3.3V, V_{REG} = 2.85V)



Typical I_{CC} versus P_{OUT}
(V_{CC} = 3.3V, V_{REG} = 2.85V)



Typical I_{CC} versus P_{OUT} over Temp (-40 to +85C)
(V_{CC} = 3.3V, V_{REG} = 2.85V)



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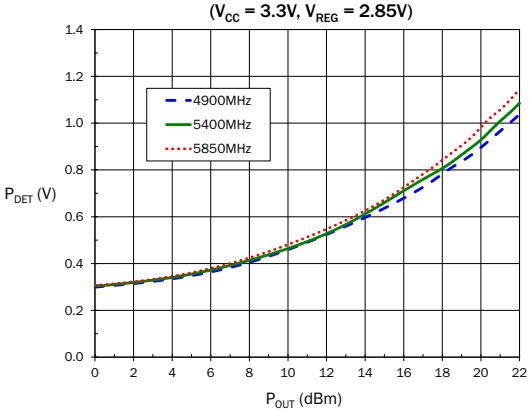
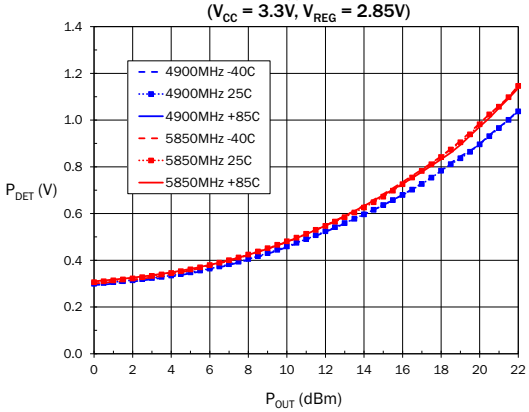
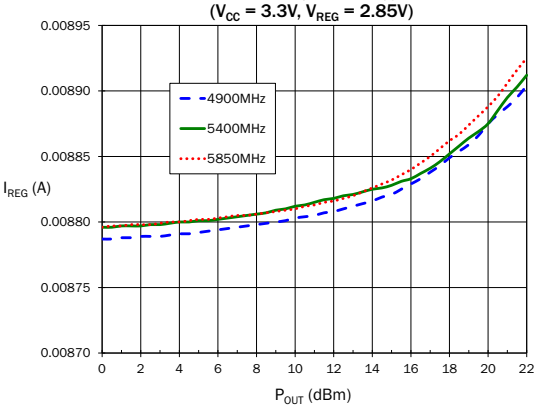
Typical P_{DET} versus P_{OUT}
(V_{CC} = 3.3V, V_{REG} = 2.85V)



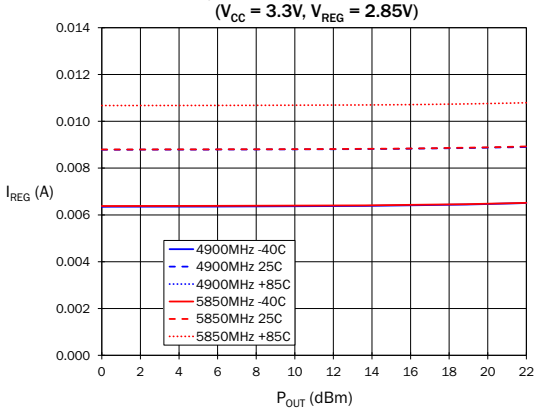
Typical P_{DET} versus P_{OUT} over Temp(-40 to +85C
(V_{CC} = 3.3V, V_{REG} = 2.85V)



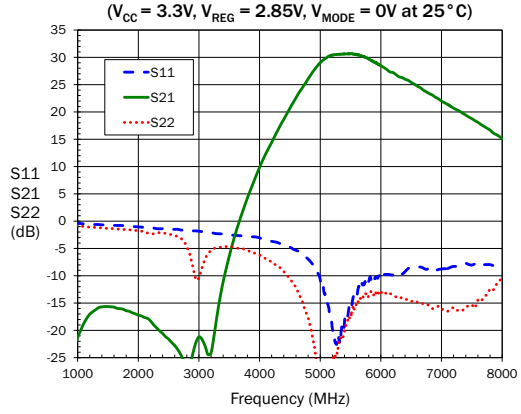
Typical I_{REG} versus P_{OUT}
(V_{CC} = 3.3V, V_{REG} = 2.85V)



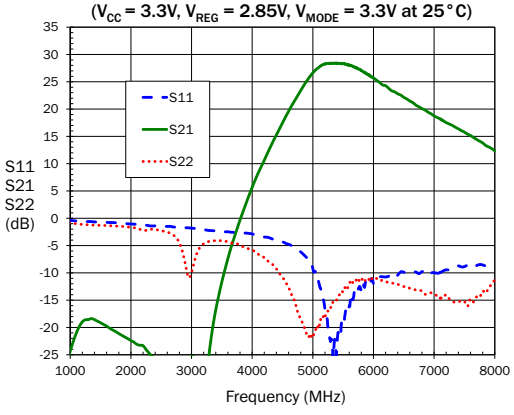
Typical I_{REG} versus P_{OUT} over Temp (-40 to +85C)
(V_{CC} = 3.3V, V_{REG} = 2.85V)



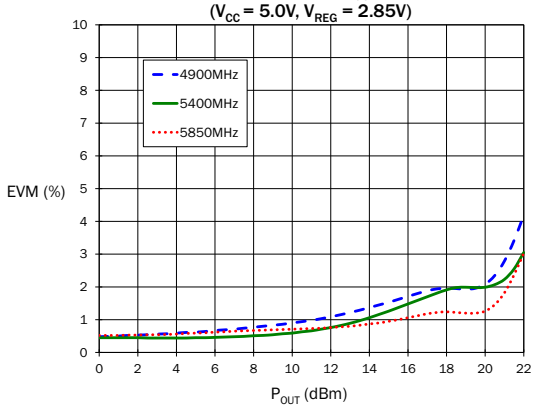
Typical S11, S21, and S22
(V_{CC} = 3.3V, V_{REG} = 2.85V, V_{MODE} = 0V at 25°C)



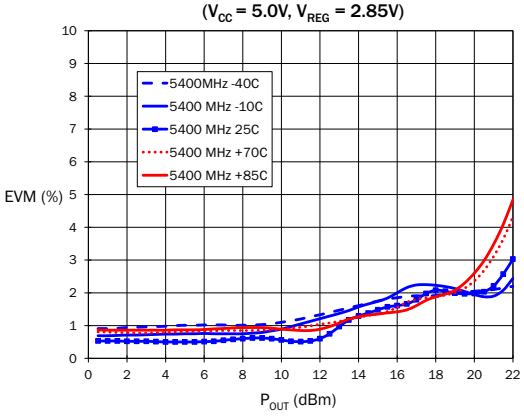
Typical S11, S21, and S22
(V_{CC} = 3.3V, V_{REG} = 2.85V, V_{MODE} = 3.3V at 25°C)



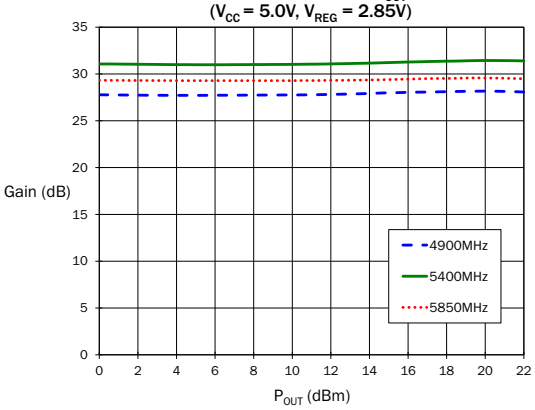
EVM versus P_{OUT}
(V_{CC} = 5.0V, V_{REG} = 2.85V)



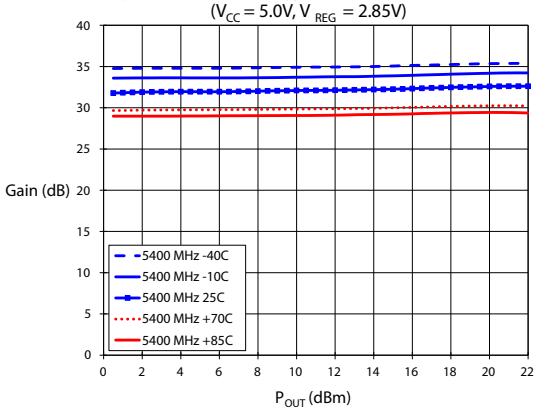
Typical EVM versus P_{OUT} over Temp (-40 to +85C)
(V_{CC} = 5.0V, V_{REG} = 2.85V)



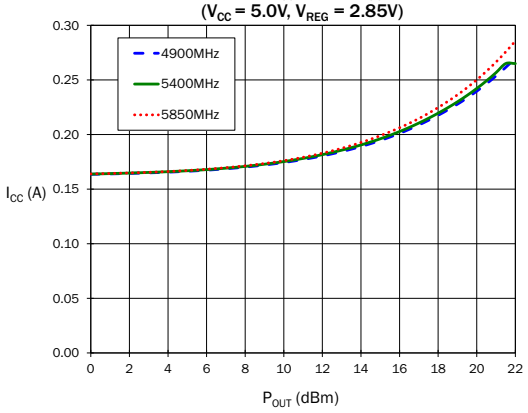
Typical Gain versus P_{OUT}
(V_{CC} = 5.0V, V_{REG} = 2.85V)



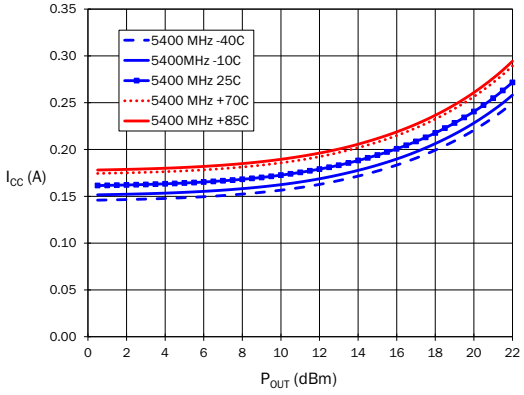
Typical Gain versus P_{OUT} over Temp (-40 to +85C)
(V_{CC} = 5.0V, V_{REG} = 2.85V)



Typical I_{CC} versus P_{OUT}
(V_{CC} = 5.0V, V_{REG} = 2.85V)



Typical I_{CC} versus P_{OUT} over Temp (-40 to +85C)
(V_{CC} = 5.0V, V_{REG} = 2.85V)



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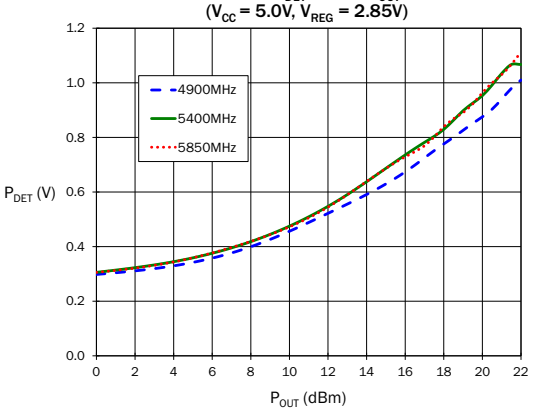
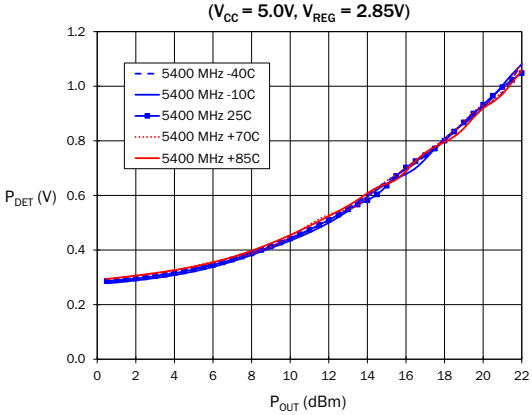
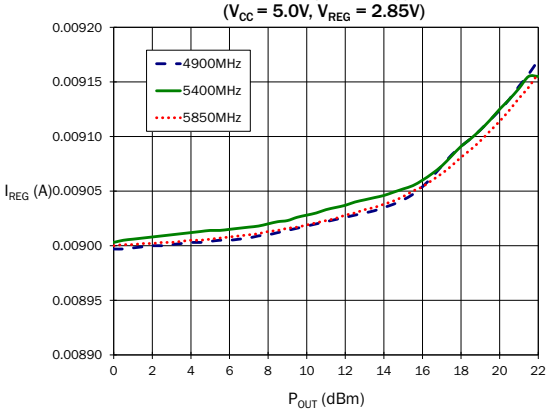
Typical P_{DET} versus P_{OUT}
(V_{CC} = 5.0V, V_{REG} = 2.85V)



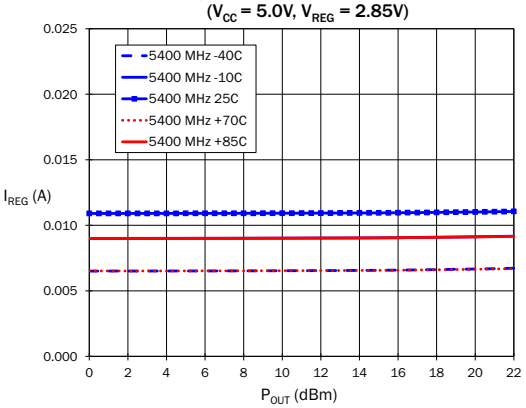
Typical P_{DET} versus P_{OUT} over Temp (-40 to +85C)
(V_{CC} = 5.0V, V_{REG} = 2.85V)



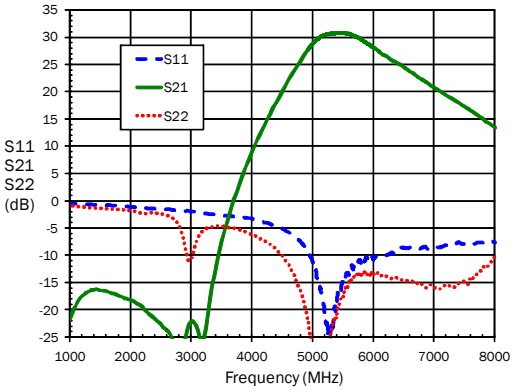
Typical I_{REG} versus P_{OUT}
(V_{CC} = 5.0V, V_{REG} = 2.85V)



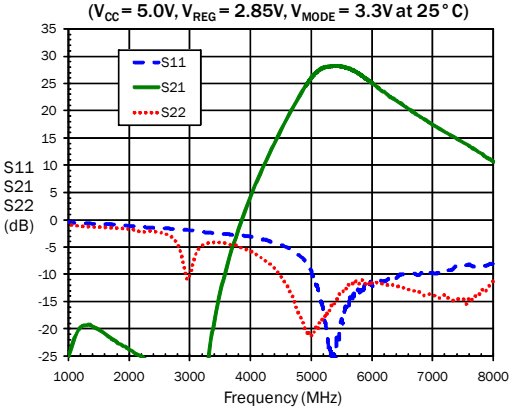
Typical I_{REG} versus P_{OUT} over Temp (-40 to +85C)
(V_{CC} = 5.0V, V_{REG} = 2.85V)



Typical S11, S21, and S22
(V_{CC} = 5.0V, V_{REG} = 2.85V, V_{MODE} = 0V at 25°C)



Typical S11, S21, and S22
(V_{CC} = 5.0V, V_{REG} = 2.85V, V_{MODE} = 3.3V at 25°C)



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Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
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- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
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- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
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- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
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