

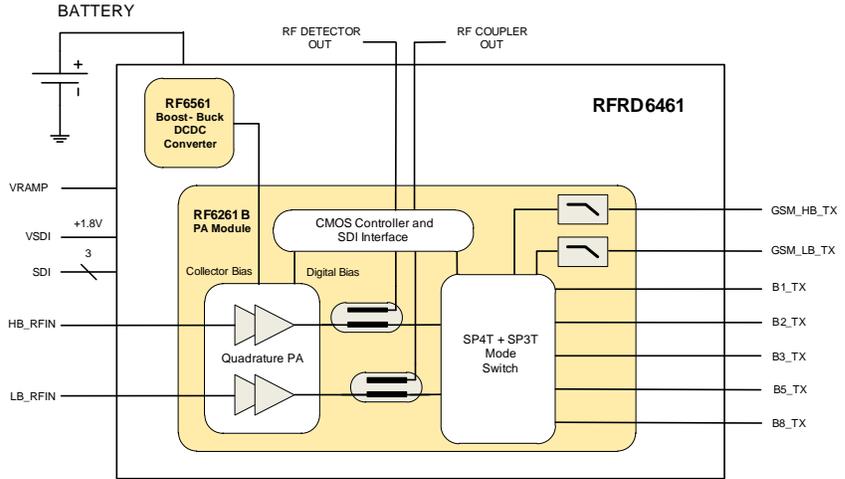
PCB Footprint: 7.6mm x 15.3mm x 1.02mm

Features

- 2 Component Placement Power Platform
 - RF6261B Power Amplifier: 6.0mm x 8.0mm
 - RF6561 PA Power Management: 1.72mm x 2.53mm
- Multimode Capability
 - GSM/EDGE/EGPRS/EDGE-Evo
 - WCDMA/HSPA+
- Multi-band Coverage
 - Quad-band EDGE (QBE) (850/900/1800/1900)
 - ≤ Penta-band 3G/4G (UMTS Bands 1-6, 8-10)
- WiFi, Bluetooth, GPS Coexistence
- Quadrature PA Technology for Superior VSWR Tolerance and TRP Compliance
- 3-Wire SDI Programmable Control Interface
 - Optimized Transmit Efficiency for All Power Levels and Modes
 - Digitally Controlled PA Bias Settings
- Feedback for Power Control, Battery Current (I_{BATT}) Optimization
 - Common Integrated Directional Coupler Output
 - Common RF Detector Output
- Small PCB Footprint: Replaces Up To Five 3G PAs + QBE PA

Applications

- 2G/3G/4G Multimode, Multi-band Smartphones, and Mobile Internet Devices
- 3G/4G Connected Devices



Functional Block Diagram

Product Description

RFMD's RFRD6461 3G multi-band, multimode PowerSmart™ power platform is targeted at smartphones and mobile internet devices (MIDs) by providing extensive flexibility and customization, "user experience" focused performance with real-time battery life optimization, and a dramatically smaller front end solution size-all while accelerating an original equipment manufacturer's (OEM's) time to market.

At the heart of the RFRD6461 is the industry's first RF configurable power platform, designed to seamlessly merge RFMD's leading, industry-proven VSWR-tolerant, quadrature power amplifier technology with RFMD's patented power management technology in a new category of cellular sub-system. Although comprised of two separate component placements, the RF6261B (or one of its tri-band or dual-band derivatives - see RF6261B data sheet for these variants) and the RF6561, these components were developed to operate seamlessly as an agile and highly RF configurable power platform. The RF configurable power platform enables up to 5 bands of WCDMA/HSPA+ operation, and provides performance and battery life customization without hardware changes as well as the ability to maximize efficiency across power levels, data rates, and during non-ideal load conditions (VSWR).

Ordering Information

RFRD6461 Fully Assembled Evaluation Board (only 6261B version available for evaluation)

Optimum Technology Matching® Applied

- | | | | |
|--|--------------------------------------|---|------------------------------------|
| <input checked="" type="checkbox"/> GaAs HBT | <input type="checkbox"/> SiGe BiCMOS | <input type="checkbox"/> GaAs pHEMT | <input type="checkbox"/> GaN HEMT |
| <input type="checkbox"/> GaAs MESFET | <input type="checkbox"/> Si BiCMOS | <input checked="" type="checkbox"/> Si CMOS | <input type="checkbox"/> BiFET HBT |
| <input type="checkbox"/> InGaP HBT | <input type="checkbox"/> SiGe HBT | <input type="checkbox"/> Si BJT | |

RF MICRO DEVICES®, RFMD®, Optimum Technology Matching®, Enabling Wireless Connectivity™, PowerStar®, POLARIS™ TOTAL RADIO™ and UltimateBlue™ are trademarks of RFMD, LLC. BLUETOOTH is a trademark owned by Bluetooth SIG, Inc., U.S.A. and licensed for use by RFMD. All other trade names, trademarks and registered trademarks are the property of their respective owners. ©2012, RF Micro Devices, Inc.

Absolute Maximum Ratings

Parameter	Rating	Unit
V _{BATT} - Battery Voltage	-0.3 to 6	V
V _{SDI} - SDI Supply Voltage	-0.3 to 3	V
V _{RAMP} - Ramp Control Voltage	-0.3 to 2.5	V
V _{CC} - PA Collector Voltage	-0.3 to 5.3	V
P _{IN} - RF Input Power	16	dBm
PA Duty Cycle (EGPRS / UMTS)	75/100	%
Storage Temperature (Ambient)	-55 to 125	°C
Output Load VSWR	10:1	
Electrostatic Discharge (ESD)HBM - RF Outputs	Class 2	
Electrostatic Discharge (ESD) HBM - RF Inputs	Class 2	
Electrostatic Discharge (ESD) HBM - All Others	Class 2	



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.

The information in this publication is believed to be accurate and reliable. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents, or other rights of third parties, resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
General Operating and Performance Conditions					
V _{BATT} - Battery Voltage	2.9	3.6	5.1	V	
I _{BATT(OFF)} - Leakage Current			25	μA	All circuits disabled
V _{SDI} - SDI Supply Voltage	1.6	1.8	3	V	
I _{SDI(OFF)} - SDI Leakage Current	0	1	10	μA	
I _{SDI(IDLE)} - Idle SDI Current Drain	0	1	10	μA	No SDI activity; register memory contents retained
I _{SDI(ON)} - Active SDI Current Drain			10	mA	During active SDI programming
V _{RAMP} - Ramp Control Voltage	0.132		2.1	V	Control voltage input to RF6561
Z _{IN} - RF Input Impedance (all RF ports)		50		Ω	
Z _{OUT} - RF Output Impedance (all RF ports)		50		Ω	
Normal Operating Temperature (Ambient)	15	25	35	°C	
Extended Operating Temperature (Ambient)	-20		85	°C	
SDI Interface Specifications					
Voltage and Timing Requirements					3.8V V _{BATT} , Temp 25 °C, Load VSWR = 1:1 unless otherwise defined
VSDI Supply Current 1			1.25	mA	Master write operation
VSDI Supply Current 2			5	mA	Master read operation
Input High Voltage	0.7*VSDI		VSDI+0.3	V	
Input Low Voltage	-0.3		0.3*VSDI	V	
Output High Voltage	0.8*VSDI		VSDI	V	
Output Low Voltage	0		0.2*VSDI	V	

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
SDI Interface Specifications (continued)					
Clock Frequency	3.5		26	MHz	
Voltage and Timing Requirements (continued)					
Clock Duty Cycle	45	50	55	%	
Data Setup Time	13.2			ns	Master write operation
Data Hold Time	13.2			ns	Master read operation
Data Setup Time	4			ns	Master write operation
Data Hold Time	15.8			ns	Master read operation
Data Valid Clock Edge		Falling			Data sent from the master is clocked on the falling edge of SDI_CLK, and data is captured on the rising edge of SDI_CLK. Message execution occurs on the falling edge of SDI_EN.
2G Specifications					
GSM850/GSM900 Band GMSK Mode					Output power set with RF detector using P _(IN) control; 3.8V V _{BATT} , Temp 25 °C, Load VSWR = 1:1, 25% duty cycle, unless otherwise defined.
Frequency Band, GSM850	824		849	MHz	
Frequency Band, GSM900	880		915	MHz	
RF Input Power	11		16	dBm	To guarantee P _{MAX} over extreme conditions
Maximum Output Power (P _{MAX})	35.0			dBm	V _{BATT} ≥ 3.4V
Maximum Output Power (Extreme)	32.5			dBm	V _{BATT} = 2.9V, Temp = 85 °C
Maximum Output Power Battery Current		1.96	2.125	A	P _{OUT} = 35.0dBm
Minimum Output Power Battery Current		29.5	50	mA	P _{OUT} = 6dBm
Noise Power in the Rx Band(non-composite)					RBW = 100kHz, 50 Averages, P _{OUT} = 35.0dBm
869MHz to 894MHz		-82	-79	dBm	TxFreq = 836MHz
925MHz to 935MHz		-83	-67	dBm	TxFreq = 897MHz
935MHz to 960MHz		-84	-79	dBm	
Harmonics					P _{MAX} = 35.0dBm
2nd Harmonic		-21	-13	dBm	V _{BATT} = 4.7V
3rd Harmonic		-42	-18	dBm	
2Fo Cross Band Coupling		-50	-25	dBm	P _{MAX} = 35.0dBm
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 8:1, all phase angles, P _{OUT} = 35dBm
Load Ruggedness	no permanent performance degradation				Load VSWR = 10:1, all phase angles
Forward Isolation 1		-60	-10	dBm	RF _(IN) applied, mode switch closed, P _(IN) = -43dBm
Forward Isolation 2		-76	-30	dBm	RF _(IN) applied, mode switch open, P _(IN) = -43dBm

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
DCS1800/PCS1900 Band GMSK Mode					Output power set with RF detector using P _(IN) control; 3.8V V _{BATT} , Temp 25 °C, Load VSWR = 1:1, 25% duty cycle, unless otherwise defined.
Frequency Band, DCS1800	1710		1785	MHz	
Frequency Band, PCS1900	1850		1910	MHz	
RF Input Power	11		16	dBm	To guarantee P _{MAX} over extreme conditions
Maximum Output Power (P _{MAX})	32.8			dBm	V _{BATT} ≥ 3.4V
Maximum Output Power (Extreme)	30.9			dBm	V _{BATT} = 2.9V, Temp = 85 °C
Maximum Output Power Battery Current		1.33	1.625	A	P _{OUT} = 32.8dBm
Minimum Output Power Battery Current		30	50	mA	P _{OUT} = 2dBm
Noise Power in the Rx Band (non-composite)					RBW = 100kHz, 50 Averages, P _{OUT} = 32.8dBm
1805MHz to 1880MHz		-85.0	-71	dBm	TxFreq = 1747MHz
1930MHz to 1990MHz		-85.0	-71	dBm	TxFreq = 1880MHz
Harmonics					P _{MAX} = 32.8dBm
2nd Harmonic		-33	-13	dBm	V _{BATT} = 4.7V
3rd Harmonic		-45	-18	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 8:1, all phase angles, P _{OUT} = 32.8dBm
Load Ruggedness	no permanent performance degradation				Load VSWR = 10:1, all phase angles
Forward Isolation 1		-54	-10	dBm	RF _(IN) applied, mode switch closed, P _(IN) = -43dBm
Forward Isolation 2		-76	-30	dBm	RF _(IN) applied, mode switch open, P _(IN) = -43dBm
2.5G Specifications					
GSM850/GSM900 Band 8PSK Mode					Output power set with RF detector using P _(IN) control; 3.8V V _{BATT} , Temp 25 °C, Load VSWR = 1:1, 25% duty cycle, unless otherwise defined.
Frequency Band, GSM850	824		849	MHz	
Frequency Band, GSM900	880		915	MHz	
Maximum Output Power (P _{MAX})	28.8			dBm	V _{BATT} ≥ 3.4V
Maximum Output Power (Extreme)	26.9			dBm	V _{BATT} = 2.9V, Temp = 85 °C
Maximum Output Power Battery Current		0.97	1.125	A	P _{OUT} = 28.8dBm
Minimum Output Power Battery Current		28	50	mA	P _{OUT} = 6dBm
Gain	23.5	31.5	33.5	dB	P _{OUT} = 28.8dBm, -20 °C ≤ Temp ≤ 85 °C, 2.9V ≤ V _{BATT} ≤ 5.1V, 1:1 ≤ VSWR ≤ 3:1
Modulation Spectrum at Offset					RBW = 30kHz for offset ≤ 1800kHz, else 100kHz; P _{OUT} = 28.8dBm
400kHz		-63	-57	dBc	Linearity is software-configurable; 3.4V V _{BATT}
600kHz		-75	-64	dBc	
EVM (Max RMS)		2.5	5	%	Linearity is software-configurable
Noise Power in the Rx Band (non-composite)					RBW = 100kHz, 50 Averages, P _{OUT} = 28.8dBm

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
2.5G Specifications (continued)					
GSM850/GSM900 Band 8PSK Mode (continued)					Output power set with RF detector using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25 °C, Load VSWR = 1:1, 25% duty cycle, unless otherwise defined.
869MHz to 894MHz		-83	-79	dBm	TxFreq = 836MHz
925MHz to 935MHz		-81	-67	dBm	TxFreq = 897MHz
935MHz to 960MHz		-82	-79	dBm	
Harmonics					P_{MAX} = 28.8dBm
2nd Harmonic		-44	-13	dBm	
3rd Harmonic		-54	-18	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 8:1, all phase angles, P_{OUT} = 28.8 dBm
Load Ruggedness	no permanent performance degradation				Load VSWR = 10:1, all phase angles
DCS1800/PCS1900 Band 8PSK Mode					Output power set with RF detector using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25 °C, Load VSWR = 1:1, 25% duty cycle, unless otherwise defined..
Frequency Band, DCS1800	1710		1785	MHz	
Frequency Band, PCS1900	1850		1910	MHz	
Maximum Output Power (P_{MAX})	28.3			dBm	$V_{BATT} \geq 3.4V$
Maximum Output Power (Extreme)	26.4			dBm	$V_{BATT} = 2.9V$, Temp = 85 °C
Maximum Output Power Battery Current		0.95	1.25	A	$P_{OUT} = 28.3dBm$
Minimum Output Power Battery Current		29	50	mA	$P_{OUT} = 2dBm$
Gain	26.5	30.0	35.7	dB	$P_{OUT} = 28.3dBm$, -20 °C ≤ Temp ≤ 85 °C, 2.9V ≤ V_{BATT} ≤ 5.1V, 1:1 ≤ VSWR ≤ 3:1
Modulation Spectrum at Offset					RBW = 30kHz for offset ≤ 1800kHz, else 100kHz; P_{OUT} = 28.3dBm
400kHz		-65	-57	dBc	Linearity is software-configurable; 3.4V V_{BATT}
600kHz		-77	-64	dBc	
EVM (Max RMS)		2.4	5	%	Linearity is software-configurable
Noise Power in the Rx Band (non-composite)					RBW = 100kHz, 50 Averages, $P_{OUT} = 28.3dBm$
1805MHz to 1880MHz		-87	-71	dBm	TxFreq = 1747MHz
1930MHz to 1990MHz		-87	-71	dBm	TxFreq = 1880MHz
Harmonics					P_{MAX} = 28.3dBm
2nd Harmonic		-41	-13	dBm	
3rd Harmonic		-56	-18	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 8:1, all phase angles, $P_{OUT} = 28.3dBm$
Load Ruggedness	no permanent performance degradation				Load VSWR = 10:1, all phase angles

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
3G Specifications					
Band 1 WCDMA Mode					Output power set with RF coupler using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25 °C, Load VSWR = 1:1, unless otherwise defined.
Frequency Band	1920		1980	MHz	
Maximum Output Power (P_{MAX})	27.3			dBm	$V_{BATT} \geq 3.4V$
Maximum Output Power (Extreme)	25.9			dBm	$V_{BATT} = 2.9V$, Temp = -20 °C to 85 °C
Maximum Linear Output Power (P_{MAX} HSUPA)	26.3			dBm	$V_{BATT} \geq 3.4V$, HSUPA Subtest 3
Typical Linear Output Power (P_{TYP})		26.3		dBm	$V_{BATT} \geq 3.4V$, Corresponds to Antenna $P_{OUT} = 23.5$ dBm
Maximum Output Power Battery Current		500	525	mA	$V_{BATT} \geq 3.4V$, ACLR at -41dBc
Typical Output Power Battery Current		375		mA	$V_{BATT} \geq 3.7V$, Temp = 25 °C, ACLR at -38dBc (software-configurable), Corresponds to Antenna $P_{OUT} = 23.5$ dBm
DG.09 Battery Current		23.2		mA	
3dBm Battery Current		13		mA	Corresponds to Antenna $P_{OUT} = 0$ dBm
Gain	21	25	29.3	dB	$P_{OUT} = 27.3$ dBm, -20 °C ≤ Temp ≤ 85 °C, 2.9V ≤ $V_{BATT} \leq 5.1V$, 1:1 ≤ VSWR ≤ 3:1
Adjacent Channel Power Leakage (ACLR) at Offset					All Power Levels
	5MHz	-41	-38	dBc	Linearity is software-configurable
	10MHz	-54	-48	dBc	
EVM (Max RMS)		1.3	3.5	%	
Noise Power in the Rx Band (non-composite)					P_{MAX} , 50 Averages, RBW = 1Hz
	2110MHz to 2170MHz	-96	-71	dBm	Measured at duplex offset frequency ($F_{TX} + 180$ MHz)
Harmonics					
	2nd Harmonic	-34	-10	dBm	
	3rd Harmonic	-46	-15	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 7:1, all phase angles
Load Ruggedness	no permanent performance degradation				Load VSWR = 8:1, all phase angles
Band 2 WCDMA Mode					Output power set with RF coupler using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25 °C, Load VSWR = 1:1, unless otherwise defined.
Frequency Band	1850		1910	MHz	
Maximum Output Power (P_{MAX})	28.1			dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C
Maximum Output Power (Extreme)	26.7			dBm	$V_{BATT} = 2.9V$, Temp = -20 °C to 85 °C
Maximum Linear Output Power (P_{MAX} HSUPA)	27.1			dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C, HSUPA Subtest 3
Typical Linear Output Power (P_{TYP})		26.7		dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C, Corresponds to Antenna $P_{OUT} = 23.5$ dBm
Maximum Output Power Battery Current		580	605	mA	$V_{BATT} \geq 3.4V$, ACLR at -40dBc

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
3G Specifications (continued)					
Band 2 WCDMA Mode (continued)					Output power set with RF coupler using P _(IN) control; 3.8V V _{BATT} , Temp 25 °C, Load VSWR = 1:1, unless otherwise defined.
Typical Output Power Battery Current		400		mA	V _{BATT} ≥ 3.7V, ACLR at -38dBc (software-configurable), Corresponds to Antenna P _{OUT} = 23.5dBm
DG.09 Battery Current		25		mA	
3dBm Battery Current		14		mA	Corresponds to Antenna P _{OUT} = 0dBm
Gain	21.5	26	30	dB	P _{OUT} = 28.1dBm, -20 °C ≤ Temp ≤ 85 °C, 2.9V ≤ V _{BATT} ≤ 5.1V, 1:1 ≤ VSWR ≤ 3:1
Adjacent Channel Power Leakage (ACLR) at Offset					All Power Levels
	5MHz	-40	-38	dBc	Linearity is software-configurable
	10MHz	-54	-48	dBc	
EVM (Max RMS)		1.2	3.5	%	
Noise Power in the Rx Band (non-composite)					P _{MAX} , 50 Averages, RBW = 1Hz
	1930MHz to 1990MHz	-89	-66	dBm	Measured at duplex offset frequency (F _{TX} + 80MHz)
Harmonics					
	2nd Harmonic	-29	-10	dBm	
	3rd Harmonic	-45	-15	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 7:1, all phase angles
Load Ruggedness	no permanent performance degradation				Load VSWR = 8:1, all phase angles
Band 3, 9, 10 WCDMA Mode					Output power set with RF coupler using P _(IN) control; 3.8V V _{BATT} , Temp 25 °C, Load VSWR = 1:1, unless otherwise defined.
Frequency Band	1710		1785	MHz	
Maximum Output Power (P _{MAX})	27.6			dBm	V _{BATT} ≥ 3.4V, Temp = 25 °C
Maximum Output Power (Extreme)	26.2			dBm	V _{BATT} = 2.9V, Temp = -20 °C to 85 °C
Typical Linear Output Power		26.5		dBm	V _{BATT} ≥ 3.4V, Temp = 25 °C, Corresponds to Antenna P _{OUT} = 23.5 dBm
Maximum Linear Output Power (P _{MAX} HSUPA)	26.6			dBm	V _{BATT} ≥ 3.4V, HSUPA Subtest 3
Maximum Output Power Battery Current		540	565	mA	V _{BATT} ≥ 3.4V, Temp = 25 °C, ACLR at -41dBc
Typical Output Power Battery Current		385		mA	V _{BATT} ≥ 3.7V, Temp = 25 °C, ACLR at -38dBc (software-configurable), Corresponds to Antenna P _{OUT} = 23.5 dBm
DG.09 Battery Current		25		mA	
3dBm Battery Current		14		mA	Corresponds to Antenna P _{OUT} = 0dBm
Gain	22.2	26	29.4	dB	P _{OUT} = 27.6dBm, -20 °C ≤ Temp ≤ 85 °C, 2.9V ≤ V _{BATT} ≤ 5.1V, 1:1 ≤ VSWR ≤ 3:1
Adjacent Channel Power Leakage (ACLR) at Offset					All Power Levels
	5 MHz	-41	-38	dBc	Linearity is software-configurable
	10 MHz	-54	-48	dBc	
EVM (Max RMS)		1.1	3.5	%	

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
3G Specifications (continued)					
Band 3, 9, 10 WCDMA Mode (continued)					Output power set with RF coupler using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25 °C, Load VSWR = 1:1, unless otherwise defined.
Noise Power in the Rx Band (non-composite)					P_{MAX} , 50 Averages, RBW = 1Hz
1805MHz to 1880MHz		-89	-66	dBm	Measured at duplex offset frequency ($F_{TX} + 95MHz$)
Harmonics					
2nd Harmonic		-18	-10	dBm	
3rd Harmonic		-48	-15	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 7:1, all phase angles
Load Ruggedness	no permanent performance degradation				Load VSWR = 8:1, all phase angles
Band 4 WCDMA Mode (continued)					Output power set with RF coupler using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25 °C, Load VSWR = 1:1, unless otherwise defined.
Frequency Band	1710		1755	MHz	
Maximum Output Power (P_{MAX})	27.3			dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C
Maximum Output Power (Extreme)	25.9			dBm	$V_{BATT} = 2.9V$, Temp = -20 °C to 85 °C
Typical Linear Output Power (P_{TYP})		26.2		dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C, Corresponds to Antenna $P_{OUT} = 23.5$ dBm
Maximum Linear Output Power (P_{MAX} HSUPA)	26.3			dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C, HSUPA Subtest 3
Maximum Output Power Battery Current		510	530	mA	$V_{BATT} \geq 3.4V$, Temp = 25 °C, ACLR at -41dBc
Typical Output Power Battery Current		360		mA	$V_{BATT} \geq 3.7V$, Temp = 25 °C, ACLR at -38dBc (software-configurable) , Corresponds to Antenna $P_{OUT} = 23.5$ dBm
DG.09 Battery Current		24		mA	
3dBm Battery Current		14		mA	Corresponds to Antenna $P_{OUT} = 0$ dBm
Gain	21.5	26	29.3	dB	$P_{OUT} = 27.3$ dBm, -20 °C \leq Temp \leq 85 °C, 2.9V $\leq V_{BATT} \leq 5.1V$, 1:1 \leq VSWR \leq 3:1
Adjacent Channel Power Leakage (ACLR) at Offset					All Power Levels
5 MHz		-41	-38	dBc	Linearity is software-configurable
10 MHz		-54	-48	dBc	
EVM (Max RMS)		1.1	3.5	%	
Noise Power in the Rx Band(non-composite)					P_{MAX} , 50 Averages, RBW = 1 Hz
2110MHz to 2155MHz		-96	-71	dBm	Measured at duplex offset frequency ($F_{TX} + 400MHz$)
Harmonics					
2nd Harmonic		-17	-10	dBm	
3rd Harmonic		-49	-15	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 7:1, all phase angles
Load Ruggedness	no permanent performance degradation				Load VSWR = 8:1, all phase angles

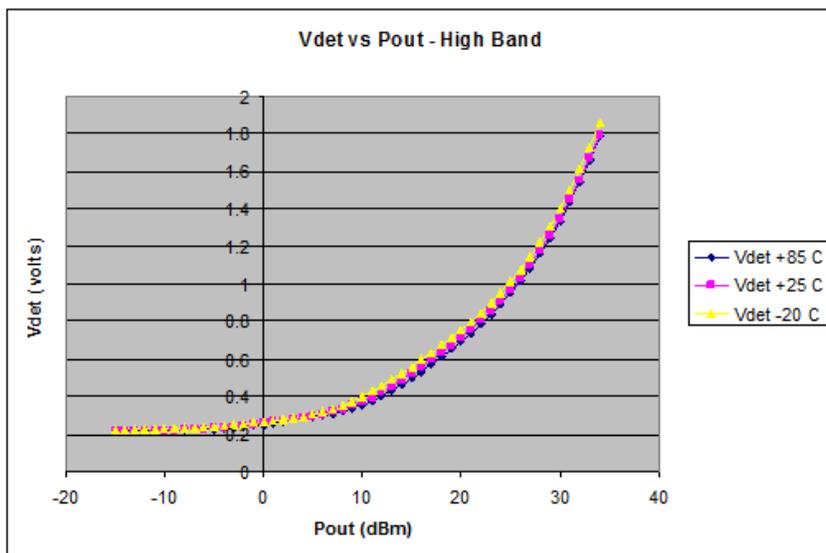
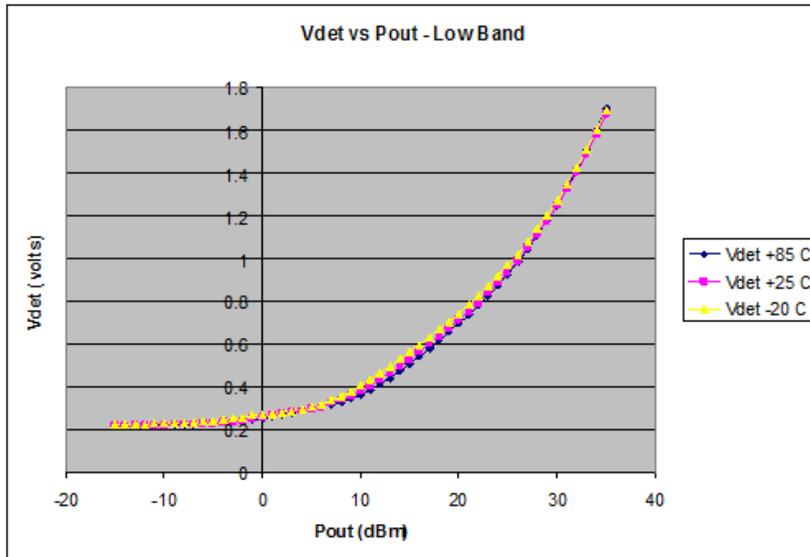
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
3G Specifications (continued)					
Band 5, 6 WCDMA Mode					Output power set with RF coupler using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25 °C, Load VSWR = 1:1, unless otherwise defined.
Frequency Band	824		849	MHz	
Maximum Output Power (P_{MAX})	27.0			dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C
Maximum Output Power (Extreme)	25.6			dBm	$V_{BATT} = 2.9V$, Temp = -20 °C to 85 °C
Typical Linear Output Power (P_{TYP})		25.9		dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C, Corresponds to Antenna $P_{OUT} = 23.5$ dBm
Maximum Linear Output Power (P_{MAX} HSUPA)	26.0			dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C, HSUPA Subtest 3
Maximum Output Power Battery Current		460	485	mA	$V_{BATT} \geq 3.4V$, Temp = 25 °C, ACLR at -45dBc
Typical Output Power Battery Current		330		mA	$V_{BATT} \geq 3.7V$, Temp = 25 °C, ACLR at -38dBc (software-configurable) , Corresponds to Antenna $P_{OUT} = 23.5$ dBm
DG.09 Battery Current		24		mA	
3dBm Battery Current		14		mA	Corresponds to Antenna $P_{OUT} = 0$ dBm
Gain	22.5	28	30.5	dB	$P_{OUT} = 27.0$ dBm, -20 °C \leq Temp \leq 85 °C, 2.9V $\leq V_{BATT} \leq 5.1V$, 1:1 \leq VSWR \leq 3:1
Adjacent Channel Power Leakage (ACLR) at Offset					All Power Levels
5MHz		-46	-36	dBc	Linearity is software-configurable
10MHz		-55	-48	dBc	
EVM (Max RMS)		1.0	3.5	%	
Noise Power in the Rx Band(non-composite)					P_{MAX} ; RBW = 1Hz, 50 Averages
869MHz to 894MHz		-87	-68	dBm	Measured at duplex offset frequency ($F_{TX} + 45$ MHz)
Harmonics					
2nd Harmonic		-15	-10	dBm	
3rd Harmonic		-38	-13	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 7:1, all phase angles
Load Ruggedness	no permanent performance degradation				Load VSWR = 8:1, all phase angles
Band 8 WCDMA Mode					Output power set with RF coupler using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25 °C, Load VSWR = 1:1, unless otherwise defined
Frequency Band	880		915	MHz	
Maximum Output Power (P_{MAX})	27.6			dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C
Maximum Output Power (Extreme)	26.2			dBm	$V_{BATT} = 2.9V$, Temp = -20 °C to 85 °C
Typical Linear Output Power (P_{TYP})		26.3		dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C, Corresponds to Antenna $P_{OUT} = 23.5$ dBm
Maximum Linear Output Power (P_{MAX} HSUPA)	26.6			dBm	$V_{BATT} \geq 3.4V$, Temp = 25 °C, HSUPA Subtest 3
Maximum Output Power Battery Current		490	515	mA	$V_{BATT} \geq 3.4V$, Temp = 25 °C, ACLR at -43dBc

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
3G Specifications (continued)					
Band 8 WCDMA Mode (continued)					Output power set with RF coupler using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25°C, Load VSWR = 1:1, unless otherwise defined
Typical Output Power Battery Current		355		mA	$V_{BATT} \geq 3.7V$, Temp = 25°C, ACLR at -38dBc (software-configurable), Corresponds to Antenna $P_{OUT} = 23.5$ dBm
DG.09 Battery Current		25		mA	
3dBm Battery Current		14		mA	Corresponds to Antenna $P_{OUT} = 0$ dBm
Gain	22.5	28	30.5	dB	$P_{OUT} = 27.6$ dBm, -20°C ≤ Temp ≤ 85°C, 2.9V ≤ $V_{BATT} \leq 5.1V$, 1:1 ≤ VSWR ≤ 3:1
Adjacent Channel Power Leakage (ACLR) at Offset					All Power Levels
	5MHz	-44	-38	dBc	Linearity is software-configurable
	10MHz	-55	-48	dBc	
EVM (Max RMS)		1.0	3.5	%	
Noise Power in the Rx Band (non-composite)					RBW = 1Hz, 50 Averages, $P_{OUT} = 27.6$ dBm
	925MHz to 960MHz	-88	-68	dBm	Measured at duplex offset frequency ($F_{TX} + 45$ MHz)
Harmonics					
	2nd Harmonic	-21	-10	dBm	
	3rd Harmonic	-42	-13	dBm	
Load Stability, maximum spurious emissions			-36	dBm	Load VSWR = 7:1, all phase angles
Load Ruggedness	no permanent performance degradation				Load VSWR = 8:1, all phase angles
RF Detector Specifications					
GMSK/8PSK Modes (see High Dynamic Range, Linear RF Detector Response section below for measured detector responses)					Output power set with RF detector using $P_{(IN)}$ control; 3.8V V_{BATT} , Temp 25°C, Load VSWR = 1:1, 25% duty cycle, unless otherwise defined.
GSM850/GSM900 Band					
High Power Output Voltage	1.2	1.7	2	V	At P_{MAX}
Offset Voltage	150	214	250	mV	
High Power Detector Slope	70	100		mV/dB	Measured at P_{TYP} $P_{TYP} = 1$ dB
Medium Power Detector Slope	30	38		mV/dB	Measured at 21dBm, 19dBm
Low Power Detector Slope	3	12		mV/dB	Measured at 8dBm, 5dBm
DCS1800/PCS1900 Band					
High Power Output Voltage	1.2	1.6	2	V	At P_{MAX}
High Power Detector Slope	70	101		mV/dB	Measured at P_{TYP} $P_{TYP} = 1$ dB
Medium Power Detector Slope	30	39		mV/dB	Measured at 21dBm, 19dBm
Low Power Detector Slope	3	9		mV/dB	Measured at 3dBm, 0dBm

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
RF Coupler Specifications					
WCDMA Mode					3.8V V _{BATT} , Temp 25°C, Load VSWR = 1:1, unless otherwise defined.
Band 1, 2, 3, 4, 9, 10					
Coupling Factor	35.5	38	39.5	dB	
Coupling Variation with Temperature	-0.4	0	0.2	dB	
Coupled Output Return Loss		-15	-12	dB	
Band 5, 6, 8					
Coupling Factor	36	38	40	dB	
Coupling Variation with Temperature	-0.4	0	0.2	dB	
Coupled Output Return Loss		-18	-15	dB	
Mode Switch Specifications (single die)					
Low Band (SP3T) + High Band (SP4T)					3.8V V _{BATT} , Temp 25°C, Load VSWR = 1:1, unless otherwise defined.
Port to Port Isolation					
Band 5 - GSM LB	-26	-27		dB	
Band 5 - Band 8	-30	-41		dB	
Band 8 - GSM LB	-26	-27		dB	
Band 1 - GSM HB	-26	-31		dB	
Band 2 - GSM HB	-27	-35		dB	
Band 3 - GSM HB	-29	-30		dB	
Band 4 - GSM HB	-24	-29		dB	
Band 2 - Band 1	-27	-29		dB	
Band 3 - Band 2	-28	-39		dB	

Parameter	Condition
WCDMA ModTC Test Conditions	
Voice	General Test Conditions (RMC 12.2kbps)
Modulation	HPSK modulated carrier in 3.84BW UL reference measurement channel (12.2kbps) ref. 3GPP 25.101 Annex A, section A.2.1 1 DPCCH, Spread code = 0, Relative power = -6.5 dB 1 DPDCH, Spread code = 16, Relative power = -1.1 dB
Pulse rate	CW testing (Not pulsed)
Input Power	Adjusted to meet output power requirement
HSUPA Subtest 3	
Modulation	HPSK modulated carrier in 3.84BW 1 DPCCH, Spread code = 256, Relative power = -14.623dB 1 DPDCH, Spread code = 64, Relative power = -19.06dB 1 HS-DPCCH, Spread code = 256, Relative power = -8.6dB
Pulse rate	CW testing (Not pulsed)
Input Power	Adjusted to meet output power requirement

High Dynamic Range, Linear RF Detector Response
 Low Band and High Band (Representative of all Modes)



Theory of Operation

RFRD6461 PowerSmart™ Power platform System Architecture

Internal to the RF6261B PA module are 2 RF paths: a low band path and a high band path implemented in GaAs HBT. There are only 2 RF inputs, one for each path. For the low band output, the path is switched between 3 outputs using a SP3T SOI (silicon on insulator) mode switch. The high band output is switched between 4 outputs using a SP4T SOI mode switch. Both switches are integrated onto a single die. In order to complete the front-end solution, the 2 GSM outputs are connected directly to an antenna switch. The 5 WCDMA outputs are connected to their respective duplexers, and the Tx ports are then routed to the same antenna switch. The antenna switch module (ASM) is recommended for multiplexing the 7 RF outputs to a single antenna port. Internal to the most available ASMs are integrated GSM Tx harmonic filters.

Each of the 2 RF paths has a dedicated directional coupler which is then cascaded into a single RF coupled output port. Additionally, the cascaded RF coupled port is internally applied to a high dynamic range linear RF detector implemented in CMOS which is then provided as a single detector output voltage.

Each of the 2 RF paths can be operated multi-mode: GSM saturated mode, EDGE/EDGE Evolution linear modes, and CDMA/WCDMA/HSPA+ linear modes. This is only accomplished by mating the PA module to the RF6561 PA power management IC (PMIC). The RF6561 was designed specifically for enabling the multi-mode operation of the single RF chain within the RF6261B PA module. To accomplish this, the RF6561 provides a scalable voltage to the PA device collectors to set the device load line for each mode. To cover all PA load line requirements while at the same time optimizing battery efficiency, boost and buck modes are utilized in a novel DC-DC converter architecture that reaches ~90% boost converter efficiencies (this includes all external losses due to the power inductor and PCB routing). The RF6561 output can provide > 2 Amps of current necessary for low band GMSK operation during poor TRP conditions, while at the same time providing ultra-low ripple voltage that meets stringent spurious emissions requirements. An external LC filter network is required like all switched mode power supplies. However, one primary innovation of the RF6561 is its ability to dither the clock frequency of the DC-DC converter PWM (pulse width modulator) using new and advanced algorithms that balance all spectrum requirements (patent pending).

The PowerSmart power platform is software configurable through the SDI bus. This enables 2 primary and key benefits. The first key benefit is the capability for dynamic and continuous optimization of transmit efficiency and current drain for every power level. The second key benefit is the ability to set a particular linearity target for every modulation format with full control of the PA bias.

Maximizing TRP (total radiated power) is addressed well with this solution. Each of the 2 RF paths inside the RF6261B utilizes a 2-stage quadrature architecture that is much more insensitive to load impedance variations relative to single-ended PA architectures. RF performance variations (output power, ACLR, EVM, harmonics, battery current, etc.) are minimized when subjected to varying antenna responses while operating in the mobile device.

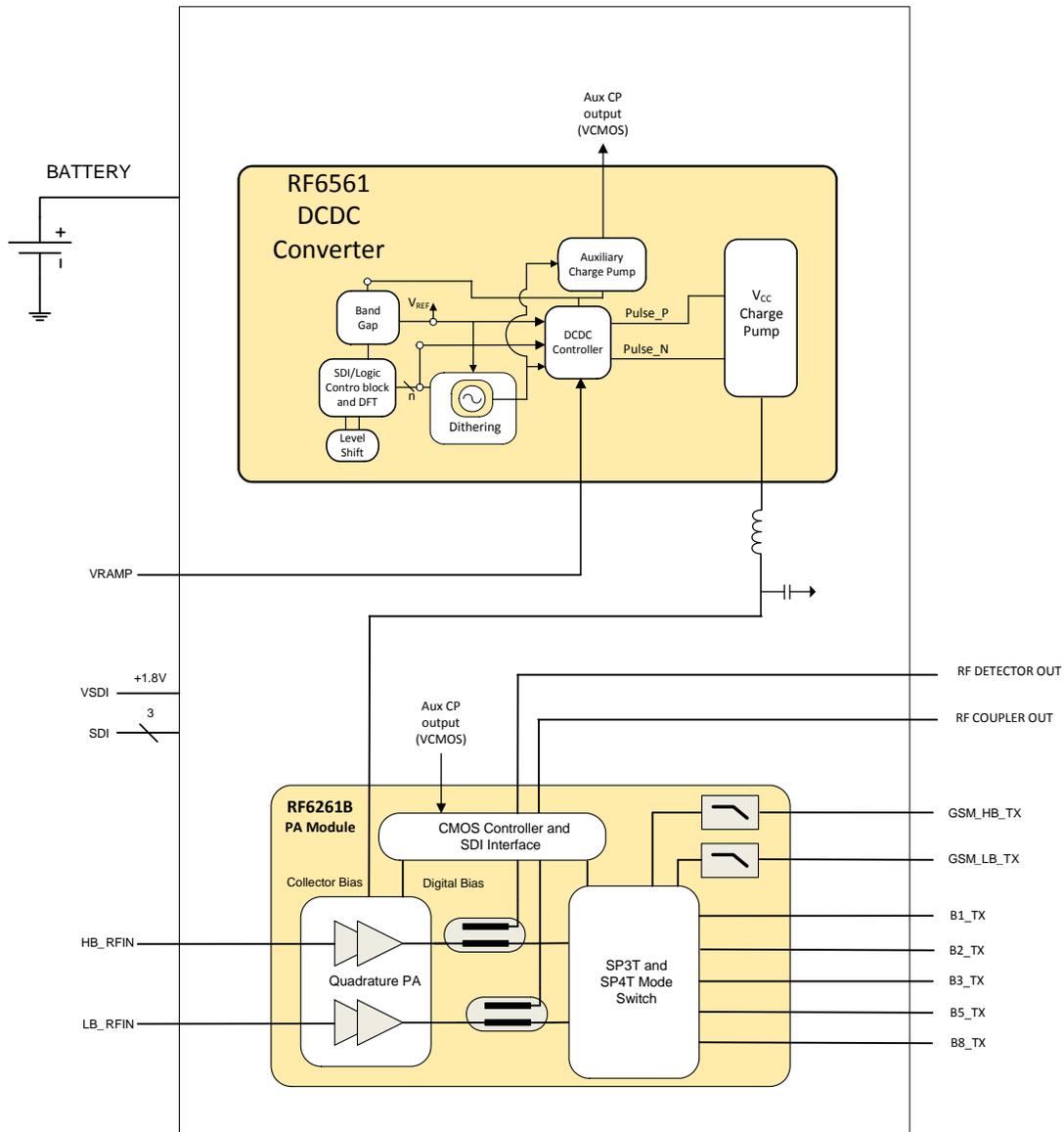
The RF6261B and RF6561 solution was designed to provide optimal performance and battery efficiency across the entire RF dynamic range with its programmable SDI interface. The RF6261B PA efficiency is optimized by setting the PA device collector voltage (V_{CC}) and by programming the digital bias DACs. The collector V_{CC} bias is provided by the RF6561 main output and controlled by the V_{RAMP} analog input pin. The digital bias is programmed using 2 DACs on the RF6261B integrated CMOS controller, one for each gain stage. The 3 bias settings can then be scaled relative to the target output power and mode. Below -5dBm, the PA bias settings should be fixed to those used for -5dBm for all lower output powers. For high power operation, the RF6561 DC-DC converter is operated in boost mode. For medium and low power operation, the converter can be switched to ultra-efficient buck modes. The combinations of SDI programmable settings can be stored in mobile device memory in "lookup tables", or LUTs. The table structure, size, and resolutions can be customized by the system designer.

The RF6261B provides flexibility for transmit power control since both a single RF coupled output and single RF detector voltage are provided for all modes and all bands. The common RF detector detects forward power across a 40dB dynamic range using a new detector architecture that is very efficient. The common RF coupled output provides -40dB to -36dB of coupling for low band and high band. It is recommended that EDGE and WCDMA linear modes use some form of closed loop power control with the transceiver. In linear mode, output power will be controlled primarily by RF input power. For GMSK saturated mode, the option exists to use closed loop power control or open loop power control. For open loop, power is controlled directly with the

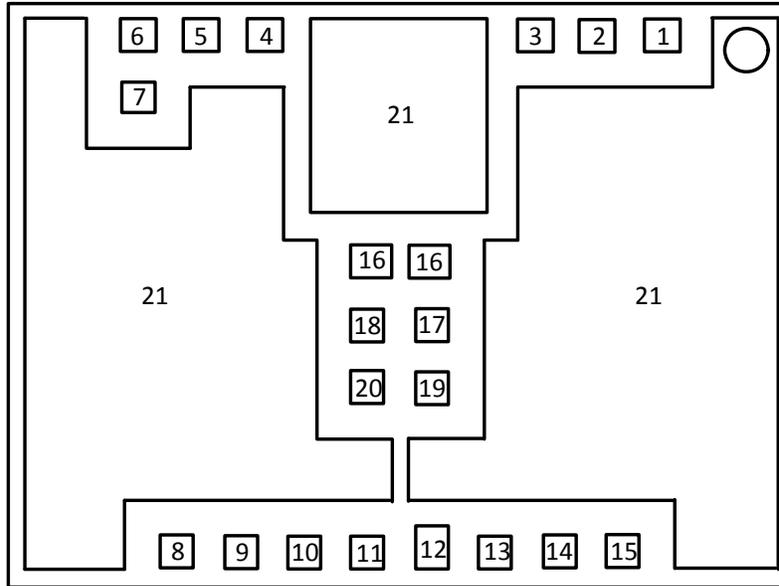
RF6561 VRAMP pin. The RF6561 and RF6261B are capable of accurately setting 2G output power across process, voltage, and temperature.

In addition to the main output of the RF6561 that provides the PA collector bias voltage, there is an auxiliary charge pump that provides a regulated 4V supply for the RF6261B. This supply is used by the PA bias circuits and CMOS mode switch control within the RF6261B. At low output power levels, the clock frequency for the auxiliary charge pump can be reduced to conserve battery current. Furthermore, there is an ultra-efficient bypass mode that directly connects the battery to the auxiliary charge pump output for operation at low output power levels.

Detailed Functional Block Diagram



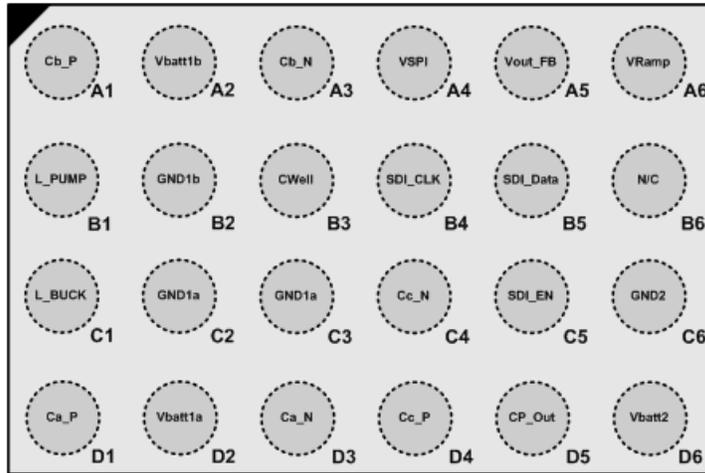
RF6261B Pin Out
(Bottom View)



RF6261B Pin Names and Descriptions

Pin	Name	Description
1	B8_TX	WCDMA Band 8 RF output
2	B5_TX	WCDMA Band 5/6 RF output
3	GSM_LB_TX	GSM/EDGE Low Band RF output
4	B2_TX	WCDMA Band 2 RF output
5	B1_TX	WCDMA Band 1 RF output
6	GSM_HB_TX	GSM/EDGE High Band RF output
7	B3_TX	WCDMA Band 3/4/9/10 RF output
8	HB_RFIN	Multi-Mode High Band RF input
9	SDI_EN	SDI Enable input
10	SDI_DAT	SDI Data input/output
11	SDI_CLK	SDI Clock input
12	SDI_GND	SDI ground
13	N/C	No connect or ground
14	VSDI	SDI Voltage Supply input
15	LB_RFIN	Multi-Mode Low Band RF input
16	VCC	PA Collector Bias Voltage input (provided by RF6561)
17	RF_OUT	RF Coupler output
18	VBATT	Battery Voltage Supply input
19	FB_AM	RF Detector output (AM analog signal)
20	VCMOS	CMOS Voltage Supply input (provided by RF6561)
21	RF_GND	RF ground

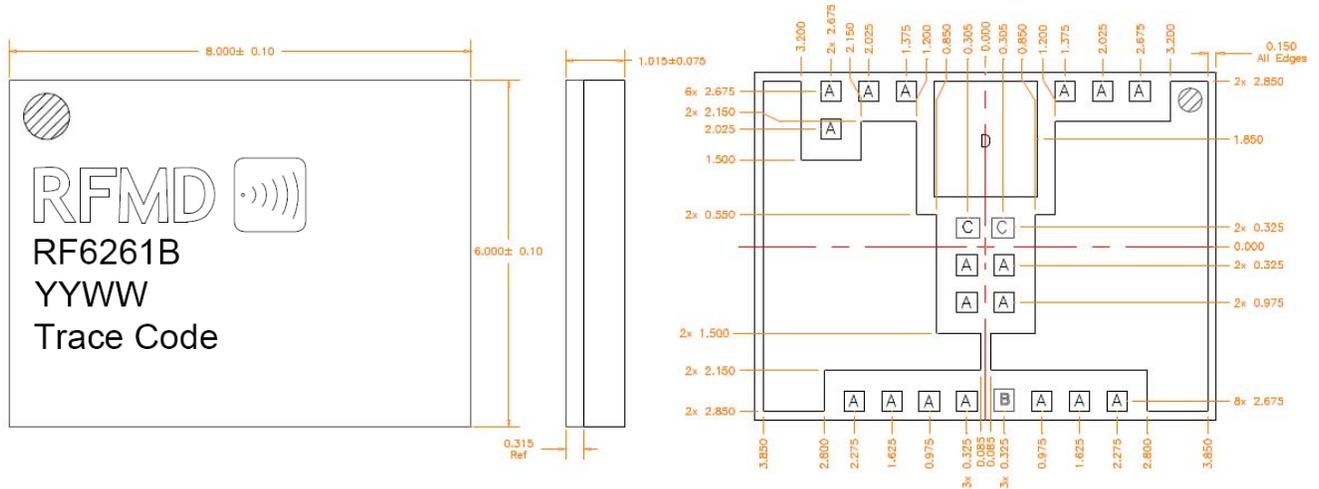
RF6561 Pin Out (Top View - Bumps Down)



RF6561 Pin Names and Descriptions

Pin	Name	Description
A1	CB_P	Main charge pump phase “b” fly capacitor positive connection
A2	VBATT1B	Battery Voltage Supply input for main charge pump phase “b”
A3	CB_N	Main charge pump phase “b” fly capacitor negative connection
A4	VSPI	SDI Voltage Supply input
A5	VOUT_FB	Voltage feedback input
A6	VRAMP	Analog input to control main charge pump buck output voltage
B1	L_PUMP	PWM output to be connected to external inductor
B2	GND1B	Ground for main charge pump phase “b”
B3	CWELL	Holding capacitor for CMOS substrate
B4	SDI_CLK	SDI clock input
B5	SDI_DATA	SDI data input/output
B6	N/C	No connect or ground
C1	L_BUCK	PWM output to be connector to external inductor
C2	GND1A	Ground for main charge pump phase “a”
C3	GND1A	Ground for main charge pump phase “a”
C4	CC_N	Auxiliary charge pump fly capacitor negative connection
C5	SDI_EN	SDI enable input
C6	GND2	Ground
D1	CA_P	Main charge pump phase “a” fly capacitor positive connection
D2	VBATT1A	Battery Voltage Supply input for main charge pump phase “a”
D3	CA_N	Main charge pump phase “a” fly capacitor negative connection
D4	CC_P	Auxiliary charge pump fly capacitor positive connection
D5	CP_OUT	Auxiliary charge pump output voltage (connected to RF6261B)
D6	VBATT2	Battery Voltage Supply input for auxiliary charge pump and other CMOS circuitry

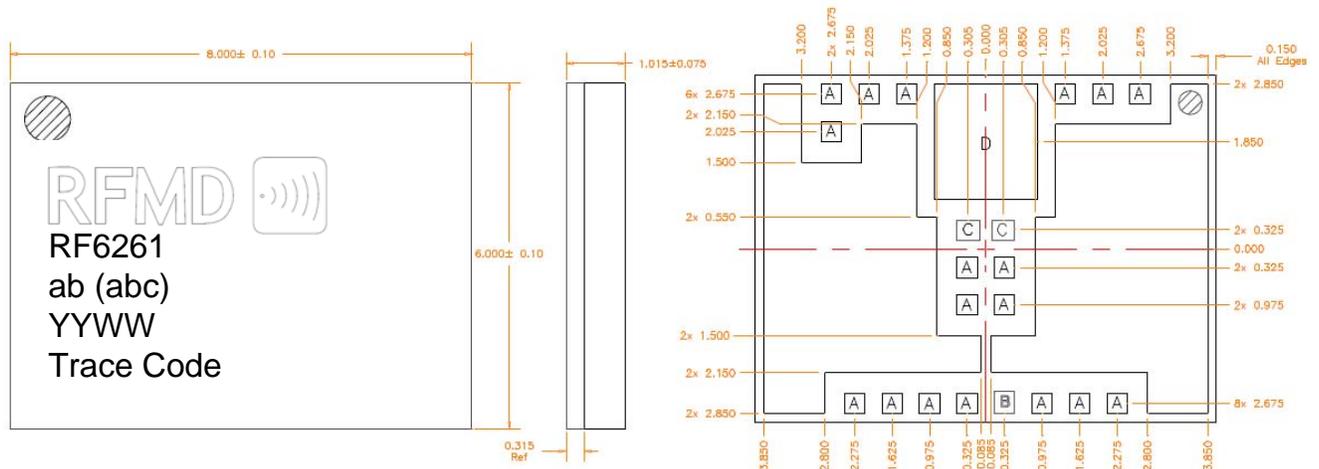
RF6261B and Derivative Package Drawings



Notes:

1. Shaded area represents Pin 1 location.
2. YY represents Year and WW represents Week

- A= 0.350 x 0.350 mm
- B= 0.350 x 0.390 mm
- C= 0.390 x 0.350 mm
- D= 1.800 x 2.000 mm

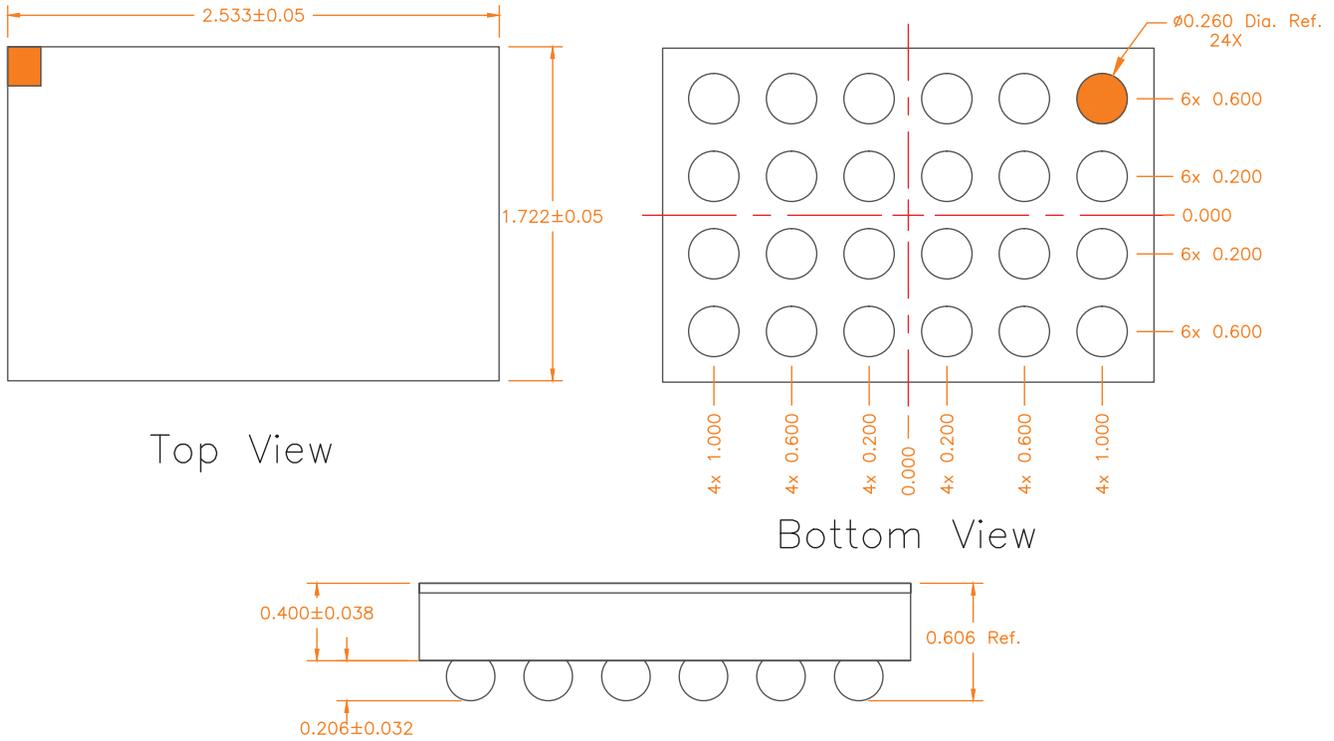


Notes:

1. Shaded area represents Pin 1 location.
2. ab = bands supported for dual-band variants.
3. abc = bands supported for tri-band variants.
4. YY represents Year and WW represents Week

- A= 0.350 x 0.350 mm
- B= 0.350 x 0.390 mm
- C= 0.390 x 0.350 mm
- D= 1.800 x 2.000 mm

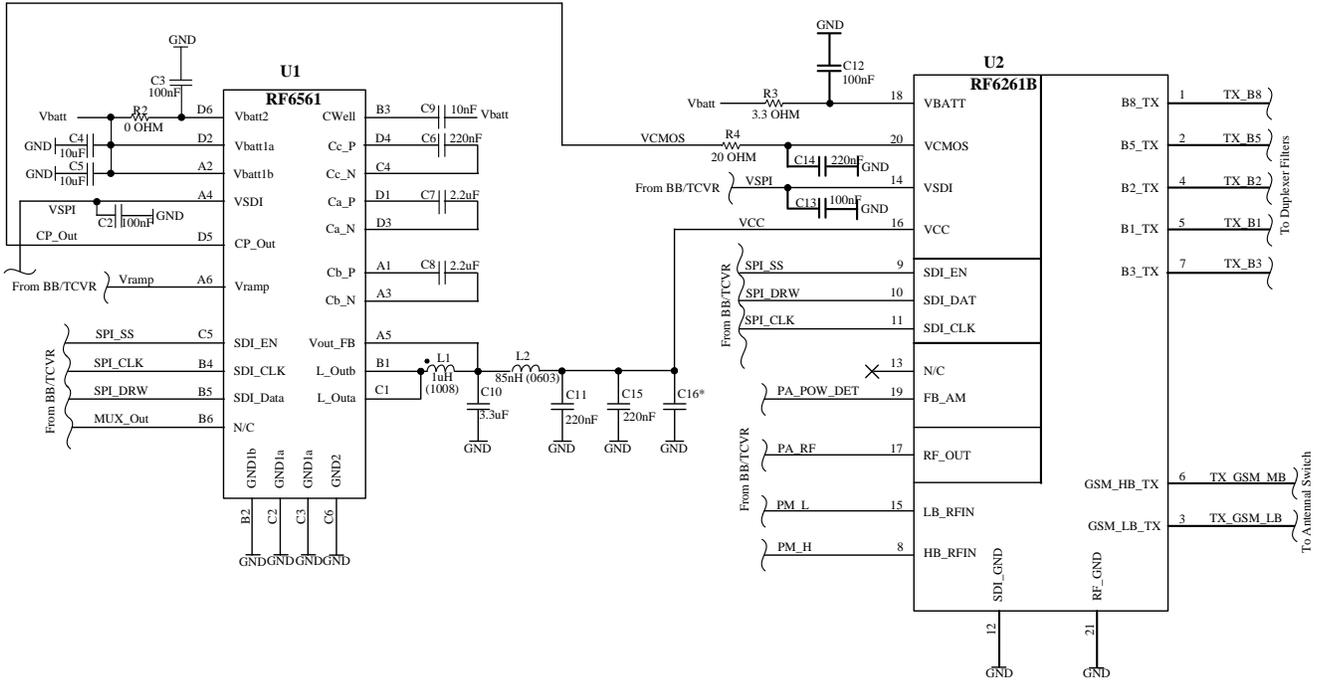
RF6561 Package Drawing



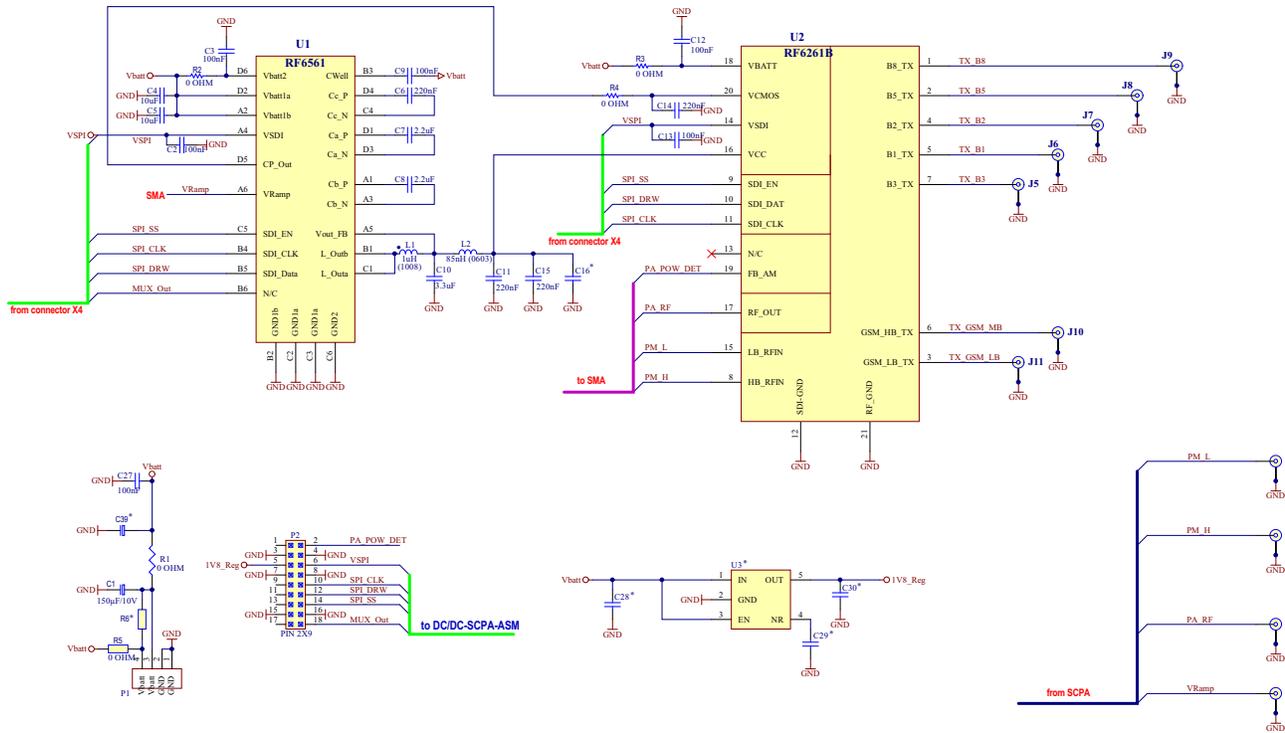
Notes:

1. Shaded area represents Pin 1 location.

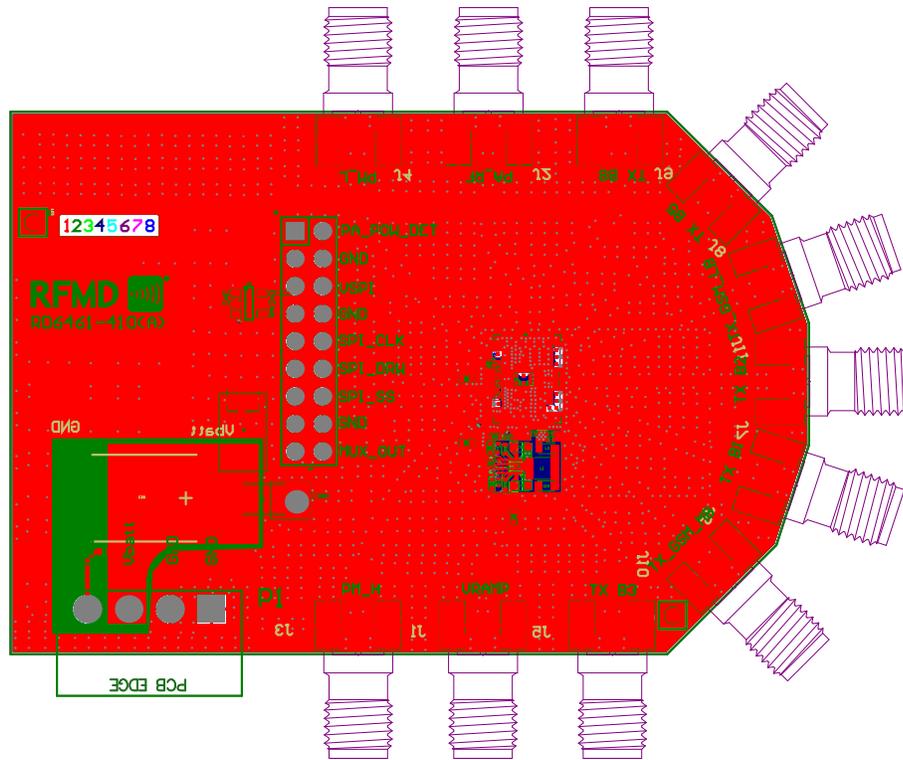
Application Schematic



Evaluation Board Schematic



Evaluation Board PCB



PCB Design Requirements

PCB Via Technology

RFMD recommends the use of 2 stacked lasermicrovias to properly route the RF6561 and defines the minimum requirement.

PCB Stackup

Routing studies have shown that 6 layers should be the minimum layer count to properly route the RF6261B and RF6561 reference design. The outer 4 layers should be HDI (high density interconnect) dielectric prepregs. The inner 2 layers should be a core laminate. Standard FR-4 dielectric typical of handsets is acceptable. Due to the scale and pin pitch of the RF6561 component, a metal spacing design rule of 75 μ m is recommended.

PCB Surface Finish

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

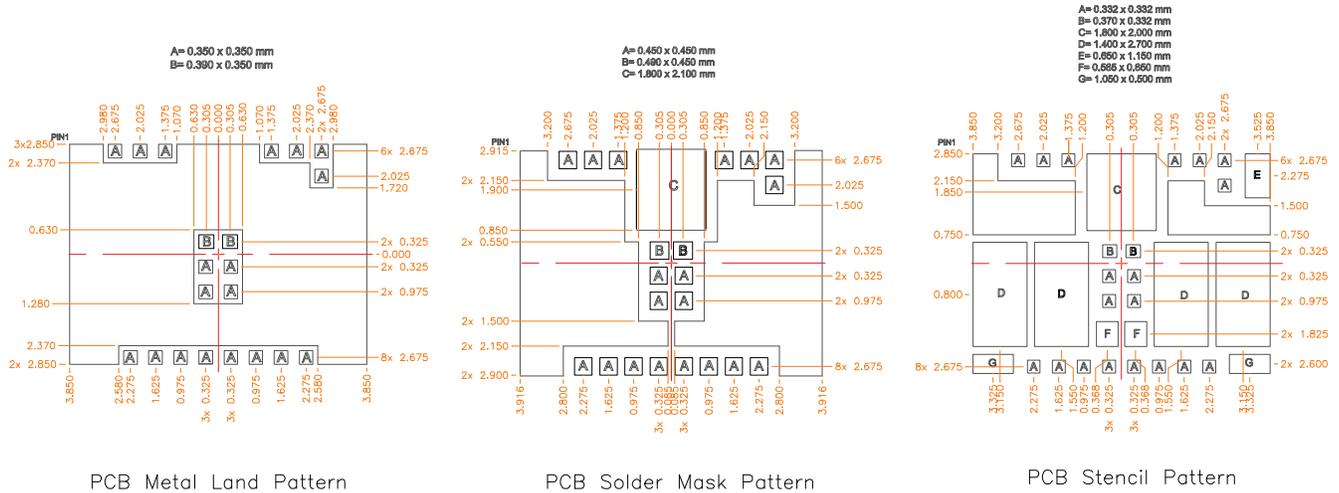
PCB Land Pattern Recommendation

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 Layout and Routing

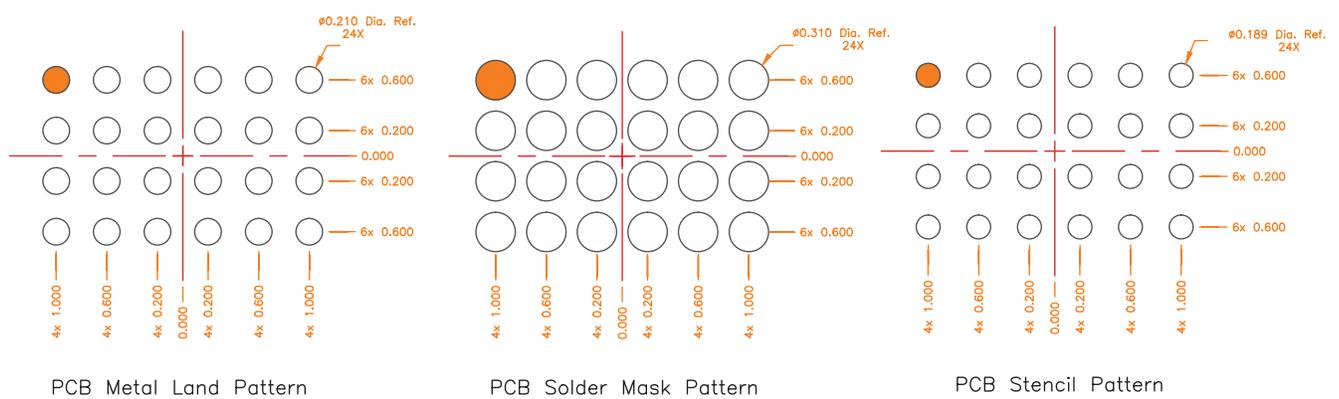
Please refer to the document RFMD PowerSmart RFRD6461 Layout Recommendation.

PCB Metal, Solder Mask, and Solder Stencil Patterns (RF6261B)



Notes:
 1. Shaded area represents Pin 1 location.

PCB Metal, Solder Mask, and Solder Stencil Patterns (RF6561)



Notes:
 1. Shaded area represents Pin 1 location.

SDI Register Maps and Programming

Please refer to the RFMD PowerSmart RFRD6461 Programming Guide.