RF7176

QUAD-BAND TX / DUAL-BAND RX GSM/GPRS TRANSMIT MODULE

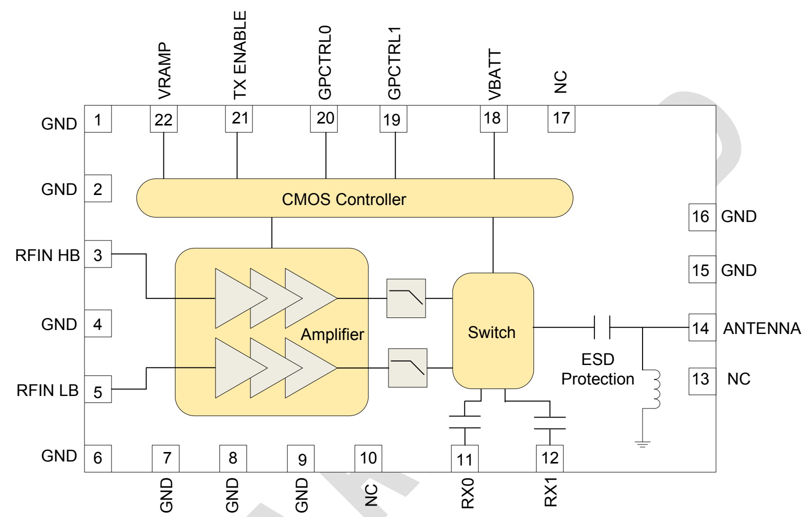
Package Style: Module 6.63mmx5.24mmx1.0mm

Features

- Enhanced Performance Transmit Module
- High Efficiency at Rated POUT VBATT=3.5 GSM850/EGSM900=42% DCS1800/PCS1900=36%
- Integrated Power Flattening Circuit
- Integrated VBATT Tracking Circuit
- 6kV Robust ESD Protection at Antenna Port
- No External Routing
- Low RX Insertion Loss
- Symmetrical RX Ports
- 0dBm to 6dBm Drive Level, >50dB of Dynamic Range

Applications

- GSM850/EGSM900/DCS1800/PCS1900 Products
- 3V Multimode Mobile Applications
- GPRS Class 12 Compliant
- Portable Battery-Powered Equipment



Functional Block Diagram

Product Description

The RF7176 is a quad-band (GSM850/EGSM900/DCS1800/PCS1900) GSM/GPRS Class 12-compliant transmit module with two symmetrical receive ports. This transmit module builds upon RFMD's leading power amplifier with PowerStar® integrated power control technology, pHEMT switch technology, and integrated transmit filtering for best-in-class harmonic performance. The results are high performance, reduced solution size, and ease of implementation. The device is designed for use as the final portion of the transmitter section in a GSM850/EGSM900/DCS1800/PCS1900 handset and eliminates the need for a PA-to-antenna switch module matching network. The device provides 50Ω matched input and output ports requiring no external matching components.

The RF7176 features RFMD's latest integrated power-flattening circuit, which significantly reduces current and power variation into load mismatch. Additionally, a V_{BATT} tracking feature is incorporated to maintain switching performance as supply voltage decreases. The RF7176 also integrates an ESD filter to provide excellent ESD protection at the antenna port.

Ordering Information

RF7176	Quad-Band GSM850/EGSM900/DCS1800/PCS1900 Transmit Module
RF7176SB	Transmit Module 5-Piece Sample Pack

RF7176PCBA-41X   Fully-Assembled Evaluation Board

Optimum Technology Matching® Applied

☒ GaAs HBT	☐ SiGe BiCMOS	☒ GaAs pHEMT	☐ GaN HEMT
☐ GaAs MESFET	☐ Si BiCMOS	☒ Si CMOS	☐ RF MEMS
☐ InGaP HBT	☐ SiGe HBT	☐ Si BJT	☐ LDMOS

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.3 to +6.0	V
Power Control Voltage (V_{RAMP})	-0.3 to +1.8	V
Input RF Power	+10	dBm
Max Duty Cycle	50	%
Output Load VSWR	20:1	
Operating Temperature	-30 to +85	°C
Storage Temperature	-55 to +150	°C

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.

RoHS status based on EUDirective2002/95/EC (at time of this document revision).

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
ESD					
ESD RF Pins			1000	V	HBM, JESD22-A114
			1000	V	CDM, JESD22-C101C
ESD Antenna Pins			6	kV	IEC 61000-4-2
ESD All Other Pins			1000	V	HBM, JESD22-A114
			500	V	CDM, JESD22-C101C
Overall Power Control V_{RAMP}					
$V_{RAMP, MAX}$			1.8	V	Max. P_{OUT}
$V_{RAMP,MIN}$		0.25		V	Min. P_{OUT}
V_{RAMP} Input Capacitance		15	20	pF	DC to 200kHz
V_{RAMP} Input Current			10	µA	V_{RAMP}=$V_{RAMP,MAX}$
Power Control Range		50		dB	V_{RAMP}=0.25V to $V_{RAMP,MAX}$
Overall Power Supply					
Power Supply Voltage	3.1	3.5	4.8	V	Operating Limits
Power Supply Current			10	µA	PIN<-30dBm, TX Enable=Low, V_{RAMP}=0.25V, Control signals=Low, Temp=-25°C to +85°C, V_{BATT}=4.8V
Overall Control Signals					
GpCtrl0, GpCtrl1 "Low"	0	0	0.5	V	
GpCtrl0, GpCtrl1 "High"	1.25	2.0	V_{BATT}	V	
GpCtrl0, GpCtrl1 "High" Current		1	2	µA	
TX Enable "Low"	0	0	0.5	V	
TX Enable "High"	1.25	2.0	V_{BATT}	V	
TX Enable "High" Current		1	2	µA	
RF Impedance					
RF Port Input and Output Impedance		50		Ω	

Table 1: Module Control and Antenna Switch Logic

TX Enable	GpCtrl1	GpCtrl0	TX Module Mode
0	0	0	Standby
0	1	0	RX0
0	1	1	RX1
1	1	0	Low Band GMSK
1	1	1	High Band GMSK

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
GSM850 Band					Nominal test conditions unless otherwise stated. All unused ports are terminated in 50Ω. V_{BATT}=3.5V, P_{IN}=3dBm, Temp=+25°C, V_{RAMP}=$V_{RAMP,MAX}$, Duty Cycle=25%, Pulse Width=1154μs. Refer to logic table for mode of operation.
Operating Frequency Range	824		849	MHz	
Input Power	0	3	6	dBm	Full P_{OUT} guaranteed at minimum drive level.
Input VSWR		2:1	2.5:1		Over P_{OUT} range (5dBm to 33dBm)
Maximum Output Power	33	33.8		dBm	Nominal conditions.
	31	34.0		dBm	V_{BATT}=3.1V to 4.8V, P_{IN}=0dBm to 6dBm, Temp=-20°C to +85°C, Duty Cycle=50%, Pulse Width=2308μs, V_{RAMP} ≤1.8V.
Minimum Power into 3:1 VSWR	30	31.5		dBm	The measured delivered output power to the load with the mismatch loss already taken into account with 1dB variation margin.
PAE (Rated P_{OUT})	36	42		%	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm
2fo Harmonic		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm
3fo Harmonic		-36	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm
All other harmonics up to 12.75 GHz		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm
Non-harmonic Spurious up to 12.75 GHz			-36	dBm	Over P_{OUT} range (5dBm to 33dBm)
Forward Isolation 1		-51	-41	dBm	TX Enable=Low, P_{IN}=6dBm, V_{RAMP}=0.25V.
Forward Isolation 2		-26	-15	dBm	TX Enable=High, P_{IN}=6dBm, V_{RAMP}=0.25V.
Output Noise Power					Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm, RBW=100kHz
869MHz to 894MHz		-86	-82	dBm	
1930MHz to 1990MHz		-117	-74	dBm	
Output Load VSWR Stability (Spurious Emissions)			-36	dBm	VSWR=12:1, all phase angles (set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm into 50Ω load; load switched to VSWR=12:1).
Output Load VSWR Ruggedness	No damage or permanent degradation to device				VSWR=20:1, all phase angles (set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm into 50Ω load; load switched to VSWR=20:1).

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
EGSM900 Band					Nominal test conditions unless otherwise stated. All unused ports are terminated in 50Ω. V_{BATT}=3.5V, P_{IN}=3dBm, Temp=+25°C, V_{RAMP}=$V_{RAMP,MAX}$, Duty Cycle=25%, Pulse Width=1154µs. Refer to logic table for mode of operation.
Operating Frequency Range	880		915	MHz	
Input Power	0	3	6	dBm	Full P_{OUT} guaranteed at minimum drive level.
Input VSWR		2:1	2.5:1		Over P_{OUT} range (5dBm to 33dBm)
Maximum Output Power	33	33.9		dBm	Nominal conditions.
	31	34.0		dBm	V_{BATT}=3.1V to 4.8V, P_{IN}=0dBm to 6dBm, Temp=-20°C to +85°C, Duty Cycle=50%, Pulse Width=2308µs, V_{RAMP} ≤1.8V.
Minimum Power into 3:1 VSWR	30	31.5		dBm	The measured delivered output power to the load with the mismatch loss already taken into account with 1dB variation margin.
PAE (Rated P_{OUT})	36	42		%	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm
2fo Harmonic		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm
3fo Harmonic		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm
All other harmonics up to 12.75 GHz		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm
Non-harmonic Spurious up to 12.75 GHz			-36	dBm	Over P_{OUT} range (5dBm to 33dBm)
Forward Isolation 1		-62	-41	dBm	TX Enable=Low, P_{IN}=6dBm, V_{RAMP}=0.25V.
Forward Isolation 2		-26	-15	dBm	TX Enable=High, P_{IN}=6dBm, V_{RAMP}=0.25V.
Output Noise Power					Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm, RBW=100kHz
925MHz to 935MHz		-84	-77	dBm	
935MHz to 960MHz		-87	-83	dBm	
1805MHz to 1880MHz		-117	-87	dBm	
Output Load VSWR Stability (Spurious Emissions)			-36	dBm	VSWR=12:1, all phase angles (set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm into 50Ω load; load switched to VSWR=12:1).
Output Load VSWR Ruggedness	No damage or permanent degradation to device				VSWR=20:1, all phase angles (set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm into 50Ω load; load switched to VSWR=20:1).

Parameter	Specification Min.	Specification Typ.	Specification Max.	Unit	Condition
DCS1800 Band					Nominal test conditions unless otherwise stated. All unused ports are terminated in 50Ω. V_{BATT}=3.5V, P_{IN}=3dBm, Temp=+25°C, V_{RAMP}=$V_{RAMP,MAX}$, Duty Cycle=25%, Pulse Width=1154µs. Refer to logic table for mode of operation.
Operating Frequency Range	1710		1785	MHz	
Input Power	0	3	6	dBm	Full P_{OUT} guaranteed at minimum drive level.
Input VSWR		1.5:1	2.5:1		Over P_{OUT} range (0dBm to 30dBm)
Maximum Output Power	30	31.5		dBm	Nominal conditions.
	28	31.7		dBm	V_{BATT}=3.1V to 4.8V, P_{IN}=0dBm to 6dBm, Temp=-20°C to +85°C, Duty Cycle=50%, Pulse Width=2308µs, V_{RAMP} ≤1.8V.
Minimum Power into 3:1 VSWR	27	28.7		dBm	The measured delivered output power to the load with the mismatch loss already taken into account with 1dB variation margin.
PAE (Rated P_{OUT})	32	36		%	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
2fo Harmonic		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
3fo Harmonic		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
4fo Harmonic		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
All other harmonics up to 12.75 GHz		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
Non-harmonic Spurious up to 12.75 GHz			-36	dBm	Over P_{OUT} range (0dBm to 30dBm)
Forward Isolation 1		-67	-53	dBm	TX Enable=Low, P_{IN}=6dBm, V_{RAMP}=0.25V.
Forward Isolation 2		-28	-15	dBm	TX Enable=High, P_{IN}=6dBm, V_{RAMP}=0.25V.
Output Noise Power					Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm, RBW=100kHz
925MHz to 935MHz		-103	-77	dBm	
935MHz to 960MHz		-101	-83	dBm	
1805MHz to 1880MHz		-91	-79	dBm	
Output Load VSWR Stability (Spurious Emissions)			-36	dBm	VSWR=12:1, all phase angles (set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm into 50Ω load; load switched to VSWR=12:1).
Output Load VSWR Ruggedness	No damage or permanent degradation to device				VSWR=20:1, all phase angles (set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm into 50Ω load; load switched to VSWR=20:1).

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
PCS1900 Band					Nominal test conditions unless otherwise stated. All unused ports are terminated in 50Ω. V_{BATT}=3.5V, P_{IN}=3dBm, Temp=+25°C, V_{RAMP}=$V_{RAMP,MAX}$, Duty Cycle=25%, Pulse Width=1154µs. Refer to logic table for mode of operation.
Operating Frequency Range	1850		1910	MHz	
Input Power	0	3	6	dBm	Full P_{OUT} guaranteed at minimum drive level.
Input VSWR		1.5:1	2.5:1		Over P_{OUT} range (0dBm to 30dBm)
Maximum Output Power	30	31.3		dBm	Nominal conditions.
	28	31.6		dBm	V_{BATT}=3.1V to 4.8V, P_{IN}=0dBm to 6dBm, Temp=-20°C to +85°C, Duty Cycle=50%, Pulse Width=2308µs, V_{RAMP} ≤1.8V.
Minimum Power into 3:1 VSWR	27	28.7		dBm	The measured delivered output power to the load with the mismatch loss already taken into account with 1dB variation margin.
PAE (Rated P_{OUT})	32	36		%	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
2fo Harmonic		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
3fo Harmonic		-36	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
4fo Harmonic		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
All other harmonics up to 12.75 GHz		-40	-33	dBm	Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm
Non-harmonic Spurious up to 12.75 GHz			-36	dBm	Over P_{OUT} range (0dBm to 30dBm)
Forward Isolation 1		-65	-53	dBm	TX Enable=Low, P_{IN}=6dBm, V_{RAMP}=0.25V.
Forward Isolation 2		-27	-15	dBm	TX Enable=High, P_{IN}=6dBm, V_{RAMP}=0.25V.
Output Noise Power					Set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm, RBW=100kHz
869MHz to 894MHz		-105	-81	dBm	
1930MHz to 1990MHz		-92	-77	dBm	
Output Load VSWR Stability (Spurious Emissions)			-36	dBm	VSWR=12:1, all phase angles (set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm into 50Ω load; load switched to VSWR=12:1).
Output Load VSWR Ruggedness	No damage or permanent degradation to device				VSWR=20:1, all phase angles (set V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm into 50Ω load; load switched to VSWR=20:1).

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
RX Section					Nominal test conditions unless otherwise stated. All unused ports are terminated in 50Ω. V_{BATT}=3.5V, P_{IN}=-10dBm, Temp=+25°C, V_{RAMP}=0.2V, Refer to logic table for mode of operation.
Insertion Loss GSM850/EGSM900 ANT-RX0/RX1		1.1		dB	Frequency=869MHz to 960MHz
In-Band Ripple GSM850/EGSM900 ANT-RX0/RX1		0.1	0.2	dB	Frequency=869MHz to 960MHz
Input VSWR GSM850/EGSM900 ANT-RX0/RX1		1.5:1	1.7:1	dB	Frequency=869MHz to 960MHz
Insertion Loss DCS1800/PCS1900 ANT-RX0/RX1		1.6		dB	Frequency=1805MHz to 1990MHz
In-Band Ripple DCS1800/PCS1900 ANT-RX0/RX1		0.1	0.2	dB	Frequency=1805MHz to 1990MHz
Input VSWR DCS1800/PCS1900 ANT-RX0/RX1		1.8:1	2:1	dB	Frequency=1805MHz to 1990MHz
TX Section					
Switch Leakage P_{OUT} at RX Port GSM850/EGSM900 ANT-RX0/RX1		-4	6		GSM850/EGSM900 TX mode: Freq=824MHz to 849MHz or 880MHz to 915MHz, GpCtrl1=High, GpCtrl0=Low, V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=33dBm at antenna port. See Note 1.
Switch Leakage P_{OUT} at RX Port DCS1800/1900 ANT-RX0/RX1		-3	6		DCS1800/PCS1900 TX mode: Freq=1710MHz to 1785MHz or 1850MHz to 1910MHz, GpCtrl1=High, GpCtrl0=High, V_{RAMP}=V_{RAMP_RATED} for P_{OUT}=30dBm at antenna port. See Note 1.

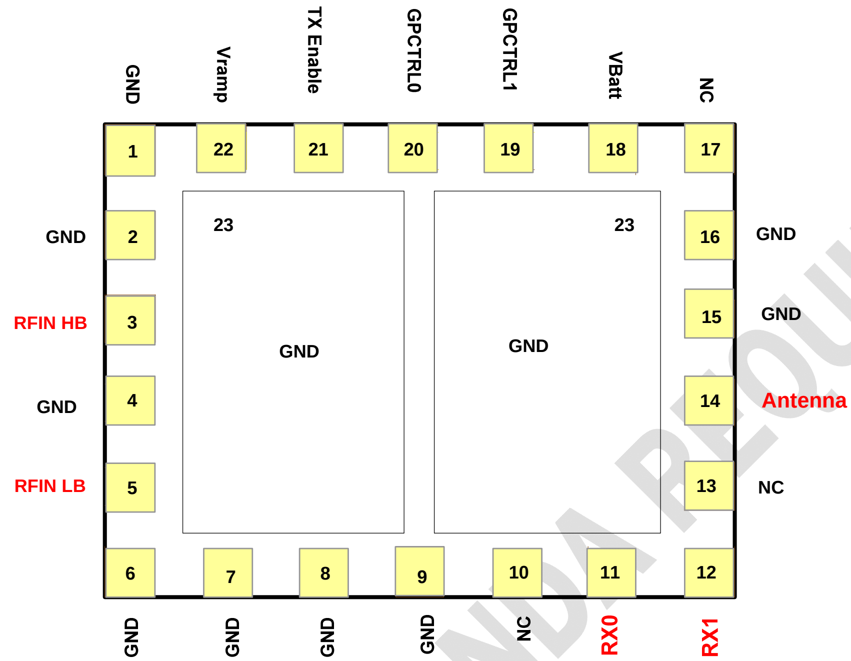
Note:

1. Better performance can be obtained in the high band with optimized matching.
2. Isolation specification set to ensure at least the following isolation at rated power: Calculation example: Isolation=P_{OUT}@Antenna – P_{OUT}@RX Port. Isolation LB=33-(-4)=37dB, HB=30-(-3)=33dB.

Pin	Function	Description
1	**GND**	Pin connected to module ground.
2	**GND**	Pin connected to module ground.
3	**RFIN HB**	RF input to the DCS1800/PCS1900 bands. This is a 50Ω input.
4	**GND**	Pin connected to module ground.
5	**RFIN LB**	RF input to the GSM850/EGSM900 bands. This is a 50Ω input.
6	GND	Pin connected to module ground.
7	GND	Pin connected to module ground.
8	GND	Pin connected to module ground.
9	GND	Pin connected to module ground.
10	**NC**	No connect.
11	**RX0**	RX0 port of antenna switch. RX0 is interchangeable with RX1.
12	**RX1**	RX1 port of antenna switch. RX1 is interchangeable with RX0.
13	**NC**	No connect.
14	**ANTENNA**	Antenna port.
15	**GND**	Pin connected to module ground.
16	**GND**	Pin connected to module ground.
17	**NC**	No connect.
18	**VBATT**	Power supply for the module. This should be connected to the battery terminal using as wide a trace as possible.
19	**GPCTRL1**	Control pin that together with GpCtrl0 selects the band of operation.
20	**GPCTRL0**	Control pin that together with GpCtrl1 selects the band of operation.
21	**TX ENABLE**	This signal enables the PA module for operation with a logic high. The switch is put in TX mode determined by GpCtrl0 and GpCtrl1.
22	**VRAMP**	V_{RAMP} ramping signal from DAC. A simple RC filter is integrated into the RF7176 module. V_{RAMP} may or may not require additional filtering depending on the baseband selected.
23	GND	Pin connected to module ground.

Pin Out

(Top View)



Theory of Operation

Theory of Operation

Product Description

The RF7176 is a quad-band transmit module (TXM) with fully-integrated power control functionality, harmonic filtering, band selectivity, and TX/RX switching. The TXM is self-contained, having 50Ω I/O terminals and two symmetrical RX ports allowing quad-band operation. The power control function eliminates all power control circuitry, including directional couplers, diode detectors, and power control ASICs, etc. The power control capability provides 50 dB of continuous control range and 70 dB of total control range, using a DAC-compatible, analog voltage input. The TX Enable feature provides for PA activation (TX mode) or RX mode/standby. Internal switching provides a low-loss, low-distortion path from the antenna port to the TX path (or RX port) while maintaining proper isolation. Integrated filtering provides ETSI-compliant harmonic suppression at the antenna port even under high mismatch conditions which is important as modern antennas often present a load that significantly deviates from nominal impedance.

Overview

The RF7176 simplifies the phone design by eliminating the need for the complicated control loop, harmonic filters, and TX/RX switch along with their associated matching components. The power control loop can be driven directly from the DAC output in the baseband circuit. The module has two RX ports for GSM850/EGSM900 and DCS1800/PCS1900 bands of operation. The two RX ports are symmetrical; they can be used either for GSM850/EGSM900 or DCS1800/PCS1900. To control the mode of operation, there are three logic control signals: TX Enable, GpCtrl0, and GpCtrl1. The RF7176 offers high efficiency at the rated P_{out} as backed-off efficiency is improved in this TXM.

Power On Sequence

The RF7176 should be powered on according to the power-on sequence below. It is designed to prevent operation of the amplifier under conditions that could cause damage to the device or erratic operation.

There are some setup times associated with the control signals of the RF7176. The most important of these is the settling time between TXEN going high and when V_{RAMP} can begin to increase. This time is often referred to as the “pedestal” and is required so that the internal power control loop and bias circuitry can settle after being turned on. The RF7176 requires at least 2 μs or two quarter-bit times for proper settling of the power control loop.

The power-down sequence is in opposite order of the power-on sequence. As described in the figure below, V_{BATT} is applied first to provide bias to the silicon control chip. Then the RF drive is applied. Finally, when TXEN is high, The V_{RAMP} signal is held at a constant 0.25V, and 2 μs later, V_{RAMP} begins to ramp up. The shape of V_{RAMP} is important for maintaining the switching transients. The basic shape of the ramping function should be raised cosine to achieve best transient performance.

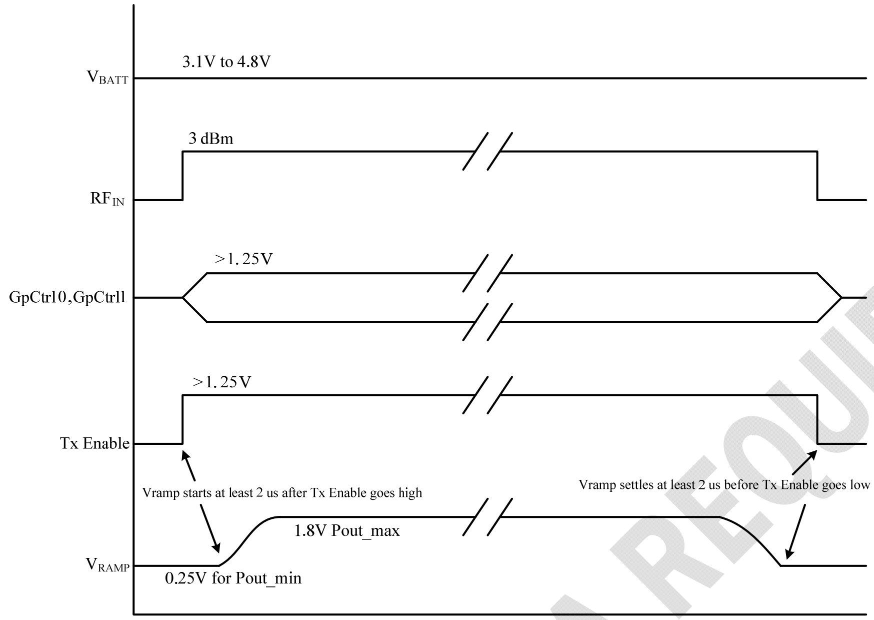


Figure 1. Timing Diagram

1. Apply V_{BATT}
2. Apply GpCtrl0, GpCtrl1, RFIN, and TX Enable
3. Apply V_{RAMP} at least 2µs after TX Enable
4. The Power Down Sequence is in opposite order of the Power On Sequence

Power Flattening and VBATT Tracking Circuit

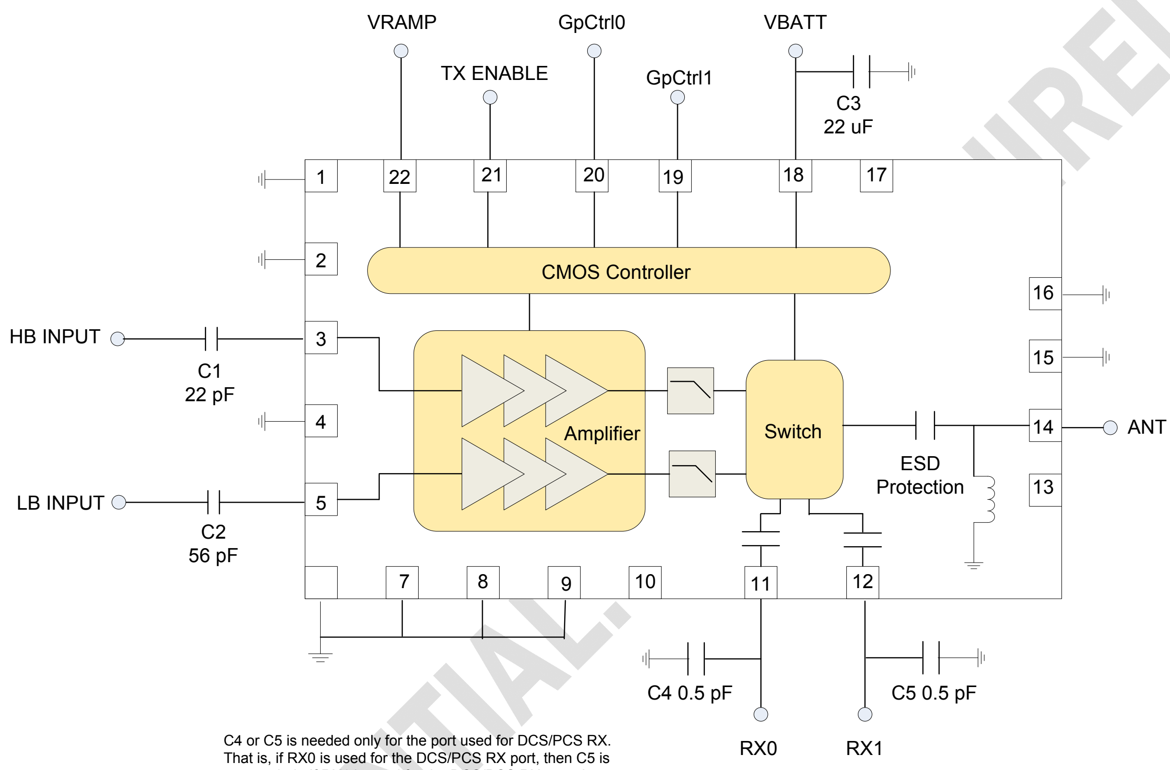
The RF7176 has an integrated power flattening circuit that reduces the amount of current variation when a mismatch is presented to the output of the PA. When a mismatch is presented to the output of the PA, its output impedance is varied and could present a load that will increase output power. As the output power increases, so does current consumption. The current consumption can become very high if not monitored and limited. The power flattening circuit is integrated onto the CMOS controller and requires no input from the user.

Into a mismatch, the current varies as the phase changes. The power flattening circuit monitors current through an internal sense resistor. As the current changes, the loop is adjusted in order to maintain current. The result is flatter power and reduced current into mismatch.

The RF7176 also incorporates a V_{BATT} tracking feature that eliminates the need for the transceiver/baseband to regulate the ramping signal as the supply voltage decreases. The internal circuit monitors the supply voltage and adjusts the ramping signal such that the switching spectrum is minimally impacted.

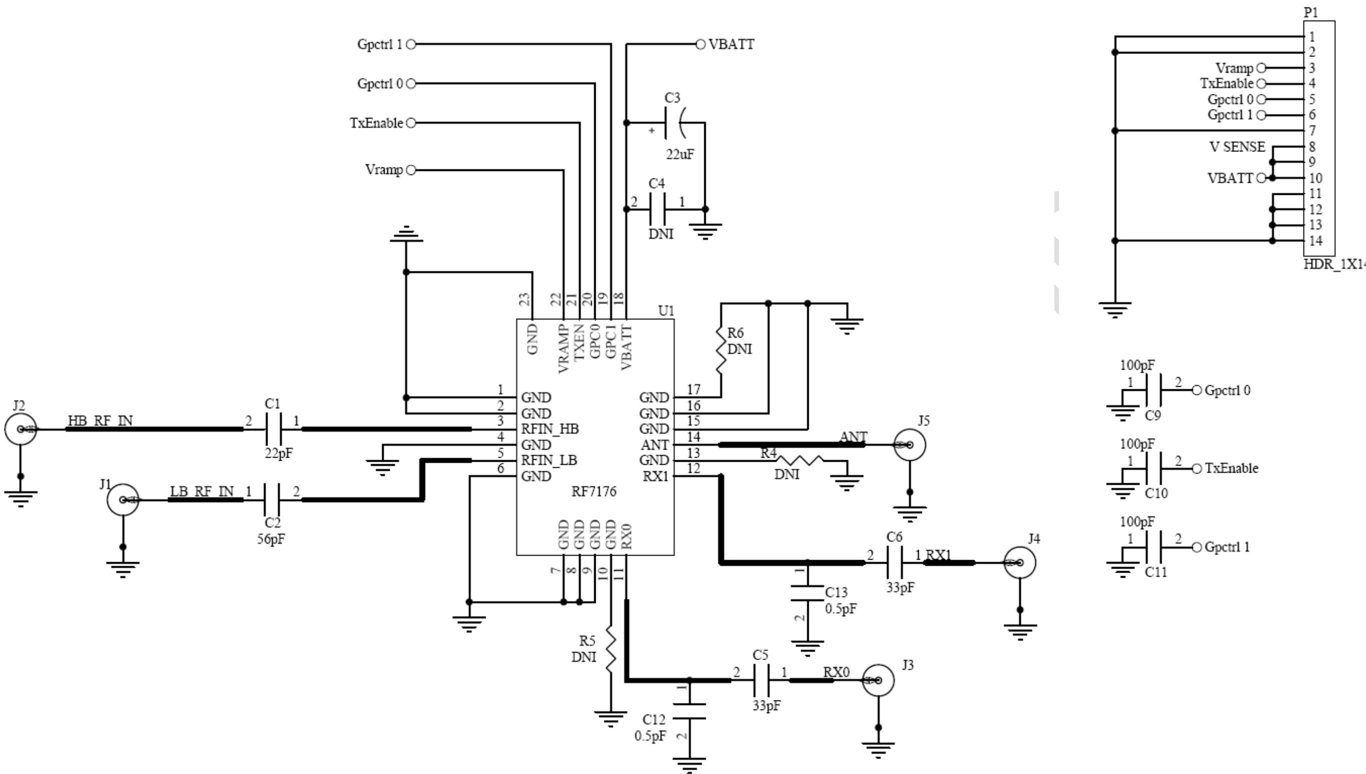
Application Schematic

*All inputs, outputs, and antenna traces are 50 Ω micro strip.
**VBATT capacitor value may change depending on application.
***RX0 and RX1 usually connect to SAW filters; C4 or C5 is used to match its respective RX port to a 50 Ω filter for improved DCS/PCS performance.
****If placing an attenuation network on the input to the power amplifier, ensure that it is positioned on the transceiver side of capacitor C1 (or C2) to prevent adversely affecting the base biasing of the power amplifier.



C4 or C5 is needed only for the port used for DCS/PCS RX. That is, if RX0 is used for the DCS/PCS RX port, then C5 is not needed. If RX1 is used for the DCS/PCS RX port, then C4 is not needed.

Evaluation Board Schematic

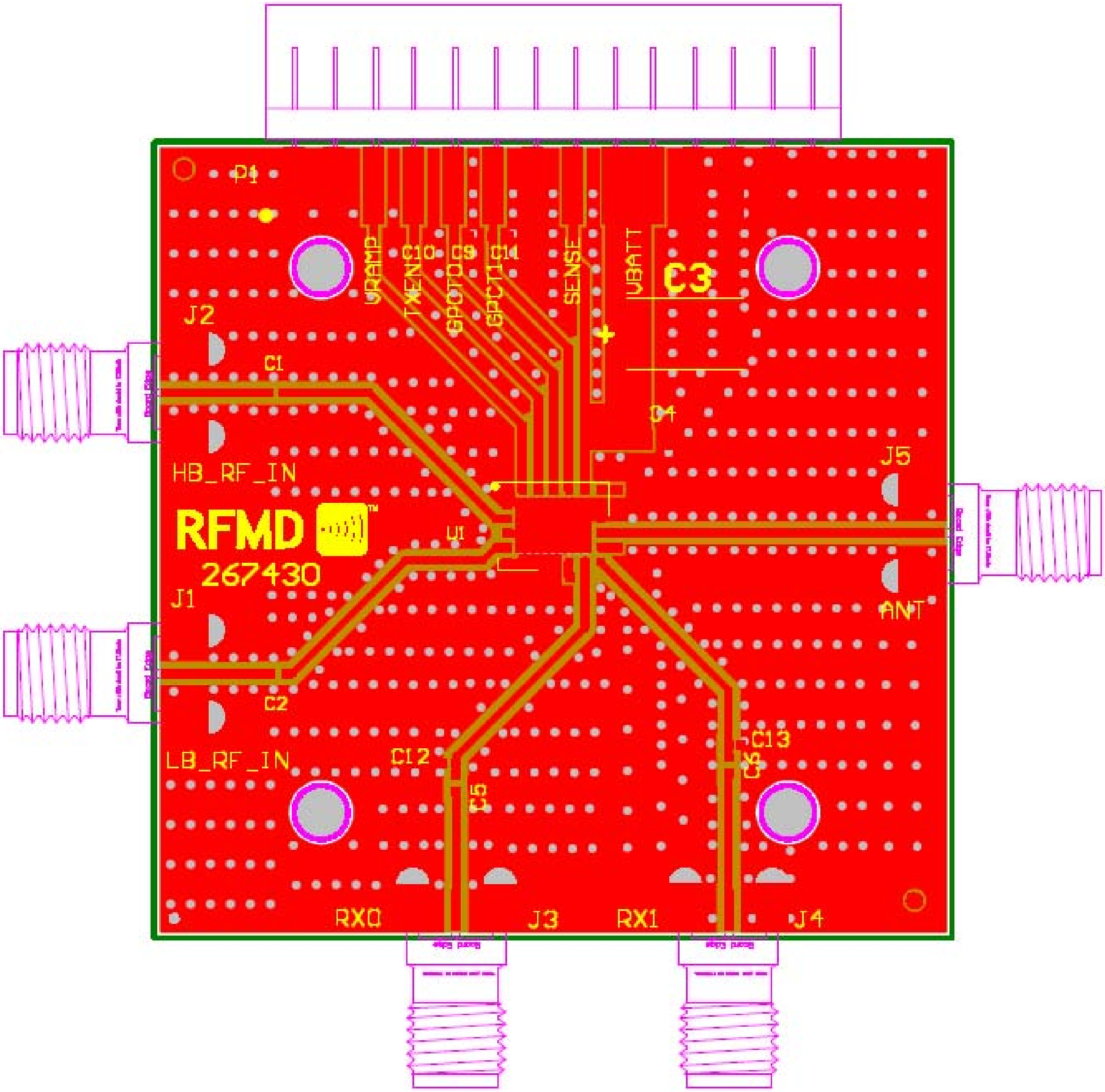


Note: C9, C10, and C11 are optional decoupling capacitors which may not be needed in the application. C5 and C6 are actually replaced by zero-ohm resistors because the blocking capacitors are internal to the TX module. C12 and C13 are used to match the RX ports to a 50Ω filter.

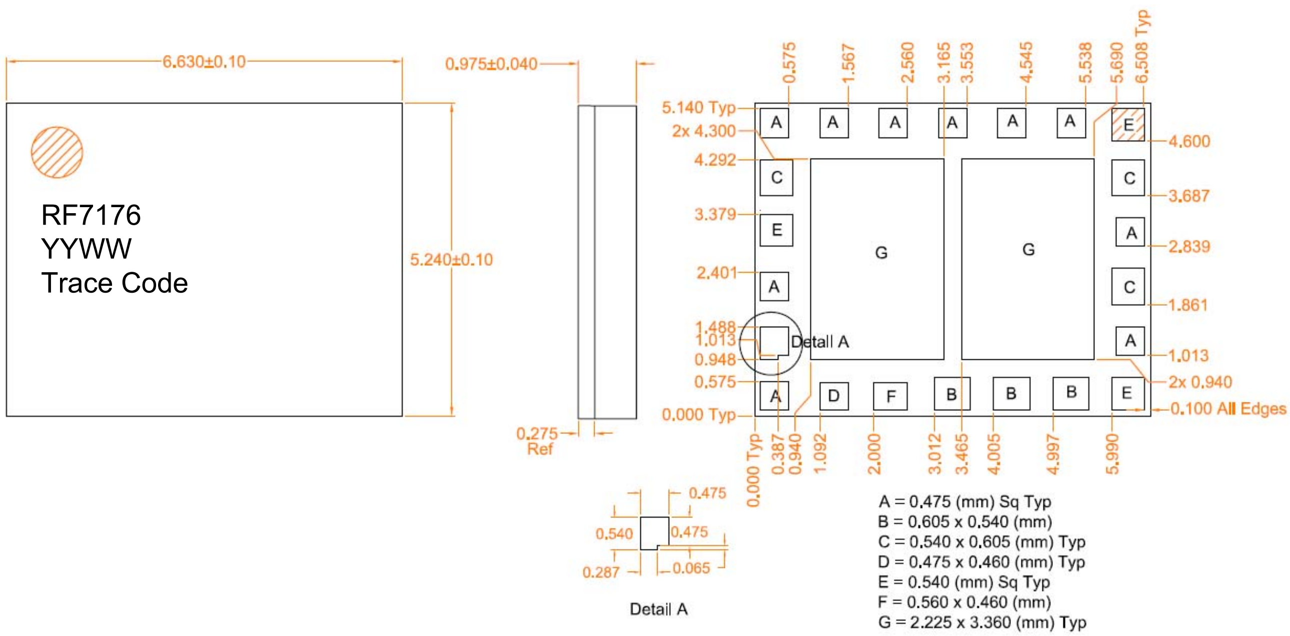
Evaluation Board Layout

Board Size 2.0” X 2.0”

Board Thickness 0.032”, Board Material FR-4/Rogers, Multi-layer



Package Drawing



Notes:
1. Shaded area represents Pin 1 location.
2. YYWW indicates year and, WW indicates work week, and Trace Code is a sequential number assigned at device assembly.

PCB Design Requirements

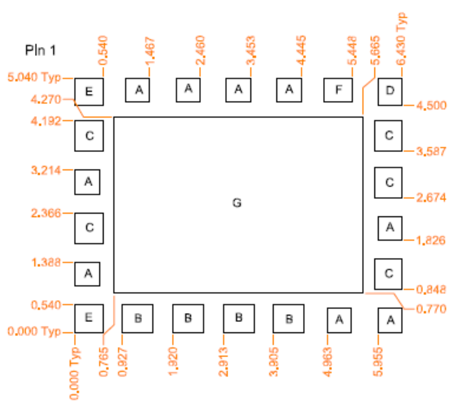
PCB Surface Finish

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

PCB Land Pattern Recommendation

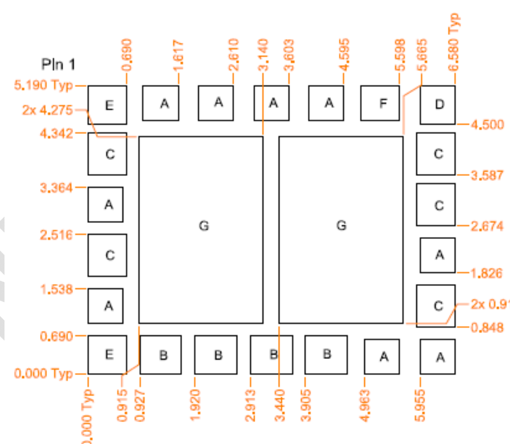
PCB land patterns for RFMD components are based on IPC-7351 standards and RFMD empirical data. The pad pattern shown has been developed and tested for optimized assembly at RFMD. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from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

PCB Metal Land and Solder Mask Pattern



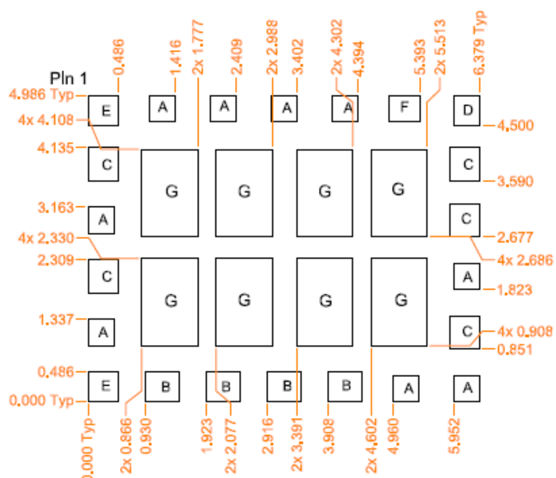
A = 0.475 mm Sq Typ
B = 0.605 x 0.540 mm Typ
C = 0.540 x 0.605 mm Typ
D = 0.475 x 0.540 mm Typ
E = 0.540 mm Sq Typ
F = 0.550 x 0.475 mm
G = 4.900 x 3.500 mm

PCB METAL LAND PATTERN



A = 0.625 mm Sq Typ
B = 0.755 x 0.690 mm Typ
C = 0.690 x 0.755 mm Typ
D = 0.625 x 0.690 mm Typ
E = 0.690 mm Sq Typ
F = 0.700 x 0.625 mm
G = 2.225 x 3.360 mm Typ

PCB SOLDER MASK PATTERN



A = 0.428 mm Sq Typ
B = 0.544 x 0.486 mm Typ
C = 0.486 x 0.544 mm Typ
D = 0.428 x 0.486 mm Typ
E = 0.486 mm Sq Typ
F = 0.495 x 0.428 mm
G = 0.911 x 1.422 mm Typ

PCB STENCIL PATTERN

Tape and Reel

Carrier tape basic dimensions are based on EIA 481. The pocket is designed to hold the part for shipping and loading onto SMT manufacturing equipment, while protecting the body and the solder terminals from damaging stresses. The individual pocket design can vary from vendor to vendor, but width and pitch will be consistent.

Carrier tape is wound or placed onto a shipping reel either 330mm (13 inches) in diameter or 178mm (7 inches) in diameter. The center hub design is large enough to ensure the radius formed by the carrier tape around it does not put unnecessary stress on the parts.

Prior to shipping, moisture sensitive parts (MSL level 2a-5a) are baked and placed into the pockets of the carrier tape. A cover tape is sealed over the top of the entire length of the carrier tape. The reel is sealed in a moisture barrier ESD bag with the appropriate units of desiccant and a humidity indicator card, which is placed in a cardboard shipping box. It is important to note that unused moisture sensitive parts need to be resealed in the moisture barrier bag. If the reels exceed the exposure limit and need to be rebaked, most carrier tape and shipping reels are not rated as bakeable at 125°C. If baking is required, devices may be baked according to section 4, table 4-1, of Joint Industry Standard IPC/JEDEC J-STD-033.

The table below provides information for carrier tape and reels used for shipping the devices described in this document.

Tape and Reel

RFMD Part Number	Reel Diameter Inch (mm)	Hub Diameter Inch (mm)	Width (mm)	Pocket Pitch (mm)	Feed	Units per Reel
RF7176TR13	13 (330)	4 (102)	12	8	Single	2500
RF7176TR7	7 (178)	2.4 (61)	12	8	Single	750

Unless otherwise specified, all dimension tolerances per EIA-481.

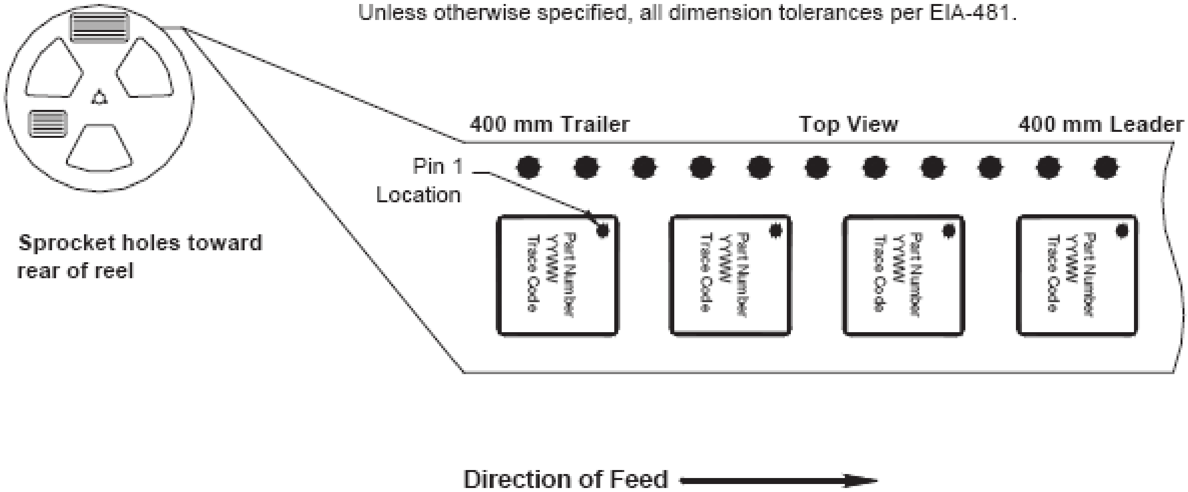


Figure 1. 5.24mmx6.63mm (Carrier Tape Drawing with Part Orientation)

RoHS* Banned Material Content

RoHS Compliant:	Yes
Package total weight in grams (g):	0.121
Compliance Date Code:	-
Bill of Materials Revision:	-
Pb Free Category:	e4

Bill of Materials	Parts Per Million (PPM)					
	Pb	Cd	Hg	Cr VI	PBB	PBDE
Die	0	0	0	0	0	0
Molding Compound	0	0	0	0	0	0
Lead Frame	0	0	0	0	0	0
Die Attach Epoxy	0	0	0	0	0	0
Wire	0	0	0	0	0	0
Solder Plating	0	0	0	0	0	0

This RoHS banned material content declaration was prepared solely on information, including analytical data, provided to RFMD by its suppliers, and applies to the Bill of Materials (BOM) revision noted above.

* DIRECTIVE 2002/95/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment