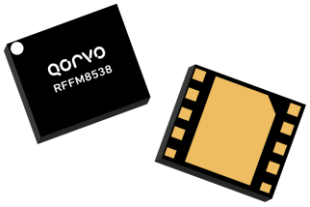
RFFM8538

5.0 GHz Wi-Fi Front-End Module

10 Pin 2.0 x 1.7 mm Laminate Package

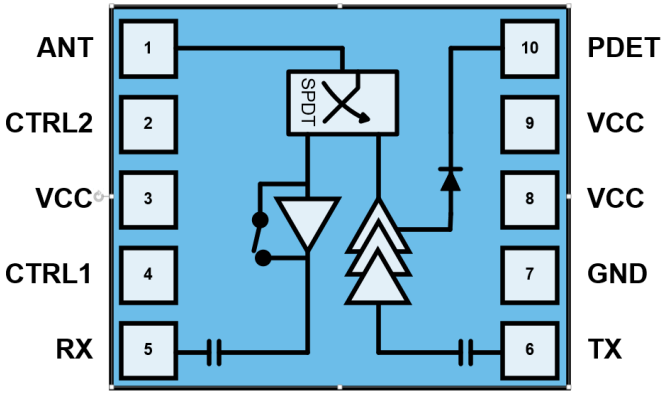


Product Overview

The RFFM8538 provides a complete integrated solution in a single front end module (FEM) for WiFi 802.11a/n/ac systems. The next generation ultra-small factor and integrated matchings minimizes layout area in the customer's application reduces the bill of materials and greatly reduces the number of external components. Performance is focused on a balance of efficiency to enable long battery life and linear power that increases the range of connection.

RFFM8538 integrates a 5 GHz power amplifier (PA), single pole double throw switch (SP2T), LNA with bypass, and a power detector coupler for improved accuracy.

Functional Block Diagram



Top View

Key Features

- P_{out} = 18.5 dBm, 802.11ac, 80MHz MCS9 at -39dB
- High Efficiency
- Internally matched RF input/output to 50 ohms
- Integrated 5 GHz PA, SP2T, LNA with Bypass and PDET
- Low Height Package,suited for SiP and CoB designs

Applications

- IEEE 802.11a/n/ac WLAN Applications
- Single-Placement RF Front-End Module
- Single-band and Dual-band Wireless LAN Systems
- Portable Battery-Powered Equipment

Ordering Information

Part Number	Description
RFFM8538SB	5 piece sample bag
RFFM8538SQ	25 piece sample bag
RFFM8538SR	7" Reel with 100 pieces
RFFM8538TR7	7" Reel with 2500 pieces
RFFM8538PCK-410	Fully Assembled Eval Board w/ 5-piece sample bag

Absolute Maximum Ratings

PARAMETER	CONDITIONS	RATING
Storage Temperature		-40 to 150 ºC
DC Supply Voltage	No RF Applied	−0.5 to +6.0 V
PA Enable Voltage		−0.5 to +5.0 V
DC Supply Current		800 mA
RF Maximum Input Power (Tx Mode/Rx Mode)	CW, 50Ω, VCC=3.7 V, T=25 ºC	+12 dBm
RF Maximum Input Power (Rx Bypass Mode)	CW, 50Ω, VCC=3.7 V, T=25 ºC	+25 dBm

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Frequency		5150	-	5925	MHz
Extended Operating Frequency		4900		5925	MHz
Operating Temperature		−20	25	65	ºC
Extended Operating Temperature	Functional with reduced performance	−40	25	85	ºC
Operating Voltage V_{CC}		3.0	3.7	4.4	V
Extended Operating Voltage V_{CC}	Functional with reduced performance	3.0	-	5.0	V
Control Voltage (V-high)	CTRL1	2.8	2.95	Vcc	V
Control Voltage (V-high)	CTRL2	2.8	3.3	Vcc	V
Control Voltage (V-Low)	CTRL1 / CTRL2	-	0	0.4	V
Control Current (I-high)	CTRL1	-	300	350	uA
Control Current (I-high)	CTRL2	-	100	200	uA
Control Current (I-low)	CTRL1 / CTRL2	-	0.1	1	uA
Leakage Current	CTRL1 / CTRL2 = 0.1 V, Vcc = 4.4 V	-	5	15	uA

Electrical specifications are measured at nominal operating conditions. Unless noted otherwise.

Logic Truth Table

MODE	CTRL1	CTRL2
802.11a/n/ac TX Mode	High	Low
802.11a/n/ac RX Gain	Low	High
802.11a/n/ac RX Bypass	Low	Low
Standby	Low	Low

Note: High = +2.8 to Vcc, Low = 0 V to +0.4 V.

Electrical Specifications – 5 GHz Transmit

(V_{CC}=3.7V; Temp=25°C; unless noted otherwise)

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Frequency		5150	-	5925	MHz
Small Signal Gain		26	28	-	dB
Gain Flatness	For any 80 MHz bandwidth	−0.25	-	+0.25	dB
Margin to Spectrum Emission Mask 11a, 6 Mbps	Pout = 22.0 dBm	-	3.0	-	dB
Margin to Spectrum Emission Mask 11n, MCS0 HT20	Pout = 21.0 dBm	-	3.0	-	dB
11a, 54 Mbps	Output Power	+18.5	+19	-	dBm
	DEVM	-	−34	−32	dB
11n, MCS7 HT20	Output Power	+18	+19	-	dBm
	DEVM	-	−38	−34	dB
11ac, MCS9 VHT40 / 80	Output Power	+17.5	+18.5	-	dBm
	DEVM	-	−39	−35	dB
Current 11a, 6 Mbps	Pout = 22.0 dBm	-	280	320	mA
Current 11a, 54 Mbps	Pout = 19.0 dBm	-	240	280	mA
Current 11n, MCS7 HT20	Pout = 19.0 dBm	-	240	280	mA
Current 11ac, MCS9 VHT40 / 80	Pout = 17.5 dBm	-	220	270	mA
Harmonics ($2f_0$), 6 Mbps	Pout = 22.0 dBm	-	−30	-	dBm/MHz
Harmonics ($3f_0$), 6 Mbps	Pout = 22.0 dBm	-	−35	-	dBm/MHz
OOB Gain	800 – 900 MHz	-	-	−57	dB
	1800 – 2100 MHz	-	-	−44	dB
	2300 – 2400 MHz	-	-	−41	dB
	2490 – 2690 MHz	-	-	−34	dB
	3400 – 3800 MHz	-	-	5	dB
	3800 – 4400 MHz	-	-	20	dB
	7250 – 7700 MHz	-	-	23	dB
	10500 – 17000 MHz	-	-	−13	dB
PA Turn-on Time from CTRL1 edge	10% to 90% of final gain	-	200	-	nS
PA Turn-off Time from CTRL1 edge	90% to 10% of final gain	-	200	-	nS
Return Loss – TX Port		-	6	-	dB
Return Loss – ANT Port		-	15	-	dB
PA Stability	Unconditionally stable into 4:1 VSWR at rated power level.	-	-	22	dBm
Ruggedness	At typical operating conditions	-	-	10:1	VSWR
Control Line Impedance CTRL1		-	2	-	M Ω
Power Detector Voltage Low	Pout = 5 dBm	0.2	-	-	V
Power Detector Voltage High	Pout = 22 dBm	-	-	1	V

Operating condition is +25degC at 3.7V unless otherwise noted.

Electrical Specifications – 5.0 GHz Receive
(V_{CC}=3.7V; Temp=25°C; unless noted otherwise)

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Frequency		5150	-	5925	MHz
Gain		10	12	-	dB
Gain Flatness	For any 80 MHz bandwidth	−0.25	-	+0.25	dB
Noise Figure		-	2.5	2.8	dB
Current		-	8	13	mA
Input IP2 – LNA mode	2500-2700 MHz, LNA Enabled	-	55	-	dBm
Input IP3 – LNA mode	1700-2700 MHz, LNA Enabled	-	15	-	dBm
Input IP3 – LNA mode	LNA Enabled	-	5	-	dBm
P1dB		-	−5	-	dBm
OOB Gain	2400-2480 MHz	-	-	−42	dB
	2480-3800 MHz	-	-	−6	dB
LNA Turn-on Time from CTRL2 edge	10% to 90% of final gain	-	500	-	nS
LNA Turn-off Time from CTRL2 edge	90% to 10% of final gain	-	500	-	nS
Control Line Impedance CTRL2		-	2	-	M Ω
Return Loss RX Port		6	-	-	dB
Return Loss ANT Port		5	-	-	dB

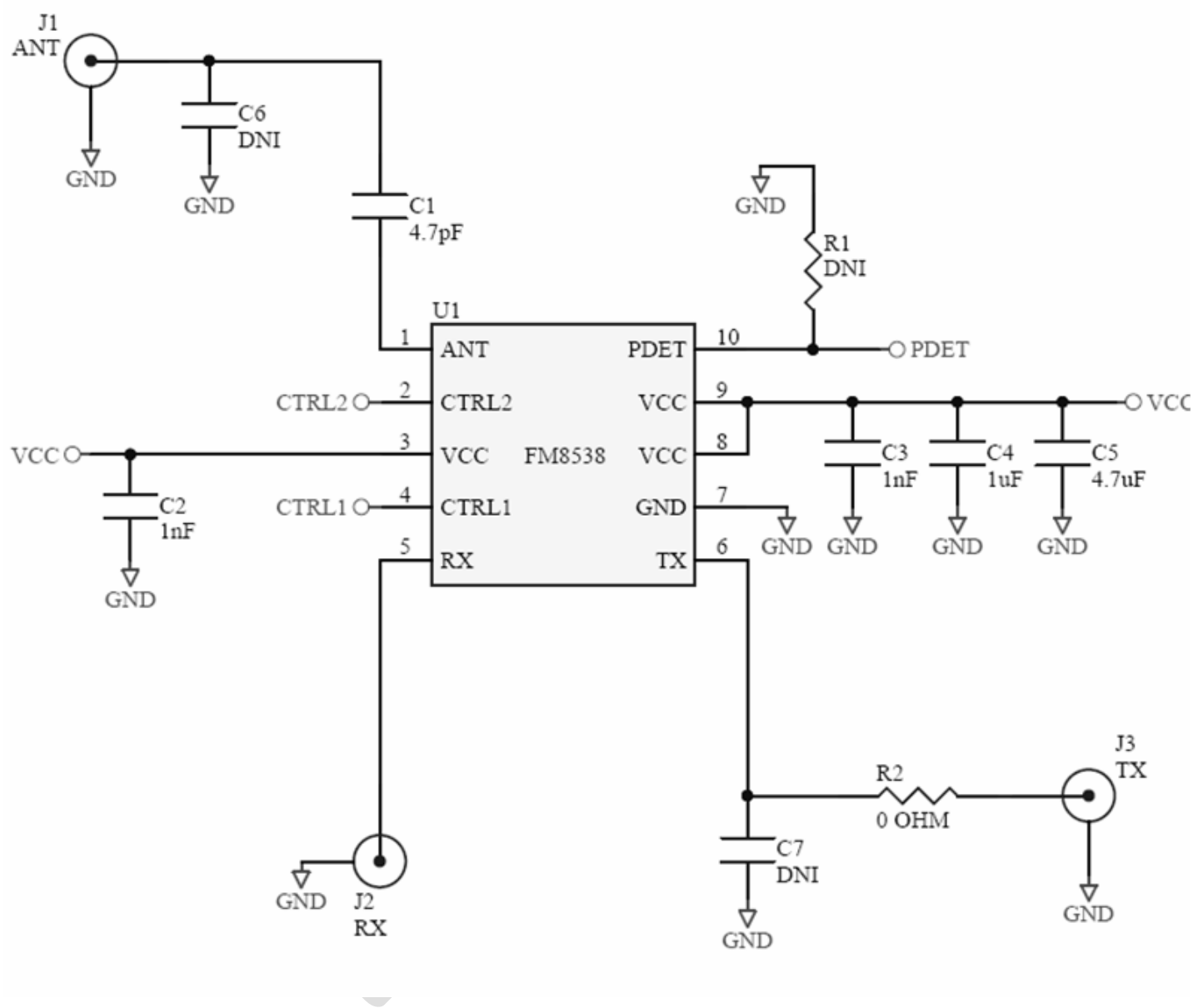
Operating condition is +25degC at +3.7 V unless otherwise noted.

Electrical Specifications – 5.0 GHz Rx Bypass
(Vcc=3.7V; Temp=25°C; unless noted otherwise)

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Frequency		5150	-	5925	MHz
Gain		-	− 4.5	−6	dB
Gain Flatness	Across band	−0.25	-	+0.25	dB
Return Loss – RX Port		7	-	-	dB
Return Loss – ANT Port		15	20	-	dBm
P1dB		-	15	-	dBm
Input IP3		-	18	-	dBm

Test condition is +25°C at +3.7V unless otherwise noted.

Application Circuit Schematic

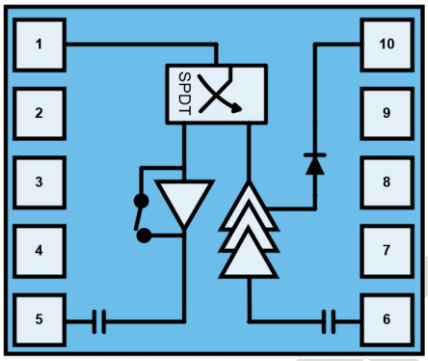


***Note: R1=DNI when populated with RFFM8248. Otherwise, please use R1=3.9 kΩ**

Bill of Material

REF. DES.	QTY	DESCRIPTION	MANUF.	PART NUMBER
PCB	1	PCB, FM8538	Performance Micro	RFFM8538-410(A)
C1	1	CAP, 10pF, 5%, 25V, HI_Q, 0201	Murata	GJM0335C1E100JB01D
C2, C3	2	CAP, 1000pF, 10%, 50V, X7R, 0201	Kamaya	GRM033R71C102KA01D
C5	1	CAP, 4.7uF, 10%, 16V, X7R, SFT TERM, 0805	TDK	CGA4J3X7R1C475K125AE
C4	1	CAP, 1uF, 20%, 6.3V, X5R, 0201	Murata	GRM033R60J105MEA2D
J1, J2, J3, J4, J99, J100	6	CONN, SMA, END LNCH, UNIV, HYB MNT, FLT	Molex	SD-73251-4000
P1, P2	1	CONN, HDR, ST, PLRZD, 3-PIN, 0.100"	ITW Pancon	MPSS100-3-C

Pin Configuration and Description

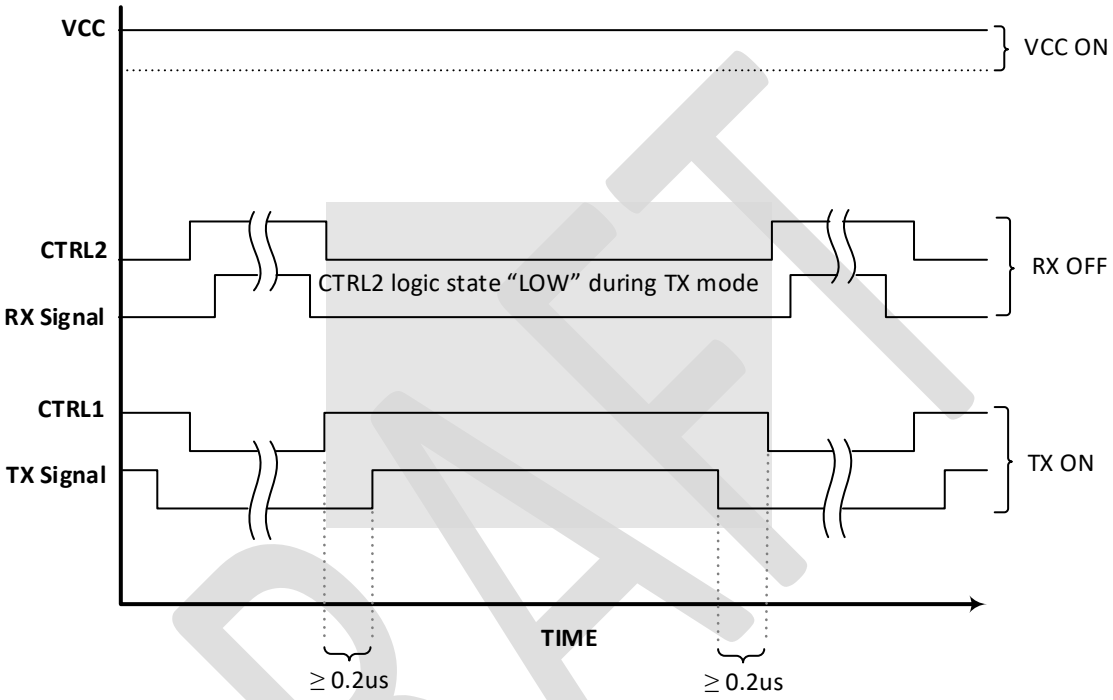


Top View

Pin Number	Label	Description
1	ANT	RF bidirectional antenna port matched to 50Ω. An external DC block is required.
2	CTRL2	Logic control voltage 2. See truth table for proper voltage settings
3,8,9	VCC	DC Power Supply voltage
4	CTRL1	Logic control voltage 1. See truth table for proper voltage settings
5	RX	RF output port for the 802.11a/n/ac A. This port is matched to 50Ω and DC blocked internally
6	TX	RF input port for the 802.11a/n/ac PA. This port is matched to 50Ω and DC blocked internally
7	GND	Ground connection
10	PDET	Power detector output PDET
Backside Pad	GND	Ground connection. The back side of the package should be connected to the ground plan though as short of a connection as possible. PCB vias under the device are required.

Timing Diagram

RFFM8538 Transmit Mode
RF/DC Power ON/OFF Sequence



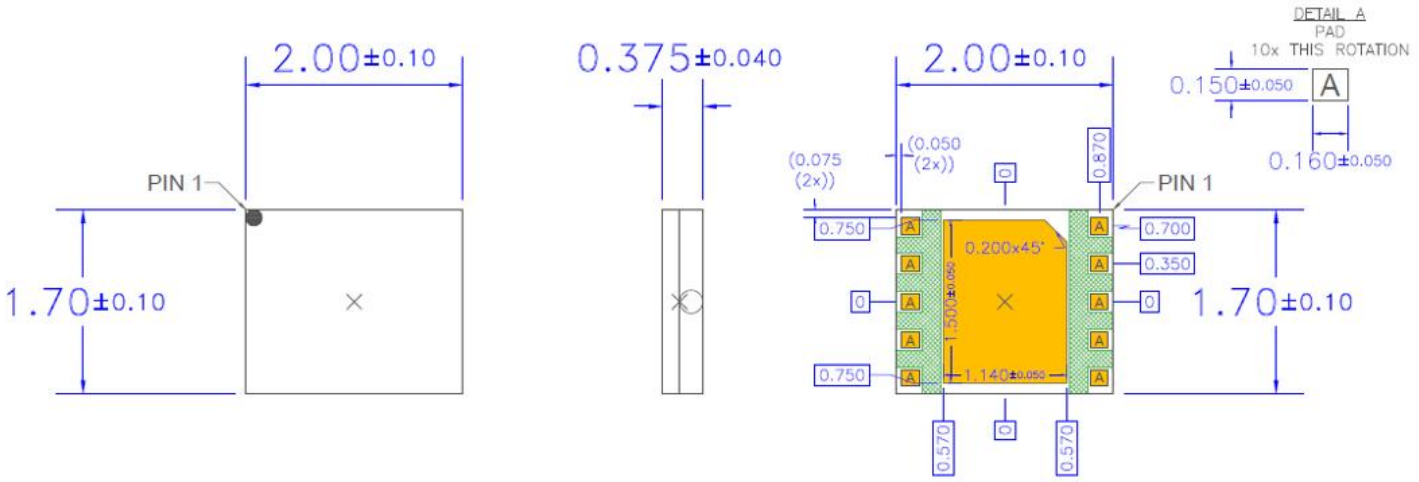
Note:
Observe the timing sequence shown in the diagram above and described below. DC, RF, and ON/OFF Time signal levels per datasheet specifications.

- Apply VCC prior to turning CTRL1 ON
- Turn CTRL1 ON prior to applying RF signal
- Turn RF signal OFF prior to turning CTRL1 OFF
- Turn CTRL1 OFF prior to turning VCC OFF
- TX/RX simultaneous transition is allowed

Package Outline Drawing

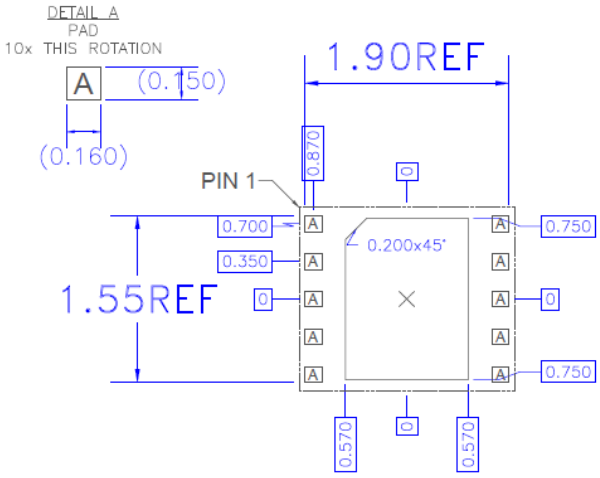
Marking: Part number – RFFM8538

Trace code – XXXX

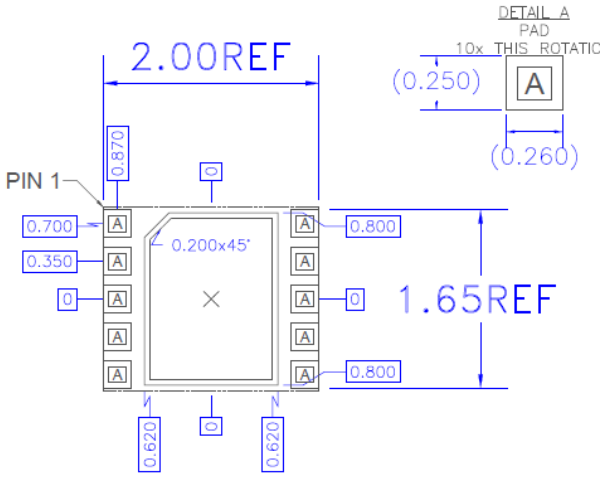


TOP VIEW **SIDE VIEW** **BOTTOM VIEW**

Recommended PCB Patterns



RECOMMENDED
LAND PATTERN



RECOMMENDED
LAND PATTERN MASK

Notes:

1. All dimensions are in microns. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESD/JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JESD22-C101

Caution!

ESD sensitive device

Solderability

Compatible with both lead-free (260 °C max. reflow temperature) and tin/lead (245 °C max. reflow temperature) soldering processes.

Package lead plating: Ni/Au

RoHS Compliance

This part is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- SVHC Free