Linear RF Power Amplifier For Quad-Band GSM/GPRS/EDGE /TD-SCDMA/TDD-LTE With SP16T Antenna Switch

Product ID：VC7916-62

Version：1.0

Preliminary Datasheet

Vanchip Technologies

Revision History

Version	Date	Author	Modify Description
1.0	May 2, 2018	Vanchip	Datasheet

Features

- Small package: 5.5 x 5.3 x 0.83mm
- ±8KV ESD Protection at Antenna Port
- MIPI RFFE Digital Interface
- Integrated Antenna Switches
- Linear EDGE Operation
- 14 Low Insertion Loss TRx Ports
- TRx Ports interchangeable
- Integrated Low Pass TX Harmonic Filter
- Advanced HBT/CMOS/SOI Process
- GPRS multi-mode capability Class 12
- Support TD-SCDMA B34/B39
- Support TDD-LTE B34/B39
- Support APT, buck DC-DC supply

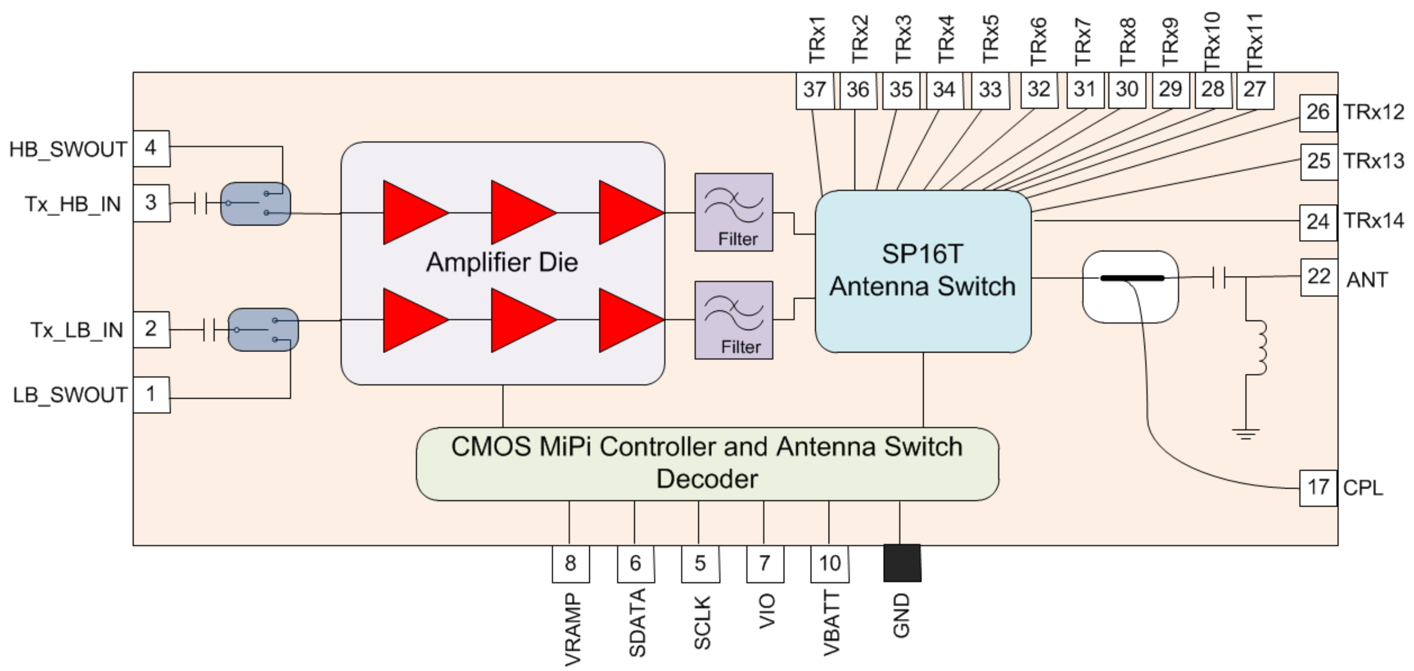
Product Description

The VC7916-62 is a high-power, high-efficiency transmit and receive Front-End Module for Quad-band GSM850/GSM900/DCS1800/PCS1900 operation. The FEM also supports Class 12 GPRS multi-slot operation ,linear EDGE operation ,TD-SCDMA HSPA and TDD-LTE.

This FEM builds upon Vanchip's unique power amplifier technology to provide maximum efficiency and over current protection, reduce output power variation under mismatched load. Integrated antenna switch module reduces PCB size, and interchangeable TRx ports are easy for layout and application. The module provides 50Ω matched input and output ports.

The VC7916-62 can sustain ±8KV ESD at Antenna port without external components. The module can sustain 20:1 VSWR mismatched condition on Antenna Port.

VC7916-62 Function Block Diagram



Absolute Maximum Ratings [1,2,3]

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply	VBATT	-1.2	–	6	V
Power Control Voltage	Vramp	-0.3	–	3	V
Input RF Power	Pin	–	–	15	dBm
Max. Burst Duty Cycle	DT	–	–	50	%
Output Load VSWR (Ruggedness)	Ru	–	–	20:1	VSWR
Current Continuous During Burst [3]	$I_{\_VBATT}$			2.5	A
MIPI Supply Voltage	VIO	–	–	2	V
MIPI Data and Clock Voltage	$V_{\_SDATA,SCLK}$	–	–	2	V
Operating Case Temperature	$T_{\_CASE}$	-30	–	+100	°C
Storage Temperature	$T_{\_STG}$	-40	–	+150	°C
Reflow Solder Temperature (J-STD-020B)	$T_{\_SOLDER}$	+260	–	–	°C
Moisture Sensitivity Level	MSL			3	
ESD Antenna Port	$ESD_{\_ANT}$	-8	–	+8	KV
ESD All Pins (Charge Device Model)	$ESD_{\_CDM}$	-1	–	+1	KV
ESD All Pins (Human Body Model)	$ESD_{\_HBM}$	-1	–	+1	KV

1. Exceeding any one more maximum rating conditions for extended periods may reduce device reliability and also may cause permanent damage to the device.
2. There is no damage to device with only one parameter set at the limit at a time and all other parameters set at recommended operating conditions.
3. Applied voltage must be current-limited to specified range.

Recommended Operating Conditions[1,2]

Parameter	Symbol	Min	Typ.	Max	Unit	Test Condition
Supply Voltage VCC	VCC	3.1	3.5	4.6	V	
Supply Voltage VBATT	VBATT	0.9	3.5	4.6	V	
MIPI Supply	VIO	1.65	1.8	1.95	V	
MIPI Signal Level (SCLK,SDATA)	$V_{\_MIPI\_LOW}$	0		0.2*VIO	V	Signal Level Low
	$V_{\_MIPI\_HIGH}$	0.8*VIO	1.8	VIO	V	Signal Level High
Leakage Current (VBATT)	$I_{\_LEAK}$			20	uA	Applied DC Only： VCC = VBATT = 4.6V, VIO = 0V
TRx Mode Current	$I_{\_TRx}$		150	300	uA	Ta= 25˚C
Operating Temperature Range	$T_{\_range}$	-25	+25	+85	˚C	

1. Normal Test Condition (NTC), defined as VBATT = VCC = 3.5V, Ta = 25˚C
2. Extreme Test Condition (ETC), defined as VBATT = VCC = 3.1V to 4.6V, T = $T_{\_range}$

MIPI RFFE REGISTER MAP (1)

Data Bit	Description	Trigger Mode	R/W	Default	Notes		
Register 0, Address 0x00 (Mode Control)							
[7]	Register Map and Power Control Selector	Trigger0	R/W	0	Linear GMSK Power Control register map		
[6:3]	PA Bias Mode Control			0000	0000 = LB EDGE	0100 = B34/39 TD-SCDMA	0110 = LB Switch OUT
					0001 = HB EDGE	0101 = B34/39 TDD LTE	0111 = HB Switch OUT
					0010 = LB GMSK	0011 = HB GMSK	
[2]	PA Enable			0	0 = PA Tx Disabled, 1 = PA Tx Enabled		
[1:0]	Power Gain Mode			00	00 = High Power Mode (HPM) 01 = Mid Power Mode (MPM) 10 = Low Power Mode (LPM) 11 = Ultra-Low Power Mode (ULPM)		
Register 1, Address 0x01 (Reserved)							
[7:0]	Reserved	Trigger0	R/W	00000000	Reserved		
Register 2, Address 0x02 (Switch Control)							
[7:5]	Reserved	Trigger0	R/W	000	Reserved		
					0x00 = Standby	0x08 = TRx4	0x10 = TRx1
[4:0]	Switch Control			00000	0x01 = TRx10	0x09 = LB PA Tx	0x11 = TRx2
					0x02 = TRx9	0x0A = Forward Isolation	0x12 = TRx11
					0x03 = Forward Isolation	0x0B = HB PA Tx	0x13 = TRx12
					0x04 = TRx5	0x0C = TRx3	0x14 = TRx13
					0x05 = TRx7		0x15 = TRx14
					0x06 = TRx6	0x0E = Forward Isolation	
					0x07 = TRx8		Other = Reserved (Do Not Use)
Register 3, Address 0x03 (RESERVED)							
[7:0]	Reserved	Trigger0	R/W	00000000	Reserved		
Register 4, Address 0x04 (RESERVED)							
[7:0]	Reserved	Trigger0	R/W	00000000	Reserved		
Register 5, Address 0x05 (RESERVED)							
[7:0]	Reserved	Trigger0	R/W	00000000	Reserved		
Register 6, Address 0x06 (RESERVED)							
[7:0]	Reserved	Trigger0	R/W	00000000	Reserved		

MIPI RFFE REGISTER MAP (2)

Data Bit	Description	Trigger Mode	R/W	Default	Notes
Register 26, Address 0x1A (RFFE Status)					
[7]	Software Reset	No	R/W	0	Reset all configurable registers to the default values except for USID, GROUP_SID, and PM_TRIG. The RFFE_STATUS register should be reset after it is read. 0: normal operation ; 1: software reset.
[6]	Command_Frame _parity_Err			0	Command Sequence received with parity error – discard command. The RFFE_STATUS register shall reset after it is read.
[5]	Command_Length _parity_Err			0	Command length error. The RFFE_STATUS register shall reset after it is read.
[4]	Address_Frame _parity_Err			0	Address frame with parity error. The RFFE_STATUS register shall reset after it is read.
[3]	Data_Frame _parity_Err			0	Data frame with parity error. The RFFE_STATUS register shall reset after it is read.
[2]	Read_Unused_Reg			0	Read command to an invalid address. The RFFE_STATUS register shall reset after it is read.
[1]	Write_Unused_Reg			0	Write command to an invalid address. The RFFE_STATUS register shall reset after it is read.
[0]	Bid_Gid_Err			0	Read command with a BROADCAST_ID or GROUP_ID. The RFFE_STATUS register shall reset after it is read.
Register 27, Address 0x1B (GROUP_ID)					
[7:4]	Reserved	No	R/W	0000	Reserved
[3:0]	Group SID			0000	Group slave ID
Register 28, Address 0x1C (PM_TRIG)					
[7:6]	PWR_MODE	No	R/W	00	00 = Normal Operation (Active) 01 = Default Settings (Startup) 10 = Low Power 11 = Reserved
[5]	Trigger Mask 2			0	Trigger Enable: 0, Trigger Disable: 1
[4]	Trigger Mask 1			0	Trigger Enable: 0, Trigger Disable: 1
[3]	Trigger Mask 0			0	Trigger Enable: 0, Trigger Disable: 1
[2]	Trigger Register 2			0	Not supported
[1]	Trigger Register 1			0	(Reserved)
[0]	Trigger Register 0			0	1 = Latch Register 0,1 contents
Register 29, Address 0x1D (PROD_ID)					
[7:0]	Product ID	No	R	10010110	Product ID[7:0] = 0x96
Register 30, Address 0x1E (MAN_ID)					
[7:0]	Manufacturer ID	No	R	00111000	Manufacture ID[7:0] = 0x38
Register 31, Address 0x1F (USID)					
[7:6]	Reserved	No	R/W	00	Reserved
[5:4]	Manufacturer_ID[MSB]		R	11	Manufacture ID[9:8] = 0x3
[3:0]	USID			1110	USID = 0xE

Table 1: GMSK and 8-PSK Recommended Operation Power Mode

GSM Band	Waveform	PA Power Mode	P_{RATED}	Unit
LB GSM850/GSM900	GMSK	High Power Mode (HPM)	33	dBm
		Medium Power Mode (MPM)	29	dBm
		Low Power Mode (LPM)	23	dBm
		Ultra Low Power Mode (ULPM)	15	dBm
	8-PSK	Medium Power Mode (MPM)	27.5	dBm
		Low Power Mode (LPM)	21.5	dBm
		Ultra Low Power Mode (ULPM)	15.5	dBm
HB DCS1800/PCS1900	GMSK	High Power Mode (HPM)	30	dBm
		Medium Power Mode (MPM)	28.5	dBm
		Low Power Mode (LPM)	22.5	dBm
		Ultra-Low Power Mode (ULPM)	14.5	dBm
	8-PSK	Medium Power Mode (MPM)	26.5	dBm
		Low Power Mode (LPM)	20.5	dBm
		Ultra Low Power Mode (ULPM)	14.5	dBm

Electrical Specifications (GSM850/GSM900 GMSK Mode)

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25˚C , Duty Cycle = 25% , Reference to Table 1, unless otherwise specified

Parameter	Symbol	PA Mode	Min.	Typ.	Max.	Unit	Condition
Operation Frequency	$f_{\_GSM850\_TX}$		824		849	MHz	
	$f_{\_GSM900\_TX}$		880		915	MHz	
Max Output Power	$P_{out\_Max\_NTC}$	GMSK_HPM	33	34		dBm	Pin = 8dBm
	$P_{out\_Max\_ETC}$	GMSK_HPM	31			dBm	Pin = 8dBm, ETC
Power Added Efficiency, Max Output power	$PAE_{\_Max\_NTC}$	GMSK_HPM		38		%	Pout = $P_{out\_Max\_NTC;}$ Pin = 8dBm
Power Added Efficiency at Rated Output Power	$PAE_{\_Rated\_HPM}$	GMSK_HPM		35		%	
	$PAE_{\_Rated\_MPM}$	GMSK_MPM		24		%	
	$PAE_{\_Rated\_LPM}$	GMSK_LPM		12		%	
	$PAE_{\_Rated\_ULPM}$	GMSK_ULPM		4		%	
Gain at Rated Output Power	$Gain_{\_Rated\_HPM}$	GMSK_HPM		29.5		dB	
	$Gain_{\_Rated\_MPM}$	GMSK_MPM		28		dB	
	$Gain_{\_Rated\_LPM}$	GMSK_LPM		27		dB	
	$Gain_{\_Rated\_ULPM}$	GMSK_ULPM		24.5		dB	
Gain Variation over Temperature	$\Delta Gain_{\_T}$	GMSK_HPM	-1.5		+1	dB	VBATT = VCC = 3.5V; T = $T_{\_range}$
		GMSK_MPM	-2		+2	dB	
		GMSK_LPM	-2		+2	dB	
		GMSK_ULPM	-1.5		+1.5	dB	
Gain Variation over Voltage	$\Delta Gain_{\_V}$	GMSK_HPM	-1		+0.5	dB	VCC=VBATT = 3.1V to 4.6V
		GMSK_MPM	-0.5		+0.5	dB	
		GMSK_LPM	-0.5		+0.5	dB	
		GMSK_ULPM	-0.5		+0.5	dB	
Output Noise Power	$PN_{\_GSM850RX}$	All GMSK PA Gain Mode at Rated Output Power			-82	dBm	ƒ= 869 to 894MHz, RBW = 100KHz, ETC
	$PN_{\_GSM900RX}$				-80	dBm	ƒ= 925 to 935MHz, RBW = 100KHz, ETC
					-82	dBm	ƒ= 935 to 960MHz, RBW = 100KHz, ETC
	$PN_{\_DCS1800RX}$				-90	dBm	ƒ= 1805 to 1880MHz, RBW = 100KHz, ETC
	$PN_{\_PCS1900RX}$				-90	dBm	ƒ= 1930 to 1990MHz, RBW = 100KHz, ETC
Harmonic	$2f_0$ to $13f_0$	All PA Gain Mode			-33	dBm	Pout ≤ $P_{RATED,}$ ETC
Stability	S	All PA Gain Mode			-36	dBm	Pout ≤ P_{RATED}; VSWR = 6:1,all phases angles, RBW = 1MHz, ETC
Ruggedness	Ru	All PA Gain Mode			20:1	VSWR	No damage or permanent degradation. All phase angles, ETC
Input VSWR	$\Gamma_{\_IN}$	All PA Gain Mode			2.5:1	VSWR	
Switching Transients	$SWT_{\_400KHz}$	GMSK_HPM			-28	dBm	400 KHz offset; measured with 30kHz RBW, Pout ≤ $P_{RATED;}$ T = $T_{\_range}$
		GMSK_MPM			-28	dBm	
		GMSK_LPM			-28	dBm	
		GMSK_ULPM			-28	dBm	
Turn On Time	$T_{\_ON}$	All PA Gain Mode			5	us	from final MIPI command to 90% V_{RF_Peak}
Turn Off Time	$T_{\_OFF}$	All PA Gain Mode			5	us	from final MIPI command to 10% V_{RF_Peak}

Electrical Specifications (DCS1800/PCS1900 GMSK Mode) (1 OF 2)

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25˚C , Duty Cycle = 25% , Reference to Table 1, unless otherwise specified

Parameter	Symbol	PA Mode	Min.	Typ.	Max.	Unit	Condition
Operation Frequency	$f_{\_DCS1800\_TX}$		1710		1785	MHz	
	$f_{\_DCS1900\_TX}$		1850		1910	MHz	
Max Output Power	$P_{out\_Max\_NTC}$	GMSK_HPM	30	31.5		dBm	Pin=6dBm
	$P_{out\_Max\_ETC}$	GMSK_HPM	28			dBm	Pin=6dBm, ETC
Power Added Efficiency, Max Output power	$PAE_{\_Max\_NTC}$	GMSK_HPM		34		%	Pout = $P_{out\_Max\_NTC;}$ Pin = 6 dBm
Power Added Efficiency at Rated Output Power	$PAE_{\_Rated\_HPM}$	GMSK_HPM		30		%	
	$PAE_{\_Rated\_MPM}$	GMSK_MPM		27		%	
	$PAE_{\_Rated\_LPM}$	GMSK_LPM		14		%	
	$PAE_{\_Rated\_ULPM}$	GMSK_ULPM		5		%	
Gain at Rated Output Power	$Gain_{\_Rated\_HPM\_DCS}$	GMSK_HPM		34.5		dB	f= 1710 to 1785MHz
	$Gain_{\_Rated\_MPM\_DCS}$	GMSK_MPM		32		dB	
	$Gain_{\_Rated\_LPM\_DCS}$	GMSK_LPM		31.5		dB	
	$Gain_{\_Rated\_ULPM\_DCS}$	GMSK_ULPM		30		dB	
	$Gain_{\_Rated\_HPM\_PCS}$	GMSK_HPM		33		dB	f= 1850 to 1910MHz
	$Gain_{\_Rated\_MPM\_PCS}$	GMSK_MPM		31		dB	
	$Gain_{\_Rated\_LPM\_PCS}$	GMSK_LPM		29.5		dB	
	$Gain_{\_Rated\_ULPM\_PCS}$	GMSK_ULPM		28		dB	
Gain Variation over Temperature	$\Delta Gain_{\_T}$	GMSK_HPM	-1.5		+1.5	dB	VBATT = VCC = 3.5V; T = $T_{\_range}$
		GMSK_MPM	-1		+1	dB	
		GMSK_LPM	-1		+1	dB	
		GMSK_ULPM	-0.5		+0.5	dB	
Gain Variation over Voltage	$\Delta Gain_{\_V}$	GMSK_HPM	-1		+0.5	dB	VCC=VBATT = 3.1V to 4.6V
		GMSK_MPM	-0.5		+0.5	dB	
		GMSK_LPM	-0.5		+0.5	dB	
		GMSK_ULPM	-0.5		+0.5	dB	

Electrical Specifications (DCS1800/PCS1900 GMSK Mode) (2 OF 2)

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25˚C , Duty Cycle = 25% , Reference to Table 1, unless otherwise specified

Parameter	Symbol	PA Mode	Min.	Typ.	Max.	Unit	Condition
Output Noise Power	$PN_{\_GSM850RX}$	All GMSK PA Gain Mode			-90	dBm	ƒ= 869 to 894MHz, RBW = 100KHz, ETC
	$PN_{\_GSM900RX}$				-90	dBm	ƒ= 935 to 960MHz, RBW = 100KHz, ETC
	$PN_{\_DCS1800RX}$				-83	dBm	ƒ= 1805 to 1880MHz, RBW = 100KHz, ETC
	$PN_{\_PCS1900RX}$				-83	dBm	ƒ= 1930 to 1990MHz, RBW = 100KHz, ETC
Harmonic	$2f_0$ to $7f_0$	All PA Gain Mode			-33	dBm	Pout ≤ $P_{RATED,}$ ETC
Stability	S	All PA Gain Mode			-36	dBm	Pout ≤ P_{RATED}; VSWR = 6:1,all phases angles, RBW = 1MHz, ETC
Ruggedness	Ru	All PA Gain Mode			20:1	VSWR	No damage or permanent degradation. All phase angles, ETC
Input VSWR	$\Gamma_{\_IN}$	All PA Gain Mode			2:1	VSWR	
Switching Transients	$SWT_{\_400KHz}$	GMSK_HPM			-28	dBm	400 KHz offset; measured with 30kHz RBW, Pout ≤ $P_{RATED;}$ T = $T_{\_range}$
		GMSK_MPM			-28	dBm	
		GMSK_LPM			-28	dBm	
		GMSK_ULPM			-28	dBm	
Turn On Time	$T_{\_ON}$	All PA Gain Mode			5	us	from final MIPI command to 90% V_{RF_Peak}
Turn Off Time	$T_{\_OFF}$	All PA Gain Mode			5	us	from final MIPI command to 10% V_{RF_Peak}

Electrical Specifications (GSM850/GSM900 8-PSK Mode)

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25˚C , Duty Cycle = 25% , Reference to Table 1, unless otherwise specified

Parameter	Symbol	PA Mode	Min.	Typ.	Max.	Unit	Condition
Operation Frequency	$f_{\_GSM850\_TX}$		824		849	MHz	
	$f_{\_GSM900\_TX}$		880		915	MHz	
Max Output Power	$P_{out\_Max\_NTC}$	8-PSK_MPM	27.5			dBm	
	$P_{out\_Max\_ETC}$	8-PSK_MPM	26			dBm	T = $T_{\_range}$
PAE at Rated Output Power	$PAE_{\_Rated\_MPM}$	8-PSK_MPM		15		%	
	$PAE_{\_Rated\_LPM}$	8-PSK_LPM		7		%	
	$PAE_{\_Rated\_ULPM}$	8-PSK_ULPM		4		%	
Gain	$Gain_{\_Rated\_MPM}$	8-PSK_MPM		30		dB	
	$Gain_{\_Rated\_LPM}$	8-PSK_LPM		29		dB	
	$Gain_{\_Rated\_ULPM}$	8-PSK_ULPM		26		dB	
Gain Variation over Temperature	$\Delta Gain_{\_T}$	8-PSK_MPM	-2		+2	dB	VBATT = VCC = 3.5V; T = $T_{\_range}$
		8-PSK_LPM	-2		+2	dB	
		8-PSK_ULPM	-2		+2	dB	
Gain Variation over Voltage	$\Delta Gain_{\_V}$	8-PSK_MPM	-1		+0.5	dB	VBATT = VCC = 3.1V to 4.6V
		8-PSK_LPM	-0.5		+0.5	dB	
		8-PSK_ULPM	-0.5		+0.5	dB	
Output Noise Power	$PN_{\_GSM850RX}$	All 8-PSK PA Gain Mode			-82	dBm	ƒ= 869 to 894MHz, RBW = 100KHz, ETC
	$PN_{\_GSM900RX}$				-80	dBm	ƒ= 925 to 935MHz, RBW = 100KHz, ETC
					-82	dBm	ƒ= 935 to 960MHz, RBW = 100KHz, ETC
	$PN_{\_DCS1800RX}$				-90	dBm	ƒ= 1805 to 1880MHz, RBW = 100KHz, ETC
	$PN_{\_PCS1900RX}$				-90	dBm	ƒ= 1930 to 1990MHz, RBW = 100KHz, ETC
Harmonic	$2f_0$ to $13f_0$	All PA Gain Mode			-33	dBm	Pout ≤ $P_{RATED,}$ ETC
Stability	S	All PA Gain Mode			-36	dBm	Pout ≤ P_{RATED}; VSWR = 6:1,all phases angles, RBW = 1MHz, ETC
Ruggedness	Ru	All PA Gain Mode			20:1	VSWR	No damage or permanent degradation. All phase angles, ETC
Input VSWR	$\Gamma_{\_IN}$	All PA Gain Mode			2.5:1	VSWR	
ACPR	$ACPR_{\pm 400KHz}$	8-PSK_MPM		-62	-57	dBc	400 KHz offset; measured with 30kHz RBW, Pout ≤ $P_{RATED;}$
		8-PSK_LPM		-65	-57	dBc	
		8-PSK_ULPM		-67	-57	dBc	
EVM	EVM	8-PSK_MPM		3.5	5	%	Pout ≤ P_{RATED}
		8-PSK_LPM			3.5	%	
		8-PSK_ULPM			3.5	%	

Electrical Specifications (DCS1800/PCS1900 8-PSK Mode)

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25˚C , Duty Cycle = 25% , Reference to Table 1, unless otherwise specified

Parameter	Symbol	PA Mode	Min.	Typ.	Max.	Unit	Condition
Operation Frequency	$f_{\_GSM1800\_TX}$		1710		1785	MHz	
	$f_{\_GSM1900\_TX}$		1850		1910	MHz	
Max Output Power	$P_{out\_Max\_NTC}$	8-PSK_MPM	26.5			dBm	
	$P_{out\_Max\_ETC}$	8-PSK_MPM	25.5			dBm	T = $T_{\_range}$
PAE at Rated Output Power	$PAE_{\_Rated\_MPM}$	8-PSK_MPM		16		%	
	$PAE_{\_Rated\_LPM}$	8-PSK_LPM		8		%	
	$PAE_{\_Rated\_ULPM}$	8-PSK_ULPM		4		%	
Gain	$Gain_{\_Rated\_MPM}$	8-PSK_MPM		36		dB	ƒ= 1710 to 1785MHz
	$Gain_{\_Rated\_LPM}$	8-PSK_LPM		35		dB	
	$Gain_{\_Rated\_ULPM}$	8-PSK_ULPM		32		dB	
	$Gain_{\_Rated\_MPM}$	8-PSK_MPM		34		dB	ƒ= 1850 to 1910MHz
	$Gain_{\_Rated\_LPM}$	8-PSK_LPM		33		dB	
	$Gain_{\_Rated\_ULPM}$	8-PSK_ULPM		30		dB	
Gain Variation over Temperature	$\Delta Gain_{\_T}$	8-PSK_MPM	-1.5		+1	dB	VBATT = VCC = 3.5V; T = $T_{\_range}$
		8-PSK_LPM	-1.5		+1	dB	
		8-PSK_ULPM	-1		+1	dB	
Gain Variation over Voltage	$\Delta Gain_{\_V}$	8-PSK_MPM	-1		+0.5	dB	VBATT = VCC = 3.1V to 4.6V
		8-PSK_LPM	-0.5		+0.5	dB	
		8-PSK_ULPM	-0.5		+0.5	dB	
Output Noise Power	$PN_{\_GSM850RX}$	All 8-PSK PA Gain Mode			-90	dBm	ƒ= 869 to 894MHz, RBW = 100KHz, ETC
	$PN_{\_GSM900RX}$				-90	dBm	ƒ= 935 to 960MHz, RBW = 100KHz, ETC
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Harmonic	$2f_0$ to $7f_0$	All PA Gain Mode			-33	dBm	Pout ≤ $P_{RATED,}$ ETC
Stability	S	All PA Gain Mode			-36	dBm	Pout ≤ P_{RATED}; VSWR = 6:1,all phases angles, RBW = 1MHz, ETC
Ruggedness	Ru	All PA Gain Mode			20:1	VSWR	No damage or permanent degradation. All phase angles, ETC
Input VSWR	$\Gamma_{\_IN}$	All PA Gain Mode			2:1	VSWR	
ACPR	$ACPR_{\pm 400KHz}$	8-PSK_MPM		-63	-57	dBc	400 KHz offset; measured with 30kHz RBW, Pout ≤ $P_{RATED;}$
		8-PSK_LPM		-65	-57	dBc	
		8-PSK_ULPM		-65	-57	dBc	
EVM (w/o Predistortion)	EVM	8-PSK_MPM		3.5	5	%	Pout ≤ P_{RATED}
		8-PSK_LPM			3.5	%	
		8-PSK_ULPM			3.5	%	

Electrical Specifications for TD-SCDMA B39

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25°C, unless otherwise specified
Signal Configuration: ETSI TS 125.102 UL reference measurement channel (12.2 kbps), 16% duty cycle.

Parameter	symbol	PA mode	Min.	Typ.	Max.	Unit	Condition
Operation Frequency	$f_{\_Band39}$		1880		1920	MHz	
Max Output Power	$P_{out\_Max\_NTC}$	MPM	25			dBm	
	$P_{out\_Max\_ETC}$		24			dBm	ETC
Power Gain	$Gain_{\_MPM\_NTC}$	MPM		30		dB	Pout = $P_{out\_Max\_NTC}$
	$Gain_{\_LPM\_NTC}$	LPM		24		dB	Pin = -35dBm
	$Gain_{\_ULPM\_NTC}$	ULPM		21.5		dB	Pin = -35dBm
Gain Variation over ETC	$\Delta Gain_{\_ETC}$	MPM	-2		+2	dB	Pout = $P_{out\_Max\_NTC}$, ETC
		LPM	-1.5		+1	dB	Pin = -35dBm, ETC
		ULPM	-0.5		+0.5	dB	Pin = -35dBm, ETC
Adjacent Channel Leakage Power Ratio	$ACLR1_{\_1.6MHz\_NTC}$	MPM		-40	-33	dBc	Pout ≤ $P_{out\_Max\_NTC}$
	$ACLR2_{\_3.2MHz\_NTC}$			-57	-48		
	$ACLR1_{\_1.6MHz\_ETC}$				-33		Pout ≤ $P_{out\_Max\_ETC}$, ETC
	$ACLR2_{\_3.2MHz\_ETC}$				-46		
EVM	$EVM_{\_RMS\_NTC}$	All PA Mode		2	5	%	Pout ≤ $P_{out\_Max\_NTC}$
Power Added Efficiency	PAE	MPM		17		%	Pout = $P_{out\_Max\_NTC}$
Input VSWR	$\Gamma_{\_IN}$	All PA Mode		2:1		VSWR	
Harmonics	2f0	All PA Mode		-40	-33	dBm	Pout ≤ $P_{out\_Max\_NTC}$,ETC
	3f0			-40	-33		
	≥4f0				-33		Pout ≤ $P_{out\_Max\_NTC}$, Harmonics up to 12.75GHz, ETC
Spectral Emission Margin	SEM1-SEM3	All PA Mode	5			dB	Pout = $P_{out\_Max\_NTC}$, Margin to ETSI SEM mask
Turn On Time	$T_{\_ON}$	All PA Mode			5	us	from final MIPI command to 90% V_{RF_Peak}
Turn Off Time	$T_{\_OFF}$				5	us	from final MIPI command to 10% V_{RF_Peak}
Stability	S	All PA Mode			-36	dBm	Pout ≤ $P_{out\_Max\_NTC}$,VSWR = 6:1, All Phase, RBW = 1MHz, ETC
Ruggedness	Ru	All PA Mode			20:1	VSWR	No damage or permanent degradation. All phase angles, ETC
Noise Power	$PN_{\_GSM900}$	All PA Mode			-95	dBm	f= 925 to 960MHz, Pout ≤ $P_{out\_Max\_NTC}$, RBW = 100kHz , ETC
	$PN_{\_DCS1800}$				-84	dBm	f= 1805 to 1880MHz, Pout ≤ $P_{out\_Max\_NTC}$, RBW = 100kHz, ETC

Electrical Specifications for TD-SCDMA B34

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25°C, unless otherwise specified

Signal Configuration: ETSI TS 125.102 UL reference measurement channel (12.2 kbps), 16% duty cycle.

Parameter	symbol	PA mode	Min.	Typ.	Max.	Unit	Condition
Operation Frequency	$f_{\_Band39}$		2010		2025	MHz	
Max Output Power	$P_{out\_Max\_NTC}$	MPM	25			dBm	
	$P_{out\_Max\_ETC}$		24			dBm	ETC
Power Gain	$Gain_{\_MPM\_NTC}$	MPM		28		dB	Pout = $P_{out\_Max\_NTC}$
	$Gain_{\_LPM\_NTC}$	LPM		22		dB	Pin = -35dBm
	$Gain_{\_ULPM\_NTC}$	ULPM		19.5		dB	Pin = -35dBm
Gain Variation over ETC	$\Delta Gain_{\_ETC}$	MPM	-2		+1.5	dB	Pout = $P_{out\_Max\_NTC}$, ETC
		LPM	-1.5		+1	dB	Pin = -35dBm, ETC
		ULPM	-0.5		+0.5	dB	Pin = -35dBm, ETC
Adjacent Channel Leakage Power Ratio	$ACLR1_{\_1.6MHz\_NTC}$	MPM		-40	-33	dBc	Pout ≤ $P_{out\_Max\_NTC}$
	$ACLR2_{\_3.2MHz\_NTC}$			-57	-48		
	$ACLR1_{\_1.6MHz\_ETC}$				-33		Pout ≤ $P_{out\_Max\_ETC}$, ETC
	$ACLR2_{\_3.2MHz\_ETC}$				-46		
EVM	$EVM_{\_RMS\_NTC}$	All PA Mode		2	5	%	Pout ≤ $P_{out\_Max\_NTC}$
Power Added Efficiency	PAE	MPM		16		%	Pout = $P_{out\_Max\_NTC}$
Input VSWR	$\Gamma_{\_IN}$	All PA Mode		2:1		VSWR	
Harmonics	2*f*0	All PA Mode		-40	-33	dBm	Pout ≤ $P_{out\_Max\_NTC}$, ETC
	3*f*0			-40	-33		
	≥4*f*0				-33		Pout ≤ $P_{out\_Max\_NTC}$, Harmonics up to 12.75GHz, ETC
Spectral Emission Margin	SEM1-SEM3	All PA Mode	5			dB	Pout = $P_{out\_Max\_NTC}$, Margin to ETSI SEM mask
Turn On Time	$T_{\_ON}$	All PA Mode			5	us	from final MIPI command to 90% V_{RF_Peak}
Turn Off Time	$T_{\_OFF}$				5	us	from final MIPI command to 10% V_{RF_Peak}
Stability	S	All PA Mode			-36	dBm	Pout ≤ $P_{out\_Max\_NTC}$,VSWR = 6:1, All Phase, RBW = 1MHz , ETC
Ruggedness	Ru	All PA Mode			20:1	VSWR	No damage or permanent degradation. All phase angles, ETC
Noise Power	$PN_{\_GSM900}$	All PA Mode			-95	dBm	*f* = 925 to 960MHz, Pout ≤ $P_{out\_Max\_NTC}$, RBW = 100kHz, ETC
	$PN_{\_DCS1800}$				-84	dBm	*f* = 1805 to 1880MHz, Pout ≤ $P_{out\_Max\_NTC}$, RBW = 100kHz, ETC

Electrical Specifications for TDD-LTE B39

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25°C, unless otherwise specified
Signal Configuration: 3GPP TS36.101, QPSK/10MHz/12RB, 40% duty cycle, unless otherwise specified

Characteristics	Symbol	PA_mode	Min.	Typ.	Max.	Unit	Test Condition
Operating Frequency	f		1880		1920	MHz	
Maximum Output Power	$P_{out\_Max\_NTC}$	MPM	25			dBm	
	$P_{out\_Max\_ETC}$		24				ETC
Power Gain	$Gain_{\_MPM\_NTC}$	MPM		33		dB	Pout = $P_{out\_Max\_NTC}$
	$Gain_{\_LPM\_NTC}$	LPM		27		dB	Pin = -35dBm
	$Gain_{\_ULPM\_NTC}$	ULPM		24.5		dB	Pin = -35dBm
Gain Variation over ETC	$\Delta Gain_{\_ETC}$	MPM	-2		+2	dB	Pout = $P_{out\_Max\_NTC}$, ETC
		LPM	-1.5		+1.5	dB	Pin = -35dBm, ETC
		ULPM	-1		+1	dB	Pin = -35dBm, ETC
Adjacent Channel Leakage Power Ratio	$E\text{-}UTRA_{\_ACLR\_NTC}$	MPM		-40	-33	dBc	Pout ≤ $P_{out\_Max\_NTC}$
	$UTRA_{\_ACLR1\_NTC}$			-40	-33		
	$UTRA_{\_ACLR2\_NTC}$			-43	-39		
	$E\text{-}UTRA_{\_ACLR\_ETC}$				-33		Pout ≤ $P_{out\_Max\_ETC}$, ETC
	$UTRA_{\_ACLR1\_ETC}$				-33		
	$UTRA_{\_ACLR2\_ETC}$				-36		
EVM	$EVM_{\_RMS\_NTC}$	All PA mode		2.5	5	%	Pout ≤ $P_{out\_Max\_NTC}$
Power Added Efficiency	PAE	MPM		16		%	Pout = $P_{out\_Max\_NTC}$
Input VSWR	$\Gamma_{\_IN}$	All PA mode			2:1	VSWR	
Harmonic	$2f_0$			-40	-33	dBm	Pout ≤ $P_{out\_Max\_NTC}$, ETC
	$3f_0$			-40	-33		
	$\geq 4f_0$				-33		Pout ≤ $P_{out\_Max\_NTC}$, Harmonics up to 12.75GHz , ETC
Spectral Emissions Margin	SEM1–SEM9		5			dB	Pout = $P_{out\_Max\_NTC}$, Margin to ETSI SEM mask
Tx Noise in Rx Bands*	$PN_{\_B34Rx}$				-75	dBm	f = 2010 to 2025 MHz, Pout ≤ $P_{out\_Max\_NTC}$, RBW = 100KHz, ETC
Turn On Time	$T_{\_ON}$				10	us	from final MIPI command to 90% V_{RF_Peak}
Turn Off Time	$T_{\_OFF}$				5	us	from final MIPI command to 10% V_{RF_Peak}
Stability	S				-36	dBm	Pout ≤ $P_{out\_Max\_NTC}$, VSWR = 6:1 , RBW = 1MHz, ETC
Ruggedness	Ru				20:1	VSWR	No damage or permanent degradation. All phase angles, ETC

* Noise power measured with 10MHz/1RB LTE waveform.

Electrical Specifications for TDD-LTE B34

Test Condition: NTC, VBATT = VCC = 3.5V, Ta = 25°C, unless otherwise specified

Signal Configuration: 3GPP TS36.101, QPSK/10MHz/12RB, 40% duty cycle, unless otherwise specified

Characteristics	Symbol	PA_mode	Min.	Typ.	Max.	Unit	Test Condition
Operating Frequency	f		2010		2025	MHz	
Maximum Output Power	$P_{out\_Max\_NTC}$	MPM	25			dBm	
	$P_{out\_Max\_ETC}$		24			dBm	ETC
Power Gain	$Gain_{\_MPM\_NTC}$	MPM		31		dB	Pout = $P_{out\_Max\_NTC}$
	$Gain_{\_LPM\_NTC}$	LPM		25.5		dB	Pin = -35dBm
	$Gain_{\_ULPM\_NTC}$	ULPM		23		dB	Pin = -35dBm
Gain Variation over ETC	$\Delta Gain_{\_ETC}$	MPM	-2		+2	dB	Pout = $P_{out\_Max\_NTC}$, ETC
		LPM	-2		+1	dB	Pin = -35dBm, ETC
		ULPM	-1		+1	dB	Pin = -35dBm, ETC
Adjacent Channel Leakage Power Ratio	$E\text{-}UTRA_{\_ACLR\_NTC}$	MPM		-40	-33	dBc	Pout ≤ $P_{out\_Max\_NTC}$
	$UTRA_{\_ACLR1\_NTC}$			-40	-33		
	$UTRA_{\_ACLR2\_NTC}$			-43	-39		
	$E\text{-}UTRA_{\_ACLR\_ETC}$				-33		Pout ≤ $P_{out\_Max\_ETC}$, ETC
	$UTRA_{\_ACLR1\_ETC}$				-33		
	$UTRA_{\_ACLR2\_ETC}$				-36		
EVM	$EVM_{\_RMS\_NTC}$	All PA mode		2.5	5	%	Pout ≤ $P_{out\_Max\_NTC}$
Power Added Efficiency	PAE	MPM		14		%	Pout = $P_{out\_Max\_NTC}$
Input VSWR	$\Gamma_{\_IN}$	All PA mode			2:1	VSWR	
Harmonic	$2f_0$			-40	-33	dBm	Pout ≤ $P_{out\_Max\_NTC}$, ETC
	$3f_0$			-40	-33		
	$\geq 4f_0$				-33		Pout ≤ $P_{out\_Max\_NTC}$, Harmonics up to 12.75GHz, ETC
Spectral Emissions Margin	SEM1–SEM9		5			dB	Pout = $P_{out\_Max\_NTC}$, Margin to ETSI SEM mask
Tx Noise in Rx Bands*	$PN_{\_B39Rx}$				-75	dBm	f=1880 to 2025 MHz, Pout ≤ $P_{out\_Max\_NTC}$, RBW = 100KHz , ETC
Turn On Time	$T_{\_ON}$				10	us	from final MIPI command to 90% V_{RF_Peak}
Turn Off Time	$T_{\_OFF}$				5	us	from final MIPI command to 10% V_{RF_Peak}
Stability	S				-36	dBm	Pout ≤ $P_{out\_Max\_NTC}$, VSWR = 6:1 , RBW = 1MHz, ETC
Ruggedness	Ru				20:1	VSWR	No damage or permanent degradation. All phase angles, ETC

* Noise power measured with 10MHz/1RB LTE waveform.

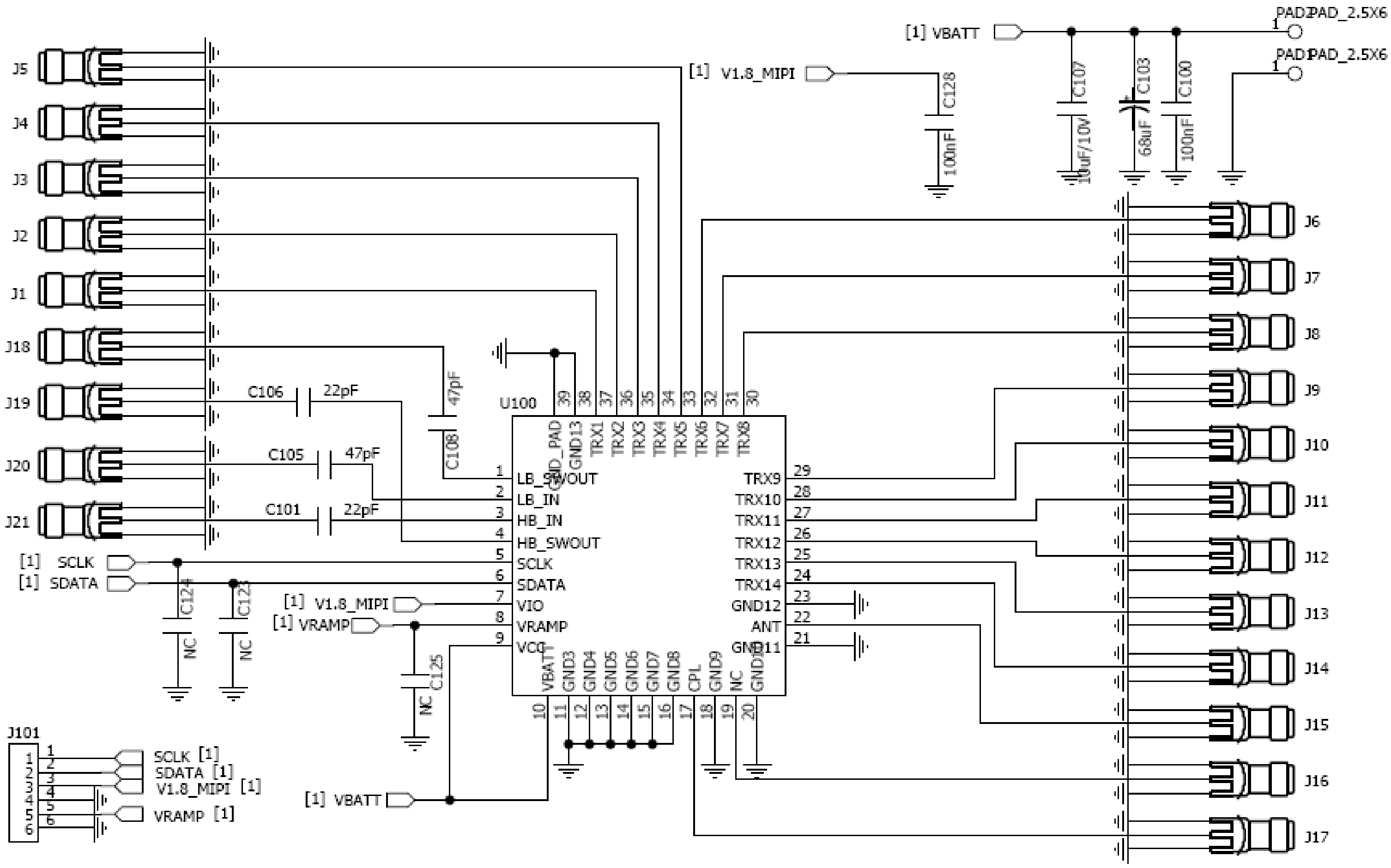
Electrical Specifications for TRx Mode

Test Condition: NTC, VBATT = 3.5V, Ta = 25 °C , unless otherwise specified

RF Ports TRx1 to TRx14						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Frequency Range	*f*	699	—	2690	MHz	
Insertion Loss	$IL_{\_TRx\_LB}$	—	0.8	1.0	dB	*f* = 699 MHz to 960 MHz, All TRx Ports
	$IL_{\_TRx\_MB}$	—	0.9	1.15	dB	*f* = 1710 MHz to 1990 MHz, TRx8
		—	1	1.3	dB	*f* = 1710 MHz to 1990 MHz, TRx3/4/5/6/7/9/10/14
		—	1.2	1.5	dB	*f* = 1710 MHz to 1990 MHz, TRx1/2/11/12/13
	$IL_{\_TRx\_HB}$	—	1.1	1.3	dB	*f* = 2010MHz to 2690 MHz,TRx8
		—	1.25	1.55	dB	*f* = 2010MHz to 2690 MHz,TRx3/4/5/6/7/9/10/14
		—	1.4	1.7	dB	*f* = 2010MHz to 2690 MHz,TRx1/2/11/12
		—	1.6	1.9	dB	*f* = 2010MHz to 2690 MHz,TRx13
TRx Mode Return Loss	RL	—	—	-12	dB	
Isolation (Active TRx port to any adjacent TRx port)	$ISO_{\_ADJ}$	22	28	—	dB	*f* = 699 MHz to 960 MHz
		17	23	—	dB	*f* = 1710 MHz to 1990 MHz
		15	21	—	dB	*f* = 2010 MHz to 2690 MHz
Isolation (Active TRx port to any non-adjacent TRx port)	$ISO_{\_NON\_ADJ}$	26	30	—	dB	*f* = 699 MHz to 960 MHz
		20	25	—	dB	*f* = 1710 MHz to 1990 MHz
		17	22	—	dB	*f* = 2010 MHz to 2690 MHz
TRx Harmonics	$2f_0/3f_0$	—	—	-55	dBm	Power in TRx Port = +27 dBm, NTC
	$2f_{0\_B13}$	—	—	-68	dBm	Power in TRx Port = +25 dBm at 787 MHz, NTC
Second Order Intermodulation Distortion	IMD2	—	—	-105	dBm	CW Pin = 20dBm; $P_{\_BLK}$ = -15dBm
Third Order Intermodulation Distortion	IMD3	—	—	-105	dBm	
Leakage power from Tx to TRx Ports	$P_{\_LEAK}$	—	—	-1	dBm	Any Tx mode to TRx1- TRx8
		—	—	2	dBm	Any Tx mode to TRx9- TRx11
		—	—	9	dBm	Any Tx mode to TRx12- TRx14
Coupling Factor in TRx Mode[1]	$CF_{\_TRX\_LB}$		-28		dB	699 to 960 MHz
	$CF_{\_TRX\_MB}$		-23		dB	1710 to 1990 MHz
	$CF_{\_TRX\_HB}$		-21		dB	2010 to 2690 MHz
TRx to TRx Switching Time	$T_{\_sw}$	—	—	5	us	from final MIPI command to 90% V_{RF_Peak}

1. Coupler Factor defined as the ratio of CPL port to ANT port output power, driven from TRx.

EVB Schematic Illustration



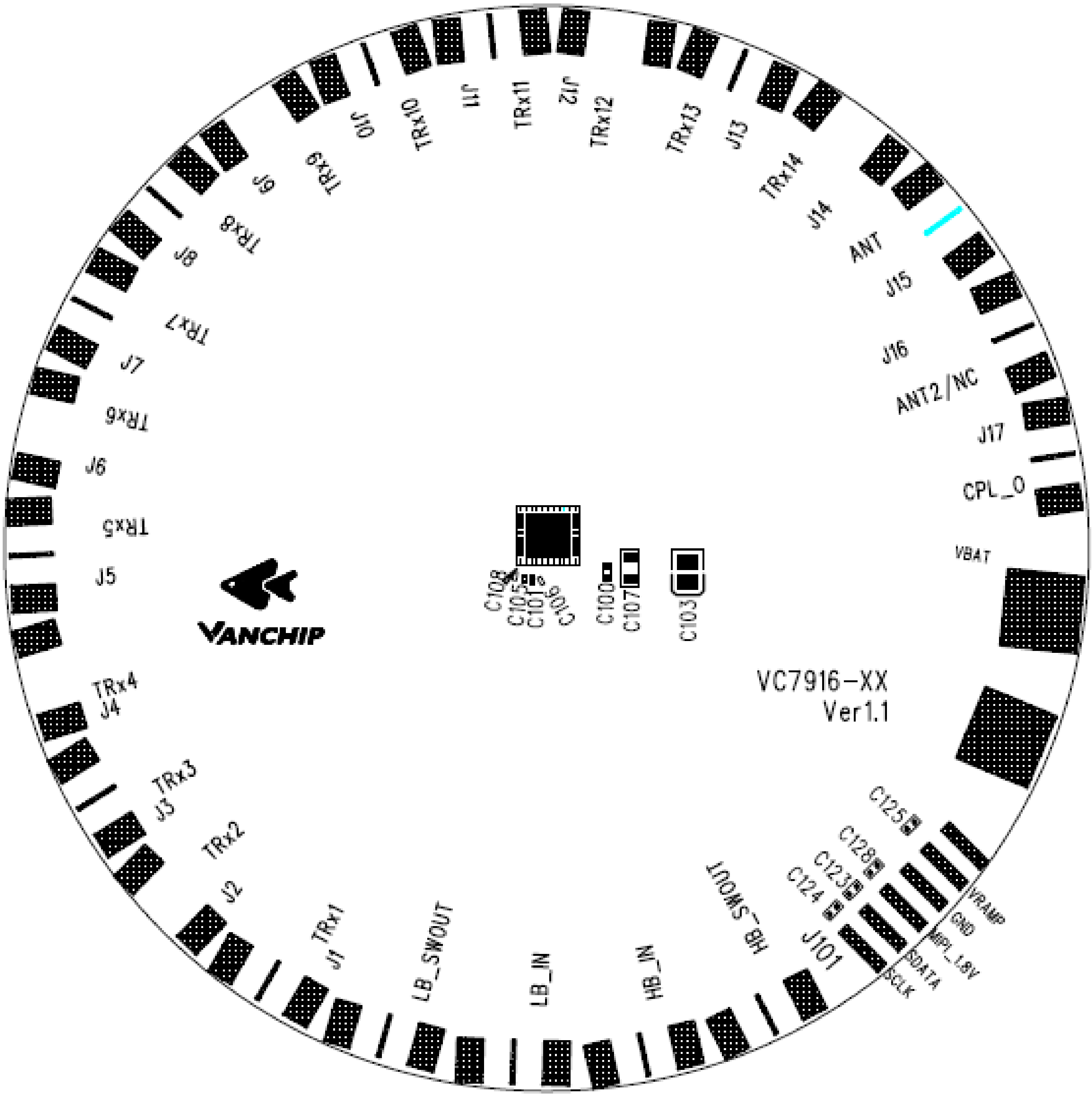
Note:

1. ALL RF Input and output Trace with 50 Ohm Microstrip-line.
2. The Schematic will be compatible with VC7916-61

Bill Of Materials for VC7916-62 EVB

Item	Qty.	Reference	Part Description	Manufacturer
1	2	C105,C108	CAP,0402,47pF,±5%,50V,COG	muRata
2	2	C101.C1106	CAP,0402,22pF,±5%,50V,COG	muRata
3	2	C100, C128	CAP,0402,100nF,±10%,10V,X5R	Yageo
4	1	C103	CAP,TANTALUM,68uF, 6.3V, ±10%	AVX
5	1	C107	CAP,0805,10uF,±20%, 6.3V,X5R	Yageo
6	21	J1,J2,J3,J4,J5,J6,J7,J8,J9,J10,J11, J12,J13,J14,J15,J17,J18,J19,J20, J21,J22	ASSY,JACK End Launch SMA, STR 50OHM	Cinch
7	1	U100	TXM, VC7916-62	Vanchip
8	4	C123,C124,C125,J16	Not Connected	
9	1	J101	Connector,6PIN	

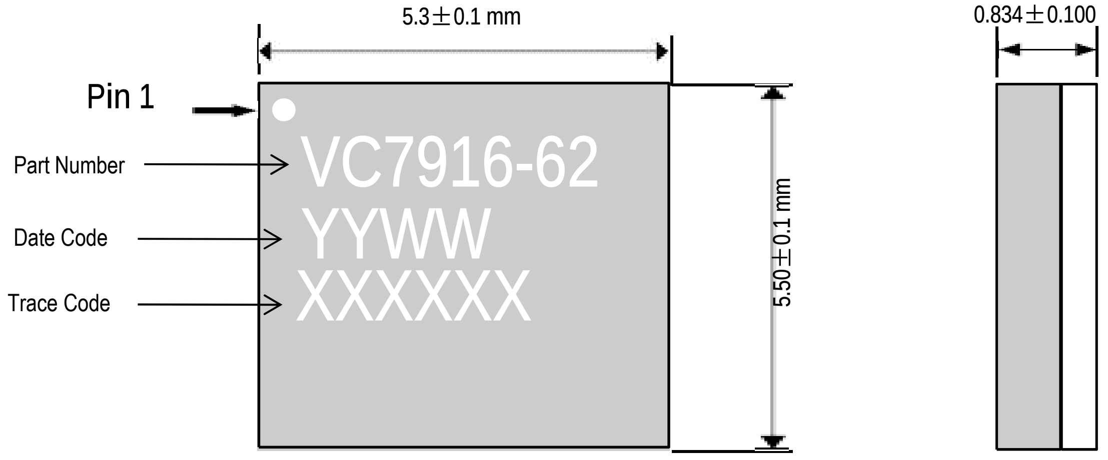
EVB TOP Assembly Illustration

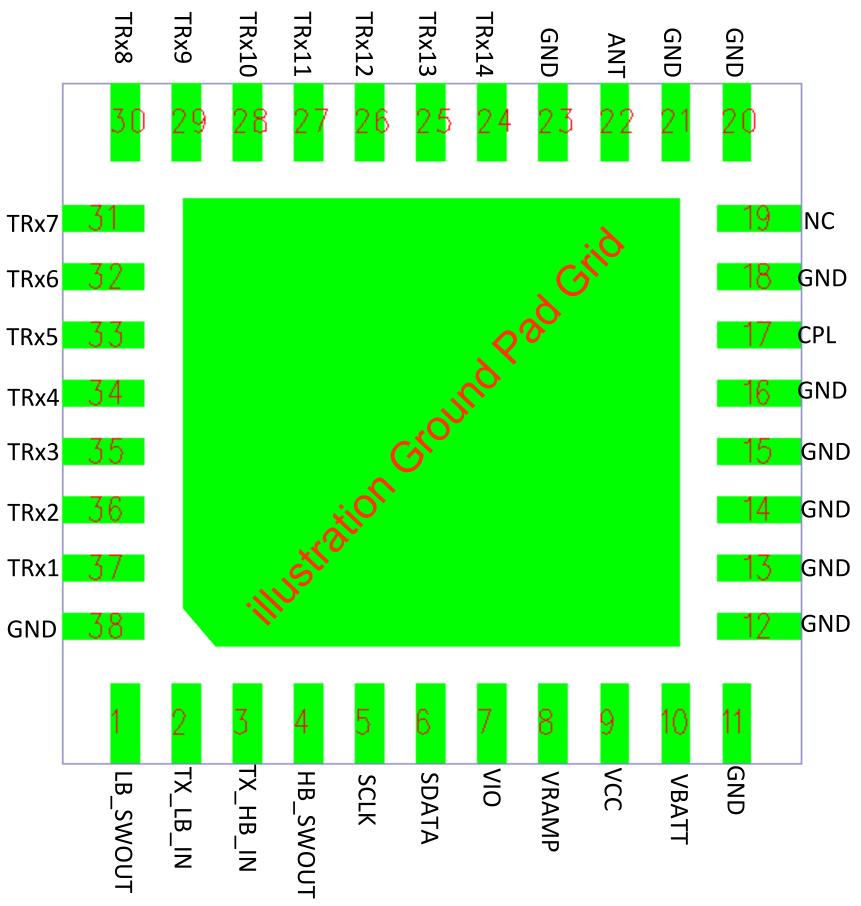


Note:

1. The EVB will be compatible with VC7916-61

Pin illustration and Description

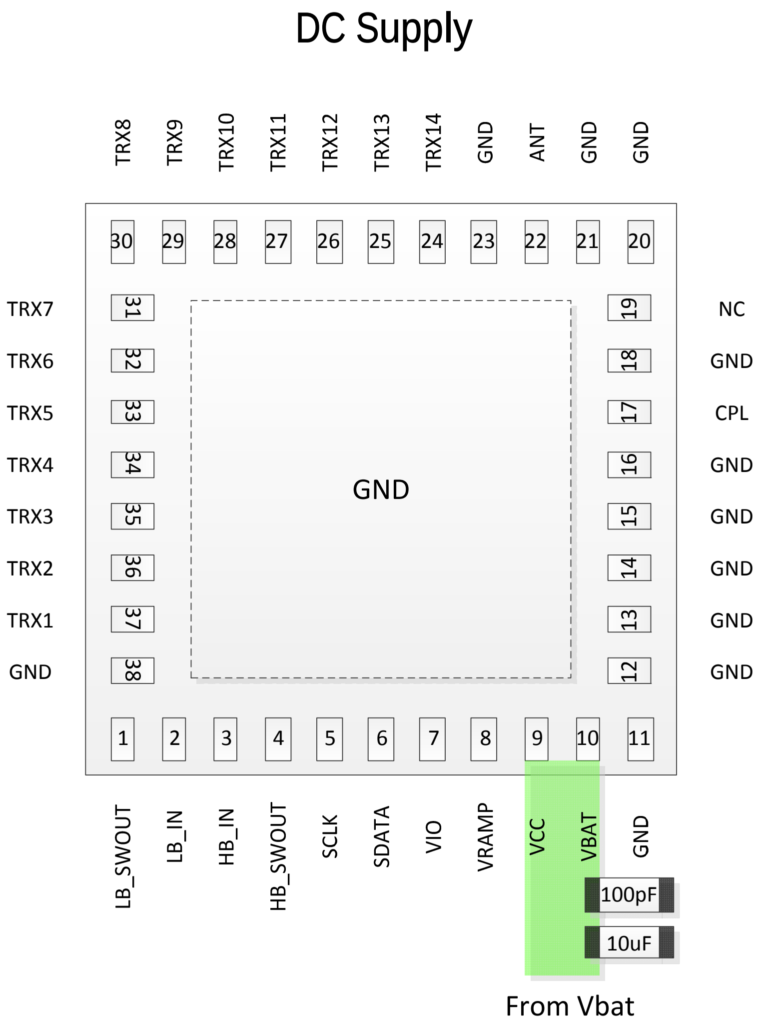


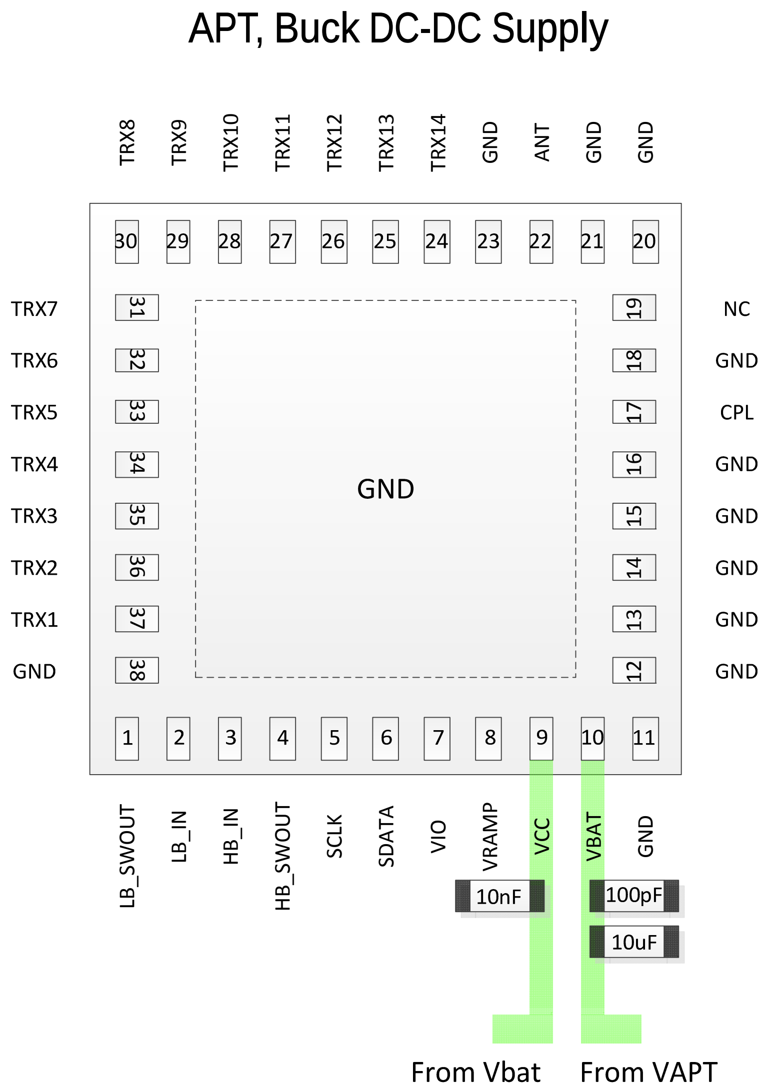


Pad layout as seen from Top View looking through package

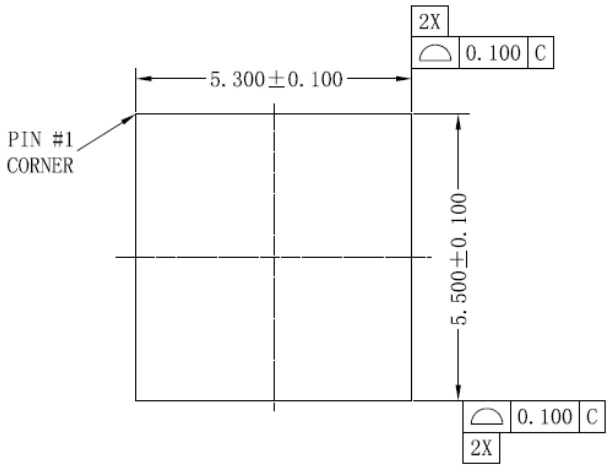
Pad	Name	Description
GND PIN		11–16,18,20,21,23,38
1	LB_SWOUT	RF Output path for TX_LB_IN Swap
2	Tx_LB_IN	Input Tx Signal 699 MHz–915 MHz
3	Tx_HB_IN	Input Tx Signal 1710 MHz–2025 MHz
4	HB_SWOUT	RF Output path for TX_HB_IN Swap
5	SCLK	MIPI Clock
6	SDATA	MIPI Data
7	VIO	MIPI Power Supply
8	VRAMP	No Function
9	VCC	Controller Supply Voltage
10	VBAT	PA Supply Voltage
17	CPL	Directional coupler RF output
19	NC	Not connect
22	ANT	PA output to Antenna
24~37	TRx14~1	Wideband TRx switch port
Ground PAD		Ground PAD Grid under Device

APT Application Schematics

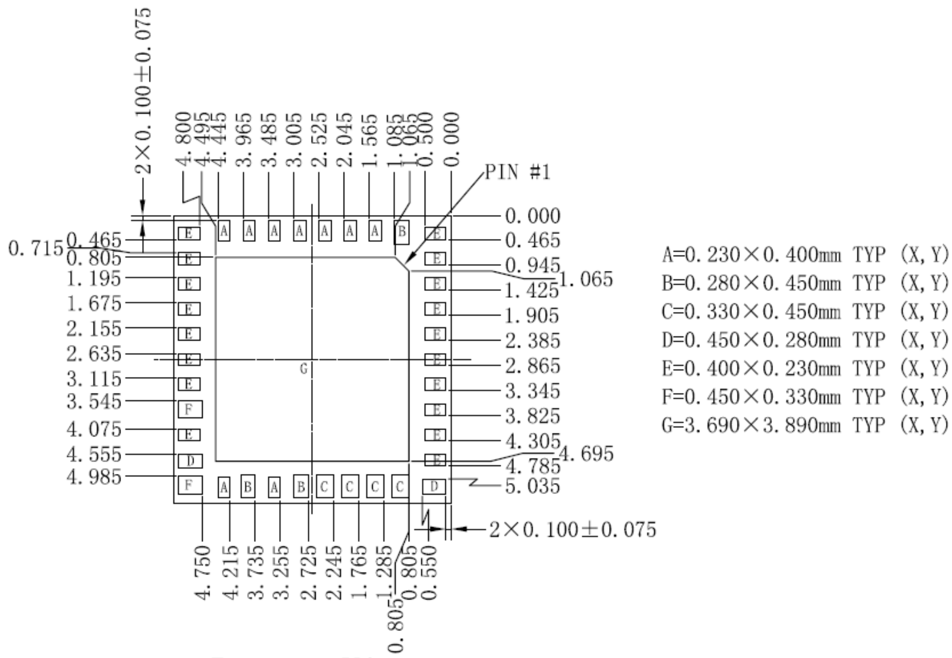




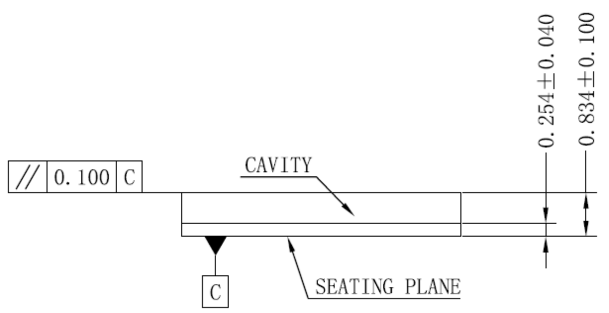
Package Outline （Unit: mm）



Top View



Bottom View

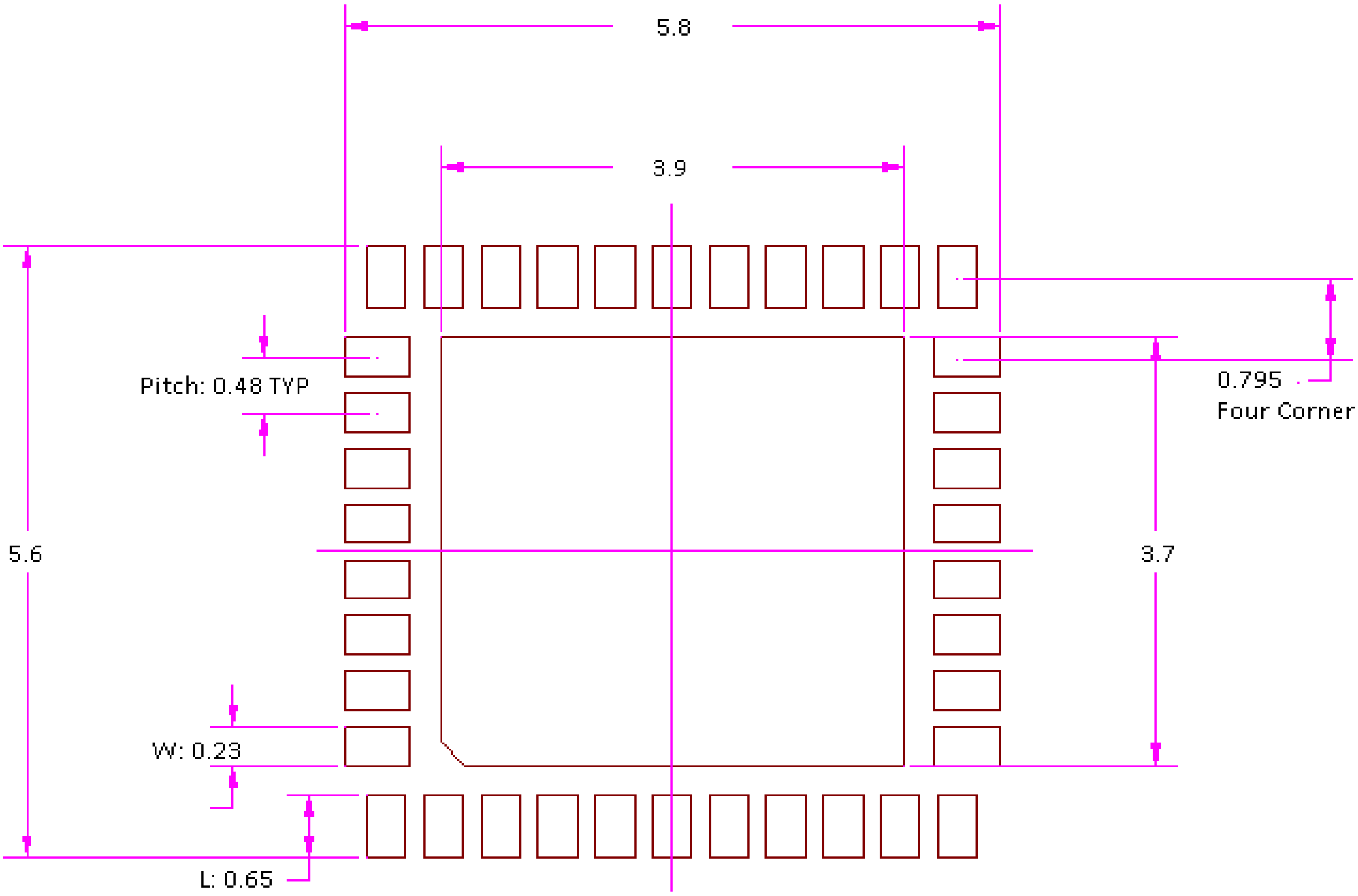


Side View

Note: Unless otherwise specified

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M-1994.

PCB Layout Footprint Recommendation（Unit: mm）



For PCB Metal/ Stencil
Pin to Pin Pitch: 0.48
L: 0.65
W: 0.23

For PCB Solder mask
Pin to Pin Pitch: 0.48
L: 0.750
W: 0.33

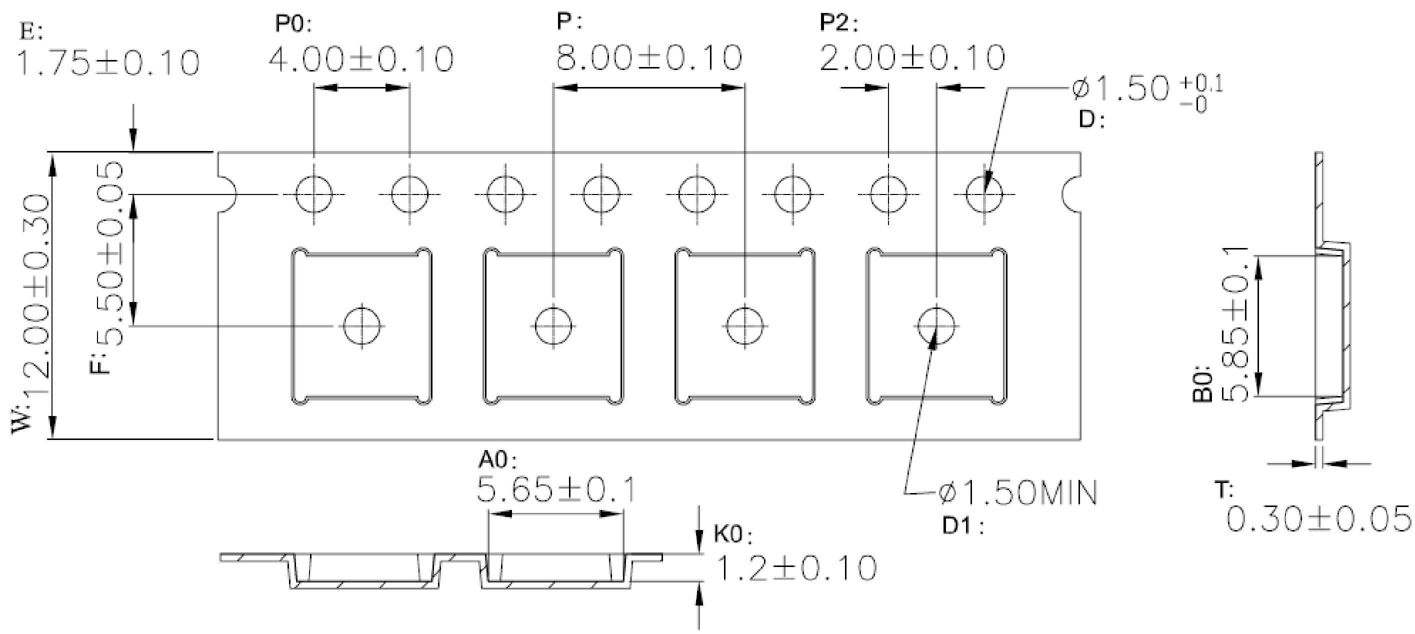
Note: Unless otherwise specified

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCING IN ACCORDANCE WITH ASME Y14.5M-1994.

Tape and Reel

VC7916-62 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.

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.



TECHNOLOGY SPECIFICATION

1. CARRIER TAPE COLOR:BLACK.
2. ANTISTATIC COATED $10^5 \sim 10^{11}$ OHMS/SQ.
3. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.20MAX.
4. CAMBER NOT TO EXCEED 1 MM IN 100 MM.
5. MOLD# BGA/LGA (5.5×5.3).
6. COVER TAPE WIDTH:9.3mm±0.1mm.
7. COVER TAPE COLOR:TRANSPARENT
8. BAN TO USE THE LEVEL 1 ENVIRONMENT-RELATED SUBSTANCES OF JCET PRESCRIBING.
9. ALL UNITS ARE IN MILLIMETER;
10. THE DIRECTION OF VIEW: