



## Absolute Maximum Ratings

PARAMETER	CONDITIONS	RATING
Storage Temperature		-40 to +150 °C
Operating Temperature		-30 to +85 °C
Supply Voltage in Standby Mode		+6 V
Supply Voltage in Idle Mode		+6 V
Supply Voltage in Operating Mode		+6 V
Supply Voltage, VBATT		+6 V
Digital control signals (VIO, SLCK, SDATA)		+2 V
RF Input Power	CW, 50 Ω, T = 25 °C	+10 dBm
Output Load VSWR (Ruggedness) ANT_LB (2G LB) <sup>*1</sup>	Open Loop <sup>*3</sup>	10:1
Output Load VSWR (Ruggedness) ANT_LB (3G/4G) <sup>*2</sup>	Closed Loop <sup>*3</sup>	10:1
Output Load VSWR (Ruggedness) 2G_HB_TXOUT (2G HB) <sup>*1</sup>	Open Loop <sup>*3</sup>	8:1
Output Load VSWR (Ruggedness) LB_TXOUT[1-4] <sup>*2</sup>	Closed Loop <sup>*3</sup>	10:1
ESD SAW Filter Pins (HBM)		500 V
ESD All (non-SAW Filter) Pins (HBM)		1000 V

<sup>\*1</sup> 2G/EDGE is 50% duty-cycle up to rated power (set under 50-ohm condition)

<sup>\*2</sup> 4G is 10M12RB modulation up to rated power (set under 50-ohm condition)

<sup>\*3</sup> Open-loop and Closed-Loop testing allows maximum RF input power to +6dBm

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.

## Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Operating Frequency Range	617		960	MHz
Operating Frequency Range (2G HB)	1710		1910	MHz
Operating Ambient Temperature	-20	+25	+85	°C
Supply Voltage, VBATT	+3.0		+4.8	V
Supply Voltage, 3G4G VCC1, VCC2	+0.5 <sup>*1</sup>		+4.6	V
Supply Voltage, 2G VCC	+0.5 <sup>*1</sup>		+4.6	V
Supply Voltage, VIO	+1.65	+1.8	+1.95	V
Vramp, GMSK (Pout=Max)			+1.65	V
Vramp, GMSK (Pout=Min)		+0.25		V
VIO Rise Time			450	µs
SCLK, SDATA Logic Low	0		0.3 * VIO	V
SCLK, SDATA Logic HIGH	0.7 * VIO	+1.8	VIO	V
SCLK, SDATA Input, Current			50	µA
SCLK Write Speed		38.4	52	MHz
SCLK Read Speed			26	MHz
Total Leakage Current (ICC+IBAT)			20	µA

<sup>\*1</sup> VCC down to 0.5V may be used for backed-off power when using DC-DC converter to reduce low power current drain.

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications

5G Waveforms

5G Waveform	Duplex Mode	Channel BW	SCS	Modulation	RB Allocation	RB Allocated	RB Start	MPR
NR1	FDD	20	15	OFDM QPSK	Inner_Full	50	25	0
NR2	FDD	20	15	OFDM QPSK	Outer_Full	100	0	1
NR3	FDD	20	15	OFDM 256QAM	Outer_Full	100	0	4.5
NR4	FDD	15	15	OFDM QPSK	Inner_Full	36	18	0
NR5	FDD	15	15	OFDM QPSK	Outer_Full	75	0	1
NR6	FDD	15	15	OFDM 256QAM	Outer_Full	75	0	4.5
NR7	FDD	10	15	OFDM QPSK	Inner_Full	25	12	0
NR8	FDD	10	15	OFDM QPSK	Outer_Full	50	0	1
NR9	FDD	10	15	OFDM 256QAM	Outer_Full	50	0	4.5

PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNITS
5G NR n13 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 4.2V, APT Mode.					
Operational Frequency Range	NR Band n13		777		787	MHz
Maximum Linear Output Power	HPM, VCC = 4.2V	NR 7	28			dBm
Gain	HPM, VCC = 4.2V	NR 7		30		dB
	HPM, VCC = 4.2V, VBAT=3.4V, Temp = -20°C to +85°C	NR 7		28		
	LPM, VCC = 1.5V, Pout=14.5dBm	NR 7		13		
PAE	HPM, VCC = 4.2V, Pout = Pmax	NR 7		28		%
Current Consumption	HPM, VCC = 4.2V, Pout = Pmax	NR 7		570		mA
	LPM, VCC ≤ 0.7V, Pout = 1.5dBm	NR 7		128		
EUTRA ACLR	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 8		-36	-33	dBc
UTRA - ACLR1	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 8		-41	-36	
UTRA - ACLR2	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 8		-42	-39	
EVM	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 9		1.8		%

PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNITS
5G NR n28 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 4.2V, APT Mode.					
Operational Frequency Range	NR Band n28		703		748	MHz
Maximum Linear Output Power	HPM, VCC = 4.2V	NR 1	28			dBm
Gain	HPM, VCC = 4.2V	NR 1		30		dB
	HPM, VCC = 4.2V, VBAT=3.4V, Temp = -20°C to +85°C	NR 1		28		
	LPM, VCC = 1.5V, Pout=14.5dBm	NR 1		16		
PAE	HPM, VCC = 4.2V, Pout = Pmax	NR 1		28		%
Current Consumption	HPM, VCC = 4.2V, Pout = Pmax	NR 1		560		mA
	LPM, VCC ≤ 0.7V, Pout = 1.5dBm	NR 1		165		
EUTRA ACLR	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-36	-33	dBc
UTRA - ACLR1	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-41	-36	
UTRA - ACLR2	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-43	-39	
EVM	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 3		1.7		%

PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNITS
5G NR n71 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 4.2V, APT Mode.					
Operational Frequency Range	NR Band n71		663		698	MHz
Maximum Linear Output Power	HPM, VCC = 4.2V	NR 1	28			dBm
Gain	HPM, VCC = 4.2V	NR 1		30		dB
	HPM, VCC = 4.2V, VBAT=3.4V, Temp = -20°C to +85°C	NR 1		28		
	LPM, VCC = 1.5V, Pout=14.5dBm	NR 1		13		
PAE	HPM, VCC = 4.2V, Pout = Pmax	NR 1		28		%
Current Consumption	HPM, VCC = 4.2V, Pout = Pmax	NR 1		570		mA
	LPM, VCC ≤ 0.7V, Pout = 1.5dBm	NR 1		128		
EUTRA ACLR	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-36	-33	dBc
UTRA - ACLR1	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-41	-36	
UTRA - ACLR2	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-42	-39	
EVM	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 3		1.6		%

Parameter	Conditions	Min.	Typ.	Max.	Units
4G FDD LTE TXOUT TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 3.8V, APT Mode, QPSK, 10MHz, 12 Resource Blocks with MPR=0				
Operational Frequency Range	Band71	663		698	MHz
	Band12/17	699		716	
	Band13	777		787	
	Band20	832		862	
	Band28	703		748	
Maximum Linear Output Power	ET mode	30			dBm
	HPM, VCC = 3.4V	28			
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C	27			
	HPM, Vcc=3.4V, 10MHz 50RB, MPR=1	27			
	HPM, Vcc=3.4V, 16QAM, 20MHz 100RB, MPR=2	26			
	HPM, Vcc=3.4V, 64QAM 20MHz 100RB, MPR=3	25			
	LPM, VCC =1.2V		14.5		
Gain	HPM, VCC = 3.4V		25		dB
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C		24		
	LPM, VCC =1.2V, Pout=14.5dBm		9		
EUTRA - ACLR <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-38	-33	dBc
UTRA - ACLR1 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-38	-36	
UTRA - ACLR2 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-60	-39	
EVM	HPM, VCC = 3.4V, Pout ≤ Pmax		3	5	%
PAE	HPM, VCC = 3.4V, Pout = Pmax		33		%
Current Consumption (Ibat+Icc)	HPM, VCC = 3.4V, Pout = Pmax		556		mA
Quiescent Current	HPM, VCC = 3.4V, No RF, Ibat+Icc		225		
B13 RX Band Noise	746 - 756MHz, 10MHz QPSK LTE 20RB		-128	-123	dBm/Hz
B28 RX Band Noise	791 – 821MHz, 20MHz QPSK LTE 20RB		-132	-130	
B20 RX Band Noise	758 – 803MHz, 20MHz QPSK LTE 25RB		-128	-126	
MB RX Noise (except harmonics)	1452 – 2200MHz, 20MHz QPSK LTE 100RB		-165	-140	
HB RX Noise (except harmonics)	2300 – 2700MHz, 20MHz QPSK LTE 100RB		-164	-140	
ISM 2.4G Noise (except harmonics)	2400 – 2483.5MHz, 20MHz QPSK LTE 100RB		-165	-140	
ISM 5G Noise (except harmonics)	5150 – 5850MHz, 20MHz QPSK LTE 100RB		-152	-140	
GPS Band Noise	1574 – 1577MHz, 20MHz QPSK LTE 100RB		-159	-137	
Harmonics	2f0		-3	5	dBm
	3f0		-52	2	
	4fo to < 12.75 GHz		-40	-30	

<sup>\*1</sup> Guaranteed by design for all supported waveforms and bandwidths with corresponded MPRs

PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNITS
5G NR n5/26 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 4.2V, APT Mode.					
Operational Frequency Range	NR Band n5		824		849	MHz
	NR Band n26		814		849	
Maximum Linear Output Power	HPM, VCC = 4.2V	NR 1	24.5			dBm
Gain	HPM, VCC = 4.2V	NR 1		27		dB
	HPM, VCC = 4.2V, VBAT=3.4V, Temp = -20°C to +85°C	NR 1		25		
	LPM, VCC = 1.5V, Pout=11dBm	NR 1		12		
PAE	HPM, VCC = 4.2V, Pout = Pmax	NR 1		16		%
Current Consumption	HPM, VCC = 4.2V, Pout = Pmax	NR 1		450		mA
	LPM, VCC ≤ 0.7V, Pout = 1.0dBm	NR 1		140		
EUTRA ACLR	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-41	-33	dBc
UTRA - ACLR1	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-45	-36	
UTRA - ACLR2	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-47	-39	
EVM	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 3		1.04		%



Parameter	Conditions	Min.	Typ.	Max.	Units
4G FDD LTE Band5/26 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = 3.4V, VBAT = 3.8V, APT Mode, QPSK, 10MHz, 12 Resource Blocks with MPR=0				
Operational Frequency Range	Band26	814		849	MHz
Maximum Linear Output Power	ET mode	26			dBm
	HPM, VCC = 3.4V	24.5			dBm
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C	23.5			
	HPM, Vcc=3.4V, 10MHz 50RB, MPR=1	23.5			
	HPM, Vcc=3.4V, 16QAM, 10MHz 50RB, MPR=2	22.5			
	HPM, Vcc=3.4V, 64QAM 10MHz 50RB, MPR=3	21.5			
	LPM, Vcc=1.2V		11		
Gain	HPM, VCC = 3.4V		24		dB
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C		22		
	LPM, VCC =1.2V, Pout=11dBm		7		
EUTRA - ACLR <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-40	-33	dBc
UTRA - ACLR1 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-42	-36	
UTRA - ACLR2 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-63	-39	
EVM	HPM, VCC = 3.4V, Pout ≤ Pmax		3	5	%
PAE	HPM, VCC = 3.4V, Pout = Pmax		18		%
Current Consumption (Ibat+Icc)	HPM, VCC = 3.4V, Pout = Pmax		460		mA
Quiescent Current	HPM, VCC = 3.4V, No RF, Ibat+Icc		225		
RX Band Noise	859 – 894MHz, 10MHz QPSK LTE 25RB		-177		dBm/Hz
MB RX Noise (except harmonics)	1452 – 2200MHz, 10MHz QPSK LTE 50RB		-180	-165	
HB RX Noise (except harmonics)	2300 – 2700MHz, 10MHz QPSK LTE 50RB		-185	-165	
ISM 5G Noise (except harmonics)	5150 – 5850MHz, 10MHz QPSK LTE 50RB		-179	-160	
GPS Band Noise	1574 – 1577MHz, 10MHz QPSK LTE 50RB		-182	-165	
TX -RX Isolation	859-894 MHz,  S21(Frx) - max(S31(Ftx)) - 3.5		57		dB
TX - RX leakage power	B26 TX = 6RB, Pout ≤ Pmax, MPR=1 Measuring TX power at RX port		-30		dBm /1.4MHz
Harmonics	2f0		-70	-40	dBm
	3f0		-75	-55	
	4fo to < 12.75 GHz		-75	-55	
	3f0, leakage at 2GHB _TXOUT		-57	-50	

<sup>\*1</sup> Guaranteed by design for all supported waveforms and bandwidths with corresponded MPRs

Parameter	Conditions	Min.	Typ.	Max.	Units
3G WCDMA Band5/26 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = 3.4V, VBAT = 3.8V, APT Mode, R99				
Operational Frequency Range	Band5/26	814		849	MHz
Maximum Output Power	ET mode	26			dBm
	HPM, VCC = 3.4V	25.5			dBm
	HPM, VCC = 3.1V, VBAT = 3.4V, Temp = -20°C to +85°C	24.5			
	LPM, VCC=1.2V		11		
	HPM, VCC = 3.4V		24		dB
Gain	HPM, VCC = 3.1V, VBAT=3.4V, Temp = -20°C to +85°C		22		
UMTS ACLR1 (±5MHz)	Pout ≤ Pmax		-42	-37	dBc
UMTS ACLR2 (±10MHz)	Pout ≤ Pmax		-58	-48	
EVM	All Condition		3	6.5	%
PAE	HPM, Pout = Pmax		20		%
Current Consumption	HPM, Pout = Pmax		500		mA
Phase discontinuity variation		-15		15	Degree
RX Band Noise	Pout ≤ Pmax		-177	-173	dBm/Hz
ISM 2.4G Noise	2400 to 2783MHz		-183	-165	
ISM 5G Noise (except harmonics)	5150 to 5850MHz		-186	-160	
GPS Band Noise	1574 to 1577MHz		-180	-165	
Harmonics	2f0		-60	-40	dBm/ MHz
	3f0		-60	-40	
	4f0 to < 12.75 GHz		-60	-40	

Parameter	Conditions	Min.	Typ.	Max.	Units
CDMA BC0, BC10 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBAT = 3.8V, APT Mode, C2K 1xRTT Modulation				
Operational Frequency Range	BC0	815		849	MHz
	BC10	814		849	
Maximum Linear Output Power	ET mode	26			dBm
	HPM, VCC = 3.4V	24.5			dBm
	HPM, VCC = 3.1V, VBAT = 3.4V, Temp = -20°C to +85°C	23.5			
	LPM, VCC=1.2V		11		
Gain	HPM, VCC = 3.4V		24		dB
	HPM, VCC = 3.1V, VBAT=3.4V, Temp = -20°C to +85°C		22		
CDMA ACLR1 (±0.885MHz)	Pout ≤ Pmax, EVDO		-49	-46	dBc
CDMA ACLR2 (±1.98MHz)	Pout ≤ Pmax, EVDO		-63	-58	
EVM	All Condition		3	5	%
Current consumption	HPM, Pout = Pmax, EVDO		500		mA
RX Band Noise	Pout ≤ Pmax, EVDO		-180	-175	dBm/Hz
GPS Band Noise	1574 to 1577MHz, EVDO		-180	-165	
Harmonics	2f0		-60	-40	dBm/ MHz
	3f0		-60	-40	
	4f0 to < 12.75 GHz		-60	-40	

PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNITS
5G NR n8 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 4.2V, APT Mode.					
Operational Frequency Range	NR Band n8		880		915	MHz
Maximum Linear Output Power	HPM, VCC = 4.2V	NR 1	24.5			dBm
Gain	HPM, VCC = 4.2V	NR 1		24.5		dB
	HPM, VCC = 4.2V, VBAT=3.4V, Temp = -20°C to +85°C	NR 1		22.5		
	LPM, VCC = 1.5V, Pout=11dBm	NR 1		10		
PAE	HPM, VCC = 4.2V, Pout = Pmax	NR 1		14		%
Current Consumption	HPM, VCC = 4.2V, Pout = Pmax	NR 1		510		mA
	LPM, VCC ≤ 0.7V, Pout = 1.0dBm	NR 1		143		
EUTRA ACLR	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-40	-33	dBc
UTRA - ACLR1	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-44	-36	
UTRA - ACLR2	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-46	-39	
EVM	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 3		1.4		%

Parameter	Conditions	Min.	Typ.	Max.	Units
4G FDD LTE Band8 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 3.8V, APT Mode, QPSK, 10MHz, 12 Resource Blocks with MPR=0				
Operational Frequency Range	Band8	880		915	MHz
Maximum Linear Output Power	ET mode	26			dBm
	HPM, VCC = 3.4V	24.5			dBm
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C	23.5			
	HPM, Vcc=3.4V, 10MHz 50RB, MPR=1	23.5			
	HPM, Vcc=3.4V, 16QAM, 10MHz 50RB, MPR=2	22.5			
	HPM, Vcc=3.4V, 64QAM 10MHz 50RB, MPR=3	21.5			
	LPM, Vcc=1.2V		11		
Gain	HPM, VCC = 3.4V		24		dB
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C		22		
	LPM, VCC =1.2V, Pout=11dBm		9		
EUTRA - ACLR <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-39	-33	dBc
UTRA - ACLR1 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-40	-36	
UTRA - ACLR2 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-65	-39	
EVM	HPM, VCC = 3.4V, Pout ≤ Pmax		2.4	5	%
PAE	HPM, VCC = 3.4V, Pout = Pmax		16		%
Current Consumption (Ibat+Icc)	HPM, VCC = 3.4V, Pout = Pmax		550		mA
Quiescent Current	HPM, VCC = 3.4V, No RF, Ibat+Icc		225		
RX Band Noise	925 – 960MHz, 10MHz QPSK LTE 25RB		-181	-175	dBm/Hz
MB RX Noise (except harmonics)	1452 – 2200MHz, 10MHz QPSK LTE 50RB		-178	-165	
HB RX Noise (except harmonics)	2300 – 2700MHz, 10MHz QPSK LTE 50RB		-182	-165	
B42 RX Noise	3400 – 3600MHz, 10MHz QPSK LTE 50RB		-185	-160	
ISM 5G Noise (except harmonics)	5150 – 5850MHz, 10MHz QPSK LTE 50RB		-174	-160	
GPS Band Noise	1574 – 1577MHz, 10MHz QPSK LTE 50RB		-178	-165	
TX -RX Isolation	925-960 MHz,  S21(Frx) - max(S31(Ftx)) - 3.5		67		dB
TX - RX leakage power	B8 TX = 6RB, Pout ≤ Pmax, MPR=1 Measuring TX power at RX port		-28		dBm /1.4MHz
Harmonics	2f0		-67	-50	dBm
	3f0		-70	-55	
	4fo to < 12.75 GHz		-73	-65	
	2f0, leakage at 2GHB _TXOUT		-49	-45	
	3f0, leakage at 2GHB _TXOUT		-61	-52	
	4f0, leakage at 2GHB _TXOUT		-55	-50	

<sup>\*1</sup> Guaranteed by design for all supported waveforms and bandwidths with corresponded MPRs

Parameter	Conditions	Min.	Typ.	Max.	Units
3G WCDMA Band8 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = 3.4V, VBAT = 3.8V, APT Mode, R99				
Operational Frequency Range	Band8	880		915	MHz
Maximum Output Power	ET mode	26			dBm
	HPM, VCC = 3.4V	25.5			dBm
	HPM, VCC = 3.1V, VBAT = 3.4V, Temp = -20°C to +85°C	24.5			
	LPM, VCC=1.2V		11		
Gain	HPM, VCC = 3.4V		24		dB
	HPM, VCC = 3.1V, VBAT=3.4V, Temp = -20°C to +85°C		22		
UMTS ACLR1 (±5MHz)	Pout ≤ Pmax		-43	-37	dBc
UMTS ACLR2 (±10MHz)	Pout ≤ Pmax		-55	-48	
EVM	All Condition		2.5	5.5	%
PAE	HPM, Pout = Pmax		20		%
Current Consumption	HPM, Pout = Pmax		594		mA
Phase discontinuity variation		-15		15	Degree
RX Band Noise	Pout ≤ Pmax		-182	-175	dBm/Hz
ISM 2.4G Noise	2400 to 2783MHz		-178	-165	
ISM 5G Noise (except harmonics)	5150 to 5850MHz		-176	-160	
GPS Band Noise	1574 to 1577MHz		-178	-165	
Harmonics	2f0		-60	-40	dBm/ MHz
	3f0		-60	-40	
	4f0 to < 12.75 GHz		-60	-40	

PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNITS
5G NR n12/17 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 4.2V, APT Mode.					
Operational Frequency Range	NR Band n12		699		716	MHz
	NR Band n17		704		716	MHz
Maximum Linear Output Power	HPM, VCC = 4.2V	NR 4	24.5			dBm
Gain	HPM, VCC = 4.2V	NR 4		28.5		dB
	HPM, VCC = 4.2V, VBAT=3.4V, Temp = -20°C to +85°C	NR 4		26.5		
	LPM, VCC = 1.5V, Pout=11dBm	NR 4		12		
PAE	HPM, VCC = 4.2V, Pout = Pmax	NR 4		16.5		%
Current Consumption	HPM, VCC = 4.2V, Pout = Pmax	NR 4		410		mA
	LPM, VCC ≤ 0.7V, Pout = 1.0dBm	NR 4		105		
EUTRA ACLR	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 5		-41.5	-33	dBc
UTRA - ACLR1	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 5		-43	-36	
UTRA - ACLR2	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 5		-49	-39	
EVM	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 6		1.07		%

Parameter	Conditions	Min.	Typ.	Max.	Units
4G FDD LTE Band12/17 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 3.8V, APT Mode, QPSK, 10MHz, 12 Resource Blocks with MPR=0				
Operational Frequency Range	Band12	699		716	MHz
	Band17	704		716	
Maximum Linear Output Power	ET mode	26			dBm
	HPM, VCC = 3.4V	24.5			
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C	23.5			
	HPM, Vcc=3.4V, 10MHz 50RB, MPR=1	23.5			
	HPM, Vcc=3.4V, 16QAM, 10MHz 50RB, MPR=2	22.5			
	HPM, Vcc=3.4V, 64QAM 10MHz 50RB, MPR=3	21.5			
	LPM, VCC =1.2V		11		
Gain	HPM, VCC = 3.4V		25		dB
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C		24		
	LPM, VCC =1.2V, Pout=11dBm		9		
EUTRA - ACLR <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-40	-33	dBc
UTRA - ACLR1 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-40	-36	
UTRA - ACLR2 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-60	-39	
EVM	HPM, VCC = 3.4V, Pout ≤ Pmax		1.3	5	%
PAE	HPM, VCC = 3.4V, Pout = Pmax		20		%
Current Consumption (Ibat+Icc)	HPM, VCC = 3.4V, Pout = Pmax		430		mA
Quiescent Current	HPM, VCC = 3.4V, No RF, Ibat+Icc		225		
RX Band Noise	728 – 746MHz, 10MHz QPSK LTE 20RB		-189	-179	dBm/Hz
MB RX Noise (except harmonics)	1452 – 2200MHz, 10MHz QPSK LTE 50RB		-184	-165	
HB RX Noise (except harmonics)	2300 – 2700MHz, 10MHz QPSK LTE 50RB		-188	-165	
ISM 5G Noise (except harmonics)	5150 – 5850MHz, 10MHz QPSK LTE 50RB		-151	-147	
GPS Band Noise	1574 – 1577MHz, 10MHz QPSK LTE 50RB		-186	-165	
TX -RX Isolation	729-746 MHz,  S21(Frx) - max(S31(Ftx)) - 3.5		69		dB
TX - RX leakage power	B12 TX = 6RB, Pout ≤ Pmax, MPR=1 Measuring TX power at RX port		-30		dBm /1.4MHz
Harmonics	2f0		-54	-40	dBm
	3f0		-84	-55	
	4fo to < 12.75 GHz		-85	-55	
	3f0, leakage at 2GHB_TXOUT		-60	-55	

<sup>\*1</sup> Guaranteed by design for all supported waveforms and bandwidths with corresponded MPRs



PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNITS
5G NR n20 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 4.2V, APT Mode.					
Operational Frequency Range	NR Band n20		832		862	MHz
Maximum Linear Output Power	HPM, VCC = 4.2V	NR 1	24.5			dBm
Gain	HPM, VCC = 4.2V	NR 1		26		dB
	HPM, VCC = 4.2V, VBAT=3.4V, Temp = -20°C to +85°C	NR 1		24		
	LPM, VCC = 1.5V, Pout=11dBm	NR 1		11.5		
PAE	HPM, VCC = 4.2V, Pout = Pmax	NR 1		16.5		%
Current Consumption	HPM, VCC = 4.2V, Pout = Pmax	NR 1		480		mA
	LPM, VCC ≤ 0.7V, Pout = 1.0dBm	NR 1		150		
EUTRA ACLR	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-38	-33	dBc
UTRA - ACLR1	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-45	-36	
UTRA - ACLR2	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 2		-49	-39	
EVM	HPM, VCC = 4.2V, Pout ≤ Pmax	NR 3		1.2		%

Parameter	Conditions	Min.	Typ.	Max.	Units
4G FDD LTE Band20 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBATT = 3.8V, APT Mode, QPSK, 10MHz, 12 Resource Blocks with MPR=0				
Operational Frequency Range	Band20	832		862	MHz
Maximum Linear Output Power	ET mode	26			dBm
	HPM, VCC = 3.4V	24.5			dBm
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C	23.5			
	HPM, Vcc=3.4V, 10MHz 50RB, MPR=1	23.5			
	HPM, Vcc=3.4V, 16QAM, 20MHz 100RB, MPR=2	22.5			
	HPM, Vcc=3.4V, 64QAM 20MHz 100RB, MPR=3	21.5			
	LPM, VCC=1.2V		11		
Gain	HPM, VCC = 3.4V		24		dB
	HPM, VCC = 3.4V, VBAT=3.4V, Temp = -20°C to +85°C		22		
	LPM, VCC =1.2V, Pout=11dBm		8		
EUTRA - ACLR <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-40	-33	dBc
UTRA - ACLR1 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-40	-36	
UTRA - ACLR2 <sup>*1</sup>	HPM, VCC = 3.4V, Pout ≤ Pmax		-60	-39	
EVM	HPM, VCC = 3.4V, Pout ≤ Pmax		2	5	%
PAE	HPM, VCC = 3.4V, Pout = Pmax		20		%
Current Consumption (Ibat+Icc)	HPM, VCC = 3.4V, Pout = Pmax		540		mA
Quiescent Current	HPM, VCC = 3.4V, No RF, Ibat+Icc		225		
RX Band Noise	791 – 821MHz, 5MHz QPSK LTE 25RB		-181	-173	dBm/Hz
MB RX Noise (except harmonics)	1452 – 2200MHz, 20MHz QPSK LTE 100RB		-182	-165	
HB RX Noise (except harmonics)	2300 – 2700MHz, 20MHz QPSK LTE 100RB		-184	-165	
ISM 5G Noise (except harmonics)	5150 – 5850MHz, 20MHz QPSK LTE 100RB		-170	-160	
GPS Band Noise	1574 – 1577MHz, 20MHz QPSK LTE 100RB		-182	-165	
TX -RX Isolation	791-821 MHz,  S21(Frx) - max(S31(Ftx)) - 3.5		60		dB
TX - RX leakage power	B20 TX = 25RB, Pout ≤ Pmax, MPR=1 Measuring TX power at RX port		-30		dBm /5MHz
Harmonics	2f0		-67	-40	dBm
	3f0		-73	-55	
	4fo to < 12.75 GHz		-75	-55	
	3f0, leakage at 2GHB _TXOUT		-59	-55	

<sup>\*1</sup> Guaranteed by design for all supported waveforms and bandwidths with corresponded MPRs

Parameter	Conditions	Min.	Typ.	Max.	Units
2G GMSK Linear Mode GSM850/GSM900 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = VBAT = 3.5V, GMSK Modulation, Duty Cycle = 25%, Period = 4.6ms.				
Operational Frequency Range	GSM850	824		849	MHz
	GSM900	880		915	
Input Power (Pin)				8	dBm
Maximum Output Power	HPM	34.5			dBm
	HPM, VBAT = 3.2V, Temp = -20 to +85°C	33			
	LPM		13		
Gain	HPM		31		dB
	LPM		17		
PAE	Pin adjusted for Pout = 34.5dBm		37		%
Switching Spectrum	ORFS 400kHz offset		-30	-26	dBm /30kHz
Harmonics	2f0		-40	-33	dBm
	3f0		-40	-33	
	4f0 to < 12.75 GHz		-40	-33	
Forward Isolation	VBAT = 3.2V, Temp = -20 to +85°C, PA OFF		-45		dBm
Noise Power, 736MHz to 757MHz	Pin adjusted for Pout=34.5dBm; RBW=100kHz		-87	-83	dBm /100kHz
Noise Power, 757MHz to 763MHz			-76	-77	
Noise Power, 869MHz to 894MHz			-85	-83	
Noise Power, 925MHz to 935MHz			-84	-73	
Noise Power, 935MHz to 960MHz			-86	-83	
Noise Power, 1805MHz to 1880MHz			-115	-77	
Noise Power, 1930MHz to 1990MHz			-113	-77	
Noise Power, 2400MHz to 2500MHz			-164	-156	dBm/Hz
Stability (Spurious), VSWR 6:1	VSWR=6:1; all phase angles; Pin adjusted to output power 33dBm into 50Ω load; VCC=4.6, VBAT= 4.8V; Temp=25°C; RBW=3MHz		-36		dBm

Parameter	Conditions	Min.	Typ.	Max.	Units
2G GMSK Linear Mode DCS1800/PCS1900 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = VBAT = 3.5V, GMSK Modulation, Duty Cycle = 25%, Period = 4.6ms. Applied the external matching network, shunt 1.2pF, at 2GHB_TXOUT on EVB.				
Operational Frequency Range	DCS1800	1710		1785	MHz
	PCS1900	1850		1910	
Input Power (Pin)				5	dBm
Maximum Output Power	HPM	32.8			dBm
	HPM, VBAT = 3.2V, Temp = -20 to +85°C	31.5			
	LPM		13		
Gain	HPM		28		dB
	LPM		19		
PAE	Pin adjusted for Pout = 32.8dBm		40		%
Switching Spectrum	ORFS 400kHz offset		-30	-26	dBm /30kHz
Harmonics	2f0		-40	-33	dBm
	3f0		-40	-33	
	4f0 to < 12.75 GHz		-40	-33	
Forward Isolation	VBAT = 3.2V, Temp = -20 to +85°C, PA OFF		-53		dBm
Noise Power, 736MHz to 757MHz	Pin adjusted for Pout = 32.8dBm; RBW = 100kHz		-94	-83	dBm /100kHz
Noise Power, 757MHz to 763MHz			-94	-77	
Noise Power, 869MHz to 894MHz			-94	-83	
Noise Power, 925MHz to 935MHz			-95	-73	
Noise Power, 935MHz to 960MHz			-97	-83	
Noise Power, 1805MHz to 1880MHz			-87	-77	
Noise Power, 1930MHz to 1990MHz			-89	-77	
Noise Power, 2400MHz to 2500MHz			-160	-156	dBm/Hz
Stability (Spurious), VSWR 6:1	VSWR=6:1; all phase angles; Pin adjusted for output power 31.5dBm into 50Ω load; VCC=4.6, VBAT= 4.8V; Temp=25°C; RBW=3MHz		-36		dBm

Parameter	Conditions	Min.	Typ.	Max.	Units
2G GMSK Saturated Mode GSM850/GSM900 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = VBAT = 3.5V, Pin = 3dBm, Duty Cycle = 25%, Period = 4.6ms.				
Operational Frequency Range	GSM850	824		849	MHz
	GSM900	880		915	
Input Power (Pin)		-1	3	5	dBm
Maximum Output Power		34.5			dBm
	VBAT = 3.2V, Temp = -20 to +85°C	33			
PAE	VRAMP adjusted for Pout = 34.5dBm		36		%
Switching Spectrum	ORFS 400kHz offset		-30	-26	dBm /30kHz
Harmonics	2f0		-40	-33	dBm
	3f0		-40	-33	
	4f0 to < 12.75 GHz		-40	-33	
Forward Isolation	VBAT = 3.2V, Temp = -20 to +85°C, PA OFF		-45		dBm
Noise Power, 736MHz to 757MHz	VRAMP adjusted for Pout=34.5dBm; RBW=100kHz		-82	-80	dBm /100kHz
Noise Power, 757MHz to 763MHz			-81	-77	
Noise Power, 869MHz to 894MHz			-80	-77	
Noise Power, 925MHz to 935MHz			-81	-73	
Noise Power, 935MHz to 960MHz			-82	-80	
Noise Power, 1805MHz to 1880MHz			-111	-77	
Noise Power, 1930MHz to 1990MHz			-110	-77	
Noise Power, 2400MHz to 2500MHz			-160	-156	dBm/Hz
Stability (Spurious), VSWR 6:1	VSWR=6:1; all phase angles; Vramp adjusted for output power 33dBm into 50Ω load; VCC=4.6, VBAT= 4.8V; Temp=-20 to +85°C; RBW=3MHz		-36		dBm

Parameter	Conditions	Min.	Typ.	Max.	Units
2G GMSK Saturated Mode DCS1800/PCS1900 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = VBAT = 3.5V, Pin = 3dBm, Duty Cycle = 25%, Period = 4.6ms. Applied the matching network, shunt 1.2pF and series 2.4nH, at 2GHB_TXOUT on EVB.				
Operational Frequency Range	DCS1800	1710		1785	MHz
	PCS1900	1850		1910	
Input Power (Pin)		-1	3	5	dBm
Maximum Output Power		32.8			dBm
	VBAT = 3.2V, Temp = -20 to +85°C	31.5			
PAE	VRAMP adjusted for Pout = 32.8dBm		37		%
Switching Spectrum	ORFS 400kHz offset		-30	-26	dBm /30kHz
Harmonics	2f0		-40	-33	dBm
	3f0		-40	-33	
	4fo to < 12.75 GHz		-40	-33	
Forward Isolation	VBAT = 3.2V, Temp = -20 to +85°C, PA OFF		-53		dBm
Noise Power, 736MHz to 757MHz	VRAMP adjusted for Pout = 32.8dBm; RBW = 100kHz		-90	-83	dBm /100kHz
Noise Power, 757MHz to 763MHz			-90	-77	
Noise Power, 869MHz to 894MHz			-90	-83	
Noise Power, 925MHz to 935MHz			-90	-73	
Noise Power, 935MHz to 960MHz			-93	-83	
Noise Power, 1805MHz to 1880MHz			-79	-77	
Noise Power, 1930MHz to 1990MHz			-81	-77	
Noise Power, 2400MHz to 2500MHz			-145	-140	dBm/Hz
Stability (Spurious), VSWR 6:1	VSWR=6:1; all phase angles; Vramp adjusted for output power 31.5dBm into 50Ω load; VCC=4.6, VBAT= 4.8V; Temp=-20 to +85°C; RBW=3MHz		-36		dBm

Parameter	Conditions	Min.	Typ.	Max.	Units
2G EDGE GSM850/GSM900 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = VBAT = 3.5V, Pout = 28.5dBm, Duty Cycle = 25%, Period = 4.6ms.				
Operational Frequency Range	GSM850	824		849	MHz
	GSM900	880		915	
Maximum Output Power		28.5			dBm
	VBAT = 3.2 to 4.5V; Temp = -20 to +85°C	27.5			
Gain			32		dB
	VBAT = 3.2V, Temp = -20 to +85°C		31		
Peak Supply Current			1200		mA
PAE			17		%
Modulation Spectrum	ORFS 200KHz offset		-35	-30	dBc /30kHz
	ORFS 400KHz offset		-65	-57	
	ORFS 600KHz offset		-75	-65	
	ORFS 1800KHz offset		-75	-65	
Switching Spectrum	ORFS 400kHz offset		-30	-26	dBm /30kHz
Harmonics	2f0		-40	-33	dBm
	3f0		-40	-33	
	4f0 to < 12.75 GHz		-40	-33	
EVM RMS			3	4.5	%
Noise Power	736MHz to 757MHz		-83	-79	dBm /100kHz
	757MHz to 763MHz		-82	-77	
	869MHz to 894MHz		-74	-73	
	925MHz to 935MHz		-76	-73	
	935MHz to 960MHz		-76	-71	
	1805MHz to 1880MHz		-115	-77	
	1930MHz to 1990MHz		-113	-77	
	2400MHz to 2500MHz		-164	-156	dBm/Hz

Parameter	Conditions	Min.	Typ.	Max.	Units
2G EDGE DCS1800/PCS1900 TX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VCC = VBAT = 3.5V, Pout = 29.1dBm, Duty Cycle = 25%, Period = 4.6ms.				
Operational Frequency Range	DCS1800	1710		1785	MHz
	PCS1900	1850		1910	
Maximum Output Power		29.1			dBm
	VBAT = 3.2 to 4.5V; Temp = -20 to +85°C	28.1			
Gain			31		dB
	VBAT = 3.2V, Temp = -20 to +85°C		30		
Peak Supply Current			1300		mA
PAE			17		%
Modulation Spectrum	ORFS 200KHz offset		-35	-30	dBc /30kHz
	ORFS 400KHz offset		-66	-57	
	ORFS 600KHz offset		-80	-65	
	ORFS 1800KHz offset		-73	-65	
Switching Spectrum	ORFS 400kHz offset		-30	-26	dBm /30kHz
Harmonics	2f0		-40	-33	dBm
	3f0		-40	-33	
	4f0 to < 12.75 GHz		-40	-33	
EVM RMS			3	6	%
Noise Power	736MHz to 757MHz		-88	-83	dBm /100kHz
	757MHz to 763MHz		-88	-77	
	869MHz to 894MHz		-89	-83	
	925MHz to 935MHz		-92	-73	
	935MHz to 960MHz		-93	-83	
	1805MHz to 1880MHz		-81	-77	
	1930MHz to 1990MHz		-83	-77	
	2400MHz to 2500MHz		-145	-140	dBm/Hz

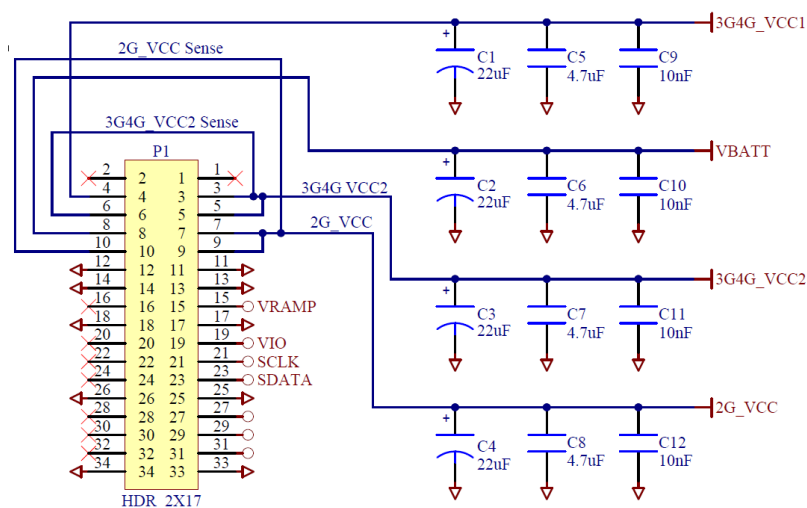
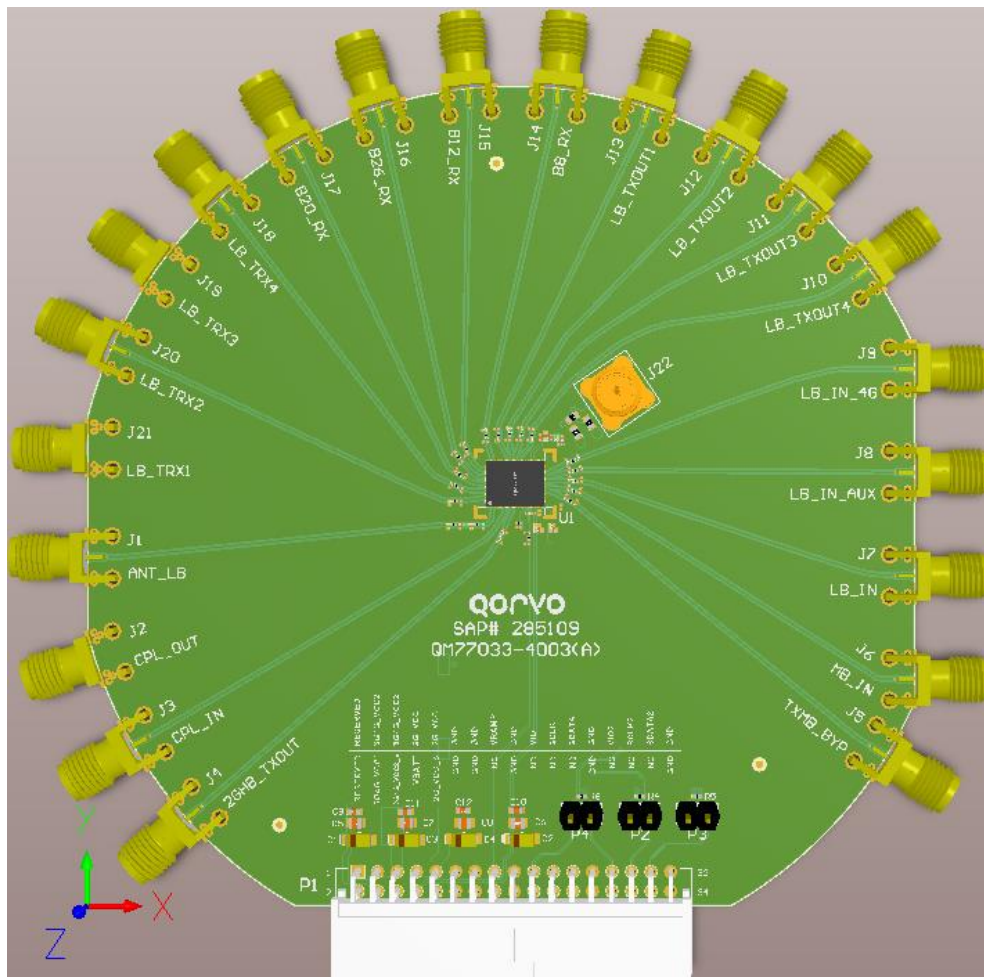


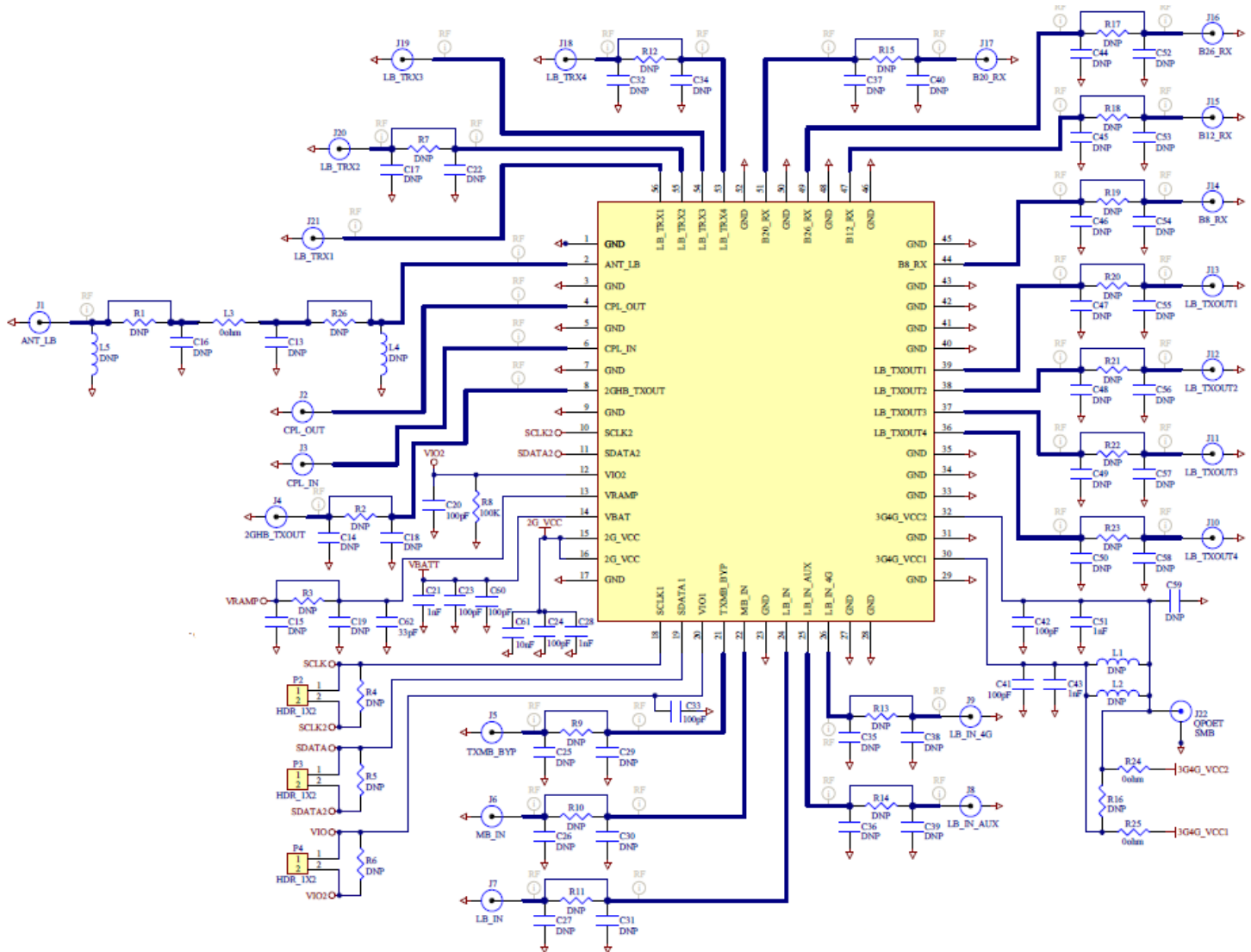
Parameter	Conditions	Min.	Typ.	Max.	Units
RX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω Temp = 25°C, VBAT = 3.8V				
Band5/26 RX	Z <sub>load</sub> = 50Ω with an ideal shunt 11nH				
Frequency Range		859		894	MHz
Insertion Loss			2.7	3.6	dB
Passband Ripple	Entire RX passband		2		dB
RX/ANT Port VSWR			2		X:1
Attenuation	MB TX, 1427~1980MHz		40		
	HB TX, 2300~2690MHz		40		
	ISM 2.4G/5G		40		
	B42 TX, 3400~3600MHz		30		
Band8 RX	Z <sub>load</sub> = 50Ω with an ideal series 2nH				
Frequency Range		925		960	MHz
Insertion Loss			2.4	3.6	dB
Passband Ripple	Entire RX passband		2		
RX/ANT Port VSWR			2		X:1
Attenuation	MB TX, 1427~1980MHz		40		dB
	HB TX, 2300~2690MHz		40		
	ISM 2.4G/5G		40		
	B42 TX, 3400~3600MHz		30		
Band12/17 RX	Z <sub>load</sub> = 50Ω with an ideal series 6.2nH				
Frequency Range		729		746	MHz
Insertion Loss			1.8	3	dB
Passband Ripple	Entire RX passband		1.5		
RX/ANT Port VSWR			2		X:1
Attenuation	MB TX, 1427~1980MHz		40		dB
	HB TX, 2300~2690MHz		40		
	ISM 2.4G/5G		40		
Band20 RX	Z <sub>load</sub> = 50Ω with an ideal shunt 22nH				
Frequency Range		791		821	MHz
Insertion Loss			2.4	3.5	dB
Passband Ripple	Entire RX passband		1.5		
RX/ANT Port VSWR			2		X:1
Attenuation	MB TX, 1427~1980MHz		40		dB
	HB TX, 2300~2690MHz		40		
	3.5G TX, 3400 to 3600MHz		40		
	ISM 2.4G/5G		60		

Parameter	Conditions	Min.	Typ.	Max.	Units
TRX Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBAT = 3.8V				
Frequency Range		617		960	MHz
Insertion Loss			0.8	1.5	dB
Isolation	Adjacent ports		30		dB
	Non adjacent ports		35		
Harmonics 2f0				-60	dBm
B13 Harmonics, 2f0	GPS		-80	-75	
Harmonics, 3f0				-60	
4f0 to < 12.75 GHz				-60	
B28 Harmonics, 3f0			-80	-75	
B12 Harmonics, 3f0			-80	-75	
B20 Harmonics, 3f0			-80	-75	

Parameter	Conditions	Min.	Typ.	Max.	Units
Bi-Directional Coupler Electrical Specifications	Unless otherwise stated: All unused RF ports terminated in 50Ω, Input and Output = 50Ω, Temp = 25°C, VBAT = 3.8V				
Frequency Range	Forward	663		915	MHz
	Reverse	824		915	
Coupling factor	Forward		20		dB
	Reverse		20		
Isolation	Forward		40		dB
	Reverse		40		
Directivity	Forward	18	20	50	dB
	Reverse	18	20	50	
Insertion Loss , CPL_IN to CPL_OUT	1427 - 2200MHz		1.5	2.0	dB
	2300 – 2690MHZ		2.0	3.0	
	3400 – 3800MHz		2.8	3.5	

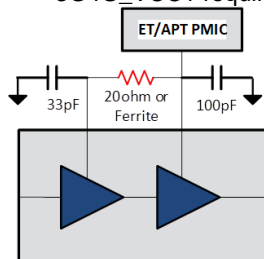
## Application Circuit Schematic (EVB shared with QM77032/33)





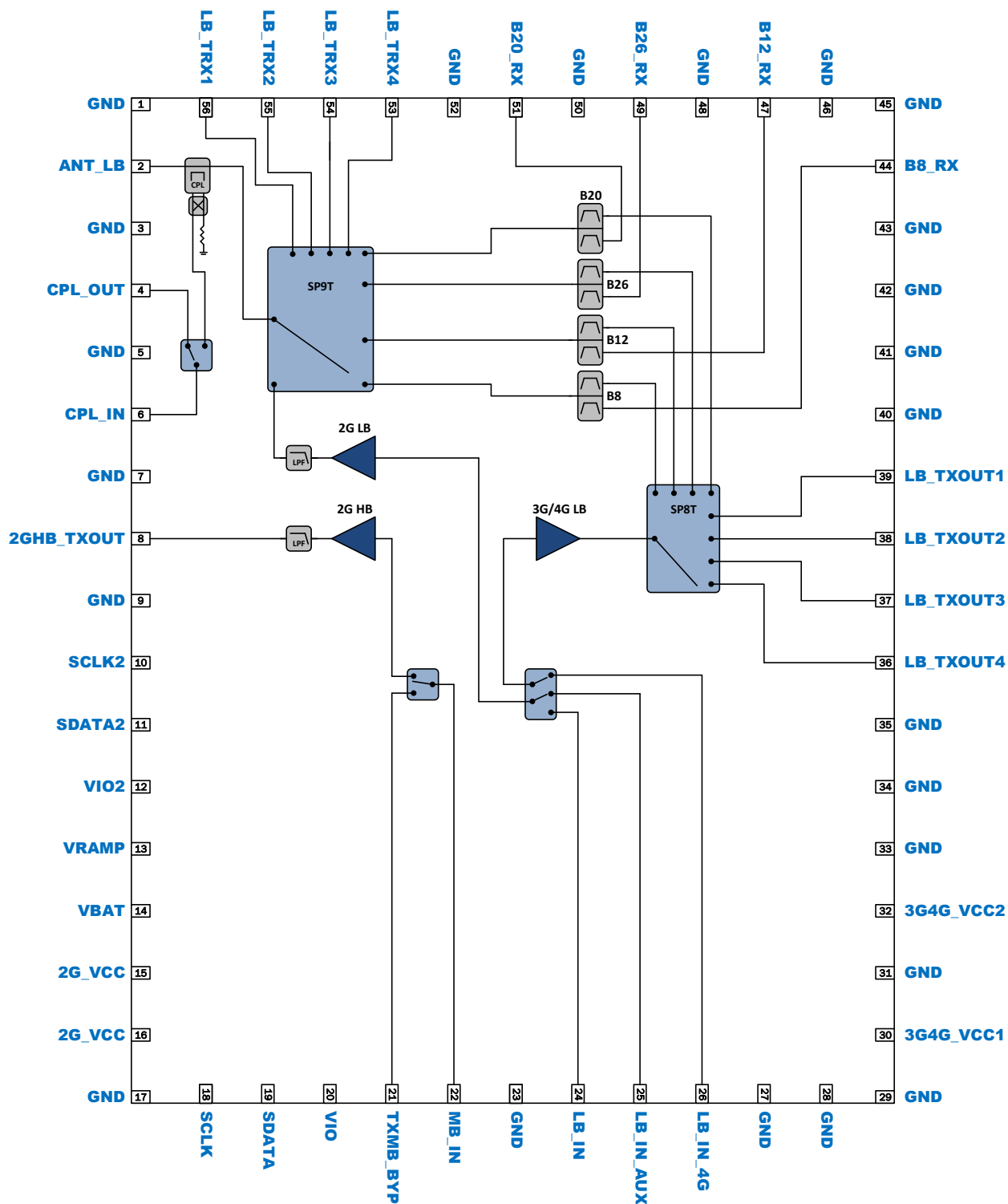
# Notes;

1. ANT\_LB and 2GHB\_TXOUT need low-pass type pi matching network close to DUT for better performance.
2. VBAT requires decoupling caps 100pF and 1nF. Placed near the VBAT pin at least 100pF.
3. 2G\_VCC requires decoupling caps 10nF, 100pF and 1nF Placed near the 2G\_VCC pin at least 10nF.
4. 3G4G\_VCC connection for ET / APT Mode with QM81010 PMIC:
  - 3G4G\_VCC1 and 3G4G\_VCC2 are tied together through the ferrite bead (preferred) or the 20Ohm resistor as shown in the block diagram.
  - 3G4G\_VCC1 requires decoupling cap 33pF and 3G4G\_VCC2 requires decoupling cap 100pF. Placed near the VCC pins.



5. Connect to Ground unused pins, pin 10/11/12, 21 or 25, if don't use.
6. RC filter for Vramp needs to be optimized on customer board.
7. VIO2 pulldown resistor (location R8) needs to be confirmed ; NOT floating from VIO2 source, if using 1 RFFE / VIO1.

## Pin Configuration and Description



Top View

Pin Number	Label	Description
2	ANT_LB	Low Band Antenna port from ASM. Internally matched to 50Ω.
4	CPL_OUT	Coupler output port for the ASM
6	CPL_IN	Coupler input port for the ASM
8	2GHB_TXOUT	RF output for the High-Band 2G PA. Internally matched to 50Ω.
10	SCLK2	SCLK MIPI digital input signal for programming the ASM (when VIO2=high)
11	SDATA2	SDATA MIPI digital input signal for programming the ASM (when VIO2=high)
12	VIO2	VIO MIPI voltage reference for programming the ASM (when VIO2=high)
13	VRAMP	Power control signal from DAC. A simple RC filter may require additional filtering depending on the baseband selected.
14	VBAT	Supply voltage bias circuitry PA/Band-Switch
15, 16	2G_VCC	Supply voltage for the power amplifier circuitry of both 2G LB and HB PAs
18	SCLK	SCLK MIPI digital input signal for programming the PA and ASM (when VIO2=0V) SCLK MIPI digital input signal for programming the PA (when VIO2=high)
19	SDATA	SDATA MIPI digital input signal for programming the PA and ASM (when VIO2=0V) SDATA MIPI digital input signal for programming the PA (when VIO2=high)
20	VIO	VIO MIPI voltage reference for programming the PA and ASM (when VIO2=0V) VIO MIPI voltage reference for programming the PA (when VIO2=high)
21	TXMB_BYP	Bypass port for the Mid-Band 3G/4G. Internally matched to 50Ω. Not DC blocked
22	MB_IN	RF input for the High-Band 2G PA. Internally matched to 50Ω. RF input for the Mid-Band 3G/4G Bypass. Internally matched to 50Ω.
24	LB_IN	RF input for the Low-Band 2G PA. Internally matched to 50Ω.
25	LB_IN_AUX	RF input for the Low-Band 2G/3G/4G PA. Internally matched to 50Ω.
26	LB_IN_4G	RF input for the Low-Band 3G/4G PA. Internally matched to 50Ω.
30	3G4G_VCC1	Supply voltage for the input amplifier stage of the 3G/4G LB PA
32	3G4G_VCC2	Supply voltage for the output amplifier stage of the 3G/4G LB PA
36	LB_TXOUT4	Low-Band 3G/4G PA/Band Mode Switch output.
37	LB_TXOUT3	Low-Band 3G/4G PA/Band Mode Switch output.
38	LB_TXOUT2	Low-Band 3G/4G PA/Band Mode Switch output.
39	LB_TXOUT1	Low-Band 3G/4G PA/Band Mode Switch output.
44	B8_RX	B8 duplexer RX port (single-ended). Also for use as GSM900 RX in 2G mode.
47	B12_RX	B12 duplexer RX port (single-ended).
49	B26_RX	B26 duplexer RX port (single-ended). Also for use as GSM850 RX in 2G mode.
51	B20_RX	B20 duplexer RX port (single-ended).
53	LB_TRX4	ASM LB TRX port. Internally matched to 50Ω. Not DC blocked. Intended for connection to ANT port of an external duplexer (FDD), or to an external BPF (TDD).
54	LB_TRX3	ASM LB TRX port. Internally matched to 50Ω. Not DC blocked. Intended for connection to ANT port of an external duplexer (FDD), or to an external BPF (TDD).
55	LB_TRX2	ASM LB TRX port. Internally matched to 50Ω. Not DC blocked. Intended for connection to ANT port of an external duplexer (FDD), or to an external BPF (TDD).
56	LB_TRX1	ASM LB TRX port. Internally matched to 50Ω. Not DC blocked. Intended for connection to ANT port of an external duplexer (FDD), or to an external BPF (TDD).
See description	GND	These pins must be grounded; 1,3,5,7,9,17,23,27,28,29,31,33,34,35,40,41,42,43,45,46,48,50,52
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.

## MIPI RFFE Information

### MIPI RFFE IDs

Parameter	ANT Switch (ASM) & Coupler	Power Amplifier & TX Distribution Switch
Default USID	0x8 (1000b)	0xF (1111b)
Product ID	0x45 (0100_0101b)	0x44 (0100_0100b)
Manufacturer ID	0x134	0x134

### 1. Antenna Switch / Coupler Section

#### Summary of User Defined Register (UDR) Space

Address	Reg #	Register name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x000	Reg00	ANT_SW_CTRL	Spare				ANT_SW_CTRL0[3:0]			
0x001	Reg01	CPL_CTRL	CPL_DIR	RDAC[3:0]				CDAC[3:0]		

#### Register0x0000 – Antenna Switch Control

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:4	SPARE	0000 = High Isolation	0000	N	T012	R/W
3:0	ANT_SW_CTRL0[3:0]	0000 = High Isolation	0000			
		0001 = 2GLB GSM/EDGE				
		0010 = B20				
		0011 = LB_TRX2				
		0100 = LB_TRX1				
		0101 = B26				
		0110 = B12				
		0111 = B8				
		1000 = Not used				
		1001 = LB_TRX4				
		1010 = LB_TRX3				
		1111 = Not used				

- Do NOT use ANT\_SW\_CTRL0=1111

#### Register0x0001 – Coupler Control

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7	CPL_DIR	0 = Normal switching, CPL_OUT = Forward Power 1 = Cross switching, CPL_OUT = Reverse Power	0	N	T012	R/W
6:3	RDAC[3:0]	Coupler isolation port 4-bit RDAC	1010			
2:0	CDAC[2:0]	000=0pF, 001=1pF, 010=2pF, 011=3pF, 100=4pF, 101=5pF, 110=6pF, 111=7pF	000			

- “CPL\_IN is connected to CPL\_OUT and internal coupler is disconnected” when RDAC[3:0],CDAC[2:0]=0000\_111.

**Register0x001C – PM Trigger**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:6	Power_Mode[1:0]	00: ACTIVE - Normal Operation	00	Y	N	R/W
		01: STARTUP - Reset all registers to default settings				
		10: ACTIVE - Low Power - Antenna in isolation				
		11: STARTUP - Reset all registers to default settings				
5:3	TriggerMask[2:0]	Setting bit TriggerMask[N] disables Trigger[N] TriggerMask[N] updates before Trigger[N] is processed	111	N		
2:0	Trigger[2:0]	Setting bit Trigger[N] loads Trigger[N]'s associated registers	000	Y		W

**Register0x001D – Product ID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	PROD_ID[7:0]	Lower eight bits of Product ID	0X45	N	N	R

**Register0x001E – Manufacturer ID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	MFG_ID_LSB[7:0]	Lower eight bits of MIPI Manufacturer ID	0X34	N	N	R

**Register0x001F – USID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:6	SPARE	Reserved	00	N	N	R
5:4	MFG_ID_MSB[9:8]	Upper two bits of MIPI Manufacturer ID	01			
3:0	USID[3:0]	Programmable Unique Slave ID	0x8			R/W

**Register0x0020 – Extended Product ID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	PROD_ID[15:8]	Upper eight bits of Product ID	0X00	N	N	R



**Register0x0022 – GSID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:4	GSID0[3:0]	Group Slave ID0	0x0	N	N	R/W
3:0	GSID1[3:0]	Group Slave ID1	0x0			

**Register0x0023 – UDR Reset**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7	UDR_RST	Setting this bit initiates a software reset	0	Y	N	W
6:0	SPARE	Reserved	0000000	N		R

**Register0x0024 – Error Status**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7	SPARE	Reserved for future use	0	N	N	R/W
6	CMD_FR_P_ERR	Command Frame received with a parity error	0			
5	CMD_LEN_ERR	Command Sequence received with an incorrect length	0			
4	ADDR_FR_P_ERR	Address Frame received with a parity error	0			
3	DATA_FR_P_ERR	Data Frame received with a parity error	0			
2	RD_INVLD_ADDR	Read Command Sequence received with an invalid address	0			
1	WR_INVLD_ADDR	Write Command Sequence received with an invalid address	0			
0	BID_GID_ERR	Read Command Sequence received with a BSID or GSID	0			

**Register0x002B – BUS Load**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:4	SPARE	Reserved	0x0	N	N	R/W
3:0	BUS_LD[3:0]	Reserved	0x0			

**Register0x002C – Test Pattern**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	TEST_PATT[7:0]	Test Pattern	0xD2	N	N	R

## 2. PA / TX Distribution Switch Section

### Summary of User Defined Register (UDR) Space

Address	Reg #	Register name	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x000	Reg00	PA_TX_MODE	Spare	TX_MODE[3:0]				TX_EN	PA_MODE[1:0]	
0x001	Reg01	PA_TX_DIST_SW	TX_DIS_SW1[3:0]				TX_DIS_SW0[3:0]			
0x002	Reg02	PA_BIAS1	PA_BIAS1_MSB[7:4]				PA_BIAS1_LSB[3:0]			
0x003	Reg03	PA_BIAS2	Spare			PF_DISABLE	PA_BIAS2[3:0]			

### Register0x0000 – PA TX Mode

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7	SPARE	Reserved	0	N	T012	R/W
6:3	TX_MODE[3:0]	0000 = 2G LB GSM (Vramp); RFIN = LB_IN	0000			
		0001 = 2G LB GSM/EDGE; RFIN = LB_IN				
		0010 = 2G LB GSM (Vramp); RFIN = LB_IN_AUX				
		0011 = 2G LB GSM/EDGE; RFIN = LB_IN_AUX				
		0100 = 4G LB + MB/HB Isolation ; RFIN = LB_IN_4G				
		0101 = 4G LB+ MB/HB Isolation; RFIN = LB_IN_AUX				
		0110 = 4G LB+ MB/HB Isolation; RFIN = LB_IN				
		0111 = Reserved				
		1000 = 2G HB GSM (Vramp); RFIN = MB_IN				
		1001 = 2G HB GSM/EDGE; RFIN = MB_IN				
		1010 = Reserved				
		1011 = Reserved				
		1100 = 4G LB + MB/HB Bypass; RFIN = LB_IN_4G				
		1101 = 4G LB + MB/HB Bypass; RFIN = LB_IN_AUX				
		1110 = 4G LB + MB/HB Bypass; RFIN = LB_IN				
		1111 = MB/HB Bypass + All LB PA Off				
2	TX_EN	1 = TX Enable 0 = TX Disable	0			
1:0	PA_MODE[1:0]	0x = High Gain Mode 1x = Low Gain Mode (-15dB)	00			

- “MH/HB isolation” when the path from MB\_IN to TXMB\_BYP is isolated.
- “MH/HB bypass” when the path from MB\_IN to TXMB\_BYP is connected.

Register0x0001 – TX Distribution Switch

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:4	TX_DIST_SW1[3:0]	Reserved	0000	N	T012	R/W
3:0	TX_DIST_SW0[3:0]	0000 = High Isolation	0000			
		0001 = Not used				
		0010 = B26 Internal Duplexer				
		0011 = B20 Internal Duplexer				
		0100 = B12 Internal Duplexer				
		0101 = LB_TXOUT2				
		0110 = LB_TXOUT3				
		0111 = LB_TXOUT4				
		1000 = Reserved				
		1001 = LB_TXOUT1				
		1010 = B8 Internal Duplexer				
		1011 = Reserved				
		1100 = Reserved				
		1101 = Reserved				
		1110 = Reserved				
		1111 = Not used				

**Register0x0002 – PA Bias1 (2G Mode, 3<sup>rd</sup> Stage)**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	PA_BIAS1_MSB[7:4] PA_BIAS1_LSB[3:0]	00000000 0uA	0000	N	T012	R/W
		00000001 60uA				
		...				
		10000000 7.680mA				
		...				
		11111111 15.300mA				

\* Don't use (2G\_EDGE==TRUE) && (Q2 ibias[7:0]==1111\_1111)

**Register0x0002 – PA Bias1 (3G/4G Mode)**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W			
7:4	PA_BIAS1_MSB[7:4]	0000 0.8V	0000	N	T012	R/W			
		0001 0.9V							
		...							
		1111 2.3V							
3:0	PA_BIAS1_LSB[3:0]	0000 0.8V	0000						
		0001 0.9V							
		...							
		1111 2.3V							

**Register0x0003 – PA Bias2 (2G Mode, 1<sup>st</sup> & 2<sup>nd</sup> Stage)**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:5	SPARE	Reserved (For Vram mode only)	000	N	T012	R/W
4	Power_FLATNESS_DIS	Reserved (For Vram mode only)	0			
7:4	SPARE	For 2G Linear / 2G EDGE Only : VCC3 LDO Voltage Regulator Output Clamp Voltage 0000 = 1.47V Vram equivalent. 0001 = 1.46V Vram equivalent. ... 1111 = 1.23V Vram equivalent.	0000			
3:0	PA_BIAS2[3:0]	0000 = 2.500V	0000			
		0001 = 2.530V				
		...				
		1111 = 2.950V				

**Register0x0003 – PA Bias2 (3G/4G Mode)**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:4	SPARE	Reserved	0000	N	T012	R/W
3:0	PA_BIAS2[3:0]	Reserved	0000			

**Register0x001C – PM Trigger**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:6	Power_Mode[1:0]	00: ACTIVE - Normal Operation	0	Y	N	R/W
		01: STARTUP - Reset all registers to default settings				
		10: ACTIVE - Low Power - Antenna in isolation				
		11: STARTUP - Reset all registers to default settings				
5:3	TriggerMask[2:0]	Setting bit TriggerMask[N] disables Trigger[N] TriggerMask[N] updates before Trigger[N] is processed	111	N		
2:0	Trigger[2:0]	Setting bit Trigger[N] loads Trigger[N]'s associated registers	000	Y	N	W

**Register0x001D – Product ID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	PROD_ID[7:0]	Lower eight bits of Product ID	0X44	N	N	R

**Register0x001E – Manufacturer ID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	MFG_ID_LSB[7:0]	Lower eight bits of MIPI Manufacturer ID	0X34	N	N	R

**Register0x001F – USID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:6	SPARE	Reserved	00	N	N	R
5:4	MFG_ID_MSB[9:8]	Upper two bits of MIPI Manufacturer ID	01			
3:0	USID[3:0]	Programmable Unique Slave ID	0xF			R/W

**Register0x0020 – Extended Product ID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	PROD_ID[15:8]	Upper eight bits of Product ID	0X00	N	N	R

**Register0x0022 – GSID**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:4	GSID0[3:0]	Group Slave ID0	0x0	N	N	R/W
3:0	GSID1[3:0]	Group Slave ID1	0x0			

**Register0x0023 – UDR Reset**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7	UDR_RST	Setting this bit initiates a software reset	0	Y	N	W
6:0	SPARE	Reserved	0000000	N		R

**Register0x0024 – Error Status**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7	SPARE	Reserved for future use	0	N	N	R/W
6	CMD_FR_P_ERR	Command Frame received with a parity error	0			
5	CMD_LEN_ERR	Command Sequence received with an incorrect length	0			
4	ADDR_FR_P_ERR	Address Frame received with a parity error	0			
3	DATA_FR_P_ERR	Data Frame received with a parity error	0			
2	RD_INVLD_ADDR	Read Command Sequence received with an invalid address	0			
1	WR_INVLD_ADDR	Write Command Sequence received with an invalid address	0			
0	BID_GID_ERR	Read Command Sequence received with a BSID or GSID	0			

**Register0x002B – BUS Load**

Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:4	SPARE	Reserved	0x0	N	N	R/W
3:0	BUS_LD[3:0]	Approximate Bus Load 0x0: 5 pF 0x1: 7 pF 0x2: 10 pF 0x3: 15 pF 0x4: 20 pF (Not available) 0x5: 30 pF (Not available) 0x6: 40 pF (Not available) 0x7: 50 pF (Not available) 0x8 to 0xF : Spare	0x0			

**Register0x002C – Test Pattern**

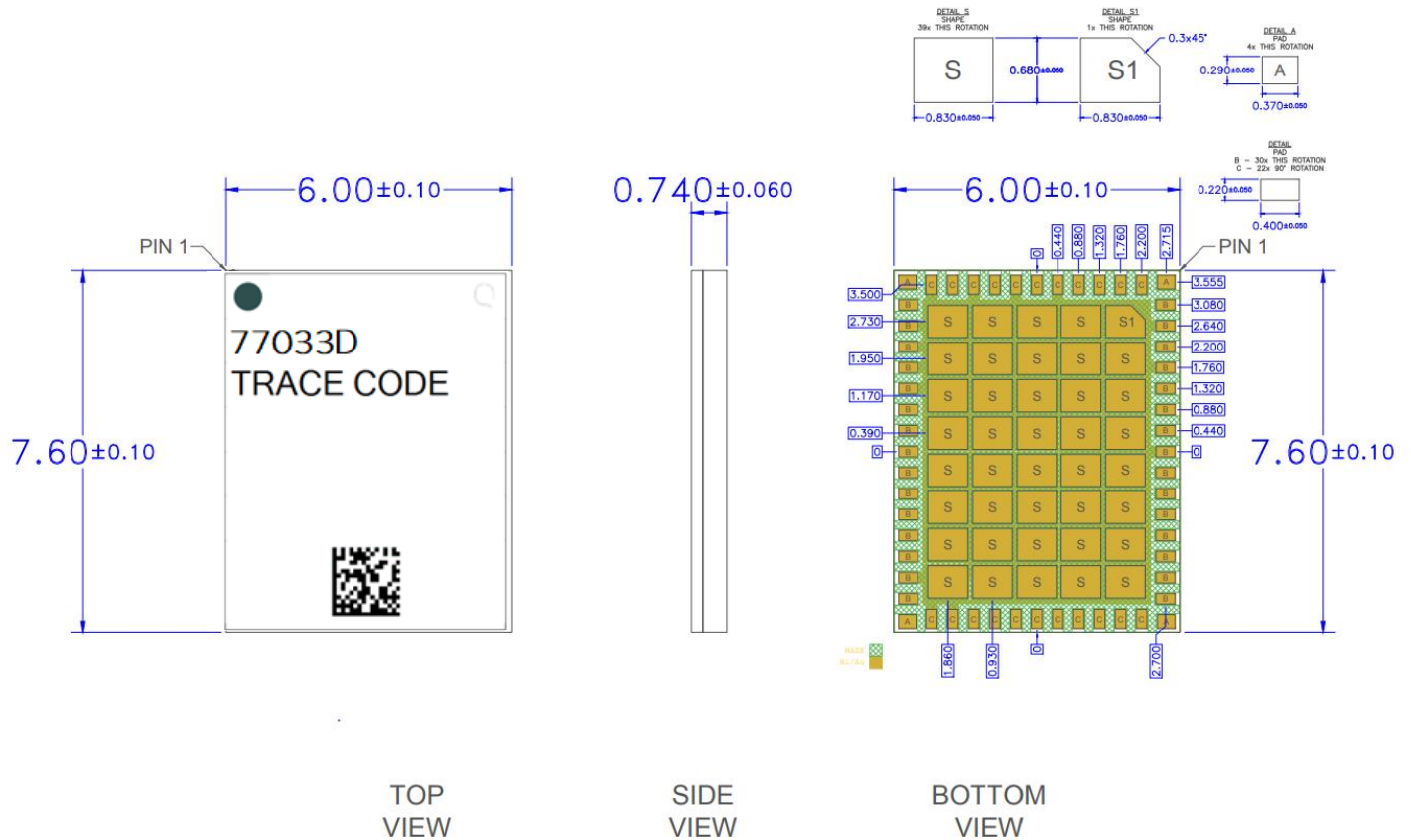
Bit(s)	Field Name	Description	Default	B/G	Trig.	R/W
7:0	TEST_PATT[7:0]	Test Pattern	0xD2	N	N	R

## Mechanical Information

### Package Marking and Dimensions

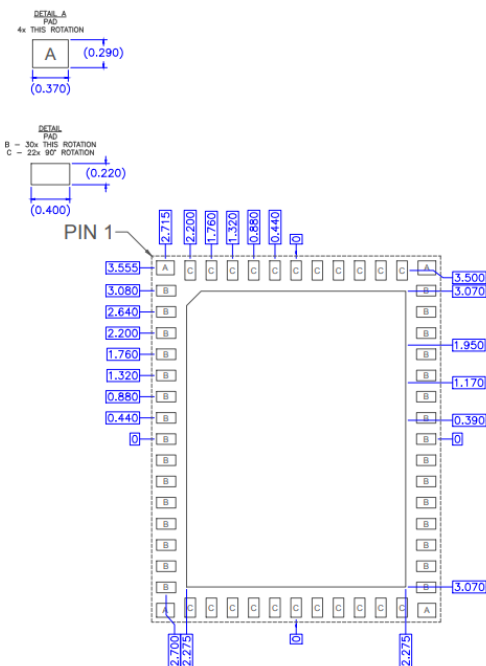
Marking: Part number – 77033D

Trace code – XXXX

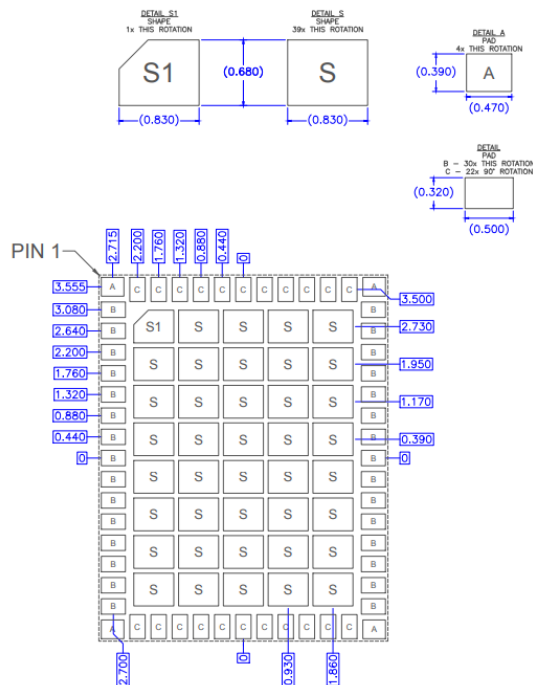


## PCB Design Guidelines

### PCB Metal Land and Solder Mask Pattern



RECOMMENDED  
LAND PATTERN



RECOMMENDED  
LAND PATTERN MASK

#### Notes:

1. All dimensions are in millimeters. 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 – Non SAW Class 1B – SAW Pins	ANSI/ESDA/JEDEC JS-001
ESD – Charged Device Model (CDM)	Class C3	ANSI/ESDA/JEDEC JS-002
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



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: Electrolytic plated Au over Ni

## 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<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- SVHC Free

