After Sales Technical Documentation
RAE/RAK–1N Series

Chapter 3
–Transceiver GE8/GE9 –
RF Block

Amendment 1 04/97

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Introduction

The RF module for Responder is taken from the HD841 project with only minor modifications in the built–in and external antenna interfaces. Otherwise the circuitry and layout are almost completely the same as in HD841 GSM and PCN versions.

Technical Summary

The RF module carries out all the RF functions of the transceiver. The GSM and PCN systems use different RF modules. The mechanical size of both modules is the same.

EMI leakage is prevented with magnesium shield B on side one and metallised plastic shield A on side two. Shield B conducts also heat out of the inner parts of the phone thus preventing excessive temperature rise.

External Signals and Connections

Table 1. List of Connectors

Connector Name	Code	Notes	Specifications / Ratings
Built–in antenna connector	5429003	SMD coaxial connector for Whip or Helix antenna	50 Ω / 2.0 W
External antenna connector	5420460	Includes antenna switch	50 Ω / 2.0 W

Main Technical Specifications

RF frequency plan

GSM

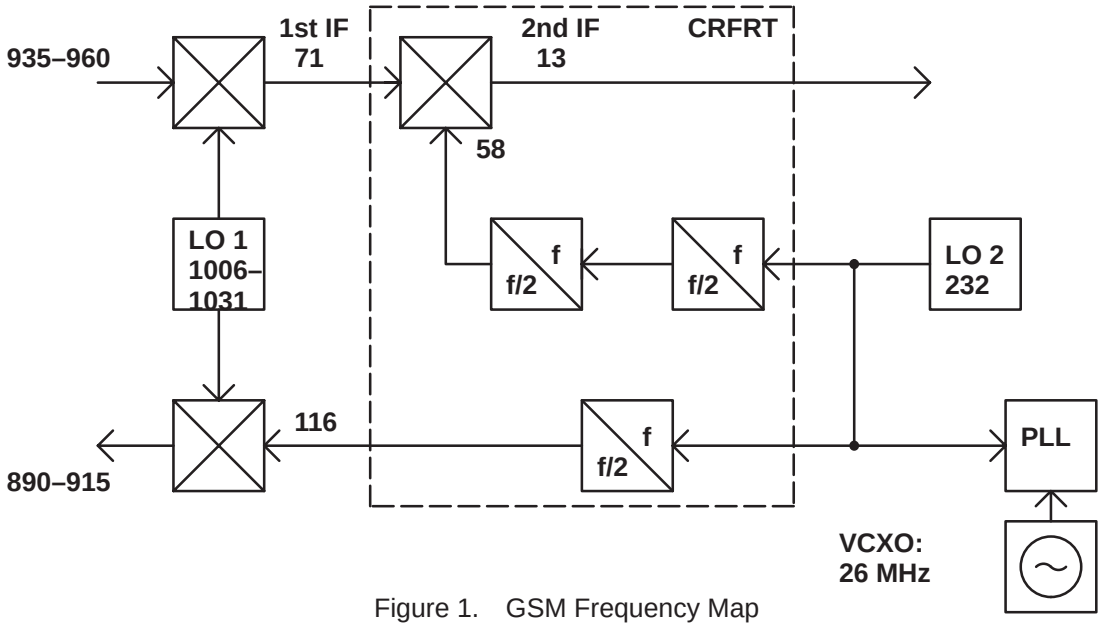

Figure 1. GSM Frequency Map

PCN

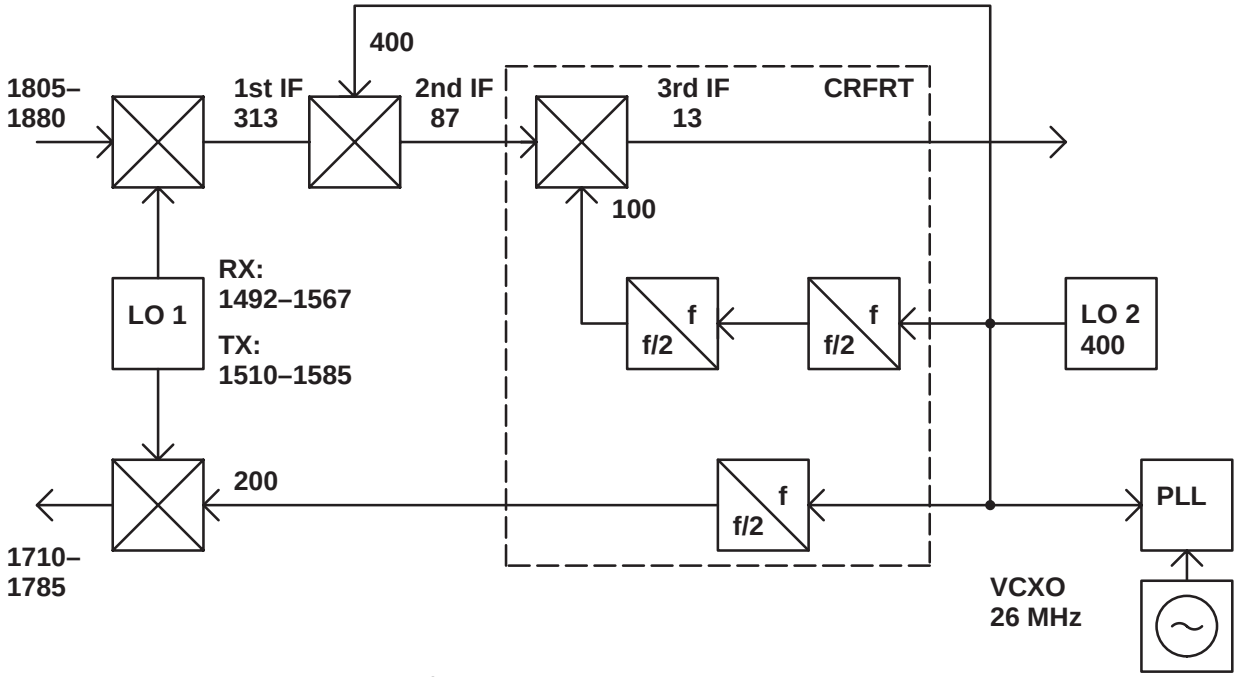

Figure 2. PCN Frequency map

Maximum Ratings

The maximum battery voltage during the transmission should not exceed 8.5 V. Higher battery voltages may destroy the power amplifier. During charging this will be quaranteed by hardware based limiting which has maximum value 7.6 +/–0.3 V. However, the maximum voltage of the Li–Ion battery will be almost 8.5 V when the battery is full. The charging algorithm ensures that the voltage never exceeds this limit.

Power Distribution Diagram

GSM/PCN:

All currents in the power distribution diagram are peak currents. Activity percentages are in CALL–mode 24.6 % for RXPWR, 15.8 % for TXPWR and 100 % for SYNTHPWR. In IDLE–mode activities are 0.4 %, 0.0 % and 1.77 % respectively. The current of each block is controlled independently, for example TXPWR and RXPWR are not on at the same time.

Regulators

There is one regulator IC in the RF unit. The regulator IC CRFCONT is an RF power supply circuit basically intended for digital handportable phones. It has 8 separate linear regulators and power on/off switches for RF–circuitry. Each regulator can be individually disabled and enabled and also has a voltage reference output.

See more details on Figure 3 and Figure 4.

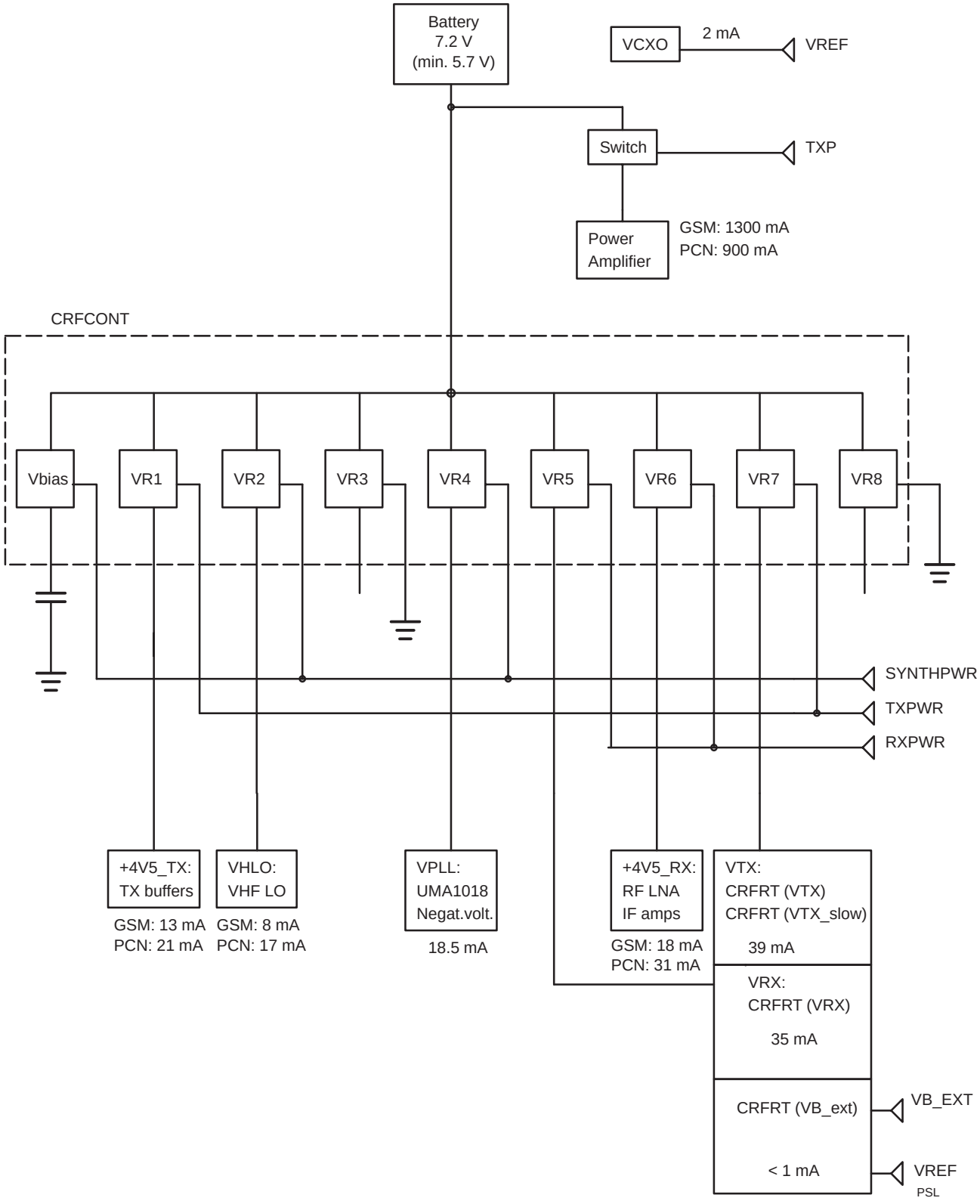

Figure 3. Power distribution diagram

Control Signals

In the following tables (Table 2, 3, 4) the RF current consumption can be seen with different status of the control signals. The VCXO current is not included in the results.

Table 2. Control Signals and Current Consumption

GSM,PCN					
SYNTHPWR	**RXPWR**	**TXPWR**	**TXP**	**Typical load current / mA**	**Notes**
L	L	L	L	0.05	Leakage current
H	L	L	L	42	Synthesizers active
H	H	L	L	116	Reception
H	L	H	L	94	TX active
H	L	H	H	1400	Transmission (GSM)
H	L	H	H	800	Transmission (PCN)

Functional Description

Receiver

The GSM receiver is a double conversion receiver. The PCN receiver has three conversions.

The received RF signal from the antenna is fed via a duplex filter to the receiver unit. The signal is amplified by a discrete low noise preamplifier. The gain of the amplifier is controlled by the AGC control line (PDATA0). The nominal gain of 10 dB in PCN is reduced in the strong field condition about 24 dB and in GSM the nominal gain of 16.5 dB is reduced about 36 dB. After the preamplifier the signal is filtered by ceramic (PCN) or SAW (GSM) RF filter. The filter rejects spurious signals coming from the antenna and spurious emissions coming from the receiver unit.

In PCN the filtered RF–signal is down converted by a passive diode mixer. The frequency of the first IF is 313 MHz. The first local signal is generated by the UHF synthesizer. The IF signal is amplified and then filtered by a microstripline filter. The filtered 1st IF is down converted by the second mixer, which is also a passive diode mixer. The 2nd IF frequency is 87 MHz. The 2nd local signal is generated by the VHF synthesizer.

In the GSM system the filtered RF–signal is also down converted by the passive diode mixer. The first IF frequency is 71 MHz and the first local signal is generated by the UHF synthesizer.

All the IF signals 71 and 87 MHz are amplified and filtered by SAW filter in GSM and PCN . The filter rejects adjacent channel signal, intermodulating signals and the last IF image signal.

The filtered IF signal is fed to the receiver part of the integrated RF circuit CRFRT. In CRFRT the filtered IF signal is amplified by an AGC amplifier which has gain control range of 57 dB. The gain is controlled by an analog signal via TXC–line. The amplified IF signal is down converted to the last IF in the mixer of CRFRT. The last local signal is generated from VHF VCO by dividing the original signal by 4 in the dividers of CRFRT.

The last IF frequency is 13 MHz in GSM and PCN. The last IF is filtered by a ceramic filter. The filter rejects signals of the adjacent channels. The filtered last IF is fed back to CRFRT where it is amplified. Finally the IF signal is split to +45 and –45 signals and then fed to RFI.

The block diagram overleaf, Figure 4., is common for GSM and PCN. Blocks in parenthesis refer to PCN only. In GSM these parts do not exist and in the signal path are replaced by direct connection to the next block.

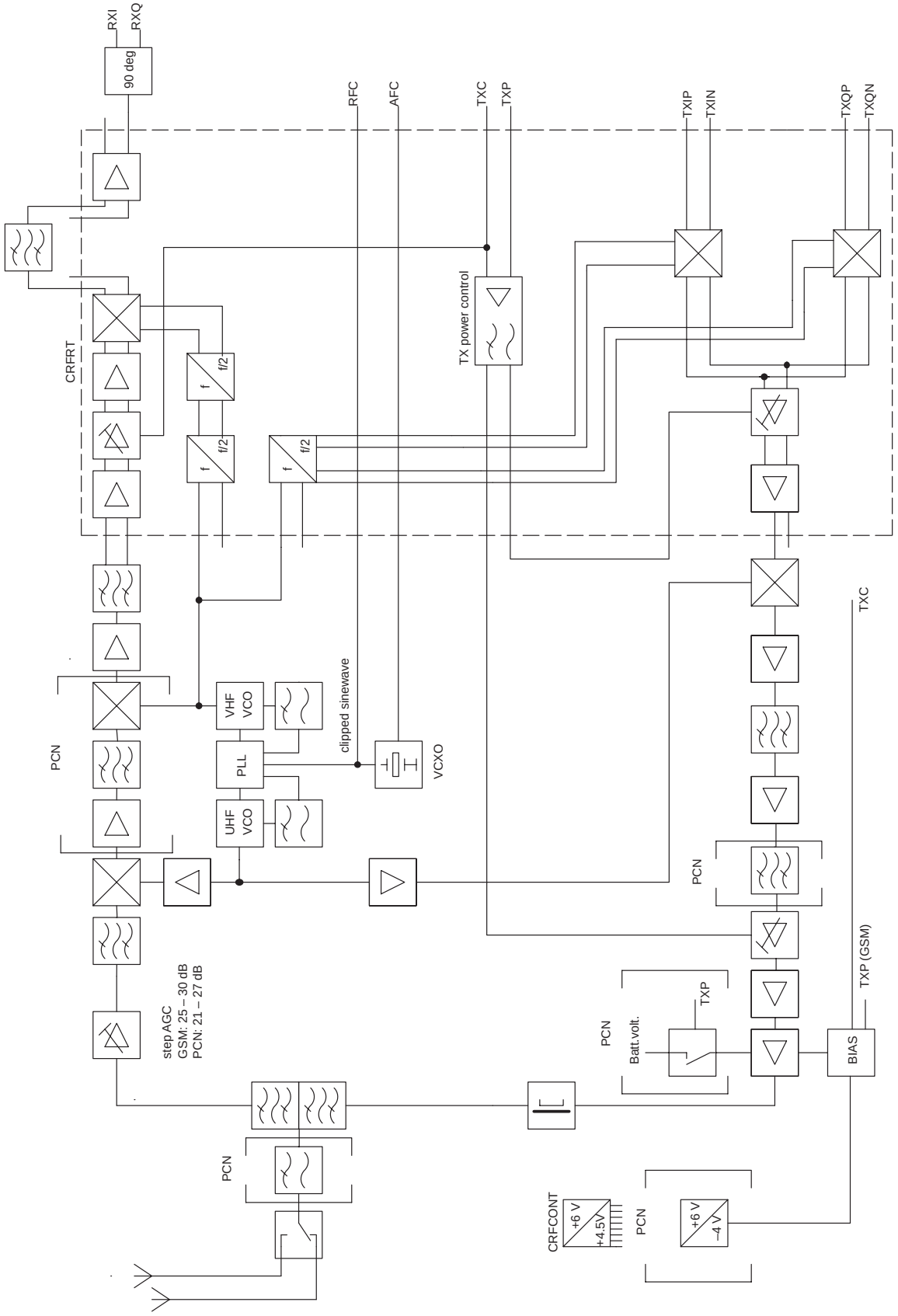

Figure 4. RF Functional Block diagram

Frequency Synthesizers

The stable frequency source for the synthesizers and base band circuits is discrete voltage controlled crystal oscillator (VCXO) in GSM and PCN.The frequency of the oscillators is controlled by an AFC voltage, which is generated by the base band circuits. The VCXO is always running when the CMT is powered up. The nominal frequency is 26 MHz in GSM and PCN.

The UHF PLL generates the down conversion signal for the receiver and the up conversion signal for the transmitter.

The VHF PLL signal (divided by 4 in CRFRT) is used as a local oscillator for the last mixer. Directly it is used as a second local oscillator in PCN. The VHF PLL signal (divided by 2 in CRFRT) is also used in the I/Q modulator of the transmitter chain. The VHF VCO is made of discrete components.

Transmitter

The TX intermediate frequency is modulated by an I/Q modulator contained on transmitter section of CRFRT IC. The TX I and Q signals are generated in the RFI interface circuit and they are fed differentially to the modulator.

Modulated intermediate signal is amplified or attenuated in temperature compensated controlled gain amplifier (TCGA). The output of the TCGA is amplified and the output level is typically –10dBm.

The output signal from CRFRT is band–pass filtered (in PCN low–pass filtered) to reduce harmonics and the final TX signal is achieved by mixing the UHF VCO signal and the modulated TX intermediate signal with passive mixer. After mixing the TX signal is amplified and filtered by two amplifiers and filters except in GSM there is only one filter. These filters are dielectric filters in both GSM and PCN. After these stages the level of the signal is typically 1 mW (0 dBm) in GSM and 2 mW (+3 dBm.) in PCN.

The discrete power amplifier amplifies the TX signal to the desired power level. The maximum output level is typically 1.5...2.0 W in GSM and 0.8...1.0 W in PCN in the antenna terminal of the duplex filter.

The power control loop controls the output level of the power amplifier. The power detector consists of a directional coupler and a diode rectifier. Transmitted power is controlled with TCGA on TX–path of CRFRT. Power is controlled with TXC and TXP signals. The power control signal (TXC), which has a raised cosine form, comes from the RF interface circuit (RFI), which is located in the baseband section.

RF Characteristics

Receiver

Table 3. RF characteristics, Receiver

Item	GSM	PCN
RX frequency range , MHz	935 ... 960	1805 ... 1880
Type	Linear, 2 IFs	Linear, 3 IFs
Intermediate frequencies , MHz	71 , 13	313, 87, 13
3 dB bandwidth ,kHz	+/– 100	+/– 100
Reference noise bandwidth ,kHz	270	270
Sensitivity , dBm	–102, S/N ratio > 8 dB, B_N = 135 kHz	–100 , S/N ratio > 8 dB, B_N =135 kHz
AGC dynamic range dB	85 , typ	81 , typ.
Receiver gain ,dB	69 , typ	67 , typ
RF front end gain control range,dB	36	24
2nd IF gain control range, dB	57	57
Input dynamic range ,dBm	–100 ... –10	–100 ... –10
Gain relative accuracy in receiving band, dB	+/–1.5	+/– 1.5
Gain relative accuracy on channel, dB	+/–0.4	+/– 0.4

Duplex filter

The duplex filter consists of two functional parts; RX and TX filters. The TX filter rejects the noise power at the RX frequency band and TX harmonic signals. The RX filter rejects blocking and spurious signals coming from the antenna. In PCN there is a lowpass filter between the duplexer and RF connector, which further improves the spurious response rejection above 2 GHz.

Pre–amplifier

The bipolar pre–amplifier amplifies the received signal coming from the antenna. In the strong field conditions the gain of the amplifier is reduced 36 dB in GSM and 24 dB in PCN, typically.

Table 4. Pre amplifier specifications

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
Frequency band	GSM PCN		935–960 1805 – 1880		MHz MHz
Supply voltage		4.27	4.5	4.73	V
Current consumption	GSM PCN	5 4	6 5.5	7 8	mA mA
Insertion gain	GSM PCN	15 8	16.5 10	17 12	dB dB
Gain flatness			+/– 0.5		dB
Noise figure	GSM PCN		2.0 2.3	2.5 2.8	dB dB
Reverse isolation		15			dB
Gain reduction	GSM PCN	33 21	36 24	39 27	dB dB
IIP3	GSM PCN	–12 –12	–10 –10		dBm dBm
Input VSWR (Zo=50 ohms)				2.0	
Output VSWR (Zo=50 ohms)				2.0	

RX Interstage Filter

The RX interstage filter is a three pole ceramic filter in PCN. In GSM there is a SAW filter. The filter rejects spurious and blocking signals coming from the antenna. It also rejects the local oscillator signal leakage.

First mixer

The first mixer is a single balanced passive diode mixer. The local signal is balanced by a printed circuit transformer. The mixer down converts the received RF signal to the first IF signal.

Table 5. Mixer Specification

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
RX frequency range	GSM PCN	935 1805		960 1880	MHz MHz
LO frequency range	GSM PCN	1006 1492		1031 1567	MHz MHz
IF frequency	GSM PCN		71 313		MHz MHz
Conversion loss		5	6	7	dB

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
IIP3	GSM PCN	2 2	5 5		dBm dBm
LO – RF isolation		15.0			dB
LO power level		3			dBm

First IF amplifier

The first IF amplifier is a bipolar transistor amplifier.

Table 6. 1st IF amplifier specification

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
Operation frequency	GSM PCN		71 313		MHz MHz
Supply voltage		4.27	4.5	4.73	V
Current consumption	GSM PCN		12 5.5	15 10	mA mA
Insertion gain	GSM PCN	18 12	20 14	22 18	dB dB
Noise figure	GSM PCN		3.5 2.5	4.0 3.0	dB dB
IIP3	GSM PCN	–5 –5	–3 –3		dBm dBm
Input impedance					matched to the mixer
Output impedance	GSM PCN				matched to the filter matched to the mixer

First IF filter

The first IF filter is a microstripline filter in PCN. In GSM the first IF filter is a SAW filter. The IF filter rejects some spurious and blocking signal coming from the front end of the receiver.

2nd mixer (only in PCN)

The 2nd mixer is a single balanced passive diode mixer. The local signal is balanced by a printed circuit transformer. The mixer down converts the 1st IF signal 313 MHz to 2nd IF signal 87 MHz.

Table 7. 2nd Mixer Specification (PCN)

Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
1st IF frequency		313		MHz
LO frequency		400		MHz
2nd IF frequency		87		MHz
Conversion loss	5	6	7	dB
IIP3	2	5		dBm
LO – RF isolation	15.0			dB
LO power level	3			dBm

2nd IF amplifier (only in PCN)

The 2nd IF amplifier is realized using resistive feedback connection for bipolar RF transistor.

Table 8. 2nd IF amplifier specification (PCN)

Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
Operation frequency		87		MHz
Supply voltage		4.5		V
Current consumption		11	15	mA
Insertion gain	14	16	18	dB
Noise figure		2.5	3.0	dB
IIP3	–3	0		dBm
Input impedance				matched to the mixer
Output impedance				matched to IF filter

2nd IF filter (only in PCN)

The second IF filter (SAW) makes the part of the channel selectivity of the receiver. It rejects adjacent channel signals (except the 2nd adjacent). It also rejects blocking signals and the 3rd image frequency.

Receiver IF circuit, RX part of CRFRT

The receiver part of CRFRT consists of an AGC amplifier of 57 dB gain, a mixer and a buffer amplifier for the last IF. The mixer of the circuit down converts the received signal to the last IF frequency. After external filtering the signal is amplified and fed to baseband circuitry. The supply current can be switched OFF by an internal switch, when the RX is OFF.

Table 9. CRFRT RX part Specifications

Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
Supply voltage	4.27	4.5	4.73	V
Current consumption		32.0	44.0	mA
Input frequency range	41 (–1 dB)		87 (–3 dB)	MHz
Local frequency range of mixer	170		400	MHz
2nd IF range	2		17	MHz
Voltage gain (max. gain) of AGC amplifier	47			dB
Noise figure			16	Max gain
AGC gain control slope	40	84	100	dB/V
Mixer output 1dB compression point		1.0		Vpp
Max output level after last IF buffer		1.6		Vpp

Last IF filter

The last IF is a ceramic filter, which makes the part of the channel selectivity of the receiver.

Transmitter

Table 10. RF Characteristics, Transmitter

Item	GSM	PCN
TX frequency range	890...915 MHz	1710...1785 MHz
Type	Upconversion	Upconversion
Intermediate frequency	116 MHz	200 MHz
Maximum output power	2 W (33 dBm)	1 W (30 dBm)
Gain control range	20 dB	20 dB
Maximum RMS phase error	5 deg.	5 deg.

Modulator Circuit, TX part of CRFRT

The modulator is a quadrature modulator contained in Tx–section of CRFRT IC. The I– and Q– inputs generated by RFI interface are DC–coupled and fed via buffers to the modulator. The local signal is divided by two to get accurate 90 degrees phase shifted signals to the I/Q mixers. After mixing the signals are combined and amplified with temperature compensated controlled gain amplifier (TCGA). Gain is controlled with power control signal (TXC). The output of the TCGA is amplified and the maximum output level is –10 dBm, typically.

Table 11. CRFRT TX–part specifications

Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
Supply voltage	4.27	4.5	4.73	V
Supply current		36	45	mA
Transmit Frequency Input	**Minimum**	**Typical / Nominal**	**Maximum**	**Unit / Notes**
LO input frequency	170		400	MHz
LO input level		0.2		Vpp
LO input resistance	70	100	130	ohm
LO input capacitance		4		pF
Modulator Inputs (I/Q)	**Minimum**	**Typical / Nominal**	**Maximum**	**Unit / Notes**
Input bias current (balanced)			100	nA
Input common mode voltage	2.0	2.2	2.4	V
Input level (balanced)			1.1	Vpp
Input frequency range	0		300	kHz
Input resistance (balanced)	200			kohms
Input capacitance (balanced)			4	pF
Output frequency	85		200	MHz

Table 11. CRFRT TX–part specifications (continued)

Modulator Inputs (I/Q)	Minimum	Typical / Nominal	Maximum	Unit / Notes
Available linear RF power		–10		dBm, ZiL=50 ohms
Available saturated RF power	–5	0		dBm, ZiL=50 ohms
Total gain control range	45			dB
Gain control slope		84		dB/V
Suppression of 3rd order prods	35			dB
Carrier suppression		35		dB
Single sideband suppression				dB
Noise floor Pout = –10 dBm			–132	dBm/Hz avg.
Noise floor Pout = –18 dBm			–137	dBm/Hz avg.
Noise floor Pout = –24 dBm			–140	dBm/Hz avg.
Noise floor Pout = –30 dBm			–142	dBm/Hz avg.
Noise floor Pout = –40 dBm			–144	dBm/Hz avg.
TX I/Q phase balance Tolerance over temp. range	–5 –2		5 2	deg deg
TX I/Q amplitude balance Tolerance over temp. range	–0.5 –0.2		0.5 0.2	dB dB

Upconversion mixer

The upconversion mixer is a single balanced passive diode mixer. The local signal is balanced by a printed circuit transformer. The mixer upconverts the modulated IF signal coming from quadrature modulator to RF signal.

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
RX frequency range	GSM PCN	890 1710		915 1785	MHz MHz
LO frequency range	GSM PCN	1006 1510		1031 1585	MHz MHz
IF frequency	GSM PCN		116 200		MHz MHz
Conversion loss		6.0	7.0	8.0	dB
IIP3	GSM PCN	0.0 0.0			dBm dBm
LO – RF isolation		15.0			dB
LO power level	GSM PCN			3.0 3.0	dBm dBm

1st TX buffer

The TX buffer is a bipolar transistor amplifier. It amplifies the TX signal coming from the upconversion mixer.

Table 12. 1st TX amplifier specification

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
Operating freq. range	GSM PCN	890 1710		915 1785	MHz MHz
Supply voltage		4.25	4.5	4.8	V
Current consumption GSM / PCN			4.5	5.0	mA
Insertion gain	GSM PCN	11 10	12 11	13 12	dB dB
Input VSWR (Zo=50 ohms)				2.0	Matched to the mixer
Output VSWR (Zo=50 ohms)				2.0	

TX interstage filters

The TX filters reject the spurious signals generated in the upconversion mixer. They also reject the local, image and IF signal leakage and RX band noise.

2nd TX buffer

The TX buffer is a bipolar transistor amplifier. It amplifies the TX signal coming from the first interstage filter.

Table 13. 2nd TX amplifier specification

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
Operating freq. range	GSM PCN	890 1710		915 1785	MHz MHz
Supply voltage		4.25	4.5	4.8	V
Current consumption	GSM PCN		9.0 16.0	10.0 17.0	mA mA
Insertion gain	GSM PCN	11 15	12 16	13 17	dB dB
Output power (Zo=50 ohms)	GSM PCN	0 2	3 7		dBm dBm
Input VSWR (Zo=50 ohms)				2.0	
Output VSWR (Zo=50 ohms)				2.0	

Power amplifier

The power amplifier is a three stage discrete amplifier. It amplifies the 0 dBm (2 dBm in PCN) TX signal to the desired output level. It has been specified for 5.5...8.5 volts operation. There are 5 x 330 μF capacitors in the near vicinity of the power amplifier to alleviate supply voltage degradation during TX burst.

Table 14. Power amplifier specification

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
DC supply voltage (no RF)				10	V
DC supply voltage		5.5	7.2	8.5	V
Operating frequency range					
	GSM	890		915	MHz
	PCN	1710		1785	MHz
Operating case temp. range					
	GSM			90	deg.C
	PCN			90	deg.C
Max Output power	GSM	34.5	35	36	dBm, normal cond
	PCN	31.5	33	34.5	dBm, normal cond
Max Output power	GSM	33.5	34	35	dBm, extreme cond. Vcc=5.4V, Ta = 55 C
	PCN	31	32.5	34	
Input power	GSM	0			dBm
	PCN	2			dBm
Gain	GSM	34.5	35	36	dB, normal cond
	PCN	29.5	31	32.5	dB, normal cond
Efficiency	GSM		42		%, Pout = 35 dBm
	PCN		38		%, Pout = 32 dBm
Input VSWR (Zo=50 ohms)				2.0	
Output VSWR (Zo=50 ohms)				2.0	
Harmonics:	$2\ f_0$			–30	dBc, Pout = 35 dBm
	$3\ f_0$, $4\ f_0$, $5\ f_0$			–40	dBc, Pout = 32 dBm
Noise power	GSM			–114	dBm/Hz at RX band
	PCN			–114	dBm/Hz at RX band
Ruggedness	VBATT GSM	8.0 V			VSWR=7, Pout=4W
	VBATT PCN	T.B.D.			T.B.D.
Stability (load VSWR 8:1)				–60	dBc, all spurious

Power control circuitry

The power control loop consists of a power detector and a differential control circuit. The power detector is a combination of a directional coupler and a diode rectifier. The differential control circuit compares the detected voltage and the control voltage (TXC) and controls voltage controlled amplifier (in CRFRT) or the power amplifier. The control circuit is a part of CRFRT.

Table 15. Power control specification

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
Supply voltage using CRFRT		4.5 4.27	4.7 4.5	4.9 4.73	V V
Supply current using CRFRT			3.0	5.0	mA
Power control range	GSM PCN	20 20			dB dB
Power control inaccuracy GSM PCN				+/–1.0 +/–1.0	dB dB
Dynamic range	GSM PCN	80 80			dB dB
Input control voltage range GSM PCN		0.1 0.1		2.8 2.8	V

Synthesizers

Reference oscillator

In GSM and PCN the reference oscillator is a discrete VCXO and the frequency is 26 MHz. In PCN the buffer amplifier for the reference oscillator is located in the RF side near the local oscillator, although it is drawn in the baseband schematic.

The oscillator signal is used for a reference frequency of the synthesizers and the clock source for the baseband circuits.

Table 16. VCXO specification

Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
Center frequency		26		MHz
Frequency tolerance				ppm, Vc=2.2 V
Frequency control range		67		ppm
Supply voltage	4.6	4.7	4.8	V
Current consumption		1.5	1.7	mA

Table 16. VCXO specification (continued)

Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
Output voltage	1.3	1.7	2.0	Vpp, sine wave for PLLs
Harmonics			–5	dBc
Control Voltage Range	0.25		4.45	V
Nominal Voltage for center frequency		2.2		V
Control Sensitivity	12	16	22	ppm/V
Frequency stability, vs. temperature vs. supply voltage vs. load vs. aging			 10 1 0.1 1	 ppm, –25...+70 deg.C ppm, 4.5 V +/– 5 % ppm, load +/– 10 % ppm, year
Operating temperature range	–20		70	deg. C
Load impedance: resistive part	2			kohm
parallel capacitance			20	pF

VHF PLL

The VHF PLL consists of the VHF VCO, PLL integrated circuit and loop filter. The output signal is used for the 2nd (and 3rd in PCN) mixer of the receiver and for the I/Q modulator of the transmitter.

Table 17. VHF PLL specification

Parameter	Minimum	Typical / Nominal		Maximum	Unit / Notes
Start up settling time				5	ms
Phase error				1	deg., rms
Sidebands		**GSM**	**PCN**		
+/– 200 kHz		–75	–75	–70	dBc
+/– 400 kHz		–84	–84	–70	dBc
+/– 1 MHz		<–85	–75	–70	dBc
+/– 2 MHz		<–85	<–80	–75	dBc
+/– 3 MHz		<–85	–85	–80	dBc
> 4 MHz		<–85	–85	–80	dBc

VHF VCO + buffer

The VHF VCO uses a bipolar transistor as a active element and a combination of a chip coil and varactor diode as a resonance circuit. The buffer is combined into the VCO circuit so, that they use same collector current.

Table 18. VHF VCO + buffer specification

Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
Supply voltage	4.2	4.5	4.8	V
Control voltage	0.5		4.0	V
Supply current GSM PCN		2.5 3.5	5.0	mA mA
Operation frequency GSM PCN		232 400		MHz MHz
Output power level		170		mV_{rms} / 1 kohm
Control voltage sensitivity GSM PCN		 12 17		 MHz/V MHz/V
Phase noise, GSM/PCN f_0 +/– 25 kHz f_0 +/– 200 kHz f_0 +/– 1600 kHz f_0 +/– 3000 kHz			 –123 –133 –143	 dBc/Hz dBc/Hz dBc/Hz
Harmonics		–32	–30	dBc

UHF PLL

The UHF PLL consists of a UHF VCO, divider, PLL circuit and a loop filter. The output signal is used for the 1st mixer of the receiver and the upconversion mixer of the transmitter. In PCN the VCO changes the frequency according to the RX/TX mode change.

Table 19. UHF PLL specification

Parameter	Minimum	Typical / Nominal		Maximum	Unit / Notes
Start up settling time				5	ms
Phase error				4	deg. rms
Settling time +/– 93 MHz GSM PCN		 525 450		800	µs µs µs
Sidebands offset from carrier		**GSM**	**PCN**		
+/– 200 kHz		–80	–74	–60	dBc
+/– 400 kHz		–87	–81	–65	dBc
+/– 600 kHz		<–90	<–90	–70	dBc
+/– 1.4 MHz...3.0 MHz		<–90	<–90	–80	dBc
> 3.0 MHz				–80	dBc

UHF VCO

The UHF VCO uses a bipolar transistor as a active element and a combination of a chip coil and a varactor diode as a resonance circuit.

UHF VCO buffers

The UHF VCO output signal is divided into the 1st mixer of the receiver and the upconversion mixer of the transmitter. The UHF VCO signal is amplified after division. There is one buffer for TX and one for RX.

Table 20. UHF VCO buffer specification

Parameter	Minimum	Typical / Nominal	Maximum	Unit / Notes
Supply voltage	4.2	4.5	4.8	V
Supply current		5.5	6.5	mA
Frequency range	See UHF VCO specification			MHz
Input power		–3		dBm
Harmonics			–10	dBc
Output amplitude		700		mVrms / 1 kohm

PLL Circuit

The PLL is Philips UMA1018 in GSM and National LMX2331 in PCN. The circuit is a dual frequency synthesizer including both the UHF and VHF synthesizers.

Table 21. PLL UMA1018 (UMA1020) specification

Parameter		Minimum	Typical / Nominal	Maximum	Unit / Notes
Supply voltage		2.7		5.5	V
Supply current	GSM PCN		8.5 12.1		mA mA
Principal input freq.	GSM PCN	500 200		1200 2000	MHz, Vdd = 4.5 V MHz, Vdd = 3.0 V
Auxiliary input freq.	GSM PCN	20 20		300 510	MHz, Vdd = 4.5 V MHz, Vdd = 3.0V
Input reference frequency		3		40	MHz, Vdd = 4.5 V
Input signal level	GSM PCN	50 –10 –15 500		500 4 4	mVrms dBm main divider dBm aux. divider mVrms ref. divider

Connections

Antenna

The default antenna in GSM transceiver is helix with turnable joint and in PCN a whip antenna with turnable joint also. The location of the antenna is in the gk2 module. The antenna signal is lead through the turnable hinge separating the gk2 and CMTmain modules using 50Ω flexible coaxial cable. The feedpoint of the antenna is matched to the 50Ω cable using LC matching transformer. There is a SMD coaxial connector on the CMT board for the cable.

Table 22. Specification of the antenna cable

Parameter		Minimum	Typical / Nominal	Maximum	Notes
Insertion loss	GSM PCN			0.6 dB 1.0 dB	Whole assembly including cable and connectors at both ends.
V.S.W.R.	GSM PCN			1.5 1.5	Whole assembly including cable and connectors at both ends.
Cable length			140 mm		

The external antenna connector includes an antenna switch between the built–in and external antennas. The nominal impedance of the external antenna connector is 50Ω. The connector is located near the duplex filter of the RF module