## Nokia Customer Care RH–19/RH–50 Series Cellular Phones

# 7 – RF Description and Troubleshooting

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## **RF** Description and Troubleshooting

#### Introduction

The sections below provide instructions how to check, repair and calibrate the RF section of RH-19/RH-50 phones.

It is assumed that for tuning and repair the phones are disassembled and tested within a repair jig MJS-52.

The following types of measurements can be done for diagnosis and repair of RH-19/RH-50 phone modules:

- RF measurements shall be done using a Spectrum Analyzer together with a high-frequency probe. (Note, that signal will be significantly attenuated). Correct attenuation can be checked using a "good" phone board for example.
- LF (Low frequency) and DC measurements shall be done with a an oscilloscope together with a 10:1 probe.
- For receiver measurements a signal generator with frequencies up to 2000 MHz is required. Most of the radio communication testers like CMU200 can be used as signal generator. The signal generator is connected to the antenna port using the repair jig MJS-52.
- Output level measurements of the transmitter shall be done with a power meter, which is connected to the antenna port using the repair jig MJS-52.

Always make sure that the measurement set-up is calibrated when measuring RF parameters at the antenna port. Remember to include the correct losses of the module repair jig (as stated on MJS-52) and the connecting cable when realigning the phone.

Most RF semiconductors are static discharge sensitive. ESD protection must be used during repair (wrist straps and ESD proof soldering irons).

Mjoelner RF ASIC is moisture sensitive. Therefore, Mjoelner RF ASIC must be in appropriate condition or pre-baked prior to soldering.

RX calibration done via Phoenix software is temperature sensitive because of calibration of the 26 MHz reference oscillator (VCXO). According to Mjoelner specification ambient temperature has to be in a range from 22°C to 36°C.

Apart from key-components described in the following sections there are a lot of discrete components (resistors, inductors and capacitors) for which troubleshooting is done by checking its proper soldering and complete assembly on the PWB. Capacitors and resistors can be checked by means of an ohm-meter, but be aware: in-circuit measurement results have to be evaluated carefully.

Note: In this document there are example measurements being depicted with Phoenix pictures. This version of Phoenix however, is not the latest version.

Note: There are two different kinds of VCOs applicable (FDK and Matsushita).

Note: There are different kinds of PAs applicable (Agilent and Renesas (RH-19) and Renesas (RH-50)).

Below the following abbreviations can be used interchangeably:

GSM850 and (E)GSM900 to refer to GSM low band.

DCS or PCN or GSM1800 GSM medium band.

PCS and GSM1900 GSM high band.

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#### RF key component placement



Figure 1: RF key component placement

Position	Component Name	Supplier and Description	Code
N801	TX-PA	Agilent, QCPM8893 (RH-19) Renesas, PF08125B-03 (RH-19) Renesas, PF08132B7 (RH-50)	4350369 4350409 4359007
L801	Directional Coupler	Murata, LDC15D190A0010A (RH-19) Murata, LDC21836M19D-185 (RH-50)	4551015 4550197
Z601	Antenna Switch Module	Hitachi Metals, SHS-L090 (RH-19) SHS-L080NT (RH-50)	4510385 4550281
Z602	SAW1800 RX	Epcos, B7714	4511313
Z603	SAW1900 RX	Epcos, B7720	4511367
Z604	SAW900 RX (RH-19) SAW850 RX (RH-50)	Epcos, B7710 (RH-19) Murata, SAFSD881MCLOTO4R13 (RH-50)	4511279 4511323
Z701	SAW900 TX (RH-19) SAW850 TX (RH-50)	Epcos, B7715 (RH-19) Murata, SAFSD836MFLOTO4R13 (RH-50)	4511311 4511317
N601	Mjoelner	Infineon, F3a	4370867
B601	XTAL	NDK	4510337
G701	VCO	FDK, IT016 (RH-19) Matsushita, ENFVJW2S05 (RH-19) Matsushita EVFVZ6P28 (RH-50)	4350315 435B036 4350391

#### RF test points

The RF power supplies are generated in the UEM and can be measured either in the Mjoelner chamber or in the base band chamber. On the following illustration small circles show the locations of the test points.

#### Receiver



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#### Transmitter



#### Synthesizer



## **RF in General**

The RH-19/RH-50 RF front-end is a triple-band direct conversion transceiver. Using direct conversion, no intermediate frequencies are used for up- or down-conversion.

The VCO oscillates on the double respectively quadruplicate frequency of the wanted RX or TX frequency, depending on the band used. The VCO frequency is divided by either 2 or 4 and fed to the mixers (down-conversion) or modulators (up-conversion). Up- or down-conversion is done in one step, directly between RF frequency and base band. All up- and down-conversion takes place in the RF ASIC named Mjoelner (N601).

Mjoelner RF ASIC also contains PLL and LNAs for all used bands. A DC control section is included to power and/or control (E)GSM TX buffer, detector and antenna switch. The Mjoelner RF ASIC is controlled via a serial bus.

Mjoelner RF ASIC contains an integrated VCXO which uses an external 26 MHz Xtal. No analogue AFC signal is needed. AFC is realized via the serial interface port of Mjoelner.

The UPP is supplied by the 26 MHz reference clock of Mjoelner.

The phone supports HSCSD (High Speed Circuit Switched Data) and GPRS (General Packed Radio Service), meaning multi-slot operation. (This does not require special equipment or procedures in repair situations.)

The following diagrams show the RF frequency scheme and the RF block diagram.



#### Figure 5: RF frequency plan



#### RF power supply configuration

Г

All power supplies for the RH-19/RH-50 RF Unit are generated in the UEM IC (D200). All RF supplies can be checked either in Mjoelner or in BB chamber.

The power supply configuration used is shown in the block diagram below. Values of voltages are given as nominal outputs of UEM. Currents are typical values.

VR1A	4.75 V 3.2 % 0.45 mA ► charge pump (VDDCP)
VR2	2.78 V 3 % 85 mA ► Tx modulator (VDDTX)
	→ Dig. control (VDDDIG)
	Ant. switch control lines (through Mjoelner)
VR3	2.78 V 3 % 3.5 mA VCXO (VDDXO)
UEM	BB buffer (VDDBBB)
 VR4	2.78 V 3 % 14 mA (Tx850/Tx900), 28 (Rx) → Rx BB section (VDDRXBB)
	► Tx buffer (through Mjoelner)
VR5	2.78 V 3 % 41 mA  PLL prescaler (VDDPRE)
	dividers, LO buffers (VDDLO)
	► PLL counters (VDDPLL)
VR6	2.78 V 3 % 11 mA ► Rx front end (VDDRXF)
VR7	2.78 V 3 % ► VCO
VIO	1.8 V 4.5 % 0.02 mA ► 13/26 MHz (SELADDR)
	→ dig. interface (VDDDL)
VREF01	1.35 V     2 %       100 uA   bias reference (VBEXT)
 VBAT	3.6 V Triple band PA

#### Figure 7: RF power distribution diagram

#### General specifications of transceiver RH-19/RH-50

Parameter	Unit
Cellular System	GSM850, (E)GSM900, GSM1800, GSM1900
RX Frequency Band	GSM850: 869 894 MHz (RH-50) EGSM: 925 935 MHz (RH-19) GSM900: 935 960 MHz (RH-19) GSM1800: 1805 1880 MHz (RH-19/RH-50) GSM1900: 1930 1990 MHz (RH-19/RH-50)
TX Frequency Band	GSM850: 824 849 MHz (RH-50) EGSM: 880 890 MHz (RH-19) GSM900: 890 915 MHz (RH-19) GSM1800: 1710 1785 MHz (RH-19/RH-50) GSM1900: 1850 1910 MHz (RH-19/RH-50)
Output Power	GSM850: +5 +33 dBm (3.2 mW 2 W) (RH-50) EGSM: +5 +33 dBm (3.2 mW 2 W) (RH-19) GSM900: +5 +33 dBm (3.2 mW 2 W) (RH-19) GSM1800: +0 +30 dBm (1.0 mW 1 W) (RH-19/RH-50) GSM1900: +0 +30 dBm (1.0 mW 1 W) (RH-19/RH-50)
Duplex Spacing	GSM850: 45 MHz (RH-50) EGSM: 45 MHz (RH-19) GSM900: 45 MHz (RH-19) GSM1800: 95 MHz (RH-19/RH-50) GSM1900: 80 MHz (RH-19/RH-50)
Number of RF Channels	GSM850: 124 EGSM: 50 + 124 = 174 GSM900: 124 GSM1800: 374 GSM1900: 299
Channel Spacing	200 kHz (each band)
Number of TX Power Levels	GSM850: 15 (RH-50) EGSM: 15 (RH-19) GSM900: 15 (RH-19) GSM1800: 16 (RH-19/RH-50) GSM1900: 16 (RH-19/RH-50)
Sensitivity, static channel	GSM850: -102 dBm (RH-50) EGSM: -102 dBm (RH-19) GSM900: -102 dBm (RH-19) GSM1800: -102 dBm (+25°C) (RH-19/RH-50) GSM1900: -102 dBm (RH-19/RH-50)
Frequency Error, static channel	< 0.1 ppm
RMS Phase Error	< 5.0 °
Peak Phase Error	< 20.0 °

## **Receiver Description and Troubleshooting**

#### General instructions for RX troubleshooting

Connect the phone to a PC with dongle and DAU-9T cable (RS232) (or DKU-5 cable (USB)). Follow the instructions below.

Connect the phone to a power supply (DC voltage of 3.6V) and a RF signal generator.

#### Measuring RX I/Q signals using RSSI reading

Start Phoenix S	Service Software	and open FBUS	connection.

Select	Scan Product	Ctrl-R

Wait until phone information is shown in the lower right corner of the screen.

Set operating mode to local mode

Select	Maintenance	Alt-M
	Testing	Т

RF Controls F

Wait until the RF Controls window has popped up

Select	Band	GSM850, GSM 900, GSM1800
		or GSM1900
	Active unit	RX
	Operation mode	Burst
	RX/TX Channel	190 (GSM850) or 37 (GSM900) or 700 (GSM1800) or 661 (GSM1900)
Select	Maintenance	Alt-M
	Testing	Т
	RSSI re	ading R

The setup should now look like this:

🌾 Phoenix	_6	BX
File Edit Product Flashing Testing Tuning Tools RD Window Help		
📔 🖆 🛃 📙 Connections: Thus 💽 Settings	gs Deparating mode: Local	
Band: GSM 850 T Monitor Channel: 190 881.600000 Operation M	n Mode: Burst 🔽 📃 Active Unit: 🗛	•
🔀 RF Controls	KRS5I Reading	
Common GSM RF Control Values Active Unit: Rx	Mgasuring mode       Regding mode         Sum vector       © Continuous         © I branch       © Ince         RSSI levet       dBm         Stat       Eprinth         Close       Help	

Note: This is an example for GSM850 (RH-50), other tunings will show a different figure.

Make the following settings on your signal generator:

- 1. Frequencies:
- GSM850: 881.66771 MHz (channel 190 +67710 kHz offset)
- GSM900: 942.46771 MHz (channel 37 + 67.710 kHz offset)
- GSM1800: 1842.86771 MHz (channel 700 + 67.710 kHz offset)
- GSM1900: 1960.06771 MHz (channel 661 + 67.710 kHz offset)
- 2. RF power level:
- - **80dBm** at the antenna connector of the phone/test jig (remembering to compensate for the cable and jig attenuation).

In RSSI reading click on Read now.

The resulting RSSI level should be –  $80dBm \pm 0.5dB$  in each band.

Measuring RX performance using SNR measurement Start Phoenix Service Software and open FBUS connection.						
	Select	Scan Product		Ctrl-R		
	Wait until phone information	is shown in the l	ower right co	mer of t	he screen.	
	Set operating mode to local m	node.				
	Select	Maintenance		Alt-M		
		Testing		Т		
		I	RF Controls	F		
	Wait until the RF Controls window has popped up.					
	Select	Band	GSM850 (R	H-50), G	SM 900 (RH-19)	
			or GSM180	0 or GSI	V1900	
		Active unit	RX			
		Operation mode	Burst			
		RX/TX Channel	190 (GSM8 700 (GSM	(50) or 3	7 (GSM900) or	
	Select	Maintenance	700 (0310)	1000) 01	Alt-M	
		Testing			Т	
		5	SNR Measurer	nent	Μ	
	Select Fast SNR (Radio Button)					

The setup should now look like this in case of e.g. RH-50 (GSM850):

16 Phoenix				
File Edit Product Flashing Testing Tuning Tools RD Window Help				
📙 🗅 🗃 📕 🛛 Connections: fbus 💽 Setting:	s Operating mode:	Local	Read 🗖 Change with F	Reset Edge: Off 💌
Active Unit: Rx 💌 🛛 Band: GSM 850 💌 🗍 Operation Mode: Burst	Monitor Chann	el: 190 881.600000		
RF Controls	🌃 SNR Measurement		_	
Common GSM RF Control Values Active Unit: Rx	Measurement results Signal Clipping Distance: II - Q I: Noise Clipping Distance: II - Q I:	13.66         SNR:         21           0.16         Sensitivity:         -107           33.85         0.17	I.06     C Signal       7.33     C Noise       C Both     C East SNR	de
Edge: Off V Tx Data Type: All 1 V	Signal I	Signal Q Noise I	Noise Q	
	1 .30	7 41	29	
Tx PA Mode:  High 📉 Tx Power Level:  5 💌	2 -213	135 46	45	
	3 -301	-136 ·1	40	
<u>C</u> lose <u>H</u> elp	4 207 5 295	-301 -0	11	
	6 .221	424 .10	-45	
	7 .359	.221 .35	-43	
	8 258	-322 22	-8	
	9 292	285 52	18	<b>•</b>
	St	ar <u>t</u> Options	<u>C</u> lose <u>H</u> elp	

Choose respective band (GSM850 (RH-50), GSM900 (RH-19), GSM1800, GSM1900).

Press SNR measurements. Start button window pops up, e.g. for GSM850 band:

Signal M	easurement		×
<u>.</u>	Turn ON the RF	generator and then press OK button.	
	Frequency: Level:	881.667710 MHz -92.0 dBm ( + attenuations )	
		OK Cancel	



Set the signal generator as shown in the above window, remembering to compensate for the cable and test jig attenuation losses.

Press OK and the window closes.

Read the SNR result. The values should be:

- RH-50: GSM850 ----> 20dB
- RH-19: GSM900 ----> 20dB
- RH-19/RH-50: GSM1800 ---> 18dB
- RH-19/RH-50: GSM1900 ---> 18dB

Measu	Iring front-end power	levels using spect	rum analyzer
	using a good sample. (500hm semi-rigid ca	The levels that are ble).	given here are measured using a resistive probe
	Start Phoenix Service	Software and oper	FBUS connection.
	Select	Scan Product	Ctrl-R
	Wait until phone info	rmation is showing	in the lower right corner of the screen.
	Set operating mode to	o local mode.	
	Select	Maintenance	Alt-M
		Testing	Т
		RF	Controls F
	Wait until the RF Con	trols window pops	up
	Select	Band	GSM 850 (RH-50) or GSM900 (RH-19),
			GSM1800 or GSM1900
		Active unit	RX
		Operation mode	Continuous
		RX/TX Channel	190 (GSM850) or 37 (GSM900) or 700 (GSM1800) or 661 (GSM1900)
	Please refer to the fau	ult finding chart for	proper levels at different test points.

#### Measuring analogue RX I/Q signals using oscilloscope

Measuring with an oscilloscope on "RXIINN" or "RXQINN" is recommended only if RSSI reading does not provide enough information. There exist dedicated test points for RX I and Q signals. Input level = -80dBm.

Start Phoenix Service Software and open FBUS connection.

Select	Scan Product	Ctrl-R

Wait until phone information is showing in the lower right corner of the screen.

Set operating mode to local mode.

Select Maintenance Alt-M

	Testing	Т
	RF Con	trols F
Wait until the RF Cont	rols window has poppe	d up.
Select	Band	GSM850, GSM 900, GSM1800 or
		GSM1900
	Active unit	RX
	Operation mode	continuous
	RX/TX Channel	190 (GSM850) or 37 (GSM900) or
		700 (GSM1800) or 661 (GSM1900)
	AGC	14

Following picture should be displayed on an oscilloscope's screen if the GSM receiver is working properly:



#### Fault finding chart of the receiver

The phone layout has dedicated test points for the analogue differential RX I and Q signals (RXIINP, RXIINN, RXQINP, RXQINN) from Mjoelner RF ASIC to UEM. The BB part is used to measure those signals by means of RSSI reading. It is assumed that correct calibration of RSSI reading has been carried out in production.

RSSIreading [dBm] =  $20\log(U_{BB}) + AGC_{calibrated}$ 

#### Therefore, don't calibrate a defective phone before the phone error has been found.

When a defective phone has been calibrated, a possible error in RX front-end might be masked. In that case one can get a reasonable RSSI reading, although the front-end shows excessive losses.

If it is not sure that **incorrect re-calibration** has been made, the following steps shall be done:

- Check if AGC calibration is within limits
- Check if SNR reading is o.k.
   Use an oscilloscope to check levels of "RXIINN" and "RXQINN".

If RX and TX path seem to be faulty it has to be checked if the synthesizer is working. If yes, then check the path from the antenna pad J615 to the antenna switch Z601 (see RX fault finding "Check RXTX switch").





#### **RX** signal paths

The signal paths of the receiver are shown in following block diagram. Note that the diagram shows GSM900 (or GSM850) receiver (above), GSM1900 receiver (middle) and GSM1800 receiver (below).



#### Antenna switch (RX/TX switch)

Signal path of RF: From the antenna-pad (J615) the RF signal is fed through the antenna low pass filter (C601, L608, C602) to the antenna switch (Z601).

The antenna switch has the function of a diplexer which consists of two paths, a GSM850/GSM900 and a combined GSM1800/GSM1900. The GSM850/GSM900 input signals pass the switch to the GSM\_RX output. GSM1800/GSM1900 input signals pass to PCN\_RX output or respectively to PCS\_RX output, depending on the control signal VANTH (Cont2).

Signal paths:

- GSM850/GSM900: RX1-GSM output of the antenna switch  $\rightarrow$  GSM850/GSM900 SAW filter (Z604).
- GSM1800: RX2-DCS output of the antenna switch  $\rightarrow$  GSM1800 SAW filter (Z602).
- GSM1900: RX3-PCS output of the antenna switch  $\rightarrow$  RX GSM1900 SAW filter (Z603).

The antenna switch including routed lines has following typical insertion losses:

- GSM850 (RH-50): 1.3dB
- GSM900 (RH-19): 1.3dB
- GSM1800 (RH-19/RH-50): 1.6dB
- GSM1900 (RH-19/RH-50): 1.6dB

#### RX front-end

The RX front-end includes three SAW filters for GSM850/GSM900 (Z604), GSM1800 (Z602) and GSM1900 (Z603). They are matched to the corresponding LNA inputs of Mjoelner RF ASIC (N601) with differential matching circuits (LC-type). The SAW filters provide out-of-band blocking immunity. The integrated LNAs provide the front-end gains. Each of the SAW filters has a single-ended input and a balanced output.

The SAW filters have maximum insertion losses of

- GSM850 (RH-50): 3.5dB
- GSM900 (RH-19): 3.5dB
- GSM1800 (RH-19/RH-50): 4.0dB
- GSM1900 (RH-19/RH-50): 4.0dB

#### **RX** paths of Mjoelner RF ASIC

The balanced RX signal is amplified by the integrated LNA and the subsequent pre-gain stage. After amplification the RX signal is down-converted.

The RX paths of Mjoelner RF ASIC consist of following sub units:

- Separate LNAs for each of the three bands: GSM850/GSM900, GSM1800 and GSM1900.
- Two PRE-GAIN amplifiers, one for GSM850/GSM900 and one common for GSM1800 and GSM1900.
- Two passive I/Q mixers (MIX), one for GSM850/GSM900 and one common for GSM1800 and GSM1900.

The BB signal paths consist of:

- Base band amplifiers (BBAMP1). These amplifiers implement the initial channel filtering.
- Low pass filters (LPF1).
- DC compensation / AGC amplifiers (DCN1). These amplifiers implement gain steps from 0dB to 24dB in 6dB steps.
- Attenuators (AGC). These implement gain steps from -48dB to OdB in 6dB steps, yielding a total gain range of 72dB together with DCN1.
- Bi-quad filters (LPF2).
- DC compensation amplifiers (DCN2).

The differential base band outputs are internally DC-coupled and are connected directly to the ADC inputs of the UEM-ASIC. The common mode level is set equal to the VBEXT reference voltage.

## **Transmitter Description and Troubleshooting**

#### General instructions for TX troubleshooting

Connect a RF cable between the test jig and the measurement equipment (GSM test equipment, power meter, spectrum analyzer, or similar).

Make use of an adequate attenuator at the input of the measurement equipment (10dB to 20dB are recommended for a spectrum analyzer or a power meter). Assure not to overload or damage the equipment.

- 1 Connect the phone to a PC with DAU-9T cable (RS232) (or DKU-5 cable (USB)) and dongle.
- 2 Provide the phone with power supply (3.6V).
- 3 Start Phoenix Service Software and open FBUS connection.
- 4 Select Scan Product Ctrl-R and wait until phone information is shown in the lower right corner of the screen.

Follow the instructions as given below.

#### TX signal paths

For easy error tracking it is important to know the signal paths of the transmitter. The components are grouped in blocks and shown on the diagram below.

Note: The diagram shows both GSM850/GSM900 transmitter (below) and GSM1800/GSM1900 transmitter (above).

Figure 10: Transmitter signal paths



The balanced TX IQ baseband signals (TXIOUTP, TXIOUTN, TXQOUTP, TXQOUTN) are provided by the base band and are fed to the **Mjoelner RF ASIC**. The TX path of the Mjoelner RF ASIC includes mainly two RF modulators for up-conversion of the base band signals, one for GSM850/GSM900 and one common for GSM1800/GSM1900. The base band signal is up-converted with the LO signal corresponding to the wanted TX channel. Both RF-TX outputs (850/900MHz and 1800/1900MHz) of the Mjoelner RF ASIC are delivering balanced signals.

The **GSM850/GSM900** output signal of the Mjoelner RF ASIC is fed through the **GSM TX SAW filter** (balanced to single ended), a 3dB pad, and the **850/900MHz buffer** to the GSM input of the **power amplifier (PA)**.

The **GSM1800/1900** output signal of the Mjoelner RF ASIC is fed through the <u>TX balun</u> (T701) (balanced to single ended), and a 3dB pad to the GSM1800/1900 input of the **power amplifier (PA)**.

The Triband PA has a maximum output power of approx. 35dBm at 850/900MHz and 33dBm at 1800/1900MHz. DC-power supply is delivered directly from the battery connectors.

The RF output power is controlled by the power control loop. From the output of the PA

both signal are going through the dual directional coupler (one of the power control loop components) to the **antenna switch**.

Note: There are two different kinds of PAs applicable (from Renesas (RH-50) or Agilent and Renesas (RH-19)).

#### Antenna switch (TX/RX switch)

The antenna switch operates as a diplexer for the RX and TX signals. Moreover, it suppresses the TX harmonics generated by the PA. The antenna switch is controlled by the Mjoelner RF ASIC using the control signals CONT1, CONT2 and CONT3.

The following table shows the possible different states.

CONT1 [Volt]	CONT2 [Volt]	CONT3 [Volt]	GSM RX	DCS RX	PCS RX	GSM TX	DCS/PCS TX
0	0	0	Х				
0	0	0		Х			
0	0	2.7				Х	
0	2.7	0			Х		Х
2.7	2.7	0					Х

To switch the TX-DCS/PCS path both signals cont1 and cont2 are activated. This increases the isolation from the TX-DCS/PCS path to the RX-DCS path and reduces the RF-power that is fed back to Mjoelner.

#### GSM (GSM850/900) transmitter

#### General instructions for GSM850/GSM900 TX troubleshooting

Start the preparations as described in section "General Instructions for TX Troubleshoot-ing".

Set operating mode to local mode.

Select	Maintenance Testing	RF Controls
Wait until the RF Controls wi	ndow has popped up	
Select	Band	GSM850 or GSM 900
	Active unit	ТХ
	Operation mode	Burst
	RX/TX Channel	190 (GSM850) or
		37 (GSM900)

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TX PA Mode	Free
TX Power Level	10
TX Data Type	Random

The setup should now look like this in case of e.g. GSM850 (RH-50):

16 Phoenix	_ 8 ×
<u>Eile Edit Product Flashing Testing Tuning Iools RD Window H</u> elp	
🗅 😂 🖶 🛛 Connections: [fbus 💽 Settings 🔄 Operating mode: Local 💽 Read 🗖 Change with Reset 🛛 Edge: [Off 💌	
KF Controls	
Common GSM RF Control Values	
Active Unit: Tx T Rx/Tx Channel: 190 836.60000	
Band: GSM 850 💌 AFC: 3140	
Operation Mode: Burst	
RX Control Values	
Monitor Channet: 190 881,600000	
AGC: 14: FEG_ON + 24 dB + const_BB_gain	
TX Control Values	
Edge: Dff 🔽 Tx Data Type: Random 💌	
Tx PA Mode: High 💌 Tx Power Level: 10	

Now the measurement equipment should detect the following output signal of the phone:

 $P_{out} = +23 dBm @ 897.4 MHz or +23 dB @ 836.6 MHz$ 

If this is not the case, then go to the following fault finding chart.

Fault finding chart for GSM850 or GSM900 transmitter

In the following, the TXP signal is used as a trigger-signal. For this purpose a TXP test point is provided on the PWP, refer to figure 3 "Test points of the transmitter".





#### GSM1800 (DCS/PCN) transmitter

#### General instructions for GSM1800 TX troubleshooting

Start the preparations as described in section "General Instructions for TX Troubleshoot-ing".

Set operating mode to local mode.

Select	Maintenance Testing	RF Controls			
Wait until the RF Controls window pops up.					
Select	Band	GSM 1800			
	Active unit	TX			
	Operation mode	Burst			
	RX/TX Channel	700			
	TX PA Mode	Free			
	TX Power Level	5			
	TX Data Type	Random			

The setup should now look like this:

K Phoenix	
<u>File Edit View Product Flashing Maintenance Tools RD Window Help</u>	
🗋 🗅 😂 📕 🛛 Connections: FBUS 💽 Settings 🖉 Operating mo	de: Local 💌 Read 🗖 Change with Reset Edge N/A
K RF Controls	
Band: ESM 1800 💌 Tx PA Mode: Free 💌	
Active Unit: Tx 💌 Tx Power Levet 5 💌	
Operation Mode: Burst 💌 Tx Data Type: Random	
Rx/Tx Channel: 700 1747.800000	
Monitor Channel: 700 1842.800000	
AGC: 14: FEG_ON + DTOS_ON + BB_42 = VGain_72	
AFC: 3049 Help	

Now the measurement equipment should detect the following output signal of the phone.

 $P_{out} = +20 dBm @ 1747.8MHz$ 

If this is not the case, then go to the following fault finding chart.

#### Fault finding chart for GSM1800 transmitter

In the following, the TXP signal is used as a trigger-signal. For this purpose a TXP test point is provided on the PWP, refer to figure 3 "Test points of the transmitter".



#### GSM1900 (PCS) transmitter

#### General instructions for GSM1900 TX troubleshooting

Start the preparations as described in section "General Instructions for TX Troubleshoot-ing".

Set operating mode to local mode.

Select	Maintenance Testing	RF Controls			
Wait until the RF Controls window pops up					
Select	Band	GSM 1900			
	Active unit	ТХ			
	Operation mode	Burst			
	RX/TX Channel	661			
	TX PA Mode	Free			
	TX Power Level	5			
	TX Data Type	Random			

The setup should now look like this:

🌃 Phoenix				
$\underline{F}ile  \underline{E}dit  \underline{V}iew  \underline{P}roduct  F\underline{I}ashing  \underline{M}aintenance$	e <u>T</u> ools <u>R</u> D <u>W</u> indow <u>H</u> elp			
📄 🖻 🚔 📕 📋 Connections: 🕅 FBUS	Settings	ating mode: Local	Read Change with Reset	Edge N/A
K RF Controls				
Band: GSM 1900 💌	Tx PA Mode: Free 💌			
Active Unit: 🛛 💌	Tx Power Level: 5	-		
Operation Mode: Burs	Tx Data Type: Rando	m		
Rx/Tx Channel: 661	1880.000000			
Monitor Channel: 661	1960.000000			
AGC: 14: FEG_ON +	DTOS_ON + BB_42 = VGain_72 🛛 🔽			
AFC: 3049		Help		
	_			
<u>l</u>				

Now the measurement equipment should detect the following output signal of the phone.

 $P_{out} = +20 dBm @ 1880MHz$ 

If this is not the case, then go to the following fault finding chart.

#### Fault finding chart for GSM1900 transmitter

In the following, the TXP signal is used as a trigger-signal. For this purpose a TXP test point is provided on the PWP, refer to figure 3 "Test points of the transmitter".


# Synthesizer Description and Troubleshooting

One PLL synthesizer is generating all the required frequencies of the 3 bands for RX and TX. The VCO frequency is divided by 2 or by 4 in Mjoelner depending on the active band.

## General instructions for synthesizer troubleshooting

Connect the phone to a PC with DAU-9T cable (RS232) or DKU-5 cable (USB). The PC must have Phoenix Service Software and dongle installed.

Then follow the instructions below.

#### Check synthesizer operation

Start Phoenix Service Software and open FBUS connection.

Select	Scan Product	Ctrl-R
Wait until phone information	is shown in the lower right co	rner of the screen.
Set operating mode to local r	node.	
Start RF Control window:		
Select	Maintenance	Alt-M
	Tuning	Т
	RF Controls	F
Wait until the RF Controls wi	ndow has popped up.	
Set the synthesizer to the fol	lowing mode:	
Select	Band	GSM850 or GSM 900
	Active unit	RX
	Operation mode	Continuous

190 (850MHz) 37 (900MHz)

RX/TX Channel

The setup should now look like this in case of e.g. 850 MHz:

16 Phoenix	. 🗗 🗙
File Edit Product Flashing Testing Tuning Tools RD Window Help	
🗅 😂 🖬 🛛 Connections: fibus 💽 Settings 🗍 Operating mode: Local 💌 Read 🗖 Change with Reset 🛛 Edge: Off 💌	
KF Controls	
Common GSM RF Control Values Active Unit: RX  Rx/Tx Channel: 190 881.600000	
Operation Mode: Continuous	
HX Control Values Monitor Channet 190 881.600000 AGC: 14: EEG: ON - 24 dB - const. RB, goint with	
Tx PA Mode: High Y Tx Power Levet 10 Y	

The frequency of 3346.4 MHz (RH-50) or 3769.6 MHz (RH-19) at the output of the VCO (G701) has to be measured with a resistive probe and a spectrum analyzer.

The tuning voltage can easily be measured at the Vc input of the VCO (C712). The tuning voltage should be  $2.3V_{DC}$  ..  $2.8V_{DC}$  at  $f_{VCO} = 3346.4$  MHz (RH-50) or 3769.6 MHz (RH-19). The (tuning sensitivity of the VCO is typically 240MHz/V).

If this is not the case, please refer to section "Fault finding chart for PLL Synthesizer" below.

## 26 MHz reference oscillator (VCXO)

The VCXO is integrated in the Mjoelner RF-ASIC (N601). The only external component is the 26 MHz crystal (B601).

The reference oscillator has two functions:

- Reference frequency for the PLL synthesizer.
- System clock for BB (RFClk\_I = 26 MHz).

For an error free initial synchronization, the 26MHz frequency of the VCXO must be accurate enough. Therefore, a VCXO-calibration value is written via the serial Bus into the RefOSCCAL register of Mjoelner and an additional bit in the RefOSCCntl register of the Mjoelner. That is necessary for the rough calibration of the VCXO

The VCXO is fine tuned by programming the AFC value via the serial bus of Mjoelner. The necessary AFC value is written into the RefOSCAFC register in Mjoelner.

#### VC0

The VCO is able to generate frequencies in the range of 3296 MHz (RH-50)/3420 MHz (RH-19) to 3980MHz when the PLL is working properly. The frequency of the VCO signal is divided by 2 or by 4 in Mjoelner RF-ASIC. This allows the generation of all the frequen-

cies in the GSM850 or GSM900, GSM1800 and GSM1900 bands both RX and TX.

The output frequency of the VCO is controlled by a DC voltage (Vc) of the PLL loop filter. The valid range of Vc is 0.7V– 3.8V when the PLL is in the steady state. The typical tuning sensitivity is 240MHz/V. Even if the PLL is not working properly (Vc outside the valid range) a frequency at the output of the VCO can be detected, between 3GHz and 4GHz (if the VCO itself is 0K).

Note: There are two different kinds of VCOs applicable from Matsushita (RH-50), FDK or Matsushita (RH-19).

## Fault finding chart for PLL synthesizer





It is important to note that the power supply of the VCXO (VR3) is only switched off in the so-called 'Deep Sleep Mode' and the power supply of the VCO (G701 VR7) is switched off in so-called 'Sleep Mode'.

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#### Figure 12: PLL block diagram



## **Frequency lists**

## GSM850 (RH-50)

СН	тх	RX	VCO TX	VCO RX	СН	тх	RX	VCO TX	VCO RX	СН	тх	RX	VCO TX	VCO RX
128	824.2	869.2	3296.8	3476.8	178	834.2	879.2	3336.8	3516.8	228	844.2	889.2	3376.8	3556.8
129	824.4	869.4	3297.6	3477.6	179	834.4	879.4	3337.6	3517.6	229	844.4	889.4	3377.6	3557.6
130	824.6	869.6	3298.4	3478.4	180	834.6	879.6	3338.4	3518.4	230	844.6	889.6	3378.4	3558.4
131	824.8	869.8	3299.2	3479.2	181	834.8	879.8	3339.2	3519.2	231	844.8	889.8	3379.2	3559.2
132	825.0	870.0	3300.0	3480.0	182	835.0	880.0	3340.0	3520.0	232	845.0	890.0	3380.0	3560.0
133	825.2	870.2	3300.8	3480.8	183	835.2	880.2	3340.8	3520.8	233	845.2	890.2	3380.8	3560.8
134	825.4	870.4	3301.6	3481.6	184	835.4	880.4	3341.6	3521.6	234	845.4	890.4	3381.6	3561.6
135	825.6	870.6	3302.4	3482.4	185	835.6	880.6	3342.4	3522.4	235	845.6	890.6	3382.4	3562.4
136	825.8	870.8	3303.2	3483.2	186	835.8	880.8	3343.2	3523.2	236	845.8	890.8	3383.2	3563.2
137	826.0	871.0	3304.0	3484.0	187	836.0	881.0	3344.0	3524.0	237	846.0	891.0	3384.0	3564.0
138	826.2	871.2	3304.8	3484.8	188	836.2	881.2	3344.8	3524.8	238	846.2	891.2	3384.8	3564.8
139	826.4	871.4	3305.6	3485.6	189	836.4	881.4	3345.6	3525.6	239	846.4	891.4	3385.6	3565.6
140	826.6	871.6	3306.4	3486.4	190	836.6	881.6	3346.4	3526.4	240	846.6	891.6	3386.4	3566.4
141	826.8	871.8	3307.2	3487.2	191	836.8	881.8	3347.2	3527.2	241	846.8	891.8	3387.2	3567.2
142	827.0	872.0	3308.0	3488.0	192	837.0	882.0	3348.0	3528.0	242	847.0	892.0	3388.0	3568.0
143	827.2	872.2	3308.8	3488.8	193	837.2	882.2	3348.8	3528.8	243	847.2	892.2	3388.8	3568.8
144	827.4	872.4	3309.6	3489.6	194	837.4	882.4	3349.6	3529.6	244	847.4	892.4	3389.6	3569.6
145	827.6	872.6	3310.4	3490.4	195	837.6	882.6	3350.4	3530.4	245	847.6	892.6	3390.4	3570.4
146	827.8	872.8	3311.2	3491.2	196	837.8	882.8	3351.2	3531.2	246	847.8	892.8	3391.2	3571.2
147	828.0	873.0	3312.0	3492.0	197	838.0	883.0	3352.0	3532.0	247	848.0	893.0	3392.0	3572.0
148	828.2	873.2	3312.8	3492.8	198	838.2	883.2	3352.8	3532.8	248	848.2	893.2	3392.8	3572.8
149	828.4	873.4	3313.6	3493.6	199	838.4	883.4	3353.6	3533.6	249	848.4	893.4	3393.6	3573.6
150	828.6	873.6	3314.4	3494.4	200	838.6	883.6	3354.4	3534.4	250	848.6	893.6	3394.4	3574.4
151	828.8	873.8	3315.2	3495.2	201	838.8	883.8	3355.2	3535.2	251	848.8	893.8	3395.2	3575.2
152	829.0	874.0	3316.0	3496.0	202	839.0	884.0	3356.0	3536.0					
153	829.2	874.2	3316.8	3496.8	203	839.2	884.2	3356.8	3536.8					
154	829.4	874.4	3317.6	3497.6	204	839.4	884.4	3357.6	3537.6					
155	829.6	874.6	3318.4	3498.4	205	839.6	884.6	3358.4	3538.4					
156	829.8	874.8	3319.2	3499.2	206	839.8	884.8	3359.2	3539.2					
157	830.0	875.0	3320.0	3500.0	207	840.0	885.0	3360.0	3540.0					
158	830.2	875.2	3320.8	3500.8	208	840.2	885.2	3360.8	3540.8					
159	830.4	875.4	3321.6	3501.6	209	840.4	885.4	3361.6	3541.6					
160	830.6	875.6	3322.4	3502.4	210	840.6	885.6	3362.4	3542.4					
161	830.8	875.8	3323.2	3503.2	211	840.8	885.8	3363.2	3543.2					
162	831.0	876.0	3324.0	3504.0	212	841.0	886.0	3364.0	3544.0					
163	831.2	876.2	3324.8	3504.8	213	841.2	886.2	3364.8	3544.8					
164	831.4	876.4	3325.6	3505.6	214	841.4	886.4	3365.6	3545.6					
165	831.6	876.6	3326.4	3506.4	215	841.6	886.6	3366.4	3546.4					
166	831.8	876.8	3327.2	3507.2	216	841.8	886.8	3367.2	3547.2					
167	832.0	877.0	3328.0	3508.0	217	842.0	887.0	3368.0	3548.0					
168	832.2	877.2	3328.8	3508.8	218	842.2	887.2	3368.8	3548.8					
169	832.4	877.4	3329.6	3509.6	219	842.4	887.4	3369.6	3549.6					
170	832.6	877.6	3330.4	3510.4	220	842.6	887.6	3370.4	3550.4					
171	832.8	877.8	3331.2	3511.2	221	842.8	887.8	3371.2	3551.2					
172	833.0	878.0	3332.0	3512.0	222	843.0	888.0	3372.0	3552.0					
173	833.2	878.2	3332.8	3512.8	223	843.2	888.2	3372.8	3552.8					
174	833.4	878.4	3333.6	3513.6	224	843.4	888.4	3373.6	3553.6					
175	833.6	878.6	3334.4	3514.4	225	843.6	888.6	3374.4	3554.4					
176	833.8	878.8	3335.2	3515.2	226	843.8	888.8	3375.2	3555.2					
177	834.0	879.0	3336.0	3516.0	227	844.0	889.0	3376.0	3556.0					

#### GSM900 (RH-19)

СН	ТΧ	RX	<b>vco т</b> х	VCO RX	СН	тх	RX	<b>VCO TX</b>	VCO RX	СН	тх	RX	<b>VCO TX</b>	VCO RX
975	880,2	925,2	3520,8	3700,8	1	890,2	935,2	3560,8	3740,8	63	902,6	947,6	3610,4	3790,4
976	880,4	925,4	3521,6	3701,6	2	890,4	935,4	3561,6	3741,6	64	902,8	947,8	3611,2	3791,2
977	880,6	925,6	3522,4	3702,4	3	890,6	935,6	3562,4	3742,4	65	903,0	948,0	3612,0	3792,0
978	880,8	925,8	3523,2	3703,2	4	890,8	935,8	3563,2	3743,2	66	903,2	948,2	3612,8	3792,8
979	881,0	926,0	3524,0	3704,0	5	891,0	936,0	3564,0	3744,0	67	903,4	948,4	3613,6	3793,6
980	881,2	926,2	3524,8	3704,8	6	891,2	936,2	3564,8	3744,8	68	903,6	948,6	3614,4	3794,4
981	881,4	926,4	3525,6	3705,6	7	891,4	936,4	3565,6	3745,6	69	903,8	948,8	3615,2	3795,2
982	881,6	926,6	3526,4	3706,4	8	891,6	936,6	3566,4	3746,4	70	904,0	949,0	3616,0	3796,0
983	881,8	926,8	3527,2	3707,2	9	891,8	936,8	3567,2	3747,2	71	904,2	949,2	3616,8	3796,8
984	882,0	927,0	3528,0	3708,0	10	892,0	937,0	3568,0	3748,0	72	904,4	949,4	3617,6	3797,6
985	882,2	927,2	3528,8	3708,8	11	892,2	937,2	3568,8	3748,8	73	904,6	949,6	3618,4	3798,4
986	882,4	927,4	3529,6	3709,6	12	892,4	937,4	3569,6	3749,6	74	904,8	949,8	3619,2	3799,2
987	882,6	927,6	3530,4	3710,4	13	892,6	937,6	3570,4	3750,4	75	905,0	950,0	3620,0	3800,0
988	882,8	927,8	3531,2	3711,2	14	892,8	937,8	3571,2	3751,2	76	905,2	950,2	3620,8	3800,8
989	883,0	928,0	3532,0	3712,0	15	893,0	938,0	3572,0	3752,0	77	905,4	950,4	3621,6	3801,6
990	883,2	928,2	3532,8	3712,8	16	893,2	938,2	3572,8	3752,8	78	905,6	950,6	3622,4	3802,4
991	883,4	928,4	3533,6	3713,6	17	893,4	938,4	3573,6	3753,6	79	905,8	950,8	3623,2	3803,2
992	883,6	928,6	3534,4	3/14,4	18	893,6	938,6	35/4,4	3754,4	80	906,0	951,0	3624,0	3804,0
993	883,8	928,8	3535,2	3/15,2	19	893,8	938,8	3575,2	3755,2	81	906,2	951,2	3624,8	3804,8
994	884,0	929,0	3536,0	3716,0	20	894,0	939,0	3576,0	3756,0	82	906,4	951,4	3625,6	3805,6
995	884,2	929,2	3536,8	3/16,8	21	894,2	939,2	3576,8	3756,8	83	906,6	951,6	3626,4	3806,4
996	884,4	929,4	3537,6	3/1/,6	22	894,4	939,4	35/1,6	3/5/,6	84	906,8	951,8	3027,2	3807,2
997	004,0	929,6	3538,4	3710,4	23	094,6	939,6	3570.0	3750.0	00	907,0	952,0	3628,0	3000,0
998	004,0	929,8	3539,2	3719,2	24	894,8	939,8	3579,2	3759,2	80 97	907,2	952,2	3028,8	3808,8
1000	005,0	930,0	3540,0	3720,0	20	805.0	940,0	3580,0	2760.9	07	907,4	952,4	3620.4	2010 4
1000	885.4	930,2	3540,0	3720,0	20	805.4	940,2	3581.6	3761.6	80	907,0	952,0	3631.2	3811.2
1001	885.6	930,4	3542.4	3722.4	28	895.6	940,4	3582.4	3762.4	90	907,0	952,0	3632.0	3812.0
1002	885.8	930.8	3543.2	3723.2	29	895.8	940.8	3583.2	3763.2	91	908.2	953.2	3632.8	3812.8
1000	886.0	931.0	3544.0	3724.0	30	896.0	941.0	3584.0	3764.0	92	908.4	953.4	3633.6	3813.6
1005	886.2	931.2	3544.8	3724.8	31	896.2	941.2	3584.8	3764.8	93	908.6	953.6	3634.4	3814.4
1006	886.4	931.4	3545.6	3725.6	32	896.4	941.4	3585.6	3765.6	94	908.8	953.8	3635.2	3815.2
1007	886.6	931.6	3546.4	3726.4	33	896.6	941.6	3586.4	3766.4	95	909.0	954.0	3636.0	3816.0
1008	886.8	931.8	3547.2	3727.2	34	896.8	941.8	3587.2	3767.2	96	909.2	954.2	3636.8	3816.8
1009	887.0	932.0	3548.0	3728.0	35	897.0	942.0	3588.0	3768.0	97	909.4	954.4	3637.6	3817.6
1010	887,2	932,2	3548,8	3728,8	36	897,2	942,2	3588,8	3768,8	98	909,6	954,6	3638,4	3818,4
1011	887,4	932,4	3549,6	3729,6	37	897,4	942,4	3589,6	3769,6	99	909,8	954,8	3639,2	3819,2
1012	887,6	932,6	3550,4	3730,4	38	897,6	942,6	3590,4	3770,4	100	910,0	955,0	3640,0	3820,0
1013	887,8	932,8	3551,2	3731,2	39	897,8	942,8	3591,2	3771,2	101	910,2	955,2	3640,8	3820,8
1014	888,0	933,0	3552,0	3732,0	40	898,0	943,0	3592,0	3772,0	102	910,4	955,4	3641,6	3821,6
1015	888,2	933,2	3552,8	3732,8	41	898,2	943,2	3592,8	3772,8	103	910,6	955,6	3642,4	3822,4
1016	888,4	933,4	3553,6	3733,6	42	898,4	943,4	3593,6	3773,6	104	910,8	955,8	3643,2	3823,2
1017	888,6	933,6	3554,4	3734,4	43	898,6	943,6	3594,4	3774,4	105	911,0	956,0	3644,0	3824,0
1018	888,8	933,8	3555,2	3735,2	44	898,8	943,8	3595,2	3775,2	106	911,2	956,2	3644,8	3824,8
1019	889,0	934,0	3556,0	3736,0	45	899,0	944,0	3596,0	3776,0	107	911,4	956,4	3645,6	3825,6
1020	889,2	934,2	3556,8	3736,8	46	899,2	944,2	3596,8	3776,8	108	911,6	956,6	3646,4	3826,4
1021	889,4	934,4	3557,6	3737,6	47	899,4	944,4	3597,6	3777,6	109	911,8	956,8	3647,2	3827,2
1022	889,6	934,6	3558,4	3738,4	48	899,6	944,6	3598,4	3778,4	110	912,0	957,0	3648,0	3828,0
1023	889,8	934,8	3559,2	3739,2	49	899,8	944,8	3599,2	3779,2	111	912,2	957,2	3648,8	3828,8
0	890,0	935,0	3560,0	3740,0	50	900,0	945,0	3600,0	3780,0	112	912,4	957,4	3649,6	3829,6
					51	900,2	945,2	3604.0	3180,8	113	912,6	957,6	3050,4	3030,4
					52	900,4	945,4	3001,6	3781,6	114	912,8	957,8	3051,2	3031,2
					53	900,6	945,0	3602,4	3702,4	110	012.0	950,0	3652.0	3032,0
					54	Q01 0	940,0	3604.0	3794 0	117	013.Z	950,2	3653 6	3833 6
					56	901,0 901.2	940,0	3604,0	3784.0	118	913,4 913 A	950,4	3654 4	3834 /
					57	901.4	946.4	3605.6	3785.6	110	913 R	958.8	3655.2	3835.2
					58	901.6	946.6	3606.4	3786.4	120	914 0	959.0	3656.0	3836.0
					59	901 A	946.8	3607 2	3787 2	121	914.2	959.2	3656.8	3836.8
					60	902.0	947 0	3608.0	3788 0	122	914.4	959.4	3657.6	3837 6
					61	902.2	947.2	3608.8	3788.8	123	914.6	959.6	3658.4	3838.4
					62	902.4	947.4	3609.6	3789.6	124	914.8	959.8	3659.2	3839.2

## GSM1800 (RH-19/RH-50)

| CH   | TX RX  | VCO TXN   | VC 0 R3  
   | CH  | TX  | RX   | VCO TX   
   | VCO RA  | CH   | TX   | RX  
  | VCO TX   | VCORX  | CH  | TX   
  | RX   | VCO TX  | VCO RX  
  |
|--|--|---
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---	--		
51.2	1/10.2 1805.2	3420.4	3610.4
   | RCR   | 1/29.0  | 1824.U   | 3458.0   
   | 3848.0  | LDA  | 1/4r.8   | 1842.8  
  | 3495.6   | 3685.8   | 794   | 1/66.6   
  | 1861.6   | 3533.2  | 3/23.2  
  |
| 513  | 1/10.4 1805.4  | 3420.8  | 3610.8   
   | 80%   | 1/29.2  | 1824.2   | 3458 A   
   | 3848.4  | rut  | 1/48.0   | 1843.0  
  | 3496.0   | 3689.0   | 195   | 1/66.8   
  | 1861.8   | 3533.8  | 3723.8  
  |
| 514  | 1/10.6 1805.6  | 3421.2  | 3611.2   
   | 0.6   | 1/20.4  | 1824.4   | 3458.8   
   | 3646.6  | 102  | 1/45.2   | 164-5.2   
  | 3400.4   | 3080.4   | 190   | 1/0/0  
  | 1862.0   | 3534.0  | 3724.0  
  |
| 515  | 1710.6 1603.8  | 342211  | 3617.0   
   | 810   | 1/20.0  | 1824.0   | 3459.2   
   | 3649.2  | 7114   | 1/45.4   | 1843.6  
  | 3490.0   | 3660.0   | 1921  | 1/6/ 4   
  | 1662.2   | 3534.4  | 3.024.4   
  |
| 517  | 1/11/2 1806/2  | 3422.4  | 3912.4   
   | 611   | 1/30.0  | 1825.0   | 3460.0   
   | 38500   | 105  | 1/48.8   | 1643.8  
  | 3407.6   | 3687.6   | 199   | 1/67.6   
  | 1862.6   | 3535.2  | 3/25.2  
  |
| 51 B   | 1711A 1806A  | 3422.8  | 3612.8   
   | 612   | 1/30.2  | 1825.2   | 3460.A   
   | 3650.4  | 104  | 1749.0   | 1644.0  
  | 3498.0   | 36683.0  | BOO   | 1/6/.8   
  | 1862.8   | 3535.8  | 3/25/6  
  |
| 519  | 1711.6 1806.8  | 3423.2  | 3613.2   
   | 613   | 1/30.4  | 1825.4   | 3460.8   
   | 3690.8  | rur  | 1/4//2   | 1644.2  
  | 3498.4   | 36881.A  | BUJ   | 1/68.0   
  | 1863.0   | 3538.0  | 3/28.0  
  |
| 520  | 1711.8 1806.8  | 3423.6  | 3613.6   
   | 614   | 1/30.6  | 1825.6   | 3461.2   
   | 36512   | L na   | 1/4//4   | 1644,4  
  | 3496.6   | 3683.3   | 815   | 1/68.2   
  | 1863.2   | 3538.A  | 3.128 A   
  |
| 521  | 1/12/0 18/07/0   | 3424.0  | 3614.0   
   | 815   | 1/30.8  | 1625.8   | 3461.6   
   | 3651.6  | 1.04   | 1/4//6   | 1644.6  
  | 3409.2   | 3689.2   | BU3   | 1/68.4   
  | 1663.4   | 3538.8  | 3/28.8  
  |
| 522<br>523   | 1/12/2 180/ 2  | 3424.4  | 30 14.4<br>39114 B   
   | 910   | 1/31.0  | 1625.0   | 3462.0   
   | 39952.4   | 211  | 1/40.8   | 18450   
  | 3409.0   | 3069.0   | BUH<br>BUS  | 1/65.0   
  | 1663.6   | 3537.6  | 3721.2  
  |
| 324  | 1/12.0 1001.0  | 3425.2  | 3013.2   
   | 010   | 1/21.4  | 10.00.4  | 3482.0   
   | 3032.6  | 112  | 1/50.2   | 1040.0  
  | 3300.4   | 3090.4   | BUD   | 1/00/0   
  | 1004.0   | 3536.0  | 3743.0  
  |
| 525  | 1712.8 1807.8  | 3425.6  | 3615.6   
   | 618   | 1/31.6  | 1826.6   | 3463.2   
   | 3653.2  | r13  | 1/50.4   | 1645.4  
  | 3900.B   | 3690.8   | RAL   | 1/60/3   
  | 1864.2   | 3538.4  | 3728A   
  |
| 526  | 1/13/0 1808/0  | 3426.0  | 3616.0   
   | 620   | 1/31.8  | 1826.B   | 3463.8   
   | 3653.6  | 114  | 1/90/6   | 1845.6  
  | 3501.2   | 3601.2   | BUR   | 1/60/4   
  | 1894.4   | 3538.8  | 3723.8  
  |
| 527  | 1/13/2 18/8/2  | 3426.4  | 3616.4   
   | 621   | 1/32.0  | 162r.0   | 3464.0   
   | 3654.0  | 115  | 1/50.8   | 1645.8  
  | 3901.6   | 3601.8   | BUN   | 1/6//6   
  | 1894.6   | 3539.2  | 3729.2  
  |
| 521  | 1/13.4 1608.4  | 3427.2  | 3010.0   
   | 922   | 1/32.2  | 1621.2   | 3464.4   
   | 3954.4  | 616  | 1/512  | 1646.0  
  | 3502.0   | 3602.0   | BTU<br>BTI  | 1/00/0   
  | 1894.0   | 3539.0  | 372370  
  |
| 530  | 1/13.8 1808.8  | 3427.6  | 3617.6   
   | 624   | 1/32.6  | 1821.6   | 3465.2   
   | 3655.2  | 118  | 1/51.4   | 1646.4  
  | 3502.8   | 3692.8   | 812   | 1//02  
  | 1865.2   | 354U.A  | 3/31.4  
  |
| 591  | 1714.0 1809.0  | 3428.0  | 361B.U   
   | 625   | 1/32.8  | 1827.B   | 3465.8   
   | 3655.6  | 719  | 1/51.6   | 1646.6  
  | 3903.2   | 3683.2   | B1.3  | 1//04  
  | 1865.4   | 3540.8  | 3/30.8  
  |
| 235  | 1/14.2 1809.2  | 3428.4  | 3618.4   
   | 828   | 1/33.0  | 1828.U   | 3466.0   
   | 3696.0  | 120  | 1/51.8   | 1846.8  
  | 3903.6   | 3683.8   | 814   | 1//08  
  | 1865.6   | 3541.2  | 3/31.2  
  |
| 533  | 1/14.4 1809.4  | 3428.8  | 3918.8   
   | 627   | 1/33.2  | 1828.2   | 3466.4   
   | 3656.4  | 121  | 1/52.0   | 1647.0  
  | 3504.0   | 3684.0   | 812   | 1//08  
  | 1865.8   | 3541.8  | 3/31.8  
  |
| 534  | 1/14.6 1809.0  | 3429.2  | 3019.2   
   | 026   | 1/33.4  | 1828.4<br>1828.8   | 3466.8   
   | 3655.8  | 122  | 1/92.2   | 1641.2  
  | 35,4.4   | 3004.4   | B10   | 1//12  
  | 1695.0   | 3542.0  | 3732.0  
  |
| 536  | 1/15.0 1810.0  | 3430.0  | 3620.0   
   | 630   | 1/33.8  | 1828.B   | 3467.6   
   | 3657.8  | 124  | 1/52.6   | 1647.6  
  | 3505.2   | 3685.2   | B18   | 1//14  
  | 1895.4   | 3542.8  | 3/32.8  
  |
| 537  | 1/15.2 1810.2  | 3430.4  | 3620.4   
   | 631   | 1/34.0  | 1820.U   | 3468.0   
   | 3658.0  | 125  | 1/52.8   | 1647.8  
  | 3905.8   | 3685.8   | RIA   | 1//16  
  | 1896.6   | 3543.2  | 3/33.2  
  |
| 23 B   | 1/15.4 1810.4  | 3430.8  | 3620.8   
   | 632   | 1/34.2  | 1829.2   | 3468.4   
   | 3658.4  | 1228   | 1/53.0   | 1648.0  
  | 3906.0   | 3686.0   | B20   | 1//18  
  | 1695.8   | 3543.8  | 3733.8  
  |
| 238  | 1/15.8 1810.8  | 3431.2  | 3621.2   
   | 633   | 1/34.4  | 1829.4   | 3468.8   
   | 3658.8  | rzr  | 1/53.2   | 1648.2  
  | 3508.4   | 3686 A   | R51   | 1/12.0   
  | 1867.U   | 3544.0  | 3/34.0  
  |
| 54U  | 1/15.6 1810.8  | 3431.6  | 3021.6   
   | 034   | 1/34.6  | 1620.5   | 3469.2   
   | 3669/2  | 1 23   | 1/554  | 1646.4  
  | 3508.8   | B. BNBE  | 622   | 1/12/2   
  | 1691/2   | 3544.4  | 3/34.4  
  |
| 547  | 1/18/2 1811 2  | 3432.4  | 3622.4   
   | 636   | 1/35.0  | 1620.6   | 3470.0   
   | 36800   | 1,211  | 1/53.8   | 1646.0  
  | 3507.8   | 3607.8   | RV4   | 1//2/8   
  | 1601 A   | 3545.2  | 3734.0  
  |
| 543  | 1/18.4 1811.4  | 3432.8  | 3622.8   
   | 637   | 1/35.2  | 1890.2   | 3470.4   
   | 3660.4  | 131  | 1/54.0   | 1649.0  
  | 390B.U   | 3608.0   | 825   | 1/12.8   
  | 1867.8   | 3545.8  | 3735.8  
  |
| 344  | 1/10.0 1011.3  | 3433.2  | 3923.2   
   | 030   | 1/35.4  | 1830.4   | 3470.8   
   | 3000.8  | 1.32   | 1/04.2   | 1099.2  
  | 3308.4   | 3090.4   | 0.20  | 1/13/0   
  | 1895.0   | 3546.0  | 3739.0  
  |
| 545  | 1/18.8 1811.8  | 3433.6  | 3623.6   
   | 639   | 1/35.6  | 1830.6   | 34/1,2   
   | 3661.2  | 133  | 1/54.4   | 164-9.4   
  | 3208.8   | 3688.8   | 821   | 1//3.2   
  | 1668.2   | 3548.A  | 3/36A   
  |
| 1946<br>1947   | 1/17.2 1812.0  | 3434.0  | 3624.0   
   | 040   | 1/35.6  | 1630.8   | 34/1.8   
   | 3661.6  | 1.34   | 1/94.6   | 1649.6  
  | 2500.2   | 3609.2   | 620   | 1/154  
  | 1095.4   | 3540.8  | 3/30.8  
  |
| 54K  | 1/1/4 18124  | 3434.8  | 3624.4   
   | 642   | 1/36.2  | 1831.2   | 3472.0   
   | 3662.0<br>3662.4  | 135  | 1/550  | 18500   
  | 3509.6   | 3700.0   | 640   | 1//38  
  | 1863.5   | 3547.8  | 3/3/3   
  |
| 549  | 1/1/.6 1812.6  | 3435.2  | 3625.2   
   | 643   | 1/38.4  | 1891.4   | 3472.8   
   | 3662.8  | 131  | 1/55.2   | 1850.2  
  | 3510.4   | 3700.4   | 831   | 1//4.0   
  | 1897.0   | 3548.0  | 3738.0  
  |
| 56 U   | 1/17.8 1812.8  | 3435.6  | 3625.6   
   | 644   | 1/36.6  | 1831.6   | 3473.2   
   | 3663.2  | 138  | 1/55.4   | 1850.4  
  | 3510.8   | 3100.8   | R35   | 1//42  
  | 1899/2   | 3548.A  | 3738A   
  |
| 551  | 1/18/0 1813/0  | 3436.0  | 3626.0   
   | 645   | 1138.8  | 1831.8   | 3473.8   
   | 3663.6  | 1.38   | 1/55.6   | 1890.6  
  | 3511.2   | 3101.2   | R33   | 1//4,4   
  | 1869/4   | 3548.8  | 3/39.8  
  |
| 55 Z   | 1/18.2 1813.2  | 3435.4  | 3026.4   
   | 040   | 1/3/.0  | 1632.0   | 34/4.0   
   | 3664.0  | 140  | 1/55.8   | 1850.8  
  | 3511.6   | 3707.8   | B34   | 1/14.6   
  | 1860.6   | 3549.2  | 3/3/2   
  |
| 554  | 1/18.6 1813.6  | 3437.2  | 3621.2   
   | 648   | 1/3/.4  | 1632.4   | 3474.8   
   | 3664.8  | (42  | 1/98.2   | 1851.2  
  | 3512.0   | 3102.4   | 836   | 17750  
  | 18/00  | 3550.0  | 3/40.0  
  |
| 565  | 1/18.8 1813.8  | 3437.6  | 3627.6   
   | 649   | 1/37.6  | 1832.6   | 3475.2   
   | 3665.2  | 143  | 1/56.4   | 1651.4  
  | 3512.8   | 3702.8   | 831   | 1//52  
  | 18/0.2   | 355U.A  | 3340.4  
  |
| 55.6   | 1/19/0 1814/0  | 3438.0  | 3628.0   
   | 650   | 1/3/.B  | 1832.B   | 3475.8   
   | 3665.6  | 154  | 1/56.6   | 1651.6  
  | 3513.2   | 3103.2   | 838   | 1/75A  
  | 1870.4   | 3550.8  | 3,40.8  
  |
| 51   | 1/19/2 1814-2  | 3438.4  | 3628.4   
   | 851   | 1/38.0  | 1833.0   | 34/6.0   
   | 3666.0  | 145  | 1/56.8   | 1651.8  
  | 3513.8   | 9103.9   | R3A   | 1//58  
  | 1810/6   | 3551.2  | 3/41.2  
  |
| 22.6   | 1/19.4 1814.4  | 3436.6  | 3626.6   
   | 852   | 1/38.2  | 1835.2   | 34/6.4   
   | 3665.4  | 140  | 1/91/0   | 1852.0  
  | 3514.0   | 3704.0   | B40   | 1/15.8   
  | 18/0.8   | 3551.8  | 3/41.8  
  |
| 202.0  | 1111020 1001420  |   |  
   | 20.00   | 10.00.0   | 1 Mail and 4   | 10 TO 10 TO 10   
   |   | 1.4  | 10.001.00  | I totalds ride  
  | and PTOT   | 101 B-17-1   | 1000  | 10.1000  
  | 1001 1200  | the second second   |   
  |
| 30.0   | 1/19.8 1814.8  | 3449.6  | 3657.6   
   | 654   | 1/38.6  | 1833.6   | 3477.2   
   | 3667.2  | 148  | 1/5f A   | 1852 A  
  | 3514.6   | 3704.8   | B42   | 17762  
  | 18/12  | 3552 A  | 3742.4  
  |
| 561  | 1/19/8 1814/8  | 3449.6<br>3440.0  | 3629.6   
   | 854<br>855  | 1/38.6<br>1/38.8  | 1833.6<br>1833.8   | 3477.2<br>3477.8   
   | 3667.2<br>3667.6  | 148<br>149   | 1/51 A<br>1/51 S   | 1852.A<br>1852.6  
  | 3514.8<br>3515.2   | 3704.8   | 842<br>843  | 1/762<br>1/764   
  | 1871.2<br>1871.4   | 3552 A<br>3552 S  | 3342.A<br>3342.8  
  |
| 561<br>562   | 1/19.8 1814.8<br>1/20.0 1815.0<br>1/20.2 1815.2  | 3449.8<br>3440.0<br>3440.4  | 3629.6<br>3630.0<br>3630.4   
   | 854<br>855<br>858   | 1138.8<br>1138.8<br>1138.8  | 1833.6<br>1833.6<br>1834.0   | 3477.2<br>3477.5<br>3478.0   
   | 3667.2<br>3667.6<br>3668.0  | 748<br>749<br>750  | 1/5/ A<br>1/5/ 8<br>1/5/ 8   | 1852.A<br>1852.8<br>1852.8  
  | 3514.8<br>3515.2<br>3515.8   | 3104.8<br>3105.2<br>3105.8   | 22 22 23<br>23 25 25  | 17762<br>17764<br>17766  
  | 18/12<br>18/14<br>18/18  | 3552.4<br>3552.8<br>3553.2  | 3742.4<br>3742.8<br>3743.2  
  |
| 560<br>561<br>562<br>563   | 1/19.8 1814.8<br>1/20.0 1815.0<br>1/20.2 1815.2<br>1/20.4 1815.4   | 3449.6<br>3440.0<br>3440.4<br>3440.8<br>3440.8  | 3629.6<br>3630.0<br>3630.4<br>3630.8   
   | 854<br>856<br>858<br>857  | 1/38.6<br>1/38.8<br>1/39.2  | 1833.6<br>1833.8<br>1834.0<br>1834.2   | 3477.2<br>3477.5<br>3478.0<br>3478.4<br>3478.4   
   | 3667.2<br>3667.6<br>3668.0<br>3668.4  | 748<br>749<br>750<br>751   | 1/5/ A<br>1/5/ 8<br>1/5/ 8<br>1/58/0   | 1852.4<br>1852.6<br>1852.8<br>1853.0  
  | 3514.8<br>3515.2<br>3515.8<br>3516.0   | 3104.8<br>3105.2<br>3105.8<br>3106.0   | 33333   | 17762<br>1776A<br>17765<br>17765   
  | 18/12<br>18/14<br>18/18<br>18/18<br>18/18  | 3552.4<br>3552.8<br>3553.2<br>3553.8  | 3/42/4<br>3/42/8<br>3/43/2<br>3/43/8  
  |
| 560<br>561<br>562<br>563<br>564<br>565   | 1/10.8 1814.8<br>1/20.0 1815.0<br>1/20.2 1815.2<br>1/20.4 1815.4<br>1/20.6 1815.8<br>1/20.6 1815.8   | 3449.6<br>3440.0<br>3440.4<br>3440.8<br>3441.2<br>3441.2  | 3629.6<br>3630.0<br>3630.4<br>3630.8<br>3631.2<br>3631.2   
   | 854<br>855<br>857<br>858<br>858<br>858  | 1738.6<br>1738.8<br>1739.0<br>1739.2<br>1739.4<br>1739.6  | 1833.6<br>1833.8<br>1834.0<br>1834.2<br>1834.4<br>1834.6   | 34712<br>34713<br>34783<br>34783<br>34783<br>34783<br>34782  
   | 3887.2<br>3887.6<br>3888.0<br>3888.4<br>3888.8<br>3888.8<br>3889.2  | 748<br>749<br>750<br>751<br>752<br>753   | 1757.8<br>1757.8<br>1757.8<br>1758.0<br>1758.2<br>1758.4   | 1852.8<br>1852.8<br>1852.8<br>1853.0<br>1853.2<br>1853.4  
  | 3514.8<br>3515.2<br>3515.8<br>3516.0<br>3516.4<br>3516.8   | 3104.8<br>3105.2<br>3105.8<br>3106.0<br>3106.0<br>3106.4<br>3106.8   | 222222222   | 1//62<br>1//64<br>1//68<br>1//68<br>1///0<br>1///2   
  | 18/12<br>18/14<br>18/18<br>18/18<br>18/20<br>18/22   | 3552/A<br>3552/8<br>3553/8<br>3553/8<br>3554/J<br>3554/A  | 3/42 A<br>3/42 8<br>3/43 2<br>3/43 8<br>3/44 A<br>3/44 A  
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| 560<br>561<br>562<br>563<br>564<br>565<br>565<br>565   | 1/1 9.8 1814.8<br>1/20.0 1815.0<br>1/20.2 1815.2<br>1/20.4 1815.4<br>1/20.6 1815.8<br>1/20.8 1815.8<br>1/20.8 1815.8   | 3449.6<br>3440.0<br>3440.4<br>3440.8<br>3440.8<br>3441.2<br>3441.6<br>3442.0  | 3629.6<br>3630.0<br>3630.4<br>3630.8<br>3631.2<br>3631.6<br>3631.6<br>3632.0   
   | 654<br>655<br>657<br>658<br>658<br>659<br>659   | 1/38.6<br>1/39.0<br>1/39.2<br>1/39.2<br>1/39.8<br>1/39.8  | 1833.6<br>1833.8<br>1834.0<br>1834.2<br>1834.4<br>1834.6<br>1834.6   | 34712<br>34713<br>34783<br>34783<br>34783<br>34783<br>34783<br>34783<br>34793  
   | 3887.2<br>3887.6<br>3888.0<br>3888.4<br>3888.8<br>3888.8<br>3889.2<br>3889.2  | 14 47 50 55 52 55 55<br>51 55 55 55 55 55<br>51 55 55 55 55 55<br>51 55 55 55 55 55 55<br>51 55 55 55 55 55 55 55 55 55 55 55 55 5 | 1/5/ A<br>1/5/ 8<br>1/5/ 8<br>1/58.0<br>1/58.2<br>1/58.4<br>1/58.6   | 1852.4<br>1852.6<br>1852.6<br>1853.0<br>1853.0<br>1853.7<br>1853.4<br>1853.6   | 3514.8<br>3515.2<br>3515.8<br>3518.0<br>3518.4<br>3518.8<br>3518.8<br>3517.2   
   | 3104.8<br>3105.2<br>3105.6<br>3106.0<br>3106.0<br>3106.8<br>3106.8<br>3107.2   | 333333333333  | 1/162<br>1/164<br>1/168<br>1/168<br>1/168<br>1/170<br>1/172<br>1/172   
  | 18/12<br>18/14<br>18/18<br>18/18<br>18/20<br>18/22<br>18/22  | 3552 A<br>3552 8<br>3553 2<br>3553 8<br>3554 0<br>3554 A<br>3554 8  | 3/42/4<br>3/42/3<br>3/43/2<br>3/43/5<br>3/44/4<br>3/44/4<br>3/44/3  
  |
| 560<br>561<br>562<br>563<br>564<br>565<br>565<br>565<br>565<br>567   | 1/10.8 1814.8<br>1/20.0 1815.0<br>1/20.2 1815.2<br>1/20.4 1815.6<br>1/20.8 1815.6<br>1/20.8 1815.8<br>1/21.0 1816.0<br>1/21.0 1816.0   | 3449.6<br>3440.0<br>3440.4<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>3440.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340.8<br>340   | 3629.6<br>3630.0<br>3630.4<br>3630.8<br>3631.2<br>3631.2<br>3631.6<br>3632.0<br>3632.0   
   | 854<br>855<br>855<br>855<br>855<br>855<br>855<br>855<br>855<br>855  | 1/38.8<br>1/39.0<br>1/39.0<br>1/39.2<br>1/39.4<br>1/39.8<br>1/39.8<br>1/39.8<br>1/39.8  | 1833.6<br>1833.8<br>1834.0<br>1834.7<br>1834.4<br>1834.6<br>1834.6<br>1834.8<br>1835.0   | 34712<br>34713<br>34783<br>34783<br>34783<br>34783<br>34793<br>34793<br>34803  
   | 3867.2<br>3867.6<br>3868.0<br>3868.4<br>3868.8<br>3869.2<br>3869.2<br>3869.2<br>3869.8<br>3869.0  | 14 14 15 15 15 15 15 15 15 15 15 15 15 15 15   | 1/5/ A<br>1/5/ B<br>1/5/ B<br>1/58.0<br>1/58.2<br>1/58.4<br>1/58.8<br>1/58.8   | 1852.6<br>1852.6<br>1852.8<br>1853.0<br>1853.0<br>1853.6<br>1853.6<br>1853.8  
  | 3514.8<br>3515.2<br>3515.8<br>3516.0<br>3516.4<br>3516.8<br>3516.8<br>3517.2<br>3517.8   | 3104.8<br>3105.2<br>3105.6<br>3106.0<br>3106.4<br>3106.8<br>3106.8<br>3101.2<br>3101.2   | 222222222222  | 11762<br>11764<br>11768<br>11768<br>11768<br>11776<br>11776<br>11777<br>11777  
  | 18/12/<br>18/14/<br>18/18/<br>18/20/<br>18/22/<br>18/24/<br>18/23/   | 3552.4<br>3552.8<br>3553.2<br>3554.0<br>3554.4<br>3554.8<br>3554.8<br>3554.8  | 3/42/4<br>3/42/3<br>3/43/2<br>3/43/3<br>3/44/4<br>3/44/4<br>3/44/2<br>3/45/2  
  |
|  | 1719.8 1814.8<br>1720.0 1815.0<br>1720.2 1815.2<br>1720.4 1815.8<br>1720.8 1815.8<br>1720.8 1815.8<br>1721.0 1816.0<br>1721.2 1816.2<br>1721.4 1816.4  | 3449.6<br>3440.0<br>3440.4<br>3440.8<br>3441.2<br>3441.6<br>3442.0<br>3442.0<br>3442.4<br>3442.8<br>3442.8  | 3629.6<br>3630.0<br>3630.4<br>3630.8<br>3631.2<br>3631.6<br>3631.6<br>3632.0<br>3632.0<br>3632.4<br>3632.4   
   | 854<br>855<br>857<br>858<br>858<br>859<br>860<br>860<br>860<br>860<br>860   | 1/38.8<br>1/38.8<br>1/39.0<br>1/39.2<br>1/39.4<br>1/39.8<br>1/39.8<br>1/39.8<br>1/40.0<br>1/40.0  | 1835.6<br>1835.8<br>1834.0<br>1834.2<br>1834.2<br>1834.4<br>1834.6<br>1834.6<br>1834.8<br>1835.0<br>1835.0   | 34/12<br>34/13/<br>34/18/<br>34/18/4<br>34/18/8<br>34/19/2<br>34/19/2<br>34/19/2<br>34/19/2<br>34/19/2<br>34/19/2<br>34/19/2<br>34/19/2  
   | 3987.2<br>3987.8<br>3988.0<br>3988.4<br>3988.8<br>3989.2<br>3989.0<br>3970.0<br>3970.4<br>3970.4  |  | 1/5/ A<br>1/5/ 8<br>1/5/ 8<br>1/58.0<br>1/58.2<br>1/58.4<br>1/58.6<br>1/58.8<br>1/58.8<br>1/58.8   | 1852.6<br>1852.6<br>1852.8<br>1853.0<br>1853.0<br>1853.4<br>1853.6<br>1853.6<br>1853.6<br>1853.8  
  | 3514.8<br>3515.2<br>3515.8<br>3516.0<br>3516.4<br>3516.8<br>3517.2<br>3517.6<br>3517.0<br>3518.0   | 3104.8<br>3105.2<br>3105.6<br>3106.4<br>3106.4<br>3106.8<br>3107.2<br>3107.2<br>3107.9<br>3107.9<br>3107.9<br>3107.9   | 333333333333333333  | 1/162<br>1/164<br>1/168<br>1/168<br>1/168<br>1/178<br>1/178<br>1/178<br>1/178  
  | 18/12<br>18/14<br>18/14<br>18/18<br>18/20<br>18/22<br>18/24<br>18/28<br>18/28  | 3552 A<br>3552 8<br>3553 2<br>3553 8<br>3554 A<br>3554 A<br>3554 8<br>3555 8<br>3555 8  | 3742.4<br>3742.3<br>3743.2<br>3743.5<br>3744.7<br>3744.7<br>3744.7<br>3745.2<br>3745.5<br>3745.5  
  |
|  | 111.8.8 (8)44.8<br>1720.0 (8)5.9<br>1720.2 (8)5.2<br>1720.4 (8)5.4<br>1720.6 (8)5.8<br>1720.6 (8)5.8<br>1720.6 (8)5.8<br>1720.6 (8)5.8<br>1720.8 (8)5.8<br>1721.2 (8)6.9<br>1721.4 (8)6.4<br>1721.6 (8)6.8   | 3449.6<br>3440.0<br>3440.4<br>3440.8<br>3441.2<br>3441.8<br>3441.2<br>3441.8<br>3442.0<br>3442.4<br>3442.8<br>3442.8<br>3442.8  | 3629.6<br>3630.0<br>3630.4<br>3630.8<br>3631.2<br>3631.6<br>3632.0<br>3632.0<br>3632.4<br>3632.8<br>3633.7<br>3633.7   
   | 854<br>855<br>855<br>855<br>855<br>855<br>855<br>855<br>855<br>855  | 1/38.8<br>1/39.0<br>1/39.0<br>1/39.2<br>1/39.4<br>1/39.8<br>1/39.8<br>1/39.8<br>1/40.0<br>1/40.0<br>1/40.2<br>1/40.4  | 1835.6<br>1835.8<br>1834.0<br>1834.2<br>1834.4<br>1834.6<br>1834.6<br>1834.6<br>1835.0<br>1835.2<br>1835.4<br>1835.6   |
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  | 3514.8<br>3515.2<br>3515.8<br>3516.0<br>3516.4<br>3516.8<br>3517.8<br>3517.8<br>3518.0<br>3518.4<br>3518.8   | 3104.8<br>3105.2<br>3105.8<br>3106.0<br>3106.4<br>3106.4<br>3106.4<br>3107.2<br>3107.2<br>3107.8<br>3108.0<br>3108.4<br>3108.4   |  
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3142,4<br>3142,8<br>3143,2<br>3143,5<br>3144,1<br>3144,1<br>3144,4<br>3145,2<br>3145,2<br>3145,5<br>3145,1<br>3145,1<br>3145,1   |
|  | 171 9.8 1814 8<br>1720.0 1815.0<br>1720.2 1815.2<br>1720.4 1815.4<br>1720.6 1815.8<br>1720.6 1815.8<br>1720.6 1815.8<br>1720.8 1815.8<br>1721.0 1816.0<br>1721.4 1816.4<br>1721.6 1816.9<br>1722.0 1817.0  | 3440.6<br>3440.0<br>3440.4<br>3440.8<br>3441.2<br>3441.2<br>3442.0<br>3442.0<br>3442.4<br>3442.8<br>3442.8<br>3442.8<br>3442.0  | 3629.6<br>3630.0<br>3630.4<br>3630.8<br>3631.2<br>3631.6<br>3632.0<br>3632.0<br>3632.4<br>3632.8<br>3632.8<br>3632.8<br>3632.8<br>3632.8<br>3632.8   
   | 854<br>855<br>855<br>857<br>858<br>857<br>857<br>857<br>857<br>857<br>857   | 1/38.8<br>1/38.8<br>1/39.0<br>1/39.2<br>1/39.2<br>1/39.8<br>1/39.8<br>1/40.0<br>1/40.2<br>1/40.8<br>1/40.8  | 1635.6<br>1635.8<br>1634.0<br>1634.2<br>1634.4<br>1634.6<br>1634.8<br>1635.0<br>1635.2<br>1635.4<br>1635.6<br>1635.6<br>1635.6   |
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  | 1/162<br>1/164<br>1/168<br>1/168<br>1/168<br>1/168<br>1/178<br>1/178<br>1/178<br>1/178<br>1/180<br>1/182  | 18/12<br>18/14<br>18/18<br>18/18<br>18/20<br>18/20<br>18/20<br>18/20<br>18/28<br>18/20<br>18/20<br>18/30<br>18/30  | 3562 A<br>3562 8<br>3563 8<br>3554 J<br>3554 A<br>3554 8<br>3555 8<br>3555 8<br>3556 J<br>3556 J<br>3556 J  |
3142,4<br>3142,8<br>3143,2<br>3143,8<br>3144,1<br>3144,4<br>3144,8<br>3145,2<br>3145,2<br>3145,8<br>3146,1<br>3146,4<br>3146,8   |
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   | 854<br>855<br>858<br>857<br>858<br>850<br>860<br>860<br>860<br>861<br>862<br>863<br>864<br>865<br>864<br>865<br>865   | 1/38.6<br>1/38.8<br>1/39.0<br>1/39.2<br>1/39.6<br>1/39.6<br>1/39.6<br>1/39.6<br>1/39.6<br>1/39.6<br>1/39.6<br>1/39.6<br>1/39.6<br>1/40.0<br>1/40.7<br>1/40.6<br>1/40.6<br>1/40.6<br>1/40.6  | 1833.6<br>1833.8<br>1834.0<br>1834.2<br>1834.4<br>1834.6<br>1834.6<br>1835.0<br>1835.7<br>1835.4<br>1835.6<br>1835.6<br>1835.6<br>1835.6   |
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3552/A<br>3552/8<br>3553/2<br>3553/3<br>3554/3<br>3554/A<br>3555/8<br>3555/2<br>3555/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>3556/2<br>356/2<br>356/2<br>356/2<br>356/2<br>356/2<br>356/2<br>356/2<br>356/2<br>356/2<br>356/ | 3142 A<br>3143 2<br>3143 2<br>3143 B<br>3144 A<br>3144 A<br>3144 A<br>3145 2<br>3145 2<br>3145 A<br>3145 A<br>3145 A<br>3145 A<br>3145 A<br>3146 A<br>3146 A<br>3147 B<br>3147 B<br>3148 A<br>3148 A<br>3148 A<br>3148 A<br>3148 A<br>3148 A<br>3148 A<br>3148 A   |
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3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1110.8 1814.8 1720.0 1815.0 1720.2 1815.2 1720.4 1815.4 1720.6 1815.8 1720.6 1815.8 1720.6 1815.8 1721.0 1815.9 1721.2 1816.9 1721.2 1816.9 1721.8 1816.8 1721.8 1816.8 1721.8 1816.8 1722.8 1817.8 1722.8 1819.8 1723.8 1819.8 1723.8 1819.8 1724.0 1819.1 1724.8 1819.8 1724.8 1819.8 1724.8 1819.8 1724.8 1819.8 1724.8 1819.8 1725.8 1820.8 1725.8 1828.8 1725.8 1828.8 1725.8 1828.8 1728.8 1828.8 1728.8 1828.8 1728.8 1828.8 1728.8 1828.8 17	3449.6 3340.0 3340.8 3340.8 3340.8 3341.5 3342.0 3350.0 33550.0 3550.0000.000	39294.6 39320.4 39320.4 39320.6 39320.6 39320.0000.00000.00000000000000000000000	834         854           855         855           855         855           855         855           956         856           960         965           965         965           965         965           965         965           965         965           966         965           968         968           917         912           913         914           914         915           914         914           917         953           958         953           954         953           955         958           953         953           954         953           955         958           958         959           959         959           959         959           959         959           959         959           959         959           959         959           959         959           959         950	1/38.6 1/38.7 1/39.0 1/39.0 1/39.2 1/39.4 1/39.6 1/39.6 1/39.6 1/39.6 1/39.6 1/39.6 1/39.6 1/39.6 1/40.6 1/41.0 1/41.6 1/41.6 1/42.6 1/44.7 1/45.7	1833.6 1833.6 1834.0 1834.7 1834.7 1834.7 1835.0 1840.0 18	3411 2 3411 8 3418 4 3418 8 3418 8 34	2651/2 2655.0 2655.4 2655.4 2655.4 2655.4 2655.2 2657.2 2657.4 26	148 4 149 149 149 149 149 149 149 149 149 1	7191.4 1191.8 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1193.0 1190.0 11	1852 A 1852 B 1853 B 1853 B 1853 B 1853 B 1853 B 1854 C 1854 C 1854 C 1854 C 1854 C 1854 C 1855 C	3514.8 3515.4 3515.4 3515.8 3515.8 3515.8 3516.8 3517.2 3518.8 3528.8 3528.8 3527.8	3114.8 3105.2 3105.2 3105.3 3105.3 3105.3 3107.3 3107.3 3107.3 3107.3 3107.4 3107.2 3107.4 3108.4 3107.2 3108.4 3107.2 3108.4 3107.2 3108.4 3107.2 3108.4 3107.2 3117.4 3117.2 3112.4 3112.4 3112.4 3115.5 31	842 845 844 845 844 845 844 845 844 845 844 845 844 845 844 85 84 85 84 85 85 85 85 85 85 85 85 85 85 85 85 85	11/162 11/168 11	18/12/ 18/18/ 18/18/ 18/18/ 18/20 18/27 18/27 18/27 18/27 18/27 18/27 18/27 18/37 18/37 18/37 18/37 18/37 18/44 18/47 18/50 18/70	3552 A 3552 A 3553 B 3553 B 3554 J 3554 J 3555 A 3555 B 3555 B 3555 B 3556 A 3556 B 3556 B 35	3142 A 3142 B 3143 B 3143 B 3144 A 3144 A 3144 A 3144 A 3144 A 3144 A 3144 A 3144 A 3145 C 3146 A 3145 C 3145 C 3145 C 3145 C 315 C
35573335555555555555555555555555555555	1110.8 1814.8 11720.2 1815.2 11720.2 1815.2 11720.6 1815.9 11720.6 1815.9 11720.6 1815.9 11721.6 1815.9 11721.6 1815.9 11721.7 1816.7 11721.7 1816.7 11721.8 1816.8 11721.8 1816.8 11721.8 1816.8 11722.6 1817.9 11722.7 1817.7 11722.6 1817.9 11723.6 1819.9 11723.6 1819.9 11723.6 1819.9 11723.6 1819.9 11723.6 1819.9 11723.6 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11724.8 1819.9 11725.8 1820.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.8 1822.9 11725.9 1172	3449.6 3340.0 3340.8 3340.8 3340.8 3340.8 3341.2 3342.0 3342.0 3342.0 3342.0 3342.0 3342.0 3342.0 3342.0 3342.0 3342.0 3342.0 3342.0 3343.0 3345.0 3345.0 3345.0 3345.0 3345.0 3345.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0 3355.0	39294 6 39300 4 39300 8 3930 2 3930 2 3940 2 39400 2 39400 2 3940 2 3940 2 3940 2 3940 2 3940	834 855 855 855 855 955 955 955 955 955 955	1/38.6 1/38.7 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/39.0 1/40.0 1/40.0 1/40.0 1/40.0 1/40.0 1/40.0 1/42.0	1835.6 1834.0 1834.0 1834.4 1834.4 1834.4 1834.4 1835.0 1835.0 1835.0 1835.0 1835.0 1835.0 1835.0 1835.0 1836.0 1837.0 1847.0 18	3411 2 3411 8 3418 4 3418 8 3418 4 3418 8 3418 8 3418 8 3418 8 3418 8 3418 8 3418 12 3480 8 3480 8 3480 8 3480 2 3480 2 3482 8 3482 8 3483 8 3484 8 3	2661/2 3867.2 3867.5 3867.5 3867.5 3867.2 3867.5 3867.2 3867.5 3877.4 39		7191.4 1191.6 1191.6 1192.0 1192.0 1192.0 1192.0 1192.0 1192.0 1192.0 1192.0 1192.0 1192.0 1190.0 11	1852.4 1852.6 1852.6 1853.0 1853.0 1853.0 1853.0 1854.2 1854.4 1854.6 1854.7 1854.7 1854.7 1854.7 1855.0 1850.0	3514.8 3515.4 3515.4 3515.4 3515.4 3516.4 3516.8 3517.7 3518.8 3517.7 3518.8 3517.7 3518.8 3518.7 3518.8 3518.8 3518.8 3518.8 3518.8 3518.8 3528.4 3528.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3522.4 3525.8 3525.8 3525.8 3526.8 3526.8 3526.8 3526.8 3526.8 3527.8 3526.8 3526.8 3526.8 3527.8 3526.8 3526.8 3526.8 3527.8 3526.8 3526.8 3526.8 3527.8 3526.8 3526.8 3526.8 3527.8 3526.8 3526.8 3526.8 3527.8 3526.8 3527.8 3526.8 3527.8 3526.8 3527.8 3527.8 3526.8 3527.8	3114.8 3105.2 3105.2 3105.3 3105.3 3105.3 3107.2 3107.8 3107.2 3107.8 3107.2 3107.2 3107.2 3107.2 3107.2 3107.2 3108.4 3108.4 3108.4 3108.4 3108.4 3108.4 3108.4 3108.4 3108.4 3108.4 3108.4 3117.2 3117.4 3117.2 3117.8 31	842 845 844 845 844 845 844 845 844 845 844 845 844 845 844 845 844 845 844 845 844 845 844 845 845	11/162/ 11/16/8/ 11/1	18/12/ 18/18/ 18/18/ 18/18/ 18/20 18/20 18/27 18/27 18/27 18/27 18/27 18/27 18/32 18/37 18/37 18/38 18/47 18/47 18/58	3552 A 3552 B 3553 B 3554 J 3554 J 3554 J 3555 B 3556 J 3556 B 3556 J 3556 B 3556 B 35	3/42/4 3/43/2 3/43/2 3/43/2 3/44/4 3/44/4 3/44/8 3/44/8 3/45/2 3/45/8 3/5/8 3/5

## Nokia Customer Care

#### GSM1900 (RH-19/RH-50)

СН	тх	RX	VCO TX	VCO RX	CH	ТΧ	RX	VCO TX	VCO RX	СН	ТΧ	RX	VCO TX	VCO RX CH	ТΧ	RX	VCO TX	VCO RX	
512	1850,2	1930,2	3700,4	3860,4	606	1869,0	1949,0	3738,0	3898,0	700	1887,8	1967,8	3775,6	3935,6 794	1906,6	1986,6	3813,2	3973,2	
513	1850,4	1930,4	3700,8	3860,8	608	1869,2	1949,2	3738,4	3898,4	701	1888,0	1968,0	3776,0	3936,0 795	1906,8	1986,8	3813,6	3973,6	
515	1850,8	1930,8	3701,6	3861,6	609	1869,6	1949,6	3739,2	3899,2	703	1888,4	1968,4	3776,8	3936,8 797	1907,2	1987,2	3814,4	3974,4	
516	1851,0	1931,0	3702,0	3862,0	610	1869,8	1949,8	3739,6	3899,6	704	1888,6	1968,6	3777,2	3937,2 798	1907,4	1987,4	3814,8	3974,8	
517	1851,2	1931,2	3702,4	3862,4	612	1870,0	1950,0	3740,0	3900,0	705	1889.0	1968,8	37778.0	3937,6 799	1907,6	1987,6	3815,2	3975,2	
519	1851,6	1931,6	3703,2	3863,2	613	1870,4	1950,4	3740,8	3900,8	707	1889,2	1969,2	3778,4	3938,4 801	1908,0	1988,0	3816,0	3976,0	
520	1851,8	1931,8	3703,6	3863,6	614	1870,6	1950,6	3741,2	3901,2	708	1889,4	1969,4	3778,8	3938,8 802	1908,2	1988,2	3816,4	3976,4	
521	1852,0	1932,0	3704,0	3864,0	616	1870,8	1950,8	3741,6	3901,6	709	1889,6	1969,6	3779,2	3939,2 803	1908,4	1988,4	3816,8	3976,8	
523	1852,4	1932,4	3704,8	3864,8	617	1871,2	1951,2	3742,4	3902,4	711	1890,0	1970,0	3780,0	3940,0 805	1908,8	1988,8	3817,6	3977,6	
524	1852,6	1932,6	3705,2	3865,2	618	1871,4	1951,4	3742,8	3902,8	712	1890,2	1970,2	3780,4	3940,4 806	1909,0	1989,0	3818,0	3978,0	
525	1853.0	1932,0	3705,6	3866.0	620	1871.8	1951,6	3743,2	3903,2	713	1890,4	1970,4	3780,8	3940,8 807	1909,2	1969,2	3818.8	3978.8	
527	1853,2	1933,2	3706,4	3866,4	621	1872,0	1952,0	3744,0	3904,0	715	1890,8	1970,8	3781,6	3941,6 809	1909,6	1989,6	3819,2	3979,2	
528	1853,4	1933,4	3706,8	3866,8	622	1872,2	1952,2	3744,4	3904,4	716	1891,0	1971,0	3782,0	3942,0 810	1909,8	1989,8	3819,6	3979,6	
530	1853,8	1933,8	3707,2	3867,6	624	1872,4	1952,4	3744,8	3904,8	718	1891,4	1971,2	3782,4	3942,4					
531	1854,0	1934,0	3708,0	3868,0	625	1872,8	1952,8	3745,6	3905,6	719	1891,6	1971,6	3783,2	3943,2					
532	1854,2	1934,2	3708,4	3868,4	626	1873,0	1953,0	3746,0	3906,0	720	1891,8	1971,8	3783,6	3943,6					
534	1854.6	1934,4	3708,8	3869.2	628	1873.4	1953,2	3746,4	3906,4	721	1892.0	1972,0	3784,0	3944,0					-
535	1854,8	1934,8	3709,6	3869,6	629	1873,6	1953,6	3747,2	3907,2	723	1892,4	1972,4	3784,8	3944,8					
536	1855,0	1935,0	3710,0	3870,0	630	1873,8	1953,8	3747,6	3907,6	724	1892,6	1972,6	3785,2	3945,2					
538	1855,2	1935,2	3710,4	3870,4	632	1874,0	1954,0	3748,0	3908,0	726	1893,0	1973,0	3786,0	3946,0					
539	1855,6	1935,6	3711,2	3871,2	633	1874,4	1954,4	3748,8	3908,8	727	1893,2	1973,2	3786,4	3946,4					
540	1855,8	1935,8	3711,6	3871,6	634	1874,6	1954,6	3749,2	3909,2	728	1893,4	1973,4	3786,8	3946,8					
542	1856,2	1936,0	3712,0	3872,0	636	1875,0	1955,0	3749,0	3910,0	730	1893,8	1973,8	3787,2	3947,2					
543	1856,4	1936,4	3712,8	3872,8	637	1875,2	1955,2	3750,4	3910,4	731	1894,0	1974,0	3788,0	3948,0					
544	1856,6	1936,6	3713,2	3873,2	638	1875,4	1955,4	3750,8	3910,8	732	1894,2	1974,2	3788,4	3948,4					
545	1857,0	1930,0	3713,0	3874,0	640	1875,8	1955,8	3751,2	3911,2	734	1894,6	1974,4	3789,2	3949,2					
547	1857,2	1937,2	3714,4	3874,4	641	1876,0	1956,0	3752,0	3912,0	735	1894,8	1974,8	3789,6	3949,6					
548	1857,4	1937,4	3714,8	3874,8	642	1876,2	1956,2	3752,4	3912,4	736	1895,0	1975,0	3790,0	3950,0					
550	1857,8	1937,8	3715,2	3875,6	644	1876,6	1956,6	3753,2	3912,8	738	1895,4	1975,2	3790,4	3950,4					
551	1858,0	1938,0	3716,0	3876,0	645	1876,8	1956,8	3753,6	3913,6	739	1895,6	1975,6	3791,2	3951,2					
552	1858,2	1938,2	3716,4	3876,4	646 647	1877,0	1957,0	3754,0	3914,0	740	1895,8	1975,8	3791,6	3951,6					
554	1858,6	1938,6	3717,2	3877,2	648	1877,4	1957,4	3754,8	3914,8	742	1896,2	1976,2	3792,4	3952,0					
555	1858,8	1938,8	3717,6	3877,6	649	1877,6	1957,6	3755,2	3915,2	743	1896,4	1976,4	3792,8	3952,8					
556	1859,0	1939,0	3718,0	3878,0	650	1877,8	1957,8	3755,6	3915,6	744	1896,6	1976,6	3793,2	3953,2					
558	1859,4	1939,4	3718,8	3878,8	652	1878,2	1958,2	3756,4	3916,4	746	1897,0	1977,0	3793,0	3954,0					
559	1859,6	1939,6	3719,2	3879,2	653	1878,4	1958,4	3756,8	3916,8	747	1897,2	1977,2	3794,4	3954,4					
560	1859,8	1939,8	3719,6	3879,6	654	1878,6	1958,6	3757,2	3917,2	748	1897,4	1977,4	3794,8	3954,8					
562	1860,2	1940,0	3720,4	3880,4	656	1879,0	1959,0	3758,0	3918,0	750	1897,8	1977,8	3795,6	3955,6					
563	1860,4	1940,4	3720,8	3880,8	657	1879,2	1959,2	3758,4	3918,4	751	1898,0	1978,0	3796,0	3956,0					
564	1860,6	1940,6	3721,2	3881,2	658	1879,4	1959,4	3758,8	3918,8	752	1898,2	1978,2	3796,4	3956,4					
566	1861,0	1941,0	3722,0	3882,0	660	1879,8	1959,8	3759,6	3919,6	754	1898,6	1978,6	3797,2	3957,2					
567	1861,2	1941,2	3722,4	3882,4	661	1880,0	1960,0	3760,0	3920,0	755	1898,8	1978,8	3797,6	3957,6					
568 569	1861,4	1941,4	3722,8	3882,8	662 663	1880,2	1960,2 1960,4	3760,4	3920,4	756	1899,0	1979,0	3798,0	3958,0					
570	1861,8	1941,8	3723,6	3883,6	664	1880,6	1960,6	3761,2	3921,2	758	1899,4	1979,4	3798,8	3958,8					
571	1862,0	1942,0	3724,0	3884,0	665	1880,8	1960,8	3761,6	3921,6	759	1899,6	1979,6	3799,2	3959,2					
573	1862,2	1942,2	3724,4	3884,4	667	1881,0	1961,0	3762,0	3922,0	760	1900.0	1979,8	3799,6	3959,6					
574	1862,6	1942,6	3725,2	3885,2	668	1881,4	1961,4	3762,8	3922,8	762	1900,2	1980,2	3800,4	3960,4					
575	1862,8	1942,8	3725,6	3885,6	669	1881,6	1961,6	3763,2	3923,2	763	1900,4	1980,4	3800,8	3960,8					
577	1863,2	1943,2	3726,4	3886,4	671	1882,0	1962,0	3764,0	3923,6	765	1900,8	1980,8	3801,6	3961,6					
578	1863,4	1943,4	3726,8	3886,8	672	1882,2	1962,2	3764,4	3924,4	766	1901,0	1981,0	3802,0	3962,0					
579	1863,6	1943,6	3727,2	3887,2	673	1882,4	1962,4	3764,8	3924,8	767	1901,2	1981,2	3802,4	3962,4					
581	1864,0	1944,0	3728,0	3888,0	675	1882,8	1962,8	3765,6	3925,6	769	1901,6	1981,6	3803,2	3963,2					
582	1864,2	1944,2	3728,4	3888,4	676	1883,0	1963,0	3766,0	3926,0	770	1901,8	1981,8	3803,6	3963,6					
583	1864,4	1944,4	3728,8	3888,8	677	1883,2	1963,2	3766,4	3926,4	771	1902,0	1982,0	3804,0	3964,0					
585	1864,8	1944,8	3729,6	3889,6	679	1883,6	1963,6	3767,2	3927,2	773	1902,4	1982,4	3804,8	3964,8					
586	1865,0	1945,0	3730,0	3890,0	680	1883,8	1963,8	3767,6	3927,6	774	1902,6	1982,6	3805,2	3965,2					
587	1865.4	1945,2	3730,4	3890,4	681	1884,0	1964,0	3768,0	3928,0	776	1902,8	1982,8	3805,6	3965,6					
589	1865,6	1945,6	3731,2	3891,2	683	1884,4	1964,4	3768,8	3928,8	777	1903,2	1983,2	3806,4	3966,4					
590	1865,8	1945,8	3731,6	3891,6	684	1884,6	1964,6	3769,2	3929,2	778	1903,4	1983,4	3806,8	3966,8					
591	1866.2	1946.2	3732.4	3892.4	686	1885.0	1965.0	3770.0	3930.0	780	1903.8	1983.8	3807.6	3967.6					
593	1866,4	1946,4	3732,8	3892,8	687	1885,2	1965,2	3770,4	3930,4	781	1904,0	1984,0	3808,0	3968,0					
594	1866,6	1946,6	3733,2	3893,2	688	1885,4	1965,4	3770,8	3930,8	782	1904,2	1984,2	3808,4	3968,4					
595	1867,0	1947,0	3734,0	3894,0	690	1885,8	1965,8	3771.6	3931,2	784	1904,6	1984,6	3809,2	3969,2					í –
597	1867,2	1947,2	3734,4	3894,4	691	1886,0	1966,0	3772,0	3932,0	785	1904,8	1984,8	3809,6	3969,6					
598	1867,4	1947,4	3734,8	3894,8	692	1886,2	1966,2	3772,4	3932,4	786	1905,0	1985,0	3810,0	3970,0					<u> </u>
600	1867,8	1947,8	3735,6	3895,6	694	1886,6	1966,6	3773,2	3933,2	788	1905,4	1985,4	3810,8	3970,8					
601	1868,0	1948,0	3736,0	3896,0	695	1886,8	1966,8	3773,6	3933,6	789	1905,6	1985,6	3811,2	3971,2					
602	1868,2	1948,2	3736,4	3896,4	696	1887,0	1967,0	3774,0	3934,0	790 701	1905,8	1985,8	3811,6	3971,6					
604	1868,6	1948,6	3737,2	3897,2	698	1887,4	1967,4	3774,8	3934,8	792	1906,2	1986.2	3812,0	3972,4					İ
605	1868.8	1948.8	3737.6	3897.6	600	1887.6	1967.6	3775 2	3935.2	703	1906.4	1986.4	3812.8	3972.8					ſ

## DC supply current check

For a quick check of the DC power supplies to the diagram below. Voltage drops are measured at the respective resistors pads.

Note: Not all currents can be checked in such a way, see <na> (not applicable) in the diagram.

Voltage drop & current 4.75 V 3.2 % charge pump (VDDCP) <na> VR1A 0.45 mA 2.78 V 3 % <na> Tx modulator (VDDTX) VR2 85 mA **Dig. control (VDDDIG)** Ant. switch control lines (through Mjoelner) R610 (47R): 2.78 V 3 % VCXO (VDDXO) VR3 116mV 2.47mA 3.5 mA **BB buffer (VDDBBB)** UEM 2.78 V 3 % <na> **Rx BB section (VDDRXBB)** VR4 14 mA (Tx900), 28 (Rx) Tx buffer (through Mjoelner) 2.78 V 3 % R628 (5R6): VR5 PLL prescaler (VDDPRE) 41 mA 53mV 9.5mA R629 (5R6): dividers, LO buffers (VDDLO) 50mV 8.9mA PLL counters (VDDPLL) 2.78 V 3 % VR6 <na> **Rx front end (VDDRXF)** 11 mA 2.78 V 3 % <na> VR7 vco 14 mA 1.8 V 4.5 % <na> 13/26 MHz (SELADDR) VIO 0.02 mA dig. interface (VDDDL) R612 (1k0): 1.35 V 2 % VREF01 bias reference (VBEXT) 662mV 100 uA 0.660mA 3.6 V VBAT <na> **Triple band PA** 

# **RF Tuning Instructions**

## General instructions for RF tuning

- Provide the phone with power supply (nominal voltage is 3.7V).
- Connect the phone to a PC with DAU-9T cable (RS232) (or DKU-5 cable (USB)).
- Start Phoenix Service Software (dongle required).
- Open FBUS connection.
- Select: File Alt-F Scan Product P Shortcut: Ctrl-R

Wait until phone information is shown in the lower right corner of the screen.

## RF tuning after repairs

The following tunings have to be performed after repairs:

- Repairs in the TX part will require "TX Power Level Tuning". When components around the modulator area are replaced (RF path from UEM via Mjoelner to RF PA) have been done, "TX IQ Tuning" is additionally required.
- In general repairs in the RX front-end or the PLL unit always require "RX Calibration" and "RX Band Filter Calibration".
- If Mjoelner was changed all calibrations mentioned above have to be done.

#### **RX** calibration

The **RX Calibration** has to be performed to determine the gains at different gain settings of the front-end and Mjoelner. The calibration must be done in all three bands.

RX Calibration requires an external signal generator. Most of the radio communication testers like CMD55 or CMU200 can be used also as a signal generator, generating a continuous RF signal with defined levels and frequencies.

**RX Calibration in GSM850/GSM900 combines two alignments: VCXO calibration and AGC calibration.** Calibration of GSM1800 and GSM1900 band only determines the AGC values.

The **VCXO calibration** detects a calibration value for VCXO control, an AFC initial value and 3 AFC-slope coefficients. The VCXO calibration ensures the function of an initial synchronization (before location update is done) when the phone has been set in Normal Mode. For an error free initial synchronization, the 26MHz frequency of the VCXO must be accurate enough. Therefore, a **VCXO cal** value is written into the RefOSCCAL register of the Mjoelner.

During VCXO-calibration, the **VCXO cal** value is changed by a DSP-algorithm until a synchronization is possible. This means that the VCXO oscillates at 26 MHz with a sufficient minimum frequency error. To further minimize the frequency error, an initial **AFC value** is determined by the DSP and written into RefOSCAFC register of the Mjoelner.

Additionally the DSP algorithm determines three AFC slope coefficients **Slope C1, C2, C3** during VCXO calibration. One AFC slope value is not sufficient for Mjoelner, because the AFC slope is a non-linear function versus time.

The **AGC-calibration** detects the gain values of the RX chain. The AGC is looped by the RF LNA, which can be switched either on or off (gain difference between on and off state is nominally 30dB) and the BB gain which is controlled by 15 gain steps RSSI0 to RSSI14 each having a graduation of 6dB. The LNA is off at steps RSSI0 to RSSI4.

AGC-calibration detects the gain at the two gain steps RSSI4 and RSSI7. All other steps are calculated.

A value **RF\_TEMP**, which represents the RF hardware temperature, is determined during RX Calibration. This temperature value is used by DSP for RSSI reporting correction in Normal Mode of the phone. It is not displayed while calibrating.

The RX calibration is only valid if the results are within certain limits. For the most recent limits refer to the production limits of FLALI and FINUI testers.

If the results are not within these limits, the RX chain is faulty.

#### RX calibration GSM850/900

Set operating mode to local mode.

Select	Maintenance		Alt-M
	Tuning	l	Т
		RX Calibration	С
Wait until the RX Calibration	window has po	pped up.	
Select	Band		GSM850 or
			GSM 900
	Autom.		-60 dBm
	1st Man.		-50 dBm
	2nd Man. Load from Pho Save to Phone	one	-85 dBm X X

The setup should now look like this (RH-50):

16 Phoenix	
File Edit Product Flashing Testing Tuning Tools RD Window Help	
D 😂 🖬 Connections: [fbus 💽 Settings] Operating mode: [Local	Read Change with Reset Edge: Off 💌
Autom. 60 dbm 1st Man. 60 dbm 2nd Man. 95 dbm	Band: GSM 850 💌
RF Controls	
Common GSM RF Control Values         Active Unit:       Rx         Active Unit:       Rx         Band:       GSM 850         Operation Mode:       Burst         RX Control Values       AFC:         Monitor Channet:       190         881.600000       AGC:         14: FEG_ON + 24 dB + const_BB_gain       T         TX Control Values       Tx Data Type:         Edge:       Off         Tx PA Mode:       High         Tx POwer Levet:       10         Close       Help	Image: Calibration mode         Image: Calibration mode

Select Automatic, press Start and a new window pops up:

VCX0 cal: Afc value : Slope C1 : Slope C2 : Slope C2 : Rssi 1 : Rssi 2 : Rssi 3 : Rssi 4 : Rssi 4 : Rssi 5 : Rssi 6 : Rssi 6 : Rssi 7 : Rssi 8 : Rssi 9 : Rssi 9 : Rssi 9 : Rssi 11 : Rssi 12 : Rssi 12 :	568 000000 3140 000000 2603 000000 516 000000 61 406250 67 406250 73 406250 73 406250 73 406250 73 406250 97 343750 109 343750 109 343750 127 343750 127 343750 127 343750 123 343750 128 343750	Calibration mode Calibration mode C Automatic C Manual	Calibrate Stop Help
---	---	---	---------------------------

Select PM settings, press OK and the window closes.

Now it is possible to press the **Calibrate** button in the RX Calibration window.

Press Calibrate and a window pops up:

Rx Calibration with band G5M850	×
Set the Rf signal generator:	
Power level: -60 dBm	
Input signal frequency: 881.667710 MHz	
Press OK to tune, press Cancel or ESC to exit tuning p	process.
OK Cancel	

Connect an external signal generator to the RF connector of the phone and compensate for external RF cable losses. Set the generator as shown in window above. If a radio communication tester (RH-50 & RH-19 CMU200, RH-19 CMD55, 8960, MT8801) is used, assure that continuous mode is switched on and modulation switched off.

Press OK and the window closes.

A typical result will look like this:



Value	Typical	Limit min.	Limit max.
VCXO cal	568	128	767
AFC value	3162	3062	3262
Slope C1	2760	1500	3500
Slope C2	-480	-700	-300
Slope C3	1	0	1
Rssi 3	79	77	82
Rssi 6	102	100	105

The results must be compared with the following limits:

For production testing a more sophisticated check of the C1 and C2 values is performed according to the following formulas:

- 1 1312 <C2 \* 0.311 + C1 \* 0.395 + Afc value <4383
- 2 1312 <C2 \* 0.407 C1 \* 0.451 + Afc value <4383
- 3 1 / [-C2 \* 3.60e-5 + C1 \* 1.99e-5] <83
- 4 1 / [C2 \* 3.15e-5 + C1 \* 1.99e-5] <83

If C1 or C2 are outside the limits in the table above, but inside the limits calculated with the four formulas, the calibration was successful anyhow.

If Rssi 2 and Rssi 6 are within the limits, all other Rssi values are valid, too.

GSM850/GSM900 receiver part has to be checked

If the whole calibration fails, the GSM850/GSM900 receiver chain or the synthesizer part (including VCX0) might be defective.

If one of the values VCXO cal, AFC value, C1, C2 or C3 fails and Rssi 4 and Rssi 7 are within the limits, the crystal B601 or the RF ASIC N601 might be defective.

Press Stop in the RX Calibration window and the GSM RX Calibration is finished.

## RX calibration GSM1800 (DCS/PCN)

Set operating mode to local mode.

Select	Maintenance		Alt-M
	Tuning	9	Т
		RX Calibration	С
Wait until the RX Calibration	window pops u	ıp.	
Select	Band	GSM 1800	
	Autom.	-60dBm	
	1 <sup>st</sup> Man.	-50dBm	
	2 <sup>nd</sup> Man.	-85dBm	
	Load from Pho	one X	
	Save to Phone	e X	

The setup should now look like this:

K Phoenix	
File Edit Product Flashing Testing Tuning Tools RD Window Help	
🗅 🖻 🖨 📕 Connections: Ibus 💽 Settings 🗍 Operating mode: Local	▼ Read Change with Reset Edge: Off ▼
Autom. 60 dbm 1st Man 60 dbm 2nd Man 95 dbm	Band: GSM 1800 💌
RF Controls	
Common GSM RF Control Values Active Unit: Rx Band: GSM 1800 Active Unit: Rx Active Unit: Rx Act	Load from Phone     Start     Calibrate
Operation Mode: Burst	Stop
Monitor Channet         700         1842.800000           AGC:         14: FEG_ON + 24 dB + const_BB_gain            TX Control Values	Calibration mode C Automatic I Manual
Edge: Off Y Tx Data Type: Random Y Tx PA Mode: High Y Tx Power Levet 10 Y	

Select Automatic, press Start and the window looks like below:



Press Calibrate and a window pops up:

Rx Calibration with band G5M	11800	×
Set the Rf signal generator:		
Power level: -60 dBm		
Input signal frequency: 1842.867710 MHz		
Press OK to tune, press Cancel	or ESC to exit tuning proc	cess.
OK	Cancel	

Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window, above. If a radio communication tester (RH-50 & RH-19 CMU200; RH-19 CMD55, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

Press OK and the window closes.

A typical result will look like this:

🌃 Phoenix			_ <u>-</u> ×
File Edit Product Flashing Testing Tuning Tools RD Window Help			
📄 🖆 🔛 🛛 Connections: Ibus 💽 Setting:	s Operating mode: Local	Read Change with Reset	Edge: Off
Autom. 60 dbm 1st Man 60 dbm 2nd Man 95 dbm			Band: GSM 1800 💌
RF Controls	KRx Calibration	X	
Common GSM RF Control Values Active Unit: Rx P Rr/Tx Channet: 700 1842.800000 Band: GSM 1800 AFC: 3143 Operation Mode: Burst RX Control Values Monitor Channet: 700 1842.800000 AGC: 14: FEG_ON + 24 dB + const_BB_gain TX Control Values Edge: Off Y Tx Data Type: Random Y Tx PA Mode: High Y Tx Power Levet: 10 Y	Calibration values:           Resi 0         55 656250           Resi 1         61 656250           Resi 2         67 656250           Resi 3         73 656250           Resi 4         79 656250           Resi 5         91 000000           Resi 6         97 000000           Resi 7         103 000000           Resi 8         109 000000           Resi 9         115 000000           Resi 9         115 000000           Resi 10         121 000000           Resi 11         127 000000           Resi 12         133 000000           Resi 13         139 000000           Resi 14         145 000000	✓ Load from Phone       ♀tart       ♀alibrate       ✓ Sage to Phone       Stop       ☐elp       Calibration mode       ○ Automatic       ○ Manual	

The results must be compared with the following limits:

Value	Typical	Limit min.	Limit max.
Rssi 3	76	74	79
Rssi 6	99	96	103

If Rssi 3 and Rssi 6 are within the limits, all other Rssi values are valid, too. If not, continue according to the instructions of RX fault finding flow chart.

Press Stop in the RX Calibration window and the GSM1800 RX calibration is finished.

#### RX calibration GSM1900 (PCS)

Set operating mode to local mode.

Select Maintenance			Alt-M
	Tuning		
		RX Calibration	С
Wait until the RX Cali	bration window pops up	).	
Select	Band	GSM 1900	
	Autom.	-60dBm	

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-50dBm

1<sup>st</sup> Man.

2 <sup>nd</sup> Man.	-85dBm
Load from Phone	Х
Save to Phone	Х

The setup should now look like this:

🌾 Phoenix	_ B ×
File Edit Product Flashing Testing Tuning Tools RD Window Help	
🗋 🗅 😂 🔚 🚽 Connections:  fbus 💽 Settings   Operating mode:	Local Read Change with Reset Edge: Off 💌
Autom. 60 dbm 1st Man. 60 dbm 2nd Man. 95 dbm	Band: GSM 1900 💌
🔞 RF Controls	
Common GSM RF Control Values Active Unit: Rx T Rx/Tx Channet: 661 1960.000000 Band: GSM 1900 AFC: 3149 Operation Mode: Burst AFC: 3149 Operation Mode: Burst AFC: 3149 Operation Mode: Burst AFC: 3149 TX Control Values Monitor Channet: 661 1960.000000 AGC: 14: FEG_ON + 24 dB + const_BB_gain Y TX Control Values Edge: Off Y Tx Data Type: Random Y Tx PA Mode: High Y Tx Power Levet: 10 Y	Image: Calibration mode         Calibration mode         Calibration         Calibration         Manual

Select Automatic, press Start and and the window reads PM values from phone:

🐕 Phoenix			_ 8 ×
Eile Edit Product Flashing Testing Tuning Tools RD Window Help			
📄 🖙 🛃 📄 Connections: Ifbus 💽 Setting	s Operating mode: Local	<ul> <li>Read</li> <li>Change with Reset</li> </ul>	Edge: Off
Autom. 60 dbm 1st Man. 60 dbm 2nd Man. 95 dbm	1		Band: GSM 1900 💌
RF Controls	K Rx Calibration		
Common GSM RF Control Values Active Unit: Rx Y Rx/Tx Channet: 661 1960.000000 Band: GSM 1900 Y AFC: 3149 Operation Mode: Burst Y RX Control Values Monitor Channet: 661 1960.000000 AGC: 14: FEG_ON + 24 dB + const_BB_gain Y TX Control Values Edge: Off Y Tx Data Type: Random Y Tx PA Mode: High Y Tx Power Levet 10 Y	PM values:           Rssi 0         58.968750           Rssi 1         64.968750           Rssi 2         70.968750           Rssi 3         76.968750           Rssi 4         82.968750           Rssi 5         91.218750           Rssi 6         97.218750           Rssi 9         115.218750           Rssi 9         115.218750           Rssi 11         127.218750           Rssi 11         127.218750           Rssi 11         127.218750           Rssi 12         133.218750           Rssi 14         145.218750	✓     Load from Phone     Stert:       ✓     ∠alibrate       ✓     Sage to Phone     Stgp       ✓     Calibration mode        ✓     Automatic	

Press Calibrate and a window pops up:

Rx Calibration with band G5M1900	×
Set the Rf signal generator:	
Power level: -60 dBm	
Input signal frequency: 1960.067710 MHz	
Press OK to tune, press Cancel or ESC to exit tunin	g process.
OK Cancel	

Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window above. If a radio communication tester (RH-50 & RH-19 CMU200; RH-19 CMD55, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

Press OK and the window closes.

A typical result will look like this:

<u>File Edit Product Flashing Testing Tuning Iools RD Window H</u> elp	
📄 🖙 🖬 📄 Connections: Ifbus 💽 Settings 📄 Operating mode: Local 💌 Read	d 🗖 Change with Reset 🛛 Edge: 🛛 🕅 💌
Autom. <u>60</u> dbm 1st Man. <u>60</u> dbm 2nd Man. <u>95</u> dbm	Band: GSM 1900 💌
🔀 RF Controls	
Common GSM RF Control Values       Rx/Tx Channet [661] 1960.000000         Bandt [GSM 1900] ♥       AFC: [3149]         Operation Mode:       Burst ♥         RX Control Values       Rsii 1         Monitor Channet [661]       1960.000000         AGC:       14: FEG_ON + 24 dB + const_88_pain         TX Control Values       Rsii 1         Edge:       Off ♥ Tx Data Type:         Raid       138.531250         Rsii 1       122.531250         Rsii 1       138.531250         Rsii 1       125.531250         Rsii 1       138.531250         Rsii 1       125.531250         Rsii 1       138.531250         Rsii 1       144.531250         Manual       Sai 14         I 144 531250       Manual	rhone <u>Stap</u> ne <u>Stap</u> Help

The results must be compared with the following limits:

Value	Typical	Limit min.	Limit max.
Rssi 3	78	76	81
Rssi 6	98	96	101

If Rssi 3 and Rssi 6 are within the limits, all other Rssi values are valid, too. If not, continue according to the instructions of RX Fault finding flow chart.

Press Stop in the RX Calibration window and the GSM1900 RX Calibration is finished.

#### RX band filter response compensation

This alignment is necessary to compensate the frequency response of the RX band filters (SAW filters).

#### RX band filter response GSM850/GSM900

Set operating mode to local mode.

Select	Maintenance		Alt-M	
	Testing		Т	
	RF Con	trols	F	
Wait until the RI	F Controls window pops up.			
Select	Band	GSM850/900		
Select	Maintenance			Alt-M
	Tuning			Т

RX Band Filter Response Compensation В

#### A window pops up:

out Signal Li	evel (dBm): -60		Load from Phone	<u>S</u> tart
Channel	Input Frequency (MHz)	Measured Level	-	Iune
			Save to Phone	Stop
			Tuning mode C Automatic C Manual	<u>H</u> elp
			Copying table to clipboard: press mouse left button on the left top of the table (with text "Charned")	

Select Load from Phone, Save to Phone.

#### Manual tuning

Press Start and then Tune and a window pops up:

Rx Band Filter Response Compensation for GSM1800	×
Manual Tuning - stage 1 of 9.	
Set the Rf signal generator:	
Power level: -60 dBm + cable attenuation	
Input signal frequency: 1802.26771 MHz	
Press OK to tune, press Cancel or ESC to exit tuning process.	
OK Cancel	

Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window above. If a radio communication tester (CMD55, CMU200, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

Press OK and a new window pops up:

Rx Band Filter Response Compensation for G5M1800	×
Manual Tuning - stage 2 of 9.	
Set the Rf signal generator:	
Power level: -60 dBm + cable attenuation	
Input signal frequency: 1805.26771 MHz	
Press OK to tune, press Cancel or ESC to exit tuning process.	
OK	

Set the generator as shown in the window above.

Press OK and a new window pops up. Repeat this sequence until the calibration is finalized on all of the 9 channels.

Press Stop and the GSM850/GSM900 RX Band Filter Response Compensation is finished.

#### Auto tuning

A faster and more convenient method for Band Filter Calibration can be performed by clicking on "Auto Tuning". This requires a Signal Generator that can be pre-programmed to sweep through user defined frequencies.

Program the signal generator according to the list of frequencies that is shown in the window's column "Input Frequency (MHz)".

Press Automatic tuning mode.

Connect an external signal generator to the RF connector of the phone and the signal generator will generate the pre-programmed frequencies after pressing: OK.

Press Start and then Tune and a window pops up:

Rx Band Filter Response Compensation for GSM850
Automatic Tuning.
Set the Rf signal generator:
Power level: -60 dBm + cable attenuation
Input signal frequencies to sweep: 867.26771 MHz 869.26771 MHz 871.66771 MHz 878.06771 MHz 881.66771 MHz 887.06771 MHz 891.86771 MHz 893.86771 MHz 895.86771 MHz
Press OK to tune, press Cancel or ESC to exit tuning process.
OK Cancel

Press OK and then Stop and the GSM RX Band Filter Response Compensation is finished.

Limits

Regarding the limits, the value of N4 is given below. Concerning the other filter frequencies please refer to Appendix A where all FLALI testcases are listed together with the limits.

Value	Typical	Limit min.	Limit max.
N4	0	-0.3	0.3

## RX band filter response GSM1800 (DCS/PCN)

Set operating mode to local mode.

Select	Maintenan	ce	Alt-M
	Test	ting	Т
		RF Controls	F
Wait until the RF Co	ntrols window has po	pped up	
Select	Band	GSM 1800	
Select	Maintenan	ce	Alt-M
	Test	ting	Т
		RX Band Filter Response Compensation	В

The RX Band Filter Response Compensation window pops up.

🐕 Phoenix			X
File Edit Product Flashing Testing Tuning Tools RD Wind	ow Help		
🗋 🖻 🗃 📕 Connections: Ifbus	Settings Operating mode: Loca	Read Change with	Reset Edge: Off
Band: GSM 1800 💌			
KRF Controls	Rx Band Filter Response Compensation		
Common GSM RF Control Values Active Unit: Rx Rx/Tx Channet: 700 1	Input Signal Level (dBm): 60	🔽 Load fr	om Phone
Band: GSM 1800  AFC: 3150	Channel Input Frequency (MHz)	Measured Level	Iune
Operation Mode: Burst			Phone Stop
RX Control Values Monitor Channel: 700 1842.800000			atic
AGC: 14: FEG_ON + 24 dB + const_BB_gain			1
TX Control Values			
Tx PA Mode: High Tx Power Level: 5			
		Copying tab press mouse on the left to with text 'C	le to clipboard: e left button op of the table hannel').

The setup should now look like this:

Select

Input Signal Level -60dBm Load from Phone X Save to Phone X Tuning mode Manual

#### Manual tuning

Press Start and then Tune and a window pops up:



Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window above. If a radio communication tester (CMD55, CMU200, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

Press OK and a new window pops up:

Rx Band Filter Response Compensation for G5M1800	×
Manual Tuning - stage 2 of 9.	
Set the Rf signal generator:	
Power level: -60 dBm + cable attenuation	
Input signal frequency: 1805.26771 MHz	
Press OK to tune, press Cancel or ESC to exit tuning process.	
Cancel	

Set the generator as shown in the window above.

Press OK and a new window pops up. Repeat this sequence until the calibration is finalized on all of the 9 channels.

Press Stop and the GSM 1800 RX Band Filter Response Compensation is finished.

Auto tuning

A faster and more convenient method for Band Filter Calibration can be performed by clicking on "Auto Tuning". This requires a Signal Generator that can be pre-programmed to sweep through user defined frequencies.

Program the signal generator according to the list of frequencies that is shown in the window's column "Input Frequency (MHz)".

Press Automatic Tuning mode and then Tune. A window pops up:

Rx Band Filter Response Compensation for GSM1800
Automatic Tuning.
Set the Rf signal generator:
Power level: -60 dBm + cable attenuation
Input signal frequencies to sweep: 1802.26771 MHz 1805.26771 MHz 1824.06771 MHz 1824.06771 MHz 1842.86771 MHz 1861.06771 MHz 1876.86771 MHz 1879.86771 MHz 1879.86771 MHz
Press OK to tune, press Cancel or ESC to exit tuning process.
OK Cancel

Connect an external signal generator to the RF connector of the phone and the signal generator will generate the pre-programmed frequencies after pressing OK.

Press Stop and the GSM 1800 RX Band Filter Response Compensation is finished.

File Edit Produc	rt Elashing Testing Tuning	Tools RD Window Help				X
	Connections: fbus	Settings	Operating mode	Local	Read Change with Res	et Edge: Off
Band: GSM 180	0 🔽					
🌃 Rx Band Filte	er Response Compensation				Į	<u> </u>
Input Signal Lev	vel (dBm): 60		🔽 Load from Phone	<u>Start</u>		
Channel	Input Frequency (MHz)	Measured Level   Difference (dB)		Iune		
497 512	1802.26771 1805.26771	-2.734 -2.328	☑ Sa <u>v</u> e to Phone	Stop		
535 606	1809.86771 1824.06771	-2.328 -2.328	Tuning mode	Help		
700	1842.86771	-2.203	<u>A</u> utomatic			
870	1876.86771	-1.844				
885 908	1879.86771 1884.46771	-1.844 -2.078				
			Copying table to clipbo press mouse left button on the left top of the tal (with text 'Channel')	ard: ble		
			ç			

Limits

Regarding limits the value for N4 is given below. Concerning the other filter frequencies please refer to Appendix A where all FLALI testcases are listed together with the limits.

Value	Typical	Limit min.	Limit max.
N4	0	-0.3	0.3

#### RX band filter response GSM1900 (PCS)

Set operating mode to local mode

Select	Maintenance		
	Testing		Т
		RF Controls	F
Wait until the RF Cor	ntrols window pops up		
Select	Band	GSM 1900	
Select	Maintenance	2	Alt-M
	Tunir	ıg	Т
RX Band Filter Response Compensation			В

Rx Band Filter Response Compensation window pops up.

The setup should now look like this:

<mark>K Phoenix</mark> File Friti: Product Elashipa Testina Tunina Taols RD Window Heln	
Image: Sector Parameter (Sector Parameter Sector Parameter Parameter Parameter Sector Parameter Par	. ] Operating mode: Local 💌 Read 🗆 Change with Reset 🛛 Edge: 🗐
Band: GSM 1900 💽	
Input Signal Level (dBm): -60	Load from Phone
Channel Input Frequency (MHz) Measured Level A Difference (dB)	
	Copying table to clipboard:       press mouse left button       on the left top of the table       (with text "Channel").

Input Signal Level	-60dBm
Load from Phone	Х
Save to Phone	Х
Tuning mode	Manual

#### Manual tuning

Select

Press Start and Tune and a window pops up:

Rx Band Filter Response Compensation for G5M1900	×
Manual Tuning - stage 1 of 9.	
Set the Rf signal generator:	
Power level: -60 dBm + cable attenuation	
Input signal frequency: 1927.06771 MHz	
Press OK to tune, press Cancel or ESC to exit tuning process.	
OK Cancel	

Connect an external signal generator to the RF connector of the phone and compensate for the external RF cable losses. Set the generator as shown in the window above. If a radio communication tester (RH-50 & RH-19 CMU200; RH-19 CMD55, 8960, MT8801) is used, assure to have continuous mode switched on and modulation switched off.

Press OK and a new window pops up:



Set the generator as shown in the window above.

Press OK and a new window pops up. Continue the sequence until the calibration is finalized on all 9 channels.

Press Stop and the GSM1900 RX BandFilter Reopens Compensation is finished.

🌃 Phoenix							_ 8 ×
<u>Eile Edit Produc</u>	t Flashing Testing Tuning:	<u>T</u> ools <u>R</u> D <u>W</u> indow <u>H</u> elp					
] 🗅 🚅 日 🌖	Connections: fbus	▼ Settings	Operating mode	CLocal 💌	Read Change with Reset	Edge: Off 💌	
Band: GSM 190	0 💌						
🔀 Rx Band Filte	er Response Compensation						<b></b>
Input Signal Lev	vel (dBm): 60		☑ Load from Phone	<u>Start</u>			
Channel	Input Frequency (MHz)	Measured Level  Difference (dB)		Iune			
496	1927.06771	-3.828	Save to Phone	Stop			
512	1930.26771	-3.828					
537	1935.26771	-2.750	Tuning mode	Help			
500	1960.06771	-2.375	C Automatic				
736	1975 06771	-3 000	Manual				
794	1986.66771	-3.344	··· <u>M</u> ariuai				
810	1989.86771	-4.250					
835	1994.86771	-3.719					
			Copying table to clipbo press mouse left button on the left top of the tab (with text 'Channel')	ard: ble			
			(				

Auto tuning

A faster and more convenient method for Band Filter Calibration can be performed by clicking on "Auto Tuning". This requires a signal Generator that can be pre-programmed to sweep through user defined frequencies.

Program the signal generator according to the list of frequencies that is visible in the window's column "Input Frequency (MHz)".

Press Automatic Tuning mode and Tune and a window pops up:



Connect an external signal generator to the RF connector of the phone and the signal generator will generate the programmed frequencies after pressing OK.

Press Stop and the GSM 1900 RX Bad Filter Response Compensation is finished.

Phoenix	* Elaching Testing Tuning	Tools PD Window Help		_ & ×
	Connections: fbus		Operating mode: Local 💌 Read 🗆 Change with Reset Edge: Off 💌	
Band: GSM 190	0 💌			
KRx Band Filte	r Response Compensation			-
Input Signal Le	vel (dBm): -60		I Load from Phone	
Channel	Input Frequency (MHz)	Measured Level  Difference (dB)	Lune	
496 512	1927.06771 1930.26771	-3.531 -3.078	Save to Phone Stop	
537 586	1935.26771 1945.06771	-2.672 -2.297	Tuning mode Help	
661 736	1960.06771 1975.06771	-2.094 -2.234	C Manual	
794	1986.66771	-3.344 -3.531		
835	1994.86771	-3.625		
-				
			Convincional de la constance de	
			press mouse left button	
		<b>-</b>	on me ierr top or me table (with text "Channel").	

Limits

Regarding the limits, the value of N4 is given below. Concerning the other filter frequencies please refer to Appendix A where all FLALI testcases are listed together with the limits.

Value	Typical	Limit min.	Limit max.
N4	0	-0.3	0.3

## RX channel select filter calibration

In the following the calibration of the Base Band filter inside Mjoelner is described. It is performed by internally measuring of a prototype filter. For this reason the calibration is done only once, and not separately in 3 bands.

Set operating mode to local mode

Select Maintenance Alt-M Tuning T RX Channel Select H filter Calibration

RX Channel Select Filter Calibration window pops up.

The setup should now look like this:

16 Phoenix		
File Edit Product Flashing Testing Tuning Tools RD Window Help		
📘 🗅 🚅 🔚 📙 Connections: fbus 💽 Setting	s Operating mode: Local 💌 Read 🔽	Change with Reset Edge: Off 💌
Rx/Tx Channel: 661 1960.000000		Active Unit: Rx 💌 🛛 Band: GSM 1900 💌
RF Controls	K Rx Channel Select Filter Calibration	
Active Unit Rx	Filter Adjustment	Load from Phone
Operation Mode: Burst	Hex 0x21 Binary 100001	Save to Phone Stop
Monitor Channel 661 1960.000000 AGC: [14: FEG_ON + 24 dB + const_BB_gain		Tuning Mode C Auto C Manual
Edge: Off Values Edge: Off V Tx Data Type: All 1 V Tx PA Mode: High V Tx Power Level: 5 V		
<u>lose</u> <u>H</u> elp		

Press Tuning mode Auto and then Tune and the optimal values are found.

Check that Load from Phone and Save to Phone are selected.

Press Stop and the RX Channel Select Filter Calibration is finished.

Limits of the GTR value = Filter adjustment value in "decimal" format:

Value	Typical	Limit min.	Limit max.
GTR	34	28	40

## **RX AM suppression**

The RH-19/RH-50 RFIC Mjoelner does not require any tuning of AM suppression.

## TX power level tuning

This tuning must be done in all three bands.

Note: TX Power Tuning must be done with a peak power meter, e.g. Anritsu model ML2408A with Anritsu Peak Power Sensor MA2442A and a suitable attenuator.

The use of the built-in power meter of GSM testers is likely to cause larger errors than the use of a dedicated power meter and might cause miss tuning so that the phone might be not compliant with the GSM specifications.

Set power supply voltage Vcc=3.6V!

#### TX power level tuning GSM850/GSM900

Set operating mode to local mode.

Select

Maintenance

Tuning

TX Power Level Tuning

Wait until the TX Power Level Tuning window has popped up.

Connect a **calibrated** power meter to the RF connector of the phone.

Select Band GSM850/GSM900

Active Unit TX

Press Start and a window pops up (e.g.GSM850):



Select Permanent memory and press Start.

Select

TX Data Type Random

The setup should now look like this (e.g.GSM850):

🌃 Phoe	enix				
<u>File</u> Ec	lit <u>P</u> roduct Fļa	ashing Te <u>s</u> ting	T <u>uning T</u> ools	s <u>R</u> D <u>W</u> indow <u>H</u> elp	
	🗲 🔚 🗍 Conn	ections: fbus		Settings	Operating mode: Local 💌 Read 🗆 Change with Reset Tx PA Mode: High 💌
TxDat	a Type: Randor	n 💌 🛛 AF	C: 3150	Active Unit: 🛛 🖉 🗍 R	Rx/Tx Channel: 190 836.600000
16 Tx 1	Power Level Tu	ining		×	
	Coefficient	Target dBm	DAC	Start	
5	0.5514	32.5	564		
6	0.479	5 30.8	490	Stop	
7	0.417	1 29.0	426	Calculate as affection to	
8	0.361	D 27.0	369	Laiculate coefficients	
9	0.315	9 25.0	323	Load from	
10	0.279	23.0	285		
11	0.250	21.0	200		
12	0.226	9 17.0	231	Save to	
14	0.191	3 15.0	195	Permanent memory	
15	0.179	13.0	183	E PC	
16	0.169	2 11.0	173		
17	0.161	B 9.0	165		
18	0.156	3 7.0	159	Band: GSM 850 💌	
19	0.152	7 5.0	156		
Bas	e 0.1310	) -27.0	134	Eage. Jon 🕅	
Test	0.131	D	134	Tx PA Mode: High 💌	
				Zero DAC:	
Tue	hannak 190				
Freq	uency: 836.60 M	Hz		Help	
,					

Select

TX PA Mode High Save to Permanent memory

Adjust DAC Values in TX PA mode 'High' for all power levels according to the target values:

TX PA Mode	Power level	Target power (dBm)
High	5	32.5
	15	13
	19	5
	Base leveli	-27

The power levels may differ from the target power levels in Phoenix.

Make sure that the output power for Power Level 5 is equal or lower than 1dB below the saturation output power. Determine the saturation power by setting the DAC Value to its maximum, for example, adjust the DAC Value to 32.3dBm for Power Level 5 if the saturation output power is only 33.3dBm.

Press calculate, check if all levels match the target values, correct if necessary.

Select

TX PA Mode

Adjust DAC Values in TX PA mode 'Low' for all power levels according to the target values.

Low

TX PA Mode	Power level	Target power (dBm)
Low	7	30
	15	13
	19	5
	Base leveli	-27

Press calculate, check if all levels match the target values, correct if necessary.

Press Stop and the TX Power Level Tuning is finished.

#### TX power level tuning GSM1800 (DCS/PCN)

Set operating mode to local mode

Select

Maintenance

Tuning

TX Power Level Tuning

Wait until the TX Power Level Tuning window has popped up.

Connect a **calibrated** power meter to the RF connector of the phone.

Select	Band	GSM 1800
	Active Unit	TX
Select	Permanent me	mory (load and save)
Select	TX Data Type	Random

The setup should now look like this:

🌃 Pho	enix					
File Edit Product Flashing Testing Tuning Tools RD Window Help						
] 🗅 🛛	ê 🔲	Connec	ctions: fbus		Settings	Operating mode: Local 💌 Read 🗆 Change with Reset 🛛 Tx PA Mode: High 💌
] Tx Da	ta Type:	Random	- AFI	C: 3150	Active Unit: Tx 💌 🛛 F	Rx/Tx Channel: 700 1747.800000
🌃 Тж	Power L	evel Tun	ing			
	Co	efficient	Target dBm	DAC	Start	
0	_	0.7899	29.5	808	Stop	
	-	0.6550	27.8	561		
3		0.3455	24.0	476	Calculate coefficients	
4		0.3997	22.0	408		
5		0.3468	20.0	354	Load from	
6		0.3043	18.0	311	Permanent memory	
7		0.2701	16.0	276	Save to	
8		0.2424	14.0	248		
9		0.2202	12.0	225	I rermanent memory	
10		0.2022	10.0	206	E PC	
	_	0.1878	8.0	192		
12		0.1753	6.0	180	Band COM 1999	
14	-	0.1676	4.0	164		
15		0 1564	0.0	160	Edge: Off 🗾 💌	
Bas	e	0.1369	-27.0	140		
Tes	t	0.1369		140	Tx PA Mode:  High 💌	
					Zero DAC:	
Fred	hannel: 7 juency: 1	'00 747.80 MI	Hz		Help	

Select

TX PA Mode

High

Adjust DAC Values for all power levels according to the target values.

Power level	Power (dBm)
0	30 (RH-19) / 29,5 (RH-50)
11	8
15	0
Base leveli	-27

The Power levels may differ from the target levels mentioned. Make sure that the output power for Power Level 0 is equal or lower than 1dB below the saturation output power. Determine the saturation power by setting the DAC Value to its maximum, for example, adjust the DAC Value to 29.7dBm for Power Level 0 if the saturation output power is only 30.7dBm.

Press calculate, check if all levels match the target values, correct if necessary.

Press Stop and the GSM 1800 TX Power Level Tuning is finished

#### TX power level tuning GSM1900 (PCS)

Set operating mode to local mode.

Select

Maintenance

Tuning

#### TX Power Level Tuning

Wait until the TX Power Level Tuning window pops up.

Connect a **calibrated** power meter to the RF connector of the phone.

Select	Band	GSM 1900
	Active Unit	TX
Select	Permanent memory (Load and Save).	
Select	TX Data Type	Random

The setup should now look like this:

ile Edit Product Flashing Testing Tuning Tools RD Window Help					
🗅 🗃 💂   Connections:  fbus 🔄 Settings   Derating mode:  Local 🗨 Read 🗆 Change with Reset   Tx PA Mode:  High 💌					
Tx Data Type: All 1 🔄 🛛 AFC. 3150 🔹 Active Unit: Tx 💌 👘 Rx/Tx Channet 661 1880.000000					
👌 Tx Power Level Tuning					
Coefficient Target dBm DAC Start					
0 0.8486 29.5 868					
1 0.7159 27.8 732 Step					
2 0.6039 26.0 617					
3 0.5057 24.0 517 Calculate coefficients					
4 0.4287 22.0 438					
5 0.3680 20.0 376 Load from					
6 0.3198 18.0 327 Permanent memory 🔽					
7 0.2813 16.0 287 Save to					
8 0.2506 14.0 256					
14 0.1620 4.0 172 bank 1300 1					
15 0.1574 0.0 161 Edge Off					
Base 0.1359 -27.0 139					
Test 0.1359 139 Tx PA Mode: High ▼					
Zero DAC:					
Tx channel: 661					
I redneuch. 1997/00 wurs					

Select

TX PA Mode

High

Adjust DAC Values for all power levels according to the target values.

Power level	Power (dBm)
0	30 (RH-19) / 29,5 (RH-50)
11	8
15	0
Base leveli	-27

The Power levels may differ from the target power levels mentioned in Phoenix. Make sure that the output power for Power Level 0 is equal or lower than 1dB below the saturation output power. Determine the saturation power by setting the DAC Value to its maximum, for example, adjust the DAC Value to 29.7dBm foe Power Level 0 if the saturation output power is only 30.7dBm.

Press calculate, check if all levels match the target values, correct if necessary.

Press Stop and the GSM1900 TX Power Level Tuning is finished.

## TX I/Q tuning

This tuning must be performed in all three bands.

#### TX I/Q tuning GSM850/GSM900

Caution: If you use a spectrum analyzer make sure that the external attenuation between phone and spectrum analyzer is high enough that the input of the analyzer can't be destroyed, 20 to 30dB is recommended. Adjust the reference level offset according to the insertion loss between the phone and the spectrum analyzer.

Note: During TX I/Q Tuning in GSM850/GSM900 band, an additional calibration value for the battery voltage A/D converter is taken. Therefore it is important to set the operating voltage to 3.6V for this alignment.

PC/Phone operation:

Set operating mode to Local Mode.

Set supply voltage to 3.6V.

Select	Maintenance		Alt-M	
	Tuning	]	Т	
		TX IQ Tuning	I	
Wait until the TX IQ Tuning window pops up.				
Select	Maintenance		Alt-M	
	Tuning	]	Т	
		RF Controls	F	

Wait until the RF Controls window pops up.

Connect a Spectrum Analyzer or GSM tester with the option 'Narrow Spectrum' to the antenna pads of the phone.

If a spectrum analyzer is used, make the following settings.

	GSM850/GSM900	
Center Frequency	836.6 MHz / 897.4 MHz	
Frequency Span	300 kHz	
Resolution Bandwidth	3kHz	
Video Bandwidth	3kHz	
Sweep Time	3 sec.	
Sweep Туре	Clear/Write	
Detector Type	Max Peak	
Reference level	35 dBm	
Marker 1	836.53229 MHz / 897.33229 MHz	
Marker 2	836.6 MHz / 897.4 MHz	
Marker 3	836.66771 MHz / 897.46771 MHz	

## Select in the RF Controls Window:

Select	Band	GSM850/GSM900	
	Active Unit	ТХ	
	Operation Mode	Burst	
	RX/TX Channel	190 (GSM850) / 37 (GSM900)	
	TX PA Mode	Free	
	TX Data Type	All1, and when finished AllO	
Select in the TX IQ Tu	ning Window:		
Select	☑ Load from Product		
Press	Start		
Select again in the RF Controls Window:			
Select	TX Power Level 9		
The setup should now look like this:

K Phoenix	
File Edit Product Flashing Testing Tuning Tools RD Window Help	
📄 🖆 🔚 🚽 Connections: fbus 💽 Setting:	Is Operating mode: Local 💌 Read Change with Reset Edge: Off 💌
Band: GSM 850 💌 🛛 Operation Mode: Burst 💌 🗍 Rx/Tx Channel	net 190 836.600000 🗍 Tx Data Type: All 1 💌 🔤 Tx PA Mode: High 💌
RF Controls	K Tx IQ Tuning
Common GSM RF Control Values Active Unit: Tx	TX1DC offset: 0.800   .10 % .5 % 0 % 5 % 10 %   .10 % .5 % 0 % 5 % 10 %   TX Q DC offset: .0.400 ✓ Load from Product   .10 % .5 % 0 % 5 % 10 %
TX Control Values Edge: Off Y Tx Data Type: All 1 Y Tx PA Mode: High Tx Power Levet 10 Y Close Help	Amplitude difference: 0.0 -6.0 6.0 
	27.0° 153.0° , , , , , , <u>, , , , , , , , , , , , , </u>

The spectrum analyzer shows a plot like this in case of 850 MHz:



The spectrum analyzer now shows a plot like this in case of 900 MHz :



The purpose of this alignment is to tune the carrier signal (at marker 2) and the +67kHz signal (at marker 3) to a minimum level.

Use the variables 'TX I DC offset' and 'TX Q DC offset' to adjust the carrier signal to a minimum level (marker 2). Tuning can be performed by using arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 2 and the peak levels at marker 1 must exceed 40dB.

The spectrum analyzer shows a plot like this in case of 850 MHz:



The spectrum analyzer now shows a plot like this in case of 900 MHz :



Use the variables 'Amplitude difference' and 'Phase difference' to adjust the +67kHz signal to a minimum level (Marker 3). Tuning can be performed by using the arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible. After tuning to the minimum the level difference between marker 3 and the peak level at marker 1 must exceed 40dB.

The spectrum analyzer shows a plot like this in case of 850 MHz.



The spectrum analyzer now shows a plot like this in case of 900 MHz:



Compare the results in the TX IQ Tuning Window with the limits below:

Value	Typical	Limit min.	Limit max.
TX I DC offset	0.1	-6	6
TX Q DC offset	0	-6	6
Amplitude difference	0	-1	1
Phase difference	87.5	80	100

Select in the TX IQ Tuning Window:

Select 🛛 Save to Product

Stop

Press

and the values are stored in the phone. The GSM850/GSM900 TX IQ Tuning is now finished.

Note: The optimum values for "TX I and Q Offset" and "Amplitude and Phase Difference" vary from phone to phone.

### TX I/Q tuning GSM1800

Caution: If you use a spectrum analyzer make sure that the external attenuation between phone and spectrum analyzer is high enough that the input of the analyzer can't be destroyed, 20 to 30dB is recommended. Adjust the reference level offset according to the insertion loss between the phone and the spectrum analyzer.

PC/Phone operation:

Set operating mode to Local Mode.

Select	Maintenance	Alt-M
	Tuning	Т
	TX IQ Tuning	Ι
Wait until the TX IQ	Tuning window has popped up.	
Select	Maintenance	Alt-M
	Tuning	Т
	RF Controls	F

Wait until the RF Controls window has popped up.

Connect a Spectrum Analyzer or GSM tester with the option 'Narrow Spectrum' to the RF connector of the phone.

If a spectrum analyzer is used, make the following settings.

	GSM1800
Center Frequency	1747.8MHz
Frequency Span	300 kHz
Resolution Bandwidth	3 kHz
Video Bandwidth	3 kHz
Sweep Time	3 sec.
Sweep Туре	Clear/Write
Detector Type	Max Peak
Reference level	35 dBm
Marker 1	1747.73229 MHz
Marker 2	1747.8 MHz
Marker 3	1747.86771 MHz

Select in the RF Controls Window:

Select	Band	GSM 1800
	Active Unit	ТХ
	Operation Mode	Burst
	RX/TX Channel	700
	TX PA Mode	Free
	TX Data Type	All1 (When finished, the same measurement with AllO)

Select in the TX IQ Tuning Window:

Select	☑ Load from Product

Press Start

Select again in the RF Controls Window:

Select TX Power Level 4

The setup should now look like this:

🔀 Phoenix		<u>- 🗆 ×</u>
<u>File Edit View Product Flashing Maintenance Tools RD Window Help</u>		
Connections: FBUS	Operating mode: Local Read Change with Reset Edge N/A	
Band: GSM 1800 💌 🗍 Operation Mode: Burst 💌 🗍 Rx/Tx Channel: 700	0 1747.800000 Tx Data Type: All 1 💌 Tx PA Mode: Free 💌	
RF Controls	Tx IQ Tuning	
Band: GSM 1800 ▼   Tx PA, Mode: Free ▼     Active Unit: Tx ▼   Tx Power Level: ▲▼     Operation Mode: Burst   Tx Data Type: All 1 ▼     Rx/Tx Channet: 700   1747.800000     Monitor Channet: 700   1842.800000     AGC: 14: FEG_0N + DTOS_0N + 8B_42 = VGain_72 ▼     AFC: 3260   Help	TX   DC offset:   0.200     .100 %   Stop     Help   Help     TX Q DC offset:   0.200     .100 %   IO0 %     .100 %	





The purpose of this alignment is to tune the carrier signal (at marker 2) and the +67kHz signal (at marker 3) to a minimum level.

Use the variables 'TX I DC offset' and 'TX Q DC offset' to adjust the carrier signal to a minimum level (Marker 2). Tuning is possible by using arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive but even possible.

After tuning to the minimum the level difference between marker 2 and the peak levels at marker 1 must exceed 40dB.



The spectrum analyzer now shows a plot like this:

Use the variables 'Amplitude difference' and 'Phase difference' to adjust the +67kHz signal to a minimum level (Marker 3). Tuning can be performed by using the arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 3 and the peak level at marker 1 must exceed 40dB.



The spectrum analyzer now shows a plot like this:

Compare the results in the TX IQ Tuning Window with the limits below:

Value	Typical	Limit min.	Limit max.
TX I DC offset	0.1	-6	6
TX Q DC offset	-0.1	-6	6
Amplitude difference	-0.1	-1	1
Phase difference	89.5	80	100

Select in the TX IQ Tuning Window:

Select	☑ Save to Product

Press Stop

and the values are stored in the phone. The GSM1800 TX IQ Tuning is now finished.

Note: The optimum values for "TX I and Q Offset" and "Amplitude and Phase Difference" vary from phone to phone.

### TX I/Q tuning GSM1900

Caution: If you use a spectrum analyzer make sure that the external attenuation between phone and spectrum analyzer is high enough that the input of the analyzer can't be destroyed, 20 to 30dB is recommended. Adjust the reference level offset according to the insertion loss between the phone and the spectrum analyzer.

PC/Phone operation:

Set operating mode to local mode

Select	Maintenance	Alt-M
	Tuning	Т
	TX IQ Tuning	Ι
Wait until the TX IQ	Tuning window has popped up.	
Select	Maintenance	Alt-M
	Tuning	Т
	RF Controls	F

Wait until the RF Controls window has popped up.

Connect a Spectrum Analyzer or GSM tester with the option 'Narrow Spectrum' to the RF connector of the phone.

If a spectrum analyzer is used, make the following settings.

	GSM1900
Center Frequency	1880MHz
Frequency Span	300 kHz
Resolution Bandwidth	3 kHz
Video Bandwidth	3 kHz
Sweep Time	3 sec.
Sweep Туре	Clear/Write
Detector Type	Max Peak
Reference level	35 dBm
Marker 1	1879.93229 MHz
Marker 2	1880 MHz
Marker 3	1880.06771 MHz

Select in the RF Controls Window:

Select	Band	GSM 1900
	Active Unit	ТХ
	Operation Mode	Burst
	RX/TX Channel	661
	TX PA Mode	Free
	TX Data Type	All1 (When finished -> All 0)
Select in the TX IQ Tun	ning Window:	
Select	☑ Load from Product	
Press	Start	
Select again in the RF	Controls Window:	
Select	TX Power Level 4	

The setup should now look like this:

The spectrum analyzer now shows a plot like this:



The purpose of this alignment is to tune the carrier signal (at marker 2) and the +67kHz signal (at marker 3) to a minimum level.

Use the variables 'TX I DC offset' and 'TX Q DC offset' to adjust the carrier signal to a minimum level (marker 2). Tuning can be performed by using arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 2 and the peak levels at marker 1 must exceed 40dB.



The spectrum analyzer now shows a plot like this:

Use the variables 'Amplitude difference' and 'Phase difference' to adjust the +67kHz signal to a minimum level (Marker 3). Tuning can be performed by using the arrow keys on the keyboard. Pushing the sliders by using the mouse is less sensitive however possible.

After tuning to the minimum the level difference between marker 3 and the peak level at marker 1 must exceed 40dB.



#### The spectrum analyzer now shows a plot like this:

#### Compare the results in the TX IQ Tuning Window with the limits below:

Value	Typical	Limit min.	Limit max.
TX I DC offset	0.2	-6	6
TX Q DC offset	-0.1	-6	6
Amplitude difference	0	-1	1
Phase difference	89.0	80	100

Select in the TX IQ Tuning Window:

Select Save to Product

Press Stop

and the values are stored in the phone. The GSM1900 TX IQ Tuning is now finished.

Note: The optimum values for "TX I and Q Offset" and "Amplitude and Phase Difference" vary from phone to phone.

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# Nokia Customer Care RH–19/RH–50 Series Cellular Phones

# **Appendix 7A: FLALI Test Cases**

# Appendix A: FLALI Test Cases with Hints for Repair

Step Name	Limits Low	Limits High	Repair Comments
Initialize RF Calibration	-0.5	0.5	If phone is not working, check RFCLK. Can be measured at R426 after power on.
Meas Operation Start Current	3.0	70.0	
Program flash	0.5	1.5	
Program flash PPM	0.5	1.5	
Reset Phone	-0.5	0.5	
Meas Local Mode Current	3.0	70.0	
Check MCU-sw version	0.0	13.0	
Write Product Info	0.5	1.5	
Write_Product_Profile	-0.5	0.5	
Read PCI Version	0.0	2000.0	
Selftest_A	-0.5	0.5	
EMCAL: Calib ADC, VBatt, BSI	26500. 0	28500. 0	
- Check ADC BATT Voltage Gain	10000. 0	11000. 0	
- Check ADC VBATT Voltage Offset Scale	2300.0	2900.0	
- Check ADC BSI Calibration Gain	950.0	1100.0	
- Check ADC Voltage offset	-50.0	50.0	
Read BTEMP ADC Value	0.0	60.0	
Calib channel filter_GTR	1.0	63.0	Check RX IQ interface signal.
- Check Channel Select VIPP	8000.0	20000. 0	If signal looks ok, then try manual calibratio with Phoenix.
- Check Channel Select VQPP	1700.0	4000.0	If calibration fails, change Mjoelner (N601).
Test_LED	2.0	10.0	
Tuning RX GSM85/GSM9 RSSI	-0.5	0.5	
- Check RX GSM85/GSM9 Gain A4	76.0	84.0	Check RX850/RX900 path (ant.switch Z601+ SAW Z604). Heat SAW solder joints. If RSSI reading is 6 to 10dB too low, then change SAW filter. If no
- Check RX GSM85/GSM9 Gain A7	98.0	106.0	signal, check RX path up to RX IQ interface. If RX IQ ok then BB check (UEM/UPP). If RX IQ not ok, change Mjoelner (N601).

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### Appendix 7A: FLALI Test Cases

Step Name	Limits Low	Limits High	Repair Comments
- Check VCXO_VALUE	128.0	767.0	VCXO/AFC calibration works only, if RX850/ RX900 chain is working.
- Check AFC_VALUE	3062.0	3262.0	If calibration does not work at all (fail at "Tun- ing RX GSM85/GSM9 RSSI"), check the RFBUS signals.
- Check AFC_Coeff1	0.0	9999.0	Check voltage supplies
- Check AFC_Coeff2	-999.0	0.0	VDDXO@C607, VDDBBB@C636 (2.7V from VR3),
- Check AFC_Coeff3	0.0	1.0	VDDDL@C628 (1.8V from VIO),
- Check Calc1	1312.0	4383.0	VBEXT@C615 (1.35V from VREF01).
- Check Calc2	1312.0	4383.0	If voltages are ok, the crystal (B601) and/or Mjoelner (N601) can be exchanged
- Check Calc3	0.0	83.0	
- Check Calc4	0.0	83.0	
Tuning RX GSM18 RSSI	-0.5	0.5	
- Check RX GSM18 Gain A4	72.0	80.0	Check RX1800 path (ant.switch Z601+ SAW Z602). Heat SAW solder joints. If RSSI reading is 6 to 10dB too low, then change SAW filter.
- Check RX GSM18 Gain A7	95.0	103.0	If no signal, check RX path up to RX IQ inter- face. If RX IQ ok then BB check (UEM/UPP). If RX IQ not ok, change Mjoelner (N601).
Tuning RX GSM19 RSSI	-0.5	0.5	
- Check RX GSM19 Gain A4	74.0	82.0	Check RX1900 path (ant.switch Z601+ SAW Z603). Heat SAW solder joints. If RSSI reading is 6 to 10dB too low, then change SAW filter.
- Check RX GSM19 Gain A7	94.0	102.0	If no signal, check RX path up to RX IQ inter- face. If RX IQ ok then BB check (UEM/UPP). If RX IQ not ok, change Mjoelner (N601).
Meas Operation SNR GSM85/GSM9 Mid	21.0	27.0	Check RX850/RX900 path, start with ant.switch (Z601), then SAW (Z604). If signal is 2 to 4dB too low, change respective comp (ant.switch or SAW).
Meas Operation SNR GSM18 Mid	19.0	25.0	Check RX1800 path start with ant.switch (Z601), then SAW (Z602). If signal is 2 to 4dB too low, change respective comp (ant.switch or SAW).
Meas Operation SNR GSM19 Mid	19.0	25.0	Check RX1900 path, start with ant.switch (Z601), then SAW (Z603). If signal is 2 to 4dB too low, change respective comp (ant.switch or SAW).
Tuning Rx GSM85/GSM9 Band Filter	-0.5	0.5	

## Appendix 7A: FLALI Test Cases

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Step Name	Limits Low	Limits High	Repair Comments
- Check RX GSM85/GSM9 Band Filter First	-6.0	2.0	If one of the steps 499507 fails, change RX850 / RX900 SAW (Z604
- Check RX GSM85/GSM9 Band Filter N1	-3.0	1.0	
- Check RX GSM85/GSM9 Band Filter N2	-3.0	1.0	
- Check RX GSM85/GSM9 Band Filter N3	-3.0	1.0	
- Check RX GSM85/GSM9 Band Filter N4	-2.0	1.0	
- Check RX GSM85/GSM9 Band Filter N5	-3.0	1.0	
- Check RX GSM85/GSM9 Band Filter N6	-3.0	1.0	
- Check RX GSM85/GSM9 Band Filter N7	-3.0	1.0	
- Check RX GSM85/GSM9 Band Filter Last	-9.0	2.0	
Tuning Rx GSM18 Band Filter	-0.5	0.5	
- Check RX GSM18 Band Filter First	-6.0	2.0	Check whole TX850/TX900 path from modula- tor output through pre-amplifier, TX SAW, PA, antenna switch according to TX fault finding tree
- Check RX GSM18 Band Filter N1	-3.0	1.0	
- Check RX GSM18 Band Filter N2	-3.0	1.0	
- Check RX GSM18 Band Filter N3	-3.0	1.0	
- Check RX GSM18 Band Filter N4	-2.0	1.0	
- Check RX GSM18 Band Filter N5	-2.0	2.0	
- Check RX GSM18 Band Filter N6	-2.0	2.0	
- Check RX GSM18 Band Filter N7	-2.0	2.0	
- Check RX GSM18 Band Filter Last	-6.0	2.0	
Tuning Rx GSM19 Band Filter	-0.5	0.5	
- Check RX GSM19 Band Filter First	-6.0	2.0	If one of the steps 10471055 fails, change RX1900 SAW (Z603)
- Check RX GSM19 Band Filter N1	-3.0	1.0	
- Check RX GSM19 Band Filter N2	-3.0	1.0	
- Check RX GSM19 Band Filter N3	-2.0	2.0	
- Check RX GSM19 Band Filter N4	-2.0	1.0	
- Check RX GSM19 Band Filter N5	-2.0	2.0	
- Check RX GSM19 Band Filter N6	-3.0	1.0	
- Check RX GSM19 Band Filter N7	-3.0	1.0	
- Check RX GSM19 Band Filter Last	-6.0	2.0	

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Appendix 7A: FLALI Test Cases

Step Name	Limits Low	Limits High	Repair Comments
Initialize VSA	-0.5	0.5	
Set VSA Parameters for GSM85/GSM9 TX Base	-0.5	0.5	
Start TX GSM85/GSM9 Pow Tunings	-0.5	0.5	
Tuning TX GSM85/GSM9 Base	-31.0	-20.0	Check whole TX850/TX900 path from modula- tor output through pre-amplifier, TX SAW, PA, antenna switch according to TX fault finding tree
- Check GSM85/GSM9 TX Base Coef	0.1	0.2	
Set VSA Parameters for GSM85/GSM9 TX Power	-0.5	0.5	
Meas TX GSM85/GSM9 PAH Tun Samples	0.0	40.0	
Tuning TX GSM85/GSM9 PAH	31.5	32.5	
End TX GSM85/GSM9 Pow Tunings	-0.5	0.5	
Meas GSM85/GSM9 TX Pow PAH LOW	-0.5	0.5	
- Check GSM85/GSM9 TX Pow PAH LOW5	31.0	35.0	
- Check GSM85/GSM9 TX Pow PAH LOW19	2.0	8.0	
Meas GSM85/GSM9 TX Pow PAH HIGH	-0.5	0.5	
- Check GSM85/GSM9 TX Pow PAH HIGH5	31.0	35.0	
- Check GSM85/GSM9 TX Pow PAL HIGH19	2.0	8.0	
Set VSA Parameters for GSM85/GSM9 TX I/Q	-0.5	0.5	
Tuning TX GSM85/GSM9 I/Q	-0.5	0.5	Check TX850/TX900 path around modulator:
- Check TX GSM85/GSM9 I DC Offset Tuning	-6.0	6.0	Check Tx IQ signals with Oscilloscope (TXIOUTP, TXIOUTN, TXQOUTP, TXQOUTN).
- Check TX GSM85/GSM9 Q DC Offset Tuning	-6.0	6.0	Is TX850/TX900 SAW filter (Z701) and TX850/ TX900 buffer (V802) ok?
- Check TX GSM85/GSM9 Amp Diff Tuning	-1.0	1.0	Maybe Mjoelner must be exchanged.
- Check TX GSM85/GSM9 Phase Diff Tuning	80.0	100.0	
Set VSA Parameters for GSM18 TX Base	-0.5	0.5	
Start TX GSM18 Power Tunings	-0.5	0.5	
Tuning TX GSM18 Base	-31.0	-20.0	Check whole TX1800 path from modulator output through, PA, antenna switch according to TX fault finding tree
- Check GSM18 TX Base Coef	0.1	0.2	
Set VSA Parameters for GSM18 TX Power	-0.5	0.5	
Meas TX GSM18 PAH Tun Samples	0.0	40.0	
Tuning TX GSM18 PAH	28.5	29.5	

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Step Name	Limits Low	Limits High	Repair Comments
End TX GSM18 Pow Tunings	-0.5	0.5	
Meas GSM18 TX Pow PAH LOW	-0.5	0.5	
- Check GSM18 TX Pow PAH LOWO	28.0	32.0	
- Check GSM18 TX Pow PAH LOW15	-3.0	3.0	
Meas GSM18 TX Pow PAH HIGH	-0.5	0.5	
- Check GSM18 TX Pow PAH HIGH0	28.0	32.0	
- Check GSM18 TX Pow PAH HIGH15	-3.0	3.0	
Set VSA Parameters for GSM18 TX I/Q	-0.5	0.5	
Tuning TX GSM18 I/Q	-0.5	0.5	Check Tx1800/1900 path around modulator.
- Check TX GSM18 I DC Offset Tuning	-6.0	6.0	Check Tx IQ signals with Oscilloscope (TXIOUTP, TXIOUTN, TXQOUTP, TXQOUTN).
- Check TX GSM18 Q DC Offset Tuning	-6.0	6.0	ls Tx1800/1900 balun (T701) ok?
- Check TX GSM18 Amp Diff Tuning	-1.0	1.0	Maybe Mjoelner must be exchanged.
- Check TX GSM18 Phase Diff Tuning	80.0	100.0	
Set VSA Parameters for GSM19 TX Base	-0.5	0.5	
Start TX GSM19 Power Tunings	-0.5	0.5	
Tuning TX GSM19 Base	-31.0	-20.0	Very unlikely, if TX1800 is ok.
- Check GSM19 TX Base Coef	0.0	0.2	
Set VSA Parameters for GSM19 TX Power	-0.5	0.5	
Meas TX GSM19 PAH Tun Samples	0.0	40.0	
Tuning TX GSM19 PAH	28.5	29.5	
End TX GSM19 Pow Tunings	-0.5	0.5	
Meas GSM19 TX Pow PAH LOW	-0.5	0.5	
- Check GSM19 TX Pow PAH LOWO	28.0	32.0	
- Check GSM19 TX Pow PAH LOW15	-3.0	3.0	
Meas GSM19 TX Pow PAH HIGH	-0.5	0.5	
- Check GSM19 TX Pow PAH HIGH0	28.0	32.0	
- Check GSM19 TX Pow PAH HIGH15	-3.0	3.0	
Set VSA Parameters for GSM19 TX I/Q	-0.5	0.5	
Tuning TX GSM19 I/Q	-0.5	0.5	Check Tx1800/1900 path around modulator.
- Check TX GSM19 I DC Offset Tuning	-6.0	6.0	Check Tx IQ signals with Oscilloscope (TXIOUTP, TXIOUTN, TXQOUTP, TXQOUTN).
- Check TX GSM19 Q DC Offset Tuning	-6.0	6.0	ls Tx1800/1900 balun (T701) ok?

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### Appendix 7A: FLALI Test Cases

Step Name	Limits Low	Limits High	Repair Comments
- Check TX GSM19 Amp Diff Tuning	-1.0	1.0	Maybe Mjoelner must be exchanged.
- Check TX GSM19 Phase Diff Tuning	80.0	100.0	
Meas TX GSM85/GSM9 I/Q MID5	-0.5	0.5	Refer to steps 534-538
- Check TX GSM85/GSM9 I/Q Fo	-120.0	-35.0	
- Check TX GSM85/GSM9 I/Q Fo+67k	-120.0	-40.0	
Meas TX GSM18 I/Q MID0	-0.5	0.5	Refer to steps 608 to 612
- Check TX GSM18 I/Q Fo	-120.0	-35.0	
- Check TX GSM18 I/Q Fo+67k	-120.0	-40.0	
Meas TX GSM19 I/Q MID0	-0.5	0.5	Refer to steps 1084 to 1089
- Check TX GSM19 I/Q Fo	-120.0	-35.0	
- Check TX GSM19 I/Q Fo+67k	-120.0	-40.0	
Measure TX On Current 850/900	0.2	0.3	
Measure TX On Current 1800	0.1	0.3	
Measure TX On Current 1900	0.1	0.2	
Operation IR Test	-0.5	0.5	
Test RTC Battery	1.0	1.0	
Meas Offstate Current	0.0	150.0	

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# Nokia Customer Care RH–19/RH–50 Series Cellular Phones

# Appendix 7B: FinUl Test Cases

# Appendix B: FinUI Test Cases with Hints for Repair

	Limits			St Da	
Test Step Name	Low	High	Avera ge	v	Repair Comments
Keypad_Start_Test	0	10	0.00	0.00	
Testmode Current Meas	10	200	78.63	11.79	
Read phone SW	0	5000	3.10	0.00	
Read phone HW	0	5000	580.0 0	0.00	
Initialize RF Calibration	-0.5	0.5	0.00	0.00	
Init TestSet	-0.5	0.5	0.00	0.00	
Set TestSet PCS	-0.5	0.5	0.00	0.00	
SIM Status	0.5	1.5	1.00	0.00	
Read Audio Calibration Values	0	0	1.00	0.00	
Check Charger Voltage	-8600	-8200	- 8428. 58	20.06	
U Charge Cal Plug	57000	63000	60466 .63	444.6 0	
I Charge Cal THWK	4050	4950	4497. 33	95.63	
Check Charger GND Plug	2	3	2.53	0.01	
Check Charger GND THWK	2	3	2.53	0.01	
Apply Bias To Mic	0	0	1.00	0.00	
ACI Test	925	1225	1072.4 9	15.78	
VOUT OFF Test	-0.5	0.5	0.05	0.01	
VOUT ON Test	1	1.6	1.32	0.01	
Keypad_functionality	1	1	1.00	0.00	
Keypad_Result_9	1	1	1.00	0.00	
Keypad_Result_5	1	1	1.00	0.00	
Keypad_Result_End	1	1	1.00	0.00	
Keypad_Result_SoftRight	1	1	1.00	0.00	
Keypad_Result_1	1	1	1.00	0.00	
Keypad_Result_VolUp	1	1	1.00	0.00	
Keypad_Result_VolDown	1	1	1.00	0.00	

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Appendix 7B: FinUI Test Cases

	Limits			C D	
Test Step Name	Low	High	Avera ge	v v	Repair Comments
Keypad_Result_Power	1	1	1.00	0.00	
Keypad Stuck Test	0	0	0.00	0.00	
Vibra Test (Shock)	250	10000	2124. 47	1182. 07	
Move robot On the Mic	0	0	1.00	0.00	
Measure audio Bias Voltage	520	720	622.2 0	4.14	
HYBRID MIC-XEAR (dB) 1,0 kHz	-5	5	0.20	1.53	
Move robot On The Earp	0	0	1.00	0.00	
HYBRID XMIC-EAR (dB) 1,0 kHz	-5	5	-0.45	1.06	
HYBRID Check IHF Ampifier State	-100	-15	-29.94	4.56	
HYBRID XMIC-IHF (dB) 0,8 kHz	-5	5	-1.11	0.92	
HYBRID XMIC-XEAR/IHF (dB) 2,4 kHz	-5	5	0.59	0.93	
Move robot Home	-0.5	0.5	0.00	0.00	
Set Fast Service Ch PCS	-0.5	0.5	0.00	0.00	
Create Call PCS	-0.5	0.5	0.10	0.00	
PCS Measure All Ch=H TxL=0	-0.5	34	0.00	0.00	
Start LCD test	0	0	1.00	0.00	
- Check PCS Burst t=1 H0	-120	-30	-70.57	1.45	
- Check PCS Burst t=2 H0	-70	-6	-18.38	0.28	
- Check PCS Burst t=4 H0	-1	1	-0.47	0.04	
- Check PCS Burst t=9 H0	-1	1	-0.01	0.02	
- Check PCS Burst t=11 H0	-70	-6	-14.77	0.32	
- Check PCS Burst t=12 H0	-120	-30	-74.86	2.95	
- Check PCS Phase Error Peak H0	0	20	8.31	1.75	Check shielding and antenna con- nection.
- Check PCS Phase Error Rms H0	0	5	2.68	0.25	Check the following capacitors if soldered properly: C701, C702, C703 (around antenna switch),
- Check PCS Freq Error H0	-180	180	19.39	13.23	C610, C741 (around VCO), C626 (around Mjølner), C709, C710, C711, C712 (loop filter).

Appendix 7B: FinUI Test Cases

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	Limits				
Test Step Name	Low	High	Avera ge	v	Repair Comments
- Check PCS TX Swit Spec 400 kHz H0	-90	-22	-30.43	0.97	
- Check PCS TX Swit Spec -400 kHz H0	-90	-22	-31.08	1.00	
-Check PCS TX Mod Spec 400kHz H0	0	15	4.39	0.95	
-Check PCS TX Mod Spec -400kHz H0	0	15	5.35	0.91	
- Check PCS BER -102 H	0	2	0.05	0.03	Check antenna connection.
- Check PCS SACCH HO	4	12	8.72	0.47	Check RX1900 path (antenna switch, SAW filter, RX IQ interface)
- Check PCS TX Power H0	26.5	33	30.42	0.40	Check shielding and antenna con- nection.
Meas PCS TX Power H1	25.5	30.5	28.74	0.35	
Contrast Tuning	-10	10	-5.75	2.07	
Check Contrast Value	0.25	0.5	0.33	0.04	
- Check PCS TX Power Linearity H0-H1	0.5	3.5	1.68	0.14	
Start Display Illumination Test	0	0	1.00	0.00	
Meas PVT TX Power H15	-5	5	1.13	0.38	Check shielding and antenna con- nection.
- Check PCS Burst t=1 H15	-120	-20	-41.55	1.23	
- Check PCS Burst t=2 H15	-70	-1	-22.08	0.87	
- Check PCS Burst t=4 H15	-1	1	-0.32	0.05	
- Check PCS Burst t=9 H15	-1	1	0.02	0.02	
- Check PCS Burst t=11 H15	-70	-1	-15.09	0.66	
- Check PCS Burst t=12 H15	-120	-20	-60.68	2.52	
Check Display Illumination	0	0	1.00	0.00	
PCS Measure All Ch=L TxL=0	-0.5	34	0.00	0.00	
Start Keypad Illumination Test	0	0	1.00	0.00	
- Check PCS Burst t=1 L0	-120	-30	-73.52	1.79	
- Check PCS Burst t=2 L0	-70	-6	-18.50	0.28	
- Check PCS Burst t=4 L0	-1	1	-0.46	0.04	
- Check PCS Burst t=9 L0	-1	1	-0.01	0.02	

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Appendix 7B: FinUI Test Cases

	Limits				
Test Step Name	Low	High	Avera ge	v	Repair Comments
- Check PCS Burst t=11 L0	-70	-6	-14.89	0.32	
- Check PCS Burst t=12 L0	-120	-30	-76.64	3.00	
- Check PCS Phase Error Peak LO	0	20	7.93	1.13	Check shielding and antenna con- nection.
- Check PCS Phase Error Rms LO	0	5	2.63	0.23	Check the following capacitors if soldered properly: C701, C702, C703 (around antenna switch),
- Check PCS Freq Error LO	-180	180	13.83	12.89	C610, C741 (around VCO), C626 (around Mjølner), C709, C710, C711, C712 (loop filter).
- Check PCS TX Swit Spec 400 kHz L0	-90	-22	-31.32	0.91	
- Check PCS TX Swit Spec -400 kHz LO	-90	-22	-31.15	0.94	
-Check PCS TX Mod Spec 400kHz L0	0	15	5.25	0.77	
-Check PCS TX Mod Spec -400kHz L0	0	15	5.45	0.73	
- Check PCS BER -102 LO	0	2	0.06	0.03	Check antenna connection.
- Check PCS SACCH LO	4	12	8.99	0.31	Check RX1900 path (antenna switch, SAW filter, RX IQ interface)
- Check PCS TX Power L0	26.5	33	30.03	0.36	Check shielding and antenna con- nection.
Check Keypad Illumination	0	0	1.00	0.00	
Meas PCS TX Power L1	25.5	30.5	28.37	0.27	Check shielding and antenna con- nection.
- Check PCS TX Power Linearity LO- L1	0.5	3.5	1.66	0.15	
Meas PVT TX Power L15	-5	5	0.42	0.31	
- Check PCS Burst t=1 L15	-120	-20	-44.29	1.42	
- Check PCS Burst t=2 L15	-70	-1	-24.17	0.91	
- Check PCS Burst t=4 L15	-1	1	-0.31	0.05	
- Check PCS Burst t=9 L15	-1	1	0.02	0.02	
- Check PCS Burst t=11 L15	-70	-1	-16.37	0.75	
- Check PCS Burst t=12 L15	-120	-20	-62.04	2.67	
Operation End display keypad Test	0	0	1.00	0.00	

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	Limits			CL D		
Test Step Name	Low	High	Avera ge	v v	Repair Comments	
End Call PCS	-0.5	0.5	0.00	0.00		
Set TestSet GSM	-0.5	0.5	0.00	0.00		
Set Fast Service Ch GSM	-0.5	0.5	0.00	0.00		
Create Call GSM	-0.5	0.5	0.10	0.00		
GSM Measure All Ch=H TxL=5	0	35	0.00	0.00		
- Check GSM Freq Error H5	-90	90	10.69	7.32	Check shielding and antenna con- nection.	
- Check GSM Phase Error Peak H5	0	20	6.05	0.98	Check the following capacitors if soldered properly: C701, C702, C703 (around antenna switch),	
- Check GSM Phase Error Rms H5	0	5	1.79	0.12	C610, C741 (around VCO), C626 (around Mjølner), C709, C710, C711, C712 (loop filter).	
- Check GSM TX Spectrum 400 kHz H5	-60	-19	-30.37	0.82		
- Check GSM TX Swit Spec -400 kHz H5	-60	-19	-30.96	0.79		
-Check GSM TX Mod Spec 400kHz H5	-100	-60	-65.00	0.66		
-Check GSM TX Mod Spec - 400kHz H5	-100	-60	-64.30	0.66		
- Check GSM BER -102 H5	0	2	0.01	0.01	Check antenna connection.	
- Check GSM SACCH H5	4	12	10.41	0.50	Check RX850/RX900 path (antenna switch, SAW filter, RX IQ interface)	
- Check GSM TX Power H5	30	35.5	32.08	0.38	Check shielding and antenna con- nection	
Meas GSM85/GSM9 Call Mode Current H5	120	360	266.6 3	35.71		
Meas GSM TX Power H6	28.5	33.5	30.31	0.38	Check shielding and antenna con- nection	
- Check GSM TX Power Linearity H5-H6	0.5	3.5	1.77	0.03		
Meas GSM PVT TX Power H19	0	10	4.79	0.47		
- Check GSM Burst t=1 H19	-120	-22	-52.88	1.76		
- Check GSM Burst t=2 H19	-70	-1	-25.97	0.88		
- Check GSM Burst t=4 H19	-1	1	-0.48	0.06		

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Appendix 7B: FinUI Test Cases

	Limits			CL D		
Test Step Name	Low	High	Avera ge	v v	Repair Comments	
- Check GSM Burst t=9 H19	-1	1	-0.01	0.02		
- Check GSM Burst t=11 H19	-70	-1	-13.66	1.57		
- Check GSM Burst t=12 H19	-120	-22	-68.50	1.84		
GSM Measure All Ch=L TxL=5	-0.5	35	0.00	0.00		
- Check GSM Burst t=1 L5	-120	-30	-80.09	2.19		
- Check GSM Burst t=2 L5	-70	-6	-16.24	0.26		
- Check GSM Burst t=4 L5	-1	1	-0.71	0.05		
- Check GSM Burst t=9 L5	-1	1	-0.12	0.03		
- Check GSM Burst t=11 L5	-70	-6	-11.88	0.23		
- Check GSM Burst t=12 L5	-120	-30	-82.79	1.77		
– Check GSM TX Spectrum 400 kHz L5	-60	-19	-28.97	0.80		
- Check GSM TX Swit Spec -400 kHz L5	-60	-19	-30.17	0.77		
-Check GSM TX Mod Spec 400kHz L5	-100	-60	-65.30	0.57		
-Check GSM TX Mod Spec - 400kHz L5	-100	-60	-64.45	0.54		
- Check GSM Phase Error Peak L5	0	20	6.11	1.95	Check shielding and antenna con- nection.	
- Check GSM Phase Error Rms L5	0	5	1.80	0.16	Check the following capacitors if soldered properly: C701, C702, C703 (around antenna switch),	
- Check GSM Freq Error L5	-90	90	8.33	7.29	C610, C741 (around VCO), C626 (around Mjølner), C709, C710, C711, C712 (loop filter).	
- Check GSM BER -102 L5	0	2	0.03	0.02	Check antenna connection.	
- Check GSM SACCH L5	4	12	9.01	0.60	Check RX850/RX900 path (antenna switch, SAW filter, RX IQ interface)	
- Check GSM TX Power L5	30	35.5	32.90	0.28	Check shielding and antenna con- nection	
Meas GSM TX Power L6	28.5	33.5	31.36	0.27	Check shielding and antenna con- nection	
- Check GSM TX Power Linearity L5-L6	0.5	3.5	1.55	0.11		
Meas GSM PVT TX Power L19	0	10	5.75	0.37		

Appendix 7B: FinUI Test Cases

RH-19/RH-50

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	Limits			C D		
Test Step Name	Low	High	Avera ge	v v	Repair Comments	
- Check GSM Burst t=1 L19	-120	-22	-56.70	1.95		
- Check GSM Burst t=2 L19	-70	-1	-27.92	0.92		
- Check GSM Burst t=4 L19	-1	1	-0.43	0.06		
- Check GSM Burst t=9 L19	-1	1	-0.01	0.02		
- Check GSM Burst t=11 L19	-70	-1	-15.54	1.88		
- Check GSM Burst t=12 L19	-120	-22	-69.77	2.01		
Handover GSM-DCS	-0.5	0.5	0.00	0.00		
DCS Measure All Ch=H TxL=0	-0.5	34	0.00	0.00		
- Check DCS Burst t=1 H0	-120	-30	-76.34	2.11		
- Check DCS Burst t=2 H0	-70	-6	-18.66	0.28		
- Check DCS Burst t=4 H0	-1	1	-0.46	0.04		
- Check DCS Burst t=9 H0	-1	1	-0.01	0.02		
- Check DCS Burst t=11 H0	-70	-6	-14.93	0.32		
- Check DCS Burst t=12 H0	-120	-30	-76.16	3.32		
- Check DCS Phase Error Peak HO	0	20	8.07	1.88	Check shielding and antenna con- nection.	
- Check DCS Phase Error Rms H0	0	5	2.57	0.26	Check the following capacitors if soldered properly: C701, C702, C703 (around antenna switch),	
- Check DCS Freq Error H0	-180	180	9.96	13.50	C610, C741 (around VCO), C626 (around Mjølner), C709, C710, C711, C712 (loop filter).	
- Check DCS BER -102 H0	0	2	0.05	0.03	Check antenna connection.	
- Check DCS SACCH H0	4	12	8.82	0.43	Check RX1800 path (antenna switch, SAW filter, RX IQ interface)	
- Check DCS TX Power H0	27	33	29.63	0.40	Check shielding and antenna con- nection	
- Check DCS TX Swit Spec 400 kHz H0	-60	-22	-32.47	0.88		
- Check DCS TX Swit Spec -400 kHz H0	-60	-22	-32.41	0.91		
-Check DCS TX Mod Spec 400kHz H0	0	15	6.75	0.66		
-Check DCS TX Mod Spec -400kHz H0	0	15	6.97	0.63		

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Appendix 7B: FinUI Test Cases

	Limits			CL D		
Test Step Name	Low	High	Avera ge	v v	Repair Comments	
Meas DCS TX Power H1	25.5	30.5	27.75	0.37	Check shielding and antenna con- nection	
- Check DCS TX Power Linearity HO-H1	0.5	3.5	1.88	0.10		
Meas DCS PVT TX Power H15	-5	5	-0.30	0.42		
- Check DCS Burst t=1 H15	-120	-20	-47.23	1.77		
- Check DCS Burst t=2 H15	-70	-1	-23.66	1.26		
- Check DCS Burst t=4 H15	-1	1	-0.28	0.06		
- Check DCS Burst t=9 H15	-1	1	0.04	0.03		
- Check DCS Burst t=11 H15	-70	-1	-15.88	1.07		
- Check DCS Burst t=12 H15	-120	-20	-62.06	3.07		
DCS Measure All Ch=L TxL=0	-0.5	34	0.00	0.00		
- Check DCS Burst t=1 L0	-120	-30	-78.55	2.25		
- Check DCS Burst t=2 L0	-70	-6	-18.62	0.27		
- Check DCS Burst t=4 L0	-1	1	-0.46	0.04		
- Check DCS Burst t=9 L0	-1	1	-0.01	0.02		
- Check DCS Burst t=11 L0	-70	-6	-14.98	0.32		
- Check DCS Burst t=12 L0	-120	-30	-77.09	3.35		
- Check DCS Phase Error Peak LO	0	20	8.18	1.83	Check shielding and antenna con- nection.	
- Check DCS Phase Error Rms L0	0	5	2.63	0.27	Check the following capacitors if soldered properly: C701, C702, C703 (around antenna switch),	
- Check DCS Freq Error LO	-180	180	7.83	12.32	C610, C741 (around VCO), C626 (around Mjølner), C709, C710, C711, C712 (loop filter).	
- Check DCS TX Spectrum 400 kHz L0	-60	-22	-31.73	1.01		
- Check DCS TX Swit Spec -400 kHz LO	-60	-22	-31.90	1.03		
-Check DCS TX Mod Spec 400kHz L0	0	15	5.98	0.89		
-Check DCS TX Mod Spec -400kHz L0	0	15	6.49	0.87		
- Check DCS BER -102 LO	0	2	0.04	0.02	Check antenna connection.	

Appendix 7B: FinUI Test Cases

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Nokia Customer Care

	Limits			St Do		
Test Step Name	Low	High	Avera ge	v v	Repair Comments	
- Check DCS SACCH LO	4	12	9.57	0.50	Check RX1800 path (antenna switch, SAW filter, RX IQ interface)	
- Check DCS TX Power L0	27	33	30.41	0.64	Check shielding and antenna con- nection	
Meas DCS TX Power L1	25.5	30.5	28.50	0.64	Check shielding and antenna con- nection	
- Check DCS TX Power Linearity L0-L1	0.5	3.5	1.91	0.08		
Meas DCS PVT TX Power L15	-5	5	0.57	0.68		
- Check DCS Burst t=1 L15	-120	-20	-50.03	2.11		
- Check DCS Burst t=2 L15	-70	-1	-23.94	1.53		
- Check DCS Burst t=4 L15	-1	1	-0.24	0.05		
- Check DCS Burst t=9 L15	-1	1	0.04	0.03		
- Check DCS Burst t=11 L15	-70	-1	-14.68	1.17		
- Check DCS Burst t=12 L15	-120	-20	-62.30	3.43		
End Call	-0.5	0.5	0.00	0.00		

Appendix 7C: Component Placement with Test Points and Detailed Description

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## RH-19/RH-50

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### Troubleshooting Appendix C

### **Receiver Test Points**

Testpoint	Antenna Feed						
Band	GSM850/GSM900	GSM1800	GSM1900				
Active Unit	RX	•					
Operation Mode	Continuous						
RX/TX Channel	190 (GSM850) 37 (GSM 900)	700	661				
AGC	14	•					
Input Power	-60dBm	-60dBm	-60dBm				
Input Frequency	881.66771 MHz (GSM850) 942.46771 MHz (GSM900)	1842.86771MHz	1960.06771MHz				
Probed Power (e.g. measured with resistive probe)	Pref (dBm) typ. – -70dBm	Pref (dBm) typ. – -70dBm	Pref (dBm) typ. – -70dBm				

		Testpoint	RX GSM		
		Band	GSM850/GSM900		
Testpoint	RX DCS	Active Unit	RX	Testpoint	RX PCS
Band	GSM1800	Operation Mode	Continuous	Band	GSM1900
Active Unit	RX	RX/TX Channel	190 (GSM850)	Active Unit	RX
Operation Mode	Continuous	AGC	14	Operation Mode	Continuous
RX/TX Channel	700	Input Power	60dBm	RX/TX Channel	661
AGC	14	Input Frequency	881 66771 MHz (GSM850)	AGC	14
Input Power	- 60dBm	input requercy	942.46771MHz (GSM900)	Input Power	– 60dBm
Input Frequency	1842.86771MHz	Probed Power	Pref - 1.0dB	Input Frequency	1960.06771MHz
Probed Power	Pref – 1.5dB			Probed Power	Pref – 1.5dB
				T TODOG T DITOT	
	RX PCS				

Testpoint	VR6
Band	GSM850/GSM900
Active Unit	RX
Operation Mode	Continuous or Burst
RX/TX Channel	190 (GSM850) 37 (GSM900)
DC Level	-2.7 V

Testpoints



Testpoint	CONT1,2,3				
Band	GSM850/GSM900				
Active Unit	RX				
Operation Mode	Continuous				
RX/TX Channel	37				
Testpoints	CONT1 (VANTM)	CONT2 (VANTH)	CONT3 (VANTL)		
DC Level	0 V	0 V	0 V		

Testpoint	CONT1,2,3		Testpoint	CONT1,2,3			
Band	GSM1800		Band	GSM1900			
Active Unit	RX		Active Unit	RX			
Operation Mode	Continuous		Operation Mode	Continuous			
RX/TX Channel	700		RX/TX Channel	661			
Testpoints	CONT1 (VANTM)	CONT2 (VANTH)	CONT3 (VANTL)	Testpoints	CONT1 (VANTM)	CONT2 (VANTH)	CONT3 (VANTL)
DC Level	0 V	0 V	0 V	DC Level	٥V	2.7 V	0 V

LNAbase\_voltage(s)

also

Testpoints		Testpoints	INPH INMH
Band	GSM1800	Band	GSM1900
Active Unit	RX	Active Unit	RX
Operation Mode	Continuous	Operation Mode	Continuous
RX/TX Channel	700	RX/TX Channel	661
AGC	14	AGC	14
Input Power	- 60dBm	Input Power	- 60dBm
Input Frequency	1960.06771MHz	Input Frequency	1842.86771MHz
Probed Power	Pref – 4.0dB	Probed Power	Pref – 4.0dB
DC Level	0.8V	DC Level	0.8V
(=LNAbase_voltage)		(=LNAbase voltage)	

Testpoint	VR4
Band	GSM850/GSM900
Active Unit	RX
Operation Mode	Continuous or Burst
RX/TX Channel	190 (GSM850) 37 (GSM900)
DC Level	-2.7 V

RXQINP (J613) RXQINN (J614) RXIINP (J611) RXIINN (J612)
GSM850/GSM900 or GSM1800 or GSM1900
RX
Continuous
37 or 190 or 700 or 661
14
- 80dBm
881.66771 / 942.46771, 1842.86771 or 1960.06771 MHz
1.2Vpp
1.36Vdc
67kHz
Tek 81072 2.50 VIS/s 159 Augs
0810 1.00 V M 20.0µs Ch1 2 1.40 V 21 Sep 2002 08:54:46

Testpoint	INPL INML
Band	GSM850/GSM900
Active Unit	RX
Operation Mode	Continuous
RX/TX Channel	190 (GSM850) 37 (GSM900)
AGC	14
Input Power	-60dBm
Input Frequency	881.66771 MHz (GSM850) 942.46771MHz (GSM900)
Probed Power	Pref -4.0dB
DC Level (=LNAbase_voltage)	V8.0

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### Troubleshooting Appendix C

#### Synthesizer Test Points







	Testpoint	VR1A
	Band	GSM850/GSM900
	Active Unit	RX
	Operation Mode	Continuous or Burst
	RX/TX Channel	190 (GSM850) 37 (GSM900)
	DC Level	4.76V

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# Troubleshooting Appendix C

TXIOUTP (R713/1

Testpoints

### Transmitter Test Points (1 of 3)





190/37 or 700 or 661

Burst

2.8V



Testpoint	VR3
Band	GSM850/GSM900
Active Unit	TX
Operation Mode	Burst
RX/TX Channel	190 (GSM850) 37 (GSM900)
DC Level	2.8V
Testecist	VIDEFOX
Testpoint	VREF01
Testpoint Band	VREF01 GSM850/GSM900
Testpoint Band Active Unit	VREF01 GSM850/GSM900 TX
Testpoint Band Active Unit Operation Mode	VREF01 GSM850/GSM900 TX Burst
Testpoint Band Active Unit Operation Mode RX/TX Channel	VREF01 GSM850/GSM900 TX Burst 190 (GSM850) 37 (GSM900)
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Transmitter Test Points (2 of 3)





1	Testpoint
)/GSM900	Band
	Active Unit
	Operation M
M850) 1900)	RX/TX Char
3m	Probed Pow

estpoint	C820 / R805 (Pin 2)
Band	GSM850/GSM900
ctive Unit	TX
peration Mode	Burst
X/TX Channel	190 (GSM850) 37 (GSM900)
robed Power	Pref +6dBm

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Transmitter Test Points (3 of 3)





	Testpoint	TX_850/900 (C824)
	Band	GSM850/GSM900
	Active Unit	TX
_	Operation Mode	Burst
	RX/TX Channel	190 (GSM850) 37 (GSM900)
	Probed Power	Pref -2.0dBm

