

Receiver

General instructions for RX troubleshooting

Connect the the phone to a PC with DAU-9P cable and dongle and follow the following instructions:

Measuring RX I/Q signals using RSSI reading

Start Phoenix Service Software

Open the FBUS connection

Select	Scan Product	Ctrl-R
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Wait until phone information shows in the lower right corner of the screen.

Set operating mode to local mode

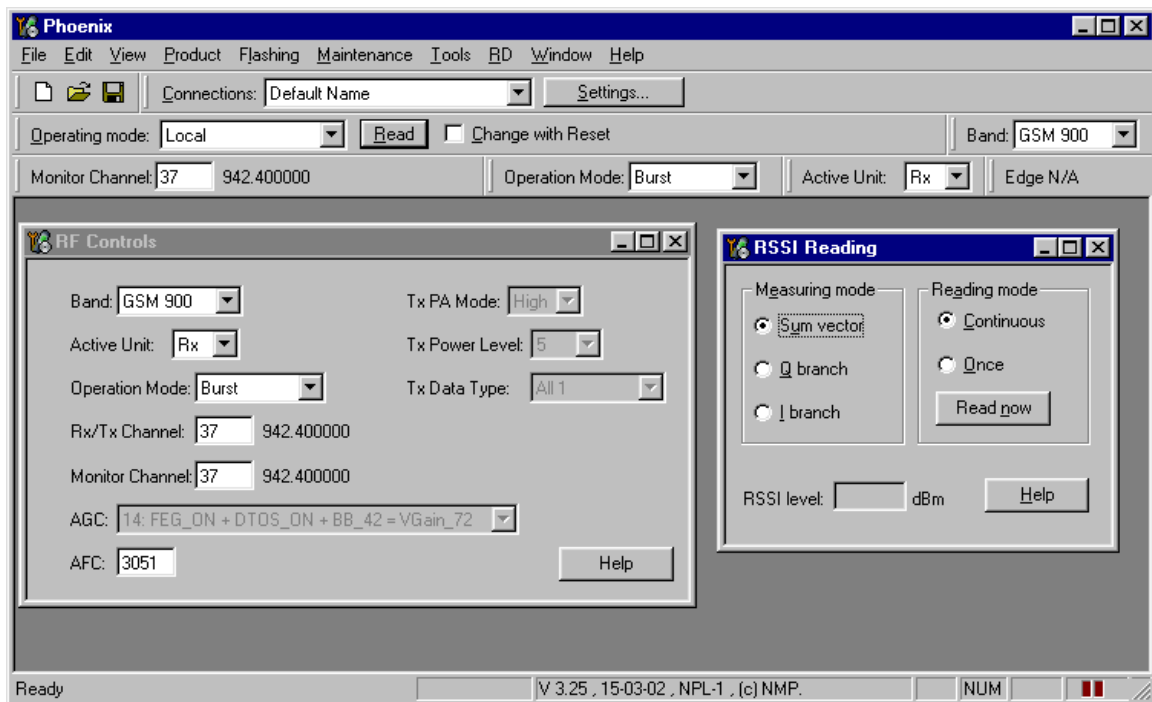
Select	Maintenance	Alt-M
	Tuning	T
	RF Controls	F

Wait until the RF Controls window pops up

Select	Band	GSM 900 or GMS 1800 or GSM 1900
	Active unit	RX
	Operation mode	Burst
	RX/TX Channel	37 or 700 or 661

Select	Maintenance	Alt-M
	Testing	T
	RSSI reading	R

The setup should now look like this:



Apply a signal with a frequency of

EGSM : 942.467 MHz (channel 37 + 67.710kHz offset)

GSM1800: 1842.867 MHz (channel 700 + 67.710kHz offset)

GSM1900: 1960.067 MHz (channel 661 + 67.710kHz offset)

and a power level of -80dBm to the RF-connector (remember to compensate for cable attenuation).

In RSSI reading click on Read now.

The resulting RSSI level should be -80dBm in each band.

Measuring RX performance using SNR Measurement

Start Phoenix Service Software

Open the 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

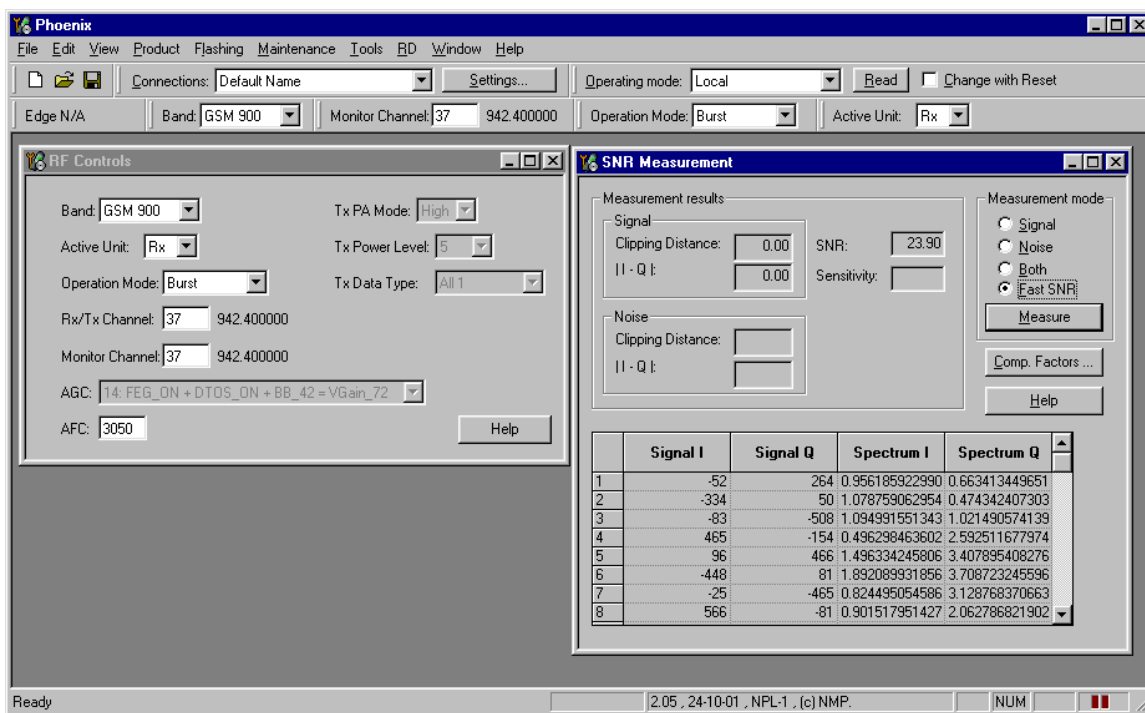
Select Maintenance Alt-M
Testing T
RF Controls F

Wait until the RF Controls window pops up

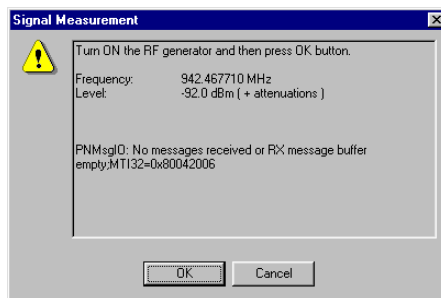
Select Band GSM 900 or GMS1800 or GSM1900
 Active unit RX
 Operation mode **Burst**
 RX/TX Channel 37 or 700 or 661

Select Maintenance Alt-M
 Testing T
 SNR Measurement M
 select Fast SNR Radio Button

The setup should now look like this:



Choose respective band (EGSM900, GSM1800, GSM1900)
 Press measure. A window pops up, e.g. for EGSM900 band:



Connect an external signal generator to the RF connector of the phone and set the generator as told in the window, taking care for external cable losses.

Press ok and the window closes.

Read the SNR result. SNR should be:

EGM900 >20dB

GSM1800 >18dB

GSM1900 >18dB

Measuring frontend power levels using Spectrum analyzer

Spectrum Analyzer (SA) level values depend on the probe type and should be validated using a good sample.

The levels that are given here are measured using a resistive probe (50Ohm semi-rigid cable).

Start Phoenix Service Software

Open the FBUS connection

Select	Scan Product	Ctrl-R
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Wait until phone information shows in the lower right corner of the screen.

Set operating mode to local mode

Select	Maintenance	Alt-M
	Testing	T
	RF Controls	F

Wait until the RF Controls window pops up

Select	Band	GSM 900 or GMS1800 or GSM1900
	Active unit	RX
	Operation mode	Continuous
	RX/TX Channel	37 or 700 or 661

Please refer to the fault finding chart for proper levels at different test points.

Measuring analogue RX I/Q signal voltages using Oscilloscope

Measuring with an oscilloscope on "RXIINN" or "RXQINN" is recommended only if RSSI reading does not provide enough information. No dedicated test points exist for RX I and Q signals, but they can be accessed by probing on via hole plating. Input level = -80dBm

Start Phoenix Service Software

Select	Scan Product	Ctrl-R
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Wait until phone information shows in the lower right corner of the screen.

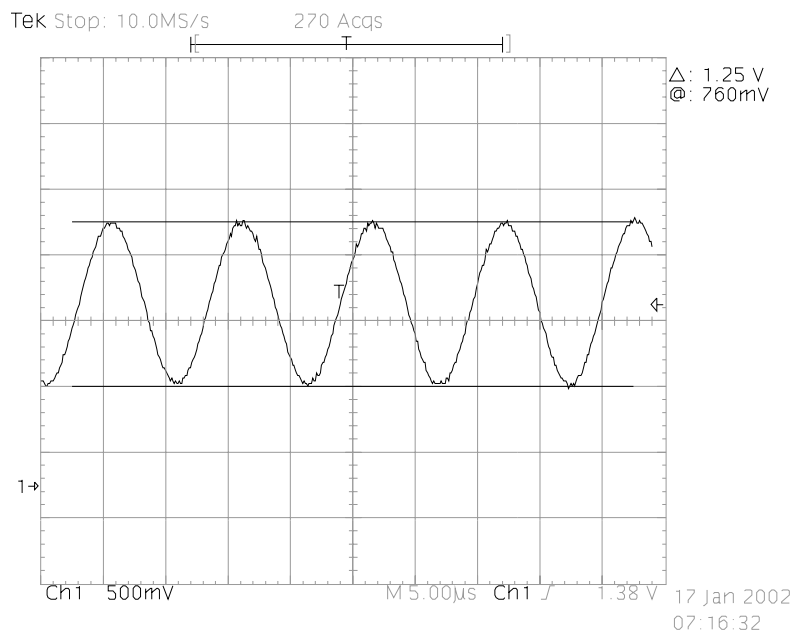
Set operating mode to local mode

Select	Maintenance	Alt-M
	Testing	T
	RF Controls	F

Wait until the RF Controls window pops up

Select	Band	GSM 900 or GMS1800 or GSM1900
	Active unit	RX
	Operation mode	continuous
	RX/TX Channel	37 or 700 or 661
	AGC	14

Following picture should be seen on a working EGSM receiver:



Signal amplitude	1.25V
DC offset	1,35V
Frequency	67kHz

Fault finding chart for receiver

The phone layout does not have 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.

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

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 have a reasonable RSSI reading, although the front end shows excessive losses.

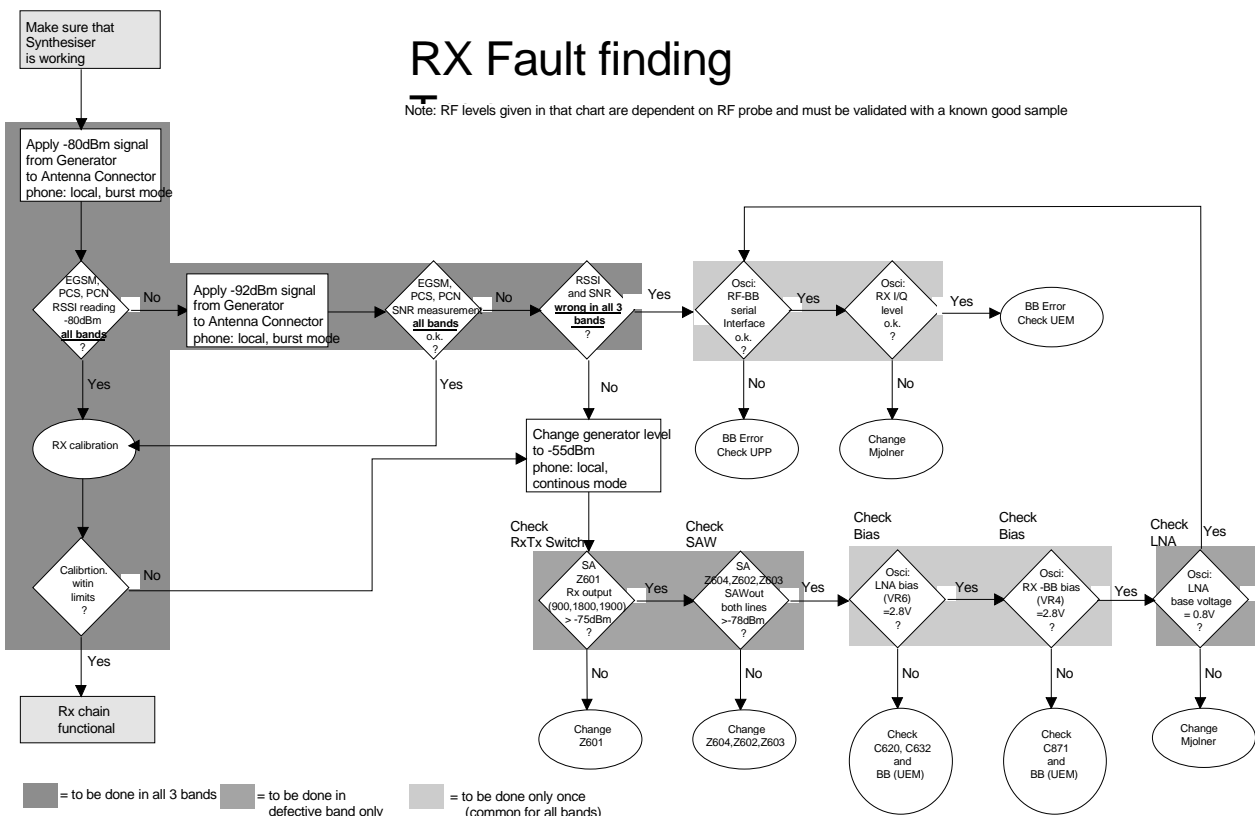
If it is not sure whether incorrect re-calibration has been taken place, following steps can be done:

Check if AGC calibration is within limits

Check if SNR reading is OK.

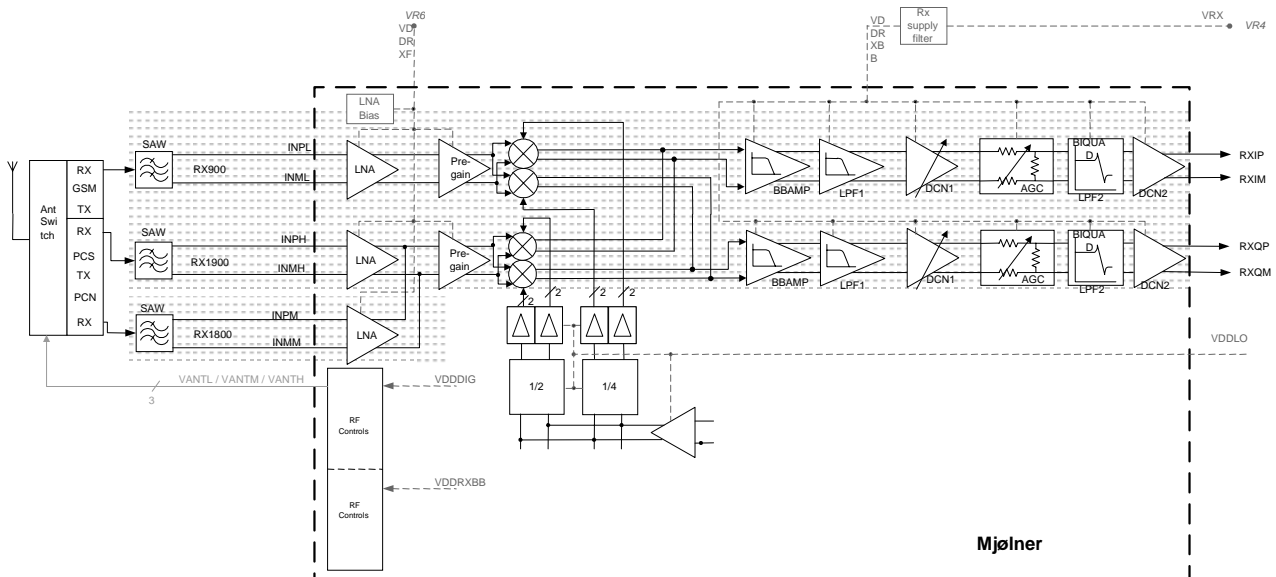
Use an Oscilloscope to check levels of "RXIINN" and "RXQINN".

If RX and TX path are faulty it has to be checked that synthesiser is working. If yes, then check path from RF connector X602 to 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 picture shows EGSM900 (EGSM) receiver (top), GSM1900 (PCS) receiver (middle) and GSM1800 (DCS/PCN) receiver (down).



Antenna switch (RX/TX Switch)

From the antenna-pad (X600) the RF signal is fed through the antenna connector (X602) to the RX/TX switch (Z601). The antenna connector represents a mechanical switch between internal antenna and external antenna feed.

The RX/TX switch (Z601) works as diplexer. EGSM900 input signals pass to GSM_Rx output. GSM1800 input signals pass to PCN_Rx output or PCS_Rx output, depending on the control signal VANTH (Cont2).

From RX1-GSM output of the antenna switch the RX signal is routed in the inner layers of the PWB to the EGSM900 SAW filter (Z604). From RX2-DCS output the GSM1800 RX signal is routed to the GSM1800 SAW filter (Z602). From RX3-PCS output the RX GSM1900 signal is routed to the GSM1900 SAW filter (Z603).

The RX/TX switch with routed lines has following typical insertion losses:

1.3dB@EGSM900, 1.6dB@GSM1800 and 1.6dB@GFSM1900.

Front-end

The RX front end includes three SAW filters (EGSM900 (Z604), GSM1800 (Z602), GSM1900 (Z603)). Each of the SAW filters is matched with a differential matching circuit (LC-type) to the corresponding LNA input of Mjoelner RF ASIC (N601). 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 which provides a balanced RX signal to the corresponding input of the Mjoelner RF ASIC.

The SAW filters have maximum insertion losses of

3.5dB@EGSM900, 4.0dB@GSM1800 and 4.0dB@GSM1900.

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 with a LO signal coming from the local oscillator.

The RX paths of Mjoelner RF ASIC consist of following building blocks:

- Separate LNAs for each of the three bands: EGSM900, GSM1800 and GSM1900.
- Two PREGAIN amplifiers, one for EGSM900 and one common for GSM1800 and GSM1900.
- Two passive I/Q mixers (MIX), one for EGSM900 and one common for GSM1800 and GSM1900.

The resulting BB signal is further amplified in the BB chain. For that no external circuitry is required:

- Base band amplifiers (BBAMP1). That amplifiers implement the initial channel filtering.
- Low pass filters (LPF1).
- DC compensation / AGC amplifiers (DCN1). They implement gain steps from 0dB to 24dB in 6dB steps.
- Attenuators (AGC). They implement gain steps from -48dB to 0dB 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 can be connected directly to the ADC inputs of the RF converter chip. The common mode level is set equal to the VBEXT reference voltage.

EGSM (EGSM900) Transmitter

General instructions for EGSM TX troubleshooting

Apply a RF-cable to the RF-connector to allow the transmitted signal to act as normal. RF-cable should be connected to measurement equipment (GSM Test equipment, Powermeter, Spectrum Analyzer, or similar). Be sure to use at least a 10-dB attenuator, otherwise the results may be incorrect.

Connect the phone to a PC with DAU-9P cable and dongle and follow the following instructions:

Connect the phone to a power supply (3.5 ... 4V).

Start Phoenix Service Software and open FBUS connection

Select File Scan Product

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

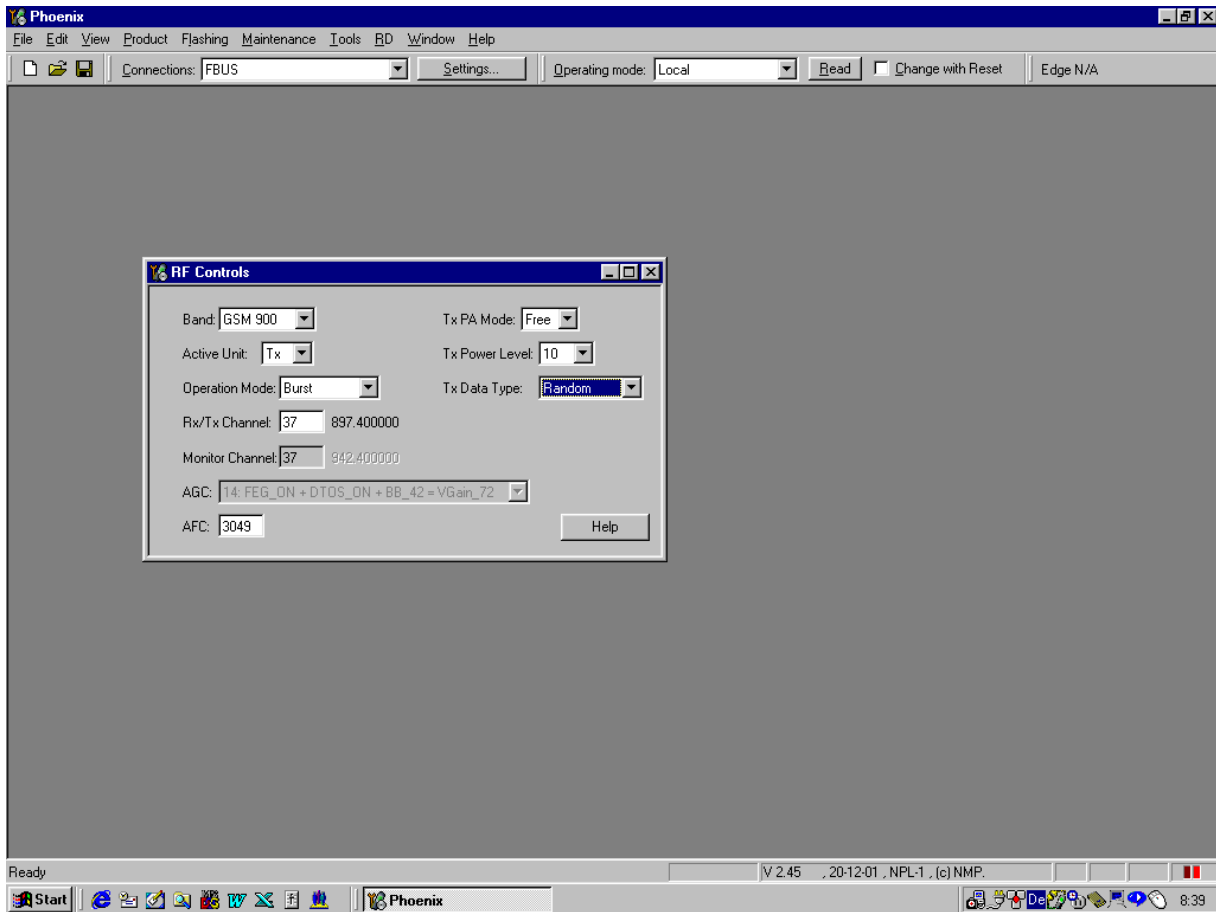
Set operating mode to local mode

Select Maintenance Testing RF Controls

Wait until the RF Controls window pops up

Select	Band	GSM 900
	Active unit	TX
	Operation mode	Burst
	RX/TX Channel	37
	TX PA Mode	Free
	TX Power Level	10
	TX Data Type	Random

The setup should now look like this:



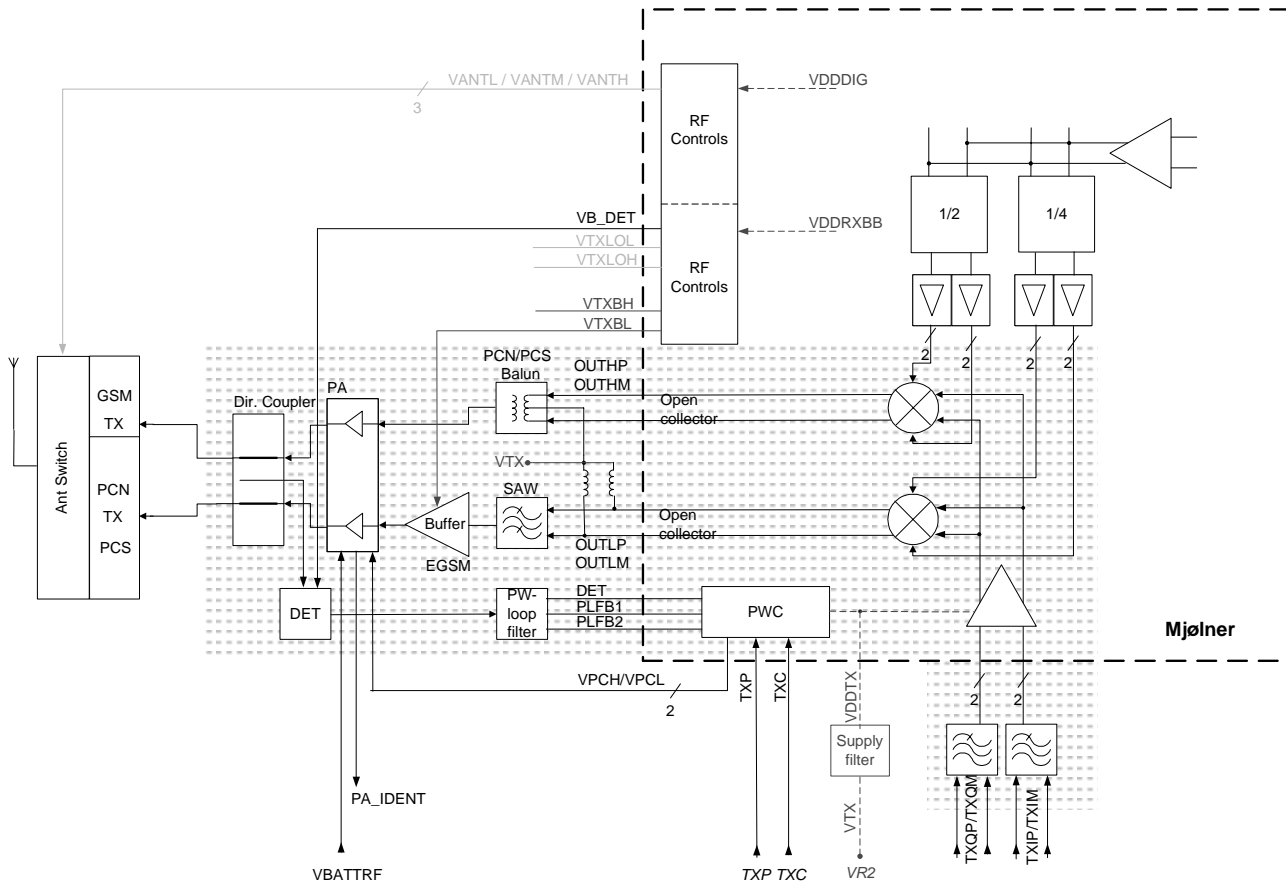
Now the measurement equipment should measure the following output signal from the phone.

- P_{out} +23dBm @ 897.4MHz

If this is not the case, then go to the fault finding chart for EGSM900 transmitter in this document for troubleshooting.

TX Path of the transmitted EGSM900 signal

For easy error tracing it is important to know the signal path of the EGSM900 transmitter. The components can be grouped into blocks and drawn as shown below. Note that the following picture shows both EGSM900 transmitter (bottom) and GSM1800/ GSM1900 transmitter (top).



EGSM900 TX path of Mjoelner RF ASIC

The balanced TX signal is provided by the base band and is coming to the Mjoelner RF ASIC. The TX paths of the Mjoelner RF ASIC include mainly two RF modulators for up-conversion of the base band signals, one for EGSM900 and one common for GSM1800/ GSM1900. The base band signal is modulated with the LO signal corresponding to the wanted TX channel. The GSM TX output of the Mjoelner RF ASIC is a balanced signal.

From the output of the Mjoelner RFASIC the signal is fed through the EGSM TX SAW filter (Balanced to single ended), a 3 dB pad, and the 900 MHz buffer to the PA EGSM input.

EGSM900 TX path of the Power Amplifier (PA)

The PA EGSM900 part has a maximum output power of app. 35dBm. Voltage supply is coming directly from the Battery connectors.

The EGSM900 output is controlled by the power control loop. From the EGSM900 output of the PA the RF signal is fed through the directional coupler (one of the power control loop components) to the antenna switch.

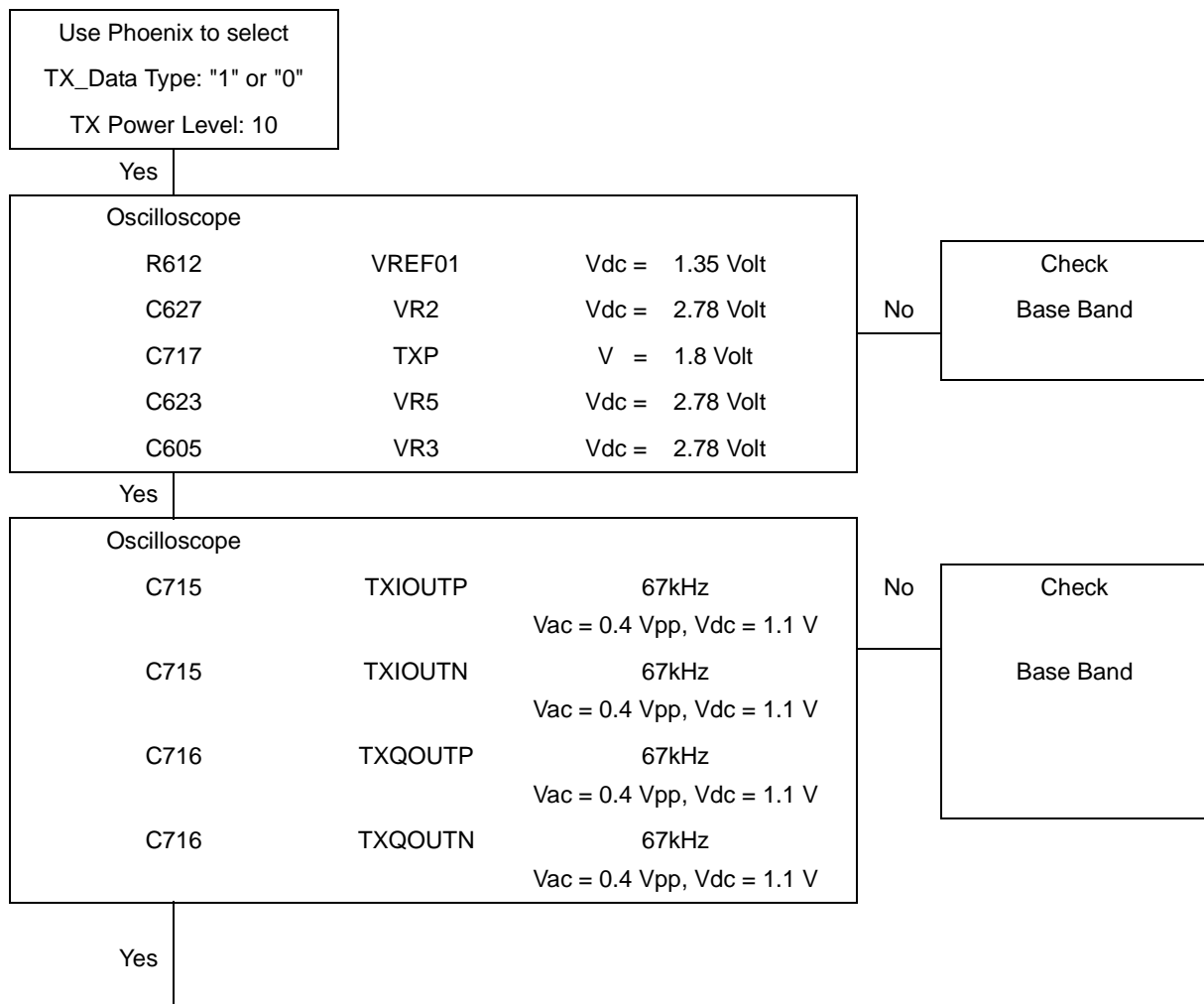
Antenna Switch (TX/RX switch)

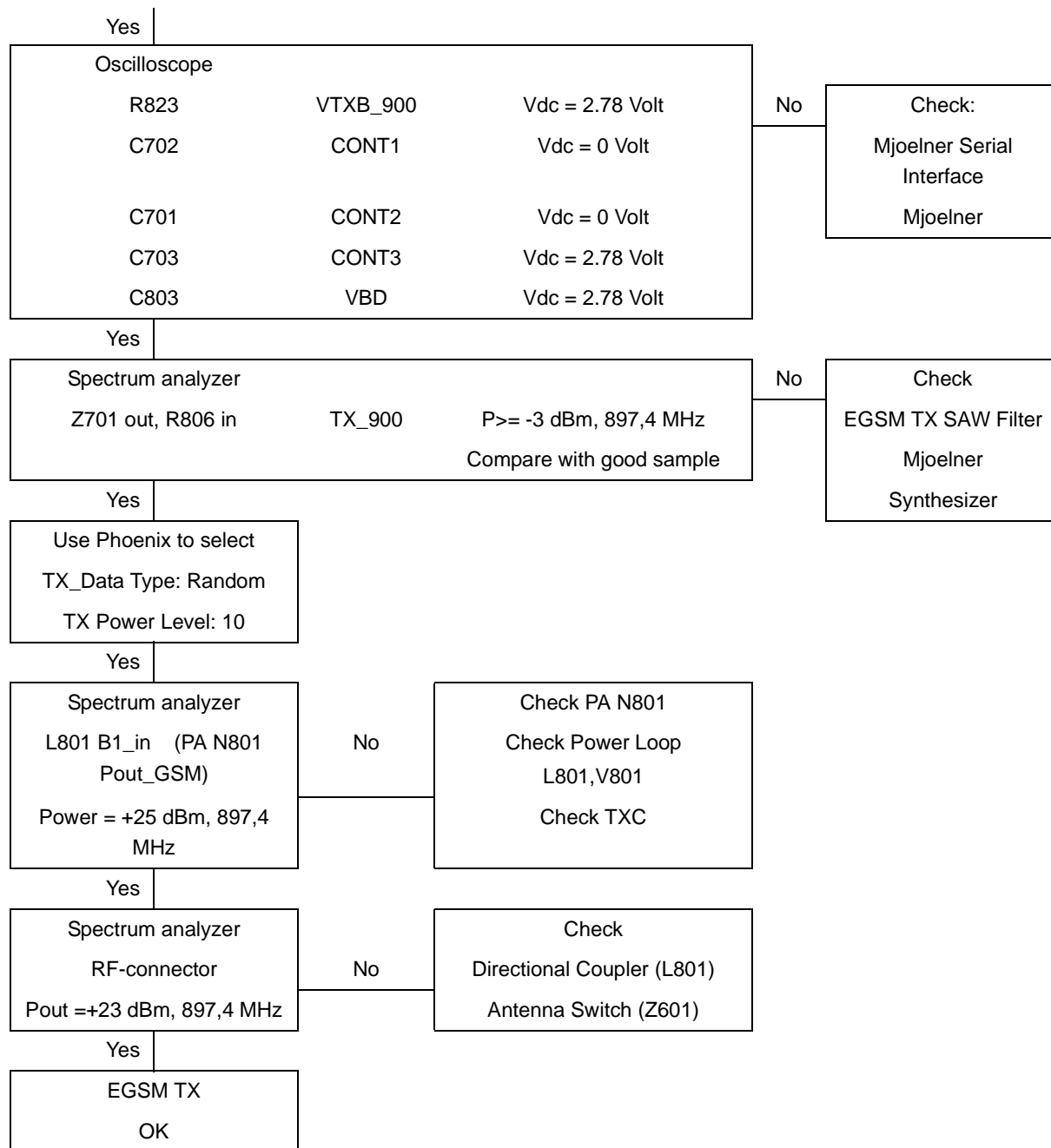
The antenna Switch works as a diplexer for the RX and TX signals. Moreover, it suppresses the TX harmonics generated by the PA. The antenna switch is controlled by the Mjoelner RF ASIC using the control signals CONT1, CONT2 and CONT3. The following table shows the possible different states.

CONT1 [Volt]	CONT2 [Volt]	CONT3 [Volt]	EGSM Rx	DCS Rx	PCS Rx	EGSM Tx	DCS/PCS Tx
0	0	0	X				
0	0	0		X			
0	0	2.7				X	
0	2.7	0			X		
2.7	0	0					X

Fault finding chart for EGSM900 transmitter

In following, it is assumed that the TXP signal is used as trigger-signal. For that a TXP test point is provided.





GSM1800 (DCS/PCN) Transmitter

General instructions for GSM1800 TX troubleshooting

Apply a RF-cable to the RF-connector to allow the transmitted signal to act as normal. RF-cable should be connected to measurement equipment (GSM Test equipment, Powermeter, Spectrum Analyzer, or similar). Be sure to use at least a 10-dB attenuator, otherwise the results may be incorrect.

Connect the phone to a PC with DAU-9P cable and dongle and follow the following instructions:

Connect phone to a power supply.

Start Phoenix Service Software and open FBUS connection

Select File Scan Product

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

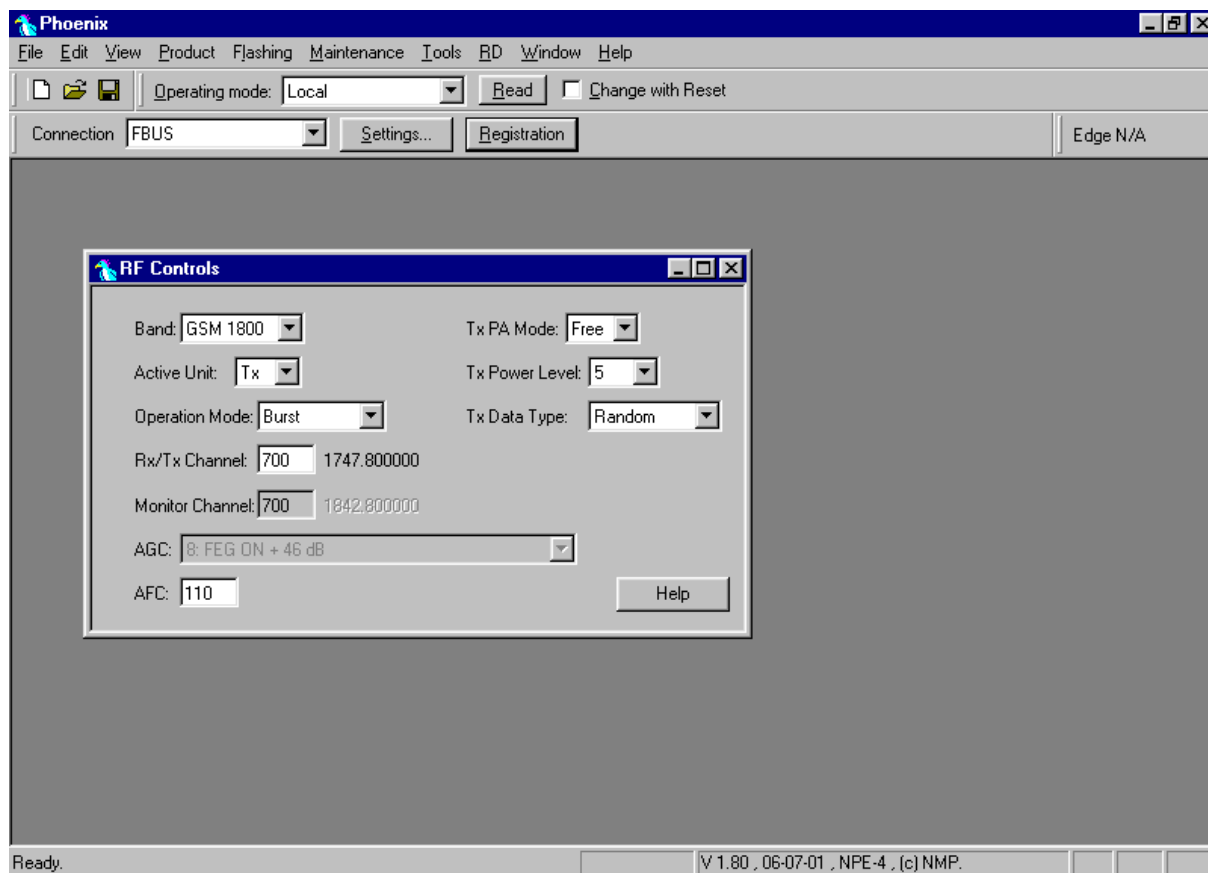
Set operating mode to local mode

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:



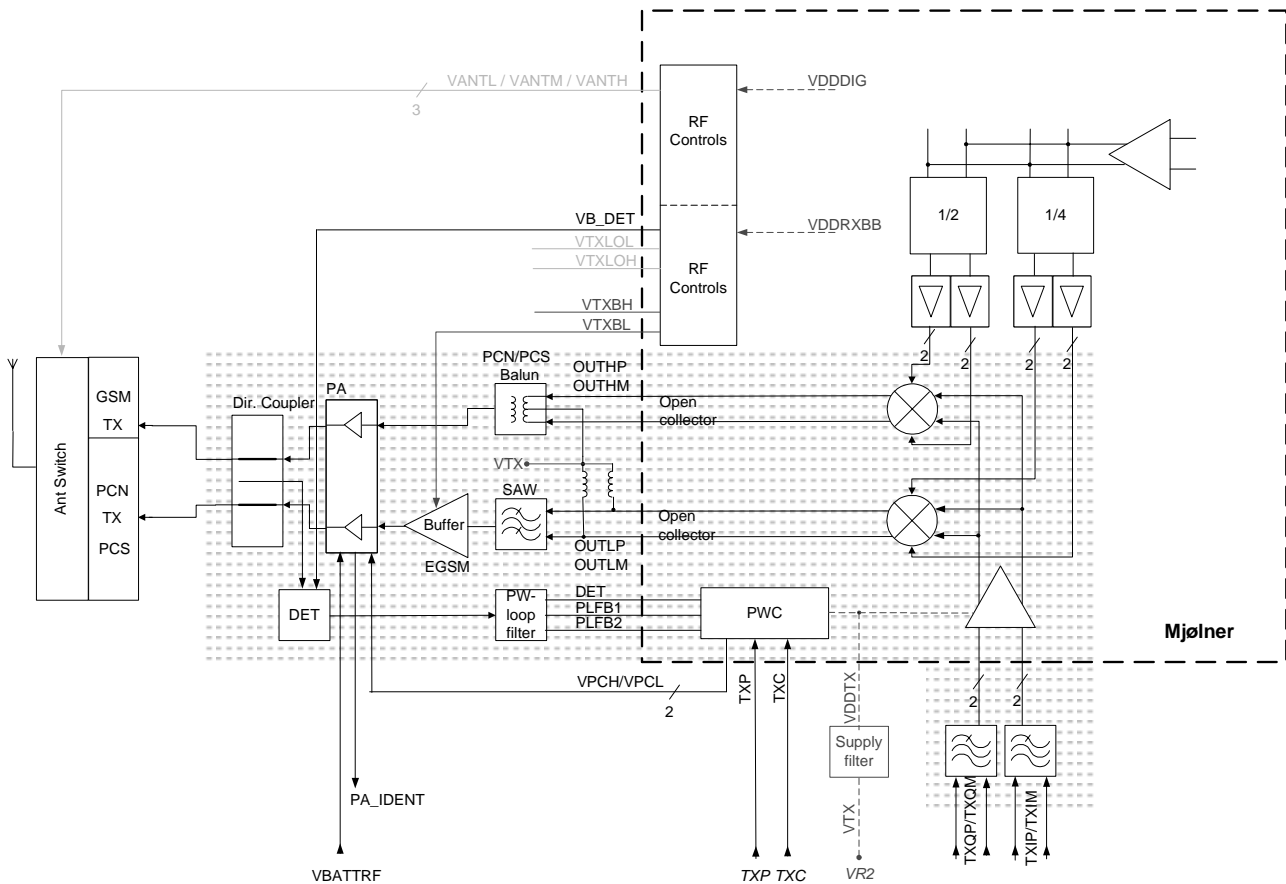
Now the measurement equipment should measure the following output signal from the phone.

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

If this is not the case, then go to the fault finding chart for GSM1800 transmitter in this document for troubleshooting.

TX path of the transmitted DCS1800 signal

For easy error tracking it is important to know the signal path of the DCS1800 transmitter. The components can be grouped into blocks and drawn as shown below. Note that the picture shows both EGSM900 transmitter (bottom) and GSM1800/GSM1900 transmitter (top).



GSM1800 path of Mjoelner RF ASIC

The balanced TX signal from base band and is coming to the Mjoelner RF ASIC. The GSM1800 path of Mjoelner RF ASIC includes a common RF modulator for GSM1800 and GSM1900. The BB signal is up-converted with the LO signal corresponding to the wanted TX channel. The GSM1800 / GSM1900 TX output of the Mjoelner RF ASIC is a balanced signal.

From the balanced output of Mjoelner RF ASIC the signal is fed through the GSM1800 TX Balun (T701) (Balanced to single ended) and a 3 dB pad to the GSM1800 / GSM1900 input of the PA.

GSM1800 path of the Power Amplifier (PA)

The GSM1800 / GSM1900 part of the PA has a maximum output of app 33dBm. The supply is coming directly from the Battery connectors.

The output is controlled by the power control loop. From the output of the PA the signal goes through the directional coupler (one of the power control loop components) to the antenna switch.

Antenna Switch

The antenna Switch works as a diplexer between RX and TX signals. Moreover, it partly suppresses the TX harmonics generated by the PA. Mjoelner RF ASIC controls the antenna switch by three voltages CONT1, CONT2 and CONT3. The following table shows the possible different states.

CONT1 [Volt]	CONT2 [Volt]	CONT3 [Volt]	EGSM Rx	DCS Rx	PCS Rx	EGSM Tx	DCS/PCS Tx
0	0	0	X				
0	0	0		X			
0	0	2.7				X	
0	2.7	0			X		
2.7	0	0					X

Fault finding chart for GSM1800 transmitter

It is useful to use the TXP signal as trigger-signal. It is provided at TXP test point.

