

**Programmes After Market Services  
NHM-2/5nx,ny/6/9 Series Transceivers**

# **Troubleshooting**

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## Component Identification:

NHM-2/5nx,ny/6/9 utilise different component brands.

None of the components must be substituted by other brands, as it will cause misalignment in the phone.

The following key components will be sourced by up to three different vendors.

Below is a list with photos that will help identify what brand of component has been used in the phone.

Component	Reference	Vendor 1	Vendor 2	Vendor 3
PA	Ref: N502	HITACHI	PHILIPS	RFMD
VCTCXO	Ref: G502	NDK	TOYOCOM	
SRAM	Ref: D302	SAMSUNG	AMIC/UMC	
DUAL RX SAW	Ref: Z500, Z501	EPCOS	PANASONIC	
EGSM TX SAW	Ref: Z503	EPCOS	PANASONIC	
FLASH	Ref: D301	ST	INTEL	
LIGHT-GUIDE	Ref:	SEIKO EPSON	PHILIPS	
GSM1800 TX SAW	Ref: Z504	PANASONIC	FUJITSU	
VCO	Ref: G500	FDK	MATSUSHITA	

### REF: N502 Hitachi, PA



### Ref: N502 Philips, PA



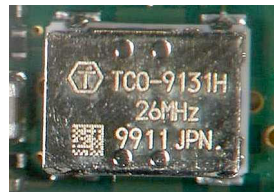
Ref: N502 RFMD, PA



Ref: G502 VCTCXO, NDK



Ref: G502 VCTCXO, TOYOCOM



Ref: D302 S-RAM, SAMSUNG



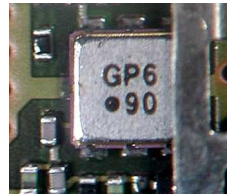
Ref: D302 S-Ram, AMIC



Ref: Z500, Z501 Dual RX SAW, EPCOS



Ref: Z500, Z501 Dual RX SAW, Panasonic



Ref: Z503 EGSM TX SAW, EPCOS



Ref: Z503 EGSM TX SAW, Panasonic



Ref: D301 FLASH, INTEL



Ref: D301 FLASH, ST



Ref: Z504 GSM1800 TX SAW, Panasonic



Ref: Z504 GSM1800 TX SAW, Fujitsu



Ref: G500 VCO, FDK



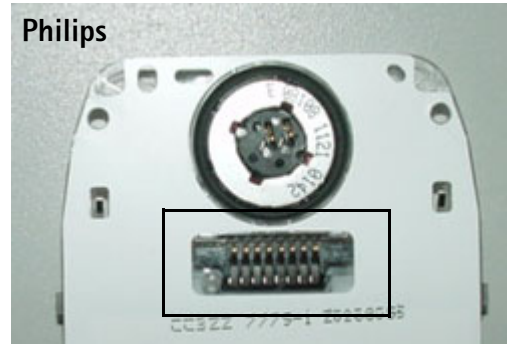
Ref: G500 VCO, Matsushita



## Display Module Suppliers

The easiest way to determine the supplier of the display module is by looking at the connector and connector cavity from the backside of the module.

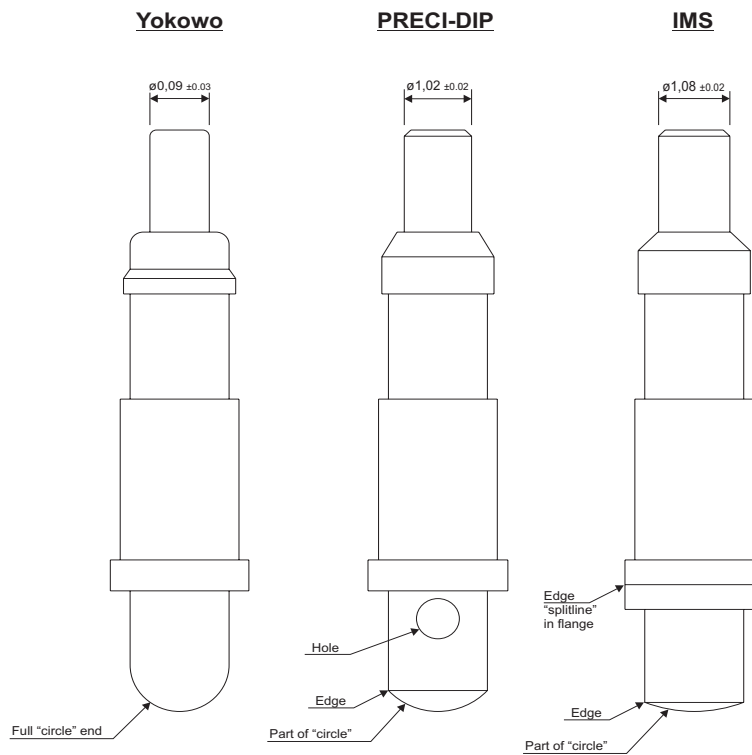
Philips display module has large "T" shaped connector and large connector cavity



Seko Epson display modules has small, square connector and small, square connector cavity



## Pogo Pin Suppliers



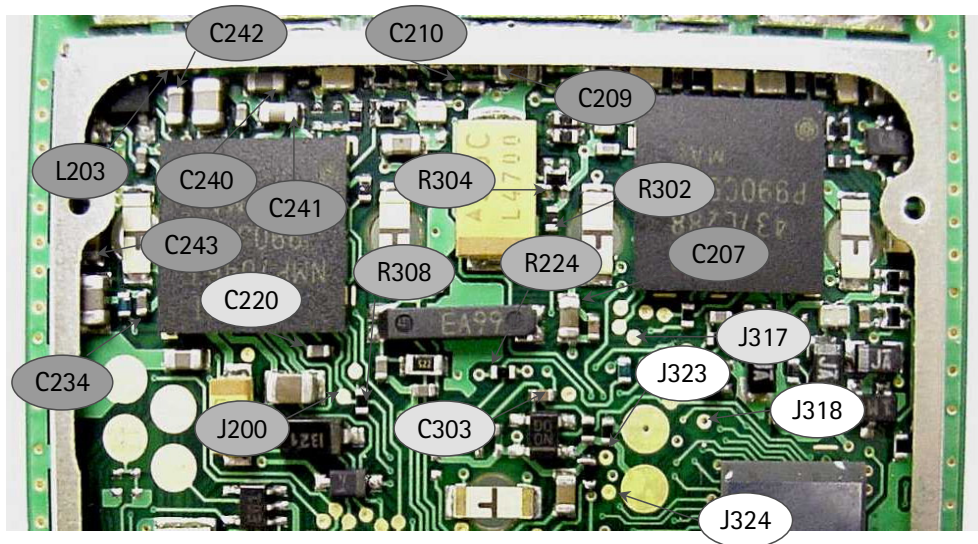


## Baseband Troubleshooting

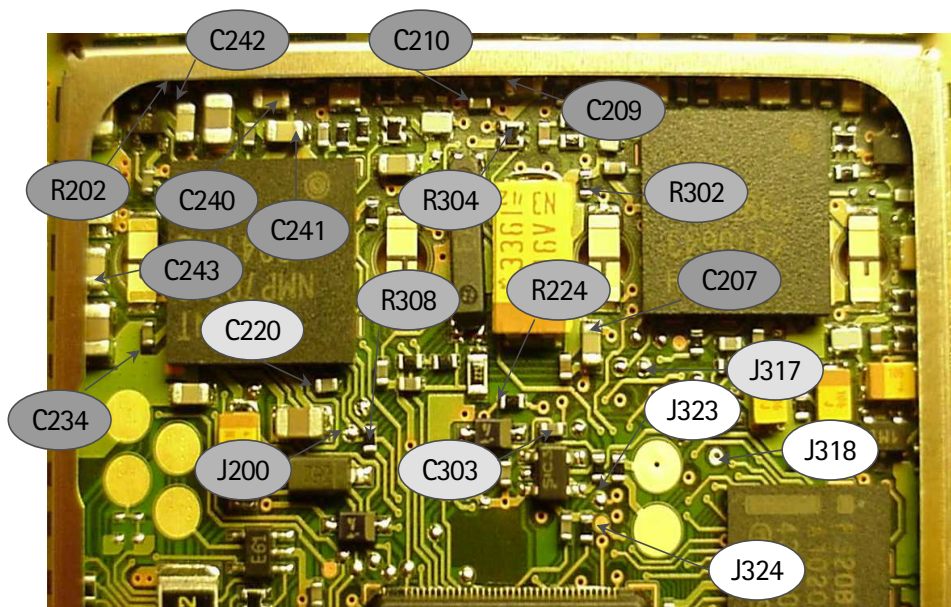
### Baseband Testpoints

Topside Components

#### ub4-08

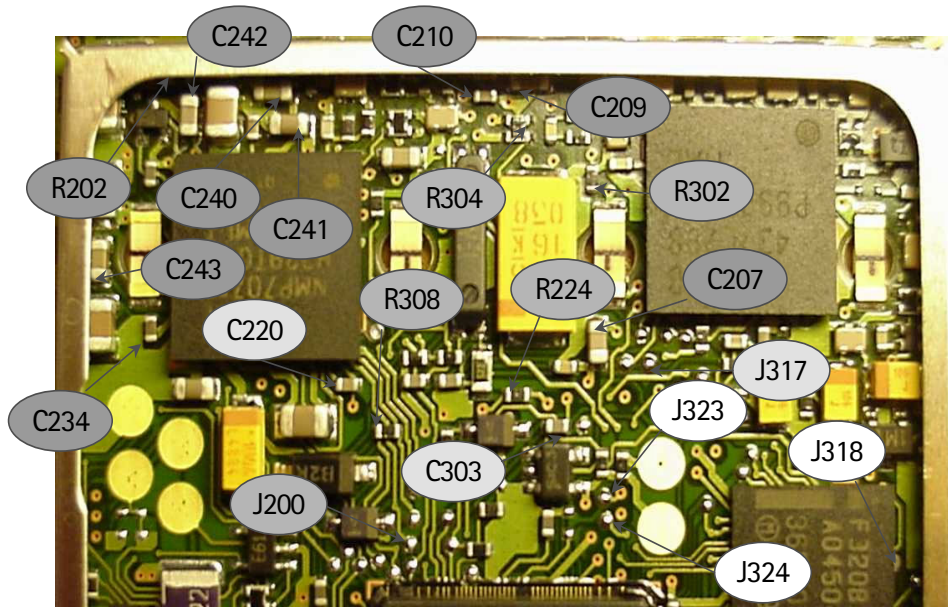


#### ub4-10



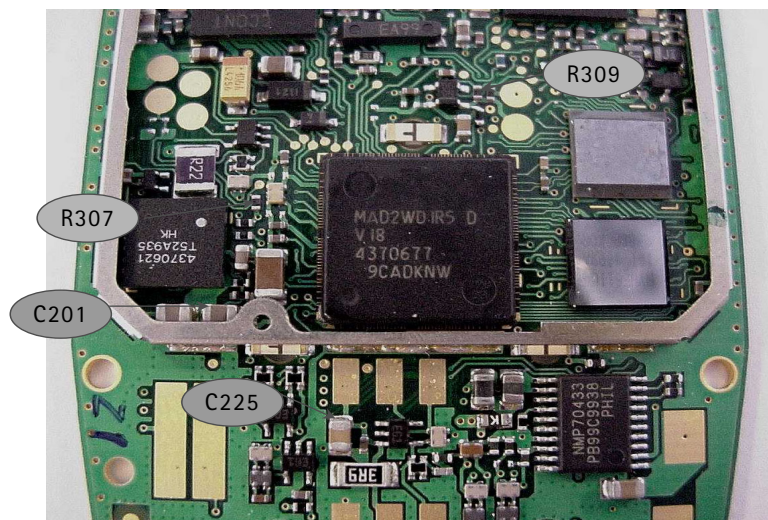


ub4-11

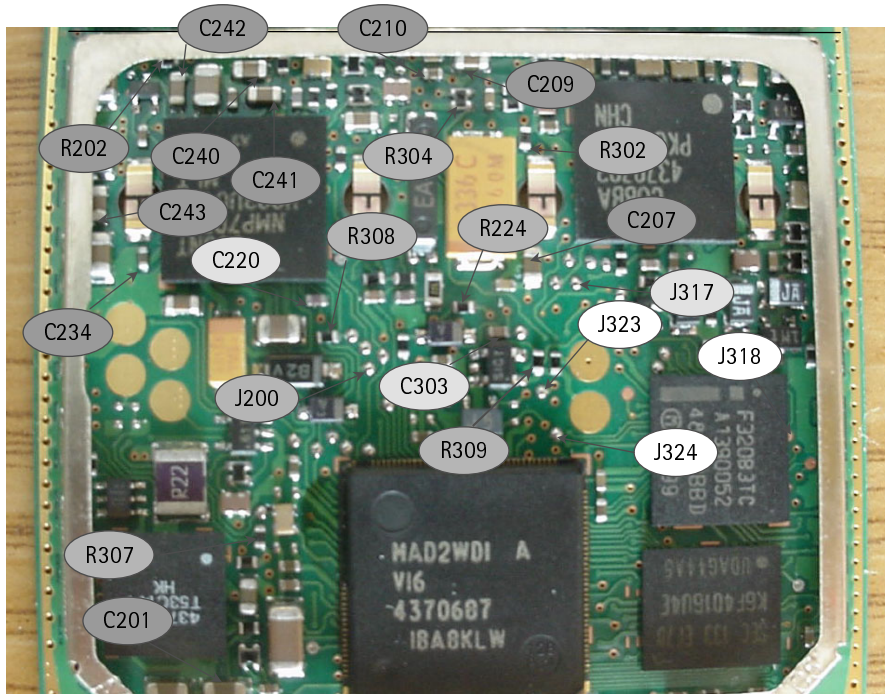


Bottom Side Components

ub4-08, ub4-10, ub4-11



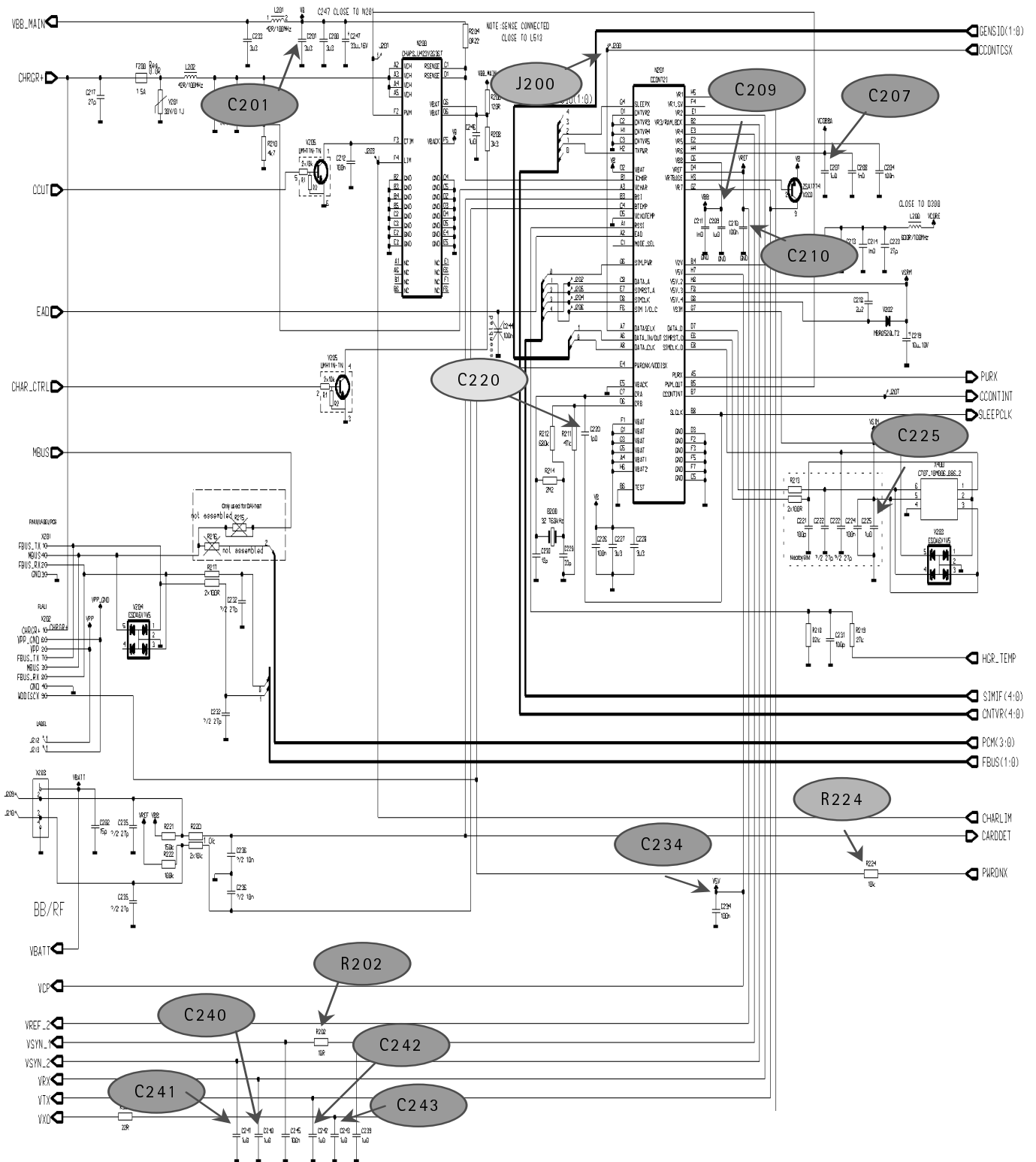
## ub4-12



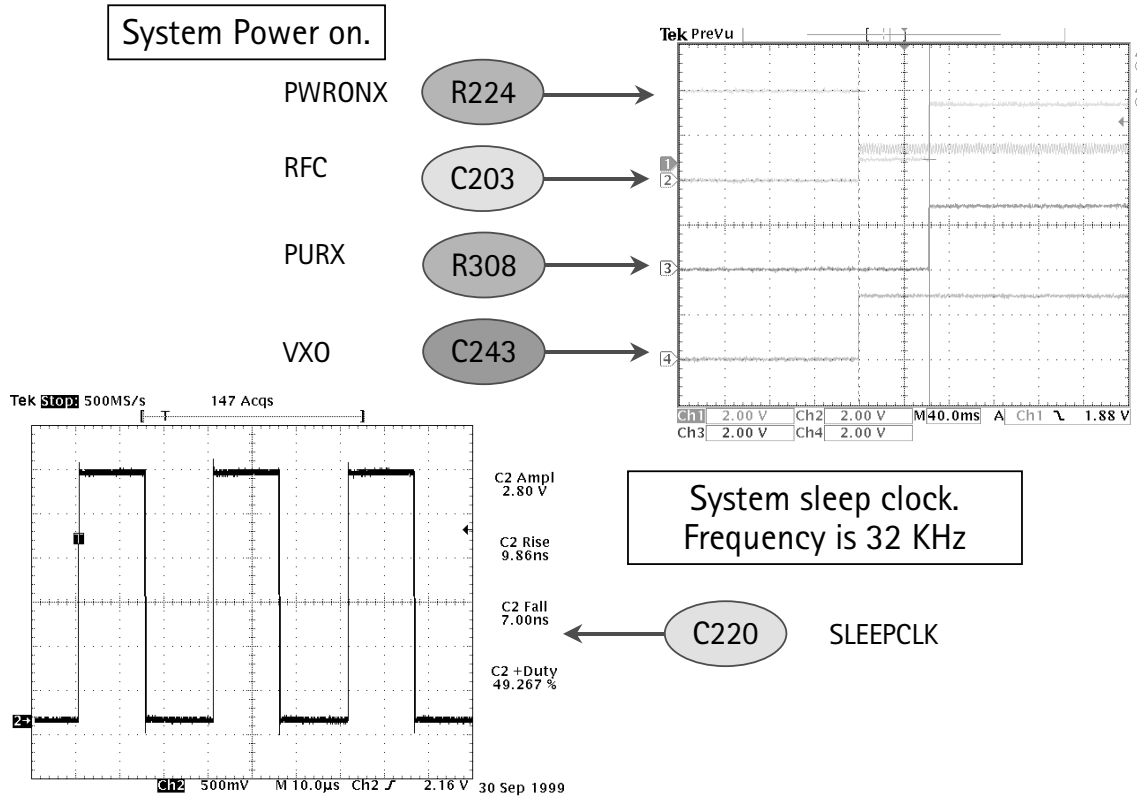
Testpoint	Net	Name	Condition	DC-level	AC-level
<b>General</b>					
R309	VPP		Flash or mulated EEPROM write	Nominal 2.8V, min 1.7V, max 2.85V	
J200	CCONTCSX		Active State	Pulsed active 0V, normal state 2.8V	
R308	PURX		Power up/down	Reset state 0V Normal state 2.8V	
R224	PWRON	PWRONX/ WDDISX	Power on	Reset state 0V Normal state 2.8V	
R304	FBUS_TX	FBUS(1)	Power on	Pulsed DC (0V to 2.8V)	
R302	FBUS_RX	FBUS(0)	Power on	Pulsed DC (0V to 2.8V)	
R307	MBUS		Power on	Pulsed DC (0V to 2.8V)	
<b>Power supplies</b>					
C201	VB (baseband)		Active state	Nominal 3.6V min 3.0V, max 4.2V	
C240	VRX		Active state	2.8V min 2.7V, max 2.85V	
R564	VX0		Active state	2.8V min 2.7V, max 2.85V	

<i>Testpoint</i>	<i>Net</i>	<i>Name</i>	<i>Condition</i>	<i>DC-level</i>	<i>AC-level</i>
R202	VSYN_1	VCOS (RF)	Active state	2.8V min 2.7V, max 2.85V	
C241	VSYN_2	Vsynte (RF)	Active state	2.8V min 2.7V, max 2.85V	
C242	VTX	Vmod (RF)	Active state	2.8V min 2.7V, max 2.85V	
C209	VBB		Active state	2.8V min 2.7V, max 2.85V	
C207	VCOBBA		Active state	2.8V min 2.7V, max 2.85V	
C234	VCP	V5V	Active state	Nominal 5.0V min 4.8V, max 5.0V	
C225	VSIM		Active state	Nominal 2.8V (3V SIM card) or 5.0V (5V SIM card)	
C210	VREF_2	VREF	Power on	1.5V ± 1.5 %	
<b>Clock</b>					
C220	SLEEPCLK	SLCLK	Power on	Pulsed DC (0V to 2.8V)	
C303	RFC	RFCLK	Active state		Typ. 0.8 Vpp (min 0.5 Vpp, max 2.0 Vpp)
J317	COBBACLK	COBBAIF(2)	Active state	Pulsed DC (0V to 2.8V)	
<b>MCU</b>					
J323	MEMC(7)	RAMSeIX	Active state	Pulsed, active 0V Non-active 2.8V	
J324	MEMC(0)	ROM1SeIX	Active state	Pulsed, active 0V Non-active 2.8V	
J318	MEMC(4)	EsysResetX	Power on	Reset state 0V, normal state 2.8V	

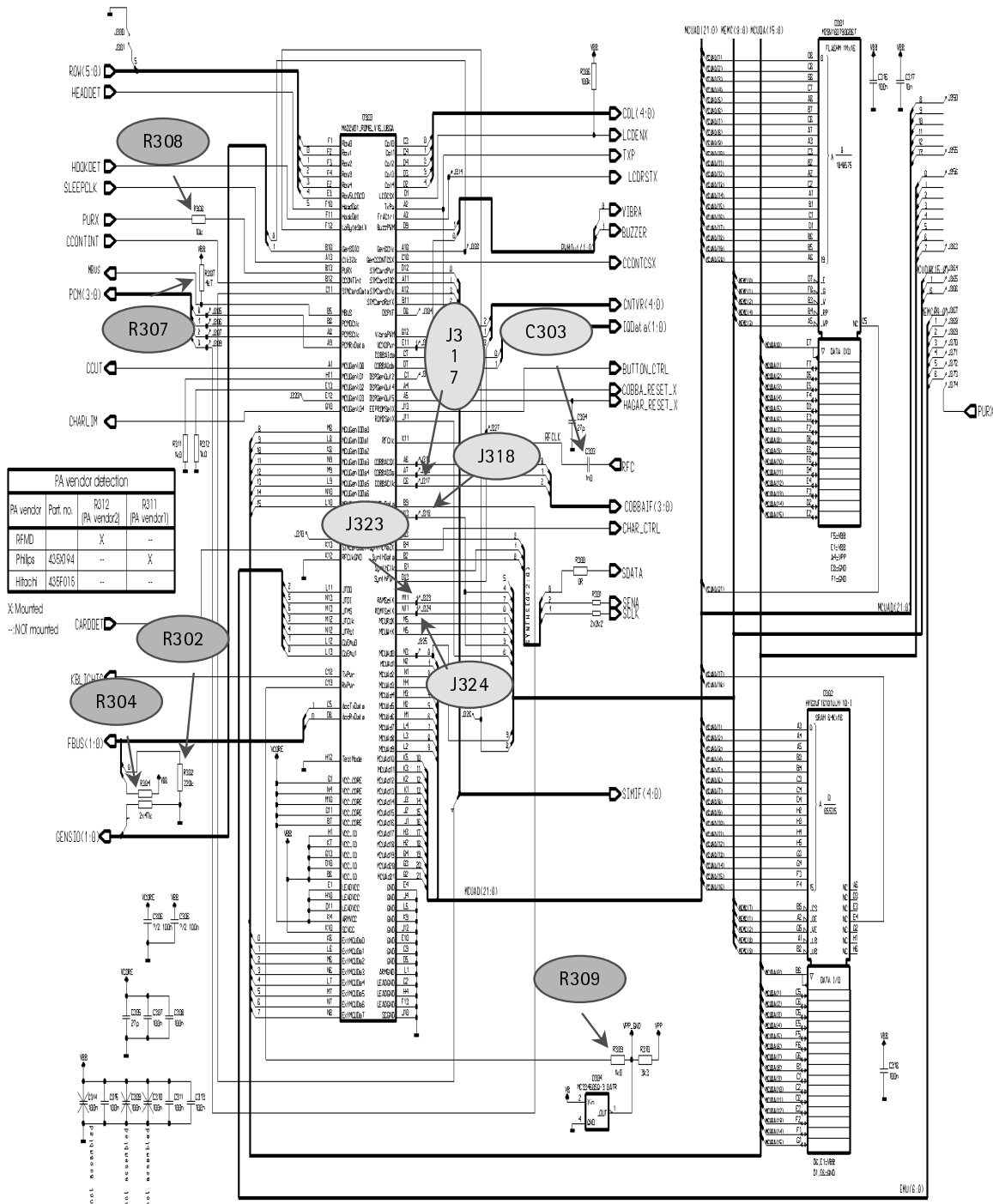
**Power Schematic - Testpoints**



Power Schematic - Plots



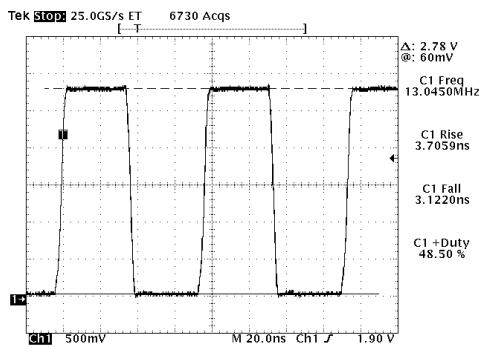
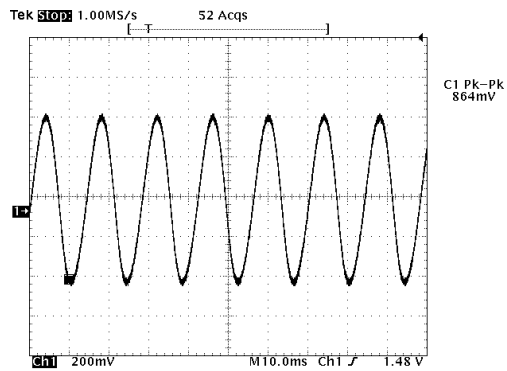
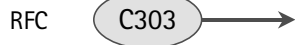
Cpu Schematic - Testpoints





CPU Schematic - Plots

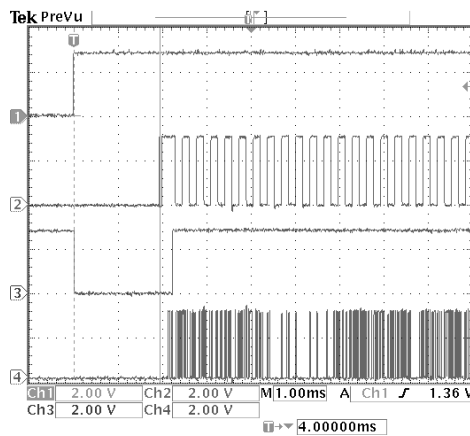
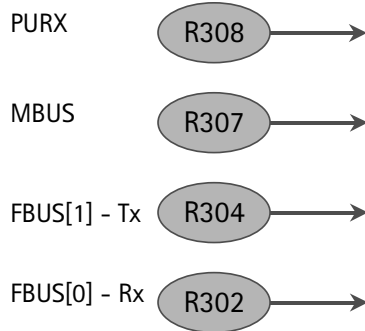
System clock.  
Frequency is 13 MHz



Cobba clock.  
Frequency is 13 MHz



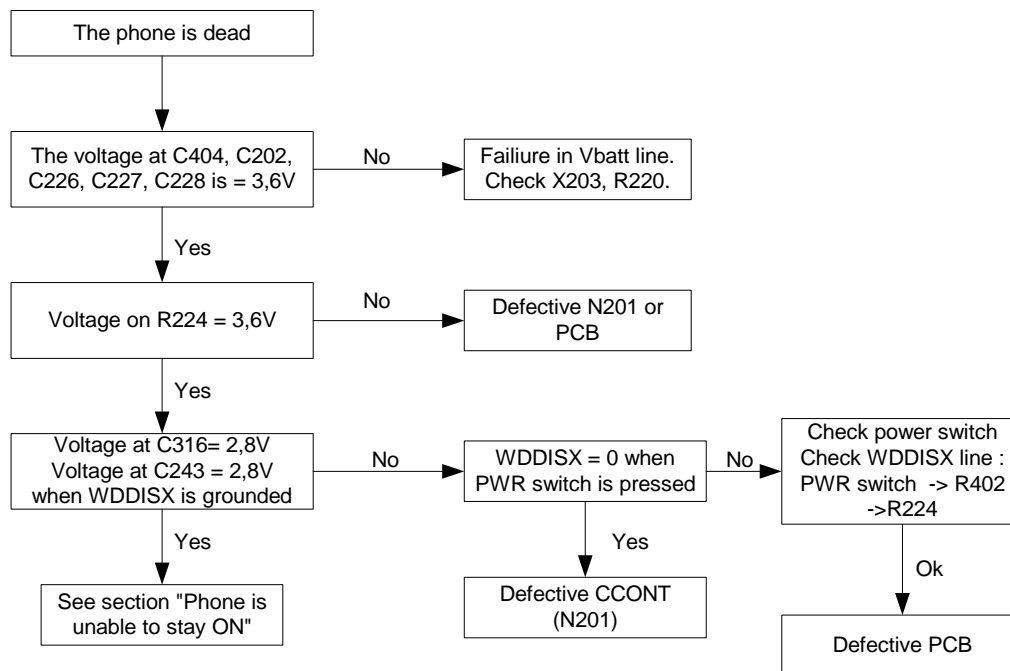
Programming flash



## Fault Finding Charts

### Phone is Dead

"Phone is dead" means that the phone does not take current when the power switch is pressed or when the watchdog disable pin WDDISX is grounded. Nominal supply voltage to the phone is 3,6 V (Vbat voltage). If the battery voltage is below 3,1 V the CCONT prevents the phone from powering up.



### Flash Programming Does Not Work

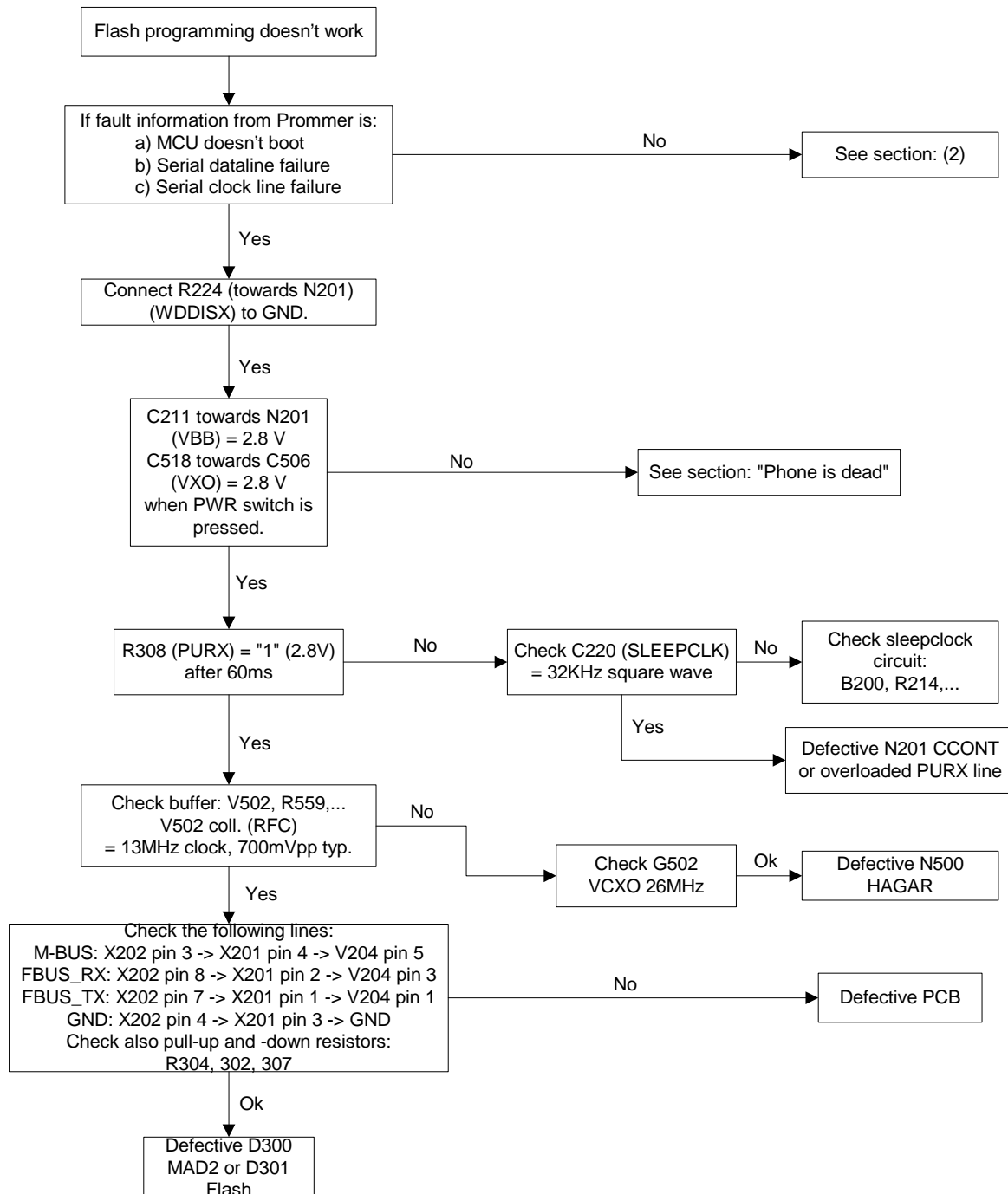
The flash programming is done in two steps and via two different connectors. FLALI (Flash align - **Production only !!!**) is the first programming step and it is done via the X202 connector. This connector, however is hidden when the PCB is placed in the D-cover and therefore the last programming step must be done via the FINUI (Final UI) connector X201. The two main differences between these two connectors are :

- Flash programming voltage is produced in a different way (external Vpp in FLALI).Signal routings are different.
- In case of a flash programming error the prommer box is able to give some information on the error that has occurred.
- The error information could be :
- MCU does not boot
- Serial clock line failure
- Serial data line failure
- External RAM failiure
- Algorithm file or alias ID not found
- MCU flash Vpp error

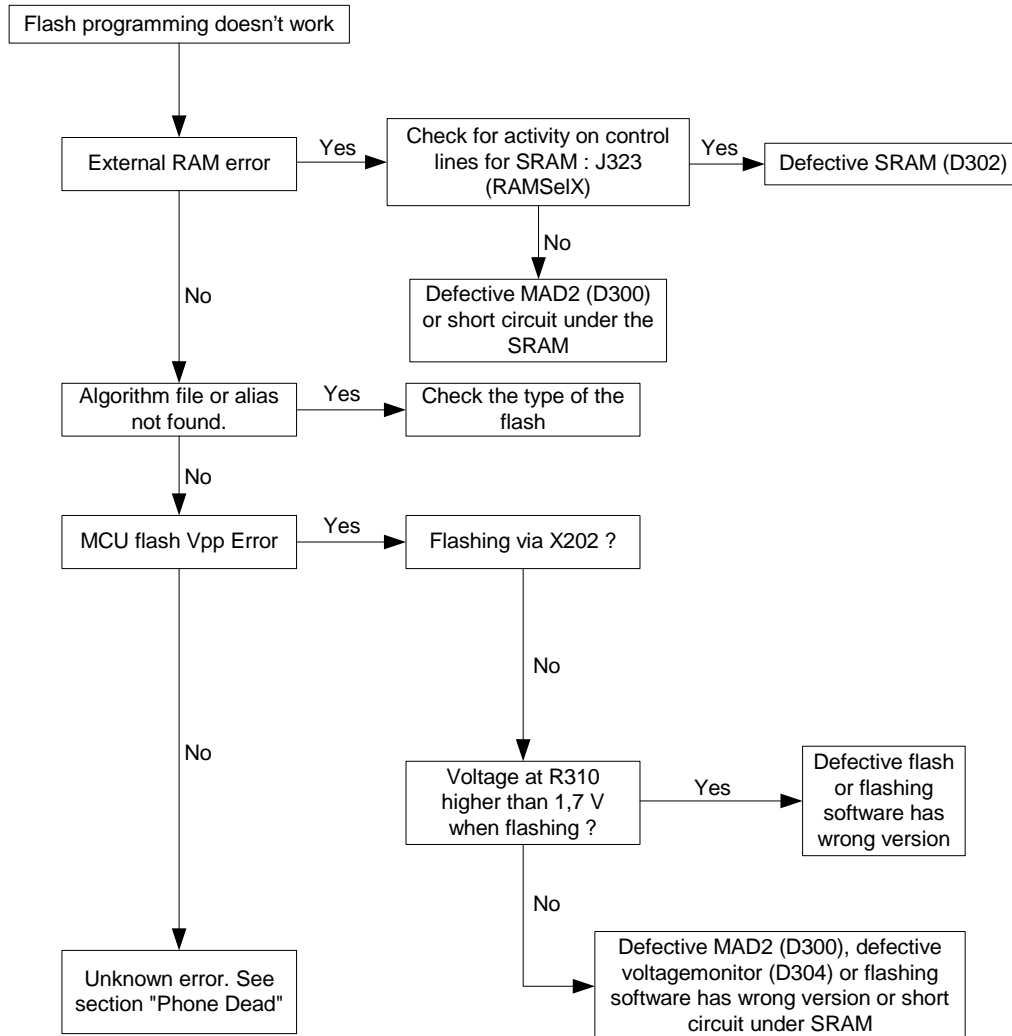
Because of the use of iBGA components it is not possible to verify if there is a short-circuit in any of the lines to and from the MAD2WD1 and the SRAM/flash circuits.

The fault finding diagrams for flash programming are as follows.

**Flash programming diagram (1)**

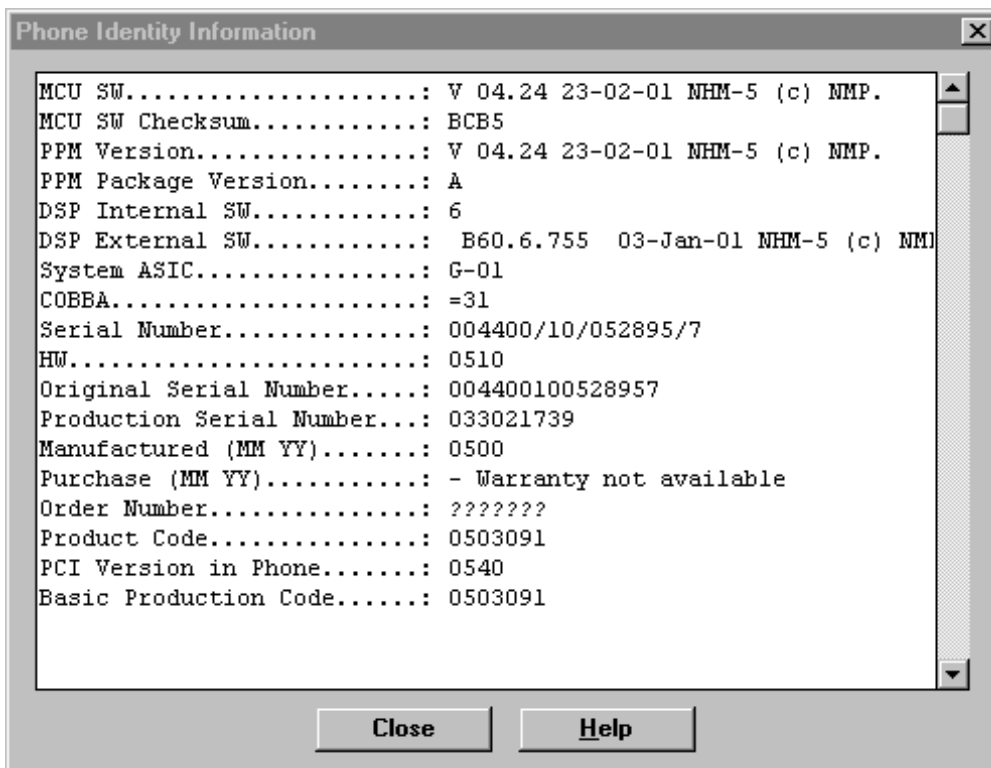


**Flash programming diagram (2)**



### Flash exchange procedure

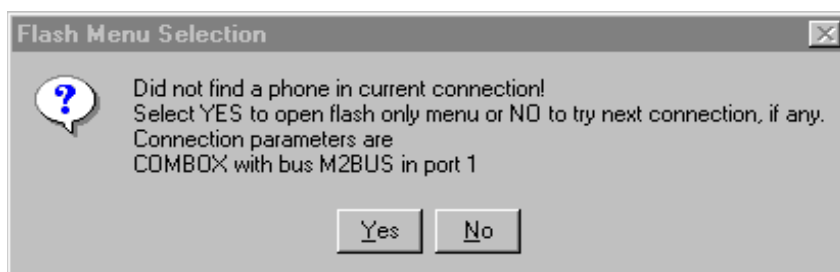
To change D301, backup the ophone identity information by using WinTesla. Open under *View* the window *Phone Information*:



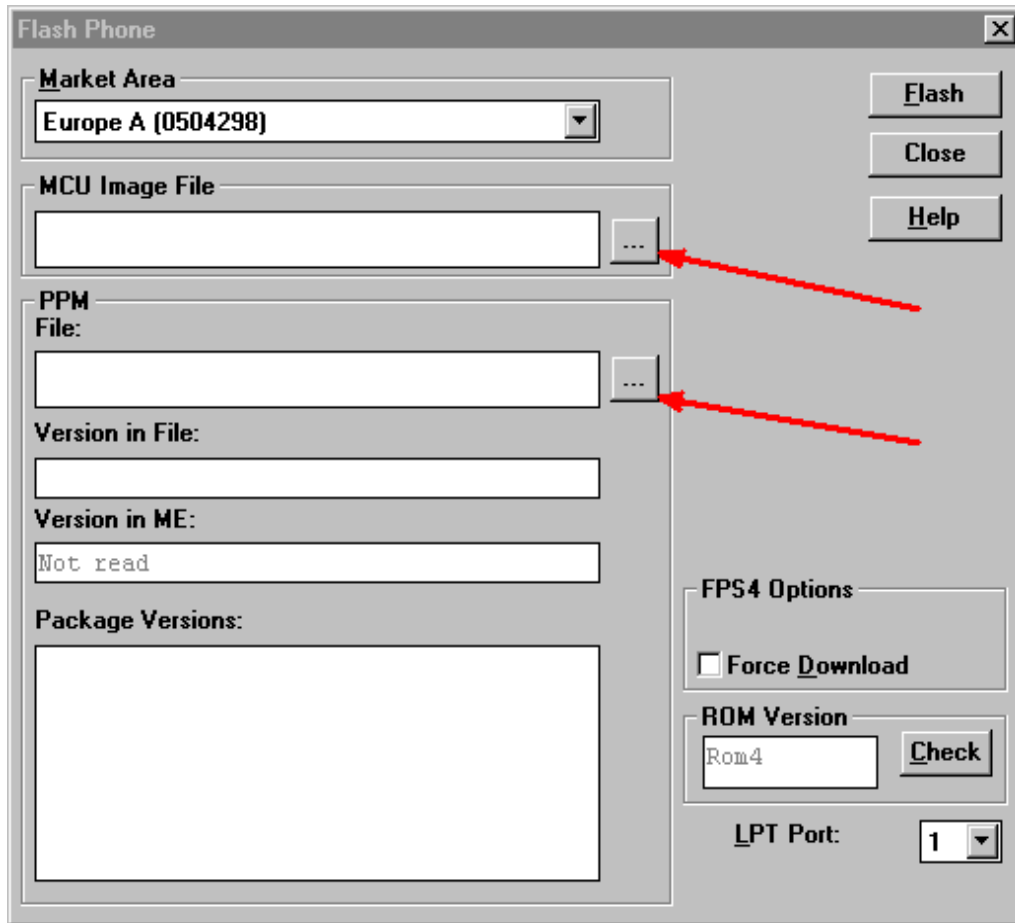
If you cannot save this data (e.g. phone does not switch on because of defect D301), it is necessary to give the phone a new identity!

If you have saved the phone identity information, you can now remove D301 and resolder the sparepart - always use approved  $\mu$ BGA rework machine for changing any  $\mu$ BGA!

After changing D301, the phone will not switch on because of the empty Flash, so that next action is making a SW-update. Start WinTesla and choose *Product / Open / NHM-5* and press OK. Now you will get the following message:

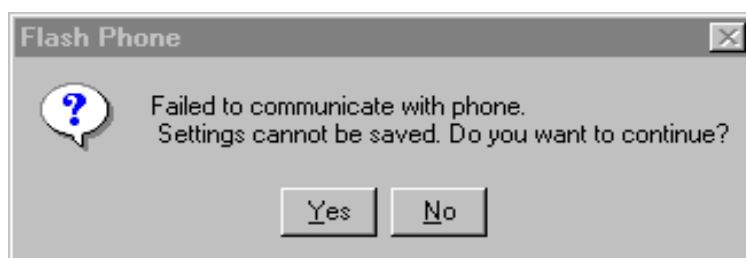


If you select Yes, WinTesla will start and you can choose *Dealer / Flash Phone*, so that you get the following window:



Now you have chosen a MCU Image File and PPM File for your phone by pressing on the squares with the three dots. At this point it is not necessary to choose the right file, because this SW-update is used only to make it possible to power the phone on.

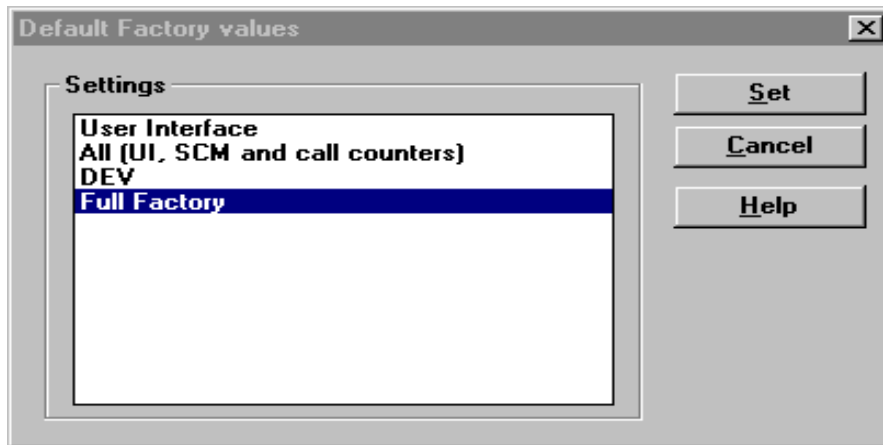
After selecting the two files, you have to press the *Flash*-button to start the SW-update. Next message will be the following:



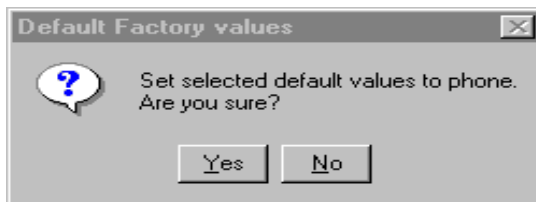
Select *Yes* and the SW-update will start. If your phone has no fault and the Flash/Eeprom was well soldered, you will get order to *Restore Default User Settings* - press OK. After that you will get message, that *Flashing completed* : press OK. Now close the *Flash Phone* window by pressing the *Close* button.

In the next step open *Software / Set Factory Values*, choose *Full factory* and press *Set*:



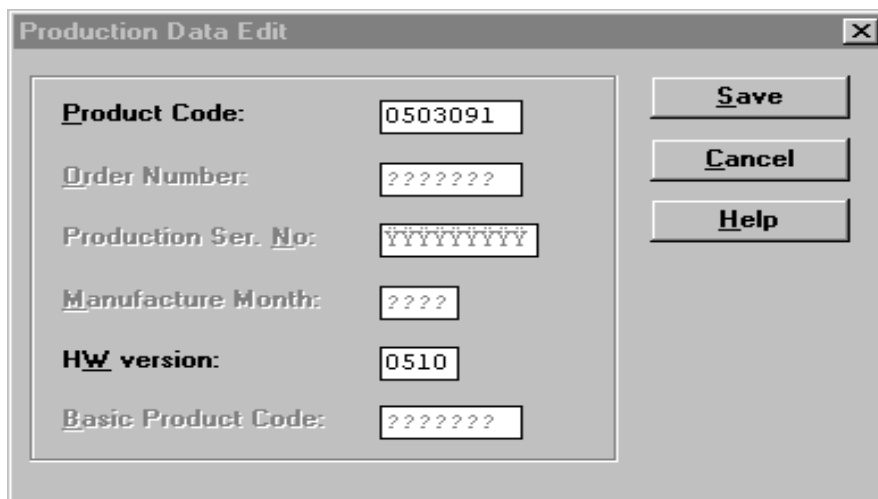


Next message you will get is this:



After pressing Yes you will get order to *Restore Default User Settings* – press OK. Now you can close window shown on the top of this page by pressing *Cancel*.

In the next step you have to open *Software / Production Data Edit*:



Rewrite product code an HW version out of your saved phone data into window and press *Save*.

After this procedure you have to write back IMEI / SIMlock data and run SW-update once more. This time you have to choose the correct flash file matching to your product code! Close the window which asks you to save user data to file by pressing *No* and *Restore Default User Settings* by pressing OK after flashing.

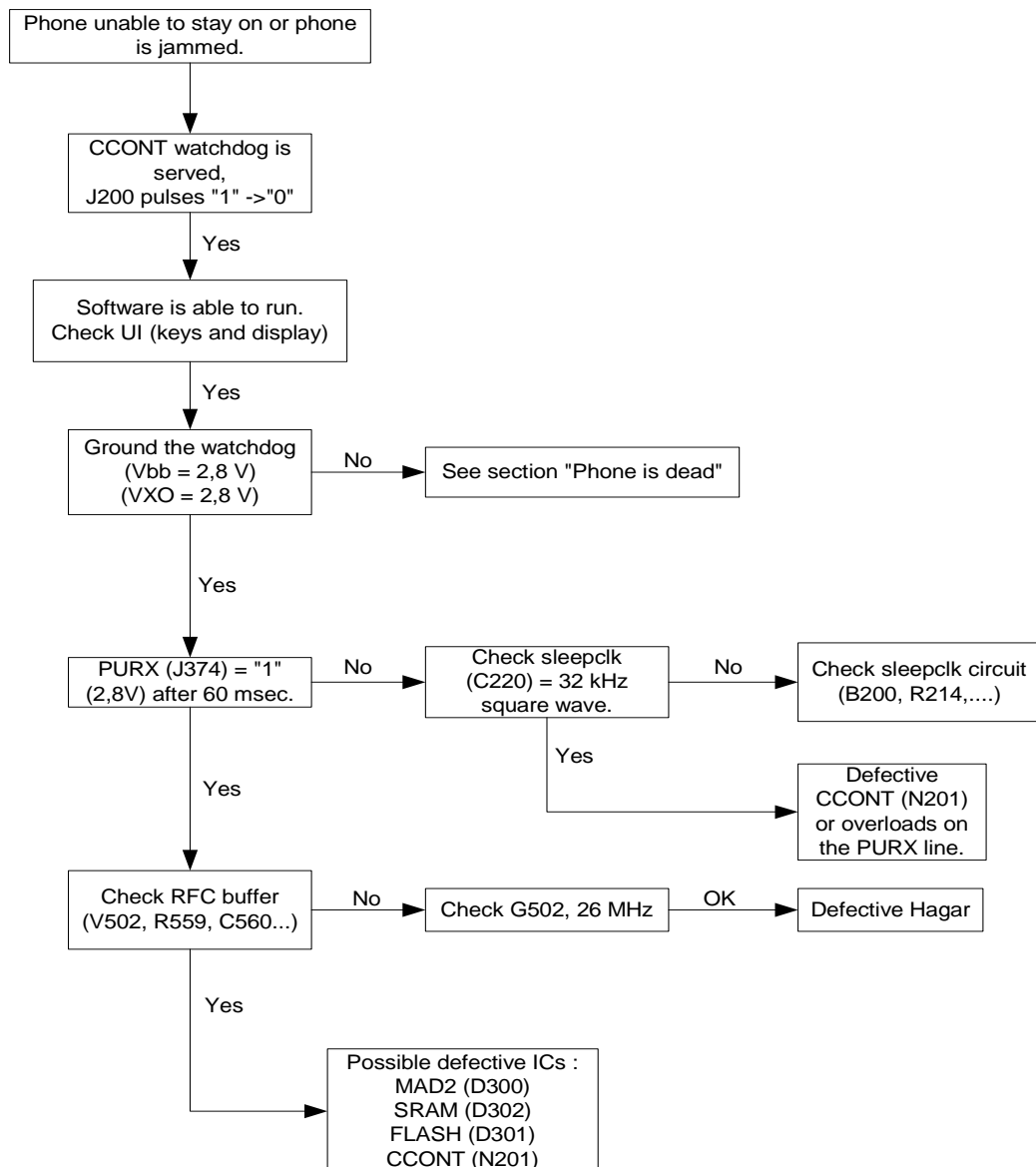
Remember to retune RX/TX values and run energy management calibration, because all tuning data is lost after changing D301!

### Phone Stays On or is Jammed

If this kind of error occurs after flashing the most plausible reason is open pins on an IC.

Normally the CCONT will power the phone down after 30 seconds if the watchdog has not been served by SW. Connecting an oscilloscope to J200 (DataSelX on the CCONT) can monitor the watchdog updating. Normally there is a short pulse from 1 to 0 every 8 seconds. Grounding J200 can disable the power off function.

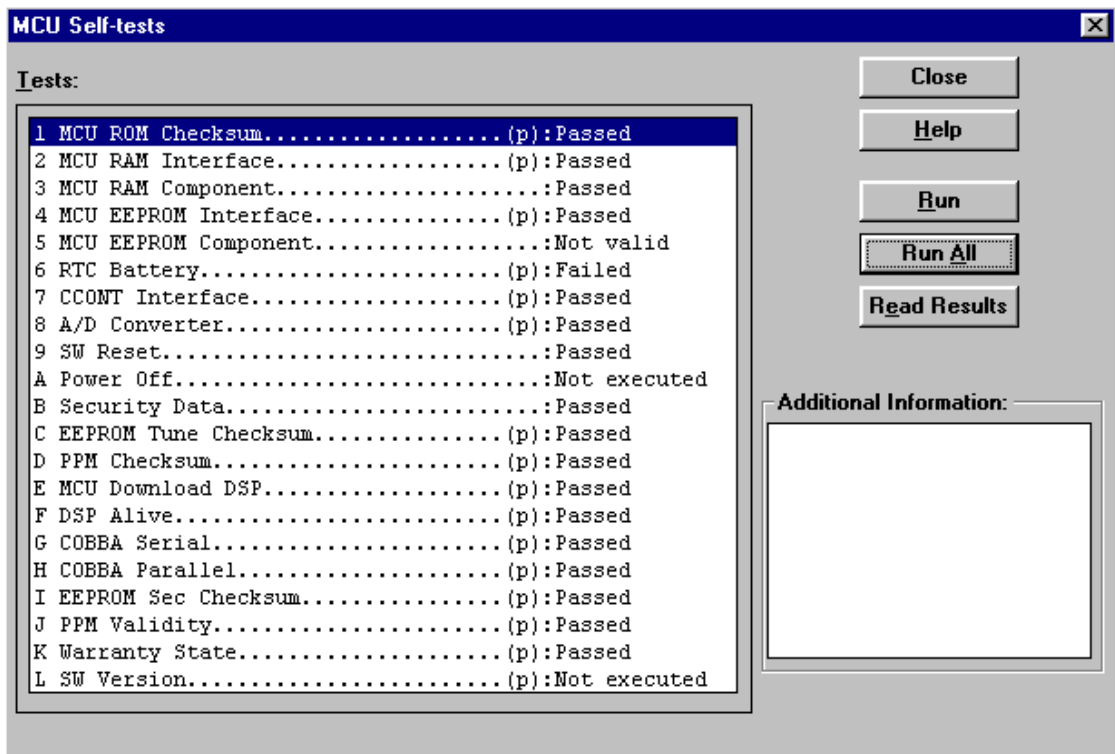
Fault finding diagram, ad. 3.



### Display Information : "Contact Service"

If the message "Contact Service" is displayed one or more parts of the software is unable to execute properly. At the same time, the watchdog is triggered and is thereby able to tell if an error has occurred. Selftest functions are executed when the phone is powered on and if one or more selftest functions fails, the message "Contact Service" is shown in the display.

MCU selftest cases can be split into two categories : the ones that are executed during power up and the ones that are executed only with a PC connected. These test and the items included are as follows :



The information shown above can be used to diagnose the phone.

Explanation of MCU ROM Checksum : A 16 bit checksum is calculated from the flash code and the result is then compared to the one found in the flash.

## **No Network Found, No Call Established**

When the phone is unable to either find a network or establish a call, both the RF part and the baseband part can cause it. The phone can be set to required mode (RF measurements) by the WinTesla service software in order to determine if the error is placed either in the RF part or the baseband part.

There are two circuits that supplies the RF part of the phone. These circuits are :

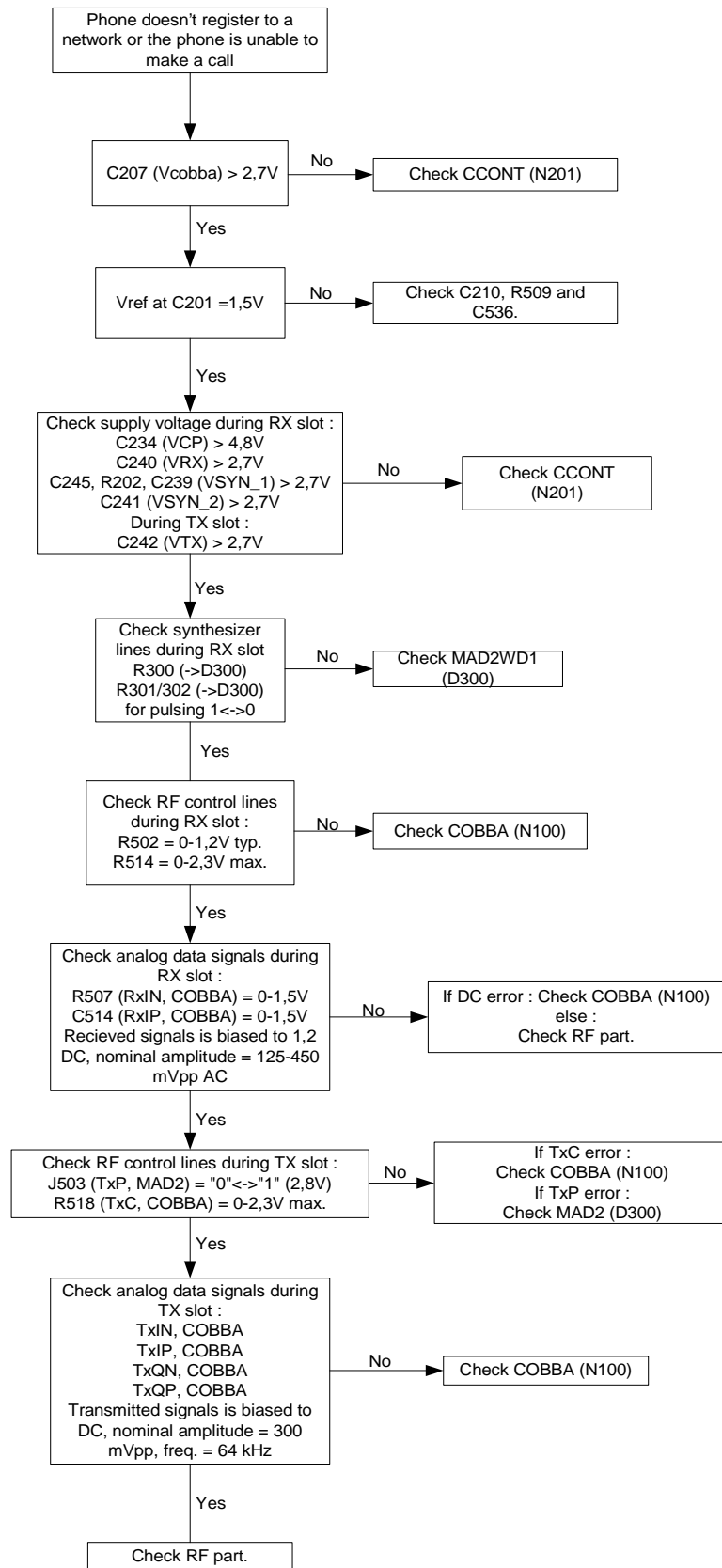
MAD2WD1 (D300)

COBBA (N100)

The MAD2WD1 circuit supplies the RF part with the digital control signals : SynthEna, TxP, etc. and the COBBA supplies the RF part with the analog control signals : AFC, TxC etc

After power up, DSP indicates all the completed functions by changing the state of the XF pin as shown overleaf.

### Phone Not Registering to a Network

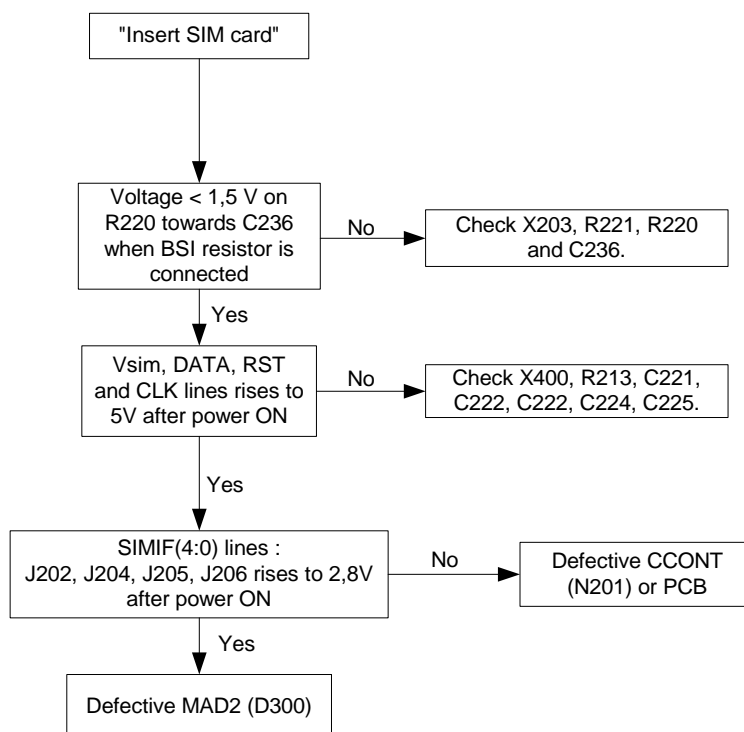


### Sim Related Errors

The SIM interface from the MAD2WD1 (D300) to the SIM connector (X400) can be tested without a SIM card. When the power is switched on and the BSI terminal is grounded by a resistor, all interface lines (VSIM, DATA\_A, SIMRST\_A, SIMCLK) rises, first to 3V the to 5V. This is repeated four times. In this way it is possible to find errors in the SIM interface without a SIM card.

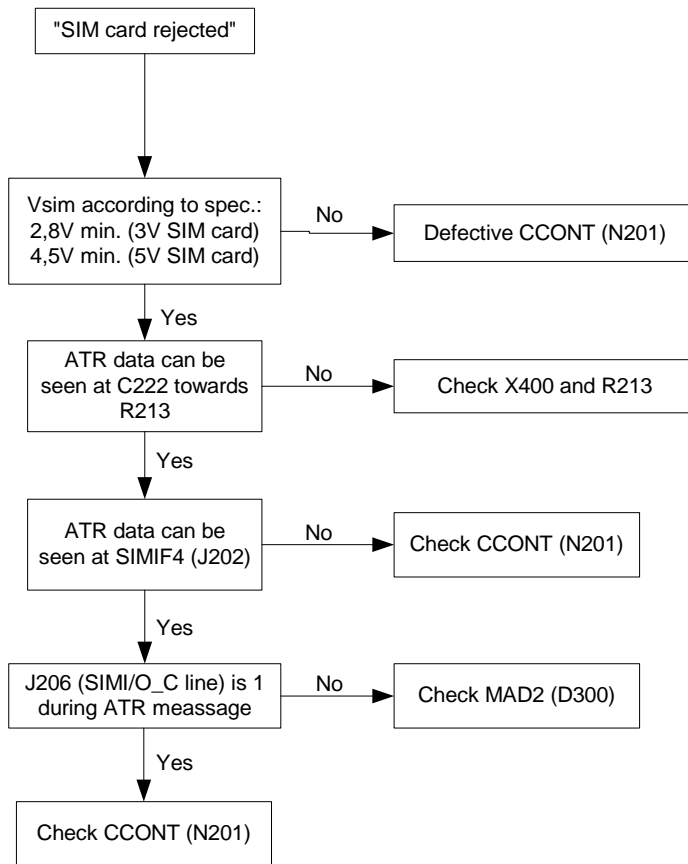
In case of a "SIM card rejected" error, the ATR message is actually sent from the SIM card but it is somehow corrupted, the data signal levels are out of spec. or the factory set values is incorrect (SIM locks etc.).

#### "Insert SIM card" error



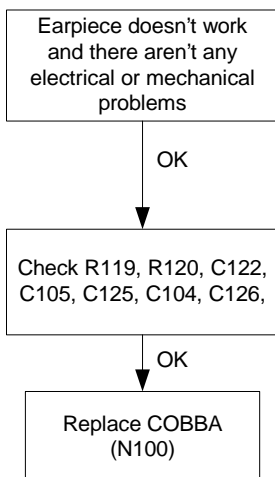


"SIM card rejected" error

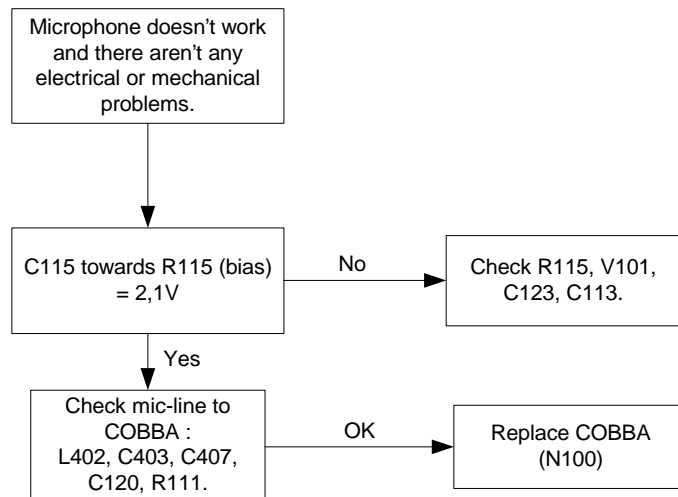


Audio Faults

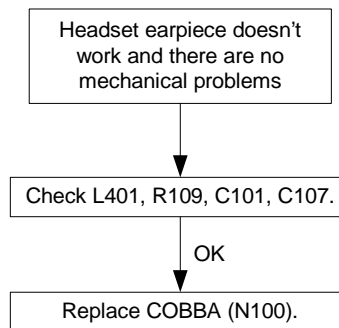
Internal earpiece



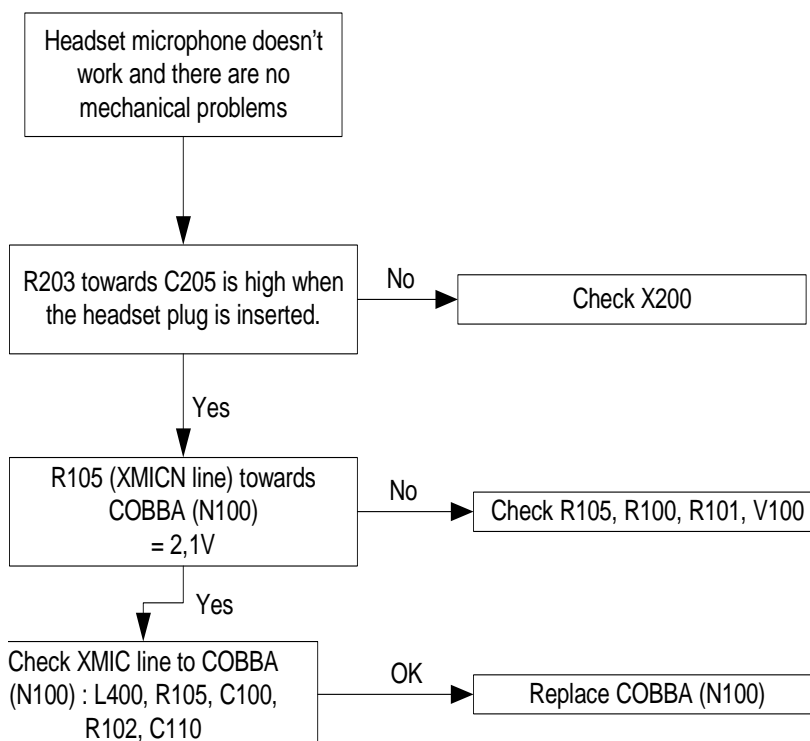
**Internal microphone**



**External earpiece**

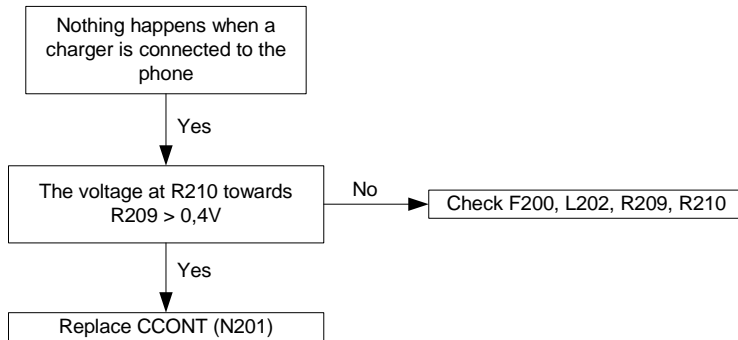


**External microphone**

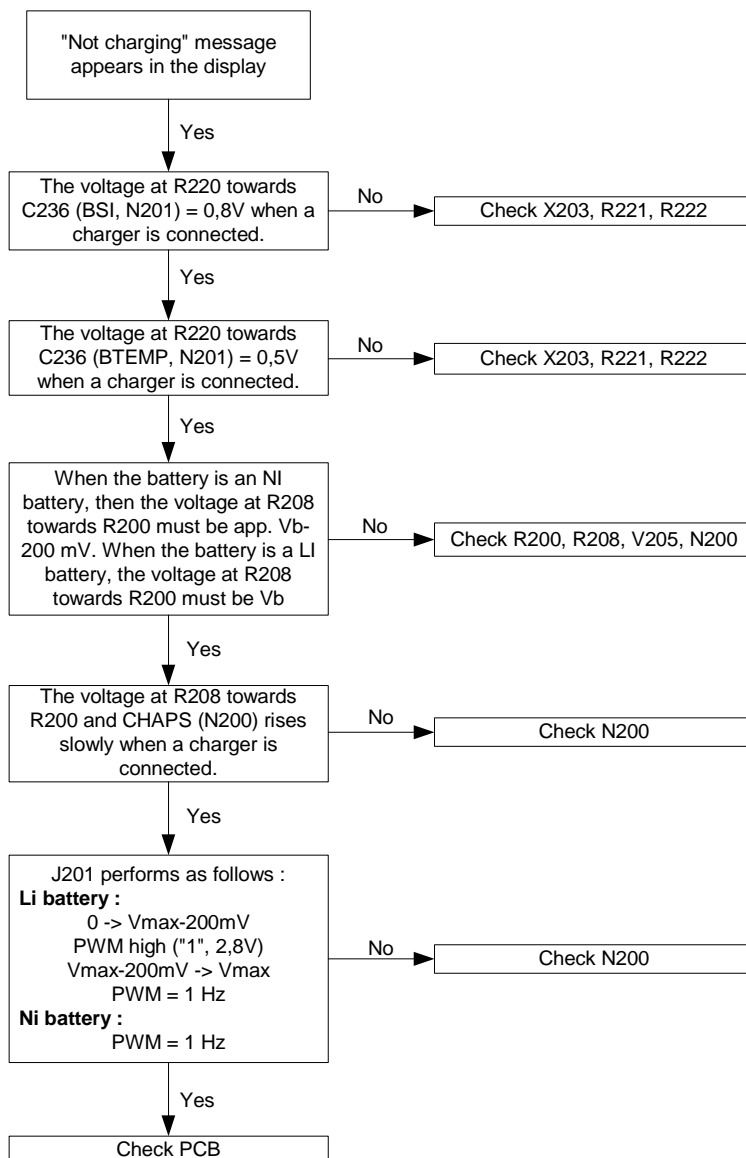


## Charging Error

### No detection of charger



### "Not Charging" message



## RF Troubleshooting

Two types of measurements are used in the following. It will be specified if the measurement type is "RF" or "LF".

- RF measurements should be done with a Spectrum Analyzer and a high-frequency 500 ohm passive probe, for example HP54006A. (Note that when measuring with the 500 ohm probe the signal will be around 20 dB attenuated. The values in the following will have these 20 dB subtracted and represent the real value seen on the spectrum analyzer).
- LF (Low frequency) and DC measurements should be done with a 10:1 probe and an oscilloscope. The probe used in the following is 10MW/8pF passive probe. If using another probe then bear in mind that the voltages displayed may be slightly different.

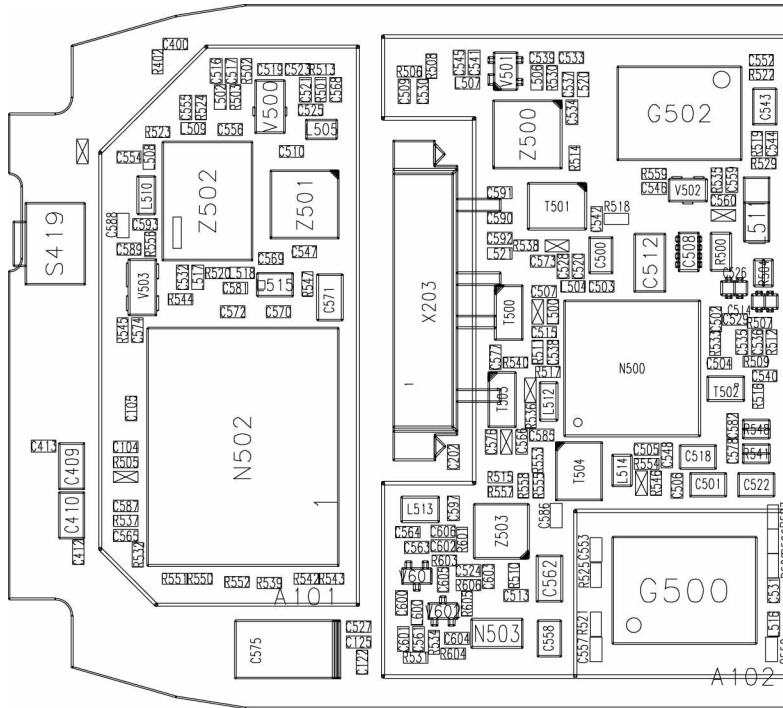
Always make sure the measurement set-up is calibrated when measuring RF parameters on the antenna pad. Remember to include the loss in the module repair jig when realigning the phone.

Most RF semiconductors are static discharge sensitive. So ESD protection must be taken during repair (ground straps and ESD soldering irons). Hagar is moisture sensitive so parts must be pre-baked prior to soldering.

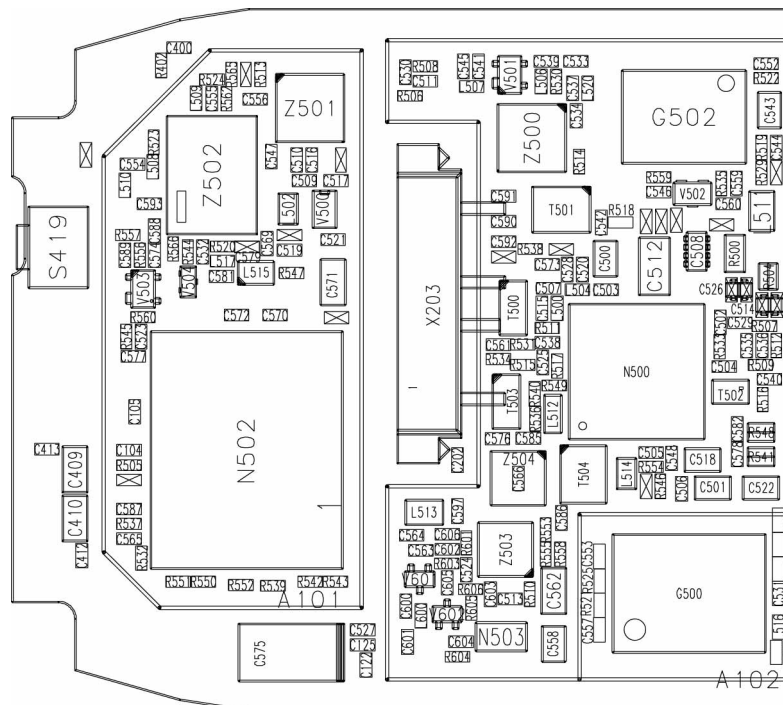
Apart from key-components described in this document there are a lot of discrete components (resistors, inductors and capacitors) for which troubleshooting is done by checking if soldering of the component is done properly and checking if the component is missing from PCB. Capacitors can be checked for short-circuiting and resistors for value by means of an ohmmeter, but be aware in-circuit measurements should be evaluated carefully.

In the following both the name EGSM and GSM900 will be used for the lower band and both PCN and GSM1800 will be used for the upper band.

# RF Key Component Placement



Ub4-08 / Ub4-09



Ub4-10 / Ub4-11 / Ub4-12.

R505, R555 and R566 do not exist on Ub4-11

R505 and R555 do not exist on Ub4-12

<b>N502</b>	<b>Power amplifier (PA)</b>
Z502	RXTX switch
Z501	1 <sup>st</sup> Dual RX SAW filter (EGSM & GSM1800)
Z500	2 <sup>nd</sup> Dual RX SAW filter (EGSM & GSM1800)
G502	VCTCXO (26 MHz Crystal oscillator)
N500	Hagar RF IC
G500	VCO (3.6 GHz UHF VCO)
Z503	EGSM TX SAW filter (GSM)
Z504	GSM1800 TX SAW filter (only module UD4 + UX4)

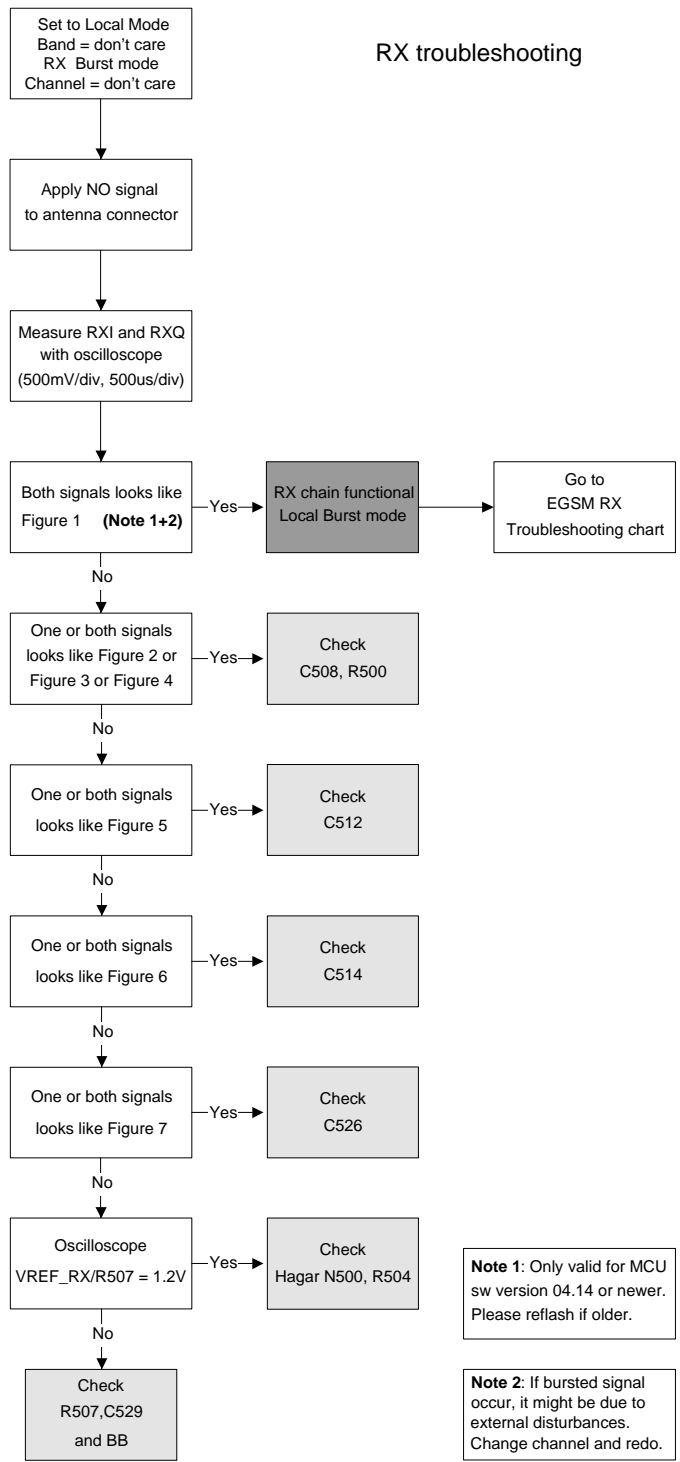
## Abbreviations in Fault Finding Charts

BB	Baseband
DC	Direct Current
ESD	Electro Static Discharge
f:	Frequency of signal (measured with Spectrum Analyzer)
LF:	Low frequency (measured with oscilloscope)
LO	Local Oscillator
P:	Power of signal in decibels (dB) (measured with Spectrum Analyzer)
PA	Power Amplifier
PCB	Printed Circuit Board
PLL	Phase Locked Loop
RF	Radio Frequency
RX	Receiver
T:	Time between pulses
TX	Transmitter
UHF	Ultra High Frequency
V:	Voltage of signal (measured with oscilloscope)
VCO	Voltage controlled oscillator
VHF	Very High Frequency



# RX Troubleshooting

Use chart below as entry point for general RX troubleshooting.



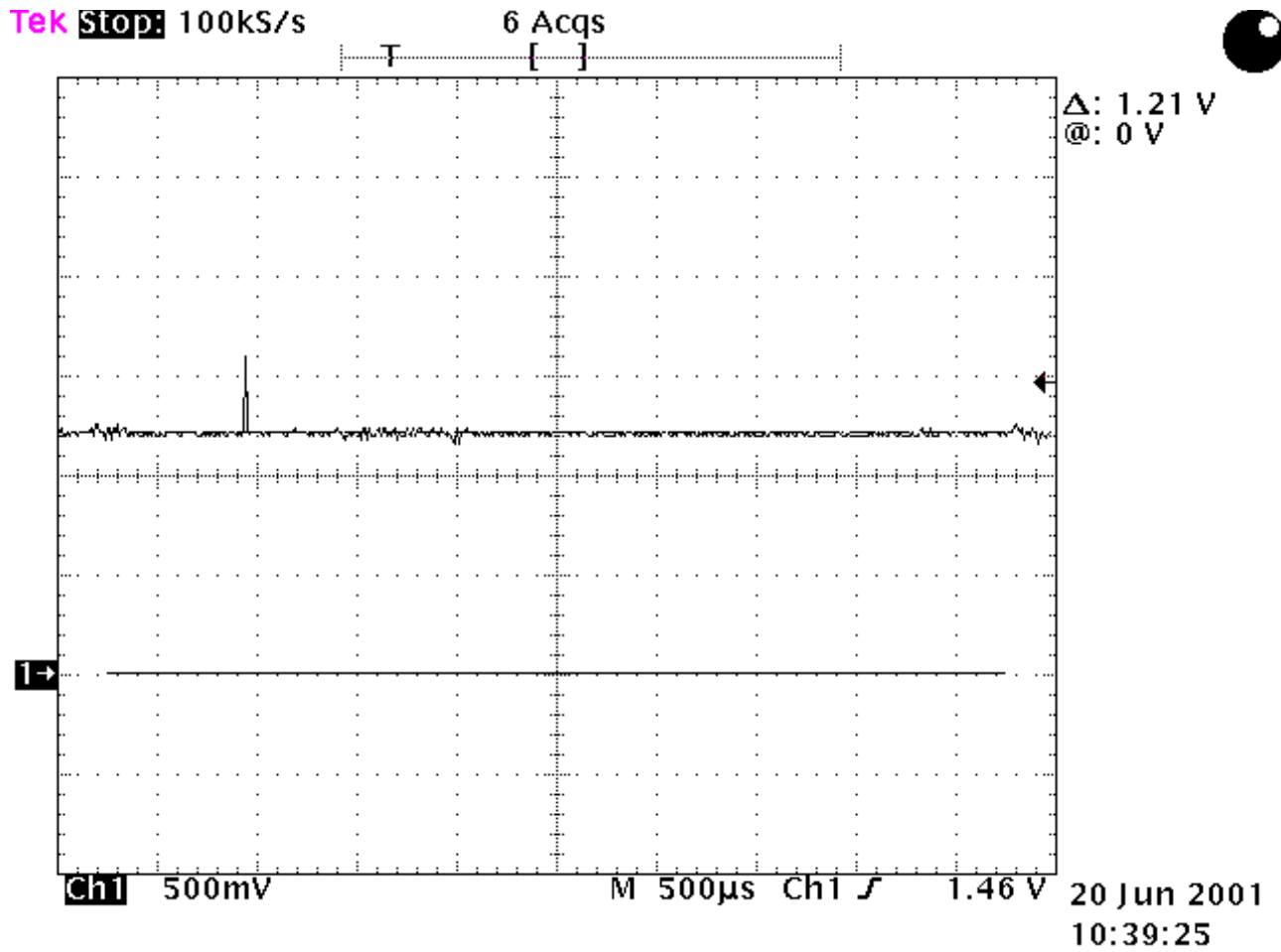


Figure 1 I/Q working ok

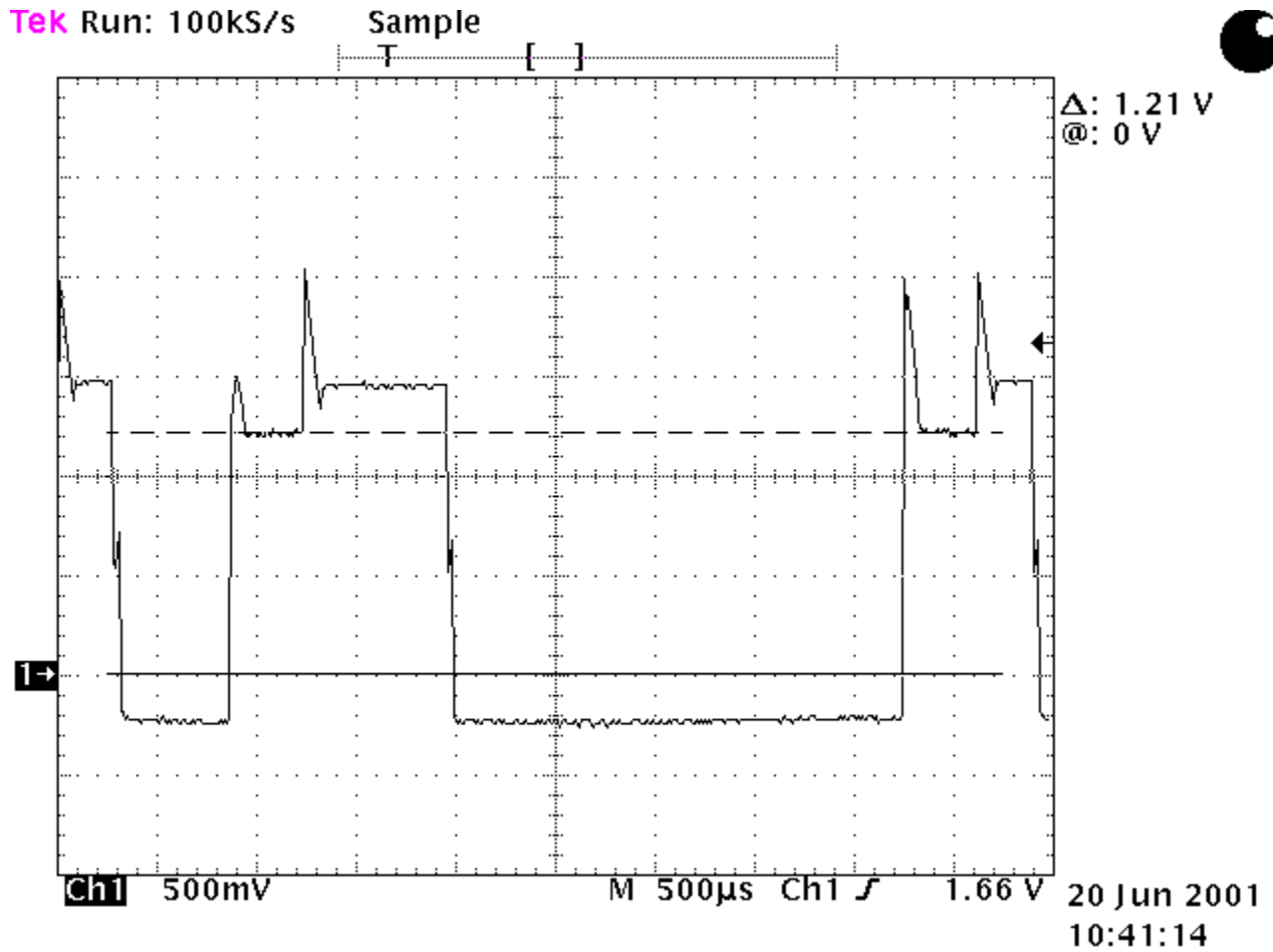


Figure 2 Check C508

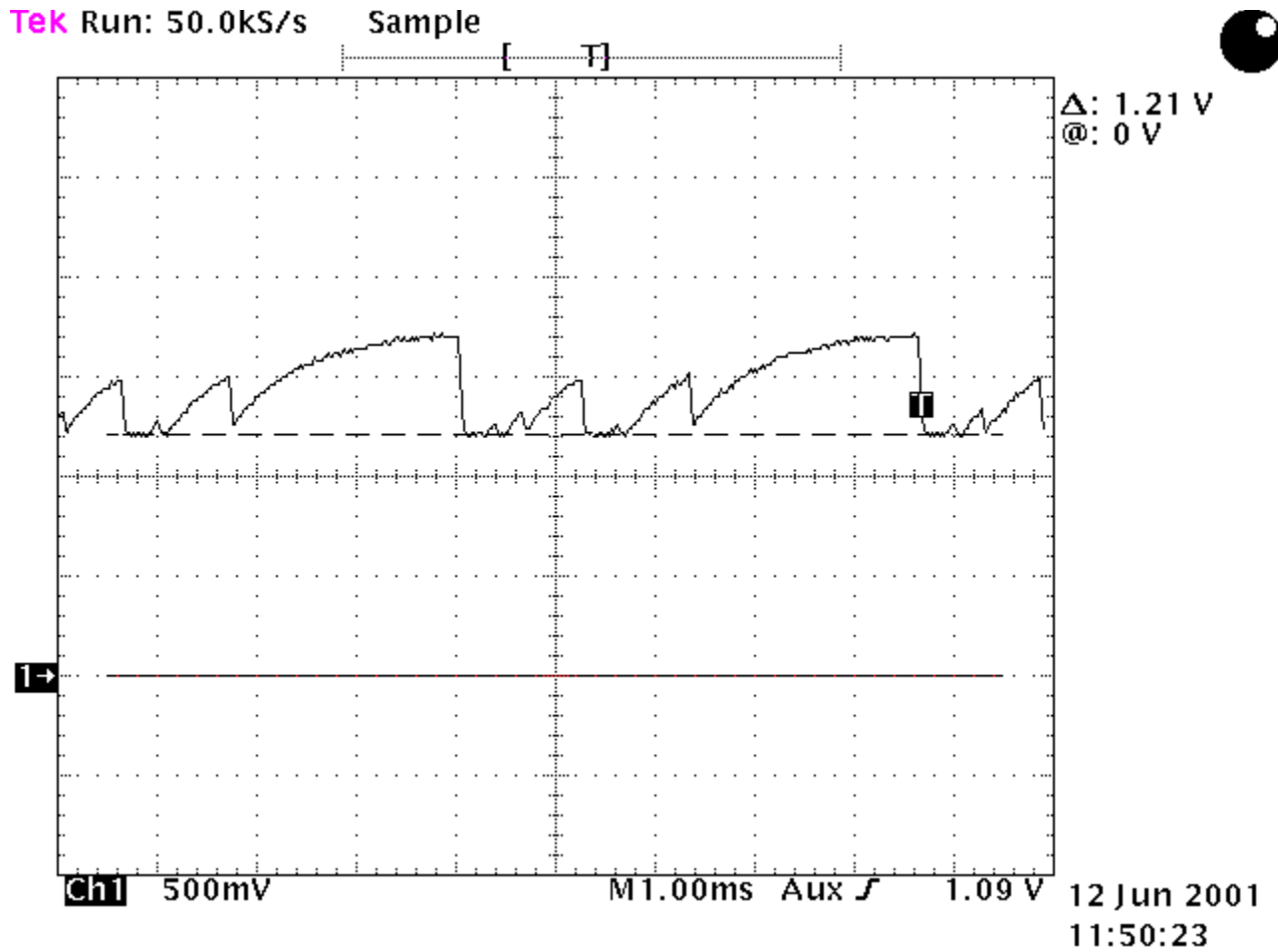


Figure 3 Check C508<sub>+</sub> C515

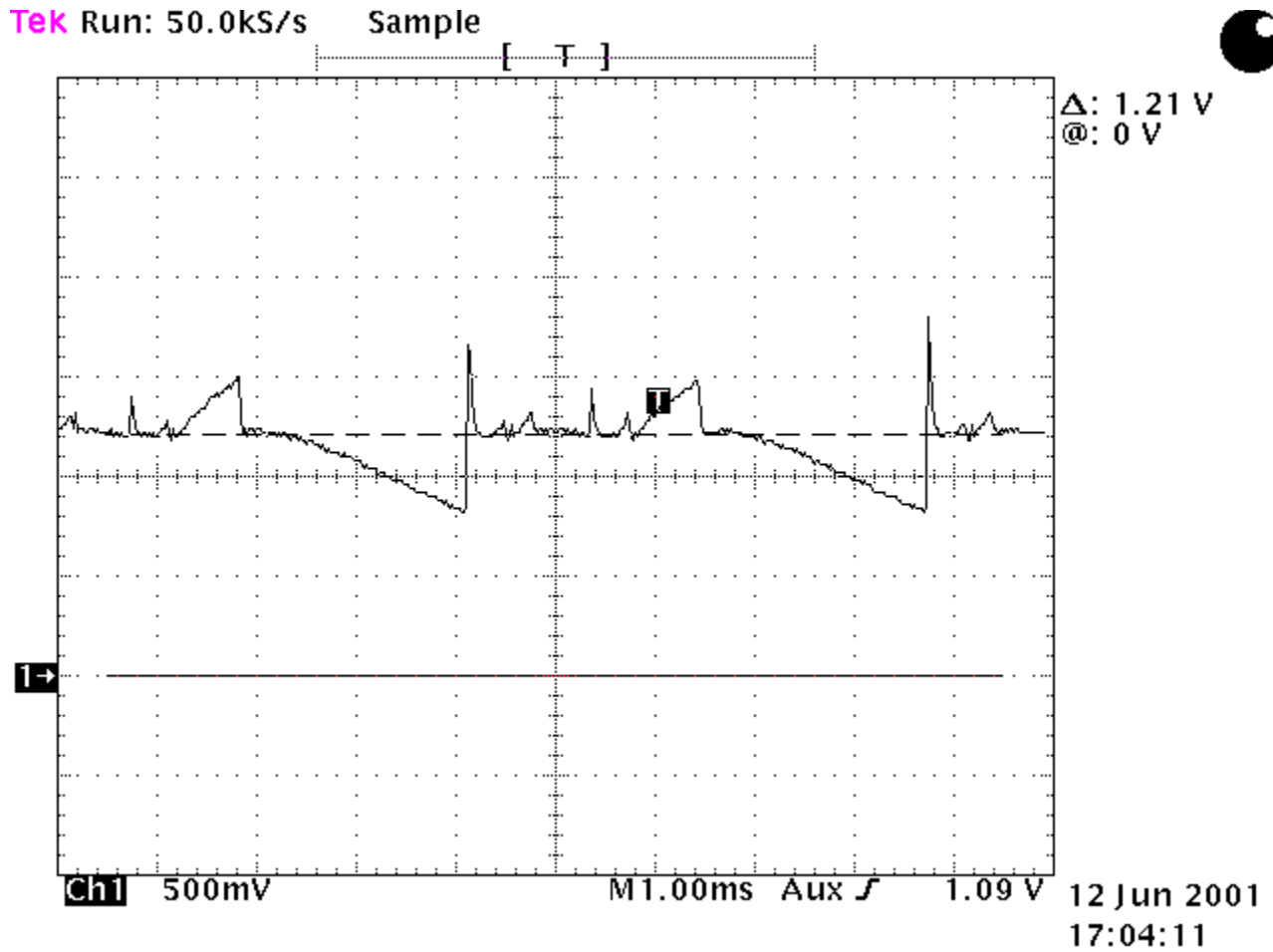


Figure 4 Check C508

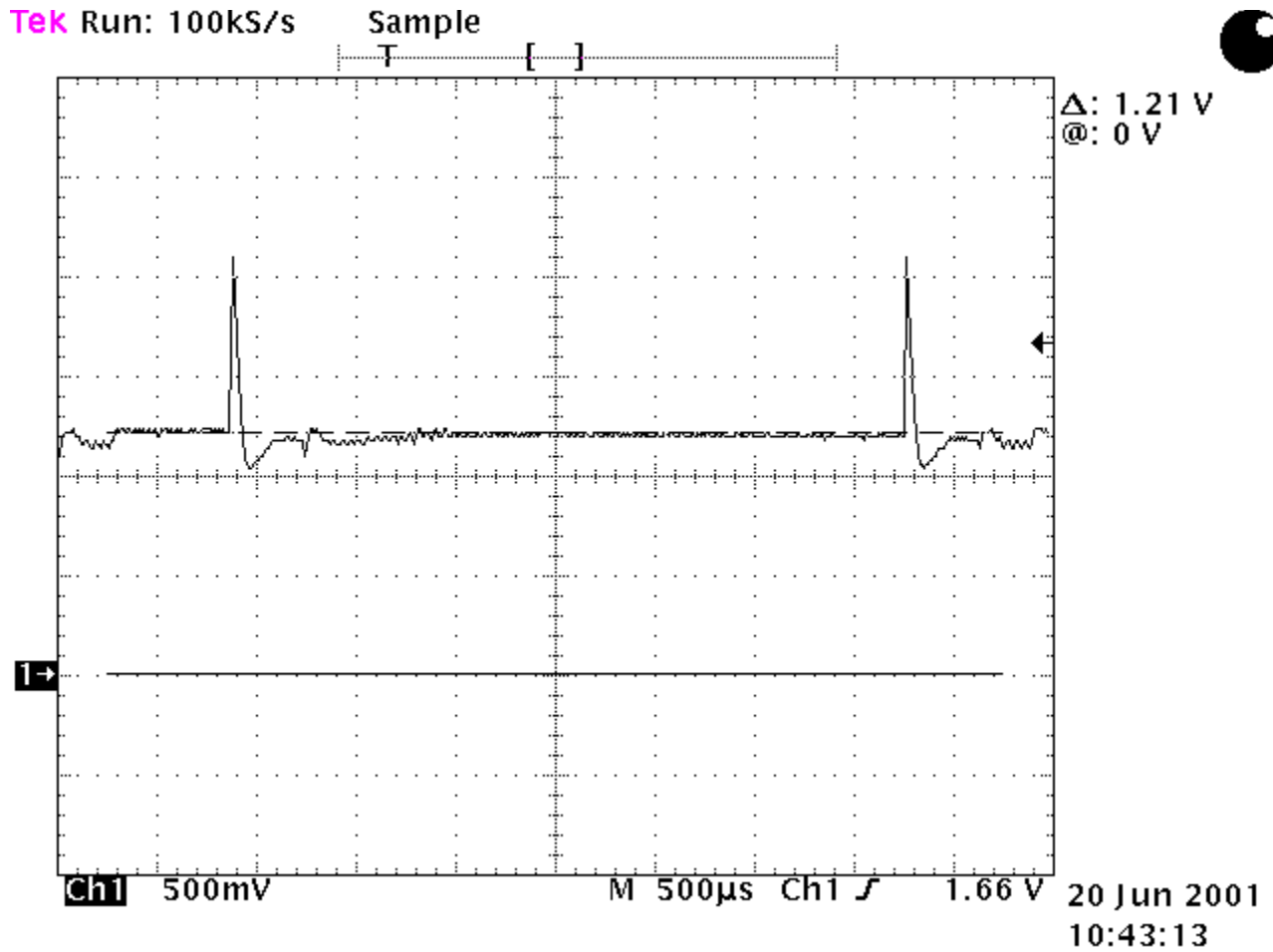


Figure 5 Check C512

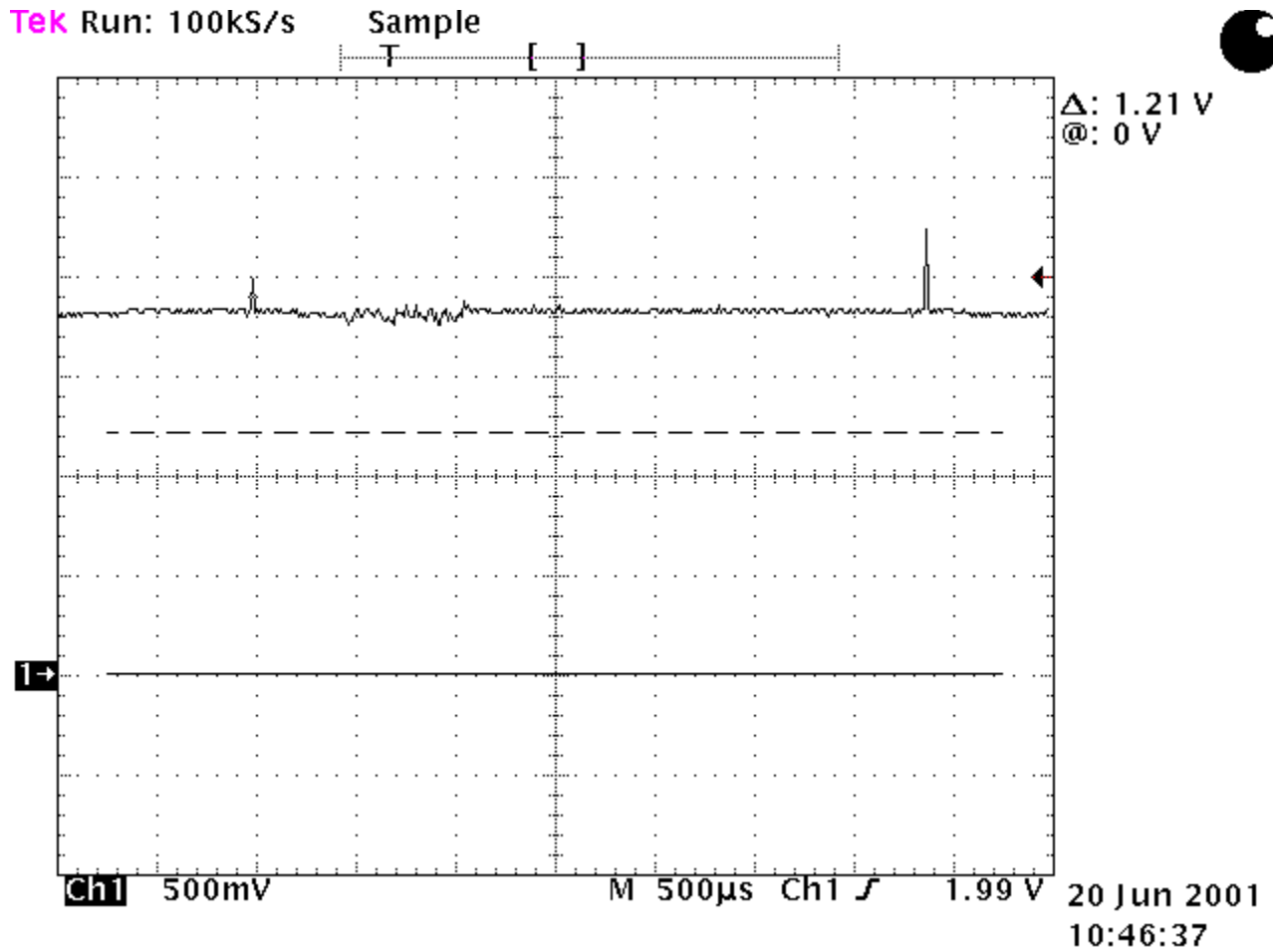


Figure 6 Check C514

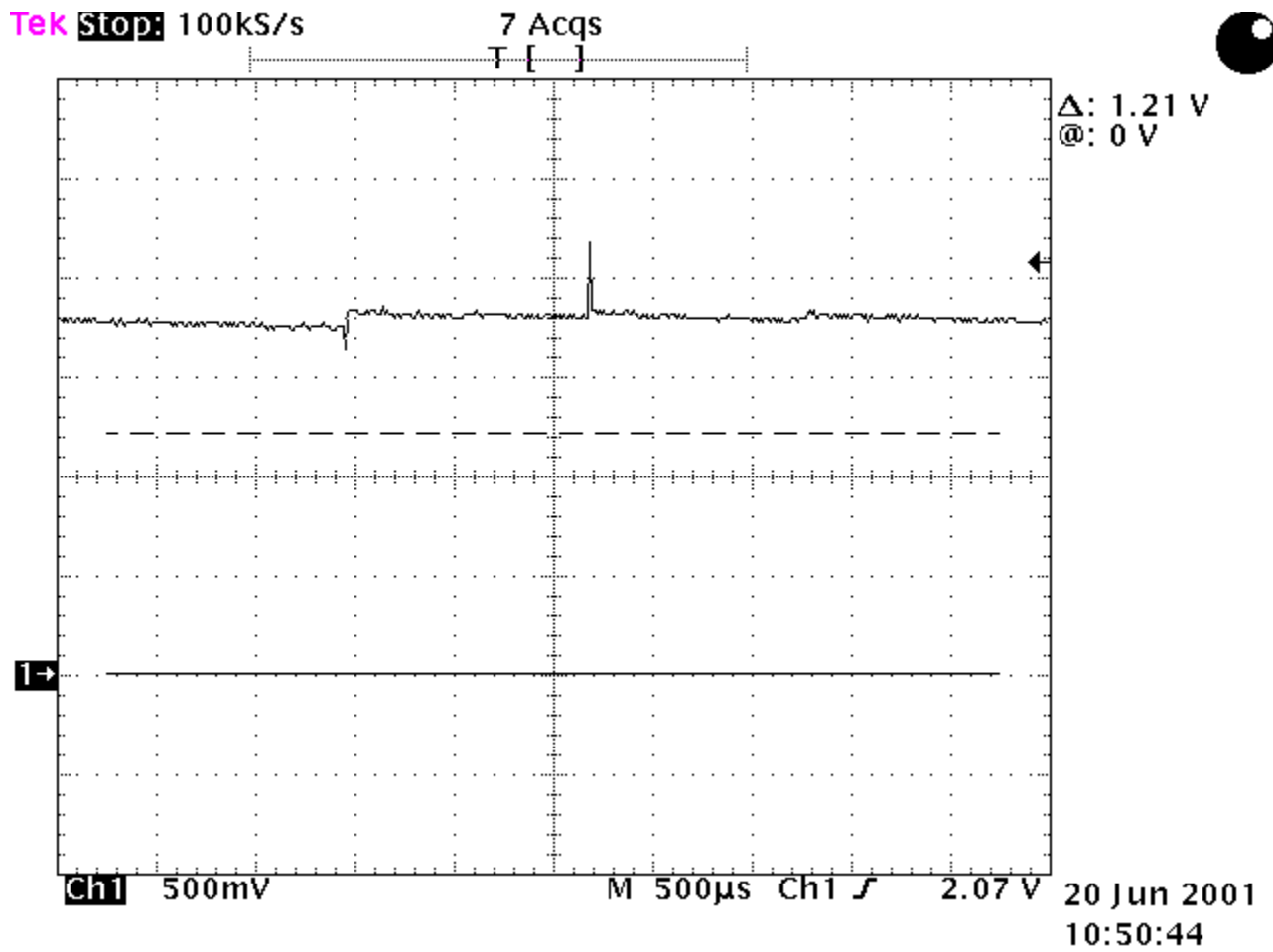
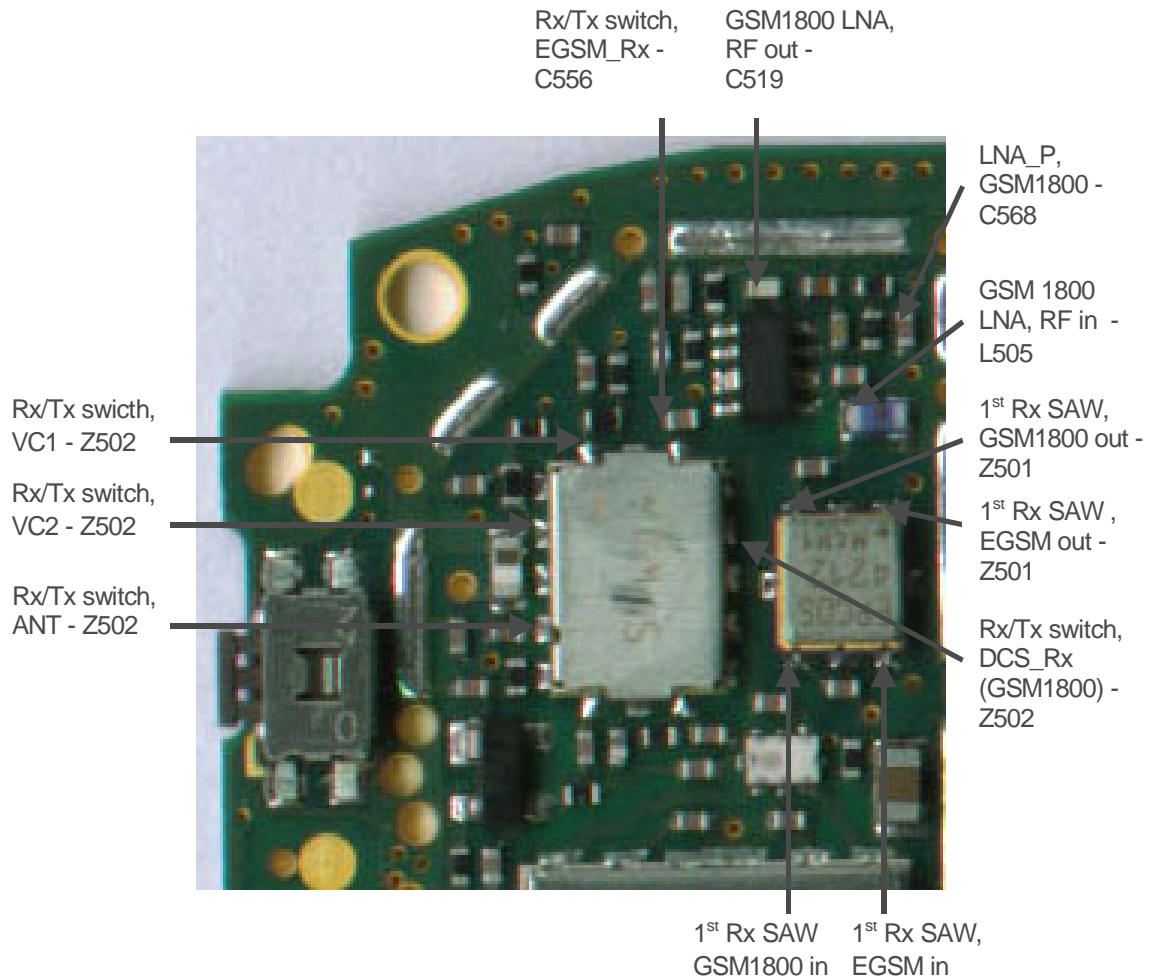


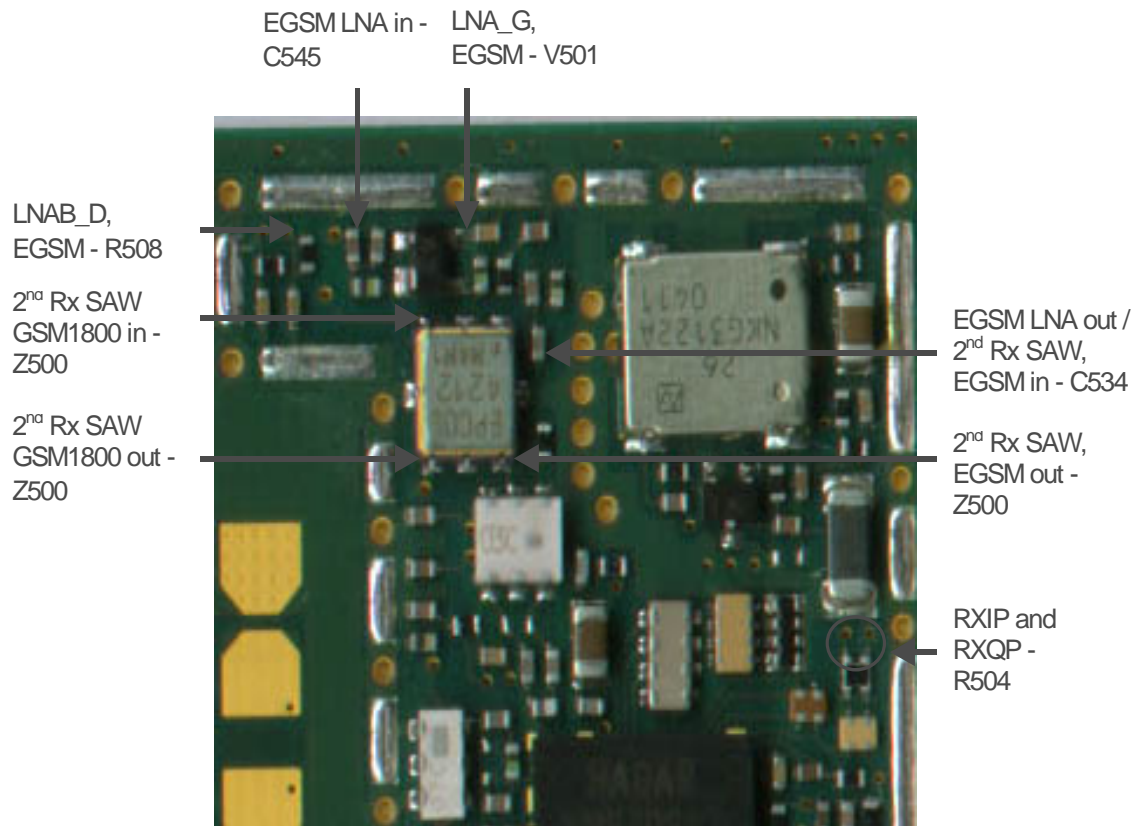
Figure 7 Check C526



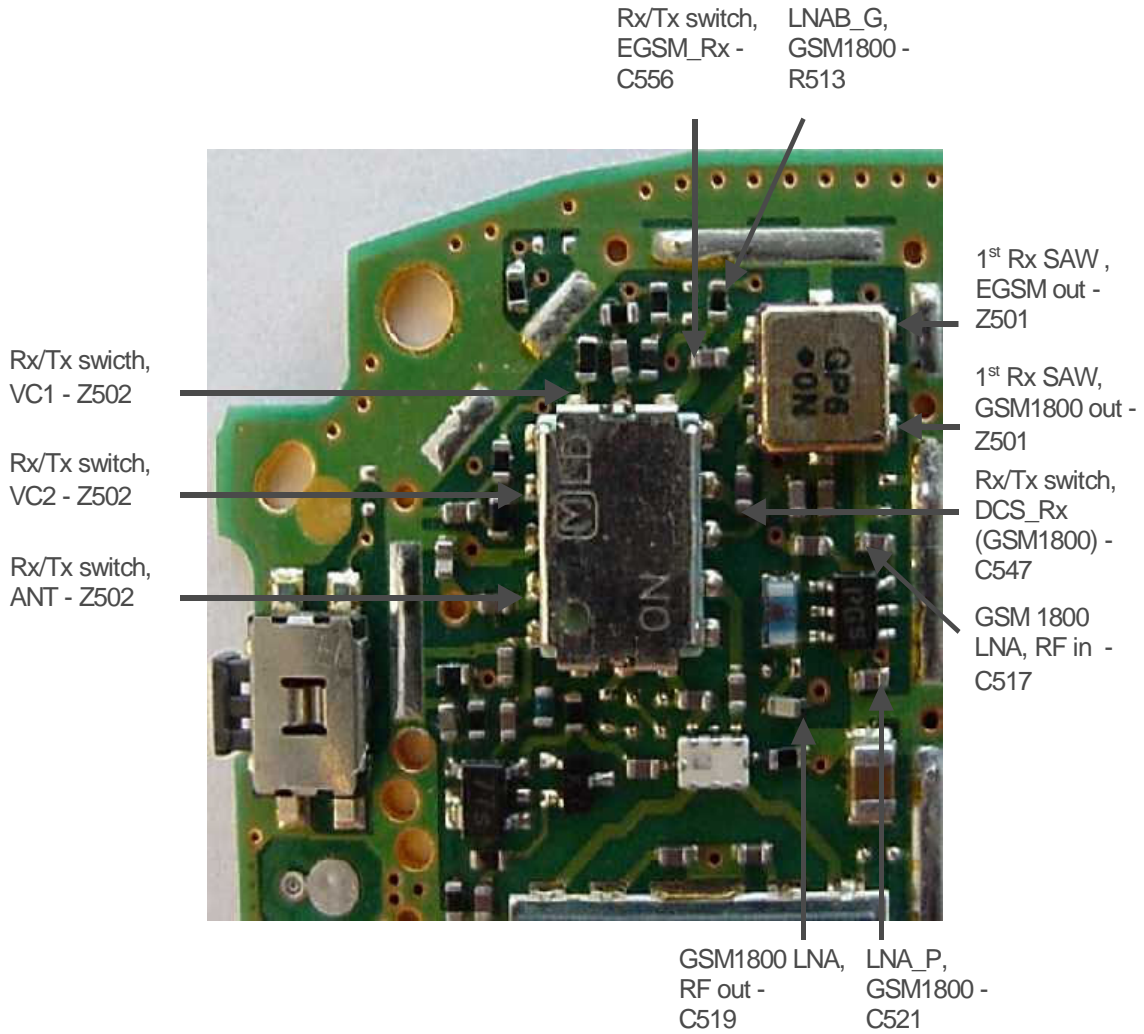
# EGSM Receiver Troubleshooting

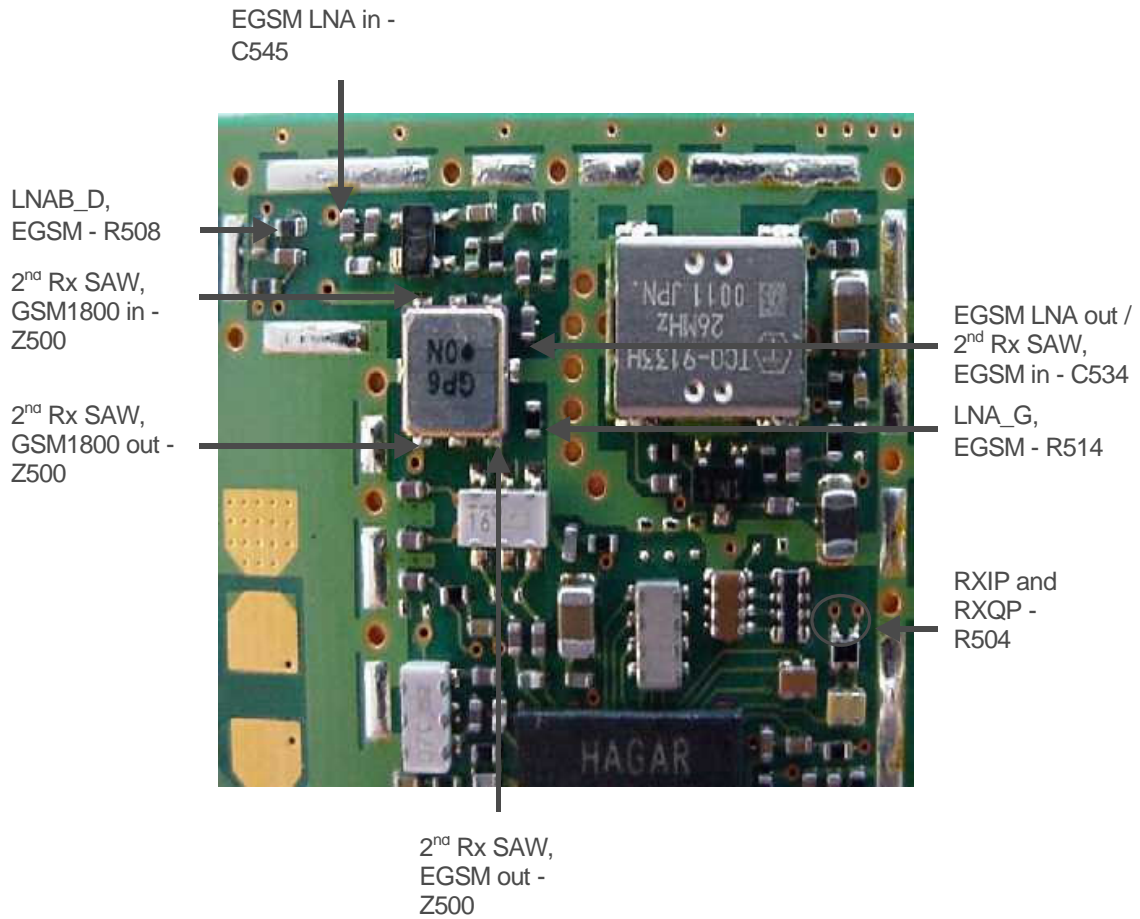
Rx measurement points, ub4\_10 / ub4\_11 / ub4\_12





Rx measurement points, ub4\_10 / ub4\_11, and ub4\_12





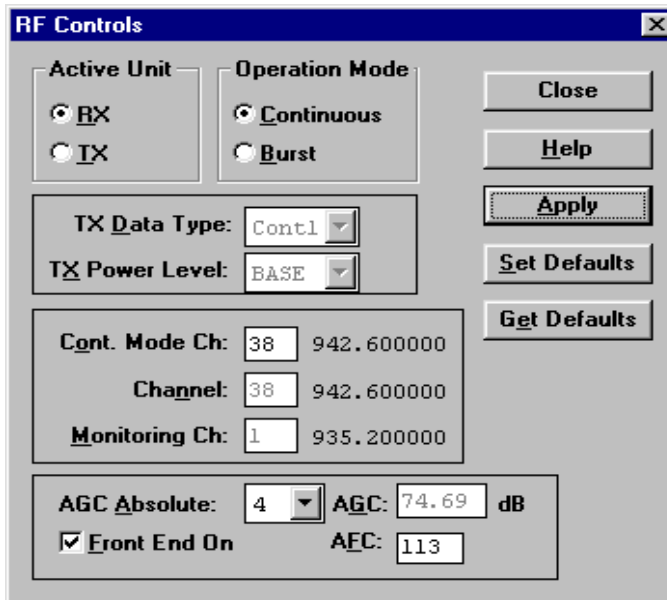
### General instructions for EGSM RX troubleshooting

Connect the phone to a PC with the module repair jig.

Start Wintesla-Service-Software and

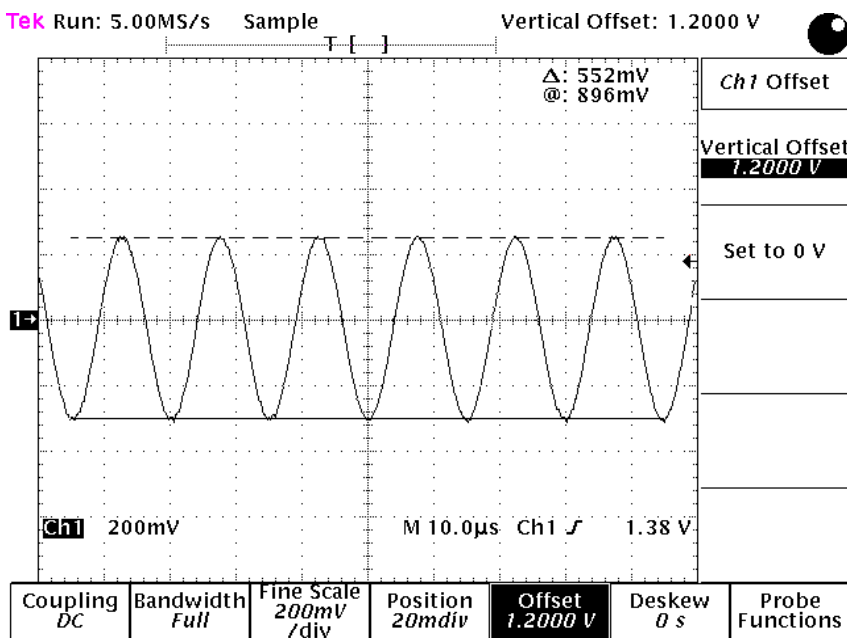
- |         |                       |           |
|---------|-----------------------|-----------|
| Select  | <u>P</u> roduct       | Alt+p     |
|         | Open...               |           |
|         | NHM-5                 |           |
| Select: | <u>P</u> roduct       | Alt+p     |
|         | <u>B</u> and          | b         |
|         | <u>E</u> GSM          | e         |
| Select: | <u>T</u> esting       | Alt+e     |
|         | <u>R</u> F Controls   | r         |
|         | <u>R</u> X Continuous | Alt+r     |
|         | Cont. Mode Ch: 38     | Alt+o, 38 |
|         | AGC Absolute: 4       |           |
|         | <u>A</u> pply         |           |

The set-up should now look like this:



Apply a 942.667 MHz (channel 38 + 67.710kHz offset) -55 dBm signal to the RF-connector.

Measuring with an oscilloscope on "RXIP" or "RXQP" this picture should be seen on a working EGSM receiver:



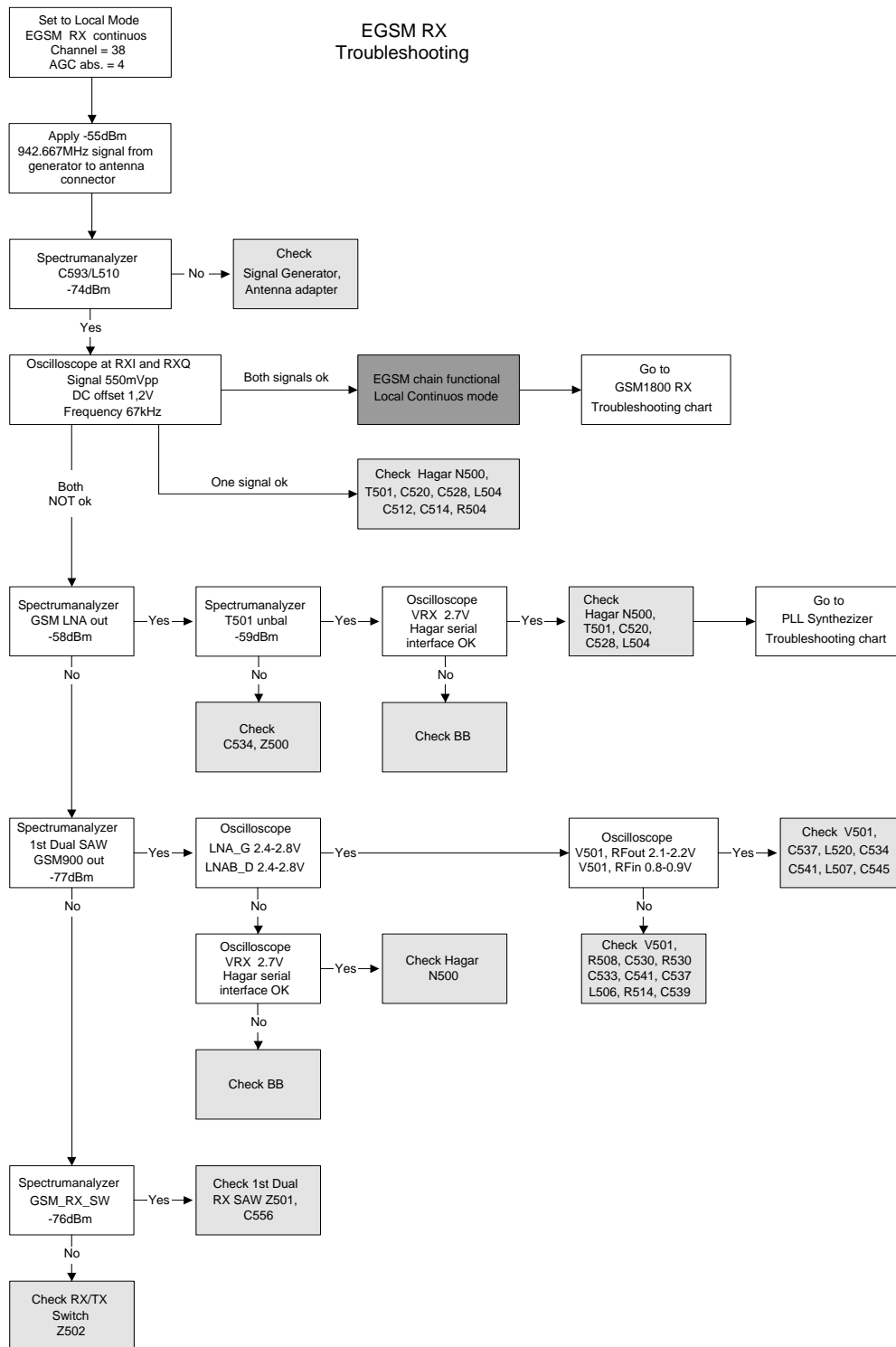
Signal amplitude ~550mV

DC offset 1,2V

Frequency 67kHz

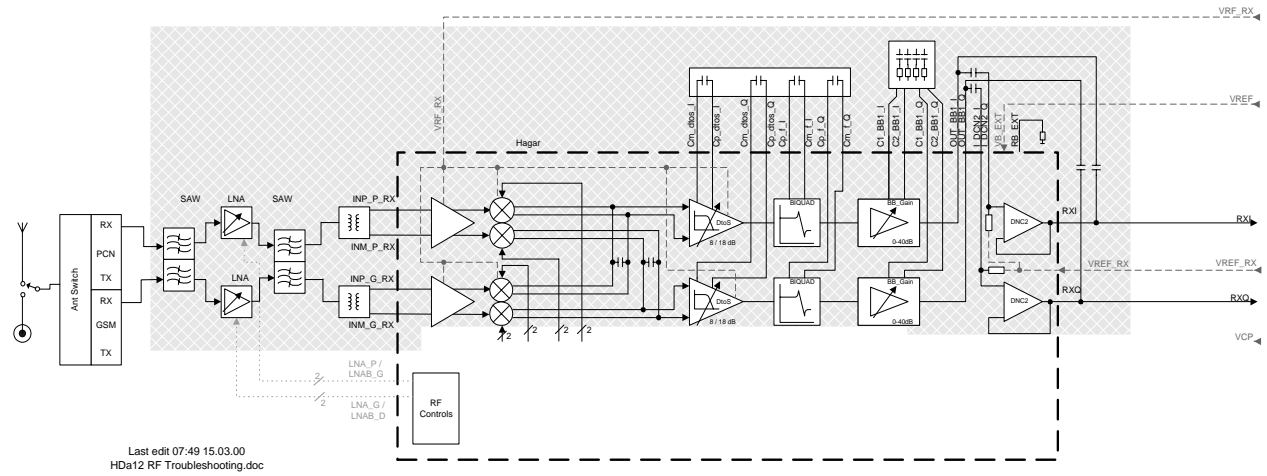
If this picture is not seen go to section Fault finding chart for EGSM receiver of this document

### Fault finding chart for EGSM receiver



## EGSM Signal path

For easy error tracing it is important to know the signal path of the EGSM receiver. The components can be grouped into blocks and drawn as shown below.



## RX/TX Switch

From the antenna-pad the RF signal is lead to the RX/TX switch (Z502).

The RX/TX switch is normally open to the two RX outlets GSM\_Rx and DCS\_Rx. If no control voltage is present at VC1 or VC2 the RX/TX switch will work as a diplexer and the EGSM signal is pass to GSM\_Rx and the GSM1800 signal to DCS\_Rx.

From GSM\_Rx the EGSM signal is feed to the 1<sup>st</sup> Dual RX SAW filter via C556.

## Front-end

The EGSM front-end consists mainly of two SAW filters (Z501 and Z500) and one LNA (V501) in-between and finally one balun (T501). The SAW filters provides out-of-band blocking immunity, the LNA provides front-end gain and the balun provides a balanced signal for Hagar (N500)

The signal-path is through Z501 (In-band insertion-loss 3,5dB), through the matching circuit (C545, L507 and C541) and to the EGSM LNA (V501, RFin).

The LNA has about 18dB gain when it is "on" (LNA\_G = 2.8V and LNAB\_D = 2.8V). If the signal applied to the antenna-connector is more than -45dBm the AGC will gain-step the LNA (LNA\_G = 2.8V and LNAB\_D = 0V) which means the LNA Gain will now have negative gain (loss) of -12 dB.

From the LNA (V501 RF out) the signal is lead through the LNA-output-matching-circuit (C537, L520 and C534), through the 2<sup>nd</sup> Dual RX SAW Z500 (In-band insertion-loss 3,5dB) to the EGSM balun T501. From the balun the signal is balanced and is lead to Hagar (N500 IMP\_G\_RX and INM\_G\_RX).

## Hagar

The balanced RX signal is mixed with a signal from the local oscillator at the same frequency as the wanted RX signal. After mixing the signal is converted to a single-ended signal in the DtoS (Differential to Single-ended) amplifier. The signal is now filtered in a BIQUAD filter to provide channel separation, amplified in the BB\_Gain amplifier and DC compensated in DCN2.

## GSM1800 Receiver Troubleshooting

### General instructions for GSM1800 RX troubleshooting

Connect the phone to a PC with the module repair jig.

Start Wintesla-Service-Software and

```

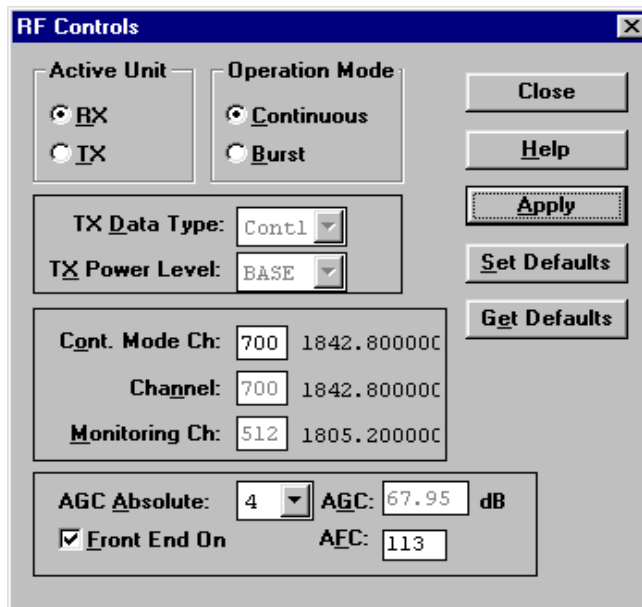
Select   Product                               Alt+p
          Open...
          NHM-5

Select:  Product                               Alt+p
          Band                                 b
          PCN                                 p

Select:  Testing                               Alt+e
          RF Controls                          r
          RX Continuous                        Alt+r
          Cont. Mode Ch: 700                   Alt+o, 700
          AGC Absolute: 4

          Apply
    
```

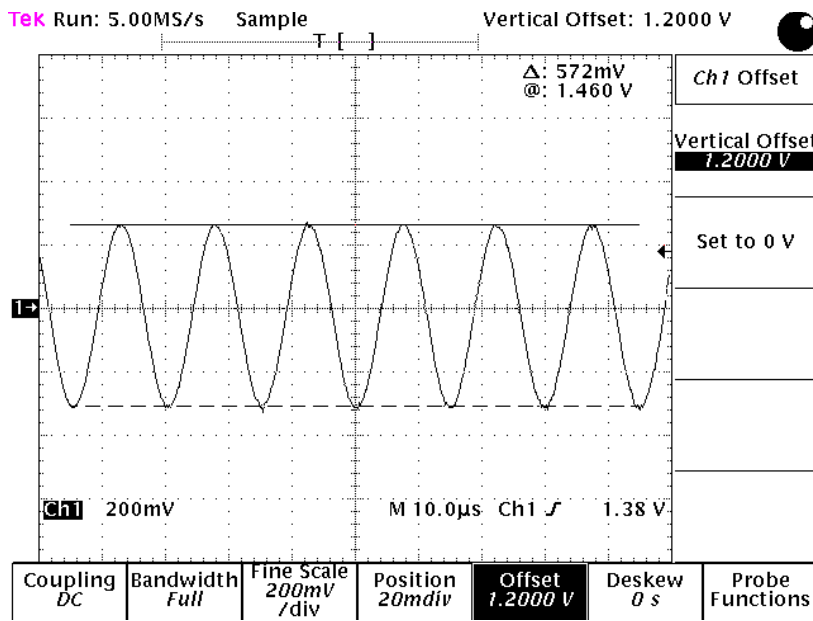
The set-up should now look like this:



Apply an 1842.867 MHz (channel 700 + 67.710kHz offset) -55 dBm signal to the RF connection (remember to compensate for cable and adapter attenuation).

Measuring with an oscilloscope on "Hagar RXI" or "Hagar RXQ" this picture should be seen on a working GSM1800 receiver:





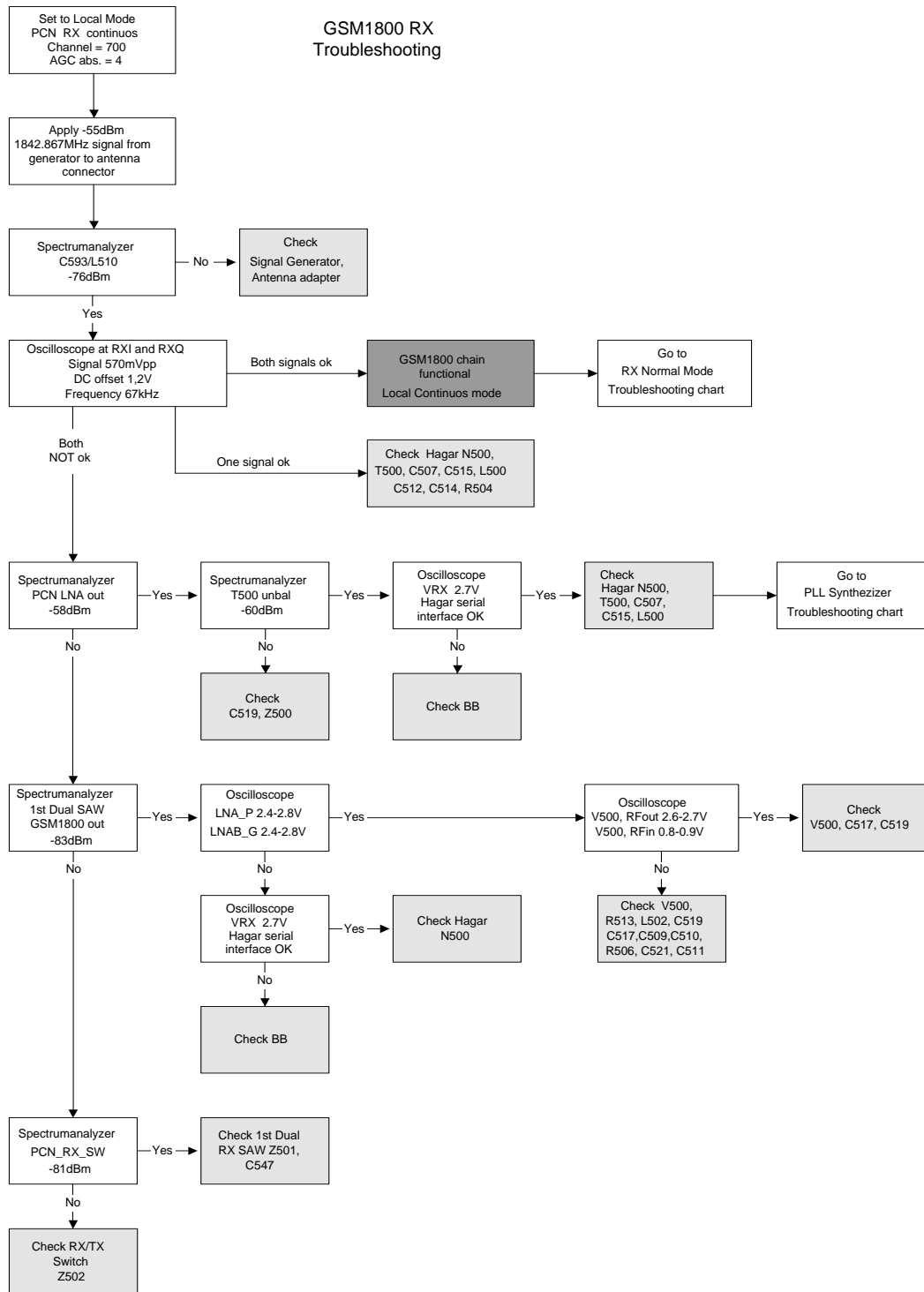
Signal amplitude ~570V

DC offset 1,2V

Frequency 67kHz

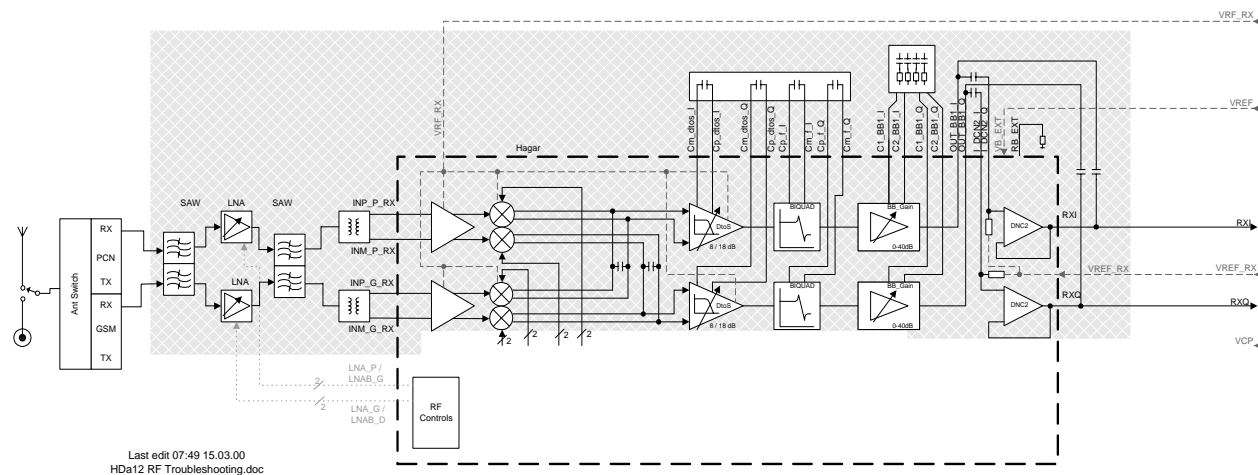
If this picture is not seen not go to section Fault finding chart for GSM1800 receiver of this document

### Fault finding chart for GSM1800 receiver



## GSM1800 Signal path

For easy error tracing it is important to know the signal path of the GSM1800 receiver. The components can be grouped into blocks and drawn as shown below.



## RX/TX Switch

From the antenna-pad the RF signal is lead to the RX/TX switch (Z502).

The RX/TX switch is normally open to the two RX outlets GSM\_Rx and DCS\_Rx. If no control voltage is present at VC1 or VC2 the RX/TX switch will work as a diplexer and the EGSM signal is pass to GSM\_Rx and the GSM1800 signal to DCS\_Rx.

From GSM\_Rx the GSM1800 signal is feed to the 1<sup>st</sup> Dual RX SAW filter via C547.

## Front-end ub4-8 / 9

The GSM1800 front-end consists mainly of two SAW filters (Z501 and Z500) and one LNA (V500) in-between and finally one balun (T500). The SAW filters provides out-of-band blocking immunity, the LNA provides front-end gain and the balun provides a balanced signal for Hager (N500)

The signal-path is through Z501 (In-band insertion-loss 3,5dB), through the matching circuit (C510, L505 and C525) and to the GSM1800 LNA (V500, RFin).

The LNA has about 17dB gain when it is "on" (LNAB\_G = 2.8V and LNA\_P = 0V). If the signal applied to the antenna-connector is more than -45dBm the AGC will gain-step the LNA (LNAB\_G = 2.8V and LNA\_P = 0V) which means the LNA Gain will now have negative gain (loss) of -8dB.

From the LNA (V500 RF out) the signal is lead through the LNA-output-matching-circuit (C519), through the 2<sup>nd</sup> Dual RX SAW Z500 (In-band insertion-loss 3,5dB) to the GSM1800 balun T500. From the balun the signal is balanced and is lead to Hager (N500 IMP\_P\_RX and INM\_P\_RX).

## Front-end ub4-10 / 11 / 12

The GSM1800 front-end consists mainly of two SAW filters (Z501 and Z500) and one LNA (V500) in-between and finally one balun (T500). The SAW filters provides out-of-band blocking immunity, the LNA provides front-end gain and the balun provides a balanced signal for Hager (N500)

The signal-path is through Z501 (In-band insertion-loss 3,5dB), through the matching circuit (C517 ) and to the GSM1800 LNA (V500, RFin).

The LNA has about 18dB gain when it is "on" (LNAB\_G = 2.8V and LNA\_P = 0V). If the signal applied to the antenna-connector is more than -45dBm the AGC will gain-step the LNA (LNAB\_G = 2.8V and LNA\_P = 0V) which means the LNA Gain will now have negative gain (loss) of -12dB.

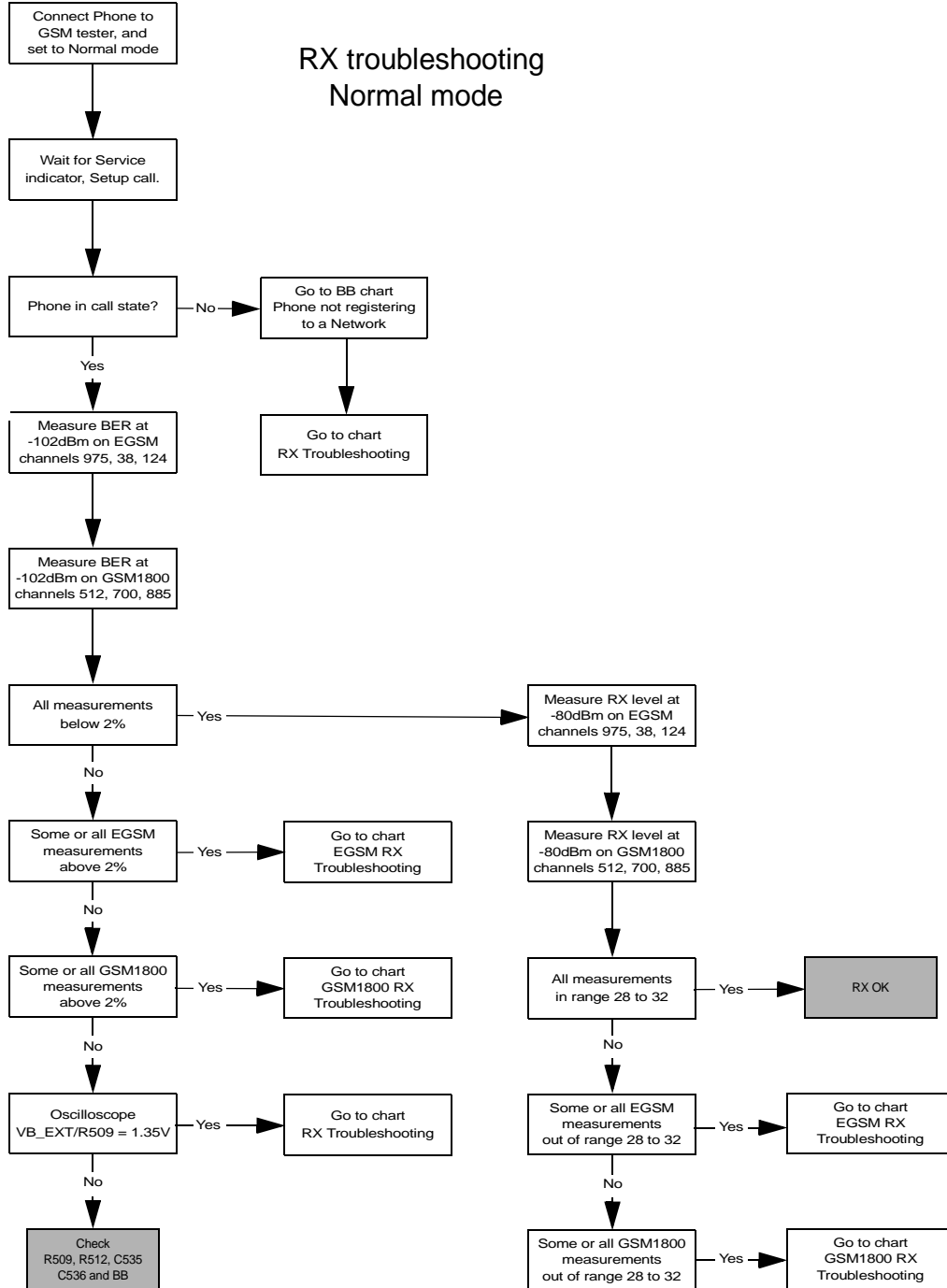
From the LNA (V500 RF out) the signal is lead through the LNA-output-matching-circuit (C519, L502), through the 2<sup>nd</sup> Dual RX SAW Z500 (In-band insertion-loss 3,5dB) to the GSM1800 balun T500. From the balun the signal is balanced and is lead to Hagar (N500 IMP\_P\_RX and INM\_P\_RX).

### **Hagar**

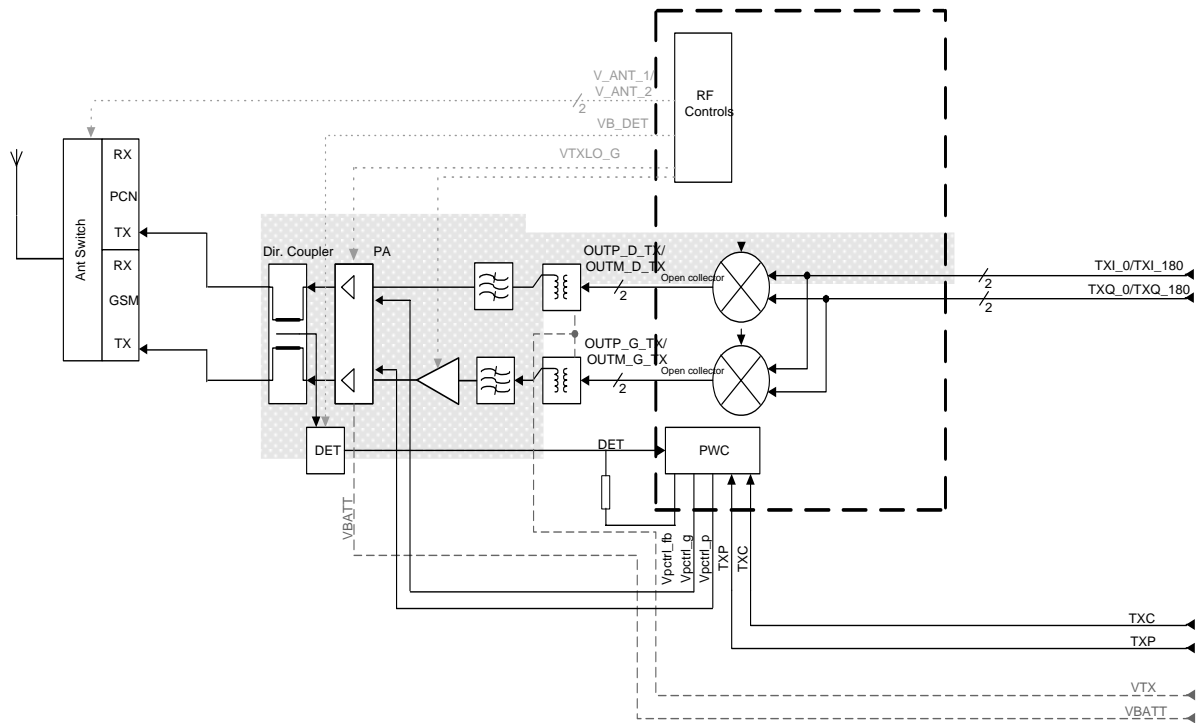
The balanced RX signal is mixed with a signal from the local oscillator at the same frequency as the wanted RX signal. After mixing the signal is converted to a single-ended signal in the DtoS (Differential to Single-ended) amplifier. The signal is now filtered in a BIQUAD filter to provide channel separation, amplified in the BB\_Gain amplifier and DC compensated in DCN2.

### RX Normal Mode Troubleshooting

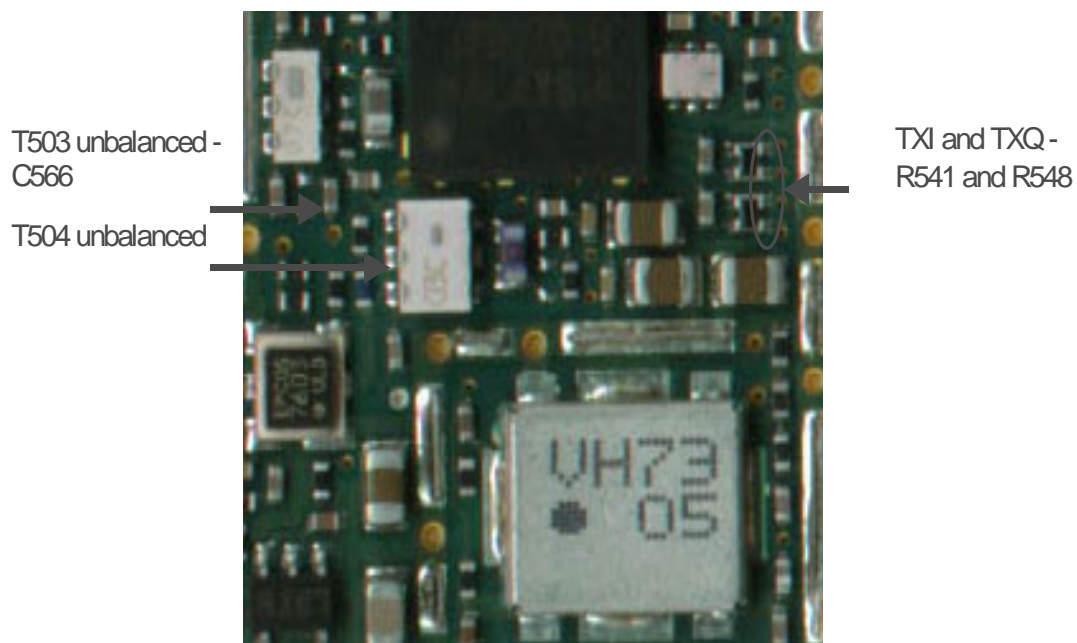
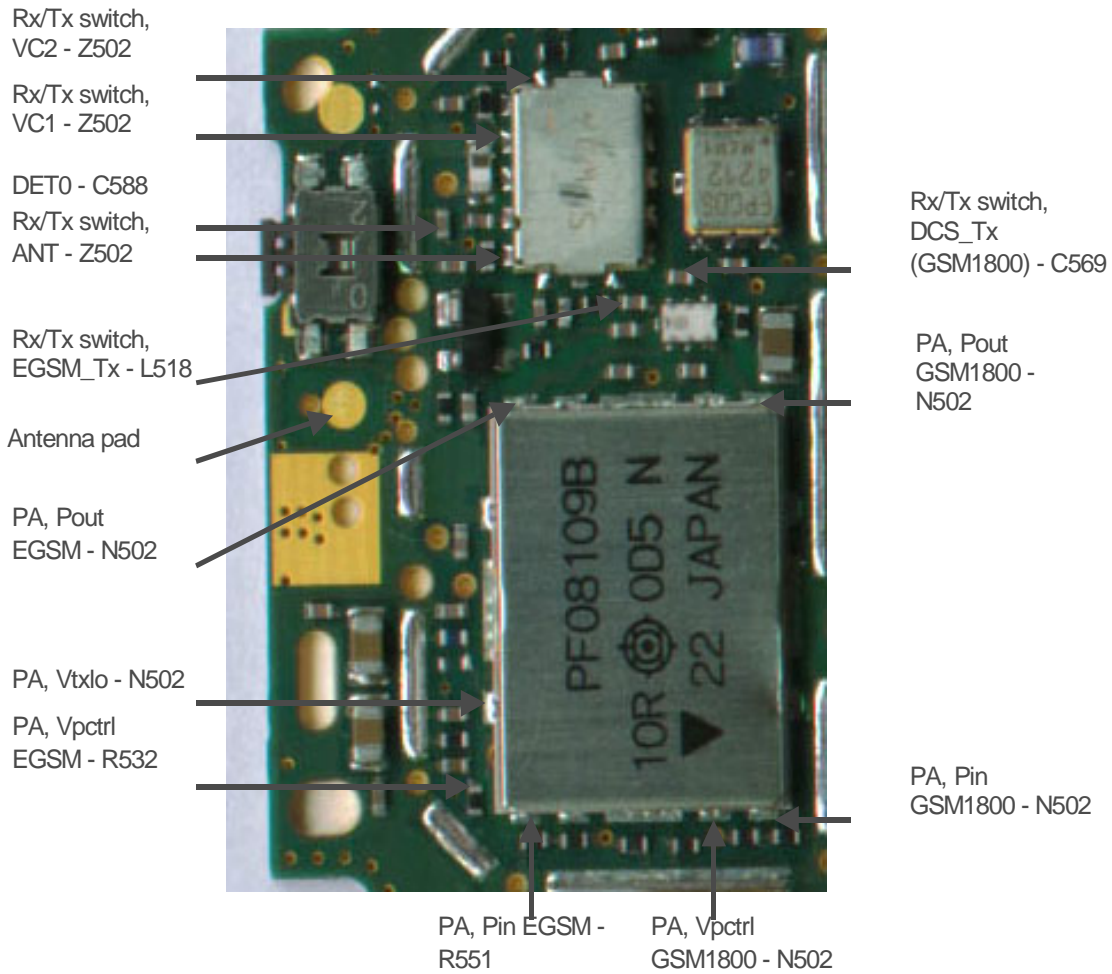
After any repair, reflash, retuning etc. the receiver performance must be checked in normal mode. Place phone PWB in module repair jig or use service battery and antenna adapter, follow instructions in chart in chart below:



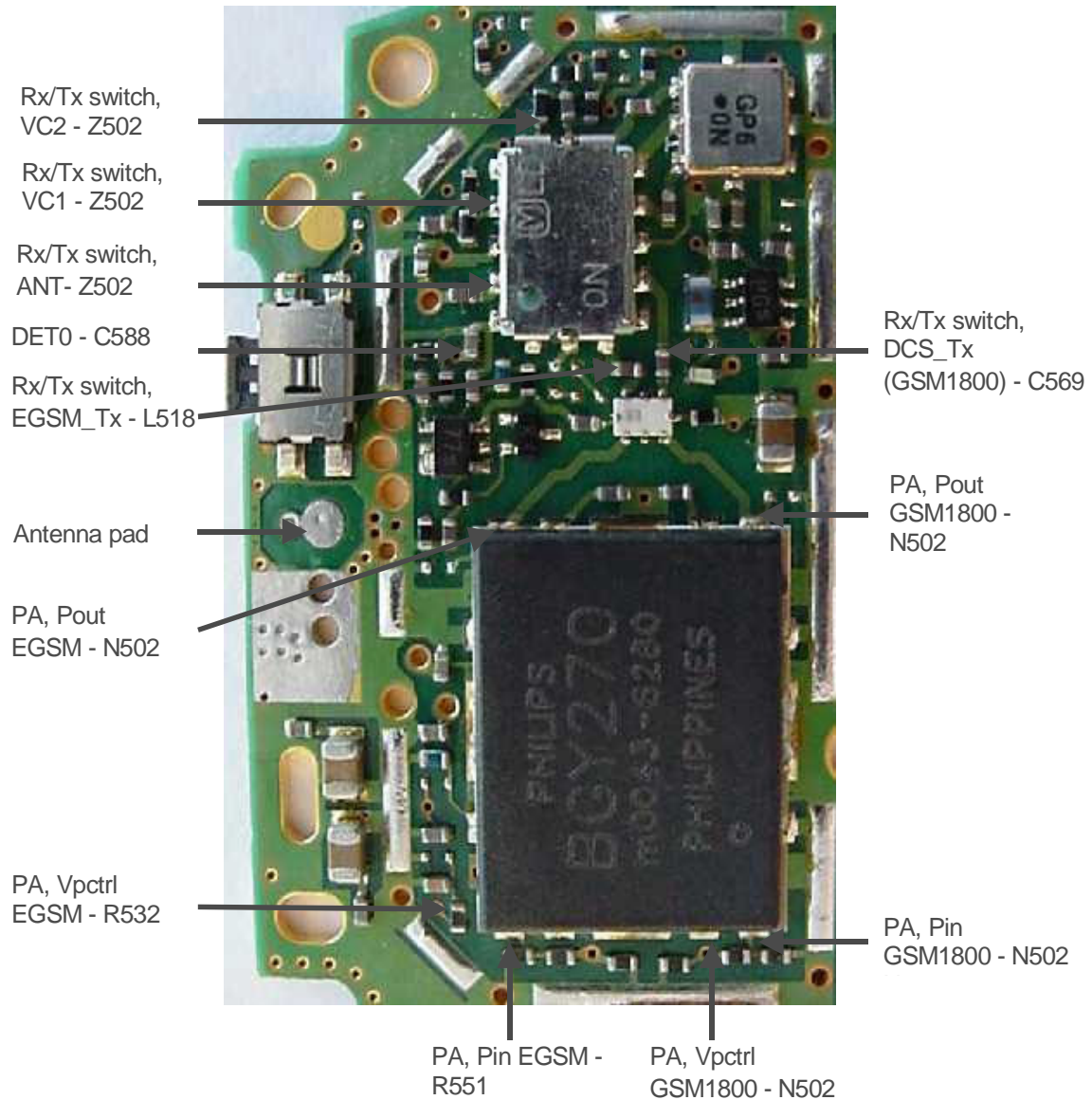
## EGSM Transmitter



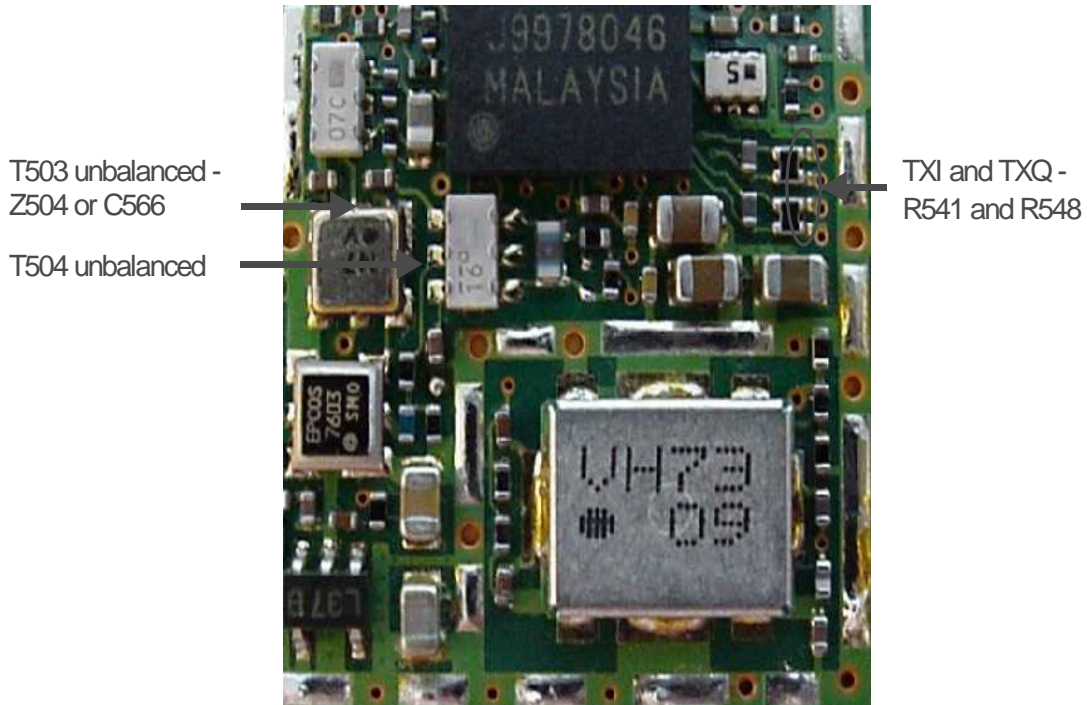
TX measurement points, ub4-08 / ub4-09



**TX measurement points, ub4-10 / ub4-11 / ub4-12**







### General instructions for EGSM TX troubleshooting

Start WinTesla-Service-Software and

- |         |                              |           |
|---------|------------------------------|-----------|
| Select: | <u>P</u> roduct              | Alt+p     |
|         | <u>B</u> and                 | b         |
|         | <u>G</u> SM                  | g         |
| Select: | <u>T</u> esting              | Alt+e     |
|         | <u>R</u> F Controls          | r         |
|         | TX <u>B</u> urst             | Alt+b     |
|         | TX <u>D</u> ata Type: Random | Alt+d, r  |
|         | TX <u>P</u> ower Level : 5   | Alt+x, 5  |
|         | Ch <u>a</u> nnel: 60         | Alt+n, 60 |
|         | <u>A</u> pply                | Alt+a     |

Your screen should look like this:

**RF Controls**

**Active Unit**  
 RX  
 TX

**Operation Mode**  
 Continuous  
 Burst

**TX Data Type:** Rand

**TX Power Level:** 5

**Cont. Mode Ch:** 60 902.000000  
**Channel:** 60 902.000000  
**Monitoring Ch:** 1 890.200000

**AGC Absolute:** 512 **AGC:** dB  
 **Front End On** **AFC:** 149

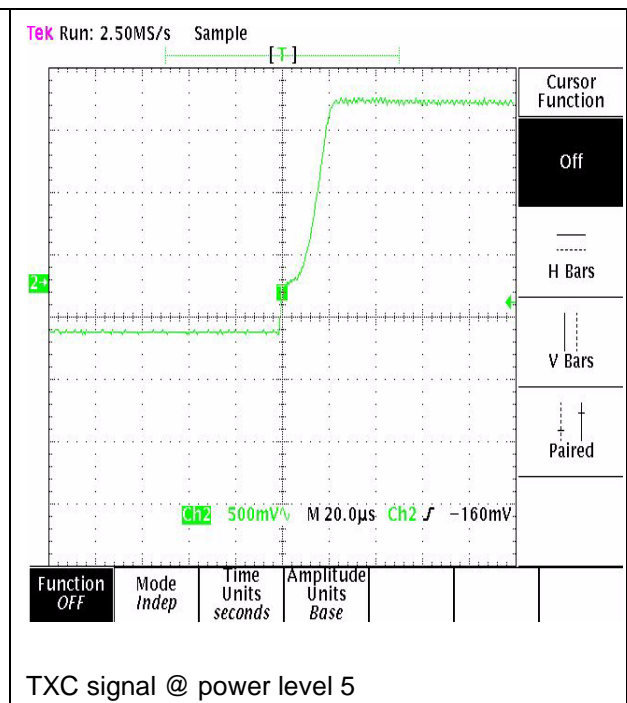
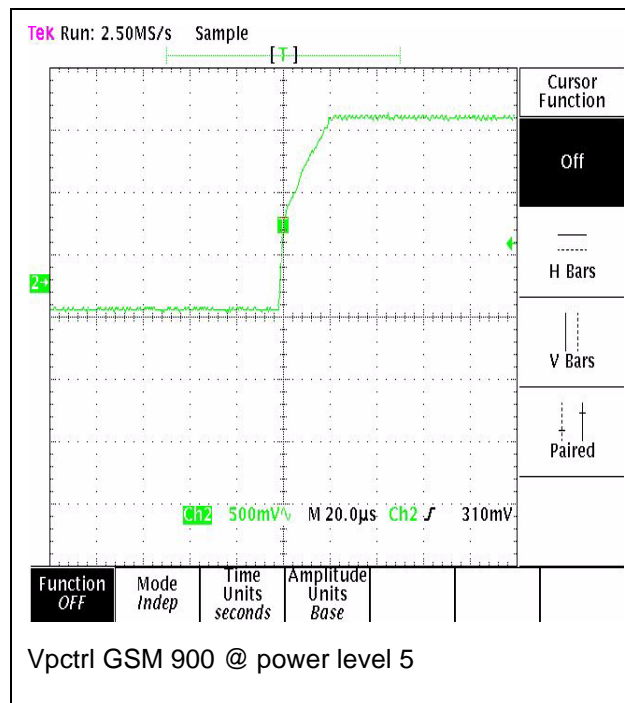
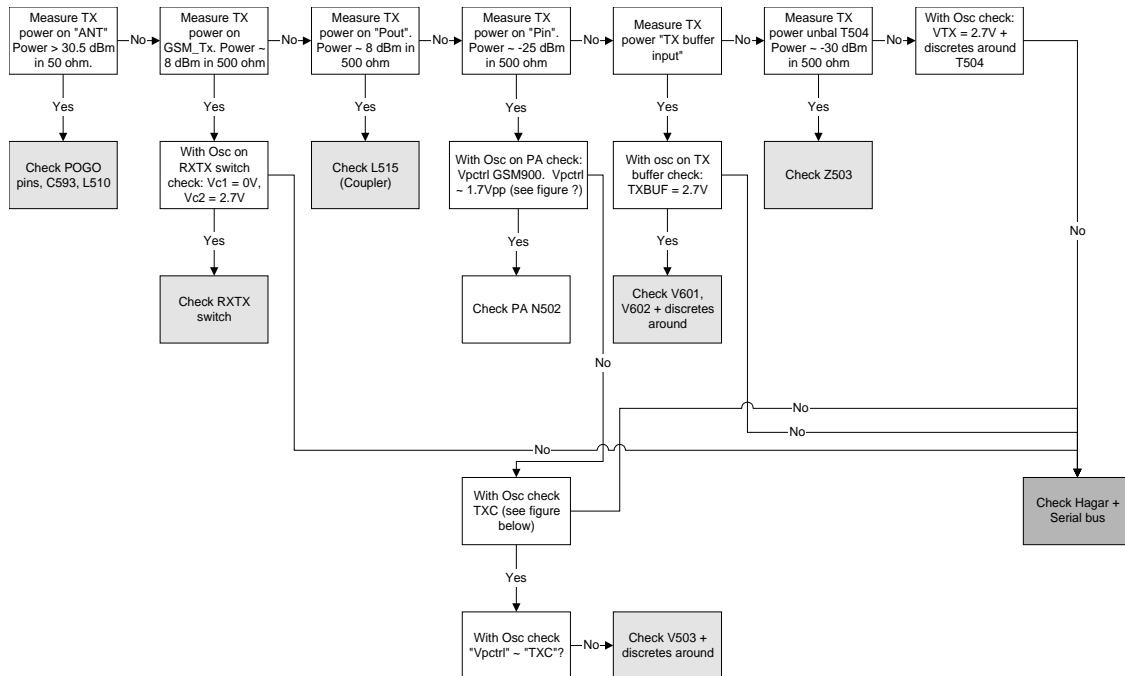
Close  
Help  
Apply  
Set Defaults  
Get Defaults

Measure the output power of the phone; it should be around 32 dBm.

### Fault finding chart for EGSM transmitter

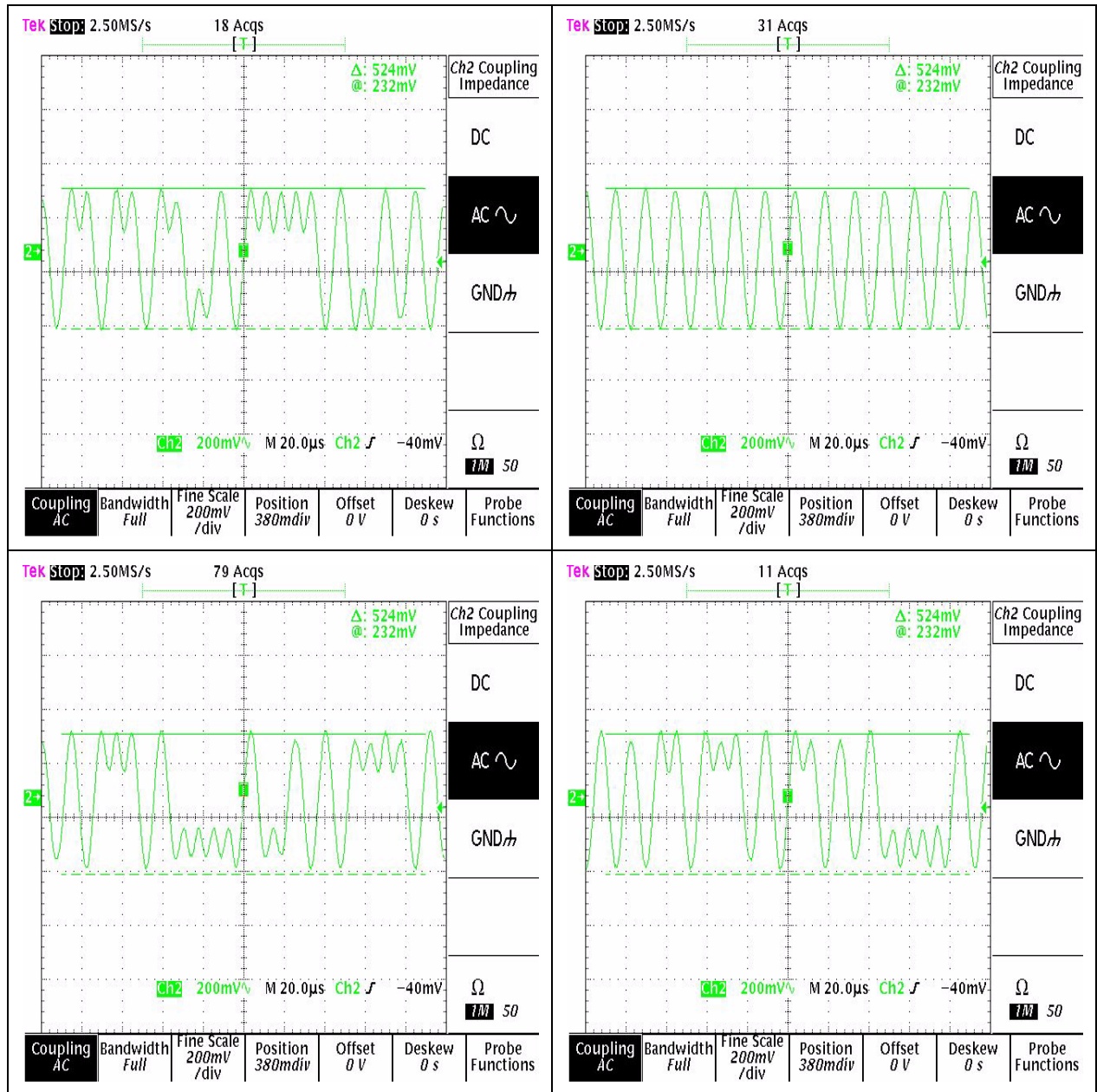
#### Fault finding in output power

For the spectrum analyzer measurements in the following chart use the 500 ohm passive probe. Since the signal measured is bursted it is advised to set the analyzer to maxhold.



### Fault finding in modulation

The following plots show different situations of TX IQ measurements. Depending on the time the modulation may cause the signal to look differently.



For how to check Hagar and serial bus see section Hagar and serial interface.

# GSM1800 Transmitter

## General instructions for GSM1800 TX troubleshooting

Apply a RF-cable to the RF-connector to allow the transmitted signal act as normal. RF-cable should be connected to measurement equipment or to at least a 10-dB attenuator, otherwise the PA may be damaged.

Start WinTesla-Service-Software and

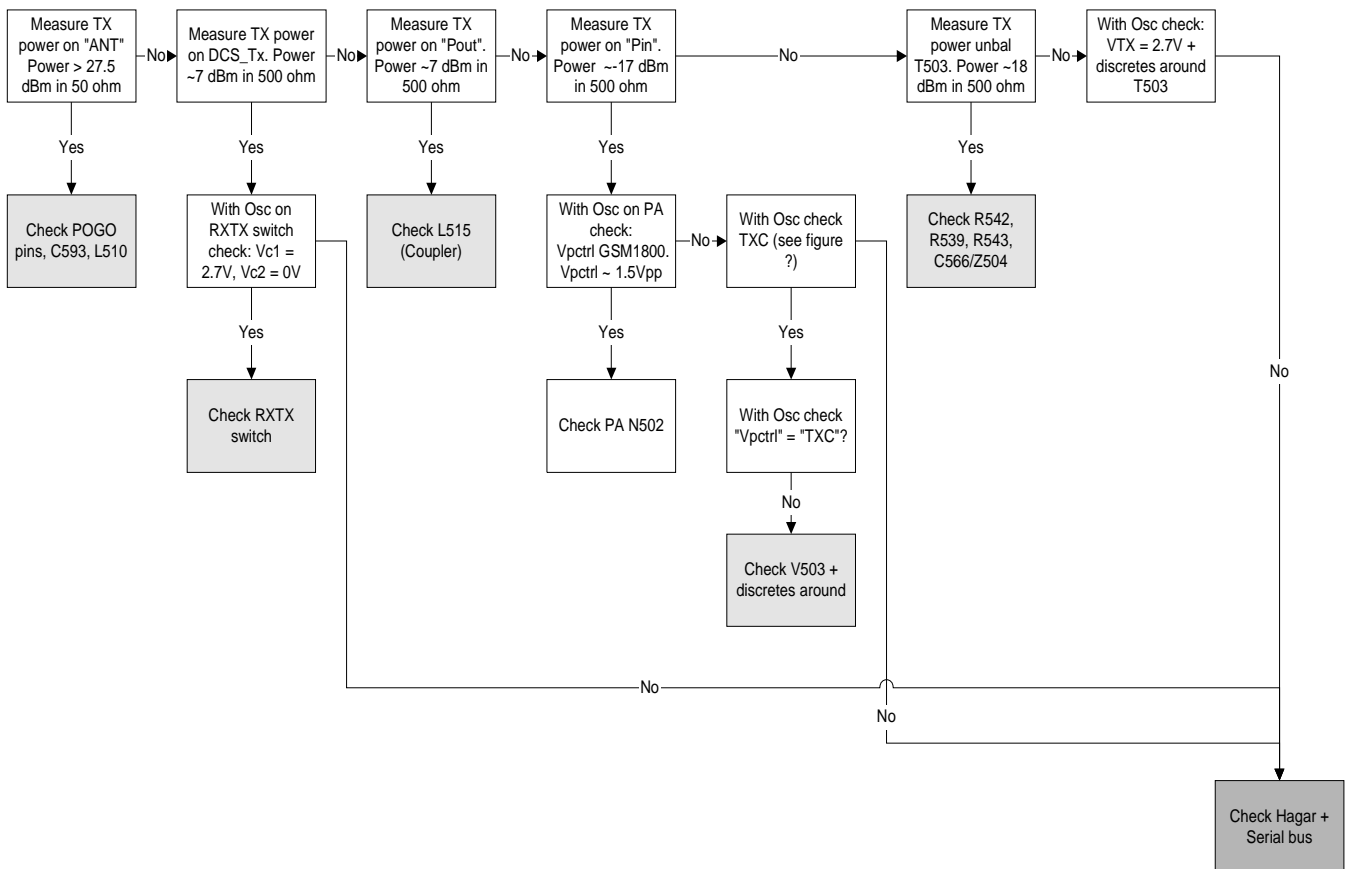
- Select: Product Alt+p
- Band b
- PCN p
- Select: Testing Alt+e
- RF Controls r
- TX Burst Alt+b
- TX Data Type: Random Alt+d, r
- TX Power Level: 0 Alt+x, 0
- Channel: 700 Alt+n, 700
- Apply Alt+a

Your screen should look like:



## Path of the transmitted GSM1800 signal

Fault finding chart for GSM1800 transmitter



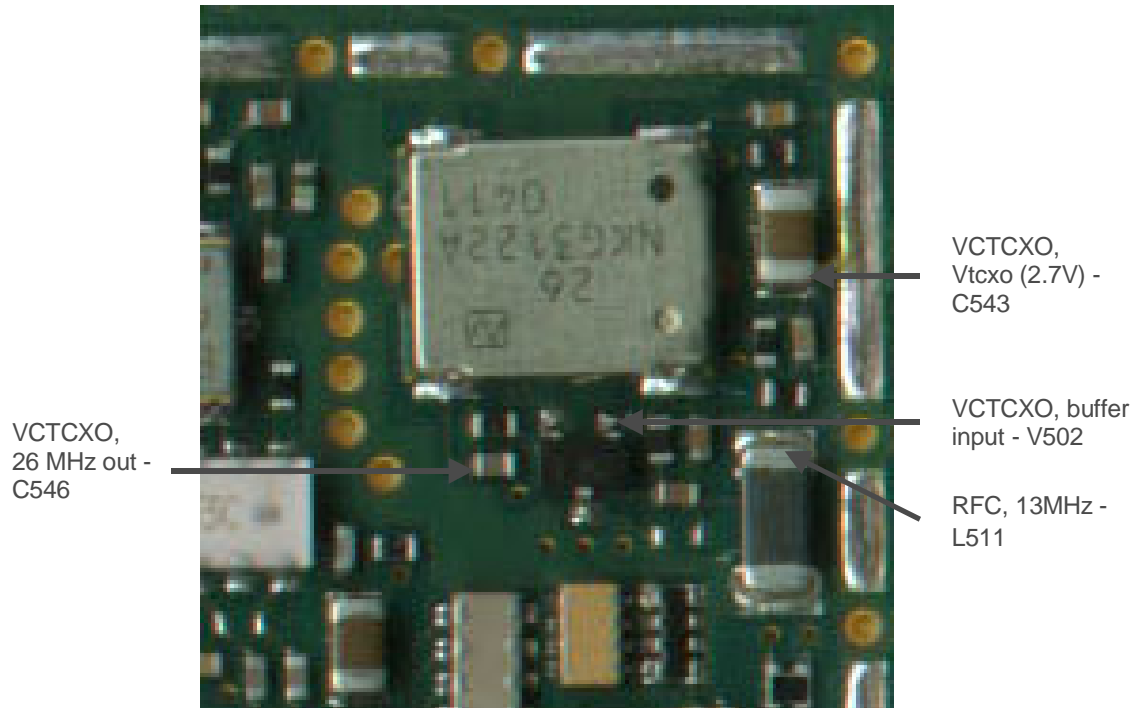
TXIQ signals look the same in EGSM and GSM1800.

## Synthesizer

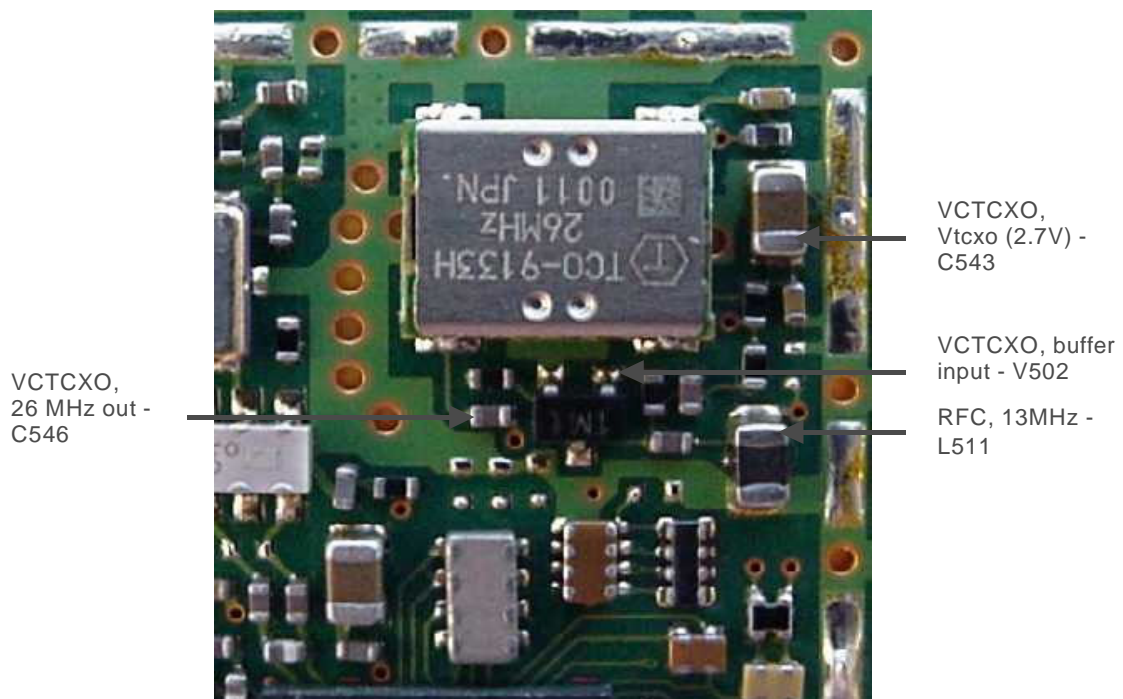
There is only one PLL synthesizer generating frequencies for both Rx and Tx in both bands (EGSM and GSM1800). VCO frequency is divided by 2 or by 4 in HAGAR depending on which band is active.

### Measurement points at the VCTCXO

VCTCXO measurement points, ub4\_08 / ub4\_09.

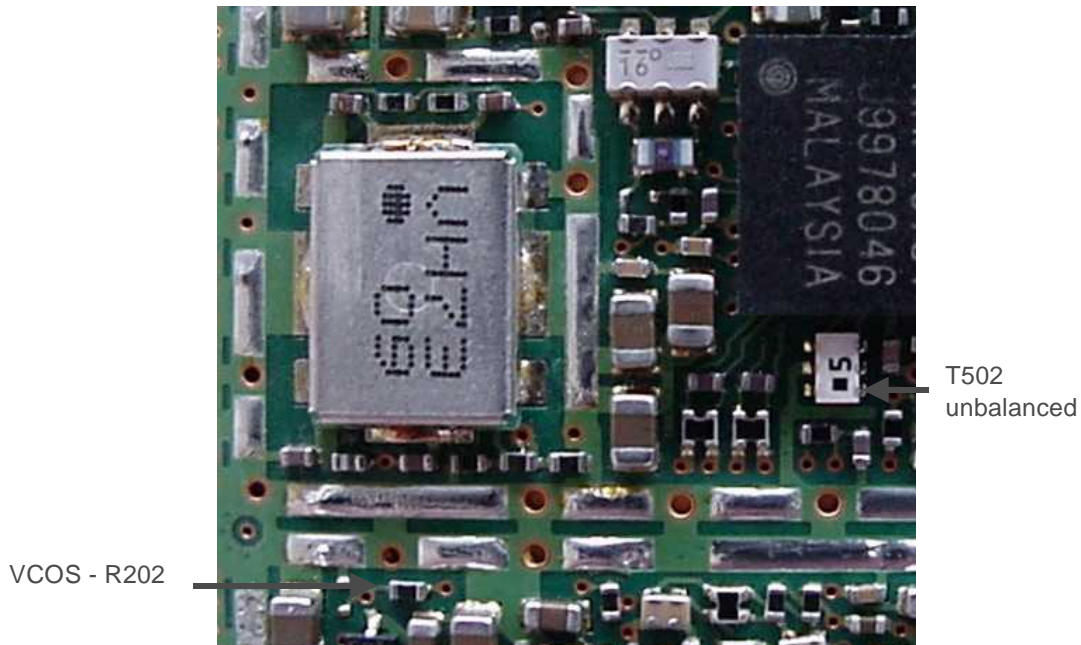


VCTCXO measurement points, ub4\_10, ub4\_11 and ub4\_12





**VCO measurement points, ub4\_08 - ub4\_12.**



**General instructions for Synthesizer troubleshooting**

Start WinTesla-Service-Software and

- |         |                           |           |
|---------|---------------------------|-----------|
| Select: | <u>P</u> roduct           | Alt+p     |
|         | <u>B</u> and              | b         |
|         | <u>E</u> GSM              | e         |
| Select: | <u>T</u> esting           | Alt+e     |
|         | <u>R</u> F Controls       | r         |
|         | <u>R</u> X Continuous     | Alt+r     |
|         | <u>C</u> ont. Mode Ch: 60 | Alt+o, 60 |

Measure the output of the VCO (G500) at T502 with spectrum analyzer and 500 ohm passive probe; the power should be around -20 dBm.

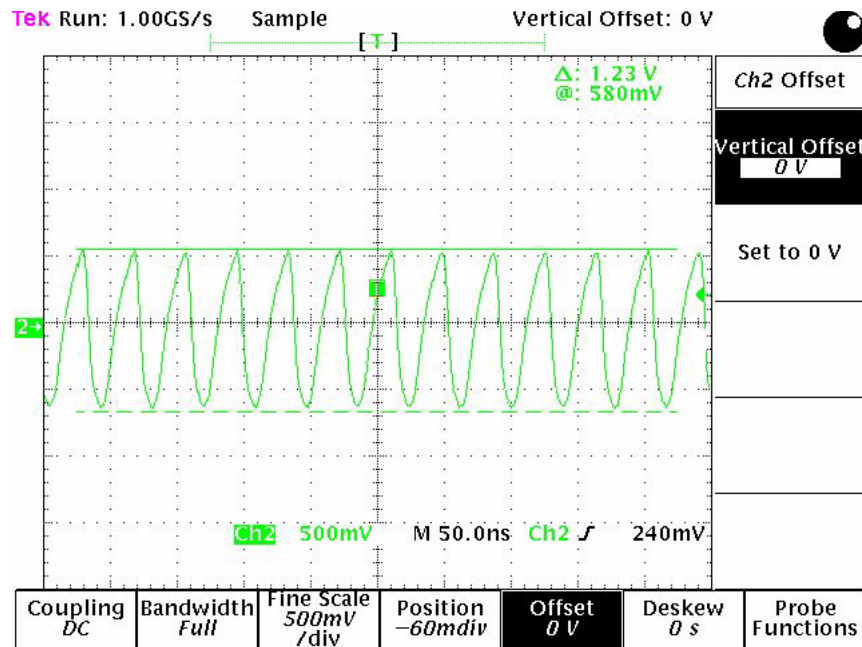
**26 MHz reference oscillator ( VCTCXO )**

The 26 MHz oscillator (G502) is used as a reference frequency for the PLL synthesizer and as the system clock for BB ( 13 MHz) after it is divided by 2 in HAGAR. 26 MHz signal from the VCTCXO is approx. 0,8 Vpp. Frequency of this oscillator is adjusted by dc voltage ( Vcon ) coming from the DAC in

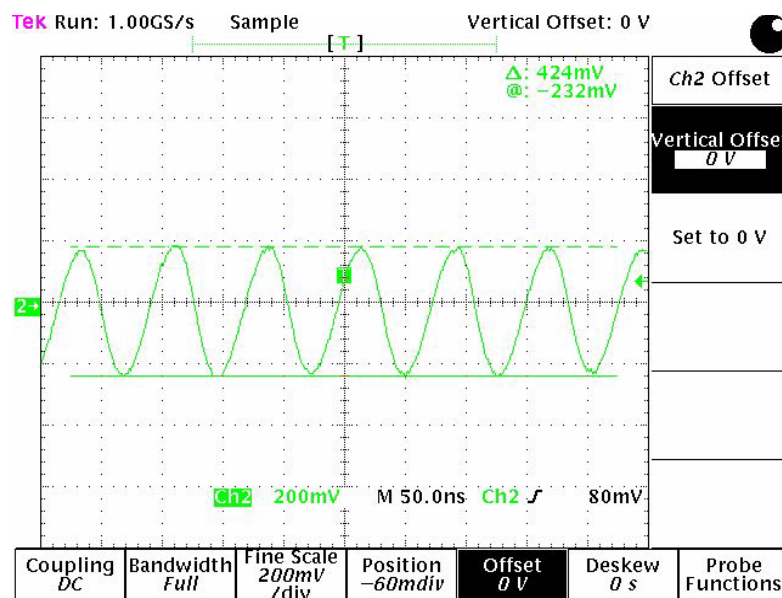


COBBA. Range of Vcon is 0.3 – 2.3 V.

**Measuring on the VCTCXO component**



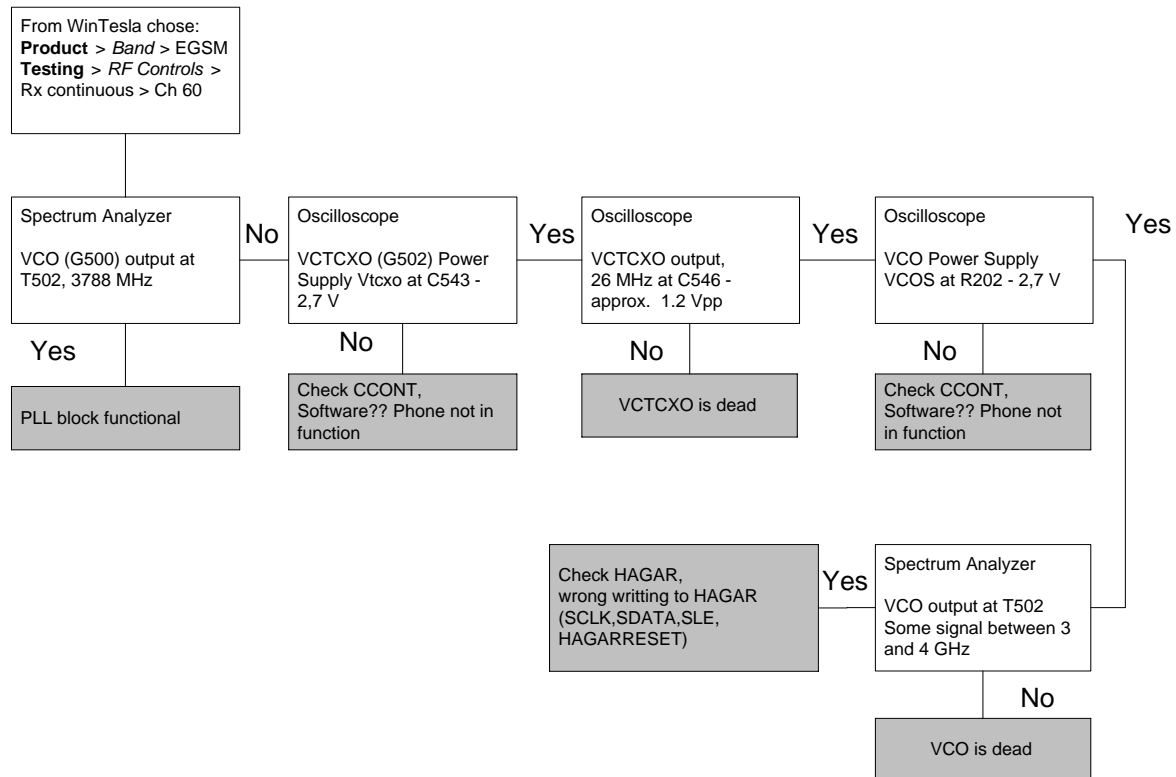
**Measuring on the VCTCXO buffer**



## VCO

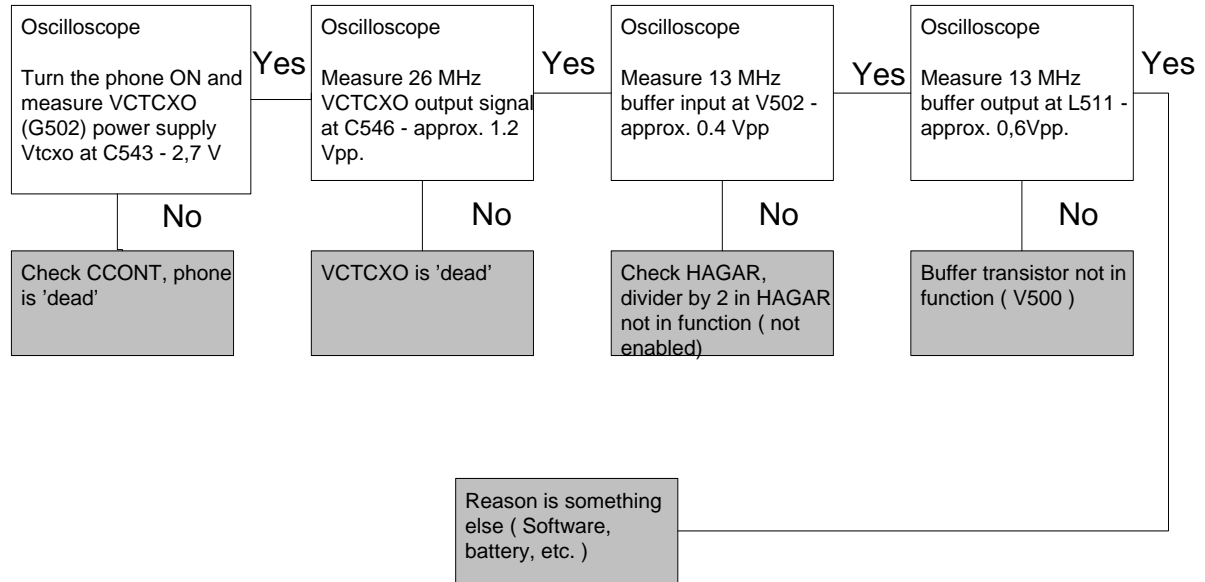
The VCO is generating frequencies in the range of 3420 – 3840 MHz when PLL is in function. These are divided by 2 or by 4 in HAGAR so that they can generate all channels in EGSM and GSM1800. Frequency of the VCO is controlled by dc voltage ( Vc ) coming from the loop filter. Range of the Vc when PLL is in function is 0.7 – 3.8 V. Even if PLL is not in lock state (Vc out of range) there is some frequency at the output of the VCO ( G500) which is between 3 and 4 GHz. This is of course true only if VCO is working and if VCO power supply is present (2.7V).

### Fault finding chart for PLL Synthesizer



It is important to say that power supply for VCTCXO ( VXO) is OFF only in 'Deep Sleep Mode' and power supply for VCO ( G500 Vcc) is OFF in 'Sleep Mode'.

If the phone gets 'dead' very short time after the power is turned ON, possible reason for this might be that 13 MHz system clock signal is not coming to the BB. Use the following chart to find the problem.



## Frequency lists

### EGSM

#### Frequency list NHM-5 / 6 EGSM

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	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	948	3612	3792
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	926	3524	3704	5	891	936	3564	3744	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	949	3616	3796
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	927	3528	3708	10	892	937	3568	3748	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	950	3620	3800
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	928	3532	3712	15	893	938	3572	3752	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	3714.4	18	893.6	938.6	3574.4	3754.4	80	906	951	3624	3804
993	883.8	928.8	3535.2	3715.2	19	893.8	938.8	3575.2	3755.2	81	906.2	951.2	3624.8	3804.8
994	884	929	3536	3716	20	894	939	3576	3756	82	906.4	951.4	3625.6	3805.6
995	884.2	929.2	3536.8	3716.8	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	3717.6	22	894.4	939.4	3577.6	3757.6	84	906.8	951.8	3627.2	3807.2
997	884.6	929.6	3538.4	3718.4	23	894.6	939.6	3578.4	3758.4	85	907	952	3628	3808
998	884.8	929.8	3539.2	3719.2	24	894.8	939.8	3579.2	3759.2	86	907.2	952.2	3628.8	3808.8
999	885	930	3540	3720	25	895	940	3580	3760	87	907.4	952.4	3629.6	3809.6
1000	885.2	930.2	3540.8	3720.8	26	895.2	940.2	3580.8	3760.8	88	907.6	952.6	3630.4	3810.4
1001	885.4	930.4	3541.6	3721.6	27	895.4	940.4	3581.6	3761.6	89	907.8	952.8	3631.2	3811.2
1002	885.6	930.6	3542.4	3722.4	28	895.6	940.6	3582.4	3762.4	90	908	953	3632	3812
1003	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
1004	886	931	3544	3724	30	896	941	3584	3764	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	954	3636	3816
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	932	3548	3728	35	897	942	3588	3768	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	955	3640	3820
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	933	3552	3732	40	898	943	3592	3772	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	956	3644	3824
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	934	3556	3736	45	899	944	3596	3776	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	957	3648	3828
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	935	3560	3740	50	900	945	3600	3780	112	912.4	957.4	3649.6	3829.6
					51	900.2	945.2	3600.8	3780.8	113	912.6	957.6	3650.4	3830.4
					52	900.4	945.4	3601.6	3781.6	114	912.8	957.8	3651.2	3831.2
					53	900.6	945.6	3602.4	3782.4	115	913	958	3652	3832
					54	900.8	945.8	3603.2	3783.2	116	913.2	958.2	3652.8	3832.8
					55	901	946	3604	3784	117	913.4	958.4	3653.6	3833.6
					56	901.2	946.2	3604.8	3784.8	118	913.6	958.6	3654.4	3834.4
					57	901.4	946.4	3605.6	3785.6	119	913.8	958.8	3655.2	3835.2
					58	901.6	946.6	3606.4	3786.4	120	914	959	3656	3836
					59	901.8	946.8	3607.2	3787.2	121	914.2	959.2	3656.8	3836.8
					60	902	947	3608	3788	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

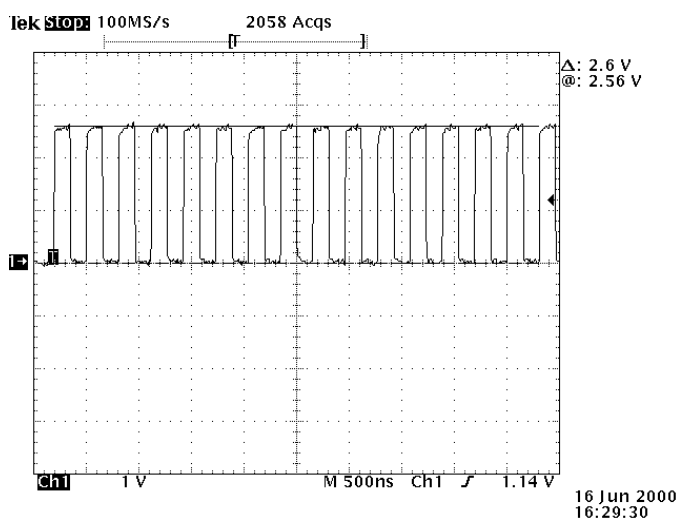


## Hagar and serial interface

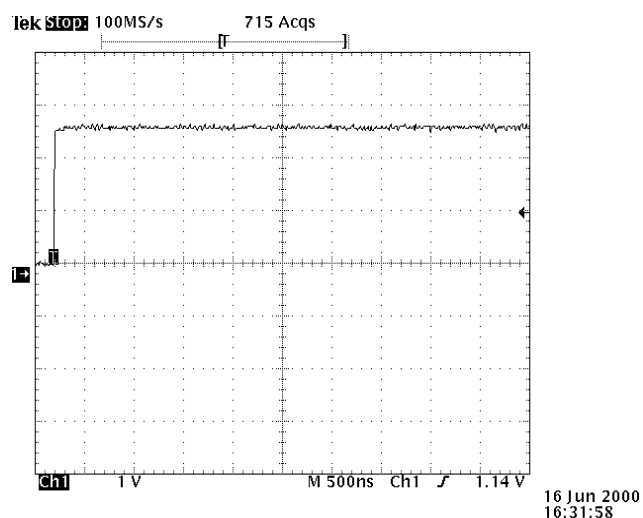
In general, if phone is not in a sleep mode, Hagar chip is always active.

This means that, as long as we have set the phone in Normal mode or in Local mode (either RX or TX band ) there is going to be some Hagar activities, which is controled through serial interface (SDATA,SCLK,SENA and HAGAR\_RESET\_X).

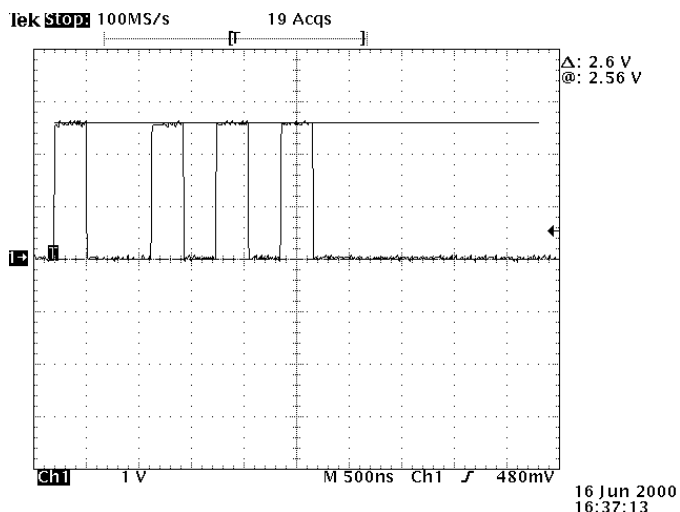
Pictures below show these four signals, measured on R301 (both SCLK and SENA) , on R300 (SDATA) and C540 (HAGAR\_RESET\_X). R301 and R300 are placed in BB part.



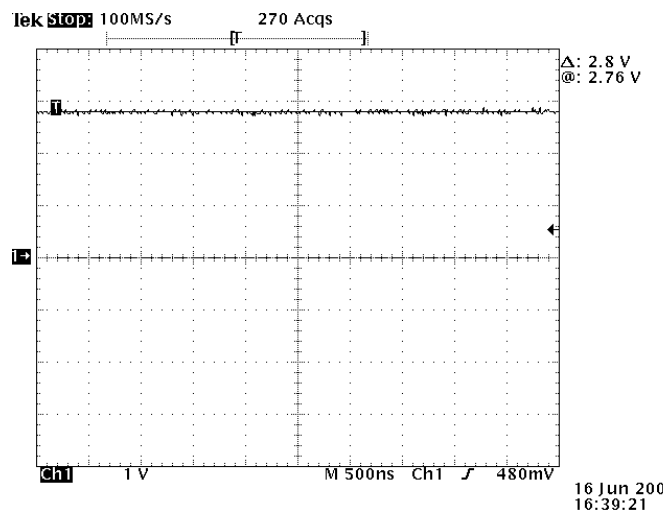
**Figure 3. SCLK - clock signal**



**Figure 4. SENA - enable signal**



**Figure 5. SDATA - data signal**



**Figure 6. HAGAR\_RESET\_X - hagar reset "on"**

First precondition for Hagar to be in active (ON) mode is that HAGAR\_RESET\_X should be high (2.8V) and VREF, which is Hagar reference voltage, at 1.35V.

Easiest way to check these two voltages is by using oscilloscope with an standard passive probe (10kΩ/8pF). HAGAR\_RESET\_X is measured on C540 and VREF on C536.

Another " good spot" to check if Hagar's internal supplies are active, is to measure either on capacitor C538 or resistor R511. R511 is Hagar connection for a external resistor in order to create internal bias currents. This volage should be exactly the same value as VREF on C536.

Next step towards examination of the the Hagar functionality can be based on verification of some important bias voltages and bias controls. Those signal coming from Hagar and they are used for controlling the LNA's biasing(both 900/1800MHz), LNA power supply and TX power detector .

As a reference, here is a list of some typical test points for both Rx and Tx mode:

Frequency Band	RX	TX
<b>EGSM</b>	<ul style="list-style-type: none"> <li><sup>2</sup> 900 LNA bias control - L506 (pulses with ≈2.34V )</li> <li><sup>2</sup> 900 LNA power supply control – R514( pulses with ≈2.75V)</li> </ul>	<ul style="list-style-type: none"> <li><sup>2</sup> supply for the 900 PA buffer – R606 (pulses with ≈2.34V)</li> <li><sup>2</sup> bias voltage for power detector – C573 ( "high" 2.8V)</li> </ul>
<b>GSM1800</b>	<ul style="list-style-type: none"> <li><sup>2</sup> 1800 LNA bias control – R502 (pulses with ≈2.34V)</li> <li><sup>2</sup> 1800 LNA power supply control – R513( pulses with ≈2.75V)</li> </ul>	<ul style="list-style-type: none"> <li><sup>2</sup> bias voltage for power detector – C573 ( "high" 2.8V)</li> </ul>

## Wintesla Tuning

Prior to any tuning the phone should be initialised:

Start Wintesla-Service-Software and

```
Select      P_r_o_d_u_c_t                A_l_t+p
              O_p_e_n...
              N_H_M-5

Select:     P_r_o_d_u_c_t                A_l_t+p
              I_n_i_t_i_a_l_i_s_e       A_l_t+l
              N_o_r_m_a_l_M_o_d_e       F5
```

### What RF to tune after repairs

Different repairs require different tuning. In general it is necessary to determine in which section the repair was done to establish which tunings to perform. To determine if RF tuning is necessary after repair it is important that the functionality of the repaired circuit is understood well. In case the circuit is not fully understood it might be wise to play it safe and do RF tunings in accordance with the table below.

In general repairs in the TX part will require tuning of "TX Power" and "TX I/Q" tuning.

In general repairs in the RX part or PLL will always require "RX Calibration" and in some cases require AM Suppression tuning (Automatic) and RX Filter Calibration (Automatic).

Other parts interfacing to TX, RX or PLL might require tuning, but common sense should be used.

In the table below guidelines for what to tune when can be seen (if it can be ruled out that a component will change RF performance, e.g. the microphone B200 there is no need to do any RF tuning).

Repairs affecting component number	Required tuning				
	RX calibration	AM suppression	RX filter calibration	TX power	TX IQ
100-199	Yes				
200-399					Yes
400-499					
500-599	Yes	Yes	Yes	Yes	Yes
600-699				Yes	Yes
Full factory setting	Yes	Yes	Yes	Yes	Yes

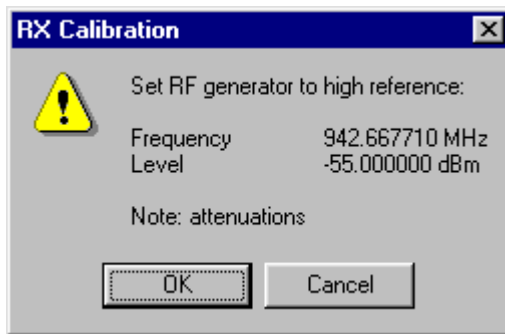


### RX Calibration

The "RX calibration" is used to determine gain at different gain-settings for front-end and Hagar and needs to be done in both bands, but the calibration only have to be started once, it will automatically proceed to the GSM1800 band after EGSM.

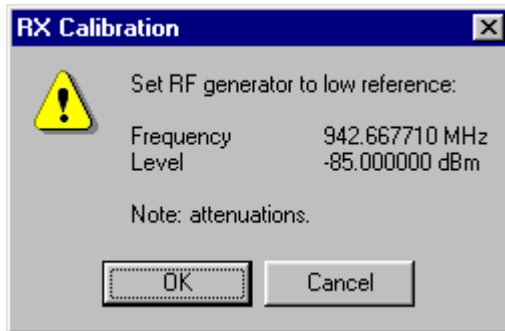
- Select: Product Alt+p
- Band b
- EGSM e
- Select: Tuning Alt+t
- RX Calibration r

A window will now pop-up:



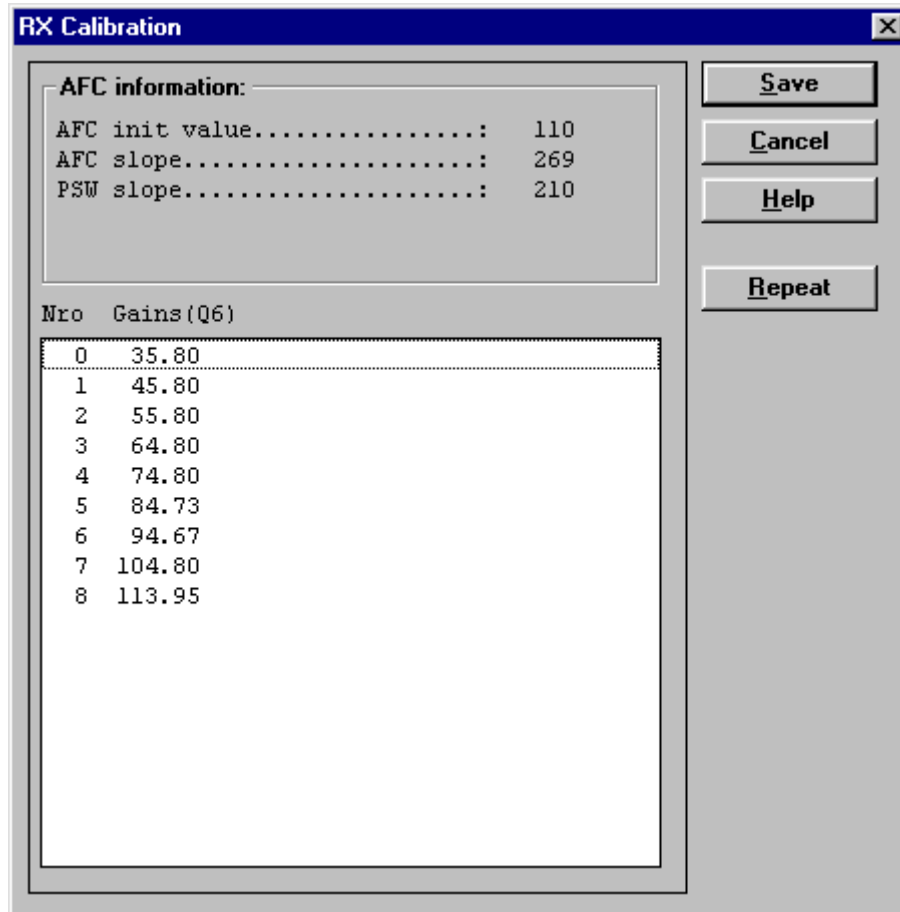
Connect an external generator to the phones RF connector and set the generator as the window tells you.

Click OK in the Wintesla window, now a new window pops up:

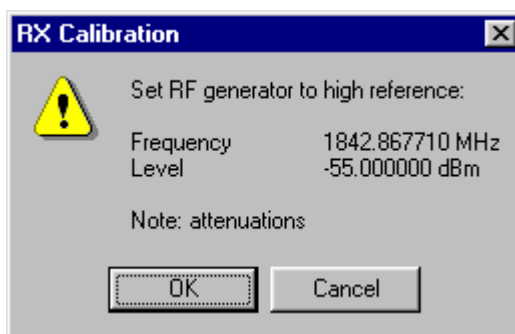


Change the level on the generator as the window tells you.

Click OK in the Wintesla window, now a new window pops up:

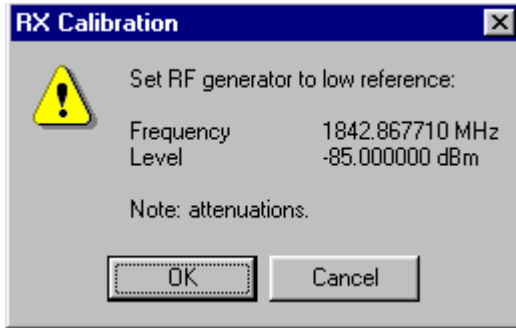


Click Save in the Wintesla window, now a new window pops up:



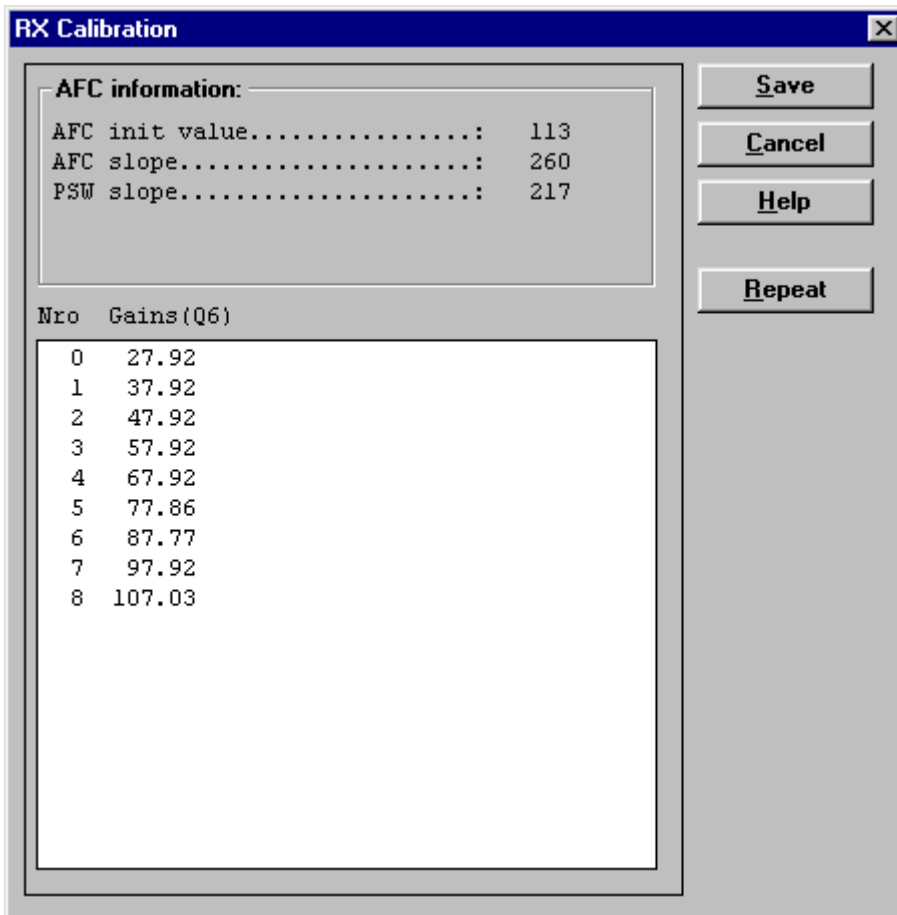
Change the level and frequency on the generator as the window tells you.

Click OK in the Wintesla window, now a new window pops up:



Change the level and frequency on the generator as the window tells you.

Click OK in the Wintelsa window, now a new window pops up:



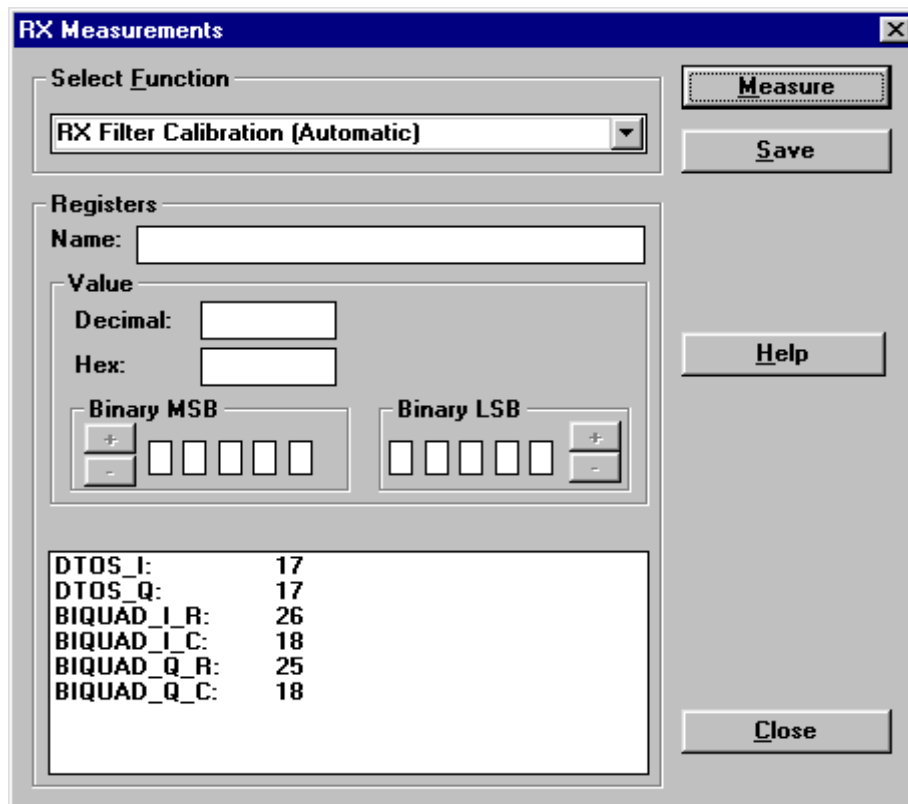
Click Save in the Wintelsa window, RX Calibration is now completed

## RX Filter Calibration (Automatic)

This calibration is calibrating the Baseband filter inside Hagar, for this reason the calibration is not done in both bands.

Select: Tuning      Alt+t  
                    RX Measurements

A window now pops-up:



In the "Select Function" frame select RX "Filter calibration (Automatic)".

No external signal is needed for this, just click "Measure", wait a few seconds and then click "Save Defaults"

RX filter calibration is now completed and the "RX Measurements" window can be closed by clicking "Close"

### RX AM Suppression (Automatic)

This calibration is tuning the AM suppression performance of Hagar mixers and will have to be done in both bands. If flash or Hagar has been replaced or Full Factory settings have been performed RX AM Suppression must be done.

EGSM

Select: Product Alt+p

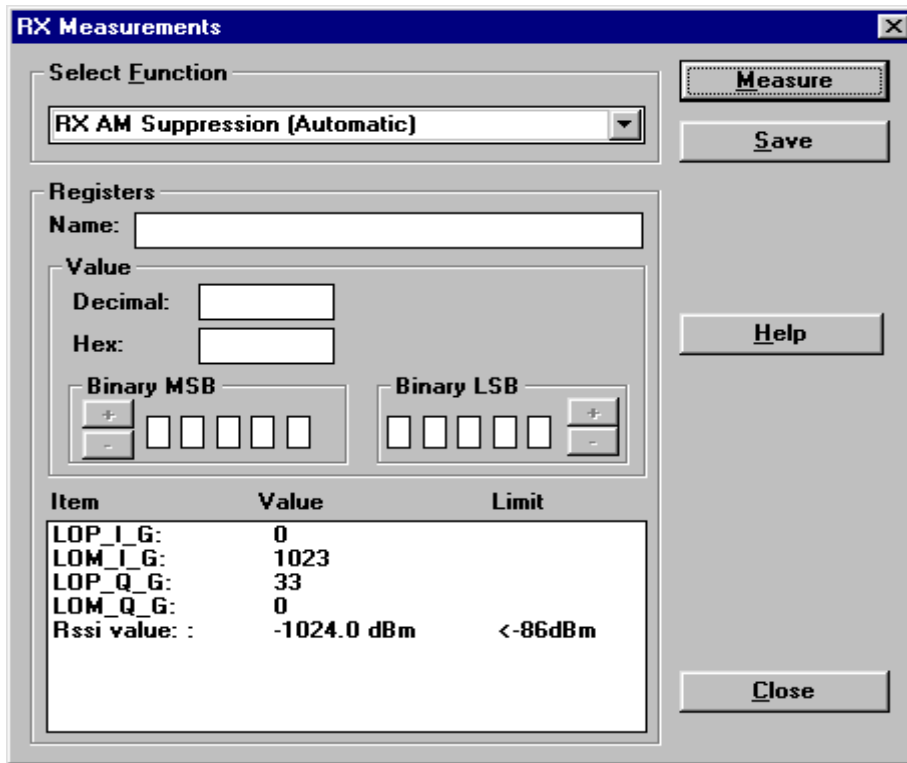
Band b

EGSM e

Select: Tuning Alt+t

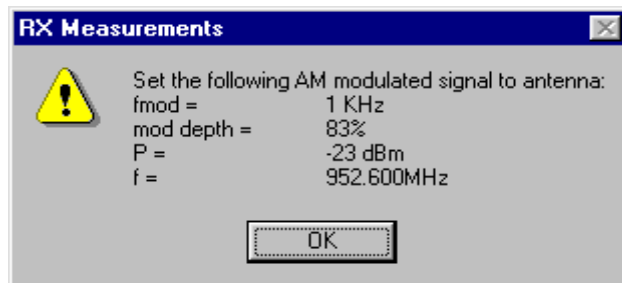
RX Measurements

A window now pops-up:



In the "Select Function" frame select RX "RX AM Suppression (Automatic)".

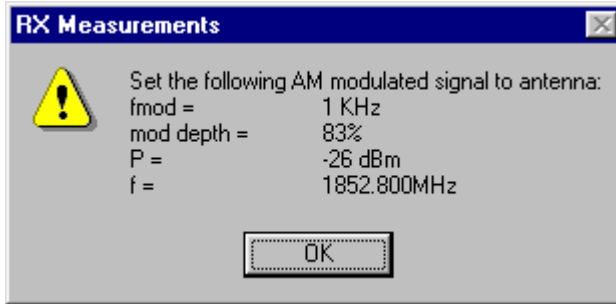
Click Measure, A window now pops-up:



Connect an external generator to the antenna connector of the phone and set-up the generator.

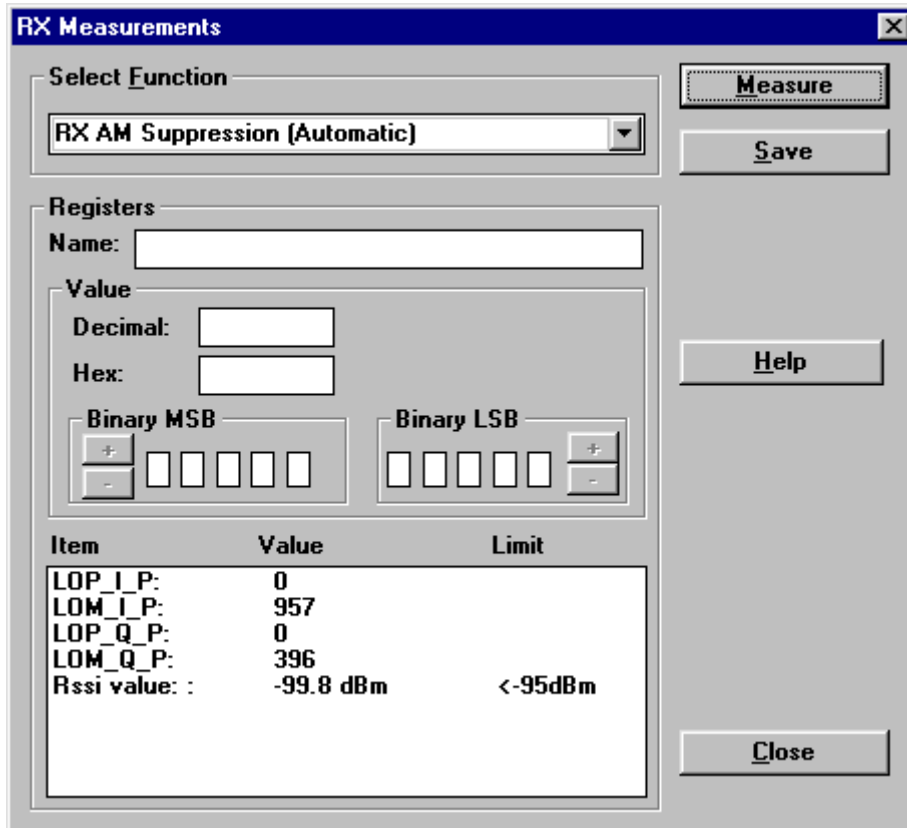


Click Measure, A window now pops-up:



Connect an external generator to the antenna connector of the phone and set-up the generator.

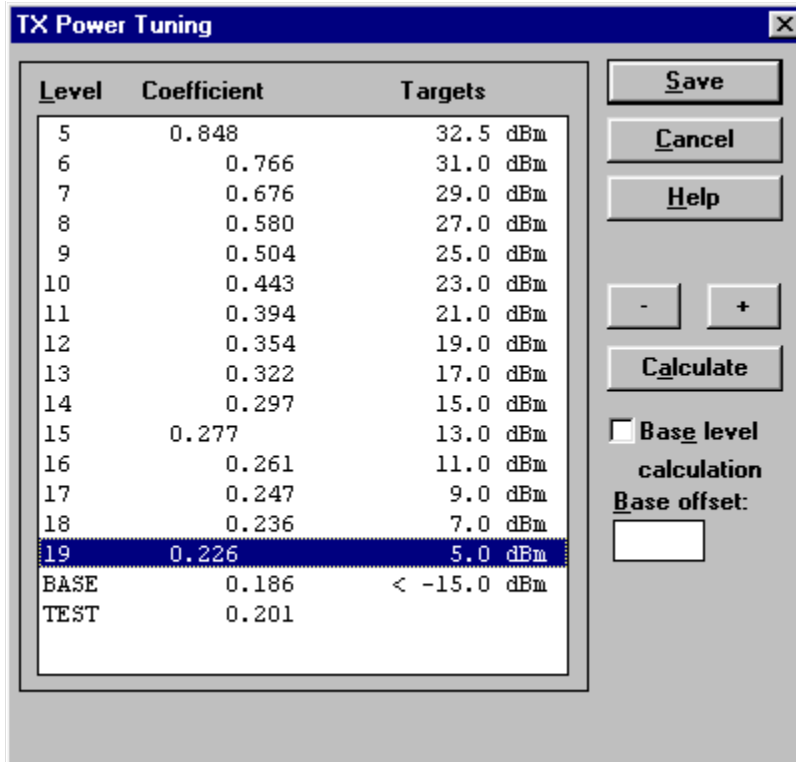
Click OK in the Wintelsa window, the RSSI value is updated in the RX Measurements window.







A window now pops-up:



Tune level 19, 15, 5 and Base in accordance with the target values.

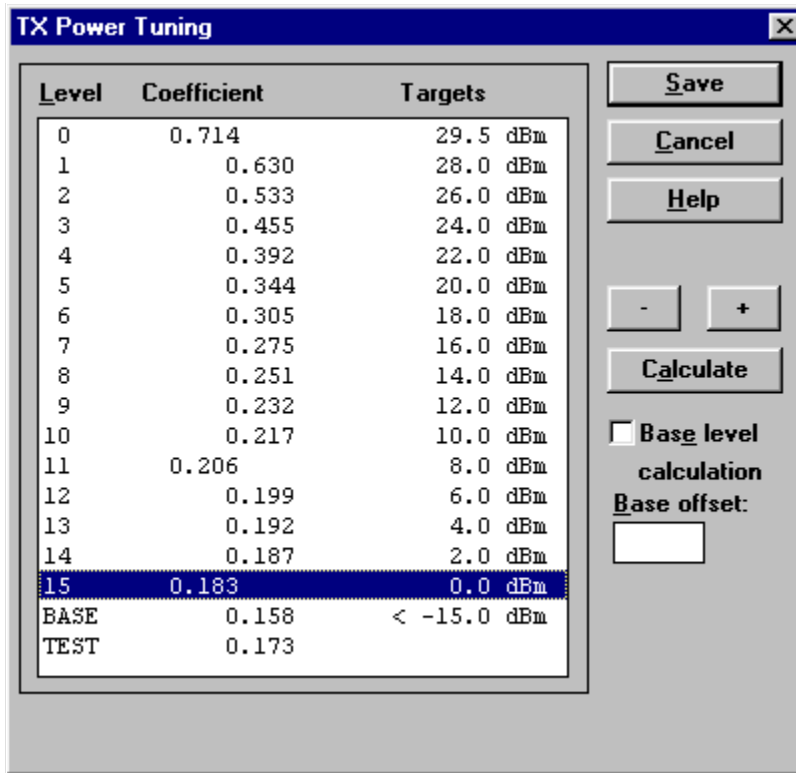
Note: Target values may vary due to different PA vendors.

Click calculate, check if the other levels match the targets, correct if necessary.

Click Save when all values match the targets.



A window now pops-up:



Tune level 15, 11, 0 and Base in accordance with the target values.

Note: Target values may vary due to different PA vendors.

Click calculate, check if the other levels match the targets, correct if necessary.

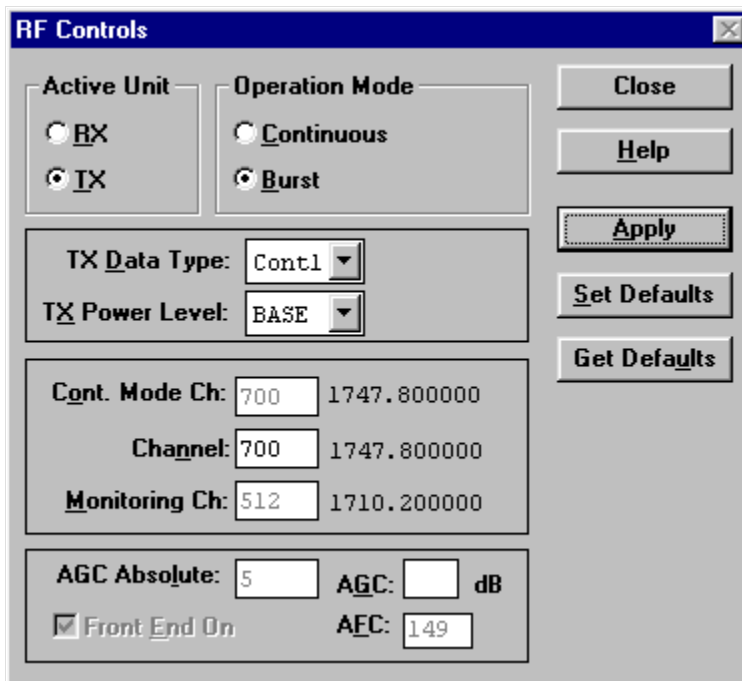
Click Save when all values match the targets.



**Initial set-up GSM1800**

Select: Product Alt+p  
          Band b  
          PCN p  
Select: Testing Alt+e  
          RF Controls r

A window now pops-up:



Set Active unit to TX

Set TX Data Type: to Cont1

Click Apply

Click Close

Go through the "Common tuning procedure for EGSM and GSM1800" described in section 11.6.2 of this document.

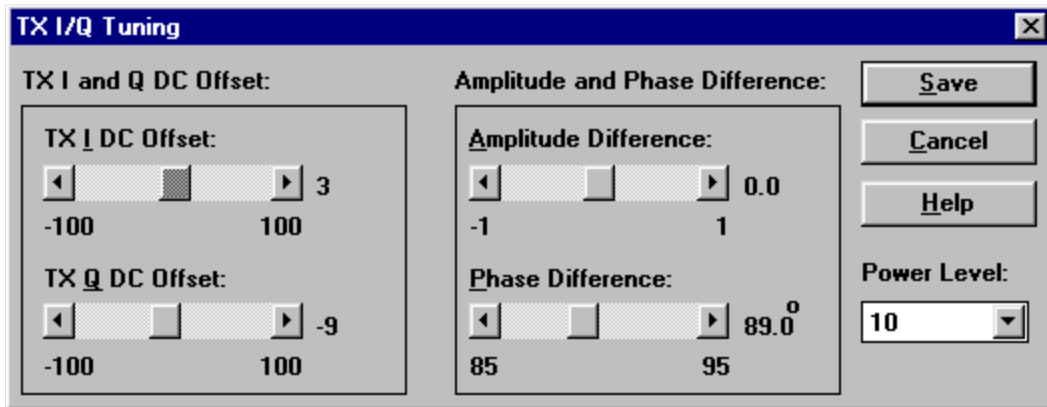
**Common tuning procedure for EGSM and GSM1800**

Select: Tuning Alt+t

TX I/Q...

Alt+q

A window now pops-up:



The carrier (M2) and +67kHz (M3) signal should now be tuned to a minimum.

The buttons in the "TX I and Q DC Offset:" will change the level of the carrier.

The buttons in the "Amplitude and Phase Difference:" window will change the level of the +67kHz signal.

When minimum values are reached, click Save

