Customer Care Solutions
NPL-3 Series Transceivers

Troubleshooting Instructions

Issue 1 3/03

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RF Troubleshooting

Introduction to RF troubleshooting

Measurements should be done using Spectrum analyzer with high-frequency high-impedance passive probe (LO-/reference frequencies and RF power levels) and Oscilloscope with a 10:1 probe (DC-voltages and low frequency signals).

The RF-section is build around one RF-ASIC (HELGO N500). For easier troubleshooting, this RF troubleshooting document is divided into sections.

Before changing HELGO, please check the following things: supply voltages are OK and serial communication coming from baseband to HELGO.

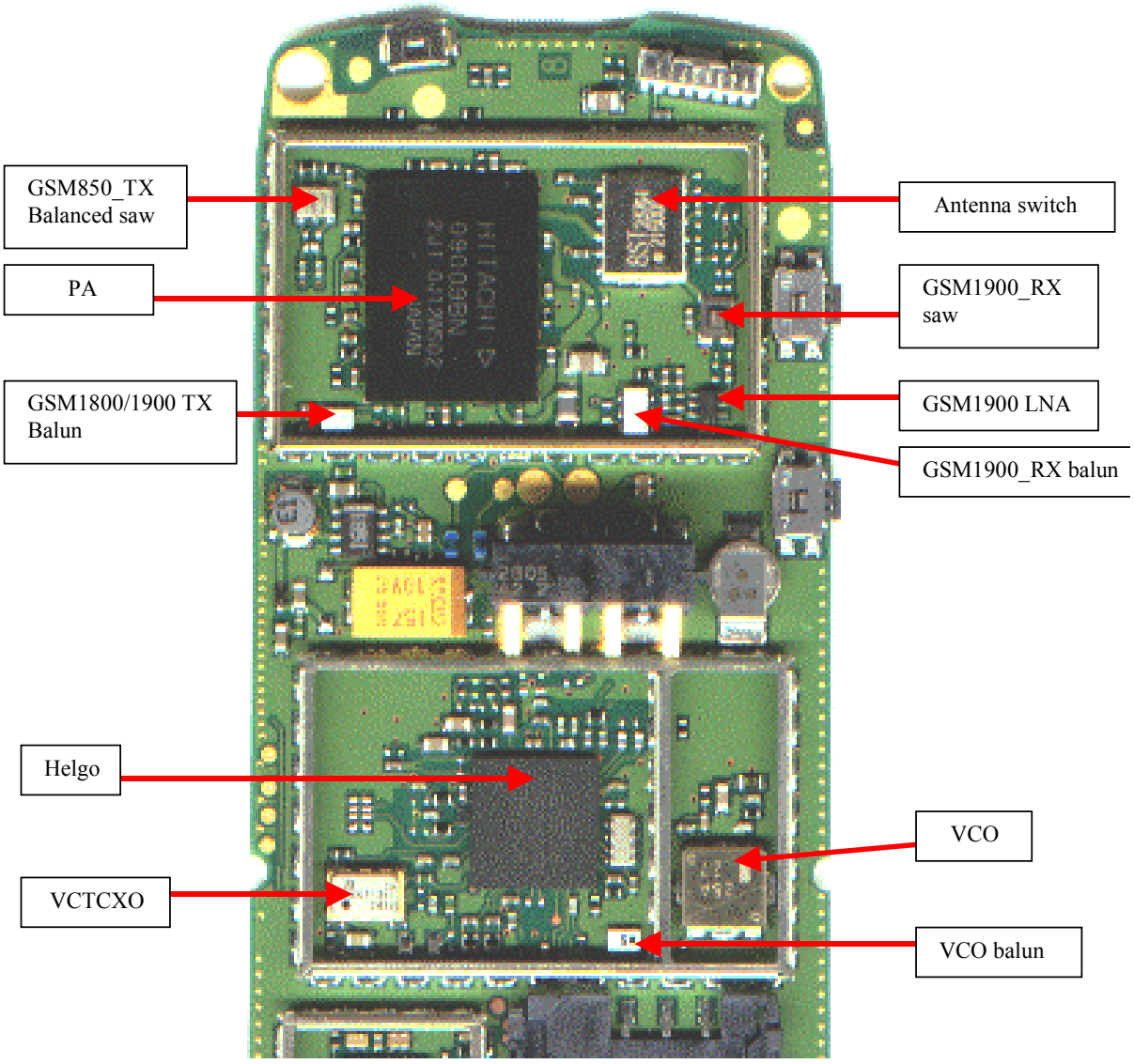
Please note that the grounding of the PA module is directly below PA-module so it is difficult to check or change. **Most RF semiconductors are static discharge sensitive!** So ESD protection must be taken care of duriong repair (ground straps and ESD soldering irons). HELGO and PA are moisture sensitive so parts must be pre-baked prior to soldering.

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

Please be aware that all measured voltages or RF levels in this document are rough figures. Especially RF levels varies due to different measuring equipment or different grounding of the used probe. When using RF probe usually a good way is to use metallic tweezers to connect probe ground to PWB ground as close to measurement point as possible.

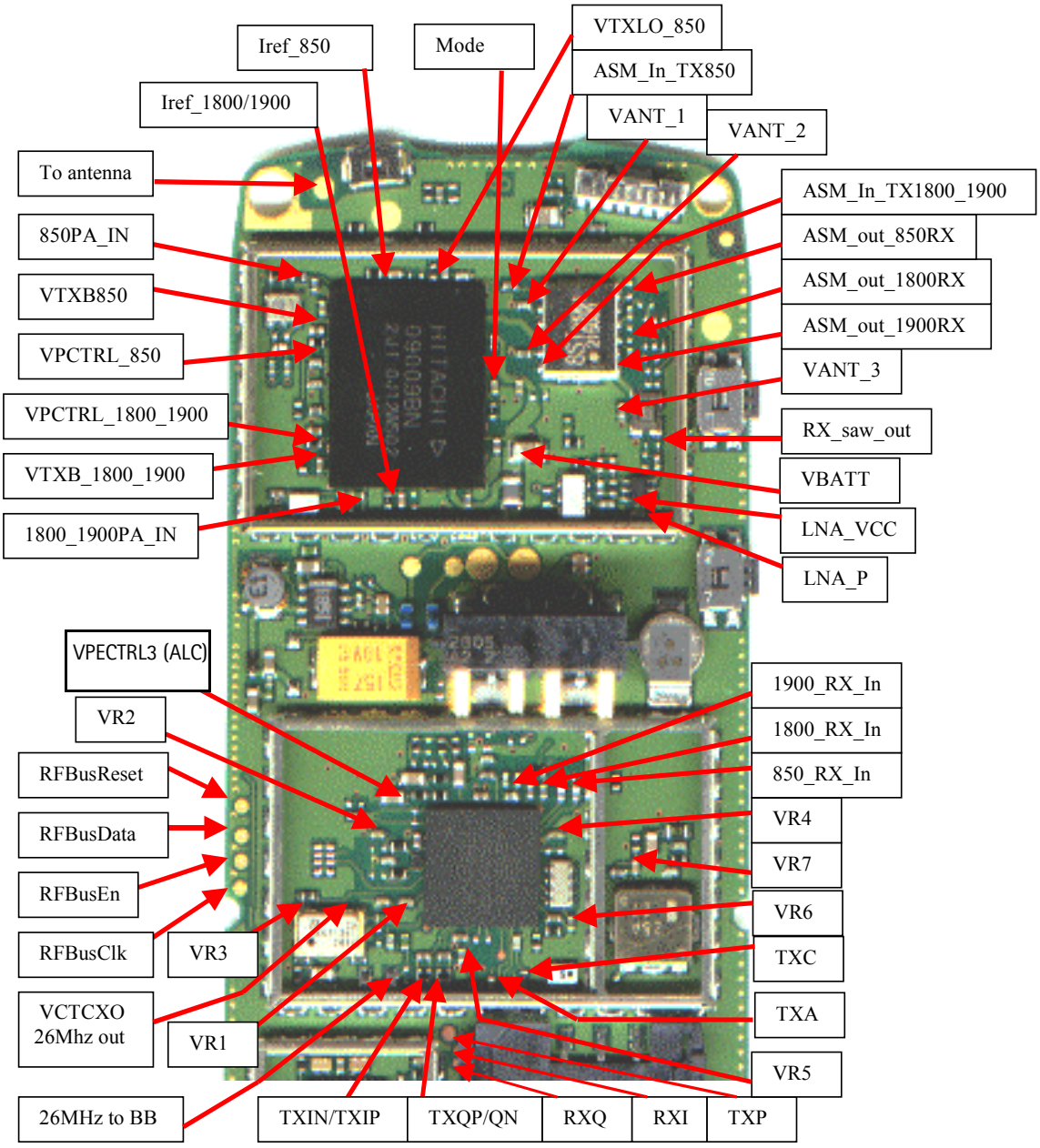
RF Key component placement

Figure 1: Component placement 1



RF Measurement points

Figure 2: Component placement 2



GSM850, GSM1800 & GSM1900 Transmitter

General instructions for Tx troubleshooting

Kindly refer to the Service Software Section, Service Concept dagram (p.40)

Connect test jig to computer with DAU-9S cable or to FPS-8 Flash Prommer with XCS-4 modular cable.

Make sure that you have PKD-1 dongle connected to computers parallel port.

Connect DC power supply to module test jig with FLC-2 cable.

Attention: When repairing or tuning transmitter use external DC supply with at least 3A current capability. Set the DC supply voltage to 3.9V and set the jumper connector on test jig to "bypass" position.

Connect an RF-cable to the module test jig (MJS-38) RF connector and to measurement equipment or at least a 10dB attenuator, otherwise the PA may be damaged. Normally a spectrum analyzer is used as measurement equipment.

Attention: Normally Spectrum analyzer maximum input power is +30dBm. It is recommended to use 10dB attenuator on Spectrum analyzer input to prevent damage.

Set the phone module to test jig and start Phoenix service sofware

Initialize connection to phone. (use FBUS driver when using DAU9S and COMBOX driver when using FPS-8)

Select product from the menu

File -> Choose product -> NPL-3

From toolbar set operating mode to "Local"

Activate RF controls window from the menu

Testing -> RF Controls

From the RF controls window

- Select band "GSM850" or "GSM 1800" or "GSM1900" (Default = "GSM850")

- Set Active unit to "Tx" (Default = "Rx")

- Set Operation mode to "Burst" (Default = "Burst")

- Set Tx data type to "Random" (Default = "All1")

- Set Rx/Tx channel to 190 on GSM850 band or 700 on GSM1800 band or 661 on GSM1900 (Defaults)

- Set Tx PA mode to "Free" (Default)

- Set power level to 5 (Default = 19) on GSM850 or to 0 (Default = 15) on GSM1800 or GSM1900

Transmitter troubleshooting diagram

Figure 3: Transmitter troubleshooting

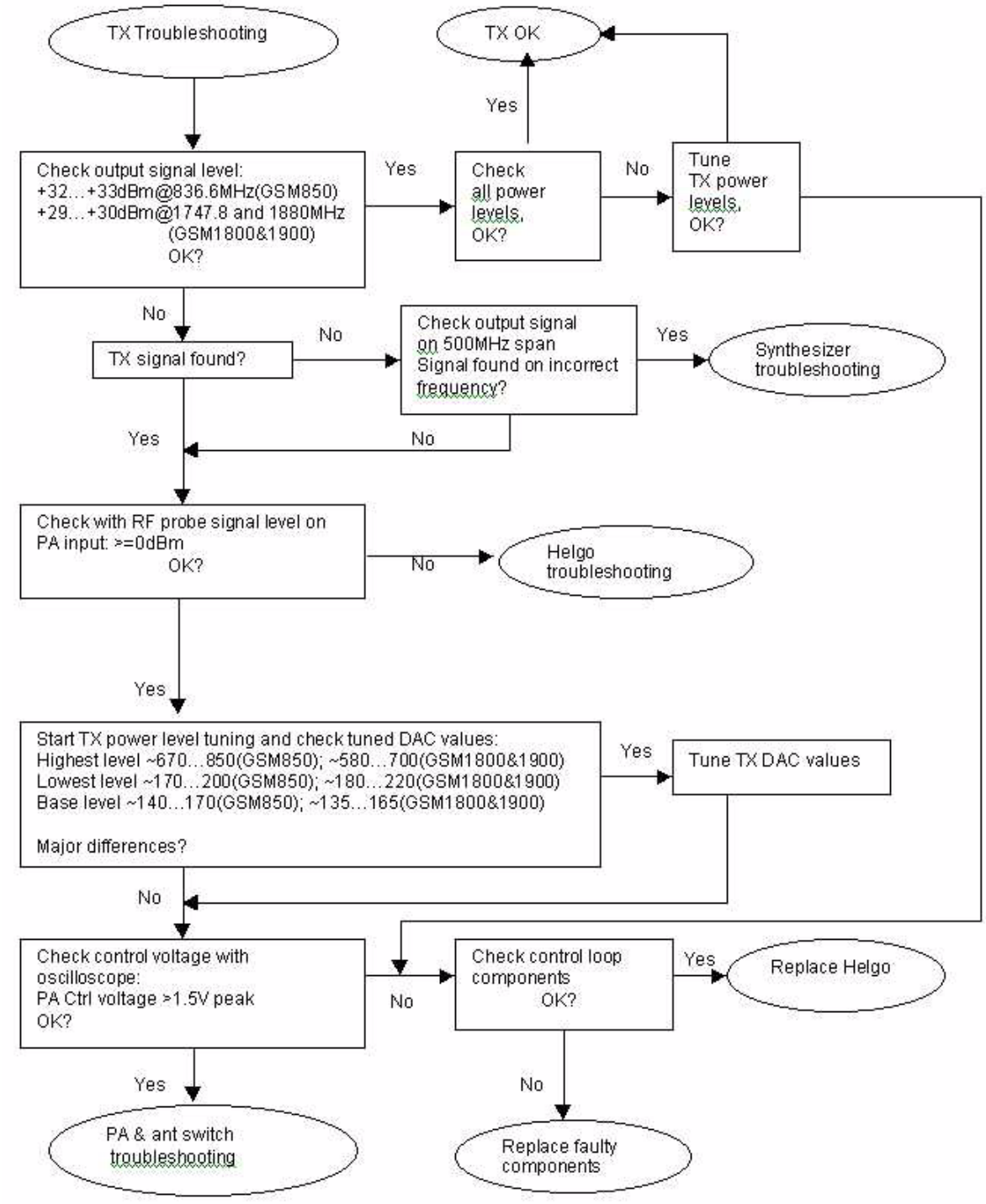


Figure 4: HELGO IC troubleshooting

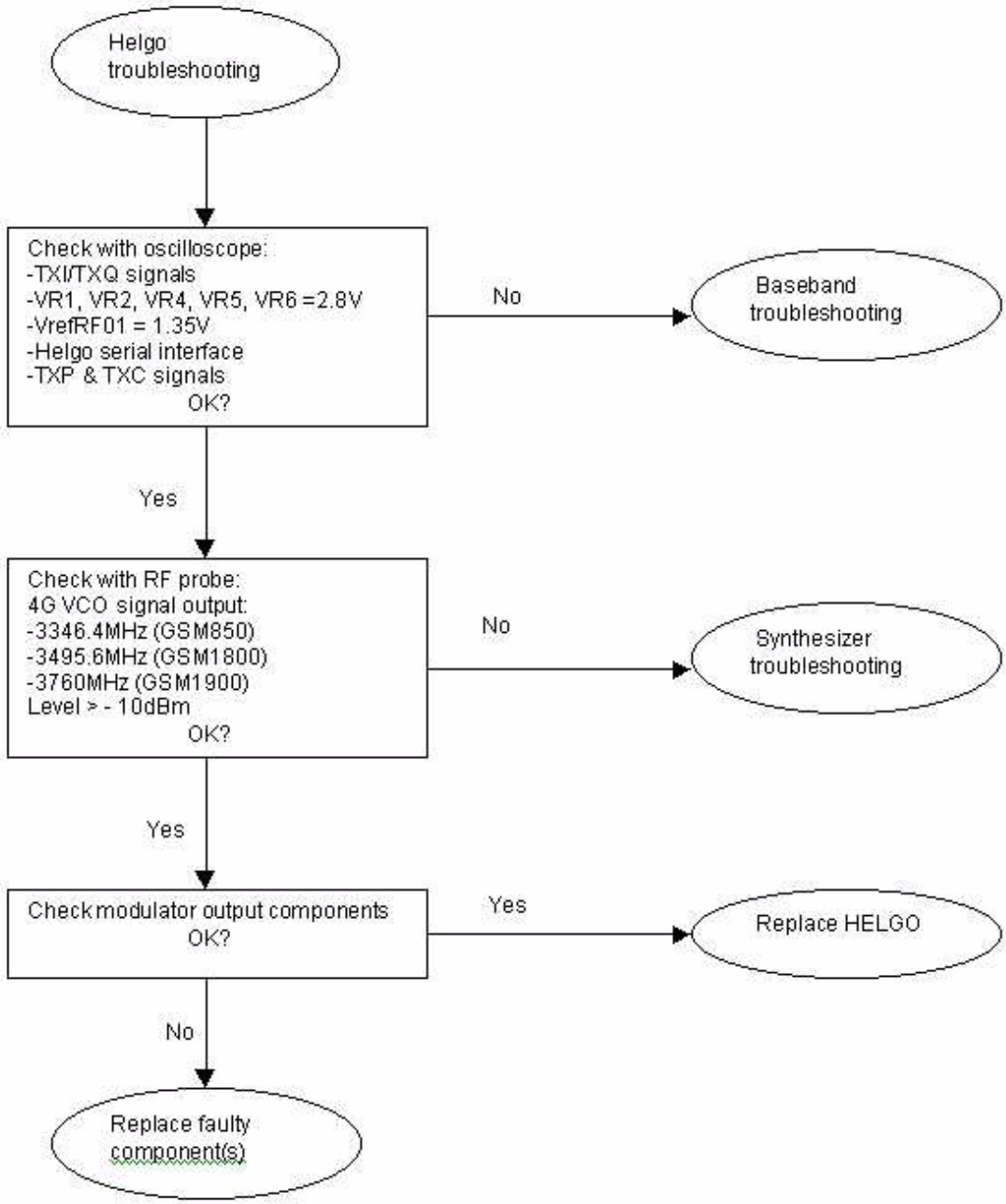
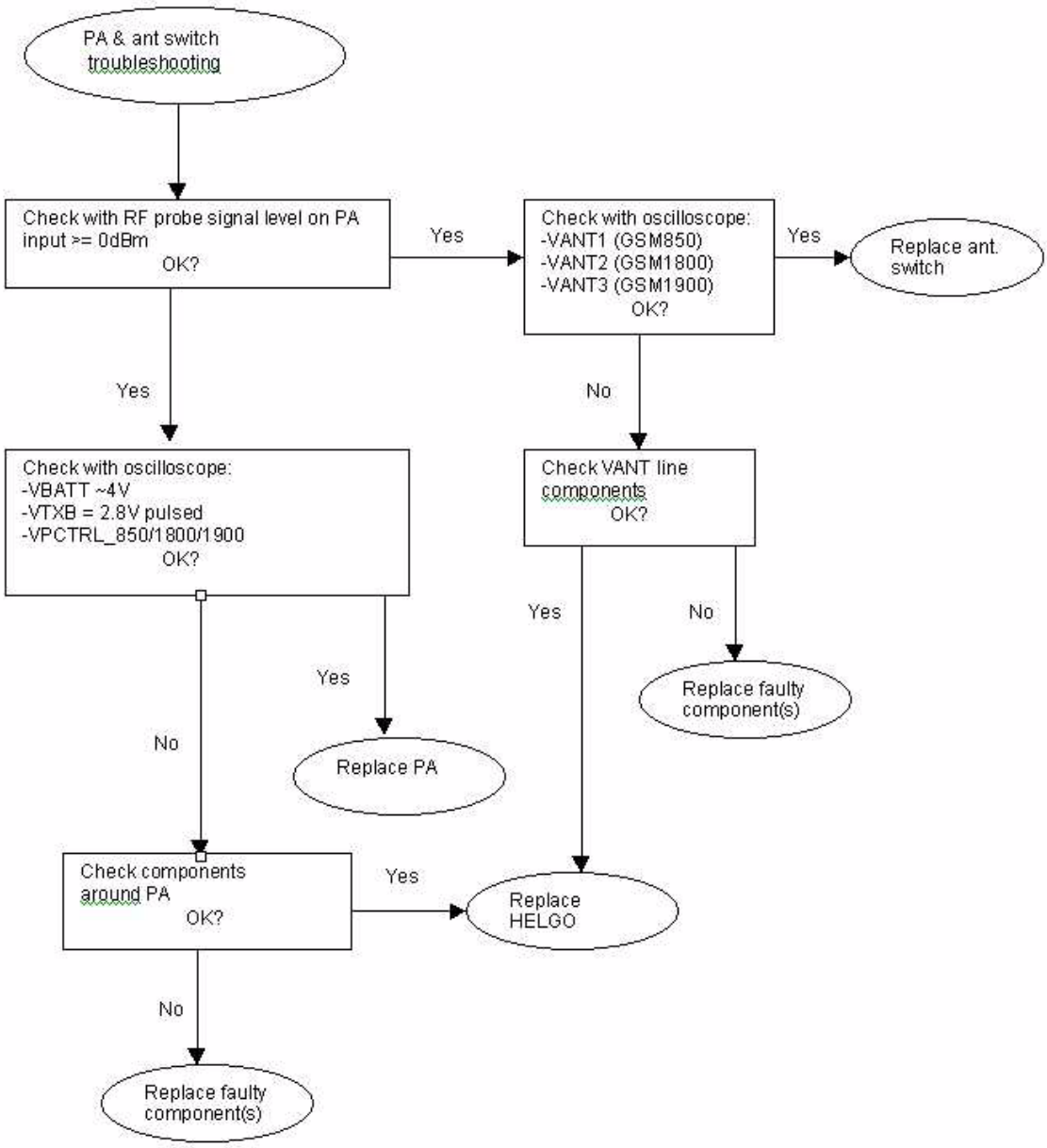
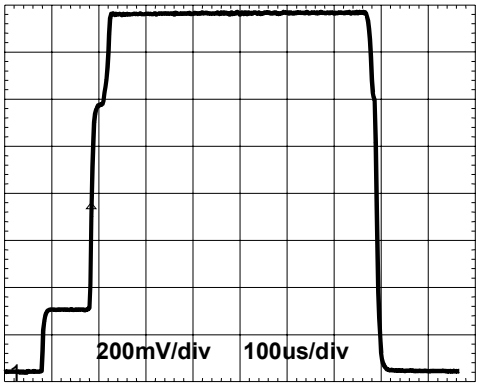


Figure 5: PA and Antenna Switch troubleshooting

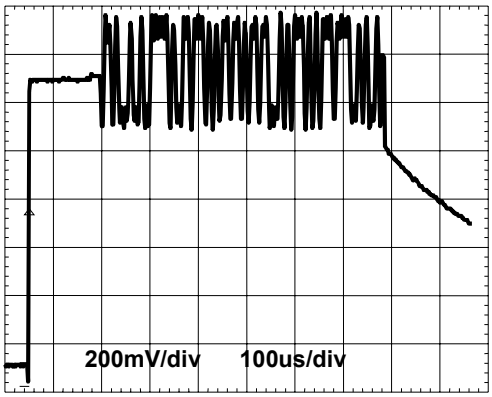


Pictures of transmitter signals

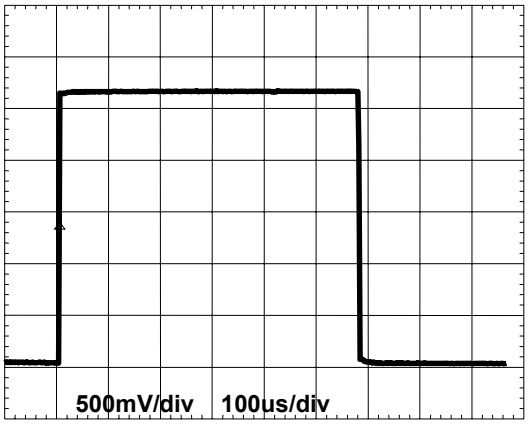
Figure 6: Transmitter signals



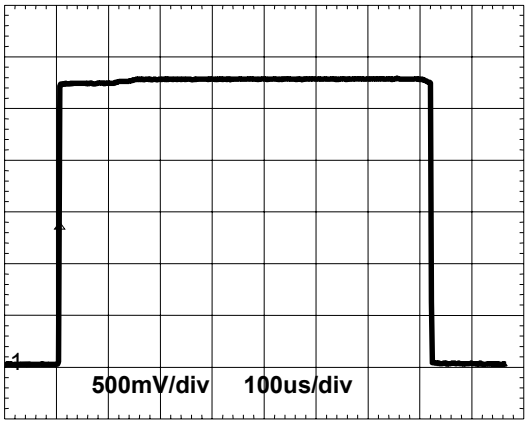
VPCTRL _850 power level high at R703/C703
VPCTRL_1800/1900 power level high at R704/C704_



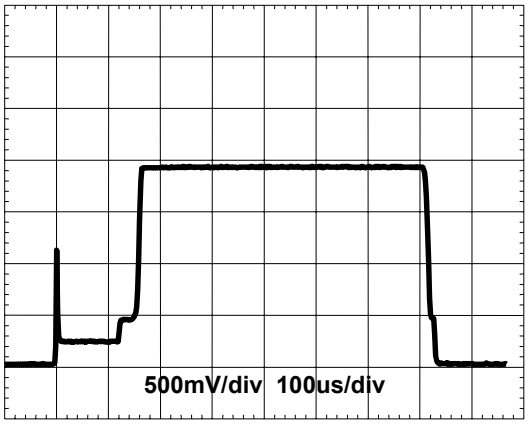
TX I/Q at R516/517 power level high Random data



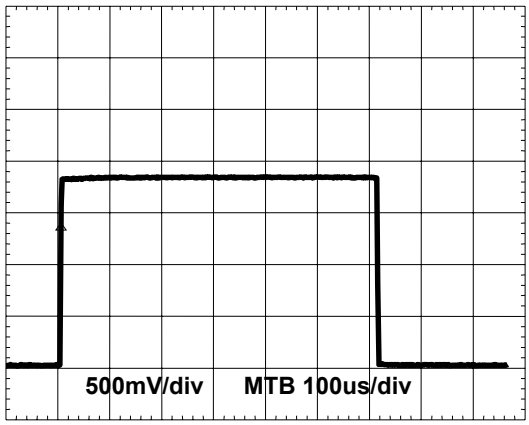
VANT_1 / GSM850 TX at C804
VANT_2 / GSM1800 TX at R808
VANT_3 / GSM1900 TX at C805 OV
(no signal/ Flatline on Oscilloscope screen)



VANT_1,VANT_2,VANT_3

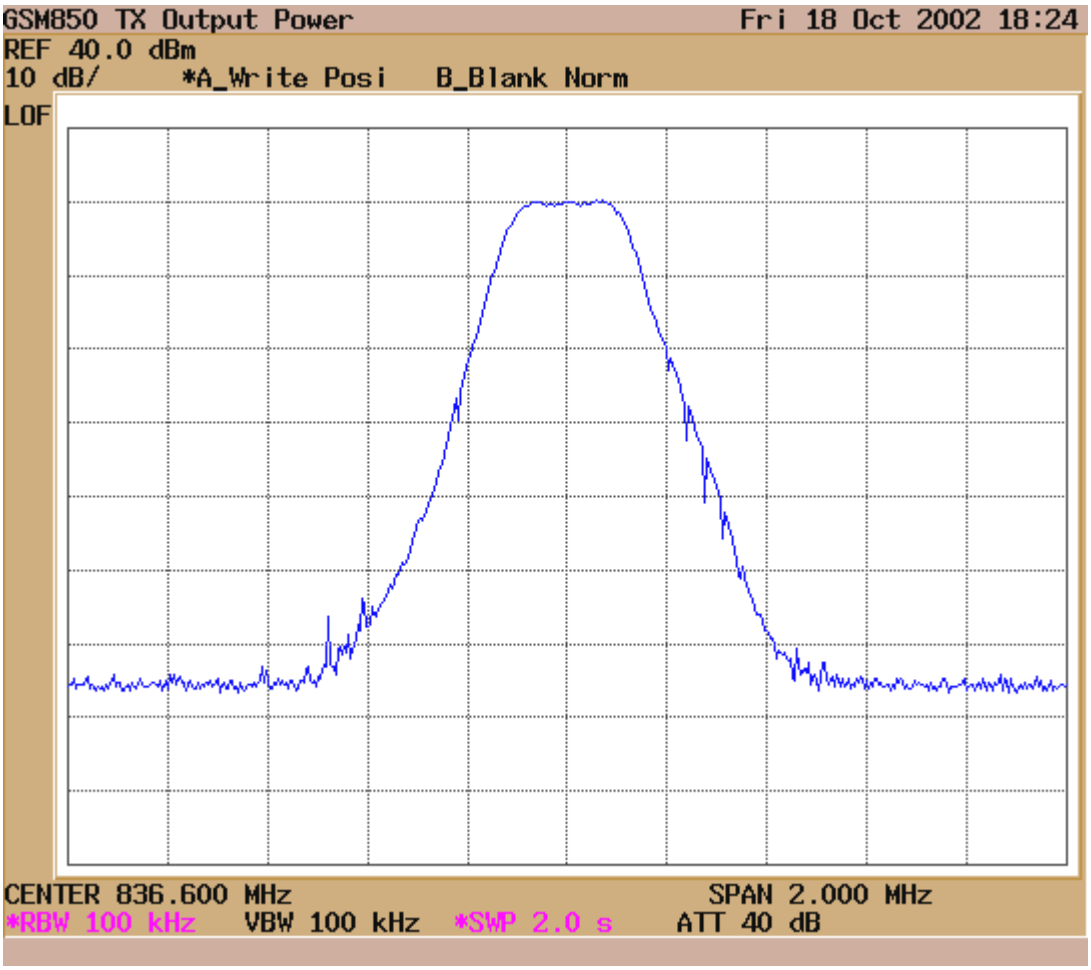


VTXB_850 at C713
VTXB_1800_1900 at C714



TXP at J504

Figure 7: Tx out signal, 850 band, burst mode, channel 190



Additional information for EDGE troubleshooting

EDGE mode troubleshooting differs slightly from basic GSM troubleshooting.

Establish connection to the phone normally (see GSM850/1800/1900 troubleshooting instructions).

Select product from the menu:

File -> Choose Product -> NPL-3

From toolbar set operating mode to "Local"

Activate RF controls window from the menu:

Testing -> RF Controls

From the RF controls window:

Select Band "GSM850" or "GSM1800" or "GSM1900" (Default="GSM850")

Set Active unit to "Tx" (Default="Rx")

Set Edge "On" (Default="Off")

Set Operation mode to "Burst" (Default="Burst")

Set Tx data type to "Alternate PN9" (Default="All1")

Set Rx/Tx channel to 190 on GSM850 or 700 on GSM1800 or 661 on GSM1900 (Defaults)

Set power level to 8 (Default = 19) on GSM850 or to 2 (Default = 0) on GSM1800 or GSM1900

NOTE! For GSM850 Edge power levels 5, 6 and 7 are not in use and for GSM1800&1900 Edge power levels 0 and 1 are not in use.

Figure 8: Transmitter EDGE troubleshooting

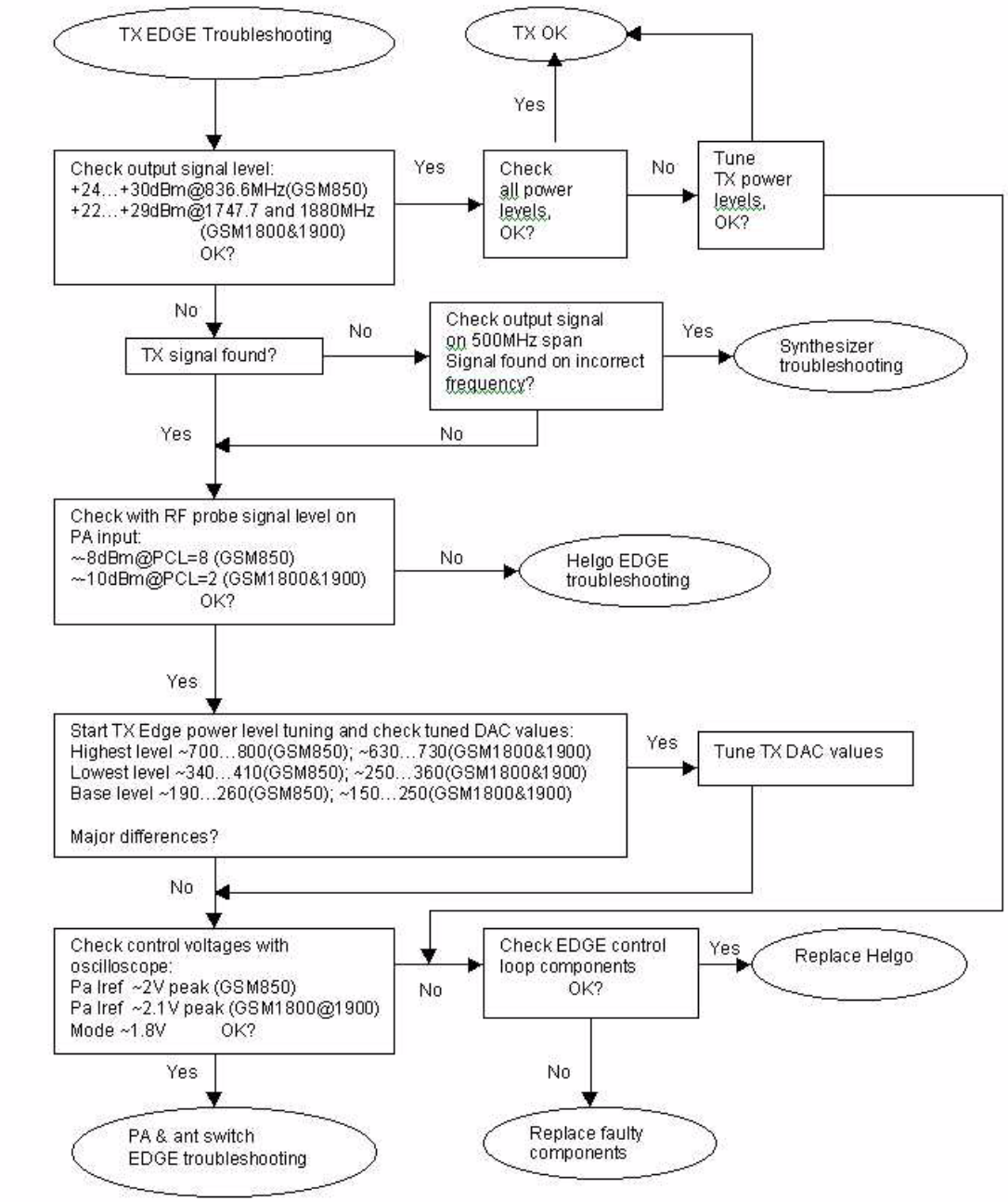


Figure 9: Helgo EDGE troubleshooting

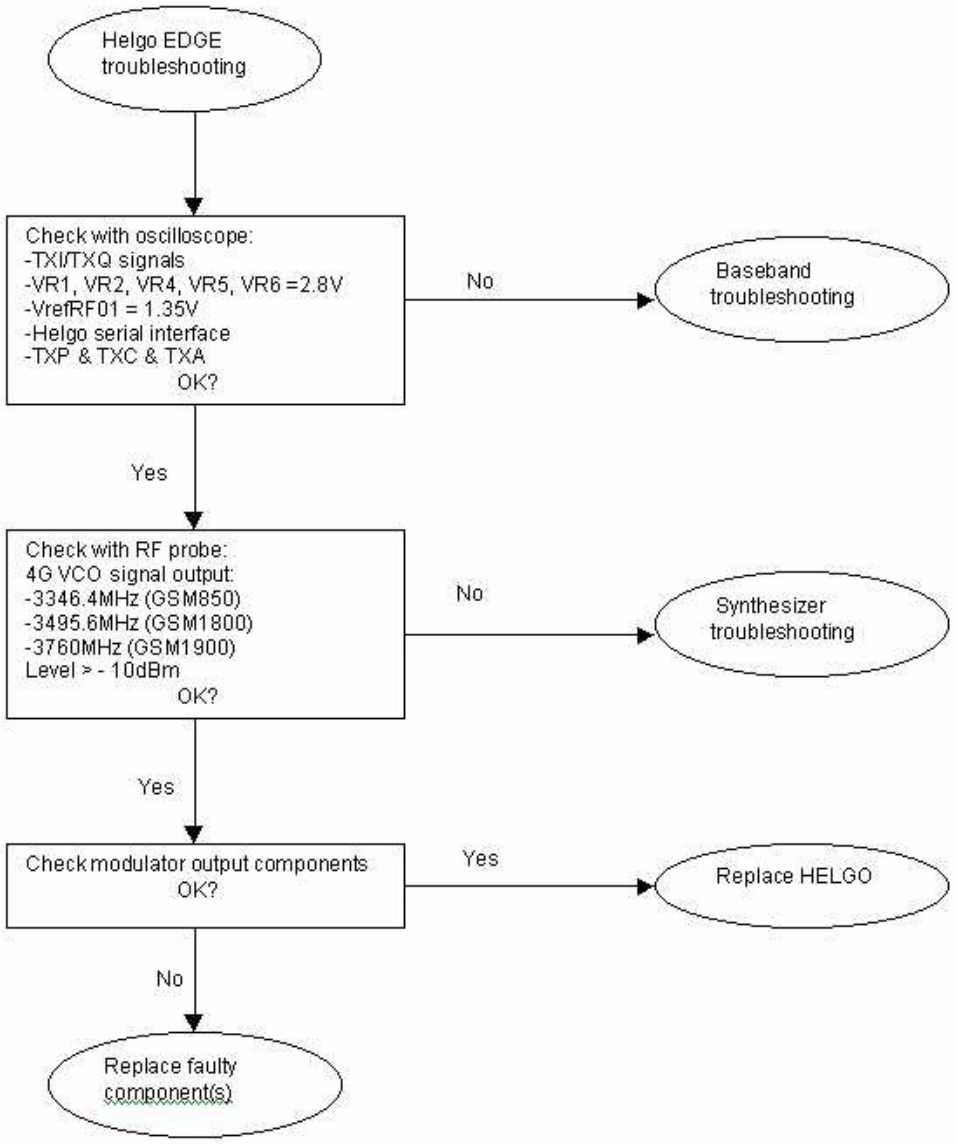
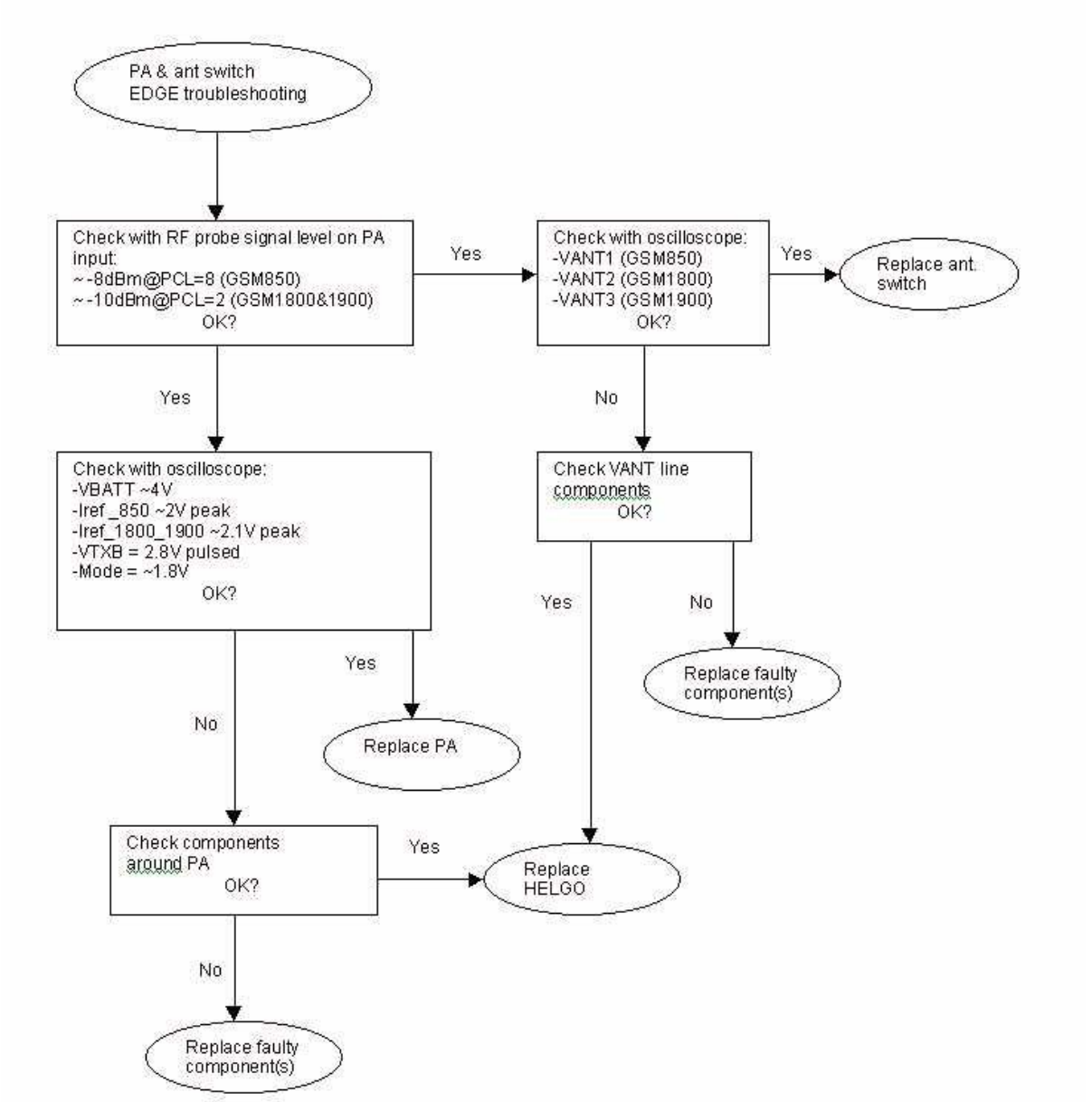


Figure 10: Pa & ant switch EDGE troubleshooting



Pictures of EDGE transmitter signals

Figure 11: I_ref_850 power level 8 at R701/C701

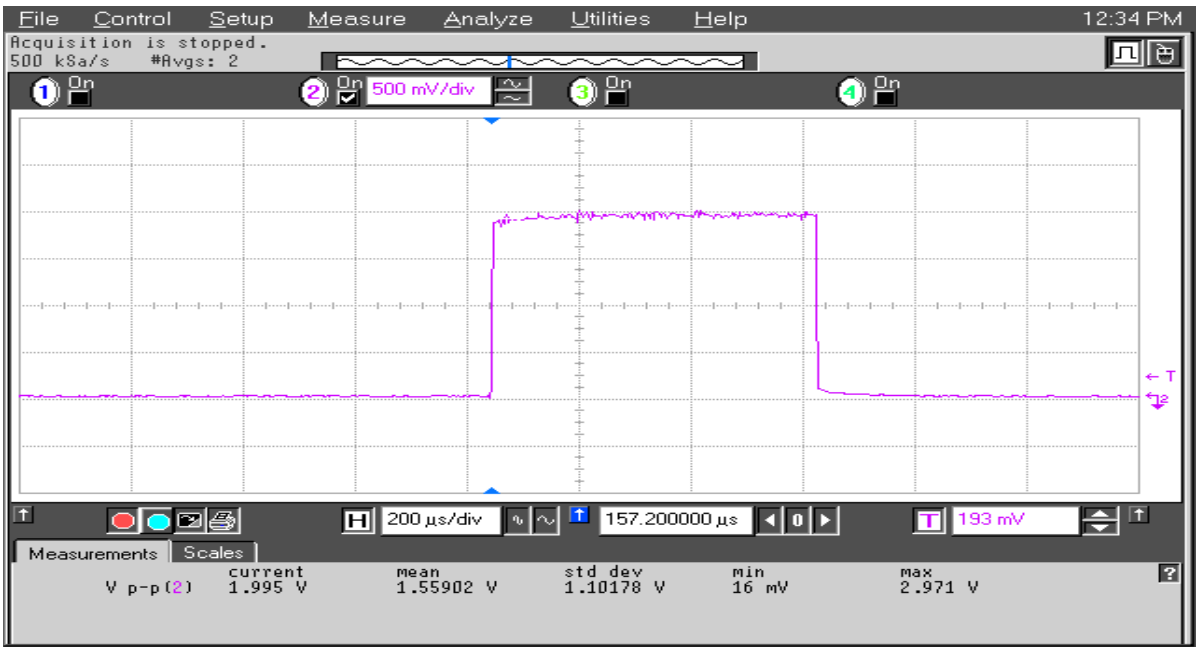


Figure 12: VTXB 850 power level 8 at C713

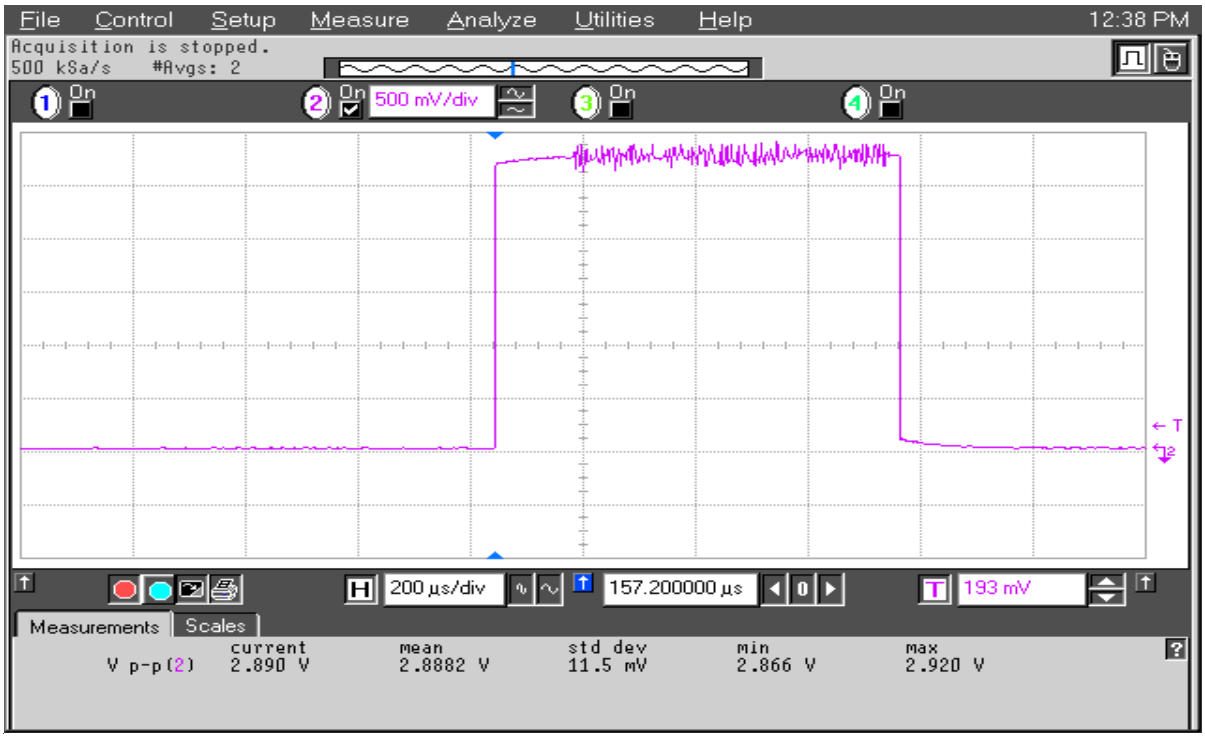


Figure 13: I_ref_1800/1900 power level 2 at R700/C700

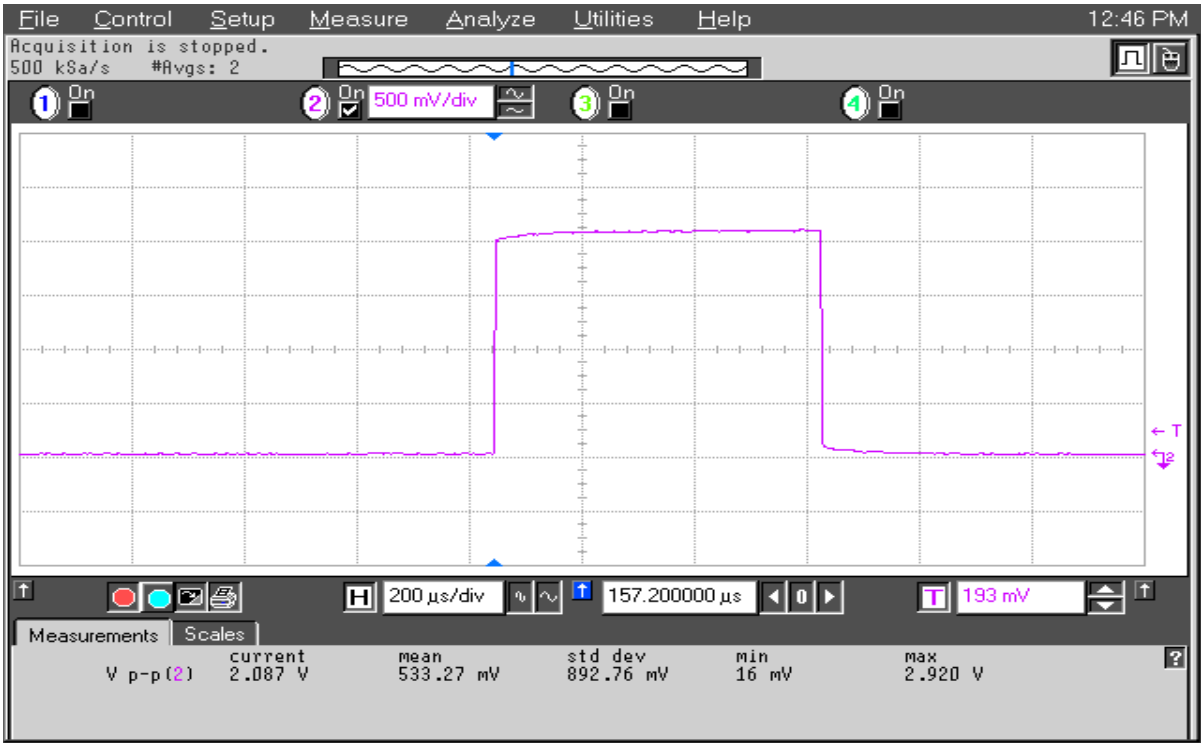


Figure 14: VTXB 1800/1900 power level 2 at C714

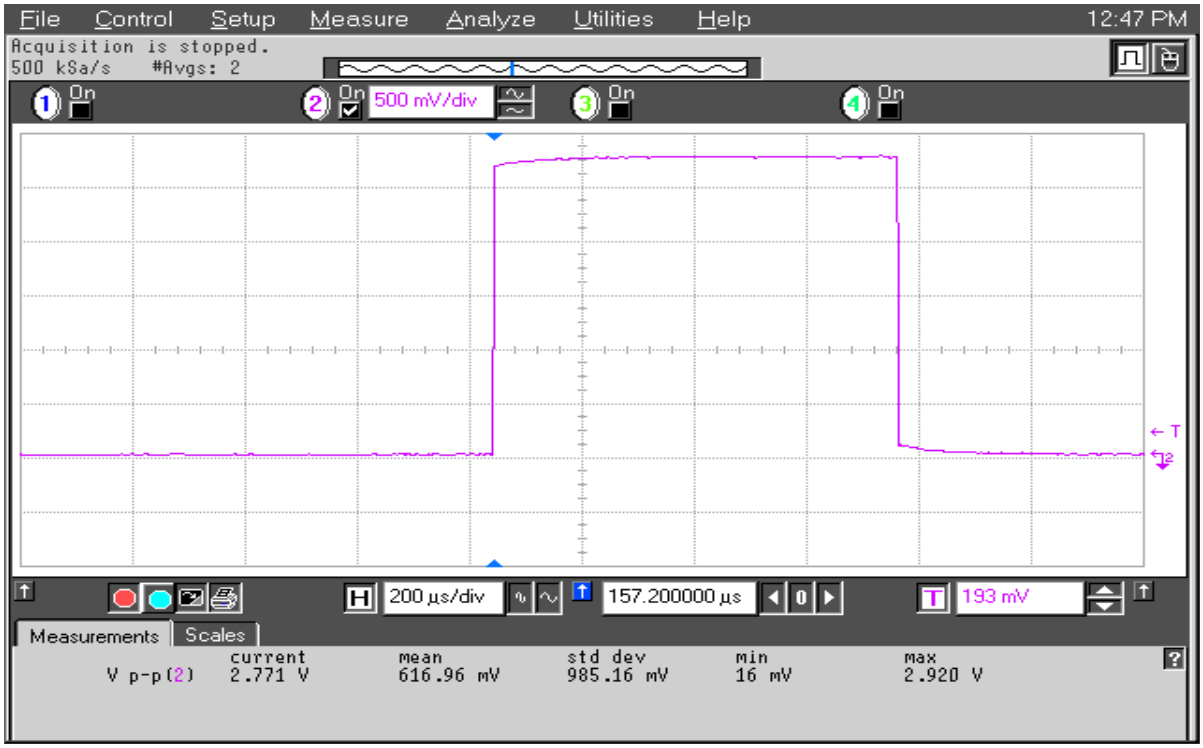


Figure 15: TXA 850/1800/1900 at C538

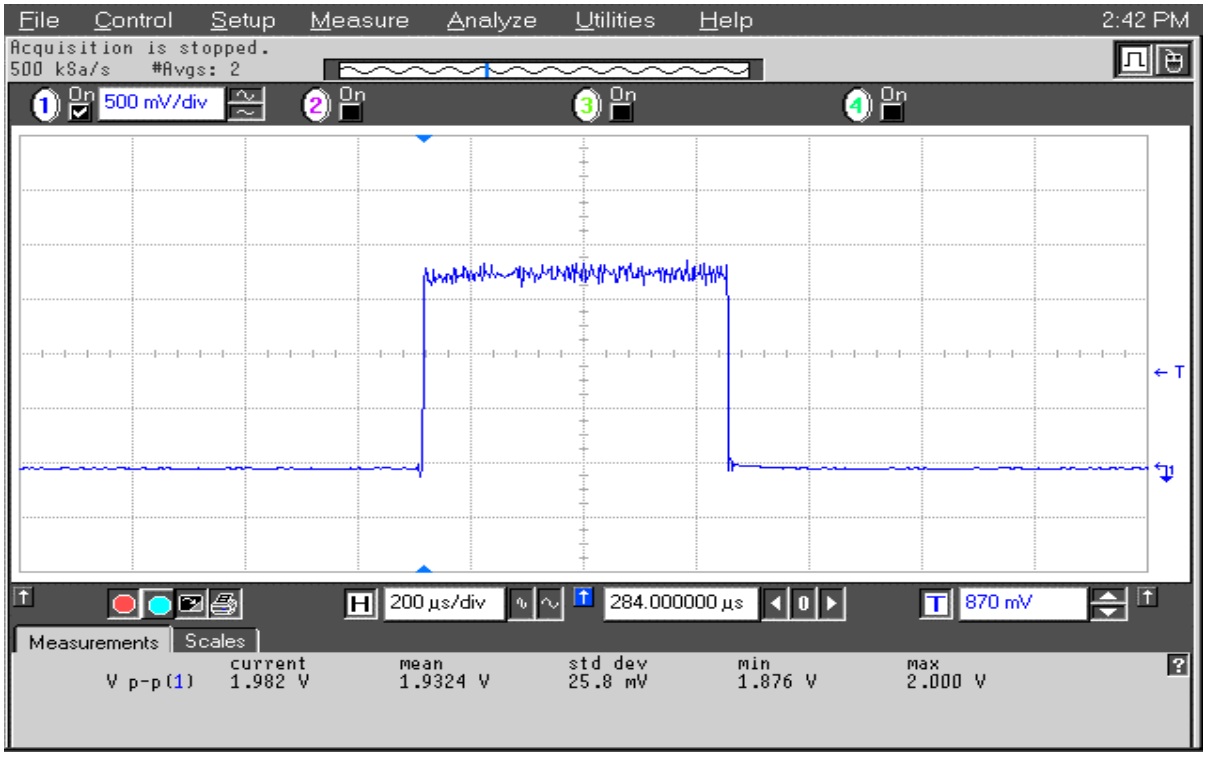


Figure 16: TXI/TXQ signal at C535/C536/R516/R517

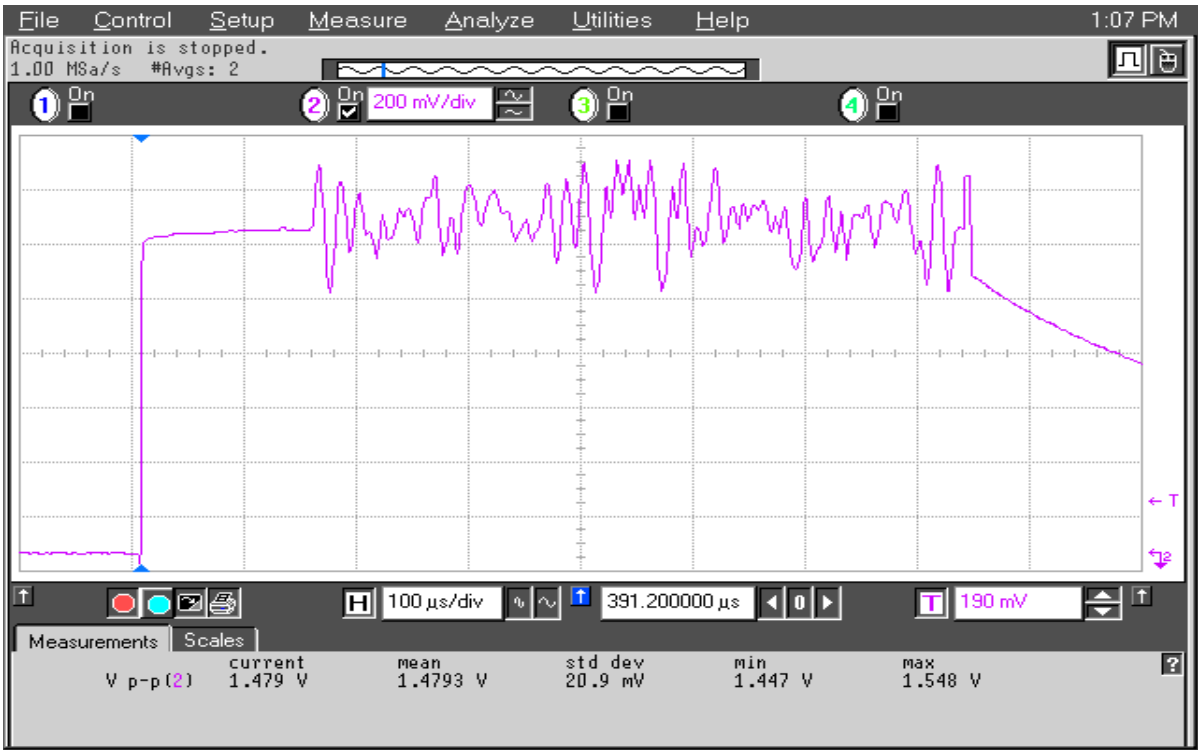
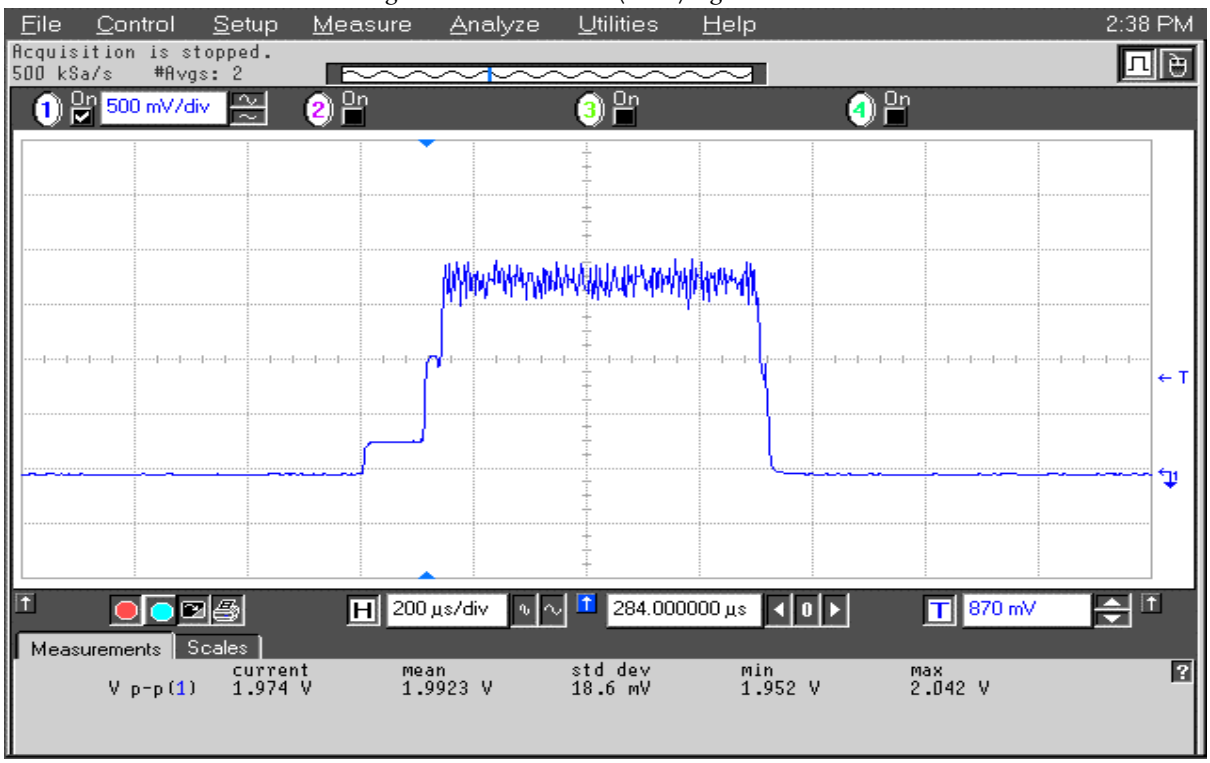


Figure 17: VPECTRL3 (ALC) signal at C512



GSM850, GSM1800 and GSM1900 Receiver

General instructions for Rx troubleshooting

Connect test jig to computer with DAU-9S cable or to FPS-8 Flash Prommer with XCS-4 modular cable.

Make sure that you have PKD-1 dongle connected to computers parallel port.

Connect DC power supply to module test jig with FLC-2 cable.

Set the DC supply voltage to 6V (test jig has internal voltage regulator of output voltage 4V).

Connect an RF-cable to the module test jig (MJS-38) RF connector and to RF signal generator.

Set the phone module to test jig and start Phoenix service sofware.

Initialize connection to phone. (use FBUS driver when using DAU9S and COMBOX driver when using FPS-8)

Choose product from the menu

File -> Choose product -> NPL-3

From toolbar set operating mode to "Local"

Activate RF controls window from the menu

Testing -> RF Controls

From the RF controls window:

- Select band "GSM850", "GSM 1800" or “GSM1900” (Default = "GSM850")

- Set Active unit to "Rx" (Default = "Rx")

- Set Operation mode to "Burst" (Default = "Burst")

For continuous mode:

- Set Operation mode to "Continuous"

- Set AGC to "12: FEG_ON + DTOS_ON + BB_30=Vgain60” (maximum gain setting used in normal mode)

(Default = "14: FEG_ON + DTOS_ON + BB_42=Vgain72")

- Set Rx/Tx channel to 190 on GSM850 band, 700 on GSM1800 band or 661 on GSM1900 (Defaults)

Apply 881.6671 MHz (channel 190 + 67.710 kHz offset), 1842.86771 MHz (channel 700 + 67.710 kHz offset) or 1960.06771 MHz (channel 661 + 67.71 kHz) –90 dBm signal to the RF-connector (remember to compensate for cable attenuation).

Measuring with an oscilloscope on "RXI" or "RXQ" following screens should be seen on a working GSM850 , GSM1800 or GSM1900 receiver:

Figure 18: RX I/Q signal ,burst mode, input level –90dBm.

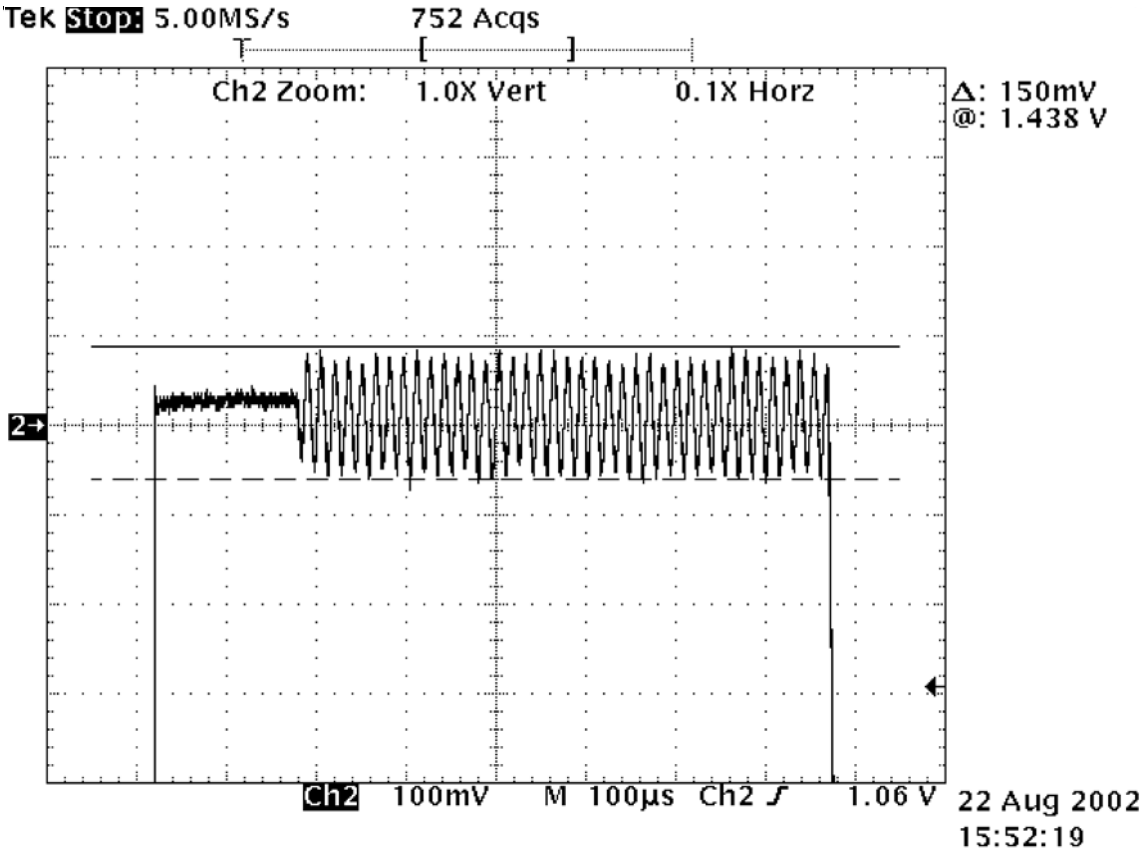


Figure 18, "RX I/Q signal ,burst mode, input level –90dBm.," on page 22: Receiver I or Q burst mode signal (channel 190) measured from testpoint RXI or RXQ with 881.6671 MHz signal, input level –90dBm at RF-connector.

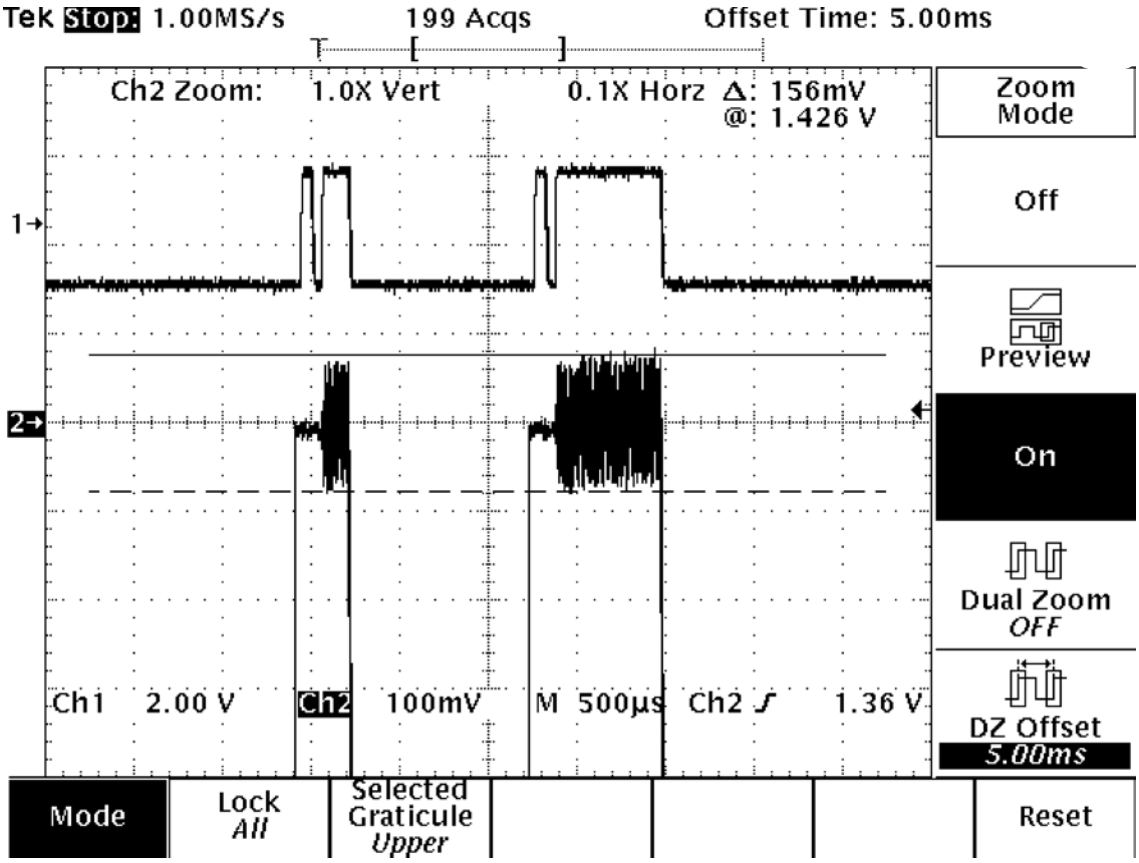
Correct signal amplitudes approximately:

- GSM850~170mVpp
- GSM1800~140mVpp
- GSM1900~160mVpp

Signal part frequency 67.7kHz sine.

DC level of signal part is 1.35V. DC level can variate about +/-100mV between I and Q signals and between different bands as well.

Figure 19: GSM1900 RX I or Q signal (trace2), burst mode.



For Figure 19, "GSM1900 RX I or Q signal (trace2), burst mode.," on page 23 GSM1900 receiver burst mode I or Q signal at ch 661 with input signal 1960.067MHz, level –90 dBm at RF-connector.

Trace2: With wider time scaling both monitoring and own RX bursts are seen, 1st burst (shorter) is monitoring and 2nd burst (longer) is own RX burst.

Trace1: External LNA VCC supply voltage at burst mode, input level –90 dBm. Measured from testpoint LNA_VCC.

Figure 20: RX I&Q, phase difference 90 deg between signals.

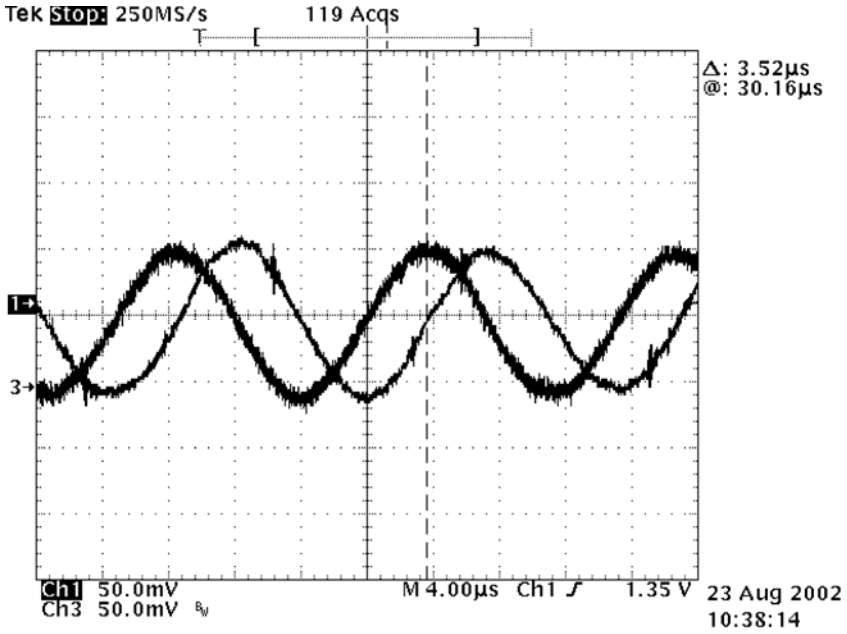


Figure 20, "RX I&Q, phase difference 90 deg between signals.," on page 24:

Detailed view of GSM850 continuous mode RX I and Q signals measured from testpoints RXI and RXQ simultaneously.

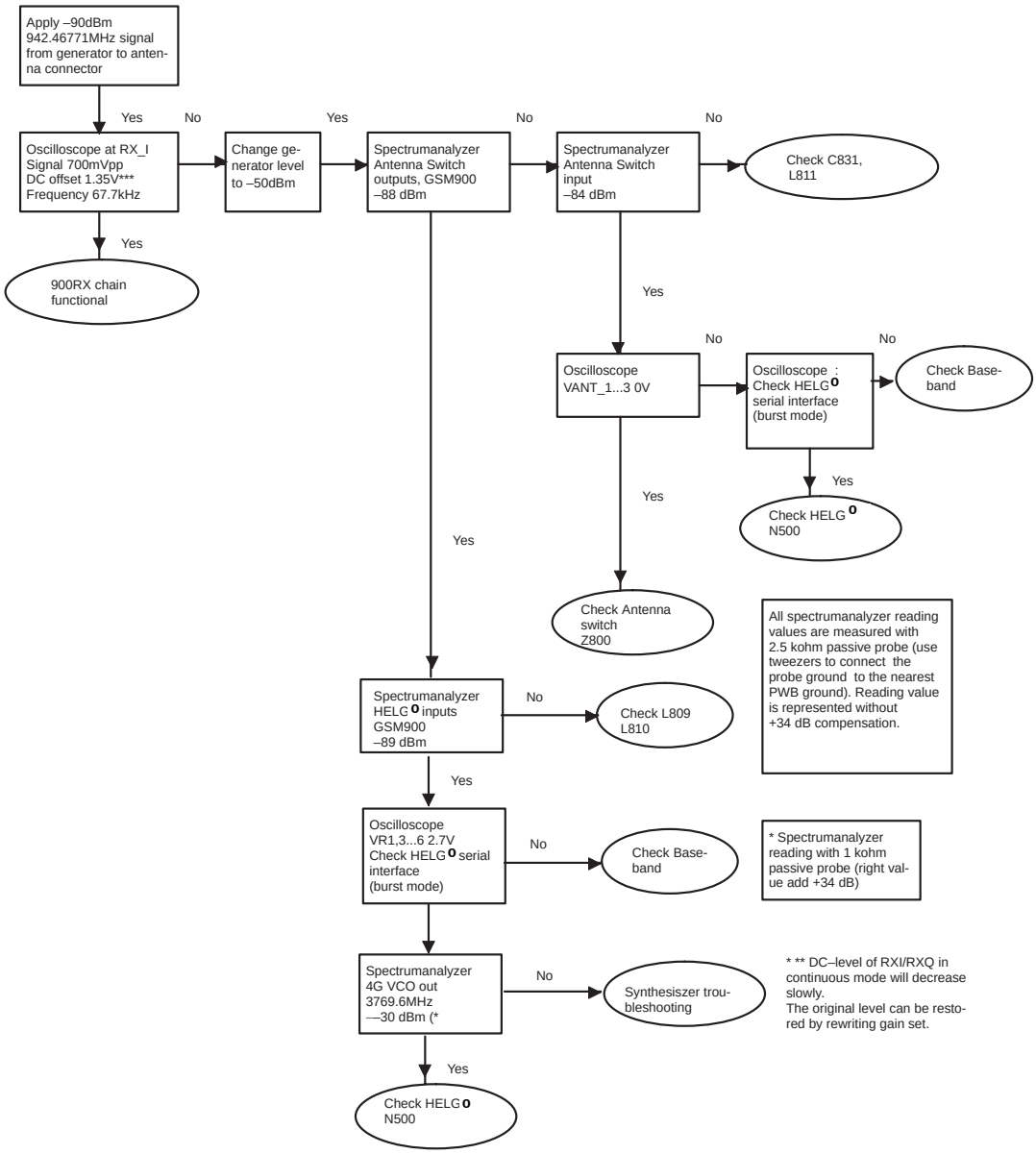
Used channel 190, input signal 881.6671 MHz, level –90 dBm at antenna port, AGC setting 12.

Phase difference should be 90 degrees between RX I and Q signals at all bands.

Troubleshooting diagram for GSM850 receiver

Phone in "Continuous" mode, AGC setting "12"

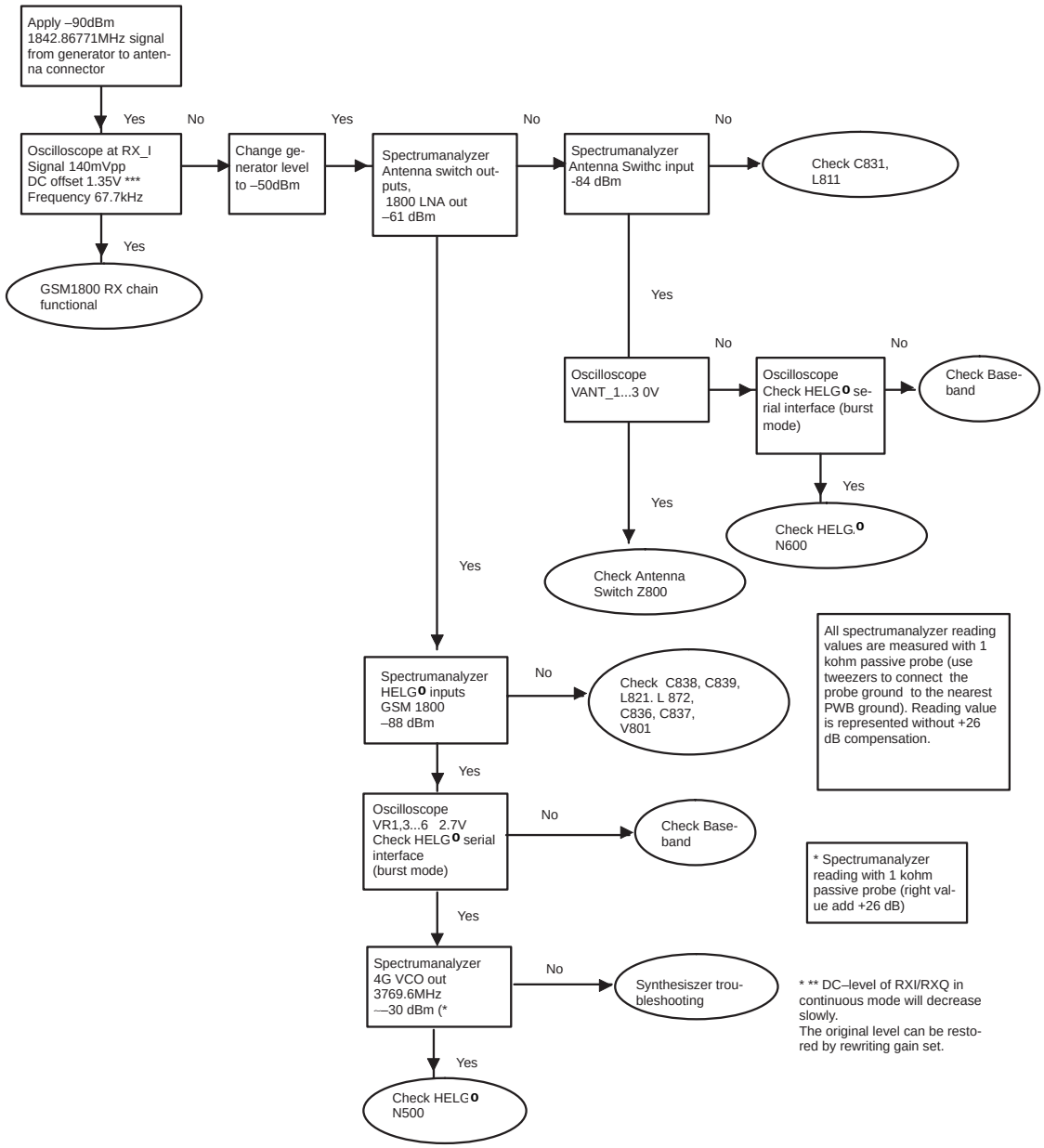
Figure 21: GSM850 receiver troubleshooting



Troubleshooting diagram for GSM1800 receiver

Phone in "Continuous" mode, AGC setting "12

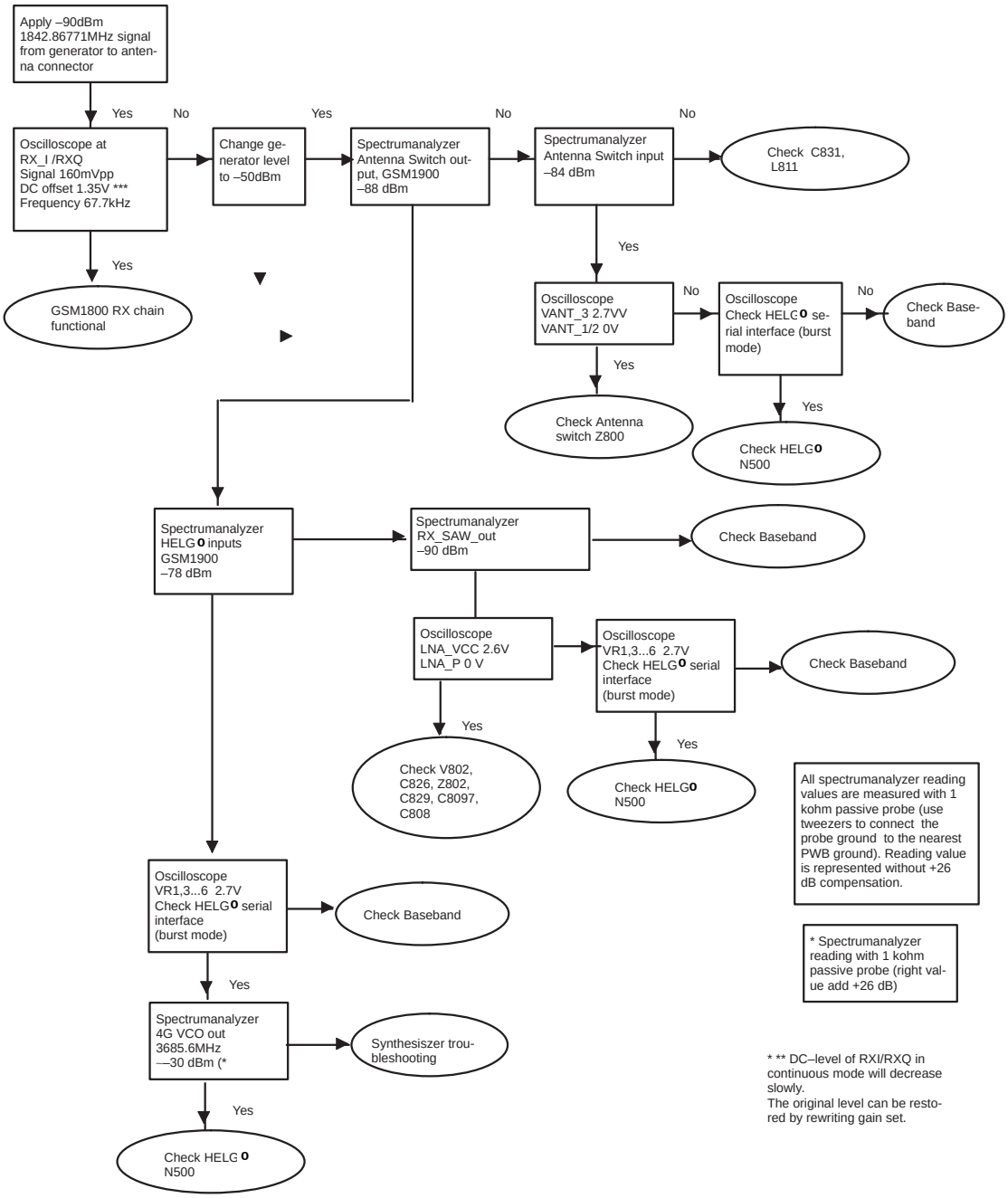
Figure 22: GSM1800 receiver troubleshooting



Troubleshooting diagram for GSM1900 receiver

Phone in "Continuous" mode, AGC setting "12

Figure 23: GSM1900 receiver troubleshooting



Synthesizer

General instructions for synthesizer troubleshooting

Connect test jig to computer with DAU9S cable or to FPS-8 Flash Prommer with XCS-4 modular cable.

Make sure that you have PKD-1 dongle connected to computers parallel port.

Connect DC power supply or FPS-8 to module test jig with PCS-1 cable.

Set the DC supply voltage to 3.9V and set the jumper connector on test jig to "bypass" position.

Set the phone module to test jig and start Phoenix service sofware

Initialize connection to phone. (use FBUS driver when using DAU9S and COMBOX driver when using FPS-8)

Select product from the menu

File -> Choose product -> NPL-3

From toolbar set operating mode to "Local"

Activate RF controls window from the menu

Testing -> RF Controls

From the RF controls window

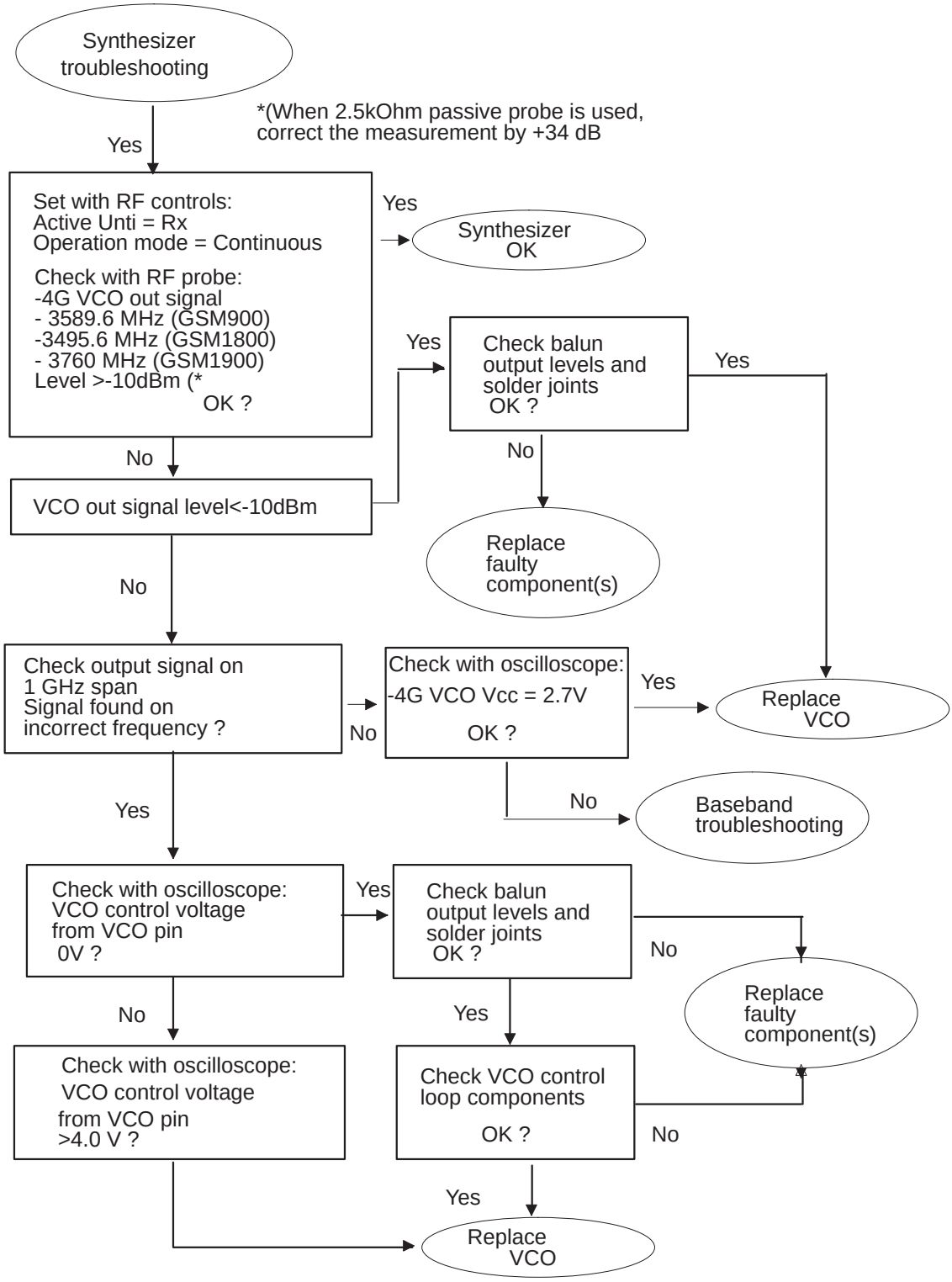
- Select band "GSM850", "GSM 1800" or "GSM1900" (Default = "GSM850")

- Set Active unit to "Rx" (Default = "Rx")

- Set Operation mode to "Continuous" (Default = "Burst")

- Set Rx/Tx channel to 190 on GSM850 band, 700 on GSM1800 band, 661 on GSM1900 band (Defaults)

Figure 24: Synthesizer troubleshooting diagram



Pictures of synthesizer signals

Figure 25: 26MHz at G501 pin out

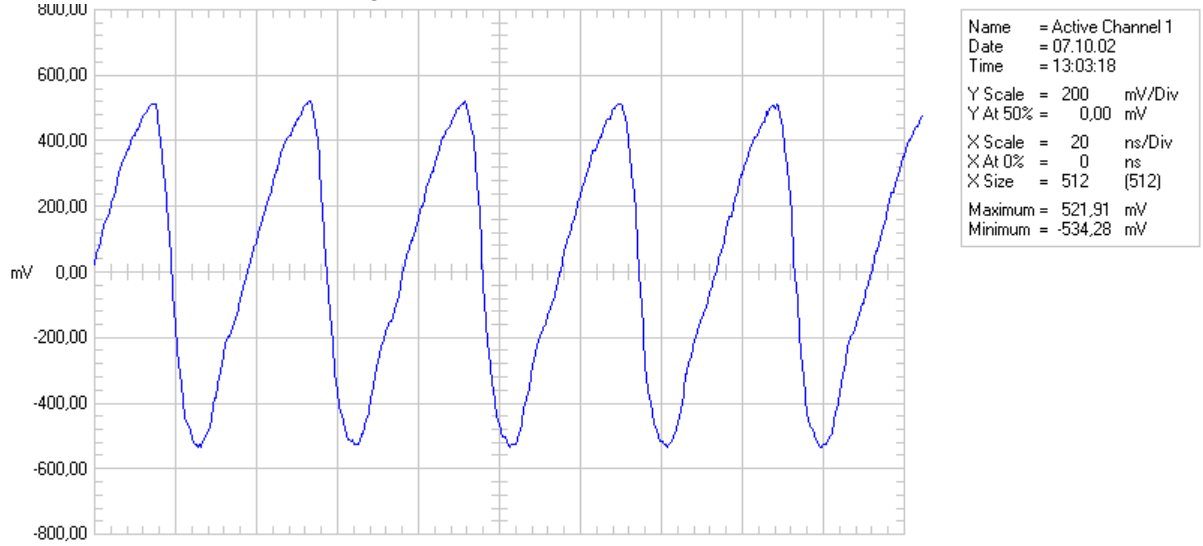


Figure 26: 26MHz RFCLK at R420/C420

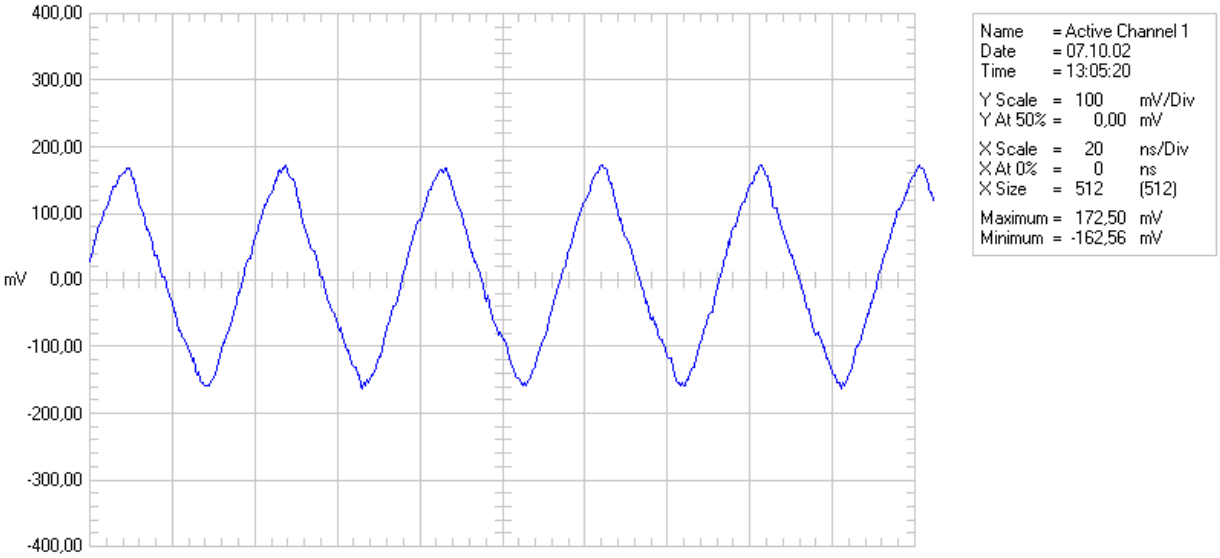


Figure 27: 1800 TX, channel 512, burst mode

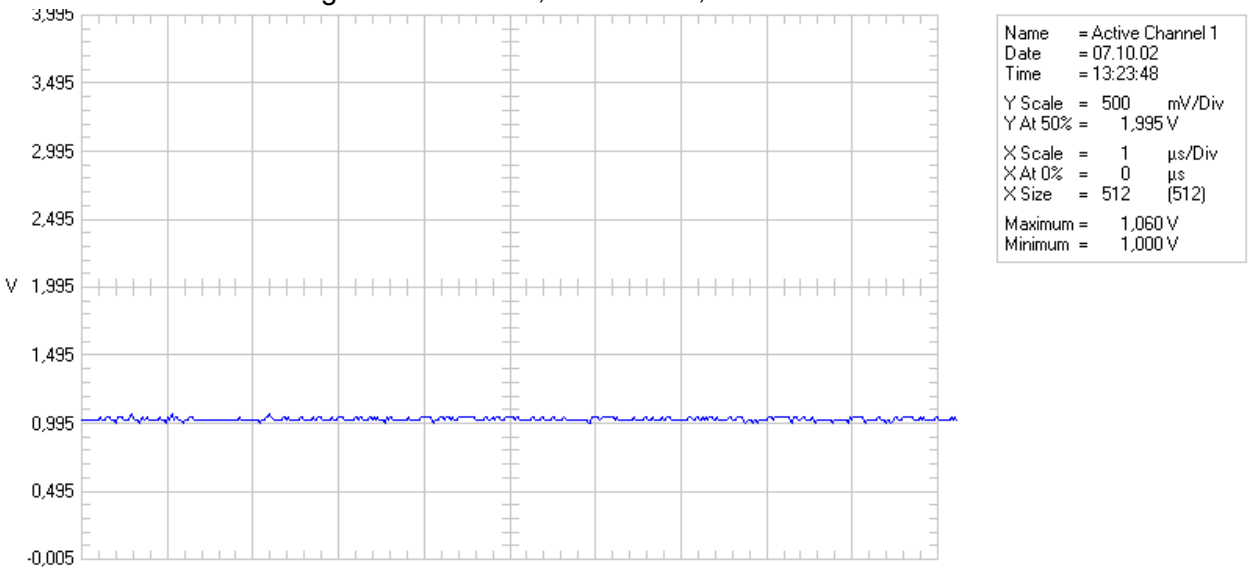


Figure 28: 1900 RX, channel 810, continuous mode

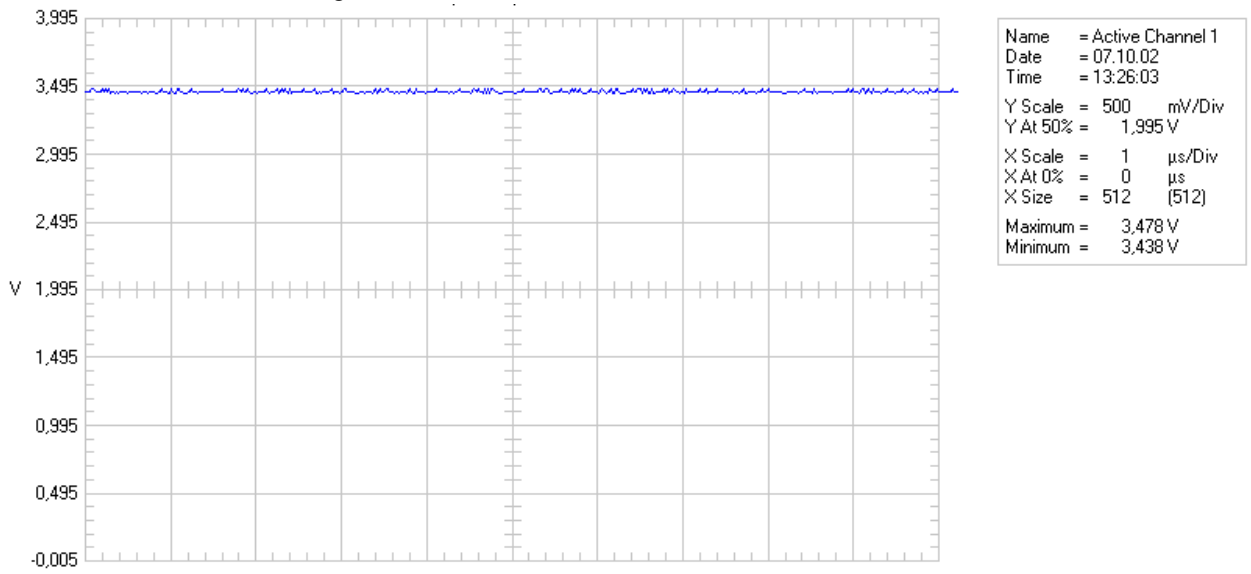
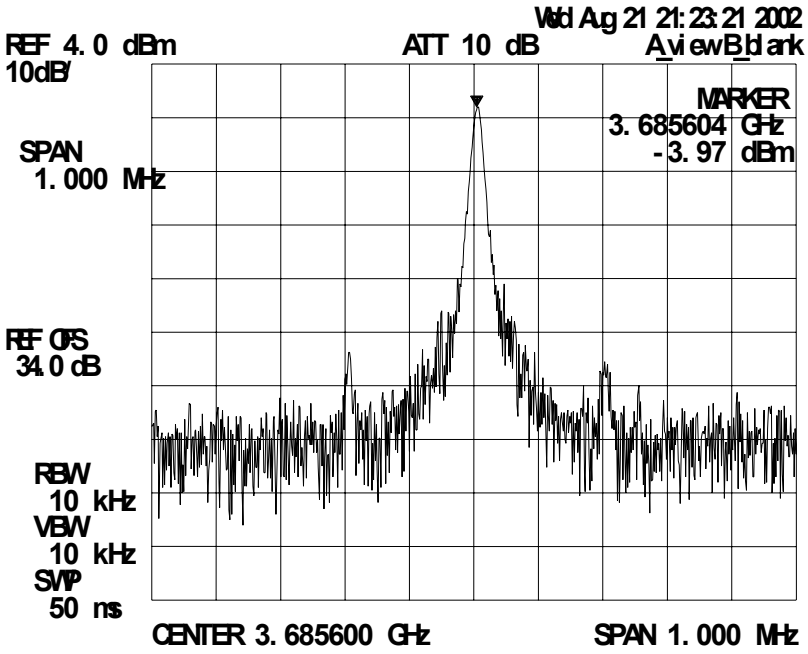
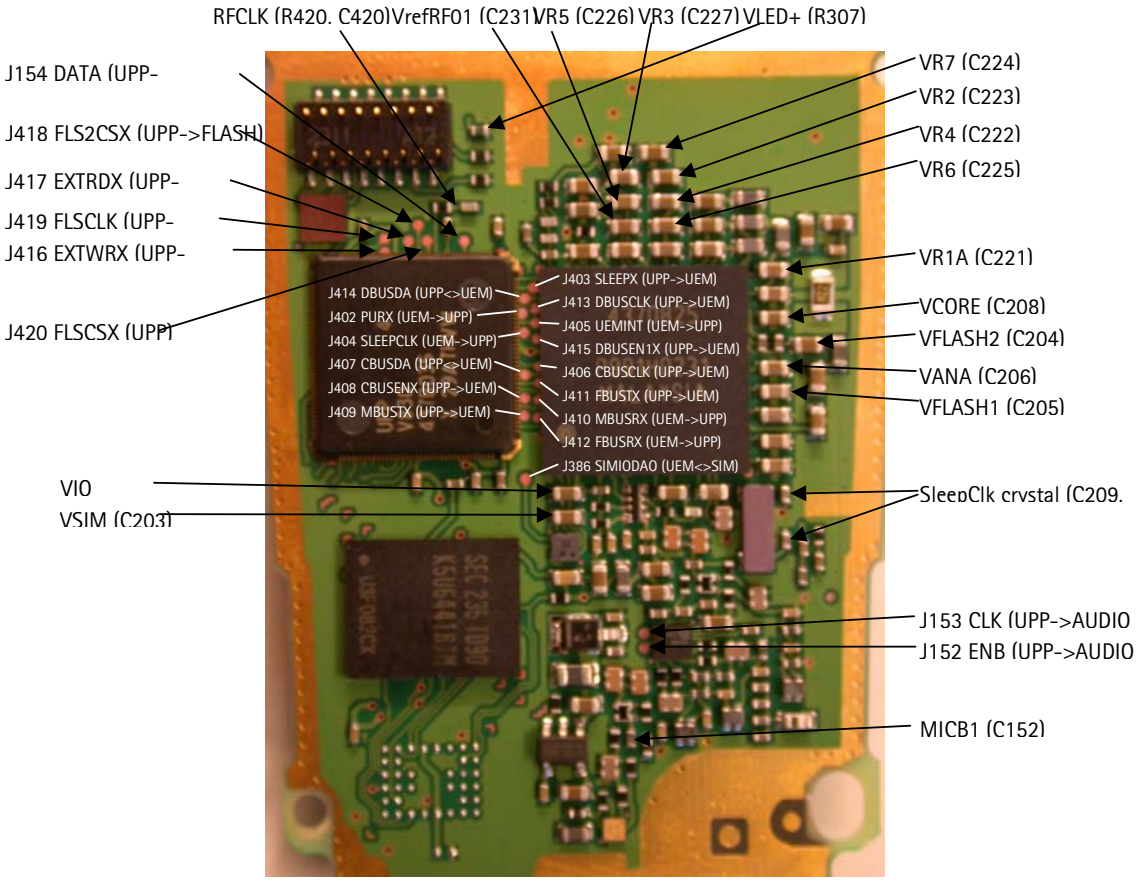


Figure 29: VCO output, 1800 band, RX on, continuous output



Baseband troubleshooting

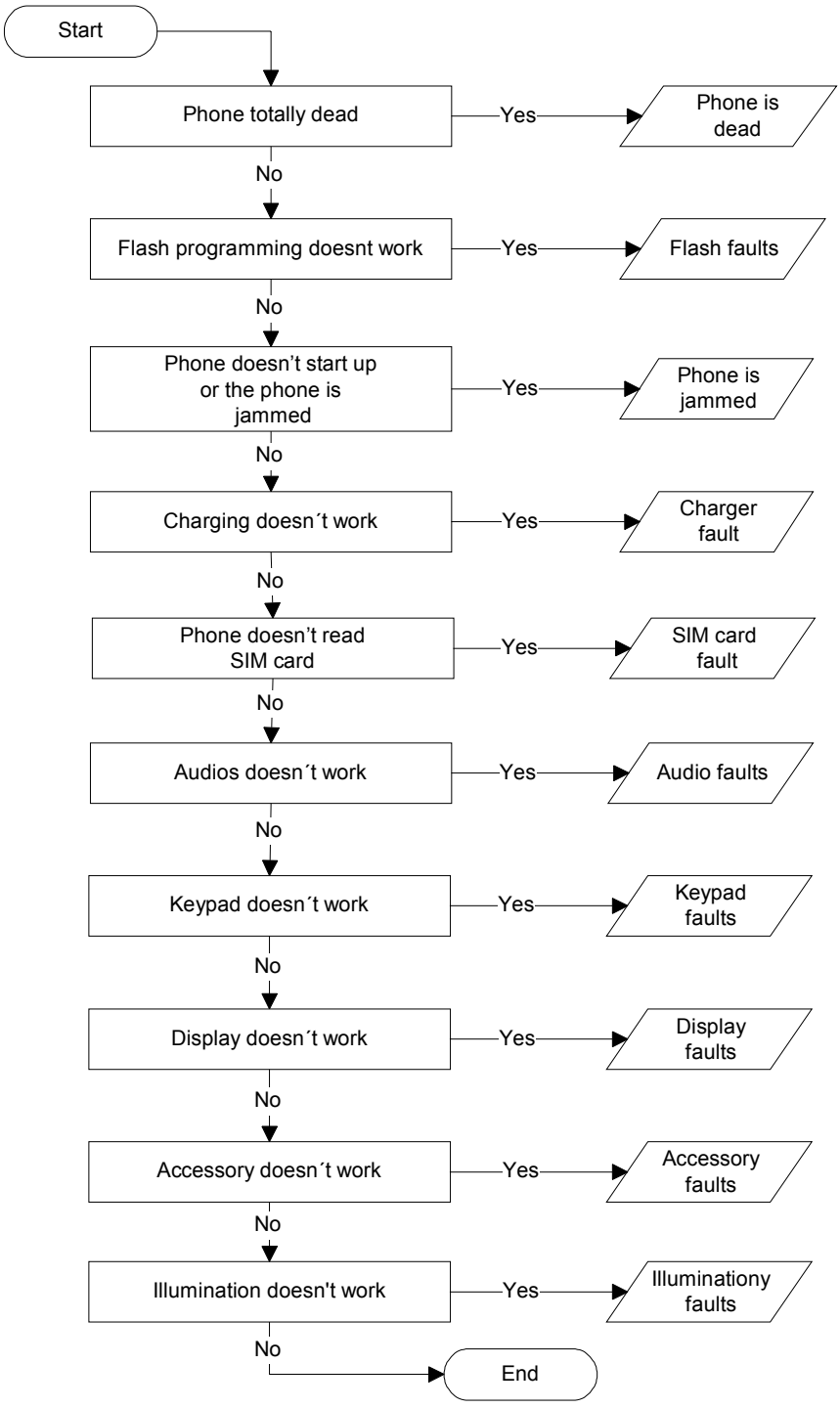
Figure 30: Basic baseband test points



The following diagrams describe baseband troubleshooting.

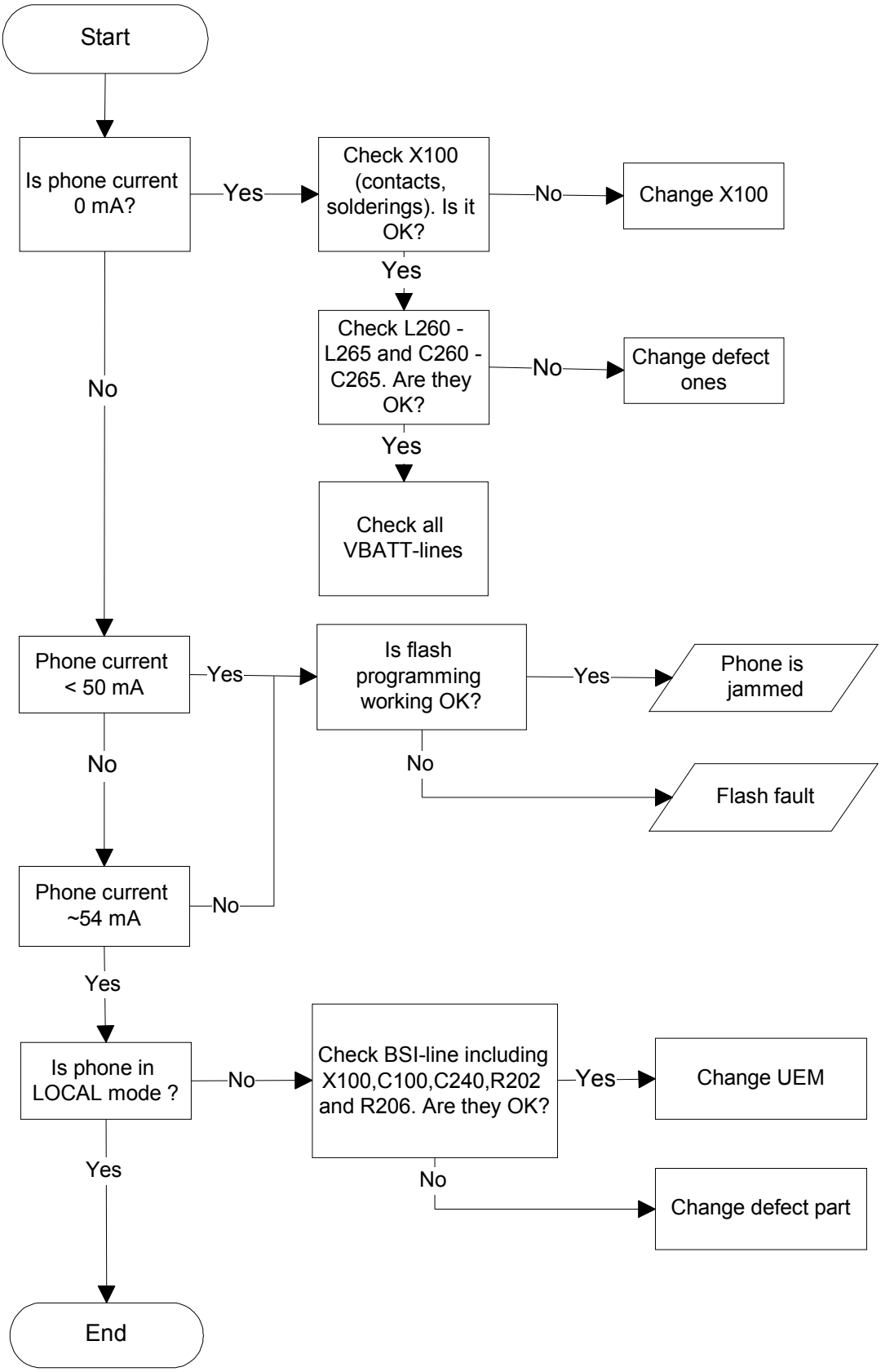
Main Troubleshooting Diagram

Figure 31: Baseband general troubleshooting



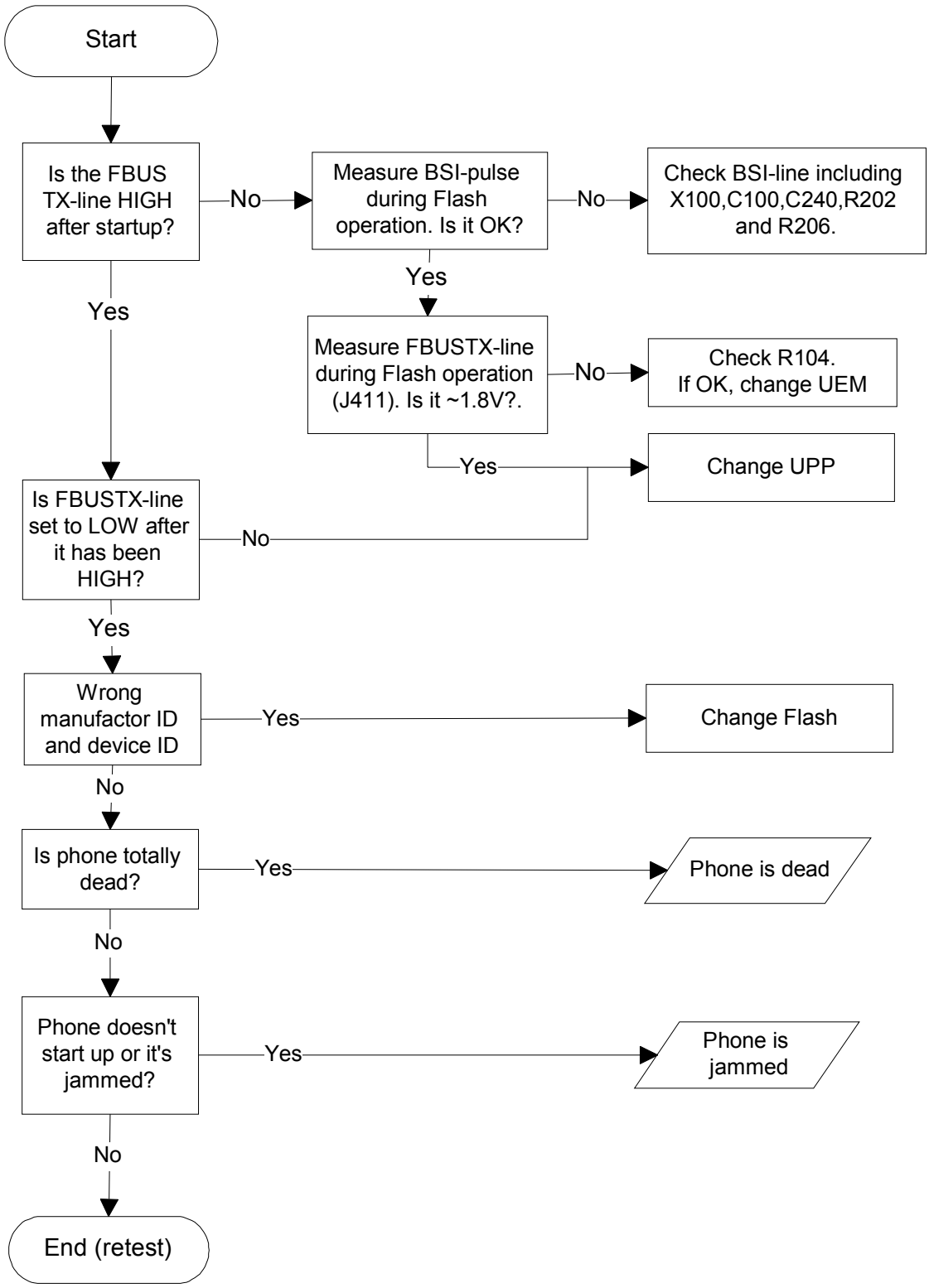
Phone is dead

Figure 32: Dead phone troubleshooting



Flash Programming Fault

Figure 33: Flash programming troubleshooting



Phone is jammed

Figure 34: Jammed phone troubleshooting (1)

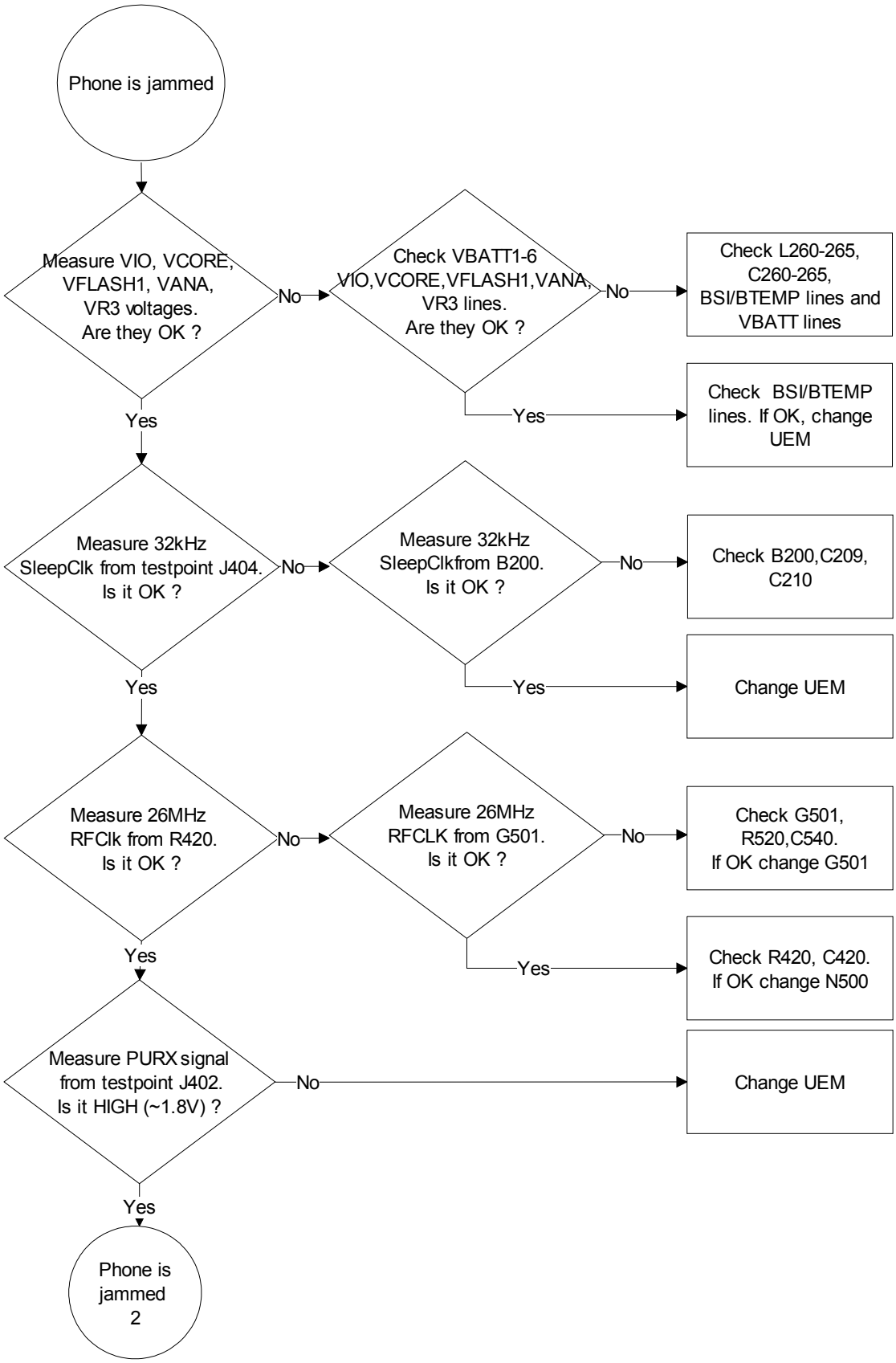
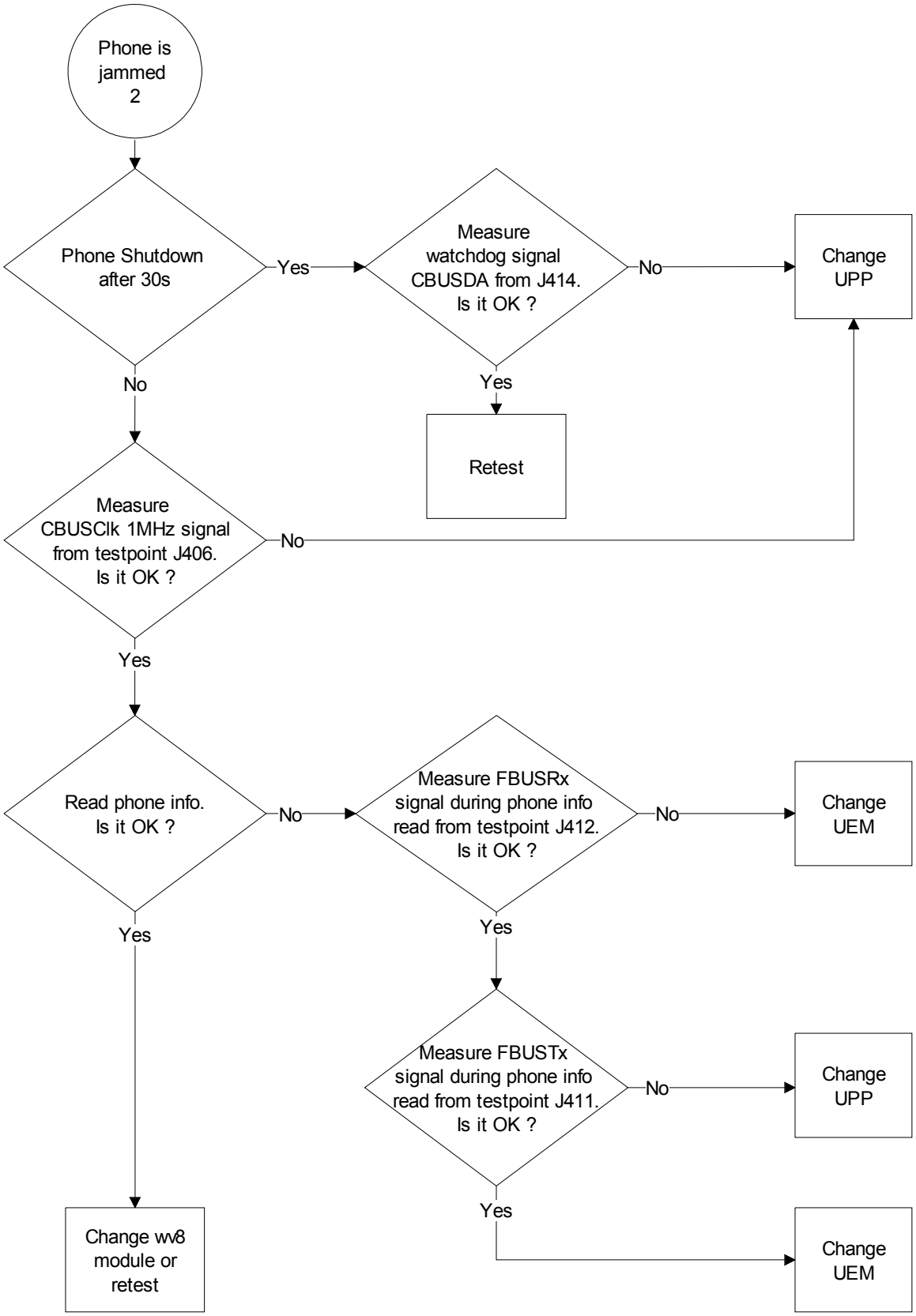
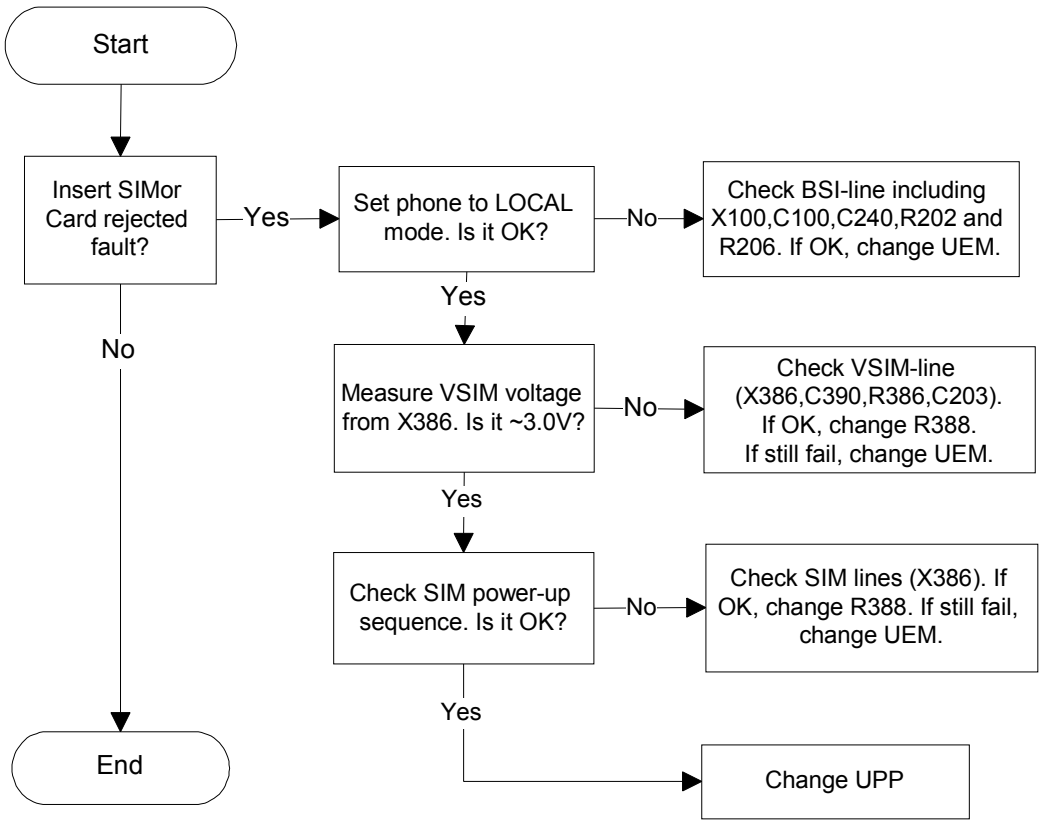


Figure 35: Jammed phone troubleshooting (2)



SIM card fault (Insert SIM / Card rejected)

Figure 36: SIM card troubleshooting



Keypad Fault

Figure 37: Keypad troubleshooting (1)

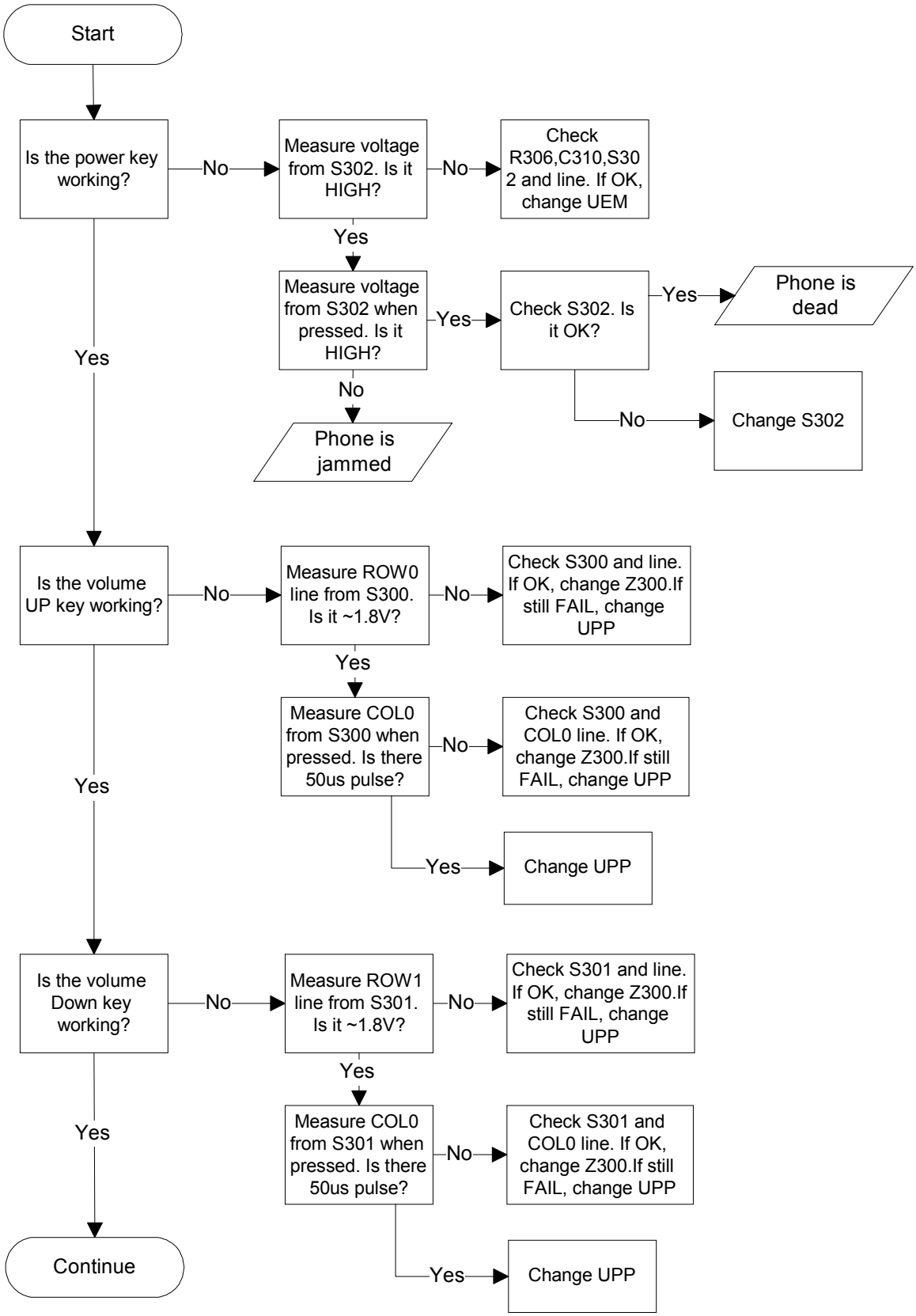
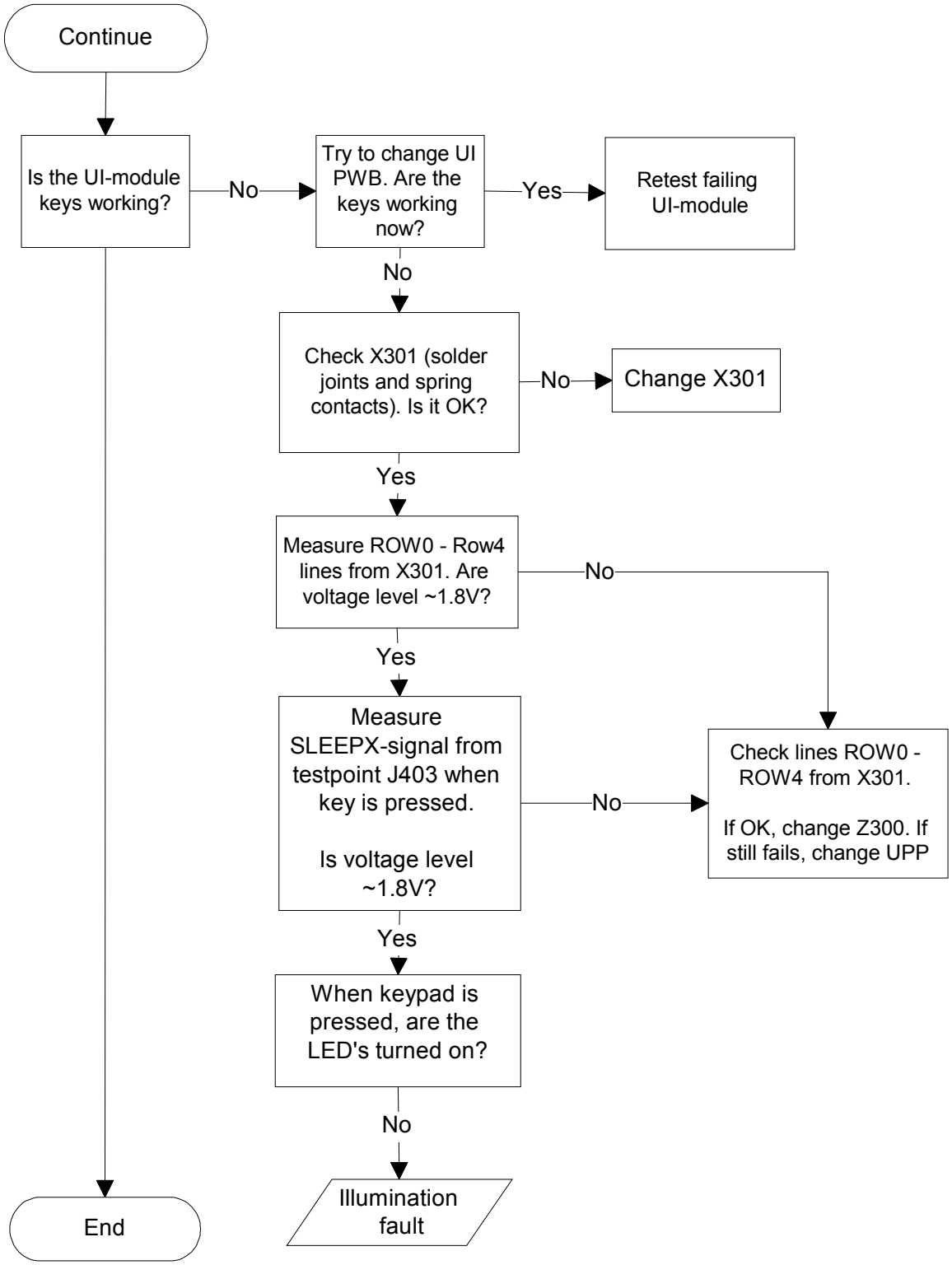
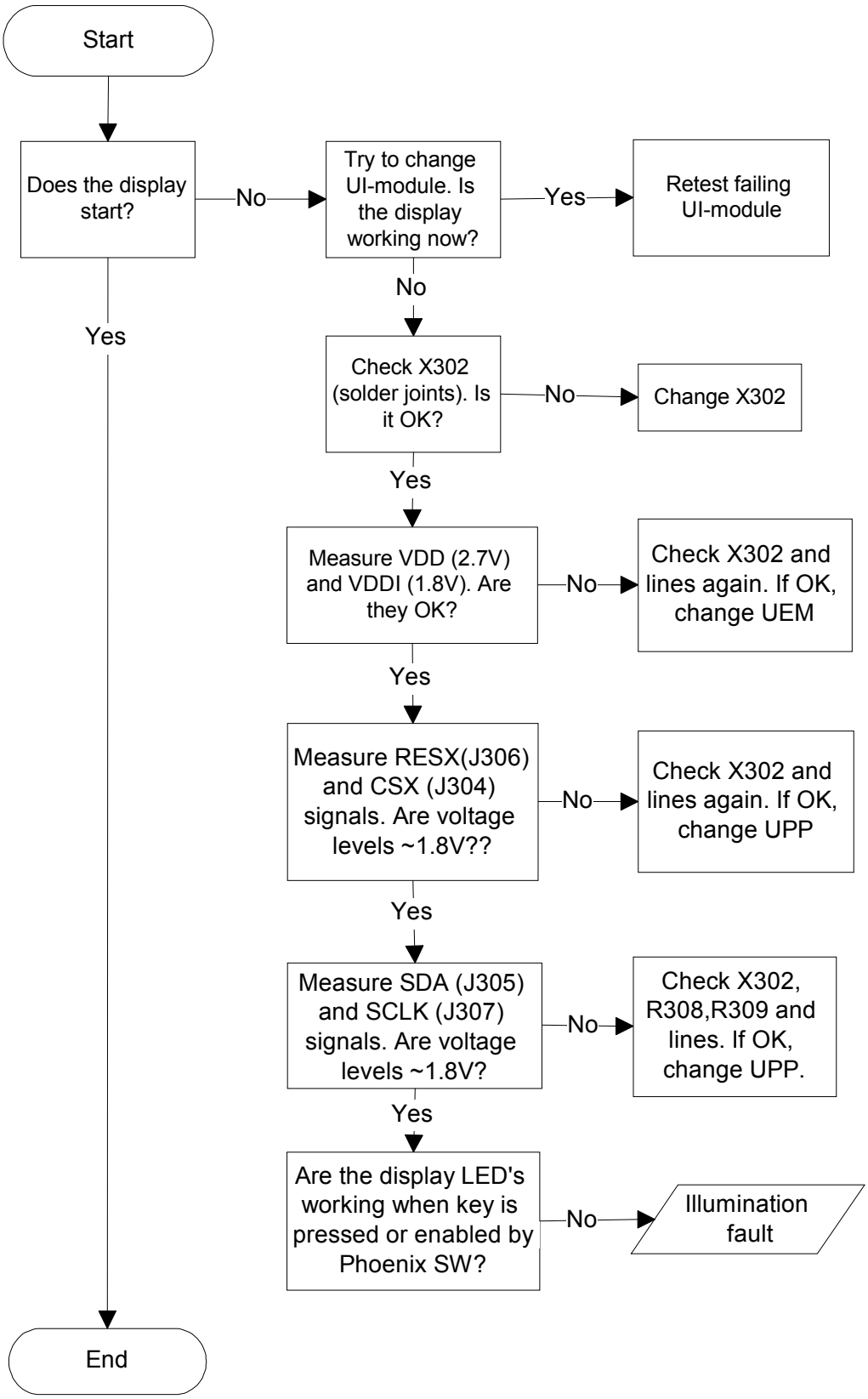


Figure 38: Keypad troubleshooting (2)



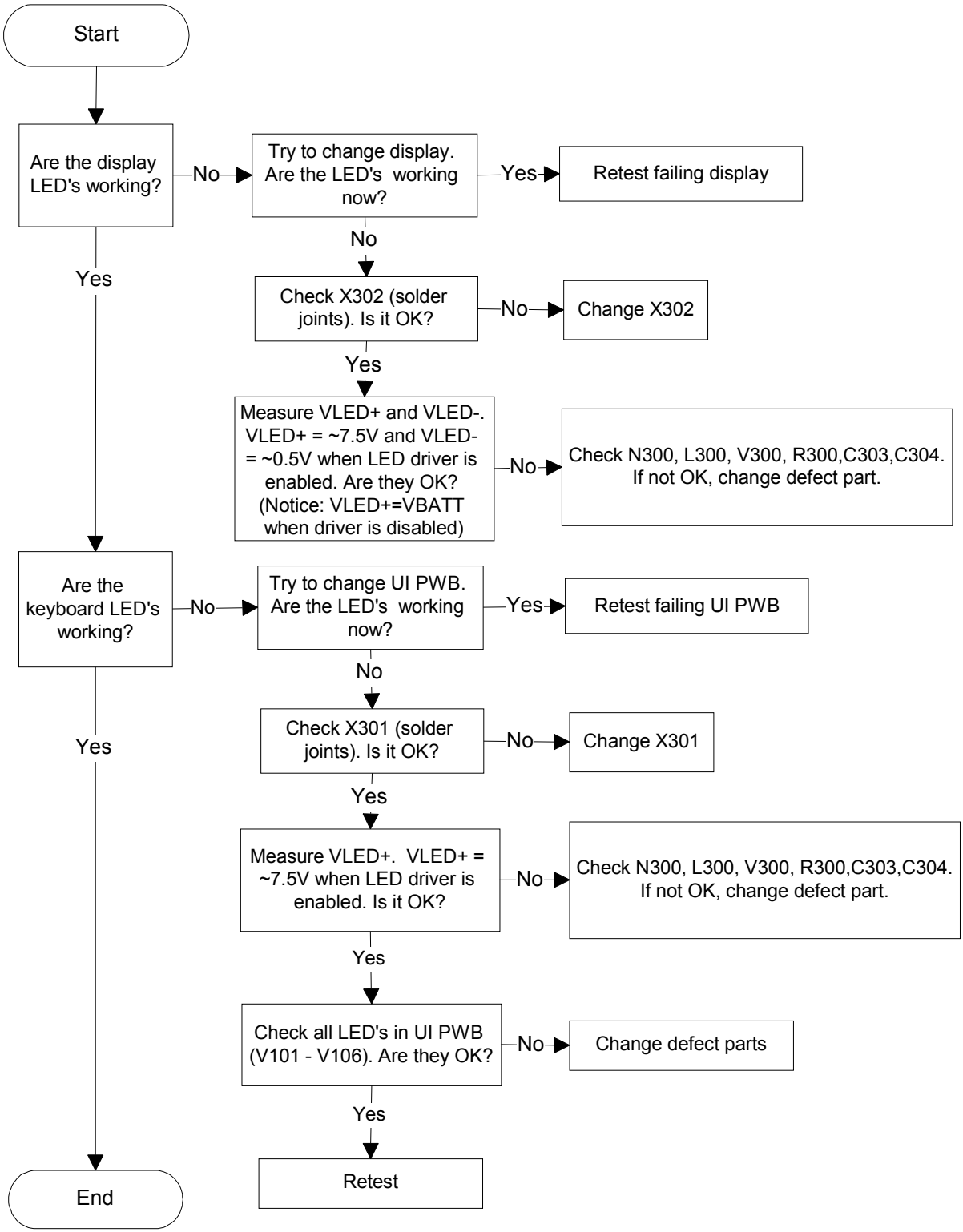
Display Fault

Figure 39: Display troubleshooting



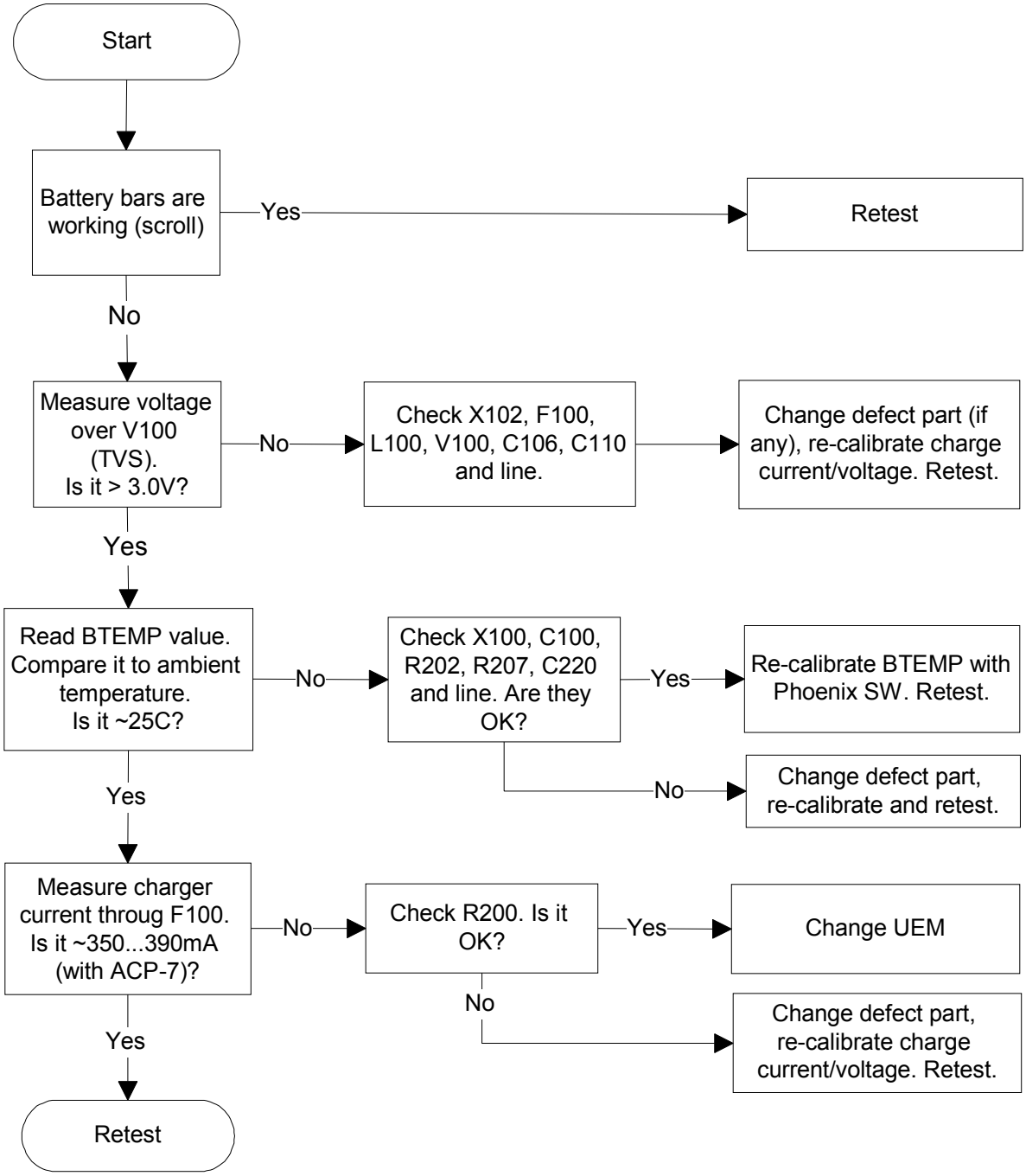
Illumination fault

Figure 40: Backlight troubleshooting



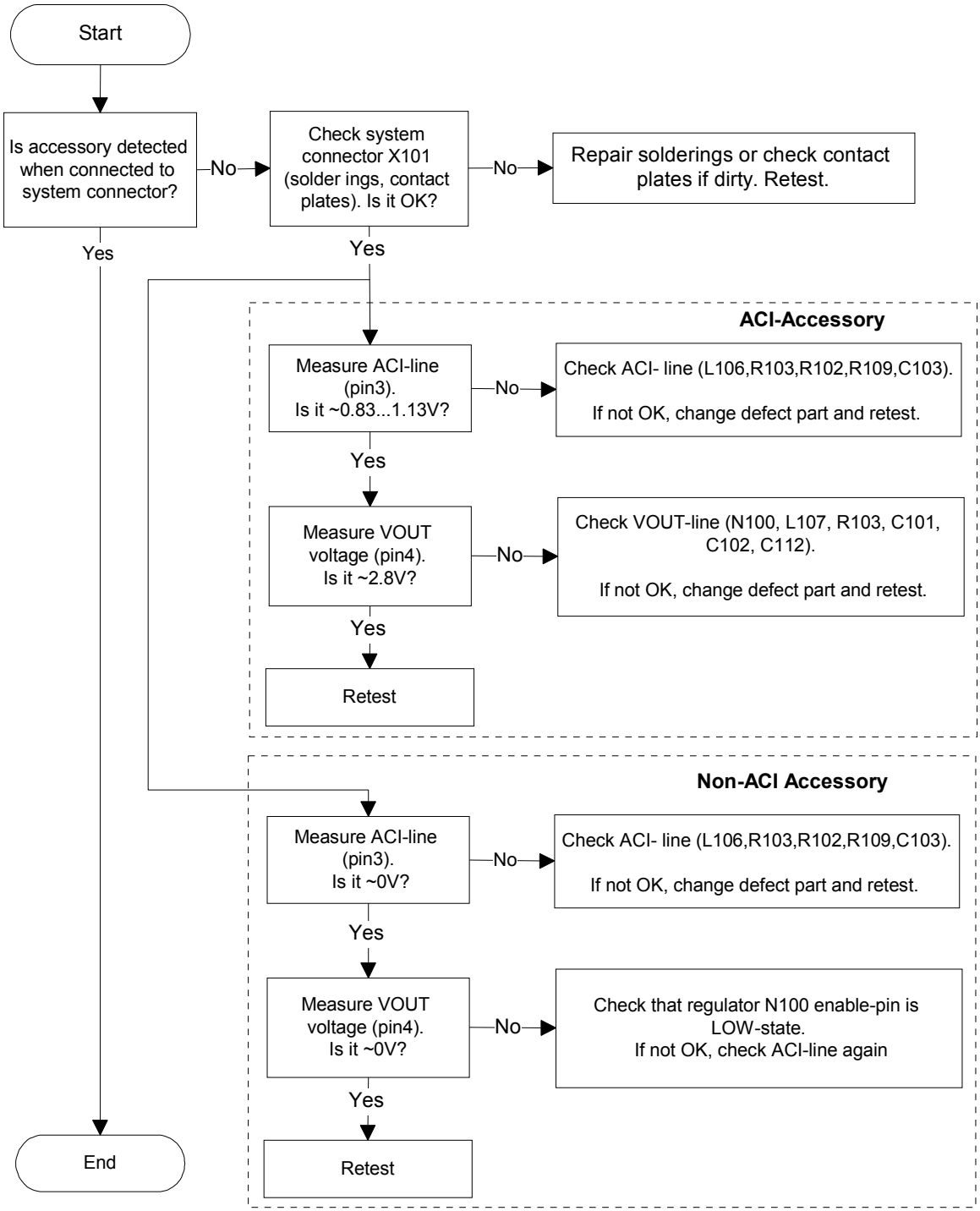
Charger Fault

Figure 41: Charging troubleshooting



Accessory Fault

Figure 42: Accessory troubleshooting



Audio Fault

Figure 43: Audio troubleshooting (1)

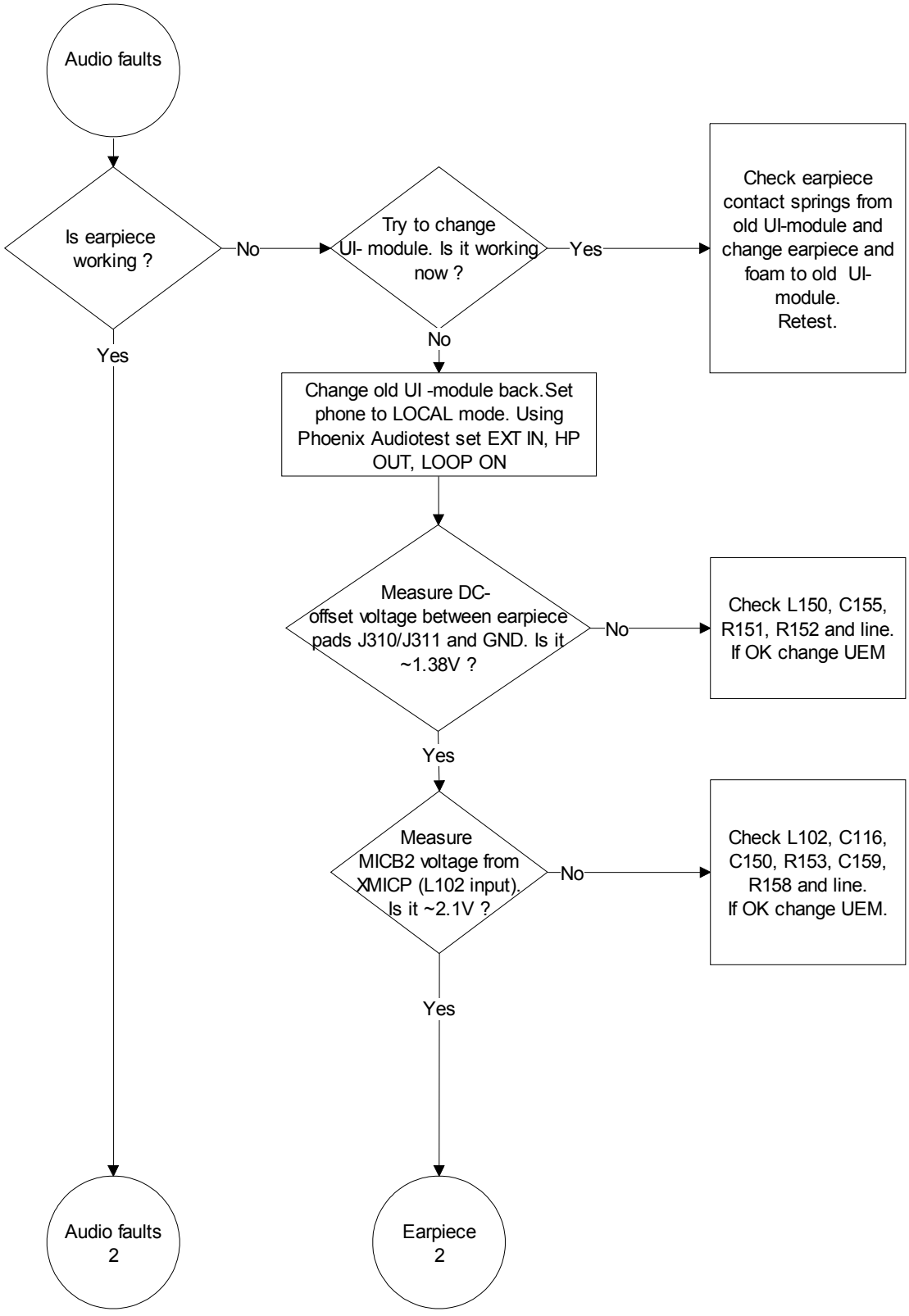


Figure 44: Audio troubleshooting (2)

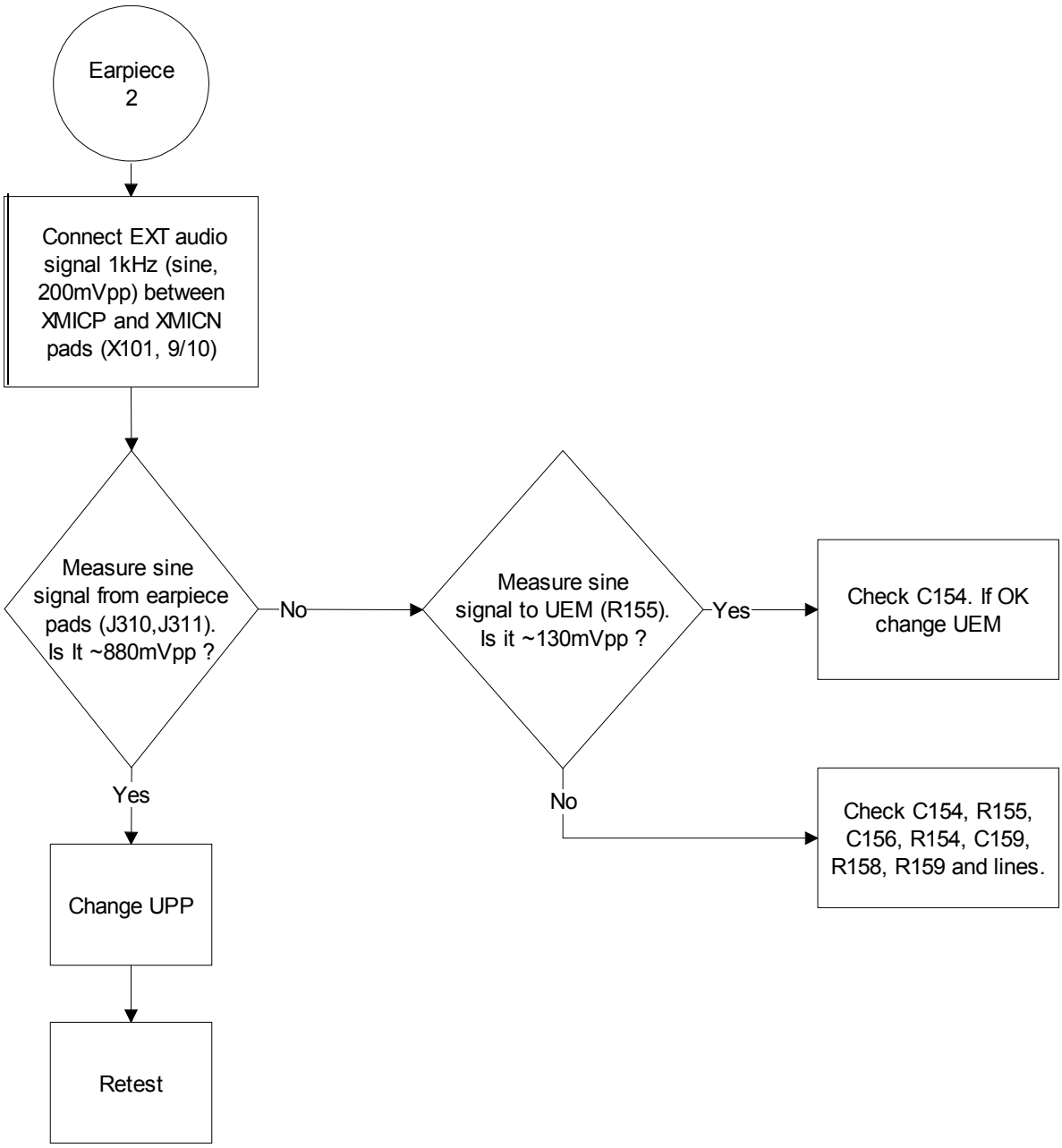


Figure 45: Audio troubleshooting (3)

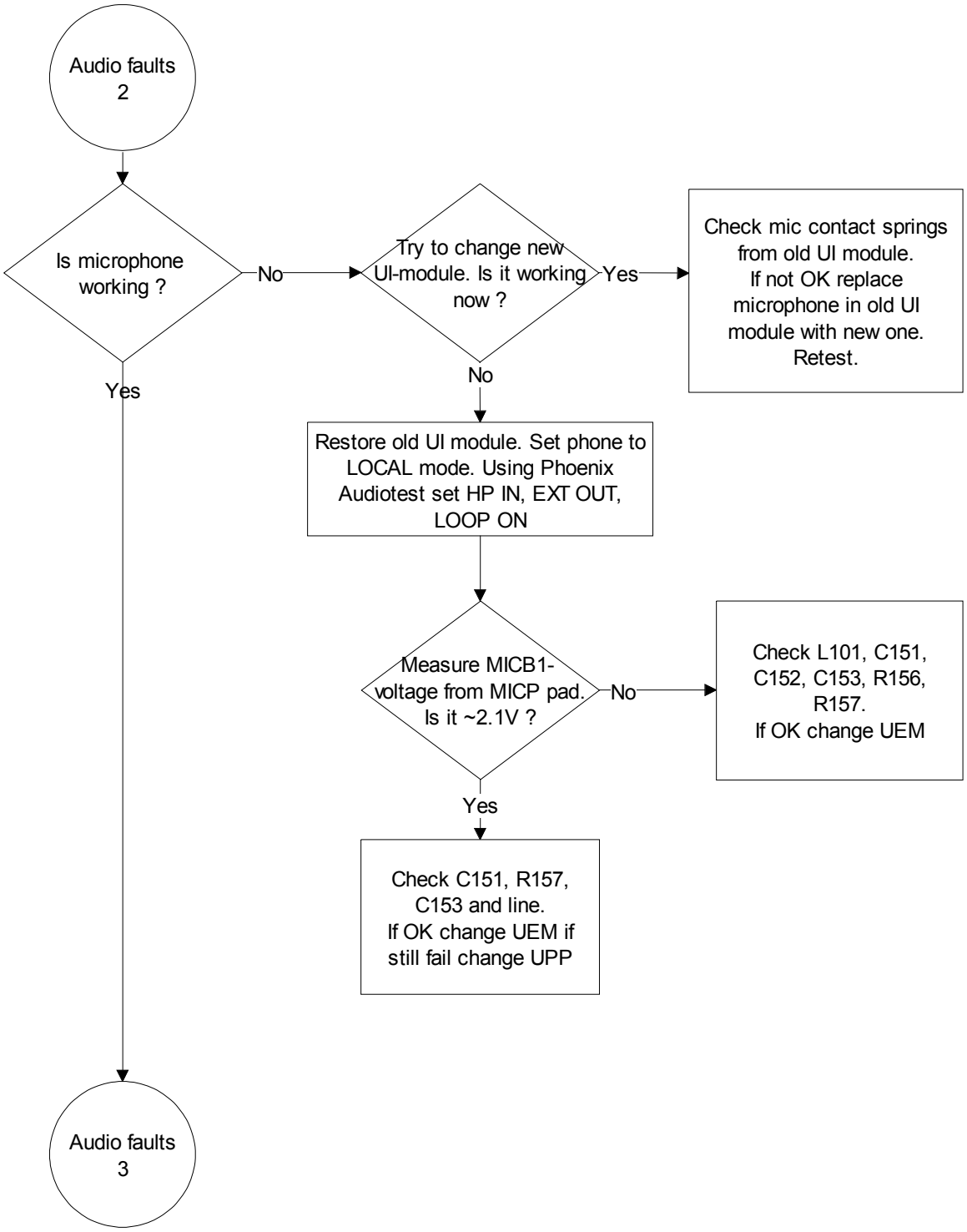
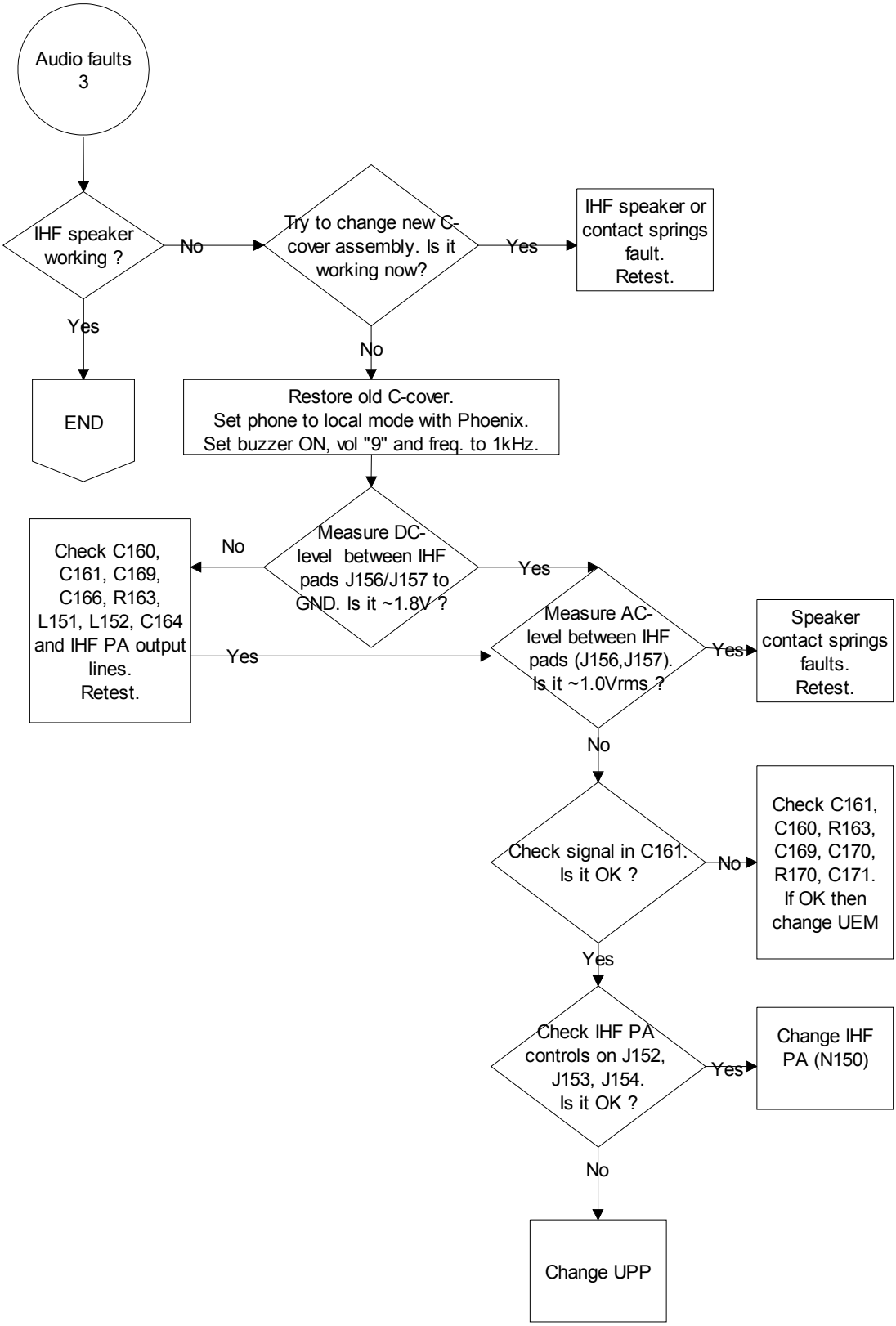


Figure 46: Audio troubleshooting (4)



FM Radio troubleshooting

FM Radio component layout

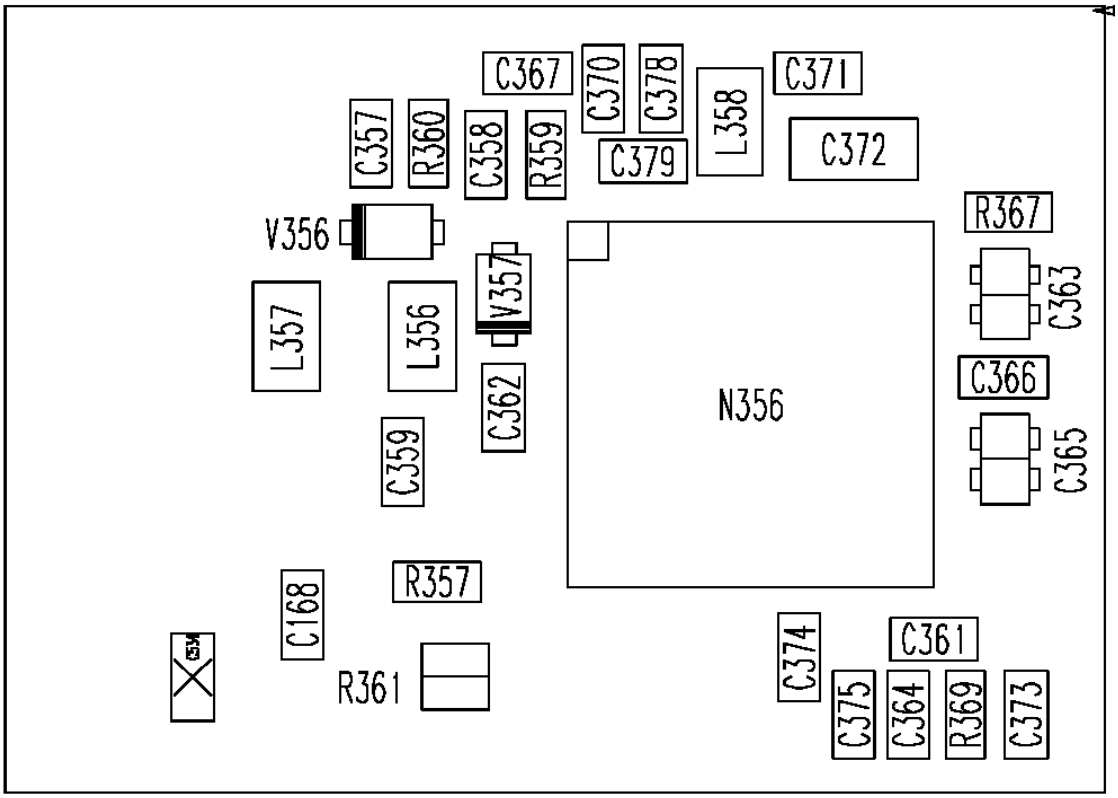


Figure 47: Component placement

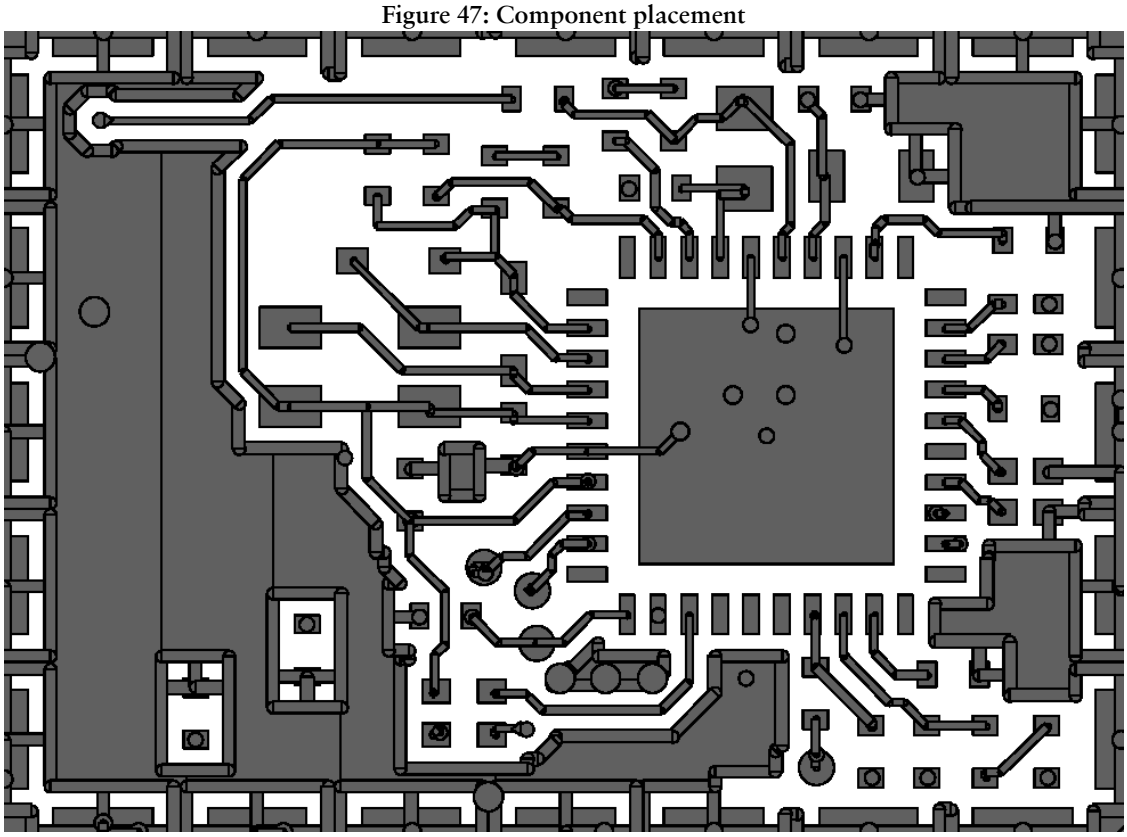


Figure 48: Trace layout.

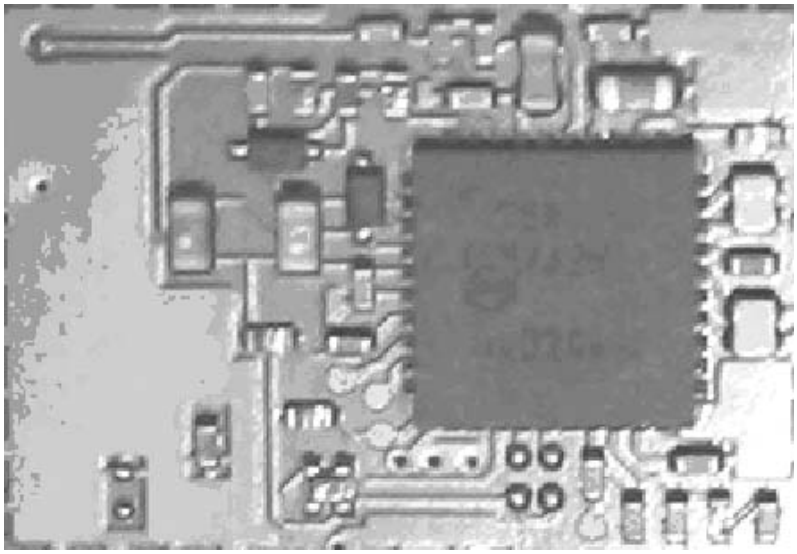


Figure 49: FM radio block layout.

Components L103, L104, L105, C107, C108, C109, C117, C162, C163, R164, R165, R166 and R167 are not shown in the picture. Those components are placed in baseband section, near audio amplifier N150.

FM Radio troubleshooting diagram

Notes to "FM Radio troubleshooting diagram"

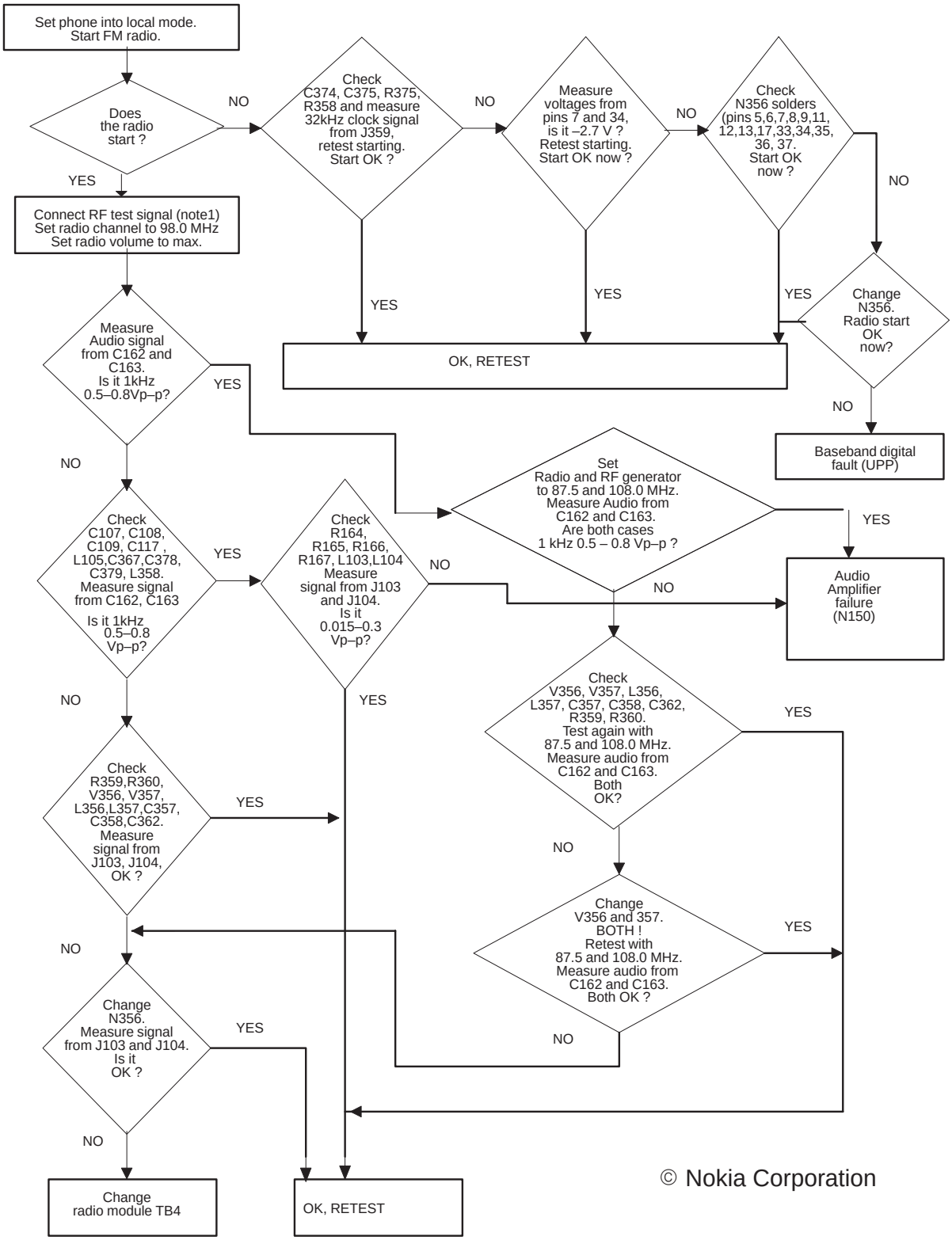
Use 1MHz 1X probe when measuring Audio and clock signals with oscilloscope.

Use active RF probe when measuring frequencies with spectrum analyzer.

Note 1. RF test signal parameters:

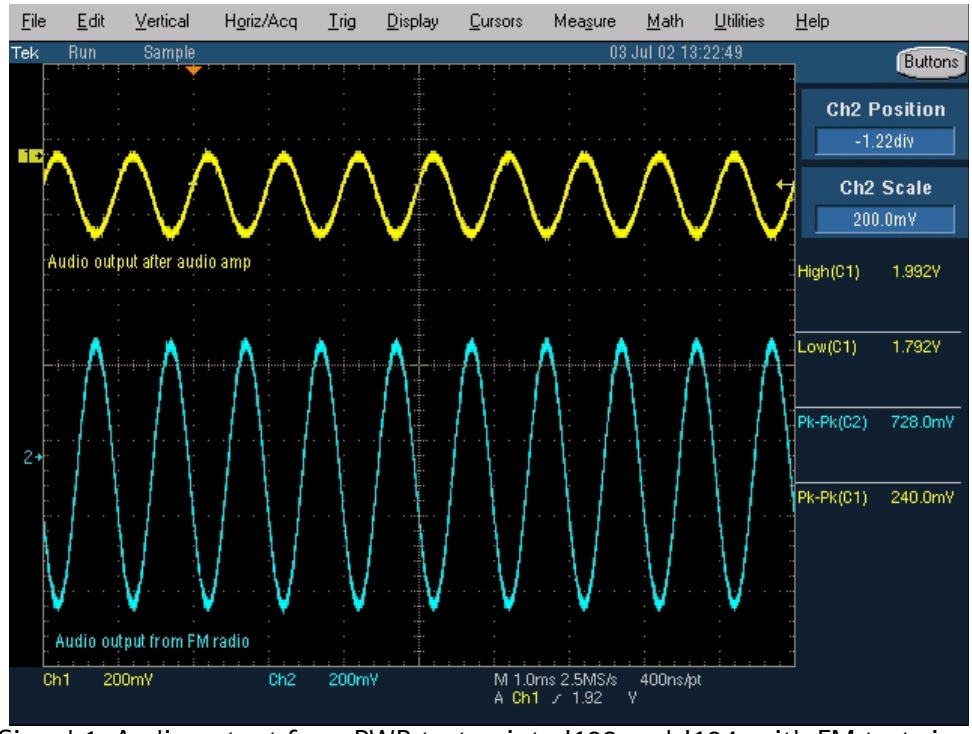
- Amplitude, *A*, –67.0 dBm
- Carrier frequency, f_c, 98,000 MHz
- Deviation, Δf, 75 kHz
- Modulating frequency f_m, 1,000 kHz (RF generator internal)
- FM stereo, mode R=L, pilot state ON

Figure 50: FM radio troubleshooting diagram



Diagrams of FM radio signals

Figure 51: Oscilloscope screen shot, Audio output



Signal 1: Audio output from PWB test points J103 and J104, with FM test signal, volume 100%.

Signal 2: Audio output from FM radio pins 22 and 23(same as in C162 and C163), with FM test signa

Figure 52: FM radio clock from test point J359, 32 kHz frequency clock signal, when radio is on.l

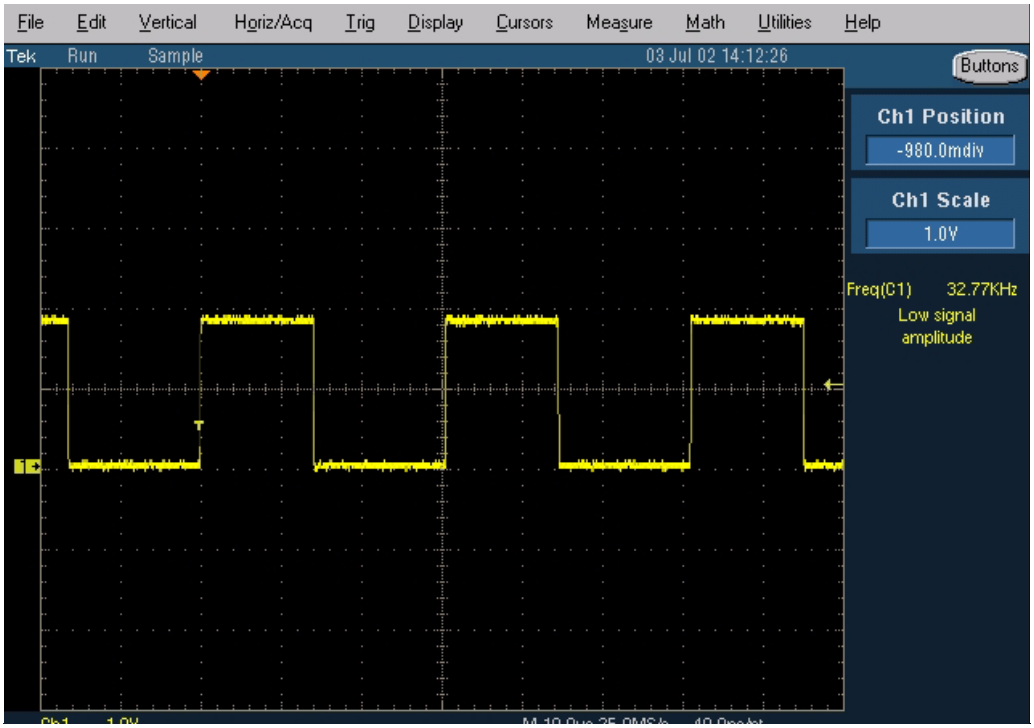


Figure 53: FM frequency from FM radio pin 37, the other end of L358, with FM test signal

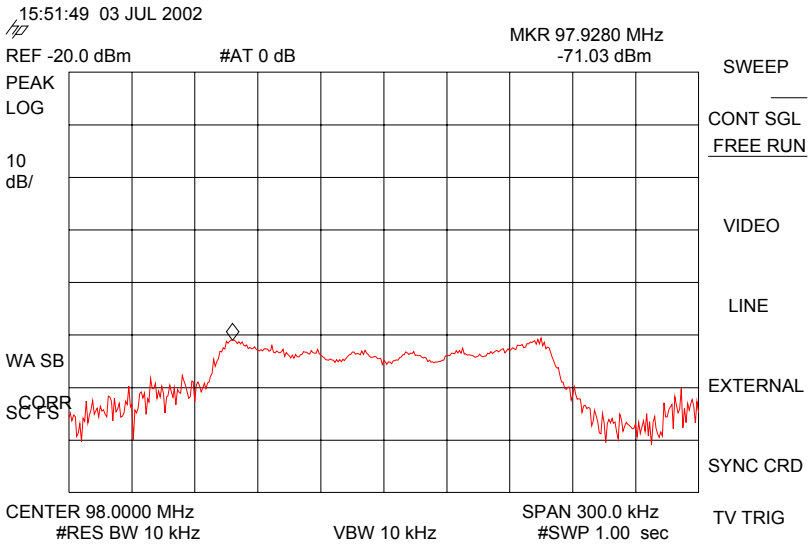
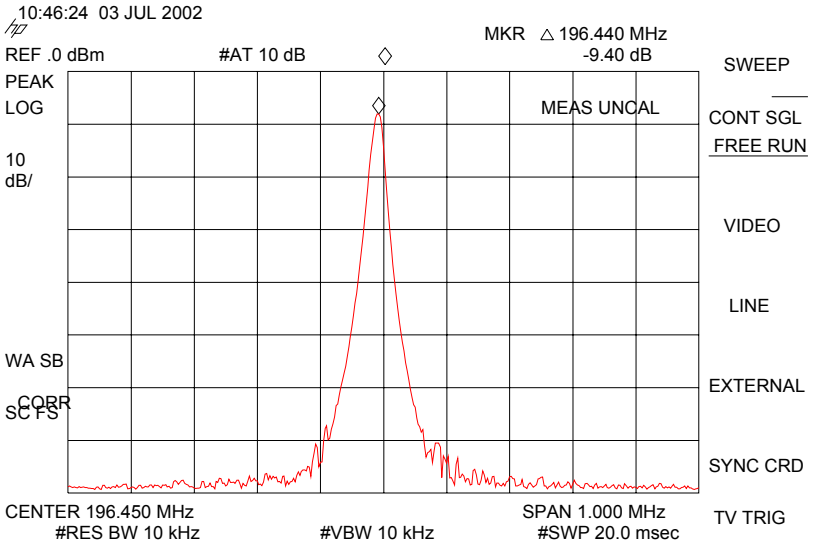


Figure 54: VCO frequency from FM radio pins 3 and 4, the other ends of V356 and V357, with FM test signal



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