Chapter 7

Troubleshooting

AMENDMENT RECORD SHEET

Amendment Number	Date	Inserted By	Comments
	02/99		Original

CONTENTS –Troubleshooting

Introduction

This document is intend to be a guide for localizing and repairing electrical faults in RAE–2 device. First there is short guide for fault localizing. Then fault repairing is divided into three troubleshooting paths, each per any module. Needed equipments are present before any actions.

Before any service operation you must be familiar with RAE–2 product and module level architecture. You must also be familiar with RAE–2 specified service tools like the WinTesla service software, Flashing tools and softwares. Basic skills of using RF measurement devices are required when you are starting to follow RF troubleshooting paths.

General

When you have a faulty RAE–2 device and you are starting troubleshooting it, check first the following basics.

- Device hasn't any mechanical damage.
- Device, especially connectors, are not dirty or moist.
- Screws are tightened as specificed.
- Battery voltage is high enough (nominal battery voltage is 3.6V).
- Current consumption is in normal area (this can be checked with Service Battery BBS–5, if ReLink mode is disabled).

Current consumption

	CMT mode (CMT current)		
PDA mode (PDA current)	**Off (< 1.0mA)**	**Idle (3–40mA)**	**Call (140–320mA)**
Active (200–380mA)	200–380mA	203–420mA	340mA–700mA
Standby (35–65mA)	35–45mA	38–85mA	175–365mA
Suspended (2–4mA)	2–3mA	5–43mA	142–323mA
Reset	<1.0mA	3–40mA	140–320mA

Note1: CMT peak current consumption might be 5x more than is specified above.

Finding faulty module

Then you define the faulty module. Normally this isn't difficult because the RAE–2 device has three quite independent modules; CMT, PDA and UI.

If you can't conclude which is the faulty module, try to program new software to the RAE–2. Usually when a module has a real fault also its programming fails. If programming succeeds, it means that the CMT and

PDA modules basically work and the fault might be in UI module or flex connectors between PDA and UI module. Before CMT programming check that PDA goes to the ReLink mode (use BBS–5 service battery).

After that you can replace the faulty module with the reference (Golden Sample) module and be sure that module is really faulty. Alternatively you can change the suspected faulty module to the reference RAE–2 device. After this cross–checking you should have found certainty about the faulty module(s) and you can start to study module level problems.

CMT Troubleshooting

The following hints should facility finding the cause of the problem when the CMT circuitry seems to be faulty. This troubleshooting instruction is divided in main level to BaseBand and RF faults.

The first thing to do is carry out a through visual check of the module. Ensure in particular that there are not any mechanical damages and soldered joints are OK. If the CMT module is able to communicate with WinTesla software, you can use it to find out faulty circuits from CMT module. Selftest checks all CMT baseband Asics and memory components and reports the result as passed or failed. If every test is passed, you can perform different kind of calibration and tuning operations and deduce which is the faulty circuit.

Baseband faults

At least the following measurement devices are needed for fault debugging in BaseBand section:

– PC for the Wintesla with software protection key (dongle)
– RS–232 cable (DAU –9C)
– Repairing jig MJS–4
– Flashing Tools FLA–7, FPS–4 and TDF–4
– Service Battery BBS–5
– Calibration Unit JBE–1
– power supply, digital multimeter and oscilloscope

CMT is totally dead

This means that CMT doesn't take current at all when the power switch is pressed or when the Watchdog Disable signal (J113) is rounded. Used battery voltage must be at least the nominal, 3.6 V.

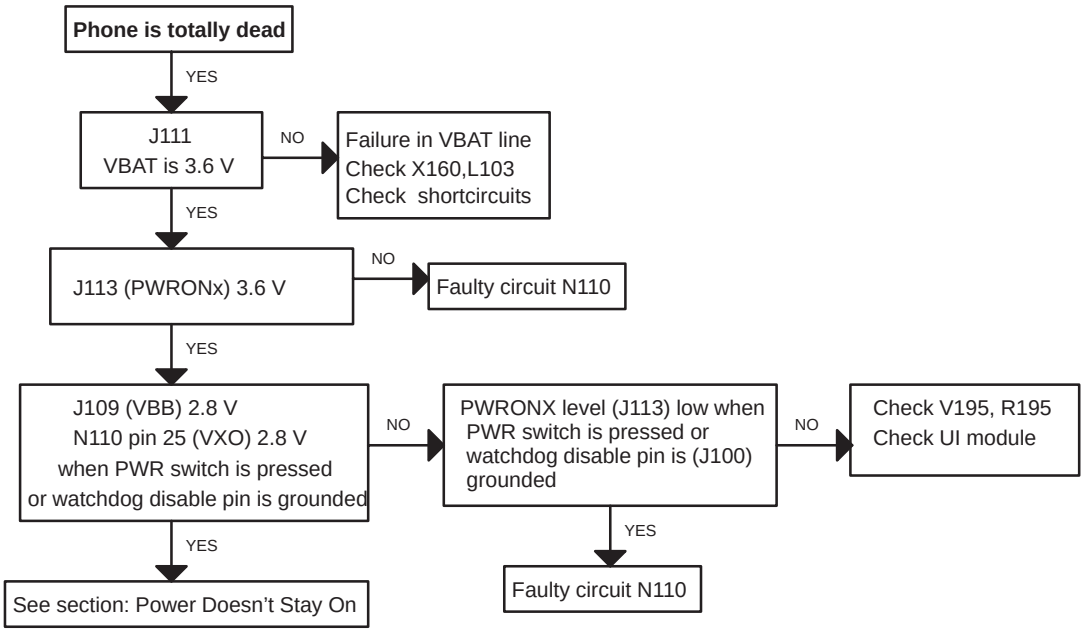


Figure 1. Trouble Shooting Diagram for Phone is totally dead failure

Power doesn’t stay on or phone is jammed

Normally the power will be switched off by CCONT (N110) after 30 seconds, if the watchdog of the CCONT can not be served by software. The watchdog updating can be seen by oscilloscope at pin 50 (DataselX) of CCONT. In normal case there is a short pulse from ”1” –> 0 every 8 seconds.

The power off function of CCONT can be prevented by connecting a short circuit wire from CCONT pin 29 (or J113) to ground.

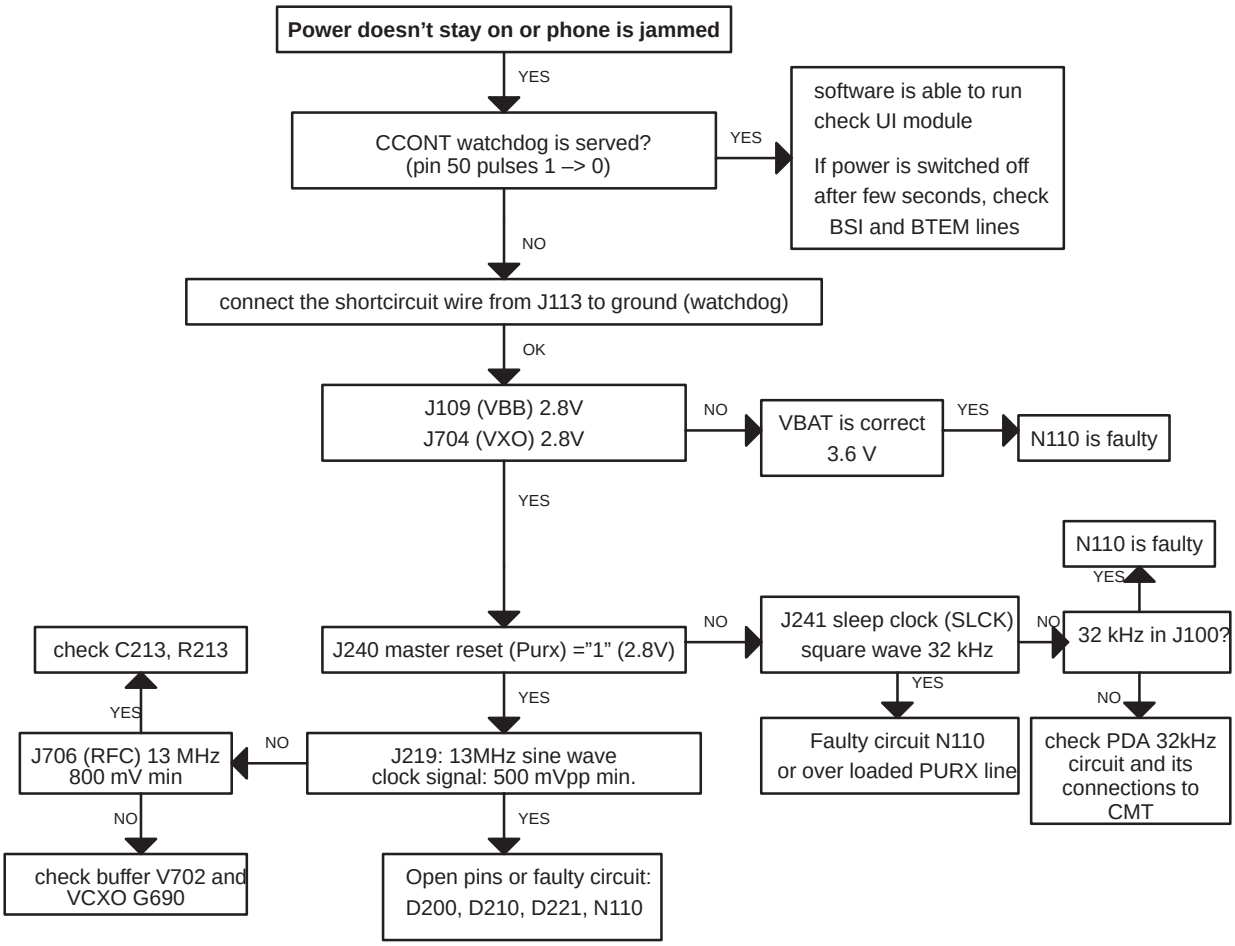


Figure 2. Trouble Shooting Diagram for Power Doesn’t Stay On or phone is jammed failures

Display Information: Contact Service

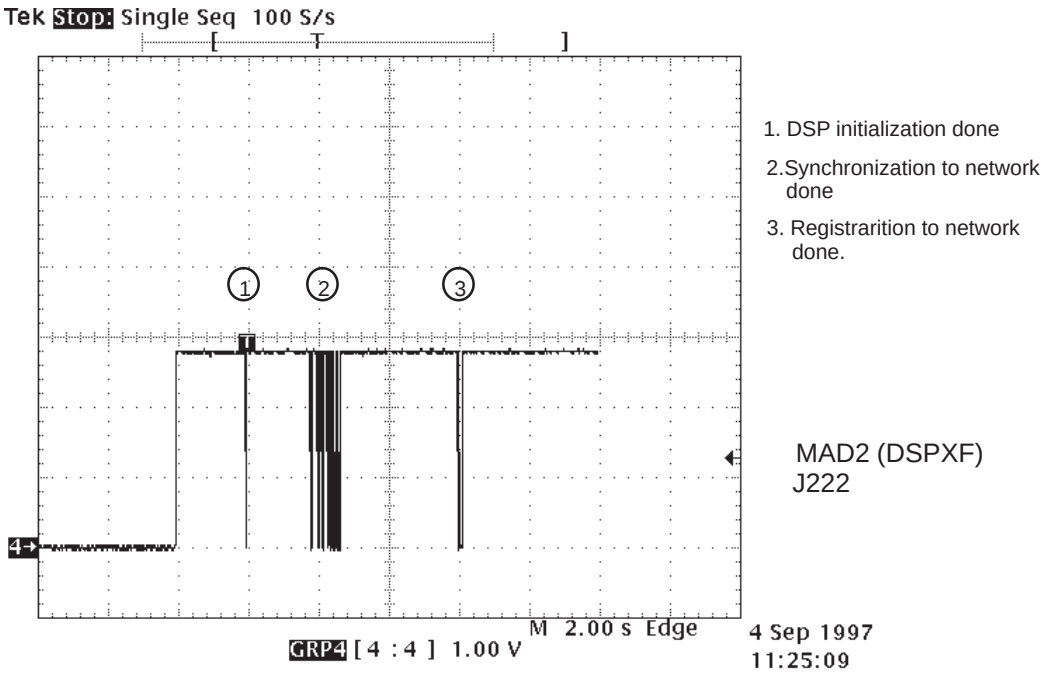
This fault means that software is able to run and thus the watchdog of CCONT (N110) can be served. Selftest functions are run when power is switched on and the software is started to execute from flash. If any of the self–tests fails, **Contact Service** text will be shown on the display. Find out which circuit is faulty using the WinTesla software (select from Testing menu item Self Tests... and WinTesla shows which circuit are not passed selftests).

The phone doesn't register to the network or phone doesn't make a call

If the phone does not register to the network or the phone does not make a call, the reason could be either the baseband or the RF part. The phone can be set to wanted mode by WinTesla service software and determinate if the fault is in RF or in baseband part (RF interface measurements).

The control lines for RF part are supplied both the System Asic (MAD2; D200) and the RFI (Cobba; N250). MAD2 handles the digital control lines (like synthe, TxP etc.) and Cobba handles the analog control lines (like AFC, TxC etc.).

The DSP software is constructed so that the operation states of DSP (MAD2) can be seen in external flag (DSPXF) output pin (J222). After power up, the DSP signals all completed functions by changing the state of the XF pin.



1. DSP initialization done
2. Synchronization to network done
3. Registrarition to network done.

MAD2 (DSPXF)
J222

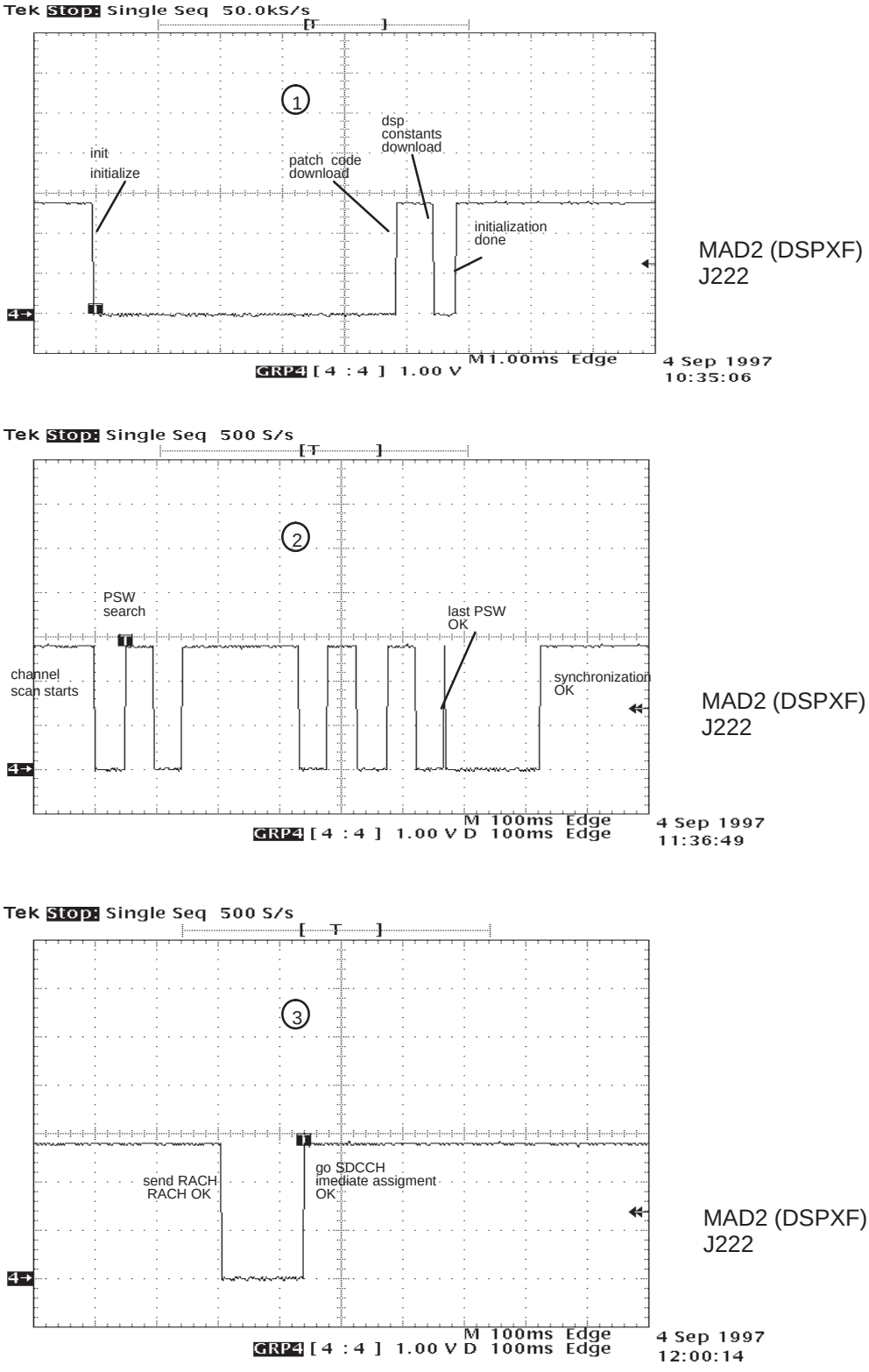


Figure 3. The states of DSP after power on

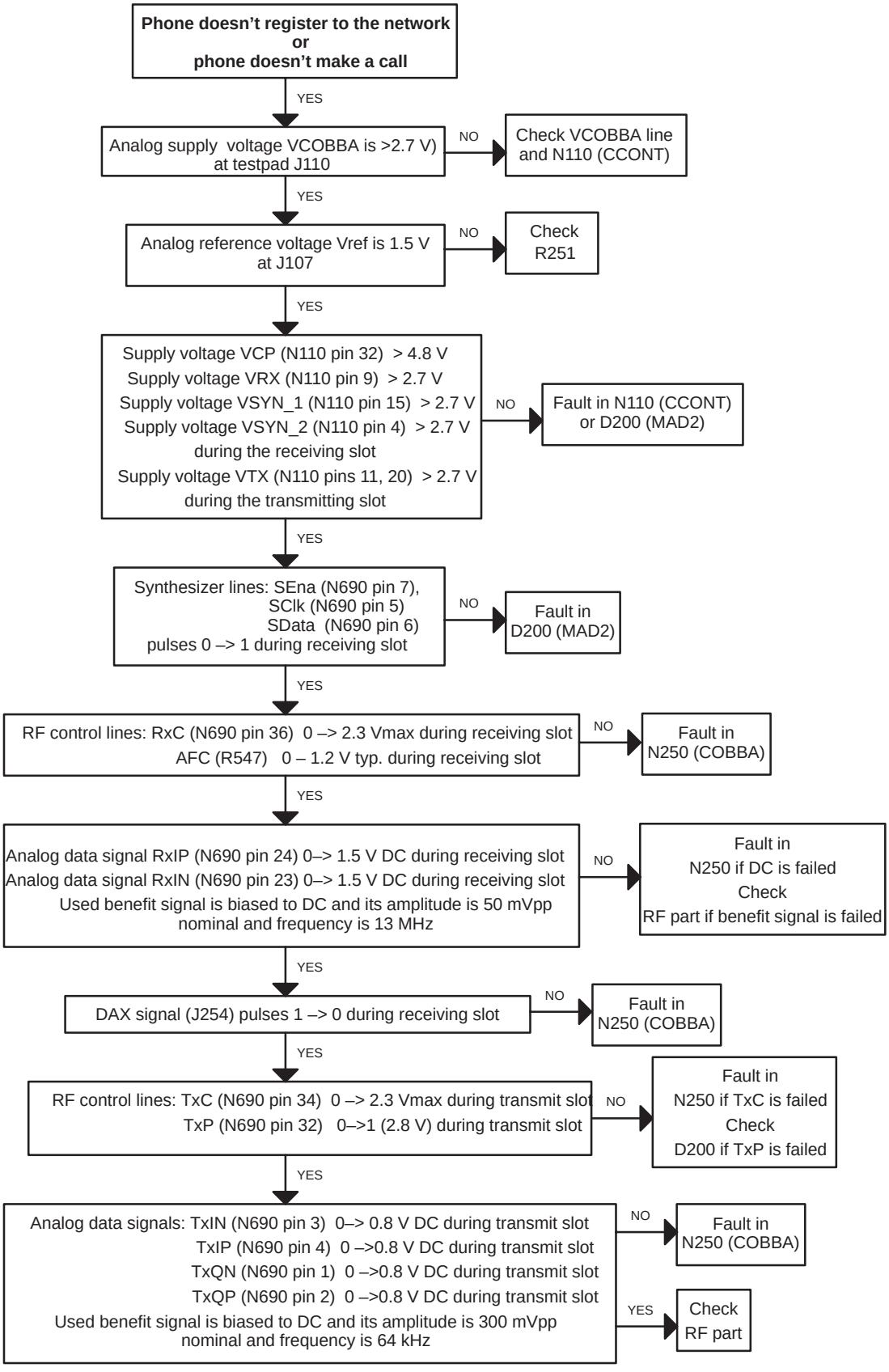


Figure 4. The phone doesn't register or doesn't make a call

SIM card is out of order

The hardware of the SIM interface from the MAD2 (D200) to the SIM connector (X150) can be tested without SIM card. When the power is switched on and if the BSI line (X160;2) is grounded by resistor, all the used lines (VSIM, RST, CLK, DATA) rise up to 5 V four times. Thus "**Insert SIM card**" faults can be found without SIM card. The fault information "**Card rejected**" means that the ATR message (the first message is always sent from card to phone) is sent from card to phone but the message is somehow corrupted, data signal levels are wrong etc. or factory set values (stored to the EEPROM) are not correct.

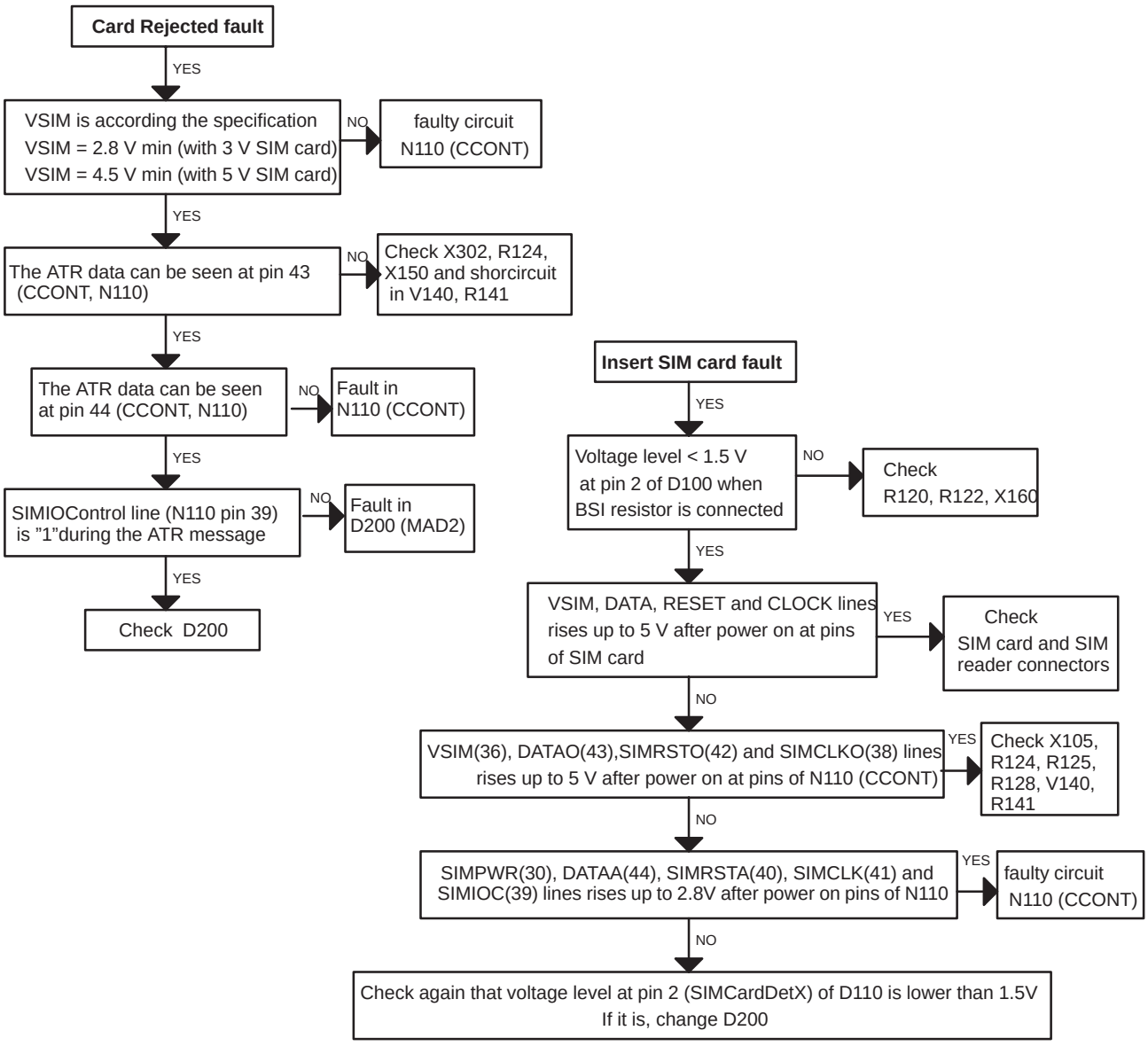


Figure 5. Troubleshooting for SIM card faults

Audio fault

Troubleshooting tree for Audio fault:

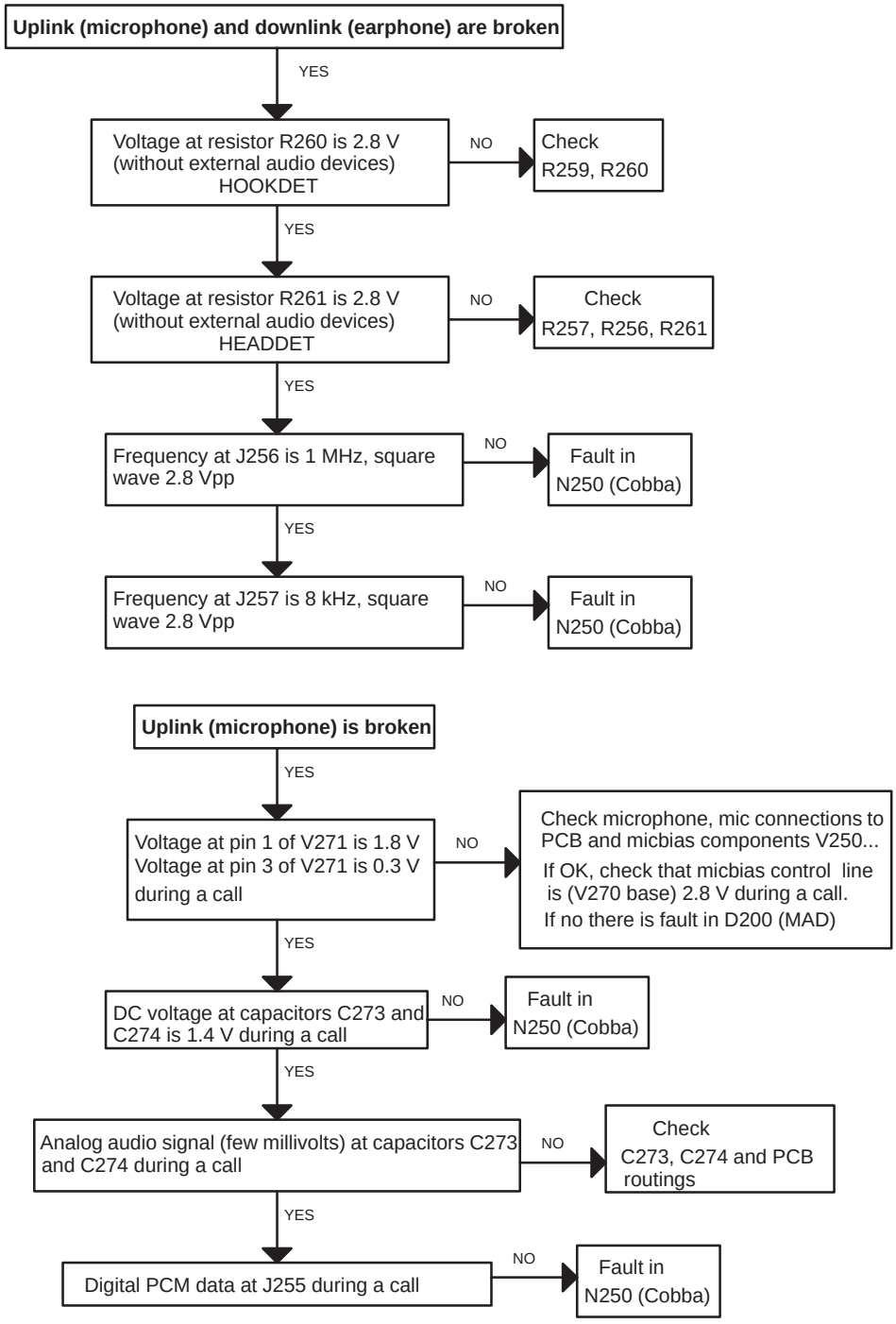


Figure 6. Trouble Shooting Diagram for Audio Failure

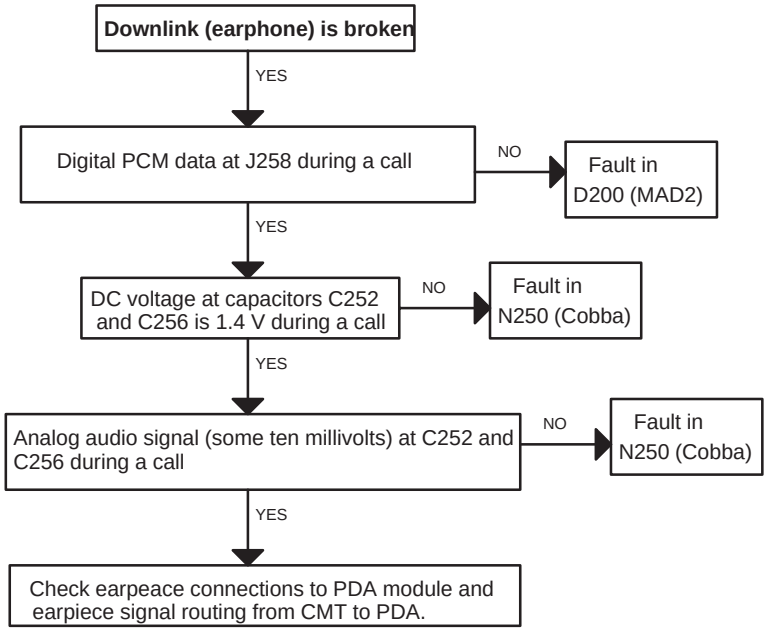


Figure 7. Trouble Shooting Diagram for Audio Failure

Charging fault

When you are charging totally empty battery, remember that start–up charging might take 2 minutes with ACP–9 charger and several minutes with ACP–7 charger. During this time display is blank.

If charger is not NMP approved type then the software doesn't start charging.

Remove and reconnect battery and charger few times before you start to measure module. This check ensure if module fault really exist.

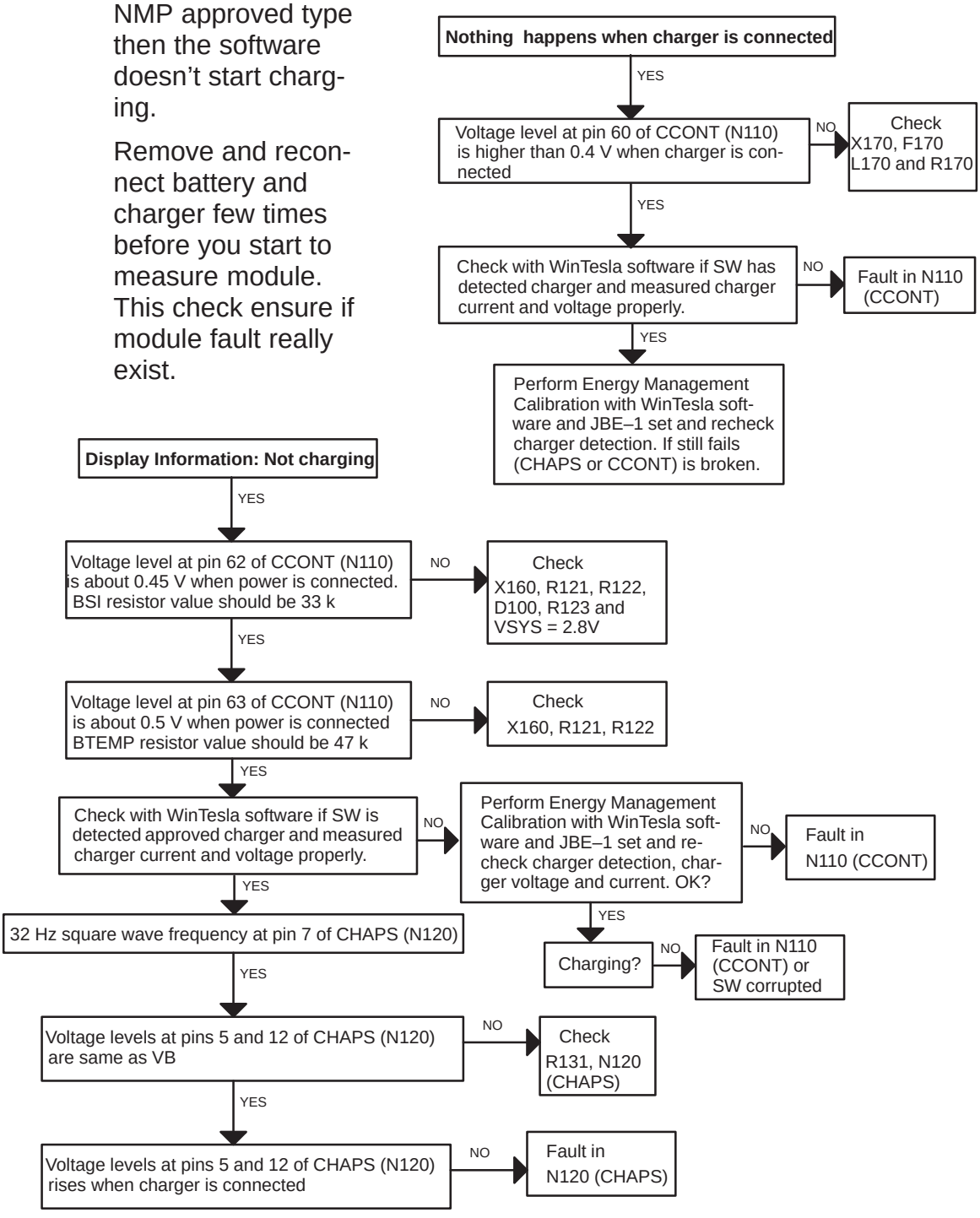


Figure 8. Trouble Shooting Diagram for Charging Failure

Flash programming doesn’t work

The flash programming is done over the system connector X170.

In flash programming error cases the flash prommer can give some information about a fault. The fault information messages could be:

- **MCU doesn’t boot**
- **Serial clock line failure**
- **Serial data line failure**
- **External RAM fault**
- **Algorithm file or alias ID don’t find**
- **MCU flash Vpp error**

In cases that the flash programming doesn’t succeed there is a possibility to check short circuits between the memories and the MCU (MAD2).This test is useful to do, when the fault information is:
MCU doesn’t boot,
Serial clock line failure or
Serial data line failure.

The test procedure is following:

1. Connect the short circuit wire between the test points J229 and ground.
2. Switch power on
3. If the voltage level in testpoint J203 is 2.8 V (”1”), the interface is OK. If there is a short circuit, the voltage level in testpoint J203 stays low and 32kHz square wave signal can be seen in the lines which are already tested.

One must be noticed that this test can be found only short circuits, not open pins. Also upper data lines (15:8) of flash circuit D210 are not included to this test.

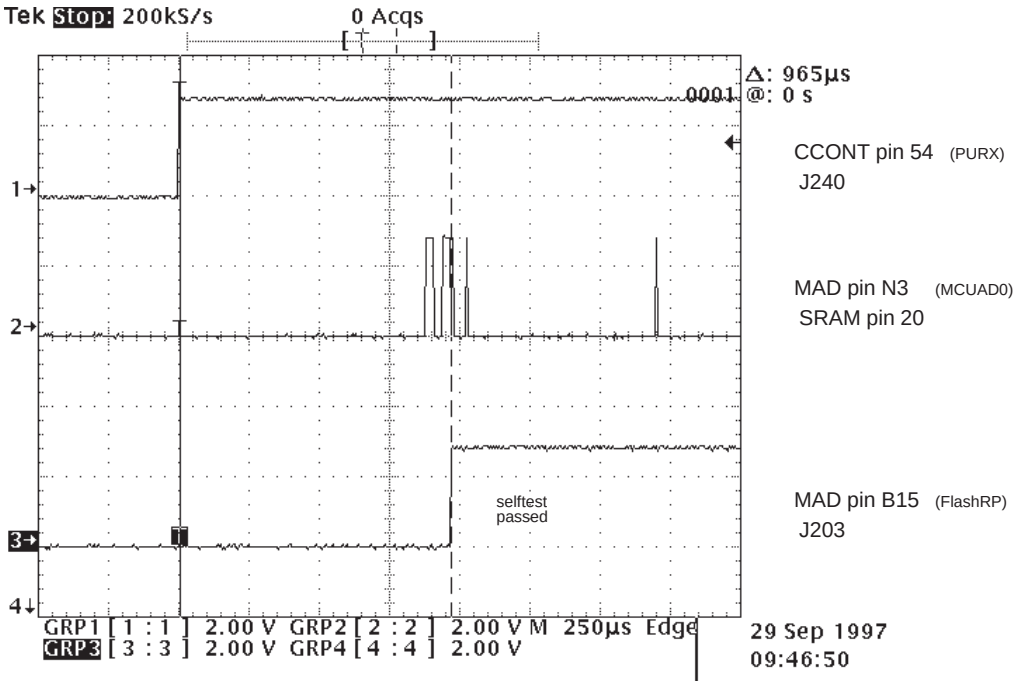


Figure 9. MAD selftest indication after power on (passed)

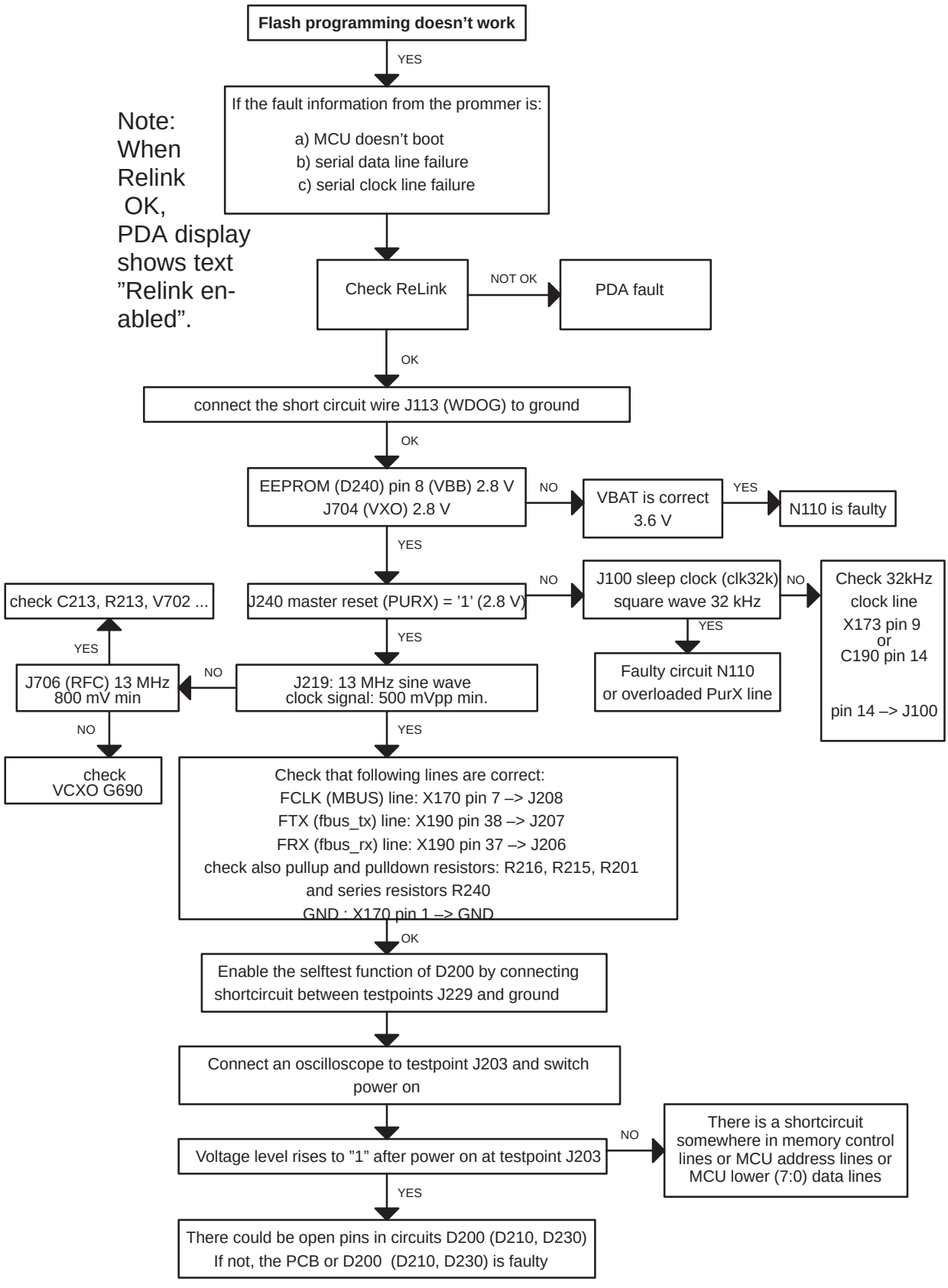


Figure 10. Trouble Shooting Diagram for flash programming doesn't work (via system connector X170)

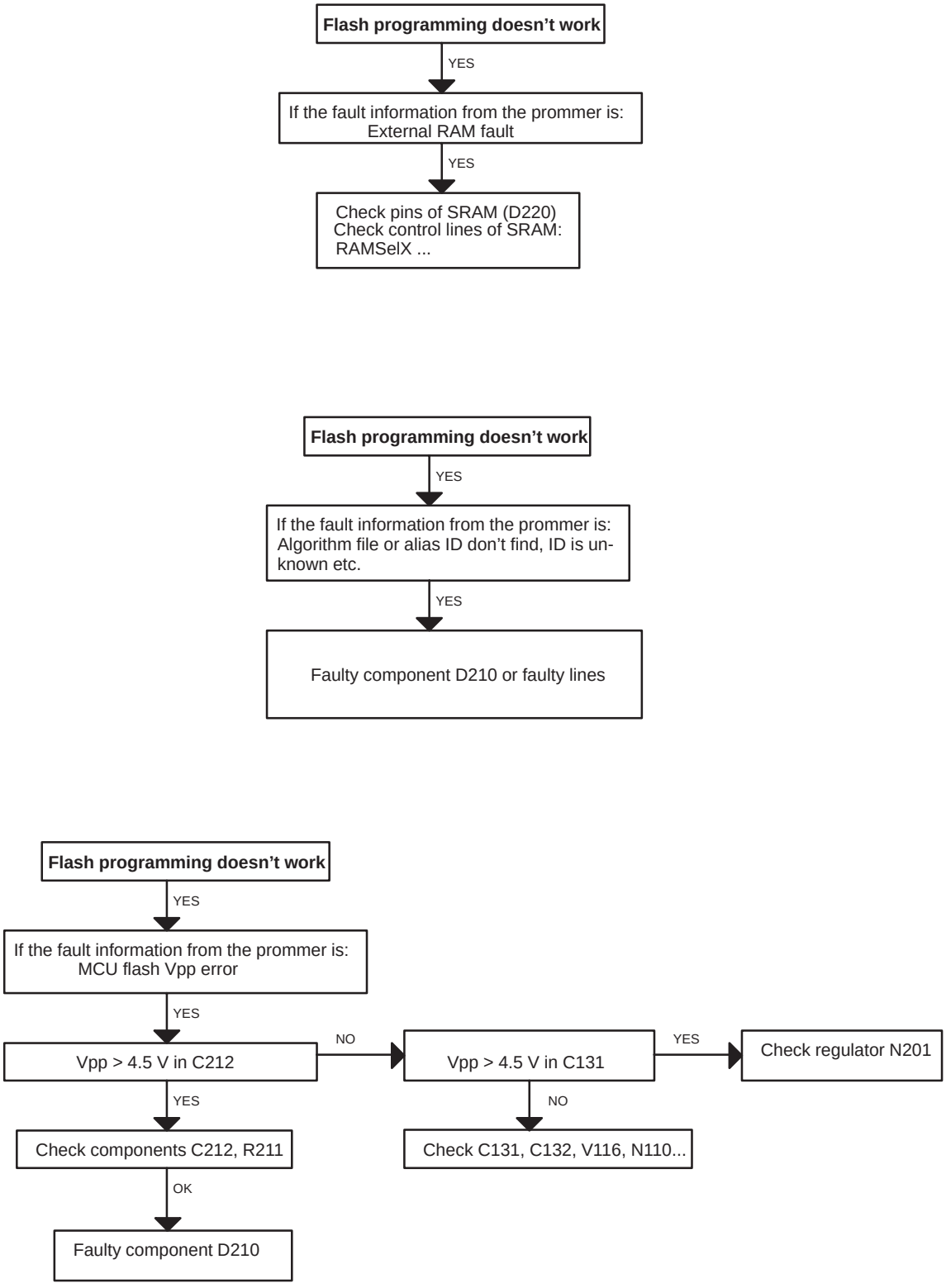


Figure 11. Trouble shooting Diagram for Flash programming doesn't work (via system connector X170)

RF Fault

Here is a block diagram for repairing the RF section. First select the fault and follow the diagram.

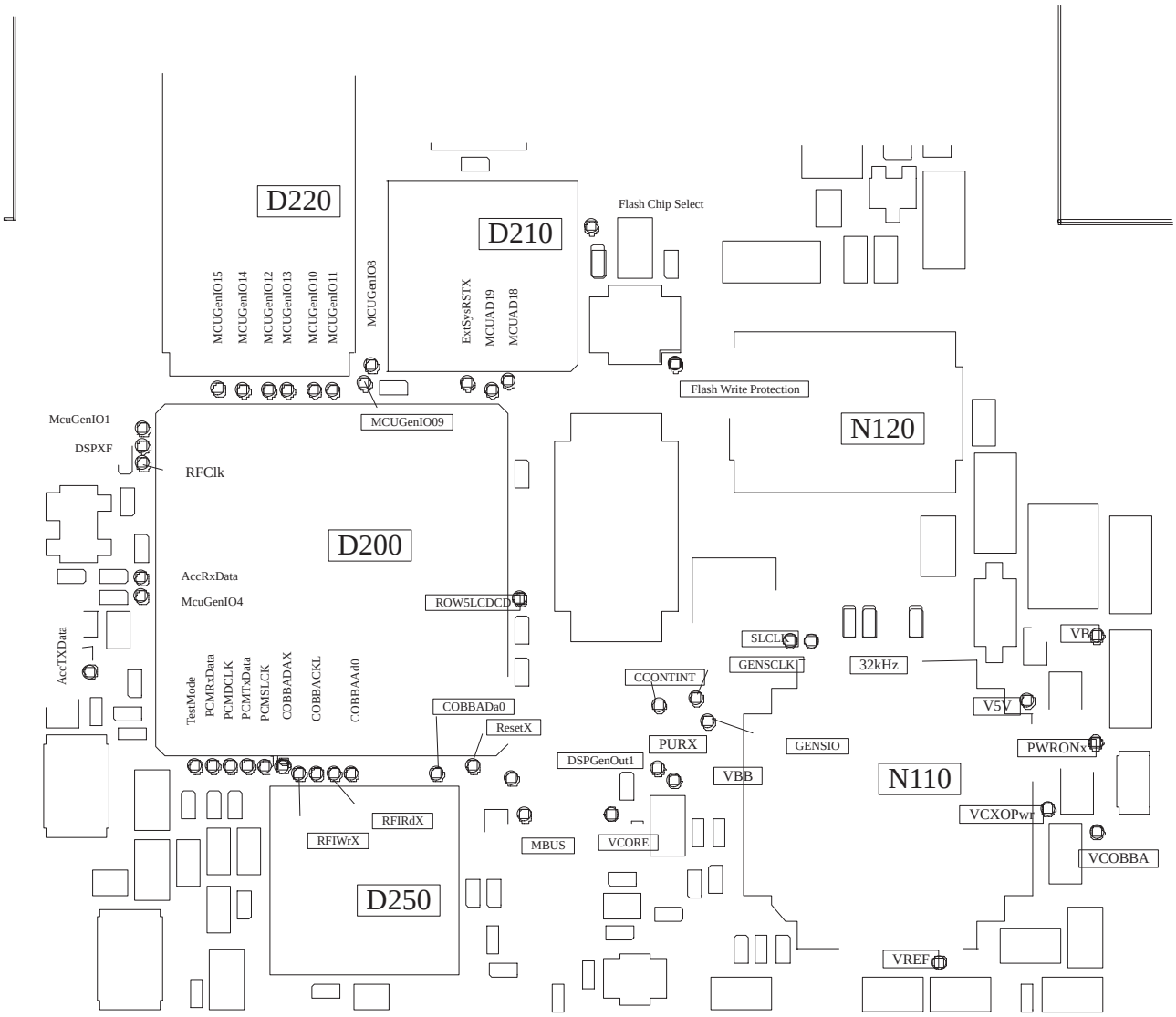
Required Servicing Equipment:

– PC for the Wintesla
– Power supply
– Digital multimeter
– Oscilloscope
– Spectrum analyzer
– GSM MS test set
– Signal generator
– RF probe
– Phone test jig

Test Points on BS8 Module

Test points are placed on baseband for service and production trouble shooting purposes in some supply voltage and signal lines.

Because some of baseband signal are routed totally inner layers (due to uBGA packages) some testpoints are added for these signals.



The figure above describes and the next table lists the test points.

Test Point	Name	Description
J100	32kHz	32kHz clock from BS1 module
J103	CCONTINT	CCONT interrupt output
J105	GENSCLK	Serial data clock
J106	GENSIO	Serial data
J107	VREF	Reference voltage
J108	V5V	Supply voltage for flash programming (Vpp) and RF circuits.
J109	VBB	Supply voltage for digital circuits
J110	VCOBBA	Supply voltage for analog circuits
J111	VB	Battery voltage
J112	VCORE	Supply voltage for MAD c07 core
J113	PWRONx	CCONT's PWRONx / Watchdog disable signal
J203	ExtSysRSTX	Testpoint for fault diagnostic. If missing, check power supply, PurX line and 13 MHz clock signal.
J204	VCXOPwr	Control line for VCXO module. If low, 13 MHz clock signal for baseband is disable.
J206	AccRxData	FBUS RX
J207	AccTxData	FBUS TX
J208	MBUS	Serial data bus max 9600b/s. Flash programming clock
J209	McuGenio4	General purpose out in MAD
J211–J218	MCUGenIO(8:15)	Test point for fault diagnostic. MCUDA(15:8)
J219	RFClk	13 Mhz System clock
J220	TestMode	MAD test mode select input
J221	DSPGenOut1	General purpose DSP out
J222	DSPXF	Test point for fault diagnostic.
J223–J224	MCUAD(18:19)	Memory address signals
J225	Flash Chip Sel	Flash chip select pin
J226	Flash Write Prot	Flash write protection pin
J229	ROW5LCDCD	Selftest pin. If shortcircuit is made between testpoint J229 and J230, the selftest will be executed.
J232	COBBAAd0	
J233	COBBADa0	
J240	PurX	Reset line from CCONT to MAD. If low, the BB circuits are in reset state.
J241	SLCLK	32 kHz clock from CCONT to MAD
J243	McuGenio1	General purpose input in MAD
J250	RFIRdX	COBBA paraller interface read strobe
J251	RFIWrX	COBBA paraller interface write strobe
J252	ResetX	COBBA master reset
J253	COBBACLK	COBBA 13Mhz clock
J254	COBBADAX	COBBA paraller interface data available strobe
J255	PCMTxData	COBBA PCM bus transmit data
J256	PCMDCLK	COBBA bus data transfer clock
J257	PCMSCLK	COBBA bus 8kHz frame sync
J258	PCMRxData	COBBA PCM bus receive data

Transmitter fault

Troubleshooting tree for Transmitter fault:

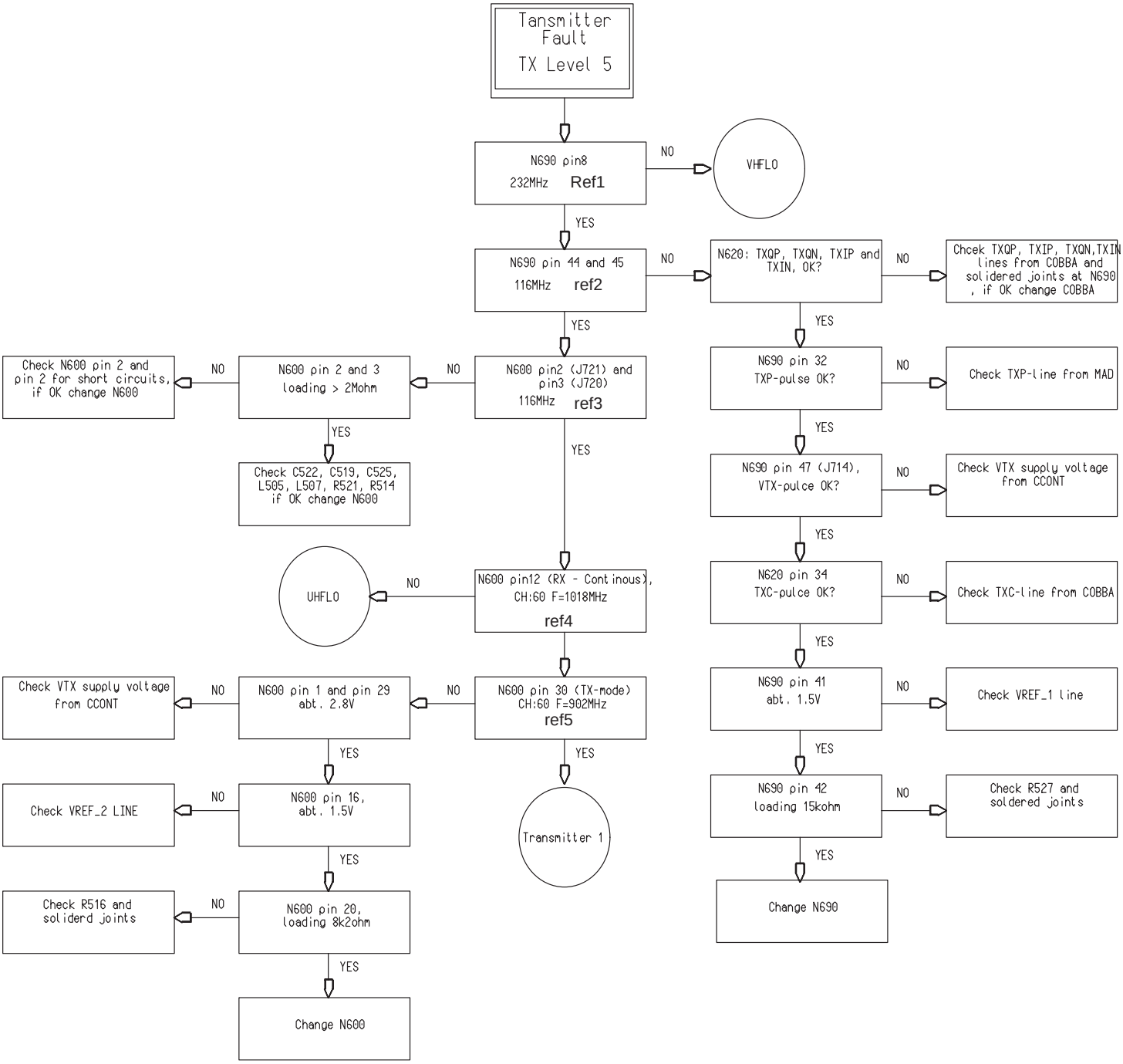


Figure 12. Transmitter fault TX level 5

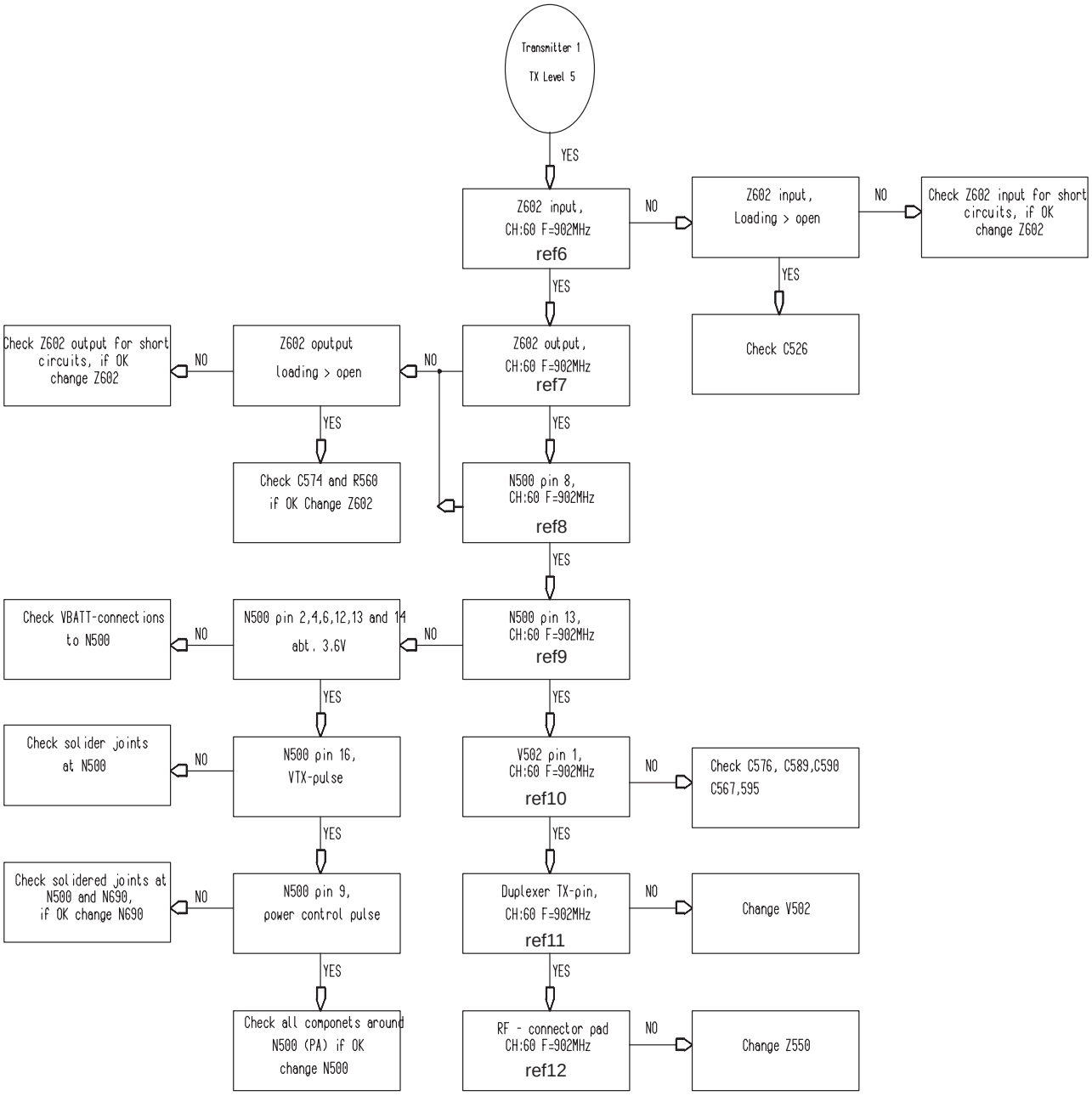
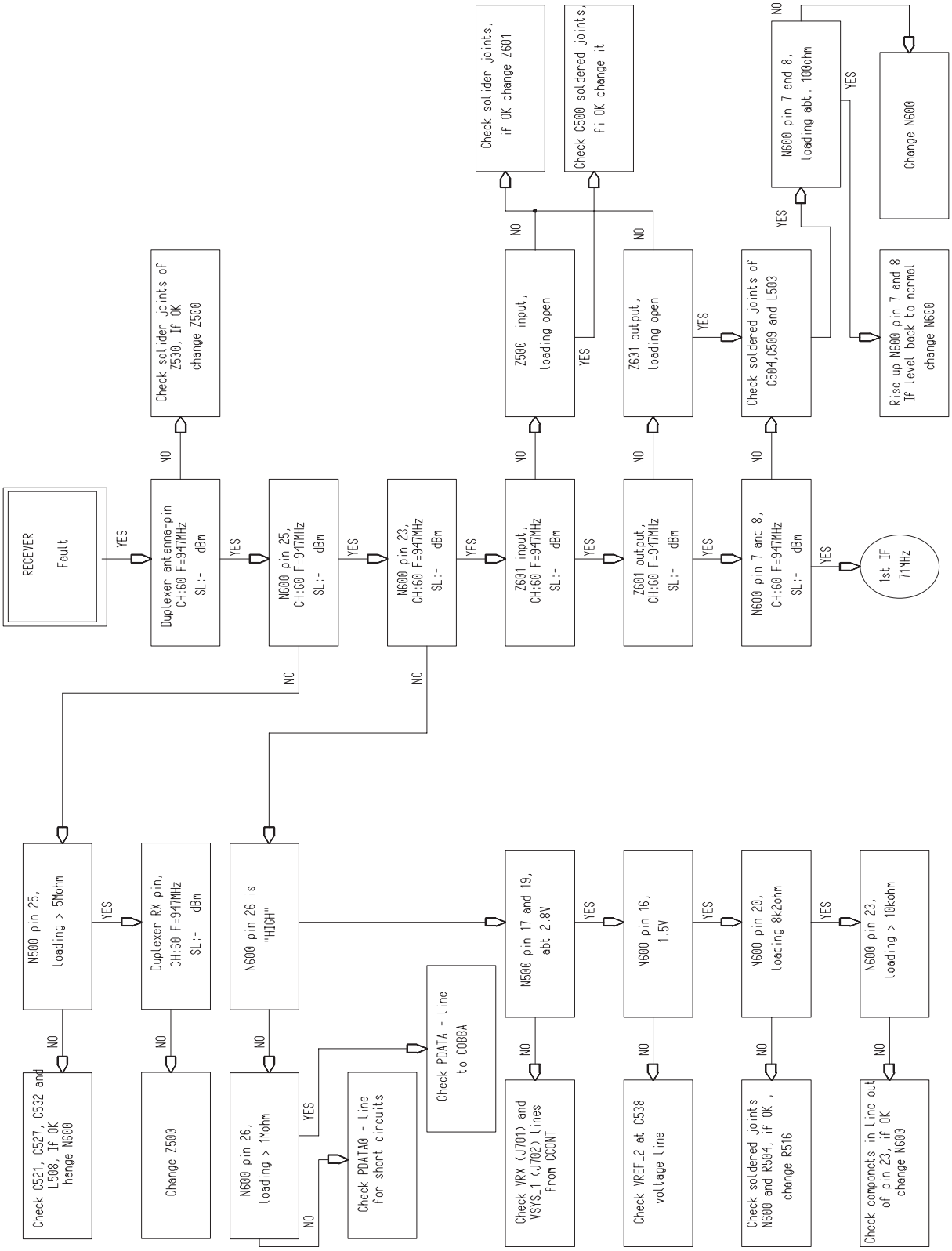


Figure 13. Transmitter 1 TX level 5

Receiver fault

Troubleshooting tree for Receiver fault:



AFC Fault

Troubleshooting tree for AFC fault:

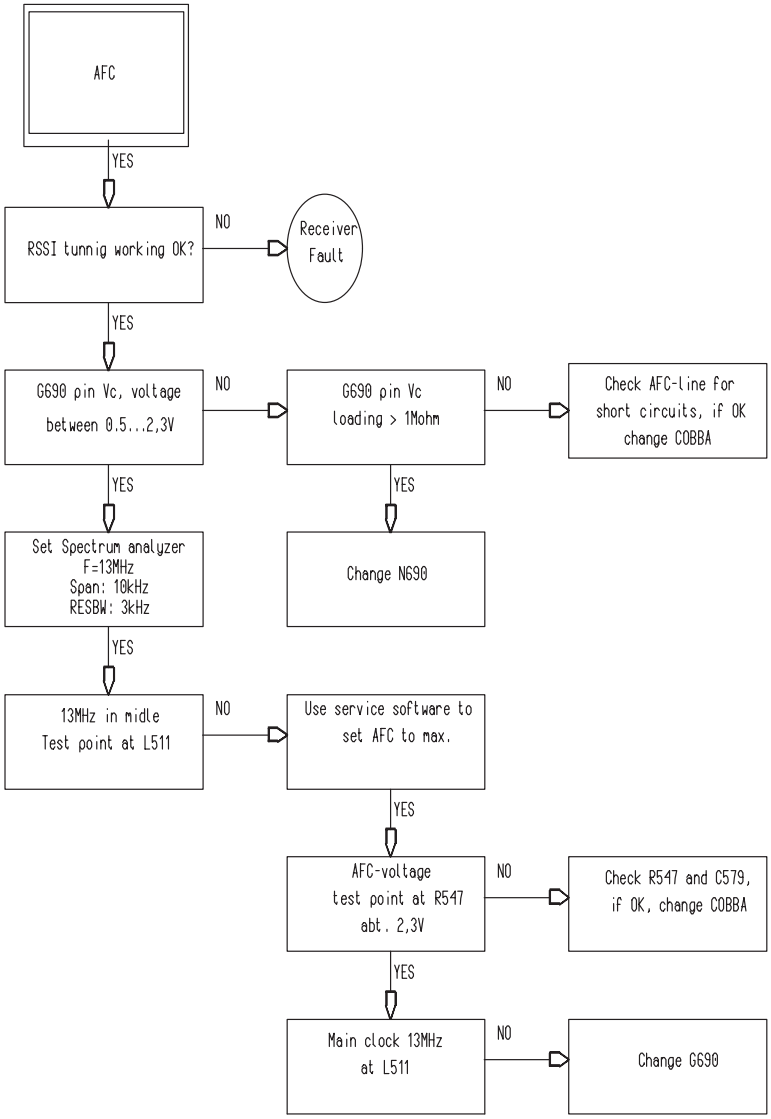


Figure 14. AFC

1st IF

Troubleshooting tree for First IF fault:

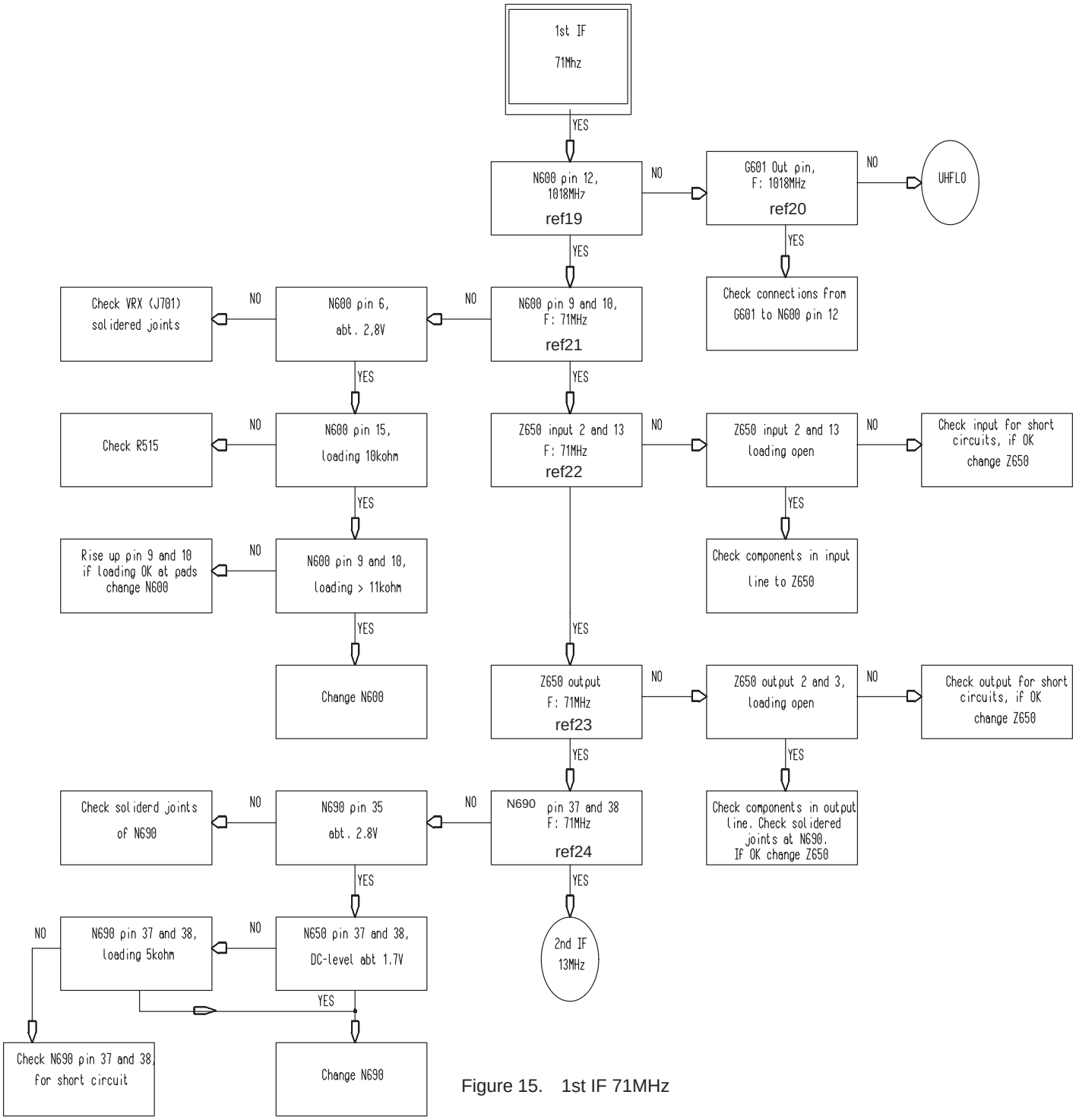


Figure 15. 1st IF 71MHz

2nd IF

Troubleshooting tree for Second IF fault:

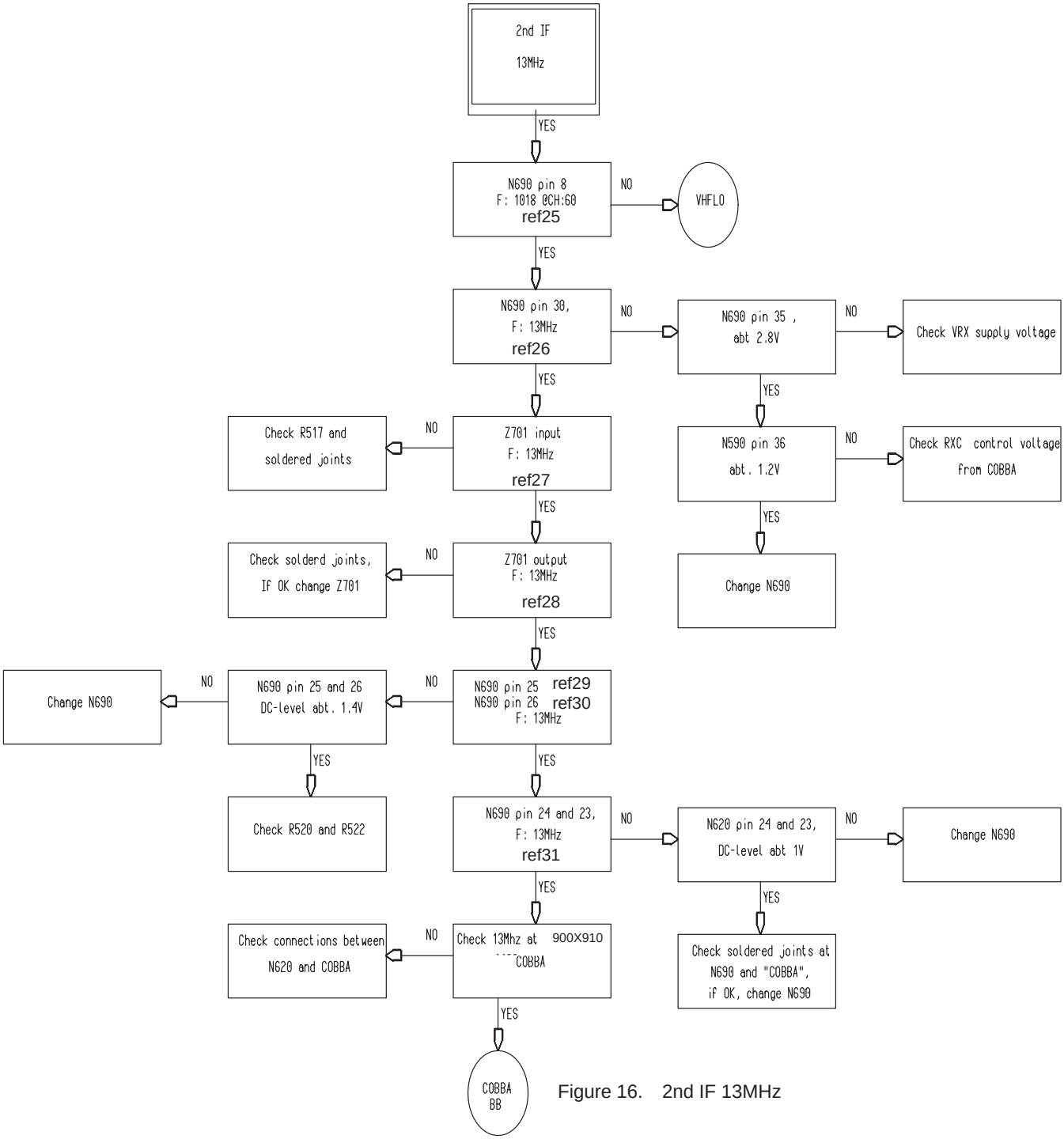


Figure 16. 2nd IF 13MHz

UHF LO

Troubleshooting tree for UHF LO fault:

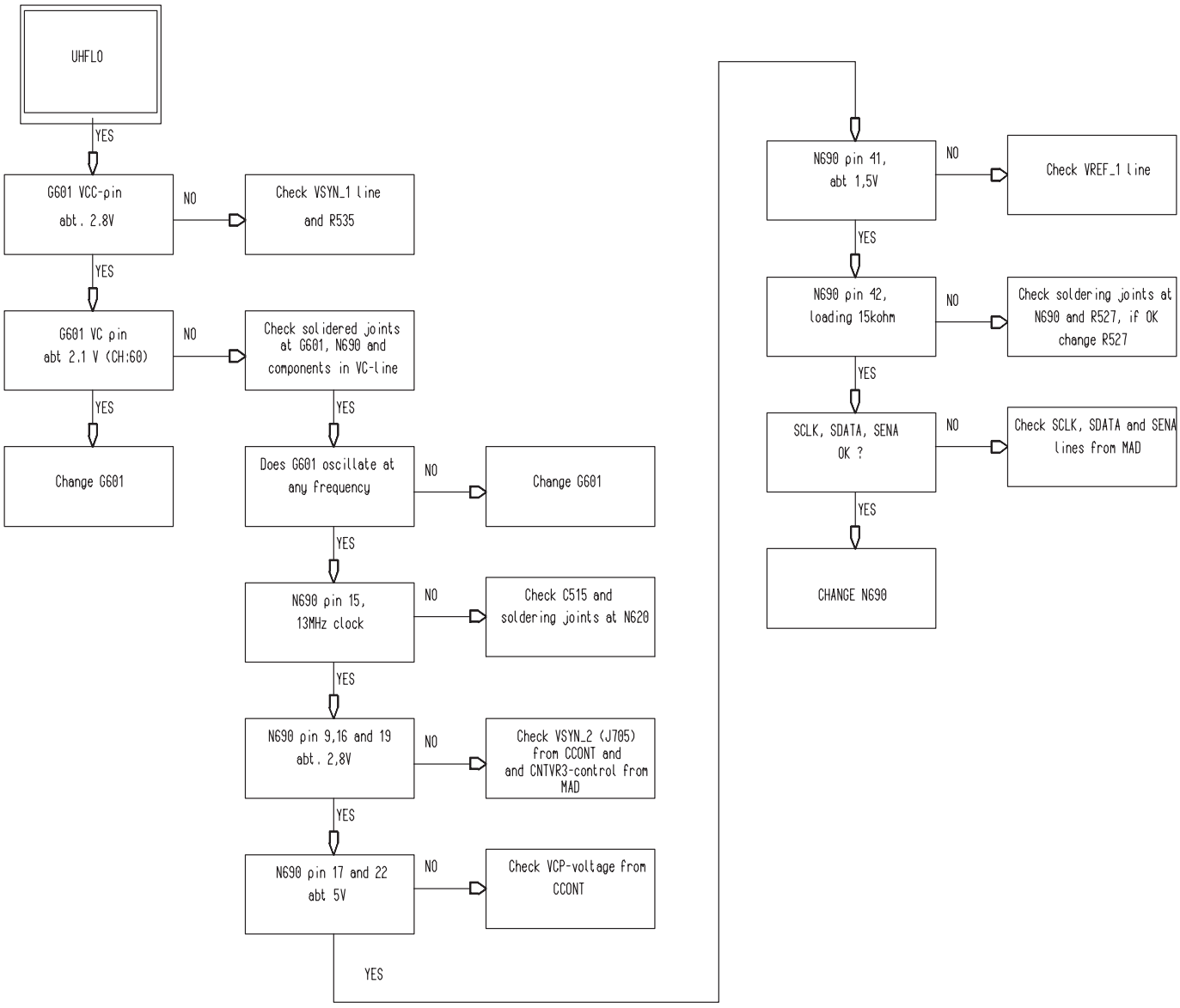


Figure 17. UHF LO

VHF LO

Troubleshooting tree for VHF LO fault:

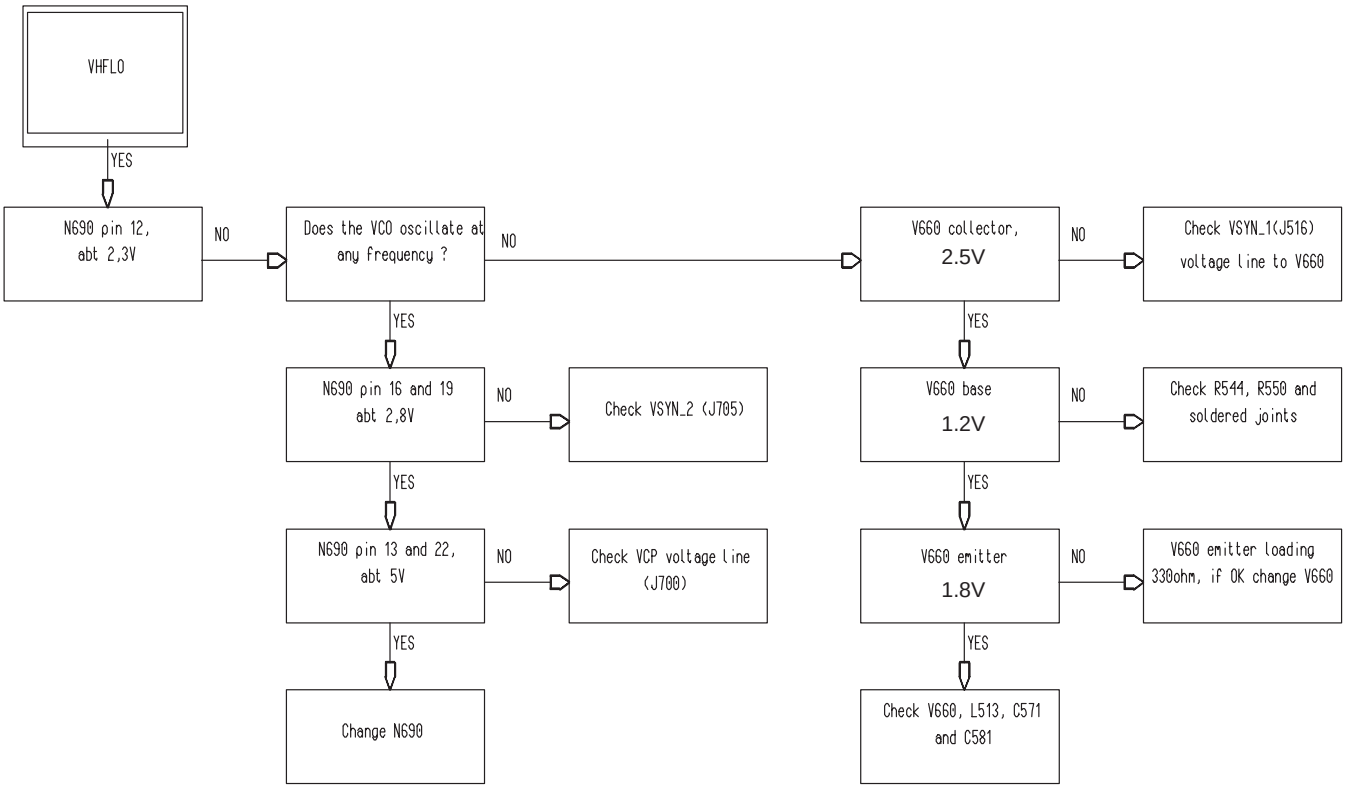


Figure 18. VHF LO

PDA Troubleshooting and Service

The purpose of this sectionis to provide methods to find the component that is malfunctioning in the PDA module of the RAE–2. Due to the large integration scale of used components, it is always not possible to point the faulty component for sure. However the flow diagram introduced here is made to fulfill the aim as well as it is possible.

Required Servicing Equipment:

– PC for the Wintesla
– Service battery BBS–5
– Service cable DAU–9C
– Combox TDC–4
– IR transceiver module JLP–1
– digital multimeter
– oscilloscope
– frequency counter (optional)

Block Diagram

The block diagram of the BS1 PDA is described in the next figure:

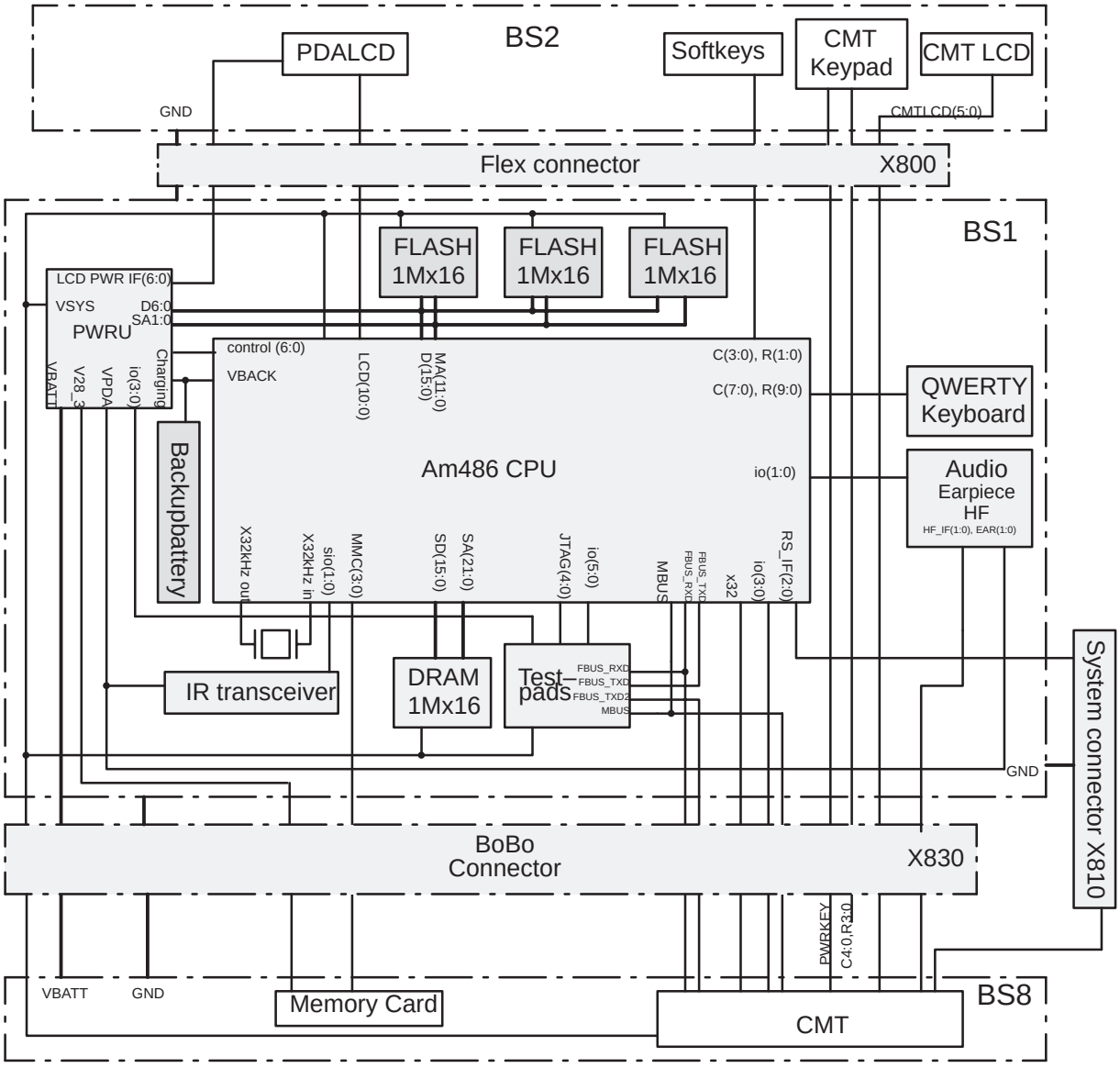


Figure 19. BS 1 PDA block in RAE–2 product

BS1 PDA Components

The following components of the BS1 have an dramatic effect to the functionality of the module, a fault in any of these may cause the module to appear totally ‘dead’:

– PDA power unit
– CPU
– PLL clock generation circuit
– UCS Flash chip

If the device has some functionality, then the following components, along with the ones above, can be tested:

– DRAM chip

– CS1 and CS0 Flash chips

– Handsfree speaker circuitry

– Earpice circuitry

– IR transceiver

– keyboard

– LCD module

– Memory Card interface

– Serial connections (FBUS and system bus)

BS1 Troubleshooting

The highest level of the RAE–2 PDA troubleshooting diagram is shown in the following figure. All the diagrams are made assuming that there is no visible faults, such as short–circuits or loose pins, on the PDA.

The module check begins with connecting the supply voltage to the PDA. If the current consumption differs a great deal from the normal limits, it is good to proceed to the Power–On check.

During BIOS detects some error during POST it tries to beep the buzzer for further fault analysis for the user. The POST beep codes, number of beeps are in the Appendix A on p.54.

If the current consumption is OK, it can be tried if the wintesla service software is able to get connection to the PDA. If the target PDA does not respond to the pings from the host, it is good to check the Power–On procedure.

When the PDA responds to the wintesla, further peripheral tests may be carried out. The execution order is not significant and it may be freely changed. Along with the actual tests, wintesla offers advanced methods for isolating the possible cause of the fault.

After all the functional tests are working, the device under test should be re–booted, and the normal usability of the GEOS, along with the CMT module should be checked before the PDA can be considered to be fully functional.

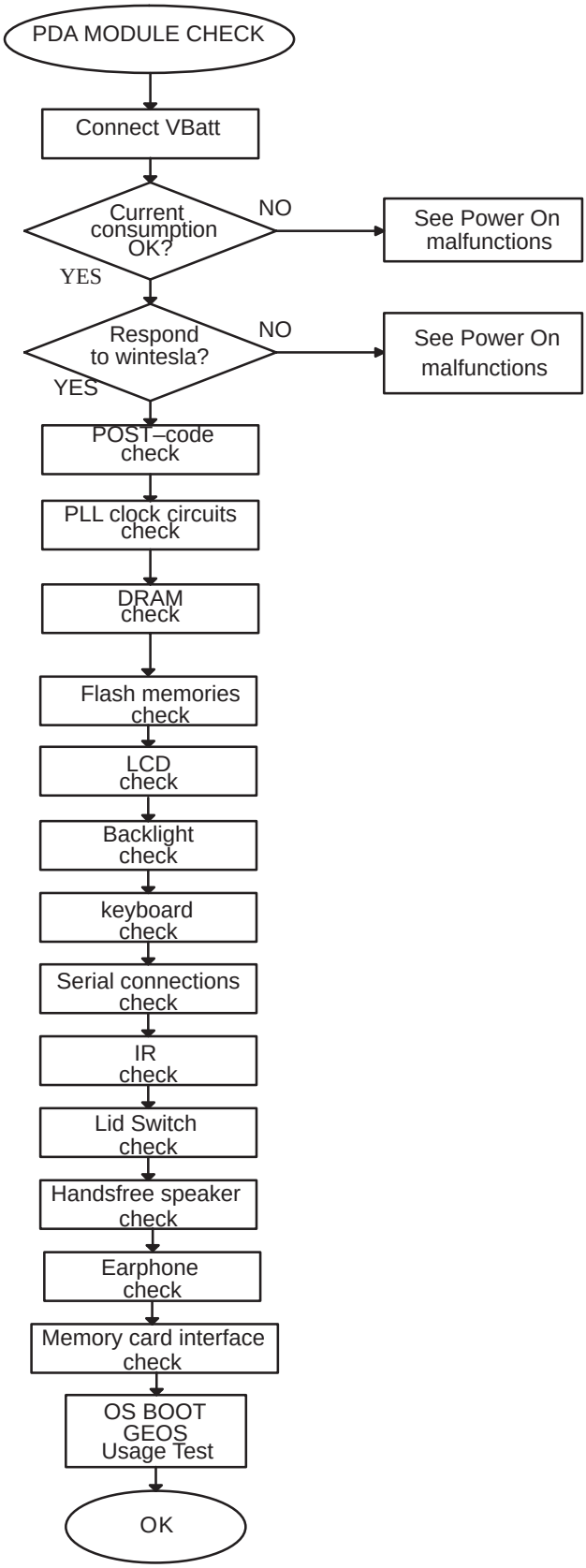


Figure 20. The highest level of the PDA troubleshooting diagrams

Power–on malfunction

The following picture illustrates the troubleshooting diagram for Power–On malfunctions.

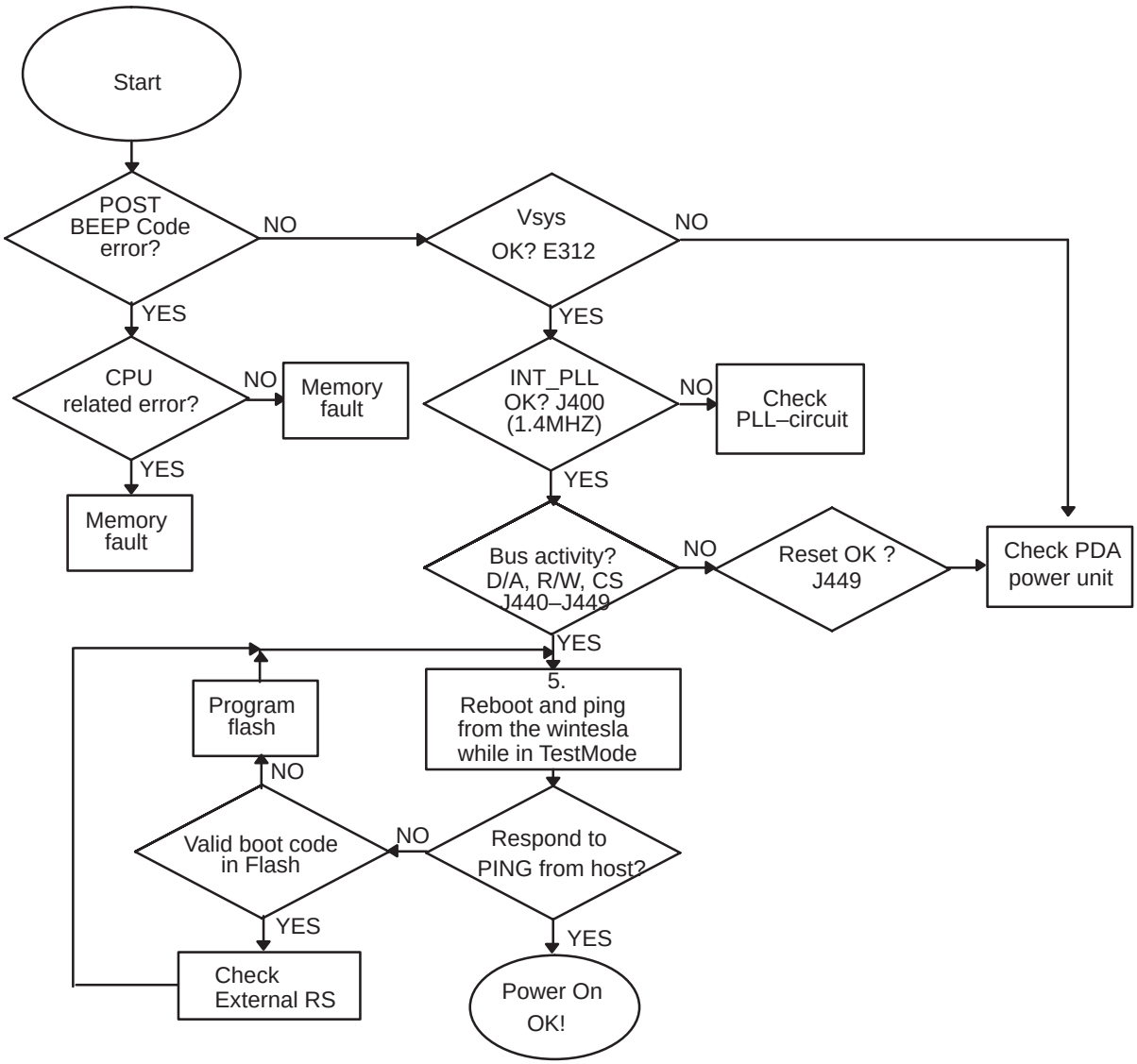


Figure 21. Troubleshooting of the power–on malfunction

Power Circuitry Check

The following figure illustrates how to check power circuits. The upper part of the flowchart must be passed before the swicthable voltages (lower part of the flowchart) can be considered to be alright.

The LCD temperature compensation affects the LCD bias voltage values. Because of this temperature compensation, the LCD bias voltages are different in different temperatures, but anyway bias voltage maximum and minimum values should differ 4 Volts from the typical value (DAC 63) in every temperature.

Figure on the next page.

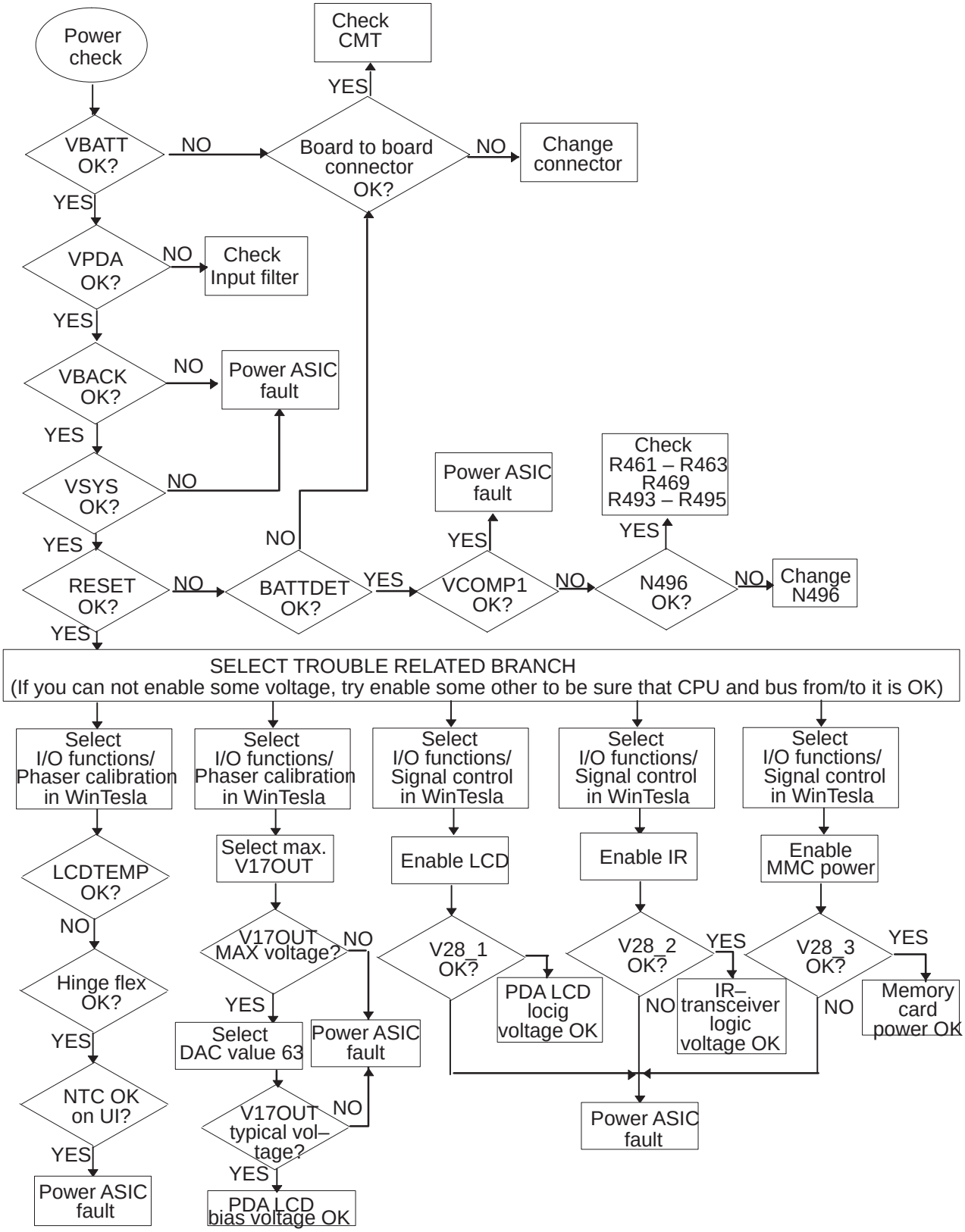


Figure 22. Power unit troubleshooting diagram

Troubleshooting Diagram of the PLL clock generation circuit

The following diagram illustrates how to check PLL clock generation circuits.

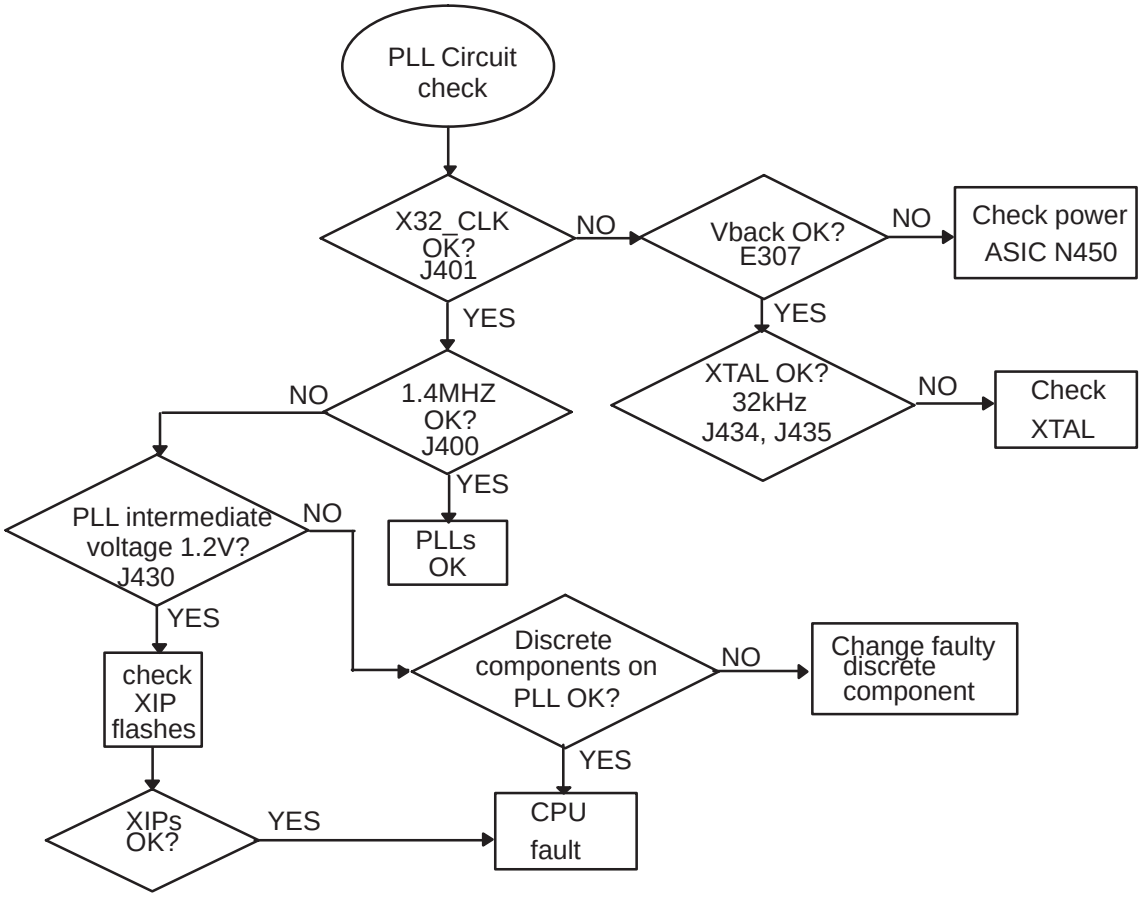


Figure 23. PLL clock generation circuit check

Troubleshooting Diagram of the DRAM

The following figure illustrates how to check DRAM. Open DRAM test in WInTesla and select RandomTest. If test passed DRAM should be alright.

If the test is not passed, run test again and measure the data and control lines activity.

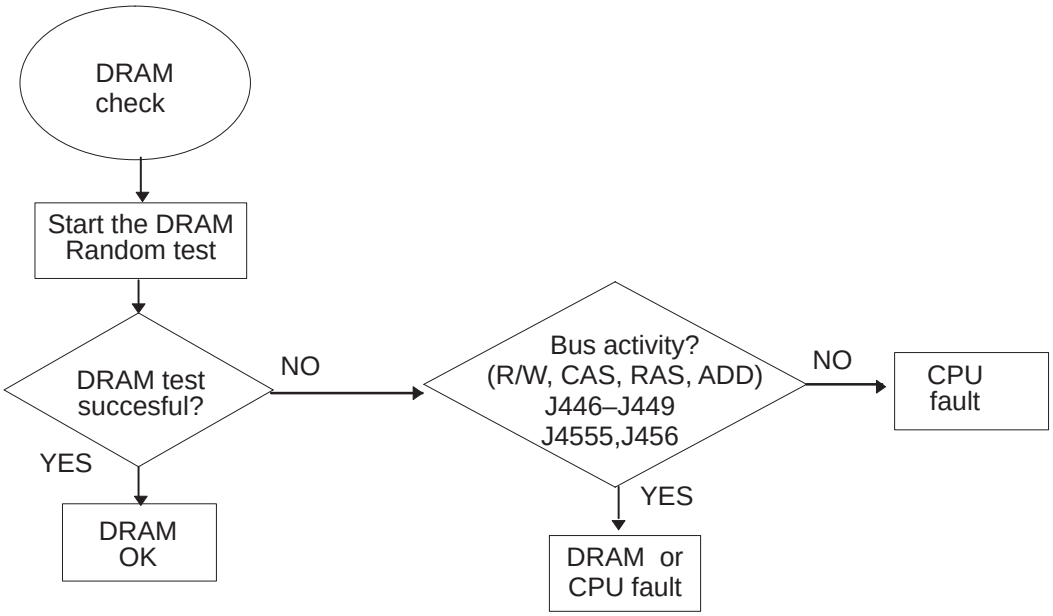


Figure 24. DRAM troubleshooting diagram

Troubleshooting Diagram of the Flash memories

The PDA comprises two kind of flash memories, two XIP (eXecute In Place) flashes and one RFD flash.

The XIP flash can be checked by comparing image checksum and calculated checksum.

If you can read and write from/to RFD flash, it is likely to be OK.

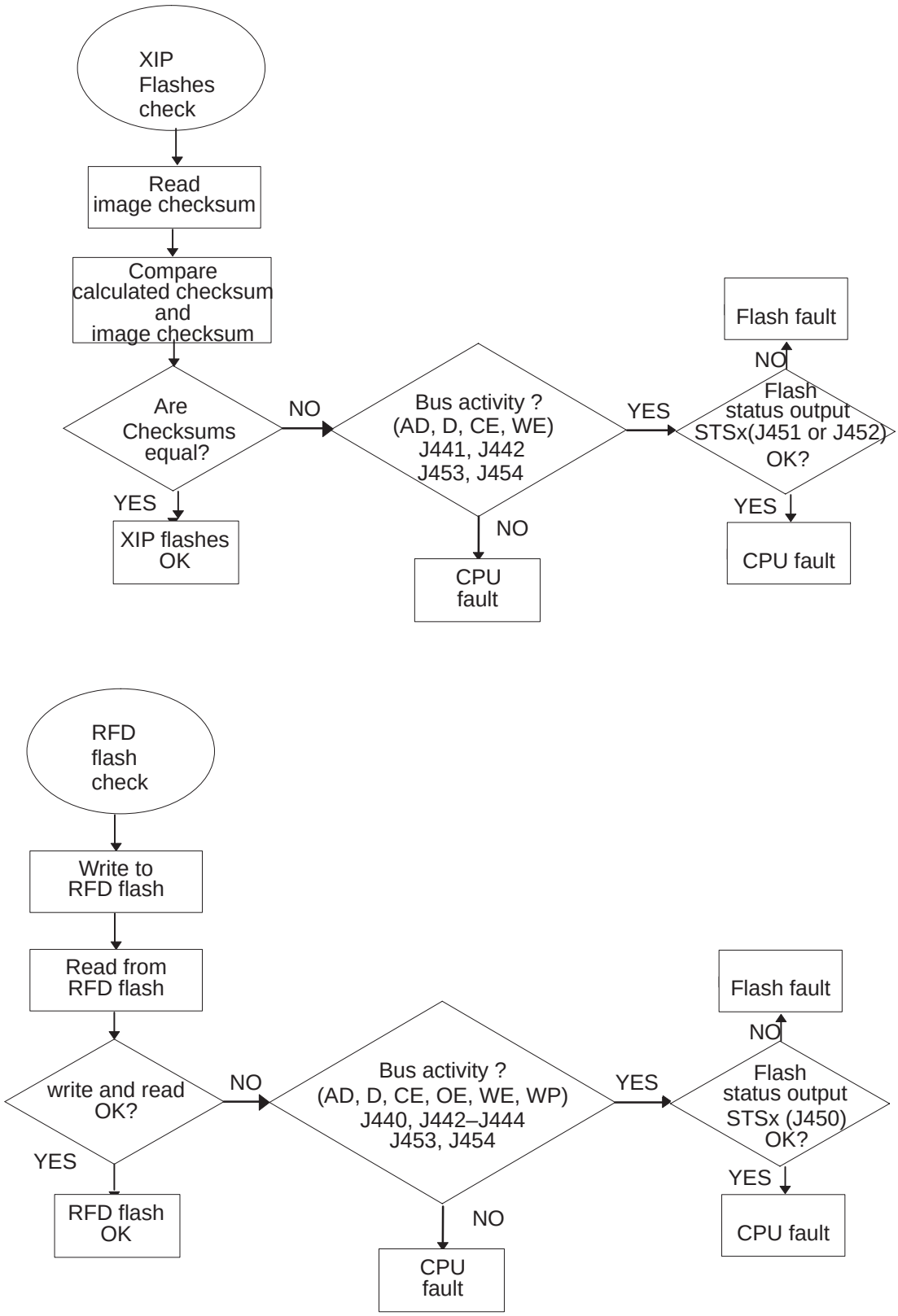


Figure 25. Flash memories troubleshooting diagrams

Troubleshooting Diagram of the LCD

The idea of the following diagram of the LCD Check is to make the difference whether the LCD BS2 module or the PDA BS1 is broken. The case where the fault is in the BS2 module is beyond the scope of this document. The fix in that case is likely the change of the whole module.

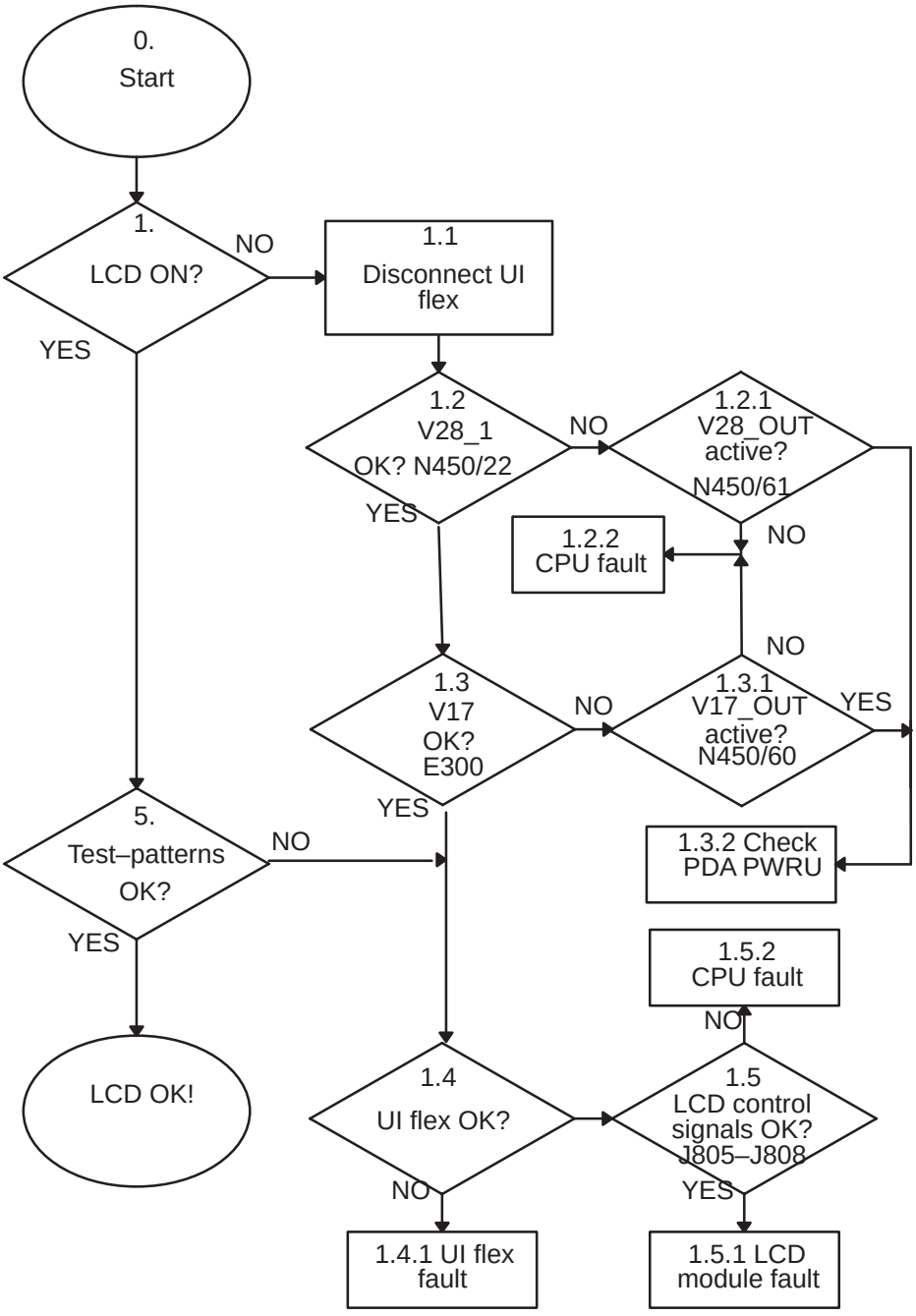


Figure 26. Troubleshooting of LCD signals

Troubleshooting Diagram of the PDA LCD Backlight

This troubleshooting diagram describe troubleshooting procedure on the PDA LCD backlight. If PDA is OK, look then backlight troubleshooting procedure from next chapter UI TROUBLESHOOTING.

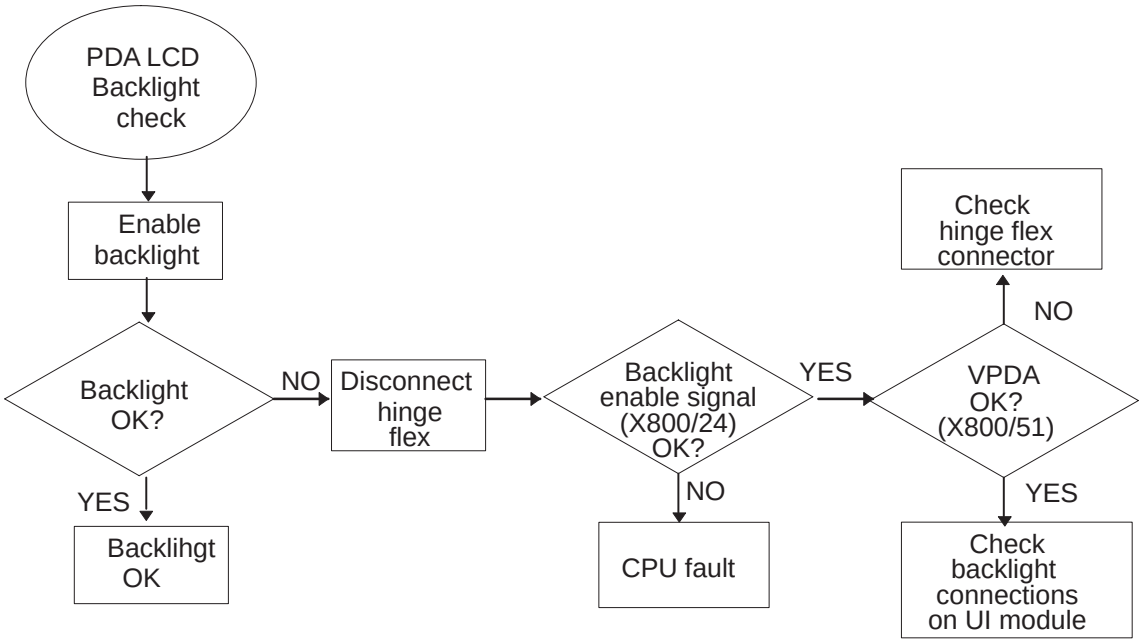


Figure 27. PDA LCD backlight troubleshooting

Troubleshooting Diagram of the PDA Keyboard

This section describe PDA keyboard troubleshooting procedure. Possible cause to keyboard faults are keyboard interface in CPU, broken keymat or keydomes (UI) . Also, dirty keymat or keypad area can cause the fault.

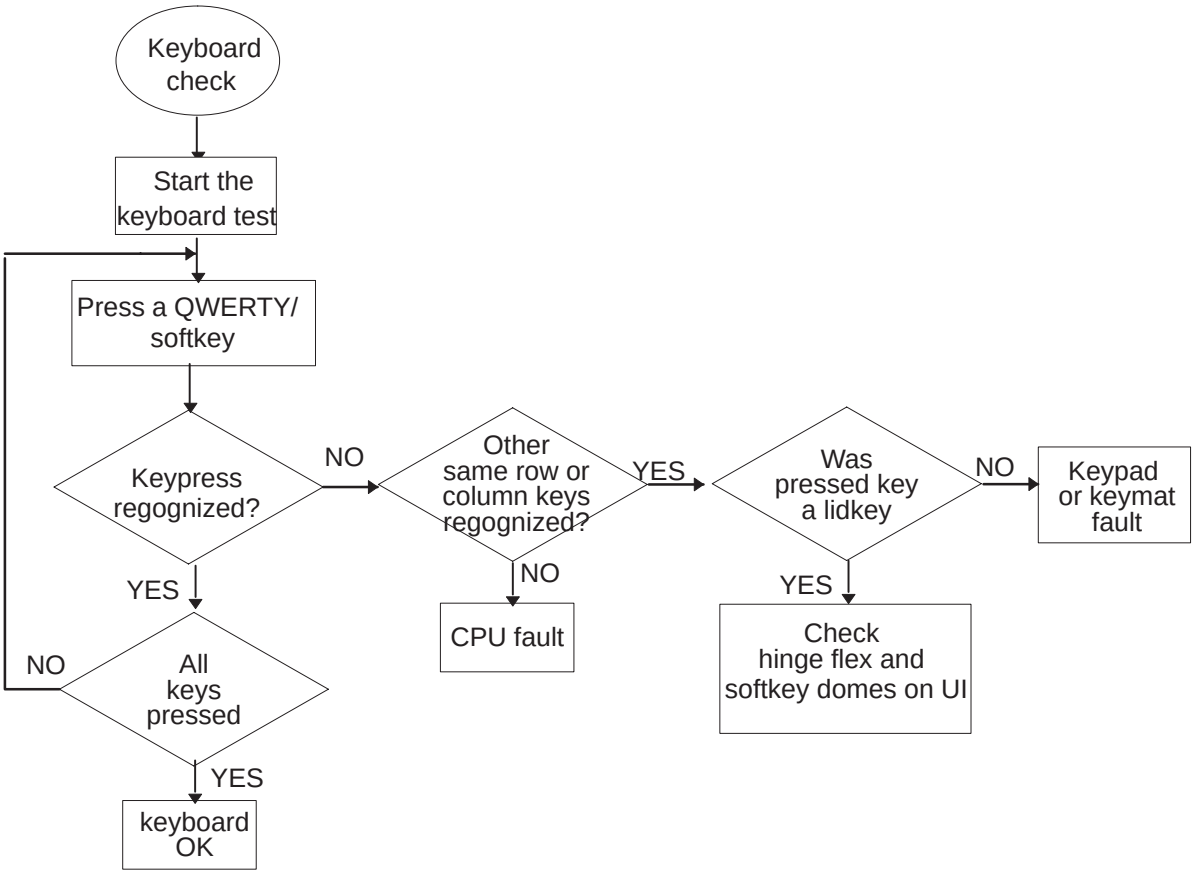


Figure 28. Keypad troubleshooting diagram

Troubleshooting Diagram of the serial connections

External bus connection is alright if the device is PINGing, if not is good to check system connector and discrete components on RX and TX lines. External bus use RS232 data protocol, but signal voltage levels on PDA and system connector are only 2.8V digital voltage levels. External buffer cable needed (DLR–2) for connecting to PC.

Serial connection between CMT and PDA (FBUS) can be checked as following flow chart described.

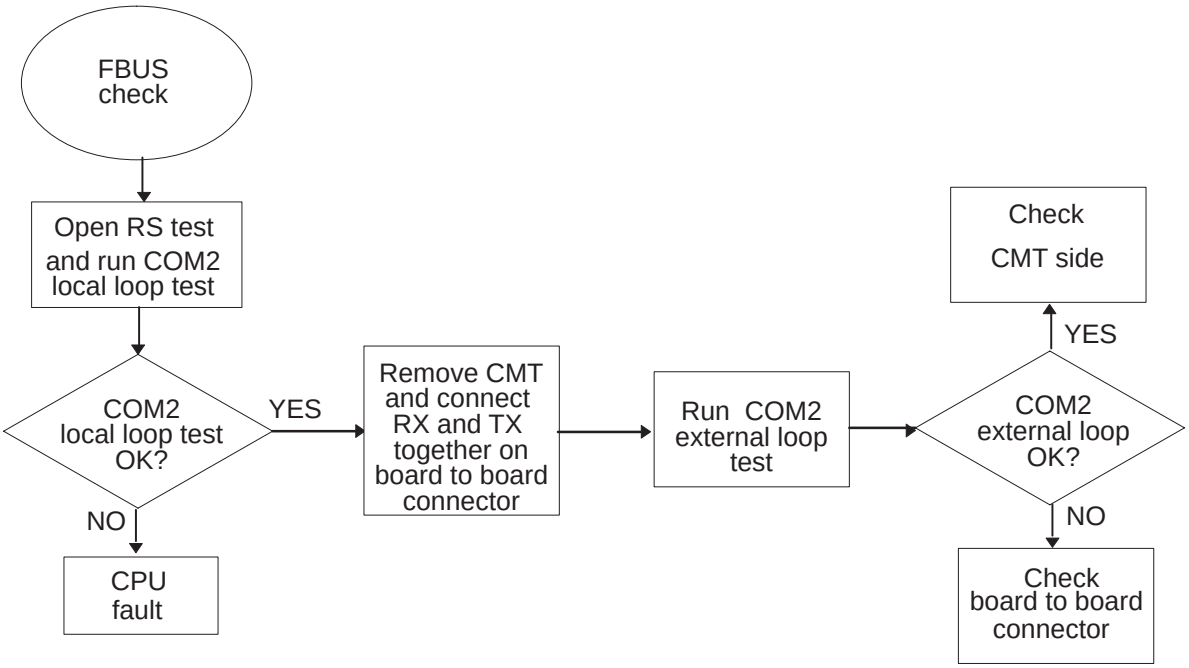


Figure 29. FBUS troubleshooting diagram

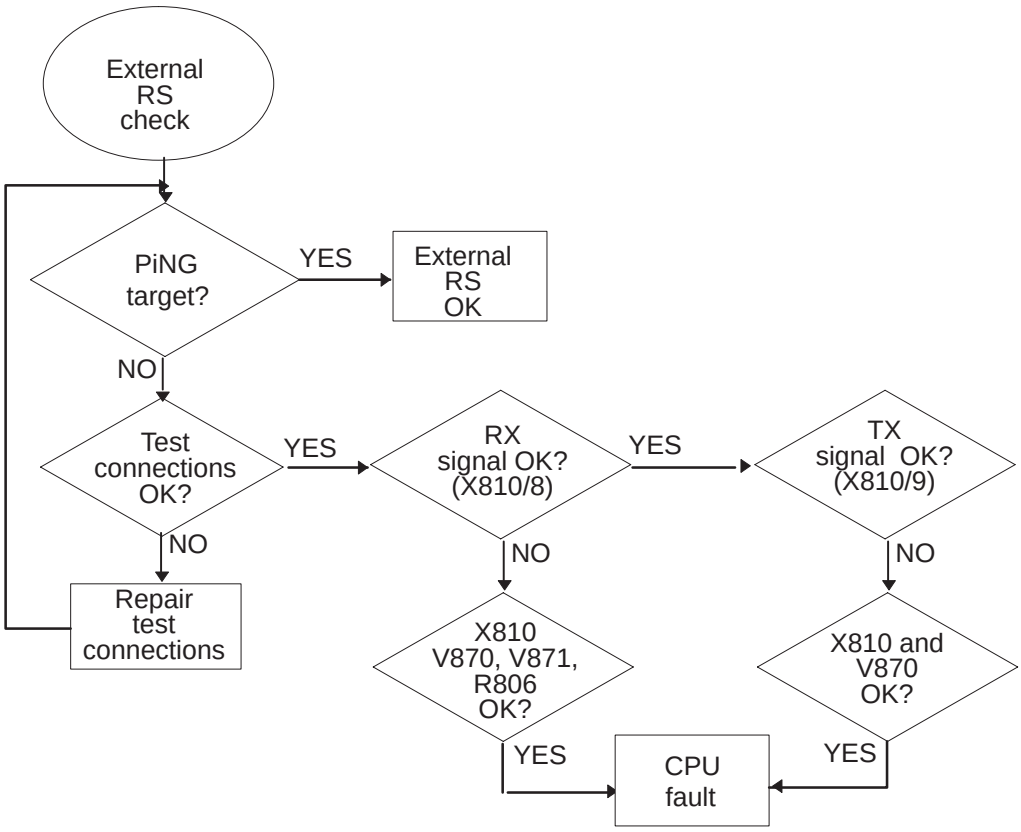


Figure 30. External serial connection troubleshooting diagram

Troubleshooting Diagram of the IR connection

This section describe infrared connection troubleshooting procedure.
IR test need Combox TDC–4 with IR transceiver JLP–1.
Place PDA so that IR transceiver have clear light route to JLP–1 and run the IR test. If test not passed follow flowchart to find out the fault.
IR shutdown is not in use.

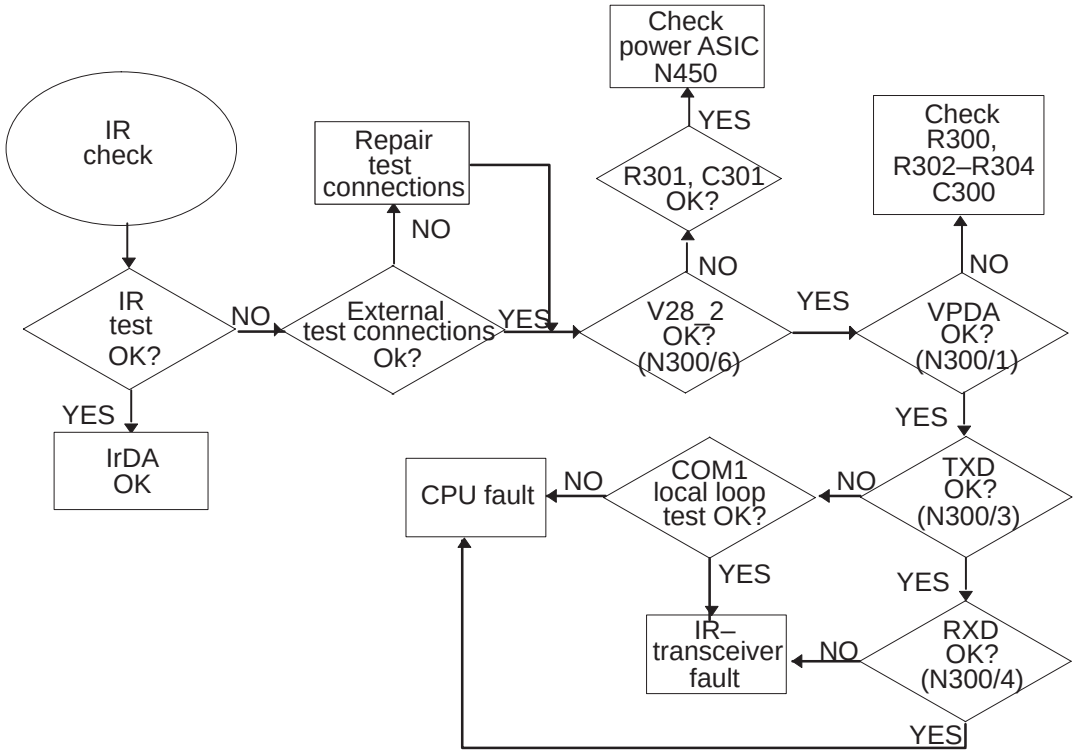


Figure 31. IR connections troubleshooting diagram

Troubleshooting Diagram of the lid switch

The idea of this diagram is to find out whether the CPU or the reed relay circuit is not working.

If CPU and reed relay circuit on PDA is alright, then possible cause of fault is magnet in lid.

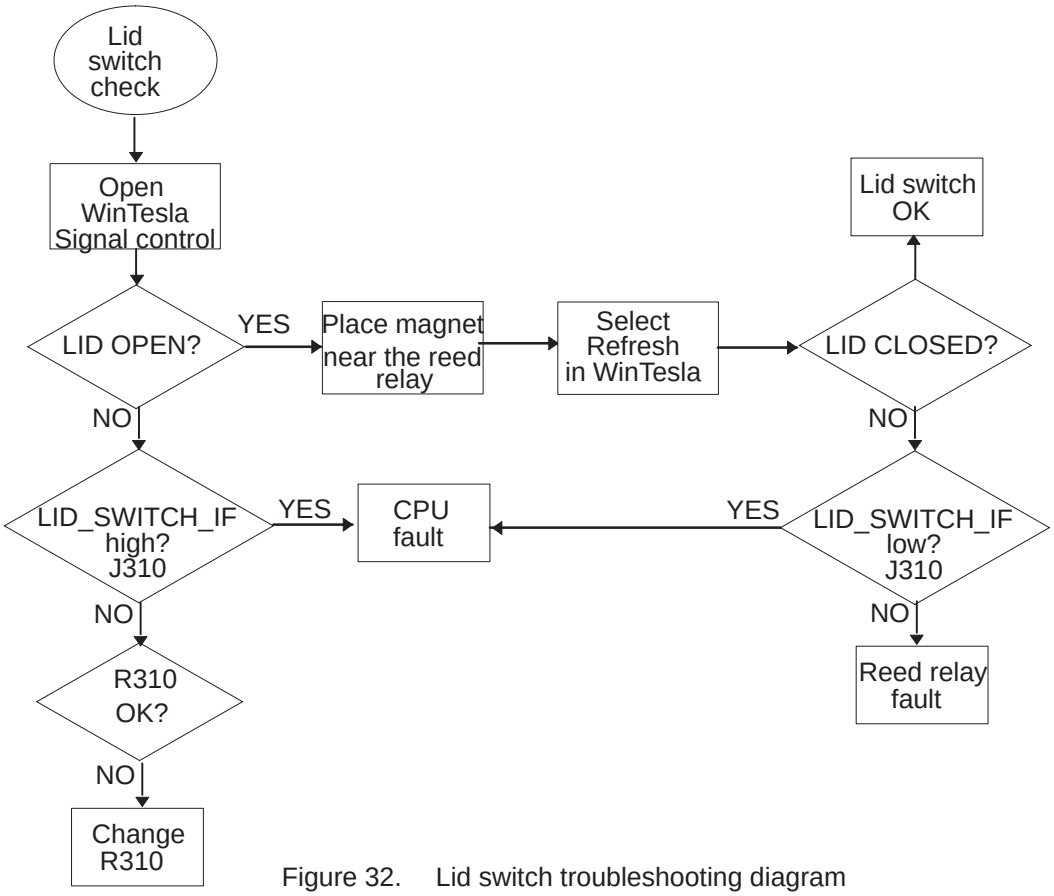


Figure 32. Lid switch troubleshooting diagram

Troubleshooting Diagram of the HF Speaker

The idea of this diagram is to find out whether the CPU, loudspeaker, or power amplifier or it circuitry is not working.

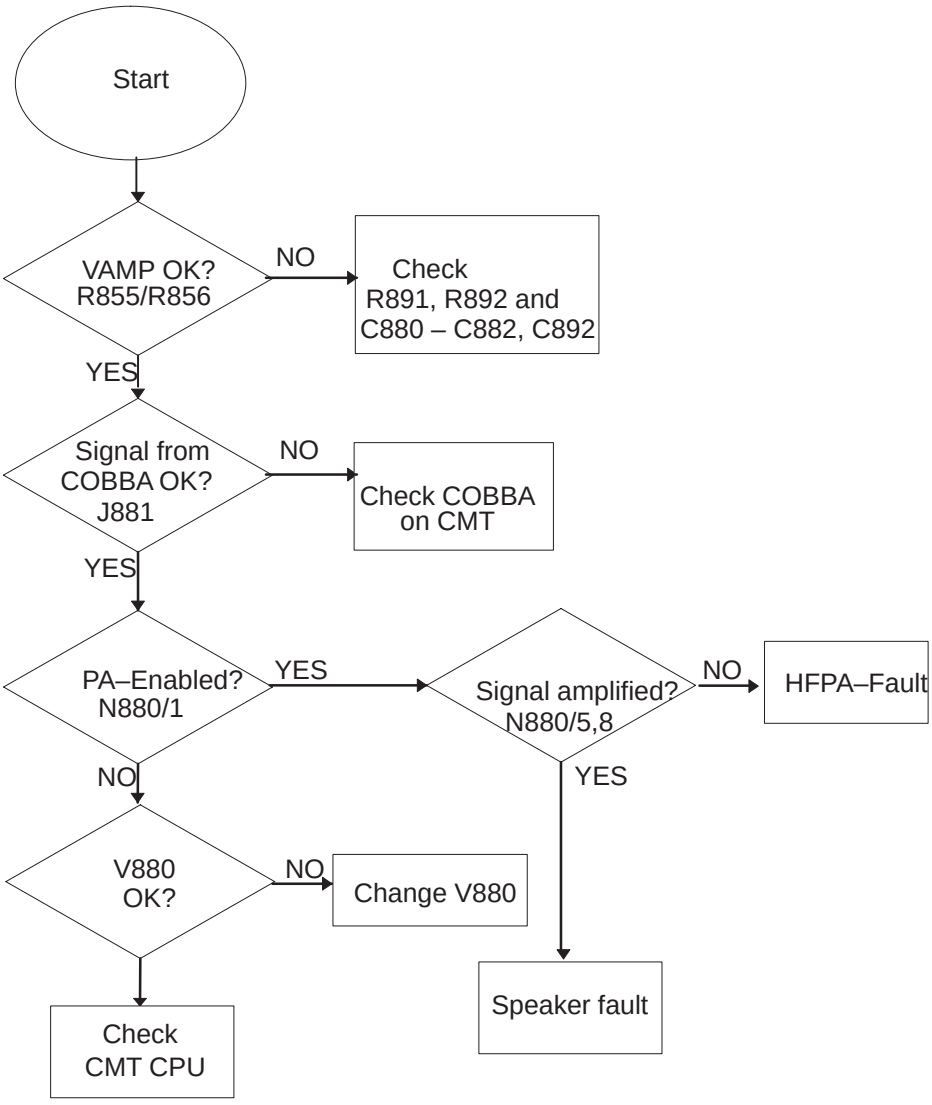


Figure 33. HF–Speaker troubleshooting diagram

Troubleshooting Diagram of the Earpiece

The following diagram illustrates how to check earpiece connections on the PDA side.

Run the wintesla buzzer test. If the sound is not good then check earpiece connections as following flowchart illustrates.

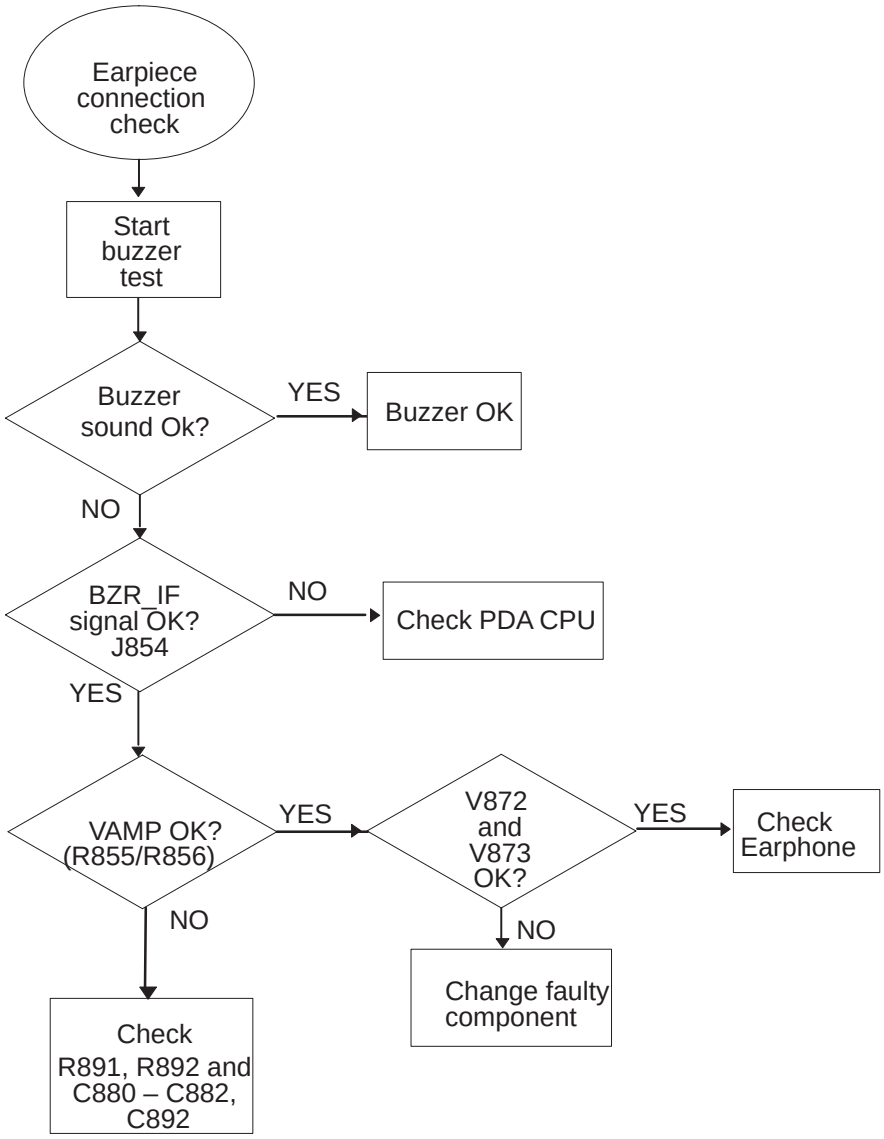


Figure 34. Earphone troubleshooting diagram

Troubleshooting Diagram of the Memory Card interface

To check the memory card interface:

- Take a good memory card and place it in the memory card connector.
- Run Wintesla MMC test. If test failed then take memory card out and run test again.
- Measure memory card system voltage and bus signals when test running.

If the signal and the card voltage are OK, then the interface is likely to be OK. If everything is not alright check interface connections as the flow-chart illustrate.

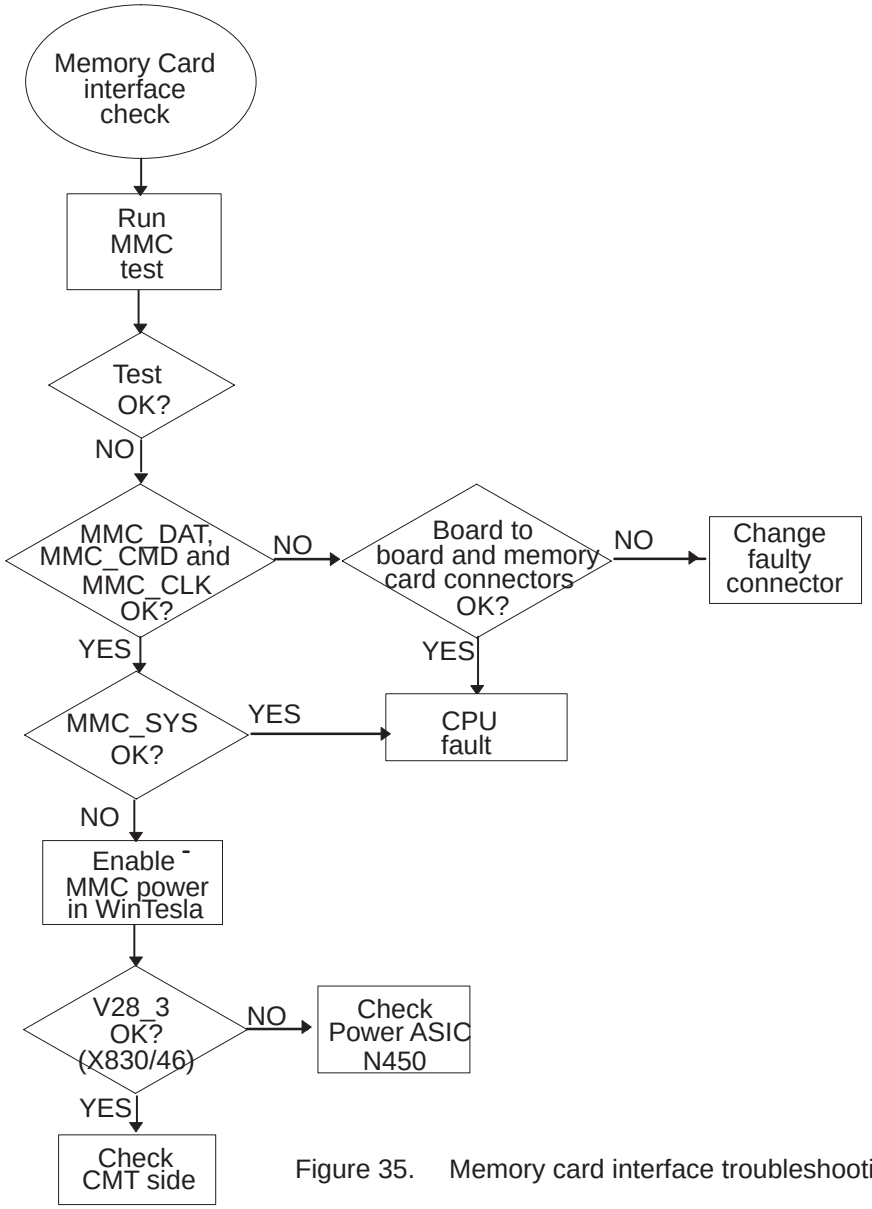


Figure 35. Memory card interface troubleshooting diagram

POST BEEP Codes

1	Memory refresh is not working.
3	Memory failure in 1st 64kB of memory.
4	Timer T1 not operational.
5	CPU test failed.
6	Gate A20 failure.
10	CMOS shutdown register failed.
13	Exhaustive low memory test failed.
14	Exhaustive extended memory test failed.
15	CMOS restart byte can’t hold data.
16	Address line test failed.
18	Interrupt controller failure.

UI Troubleshooting

Mechanical Troubleshooting

In mechanical failures it is better to replace a whole unit or module than try to fix it in service. The replaceable units or modules on BS2 UI module are:

– BC2 CMT LCD module
– PDA LCD display
– UI PCB
– EL backlight panels
– Keydome sheets

Keyboard Troubleshooting

– Equipment: Resistance meter (multimeter)
– If CMT keyboard does not function when the lid is closed, it is possible that reed relay (in the BS1 module) is damaged. If text ”Please close cover” comes to CMT LCD when a CMT key is pressed when lid is closed, the reed relay is probably damaged.
– Check that the dome sheets are properly placed. Improperly placed dome sheet may cause malfunction of some key(s) or power down of the CMT when a key is pressed.

Table 1. CMT keyboard checklist.

Non–functioning CMT keys	Check components
6, 9, #	R704, C707
1, 2, 3, Soft_left	R705, C706
4, 5, Send, Up	R705, C714
7, 8, End, Down	R705, C713
0, *, Mode, Soft_right	R706, C712
3, 6, Send, End, Mode	R706, C708
9, Soft_left, Soft_right, Up, Down	R707, C709
1, 4, 7, #, *	R707, C710
2, 5, 8, 0	R708, C711

CMT LCD Module Troubleshooting

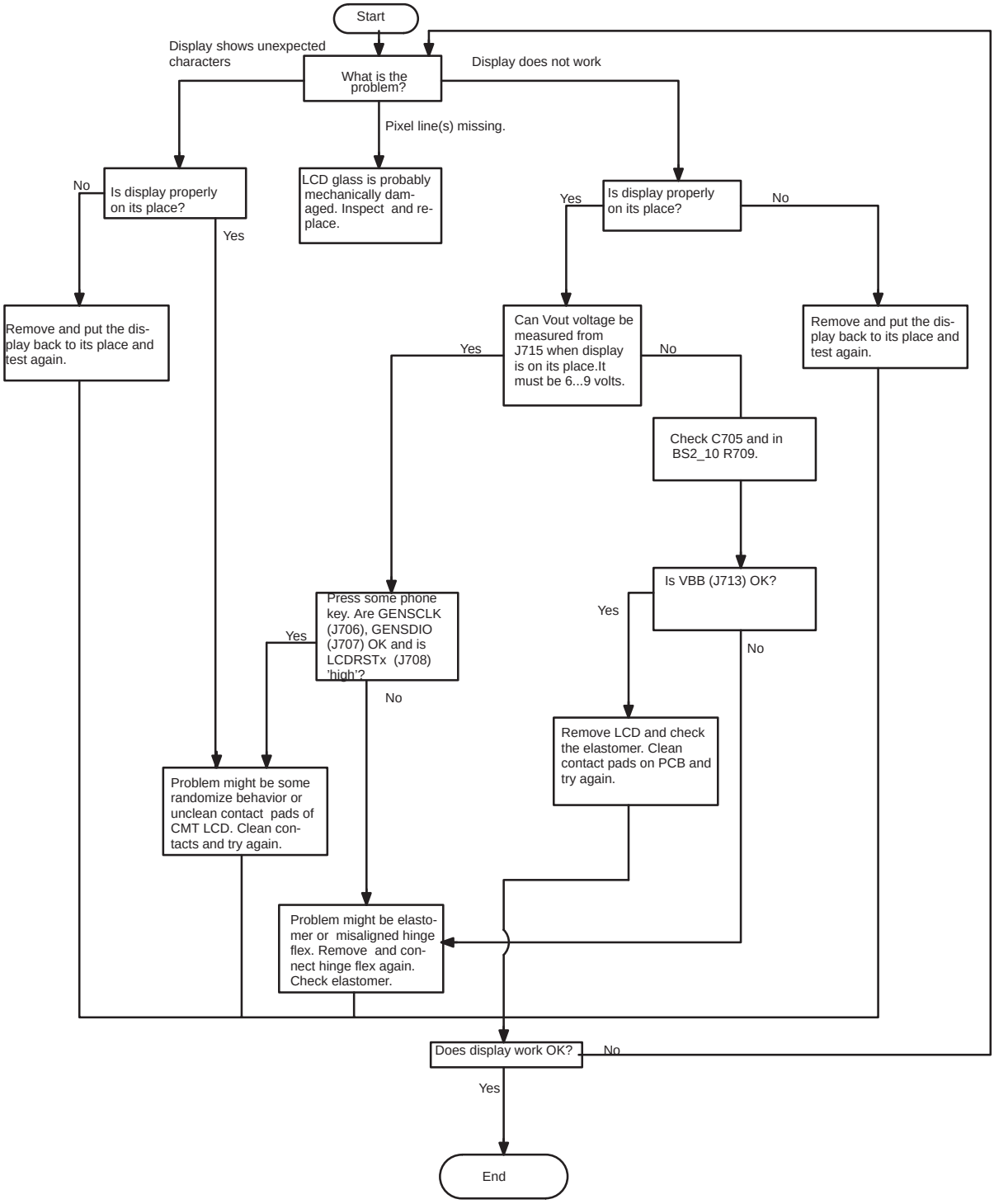


Figure 36. Flow chart for the troubleshooting of CMT LCD module.

– Testing equipment: Multimeter and oscilloscope.

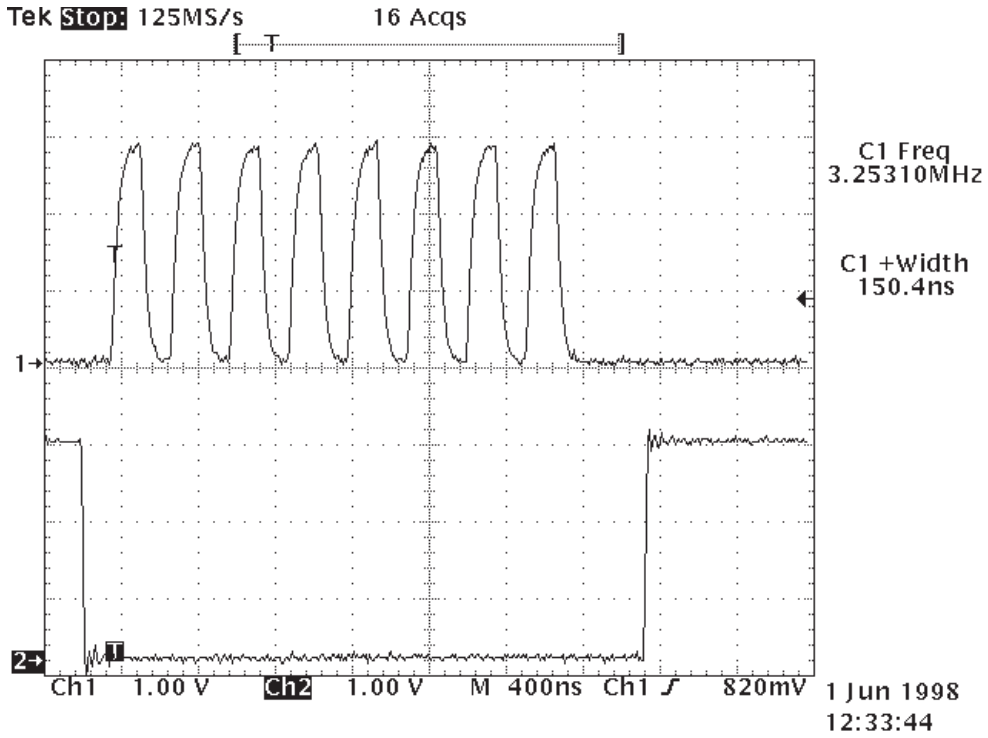


Figure 37. GENSCLK (J706) and LCDCSx (pin 5/H700) , LCD active after pressing a key.

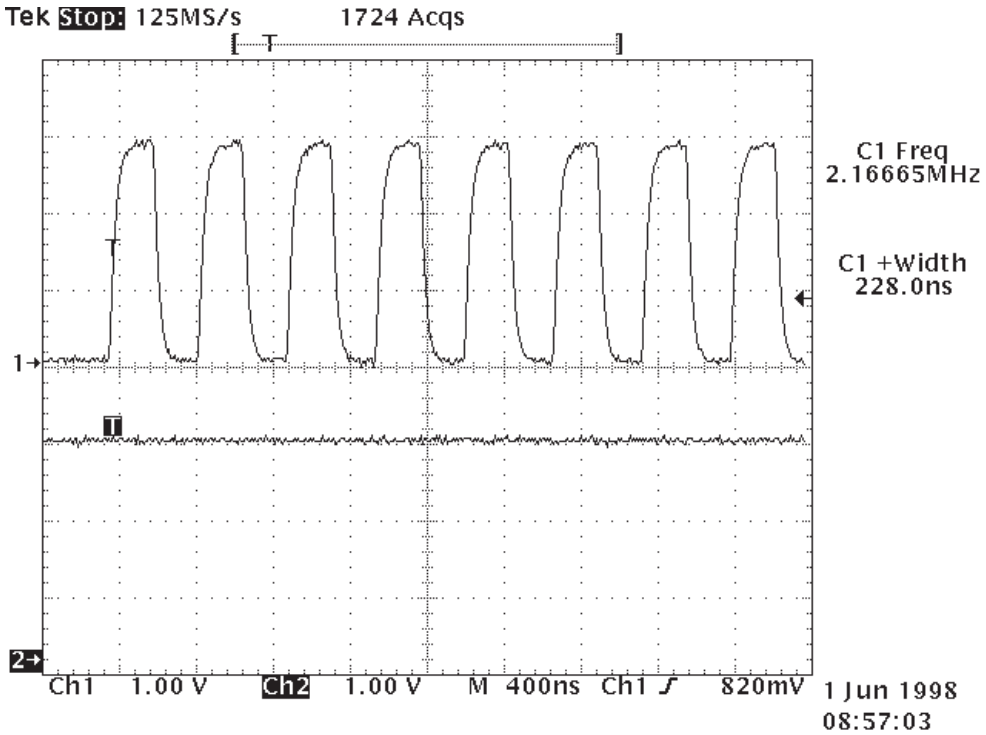


Figure 38. GENSCLK (J706) and LCDCSx (pin 5/H700), LCD inactive, serial bus used for communication between MAD and CCONT.

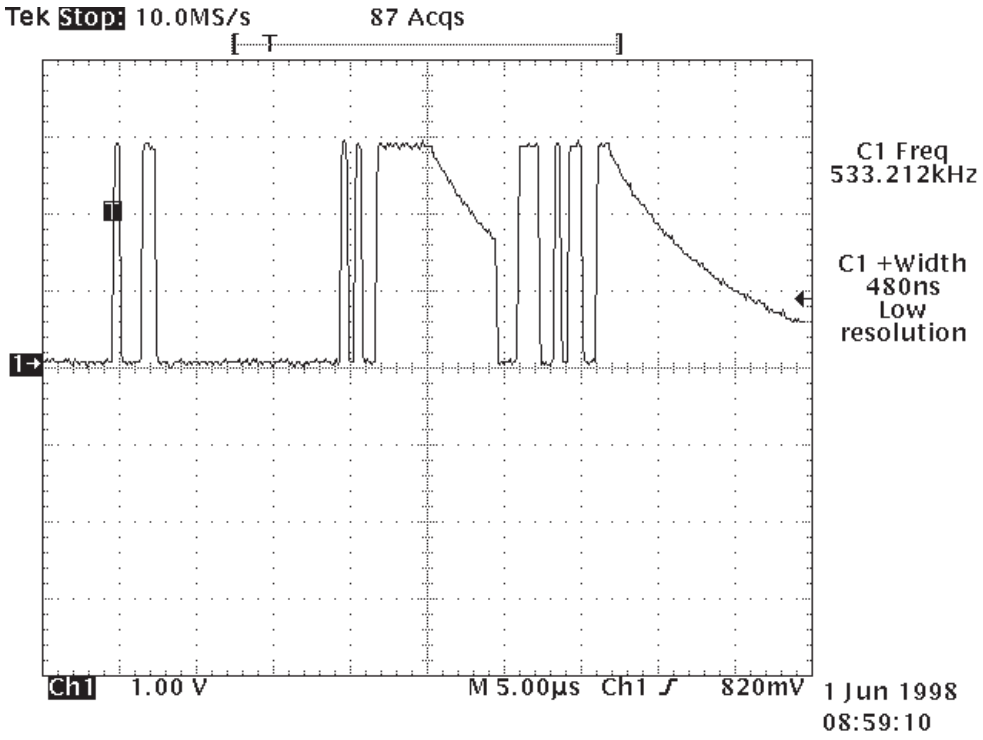


Figure 39. GENSDIO (J707)

PDA LCD Display Troubleshooting

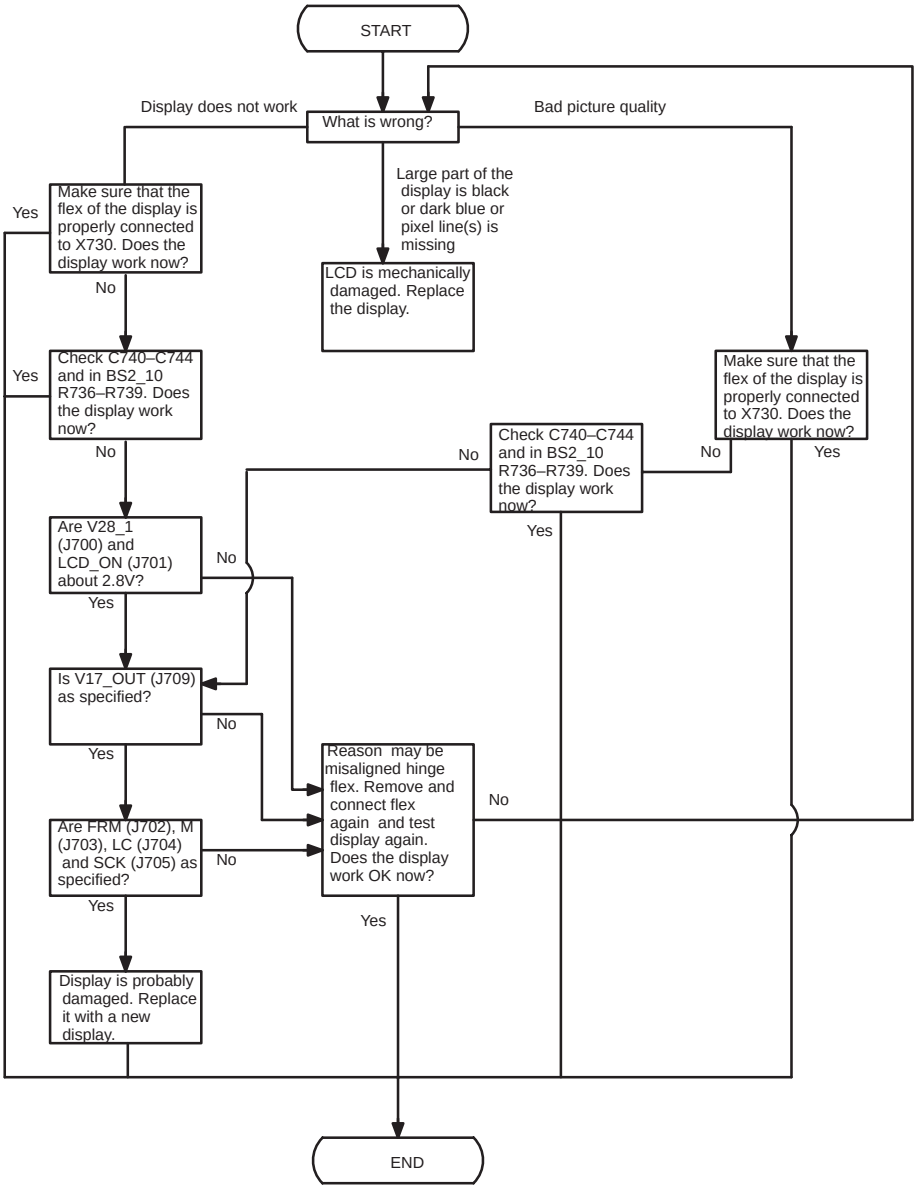


Figure 40. Flowchart for troubleshooting of the PDA LCD.

– Testing equipment: Multimeter and oscilloscope.

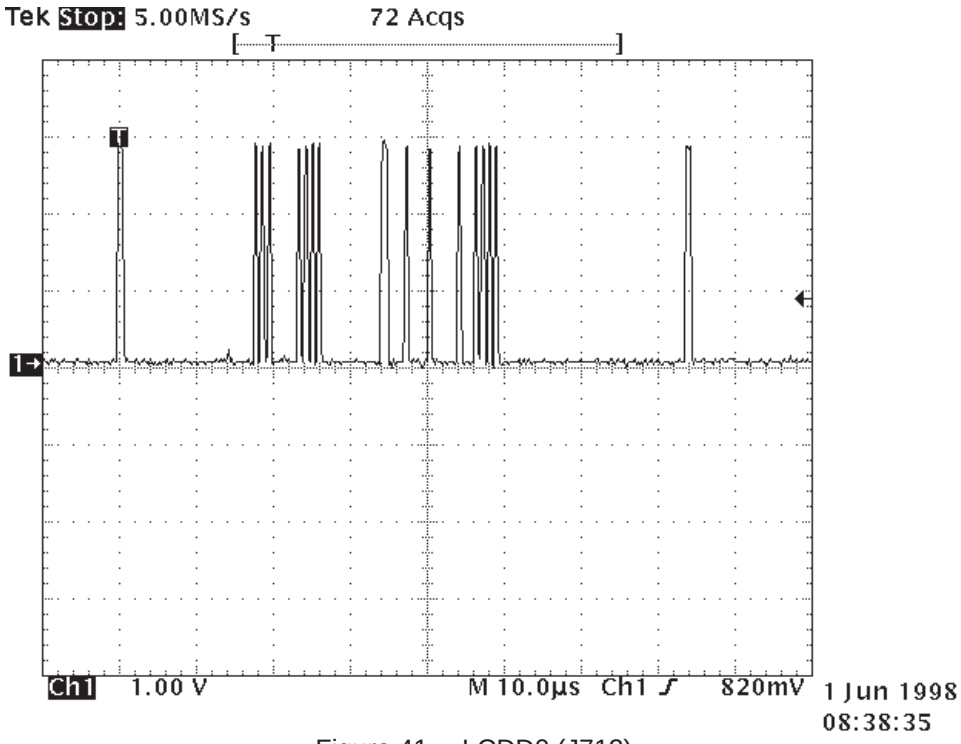


Figure 41. LCDD0 (J712)

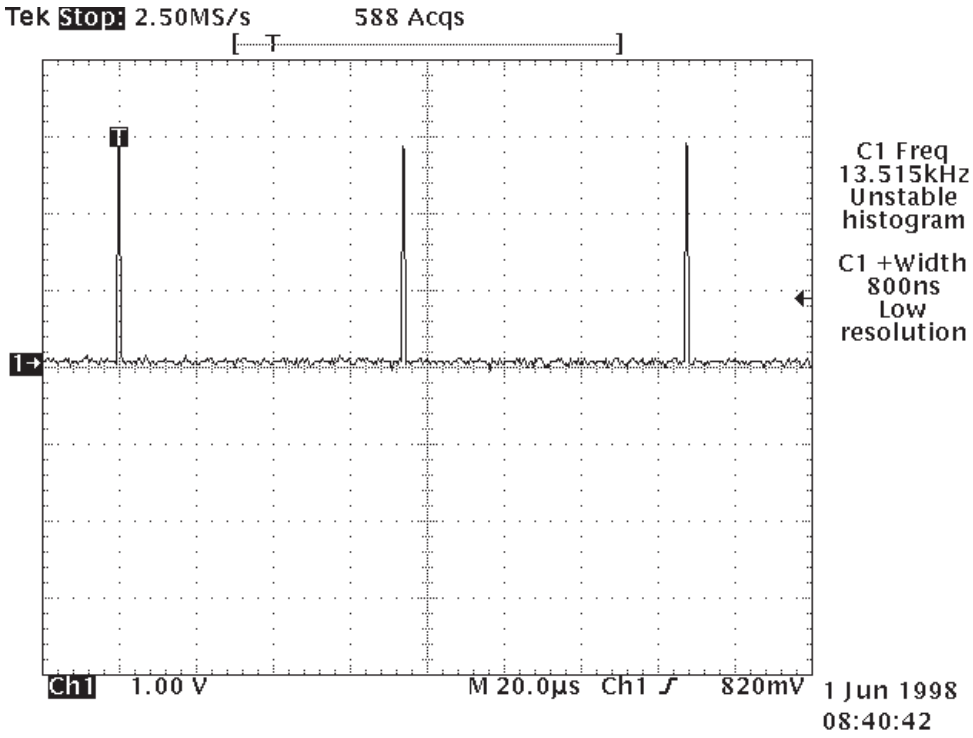


Figure 42. LC (J704)

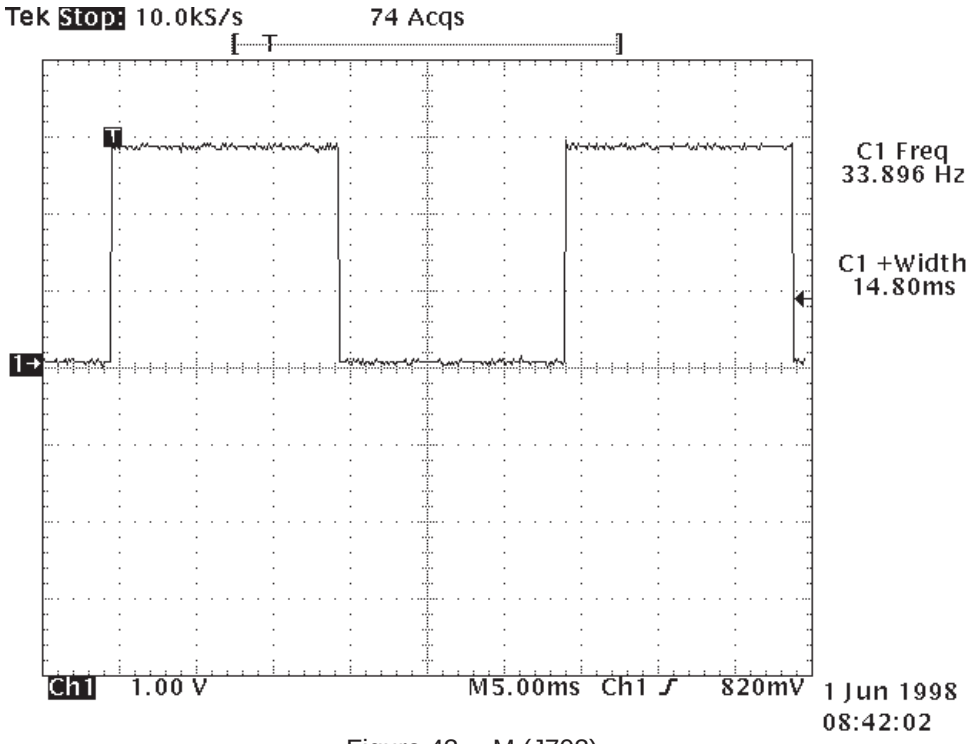


Figure 43. M (J703)

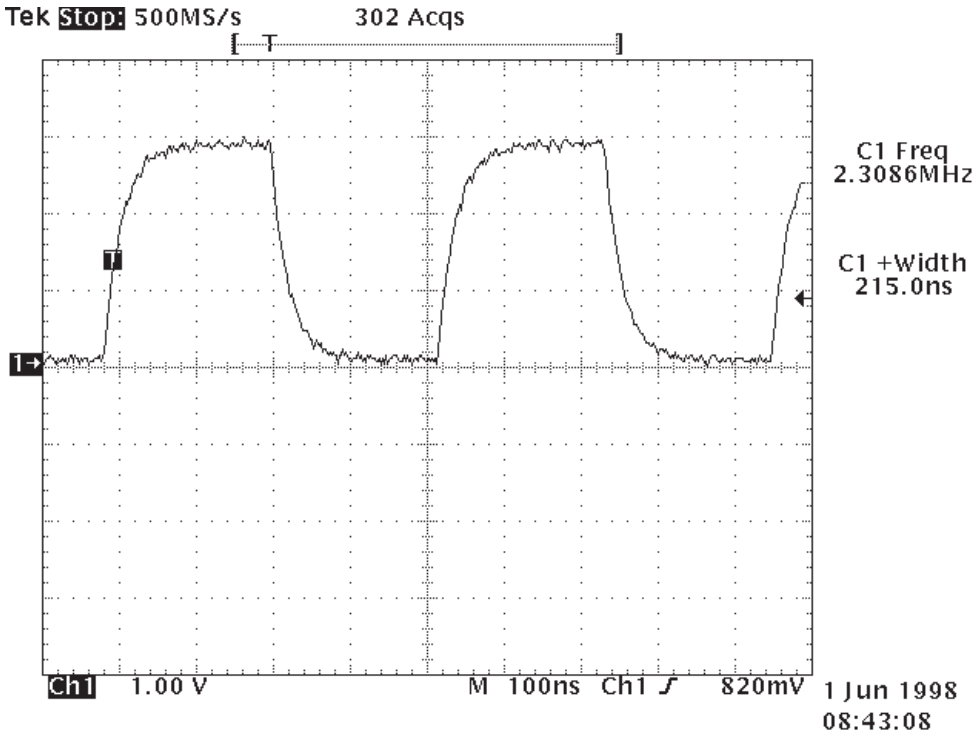


Figure 44. SCK (J705)

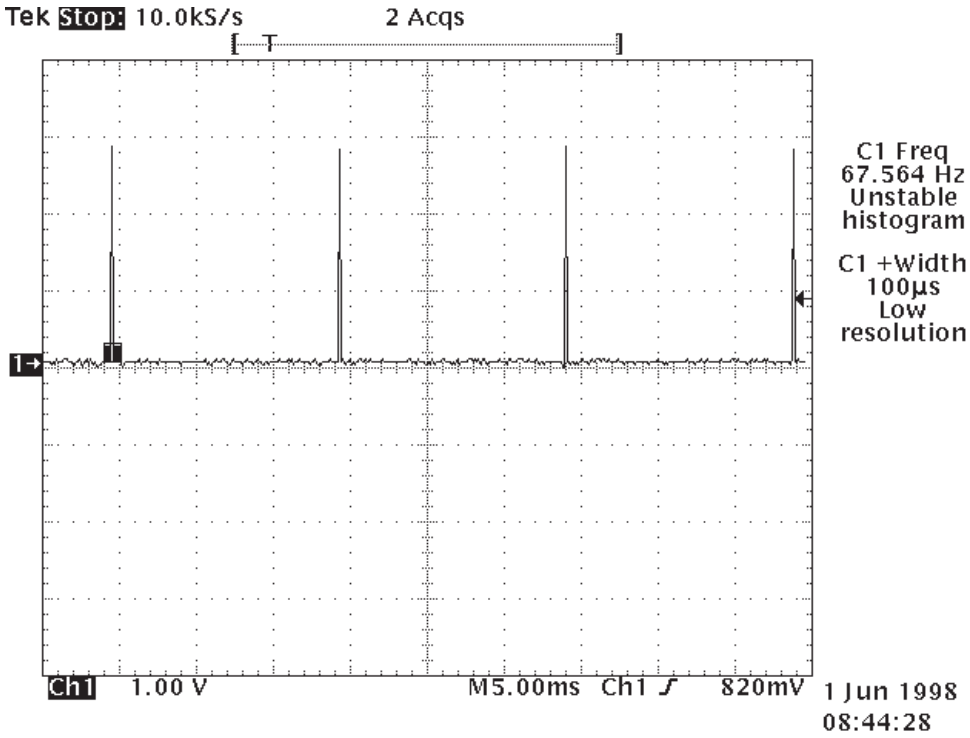


Figure 45. FRM (J702)

CMT Backlighting Circuit Troubleshooting

When troubleshooting the CMT backlighting circuit, remember that backlighting goes off after a certain period from the last key pressing.

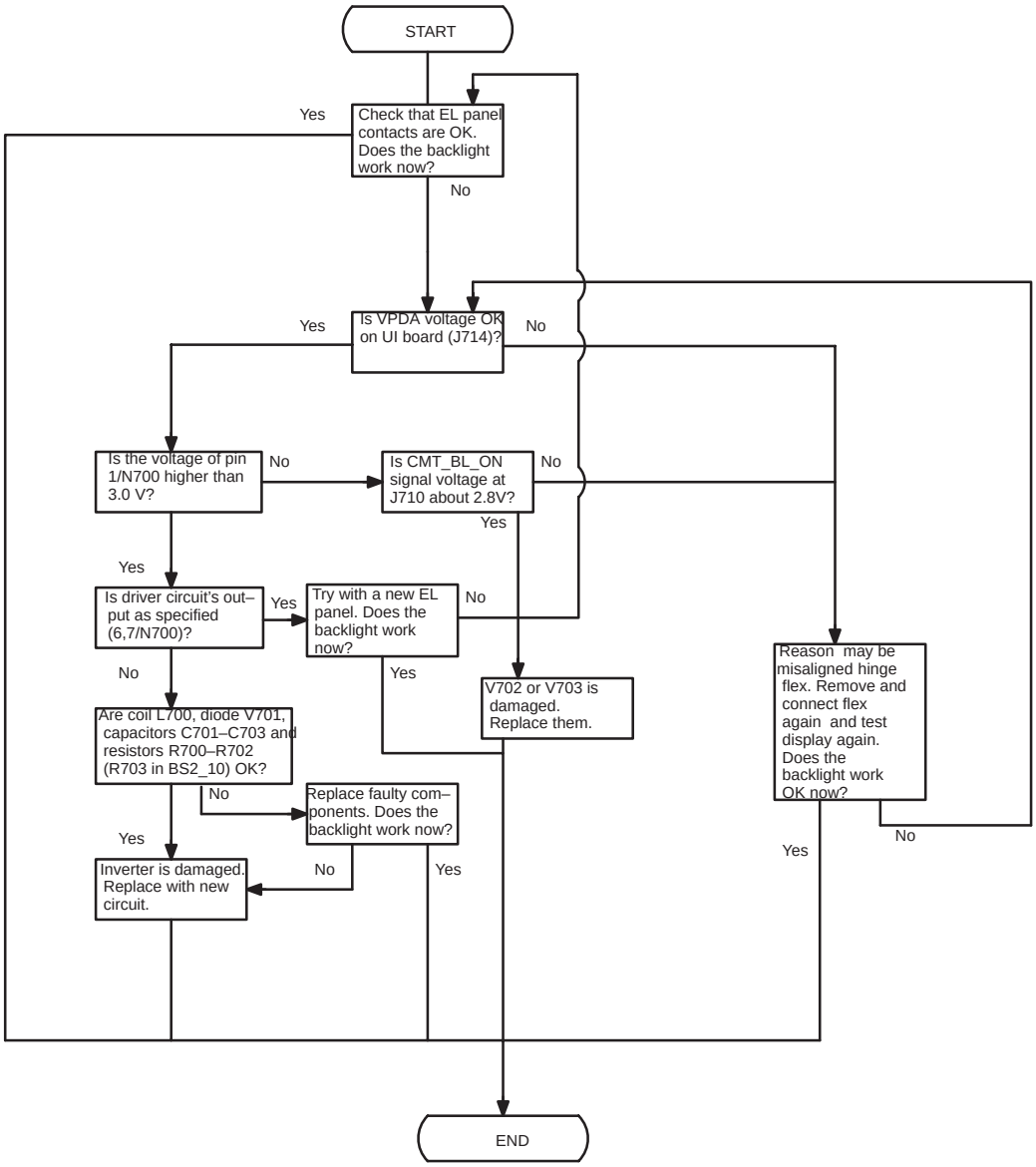


Figure 46. Flowchart for troubleshooting of the CMT backlighting circuit.

PDA LCD Backlighting Circuit Troubleshooting

For PDA backlighting troubleshooting you can use test mode and WinTesla SW to set the backlighting on all the time.

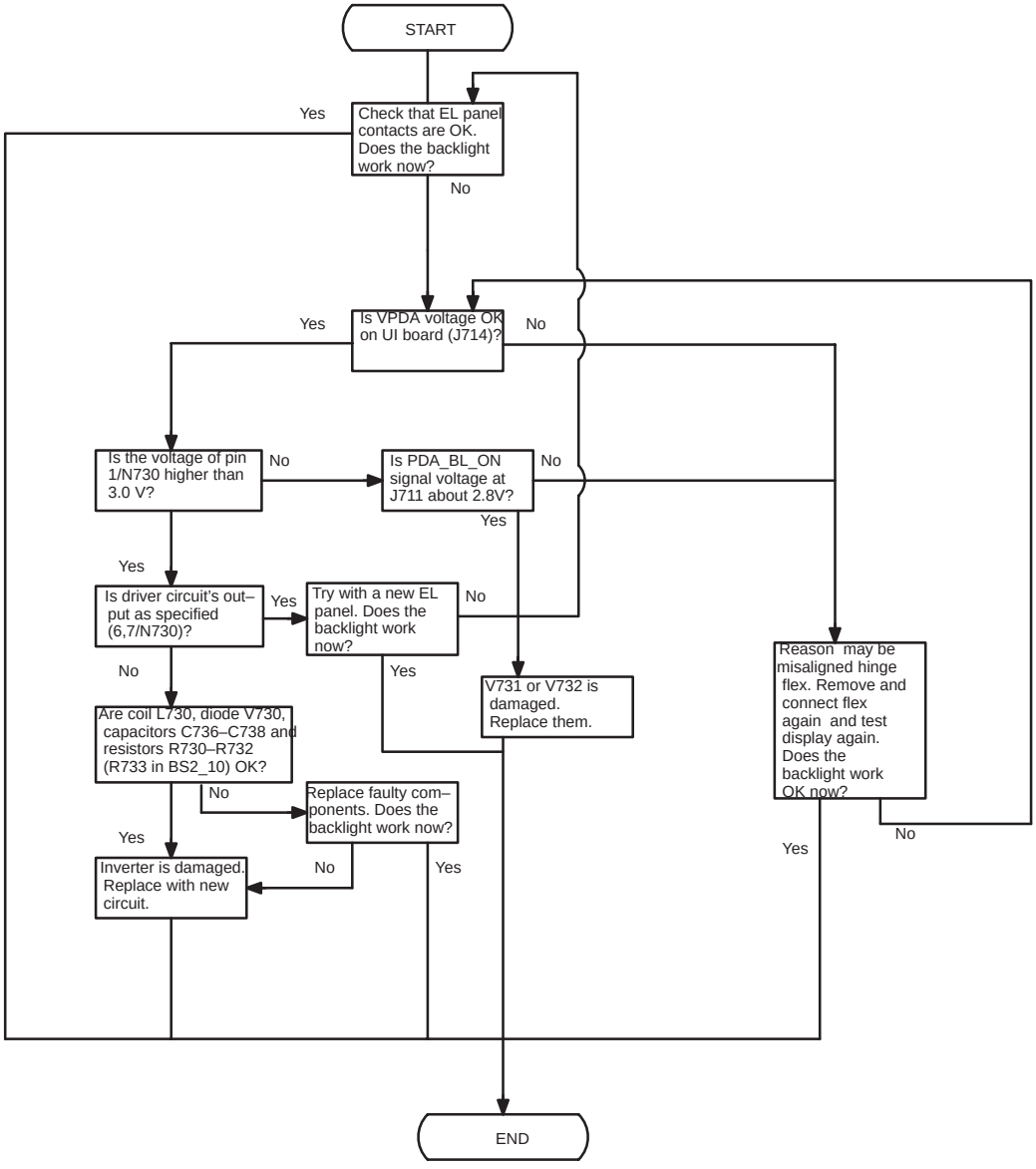


Figure 47. Flowchart for troubleshooting of the PDA backlighting circuit.

– Testing equipment: Multimeter and oscilloscope. Note that voltage rating of the oscilloscope and probe must be over 250 V peak–to–peak.

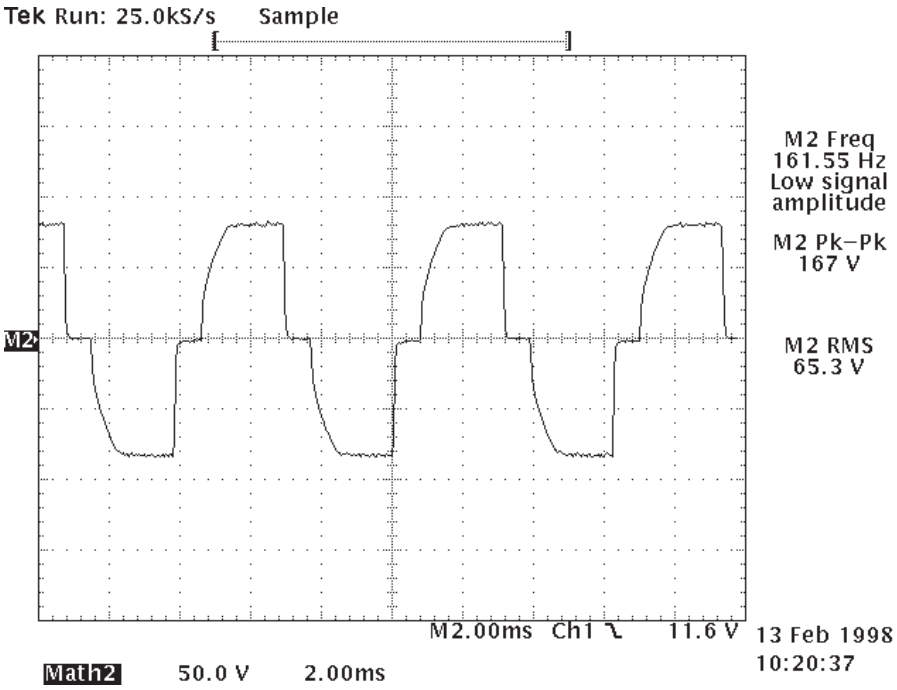


Figure 48. Example of a typical EL driver output waveform, measured between pins 6 and 7 of the driver.