GB310 Service Manual

(GSM Cellular Phone)

Pantech Co., Ltd., Korea

June 7, 2004
1st Edition

For Use by Authorized Service/Maintenance Personal Only

Documents to Receive This Addendum:

GB310 Maintenance/Repair/Operating Manual

CONTENTS

SECTION 1 INTRODUCTION 3

1.1 INTRODUCTION 3
1.2 FREQUENCY ALLOCATION AND ITS USE 3
1.3 ITEM NAME AND USE 4
1.4 CHARACTERISTICS 4

SECTION 2 ELECTRICAL SPECIFICATIONS....5

2.1 GENERAL 5
2.2 TRANSMITTER....5
2.3 RECEIVER....5

SECTION 3 OPERATION....6

3.1 NAME OF EACH PART....6
3.2.DISPLAY 7
3.3 KEYPAD 7

SECTION 4 THEORY OF OPERATION....8

4.1 LOGIC SECTION....8
4.1.1 DC DISTRIBUTION AND REGULATION PART....8
4.1.2 LOGIC PART....8
4.1.2.1 SUMMARY....8
4.1.2.2 BASEBAND DIGITAL SIGNAL PROCESSING....8
4.1.3 MEMORY PART....10
4.1.4 NOTIFICATION PART 11
4.1.5 KEY PAD PART 11
4.1.6 LCD MODULE(DISPLAY PART) 11
4.2 RADIO TRANSCEIVER SECTION....12
4.2.1 DC DISTRIBUTION AND REGULATION PART....13
4.2.2 TRANSCEIVER PIN DESCRIPTION....14
4.2.3 RECEIVE SECTION....17
4.2.3.1 AN OVERVIEW OF RECEIVE SECTION 17
4.2.3.2 RECEIVER PART....18
4.2.4 TRANSMIT SECTION 19
4.2.4.1 AN OVERVIEW OF TRANSMIT SECTION 19
4.2.4.2 TRANSMITTER PART....20
4.2.5 OFFSET PLL....21
4.2.5.1 AN OVERVIEW OF OFFSET PLL....21
4.2.5.2 VCTCXO(VOLTAGE CONTROLLED TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR):V801....22

SECTION 5 ALIGNMENT PROCEDURE....23

5.1 RECOMMENDED TEST EQUIPMENT 23
5.2 CONNECTION OF TEST EQUIPMENT 23

SECTION 6 EQUIPMENT REPAIR PROCEDURE....24

6.1 NO POWER ON WITH BATTERY APPLIED 24
6.1.1 POWER CHECK....24
6.1.2 OSCILLATION CHECK 30
6.1.3 KEYPAD LED NOT IN OPERATION(3-COLOR AND BLUE)....31
6.1.4 LCD EL BACKLIGHT LED NOT IN OPERATION(WHITE)....33
6.2 AUDIO PART(EARPIECE, HANDS FREE EARPHONE, MICROPHONE, HANDS FREE MIC)....35
6.2.1 NO RECEIVING TONE HEARD (EARPIECE) 35
6.2.2 NO RECEIVING TONE HEARD (HANDS FREE EARPHONE)....35
6.2.3 SIDETONE NOT TRANSMITTED (EARPIECE)....38
6.2.4 SIDETONE NOT TRANSMITTED (HANDS FREE MIC)....38
6.2.5 HOOK SWITCH NOT WORKING 39
6.2.6 MELODY NOT RINGING 40

6.2.7 VIBRATOR NOT WORKING …………………………………………………………………..…41
6.3 SIM CARD PART ……………………………………...……………………………………………….42
6.3.1 SIM ERROR ……………………………………………………………………………………………42
6.4 CHARGER PART…………………………………………………………………………………..43
6.4.1 CHARGING ERROR ……………………………..……………………………………………………43
6.5 RF PART……………..………………………………………………………………………………… 45
6.5.1 TEST CONDITIONS……………………………………………………………… …………………45
6.5.2 POWER SUPPLY CHECK POINT……………………………………………………………………46
6.5.3 POWER AMPLIFIER MODULE ………………………………………………………………………...48
6.5.4 VCTCXO...…………...…………………………………………………………………………………..50
6.5.5 ANTENNA SWITCH MODULE……………………………………………………….…………………..51

SECTION 1. Introduction

1.1 An Introduction of GSM Digital Cellular Mobile Communication System

GSM (Global System for Mobile communication) concluded that digital technology working in the Time Division Multiple Access (TDMA) mode would provide the optimum solution for the future system. Specifically , a TDMA system has the following advantage

- Offers a possibility of channel splitting and advanced speech coding ,resulting in improved spectrum efficiency.
- Offers much greater variety of service than the analog
- Allows considerable improvements to be made with regards to the protection of information.

The GSM system is basically designed as a combination of three major subsystem;
The network subsystem, the radio subsystem, and the operation support system.
The functional architecture of a GSM system can be divided into the Mobile Station (MS), the Base Station (BS), and the Network Subsystem (NS). The MS is carried by the subscriber, the BS subsystem controls the radio link with the MS and the NS performs the switching of calls between the mobile and other fixed or mobile network users as well as mobility management. The MS and the BS subsystem communicate across the Um interface also known as radio link
The specifications relating to MS are as follows:

- TS 100 607-1 : Digital cellular telecommunication system(Phase2+)Mobile Station (MS) con Formance specification Part1:Conformance specification

1.2 Frequency Allocation and Its Use

- Transmit frequency band : 824MHz ~ 849MHz(For GSM850) , 1850MHz ~1910MHz(For PCS)
- Receive frequency band: 869MHz ~ 894MHz(For GSM850) , 1930MHz ~ 1990MHz(For PCS)
- Channel spacing : 200 KHz
- ARFCN(Absolute Radio Frequency Channel Number) : 128~251 (For GSM850), 512~810 (For PCS)
- Transmit-receive frequency spacing: 45 MHz(For GSM850), 80MHz(For PCS)
- Frequency band and Channel Arrangement

For GSM850 Band Fl(n)=824.2+0.2*(n-128) 128 ≤n≤ 251 Fu(n)=Fl(n)+45
824 MHz ~849 MHz : Mobile Transmit,Base receive
869 MHz ~894 MHz : Base Transmit, Mobile receive
For PCS Band Fl(n)=1850.2+0.2*(n-512) 512 ≤n≤ 810 Fu(n)=Fl(n)+80
1850 MHz ~1910 MHz : Mobile Transmit,Base receive
1930 MHz ~1990 MHz : Base Transmit, Mobile receive
** Fl(n)= frequency value of the carrier , Fu(n)= corresponding frequency value in upper band

1.3 Item Name and Usage

GB310, GSM digital cell phone, is supercompact, superlight mobile communication terminal for personal use. It has a 850MHz and 1900MHz frequency band and adopts GSM850 and PCS mode having excellent spectrum efficiency, economy, and portability.

This product is GSM Cellular type portable phone, adopting 1-cell Li-ion battery and power saving circuit to maximize its operation time. Also, it is equipped with a fixed snap-in antenna and its color LCD with font built in enables both Chinese and English text service. And power control(basic feature of GSM), security feature, voice symbol feature, and variable data rate feature are used appropriately to ensure its best performance. This product consists of a handset, battery pack, and Travel charger.

1.4 Characteristics

1) All the active devices of GB310 are made of semiconductors to ensure excellent performance and semi-permanent use.
2) Surface mounting device (SMD) is used to ensure high reliability, compactness and lightness.
3) GB310 adopts the Silabs's AERO I RF transceiver, which is CMOS RF front-end for multi-band GSM digital cellular handsets. The AERO I's highly-integrated architecture eliminates the IF SAW filter, low noise amplifiers (LNAs) for three bands, transmit and RF voltage-controlled oscillator (VCO) modules, and more than 60 other discrete components found in conventional GSM handsets to deliver smaller, more cost effective GSM solutions that are easier to design and manufacture.
4) GB310 is designed to perform excellently even in the worst environment

Section 2. Electrical Specifications

2.1 General GSM850 / PCS Band

Mobile Transmit Frequency	824 MHz ~ 849 MHz / 1850MHz ~ 1910MHz
Mobile Receive Frequency	869 MHz ~ 894 MHz / 1930MHz ~ 1990MHz
The Number of Time Slot	8
The Number of Channels	124 / 299
Channel Spacing	200 kHz
Power Supply	Rechargeable Li-Ion Battery 3.7V/780mAH
Operating Temperature	-10℃ ~ +55℃
Dimension	99(H) ×46(W) ×19(D) mm (SLIM)
Weight	72 g

2.2 Transmitter GSM850 / PCS Band

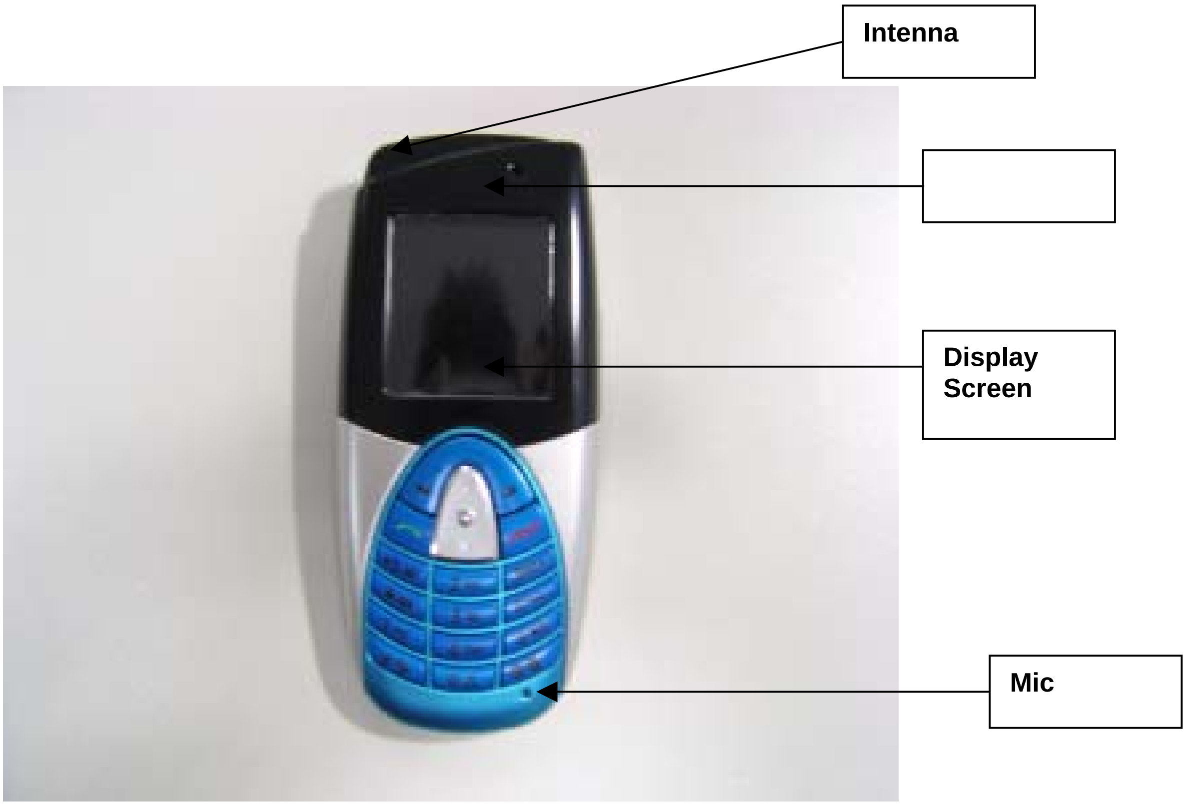
Maximum Output Power	33±2 / 30±2 dBm
Frequency Error	±90Hz / ±180Hz
Phase Error	RMS < 5° , PEAK < 20°
Minimum Output Power	5±5 / 0±5 dBm
Power Control	5~19(2 dB Step) / 0~15(2 dB Step)
Output RF Spectrum	TS 100 910V6.2.0
Switching Transient	TS 100 910V6.2.0
Intermodulation attenuation	
Conducted Spurious Emissions	Idle Mode -57dBm 9KHz~824M / 849MHz~1GHz -59dBm 824MHz~849MHz -53dBm 1.85~1.91GHz -47dBm 1~1.85GHz / 1.91GHz~12.75GHz
	Allocated Channel -36dBm 9KHz~ 1GHz -30dBm 1GHz~ 12.75GHz

2.3 Receiver

Reference Sensitivity	For GSM850 small MS :-102dBm	
	For PCS1900 class3 MS : -102dBm	
For Adjacent interference	C/Ic	9 dB
For Adjacent(200KHz) interference	C/Ia1	-9 dB
For Adjacent(400KHz) interference	C/Ia2	-41 dB
For Adjacent(600KHz) interference	C/Ia3	-49 dB

Section 3 Operation

3.1 Name of each part



3.2 Display(Single LCD)

Parameter	Projected Actual (MAIN LCD)
Display	Color LTPS LCD with white LED back lighting 65k colors European Character : (font size : 16×16) 7 lines x 8 characters Chinese Character : (font size : 16×16) 7 lines × 8 characters
Driver	S6B33B0A02 (Samsung)
Module Dimen.	33.35(W) x 66.42(H) x 3.2(T)
Active Area	26.1(W) x 28.15(H)
Dot pitch	0.068(W) x 0.22(H)

3.3 Keypad

	Market Goal	Projected Actual	Comments
English Keypad	0-9, *,# Send (Color) End/Pwr (Color) Up (Melody), Down (Phonebook), SoftKey1(My menu), SoftKey2(CLR) * Key: Vib. Mode # Key: Auto Lock 0/+Key: International 2 Volume Keys	0-9, *,# Send (Color) End/Pwr (Color) Up (Melody), Down (Phonebook), SoftKey1 (My menu), SoftKey2 (CLR) * Key: Vib. Mode # Key: Auto Lock 0/+Key: International 2 Volume Keys	Meets Goal. (Industrial design sample required) Meets Goal Keys for VR and Lock International Volume up/down

Section 4. Theory of Operation

4.1 Logic Section

4.1.1 DC Distribution and Regulation Part

Applying battery voltage and pressing "END" key on the key pad short-circuits "Ground" and "$\overline{\text{PowerON}}$". AD6535(U102) control that power manage regarding power on/off in handset Pressing POWERKEY on the key pad is active on the handset.
This will turn on all the LDOs, when $\overline{\text{PowerON}}$ is held low. The power of RF Tx power amplifier is supplied directly by the battery.

4.1.2 Logic part

4.1.2.1 Summary

The logic part consists of AD6525 ARM7 microprocessor-combined DBB(Digital BaseBand) GSM-ASIC, COMBO(flash ROM & SRAM), AD6535 ABB(Analog BaseBand) Chip. AD6525 is GSM-ASIC chipset implemented for GSM terminal's system control and baseband digital signal processing.

Major parts used in the logic part are as follows:

1) AD6525 : U101, [ARM7 Processor Core + DBB GSM Signal Processing] ASIC
2) AD6535 : U102, Analog Baseband Processor (Power management + Voice Codec)
3) COMBO MEMORY(Flash ROM : U103, 64Mbit Flash Memory + 16Mbit SRAM)

4.1.2.2 Baseband Digital Signal Processing

AD6525 is a GSM core device containing ARM7 CPU core. AD6525 is 160 pin LFBGA (mini-BGA) package, consisting of terminal chips. The function and characteristics of clock are as follows:

1) Complete single chip GSM Processor
2) Channel codec sub-system
   - Channel coder and decoder
   - Interleaver and Deinterleaver
   - Encryption and Decryption
3) Control Processor Subsystem including
   - Parallel and serial Display interface
   - Keypad Interface
   - SIM Interface
   - Control of RADIO subsystem
   - Real Time Clock with Alarm

☞ Configuration by Function of AD6525

1 Microprocessor Core

AD6525 has a built-in ARM7 microprocessor core, including microprocessor interrupt controller, timer/counter, and DMA controller. And besides, 32bit data path is included, and up to 8Mbyte addressing is enabled and can be extended up to 16Mbyte. Although external clock should be provided to operate the microprocessor, this core uses 13MHz VCTCXO to provide clock.

2 Input Clock

1) Main Clock(13 MHz):

This is the clock needed for the microprocessor built in AD6525 to operate.

2) VC-TCXO(13 MHz) , 32.768KHz Clock:

This is the system reference clock to control SLEEP mode.

This is the clock derived from 13MHz VC-TCXO clock, provided by RF part. It is the timing reference clock for GSM signal processing.

3 DSP Subsystem

This is a GSM signal processing part in GSM mode, consisting of speech transcoding and Channel equalization as follows:

1) Speech transcoding

In full rate, the DSP receives the speech data stream from VBC and encodes data from 104kbps to 13kbps. Using algorithm is Regular Pulse Excitation with Long Term Prediction (RPE-LTP).

2) Equalization

The Equalizer recovers and demodulates the received signal

The Equalizer establishes local timing and frequency references for mobile terminal as well as RSSI calculation.

The equlization algorithm is a version of Maximum Likelihood Sequency Estimation(MLSI) using Viterbi Algorithm.

☞ GSM Core and RF Interface

1) Transmitter:

AD6535 ABB receive data at 270kbps and use an on chip lock-up table to perform GMSK modulation. A pair of 10bit matched differential DACs convert the modulated data and pass I and Q analog data to the transmit section of the radio system.

2) Receiver:

The receiver I and Q signals are sampled by a pair of ADCs at 270kbps.

The I and Q samples are transferred to the EGSMP through a dedicated receive path serial port.

4 RF Interface

This interfaces the RF part to control power amplifier, Tx LO buffer amplifier, VC-TCXO, and AGC-end on transmit/receive paths in the RF part.

1) Transmitter Interface:

This transmits TX_AGC signal to Tx AGC amplifier to adjust transmit power level and sends Ramp_DAC signal to the RF part to control power amplifier.

2) Receiver Interface:

This transmits RX_AGC signal to Rx AGC amp. to adjust receive path gain.

5 General Purpose ADC Support

The AD6535 includes a general purpose 10bit auxiliary ADC with four multiplexed input channel These are used for measurment of battery voltage ID , temperature and accessory ID.

6 USC(Universal System Connector) Interface

A Typical GSM handset requires serial connections to provide data during normal phone operation manufacturing,testing and debugging.

7 General Purpose Interface

The AD6525 provides 32 interface pin for control of peripheral devices.
All GPIO pins start up as inputs. Additional purpose inputs and outputs are available under SW control.

8 Speech Transcoding

In full rate mode, the DSP receive the speech data stream from the ABB and encodes data from 104kbps to 13kbps.Using algorithm is Regular Pulse Exitation with Long Term Prediction as specified GSM Recommandation

9 Power Down Control Section

1) Idle Mode Control:

If IDLE/ signal turns ‘Low’, transmitter section becomes disabled.

2) Sleep Mode Control:

If IDLE/ and SLEEP/ signals turn ‘Low’, all the sections except for VC-TCXO circuit become disabled.

3) Receiver & Transmitter Mode Control:

If IDLE/ and SLEEP/ signals turn ‘High’, all the sections become enabled to perform transmit/receive operation.

4.1.3 Memory Part

Memory consists of COMBO (flash ROM & SRAM).

1 Flash ROM

Flash ROM has a capacity of 64Mbit(8MByte). The main programs of the terminal(call processing, user interface, and diagnostic task) and supplemental programs (NAM program and test program) are stored in the flash ROM. Even if the program version may be changed in the future, customers can download the program.

2 Static RAM

SRAM has a capacity of 16Mbit(2MByte) and stores system parameters, data buffer, and stack of each task in it.

3 Key Tone Generation

All alert signals are generated by the DSP and output to the ABB audio output.

These alert can be used for the earpiece.

4.1.4 Notification Part

The notification of incoming call is given by melody, vibrator, and 2color-LED.

1) Melody:

   This is a device sounding alert/melody tones.

   The melody datas are stored in flash memory (U103) And generated by Melody IC(U104).

2) Vibrator:

   This is a device enabling vibration. The vibrator data is stored in flash memory(U103) And generated by A10(GPIO_9)pin.

3) 2color-LED:

   This is a device to indicate a notification mode using the lamp.

   U102 Nos. L16 and M16 signal drives the lamp to flash.

4.1.5 Key Pad Part

To enable key operation to input information, the key matrix is configured using strobe signal of KEYPADROW(0-4) and 5 input ports of KEYPADCOL(0-4). Also, to use the key even at light, the backlight circuit is provided for LED 8s.

4.1.6 LCD Module(Display Part)

LCD module consists of LCD, controller, LED-Backlight,

LCD: 1S/W Icon x 1 lines[(128x3)x128] can be displayed on the LCD panel. 6 icons could be provided by S/W. Controller with English font built in has been used.

LED-backlight Using illuminates the LCD panel, and LCD reflector enhances LCD display effect.

4.2 Radio Transceiver Section

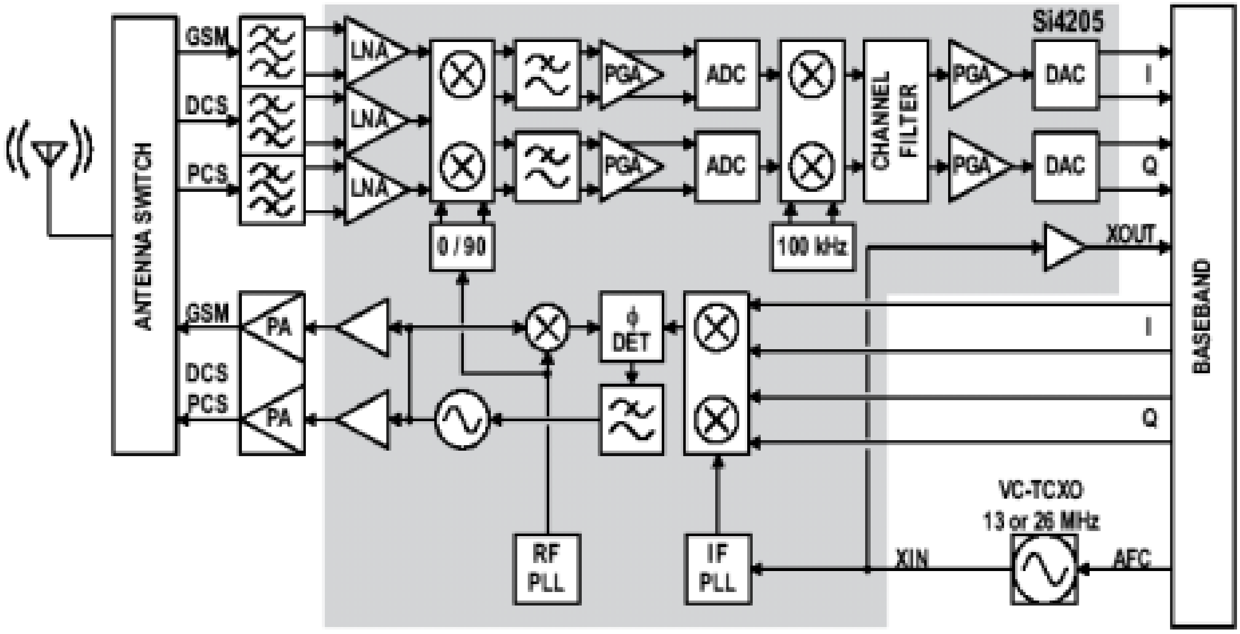


Fig.4-1. RF Transceiver block diagram

The GB310's RF Transceiver(U304), which is AERO I, consists of the GSM transmitter,the GSM Receiver, and the RF synthesizer. The highly integrated solution eliminates the IF SAW filter, external low noise amplifiers (LNAs) for three bands, transmit and RF voltage controlled oscillator (VCO) modules, and more than 60 other discrete components found in conventional designs.

The receive section uses a digital low-IF architecture that avoids the difficulties associated with direct conversion while delivering lower solution cost and reduced complexity.

The transmit section is a complete up-conversion path from the baseband subsystem to the power amplifer (U303) and uses an offset phase locked loop (PLL) with a fully integrated transmit VCO.

The RF synthesizer includes integrated RF and IF VCO's, Varactors, and Loop filters. The unique integer-N PLL architecture used in the RF synthesizer produces a transient response that is superior in speed to fractional architectures without suffering the high phase noise or spurious modulation effects often associated with those designs.

The following Figure shows GB310's top view of PCB artworks.

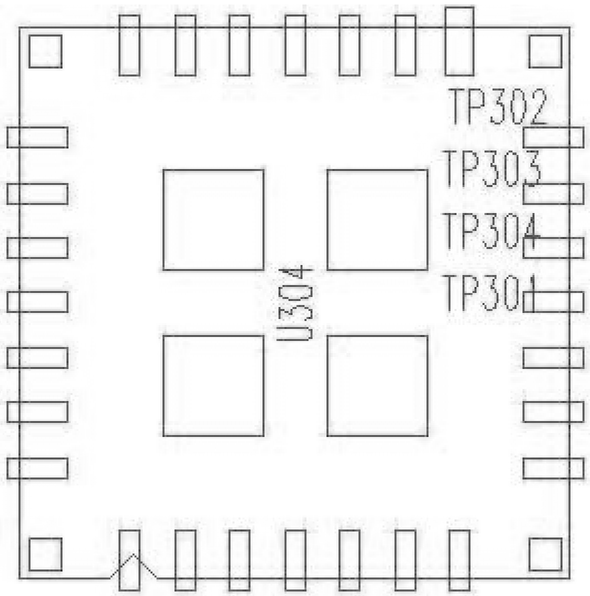


Fig.4-2. Top view of RF Transceiver PCB Layout

4.2.1 DC Distribution and Regulation Part

The battery voltage, in return, is applied to the logic part and RF part via LDO(Low Drop-Out) regulator. As several LDO regulators are used, power can be supplied for each necessary part efficiently. Audio/Logic parts use +2.8V. Si4205 RF Transceiver (U304) and RF3133 Power Amplifier (U303) also use +2.8V DC voltage.

4.2.2 Transciever pin description

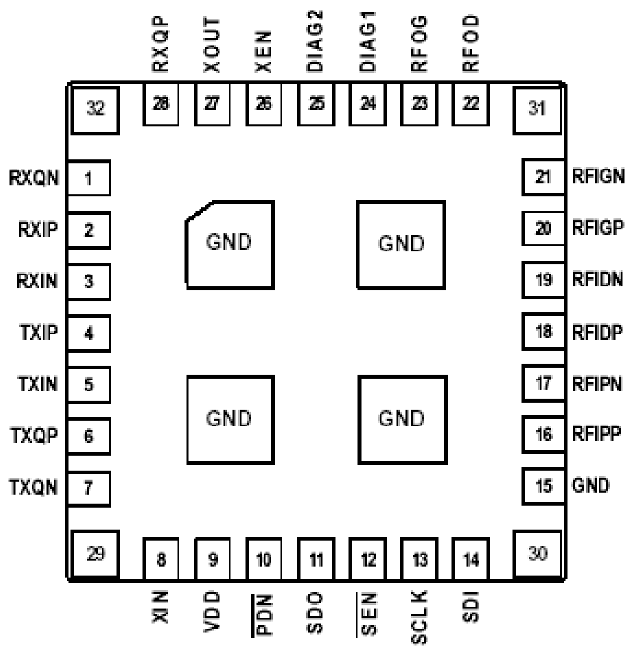


Fig.4-3. Top View of Si4205-BM

Pin Number(s)	Name	Description
1, 28	RXQN, RXQP	Receive Q output (differential).
2, 3	RXIP, RXIN	Receive I output (differential).
4, 5	TXIP, TXIN	Transmit I input (differential).
6, 7	TXQP, TXQN	Transmit Q input (differential).
8	XIN	Reference frequency input from crystal oscillator.
9, 32	VDD	Supply voltage.
10	PDN	Powerdown input (active low).
11	SDO	Serial data output.
12	SEN	Serial enable input (active low).
13	SCLK	Serial clock input.
14	SDI	Serial data input.
15, 29–31	GND	Ground. Connect to ground plane on PCB.
16, 17	RFIPP, RFIPN	PCS LNA input (differential). Use for PCS 1900 band.
18, 19	RFIDP, RFIDN	DCS LNA input (differential). Use for DCS 1800 band.
20, 21	RFIGP, RFIGN	GSM LNA input (differential). Used for GSM 850 or E-GSM 900 bands.
22	RFOD	DCS and PCS transmit output to power amplifier. Used for DCS 1800 and PCS 1900 bands.
23	RFOG	GSM transmit output to power amplifier. Used for GSM 850 and E-GSM 900 bands.
24, 25	DIAG1, DIAG2	Diagnostic output. Can be used as digital outputs to control antenna switch functions.
26	XEN	XOUT pin enable.
27	XOUT	Clock output to baseband.

Table 4-1. Pin Description of Si4200DB-BM

4.2.3 Receiver Section

4.2.3.1 An Overview of Receive section

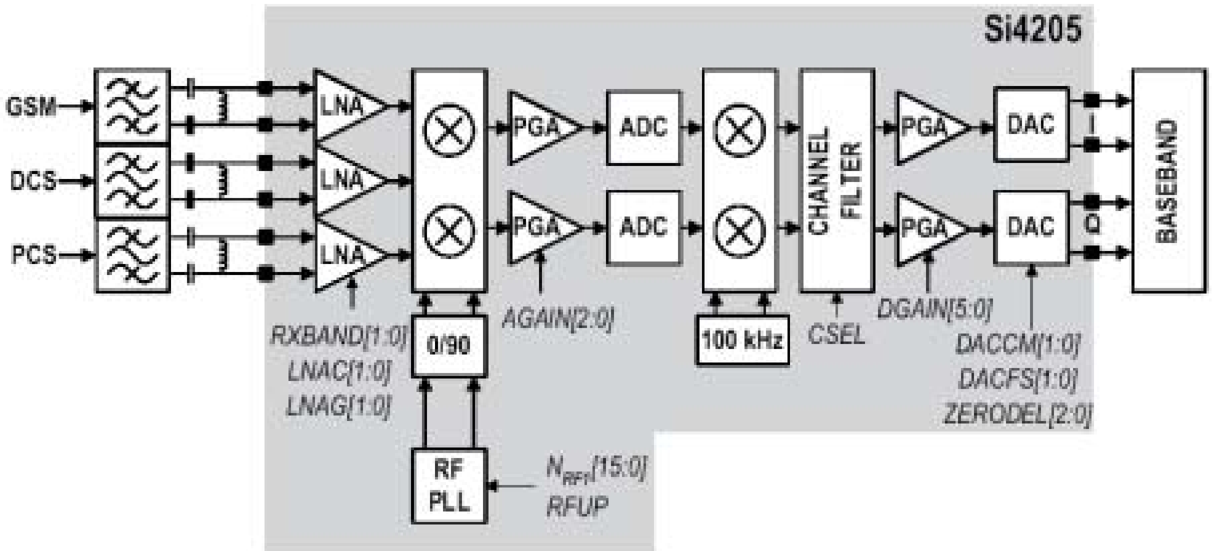


Fig.4-6. Receiver block diagram

GB310's Aero I transceiver uses a low-IF receiver architecture which allows for the on-chip integration of the channel selection filters, eliminating the external RF image reject filters and the IF SAW filter required in conventional superheterodyne architectures. Compared to a direct-conversion architecture, the low-IF architecture has a much greater degree of immunity to dc offsets, which can arise from RF local oscillator (RFLO) self-mixing, 2nd-order distortion of blockers, and device 1/f noise. This relaxes the common-mode balance requirements on the input SAW filters, and simplifies PC board design and manufacturing.

Three differential-input LNAs are integrated on the Aero I transceiver. The GSM input supports the GSM 850 (869–894 MHz) or EGSM 900 (925–960 MHz) bands. The DCS input supports the DCS 1900 (1930–1990 MHz) band. The PCS input supports the PCS 1900 (1930–1990 MHz) band. GB310 use only two inputs that are GSM850 and PCS inputs.

The LNA inputs are matched to the 150 Ω balancedoutput SAW filters through external LC matching networks. The LNA gain is controlled with the LNAG and LNAC bits.

A quadrature image-reject mixer downconverts the RF signal to a 100 kHz intermediate frequency (IF) with the RFLO from the frequency synthesizer. The RFLO frequency is between 1737.8 to 1989.9 MHz, and is internally divided by 2 for GSM 850 and E-GSM 900 modes. The mixer output is amplified with an analog programmable gain amplifier (PGA), which is controlled with the AGAIN bits in register 05h. The quadrature IF signal is digitized with high resolution A/D converters (APCS).

The ADC output is downconverted to baseband with a digital 100 kHz quadrature LO signal. Digital decimation and IIR filters perform channel selection to remove blocking and reference interference signals. The response of the IIR filter is programmable to a high selectivity setting or a low selectivity setting. The low selectivity filter has a flatter group delay response which may be desirable where the final channelization filter is in the baseband chip. After channel selection, the digital output is scaled with a digital PGA, which is controlled with the DGAIN bits.

The LNAG, LNAC, AGAIN and DGAIN bits must be set to provide a constant amplitude signal to the baseband receive inputs.

DACs drive a differential analog signal onto the RXIP, RXIN, RXQP, and RXQN pins to interface to standard analog-input baseband ICs. No special processing is required in the baseband for offset compensation or extended dynamic range. The receive and transmit baseband I/Q pins can be multiplexed together into a 4-wire interface. The common mode level at the receive I and Q outputs is programmable, and the full scale level is also programmable.

4.2.3.2 Receiver Part

A. Diplexer: U320

Diplexer consists of Tx filter, having an antenna port, and dual configuration with the transmitting path isolated from the receiving path. A signal receives from the antenna of frequency band which is 881.5±12.5MHz for GSM850 bands, 1960.2±30 MHz for PCS bands and transmits it to dual saw filter. The Tx filter passes through the output signals of frequency band that is 836.5MHz ± 12.5MHz for GSM850 bands, 1880.2 ±30 MHz for PCS bands from the power amplifier and transmits it to the antenna. The maximum insertion loss is about 0.8 dB for the receiving bands at 25^{o} C and about 1.35 dB for the transmitting bands at 25^{o} C.

B. SAW filter (BPF / Band select filter): F301, F303

The **F301** filter is for the GSM850 band signals which range 881.5±12.5MHz with low insertion loss. And the **F303** filter passes the PCS bands that cover 1960.2±3MHz.

These filters degrade other band signals with high passing loss of 30~60 dB. The GSM850 and PCS's maximum insertion loss is 3.2 dB.

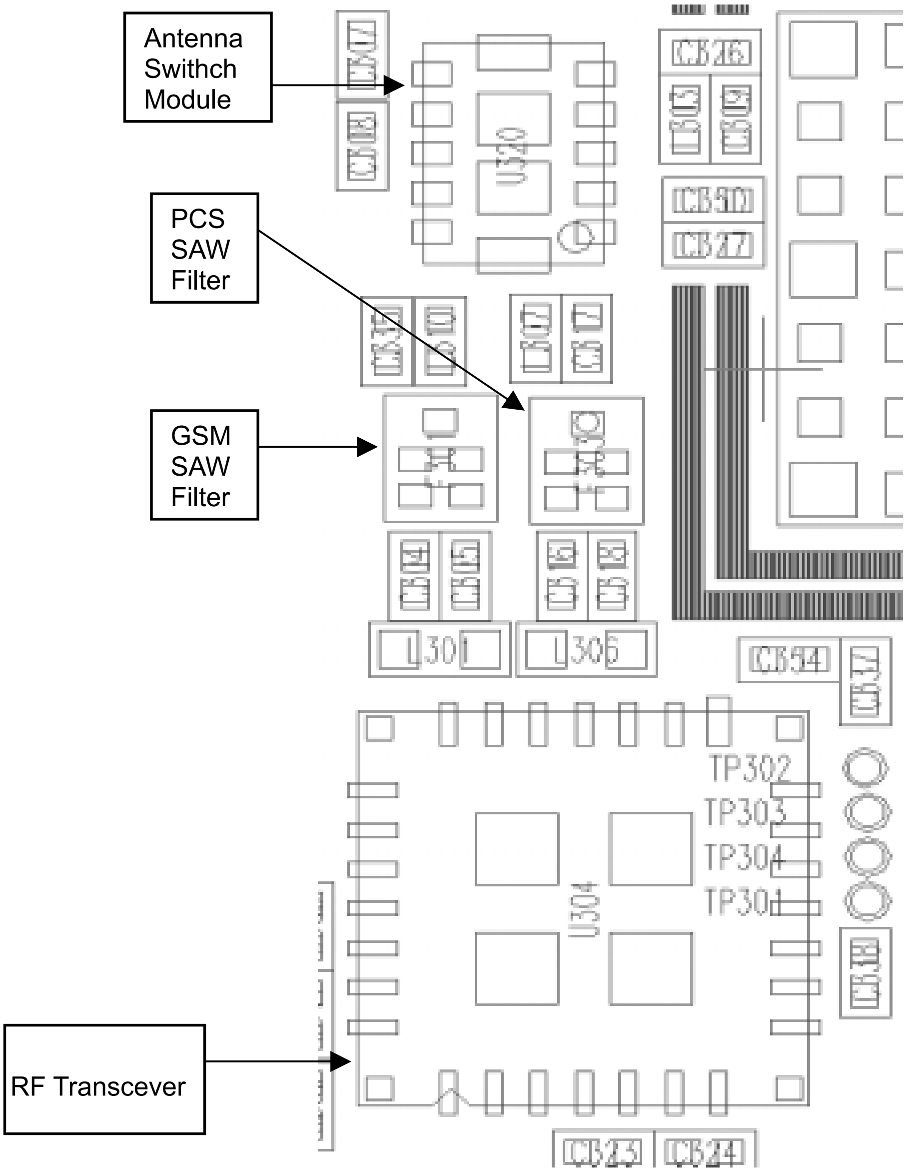


Fig.4-7. Receiver part PCB Layout

4.2.4 Transmit Section

4.2.4.1 An Overview of Transmit Section

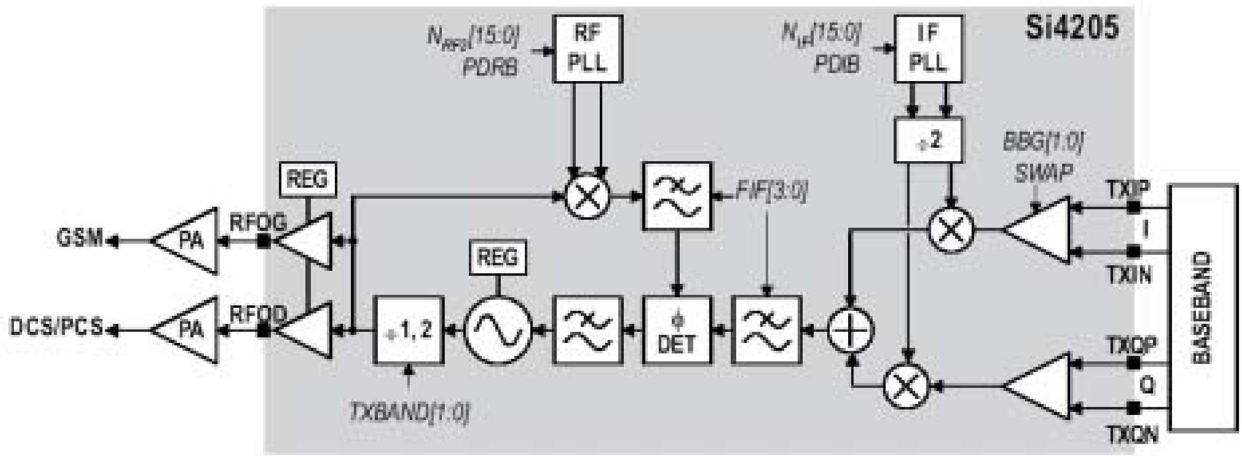


Fig.4-8. Transmitter block diagram

The transmit (TX) section consists of an I/Q baseband upconverter, an offset phase-locked loop (OPLL) and two output buffers that can drive external power amplifiers (U303), one for the GSM 850 (824 to 849 MHz) and E-GSM 900 (880 to 915 MHz) bands and one for the DCS 1800 (1710 to 1785 MHz) and PCS 1900 (1850 to 1910 MHz) bands. The OPLL requires no external duplexer to attenuate transmitter noise or spurious signals in the receive band, saving both cost and power. Additionally, the output of the transmit VCO(TXVCO) is a constant-envelope signal that reduces the problem of spectral spreading caused by non-linearity in the PA.

A quadrature mixer upconverts the differential in-phase (TXIP, TXIN) and quadrature (TXQP, TXQN) signals with the IFLO to generate a SSB IF signal that is filtered and used as the reference input to the OPLL. The IFLO frequency is generated between 766 and 896 MHz and internally divided by 2 to generate the quadrature LO signals for the quadrature modulator, resulting in an IF between 383 and 448 MHz. For the GSM 850 band, two different IFLO frequencies are required for spur management. Therefore, the IF PLL must be programmed per channel in the GSM 850 band. The OPLL consists of a feedback mixer, a phase detector, a loop filter, and a fully integrated TXVCO. The TXVCO is centered between the DCS 1800 and PCS 1900 bands, and its output is divided by 2 for the GSM 850 and E-GSM 900 bands. The RFLO frequency is generated between 1272 and 1483 MHz. To allow a single VCO to be used for the RFLO, high-side injection is used for the GSM 850 and E-GSM 900 bands, and low-side injection is used for the DCS 1800 and PCS 1900 bands. The I and Q signals are automatically swapped when switching bands. Additionally, the SWAP bit in register 03h can be used to manually exchange the I and Q signals.

Low-pass filters before the OPLL phase detector reduce the harmonic content of the quadrature modulator and feedback mixer outputs. The cutoff frequency of the filters is programmable.

4.2.4.2 Transmitter Part

A. 6 dB attenuator : Z301, Z302

These passive components are adopted for PAM to operate in a stable output power.

B. ASM(Antenna Switch Module / built in LPF): U320

These filters pass through the signals of which frequency band of 824~849MHz, 1850MHz~1910MHz which is the transmit frequency of GSM850, PCS system terminal, and it suppresses other images and spurious frequencies when the terminal transmits GMSK modulated frequencies.

C. Power AMP Module(PAM): U303

This device amplifies signals ahead of transmiting them through the antenna to provide a sufficient RF power. It has amplification factor of 28dB and efficiency of about 50% typically in GSM850 band and amplification of 27dB and efficiency of about 50% typically PCS band.

D. RF Switch connector: J301

RF Swithch connector used to test Mainboard's RF characteristics.

E. Intenna: Intenna Contact Plate

This device enables signals to be transmitted and received from BTS by Um interface.

The antenna is contacted through Antenna Contact Plate.

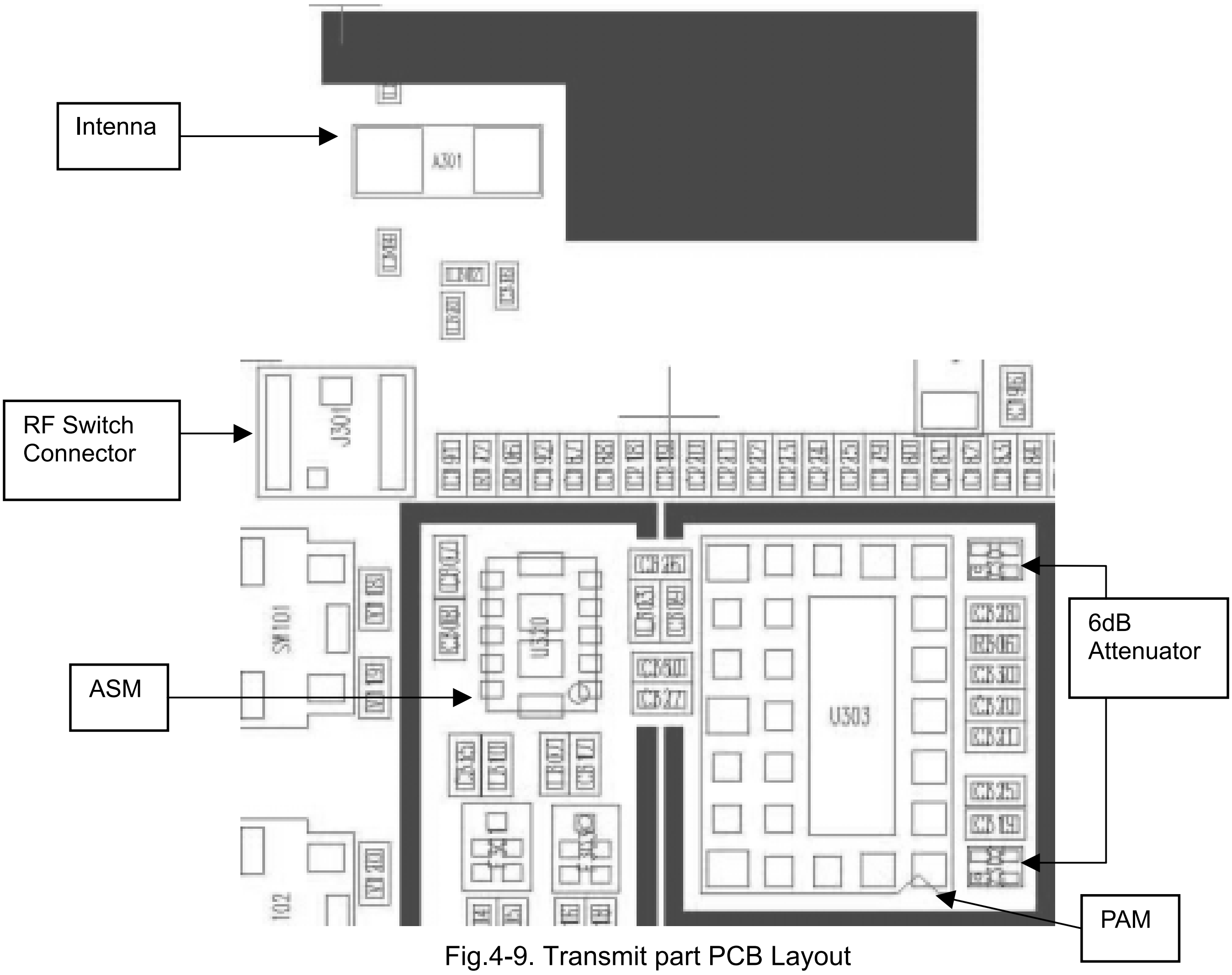


Fig.4-9. Transmit part PCB Layout

4.2.5 Offset PLL

4.2.5.1 An Overview of Offset PLL

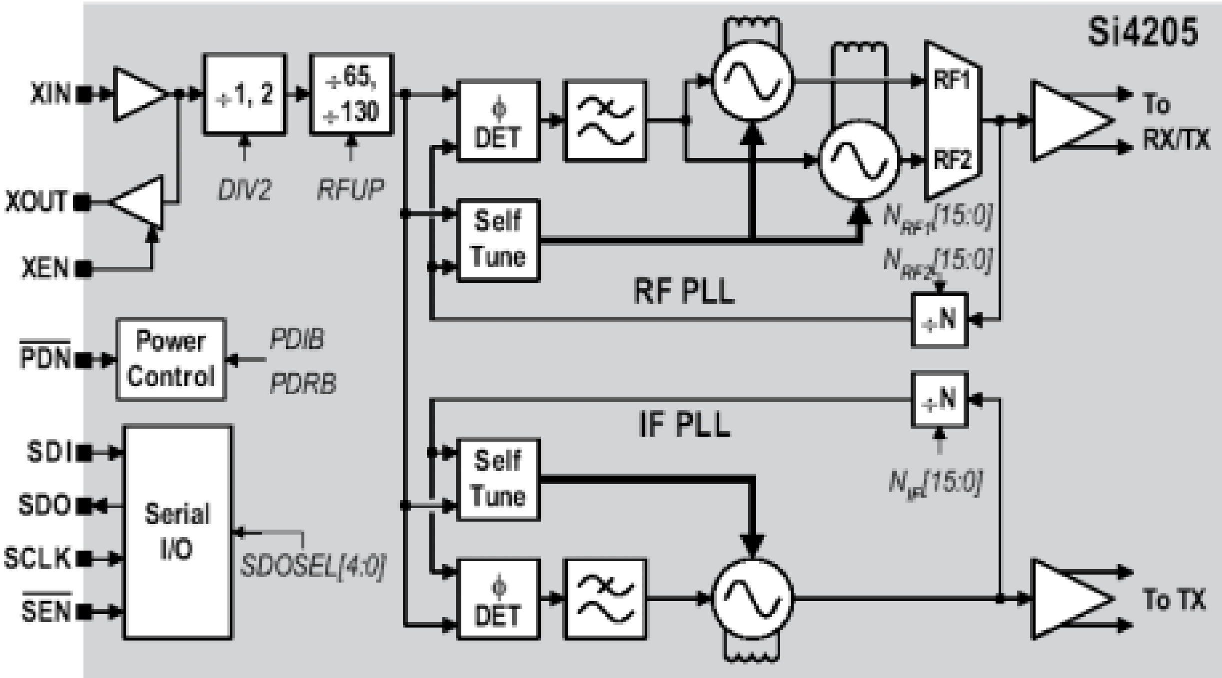


Fig.4-10. Si4205 Frequency Synthesizer Block Diagram

The Aero I transceiver integrates two complete PLLs including VCOs, varactors, resonators, loop filters, reference and VCO dividers, and phase detectors. The RF PLL uses two multiplexed VCOs. The RF1 VCO is used for receive mode, and the RF2 VCO is used for transmit mode. The IF PLL is used only during transmit mode. All VCO tuning inductors are also integrated.

The IF and RF output frequencies are set by programming the N-Divider registers, NRF1, NRF2 and NIF. Programming the N-Divider register for either RF1 or RF2 automatically selects the proper VCO. The output frequency of each PLL is as follows:

$$fOUT = N \times f\phi$$

The DIV2 bit in register 31h controls a programmable divider at the XIN pin to allow either a 13 or 26 MHz reference frequency. For receive mode, the RF1 PLL phase detector update rate (fϕ) should be programmed fϕ = 100 kHz for PCS 1900 bands, and fϕ = 200 kHz for GSM 850 bands. For transmit mode, the RF2 and IF PLL phase detector update rates are always fϕ =200 kHz.

4.2.5.2 VC-TCXO(Voltage Controlled Temperature Compensated Crystal Oscillator): U302

This is the mobile station's reference frequency source. Its frequency is 13MHz, this signal is applied to Si4205(U304)_pin8.

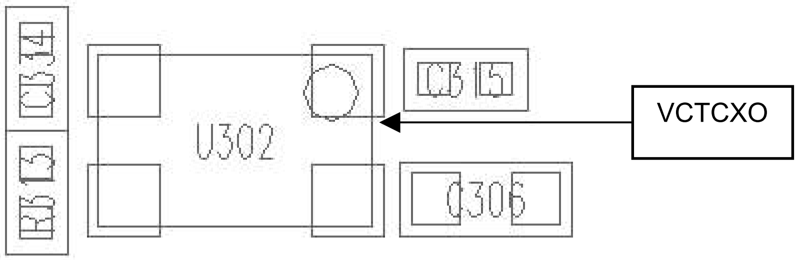


Fig.4-11. Top view of VCTCXO part on the PCB artwork

Section 5. Alignment Procedure

5.1 Recommended Test Equipment

Model No.	Description	Maker	Remark
8960	GSM Mobile Station Test Set	Agilent Technologies	
8593E	Spectrum Analyzer	Hewlett Packard	
TDS 340A	Oscilloscope	Tektronix	
FLUKE 87	Digital Multimeter	Fluke	
E3630A	DC Power Supply	Hewlett Packard	
Others	Accessory		Interface Connectors RF Connectors

5.2 Connection of Test Equipment

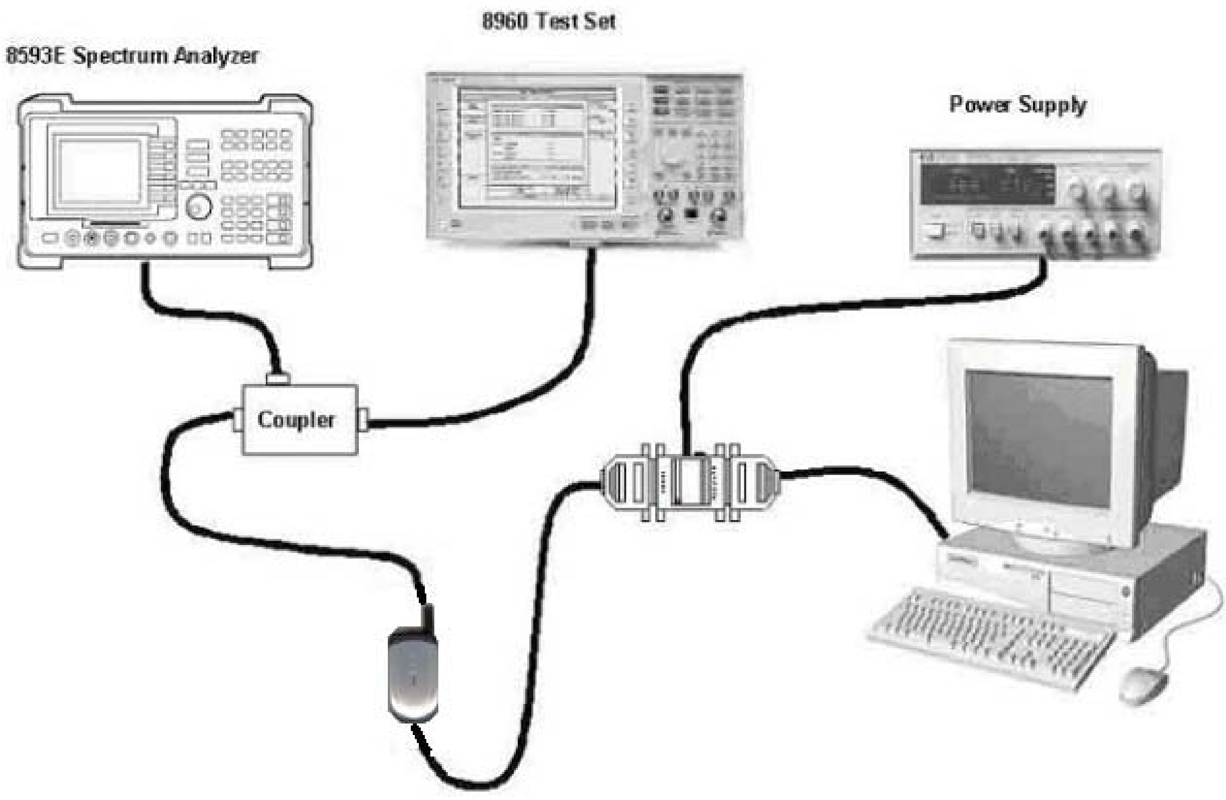


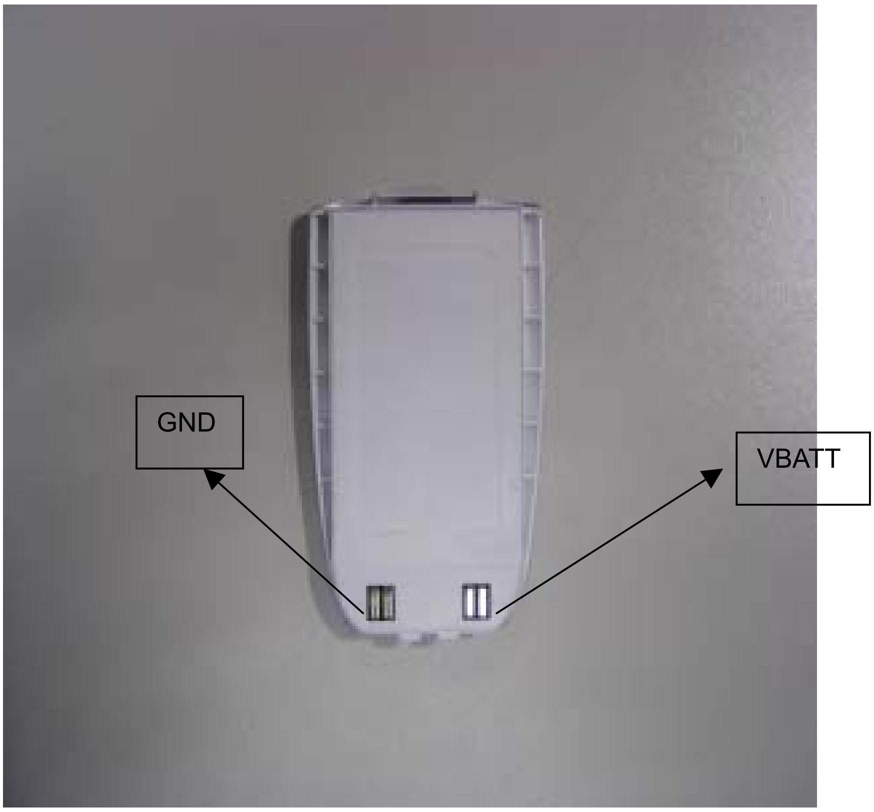
Fig.5-1. Test Set Configuration

SECTION 6. Equipment Repair Procedure

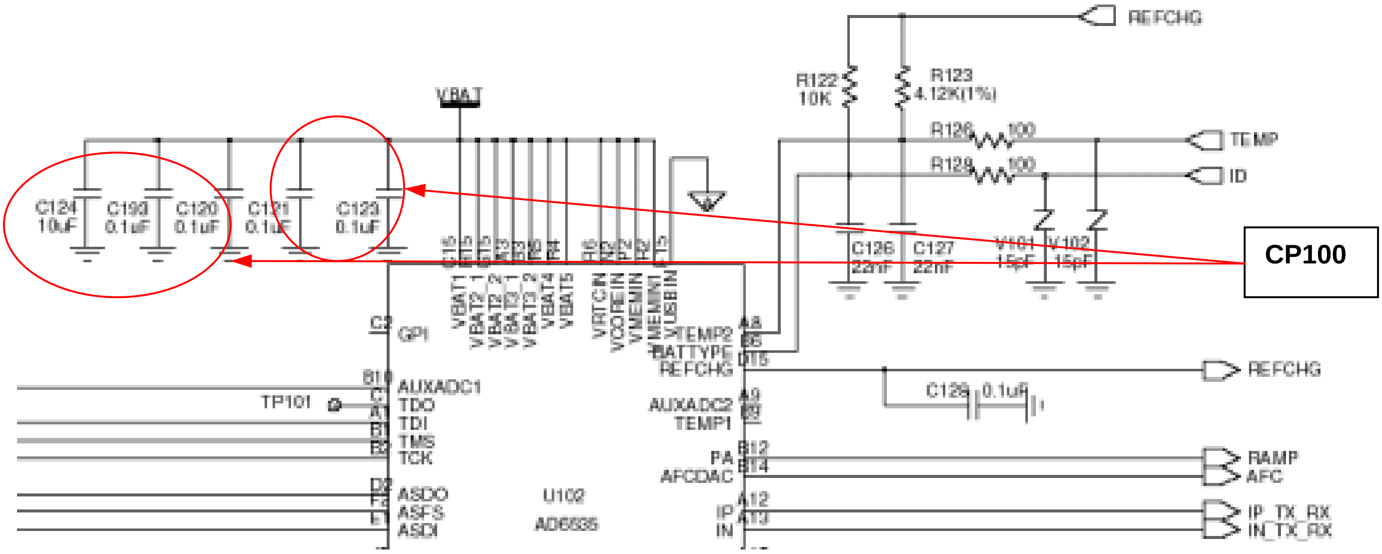
6.1 No Power On with battery Applied.

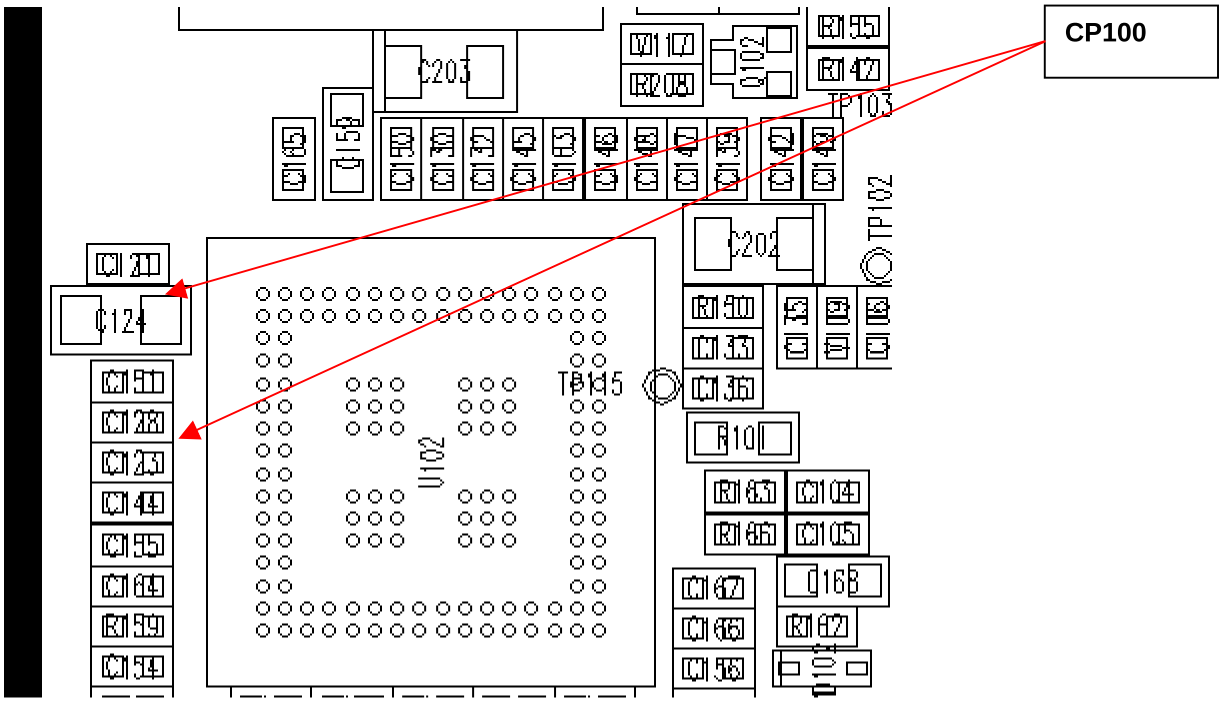
6.1.1 Power CHECK

1. Check battery power : 3.5V~4.2V.

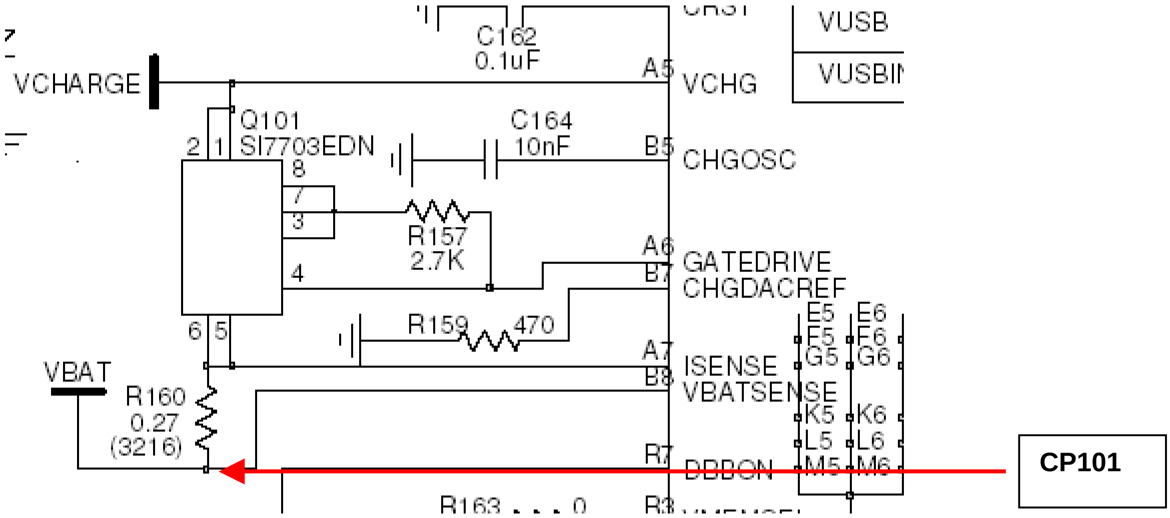


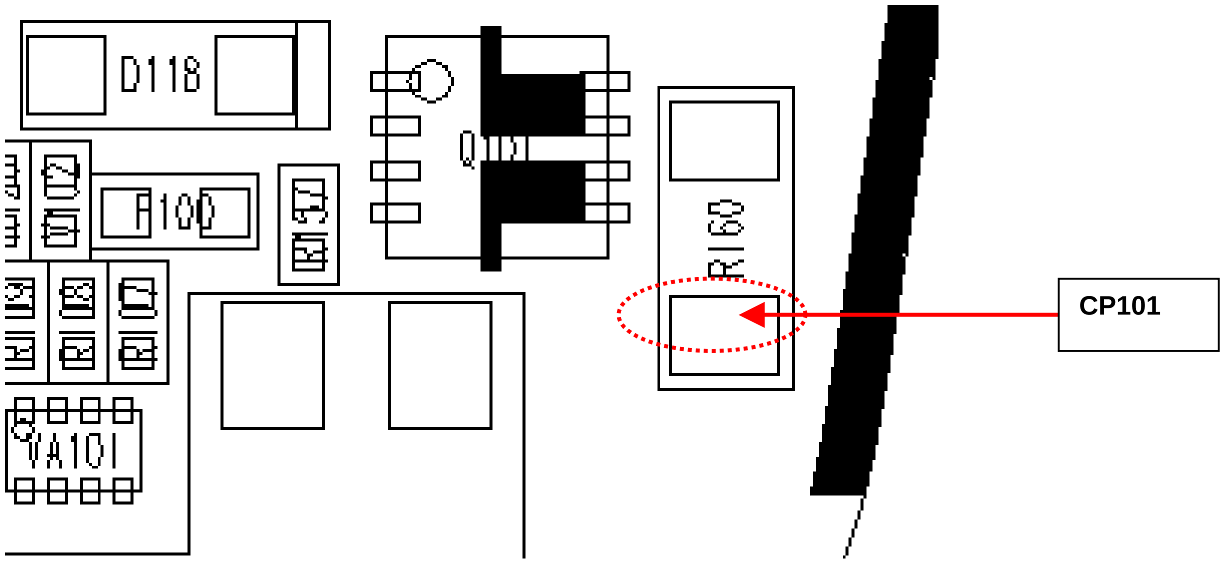
2. Check to see if C124.1 or C123 pin voltage is same with battery power : CP100



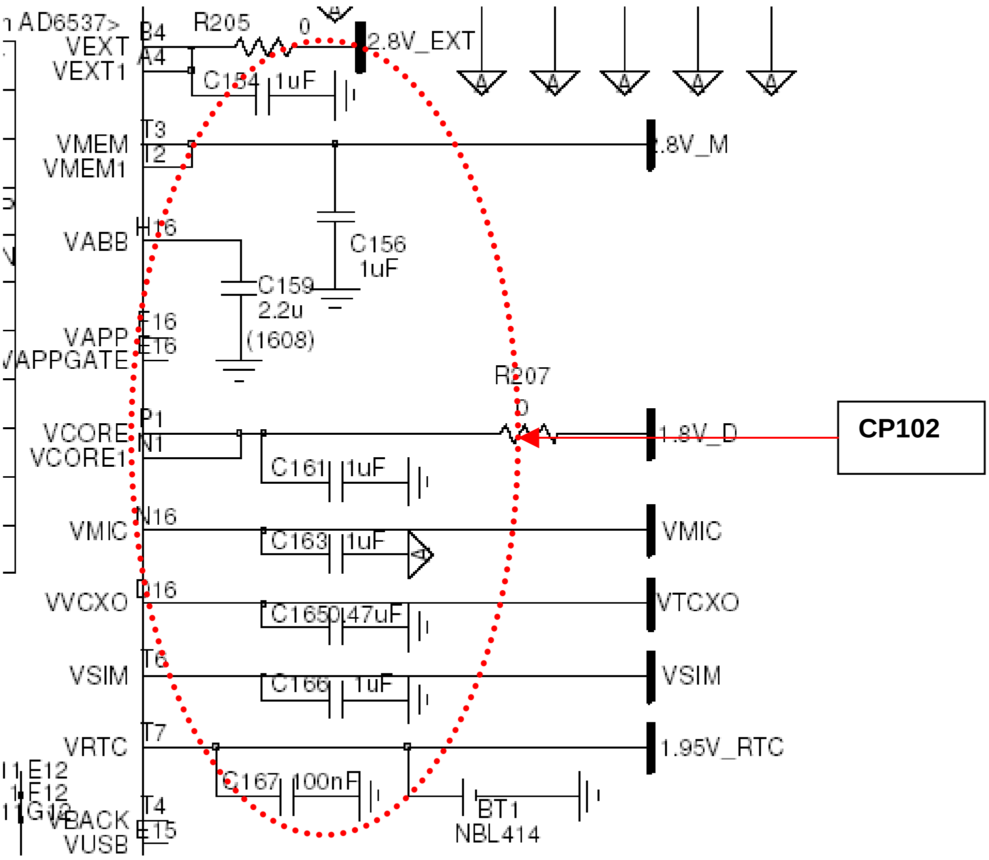


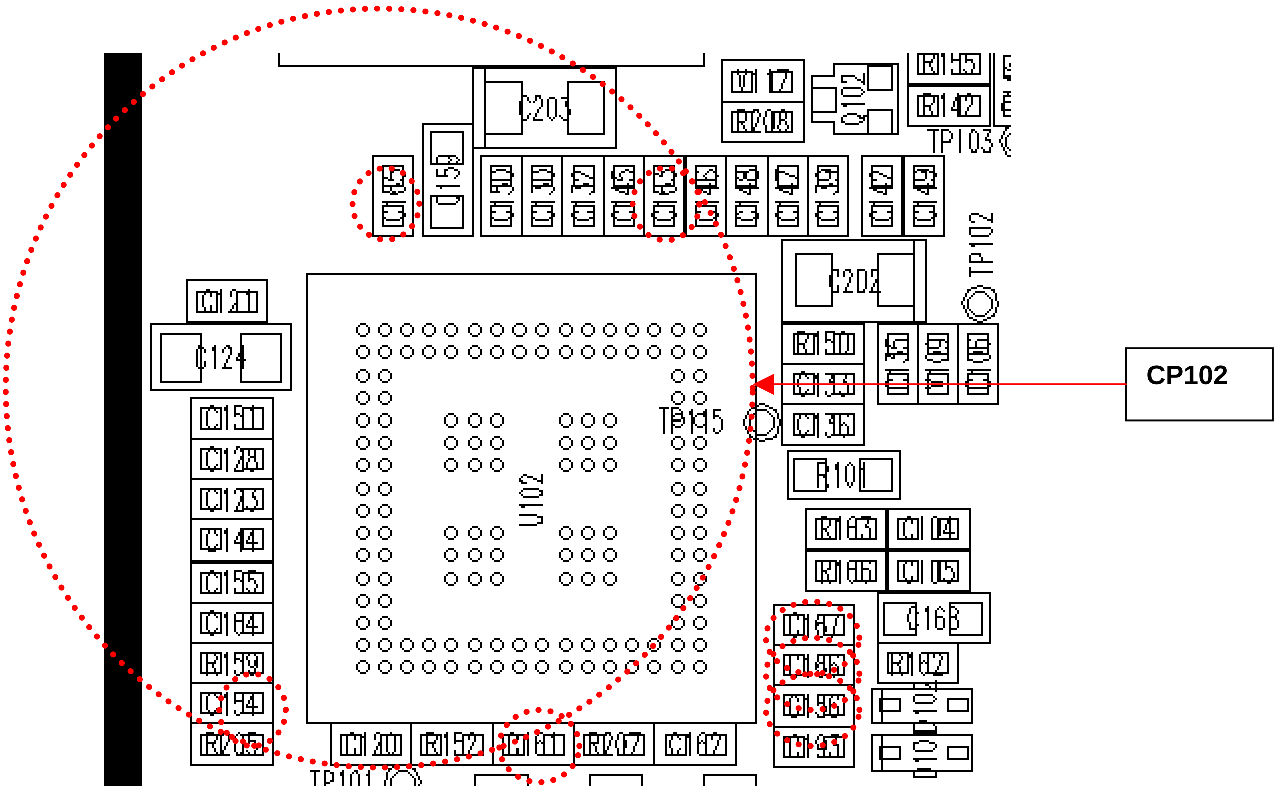
3. Check to see if Q101.5,6 and R160 pin is same with battery power : CP101





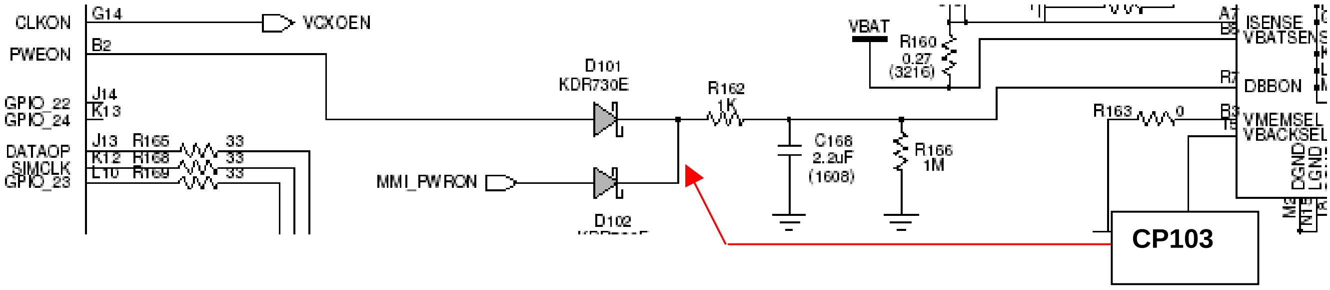
4. Check to see if U102 and C154, C156, C161, C163, C165, C166, C167 pin is 2.8V_EXT, 2.8V_M, 1.8V_D, VMIC, VTCXO, VSIM, 1.95V_RTC : CP102

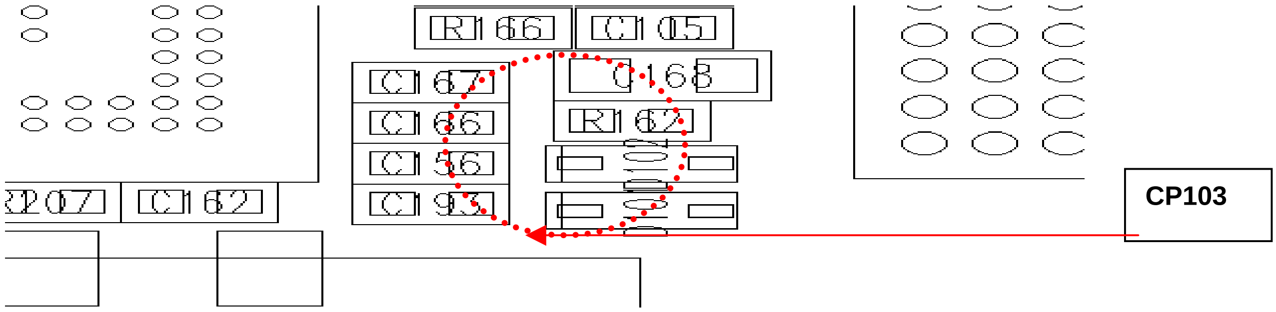




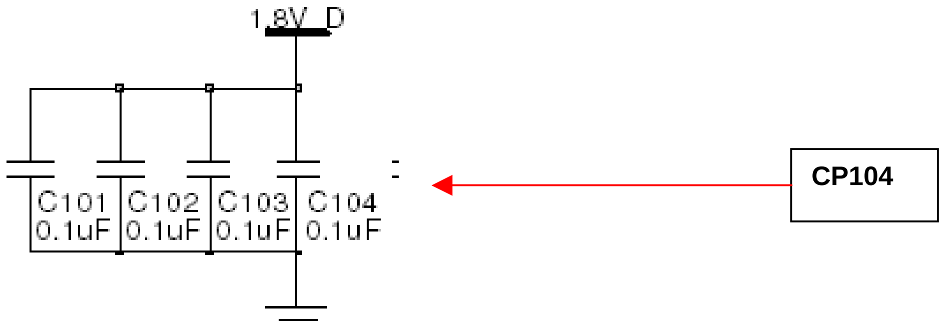
6. Check to see if U102.R7 or D101, D102, C168, R162 pin becomes to 0V : CP103

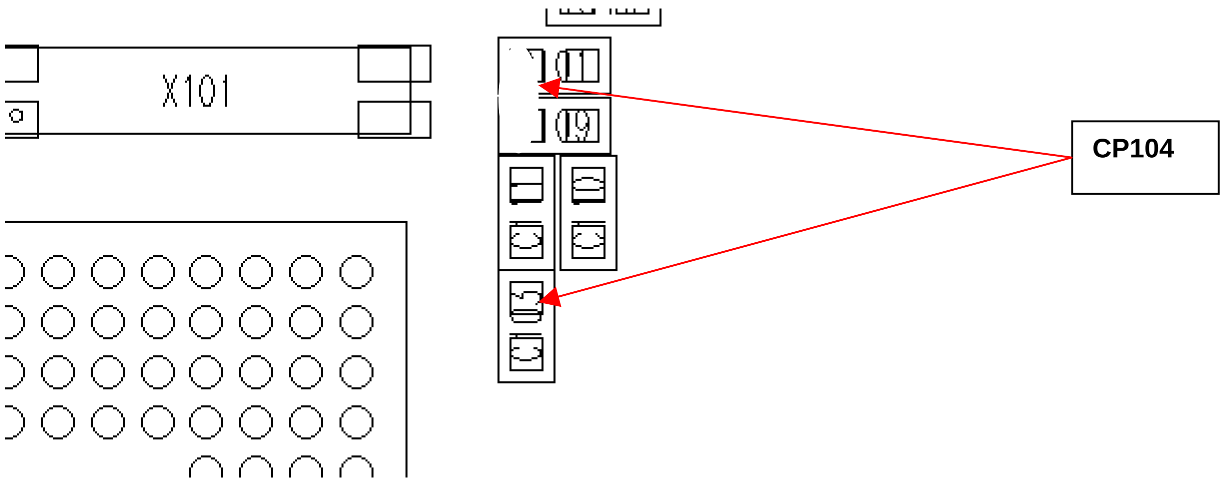
Pressing "END" key to turn on equipment.



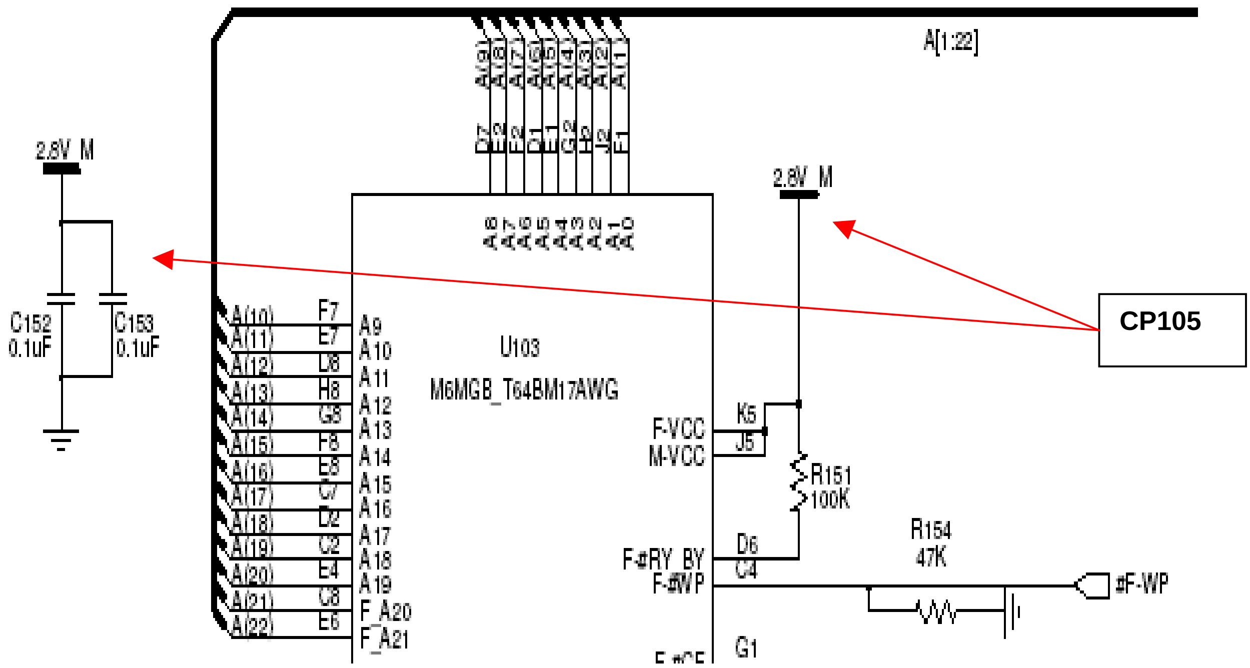


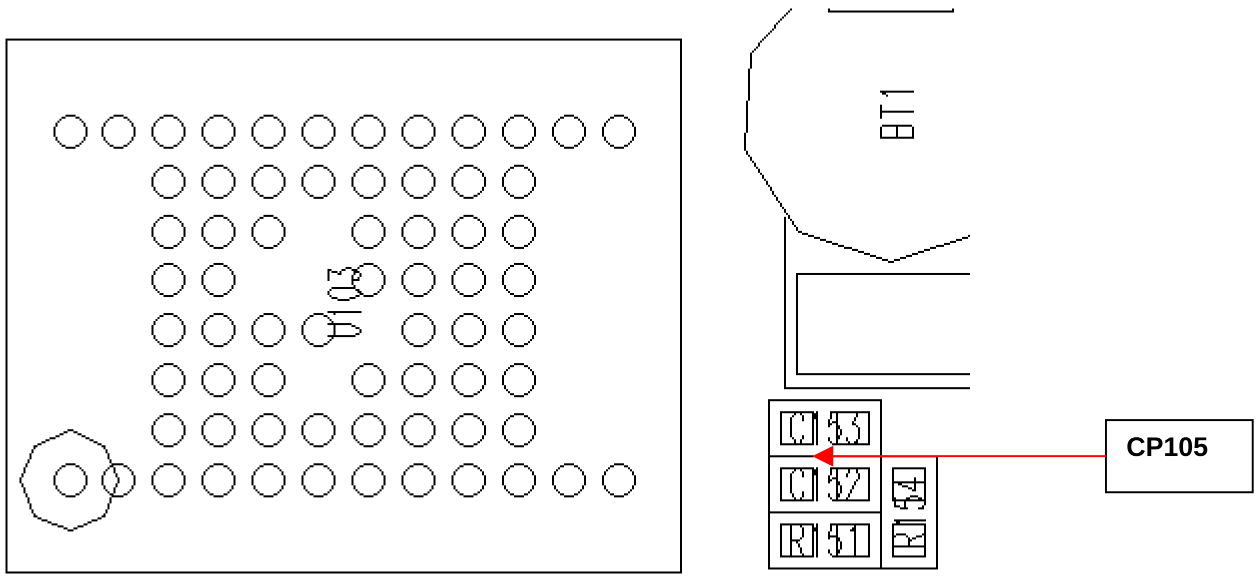
7. Check to see if C101 and C102 is 1.8V_D : CP104



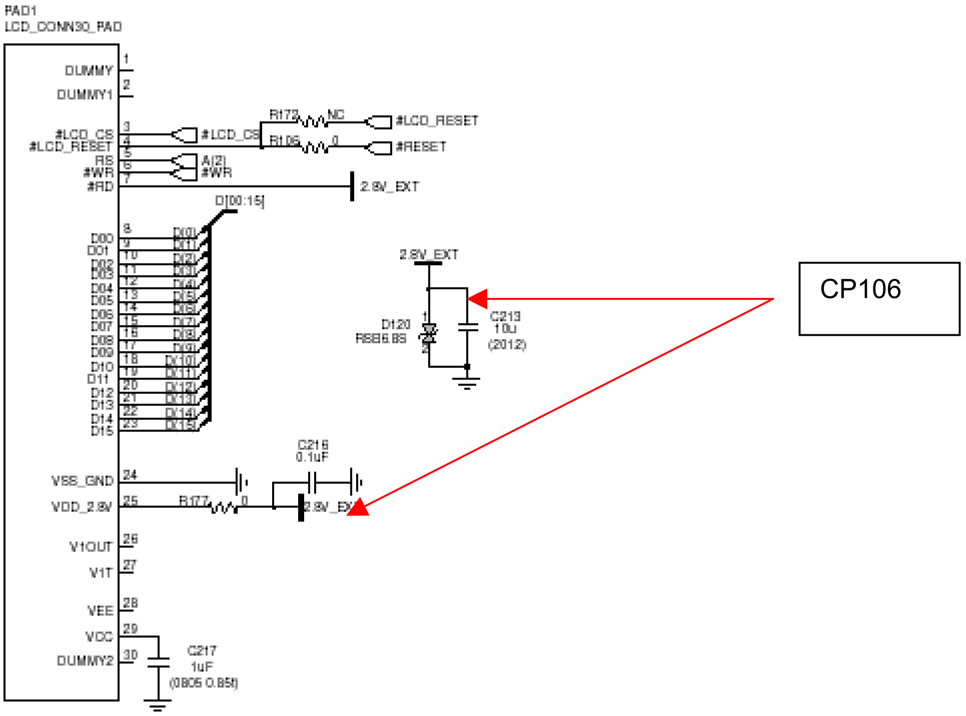


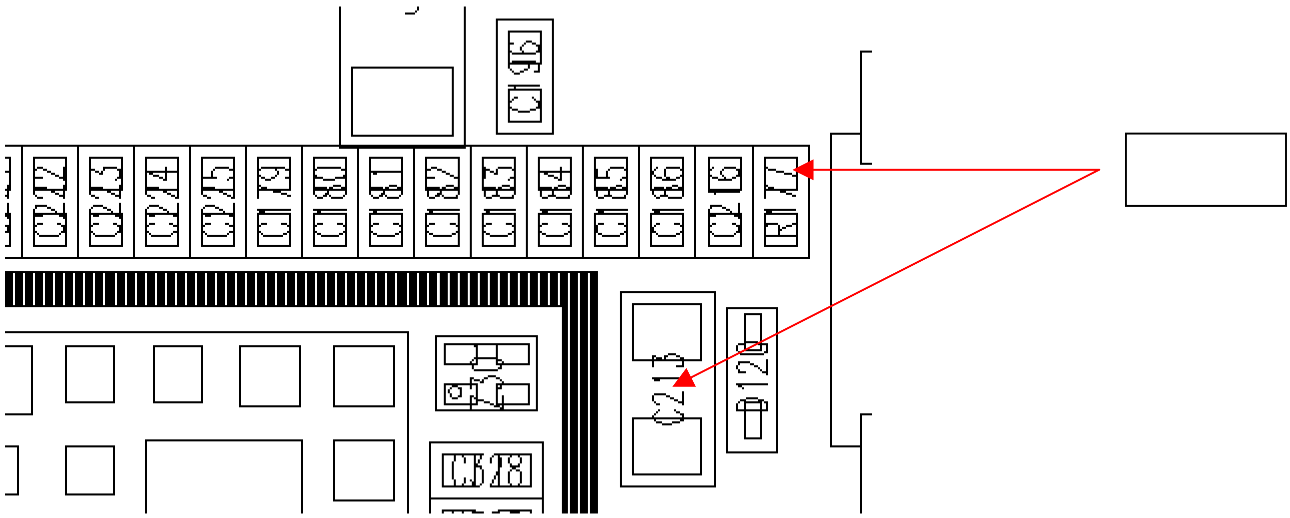
8.Check to see if U103.K5,J5 pin and C152,C153 is 2.8V_M : CP105





9.Check to ses if PAD1 pin R177and D1?0, C213 pin is 2.8V_EXT : CP106

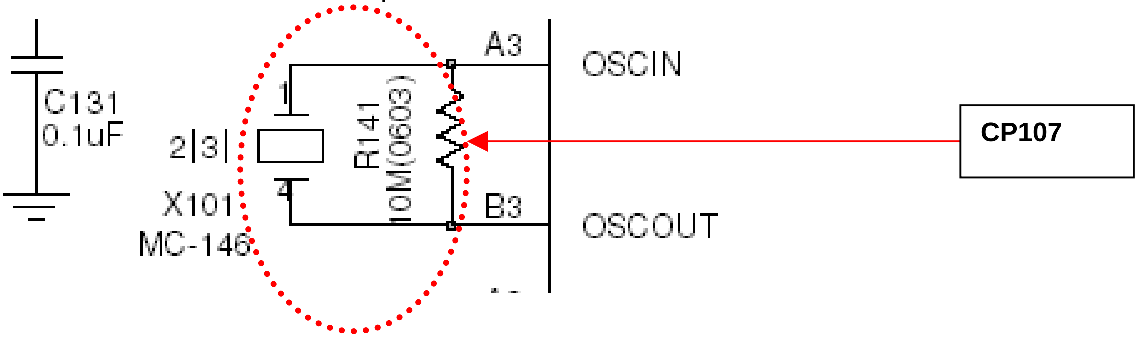


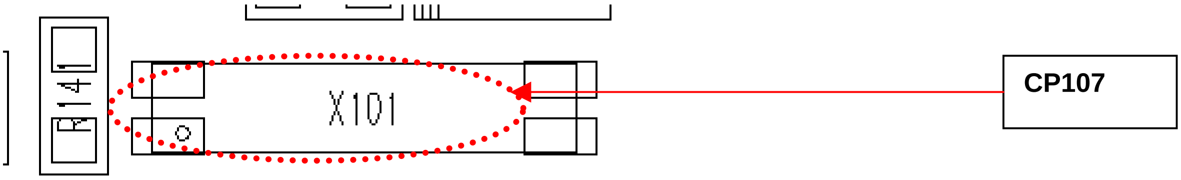


6.1.2 Oscillation CHECK

1. Check to see if U101 No. A3 and B3 pin is oscillated(32.768KHz) : CP107

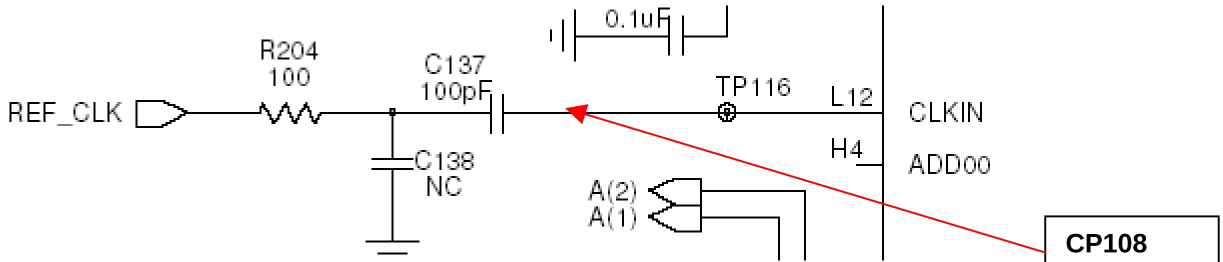
NO → Check R141 and then replace X101

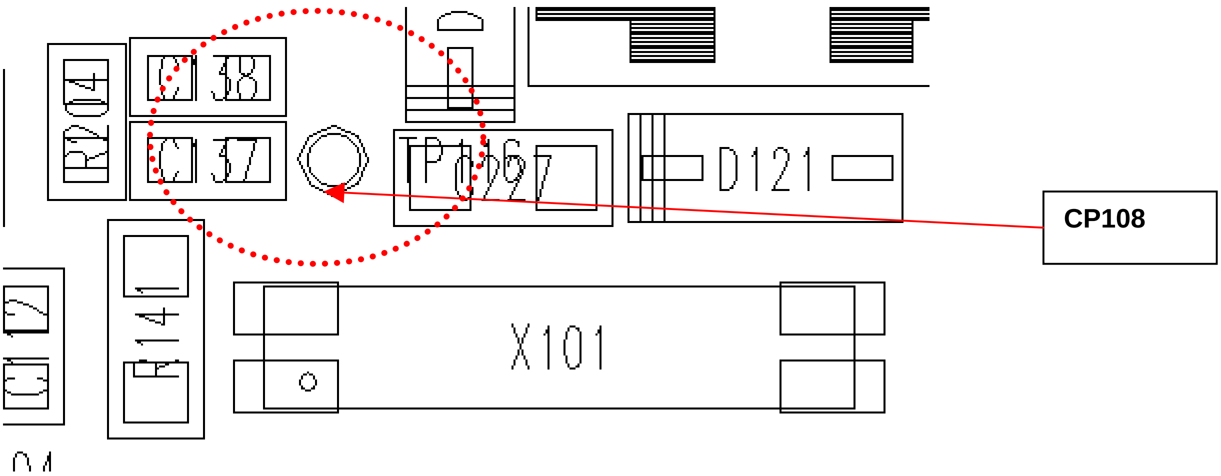




2. Check to see if U101.L12 pin Master Clock(13MHz). : CP108

NO → Check TP116, C137 pin and then check the PCB pattern, soldering





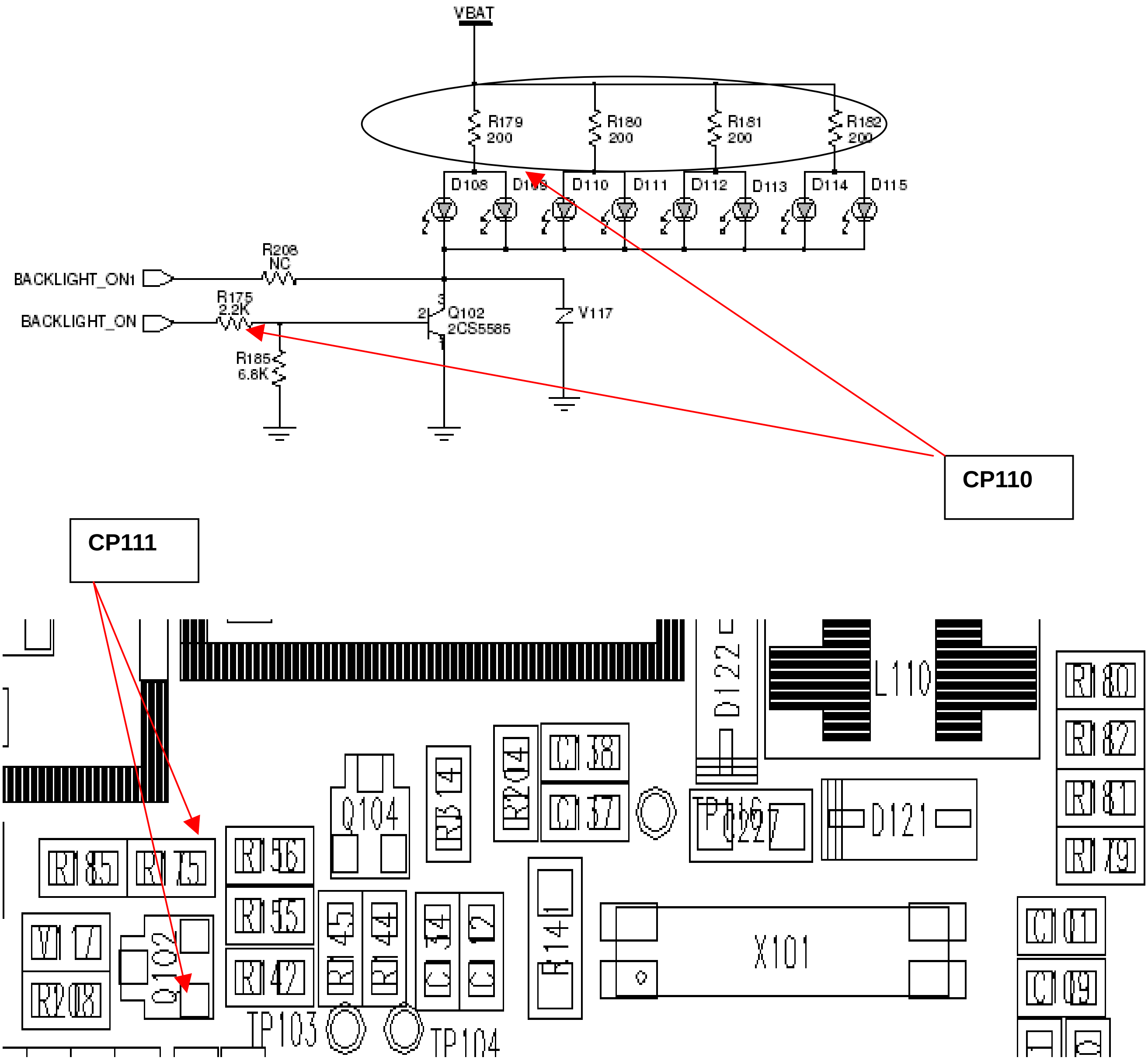
6.1.3 KEYPAD LED Not in Operation

1. Check to see if R179 ~ R182 are same with battery voltage : CP110

   NO → Replace the resistors.

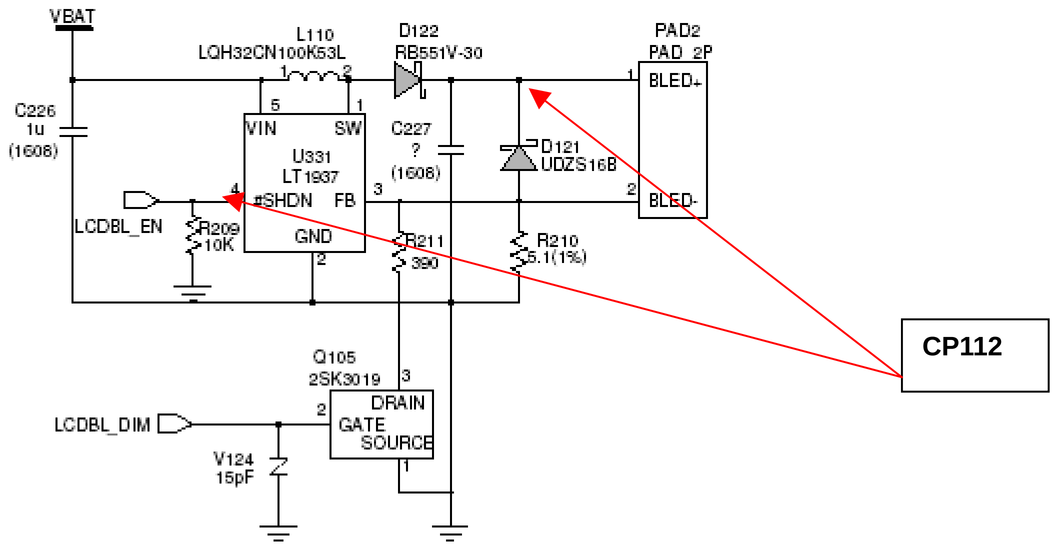
2. Check R175 signal (control PWM) : CP111

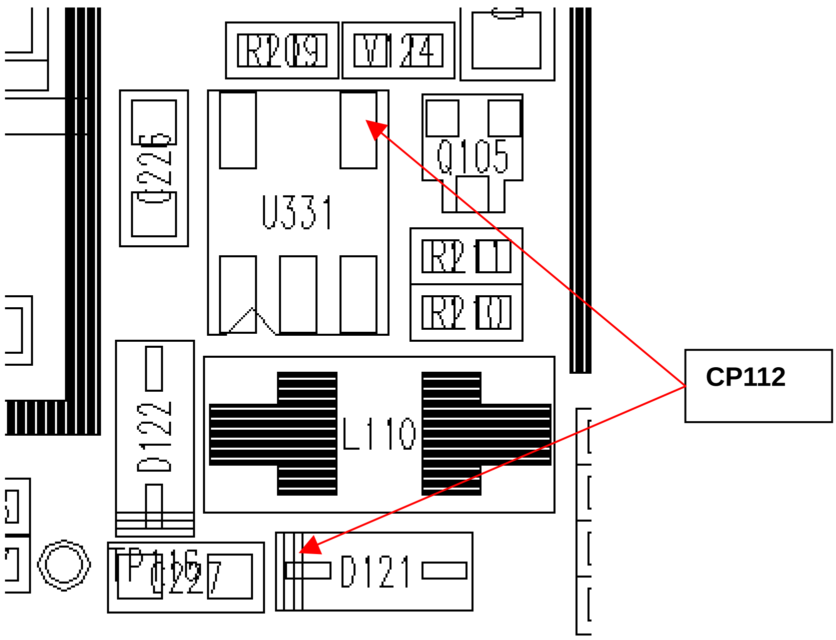
3. Check Q102



6.1.4 LCD Backlight Not in Operation (White)

1. Check to see if U331.4 or R209 pins are controlled GPIO (2.8V): CP112
2. Check to see if D121 or PAD2 1pin is around 10V.





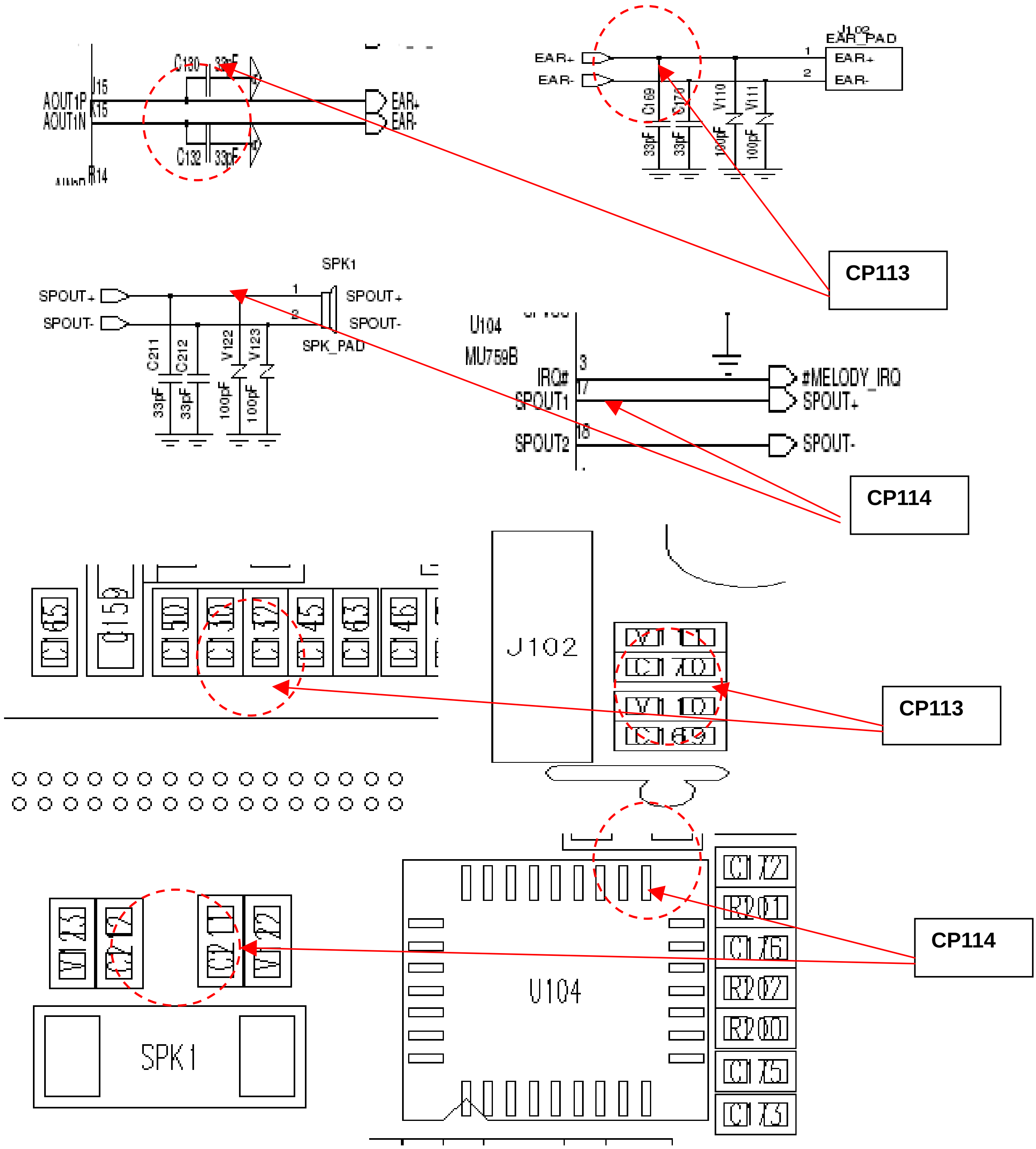
6.2 Audio Part (Earpiece, Hands-free Earphone, Microphone, Hands-free Mic)

6.2.1 No receiving tone heard (Ear-piece)

1.DTMF,BEEP TONE: Check U102.J15 and K15(C130,C132,C169,C170) pins (Ear Signal) for waveform : CP113 NO → Replace U102.

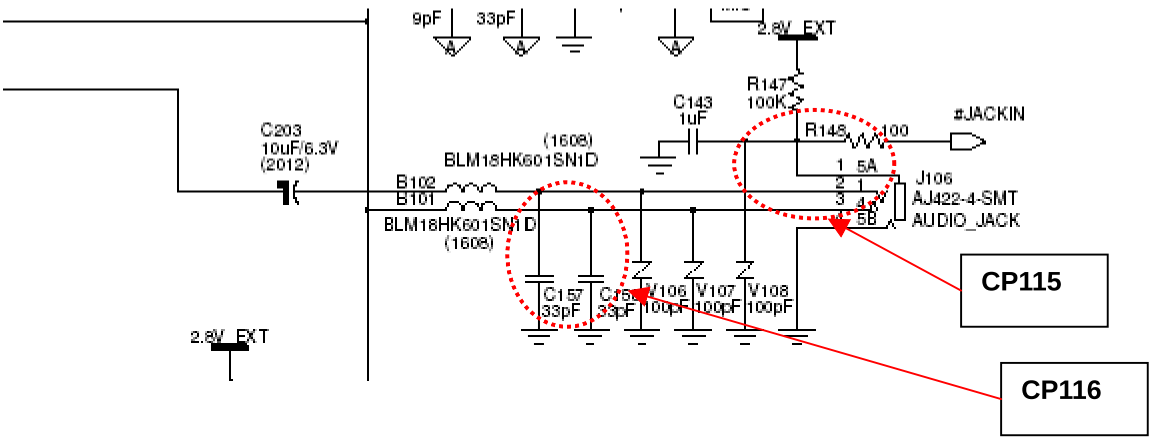
2.VOICE,BELL TONE : Check U104.17,18 and C211,C212 pins for waveform. : CP114

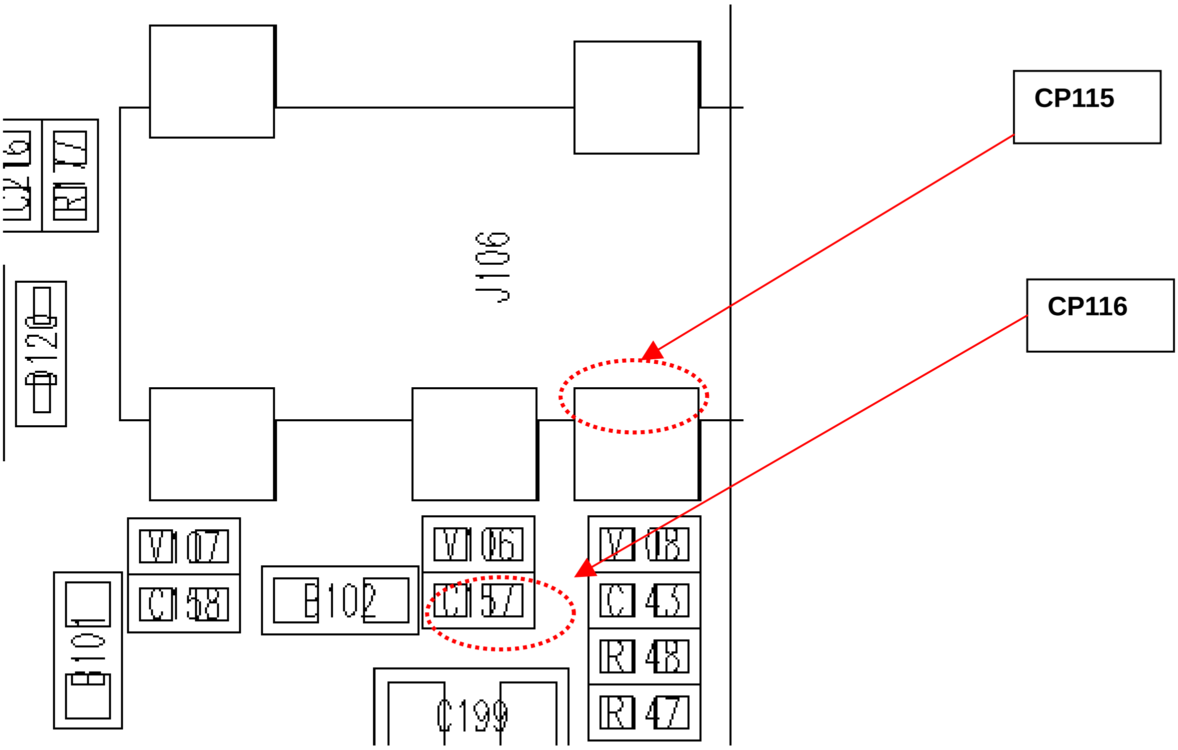
NO → Replace U104.



6.2.2 No Receivng tone heard (Hands-free Earphone)

1. Check to see if U101.B11 (J106.1) is around 0V:
   NO → Check to see J106 : CP115
   Set to HP8922M to connect a call and then set to 1kHz.
2. Check C157 pin for waveform : CP116
3, Check Hands-free Earphone





6.2.3 Side Tone Not transmitted (Ear-piece)

Repeat 6-2-1 No receiving tone heard.(Ear-piece)

1. Check to see if Mic + pin is around 1.84V : CP117

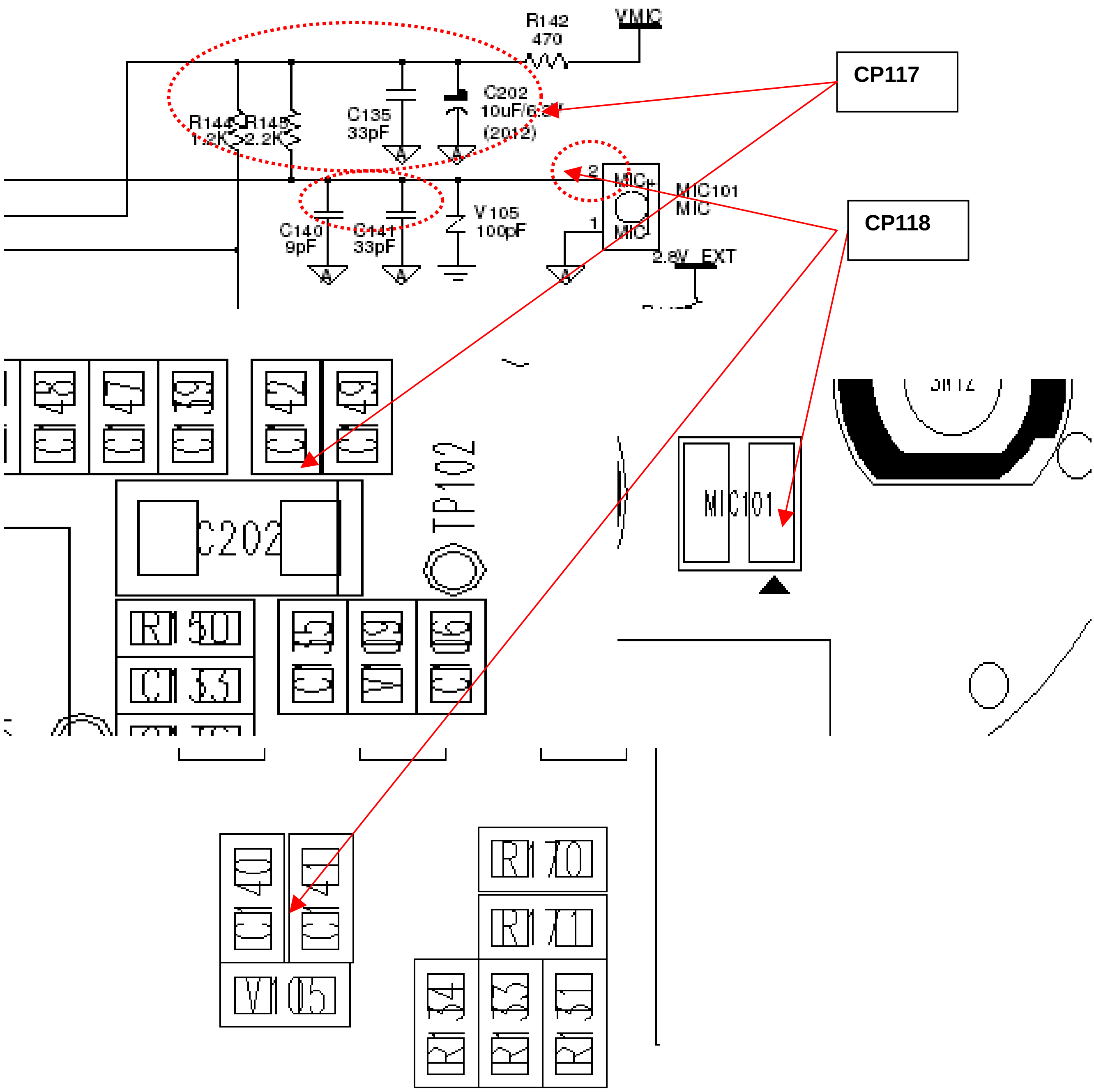
NO → Check that R142, C202, C135 and R145 is cold solder, broken, short to the other PCB pattern or not

If you find out any defective part, you replace it.

Set to HP8922M to connect a call and then set to 1kHz with Echo audio mode.

2. Check C140.C141 pins for wave form : CP118

NO→ Replace MIC



6.2.4 Side Tone Not transmitted (Hands-free Mic.)

Repeat 6-2-2 No receiving tone heard.(Hands-free Earphone).

1. Check to see if R144 pin is 2.5V : CP119

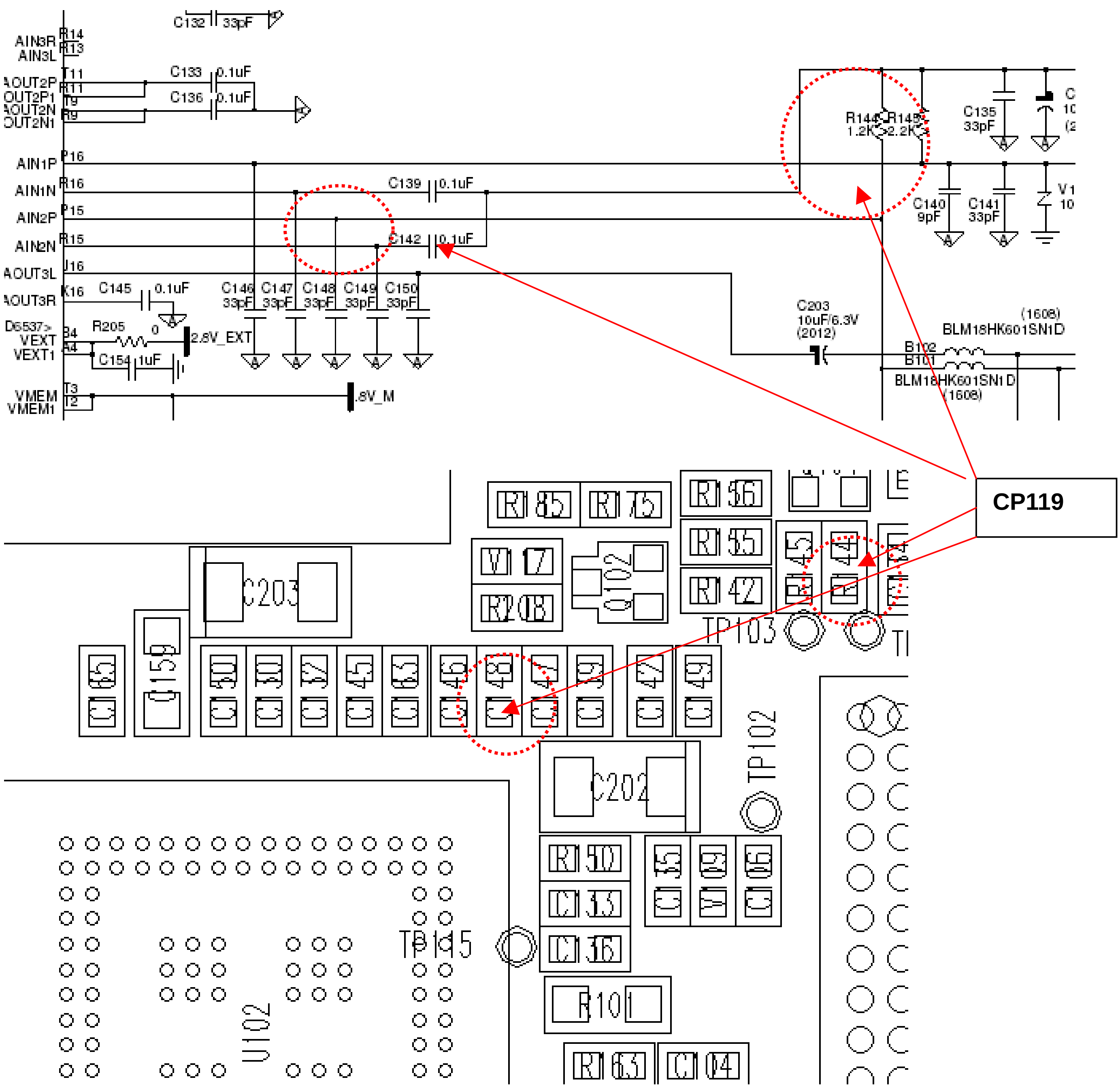
NO → Check that C148 is cold solder,broken,short to the other PCB pattern or not.

If you find out any defective part, you replace it.

Set to HP8922M to connect a call and then set to 1kHz with Echo audio mode.

3. Check C148 pins for wave form : CP119

NO → Replace Handsfree Mic.



6.2.5 Hook Switch not working

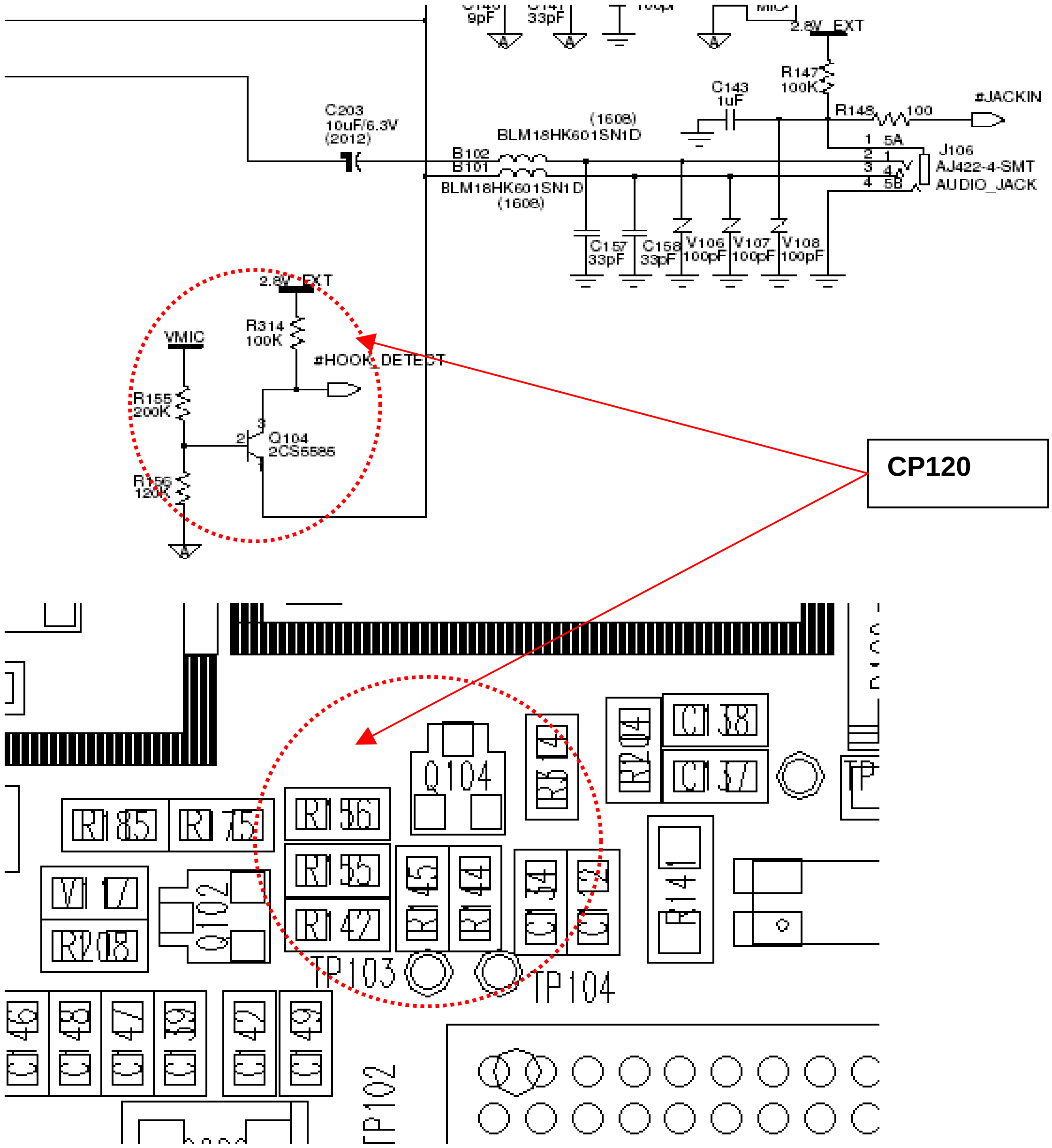
1. Check to see if Q104.1 pin is 2.4V : CP120
2. Check to see if Q104.1 pin is 0V during pressing Hook Switch : CP120

   NO → Check that R155 and R156 cold solder, broken, short to the other PCB pattern or not

   If you find out any defect, you replace it
3. Check to see if Q104.1 pin is around 0V, when you press Hook Switch : CP120

   NO→ Check that Q104 cold solder, broken, short to the other PCB pattern or not

   If you find out any defect, you replace it



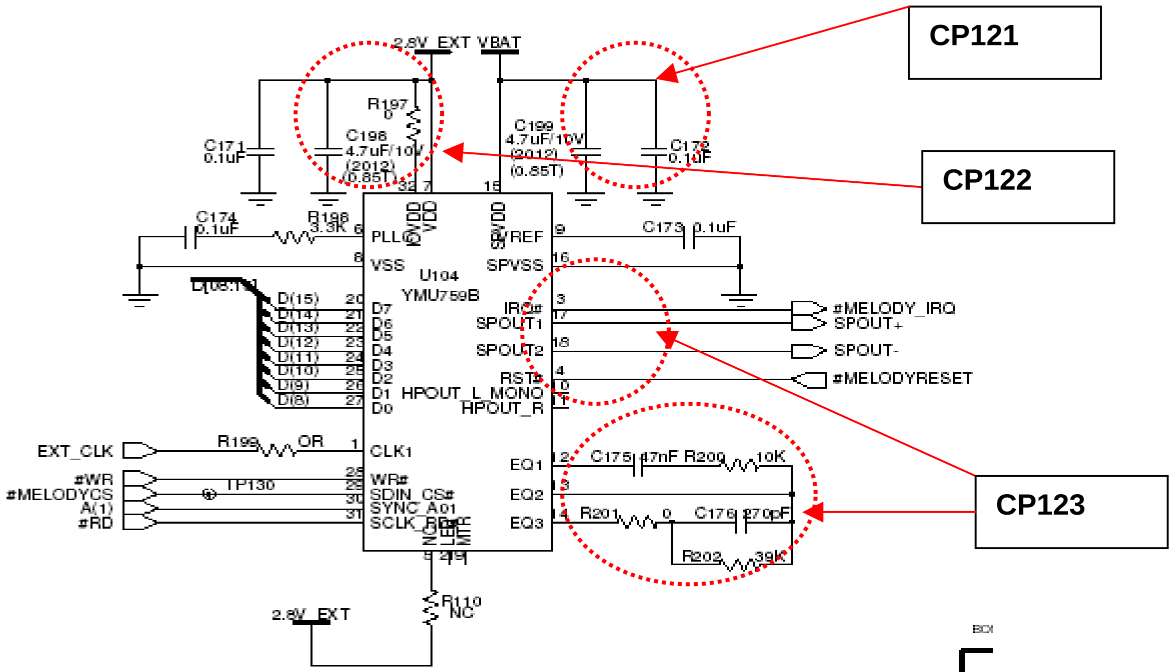
6.2.6 Melody not ringing

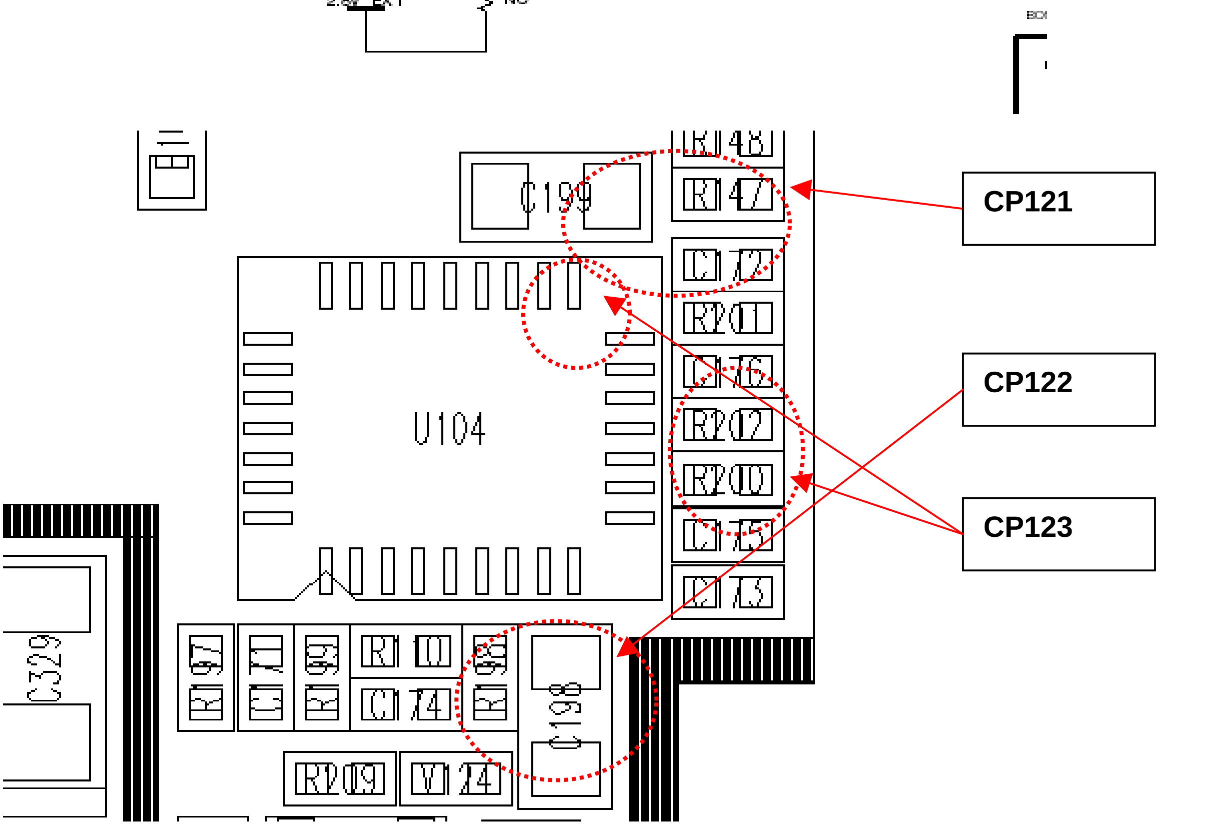
1. Check to see if C199, C172 is Vbat : CP121
2. Check to see if R197,C198 is 2.8 V : CP122

3.Check U104.12,13,14pin for waveform: CP123

NO → Check that C175,R200,R202,C176and R201 cold solder, broken, short to the other PCB pattern or not

Check U104,17,18pin SPOUT1,SPOUT2 for waveform : NO → replace SPK.





6.2.7 Vibrator not working

1. Check to see if Q103.1 pin is 2.8V (duty : 60%, 70Hz) : CP124

   NO → Check to see Q103 cold solder, broken, short to the other PCB pattern or not

   If you find out any defect, you replace it

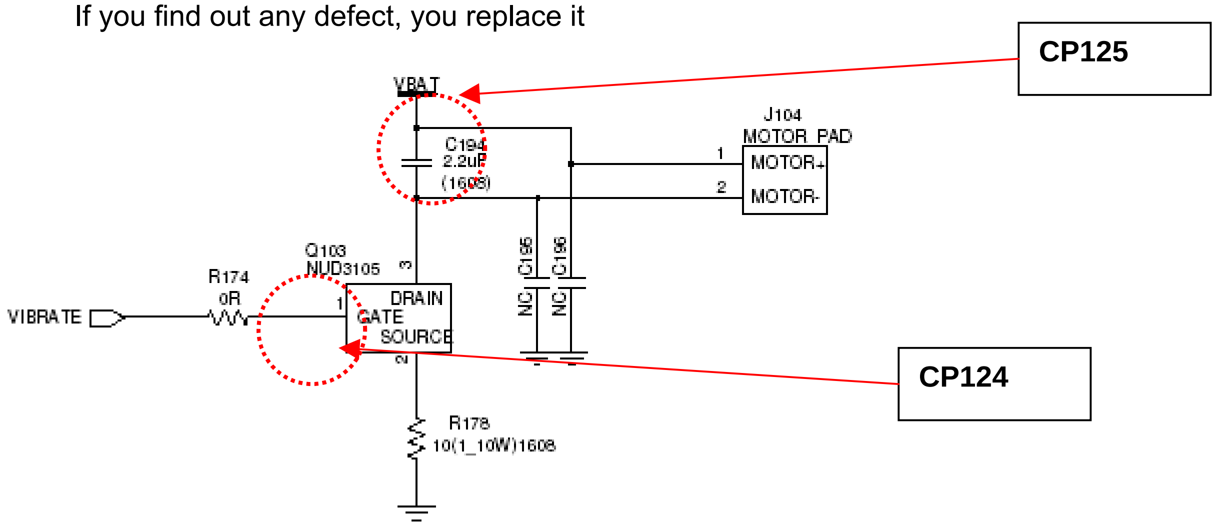
2. Check to see C194 is same with battery power : CP125

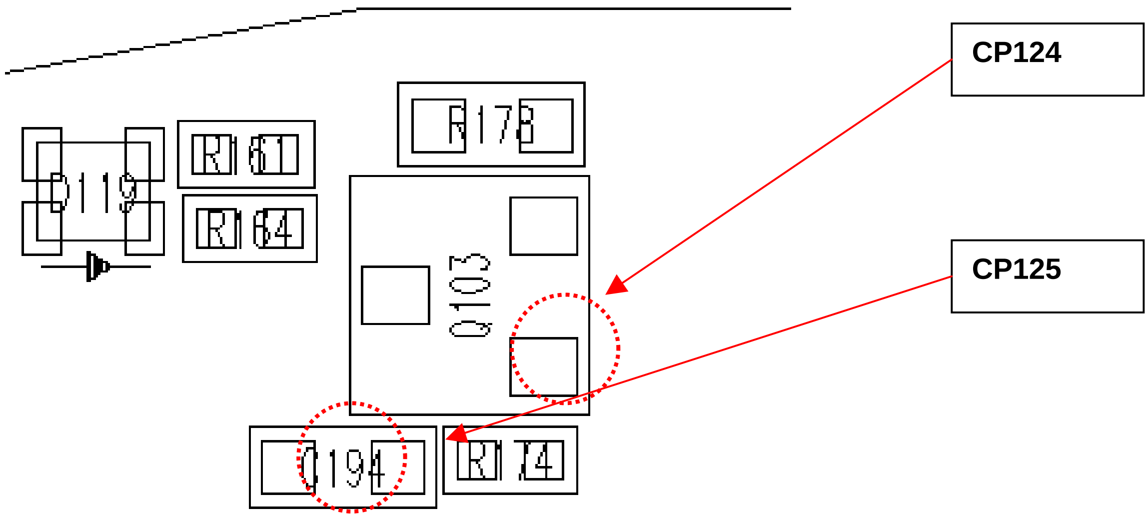
   NO → Check to see Q103 cold solder, broken, short to the other PCB pattern or not

   If you find out any defect, you replace it

3.Check to see Vibrator

   If you find out any defect, you replace it





6.3 SIM card part

6.3.1 SIM error

1. Check to see if J105.1 pin is around 2.85V : CP126

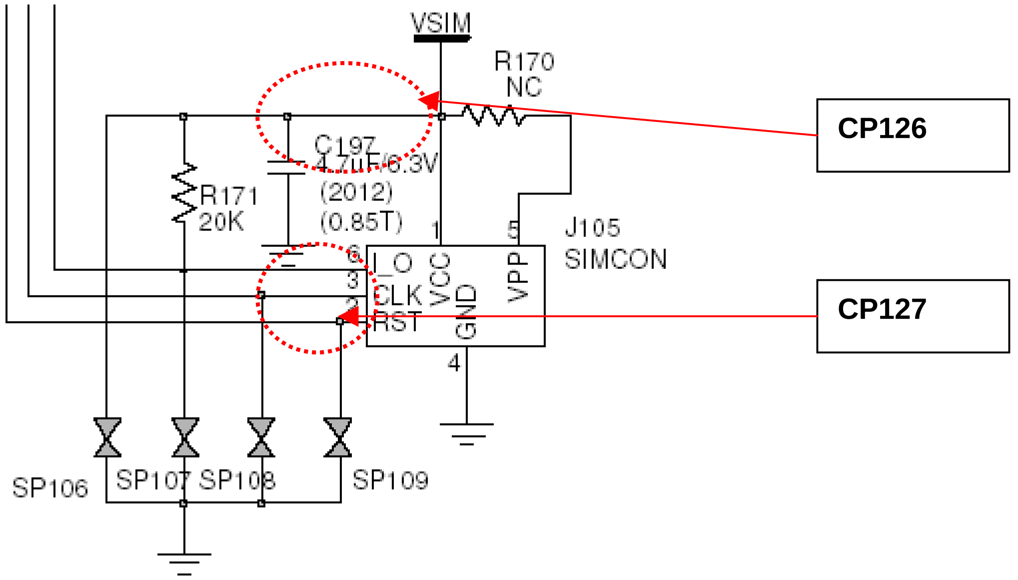
NO → Check to see C197 pin cold solder, broken, short to the other PCB pattern or not :

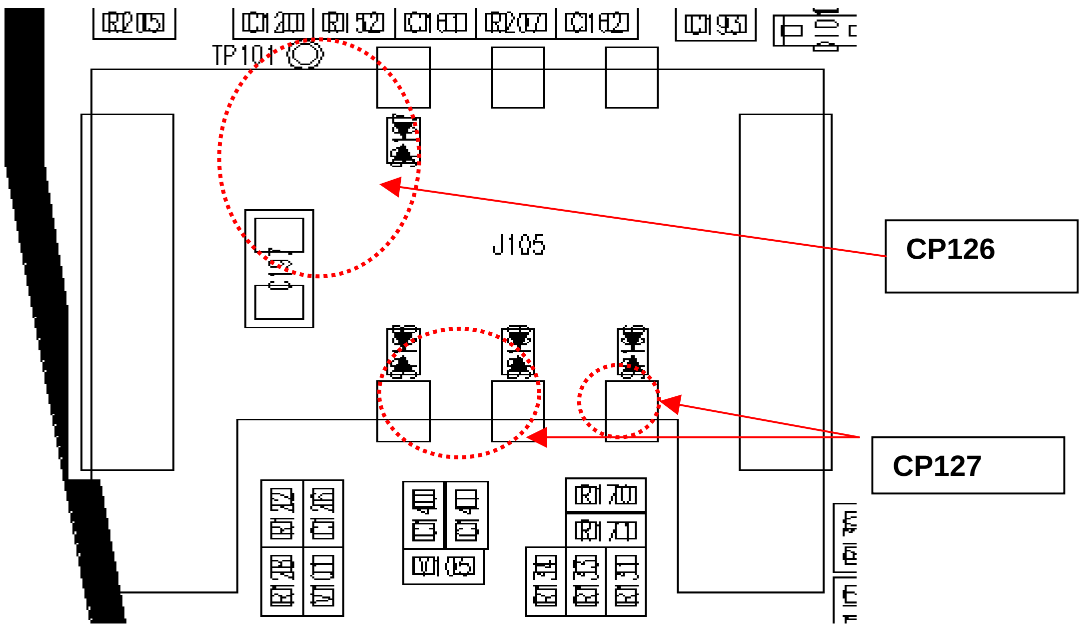
If you find out any defect, you replace it

2.Check to see J105.2, 3, 6 for wave form : CP127

NO → Check to see J105, R171 cold solder, broken, short to the other PCB pattern or not

If you find out any defect, you replace it





6.4 Charger part

6.4.1 Charging error

Insert adaptor into I/O jack.

1. Check to see if F100, D118 pin is 5.2V : CP128

   NO → Check to see J101.23, 24(I/O connector) pin and F100, D118 cold solder, broken, short to the other PCB pattern or not :

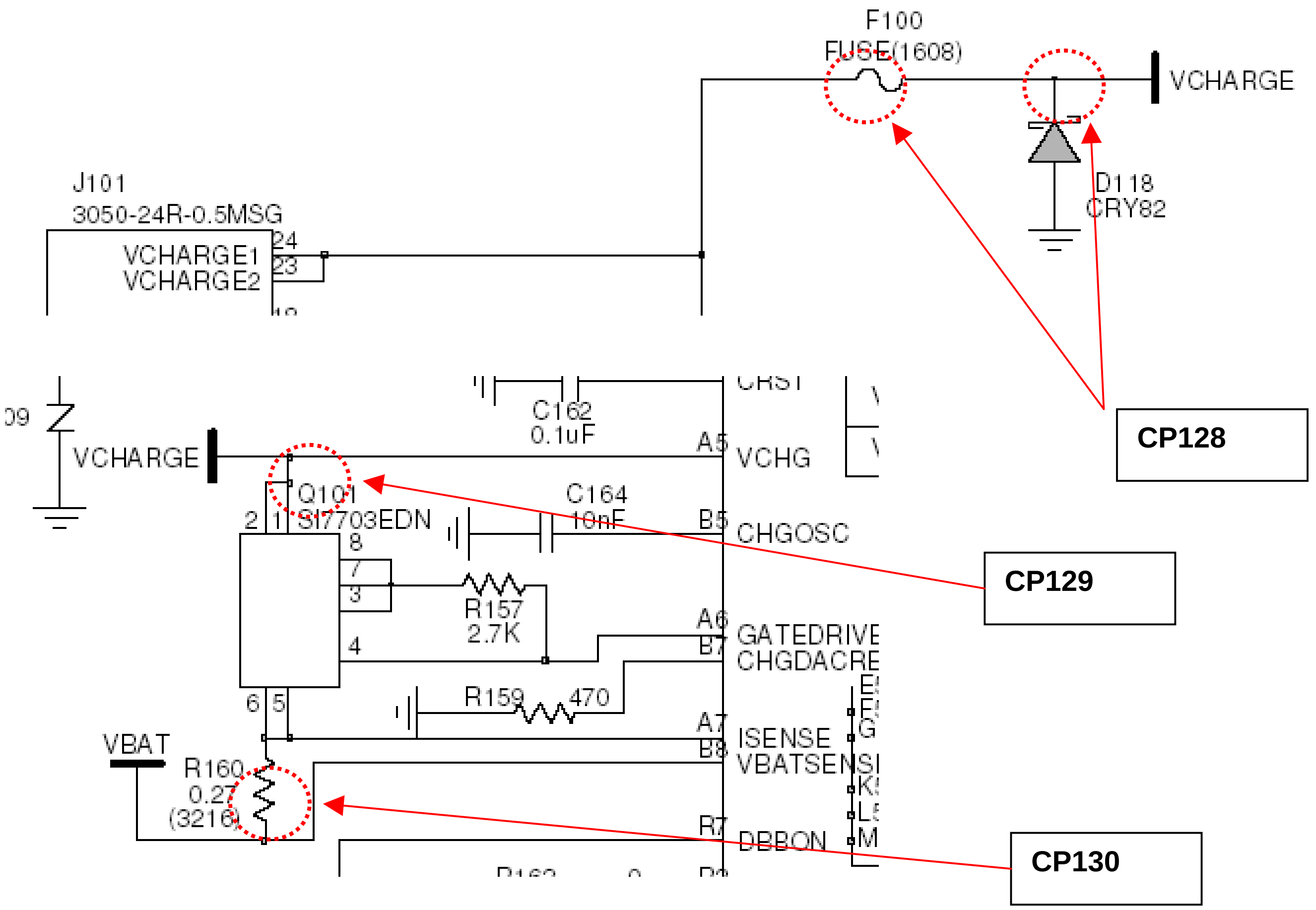
   If you find out any defect, you replace it

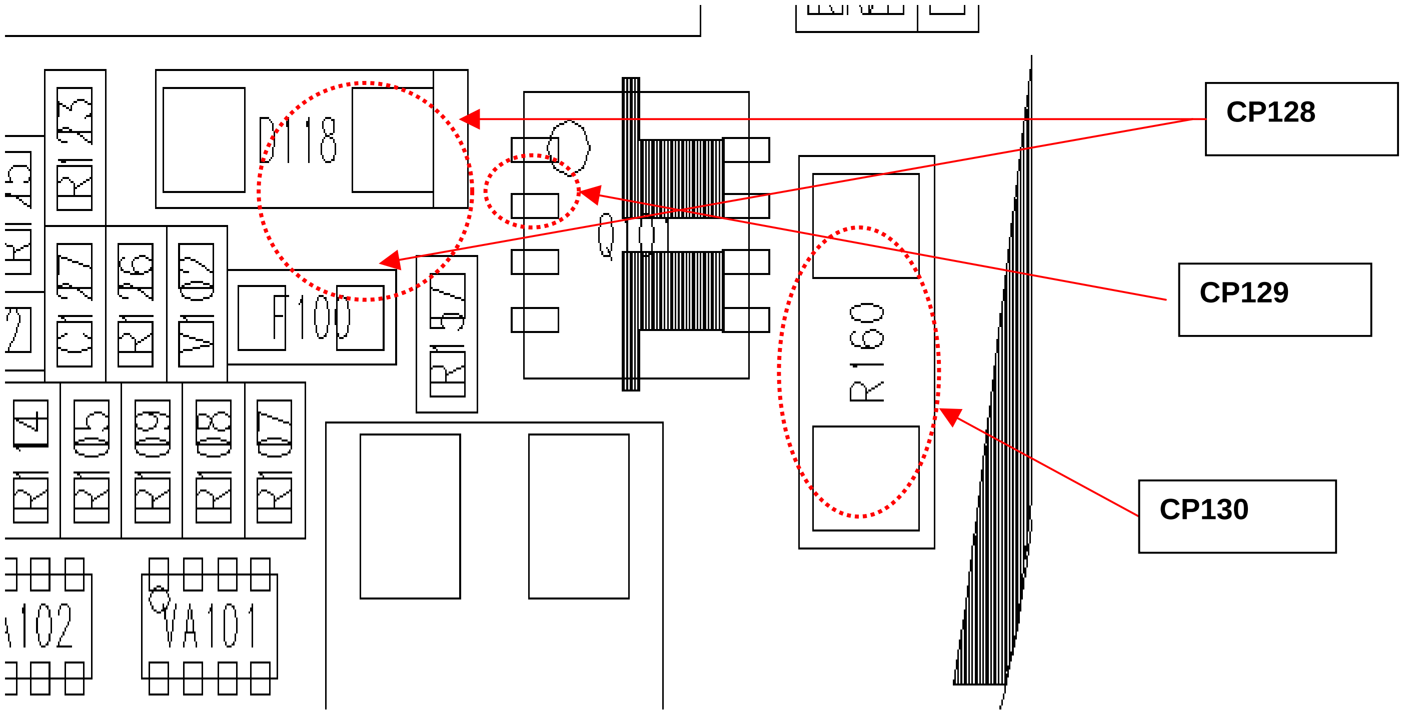
2. Check to see Q101 No.1,2 pin is 5.2V : CP129

   NO → Check to see Q101, R157, R159, C164 cold solder, broken, short to the other PCB pattern or not

   If you find out any defect, you replace it

3. Check to see R160.1 and R160.2 between voltage is about 150mV : CP130





CP128
CP129
CP130
D118
F100
Q101
R160
VA101

6.5 RF Part

6.5.1 Test conditions

1. Test condition 1 : VBAT = 3.8V during all tests

2. Test condition 2 : Traffic channel :GSM850 Band
   Tx mode
   Ch190
   Power Level : 13

3. Test condition 3 : Traffic channel : PCS Band
   Tx mode
   Ch662
   Power Level : 10

4. Test condition 4 : Traffic channel :GSM850 Band
   Rx mode
   Ch190
   Input power : -70dBm

5. Test condition 5 : Traffic channel : PCS Band
   Rx mode
   Ch662
   Input power : -70dBm

6. RF power values are measured using 50Ω coaxial cable.

6.5.2 Power Supply Check Point

Step	Test point	Typical Value	Condition	Checking Point
2-1	U305 Pin#1	3.8V	2, 3, 4, 5	Check route connection : VBAT
2-2	U305 Pin#5	2.8V	2, 3, 4, 5	Check route connection : VBAT
2-3	U303 Pin#4	3.8V	2, 3, 4, 5	Check route connection : VBAT
2-4	U303 Pin#5	2.8V	2, 3, 4, 5	Check route connection : VCC_RFCHIP

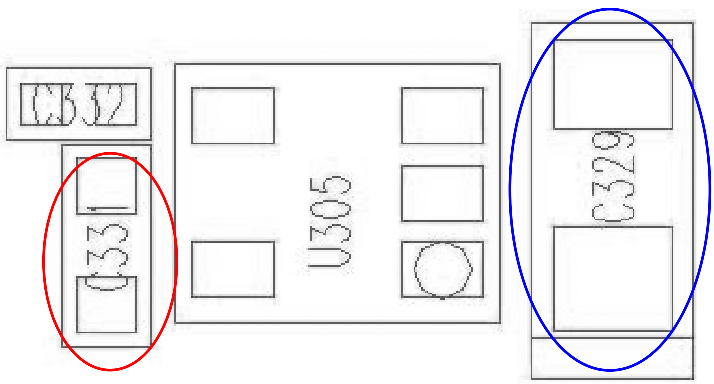


Fig.6-1 U305 Regulator Power Supply PCB Layout

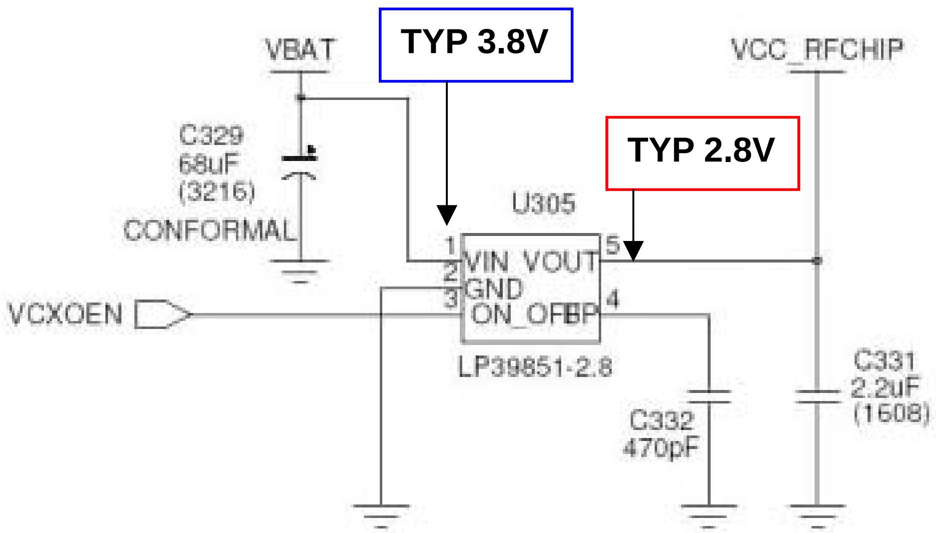


Fig.6-2 U305 Regulator Power Supply Schematic

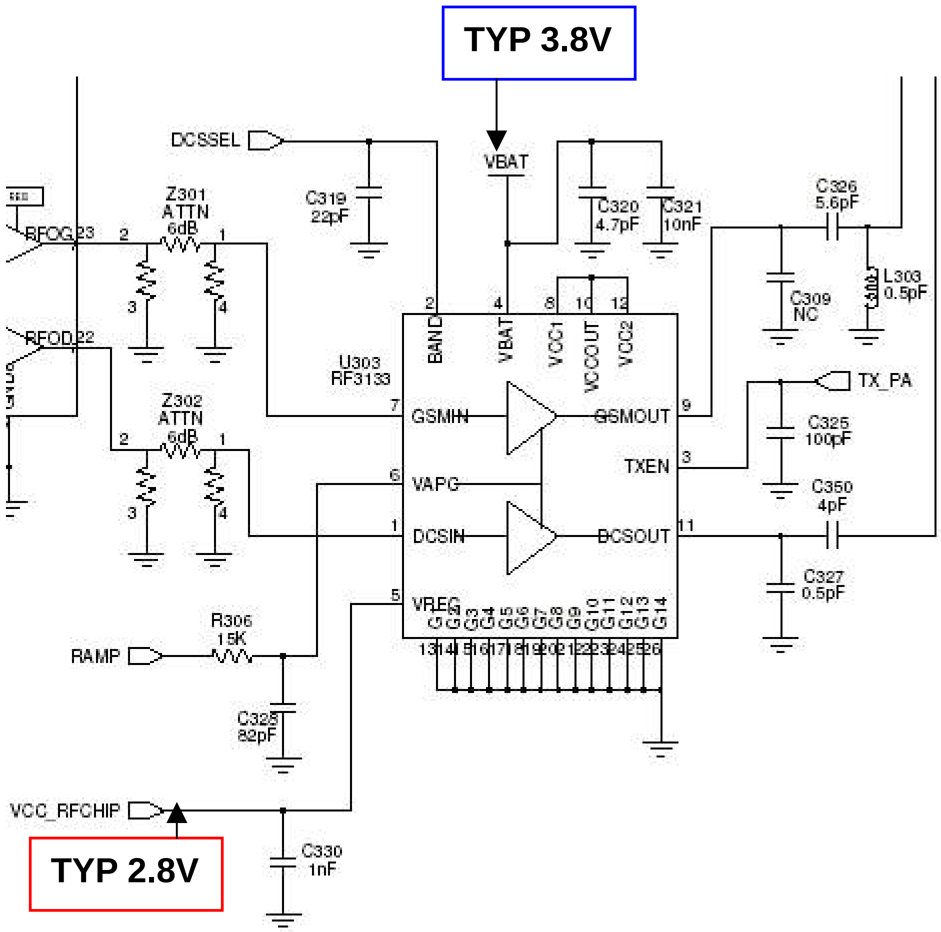


Fig.6-3 U303 PAM's Power Check Point

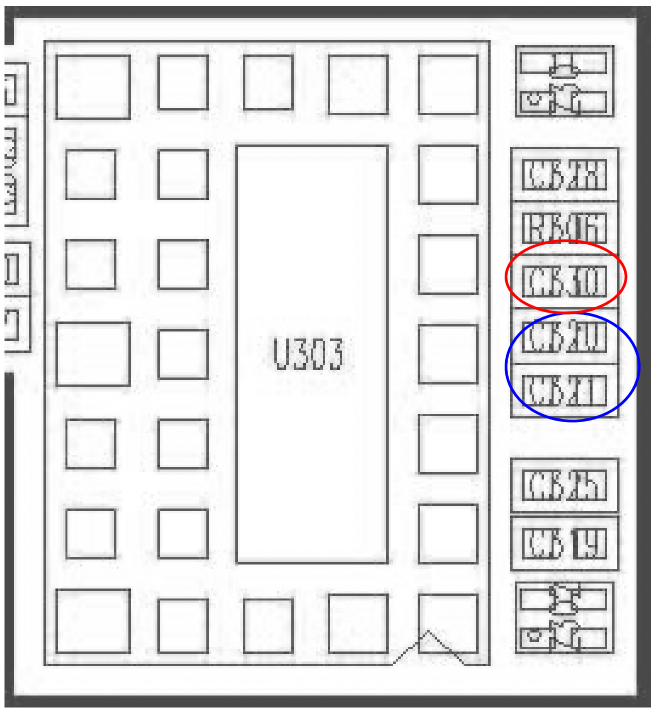


Fig.6-4 U303 PAM's PCB Layout

6.5.3 Power Amplifier Module

- First check the Power Supply Check point following 6.3.2. Then you can trace the guideline of PAM as follows .

Step	Test point	Typical Value	Condition	Checking Point
3-1	U303 Pin#3	Logic High	2, 3	Check route connection : TXEN
3-2	U303 Pin#2	Logic High	3, 5	Check this pin 2, When Logic High, then PCS Mode. While Logic Low , GSM850 mode is operating.
		Logic Low	2, 4	

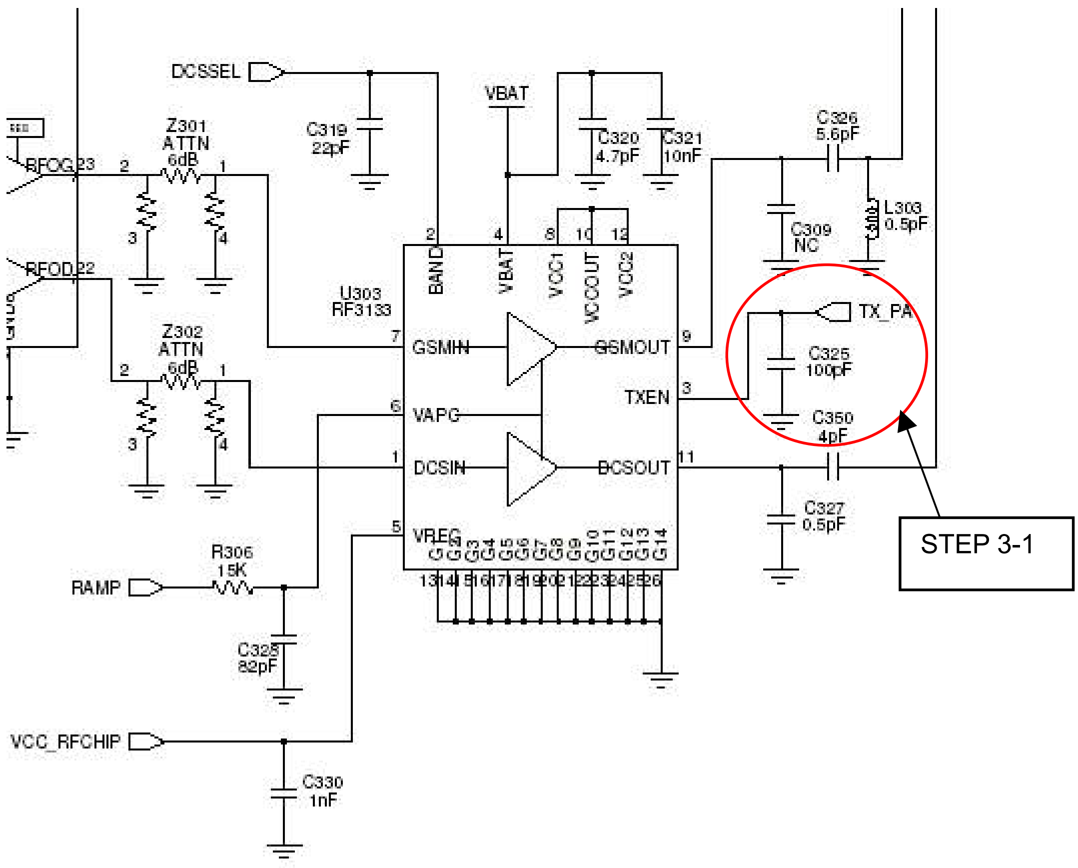


Fig.6-5. U303 PAM TXEN Test Point Circuit

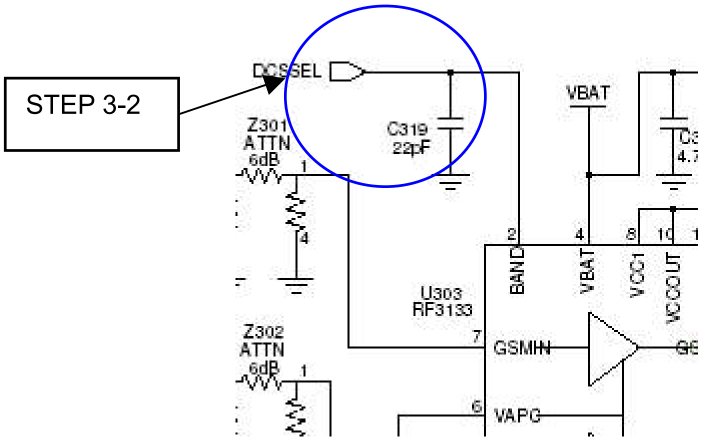


Fig.6-6. U303 PAM PCSSEL Test Point Circuit

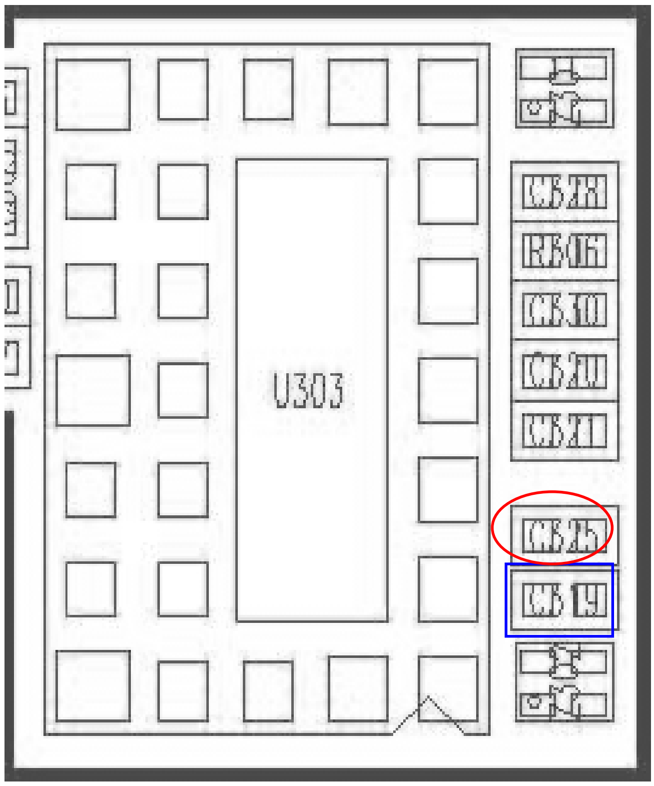


Fig.6-7. U303 PAM TXEN and PCSSEL Test Point on the PCB Layout

6.5.4 VCTCXO

Step	Test point	Typical Value	Condition	Reaction to Abnormality
4-1	U302 Pin#1	0.5V ~ 2.5V	2, 3, 4, 5	Check route connection : AFC
4-2	U302 Pin#4	2.8V	2, 3, 4, 5	Check route connection : VTCXO

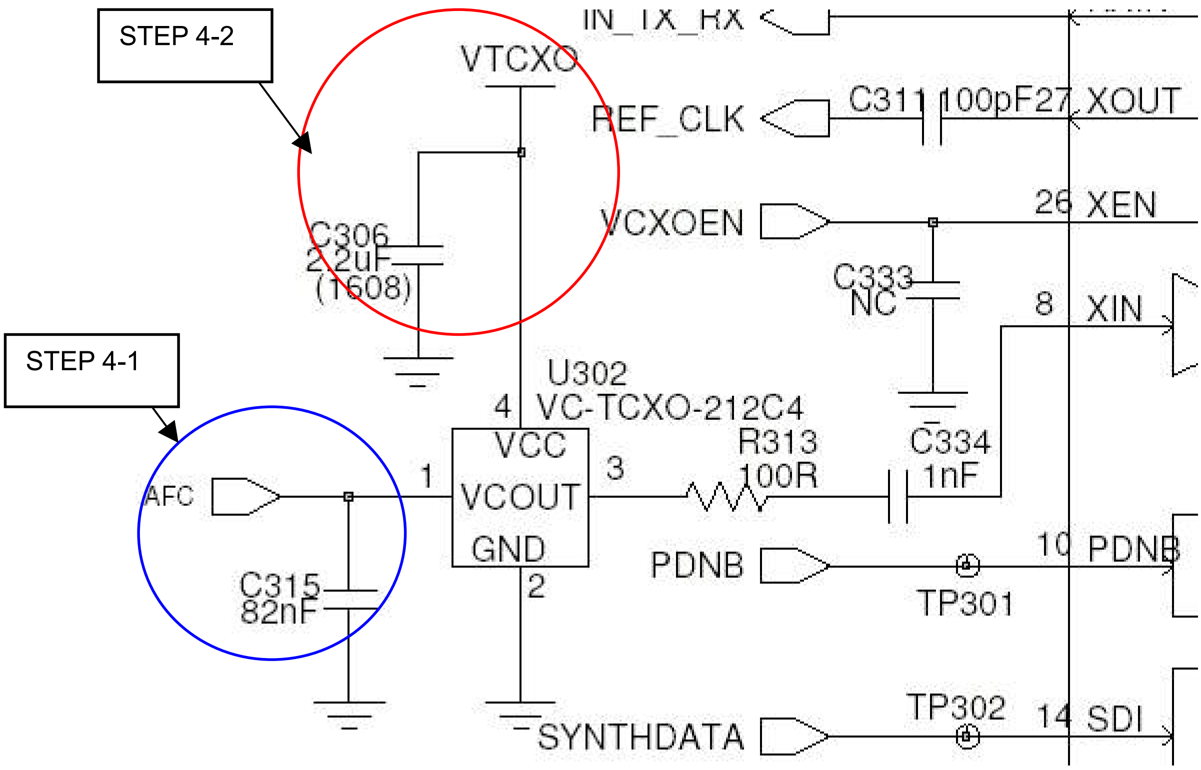


Fig.6-8. U302 VCTCXO Check Point Circuit

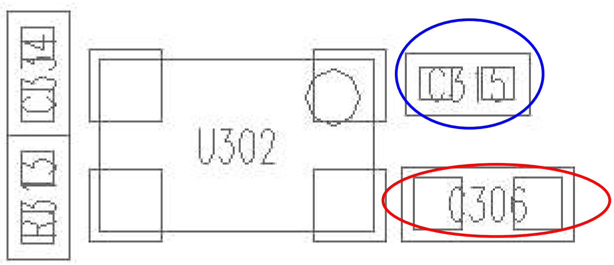


Fig.6-9. U302 VCTCXO Check Point on the PCB Layout

6.5.5 Antenna Switch Module

Step	Test point	Typical Value	Condition	Check point
5-1	U320 Pin#11	2.6V	2	When Pin#11 is Logic High and Pin#2 is Logic Low the mode is GSM 850 band. While Pin#2 is Logic High and Pin#11 is Logic Low the operating mode is PCS band.
5-2	U320 Pin#2	2.6V	3	

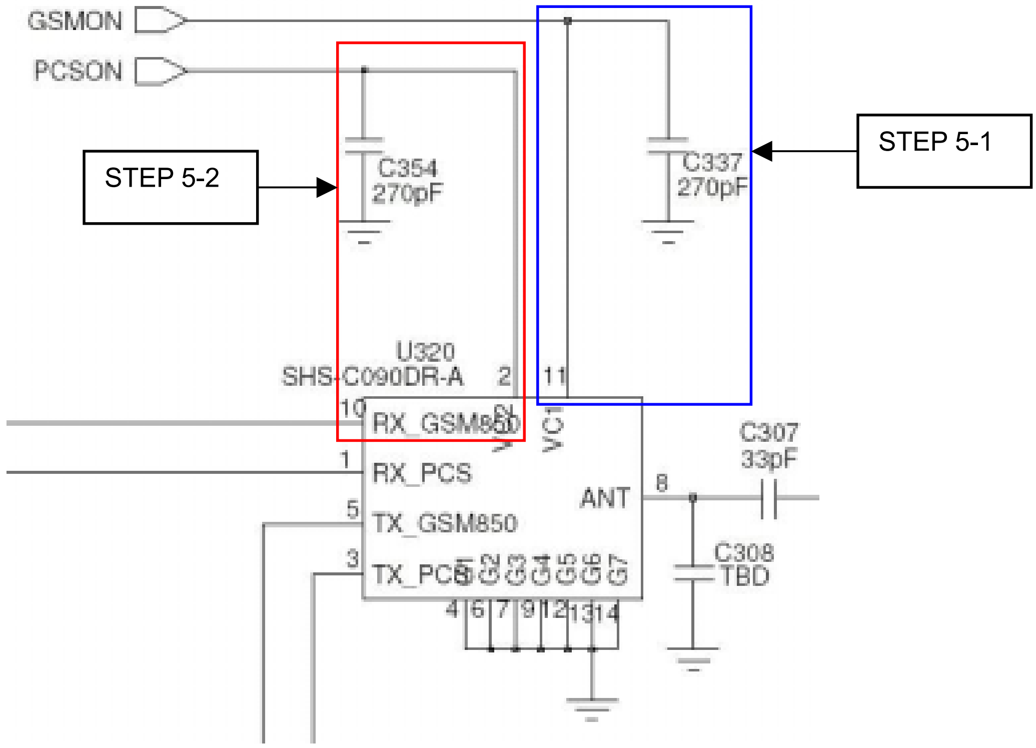


Fig. 6-10 U320 Antenna Switch Module Circuit

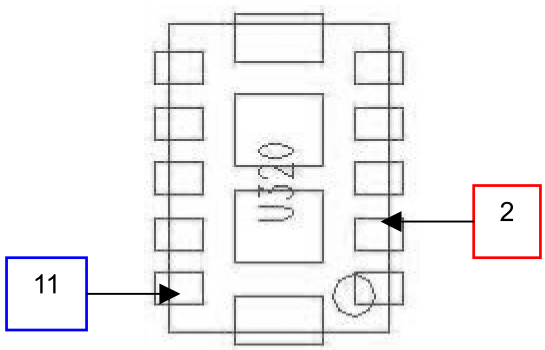


Fig. 6-11 U320 Antenna Switch Module PCB Layout