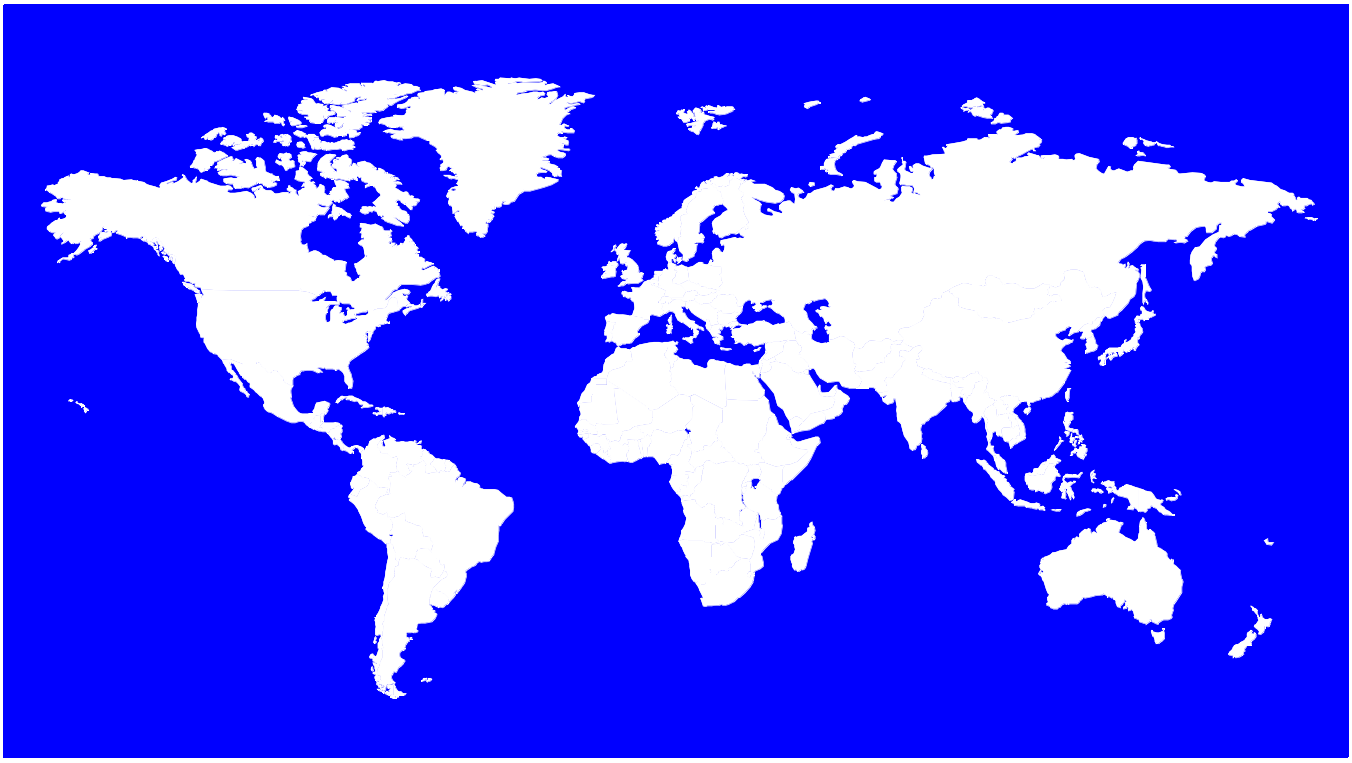
MOTOROLA

Cellular Subscriber Sector

CDMA StarTAC 800Mhz
Dual Mode-CDMA/Amps, Namps



The World's Leading Cellular Telephone Manufacturer

Service Manual
Level III
ST7860W / P8160 / T8160

COMPUTER SOFTWARE COPYRIGHTS

MOTOROLA

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Preface

ST7860 vs.ST7760

Logic Changes

- The biggest change from ST7760 is a new IC called Casper (U1100). Casper is the 338 CPU, DSP, and CRIB ASIC in one package. However, it is identical in architecture to ST7760 Hence, any lines that interface those chips together on ST7760 are all internal to the IC now. Obviously, any lines that interface with the rest of the board (CIA, GCAP, 3WB, Memory, and RF) are still external.
- Aux_Battery is eliminated; this has reduced the complexity of the battery circuitry. There are only two power sources now: 'BATT+" and 'EXT_B+'.
- The memory devices are larger. Consequently, the SRAM has an additional line running to it. The Flash's Chip Select scheme is slightly different than ST7760 because of a new memory map.
    - Flash: 8Mb & 16 Mb on ST7760 to 16 Mb and 32 Mb on ST7860
    - SRAM: 1Mb on ST7760 to 2Mb on ST7860
    - EEPROM: 128 kb on ST7760 to 256 kb on ST7860
- An External B+ Disconnect Circuit has been added (it is identical to AMPS V3620). If the voltage on Ext_B+ rises above 6.75V, a voltage detector disconnects Ext_B+ from the rest of the board. This is for over voltage protection.
- New 1.8V regulator. ST7760 ran the 338 CPU, DSP, and CRIB at 2.75V. ST7860 uses Casper that is powered by 1.8V.The ST7860 boards will be built in two different scenarios to supply this 1.8V. There is a new IC called CCAP Lite (U2000 drop-in) that is almost identical to GCAP Lite. The main difference you need to be concerned with is that GCAP Lite had Pin 3 (V_{OUT1}) disabled. This pin is the 1.8V regulator on CCAP Lite. This is the supply that CASPER runs off of. However, CCAP Lite's are in short supply right now. Hence, we will be using a second solution to supply the 1.8V to CASPER. ST7860 will be using the current GCAP Lite that is used on ST7760 and a discrete 1.8V regulator (U2100) located below the Flash (U1200). The initial shipping configuration of ST7860 will be with this layout.
- A new headset jack is being used to commonize 800 CDMA with ST7762 and ST7867. However, the detection scheme is slightly different than ST7760.
- The display is holographic films (similar to Iridium) and EL backlit displays.

RF Changes

- A CDMA intermediate frequency amplifier was added. This amplifier improves the receiver sensitivity in the low gain path in CDMA mode.
- An amplifier used to isolate the main VCO from the RX and TX was changed from a monolithic device to a discrete design.
- The control circuitry and DC levels to the switch used to match the antenna in both the up and down position was modified.

Mechanical Changes

- Since there will be no Aux_Batt support in ST7860, there is no need for external Aux. Batt. contacts on the rear housing. Hence, ST7860 will be shipping with the same front and rear housings as ST7760 with the exception of the Aux. Batt. contacts. The rear housing will look similar to the AMPS StarTAC 3000. The top flip will be identical.

Specifications

Overall System

Table 1:

Function	*Specification*
Frequency Range	824.04 - 848.97 MHz Tx, Channels 1 to 799, $f_{Tx} = 0.03 * N + 825$ MHz Channels 990 to 1023, $f_{Tx} = 0.03(N—1023) + 825$ MHz 869.04 - 893.97 MHz Rx Channels 1 to 799 is $f_{Rx} = 0.03 * N + 870$ MHz Channels 990 to 1023, $f_{Rx} = 0.03(N—1023) + 870$ MHz
Channel Spacing	30 KHz
Channels	832
Duplex spacing	45 MHz(amps)
Frequency Stability	+/- 2.5 ppm (Amps)
Operating Voltage	3.6 - 4.8 VDC
Display	96 X 32 LCD
RF Power Output	0.6 watts - 28.0 dBM into 50 ohms (AMPS, nominal) 0.25 watts - 24.0 dBM into 50 ohms (CDMA, nominal)
Input/Output Impedence	50 ohms (nominal)
Spurious / Harmonic Emissions	Complies with Title 47, Part 22 of the code of Federal Regulations.
Audio Distortion	Less than 5% at
Hum and Noise(C-MSG)	32 dBm below +/- 8kHz deviation(transmit and recieve)
Modulation	F3: + 12 kHz for 100% at 1 kHz, AMPS (wide) 1M25D1W (1.25 MHz bandwidth) CDMA
Transmit Audio Response	6 dBm/octave pre-emphasis
Transmit Audio sensitivity	(AMPS) + 2.9 kHz deviation (nom.) @ 97 dBm SPL input @ 1 kHz
Transmit Duty Cycle	full, 1/2, 1/4, 1/8 rate (CDMA Mode)
CDMA Transmit Waveform Quality(Rho)	0.94
Reciever Sensitivity	-116 dBm (AMPS, SINAD, C-MSG weighted) -104 dBm (CDMA, 0.5% Static FER)

Table 1:

Function	*Specification*
Alternate Channel Desense Protection	-60 db@+/- 60kHz (Amps)

Table 2: Environmental

Function	*Specification*
Temprature Range	Operational -30 o C to +60 o C (-22 o F to +140 o F) Storage -55 o C to +85 o C (-67 o F to +185 o F) Thermal Shock -40 o C to +85 o C (-40 o F to +185 o F) meets Mil. Std. 810C
Shock	Exceeds EIA Standards RS152B (Section 15) and IS-19
Drop	Exceeds EIA Standards RS316B and IS-19
Humidity	95% Relative Humidity; meets EIA Standard IS-19
Vibration	Exceeds EIA Standards RS316B and IS-19
Salt Fog	Salt Solution fog at 35 o C (95 o F), tested for 48 hours
Dust	140 mesh blown silica flour test, tested for 5 hours
Notes:	• EIA (Electronic Industries Association) Standard RS152B states the minimum stan-dards for Land Mobile Communications, FM or PM transmitters 25-470 MHz. • EIA IS-19 states the recommended standards for 800 MHz cellular subscriber units. • EIA Standard RS316B states the standards for portable land mobile communications. • U.S. Military Standard 810D establishes uniform environmental test methods for deter-mining the resistance of equipment to the effects of natural and induced environments peculiar to military operations. • TIA/EIA/IS-98 Recommended Minimum Performance Standards for Dual-Mode Wide band Spread spectrum Cellular Mobile Stations.

Specifications subject to change without notice.

Foreword

Scope of Manual

This manual is intended for use by experienced technicians familiar with similar types of equipment. It is intended primarily to support basic servicing, which consists primarily of mechanical repairs and circuit board replacement.

Authorized distributors may opt to receive additional training to become authorized to perform limited component repairs. Contact your regional Customer Support Manager for details.

Model and Kit Identification

Motorola products are specifically identified by an overall model number on the product label. In most cases, assemblies and kits which make up the equipment also have kit numbers stamped on them.

Replacement Parts Ordering

Motorola maintains a parts office staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Cellular products. Orders for all parts should be sent to the Motorola International Logistics Department at the following address:

Attn.: Global Spare Parts Department
Motorola Cellular Subscriber Group
2001 N, Division St.
Harvard, IL 60033-3674
U. S. A.
FAX: 1-815-884-8354

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Service

Motorola's regional Cellular Subscriber Service Centers offer some of the finest repair capabilities available to Motorola Subscriber equipment users. The Cellular Subscriber Service Centers are able to perform computerized adjustments and repair most defective transceivers and boards. Contact your regional Customer Service Manager for more information about Motorola's repair capabilities and policy for in-warranty and out-of-warranty repairs in your region.

General Safety Information

CAUTION

Do not jump start vehicle or use an automotive battery charger while the vehicle adapter option and the portable radiotelephone are connected to the vehicle electrical system, as this may cause serious damage to the radio. Disconnect the radio by removing the cable kit fuses.

Portable Operation

DO NOT hold the radio so that the antenna is very close to, or touching, exposed parts of the body, especially the face or eyes, while transmitting. The radio will perform best if it is held in the same manner as you would hold a telephone handset, with the antenna angled up and over your shoulder. Speak directly into the mouthpiece.

DO NOT operate the telephone in an airplane.

DO NOT allow children to play with any radio equipment containing a transmitter.

Mobile Operation (Vehicle Adaptor)

As with other mobile radio transmitting equipment, users are advised that for satisfactory operation of the equipment and for the safety of personnel, it is recommended that no part of the human body shall be allowed to come within 20 centimeters of the antenna during operation of the equipment.

DO NOT operate this equipment near electrical blasting caps or in an explosive atmosphere. Mobile telephones are under certain conditions capable of interfering with blasting operations. When in the vicinity of construction work, look for and observe signs cautioning against mobile radio transmission. If transmission is prohibited, the cellular telephone **must be turned off** to prevent any transmission. *In standby mode, the mobile telephone will automatically transmit to acknowledge a call if it is not turned off.*

All equipment must be properly grounded according to installation instructions for safe operation.

DESCRIPTION

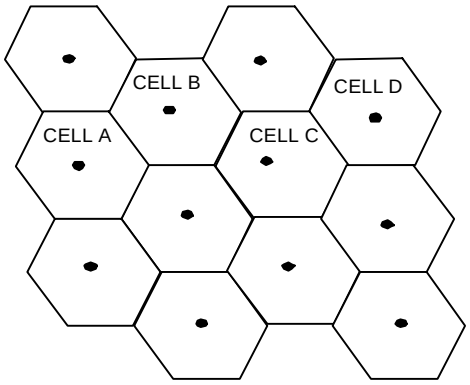
Table 3:

Note
The following description is intended only as a preliminary general introduction to cellular systems. This description is greatly simplified and does not illustrate the full operating capabilities, techniques, or technology involved in cellular systems.

Overall Concept

Cellular systems are used to provide radio-telephone service in the frequency range of 824-894 MHz.
A cellular system provides higher call handling capacity and system availability than would be possible with conventional radiotelephone systems that require total system area coverage on every operating channel. The cellular system divides the system coverage area into several adjoining sub-areas, or cells. Each cell contains a base station (cell site) which provides transmitting and receiving facilities. CDMA is a "spread spectrum" technology, which means that it spreads the information contained in a particular signal of interest over a greater bandwidth than the original signal. With CDMA, unique digital codes, rather than separate RF frequencies or channels are used to differentiate subscribers. The codes are shared by both the mobile station and base station and are called "pseudo-random code sequences". Since CDMA is a spread spectrum technology, all users share a range of the radio spectrum. CDMA cell coverage is dependent upon the way the network is designed. For each system 3 characteristics must be considered: coverage, quality, and capacity. These 3 must be balanced for desired lever of perfor-mance.
Some of the CDMA benefits are:
- Improved call quality with better and more consistent sound.
- Enhanced privacy.
- Variable rate vocoder.

Figure 1: Hypothetical Cell System



Operation

In Figure 1: "Hypothetical Cell System", the area bounded by bold lines represents the total coverage area of a cellular system.
This area is divided into several cells, each containing a cell site base station which interfaces radiotelephone subscribers to the switching system. Since there are no channels in CDMA, a user has a better chance of completing a call. Also, now there is no hard handoff between cell sites since all sites operate on the same frequency. This is called soft handoffs. In this system, subscribers in cell A & D simul-taneously operate in the same frequency. As a user moves from cell site to cell site, the base station monitors the signal strength of the user. Based on this signal strength, the base station decides which cell shall carry the call. When a radiotelephone is in use well within a cell, the signal strength received at the cell site base station will be high. As the phone is moved towards the edge of the cell, its received signal strength decreases.
Signal strength information therefore provides an indication of the subscriber's distance from a cell's base station. This change is handled

automatically, and is completely transparent to the user. For example, assume that a cellular tele-phone initiates a call in cell A and then moves across the system area through cells B and C to cell D. As the phone moves into cell B, it is instructed to change to a different frequency that operates through the B cell on that frequency. A similar change is performed when the phone moves from cell B to cell C and again when the phone moves from cell C to cell D. In this example, the radiotelephone has operated in four cell sites, through four cell sites, and on the same spread spectrum without interruptions in voice communications. As the radiotelephone leaves a cell, the frequency on which the phone and base station were operating is made available to another subscriber in that cell. Since this radiotelephone is dual mode, the radiotelephone can operate in either a CDMA system or Analog system.

Service Area

The area within which calls can be placed and received is defined by the system oper-ator. (Because this is a radio system, there is no exact boundary that can be drawn on a map.) If the portable is outside the radio service area, a No Svc (no service) message will appear on the phone's display, and calls cannot be placed or received. If this happens during a conversation, the call is lost. Places where the ability to place or receive calls would be lost are in totally enclosed areas, such as underground parking garages, in buildings without windows, and in elevators. This situation would be indicated either by the No Svc message illuminating, or by the sound of either a fast busy signal or a high-low siren signal when call placement is attempted. General usage in buildings having reason-able glass area is usually quite good. However, it may be necessary to move closer to a window to ensure reliable opera-tion.

Theory of Operation

Reciever Circuitry

RF enters the phone via the internal antenna, A1, or via the accessory connector. RF switch U75 selects which antenna is used. The received RF signal is routed through monoblock duplex filter FL75. Then the RF signal is routed through either a direct path through RF switches U100, or through additional gain and filtering stages,Q100, Q103, FL100, and Q150. The received signal then enters the Mixer U200.

The local oscillator input to the mixer is a 978-1004 MHz VCO, U626 controlled by the IF/Synthesizer IC U700. The 109.65 MHz mixer output is routed to separate paths for AMPS and CDMA modes.

Transmitter Circuitry

The modulated TX Offset VCO signal is mixed with-the 978-1004 MHz local oscil-lator signal in TX Mixer U400 to produce an 823-849 MHz transmit signal. This signal passes through filter FL400 and voltage controlled attenuator U400 which controls the TX output power. Then the TX signal is amplified by U450 and passes through Tx isolator U475. The output passes through the mono-block duplex filter FL75 to RF switch U75 to either the internal antenna or the accessory connector.

Frequency Synthesizer Circuitry

The phone contains three PLL frequency synthesizers in the IF/Synthesizer IC U700. One synthesizer controls the tunable 978- 1004 MHz main local oscillator, U626. The second synthesizer controls the TX offset oscillator (internal to U700) which operates at a fixed frequency of 309.3 MHz for AMPS, and 309.6 MHz for CDMA. The TX offset signal is divided by 2 before going to the TX mixer. TX modulation occurs in the TX offset
synthesizer in both AMPS and CDMA modes. The third synthesizer (also internal to U700) operates at a fixed frequency of 219.3 MHz for AMPS, 219.8 MHz for CDMA. This oscillator is divided by 2 and
used to mix the received first IF signal down to baseband. All synthesizers obtain their frequency reference from the 16.8 MHz reference oscillator, U325.

Transmit Power Control Circuitry

The power control signal controls voltage controlled attenuator U400 which is the TX mixer. A detected sample of the TX output signal with a variable reference voltage. A closed loop adjusts the Power Control signal such that the sampled RF signal level matches the reference level. In AMPS mode, the RF power range is +8 dBm to +28 dBM. In CDMA mode the RF power range is -50 dBm to +24 dBm. In CDMA mode, the power control can operate in either open-loop or closed-loop modes. In open-loop mode, the power level is proportional to the received signal level. In closed loop mode, the power level is controlled by the CDMA cell, based on received signal strength at the cell site.

Receive Audio - AMPS Mode

AMPS discriminator audio is routed to U1900 to be digitized. All receive audio filtering and gain control is performed in the digital domain by DSP U1600. The processed RX
audio is converted back to analog by U1900 and amplified by the GCAP IC U2000. The received audio is then routed to either the internal earpiece speaker.

Receive Audio - CDMA Mode

Received CDMA OQPSK data (RX I, RX Q) is gain

controlled and converted to digital by U1900. The 1.2288 Mb/sec. RX data stream is then decoded by the U1100 Modem IC to produce a signal containing only the desired data. The digital speech data is routed through the microprocessor U1100, decoded by the U1100 CELP Vocoder, and sent to U1900 to be converted into analog audio. The audio signal is then amplified by U2000 and sent to the earpiece speaker.

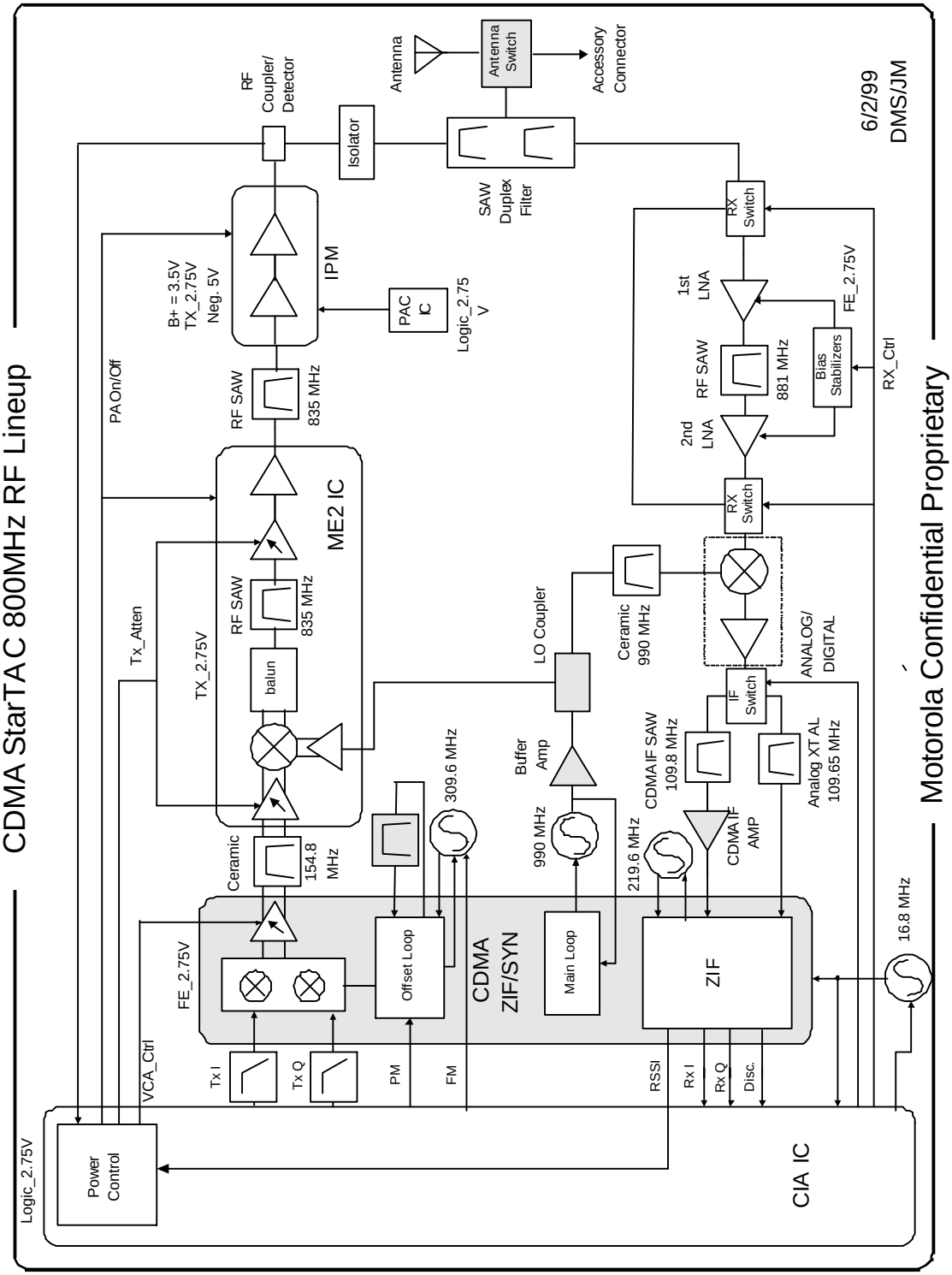
Transmit Audio - AMPS Mode

Audio from the internal microphone is ampli-fied and converted to data by U1900. In AMPS mode, the digitized microphone audio is then sent to DSP U1100 which performs all compression, pre-emphasis, limiting, and bandpass filtering functions in the digital domain. All AMPS signalling (SAT, ST, DTMF) is also generated in the digital domain by DSP U1100. The digitized AMPS TX audio signal is converted back to analog by the U1900 and sent to the 154.65 MHz TX Offset VCO to modulate the transmitter.

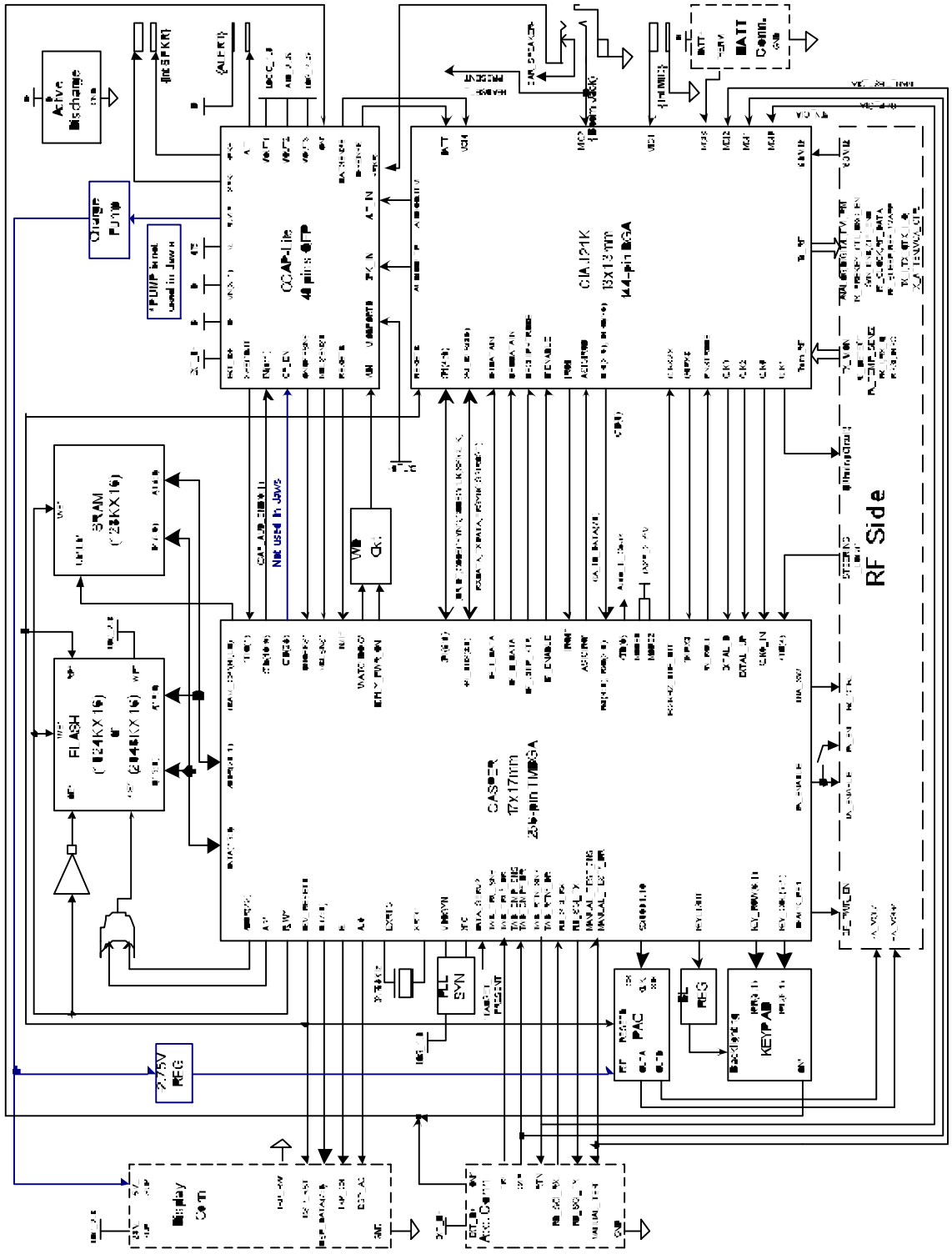
Transmit Audio - CDMA Mode

In CDMA mode, the digitized TX audio is processed by a CELP variable rate vocoder, U1100. The digital signal is then routed through microprocessor U1100 and processed by the CDMA Modem IC, U1100, which produces the 1.2288 Mb/sec. CDMA data stream. This stream is then converted to analog OQPSK signals (TX I, TX Q) by D/A U1900. The TX I and TX Q signals are sent to the IF/Synthesizer IC U700 which modulates the 154.8 MHz TX offset VCO.

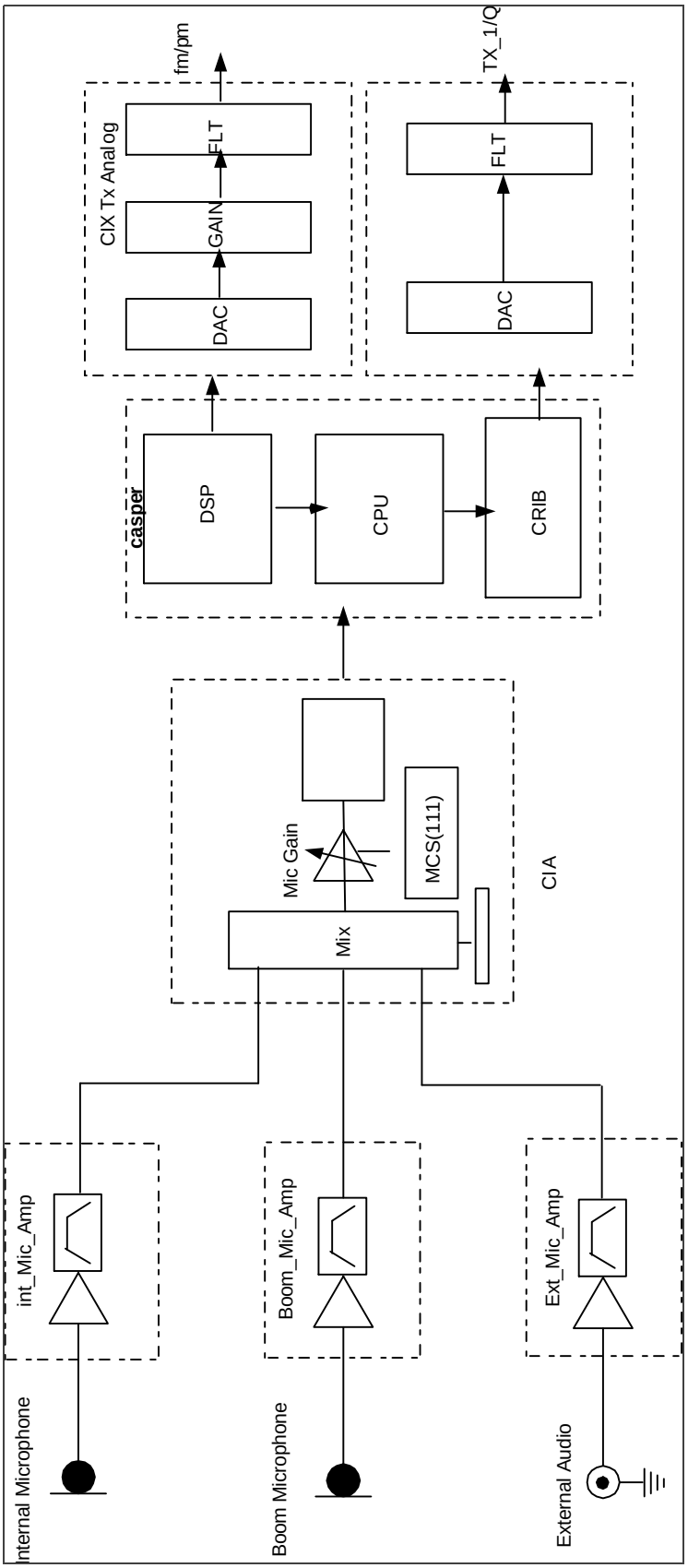
RF Block Diagram



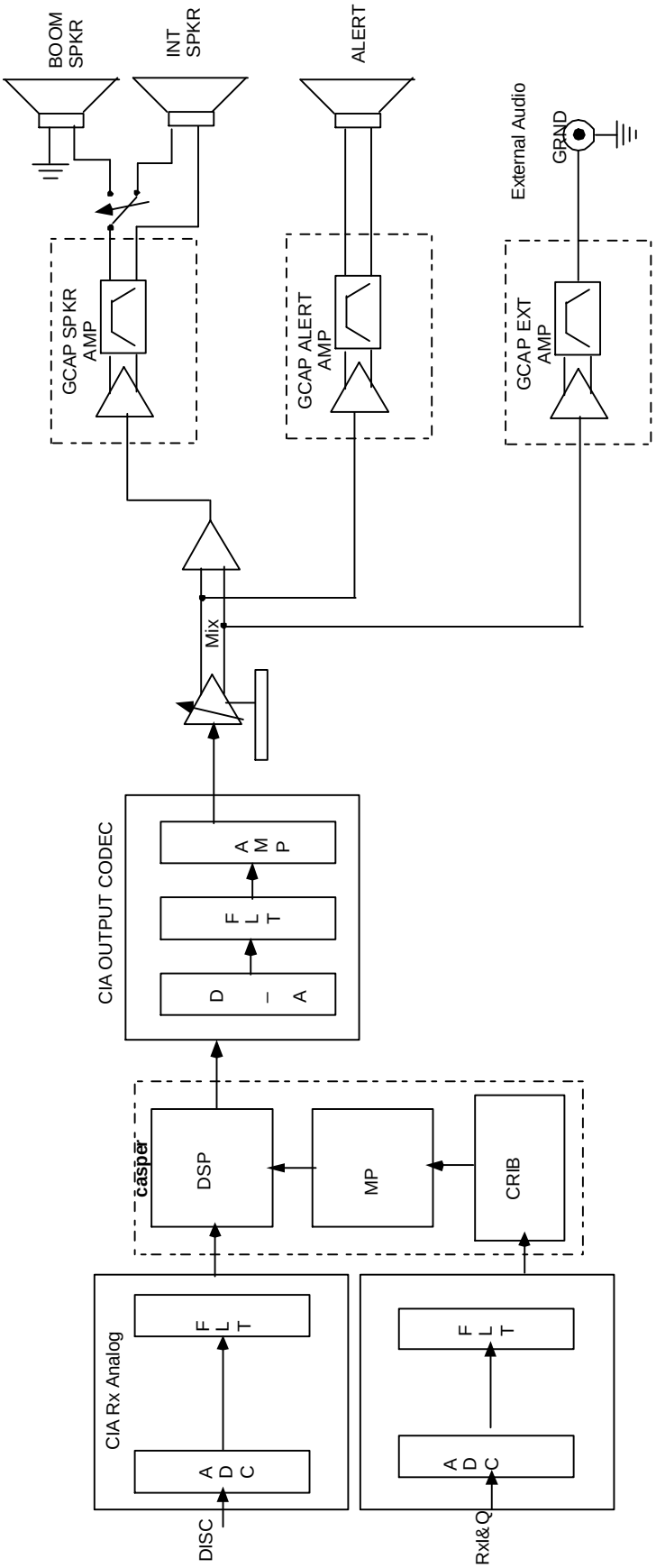
Audio Logic Side Block Diagram



Reverse Audio Functionality:



Forward Audio Functionality:



Test Mode / Test Menu

Introduction

Manual Test Mode software allows service personnel to monitor the telephone status on the display, and manually control tele-phone functions via the keypad.

Manual Test Mode operates at two levels: - Status Display Level, which allows the phone to operate normally while providing status indications in the display. Servicing Level, which disables normal call-processing and allows commands to be entered through the keypad to manually control operation of the phone.

Status Display Level

Status Display Level is the power-up state in Manual Test Mode. Manual Test Mode is entered by momentarily shorting the test pin of the accessory connector J3 to ground, while turning the phone on. Use the MCEL 2000 (SLN6625A) and Test Cable (SKN4800A). See Figure 7: “Connections for Testing and Adjustments” on page 48 In this level of Manual Test Mode the phone will place and receive calls as normal, but the display shows status information. The first line of data indicates channel number, RSSI value, and call-processing mode. The second line of data indicates SAT frequency, carrier state, signaling tone state, power level, voice/data channel mode, Rx audio state, and Tx audio state. The format and explanation of this status information is given in Table 1 under “02# Radio Status Request.” When dialing a phone number, the status display ceases when the first digit of the phone number is entered. The telephone number is displayed in the normal manner as entered. When the Snd button (or End or Clr) is pressed, the status information display resumes.

Servicing Level

The servicing level allows service personnel to manually control operation of a phone by entering test commands through the tele-phone keypad. Parameters such as oper-ating channel, output power level, mut-ing, and data transmission can all be selected by entering the corresponding commands. To enter the Servicing Level, press the # but-ton while in Status Display level (power-up state of Manual Test Mode). In the Servicing Level, automatic call processing functions are disabled, and the phone is instead con-trolled manually by keypad commands. Table 2: “Test Commands For Manual Test Mode” on page 14 shows the test commands and the corresponding results.

NOTE

There is no Status Display when the phone is in CDMA mode.

CDMA Specific Features

Test Menu

A Test Menu allows a user to initiate Markov calls, place Service Option 2 calls

and set Software Configuration Options. The Test Menu is intended to provide a simple mechanism to perform various test and S/W debugging functions. Items will be added to and deleted from the menu period-ically. When Test Menu is enabled, it is entered by pressing the FCN key twice. Refer to Step "09" on page 27 for information on how to enable/disable the Test Menu during NAM programming. Almost every Test Menu command accepts a parameter or data in the scratchpad. The procedure for transferring the scratchpad data and executing the Test Menu command is as follows:

Step 1. Decide which Test Menu command is going to be executed.

Step 2. Enter the necessary user input into the scratchpad.

Step 3. Press the FCN key twice to acti-vate the Test Menu.

Step 4. Press the volume keys until the desired Test Menu command is indi-cated on the display.

Step 5. Press the SND key to activate the command.

While the Test Menu is displayed, any key-press that is not volume or SND will also cause the menu to be exited without execut-ing the current option. The Test Menu will also be exited whenever an incoming call is detected.

Markov Calls

During a Markov call, the "(G)ood" rate will be on the top line, and the "(T)otal" on the bottom line of the display. The display will cycle through all rates: (F)ull, (1/2) Half, (1/4) Quarter, and (1/8) Eight.

- Mobile originated Markov calls are performed by entering a telephone number and selecting a Test Menu option. Refer to the "Test Menu" section for further informa-tion.

- Mobile terminated Markov calls (Land to Mobile) are currently NOT supported. Pressing the SND key initiates a Markov call with the number in the scratchpad. If scratchpad is empty, "1234567" is used. This feature has no value in AMPS mode.

Service Option 2

For Service Option 2 calls, the In Use indi-cator will come on, but the display will remain blank.

- - Mobile originated Service Option 2 calls are performed by entering a telephone number and selecting a Test Menu option. Refer to the "Test Menu" section for further information.
- - Mobile terminated Service Option 2 calls will be automatically answered. Pressing the SND key initiates a Service Option 2 call with the number in the scratchpad. This feature has no value in AMPS mode.

SW (Software) DIP

Pressing the SND key initiates a one or more SW DIP functions based on the number in the scratchpad. Possible SW DIP functions are:

1: Disables closed loop power control.

4: Forces vocoder to provide full rate voice (may be enabled at any time during a call).

128: Sets the conversation audio path to "audio out" and "audio in" on the external connector.

For example, to disable closed loop power control, the user enters the following key sequence:

1 + FCN + FCN + ^ + SND

Undo all SW DIP settings (default at power on) by pressing:

0 + FCN + FCN + ^ + SND

These may be combined to do more than one at a time. For example, 4 and 1 may be combined by entering 5 before entering menu and selecting SW DIP.

Test Mode

Also included in the software is a Manual Test Mode, which allows viewing the ESN, software version number, and programming the phone number (NAM).

To enter Manual Test Mode:

- 0 0 * * 83786633

(83786633 spells “TESTMODE” on the keypad).

Handset Commands

Table 4:

Key	***Function***
*	Toggles the display to the next location (enters data displayed to buffer). When hit at last program step, the command is terminated (if required, information may also be programmed into the EEPROM). If the command relates to a test function with multiple data displays, the * key is used to pause scanning data or to step through sequential test func-tions. Entering the * key during a pause time resumes scanning.
CLR/END	Resets the location to presently programmed information (if the command allows user input).
#	Terminates command without changing any of the programmed informa-tion. Each command consists of at least two digits entered from the telephone keypad with the entry terminated using the # key. For commands that initiate an action that requires a response or that accu-mulates error counts, the # key terminates the test.
DIGIT	Enter digit value. If the value to be modified is filled or exceeded, the **CLR** must be pressed before more digit selections are allowed. This is valid only if the command allows user input.
For The Gain and power Phasing handset test commands only	
	translated into HEX A-F respectively.
Volume up/ down	Increments/decrements the current data value. If the maximum value for this data location is exceeded then it is set to zero.
STO	Shortcut to save values and quit test command.

This will cause the phone to enter the Test

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
#	Suspend		Terminate normal mode and enter Test Command Mode. This command is valid only when in normal mode. The # key must be held for 2 seconds to suspend with handset. Performs initialization as in the INIT test command.
01#	Restart		Equivalent to turning power off, then on again.
02#	Radio Start Request	AAAZBBBC-DEFGHI	Display the current radio status: **Handset Display Format:** AAA = Current channel (1000-1023 represented as A00-A23) Z = Blank - AMPS **Analog Mode:** BBB = RSSI reading (averaged) for this channel. C = Digital Color Code (data channel) 0-3 DCC, 4 invalid = SAT Frequency (voice channel) 0=5970 Hz; 1=6000 Hz; 2=6030 Hz; 3=No SAT Lock D = Carrier (0=OFF, 1=ON) E = Word sync status (data channel) and Signalling tone (voice channel) (0=OFF, 1=sync acquired/ON) F = RF Power Level (Steps 0-7) G = Reception Mode (0=voice channel, 1=data channel) H = Receive Audio (0=enabled, 1=muted) I = Transmit Audio (0=enabled, 1=muted) **CDMA Mode: (Not currently supported)** **Bit fields undefined**
03#	(not used)		
04#	Initialize Trans-ceiver		Initialize the current radio as follows: 1. Carrier = OFF 2. RF power attenuation set to level 2 3. Signaling Tone = OFF 4. SAT transponding = OFF 5. Audio Path = TO INTERNAL SPEAKER 6. DTMF & Audio Tones = OFF 7. Receive Audio & Transmit Audio = MUTED 8. AMPS Mode If the radio is a CDMA only model (not dual mode), it will default to CDMA mode instead.
05#	Carrier on		Turn on the carrier. **05#** turns the carrier on with a nominal value for the DAC for an output power level.
06#	Carrier Off		Turn off the carrier.

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
07#	RXMUTE		Mute Recieve Audio
08#	RXUNMUTE		Unmute recieve audio
09#	TXMUTE		Mute Transmit audio.
10#	TXUNMUTE		Unmute transmit audio
11X#	Loadsynth		Load the specified channel into the radio synthesizer. X-Enter up to 4-digits for the channel number. Channel numbers must be in the range of 1 to 1024. Narrow mode channel numbers not currently supported.
12X#	Set-Attn		In AMPS mode: Set the AMPS RF power attenuation to the value specified (0-7).
14#	STON		Enables continuous signalling tone.
15#	STOFF		Disables signalling tone.
16#-18#	(Not Used)		
19#	Version		Displays version corresponding to the two digit option x. The following table show the valid options for x: Decimal 00 Call processor 01 CDMA test command document number 02 Date 03 Time 22 DSP mask version 23 DSP patch version - The call processor (factory version) number in the format: 00 XXXX - The CDMA test command document number: 01 XXXX - The date the build was created in the format: 01JAN96 - The time the build was created in the format: xxyyzz where xx is the hour, yy is the minute, and zz is the second. - The version of the DSP mask xxxxyyyyyyzzzz where xxxx is the version, yyyyyy is the date, and zzzz is the device. - The version of the DSP patch xxxxyyyyyyzzzz where xxxx is the version, yyyyyyis the date, and zzzz is the device. All data fields can be viewed by hitting the * key repeatedly. To exit hit the # key.

Note: Use the PATH command (**35A#**) to select the audio path to test before using commands **07#** through **10#**. (Default path is to internal speaker and microphone).

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
19X	Multi-Version		Displays version corresponding to the two digit option x. The following table show the valid options for x: Decimal 00 Call processor 01 CDMA test command document number 02 Date 03 Time 22 DSP mask version 23 DSP patch version - The call processor (factory version) number in the format: 00 XXXX - The CDMA test command document number: 01 XXXX - The date the build was created in the format: 01JAN96 - The time the build was created in the format: xxyyzz where xx is the hour, yy is the minute, and zz is the second. - The version of the DSP mask xxxxyyyyyyzzzz where xxxx is the version, yyyyyy is the date, and zzzz is the device.
20#-24#	(not -used)		
25X#	Sat/Dsat On		Enable SAT/DSAT transponding. For AMPS mode, the bye following the opcode is the color code of the SAT frequency that the radio may expect to receive. The command only uses the narrow phase lock loop mode and locks only to the frequency selected (+/- 15 Hz). Valid color codes for X: 0 = 5970 Hz 1 = 6000 Hz 2 = 6030 Hz
26#	Sat/Dsat Off		Disable the transponding of Sat/Dsat.
27X#	Cdata		AMPS: Continuous Transmit Data on the reverse Analog Control Channel. CDMA: Random Transmit Data (RTD) on the reverse CDMA channel. Input Action 0 Start (AMPS) / Variable Rate (CDMA) 1 Full Rate (CDMA) 2 Half Rate (CDMA) 4 Quarter Rate (CDMA) 8 Eighth Rate (CDMA) 9 Stop RTD (AMPS, CDMA)
28#	HITNON		Tuen on high tone (frequency 1150 Hz +/- 55Hz)
29#	HITNOFF		Turn off high tone.
30#	LOTNON		Turn on low tone (frequency 770 Hz +/- 40 Hz)

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
31#	LOTONFF		Turn off low tone.
32#	INVM		Initialize non-volatile memory to all zeros. This command should be reserved for special situations where reprogram-ming will be required (such as memory chip or circuit board replacement or when a radiotelephone is to be reissued to a new subscriber). This command may take a minute or more to complete; during which time the number 32 will be displayed. DO NOT turn off the radiotelephone until the normal servicing level display resumes.
33X#	DTMFON		Generates a continuous DTMF tone as specified by input X. Input X may be 0-9 for keypad DTMF, 10-18 for single low or high tone, and 20-25 for tripled low or high tone.
34#	DTMFOFF		Turn off DTMF tones.

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*

35X#	Path		Change the audio path to A, where A =:
			0 = Hands free (selects input signal AUDIO IN @ J3-pin 8 and outputs audio signal AUDIO OUT/ON-OFF @ J3-pin 7; internal speaker and microphone are muted.)
			1 = Speaker (normal audio path; selects internal mic and outputs audio @ AUDIO OUT/ON-OFF @ J3-pin 7; internal speaker is muted.)
			2 = Alert (activates the alert transducer for as long as the # key is pressed. To prevent overstressing the alert transducer., DO NOT hold the # key down for extended periods.)
			3 = Handset (selects the internal mic and speaker.)
			4 = Mute (all audio paths and supplies are off, DSP put to sleep.) This command must be followed by a different AUDIO-PATH command (not MUTE) in order to guar-antee proper DSP functionality. Failure to do so may result in a radio failure.
			5 = Internal MIC Test (routes the internal mic audio directly to AUDIO OUT/ON-OFF @ J3-pin 7, and routes audio input at AUDIO IN @ J3-pin 8 directly to the earpiece speaker.)
			6 = External Handset (selects input audio at AUDIO IN @ J3-pin 8, and outputs audio at AUDIO OUT/ON-OFF @ J3-pin 7; internal speaker and mic are muted, and sidetone is turned on.)
			7 = Reserved (not supported)
			8 = Reserved (not supported)
			9 = Boom MIC (selects input audio at AUDIO IN and outputs audio at AUDIO OUT/ON-OFF to headset connector; internal speaker and mic are muted, and sidetone is turned on.)
			This command enables all internal and external hardware controls necessary to route audio to/from the correct outputs/inputs.

36#	(not used)		
37#	(not used)		
38#	SND-SN	AABB	Returns serial number contents. If all bytes = 00, no serial number is programmed. Display four byte serial number in hexadecimal one byte at a time, along with a byte count. The * key causes the next byte/count to be displayed.
39#-44#	(not used)		
45#	READRSSI		Returns the RSSI reading taken on the current channel. The number is displayed as a three digit decimel number.
46#	(not used)		

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
47X#	set-aud		Sets the audio level to the value specified by X. Audio level X is represented as 0 = lowest, 15 = loudest. Range of 8-15 has DTMF Feedback boost bit enabled.
48#	SIDETN		Enable sidetone. (Command **05#** must also be executed).
49#	SIDETF		Disable sidetone. (Command 06# must also be executed)
50# -54#	not used		
55#	Prog-nam	nam	Programs the NAM through the handset. This version uses supports only currently required NAM fields and it supports programming of data logger bytes. At the last step, the user enters a 1 to begin programming the data logger bytes. Handset key entry is defined in Table 1: "Handset Command Key Entry" on page 13. Refer to "NAM Programming" on page 25 of this manual for programming details.
56#	Auto-Cycle		Puts the radio in autocycle mode (CDMA only). Exit this command with the # key. This command causes the radio to infinitely loop between 2 cycles. One cycle is the display/transmit and the other is standby. The display/transmit cycle has a duration of 90 seconds and the radio has the following setup: - Display has all 8's showing. - Turn on variable rate random transmit data. - Carrier is enabled. The standby cycle has a duration of 4.5 minutes and the radio has the following setup: - Display is blank. - Turn off variable rate random transmit data - Carrier is disabled. This test command forces the radio into CDMA mode.

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
57X#	CP_Mode		Select radio call processing mode. This command will set up the radio to operate in the mode selected and will also perform initialization as specified by the INIT command. The synthesizer will be reprogrammed to setup parameters for the mode selected. 0 AMPS signalling (stop call processing test commands and PCM Loopback) 1 Not supported - NAMPS signalling 2 Not supported - Reserved for NAMPS expansion 3 Not supported - Reserved for NAMPS expansion 4 Not supported - Reserved for NAMPS expansion 5 CDMA signalling (stop call processing test commands and PCM Loopback) 6xy SIMVC test command From the handset, x is the maximum rate and y is the minimum rate. Valid rates for x and y are: 4 - Full rate 3 - Half rate 2 - Quarter rate 1 - Eighth rate From the Computer, no parameters are accepted and Full rate is forced. (This is not supported yet) 7 Start PCM Loopback 8 CDMA T-Tester mode (channel must be set by LOAD-SYTH. Handset only). 9 Not supported - CDMA force random data transmis-sion 12 Stop CPU - There is no way out of this except cycling power.
58#	COMPD-ON		Turns on the computer.
59#	COMPD-OFF		Turns off the computer.
60#-67#	not used		
68#	Read Model		MODEL Read radio model type. Displays three radio model bytes: hardware (model), flex (type), and factory.
69#-71#	not used		

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
72X	gain phase		Program AMPS (only) gain phasing values through the handset. Gain phasing depends on the call processing mode. It is the responsibility of the user to select the proper call processing mode before using this test command. This command reprograms the EEPROM phasing values for MOD, MIC, AUX, etc. The value in X selects which step to start on. If no value for X is entered, it will start at step 0. The command keys are defined in Table 1: "Handset Command Key Entry" on page 13. NOTE: If you power down the radio after changes are made, the power up sequence re-programs the hardware with the correct phasing values. Refer to the "Tests and Adjustments" on page 47 for instructions on entering parameters from the keypad. AMPS GAIN PHASING RANGE STEP # PARAMETER (HEX) 00-04 MOD 0- MOD 4 0-7 05 Aux. audio path deviation 0-1 06 MIC audio deviation 0-F 07 DTMF deviation 0-3 08 Data deviation 0-3 09 SAT deviation 0-3 0A Discriminator audio gain 0-7 0B AFC WARP Analog 0-FF

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
73#	PWR-Phase		Programs power phasing values through the handset. Power phasing depends on the call processing mode. It is the responsibility of the user to select the proper call processing mode before using this test command. This command reprograms the EEPROM phasing values for Max. Power Level, Attenuator Slope Adjust, etc. The value in X selects which step to start on. If no value for X is entered, it will start at step 0. The command keys are defined in Table 1: "Handset Command Key Entry" on page 13. NOTE: If you power down the radio after changes are made, the power up sequence re-programs the hardware with the correct phasing values. Refer to "Tests and Adjustments" on page 47 for instruc-tions on entering parameters from the keypad. Analog Power Level Parameters: RANGE STEP # POWER LEVEL (HEX) 00 Power Step 0 00-FF 01 Power Step 1 00-FF 02 Power Step 2 00-FF 03 Power Step 3 00-FF 04 Power Step 4 00-FF 05 Power Step 5 00-FF 06 Power Step 6 00-FF 07 Power Step 7 00-FF 08-0B Do Not Adjust CDMA Power Level Parameters: RANGE STEP # POWER LEVEL (HEX) 00 Attenuator Slope Adjust 00-FF 01 Attenuator Offset Adjust 00-FF 02 Clamp Adjust 00-FF 03 VCA Slope Adjust 00-FF 04 VCA Offset Adjust 00-FF 05 PMax 1 (Chan. 991-1023, 1-100) 00-FF 06 PMax 2 (Chan. 101-322) 00-FF 07 PMax 3 (Chan. 323-544) 00-FF 08 PMax 4 (Chan. 545-766) 00-FF 09 PMax 5 (Chan. 767-990) 00-FF

Table 5:

Keypad Entry	*Command Description*	*Status Display*	*Result*
73#	PWR-Phase		STEP # POWER LEVEL (HEX) 0A Ch. Gain Adj. 1 (Chan. 991-1023, 1-100) 00-FF 0B Ch. Gain Adj. 2 (Chan. 101-322) 00-FF 0C Ch. Gain Adj. 3 (Chan. 323-544) 00-FF 0D Ch. Gain Adj. 4 (Chan. 545-766) 00-FF 0E Ch. Gain Adj. 5 (Chan. 767-990) 00-FF 0F TX Gain Adjust 1 00-FF 10 TX Gain Adjust 2 00-FF 11 TX Gain Adjust 3 00-FF 12 TX Gain Adjust 4 00-FF 13 TX Gain Adjust 5 00-FF 14 TX Gain Adjust 6 00-FF 15 TX Gain Adjust 7 00-FF 16 TX Gain Adjust 8 00-FF 17 VC Sense Slope Adjust 00-FF 18 VC Sense Offset Adjust 00-FF 19 VC Sense Zero Adjust 00-FF 1A Available 00-FF 1B Not Available 00-FF

NAM Programming

Introduction

The Number Assignment Module (NAM) is

a section of memory that retains information about the phone's characteristics, such as the assigned telephone number, system identifi-cation number, and options information.
Two methods are available to program the NAM using the keypad: Test Mode and User Mode.
Regardless of the method used, the NAM must be programmed before the phone can be placed into service. This chapter covers the NAM Programming steps for Test Mode NAM Programming.

Test Mode Programming

Table 3: "Minimum Required Test Mode NAM Programming Steps" on page 25 shows the minimum required Test Mode NAM programming steps. Table 4: "Test Mode NAM Programming Sequence" on page 26 lists all NAM programming steps, complete with parameters and definitions.

IMPORTANT

Consult with the System Operator regarding NAM information. Incorrect NAM entries can cause the phone to operate improperly or not at all.
.
For Test Mode NAM programming, the portable must be in the Servicing Level of Manual Test Mode (See "Test Mode/Test Menu" on page 11.) To enter test mode, the Manual Test pin (recessed center pin of the J6 battery connector) must be momentarily grounded while powering up the phone. This can be accomplished in a variety of ways, such as by using a 6.8 VDC power supply and an MCEL 2000 test cable or test plug. After powering up in test mode, press the # button to enter Servicing Level. Once in Test Mode Servicing Level, enter 55# to place the phone in NAM programming mode. The display will show factory default NAM data or show new data as it is entered, scrolling from left to right. Sequentially step through the procedures shown in Table 4: "Test Mode NAM Programming Sequence" on page 26 using the * key. Enter new data as required, or skip past factory default values for parameters that do not need to be changed.
If a second phone number is to be programmed, step 11 bit 6 must be set to 1. This bit enables dual-NAM operation and will cause NAM programming steps 1-6 and 12 to be repeated for the second phone number.

Minimum Required Test Mode NAM Programming Steps

Table 6:

Service Type	Minimum Required Programming Steps
Single NAM Dual NAM (part A) Dual NAM (part B)	1, 3, 4, 6, 8, 9 1, 3, 4, 6, 8, 9, 11 1, 3, 4, 6

Test Mode NAM Programming Sequence

Advances to the next programming step; also programs the NAMafter the last programming step is entered. A valid value must be entered. Otherwise the * will not advance to the next NAM step.

Clears the entered information and displays previously entered data for the current programming step.
CLR=
Exits the programming mode without pro-gramming the NAM.

#

Test Mode NAM Programming Sequence

Table 7:

Step	*Factory Default*	*Description*
01	00000	**Home System ID (SID) Number.** Number assigned by system operator for system identification.
02	00000100	**A OPTION BYTE.** The display for step 02 represents the status of eight options, A7 through A0. Bit A7 (msb) is programmed first, followed by A6-A0. Bits enter display on the right and scroll left.
	0	**Local Use (Bit A7).** If set to 1 phone will respond to local control orders in the home area or when the group ID is matched. Assigned by system operator.
	0	**Preferred System (Bit A6).** Applies to units capable of operating on two service systems (A or B). 0 = system B; 1 = system A.
	0	**End-to-End Signaling (Bit A5).** When enabled, the phone is equipped for DTMF signaling during a call. 1 = enabled, 0 = disabled.
	0	**Markov test override MSB (Bit A4).** Enter 0.
	0	**Markov test override (Bit A3).** Enter 0.
	1	**Bit not used (Bit A2).** Enter 1.
	0	**Markov test override LSB.** Enter 0
	0	**MIN Mark (Bit A0).** Supplied by system operator. When enabled the user's area code will be sent with each call initiated or answered. 1 = enabled, 0 = disabled.
03	1111110111	**User 10 digit radiotelephone phone number (MIN).** 10_digits including area code; changing this value sets default for AOC. Number is assigned by system operator.
04	010 042 074 106	**Station class mark (SCM).** A 2 digit number assigned by the system operator. Indicates maximum power step, VOX capability, and number of channels used. CDMA only & Non-Slotted mode configuration CDMA only & Slotted mode configuration Dual Mode & Non-Slotted mode configuration Dual Mode & Slotted mode configuration
05	Last digit of access over-load class	**Access overload class.** Specifies the level of priority assigned to the phone when accessing the system. Assigned by system operator.
06	000000	**Security code.** A 6-digit number supplied by the user. This number is used by the user to access or change "security" features such as the 3-digit unlock code or the service level.

Table 7:

Step	*Factory Default*	*Description*
07	123	**Unlock code.** A 3-digit number supplied by the user. If the lock feature is enabled by the user, the phone can be operated only by individuals who know the unlock code.
08	4	**Service level.** This 1-digit number supplied by the user allows various call placement restrictions if desired.
09	01100000 Test Menu enabled 00100000 Test Menu disabled 0	**B OPTION BYTE** The display for step 10 represents the status of eight options, B7 through B0. B7 (msb) is programmed first followed by B6-B0. Bits enter display on the right and scroll left. **Display Pilot Set Status/AMPS Status Mode (Bit B7).** CDMA: These statistics are useful for testing handoff parameters. When enabled, this feature displays the strongest pilot offset in the "Active Set" (only member during Idle) on the top line of the display, and the strongest pilot in the "Neighbor Set" on the bottom line. Each line has the same format. The left most 3-digit number is the pilot offset, and the right number is a relative signal strength. IDLE HANDOFF (handoffs on a paging channel) occurs when a Neighbor pilot is judged to be better. That neighbor pilot will be promoted to the active set, and thus move to the top line of the display. SOFT HANDOFF (handoff on a traffic channel) occurs when a Neighbor pilot fulfills requirements set by the network, and the network directs the mobile to add the new pilot to the Active Set. Pilot Set status is enabled by setting Step #9, bit #7 to 1. Channel Statistics is disabled by setting Step #9, bit #7 to 0. **WARNING: Turning on this option makes it difficult to see the Markov error rate statistics in a call.** AMPS: In AMPS mode, setting this bit to 1 causes status information similar to current Motorola AMPS products to be displayed. The contents of the display depends on the channel being monitored.
	0	**Test Menu (Bit B6).** This bit allows the user to enable or disable the FCN key Test Menu. Refer to "Test Menu" on page 12 for further information on Test Menu. 1 = enabled, 0 = disabled.
	1	**Paging Channel Message Filtering (Bit B5).** This bit limits the amount of paging channel messaging seen by the data logger debugging tool. A user not using this tool should see no noticeable difference in performance. 1 = enabled, 0 = disabled.

Table 7:

Step	*Factory Default*	*Description*
	0	**Portable Data Logging (Bit B4).** Enter 0.
	0	**Single Serving System Scan (Bit B3)**. This bit allows the user to enable or disable the serving system scanning on serving systems other than the phone's home serving system. If the phone has an odd Home System Identifier (Step 1), it's home serving system is A, otherwise it is B. If Single Serving System Scanning is enabled, only the home serving system will be scanned, otherwise both serving systems will be scanned. 1 = enabled, 0 = disabled.
	1	**Auto Recall (Bit B2).** When set to one, the user may access repertory by a one or two digit send sequence (speed dialing).
	0	**Disable Service Levels (Bit B1).** If set to 1, the service level (call restric-tions) cannot be changed by the user.
	0	0 **Lock Disable (Bit B0).** When set to 1, the user cannot lock and unlock the phone unit via the 3 digit lock code.
10	00000000	**C OPTION BYTE** The display for step 11 represents the status of eight options, C7 through C0. C7 (msb) is programmed first followed by C6-C0. Bits enter display on the right and scroll left.
	0	**User Mode NAM Programming Disable (Bit C7).** When set to 1, User Mode NAM programming cannot be accessed.
	0	**Dual NAM System Registration Enable (Bit C6).** Enter 1 if dual NAM operation is desired (for models capable of dual system operation). Enter 0 for single NAM operation
	0	**Test Mobile Enable/Auto Answer (Bit C5).** Enter 0.
	0	**Auto Redial Disable (Bit C4).** When set to 1, the user cannot access the 6-minute auto redial feature.
	0	**Three Wire Bus Speaker Disable (Bit C3).** This bit is used to disable internal handset speaker when adding V.S.P. option. 1 = handset speaker disabled, 0 = handset speaker enabled.
	0	**Bit not used (Bit C2).** Enter 0.
	0	**Selectable System Scan Disable (Bit C1).** When set to 1, the user cannot select the primary system.
	0	**Diversity Antenna (Bit C0).** (Extended systems only) 0 = Non-diversity, 1 = Diversity.
11	0334	**AMPS Initial paging channel.** There are 4 significant bits for the initial paging channel. For system A enter 0333 and system B enter 0334.

Table 7:

Step	*Factory Default*	*Description*
12	0333	**AMPS Initial A system channel.** To initialize system A enter 0333.
13	0334	**AMPS Initial B system channel.** To initialize system B enter 0334.
14	021	**AMPS Dedicated Paging Channels.** Number of dedicated paging chan-nels is 21. Enter 021.
15	00001000	**D OPTION BYTE**. The display for step 16 represents the status of eight options, D7 through D0. D7 (msb) is programmed first, followed by D6-D0. Bits enter display on the right and scroll to left.
	0	**Enhanced Scan (Bit D7)**. Enter 1.
	0	**Cellular Connection 1 (Bit E6)**. Normally set to 0.
	0	**Long Tone DTMF Enable (Bit E5)**. Normally set to 1.
	0	**Transportable Transducer Disable (Bit E4)**. Enter 0.
	1	**Bit not used (Bit E3)**. Normally set to 0.
	0	**Handset Test Mode Disable (Bit E2)**. Enter 0.
	0	**Failed Page Indication Disable (Bit E1)**.
	0	**Word Sync Scan Disable (Bit E0)**. Set to 1.
16	00100111	**E OPTION BYTE**. The display for step 16 represents the status of eight options, E7 through E0. E7 (msb) is programmed first, followed by E6-E0. Bits enter display on the right and scroll to left.
	0	**Bit not used (Bit E7)**. Enter 0.
	0	* **Preferred mode (Bit E6)**. Normally set to 0. Bit 6 - 1 and Bit 5 - 1 = Analog preferred Bit 6 - 1 and Bit 5 - 0 = Analog only
	1	**Preferred mode (Bit E5)**. Normally set to 1. Bit 5 - 1 and Bit 6 - 1 = CDMA preferred Bit 5 - 1 and Bit 6 - 0 = CDMA only
	0	**Extended Address Method (Bit E4)**. Enter 0.
	0	**Preferred Analog Serving System (Bit E3)**. Normally set to 0.
	1	**Config. for mob term using home SID, NID pair (Bit E2)**. Enter 1. 1 = Allow mobile terminated call while using a home (SID, NID) pair. 0 = Disallow mobile terminated call while using a home (SID, NID) pair.
	1	**Config. for mob term while SID roamer (Bit E1)** Enter 1. 1 = Allow mobile terminated call while a SID roamer. 0 = Disallow mobile terminated call while a SID roamer.

Table 7:

Step	*Factory Default*	*Description*
	1	† **Config. for mob term while NID roamer (Bit E0)**. Enter 1. 1 = Allow mobile terminated call while a NID roamer. 0 = Disallow mobile terminated call while a NID roamer.
17	0	**CDMA: Slot Cycle Index.** TBD
18	Entry Required	**CDMA: SID (SID_NIDp).** Up to 5-digits.
19	00000	**CDMA: Network ID Number (NID of SID_NIDp).** Up to 5-digits.
20	111111	**Mobile Country Code (first 3-digits), IMSI 11 (1-digit), IMSI 12 (1-digit).**
21	Entry Required	**CDMA: Primary Channel.** System A up to 4 decimal digits.
22	Entry Required	**CDMA: Primary Channel.** System B up to 4 decimal digits.
23	Entry Required	**CDMA: Secondary Channel.** System A up to 4 decimal digits.
24	Entry Required	**Secondary Channel.** System B up to 4 decimal digits.
25	0	**Data Logger Switch.** Enter 0. 1 = enabled, 0 = disabled.

* These bits will determine which modes of operation the radio will attempt
when seeking communication with a Base Station. Care should be taken when
either the CDMA only or the Analog only modes of operation are selected,
because this configuration will cause a dual mode phone to operate as a single
mode phone. Another issue to be aware of is that whenever Bit 5 is set to 0, no
handoffs between Analog and CDMA mode can take place. No examination of
the RF environment is performed when setting these fields.

† Setting these bits also effects the registrations that are transmitted by the
Mobile Station. If bits are set such that the Mobile cannot receive any incoming
calls (in CDMA mode), it is not necessary to send out any Registration mes-sages.

It should be noted that if all Mobile Terminated Call Preference bits are
set to zero, that there would (in a spec compliant system) be no way for the

Mobile Station to receive incoming calls.

Introduction

The CDMA StarTAC allows keypad controlled testing of various analog and digital operating parameters.

This chapter includes the keypad button functions and recommended equipment setup to use when testing a phone.

Automatic Call-Processing Tests

Most communications analyzers can simulate a cell site in order to perform automatic call-processing tests. Automatic call processing tests can be performed while the phone is in its power-up state. However, it is useful to do the tests with the phone in Test Mode Status Display.

Refer to the communications analyzer's manual for details about performing call-processing tests. The following call-processing test sequence is recommended:

1. Inbound call, analog mode
2. Outbound call, analog mode
3. Analog-to-Analog channel handoff
4. Analog-to-Digital channel handoff
5. Inbound call, digital mode
6. Outbound call, digital mode
7. Digital-to-Digital channel handoff
8. Digital-to-Analog channel handoff

Handoffs should be performed between low, middle, and high frequency channels.

Analog Test Measurements

- RX Sensitivity (SINAD)
- RX Audio Distortion
- TX Power Out
- TX Frequency Error
- TX Audio Distortion
- TX Maximum Deviation
- TX SAT Deviation
- TX ST Deviation

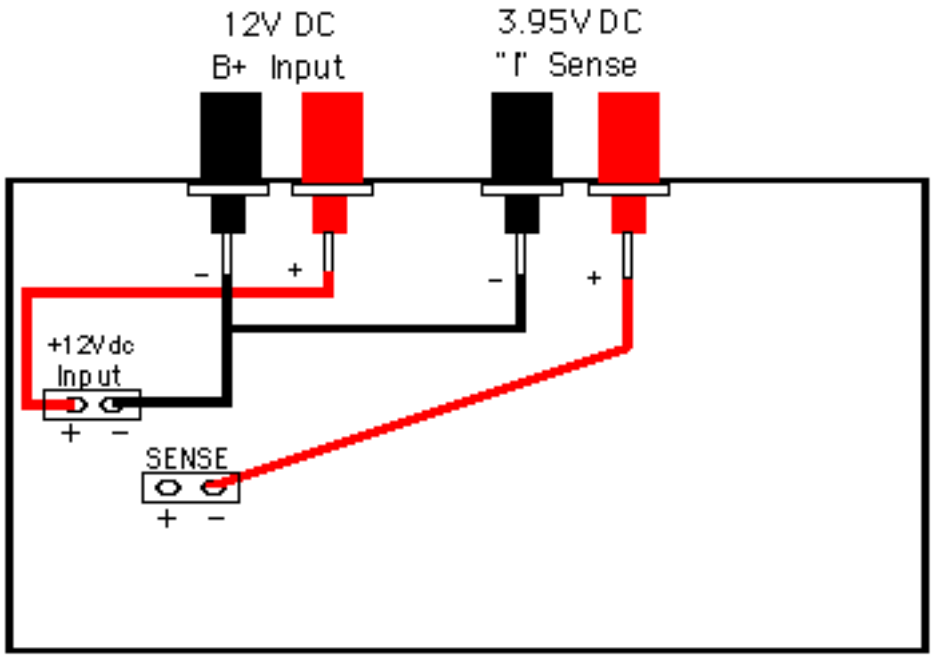
Digital Test Measurements

- Digital RX Sensitivity (FER)
- Digital Power Out
- TX Frequency Error
- Waveform Quality (Rho)

The analog and digital parameters are stored in EPROM on the Transceiver Board. Each transceiver is shipped from the factory with these parameters already calibrated. However, if a board is repaired, these parameters should be measured and, if necessary, adjusted. Checking and adjusting calibration parameters is also useful as a trouble-shooting/diagnostic tool to isolate defective assemblies.

MCEL 2000 Modifications

The diagram below shows the modification that the MCEL 2000 needs in order to properly supply the correct operating voltage to the cellular phone.



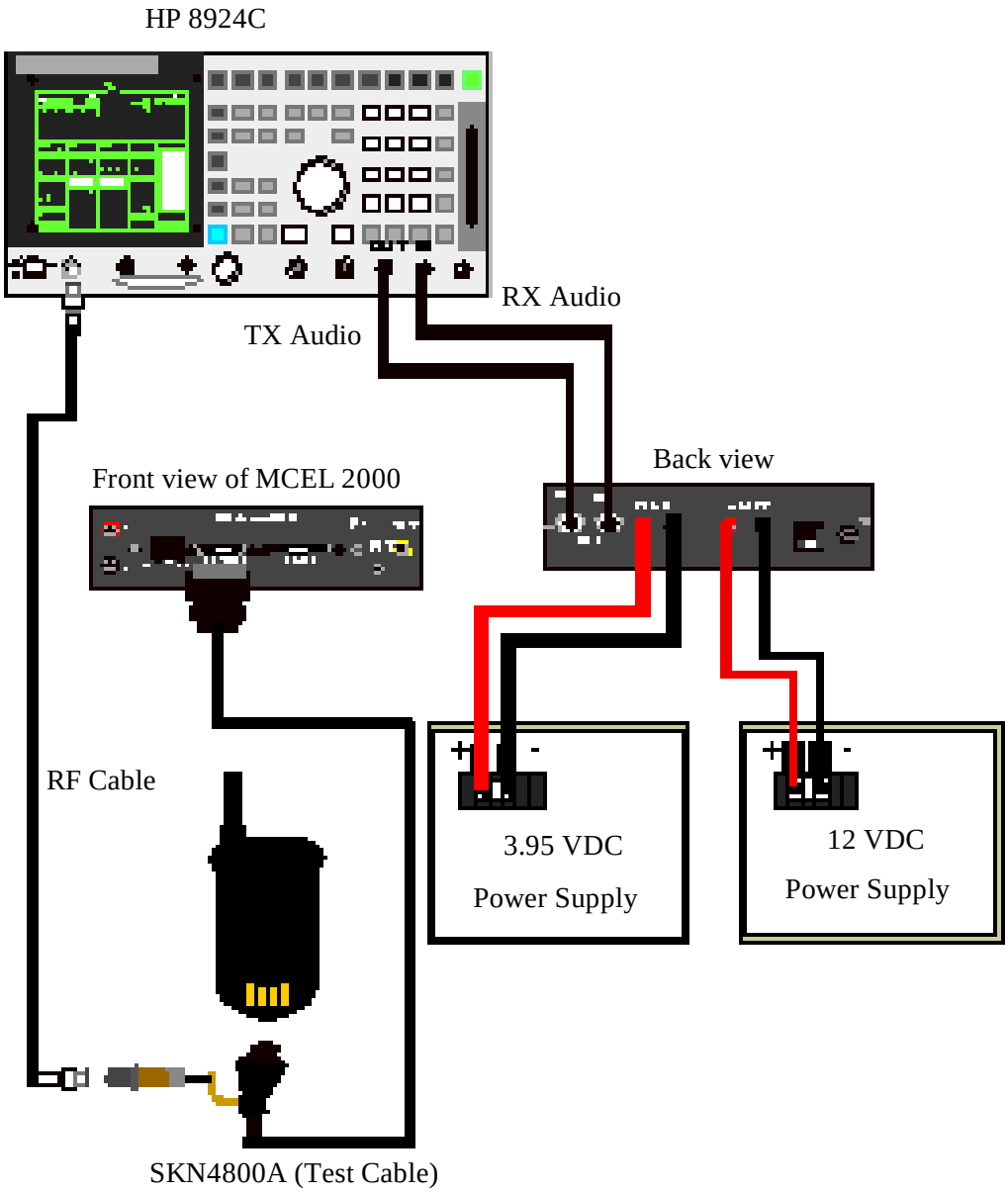
Test Connections

The diagram below shows the recommended connections for testing and keypad calibration of the transceivers.

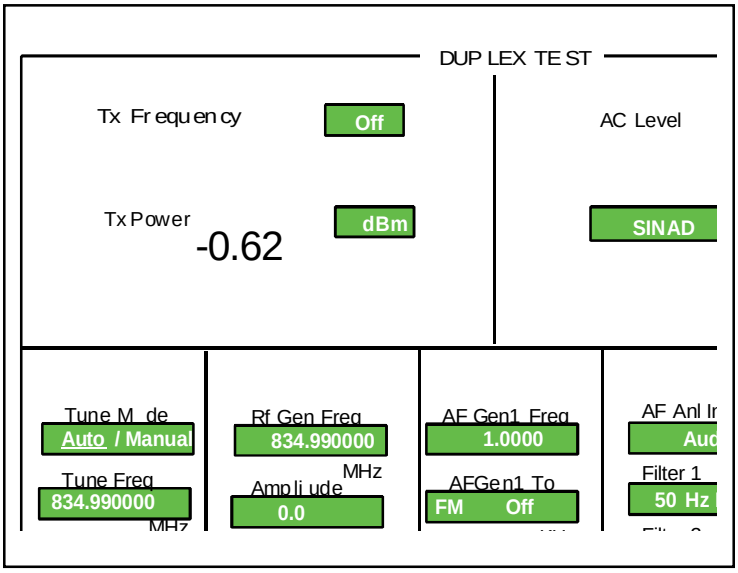
The MCEL2000 test interface and an RF adapter with a low loss RF cable is used to interface with the communications analyzer.

A variety of communications analyzers may be used. Refer to the analyzer manufacturer's user manual for proper setup before starting tests.

Connections for Testing



RF Cable Test



To test the RF cable for proper loss:

- **Tune Freq** should be set to TX frequency: 834.990000 MHz.
- **RF Gen Freq** should be set to same frequency (834.990000 MHz).
- **Tx Power** should be set to read in dBm, not Watts.

In order to properly measure and adjust the parameters of a telephone, it is important that you use RF cabling that has minimal loss. Therefore, it is important that you test the RF cable for proper loss. This can easily be done by using the DUPLEX TEST screen of your HP8924. To test the cable, set up the DUPLEX screen as shown above.

Action:

Take the cable under test and connect it from the RF in/out port to the Duplex Out port. At this point you will be getting some type of power reading for cable loss.

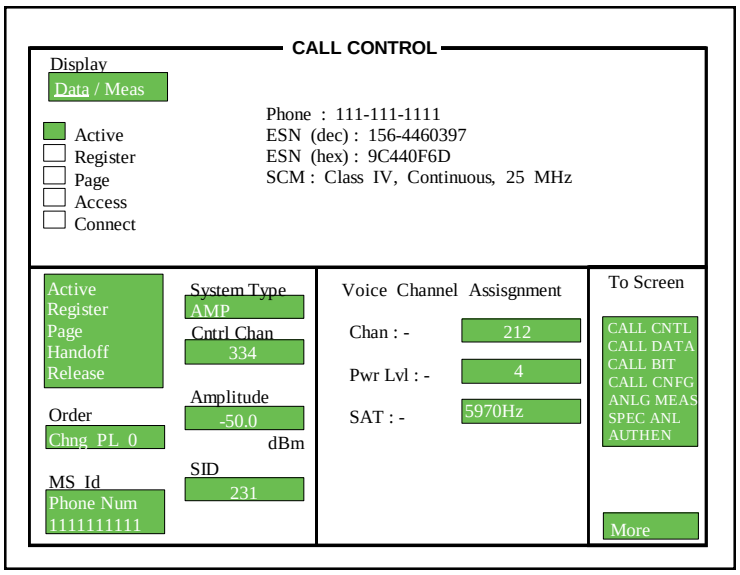
Good range: -.2 dBm through -.8 dBm

Bad cable: More than -.8 dBm

If the reading you are getting shows gain (positive number,) you may need to zero the power meter. This may happen on an HP8924 whose memory has just been cleared.

To zero the meter, press the **TX** button on the 8924 panel. Bring the cursor down to the field under **TX Pwr Zero** where it reads **Zero**. Tap the cursor on the Zero field and it will highlight for a moment as it zeroes the meter. Set up the screen as shown above, and test your cable.

Set up for Analog call



Select CALL CTRL from the ANALOG SCRNS Control panel

- Select System type: **AMPS**
- Zero the RF Power meter in the: **Call Config Screen**
- Set Amplitude to: **-50 dBm**
- Set SID: **Your phone's System ID**
- Select: **Active**
- **Voice Channel Assignment Type:**
- Chan: **212**
- Pwr Lvl: **4**
- SAT: **5970Hz**

Registration

1. Put the Test Set in Active state by selecting **Active** from the list on the left side of the screen.
2. Select **Data** from the **Data/Meas** field. This is the default mode.
3. Select **Register** from the list to register phone.
4. If the registration message has been received, the Test Set will display registration data in the upper half of the screen as shown in the sample screen above.

Page

1 Select page from the list on the left side of the screen.

2 If the mobile responds, you will see the Access annunciator light briefly.

3 Answer the call by raising the flip or press SEND on the mobile to start the conversation.

4 The Connect annunciator lights. This is the Connect state.

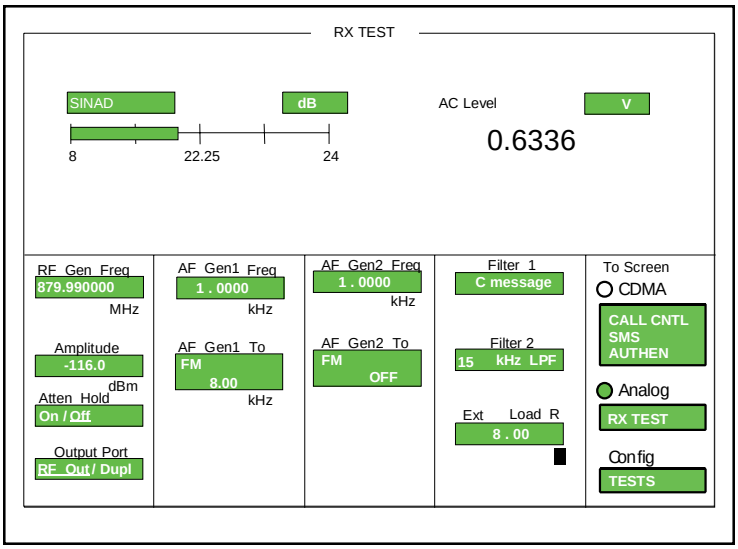
Origination

1 Dial the desired phone number on the mobile station and press SEND.

2 The Access annunciator will light while the Test Set signals the mobile on the assigned voice channel.

3 The connect annunciator will light if the mobile properly signals the Test Set.

RX Sensitivity Test (SINAD)



Communications Analyzer Setup:

- Select **RX** button from the Analog Screen Control panel
- Set **RX frequency** to **879.990 MHz**
- Set **Amplitude** to **-116 dBm**
- Set **AF gen1** to **1 kHz frequency** at **8 kHz deviation**, using **FM modulation** (PLEASE NOTE: this is for AMPS only; NAMPS uses much lower deviation)
- Set **AF Filter 1** set to **C message filtering**
- Set **AF Filter 2** to **15 kHz**

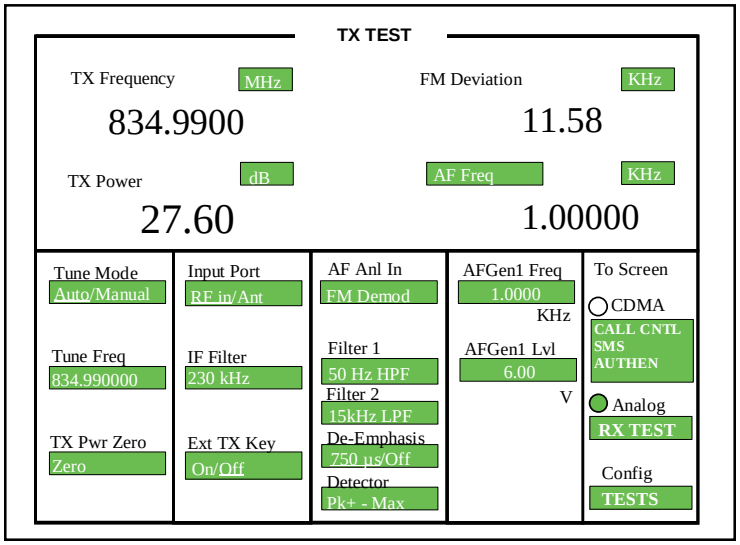
Test Mode Commands:

11333#	Load synthesizer to channel 333
08#	Unmute receive audio path
58#	Turn on compandor
474#	Set volume control to level 4
356#	Set RX audio path to Ext. Audio-Path

Sinad measured on the communications analyzer must be more than 12dB.

Duplex SINAD can be measured with the same setup by entering 122# and the 05# test command, which turns on the transmitter at power step 2. If radio has NAMPS capabilities, narrow band SINAD can be measured by entering 571# and setting the FM Deviation to 3kHz. Refer to the RX troubleshooting section for radios not within the pass specifications.

TX Power Out Test



Communications Analyzer Setup:

- Select **TX** button from the Screen Control panel
- **PWR** is measured in **dBm**
- Set **Frequency Measurement** to **auto or manual** (display will show TX Freq. Error)
- Set **TX frequency** to **834.990 MHz**
- Set **IF filter** to **230 kHz**
- Set **AF Filter 1** to **50 Hz**
- Set **AF Filter 2** to **15 kHz**
- Set **AF gen1** for **1 kHz frequency** at **6V level** (output will go to the **audio** port)

Test Mode Commands:

11333# Load synthesizer to channel 333
12X# Set power level to step X, where X is a power level from 1 to 7.
05# Turn on transmit carrier

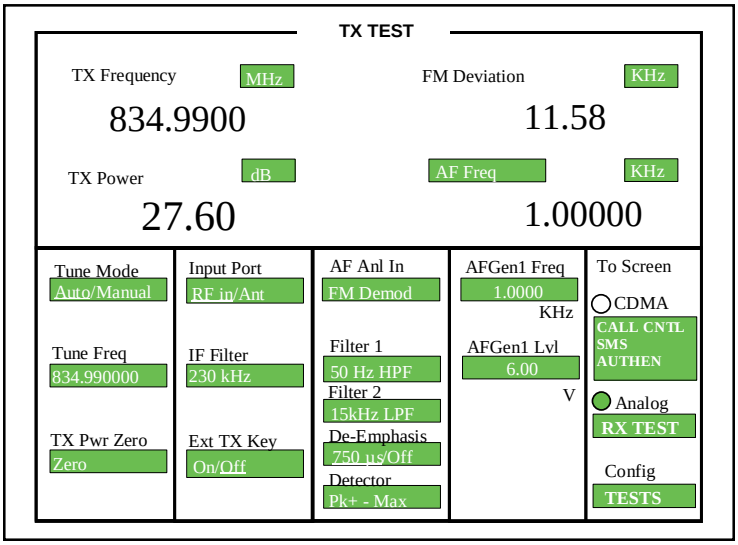
The TX Power Out specification for each portable power level is as follows:

Power Step 2 25dBm - 29dBm
Power Step 3 21.5dBm - 25.5dBm
Power Step 4 17.5dBm - 21.5dBm
Power Step 5 13.5dBm - 17.5dBm
Power Step 6 9.5dBm - 13.5dBm
Power Step 7 5.3dBm - 9.5dBm

Refer to the TX troubleshooting section for radios not within the pass specifications.

Note: When taking measurements, remember to compensate for cable loss.

TX Frequency Error Test



Communications Analyzer Setup:

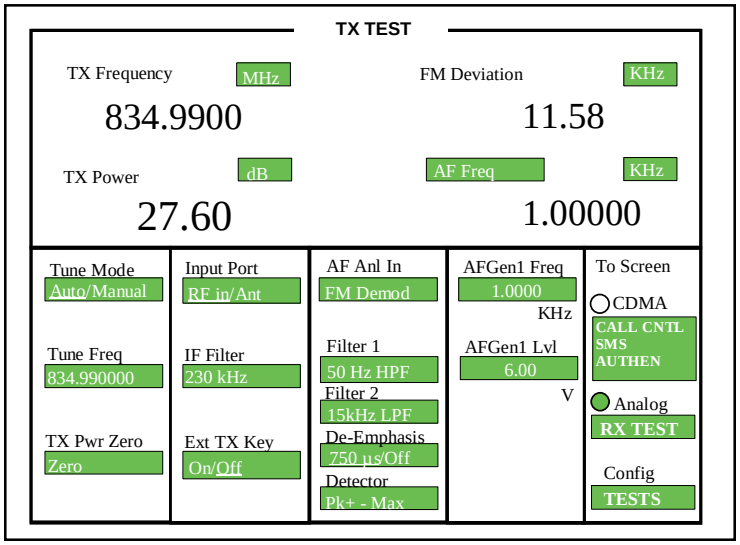
- Select **TX** button from the Analog Screen Control panel
- **PWR** is measured in **dBm**
- Set **Frequency Measurement** to **auto or manual** (display will show TX Freq. Error)
- Set **TX frequency** to **834.990 MHz**
- Set **IF filter** to **230 kHz**
- Set **AF Filter 1** to **50 Hz**
- Set **AF Filter 2** to **15 kHz**
- Set **AF gen1** for **1 kHz frequency** at **6V level** (output will go to the **audio** port)

Test Mode Commands:

11333# Load synthesizer to channel 333
122# Set power level to step 2
05# Turn on transmit carrier

The frequency error measured on the communications analyzer must be less than ±1 kHz.

TX Maximum Deviation Test



Communications Analyzer Setup:

- Select **TX** button from the Analog Screen Control panel
- **PWR** is measured in **dBm**
- Set **Frequency Measurement** to **auto or manual** (display will show TX Freq. Error)
- Set **TX frequency** to **834.990 MHz**
- Set **IF filter** to **230 kHz**
- Set **AF Filter 1** to **50 Hz**
- Set **AF Filter 2** to **15 kHz**
- Set **AF gen1** for **1 kHz frequency** at **6V level** (output will go to the **audio** port)

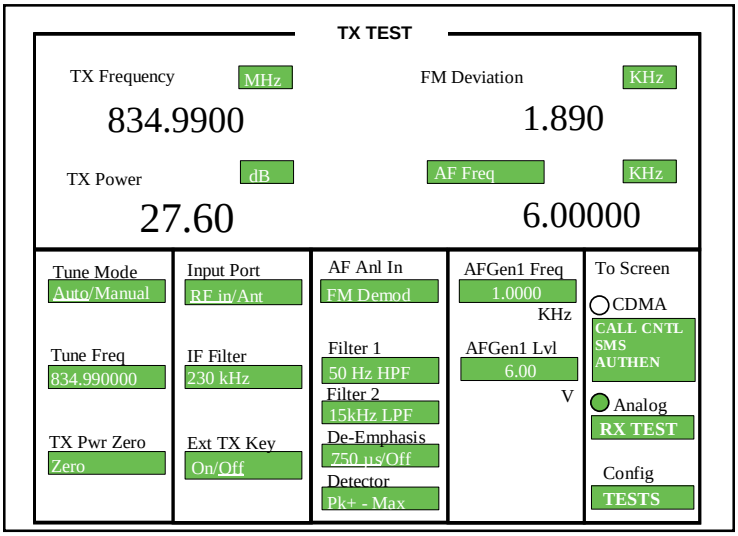
Test Mode Commands:

11333# Load synthesizer to channel 333
122# Set power level to power step 2
05# Turn on transmit carrier
356# Select External TX Audio path
10# Unmute TX Audio path
58# Turn on compandor

View FM Deviation for reading.

TX Maximum Deviation Pass Specifications: 9.8 kHz - 12 kHz

TX SAT Deviation Test



Communications Analyzer Setup:

- Select **TX** button from the Analog Screen Control panel
- **PWR** is measured in **dBm**
- Set **Frequency Measurement** to **auto or manual** (display will show TX Freq. Error)
- Set **TX frequency** to **834.990 MHz**
- Set **IF filter** to **230 kHz**
- Set **AF Filter 1** to **50 Hz**
- Set **AF Filter 2** to **15 kHz**
- Set **AF gen1** for **1 kHz frequency** at **6V level** (output will go to the **audio** port)

Test Mode Commands:

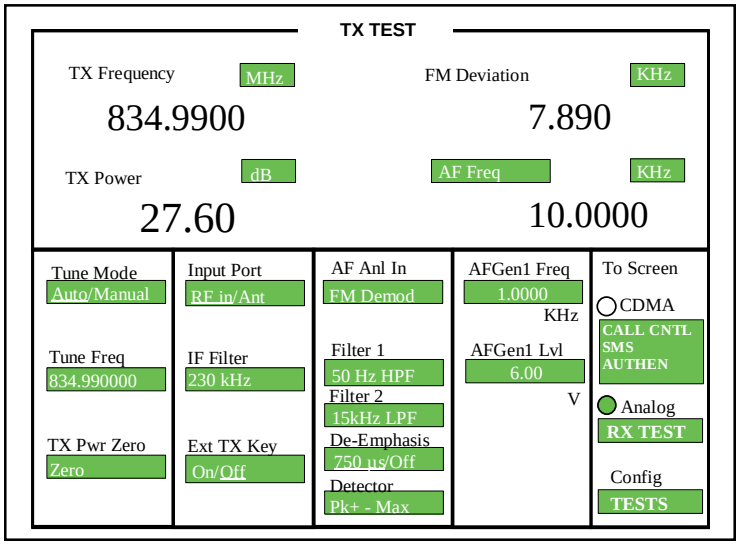
11333# Load synthesizer to channel 333
122# Set power level to step 2
05# Turn on transmit carrier
251# Enable 6000 Hz SAT tone

View FM Deviation for the reading.

The transponded peak SAT FM deviation should be 2 kHz ±200 Hz.

The demodulated signal on the communications analyzer should have an audio frequency of 6000 Hz.

TX ST Deviation Test



Communications Analyzer Setup:

- Select **TX** button from the Analog Screen Control panel
- **PWR** is measured in **dBm**
- Set **Frequency Measurement** to **auto or manual** (display will show TX Freq. Error)
- Set **TX frequency** to **834.990 MHz**
- Set **IF filter** to **230 kHz**
- Set **AF Filter 1** to **50 Hz**
- Set **AF Filter 2** to **15 kHz**
- Set **AF gen1** for **1 kHz frequency** at **6V level** (output will go to the **audio** port)

Test Mode Commands:

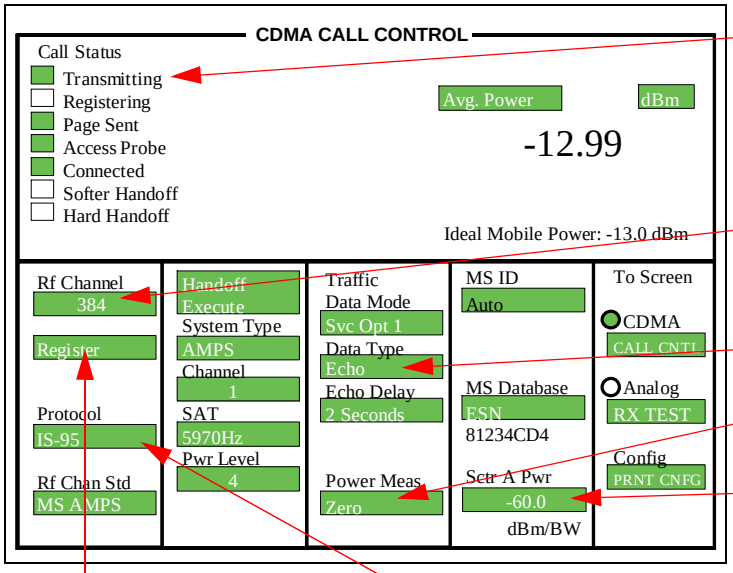
11333# Load synthesizer to channel 333
122# Set power level to power step 2
05# Turn on transmit carrier
14# Enable signaling tone

View FM Deviation for reading.

The peak ST deviation measured on the communications analyzer should be 8 kHz ±800 Hz deviation.

The demodulated signal on the communications analyzer should have an audio frequency of 10 kHz.

Set up for CDMA call



Pseudo LED's show call Status
The "Transmitting "light means that the HP 8924C is configured and transmitting the required CDMA signals to make a call.

Enter the expected RF channel number

Select Echo Mode

Zero the Power Meter

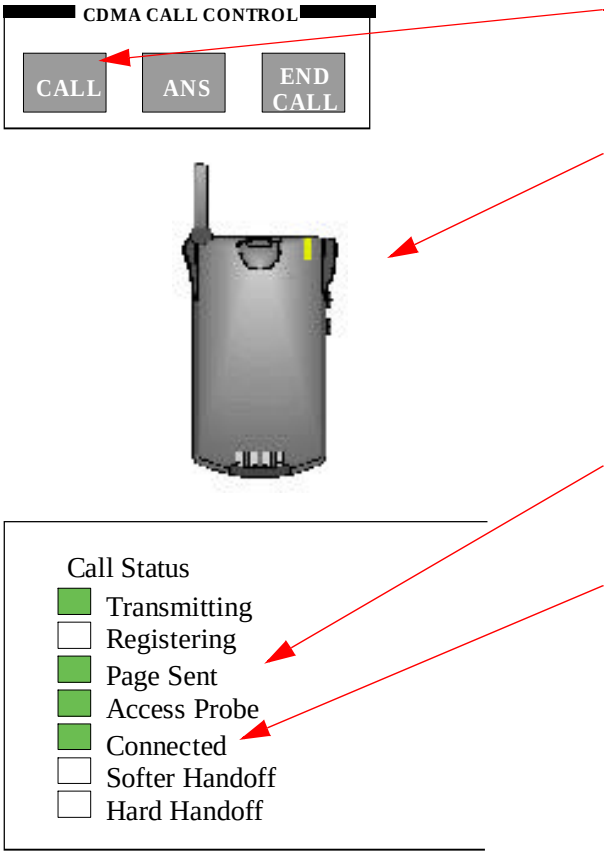
Set CDMA Generator Power to -60 dBm/1.23MHz

Select Protocol

Once the Phone Acquires Service, Register it by Using the Knob

1. Enter the channel number that the CDMA phone expects to find a CDMA system on. The IS-95A standard defines a primary and secondary channel number for both the A and B service providers. These channels are: 283 and 691 for the A side, and 384 and777 for the B side. A CDMA phone will only look for a CDMA system on power-up at its programmed primary or secondary channels. The HP 8924C defaults to channel 384. The phone you are using is set to B side service with a primary channel of 384.
2. Select the necessary protocol (IS-95, ID-95A, J-STD-008). For this demo we select IS-95.
3. Select the Traffic Data Mode to Service Option 001 (duplexed voice mode).
4. Set the Data Type to echo. This will allow you to speak into the phone under test and hear the voice quality echoed in the phone via the CDMA link from the HP 8924C.
5. Zero the average power detector. This is a good time to perform this step since no power is being transmitted by the phone.
6. Finally, set the Sector A power to -60 Dbm/1.23 MHz. You are now ready to make a CDMA phone call.
7. Make sure that the phone has acquired service (some type of display indicator on the phone).
8. Register the phone. This step is not required for mobile initiated calls. When registration is successful, the Registration Indicator will go out. The MS database should now show an ESN value.

Making a CDMA Phone Call



Press the front panel "CALL" key to initiate a CDMA call.

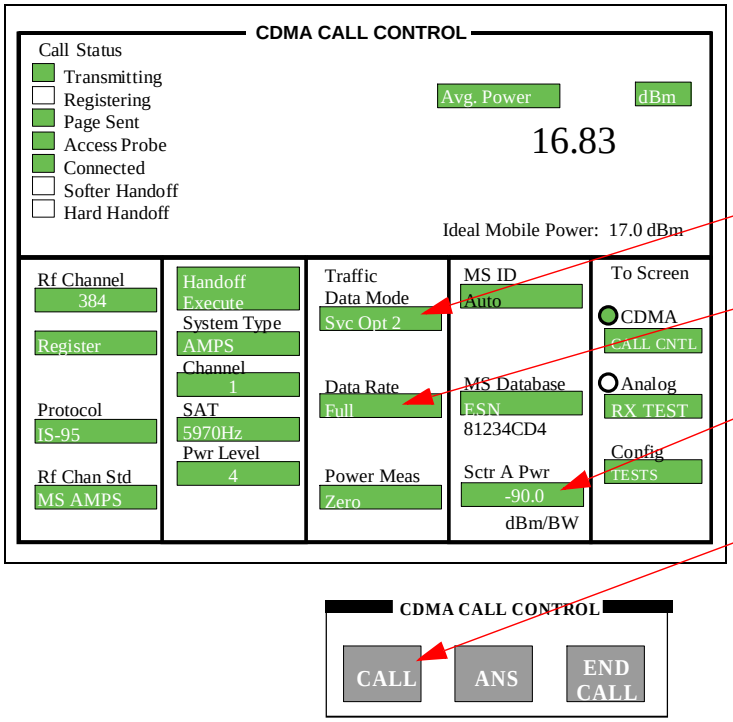
Answer the call on the CDMA Phone. Then speak into the phone and wait to hear your voice echoed back to you by the HP8924C.

Each light activates as the call processing proceeds.

The "Connected" light indicates that the call was successfully completed.

1. Press the HP 8924C's CALL button.
2. Notice the call status indicators are activated at each step in the call process. First the PAGE indicator activates when the HP 8924C sends out a page message on its paging channel. When the mobile answers with an access probe, the access probe indicator is activated.
3. The phone will now ring, or indicate on its' display there is an incoming call.
4. To complete the call, press the send key on the phone. The connected indicator should now be on. When the HP 8924C receives an acknowledgment from the phone that the traffic channel connection process is completed, the connected indicator is activated.

Set up for CDMA RF Parametric Measurements



Setup a CDMA Call with the following parameters:

- Traffic Data Mode:
  Service Option 2
- Data Rate:
  Full
- Set Sector A's power:
  -90 dBm/1.23 MHz
- Press the front panel "CALL" key

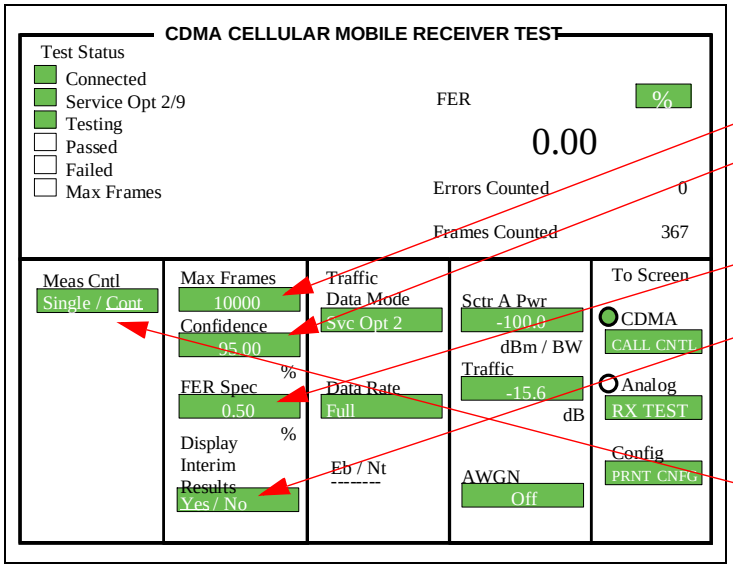
While service option 001 calls are useful for the verification of CDMA mobile functionality, parametric tests cannot be accurately made in this mode. The TIA IS-98A minimum performance standard recommends that testing be made using service option 002. In service option 002, the mobile under test demodulates the received signal and then re-transmits this data to the HP 8924C. This mode allow accurate receiver performance measurements.

To make a service option 002 call:

1. Press the **END CALL** front panel key to terminate the service option 001 call.
2. Return to the CDMA Call Control screen.
3. Change the Traffic Data Mode to Service Option 002.
4. Make sure that the Data Rate is set to Full.
5. Set Sector A's power to -90 dBm/1.23 MHz (this value may need some adjustment for varying cable losses - some phones with their associate fixtures may require higher levels due to path losses to make a phone call).
6. Press the HP 8924C's front panel CALL button.

The HP 8924C's call status indicators should now indicate that a call is connected. Depending on the phone being used, either SO2 or Loopback will be shown on the phone's display. Also available is service option 03 (voice EVRC), along with service option 09 and service option 32768 for 14.4 vocoder type phones.

Making a Receiver Sensitivity Measurement



To make an FER Measurement:

- Enter the Maximum number of frames to Test: 10,000
- Enter the Confidence: 95%
- Enter the Target FER Specification: 0.5%
- Enable the display of interim results: Yes

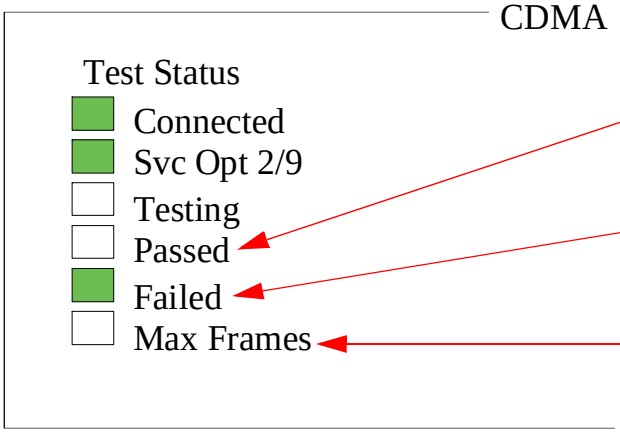
Arm the Measurement

- Place the cursor at the “Cont” field under Meas Cntl
- Push the Knob

Now that you have a service option 002 call connected, you are ready to make parametric receiver and transmitter measurements. To perform receiver measurements:

1. Go to the **RX Test screen**
2. Notice that the RX Test screen also has call status indicators that show if the call is still connected and if the call is a service option 002 call.
3. The parameter used to evaluate CDMA receiver quality is frame-error-rate. To setup a FER measurement with the HP 8924C, you need to enter three parameters: Max Frames, Confidence, and FER Spec.
4. Enter 10,000 into the Max frames field. This sets an upper bound to the time limit of the test.
5. Enter 95% into the Confidence field. This field sets the desired confidence limit for the test. If confidence limit testing is not desired, you can turn this field off. In that case, the FET test will run until the number of frames tested reaches the value entered into the Max Frames field.
6. Enter 0.5% into the FER spec field. This field sets the desired FER specification to test to.
7. Make sure that the Display Interim Results field is set to yes.
8. Use the knob to place the cursor in front of the Arm field. Press the knob to start the measurement.

Receiver Test Termination



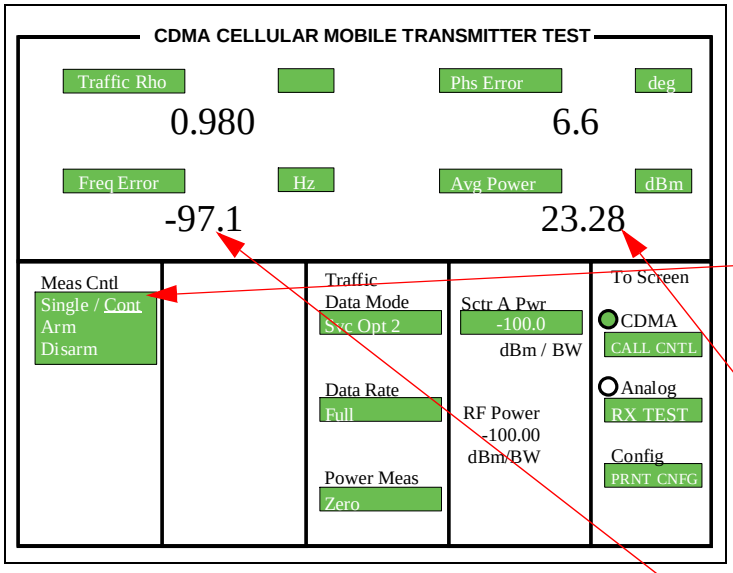
There are 3 possible outcomes to an FER Test:

- **Passed:** this means that the measured FER meets the target FER specification with the specified confidence.
- **Failed:** this means that the measured FER does not meet the target FER specification with the specified confidence.
- **Max Frames:** this means that the test was indeterminate in that the measured FER could neither pass nor fail the target FER specification with the specified confidence in the number of frames specified.

There are three possible outcomes for a confidence interval receiver frame-error-rate test with the HP 8924C:

1. When the HP 8924C determines that the measured FER will meet the user specified FER specification with the specified confidence level, the test is halted and the Passed indicator is activated.
2. The HP 8924C extends the TIA recommendation to also check for failures with the user specified confidence level. In other words, if the HP 8924C detects that the measured FER will fail the user entered FER specification with the specified confidence level, the test is halted and the Failed indicator is activated. This feature eliminates wasted time testing phones that are clearly failing the test.
3. If neither the pass or fail conditions are met, the FER test will run until the number of frames counted equals the valued entered into the Max Frames field. When this occurs, the Max Frames indicator is activated. If the confidence interval is turned off, the HP 8924C does not perform any confidence level checking and the FER test will run until the number of frames tested equals Max Frames.

CDMA Transmitter Tests



To make Concurrent RX and TX Measurements:

- Restart FER with Confidence Limits Off
- Go to the TX Test Screen
- Switch to Continuous Measurements

Read Average Power

- Check Max Power
- Check Open Loop Power Control

Read Rho Measurements

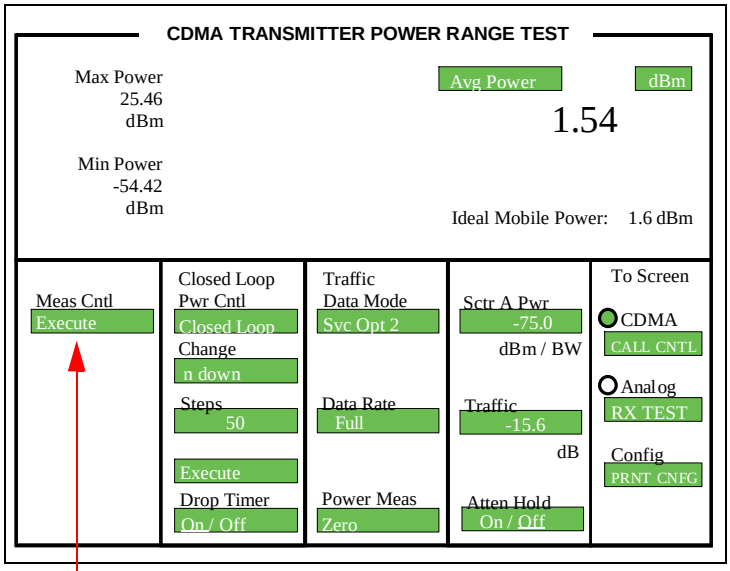
- Waveform Quality
- Frequency Error
- Amplitude & Phase Error

Simultaneous and transmitter tests is another feature of the HP 8924C. Simultaneous measurements results in much reduced test time. To make simultaneous receiver sensitivity and transmitter measurements:

1. Go to the TX test screen. (Press TX Test under the CDMA screens area.)
2. Make sure that the Meas Cntl is in Continuous mode. The HP 8924C will now make TX measurements.
3. Now select several measurement field and change the measurement types. Note: TM Rho (Test Mode Rho) only works with phones that have Test Mode functionality.

Now switch back to the RX Test screen. Notice that the FER test continued to run while you were making TX measurements.

CDMA Transmitter Power Range Test

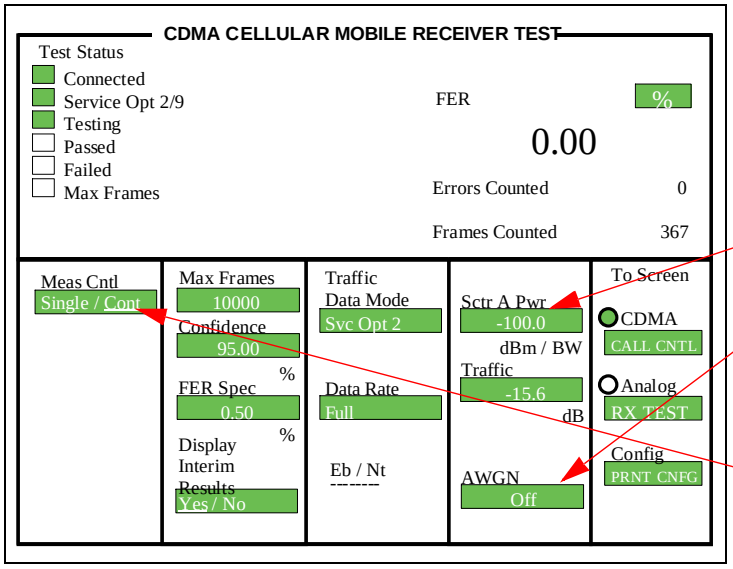


Select Execute

The ability to do min/max power measurements just by selecting Execute is another advanced feature of the HP 8924C. In this screen you can also control and test each power step while comparing Ideal Mobile Power to actual Avg Power measurements.

1. Go the CDMA Transmitter Power Range Test screen (press the blue Shift key and then the Range key).
2. Now execute the min/max power measurement (use the knob and select execute under the min/max power field).
3. You will also notice in this screen you can select closed-loop power control to manually control power settings of the phone. Note: If “always down” is selected, the phone will step its power down until the call is lost. If power control is changed, be sure to return it to “closed-loop” before proceeding onto the next test.

FER with AWGN Tests



To make a CDMA FER with AWGN measurement:

- Use the same setup as for the receiver sensitivity test
- Set Sector A Power to -75 dBm/ 1.23 MHz
- Set AWGN Power to -74 dBm/1.23 MHz

Arm the Measurement

- Place the cursor at the "Cont" field under Meas Cntl
- Push the knob

The other key receiver measurement for CDMA phones is the FER with AWGN test. In this test, large amounts of uncorrelated noise is added to simulate the actual conditions encountered by a CDMA phone in actual use. To make this measurement:

1. Set the Sector A Power to -55 dBm/1.23 MHz.
2. Set the AWGN source to -54 dBm/1,23 MHz (this means that the traffic channel is 16.6 dB below the noise level!).
3. Arm the measurement by selecting Continuous in the Meas Cntl field.
4. Under these conditions, a CDMA phone should meet 0.5% FER with 95% confidence.

Standards specify other tests for other rates. These can be performed by changing the Data Rate and Traffic level to the specified settings.

Disassembly

Introduction

To perform most repairs, the unit must be disassembled in order to gain access to the various internal components. Reasonable care should be taken in order to avoid damaging or stressing the housing and internal components. Motorola recommends the use of a properly grounded high impedance conductive wrist strap while performing any of these procedures.

CAUTION

Many of the integrated circuit devices used in this equipment are vulnerable to damage from static charges. An anti-static wrist band, connected to an anti-static (conductive) work surface, must be worn during all phases of disassembly, repair, and reassembly.

Recommended Tools

The following tools are recommended for use during the disassembly and reassembly of the StarTAC.

- Anti-Static Mat Kit (RPX-4307A); includes:
  - — Anti-Static Mat 66-80387A959
  - — Ground Cord 66-80387A989
  - — Wrist Band 42-80385A59
- Plastic Prying Tool SLN7223A
- Antenna Tool SYN5179A
- Tweezers

Transceiver Disassembly

Refer to the disassembly instructions and photo sequence on the following pages.

NOTE

Service personnel should be familiar with all of the following information before attempting unit disassembly.

Antenna Removal

Step 1. Turn off the telephone.

Step 2. Press down on the battery's tab and remove the battery from the housing.

Step 3. Use the antenna tool to remove the antenna.

Place the wide tip of the antenna in the large opening of the antenna tool.

Put the bottom of the tool on the grooves in the base of the antenna.

Turn counterclockwise until the antenna is free from the phone housing.

Opening Housing

Step 1. With flat surface of tool facing up, insert housing opener at a 45º angle. Make sure you can see top of tool in seam.

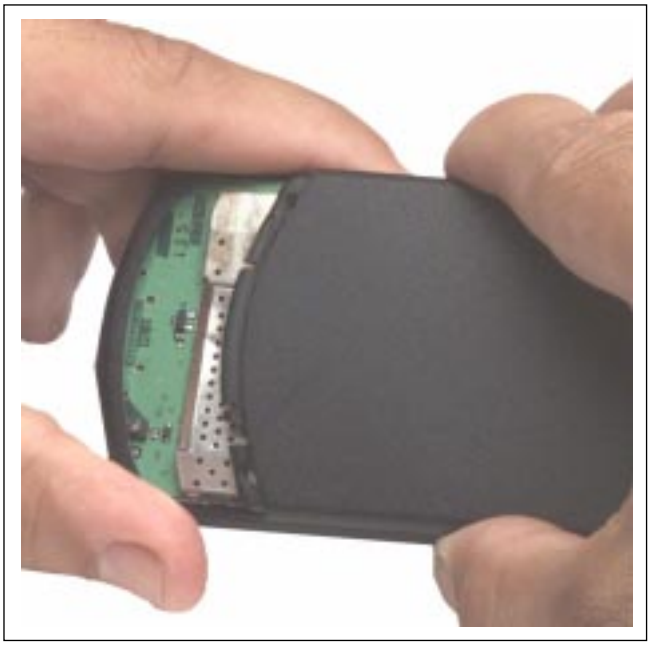
Step 2. Press and push corner outwards with left thumb while right hand twists phone.

Step 3. After phone has started to open, lift at antenna collar to release entire side.

Step 4. Using the small plastic prying tool, slide under housing all the way to corner and lift housing off corner.

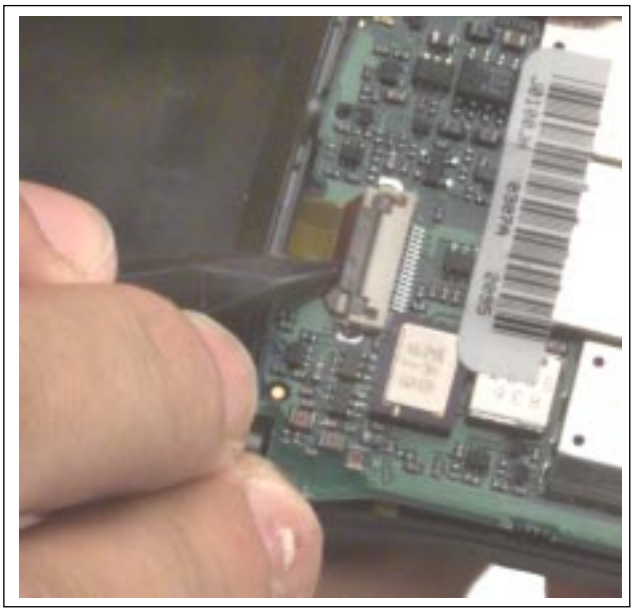
Step 5. With flat surface of tool facing up, insert housing opener at a 45º angle. Make sure you can see top of tool in seam.

Step 6. Grasp the backhousing and pull the backhousing off going straight across phone.



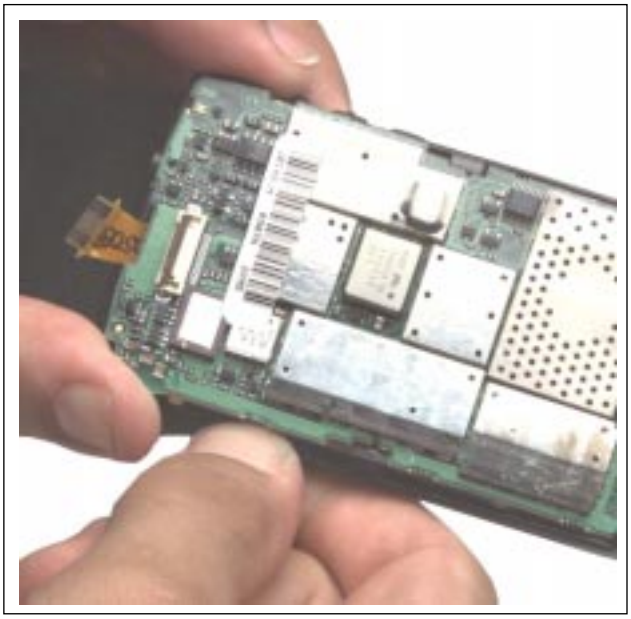
Board Removal

Step 1. Open the flex connector and pull out the flex.



Step 2. Using your thumb, pry the side tabs away from the assembly to allow it to be easily removed.

Step 3. Starting at the top of the board, using your thumb and index finger, lift the board assembly out of the front housing



Step 4. Using your index finger, lift and seperate the display board and audio-logic board assembly from the transceiver board.

Flip Removal

Step 1. Using the pointed end of the plastic disassembly tool, pry off the left side of the cover.

Step 2. Using the pointed end of the plastic prying tool, insert it on the right side of the locking tab.

While pushing inward, force the locking tab to the left to release.

Step 3. Once the tab is released, peel off and slide the cover away from the flip.

Step 4. Remove the flip by pulling up on the hinge pin side and out on the other side.

The hinge shaft may come loose from the flip.

Speaker / Vibrator Removal

Step 1. Rest flip housing on a flat surface. Slip the tweezers between front housing and battery contacts.

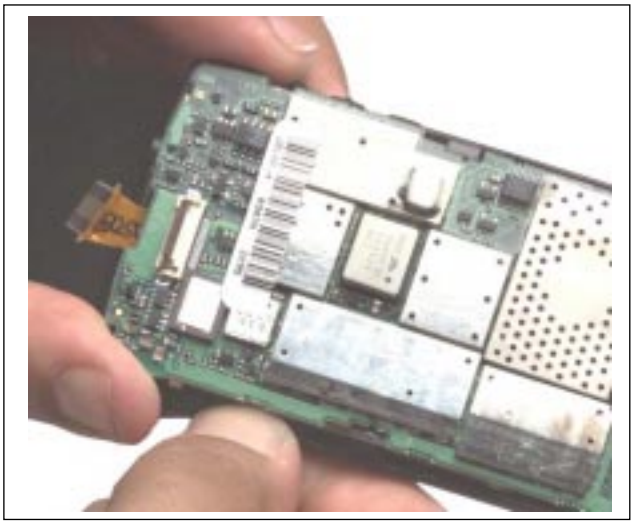
Pry up to unsnap front housing and battery contacts.

The speaker, vibrator, and flex should be exposed.

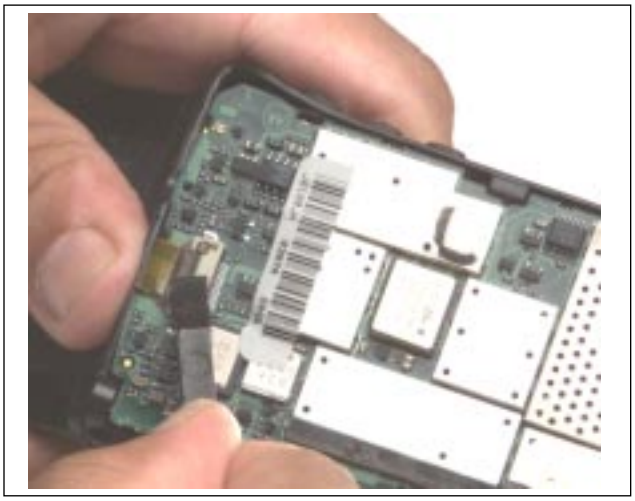
Board Assembly

Step 1. Place the display and audio logic board on top of RF board and press firmly making sure your Inter connector is properly connected.

Step 2. To place the board back into the housing, pry the side tabs away from the board assembly to allow it to be re-inserted.



Step 3. Insert the flex into connector and close flex connector.



Closing housing

Step 1. Place backhousing on phone making sure side snaps clip the backshouing and push forward snapping everything back in place.

Step 2. Insert antenna.

Troubleshooting

Introduction

Known good replacement parts and assem-blies should be available to be used for troubleshooting by substitution, and for replacement of defective parts/assemblies. Defective circuit boards should be forwarded to the appropriate Motorola service facility for repair. Refer to the "Replacement Parts" section of this manual for a list of replacement part descriptions and part numbers.

CAUTION

Many of the integrated circuit devices used in this equipment are vulnerable to damage from static charges. An ESD-safe workstation should be used when-ever a transceiver is opened.

Troubleshooting and Repair

The troubleshooting chart in Table 7, "Assembly Replacement Level Trouble-shooting and Repair Chart," on page 56 shows some typical malfunction symptoms and the corresponding verification and repair procedures. Refer to the disassembly instructions located in the "Disassembly" section of this manual for instructions on removing parts/assemblies.

GSM Testing after Repair

After any repair work has been carried out, the unit should be thoroughly tested to ensure that it operates correctly. This is especially important if the Logic / RF assembly is replaced.

For general repairs which do not include replacing the Logic/RF assembly, simply placing a call and checking signal strength, and transmit and recieve audio quality is normally sufficient.

When the Logic/RF assembly is replaced, the unit must have a comprehensive test on a GSM/ DCS compatible communications analyzers. See "Testing" for further details. Placing a call on air is usually carried out at this stage to complete the testing procedure.

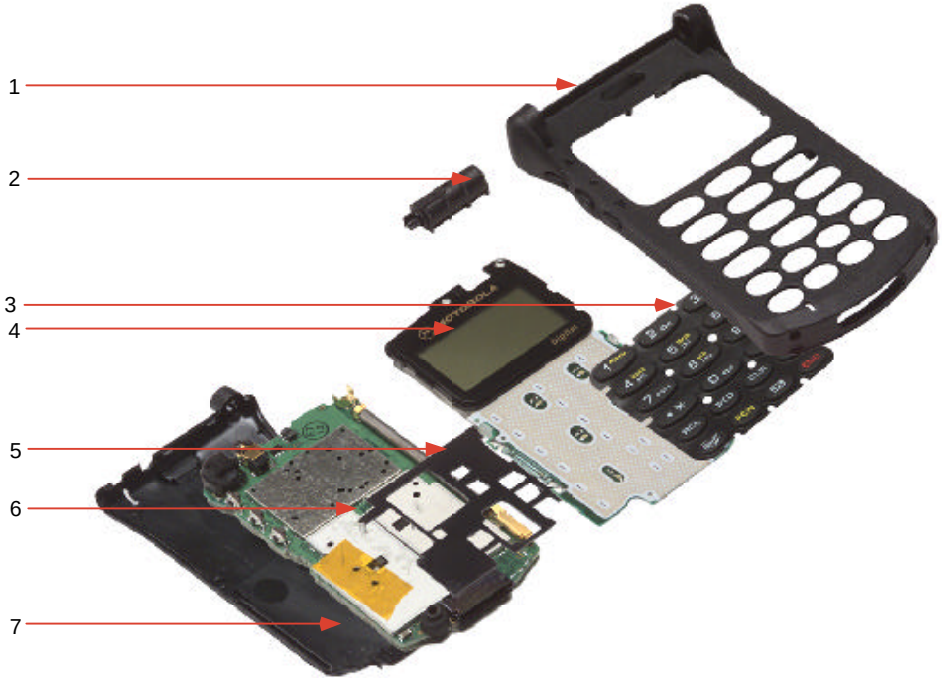
Table 12:

Symptom	*Probable Cause*	*Verification and Remedy*
1. Phone will not turn on or stay on.	a) Battery either discharged or defective.	1. Measure battery voltage across a 50 ohm (>1 Watt) load. 2. If the battery voltage is <3.4 V DC, recharge the battery using the appropriate battery charger. 3. If the battery will not recharge, replace the battery.
	b) Battery connector open or misaligned.	1. Visually inspect the battery connectors on both the battery pack and the transceiver, including the solder connections from the battery connector to the main PC board. 2. Realign the contacts or, if necessary, replace either the battery or battery connector.
	c) Switch inside option connector is open.	1. Measure resistance across the two option connector solder connections on the RF side of the RF/Audio-Logic board. 2. If the switch measures open, replace the option connector.
	d) Keypad membrane defective.	1. Replace the keypad membrane with a known good part. 2. Temporarily connect +6 V DC to the battery contacts. 3. Depress the **PWR** button; if unit turns on and stays on, disconnect the power source and reassemble the phone with the new keypad membrane.
	e) Keypad board defective.	1. Replace keypad board assembly with a known good assembly. 2. Temporarily connect +6 V DC to the battery contacts. Depress the **PWR** button. 3. If the units turns on and stays on, discon-nect the power source and reassemble the phone with the new keypad board assembly.
	f) RF/Audio-Logic Board defective.	1. Remove the RF/Audio-Logic Board. Substitute a known good board. 2. Temporarily connect +6 V DC to the battery contacts. 3. Depress the **PWR** button; if unit turns on and stays on, disconnect the power source and reassemble the phone with the new RF/Audio-Logic board and re-test phone.

Table 12:

Symptom	*Probable Cause*	*Verification and Remedy*
2. Phone exhibits poor reception and/or erratic operation (such as calls frequently dropping, weak and/or distorted audio, etc.)	a) Defective antenna or damaged antenna connector.	1. Make sure the antenna shaft ferrule is screwed into the antenna socket. 2. Make sure pin on antenna coil is seated in antenna connector socket. 3. Replace the antenna with a known good antenna.
	b) Defective RF/ Audio-Logic Board.	Replace the transceiver board (refer to symptom 1c Verification and Re edy.)
3. Display is erratic, or provides partial or nodisplay.	a) Defectivedisplay module.	1. Gain access to RF/Audio-Logic board or keypad board as described in the "Disassembly" section of this manual. 2. Check connection. If connection not at fault, proceed to b.
	b) RF/Audio-Logic board defective.	Replace the RF/Audio-Logic Board (refer to symptom 1f Verification and Remedy).
4. Alert ringer volume is distorted or too low.	a) Alert ringer defective.	Replace the defective speaker or alert ringer with a known good speaker or alert ringer.
	b) RF/Audio-Logic board defective.	Replace the RF/Audio-Logic Board (refer to symptom 1f Verification and Remedy).
5. Transmit audio is weak, distorted, or dead.	a) Microphonedefective.	Replace defective microphone.
	b) RF/Audio-Logic board defective.	Replace the RF/Audio-Logic Board (refer to symptom 1f Verification and Remedy).
6. Receive audio is weak and/or distorted.	a) Speaker defective.	Replace defective speaker.
	b) RF/Audio-Logic board defective.	Replace the RF/Audio-Logic Board (refer to symptom 1f Verification and Remedy).
7. StarTAC 800 (CDMA) model does not sense when flip is opened and closed.	a) Defective reed switch or magnet on keypad board	Replace keypad board assembly or magnet/flip assembly.

Replacement Parts



1.Front Housing

2. Flip Hinge

3.Keypad

4. Keyboard

5. Mylar

6. Transceiver Board

7. Rear Housing

Table 13:

Schematic Reference:8485920J01

Mechanical Parts List

Part Number	Description
0103850K04	ASSY CDMA FRNT HSNG
0104866Z06	ASSY FLIP
0104976Z02	ASSY ANT WHIP
0185771K01	ASSY REAR HSNG
0187394K01	ASSY EL DISPLAY KEYBOARD
0909399T07	JACK MOD 2.5MM PLUG SMD
0909449B04	RECEPT MOD 15PIN INSMLD
1185855G01	PROTECTIVE TAPE MYLAR
2809454C02	PLUG LO PROFILE SMD 32 POS
3704947Z01	TUBE ANTENNA
3809423U03	KEYPAD CDMA STARTAC
3909101E01	CNTCT ANT UPPER
3909102E01	CNTCT ANT LOWER
4009060E01	SW TACTILE SMD
4209480E01	CLIP ANTENNA
4709038K01	SHAFT RIGHT CVR
5009135L07	MIC ELECT 6MM PINS
5009365S01	ALERT 3V SMD
5509242E01	HINGE GSM
5803912K02	ISLTR CER TX 836MHZ 7MM SMD
8485920J01	PCB MAIN PORTABLE

RF Side Parts List

Ref. Des.	Part Number	Description
C00050	2113743N40	CAP CHIP 39.0 PF 5% COG
C00051	2113743N40	CAP CHIP 39.0 PF 5% COG
C00052	2113743N40	CAP CHIP 39.0 PF 5% COG
C00053	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00054	2113743N40	CAP CHIP 39.0 PF 5% COG
C00060	2113743N40	CAP CHIP 39.0 PF 5% COG
C00065	2113743N40	CAP CHIP 39.0 PF 5% COG
C00076	2113743N40	CAP CHIP 39.0 PF 5% COG
C00077	2113743N40	CAP CHIP 39.0 PF 5% COG
C00078	2113743N07	CAP CHIP 1.5 PF +-.25PF COG
C00080	2113743N07	CAP CHIP 1.5 PF +-.25PF COG
C00081	2113743N30	CAP CHIP 15.0 PF 5% COG
C00082	2113743N26	CAP CHIP 10.0 PF 5% COG
C00083	2113743N40	CAP CHIP 39.0 PF 5% COG
C00084	2113743N40	CAP CHIP 39.0 PF 5% COG
C00085	2113743N40	CAP CHIP 39.0 PF 5% COG
C00086	2113743N40	CAP CHIP 39.0 PF 5% COG

C00087	2113743N40	CAP CHIP 39.0 PF 5% COG
C00088	2113743N40	CAP CHIP 39.0 PF 5% COG
C00089	2113740F41	CAP CHIP REEL CL1 +/-30 39
C00090	2113743N40	CAP CHIP 39.0 PF 5% COG
C00100	2113743N40	CAP CHIP 39.0 PF 5% COG
C00101	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C00102	2113743N03	CAP CHIP 1.0 PF +-.25PF COG
C00104	2113743E20	CAP CHIP .10 UF 10%
C00105	2113743N40	CAP CHIP 39.0 PF 5% COG
C00106	2113743E20	CAP CHIP .10 UF 10%
C00107	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C00110	2113928C03	CAP CER CHIP 1.0 UF 6.3V 10%
C00152	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00154	2113743L17	CAP CHIP 1000 PF 10% X7R
C00155	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00156	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C00200	2113743N40	CAP CHIP 39.0 PF 5% COG
C00201	2113743N40	CAP CHIP 39.0 PF 5% COG
C00203	2113743N54	CAP CHIP 150 PF 5% COG
C00204	2113743N28	CAP CHIP 12.0 PF 5% COG
C00206	2113743L17	CAP CHIP 1000 PF 10% X7R
C00207	2113743N30	CAP CHIP 15.0 PF 5% COG
C00250	2113743N40	CAP CHIP 39.0 PF 5% COG
C00252	2113743N23	CAP CHIP 7.5 PF + -.5PF COG
C00254	2113743N16	CAP CHIP 3.9 PF +-.25PF COG
C00255	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00256	2113743N30	CAP CHIP 15.0 PF 5% COG
C00257	2113743N03	CAP CHIP 1.0 PF +-.25PF COG
C00258	2113743N11	CAP CHIP 2.4 PF +-.25PF COG
C00259	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C00260	2113743N35	CAP CHIP 24.0 PF 5% COG
C00261	2113743N40	CAP CHIP 39.0 PF 5% COG
C00265	2113743L17	CAP CHIP 1000 PF 10% X7R
C00266	2113743L17	CAP CHIP 1000 PF 10% X7R
C00300	2113743E20	CAP CHIP .10 UF 10%
C00301	2113741F49	CAP CHIP CL2 X7R REEL 10000
C00302	2113743N42	CAP CHIP 47.0 PF 5% COG
C00303	2113743N40	CAP CHIP 39.0 PF 5% COG
C00304	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00305	2113743N14	CAP CHIP 3.3 PF +-.25PF COG
C00325	2113743L41	CAP CHIP 10000 PF 10% X7R
C00326	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00327	2113928C03	CAP CER CHIP 1.0 UF 6.3V 10%
C00328	2113743N46	CAP CHIP 68.0 PF 5% COG
C00330	2113743L25	CAP CHIP 2200 PF 10% X7R
C00331	2113928G01	CAP CER CHIP .22 UF 6.3V 10%
C00332	2113741F25	CAP CHIP CL2 X7R REEL 1000
C00350	2113743N40	CAP CHIP 39.0 PF 5% COG
C00351	2113743N40	CAP CHIP 39.0 PF 5% COG
C00401	2113743N30	CAP CHIP 15.0 PF 5% COG
C00402	2113743N69	CAP CHIP 1.8PF 16V +/-.25PF

C00403	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C00404	2113743L17	CAP CHIP 1000 PF 10% X7R
C00405	2113743N40	CAP CHIP 39.0 PF 5% COG
C00406	2113743N40	CAP CHIP 39.0 PF 5% COG
C00407	2113743L41	CAP CHIP 10000 PF 10% X7R
C00408	2113743N40	CAP CHIP 39.0 PF 5% COG
C00409	2113743N40	CAP CHIP 39.0 PF 5% COG
C00410	2113743N40	CAP CHIP 39.0 PF 5% COG
C00411	2113743N40	CAP CHIP 39.0 PF 5% COG
C00412	2113743N40	CAP CHIP 39.0 PF 5% COG
C00413	2113743N40	CAP CHIP 39.0 PF 5% COG
C00414	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00415	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00416	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C00417	2113743N40	CAP CHIP 39.0 PF 5% COG
C00418	2113743N40	CAP CHIP 39.0 PF 5% COG
C00452	2113743N40	CAP CHIP 39.0 PF 5% COG
C00454	2113743N42	CAP CHIP 47.0 PF 5% COG
C00455	2113743G26	CAP CHIP 4.7 UF 16V +80-20%
C00456	2113741F25	CAP CHIP CL2 X7R REEL 1000
C00457	2113743L17	CAP CHIP 1000 PF 10% X7R
C00458	2113743L17	CAP CHIP 1000 PF 10% X7R
C00460	2113740F29	CAP CHIP REEL CL1 +/-30 12
C00461	2113740F22	CAP CHIP REEL CL1 +/-30 6.2
C00462	2113740F05	CAP CHIP REEL CL1 +/-30 1.2
C00463	2113740F41	CAP CHIP REEL CL1 +/-30 39
C00467	2113743N21	CAP CHIP 6.2 PF + -.5PF COG
C00468	2113743N40	CAP CHIP 39.0 PF 5% COG
C00471	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00472	2113928G01	CAP CER CHIP .22 UF 6.3V 10%
C00473	2113743L17	CAP CHIP 1000 PF 10% X7R
C00475	2113740F02	CAP CHIP REEL CL1 +/-30 .75
C00476	2113743E20	CAP CHIP .10 UF 10%
C00477	2113743N40	CAP CHIP 39.0 PF 5% COG
C00478	2109622N06	CAP CER CHIP NPO CLASS I
C00480	2113743N40	CAP CHIP 39.0 PF 5% COG
C00481	2113743N40	CAP CHIP 39.0 PF 5% COG
C00482	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00483	2113743N40	CAP CHIP 39.0 PF 5% COG
C00485	2311049B08	CAP TANT CHIP 1.0 UF 10V 10%
C00486	2311049B08	CAP TANT CHIP 1.0 UF 10V 10%
C00487	2311049B08	CAP TANT CHIP 1.0 UF 10V 10%
C00488	2311049B08	CAP TANT CHIP 1.0 UF 10V 10%
C00600	2113743B29	CAP CHIP 1.00 UF 10% 16V
C00601	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C00602	2113743L41	CAP CHIP 10000 PF 10% X7R
C00625	2113743L41	CAP CHIP 10000 PF 10% X7R
C00626	2113743N40	CAP CHIP 39.0 PF 5% COG
C00627	2311049A89	CAP TANT CHIP 22 UF 4V 10%
C00628	2113743N40	CAP CHIP 39.0 PF 5% COG
C00629	2113743N07	CAP CHIP 1.5 PF +-.25PF COG

C00630	2113743N40	CAP CHIP 39.0 PF 5% COG
C00631	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00632	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00633	2113743N40	CAP CHIP 39.0 PF 5% COG
C00650	2113743N16	CAP CHIP 3.9 PF +-.25PF COG
C00651	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00652	2113743N28	CAP CHIP 12.0 PF 5% COG
C00653	2113743N28	CAP CHIP 12.0 PF 5% COG
C00654	2113740F03	CAP CHIP REEL CL1 +/-30 1.0
C00655	2113743E12	CAP CHIP .047 UF 10% X7R
C00656	2311049A07	CAP TANT CHIP 1 10 16 A/P
C00657	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00658	2113928C03	CAP CER CHIP 1.0 UF 6.3V 10%
C00675	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00676	2113743L17	CAP CHIP 1000 PF 10% X7R
C00677	2113743L41	CAP CHIP 10000 PF 10% X7R
C00678	2113743N03	CAP CHIP 1.0 PF +-.25PF COG
C00679	2113743N03	CAP CHIP 1.0 PF +-.25PF COG
C00700	2113743E20	CAP CHIP .10 UF 10%
C00701	2113743N40	CAP CHIP 39.0 PF 5% COG
C00703	2113743N40	CAP CHIP 39.0 PF 5% COG
C00704	2113743E20	CAP CHIP .10 UF 10%
C00705	2113743N40	CAP CHIP 39.0 PF 5% COG
C00706	2113743E20	CAP CHIP .10 UF 10%
C00707	2113743N40	CAP CHIP 39.0 PF 5% COG
C00708	2311049A07	CAP TANT CHIP 1 10 16 A/P
C00709	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00728	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00729	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00730	2113743L01	CAP CHIP 220 PF 10% X7R
C00731	2113743L01	CAP CHIP 220 PF 10% X7R
C00732	2113743L41	CAP CHIP 10000 PF 10% X7R
C00733	2113743L41	CAP CHIP 10000 PF 10% X7R
C00740	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00741	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00750	2113743L41	CAP CHIP 10000 PF 10% X7R
C00751	2113743L41	CAP CHIP 10000 PF 10% X7R
C00752	2113743L41	CAP CHIP 10000 PF 10% X7R
C00753	2113743L41	CAP CHIP 10000 PF 10% X7R
C00754	2113743L21	CAP CHIP 1500 PF 10% X7R
C00755	2113743L41	CAP CHIP 10000 PF 10% X7R
C00756	2113743L41	CAP CHIP 10000 PF 10% X7R
C00757	2113743N36	CAP CHIP 27.0 PF 5% COG
C00775	2113741F25	CAP CHIP CL2 X7R REEL 1000
C00776	2113928G01	CAP CER CHIP .22 UF 6.3V 10%
C00777	2113743L41	CAP CHIP 10000 PF 10% X7R
C00778	2113743L41	CAP CHIP 10000 PF 10% X7R
C00779	2113743L41	CAP CHIP 10000 PF 10% X7R
C00780	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C00781	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C00782	2113743F18	CAP CHIP 2.2 UF 16V +80-20%

C00783	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C00784	2113743E20	CAP CHIP .10 UF 10%
C00785	2113743L41	CAP CHIP 10000 PF 10% X7R
C00786	2113741F49	CAP CHIP CL2 X7R REEL 10000
C00787	2113743N40	CAP CHIP 39.0 PF 5% COG
C01004	2113743N40	CAP CHIP 39.0 PF 5% COG
C01054	2113743N40	CAP CHIP 39.0 PF 5% COG
C01056	2113743N50	CAP CHIP 100 PF 5% COG
C01752	2113743N40	CAP CHIP 39.0 PF 5% COG
C01753	2113743N40	CAP CHIP 39.0 PF 5% COG
C01754	2113743N40	CAP CHIP 39.0 PF 5% COG
C01755	2113743N40	CAP CHIP 39.0 PF 5% COG
C02300	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C02301	2113928G01	CAP CER CHIP .22 UF 6.3V 10%
C02500	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C02501	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C05000	2113743N40	CAP CHIP 39.0 PF 5% COG
CR0300	4862824C01	DIODE VARACTOR
CR0475	4809606E05	DIODE DUAL SCHOTTKEY SOT-143
CR0650	4809877C17	DIODE VARACTOR MA4ST340 SOD323
CR0651	4862824C01	DIODE VARACTOR
CR0700	4809606E03	DIODE DUAL ARRAY DAP222
CR1150	4809118D02	LED BICOLOR LNJ115W8POMT
FL0075	9109361K03	FLTR SAW DUPLEX 850MHZ SMD
FL0100	9103913K02	FLTR SAW TX 881MHZ SMD
FL0200	9109303U02	FLTE CER LC 991MHZ 3225 SMD
FL0250	9109142L03	FLTR XTAL 109.65MHZ 5X7MM SMD
FL0251	9103786K01	FLTR SAW IF 109.8MHZ SMD
FL0400	9103914K01	FLTR CER LC BP 155MHZ 4532 SMD
FL0401	9109247M03	FLTR SAW BP 836MHZ 3X3MM SMD
FL0402	9103913K01	FLTR SAW TX 836MHZ SMD
J01000	0909059E01	RECPT ZIF 16 POS SMD
J05000	0909195E01	SKT BOT ENTRY 2 POS
L00077	2409646M08	IND CER MULTILYR 15NH 1608
L00080	2409594M11	IND CHIP 15.0NH 5% ACCU-L
L00081	2409594M10	IND CHIP 12.0NH 5% ACCU-L
L00082	2409594M11	IND CHIP 15.0NH 5% ACCU-L
L00102	2409646M07	IND CER MULTILYR 12NH 1608
L00150	2409646M02	IND CER MULTILYR 4.7NH 1608
L00151	2409646M70	IND CER MULTILYR 56NH 1608
L00152	2409646M06	IND CER MULTILYR 10NH 1608
L00200	2409646M08	IND CER MULTILYR 15NH 1608
L00203	2404574Z11	IND CHIP WW 150NH 2% 2012 SMD
L00250	2404574Z13	IND CHIP WW 220NH 2% 2012 SMD
L00251	2404574Z13	IND CHIP WW 220NH 2% 2012 SMD
L00252	2404574Z07	IND CHIP WW 68NH 2% 2012 SMD
L00253	2404574Z08	IND CHIP WW 82NH 2% 2012 SMD
L00300	2462587V27	CHIP IND 27 NH 5% 0805
L00330	2462587P36	CHIP IND 100000 NH
L00400	2409646M22	IND CER MULTILYR 82 NH 1608
L00401	2409646M04	IND CER MULTILYR 6.8NH 1608

L00402	2409646M08	IND CER MULTILYR 15NH 1608
L00403	2409646M42	IND CER MULTILYR 2.7NH 1608
L00404	2409646M08	IND CER MULTILYR 15NH 1608
L00411	2409646M22	IND CER MULTILYR 82 NH 1608
L00412	2409646M05	IND CER MULTILYR 8.2NH 1608
L00450	2409646M10	IND CER MULTILYR 22NH 1608
L00451	2409594M07	IND CHIP 6.5NH .5NH ACCU-L
L00452	2409646M03	IND CER MULTILYR 5.6NH 1608
L00627	2409646M09	IND CER MULTILYR 18NH 1608
L00650	2462587V26	CHIP IND 22 NH 5% 0805
L00675	2462587P09	CHIP IND 560 NH 10%
L00676	2409704K48	IND CHIP MULTILYR 82NH 2012
L00728	2409646M73	IND CER MULTILYR 100NH 1608
L00729	2409646M73	IND CER MULTILYR 100NH 1608
L00777	2462587Q44	IND CHIP 560 NH 10%
Q00050	4809939C03	TSTR DUAL NPN/PNP UMH3
Q00060	4809939C23	TSTR DUAL NPN/NPN UM6
Q00080	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q00081	4809579E24	TSTR FET P-CHAN 2SJ347 SC90
Q00100	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00150	4809527E33	TSTR NPN RF MRF1047 SC70
Q00250	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00251	4809608E03	TSTR DIG PNP DTA114YE
Q00325	4809939C04	TSTR DUAL PNP/NPN UMC3
Q00350	4809608E03	TSTR DIG PNP DTA114YE
Q00450	4809939C04	TSTR DUAL PNP/NPN UMC3
Q00451	4809607E02	TSTR SIG PNP 25A1774
Q00452	4809579E29	TSTR FET P-CHAN SI3443DV 6TSOP
Q00480	4809976N04	TSTR FET RF GAAS SWITCH
Q00625	4809940E01	TSTR NPN MRF947 A/P
Q00675	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00700	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q00701	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q01008	4809579E27	TSTR FET P-CHAN SI3441 6TSOP
Q02500	4809579E12	TSTR MOSFET P-CHAN ML6302
Q02501	4809579E12	TSTR MOSFET P-CHAN ML6302
Q02503	4809939C04	TSTR DUAL PNP/NPN UMC3
Q02504	4809940E02	TSTR DIG NPN DTC114YE
R00050	0662057M98	RES. CHIP 10K 5% 20X40
R00051	0662057M98	RES. CHIP 10K 5% 20X40
R00052	0662057M98	RES. CHIP 10K 5% 20X40
R00060	0662057N33	RES. CHIP 270K 5% 20X40
R00065	0662057N33	RES. CHIP 270K 5% 20X40
R00080	0662057M98	RES. CHIP 10K 5% 20X40
R00081	0662057N33	RES. CHIP 270K 5% 20X40
R00082	0662057M98	RES. CHIP 10K 5% 20X40
R00083	0662057N15	RES. CHIP 47K 5% 20X40
R00100	0662057M52	RES. CHIP 120 5% 20X40
R00101	0662057M66	RES. CHIP 470 5% 20X40
R00105	0662057M01	RES. CHIP 0 5% 20X40
R00150	0662057M58	RES. CHIP 220 5% 20X40

R00151	0662057M34	RES. CHIP 22 5% 20X40
R00152	0662057M58	RES. CHIP 220 5% 20X40
R00200	0662057M40	RES. CHIP 39 5% 20X40
R00204	0662057M01	RES. CHIP 0 5% 20X40
R00250	0662057M98	RES. CHIP 10K 5% 20X40
R00261	0662057M64	RES. CHIP 390 5% 20X40
R00262	0662057M82	RES. CHIP 2200 5% 20X40
R00263	0662057M78	RES. CHIP 1500 5% 20X40
R00264	0662057M32	RES. CHIP 18 5% 20X40
R00300	0662057M86	RES. CHIP 3300 5% 20X40
R00301	0662057M98	RES. CHIP 10K 5% 20X40
R00325	0662057M74	RES. CHIP 1000 5% 20X40
R00331	0662057M98	RES. CHIP 10K 5% 20X40
R00332	0662057M84	RES. CHIP 2700 5% 20X40
R00333	0662057N03	RES. CHIP 15K 5% 20X40
R00400	0662057N33	RES. CHIP 270K 5% 20X40
R00401	0662057M50	RES. CHIP 100 5% 20X40
R00402	0662057M50	RES. CHIP 100 5% 20X40
R00403	0662057M76	RES. CHIP 1200 5% 20X40
R00407	0662057N06	RES. CHIP 20K 5% 20X40
R00408	0662057N13	RES. CHIP 39K 5% 20X40
R00409	0662057M84	RES. CHIP 2700 5% 20X40
R00410	0662057M26	RES. CHIP 10 5% 20X40
R00411	0662057M84	RES. CHIP 2700 5% 20X40
R00412	0662057M58	RES. CHIP 220 5% 20X40
R00413	0662057N06	RES. CHIP 20K 5% 20X40
R00414	0662057N13	RES. CHIP 39K 5% 20X40
R00454	0662057N23	RES. CHIP 100K 5% 20X40
R00455	0662057M90	RES. CHIP 4700 5% 20X40
R00456	0662057M92	RES. CHIP 5600 5% 20X40
R00457	0662057M26	RES. CHIP 10 5% 20X40
R00475	0662057M95	RES. CHIP 7500 5% 20X40
R00476	0662057M90	RES. CHIP 4700 5% 20X40
R00477	0662057M94	RES. CHIP 6800 5% 20X40
R00478	0662057N11	RES. CHIP 33K 5% 20X40
R00479	0662057N09	RES. CHIP 27K 5% 20X40
R00480	0662057N13	RES. CHIP 39K 5% 20X40
R00481	0662057M74	RES. CHIP 1000 5% 20X40
R00482	0662057M98	RES. CHIP 10K 5% 20X40
R00483	0662057N15	RES. CHIP 47K 5% 20X40
R00484	0662057N29	RES. CHIP 180K 5% 20X40
R00485	0662057N31	RES. CHIP 220K 5% 20X40
R00490	0662057N23	RES. CHIP 100K 5% 20X40
R00600	0662057M74	RES. CHIP 1000 5% 20X40
R00601	0662057M46	RES. CHIP 68 5% 20X40
R00602	0662057M60	RES. CHIP 270 5% 20X40
R00603	0662057M19	RES. CHIP 5.1 5% 20X40
R00625	0662057M48	RES. CHIP 82 5% 20X40
R00626	0662057M48	RES. CHIP 82 5% 20X40
R00627	0662057M48	RES. CHIP 82 5% 20X40
R00628	0662057M43	RES. CHIP 51 5% 20X40

R00632	0662057M50	RES. CHIP 100 5% 20X40
R00633	0662057M86	RES. CHIP 3300 5% 20X40
R00634	0662057M84	RES. CHIP 2700 5% 20X40
R00650	0662057M74	RES. CHIP 1000 5% 20X40
R00651	0662057M95	RES. CHIP 7500 5% 20X40
R00652	0662057M76	RES. CHIP 1200 5% 20X40
R00653	0662057N01	RES CHIP 12K 5% 20X40
R00654	0662057N12	RES. CHIP 36K 5% 20X40
R00675	0662057M50	RES. CHIP 100 5% 20X40
R00676	0662057M84	RES. CHIP 2700 5% 20X40
R00677	0662057M76	RES. CHIP 1200 5% 20X40
R00678	0662057M62	RES. CHIP 330 5% 20X40
R00700	0662057M26	RES. CHIP 10 5% 20X40
R00703	0662057M26	RES. CHIP 10 5% 20X40
R00709	0662057M26	RES. CHIP 10 5% 20X40
R00725	0662057N19	RES. CHIP 68K 5% 20X40
R00726	0662057M98	RES. CHIP 10K 5% 20X40
R00727	0662057M98	RES. CHIP 10K 5% 20X40
R00728	0662057M50	RES. CHIP 100 5% 20X40
R00729	0662057M26	RES. CHIP 10 5% 20X40
R00730	0662057M76	RES. CHIP 1200 5% 20X40
R00731	0662057M76	RES. CHIP 1200 5% 20X40
R00732	0662057M26	RES. CHIP 10 5% 20X40
R00752	0662057M50	RES. CHIP 100 5% 20X40
R01009	0662057M98	RES. CHIP 10K 5% 20X40
R02500	0662057N15	RES. CHIP 47K 5% 20X40
R02501	0662057M50	RES. CHIP 100 5% 20X40
SH0001	2609473U01	SHIELD ZIF CDMA
SH0002	2609474U01	SHIELD VCO CDMA
SH0003	2609476U01	SHIELD TXME CDMA
SH0004	2609477U01	SHIELD PA CDMA
SH0005	2609478U01	SHIELD RXFE CDMA
SH0006	2609479U01	SHIELD RXIF CDMA
U00075	5109572E06	IC GAAS RF SW SPDT AS139-73
U00080	5109572E06	IC GAAS RF SW SPDT AS139-73
U00100	5109572E26	IC GAAS RF SW SPDT AS139
U00101	5109781E91	IC LV BIAS STAB/ENN MDC5001T1
U00102	5109768D06	IC TEMP SNSR LM60CIM3X SOT23
U00150	5109781E91	IC LV BIAS STAB/ENN MDC5001T1
U00151	5109572E26	IC GAAS RF SW SPDT AS139
U00200	5109940K28	IC MMIC GAAS MXR W/IF TQ5M31
U00250	5109572E26	IC GAAS RF SW SPDT AS139
U00325	4809718L06	OSC MOD TXCO 16.8MHZ SMD
U00400	5109923D29	IC CUST MXR/XCVR ME2 20TSSOP
U00401	5109768D06	IC TEMP SNSR LM60CIM3X SOT23
U00402	5109512F17	IC VOLT REG MC33263NW-28R2 SOT
U00450	5109730C05	IC INT PA GAAS 1.4W RMPA0913
U00475	5803912K02	ISLTR CER TX 836MHZ 7MM SMD
U00480	5109781E15	IC VOLT INV/REG MAX850
U00626	4809283D18	OSC MOD VCO 991MHZ SMD CDMA
U00700	5109879E19	IC BICMOS ZIF/SYNTH SC79836GC

U02300	5109632D99	IC CUST PAC MAX511EEE 16QSOP
VR0450	4813830A73	DIODE 2.7V 5% 225MW
VR1000	4809788E06	DIODE ZENER 6.8V UDZ6.8B

Audio logic

Ref. Des	Part Number	Description
A00001	3909101E01	CNTCT ANT UPPER
A00002	4209480E01	CLIP ANTENNA
A00003	4209480E01	CLIP ANTENNA
A00004	3909102E01	CNTCT ANT LOWER
C01005	2113743N40	CAP CHIP 39.0 PF 5% COG
C01006	2113743N40	CAP CHIP 39.0 PF 5% COG
C01007	2113743N40	CAP CHIP 39.0 PF 5% COG
C01008	2113743N40	CAP CHIP 39.0 PF 5% COG
C01020	2113743N40	CAP CHIP 39.0 PF 5% COG
C01021	2113743N40	CAP CHIP 39.0 PF 5% COG
C01022	2113743N40	CAP CHIP 39.0 PF 5% COG
C01023	2113743N40	CAP CHIP 39.0 PF 5% COG
C01024	2113743N40	CAP CHIP 39.0 PF 5% COG
C01052	2113743N40	CAP CHIP 39.0 PF 5% COG
C01053	2113743N40	CAP CHIP 39.0 PF 5% COG
C01055	2113743N40	CAP CHIP 39.0 PF 5% COG
C01057	2113743N40	CAP CHIP 39.0 PF 5% COG
C01060	2113743G26	CAP CHIP 4.7 UF 16V +80-20%
C01061	2113743L41	CAP CHIP 10000 PF 10% X7R
C01100	2113743E20	CAP CHIP .10 UF 10%
C01102	2113743G26	CAP CHIP 4.7 UF 16V +80-20%
C01105	2113741F37	CAP CHIP CL2 X7R REEL 3300
C01106	2113743E20	CAP CHIP .10 UF 10%
C01107	2113743L41	CAP CHIP 10000 PF 10% X7R
C01108	2113743E20	CAP CHIP .10 UF 10%
C01117	2113743E20	CAP CHIP .10 UF 10%
C01118	2113743L41	CAP CHIP 10000 PF 10% X7R
C01119	2113743L41	CAP CHIP 10000 PF 10% X7R
C01120	2113743L41	CAP CHIP 10000 PF 10% X7R
C01121	2113743L41	CAP CHIP 10000 PF 10% X7R
C01122	2113743L41	CAP CHIP 10000 PF 10% X7R
C01123	2113743L41	CAP CHIP 10000 PF 10% X7R
C01124	2113743L41	CAP CHIP 10000 PF 10% X7R
C01125	2113743L41	CAP CHIP 10000 PF 10% X7R
C01126	2113743L41	CAP CHIP 10000 PF 10% X7R
C01127	2113743L41	CAP CHIP 10000 PF 10% X7R
C01128	2113743L41	CAP CHIP 10000 PF 10% X7R
C01129	2113743L41	CAP CHIP 10000 PF 10% X7R
C01160	2113743N50	CAP CHIP 100 PF 5% COG
C01161	2113743N50	CAP CHIP 100 PF 5% COG
C01200	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01201	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01302	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01400	2113743L41	CAP CHIP 10000 PF 10% X7R

C01614	2113743L41	CAP CHIP 10000 PF 10% X7R
C01616	2113743A27	CAP CHIP .470 UF 10% 16V
C01701	2113743N40	CAP CHIP 39.0 PF 5% COG
C01707	2113743L01	CAP CHIP 220 PF 10% X7R
C01709	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01720	2113743N40	CAP CHIP 39.0 PF 5% COG
C01721	2113743N40	CAP CHIP 39.0 PF 5% COG
C01722	2113743N40	CAP CHIP 39.0 PF 5% COG
C01723	2113743N40	CAP CHIP 39.0 PF 5% COG
C01724	2113743N40	CAP CHIP 39.0 PF 5% COG
C01725	2113743N40	CAP CHIP 39.0 PF 5% COG
C01730	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C01731	2113743N40	CAP CHIP 39.0 PF 5% COG
C01750	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01751	2113743N40	CAP CHIP 39.0 PF 5% COG
C01770	2113743N26	CAP CHIP 10.0 PF 5% COG
C01771	2113743N36	CAP CHIP 27.0 PF 5% COG
C01901	2113743M08	CAP CHIP 22000 PF +80-20% Y5V
C01902	2113743G26	CAP CHIP 4.7 UF 16V +80-20%
C01903	2113743E20	CAP CHIP .10 UF 10%
C01907	2113743L33	CAP CHIP 4700 PF 10% X7R
C01908	2113741F12	CAP CHIP CL2 X7R REEL 300
C01909	2113741F12	CAP CHIP CL2 X7R REEL 300
C01910	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01912	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01913	2109622N06	CAP CER CHIP NPO CLASS I
C01914	2113743E20	CAP CHIP .10 UF 10%
C01915	2113741F33	CAP CHIP CL2 X7R REEL 2200
C01916	2113743E20	CAP CHIP .10 UF 10%
C01917	2113743N40	CAP CHIP 39.0 PF 5% COG
C01919	2113743E20	CAP CHIP .10 UF 10%
C01920	2113743E10	CAP CHIP .033 UF 10% X7R
C01921	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01922	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01923	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01924	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01925	2113743L41	CAP CHIP 10000 PF 10% X7R
C01930	2113743E20	CAP CHIP .10 UF 10%
C01933	2113743L41	CAP CHIP 10000 PF 10% X7R
C01934	2113743L41	CAP CHIP 10000 PF 10% X7R
C02000	2185736G01	CAP CER Y5V 22UF 10V 3225 SMD
C02001	2185736G01	CAP CER Y5V 22UF 10V 3225 SMD
C02002	2185736G01	CAP CER Y5V 22UF 10V 3225 SMD
C02003	2185736G01	CAP CER Y5V 22UF 10V 3225 SMD
C02006	2113743E03	CER CHIP CAP .015UF
C02007	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C02008	2113743E03	CER CHIP CAP .015UF
C02011	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C02012	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C02013	2309121D19	CAP CHIP TANT 10 UF 10% 10 V
C02014	2113743L21	CAP CHIP 1500 PF 10% X7R

C02018	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C02019	2185736G01	CAP CER Y5V 22UF 10V 3225 SMD
C02021	2113743L41	CAP CHIP 10000 PF 10% X7R
C02022	2311049C18	CAP TANT CHIP 4.7UF 6V 10%
C02023	2113743E07	CER CHIP CAP .022UF
C02024	2185736G01	CAP CER Y5V 22UF 10V 3225 SMD
C02099	2113743E20	CAP CHIP .10 UF 10%
C02100	2113743G26	CAP CHIP 4.7 UF 16V +80-20%
C02101	2113743G26	CAP CHIP 4.7 UF 16V +80-20%
C02102	2113743E20	CAP CHIP .10 UF 10%
C02400	2185736G01	CAP CER Y5V 22UF 10V 3225 SMD
C02402	2113928A01	CAP CER CHIP 1.0 UF 10V
C02403	2113928A01	CAP CER CHIP 1.0 UF 10V
CR1000	4809653F02	RECT SCHOTTKY 1.0A UPS5817
CR1011	4813830A70	DIODE DL 5.6V COM ANODE
CR1012	4813830A70	DIODE DL 5.6V COM ANODE
CR1013	4813830A70	DIODE DL 5.6V COM ANODE
CR1060	4809606E02	DIODE DUAL ARRAY DAN222
CR1750	4809606E02	DIODE DUAL ARRAY DAN222
CR2002	4809653F02	RECT SCHOTTKY 1.0A UPS5817
CR2003	4809606E01	DIODE ULTRA HIGH SPEED UMT PKG
CR2050	4809606E01	DIODE ULTRA HIGH SPEED UMT PKG
J00001	0909449B04	RECEPT MOD 15PIN INSMLD
J00101	2809454C02	PLUG LO PROFILE SMD 32 POS
J02000	0909399T07	JACK MOD 2.5MM PLUG SMD
L02000	2485719G01	IND CHIP W 15UH 10% 3225 SMD
LS0001	5009365S01	ALERT 3V SMD
Q01000	4809579E39	TSTR FET DUAL FDG6323L SC70-6
Q01004	4809523E02	TSTR FET/SCHTKY DIODE 8SOIC
Q01010	4809579E27	TSTR FET P-CHAN SI3441 6TSOP
Q01020	4809579E29	TSTR FET P-CHAN SI3443DV 6TSOP
Q01021	4809940E02	TSTR DIG NPN DTC114YE
Q01022	4809940E02	TSTR DIG NPN DTC114YE
Q01060	4809579E40	TSTR FET DUAL N/P FDG6320C SC7
Q01101	4809608E03	TSTR DIG PNP DTA114YE
Q01150	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q01151	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q01160	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q01161	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q01703	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q01704	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q01705	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q01731	4809579E40	TSTR FET DUAL N/P FDG6320C SC7
Q01750	4809607E04	TSTR SIG PNP 2SB1132 SOT89

Q01751	4809940E03	TSTR DIG NPN DTC114TE
Q01900	4809608E03	TSTR DIG PNP DTA114YE
Q02400	4809608E03	TSTR DIG PNP DTA114YE
R01001	0662057N23	RES. CHIP 100K 5% 20X40
R01002	0662057N23	RES. CHIP 100K 5% 20X40
R01004	0680195M64	RES 0.24 OHM 1/2W
R01008	0662057M82	RES. CHIP 2200 5% 20X40
R01011	0609591M37	RES CHIP DUAL 10K 5% 0.63W
R01020	0662057V07	RES CHIP 15K 1% 1/16W
R01021	0662057V02	RES CHIP 10K 1% 1/16W
R01022	0662057M98	RES. CHIP 10K 5% 20X40
R01023	0662057M98	RES. CHIP 10K 5% 20X40
R01024	0662057M98	RES. CHIP 10K 5% 20X40
R01025	0662057M98	RES. CHIP 10K 5% 20X40
R01026	0662057M84	RES. CHIP 2700 5% 20X40
R01060	0660076N25	RES CHIP 100 OHM 1/16 W
R01061	0662057N47	RES. CHIP 1.0 MEG 5% 20X40
R01070	0662057M50	RES. CHIP 100 5% 20X40
R01071	0662057M50	RES. CHIP 100 5% 20X40
R01100	0662057M01	RES. CHIP 0 5% 20X40
R01101	0662057M01	RES. CHIP 0 5% 20X40
R01103	0662057M90	RES. CHIP 4700 5% 20X40
R01104	0662057M01	RES. CHIP 0 5% 20X40
R01105	0662057N15	RES. CHIP 47K 5% 20X40
R01106	0662057N15	RES. CHIP 47K 5% 20X40
R01107	0662057N15	RES. CHIP 47K 5% 20X40
R01110	0662057M98	RES. CHIP 10K 5% 20X40
R01111	0662057M98	RES. CHIP 10K 5% 20X40
R01113	0662057N05	RES. CHIP 18K 5% 20X40
R01117	0662057M01	RES. CHIP 0 5% 20X40
R01118	0662057N15	RES. CHIP 47K 5% 20X40
R01120	0662057M26	RES. CHIP 10 5% 20X40
R01125	0662057M90	RES. CHIP 4700 5% 20X40
R01150	0662057M64	RES. CHIP 390 5% 20X40
R01151	0662057M52	RES. CHIP 120 5% 20X40
R01160	0662057M98	RES. CHIP 10K 5% 20X40
R01161	0662057M98	RES. CHIP 10K 5% 20X40
R01162	0662057M85	RES. CHIP 3000 5% 20X40
R01203	0662057M01	RES. CHIP 0 5% 20X40
R01204	0662057M01	RES. CHIP 0 5% 20X40
R01207	0662057M01	RES. CHIP 0 5% 20X40
R01300	0662057M01	RES. CHIP 0 5% 20X40
R01700	0662057M98	RES. CHIP 10K 5% 20X40
R01701	0662057M90	RES. CHIP 4700 5% 20X40
R01702	0662057M98	RES. CHIP 10K 5% 20X40
R01703	0662057M98	RES. CHIP 10K 5% 20X40
R01704	0662057N15	RES. CHIP 47K 5% 20X40
R01706	0662057N10	RES. CHIP 30K 5% 20X40
R01707	0662057M98	RES. CHIP 10K 5% 20X40
R01710	0662057M01	RES. CHIP 0 5% 20X40
R01711	0662057N23	RES. CHIP 100K 5% 20X40

R01712	0662057M54	RES. CHIP 150 5% 20X40
R01716	0662057M98	RES. CHIP 10K 5% 20X40
R01718	0662057M85	RES. CHIP 3000 5% 20X40
R01720	0662057M01	RES. CHIP 0 5% 20X40
R01725	0662057M98	RES. CHIP 10K 5% 20X40
R01730	0662057M98	RES. CHIP 10K 5% 20X40
R01731	0662057N34	RES. CHIP 300K 5% 20X40
R01750	0662057N23	RES. CHIP 100K 5% 20X40
R01751	0662057N01	RES CHIP 12K 5% 20X40
R01752	0662057N11	RES. CHIP 33K 5% 20X40
R01771	0662057N39	RES. CHIP 470K 5% 20X40
R01773	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R01900	0662057M88	RES. CHIP 3900 5% 20X40
R01901	0662057M74	RES. CHIP 1000 5% 20X40
R01902	0662057M90	RES. CHIP 4700 5% 20X40
R01906	0662057M98	RES. CHIP 10K 5% 20X40
R01907	0662057N27	RES. CHIP 150K 5% 20X40
R01909	0662057M94	RES. CHIP 6800 5% 20X40
R01910	0662057N27	RES. CHIP 150K 5% 20X40
R01911	0662057N15	RES. CHIP 47K 5% 20X40
R01912	0662057N20	RES. CHIP 75K 5% 20X40
R01913	0662057N03	RES. CHIP 15K 5% 20X40
R01914	0662057M01	RES. CHIP 0 5% 20X40
R01915	0662057M01	RES. CHIP 0 5% 20X40
R01916	0662057M98	RES. CHIP 10K 5% 20X40
R01917	0662057M98	RES. CHIP 10K 5% 20X40
R01918	0662057N01	RES CHIP 12K 5% 20X40
R01919	0662057M01	RES. CHIP 0 5% 20X40
R01930	0662057V07	RES CHIP 15K 1% 1/16W
R01931	0662057V07	RES CHIP 15K 1% 1/16W
R01932	0662057M95	RES. CHIP 7500 5% 20X40
R01933	0662057M95	RES. CHIP 7500 5% 20X40
R02000	0662057M58	RES. CHIP 220 5% 20X40
R02001	0662057M01	RES. CHIP 0 5% 20X40
R02002	0662057M02	RES. CHIP 1.0 5% 20X40
R02004	0662057N19	RES. CHIP 68K 5% 20X40
R02005	0662057N37	RES. CHIP 390K 5% 20X40
R02006	0662057M01	RES. CHIP 0 5% 20X40
R02007	0662057M66	RES. CHIP 470 5% 20X40
R02013	0662057N09	RES. CHIP 27K 5% 20X40
R02014	0662057N09	RES. CHIP 27K 5% 20X40
R02015	0662057M92	RES. CHIP 5600 5% 20X40
R02017	0662057M01	RES. CHIP 0 5% 20X40
R02018	0662057N11	RES. CHIP 33K 5% 20X40
R02020	0662057M01	RES. CHIP 0 5% 20X40
R02023	0662057M01	RES. CHIP 0 5% 20X40
R02101	0662057M01	RES. CHIP 0 5% 20X40
R02103	0662057M01	RES. CHIP 0 5% 20X40
R02400	0662057M32	RES. CHIP 18 5% 20X40
R02401	0662057N27	RES. CHIP 150K 5% 20X40
R02402	0662057N07	RES. CHIP 22K 5% 20X40

R02403	0662057M94	RES. CHIP 6800 5% 20X40
R02404	0662057M74	RES. CHIP 1000 5% 20X40
SH1000	2609475U01	SHIELD REFUSE CDMA
U01100	5109773F15	IC CUST CASPER PCZ9009VHR2
U01102	5109817F17	IC VOLT DECT 2.7V ILC5061 SOT
U01201	5109522E14	IC 2-INPUT OR GATE TC7S32FU
U01202	5109522E15	IC SNGL INV TC7S04FU
U01203	5109522E22	IC SNGL AND GATE TC7S08FU
U01204	5109522E22	IC SNGL AND GATE TC7S08FU
U01300	5109509A25	IC SRAM 128KX16 KM616FU20AZI-1
U01400	5199423A01	IC EEPROM 32KX8 AT25256T2-10TI
U01701	5109781E93	IC VOLT REG 2.8V TK11228BVCB
U01200	5199422A01	IC FLASH 16MB GT28F160C3BA90
U01900	5109923D36	IC CUST CIA SC29100GRC2 J21K
U02000	5109923D38	IC CUST BICMOS GCAP LT 48QFP
U02100	5109512F32	IC VOLT REG 16V TK11218BMIL
VR1020	4809788E08	DIODE ZENER 8.2V UDZTE178.2B
Y01770	4809995L08	XTAL QUARTZ 32.768KHZ MC-156

Image	Item/Part#	Description	Supplier
	Plastic Prying Tool SLN7223A	Used for dissassembly of housings without damaging the plastics	Motorola, Inc.
	Antenna Removal Tool SYN5233A	This antenna removal tool offers the ability to attach a TORX handle for easier re-moval of the antenna	Aftermarket Accessories Division (AAD)
	Antenna Removal Tool SYN5179A	This is a low cost antenna removal tool	Aftermarket Accessories Division (AAD)
	Housing disassembly Tool SYN5367A	Used for disaassembly of StarTAC housings	Aftermarket Accessories Division (AAD)
	StarTAC Extension Board SKN4855A	Provides seperation of the main board and daughter board to allow component access for troublshooting	Aftermarket Accessories Division (AAD)
	StarTAC Test Cable SKN4800A	Used in conjunction with a MCEL 200/2000 to interface test equipment to the Star TAC	Aftermarket Accessories Division (AAD)

Service Diagrams - Section B

Service Diagrams

The service diagrams were carefully prepared to allow a Motorola certified technician to easily troubleshoot cellular phone failures. Our professional staff provided directional labels, color coded traces, measurement values and other guidelines to help a technician troubleshoot a cellular phone with speed and accuracy.

We worked hard in trying to provide the best service diagrams, therefore, to avoid clut-tered diagrams, we excluded some compo-nents from the service diagrams. Our professional staff carefully selected to excluded components that are unlikely to fail.

Test Point Measurements

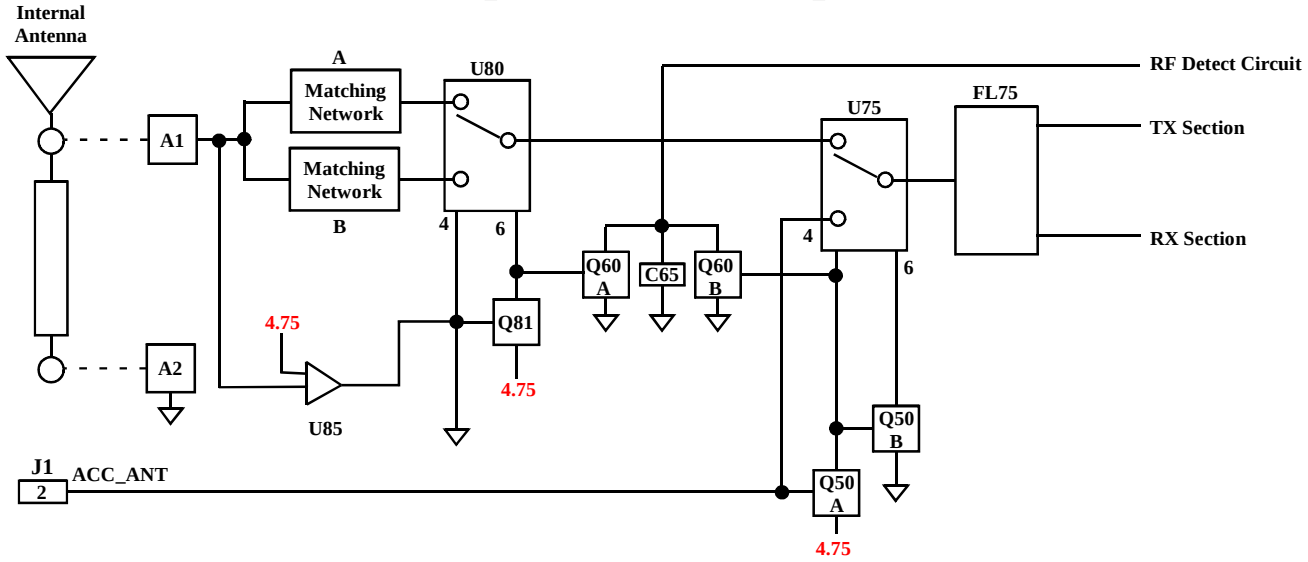
The measurements labeled on the service diagrams are approximate values and may vary slightly. These measurements are dependent on the accuracy of the test equipment.

It is strongly recommended that the test equipment calibration schedule be followed as stated by the manufacturer. RF probes should be calibrated for each frequency in which tests are going to be performed.

The types of probes used will also affect measurement values. Test probes and cables should be tested for RF losses and loose connections.

Because of the sensitivity of RF, measured readings will be greatly affected if they're taken in certain locations. To get the most accurate readings, take measurements nearest to the labeled measurement on the service diagram.

CDMA StarTAC™(ST7860): Antenna Circuit



B2

Description

The antenna match switch U80 changes the antenna match based on whether the antenna is up or down. Matching network A is used when the antenna is in the up posi - tion and matching network B i s used when the antenna posi tion is down. U85 and Q81 det ermine the state of U80. In the antenna up position the input of U85 is pulled high. This w ill pull pin 4 of U80 low. At the s ame time Q81 is turned on allowing pin 6 of U80 to be pull ed high. Thi s state will position U800 to use matching netw ork A. In addition, when pin 6 of U80 is high, Q60-A is t urned on allowing C65 to be bypassed. This function changes the characteristics of the RF detect ciruit allowing a TX power output reduction.

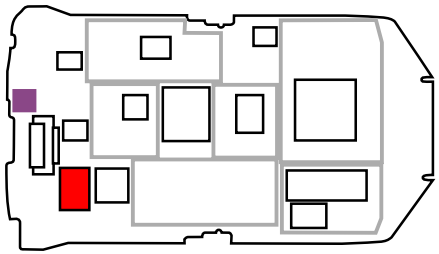
In the antenna down position contact A1 is shorted to conta ct A2. This will a llow pin 4 of U80 t o be pulled high. At the same time Q81 is turned off allowi ng pin 6 of U80 to be pulled low. This state will position U800 to use matc hing network B. In additi on, when pin 6 of U80 is low, Q60-A is turned off allowing C65 to be used wi th the RF detect ciruit. This function retains the normal characteristics of the RF detect ciruit, thus, not allowing any TX power reduction.

U75 switches the RF routing between the internal antenna and ACC_ANT. If no loa d is present at J1 pin 2, Q50-A(bipolar) will not be biased allowing pin 4 of U75 to be pulled low. At t he same time th e Q50-B(bipolar) won't be biase d, allowing pin 6 of U75 to be pulled high. Th is state will p osition U75 to route the RF sig nals through th e internal antenna. In addition, when pin 4 of U75 is low, Q60-B is not biased allowing C65 to be used with the RF detec t circuit. As explained before, the TX power out - put will not be reduce d.

When a load is present at J1 pin 2, Q50-A will be biased causing pin 4 of U75 to be pulled high. At the same time, Q50-B will be baised causing pin 6 of U75 to be pulled low. This state will positi on U75 to route the RF signals through the ACC_ANT. In addition, w hen pin 4 of U75 is hi gh Q60-B is biased allowing C65 to be bypassed. This function will reduce the TX p ower output.

FL75 is a du plex filter that provides TX and RX isolation.

CDMA StarTAC™(ST7860): Antenna Circuit

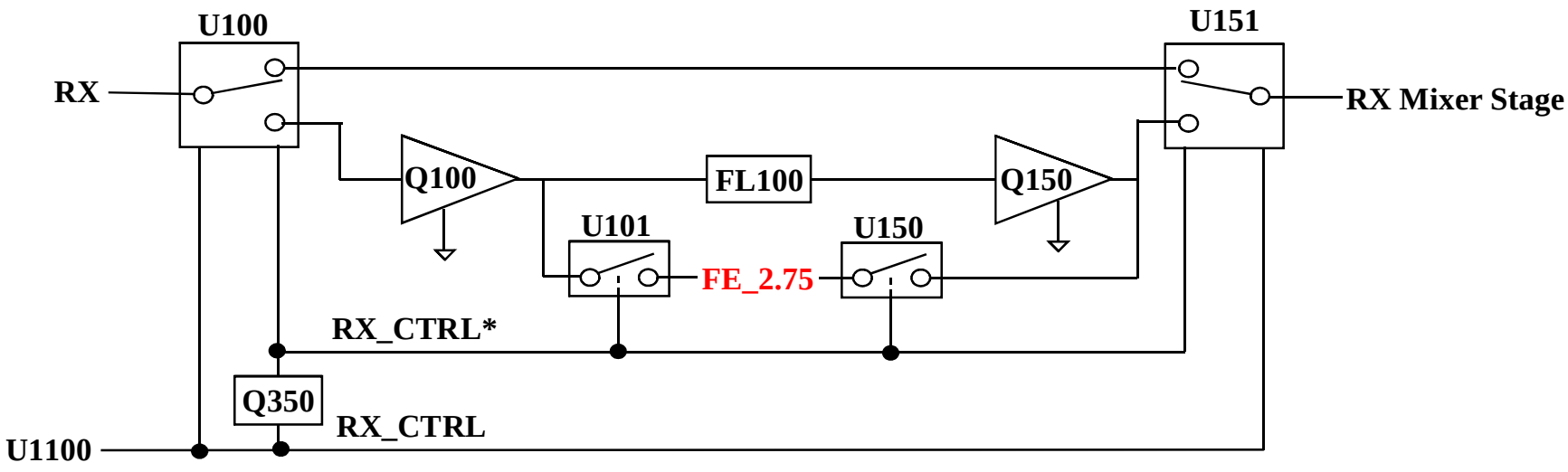


	INT ANT	ACC ANT
A	0V	4.7V
B	4.7V	0V
G	4.7V	2V

	ANT UP	ANT DWN
C	0V	4.7V
D	4.7V	0V
E	.028V	.1V

B3

CDMA StarTAC™(ST7860): RX Front End



B4

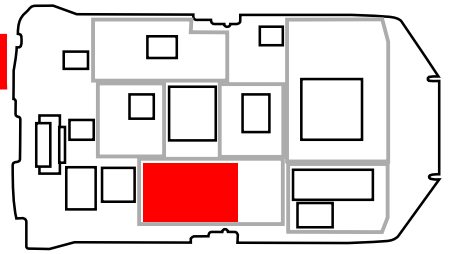
Description

After the RX signal is isolated from the TX signal, using FL75, the RX signal enters switch U100. U100 routes the RX signal to a low noise amplifier chain or a bypass path. In AMPS mode, the signal is always routed to the amplifier chain. In CDMA mode, the path is determined by the signal strength, typically >-89dBm will be routed to the amplifier chain. U100 is controlled by the CRIB via the RX_CTRL line. RX_CTRL is complimented with Q350 producing RX_CTRL*. Both RX_CTRL and RX_CTRL* are used to change the states of U100 and U151.

The low noise amplifier chain consists of a first stage amplifier(Q100) with active bias stabilizing IC(U101) , an interstage filter(FL100), and a second stage amplifier(Q150) with active bias stabilizing IC(U150). Bias stabilizers U101 and U150 are controlled by RX_CTRL*. During bypass, Q100 and Q150 are off.

Once the RX signal goes to its proper channel it enters switch U151 and then routed to the mixer stage.

CDMA StarTAC™(ST7860): RX Front End



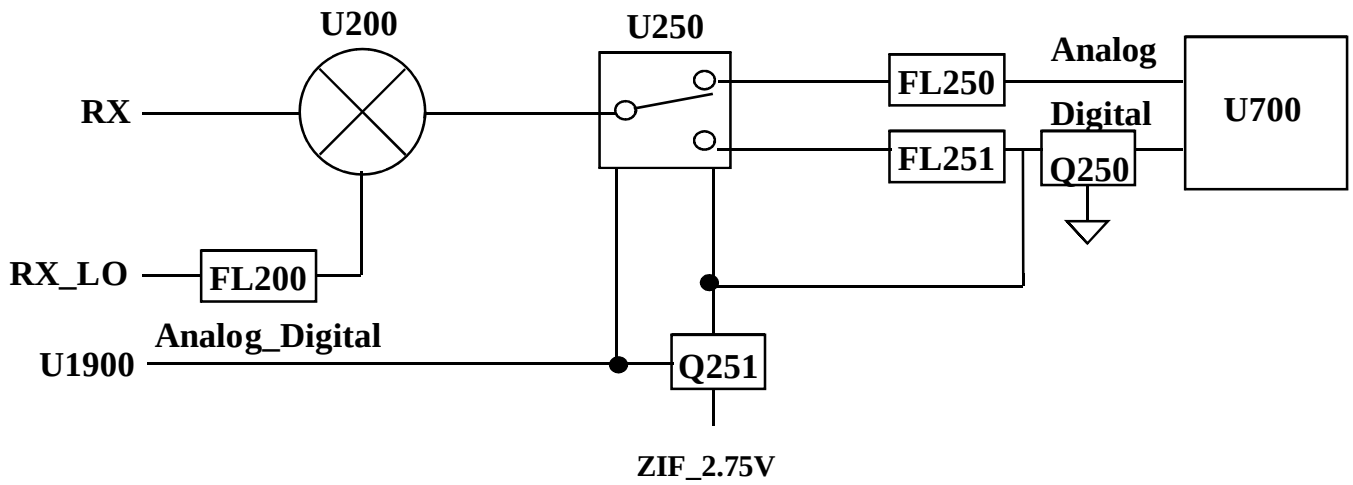
	LNA ON	LNA OFF
A	0V	2.7V
B	2.7V	0V
C	0.76V	0V
D	2V	2.7V
E	0.75V	0V
F	2V	2.7V

Channel: 385
RX Input Freq: 881.55MHz
RX Input: -20dBm (LNA Off)
RX Input: -60dBm (LNA On)
RX SIGNAL
VOLTAGE SUPPLIES
Colored boxes represent the area in which the components are placed.

B5

FE_2.75V page B21
2.78V
C104
C105
C106
L102
R101
-59.7 dBm@-60 dBm
C152
U150
C154
C155
C
D
E
F
U101
R100
C107
FL100
L151
L150
L152
R15 2
R150
2V
Q100
.76V
.0V
2.76V
Q150
R151
-62 dBm@-60 dBm
C351
Q350
-49 dBm@-60 dBm
C156
R113
C102
C101
C350
-67.8 dBm
@-60 dBm
C78
C100
U151
C200
-29.7 dBm@-20 dBm
-51.2 dBm@-60 dBm
U100
C200
page B7
FL75
page B3
RX_CTRL
A
U1100
page B37
-29.7 dBm@-20 dBm
-67.8 dBm@-60 dBm
RX_CTRL*
B
-29.1 dBm@-60 dBm
2.78V
FE_2.75V
page B21

CDMA StarTAC™(ST7860): RX Mixer



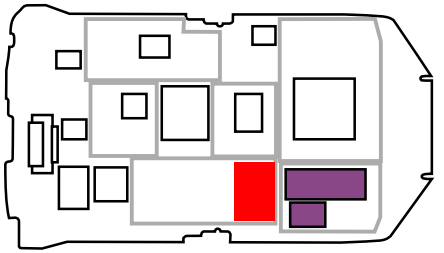
B6

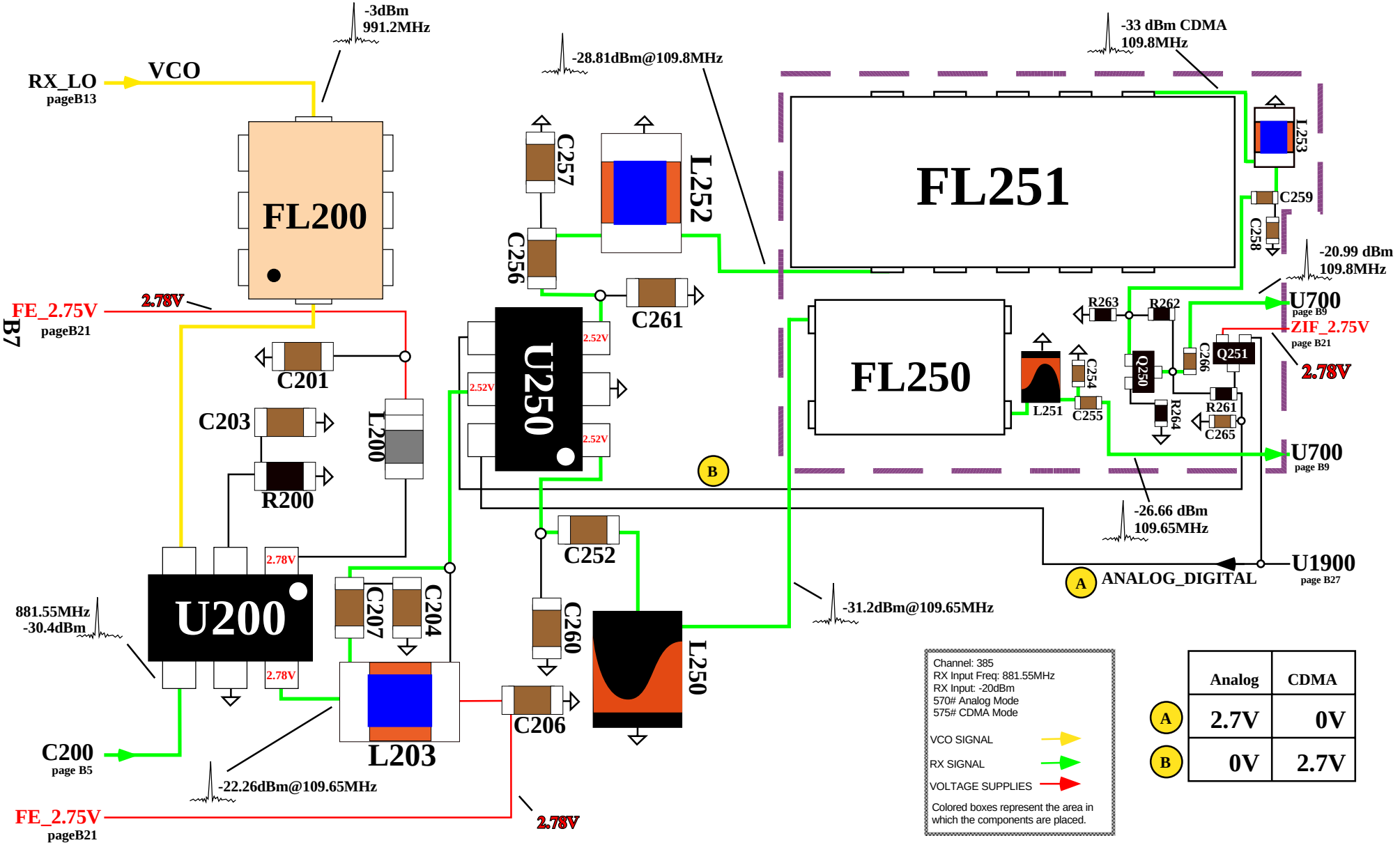
Description

Once the RX signal leaves U151 it is downconverted to an intermediate frequency by mixer U200. RX_LO is the local oscillator that is filtered by FL200 and then mixed using U200. The result is an intermediate frequency of 109.8 MHz for CDMA or 109.65 MHz for analog mode. The IF signal is then routed to either SAW filter FL251 in CDMA mode or crystal filter FL250 in analog mode by IF switch U151. The state of U151 is controlled by U1900(CIA) via the Analog_Digital line. Q251 compliments the state of the Analog_Digital line for control of U250.

After the IF signal is filtered, the signal enters U700(ZIF/SYN) for further processing.

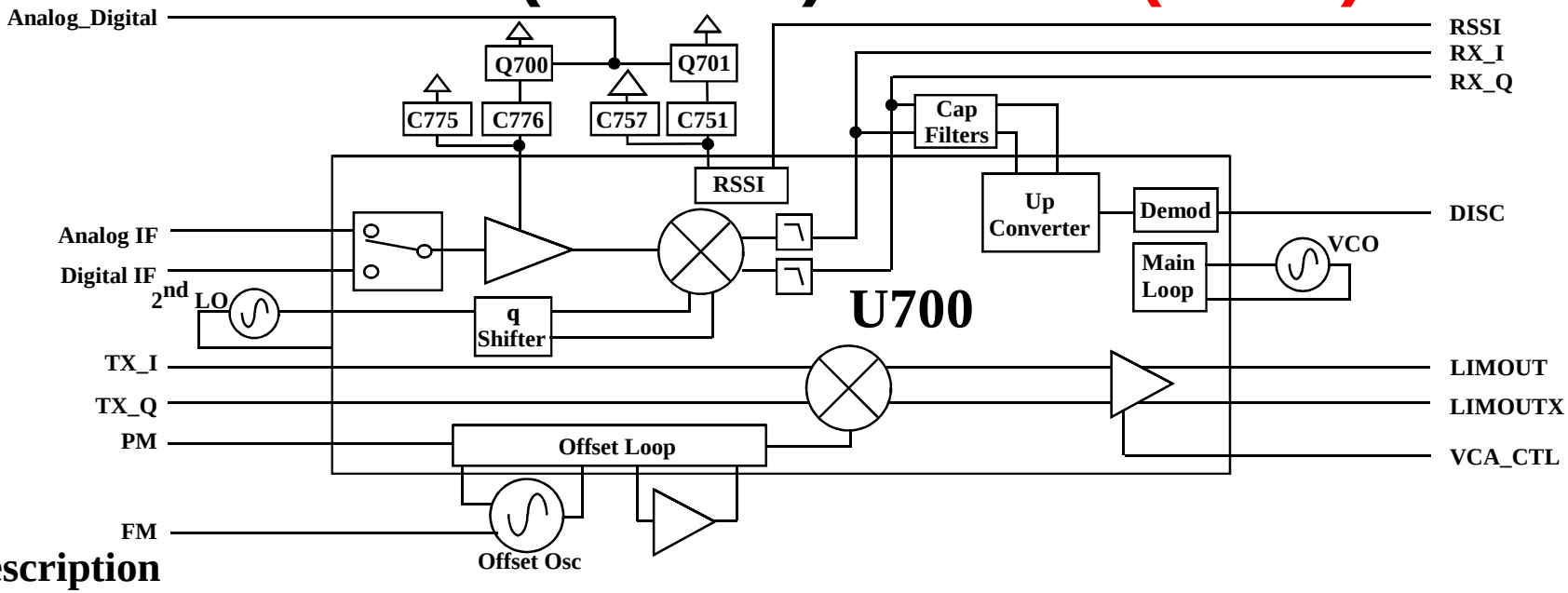
CDMA StarTAC™(ST7860): RX Mixer





	Analog	CDMA
A	2.7V	0V
B	0V	2.7V

CDMA StarTAC™(ST7860): ZIFSYN(U700)



Description

B8

U700(ZIF/SYN) can be divided into two functional subsystems: The ZIF (Zero-Intermediate-Frequency) which provides all of the functions of the back-end of a receiver, and the SYN (SYNthesizer) which contains phase-locked loops and modulators to produce the Local Oscillator (LO) and modulated transmit carrier.

The ZIF implements the back end of the receiver for both CDMA and analog reception. An internal IF switch selects which of the two IF inputs are to be used. The incoming signal is attenuated, amplified and mixed down to an extremely low frequency(Baseband)-not quite DC. The baseband signal is low-pass filtered using a programmable low-pass filter. In CDMA mode, the baseband signal is routed to U1900(CIA) via the RX_I and RX_Q lines. In analog mode, the baseband signal is up-converted and then FM-demodulated, producing the DISC signal which is routed to U1900(CIA) for filtering and de-emphasis.

The first amplifier and an Automatic Gain Control(AGC) circuit that adjusts the amplifier gain to maintain a constant level in the baseband filter. ACG circuit capacitance is varied with respect to the operating mode(e.i. analog, digital). The Analog_Digital line controls Q700 which allows C776 to be used or bypassed in the AGC circuit.

The first mixing that occurs in the ZIF requires a 2 nd Local Oscillator that is running at twice the IF frequency. The 2nd LO frequencies are 219.3 MHz for analog mode and 219.6MHz for CDMA mode. The 2nd LO is divided in half then phased shifted before being mixed with the IF signal.

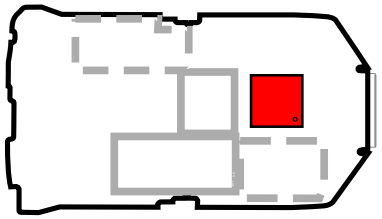
The RSSI(Receive Signal Strength Indicator) is a voltage that increases with respect to the received signal strength. The RSSI signal has a filtering capacitance(C751,C757) that changes with respect to the operating mode(e.i. analog, digital). The Analog_Digital line controls Q701 which will allow C751 to be used or bypassed in the RSSI filtering circuit.

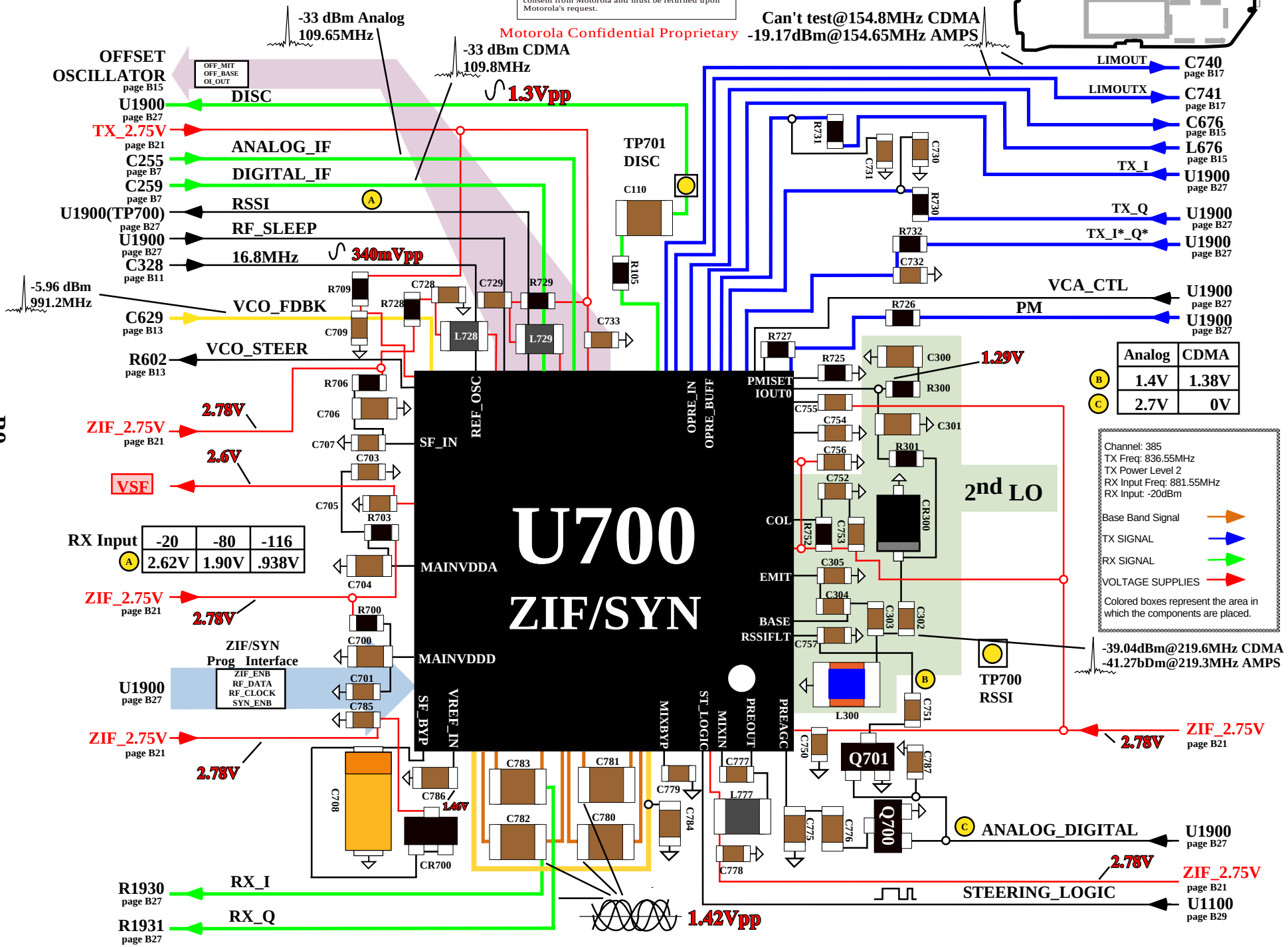
Since the IF frequencies of the receiver change when different operating modes are being used, it's necessary to synthesize different frequencies for both the Main Loop and Offset Loop. The Main Loop frequencies will be 0.15MHz higher in CDMA mode than in AMPS mode for the same channels. Likewise the Offset VCO will operate at 2*0.15MHz higher frequency in CDMA mode than in AMPS mode.

To support NAMPS, provision must be made to trasmit DSAT(Digital Supervisory Audio Tone), which contains many low frequencies. It's difficult to transmit low frequencies using FM, since the TX PLL has a natural tendency of tracking out low frequencies. For this case a "Dual-port" modulation strategy is used by applying modulation to the FM and PM ports simultaneously. Once the signal is modulated with the Offset oscillator it is attenuated and then routed to the LIMOUT and LIMOUTX ports.

In CDMA mode U1900(CIA) routes TX_I and TX_Q to U700(ZIF/SYN). TX_I and TX_Q is then modulated with the Offset oscillator, attenuated, and routed to the LIMOUT and LIMOUTX ports. The VCA_CTL line adjusts the amount of attenuation being applied to the TX signal.

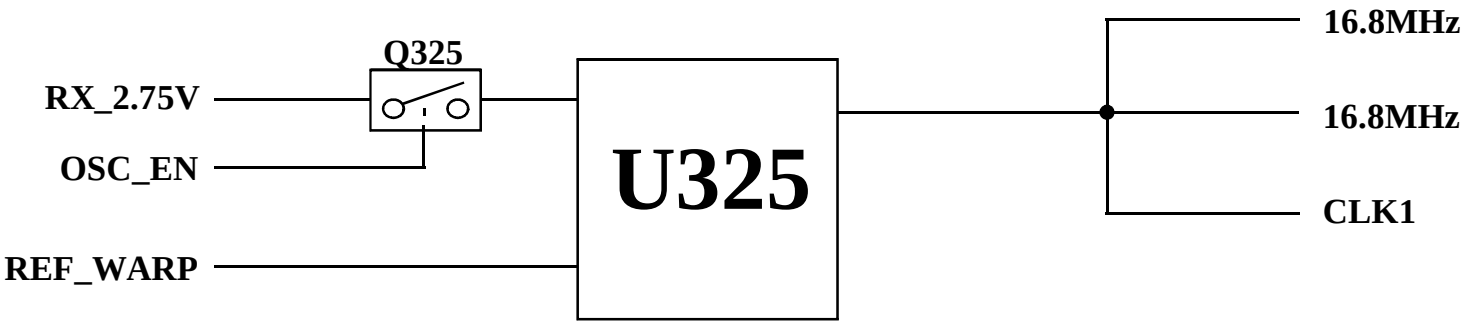
CDMA StarTAC™(ST7860): ZIF/Synth





B9

CDMA StarTAC™(ST7860): Reference Oscillator



B10

Description

The reference oscillator U325, operating a t 16.8MHz, provides a "reference frequenc y" for the RF synthesizers and various lo gic circuits. U1900(CIA) switches U325 on and off via th e OSC_EN line. The OSC_EN line switches Q325 on or off, controlling th e supply volt age to U325. U1900 can "fine tune" U325 via the REF_WARP line. Tuning of the reference oscillato r is needed to synchronize frequencies with the cellular base stat ion, therefore, the signal received from the base will be used to deter-mine the correct reference frequency.

The ouput of U325 is s plit into two signals . U325 operates at 16.8MHz which is used f or the RF frequency r eference. The other p ath is sent to the lo gic section for logic clock synchronization.

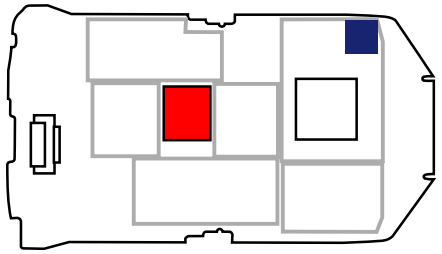
The CLK 1 signal is used on ly when the radio is in sl eep mode. U325 is disabled to reduce current and CLK 1 is activated from U1900 (CIA). This allows the RF circuit to contin ue operat ing in sl eep mode condition s.

CDMA StarTAC™(ST7860):Reference Oscillator

Channel: 385
TX Freq: 836.55MHz
TX Power Level 2
RX Input Freq: 881.55MHz
RX Input: -20dBm

VOLTAGE SUPPLIES →

Colored boxes represent the area in which the components are placed.



B11

U325

+VCC

2.74V

1.4V

AFC

U1900 page B27

REF_WARP

C325

R325

Q325

C326

C327

2.75V

U1900 page B27

OSC_EN

RF_2.75V page B21

C330

R331

C332

C331

R333

R332

C328

340mVpp

16.8MHz

U700 page B9

CLK1

U1900 page B27

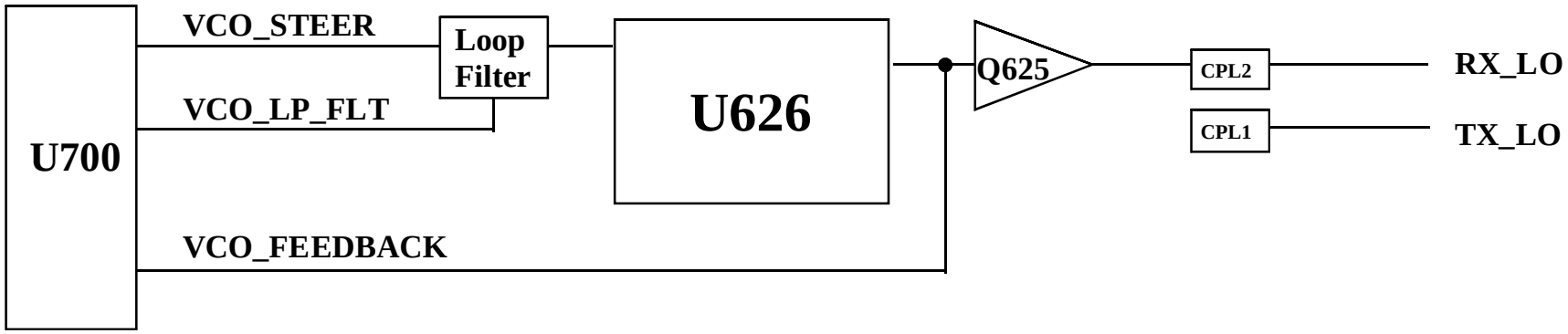
16.8MHz OUT

L330

16.8MHz

U1900 page B27

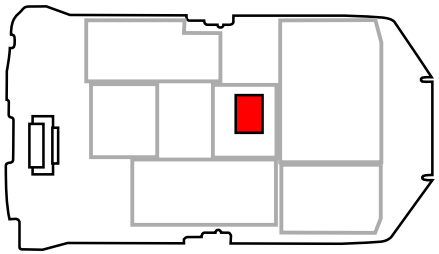
CDMA StarTAC™(ST7860): VCO Circuit



Description

The Main Local Oscillator(LO) is synthesized by U700(ZIF/SYN) via the VCO_STEER line. The VCO_STEER line determines the frequency of the VCO and because of its extreme sensitivity to noise, a loop filter is included in the circuit. The output of the VCO is fed back to U700 to ensure that the VCO frequency is just as accurate as the original reference. The output of U626 is amplified by Q625, coupled by CPL2 and CPL1, and split in two to produce the RX_LO and TX_LO outputs.

CDMA StarTAC™(ST7860):VCO Circuit



Channel 385
VCO SIGNAL
VOLTAGE SUPPLIES
Colored boxes represent the area in which the components are placed.

B13

Channel	991	385	799
A	.8V	1.33V	1.81V

A
VCO_STEER
U700
page B9

C602 R602 C601

C600

U626

2.6V
VSF
page B9
R603
C627

R600

-3 dBm
991.2MHz
RX_LO
FL200-8
page B7

VCO_FEEDBACK
U700
page B9
R601
C629

VCO_LP_FLT
U700
page B9

C626
C625

C628
R625
-5.96 dBm
991.2MHz

TX_LO
R405
page B17

C632 R632 C631
R633

CPL1
CPL2

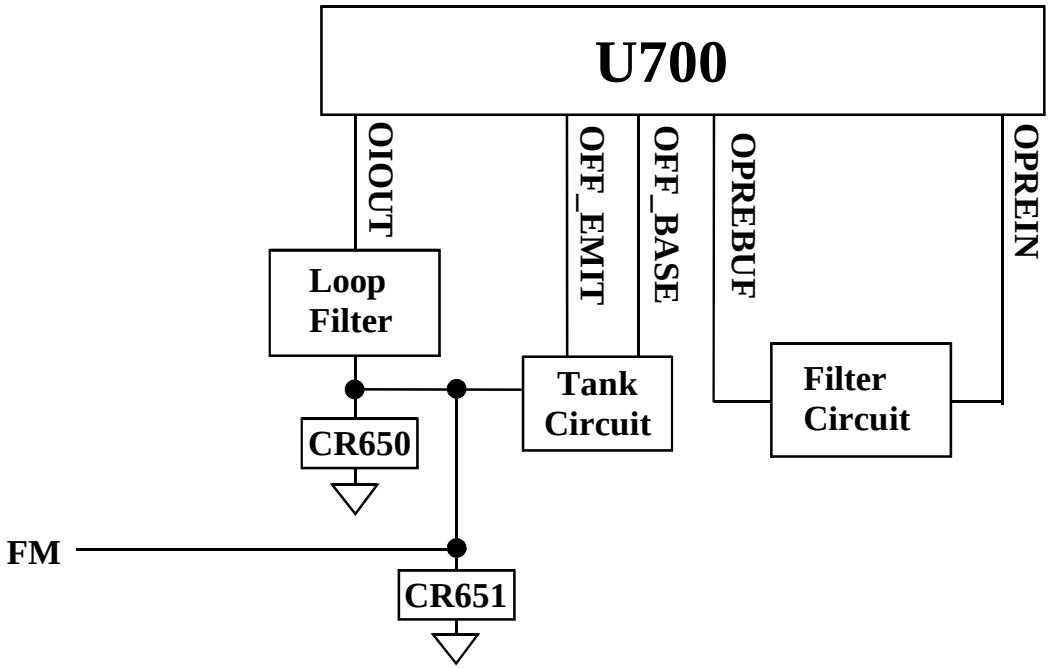
L627
Q625
C630
R634
R626
R627

-10 dBm
991.2MHz
R628
C633

2.78V
FE_2.75V
page B21

0 dBm
991.2MHz
-16 dBm
991.2MHz

CDMA StarTAC™(ST7860): TX Offset Oscillator



B14

Description

The Offset Oscillator is synthesized by U700(ZIF/SYN) via the OIOUT line. The OIOUT line determines the frequency of the internal Offset oscillator and because of its extreme sensitivity to noise, a loop filter is included in the circuit. CR650 is used to provide tuning control to the tank circuit. The FM signal coming from U1900(CIA) is injected directly in the offset oscillator. The operating frequency for the offset oscillator is 309.3MHz in analog mode and 309.6 in CDMA mode. U1900(CIA) injects the FM signal directly in the Offset oscillator

CDMA StarTAC™(ST7860): Offset Oscillator

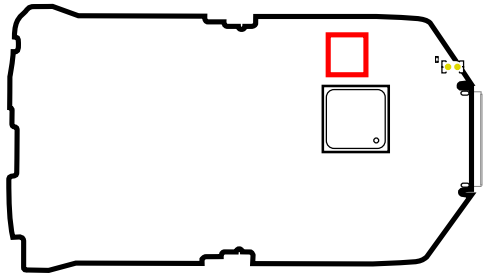
Channel: 385
TX Freq: 836.55MHz
TX Power Level 2
SAT 0: 250#

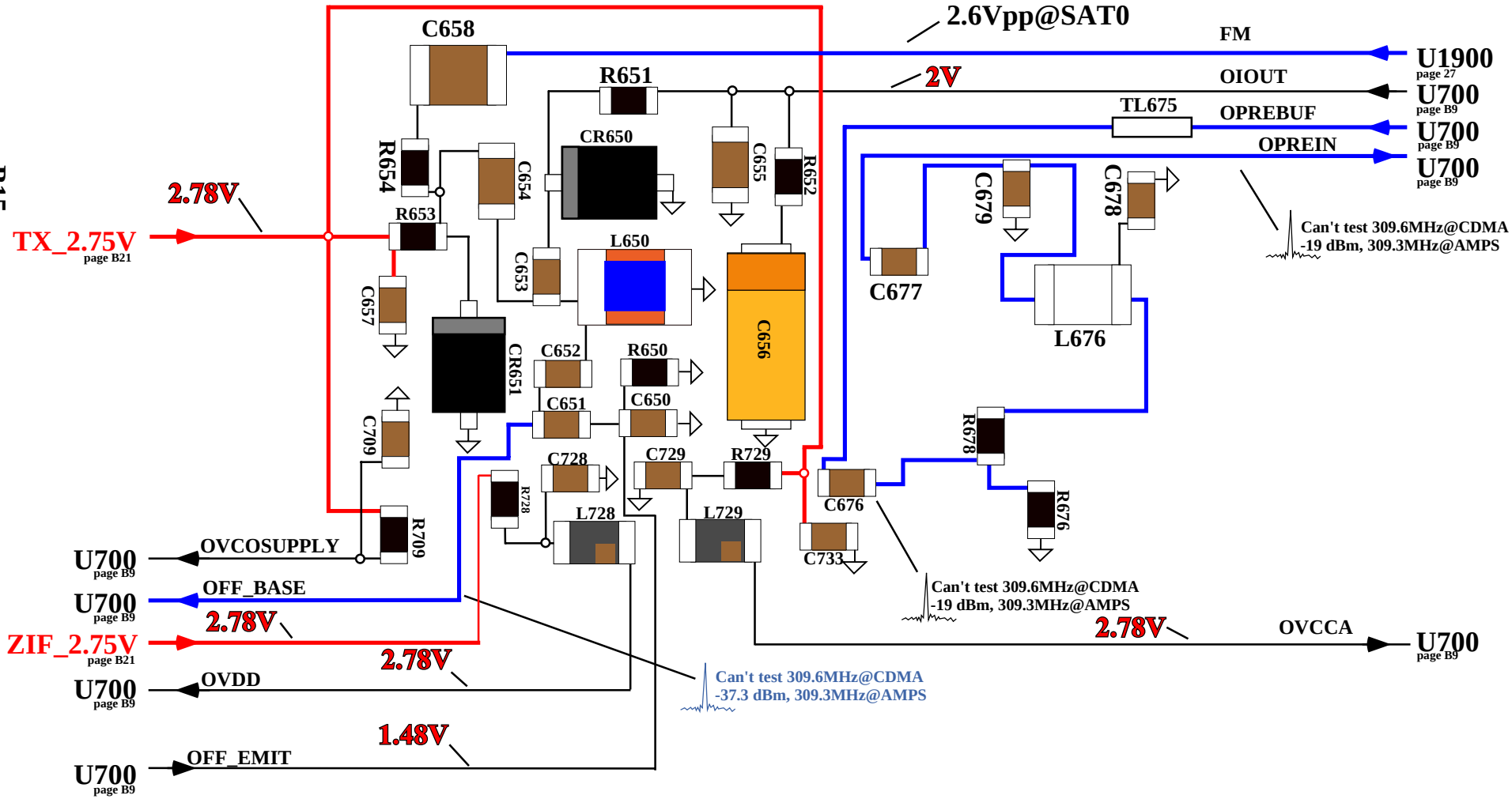
Measure in proximity. Don't make contact to component

TX SIGNAL

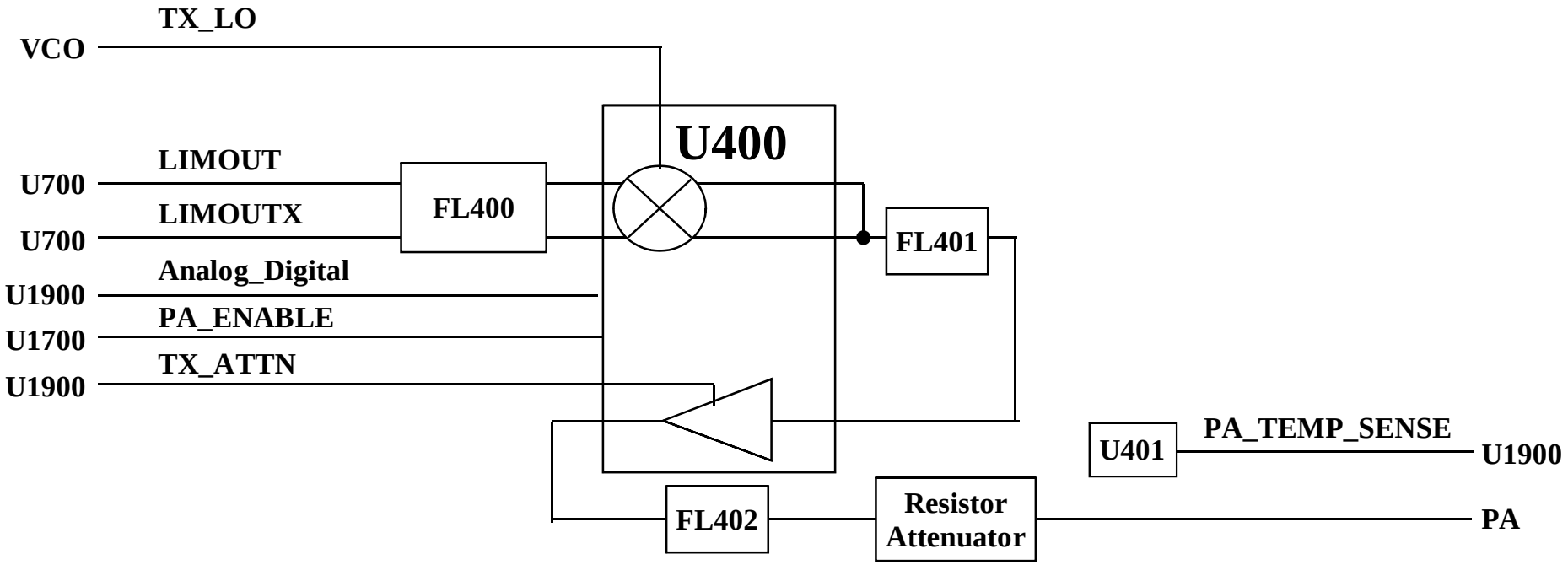
VOLTAGE SUPPLIES

Colored boxes represent the area in which the components are placed.





CDMA StarTAC™(ST7860): Mixer-Exciter(U400)

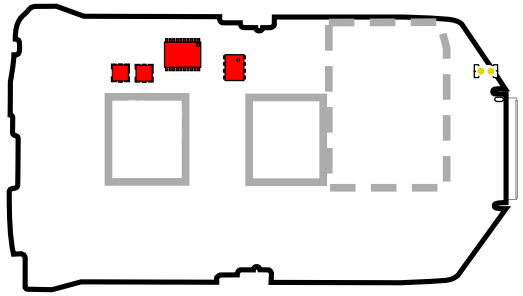


Description

Once the TX signal leaves U700(ZIF/SYN) it is filtered(FL400) and then mixed with the VCO via the TX_LO line. The result will be the TX carrier which is filtered(FL401) and then routed to the exciter of U400. The TX carrier is filtered(FL402), attenuated(resistor network), and send to the PA section. U400 has a dual mode exciter for CDMA and analog operation. U1900(CIA) changes the U400 states between analog and CDMA via the Analog_Digital line. TX_ATTN is used to adjust the output power level of U400, necessary for TX power steps. The PA_ENABLE line, controlled by U1100, switches the exciter on and off. U401 is a device used to sense the operating temperature of the final PA.

CDMA StarTAC™(ST7860): Mixer and Exciter

Motorola Confidential Proprietary



Channel: 385
TX Freq: 836.55MHz
TX Power Level 2

TX SIGNAL
VCO SIGNAL
VOLTAGE SUPPLIES

Colored boxes represent the area in which the components are placed.

A	Analog	CDMA
	2.7V	0V

3 dBm
836.55MHz

2.78V

AUD_2.75V
page B23

ANALOG_DIGITAL
U1900
page B27

PA_TEMP_SENSE
U1900
page B27

0.81V

2.78V

TX_2.75V
page B21

TX_LO
TX_LO
page B13

-15 dBm
991.2MHz

2.78V
FE_2.75V
page B21

TX_ATTN
U1900
page B27

U401
U400
FL402
FL401
FL400

L401 L402 L403 L404 L411 L412 L400
C406 C407 C408 C409 C410 C411 C412 C413 C414 C415 C416 C417 C418 C405
R401 R402 R403 R407 R408 R409 R410 R411 R412 R413 R414
C740 C741

LIMOUT
U700
page B9

LIMOUTX
U700
page B9

2.78V
AUD_2.75V
page B23

-23.72@154.65MHz AMPS
Can't test@154.8MHz CDMA

-19.17@154.65MHz AMPS
Can't test@154.8MHz CDMA

C468
page B19

-6.3 dBm
836.55MHz

-5.64 dBm
836.55MHz

U1100
page B29

PA_ENABLE

2dBm
836.55MHz

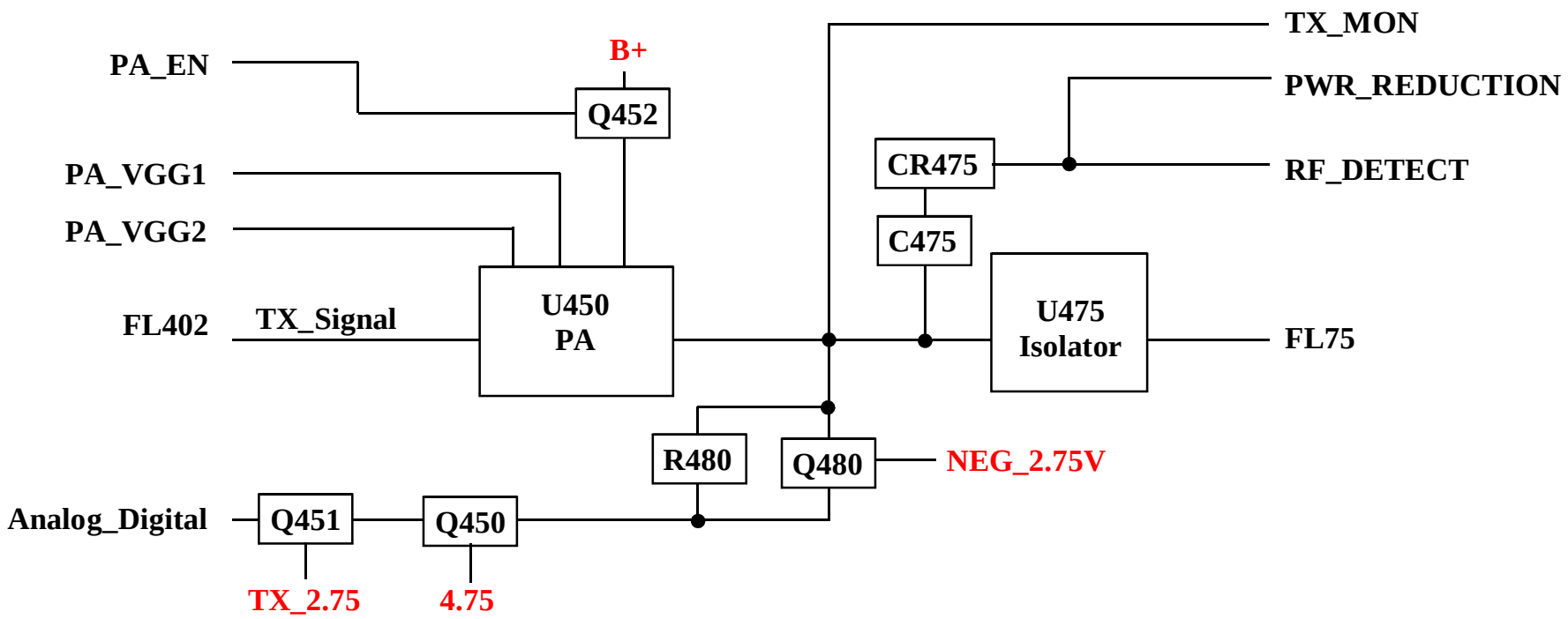
C	TX On	TX Off
	2.56V	0V

2	3	4	5	6	7	AMPS PWR STEP
2.29V	2.29V	2.28V	2.28V	1.83V	1.83V	B

-110dBm	-95dBm	-75dBm	-65dBm	-45dBm	CDMA PWR STEP "OPEN LOOP PWR"
1.71V	1.68V	1.14V	0.9V	0.56	B

B17

CDMA StarTAC™(ST7860): PA Circuit



B18

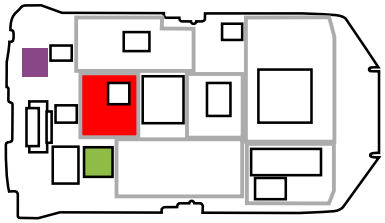
Description

The TX signal coming from the exciter is amplified by a two stage PA(U450) to obtain the proper output power. The PA supply can be turned on and off by the PA_EN line. When transmitting PA_EN is held low. A low state at the input of Q452 will allow B+ to supply U450. When not transmitting PA_EN is held high. This will turn off Q452 which will not allow B+ to supply U450. The TX_MON line is used to protect against false transmission of TX energy. If this line is high when the radio is not suppose to be transmitting, the radio will be shut down by the microprocessor.

The PA load impedance can be toggled between analog and CDMA mode. The load impedance is controlled by the Analog_Digital line. In analog mode Analog_Digital is held high causing Q451 to output a low. A low state at the input of Q450 will allow the output to be pulled to a negative state. During this state, Q480 is shorted allowing R480 to be bypassed. This condition changes the load impedance of the PA. In CDMA mode Analog_Digital is held low causing Q451 to output a high. A high state at the input of Q450 will produce a high positive state at the output. During this state, Q480 is open allowing R480 to be used in the PA load impedance circuit.

The quiescent current of the driver and final stages of the PA are set by the PA_VGG1 and PA_VGG2 control lines respectively. The isolator U475 provides a constant load to the PA output. The capacitive coupler C475 couples the PA output to the RF detect circuit. The RF_DETECT line is used to sample the TX signal level and feed it back to the power control circuitry to ensure that the proper power level is being used. The PWR_REDUCTION line will change the dc output level of the RF_DETECT line. The PWR_REDUCTION line is used in conjuction with the Antenna switch circuit.

CDMA StarTAC™(ST7860): PA Circuit



TX On	TX Off
0V	3.5V

B19

U1900 page B27 — RF_DETECT (B)

TX_2.75V page B21 — C476

2.78V — R475, R479, R477, R478, C478, C477, R490, CR475 (1, 2, 3, 4), R476

VR450 — R454, R455, C452

PWR_REDUCTION

Q60 page B3

TX_MON

U1900 page B27 — 1.8V

Power Step	2	3	4	5	6	7
B	0.88V	0.66V	0.44V	0.29V	0.21V	0.15V

C475, C463

FL75 page B3 — 22.12 dBm 836.55MHz

Channel: 385
TX Freq: 836.55MHz
TX Power Level 2

TX SIGNAL

VOLTAGE SUPPLIES

Colored boxes represent the area in which the components are placed.

U475

TL452

B+ page B25 — 3.8V

4.75 page B23 — 4.8V

21.52 dBm 836.55MHz

TX_2.75V page B21 — 2.78V

U1900 page B27 — ANALOG_DIGITAL (A)

	Analog	CDMA
A	2.7V	0V
D	-2.83V	4.73V

-2.3 dBm 836.55MHz

C — PA_EN — Q1160 page B29

R410 page B17 — -1.1V — PA_VGG2 — U2300-9 page B21

C468, L452, C457, C457, C454, R456, -627V, R457

U450 — 3.45V, -.627V, -.627V, 3.2V, C458

C472, L450, C471, C473

Q452 — 3.4V

L451, TL450, C460

PA_VGG1 — -1.0V — U2300-10 page B21

TL451

C455, C456, C461, C462

Q480 — C480, R481, R480 — D

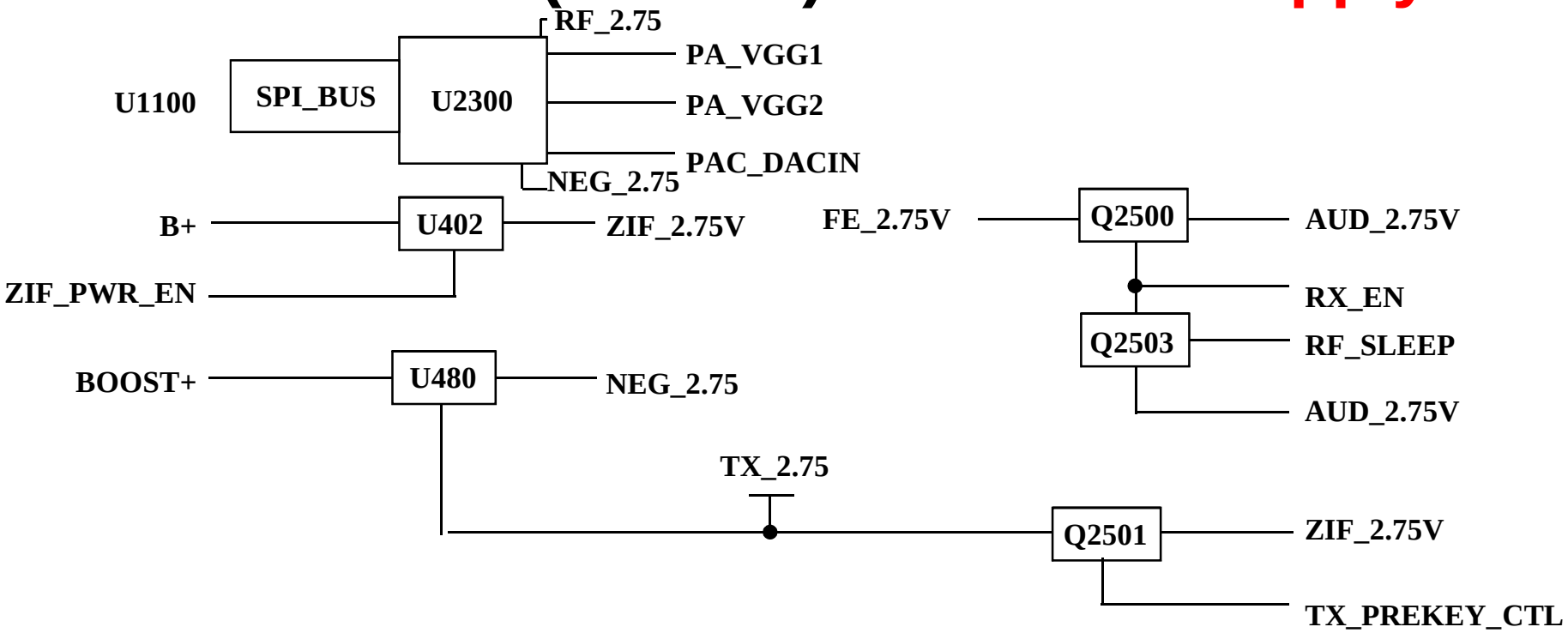
-2.9V — NEG_2.75V page B21

C481, R482

Q450 — 1 NC, 0V, C482, R483, C483

Q451

CDMA StarTAC™(ST7860): PAC-NEG Supply



B20

Description

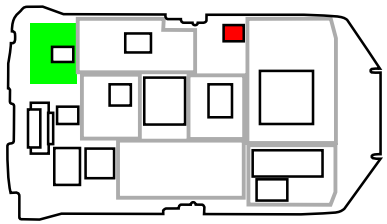
The PAC IC(U2300) is used to control the negative gate bias voltages to the PA device via the PA_ VGG1 and PA_VGG2 lines. It's also used to control charging rate of the internal charger circuit via the PAC_DACIN line. The output ports are programmed via the DSP SPI bus .

U402 is used to produce the ZIF_2.75V supply. This supply can be switched on or off via the ZIF_PWR_EN line.

Q2501 allows ZIF_2.75V supply the TX_2.75 line only when the TX_PREKEY_CTL line is high. In other words, TX_2.75 is present only when the radio is transmitting. U480 converts the positive BOOST+ supply to a negative voltage(NEG_2.75). NEG_2.75 is only active when TX_2.75 is available, when the radio is transmitting.

FE_2.75 can be turned on or off via Q2500. FE_2.75 is sourced from AUD_2.75V. When the radio is not in sleep mode line RF_SLEEP is held low. This state will open Q2503 allowing the gate of Q2500 to stay low. This condition will switch Q2500 on and allow FE_2.75V be supplied by AUD_2.75V. When the radio is in sleep mode, every state will be inversed, causing FE_2.75V to be turned off.

CDMA StarTAC™(ST7860): PAC - NEG SUPPLY



VOLTAGE SUPPLIES →

Colored boxes represent the area in which the components are placed.

TX On	TX Off
2.82V	0V

A A

TX_PREKEY_CTL ← U1900 page B27

0V RF_SLEEP ← U1900 page B27

2.8V ZIF_2.75V

-2.85 NEG_2.75V

PAC_DACIN ← U2000-11 page B23

PA_VGG1 ← U450-12 page B19

PA_VGG2 ← U450-11 page B19

-2.85 NEG_2.75V

2.78V RF_2.75V

RESETB page B23

PAC_SPI_2 ← U1100 page B29

PAC_SPI_1 ← U1100 page B29

PAC_SPI_0 ← U1100 page B29

2.78V FE_2.75V

RX_EN 0V ← U1900 page B27

TX_2.75V

-2.85 NEG_2.75V

-1.3V

CR480 NC

R485 R484

5.6V

B21 BOOST page B23

2.8V ZIF_2.75V

C403

C487 C488

3.8V B+ page B25

U402

U480

2.78V

U1100 pageB29 ZIF_PWR_EN

C404 .65V

R400

C485 C486

-5.3V 2.8V

TX_2.75V

RF_2.75V

2.8V AUD_2.75V pageB23

6.4Vpp

C2301

U2300

NC NC NC -1.3V -1.4V

Q2501

R2501

C2300

NC

Q2503

3 4 5

2 1 NC

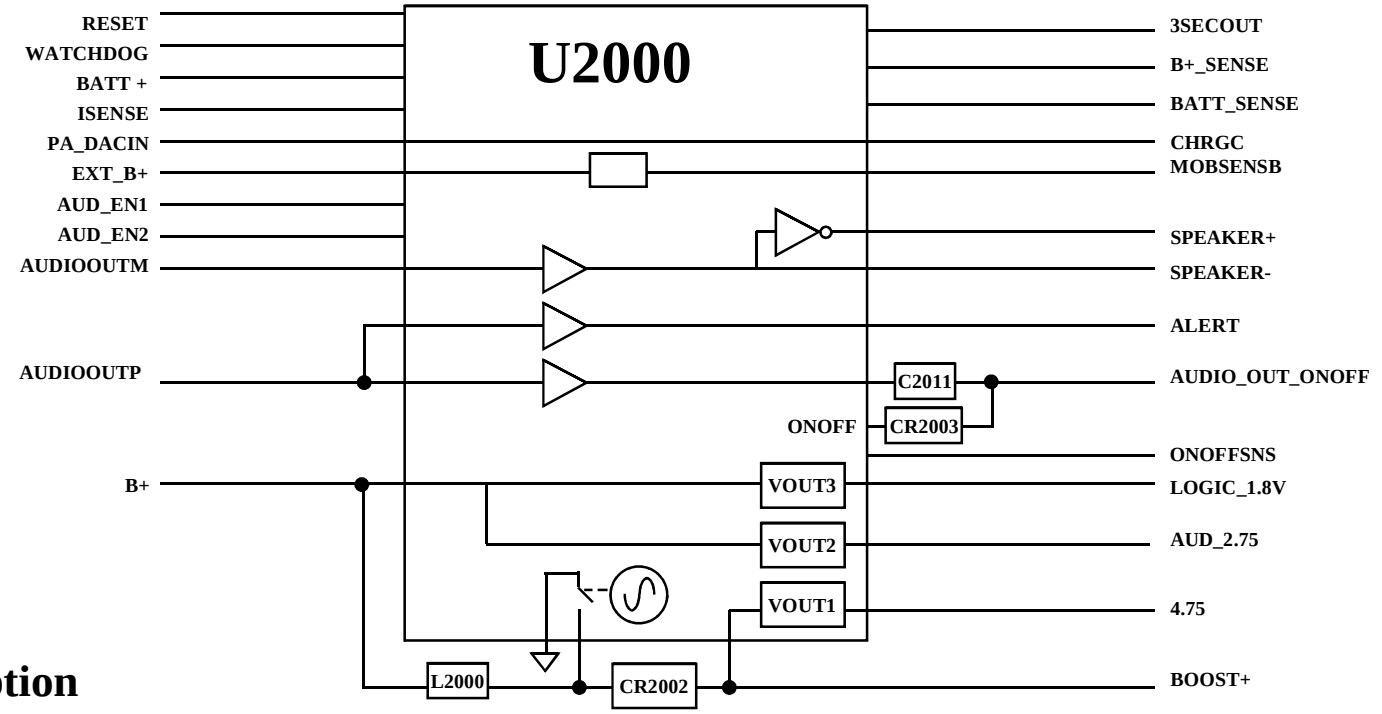
C2501

Q2500

C2500

R2500

CDMA StarTAC™(ST7860): GCAP Lite(U2000)



B22

Description

The GCAP Lite(U2000) provides control, audio, and regulator functions of the radio. U2000 produces supplies LOGIC_1.8V, AUD_2.75, 4.75, and BOOST+. LOGIC_1.8V is used to supply all the logic circuitry. AUD_2.75 is used to supply the RF and audio circuits. BOOST+ is use dto supply an inverting regulator for PA gate biasing. The BOOST+ switching supply that is capable of taking a low voltage and boost it up to greater than 5V. Supply 4.75 relies on the BOOST+ supply for proper operation. Supply 4.75 is not required for radio operation.

The AUDIO_ON_OFF line is used to turn the radio on or off and route audio to the external connector. C2011 and CR2003 provide isolation of both functions. As soon as U2000 has a supply, the AUDIO_ON_OFF line is pullled high. U2000 will monitor this line for state changes. When a device ,external to U2000, pulls AUDIO_ON_OFF low U2000 proceeds to the radio turn on sequence or the radio shut down sequence.

U1900(CIA) sends an audio signal via AUDIOOUTP to U2000(GCAP Lite). In U2000 the audio is amplified and routed to either the alert or to the AUDIO_OUT_ONOFF line. The routing is controlled via the AUD_EN1 and AUD_EN2 lines. U1900 also sends an audio signal via AUDIOOUTP to U2000. The audio signal is amplified and routed to either the internal speaker of the Boom speaker. The routing of the speaker is controlled by the state of the headset jack.

The MOBSENSB line is used to inform the microprocessor whether the radio is using an external supply or battery supply. B+_SENSE is used to report the voltage level of the B+ supply to the microprocessor BATT_SENSE is used to report the battery voltage level during charging conditions.

During charging conditions the PAC IC sends a dc signal to U2000 via the PA_DACIN line. This line is used to control CHRGC which controls the battery charging rate. ISENSE is used to measure the charge current. BATT + is used to read the voltage level of the charger.

U1100(CASPER) sends a watchdog signal to U2000 indicating that there is normal logic operation and to continue supplying voltage to the radio.

The 3SECOUT line is used during "power cut" conditions. It allows a maximum 3 second power cut without disturbing its current operating state. Very useful when switching batteries during conversation mode.

CDMA StarTAC™(ST7860): GCAP(U2000)

B23

B+ page B25 — 3.8V

U1900 page B27 — AUDIO_OUTM — 1Vpp — C2006

C2012

C2008 C2005 C2010 C2004 R2004 R2022

C2002 — 4.77V

CR2050

R2009 R2006 R2003 R2005

C2007 — 2.75V

CR2001 — 2Vpp@Max Volume — ALT- page B43

U2100 page B25 — 1.8V_EN

U1900 page B27 — AUDIO_OUTP — 1Vpp — R2007

C2099 — 3.39V

BATT+ page B40

R2013 R2000

C2011

Q1004-4 pageB25 — CHRGC

Q1004-3 pageB25 — ISENSE

U2300 page B25 — PAC_DACIN

J1000-7 page B40 — SPKR +

J2000-3 page B40 — SPKR - — 1Vpp

R2014

C2014

R2015

U1100 page 29 — 3 SEC OUT — 2.77V

C2023 — CR2003 — 2.92V

4.75V — C2000 — 4.75V

J101-31 page B40

J1-9 page B40 — AUDIO_OUT_ON/OFF — 3.2V

U1100 page B29 — ON_OFF_SENSE — 2.76V

B+ page B25 — 3.8V

EXT_B+ page B25 — 3.95V — R1008

AUD_2.75V — 2.76V

U1100 page B29 — MBLSENSB — C

R2002

U2000 GCAP

pins 1–12 (top), 13–24 (left), 25–36 (bottom), 37–48 (right)

BATT_SENSE — 1V — 1.53V — U1900 pageB27

B+_SENSE — 4.77V — U1900 pageB27

LOGIC_4.8V

4.75V — 4.75V

B+ pageB25 — 3.8V

L2000

C2022 — 1.38V — 5.55V — BOOST +

A — AUD_EN2 — U1100 page B29

B — AUD_EN1 — U1100 page B29

CR2002

???V — C2021

R2021 — 2.77V — RESETB

2.75V — LOGIC_2.75V

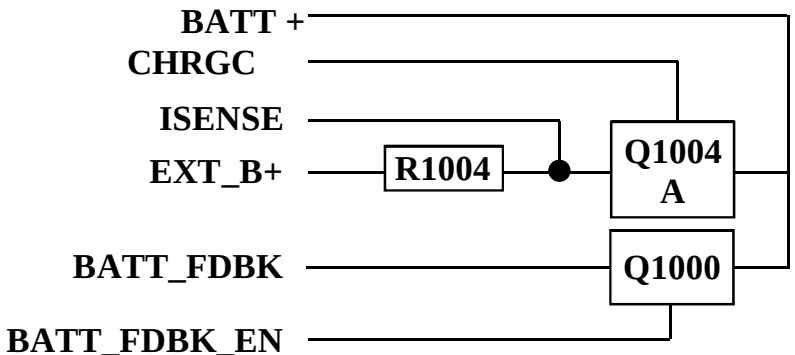
2.77V — WATCHDOG — Q1731 page B31

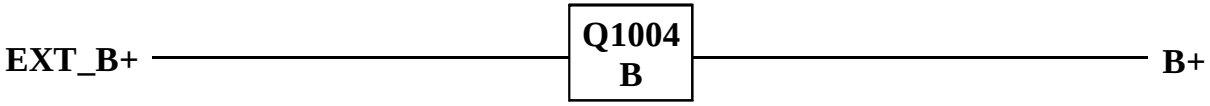
C2001 C2024 C2019 C2003 C2013

Source	Battery	Ext B+
C	2.79V	0V

Audio Path	Alt	Spkr	Ext Aud Out
Command	352#	353#	356#
A	2.77V	0V	2.77V
B	0V	2.77V	2.77V

CDMA StarTAC™(ST7860): Charger



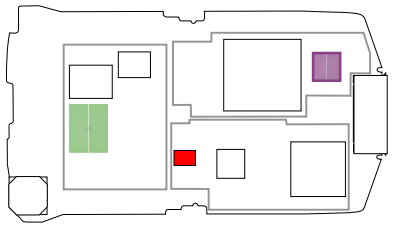


Description

The internal charger will be activated only when there is an external power source, a Motorola battery is attached, the MAN_TEST line is loaded down, and BATT_FDBK is enabled. As EXT_B+ passes thru R1004 U2000(GCAP) reads the charge current for proper control of the charger. CHRGC controls the amount of charge to the batteries by varying the gate voltage of Q1004. The output of Q1004 is routed to two different sections via ISENSE. One section is the BATT+ line The second section is the BATT_FDBK line. BATT_FDBK_EN switches Q1000 on or off to disable or enable BATT_FDBK.

EXT_B+ is selected for the B+ power source if present. During this condition, EXT_B+ supplies BATT+ via Q1004.During transmission the battery thresholds change, therefore, a compensation needs to take place. For this reason the TX_PREKEY_CTL line is routed to Q1006, Q1005, and U1000.

CDMA StarTAC™(ST7860): Charger & Supplies



Charger	On	Off
A	3.9V	4.38V
C	2.76V	0V
D	3.92V	0V

B+ 3.73V

U1100 pageB29 — BATT_FDBAK_EN (C)

CR1000

Q1004

R1004

5.32V — EXT_B+

A — CHRGC — U2000 -15 page B23

5.39V — ISENSE — U2000 -16 page B23

3.79V

R1001

Q1000

R1002

BATT+ pageB40

J1-4 pageB40 — BATT_FEEDBACK (D)

B25

5.32V — EXT_B+

Q1020

VR1020

EXT_B+	<6.8V	>7.3V
B	~EXT_B+ Voltage Level	0V
E	0V	2.6V
F	2.8V	0V

R1023 R1027 Q1022 R1025 R1026

F — R1024

Q1021

R1022

R1020 R1021

U1102

5.34V — RAW_EXT_B+

J1-14 pageB40

C2101 C2100 C1060

R2104

1.81V — CASP_1.8V

U2100

1.24V

C2102

2.74V — 1.8V_EN — U2000 page B23

4.96V — B+

R1061

C1061

0V

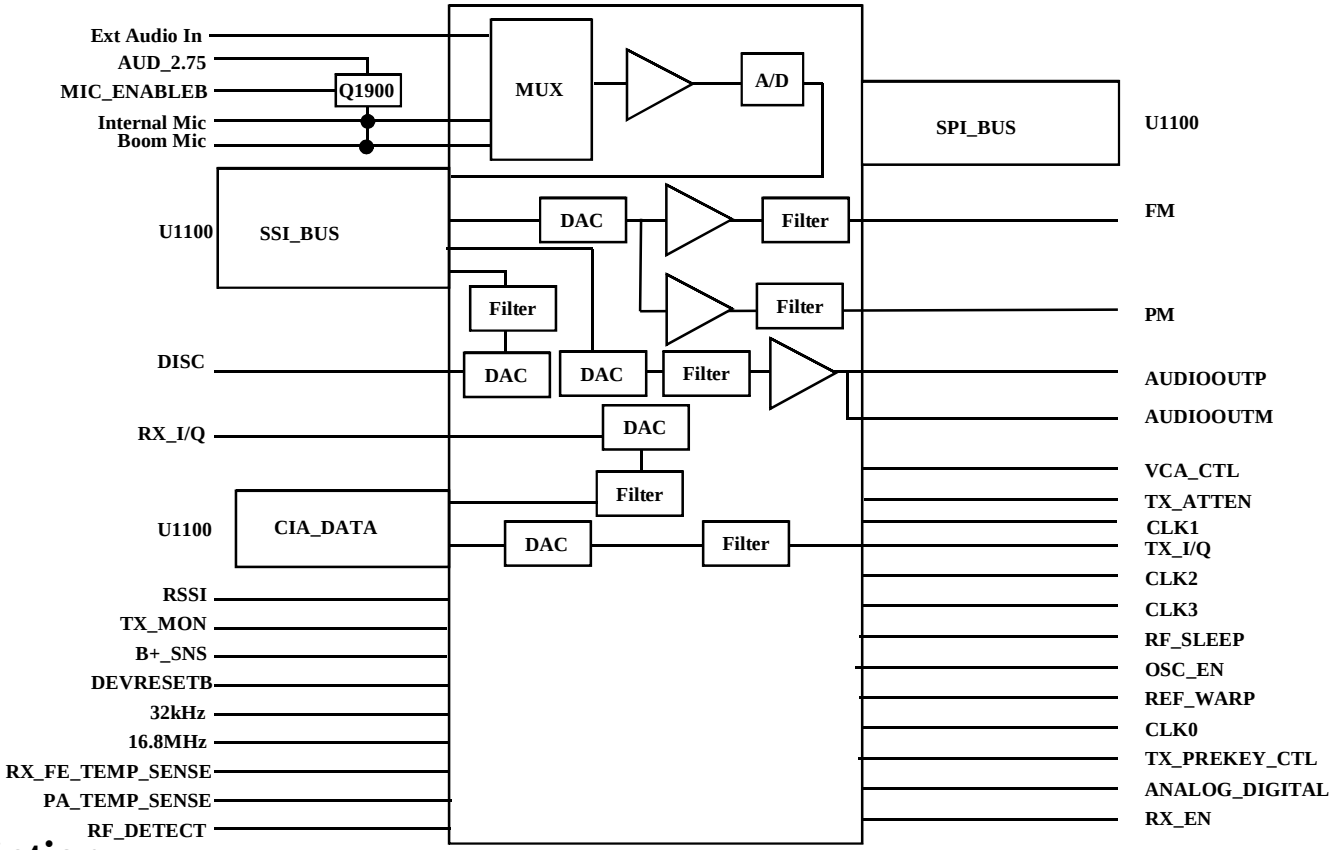
CR1060

Q1060

R1060

4.7V

CDMA StarTAC™(ST7860): CIA(U1900)



Description

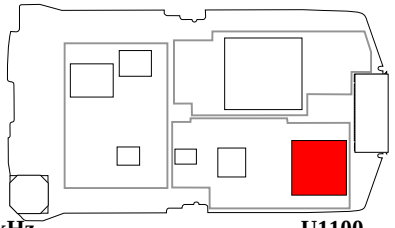
The CIA(U1900) provides the data converter interface between the DSP and the RF(transmit) or audio(receive) functions. U1900 has three different audio sources, the internal mic, Boom mic, and the External audio input. The internal mic and boom mic lines are biased by switching Q1900 on with the MIC_ENABLEB line. A mux internal to U1900 selects one audio input for amplification and A/D conversion. The digitaized audio is then sent to the DSP inside U1100 via SSI_BUS for filtering and wave shaping.

In analog mode the DSP sends the processed audio to the CIA's DAC to perform a digital to analog conversion on the signal for FM modulation. In digital mode, the audio is processed by the DSP into reverse voice packets. These voice packets are then sent to the microprocessor(U1100) and placed into CDMA packets. The data is then sent to CRIB (inside of U1100) for encryption. The CRIB then sends the data via CIA_DATA to the CIA for D/A conversion. The resulting signal is then sent to the RF section for transmission via TX_I/Q lines.

In analog mode, the RF signal is applied to the DISC input of U1900(CIA), The signal is digitized and send to the DSP via the SSI_BUS. The data is processed in the DSP and returned to the CIA for D/A converstion. The converted signal is then filtered, amplified, and routed to lines AUDIOOUTP and AUDIOOUTM. In digital mode, the demodulated signals are applied to the RXI/Q input of the CIA. The CIA digitizes the signal and passes the data to the CRIB via CIA_DATA. The CRIB removed the overhead bits and passes the data to the microprocessor(U1100). The microprocessor extrracts the voice packets and sends them to the DSP. The DSP passes the data to the CIA via the SSI_BUS where it is converted to analog signal and routed to the AUDIOOUTP and AUDIOOUTM lines.

The CIA received various signals that are A/D converted and then send to the microprocessor for processing via the SPI_BUS. The microprocessor also sends information to the CIA for D/A conversion for the control of RF circuits. Clock signals are sent from the CIA to various logic ICs. These clock signals are derived from the reference frequency input 16.8MHz.

CDMA StarTAC™(ST7860): CIA(U1900)



B27

U1100 page B29 — SSI_BUS

U1100 page B29 — CIA_DATA

CIA_VDDD — 2.76V

LOGIC_2.75V page B23 — 2.76V

CIA_VDDA — 2.76V

AUD_2.75V page B23 — 2.76V

Power Step	2	3	4	5	6	7
B	1.09V	0.8V	0.5V	0.32V	0.22V	0.14V

J1-8 page B40 — AUDIO_IN_CLK — 7.4Vpp

HP8924 Setup
AFGEN Aud Out: 2.4V
RX amplitude: -80dBm
VOLTAGE SUPPLIES
Colored boxes represent the area in which the components are placed.

2.4Vpp — DISC — C110 page B9

RX Input	-20	-80	-116
A	2.4V	1.68V	.743V

U700 page B9 — A — RSSI

U700 page B9 — RX_I — 60mVpp

J2000-2 page B23 — Headset Mic — 1.92V

U700 page B9 — RX_Q

U1100 page B29 — MIC_ENABLEB — 0V

AUD_2.75 page B23 — 2.79V

U700 page B9 — B — VCA_CTL

U2000-46 page B23 — B+_SNS — 1.12V

RESETB page B23 — 2.79V

U1100 page B29 — SPI_BUS

U1900 CIA

MIC3MIN, MIC3OUT, MIC2OUT, MIC2MIN, MIC1OUT, MIC1MIN, RSSI, RX_I, RX_Q, MIC_PLS, PLL_FLT

Q1900 — C — D — 2.75V

C1902 — 1.3V — 1.77V

U1100 page B29 — 32kHz
U1100 page B29 — CHIPX8
U1100 page B29 — CLK3 — 1.12MHz
R1792 page B29 — CLK2 — 32.8kHz
R332 page B11 — CLK1
R1794 page B29 — CLK0 — 5.6MHz
U1100 page B29 — µP_ASIC_INT
U401-2 page B17 — PA_TEMP_SNS
R413 page B17 — TX_ATTEN
R479 page B19 — RF_DETECT
R726 page B9 — PM
C658 page B15 — FM
R731 page B9 — TX_I
R730 page B9 — TX_Q
R732 page B9 — TX_I*_Q*
R2501 page B21 — TX_PREKEY_CTL
R2500 page B21 — RX_EN
Q250,U400 page B17 — ANALOG_DIGITAL
R455 page B19 — TX_MON
C2099 page B23 — AUDIOOUTP
C2006 page B23 — AUDIOOUTM

ZIF_SYN PROGRAMMING INTERFACE
U700 page B9 — RF_SLEEP
U700 page B9 — OSC_EN
Q325 page B11

CIA_TX
U1100 page B37

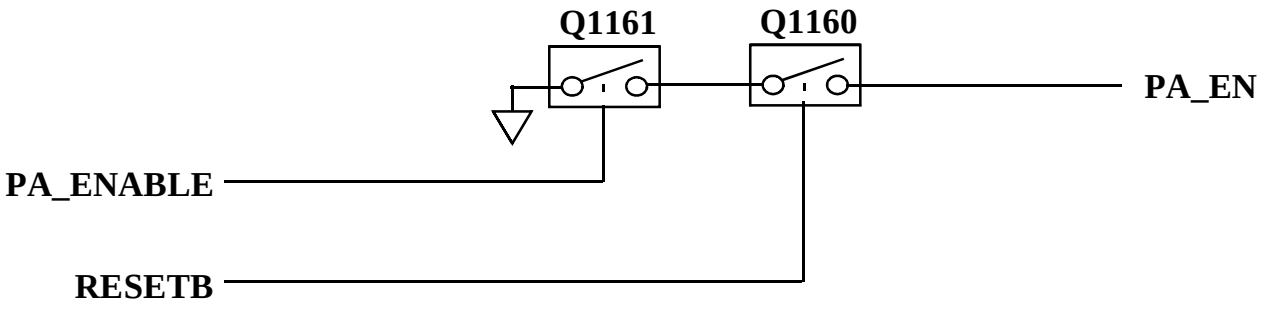
Internal Mic — R1900 — J5000-1 page B42

REF_WARP — R325 page B11

16.8MHz — 700mVpp — U325 page B11

Internal Mic	Enabled	Disabled
C	0V	2.7V
D	2.7V	0V

CDMA StarTAC™(ST7860): PA Enable



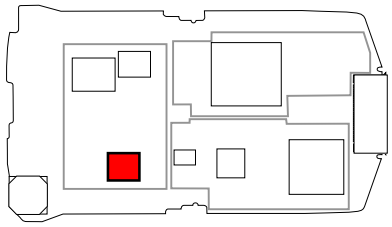
B28

Description

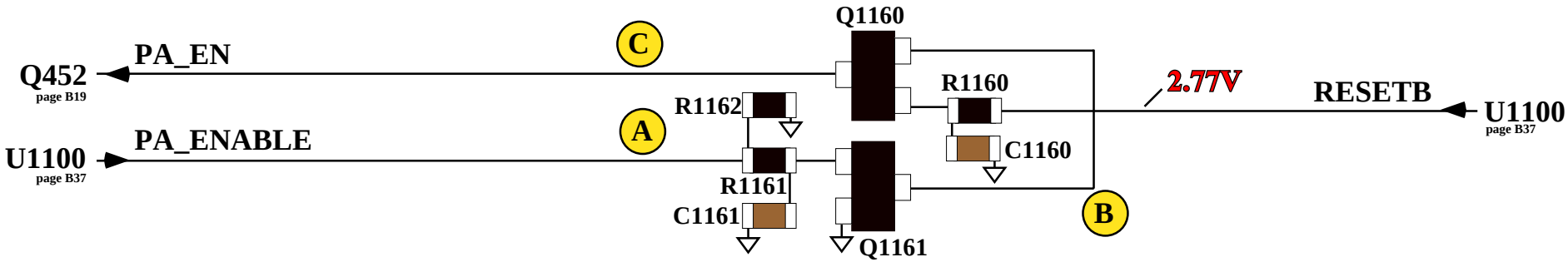
PA_ENABLE controls the state of the final stage PA(U450). During transmit conditions, PA_ENABLE is pulled high. This allows Q1161 to be switched on which will force the output of Q1161 to ground. As long as a reset is not initiated, the output of Q1160 will be the same state as the input of Q1160. RESETB is normally pulled high while the phone is on. When a system reset is initaited, RESETB will be pulled low. This will force Q1160 to be turned off, allowing PA_EN to be pulled high, thus, switching the final stage PA(U450) off during a system reset.

When the phone is not transmitting, PA_ENABLE is pulled low. A low state at the input of Q1161 will switch the transistor off. Q1160 will also be switched off and PA_EN will be pulled high. This condition will disable the PA(U450).

CDMA StarTAC™(ST7860): PA Enable

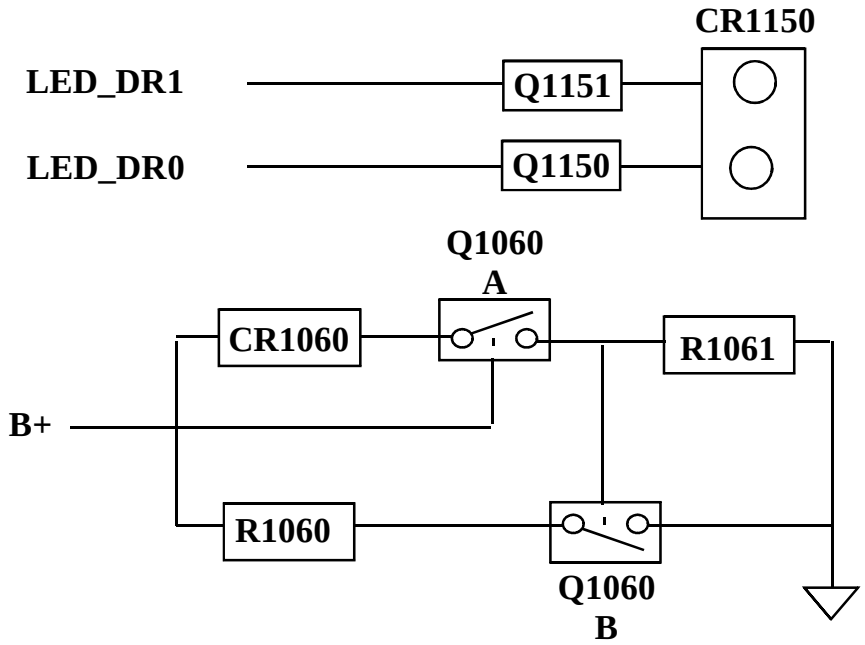


B29



	TX On	TX Off
A	2.58V	0V
B	0V	2.2V
C	0V	3.6V

CDMA StarTAC™ (ST7860): Drivers & B+ Shunt



B30

Description

The color of CR1150 is controlled by the CRIB via the LED_DR1 and LED_DR0. A low state on LED_DR1 and high state on LED_DR0 will light CR1150 green. A high state on LED_DR1 and low state on LED_DR0 will light CR1150 red. A low state on LED_DR1 and LED_DR0 will light CR1150 orange.

The B+ shunt circuit includes Q1060 and its related components. This circuit is used to provide different shunt resistances when a voltage source is present and not present. When a voltage source exists in the radio, whether it's on or off, Q1060A will be switched on. This condition will allow R1061 to be used as a shunt resistor for the B+ line. Q1060B will also be turned off during this state.

When there is no voltage source present at B+, Q1060A is turned off. This condition will then allow Q1060B to be turned on. R1060 will now be used as the shunt resistor for the B+ line.

CDMA StarTAC™(ST7860): Drivers & B+ Shunt

LED	Red	Green
A	0V	3V
B	3V	0V
C	1.3V	1.2V
D	1.3V	1.6V

B31

B+
page B25

3.79V

R1061

C1061

CR1060

Q1060

R1060

C1060

R1151

Q1151

R1150

Q1150

GRN_LED_DR

RD_LED_DR

U1100
page B29

U1100
page B29

CR1150

2.79V

LOGIC_2.75
page B23

R2401

HDST_PRESENT

U1100
page B29

R2404

R2403

C2402

Q2400

2.8V

AUD_2.75
page B23

R2402

BOOM_MIC

J2000-2
page B40

C2403

2.8V

AUD_2.75
page B23

Boom Mic	Present	Not Present
G	2.76V	0V
H	1.35V	2.78V

J101-32
page B37

BL_DRIVER

3.79V

B+
page B25

U1701

NC

U1100
page B29

BL_CONTROL

Backlight	On	Off
E	???V	???V
F	???V	???V

WATCHDOG

U2000-31
page B23

2.79V

WATCHDOG*

U1100
page B29

C1731

Q1731

R1730

1.39V

DSPLY_PWR_ON

U1100
page B29

R1731

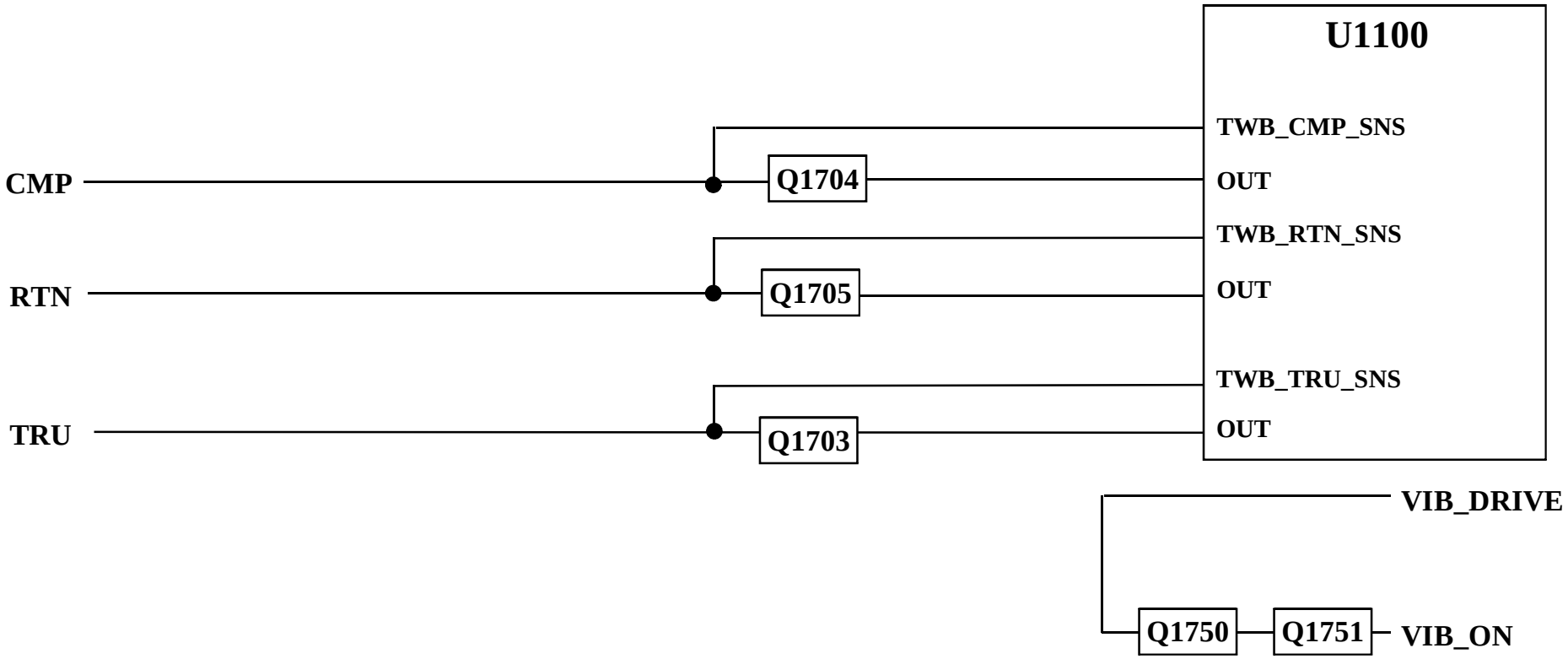
C1730

LOGIC_2.75
page B23

VOLTAGE SUPPLIES

Colored boxes represent the area in which the components are placed.

CDMA StarTAC™ (ST7860): Vibrator/3WB



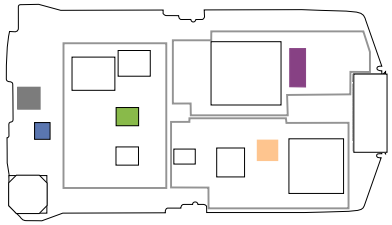
B32

Description

The 3-wire bus is a communic ation interface for devices external to the radio. The 3-wire bus consists of the CMP, RTN, and TRU lines. T he TRU data is sent by the CRIB (inside of U1100) to Q1703 . The T RU data is then routed to the external c onnector. When the radio is receiving TRU data, it is routed directly to U1100. T he RTN data is sent by U1100 t o Q1705 The RTN data is the n routed to the external con nector. When the radio is r eceiving RTN data, it is rou ted directly to U1100.The CMP data is sent by the CRIB to Q1704 . The TRU data is then routed to the external co nnector. When the radio is receiving CMP data, it is routed directly to U1100.

To activate the v ibrator Q1751 and Q1750 are driven on by pulling VIB_ON high.

CDMA StarTAC™(ST7860): Vibrator/3WB



VOLTAGE SUPPLIES →

Colored boxes represent the area in which the components are placed.

B33

J1-13 page B40 — TRU — 3Vpp

J1-11 page B40 — RTN

J1-12 page B40 — CMP

Vibrator	On	Off
A	2.78V	0V
B	2.78V	0V

3.8V

B+ page B25

3.75V

Q1750

U1100 page B29 — VIB_ON (A)

J1000-15 page B40 — BATT_GND

C1051

Q1751

R1751

R1752

CR1750

C1750

C1751

J1000-9 page B40 — VIB_DRIVE (B)

J1000-8 page B40 — EAR_SPEAKER- — 1.4V

J2000-5 page B40

R2001 page B23

J1000-7 page B40 — SPEAKER+ — 1.4V

LOGIC_2.75 page B23

R1011

CR1011

J1000-6 page B40 — THERMISTOR

U1900 page B27 — THERM_CIA — 2.79V

Q1703

R1704 — 2.79V — LOGIC_2.75 page B23

R1700 — TRU_SNS → U1100 page B29

TRU_DRV → U1100 page B29

Q1705

R1725 — 2.79V — LOGIC_2.75 page B23

RTN_SNS → U1100 page B29

R1716 — RTN_CIA → U1900 page B27

RTN_DVR → U1100 page B29

Q1704

R1706 — 2.79V — LOGIC_2.75 page B23

R1702 — CMP_CIA → U1900 page B27

CMP_SNS → U1100 page B29

CMP_DVR → U1100 page B29

BATT_SERIAL_DAT → U1100 page B29; J1000-11 page B40

CDMA StarTAC™(ST7860): Memory

BLOCK DIAGRAM NOT NECESSARY
REFER TO PAGE B35

Description

The flash EPROM(U1200) has 16MB and 32MB of memory. It stores the instruction set for radio operation, gain bytes, NAM information, and reperatory memory. U1400 has a serial interface to the microprocessor. U1300(SRAM) has 2MB of memory.

U1201 is an OR gate used to enable communication to the EP ROM(U1200). U1202 is an infverter used for the ouput enable of U1200.

CDMA StarTAC™(ST7860): MEMORY

VOLTAGE SUPPLIES →

Colored boxes represent the area in which the components are placed.

U1100 page B29 — µP_ADDR_BUS

U1100 page B29 — µP_DATA_BUS

U1100 pageB29 — AS — 3Vpp — 3Vpp

U1100 pageB29 — µP_CS

U1201

2.69V

R1217

U1200 EPROM

CE

OE

3Vpp

U1300 SRAM

VCC

C1302

2.77V

U1100 page B29 — R_W — 3Vpp

C1200 C1201

U1202 (1 2 3 4 5)

2.79V

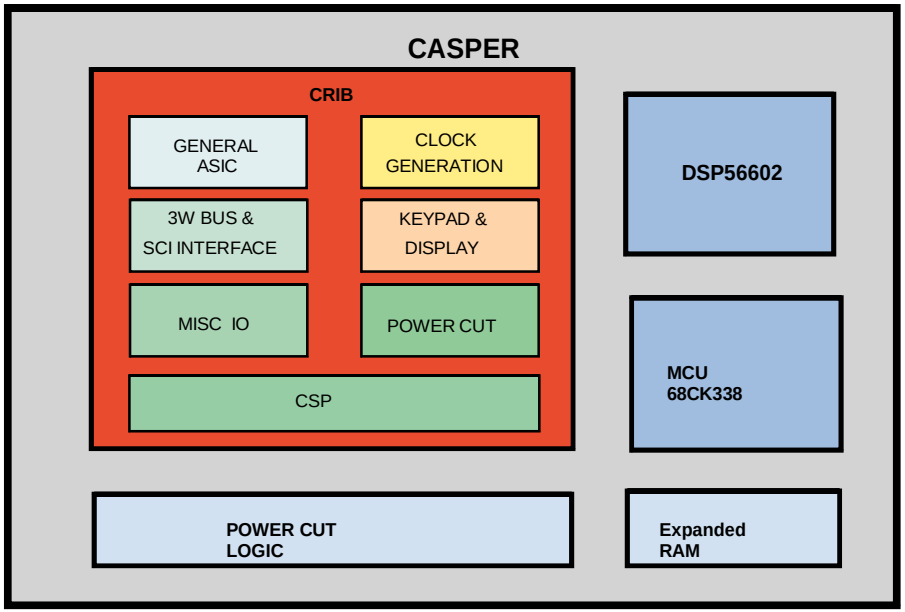
DEV RESET B page B37

2.77V

LOGIC_2.75V page B23

B35

CDMA StarTAC™(ST7860): CASPER(U1100)



Description

The CASPER(U1100) integrates the microprocessor, DSP, and CRIB. The microprocessor controls the following functions:

* Control of audio and RF hardware
* EEPROM and EPROM access
* Charger control
* Battery control

In CDMA mode, the DSP section provides encoding and decoding of speech (13k, 8k, EVRC). It also provides control of the gate biasing for the final PA. In analog mode, the DSP provides TX, RX audio processing. SAT detection and generation is accomplished in the DSP. Finally, the DSP provides data encoding.

The CRIB is an integrated RIB and CSP. The following is a list of functions for each section of the CRIB:

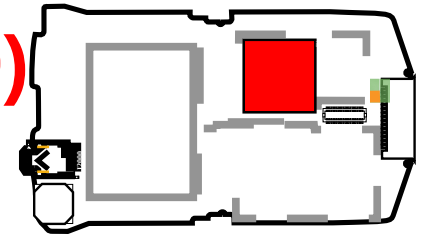
RIB Section

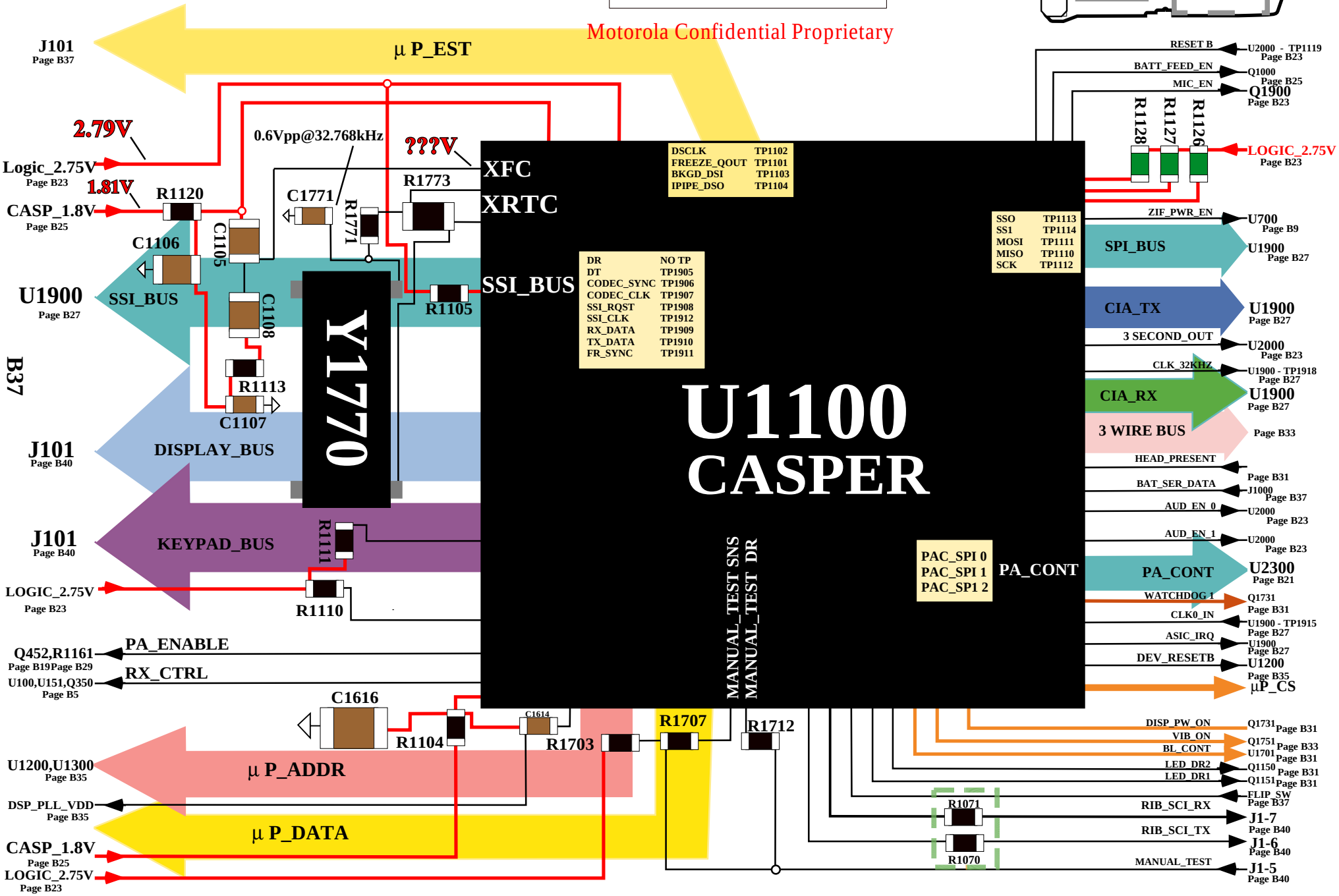
* Adrress / data buffering
* Interrupt generation
* Watchdog Circuit
* Three-wire bus interface
* Keypad scanning circuit
* Miscellaneous I/O circuit
* Display SPI circuit
* Slotted-mode LED circuit
* Power cuts support

CSP Section

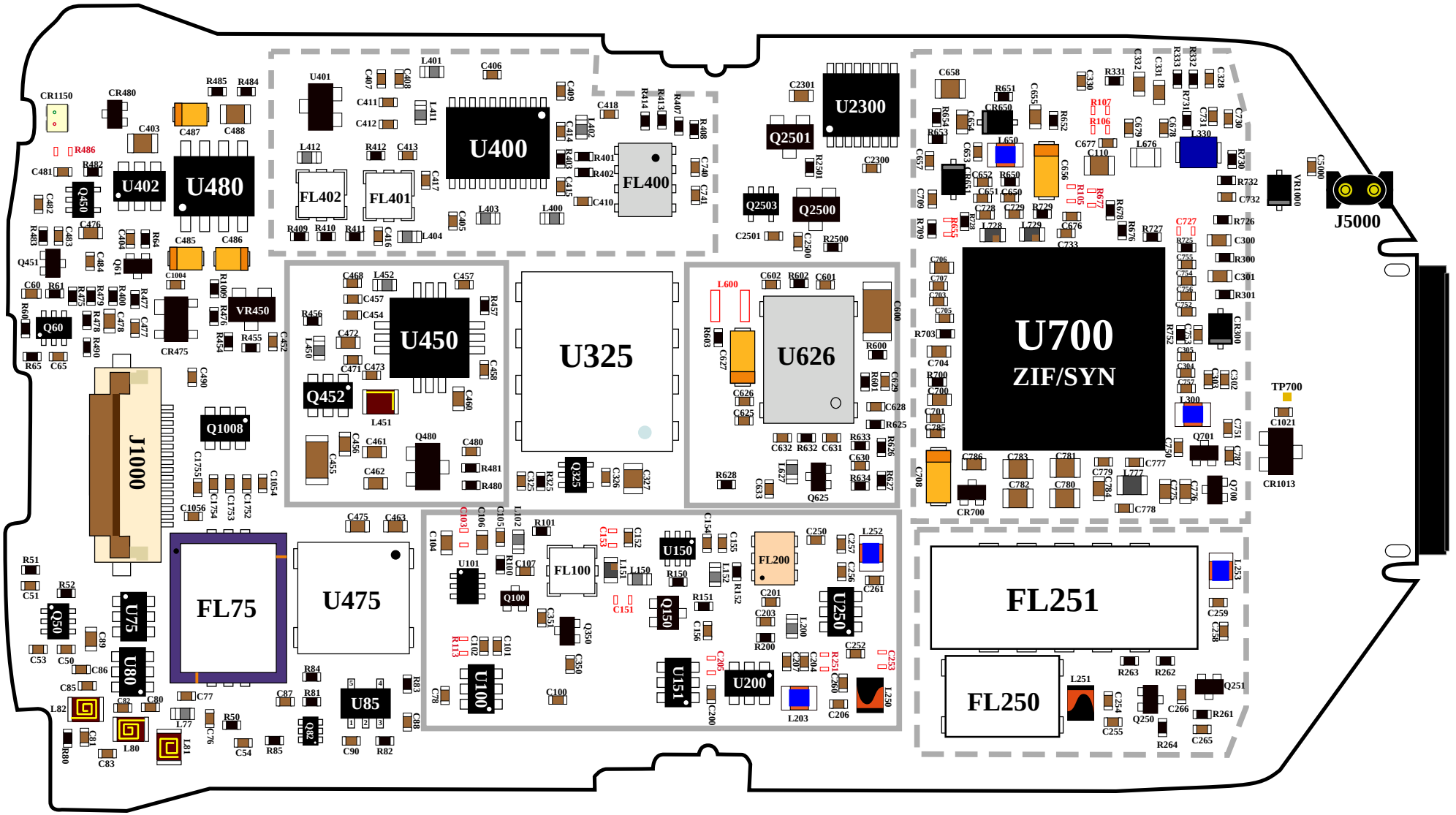
* Implements a majority of the digital modem functions
* Transmitter unit
* Decoder unit
* Demodulator unit
* Search processor unit
* Rapid service detector unit

CDMA StarTAC™(ST7860):CASPER(U1100)



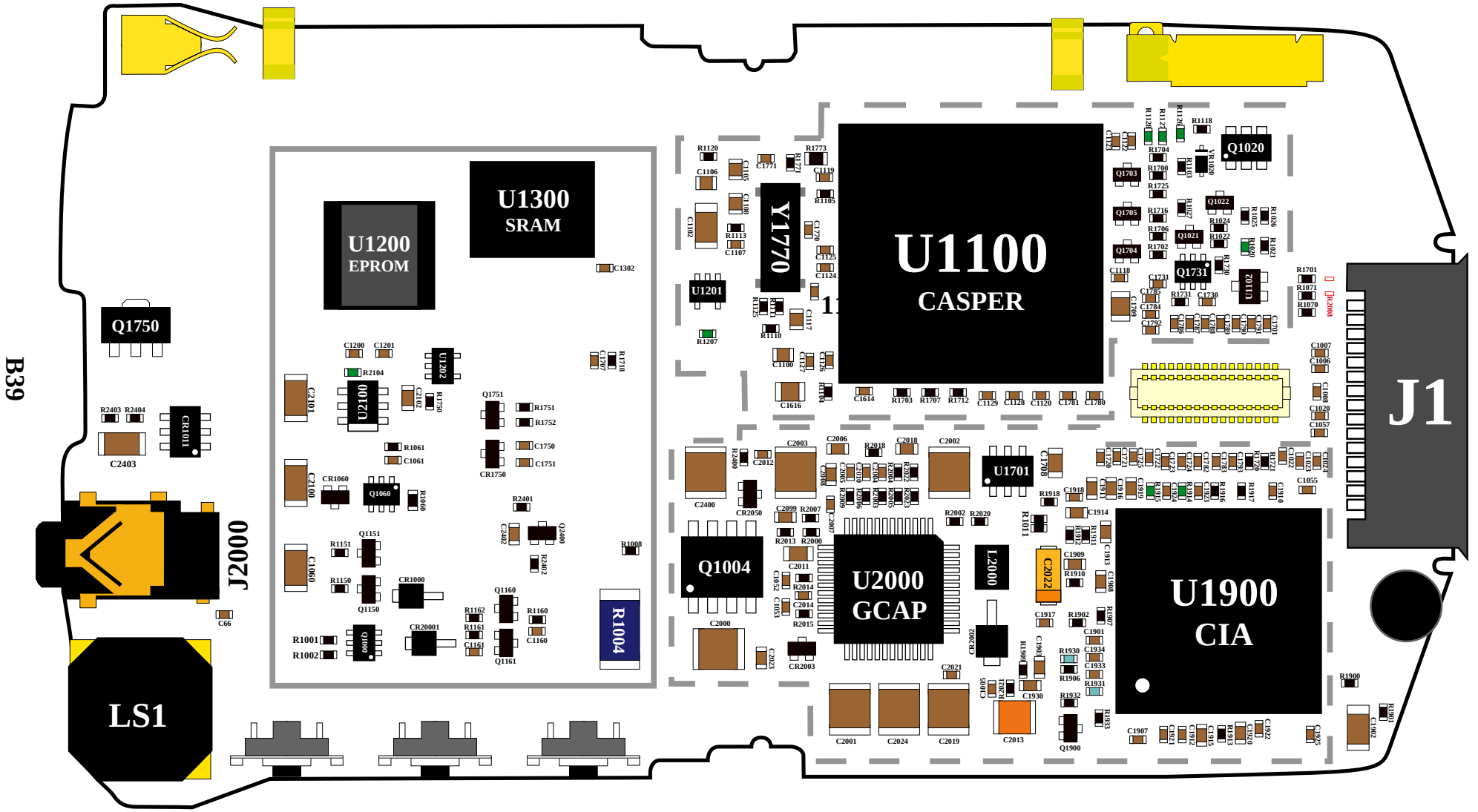


CDMA StarTAC™(ST7860): Layout Side 1



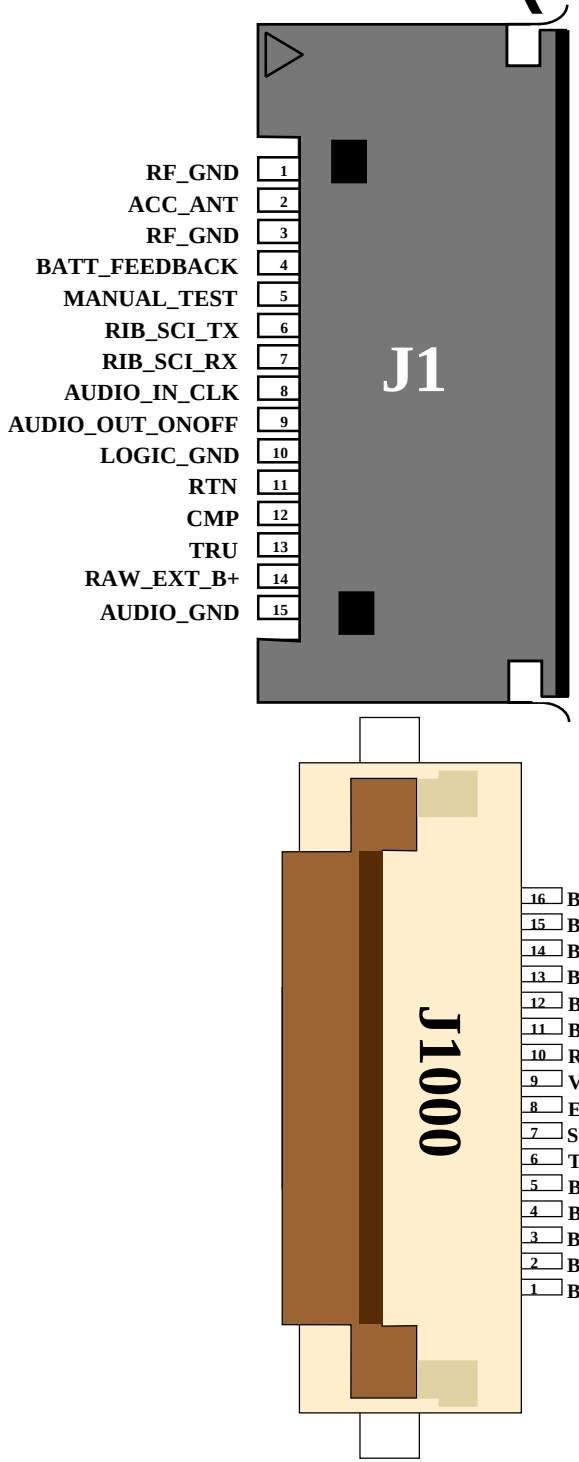
P6.6 Board

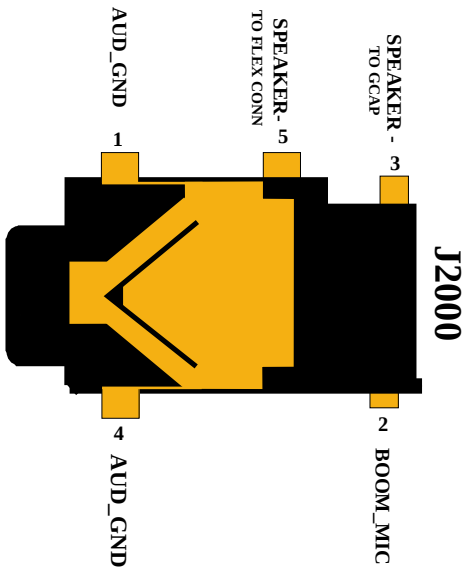
CDMA StarTAC™(ST7860): Layout Side 2

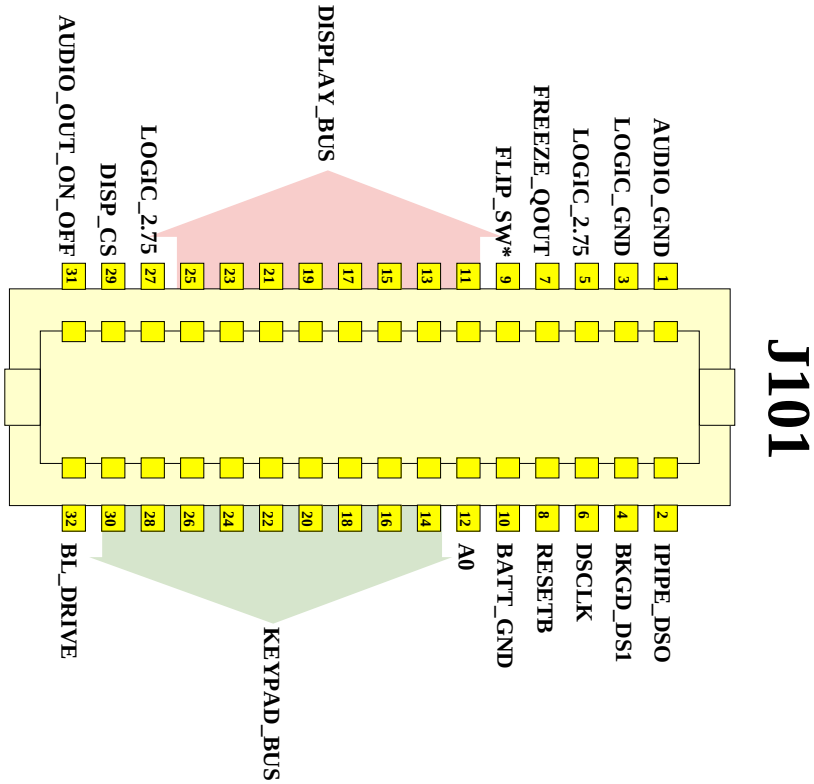


P6.6 Board

CDMA StarTAC™(ST7860): CONNECTORS

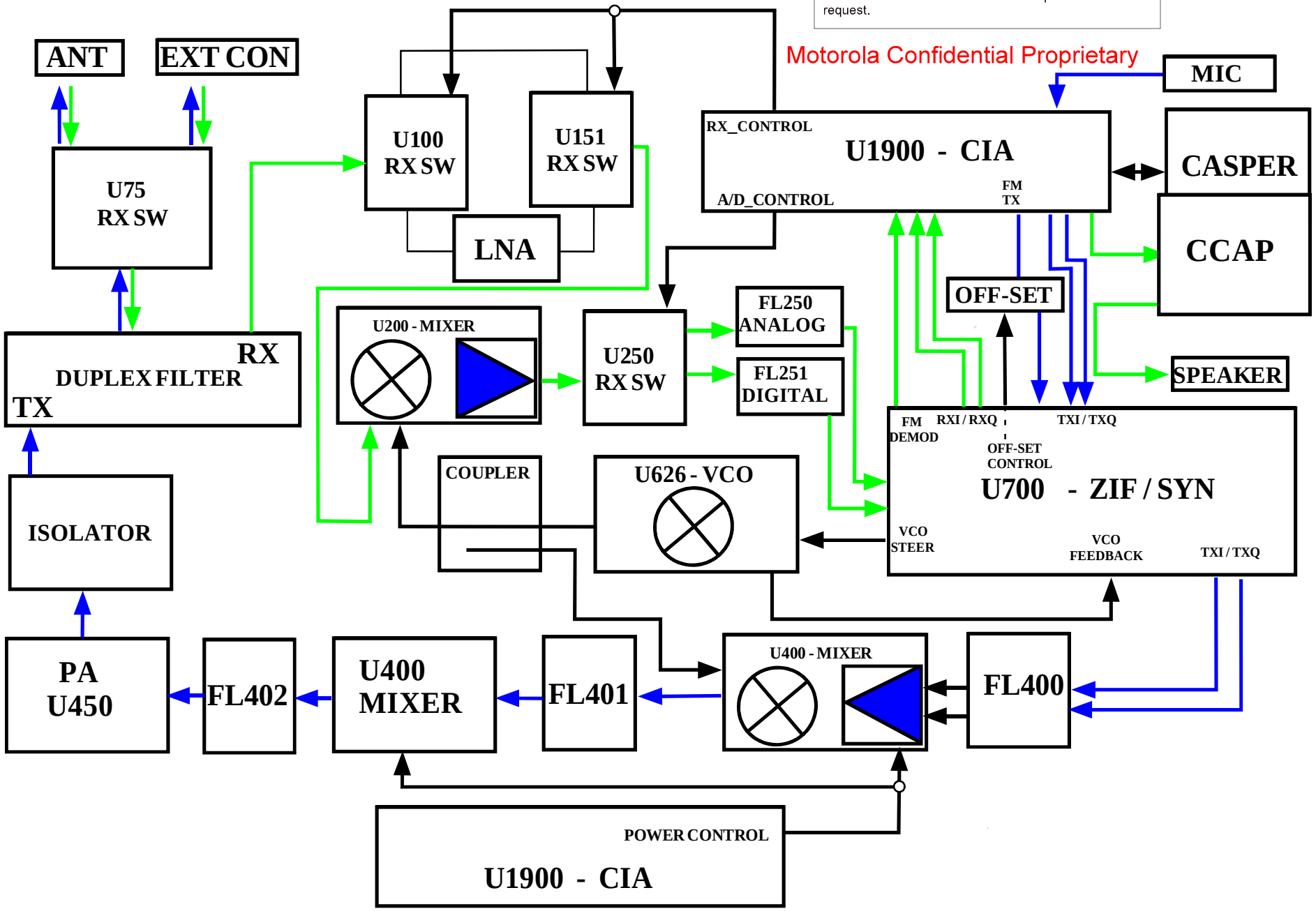






B40

CDMA StarTAC™(ST7860): RF Block Diagram



B41