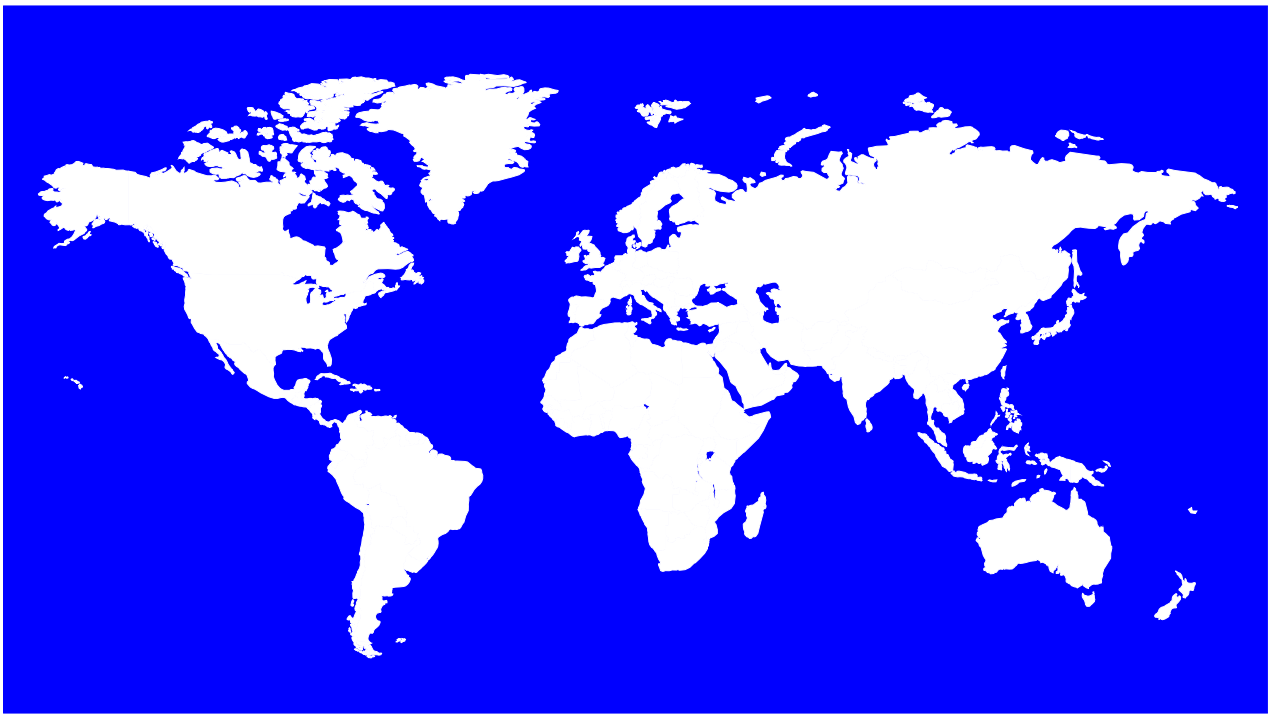
MOTOROLA

Cellular Subscriber Sector

StarTAC 160 (GSM)



The World's Leading Cellular Telephone Manufacturer

Service Manual

Issue 1.0

Preface

Specifications

Table 1: General

Function	*Specification*
Frequency Range	890-915 MHz TX 935-960 MHz RX
Channel Spacing	200 kHz
Channels	124 carriers with 8 channels per carrier
Modulation	GMSK at BT = 0.3
Transmitter Phase Accuracy	5 Degrees RMS, 20 Degrees peak
Duplex Spacing	45 MHz
Frequency Stability	± 0.10 ppm of the downlink frequency (Rx)
Operating Voltage	+3.0V dc to +5.1V dc (battery) +4.4V dc to +6.5V dc (external connector)
Transmit Current	<200 mA average, 1.0 A peak
Stand-by Current	Average 10mA (DRX 2)
Dimensions	98.3 mm (L) x 57.3 mm(W) x 22.5 mm(D)
Size (Volume)	100 cubic cm
Weight	Approximately 99.5 g; Includes Slim LiIon battery pack and antenna
Temperature Range	-20°C to +55°C

Table 2: Transmitter

Function	*Specification*
RF Power Output	33 dBm ± 2dBm

Table 2: Transmitter

Function	*Specification*
Output Impedance	50 ohms (nominal)
Spurious Emissions	-36 dBm up to 1 GHz, (<-30 dBm > 1 GHz)

Table 3: Receiver

Function	*Specification*
RF Level	-102 dBm
RX bit error rate (100 k bits)	< 2%
Channel Hop Time	500 microseconds
Time to Camp	Approximately 10 seconds

Table 4: Speech Coding

Function	*Specification*
Speech Coding Type	Regular Pulse Excitation / Linear Predictive Coding with Long Term Prediction. (RPE LPC with LTP).
Bit Rate	13.0 k bps
Frame Duration	20 ms
Block Length	260 bits
Classes	Class 1 bits = 182 bits. Class 2 bits = 78 bits
Bit Rate with FEC Encoding	22.8 k bps

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 electrical and mechanical repairs. Repairs not covered in the scope of this manual should be forwarded to Motorola's regional Cellular Subscriber Support Centers.

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 FCC label. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them.

Service

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

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.

General Safety Information

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 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.

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.

Portable/Mobile Telephone Use and Driving

Safety is every driver's business. The portable telephone should only be used in situations in which the driver considers it safe to do so. Use of a cellular portable while driving may be *illegal* in some areas.

Refer to the appropriate section of the product service manual for additional pertinent safety information.

MOTOROLA

Cellular Subscriber Sector

CONTENTS

StarTAC 160 (GSM)

Description

Product Description

General

This personal cellular telephone is a microprocessor controlled, full duplex, synthesized FM radiotelephone using digital modulation techniques, for use in compatible 900 MHz cellular radiotelephone systems. When operated properly, the equipment will provide the user with land-linked telephone service through individual cell site base stations, all linked to a central control office. The phone has a 3.0 Watt maximum power capability.

Physical Packaging

The transceiver circuitry is contained in a water resistant polycarbonate plastic housing that is less than 100 cc at a weight of less than 100 grams with the lightest battery.

The transceiver circuitry is contained on two multi-layer boards, the RF/Logic board, and the keyboard assembly.

The RF/Logic board houses the RF and Audio/Logic circuitry on separate sides in addition to SIM contacts, the alert, a 16 position ZIF connector, the microphone, and an external connector.

The keyboard assembly houses the display, reed switch, and keyboard LEDs. Electrical connections between the two boards are provided by connectors at the lower portion of each board.

The silent alert and speaker are located inside the top portion of the housing and is connected to the RF/Logic board via a flex strip that connects to the 16 position ZIF.

Operating power for the personal telephone can be obtained from any one of the main or auxiliary batteries, or an external supply such as a cigarette lighter adapter (CLA).

NOTE

The phone may have various battery options as standard depending on the particular market requirements.

Theory of Operation

GSM System Overview

NOTE

The following description is intended only as a preliminary general introduction to the Global System for Mobile communications (GSM) cellular network. This description is greatly simplified and does not illustrate the full operating capabilities, techniques, or technology incorporated in the system.

General Cellular Concept

The cellular systems are used to provide radiotelephone service in the frequency range 890-960 MHz. A cellular system provides higher call handling capacity and system availability than would be possible with conventional radiotelephone systems (those which require total system area coverage on every operating channel) by dividing 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, for an allocated set of duplex frequency pairs (channels). Since each cell is a relatively small area, both the cell site and the radiotelephone that it supports can operate at lower power levels than would be used in conventional systems.

Using this technique, radiation on a given channel is virtually contained in the cell operating on that channel and, to some extent, those cells directly adjacent to that cell.

Since the coverage area of a cell on a given channel is limited to a small area (relative to the total system coverage area), a channel may be reused in another cell outside the coverage area of the first. By this means, several subscribers may operate within the same geographic area, without interference with each other, on a single channel.

GSM Description

Unlike previous cellular systems, GSM uses digital radio techniques. The GSM system has the following advantages over previous analogue systems:-

- *International Roaming* - Due to international harmonization and standardization, it will be possible to make and receive calls in any country which supports a GSM system.
- *Digital Air Interface* - The GSM phone will provide an entirely digital link between the telephone and the base station, which is, in turn, digitally linked into the switching subsystems and on into the PSTN.
- *ISDN Compatibility* - ISDN is a digital communications standard that many countries are committed to implementing.

It is designed to carry digital voice and data over existing copper telephone cables. The GSM phone will be able to offer similar features to the ISDN telephone.

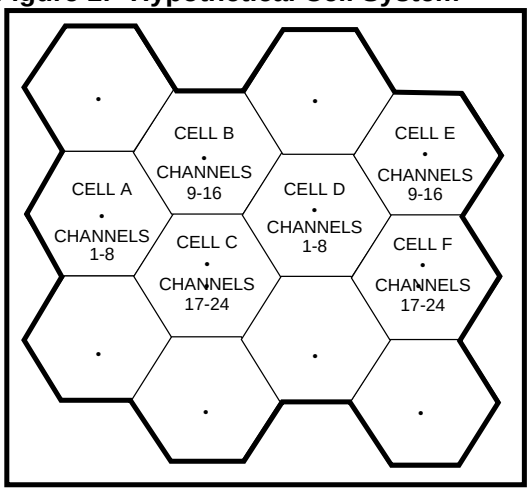
- *Security and Confidentiality* - Telephone calls on analogue systems can very easily be overheard by the use of a suitable radio receiver. GSM offers vastly improved confidentiality because of the way in which data is digitally encrypted and transmitted.

- *Better Call Quality* - Co-channel interference, handover breaks, and fading will be dealt with more effectively in the digital system. The call quality is also enhanced by error correction, which reconstructs lost information.

- *Efficiency* - The GSM system will be able to use spectral resources in a much more efficient way than previous analogue systems.

In the figure below, the area bounded by bold lines represents the total coverage area of a hypothetical system. This area is divided into several cells, each containing a cell site (base station) operating on a given set of channels which interfaces radiotelephone subscribers to the telephone switching system.

Figure 1: Hypothetical Cell System



The radiotelephones themselves are capable of operation on any channel in the system, allowing them to operate in any cell. Due to the low power requirements for communications between radiotelephones in a particular cell and the cell site, operating channels may be repeated in cells which are outside the coverage area of each other.

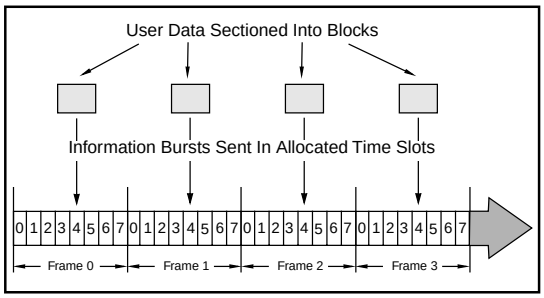
For example, presume that cell A operates on channels arbitrarily numbered 1 through 8, cell B operates on channels 9 through 16, cell C operates on channels 17 through 24 and cell D operates on channels 1 through 8 (repeating the usage of those channels used by cell A). In this system, subscribers in cell A and subscribers in cell D could simultaneously operate on channels 1 through 8.

The implementation of frequency re-use increases the call handling capability of the system, without increasing the number of available channels. When re-using identical frequencies in a small area, co-channel interference can be a problem. The GSM system can tolerate higher levels of co-channel interference than analogue systems, by incorporating digital modulation, forward error correction and equalization. This means that cells using identical frequencies can be physically closer, than similar cells in analogue systems. Therefore the advantage of frequency re-use can be further enhanced in a GSM system, allowing greater traffic handling in high use areas.

By incorporating Time Division Multiple Access (TDMA) several calls can share the same carrier. The carrier is divided into a continuous stream of TDMA frames, each frame is split into eight time slots. When a connection is required the system allocates the subscriber a dedicated time slot within each TDMA frame. User data (speech / data) for transmission is digitized and sectioned into blocks. The user data blocks are sent as information bursts in the allocated time slot of each TDMA frame, see Figure 2: “TDMA Transmission” on page 5.

The data blocks are modulated onto the carrier using Gaussian Minimum Shift Keying (GMSK), a very efficient method of phase modulation.

Figure 2: TDMA Transmission



Each time an information burst is transmitted, it may be transmitted on a different frequency. This process is known as frequency hopping. Frequency hopping reduces the effects of fading, and enhances the security and confidentiality of the link. A GSM radiotelephone is only required to transmit for one burst in each frame, and not continually, thus enabling the unit to be more power efficient.

Each radiotelephone must be able to move from one cell to another, with minimal inconvenience to the user. The mobile itself carries out signal strength measurements on adjacent cells, and the quality of the traffic channel is measured by both the mobile and the base station. The handover criteria can thus be much more accurately determined, and the handover made before the channel quality deteriorates to the point that the subscriber notices.

When a radiotelephone is well within a cell, the signal strength measured will be high. As the radiotelephone moves towards the edge of the cell, the signal strength and quality measurement decreases.

Signal information provides an indication of the subscriber's distance from the base station. As the radiotelephone moves from cell to cell, its control is handed from one base station to another in the new cell.

This change is handled by the radiotelephone and base stations, and is completely transparent to the user.

Service Area

The area within which calls can be placed and received is defined by the system operators. (Because this is a radio system, there is no exact boundary that can be drawn on a map.) If the telephone is outside a coverage area, the ∅ (no service) indicator will illuminate and calls will be unable to be placed or received. If this happens during a conversation, the call will be lost. There may also be small areas within a particular service area where communications may be lost.

The radiotelephone's identity information is held by its local GSM system in its Home Location Register (HLR) and Visitor Location Register (VLR). The VLR contains identity information on all local active radiotelephones. Should you roam to another area, system or country the radiotelephones identity information is sent to the VLR in the new system. The new system will then check the radiotelephones details with your home system for authenticity. If everything is in order it will be possible to initiate and receive calls whilst in the new area.

Identity and Security

Transceiver Labelling

Introduction

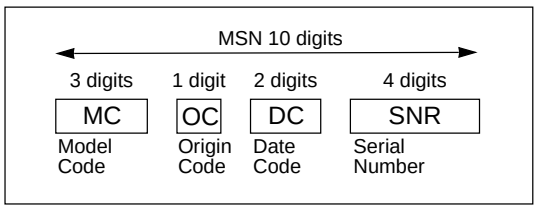
Each Motorola GSM transceiver will be labelled with various number configurations. The following information shows and explains the common labelling titles.

Title Explanations

MSN

The Mechanical Serial Number (MSN) is an individual number, uniquely identifying the unit. The MSN will remain the same throughout the units life, even if the main board is replaced. Because the MSN is unique to the unit, it is often used for logging and tracking purposes by Motorola National Service Centres on EPPRS. The MSN is divided into the sections shown below.

Figure 3: MSN Configuration

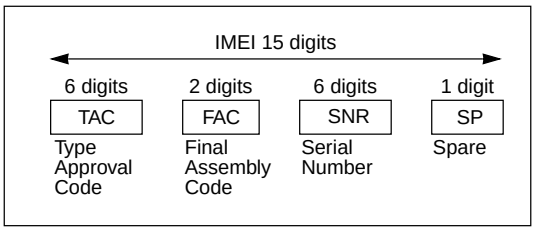


CEPT GSM

This is the International Mobile Station Equipment Identity (IMEI) number. The IMEI is held in the logic circuitry.

If the main board is replaced then the units IMEI will change, therefore the units labelling should be updated with the new IMEI. An IMEI uniquely identifies a mobile station equipment to the system, and is divided into the sections shown below.

Figure 4: IMEI Configuration



REV S/H

This configuration consists of two blocks of two digits, and denotes the software and hardware versions within the unit. The first two digits correspond to the software version, and the last two digits correspond to the hardware version. If a version update is carried out on the unit, the corresponding change information should be made apparent on the labelling.

Model

The model number defines the type of product. Each product type is issued a common model number.

Package

The package number is used to determine the type of equipment, the mode in which it was sold, and the language with which it was shipped.

Mini SIM CARDS

Introduction

The Motorola GSM StarTAC 160 is designed to work with the mini size Subscriber Identity Module (SIM). The Mini SIM card slides into the phone sideways. The Mini SIM card contains all the personal data required to access GSM services. Data held by the Mini SIM card includes:

- International Mobile Subscriber Identity
- Temporary Mobile Subscriber Identity
- Home system
- Services subscribed to
- PIN and unblocking codes
- Call barring codes

The Mini SIM card may also be capable of storing phone numbers and names.

Mini SIM Card Insertion/Removal

The Mini SIM card must be inserted into the unit correctly so that the card can be read, and the data checked for validity, before operation on the system will be enabled. The card contains all of the user's personal identification numbers and details of the system the phone operates on.

Figure 5: Inserting Mini SIM Card

The Mini SIM card is placed in the tray and the tray slid into the side of the phone. Ensure that the Mini SIM card sits correctly in the tray before trying to insert the tray into the phone. The tray should be competely and securely seated in the slot on the side of the phone.

To remove the Mini SIM tray from the unit, pull the sliding Mini SIM tray sideways away fron the phone. The User Guide contains full information about inserting and removing the Mini SIM card.

Security Information

To stop unauthorized personnel using your Mini SIM card, the option of using a Personal Identity Number (PIN) is available. When enabled the option requires (on power up) a verification number to be entered via the unit's keypad, before the card can be used. Three attempts to enter the correct PIN may be made. If after the three entries the correct PIN has not been entered, the card becomes blocked. To unblock the card an unblocking / super PIN code must be entered. Ten attempts to enter the correct unblocking code are permitted, if after ten attempts the correct code has not been entered, the Mini SIM card is corrupted and becomes useless.

Another option available for the Mini SIM card is call barring. If subscribed to, the call barring of incoming and / or outgoing calls may be accomplished by entering a special key sequence. The key sequence includes a "barring code", which determines the type of restriction incorporated, and a password to validate the request. The initial password is provided when you subscribe to the service. The password can be changed by entering a set key sequence.

A valid standard sized Mini SIM card can be used in any working GSM transceiver, regardless of the manufacturer, which is compatible with the standard size Mini SIM card.

To protect the actual unit from unauthorized use, a lock function on the hardware is available. When enabled, this function requires that a three or four digit unlock code be entered, via the units keypad, before normal operation of the transceiver can take place. The lock code can be changed by entering a set key sequence.

Further information on set key sequences can be derived from the unit's User Guide.

Testing

Verification

Introduction

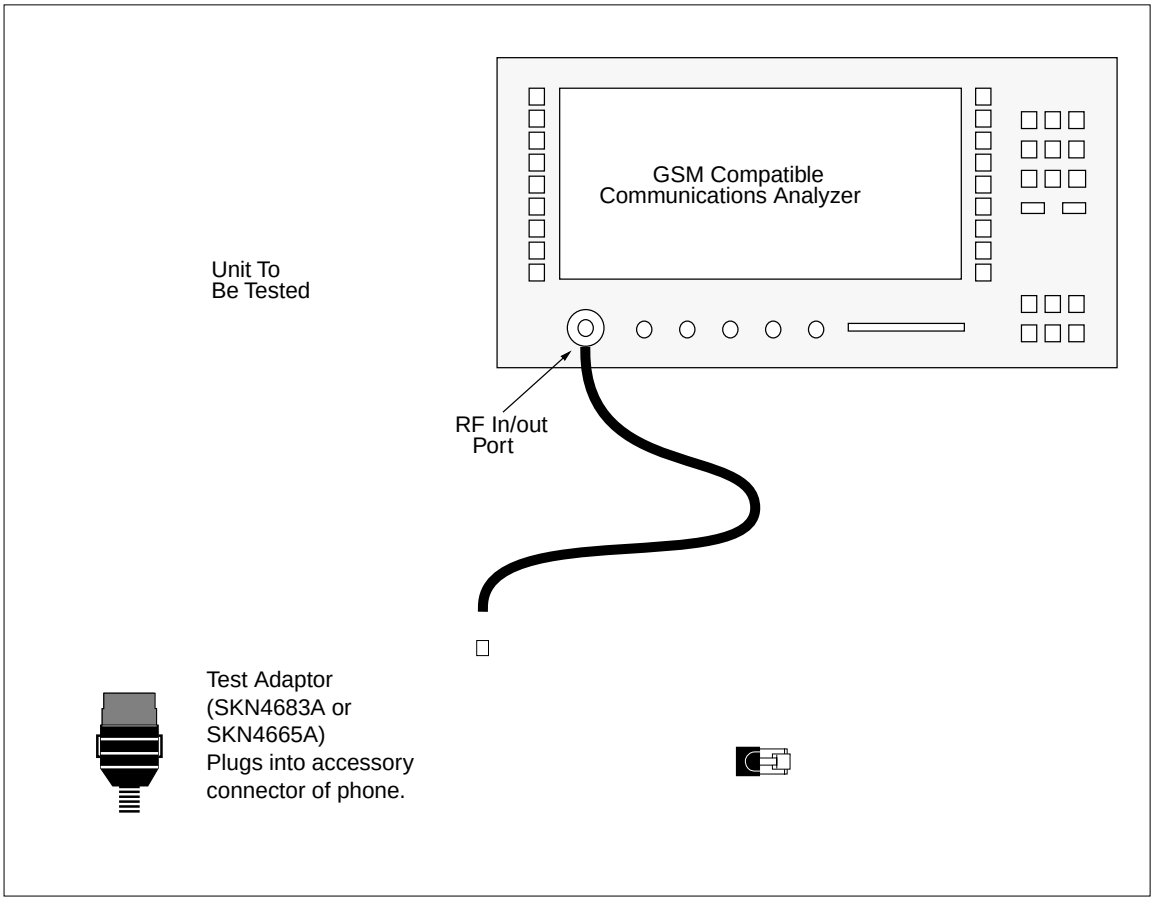
To test the StarTAC cellular telephone for functional verification, the following equipment will be required:

- GSM compatible communications analyzer.
- Antenna test adaptor (Part No 5880348B33), and appropriate cable / connectors.
- Test Mini SIM card.
- Charged battery pack.

Equipment Configuration

Initially insert the test Mini SIM card into the slot at the side of the personal cellular telephone. If required, further information on Mini SIM card insertion is available on page 8. The telephone's antenna should now be removed, see "Disassembly" on page 19 for further details. When the antenna has been removed, attach the antenna adaptor to the unit. Slide a charged battery on to the back of the personal telephone, so that the telephone can be powered up. Finally, connect a cable from the antenna connector to the RF in / out port of the communications analyzer, and power both the analyzer and personal telephone on. The equipment set up shown in Figure 6: "Testing Configuration" should now be in place.

Figure 6: Testing Configuration



Accessing The Manual Test Mode

When the Test Mini SIM card is in place, power up the telephone. Once the initial automatic ‘wake up’ sequence has taken place correctly, depress the # key (on the units keypad) for three seconds. After three seconds ‘TEST’ should appear in the display, indicating that the unit is now in the Manual Test Mode. Table 1: “GSM Test Commands” on page 13 shows the available Manual Test commands and their corresponding results.If a customer should forget the security code in their unit, it can only be read or changed by using a Test Mini SIM card.

Table 1: GSM Test Commands

Key Sequence	*Test Function/Name*
#(hold down for 2 seconds)	Enter manual test mode
01#	Exit manual test mode
02xxyyy#	Display/modify TX power level DAC & load PA calibration table
03x#	DAI
05x#	Initiate Exec Error Handler Test
07x#	Mute RX audio path
08#	Unmute RX audio path
09#	Mute TX audio path
10#	Unmute TX audio path
11xxx#	Program main LO to channel
12xx#	Set TX power level to fixed value
13x#	Display memory block usage
14x#	Initiate Out of Memory condition
15x#	Generate tone
16#	Mute tone generator
19#	Display S/W version number of Call Processor
20#	Display S/W version number of Modem
22#	Display S/W version number of Speech Coder
24x#	Set step AGC
25xxx#	Set continuous AGC
26xxxx#	Set continuous AFC
31x#	Initiate Pseudo-Random Sequence- with Midamble
32#	Initiate RACH Burst Sequence
33xxx#	Synchronize to BCH carrier
34xxxyy#	Configuration to TCH/FS & Enable TCH loopback w/o Frame Ensure Indication
36#	Initiate acoustic loopback
37#	Stop test
38#	Activate Mini SIM

Table 1: GSM Test Commands

Key Sequence	*Test Function/Name*
39#	Deactivate Mini SIM
40#	Initiate sending all 1’s
41#	Initiate sending all 0’s
42#	Disable echo processing
43x#	Change audio path
45xxx#	Serving cell power level
46#	Display current value of AFC DAC
47x#	Set audio volume
51#	Enable sidetone
52#	Disable sidetone
57#	Initialize non-volatile memory
58#	Display security code
58xxxxxx#	Modify security code
59#	Display lock code
59xxx#	Modify lock code
60#	Display IMEI
61#	Display MCC portion of the LAI
61xxx#	Modify MCC portion of the LAI
62#	Display MNC portion of the LAI
62xx#	Modify MNC portion of the LAI
63#	Display LAC portion of the LAI
63xxxxx#	Modify LAC portion of the LAI
64#	Display Location Update Status
64x#	Modify Location Update Status
65#	Display IMSI
66xyyy#	Display/modify TMSI
67#	Zero PLMN Selector
68#	Zero forbidden PLMN list
69x#	Display/modify Cipher Key Sequence Number
70xxyyy#	Display/modify BCCH allocation table
71xx#	Display internal information
72xx#	Display Passive Fail codes
73xyyy#	Display/modify Logger Control Block
7536778#	Initiate transfer to Flash Memory

Personality Transfer

Introduction

Due to the different variations (OEM looks) of the GSM StarTAC™ personal cellular telephones, each main board must be configured correctly to ensure that the unit takes on the correct personality required. Therefore, when a main board is replaced its personality must be transferred into the new board, so that it functions correctly in the customers unit. There are two possible methods of transfer:

- Normal Transfer, and;
- Master Transfer.

If the defective unit powers up, then the Normal Transfer method should be followed. If the faulty unit will not power up, then a Master transfer will be required to configure the replacement board, once installed.

Normal Transfer

This method allows the personality, selected features and stored phone numbers of a defective radio, to be transferred into a repaired radio. Data is transferred from the donor unit into the recipient unit using a Transfer card (Part No 5104025D01). The instruction steps should be followed in order.

Step 1. Insert the Transfer card into the slot located on the back of the donor unit. Turn the donor unit on, the display should show ‘Clone’.

Step 2. The donor unit is now in the cloning mode, and ready to transfer the first block of data.

Step 3. Enter 021# via the units keypad. This command will cause the first block of information to be uploaded into the Transfer card.

Step 4. While data transfer is taking place between the unit and the card, ‘Please Wait’ will be displayed. After a short period of time, if the data transfer has been completed correctly, ‘Clone’ will re-appear in the donor units display.

Step 5. When the first data block has been successfully uploaded, remove the card from the donor.

Step 6. Insert the Transfer card into the slot located on the back of the recipient unit. Turn the recipient unit on, the display should show ‘Clone’.

Step 7. The recipient unit is now in the cloning mode, and ready to receive the first block of data.

Step 8. Enter 03# via the units keypad. This command will cause the recipient unit to download the first data block from the Transfer card.

Step 9. While data transfer is taking place between the card and the unit, ‘Please Wait’ will be displayed. After a short period of time, if the data transfer has been completed correctly, ‘Clone’ will re-appear in the recipient units display.

Step 10. The second data block must now be transferred. Repeat steps 1 to 9, but enter 022# to program the second data block into the Transfer card.

Step 11. The third data block (known as table 5#) must now be transferred. Repeat steps 1 to 9, but enter 025# to program the third data block into the Transfer card.

Step 12. When the third block of data has been transferred successfully, remove the Transfer card and check the repaired radio functions correctly. See “Testing” on page 11.

Master Transfer

This method of transfer should only be followed when the defective unit will not power up, or complete a Normal Transfer. As mentioned earlier, there are different variations (OEM looks) of the Motorola GSM StarTAC™ cellular telephones, each model requiring the main board to be configured differently for correct operation. When carrying out a Master Transfer it is not possible to transfer the customers selected features or stored phone numbers, only the personality can be programmed into the repaired unit.

Each different version of the GSM StarTAC™ cellular telephone, has its own Master Transfer card which contains essential set up information. Master SIM cards may be ordered pre-programmed, or created from a Normal Transfer card. The instruction steps should be followed in order.

Step 1. Select the required Master SIM card.

Step 2. Insert the Master Transfer card into the slot located on the back of the repaired unit. Turn the unit on, the display should show ‘Clone’.

Step 3. Enter 03# via the units keypad. This command will cause the configuration data to be downloaded from the Master Transfer card.

Step 4. While data transfer is taking place between the card and the unit ‘Please Wait’ will be displayed. After a short period of time, if the data transfer has been completed correctly, ‘Clone’ will re-appear in the recipient units display.

Step 5. When the data block has been transferred successfully, remove the Master Transfer card and check the repaired radio functions correctly. See “Testing” on page 11.

At no point should either 021# or 022# be entered while a Master Transfer card is in the radio. If either of the stated commands are entered, the master information on the card will be erased. To prevent the above happening the card can be locked by entering 06# via the units keypad, with the card inserted. Unlock the card by entering 07#.

- If during either transfer process a problem arises, an error message will be displayed. If the Transfer card is removed before the data transfer is completed ‘Bad Data on Card’ will appear in the display. If either situation arises, the process should be repeated.

Master SIM Card Creation

When required a Master SIM card can be created by:

Step 1. Insert a Transfer card into a unit which is already configured in the desired way. Turn the unit on, the display should show ‘Clone’.

Step 2. Enter 024# via the units keypad. This command copies the personality information in the unit onto the Transfer card to create a Master Transfer card.

Step 3. While data transfer is taking place between the unit and the card ‘Please Wait’ will be displayed. After a short period of time, if the data transfer has been completed correctly, ‘Clone’ will re-appear in the recipient units display.

Step 4. A Master Transfer card has now been created. Lock the card to prevent accidental information erasure (the card can be locked by entering 06# via the units keypad, with the card inserted). Remove the card from the unit, and store until required.

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 SYN5233A
- Dental Pick
- Tweezers
- Housing prying tool SYN5367A
- Adjustable torque driver. Tohnichi RTD24Z or equivalent

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.

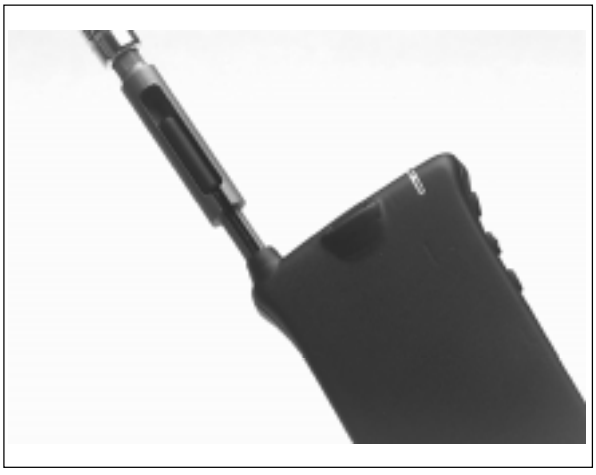
Step 3. Use the antenna tool to remove the antenna.

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.

When re-assembling, recommended torque is 10 inch-pounds.



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.

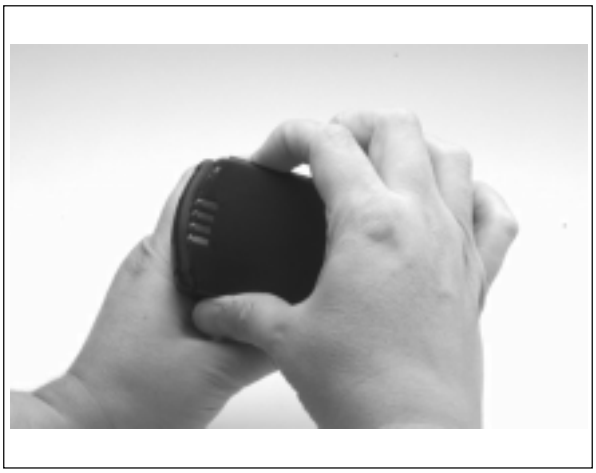
Step 2. Press and push corner outwards with left thumb while right hand twists phone like a rag.

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

Step 4. Using a small blade screwdriver, slide under housing all the way to corner and lift housing off corner.

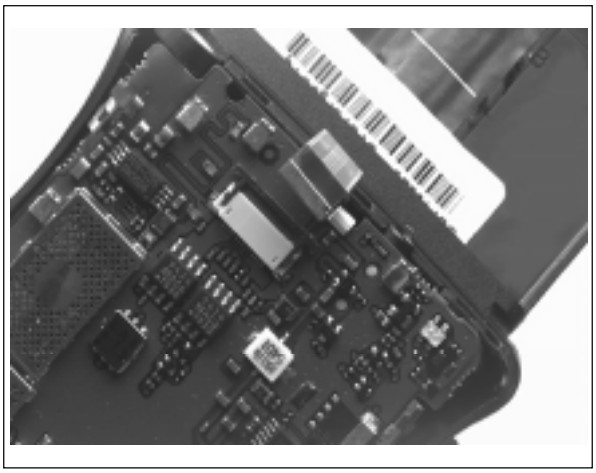
Step 5. With flat surface of tool facing up, insert housing opener at a 45º angle. Make sure you can see top of tool in seam.

Step 6. Using index finger, pull housing off going straight across phone.

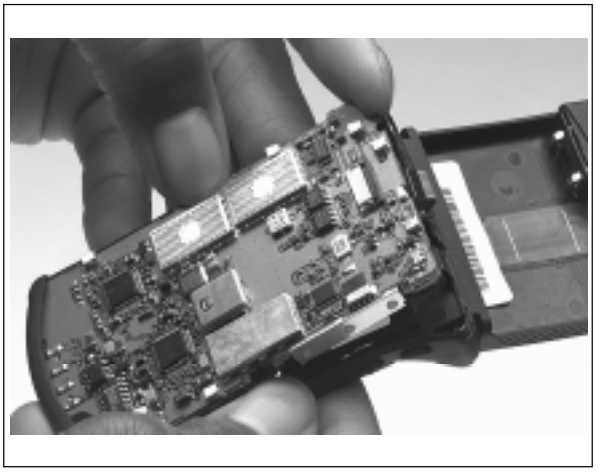


Board Removal

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

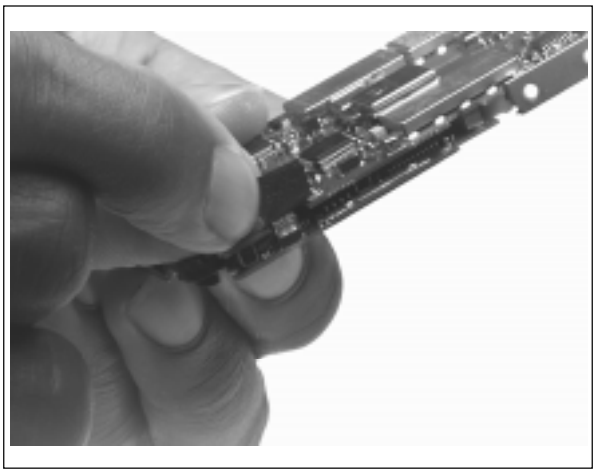


Step 2. With your thumbs, pry the side tabs away from the board assembly to allow it to be easily removed.
Starting at the top of the board, lift the board assembly out of the front housing.

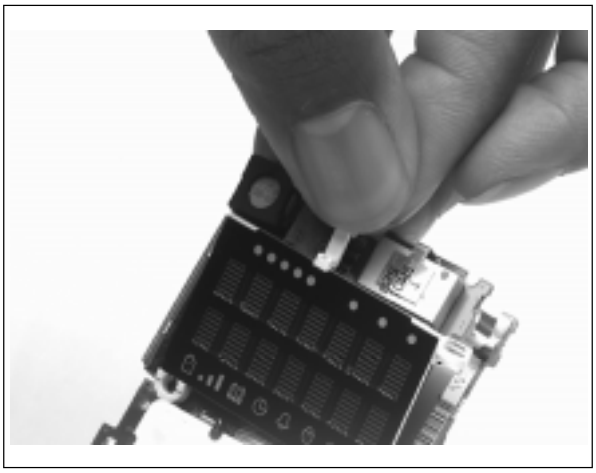


Step 3. Pull the tape off of the microphone connector and pull the connector out.

Remove antenna tube.



Step 4. Lift the white display clip off the transceiver board.



Flip Removal

Step 1. Using a dental pick, remove the adhesive strip off the base of the flip.

Step 2. Using tweezers, press the hinge pin button in and over toward the middle of the flip.

Also, move the hinge pin section above the button toward the middle of the flip.

Note: When reassembling the flip, the button will click back into place.

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 a dental pick between front housing and battery contacts.

Pry up to unsnap front housing and battery contacts.

The speaker, vibrator, and flex should be exposed.

Troubleshooting

Introduction

Assembly replacement level troubleshooting and repair of the StarTAC personal telephone is limited to those components listed in the Replacement Parts List. See “Replacement Parts” on page 45.

It is recommended that known good replacement parts and assemblies be available to be used for troubleshooting by substitution, and for replacement of parts/assemblies found to be defective.

Troubleshooting And Repair

The troubleshooting information in Table 7, Table 8, and Table 9 shows some typical malfunction symptoms and the corresponding verification and repair procedures. Additionally, the “Troubleshooting Supplements” are offered to assist in corrective action of more detailed symptoms. Refer to the disassembly instructions located in “Disassembly” on page 19 for instructions on removing and replacing parts/assemblies from the personal telephone.

If the Logic/RF assembly is replaced a personality transfer will be necessary. See “Personality Transfer” on page 15.

NOTE

Defective Logic/RF assemblies must be replaced with pre-tested, pre-phased assemblies.

Testing After Repair

After any repair work has been carried out, the unit should be thoroughly tested to ensure that its 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 receive audio quality is normally sufficient.

When the Logic/RF assembly is replaced, the unit must have a comprehensive test on a GSM compatible communications analyzers. See “Testing” on page 11 for further details. Placing a call on air is usually carried out at this stage to complete the testing procedure.

Table 7: Receiver Troubleshooting and Repair Chart

RX Symptom	*Probable Cause*	*Verification and Remedy*
1. Portable telephone exhibits poor reception and/or erratic operation (such as calls frequently dropping, weak and/or distorted audio, etc.).	a) Antenna assembly is defective.	1. Check to make sure that the antenna pins are properly connected to the Logic/RF assembly. If OK, substitute a known good antenna assembly. 2. If the fault is still present, proceed to b.
	b) Defective or mis-phased RF/Audio-Logic Board.	1. Check for appropriate frequencies and power level gains/losses in the RX path. Reference RF Block Diagram. 2. Replace malfunctioning components if listed on parts list. Likely fail components are: FL451, FL452, Q418, Q420, Q421, U201, U500. 3. If parts replacement doesn't correct the fault, replace transceiver.
	c) Defective keypad board. (i.e. SEND key won't work)	1. Substitute keypad board with a known good keypad and logic board. 2. If known good board works, place the keypad from the defective unit onto it and attempt to function. 3. If unit functions properly, replace the mylar barrier on the defective unit and then attempt to function defective unit with original keypad. 4. If fault persists, replace the logic board.
2. Receive audio is weak and/or distorted.	a) Earpiece speaker defective.	1. Gain access to earpiece speaker as described in "Disassembly" on page 19. 2. Substitute a known good earpiece speaker. Place a call and verify improvement in earpiece audio. If good, re-assemble portable with new earpiece speaker. 3. If earpiece speaker not at fault, re-install original earpiece speaker and proceed to c.
	b) Antenna assembly is defective.	1. Check to make sure antenna pin is properly connected to the Logic/RF Board Assembly. If OK, substitute a known good antenna assembly. 2. If antenna assembly is not at fault, re-install original antenna assembly and proceed to d.

Table 7: Receiver Troubleshooting and Repair Chart

RX Symptom	*Probable Cause*	*Verification and Remedy*
2. Receive audio is weak and/or distorted.	c) Logic/RF Board Assembly defective.	1. Replace Logic/RF Board Assembly. 2. If substitute Logic/RF Board Assembly works, the original is faulty and should be examined for improper solder and/or connections. Likely fail components: J601, U500, U900.

Table 8: Transmitter Troubleshooting and Repair Chart

TX Symptom	*Probable Cause*	*Verification and Remedy*
1. Transmit audio is weak, (usually indicated by called parties complaining of difficulty in hearing voice from portable phone).	a) Microphone connections to Logic/RF board defective.	1. Gain access to the Microphone as described in “Disassembly” on page 19. 2. Check connections (including checking for polarity) and if OK, proceed to b.
	b) Microphone defective.	1. Gain access to microphone. 2. Disconnect and substitute a known good Microphone. 3. Place a call and verify improvement in portable transmit signal as heard by called party. If good, re-assemble portable with new Microphone. 4. If Microphone is not at fault, re-install original Microphone and proceed to c.
	c) Logic/RF Board Assembly defective.	1. Replace Logic/RF Board Assembly. 2. If Logic/RF Board Assembly is at fault, examine it for improper solder and connections. Likely fail components: Q300, Q303, U201, U300, U301.

Table 9: Logic/Processing Troubleshooting and Repair Chart

Logic/Processing Symptom	*Probable Cause*	*Verification and Remedy*
1. Unit Doesn't 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 <3.6 V DC, recharge the battery using the appropriate battery charger. 3. If the battery will not recharge, replace the battery. 4. If battery is not at fault, proceed to b.
	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. Removing the battery connector assembly has to be done with extreme care to avoid damaging the PCB. 3. If battery connectors are not at fault, proceed to c.
	c) Defective RF/Audio-Logic Board assembly.	1. Gain access to Keypad/Display / main board as described in "Disassembly" on page 19. 2. Remove the Logic/RF Assembly. Substitute a known good assembly. 3. Temporarily connect a 4.4 V dc supply to J600. 4. Depress the **PWR** button; if unit turns on and stays on, disconnect the dc power source and reassemble the telephone with the new Logic/RF Board assembly and refer to "Testing After Repair" on page 27. 5. If Logic/RF Board Assembly is not at fault, re-install original Logic/RF Board Assembly and proceed to d.
	d) Keypad/Display circuit board failure.	1. Replace the Keypad/Display board. 2. Temporarily connect a 4.4 V dc supply to J600. 3. Depress the **PWR** button; if unit turns on and stays on, disconnect the dc power source and reassemble the telephone with the new Keypad/Display board.

Table 9: Logic/Processing Troubleshooting and Repair Chart

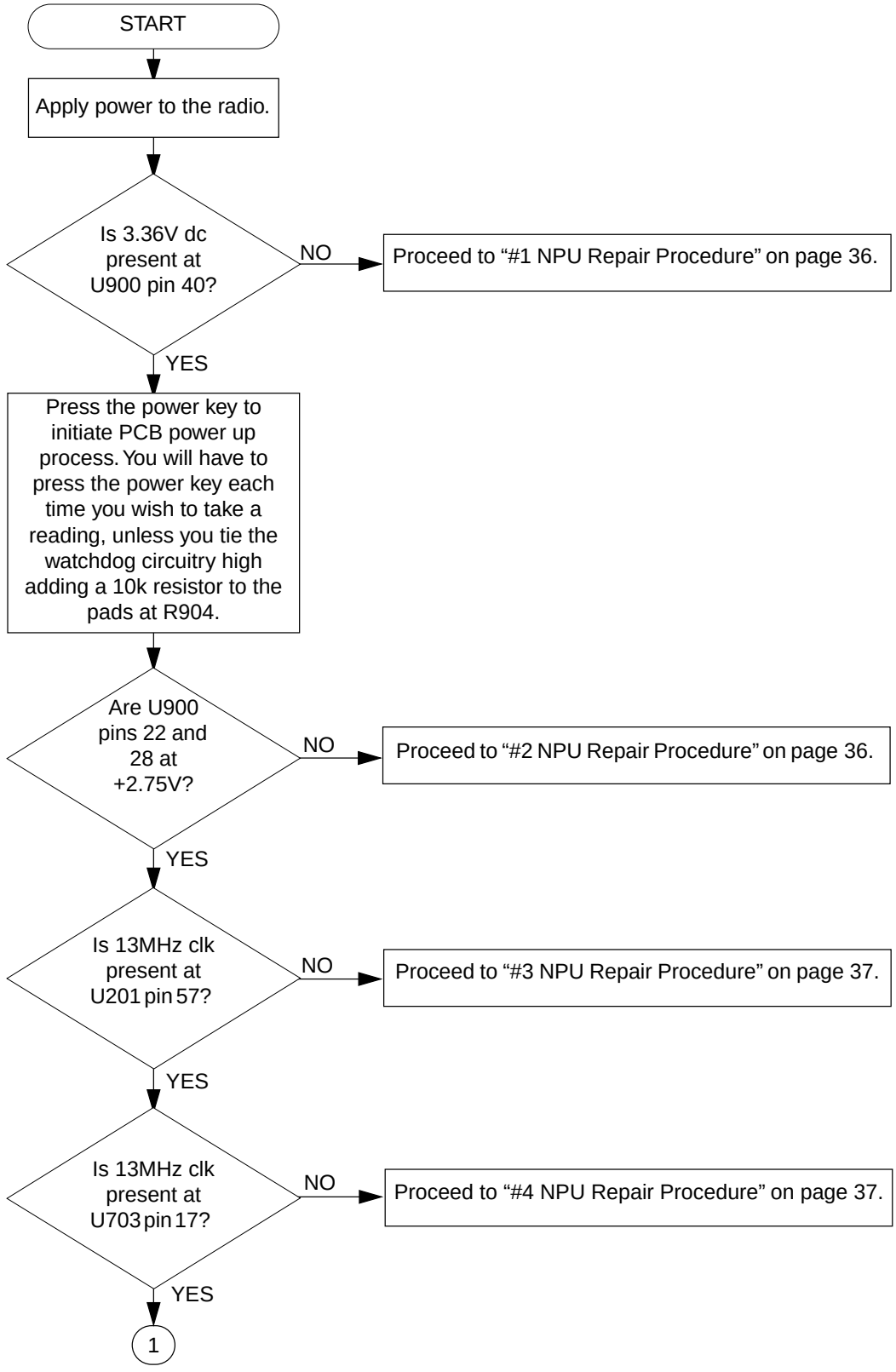
Logic/Processing Symptom	*Probable Cause*	*Verification and Remedy*
2. Display is erratic, or provides partial or no display.	a) Mating connections to/from Display board faulty.	1. Replace Keypad / Display board.
	b) Display board defective.	1. Replace Keypad / Display board.
	c) Logic/RF Board Assembly defective.	1. Substitute a known good Logic/RF Assembly. 2. If known assembly works, the original is faulty and should be examined for improper solder and/or connections. Likely fail components: J101, keyboard.
3. Incoming call alert transducer audio distorted or volume is too low.	a) Alert transducer defective.	1. Gain access to alert speaker as described in “Disassembly” on page 19. 2. Disconnect the alert speaker. 3. Connect a known good alert speaker. 4. Place call to portable telephone from land-line or other mobile/portable telephone and verify alert signal volume and clarity. If good, re-assemble portable with new alert speaker. 5. If alert speaker not at fault, re-install original alert speaker and proceed to c.
	b) Logic/RF Board Assembly defective.	1. Replace Logic/RF Board Assembly. 2. If Logic/RF Board Assembly is at fault, examine it for improper solder and/or connections. Likely fail components: U500, and U900.
4. Phone will not recognize/ accept SIM card	a) SIM card defective	1. Initially check that the contacts on the card are not dirty; clean if necessary, and check if fault has been eliminated. 2. If the contacts are clean, insert a known good SIM card into the portable telephone. Power up the unit and confirm whether or not the card has been accepted. If the fault no longer exists, the defective SIM card should be replaced. 3. If the SIM card is not at fault, proceed to b.
	b) Logic/RF Board Assembly defective.	1. Replace Logic/RF Board Assembly with a known good board. If good board works, original is faulty. 2. Examine the original Logic/RF Board Assembly for improper solder and/or connection. Likely fail components: J101.

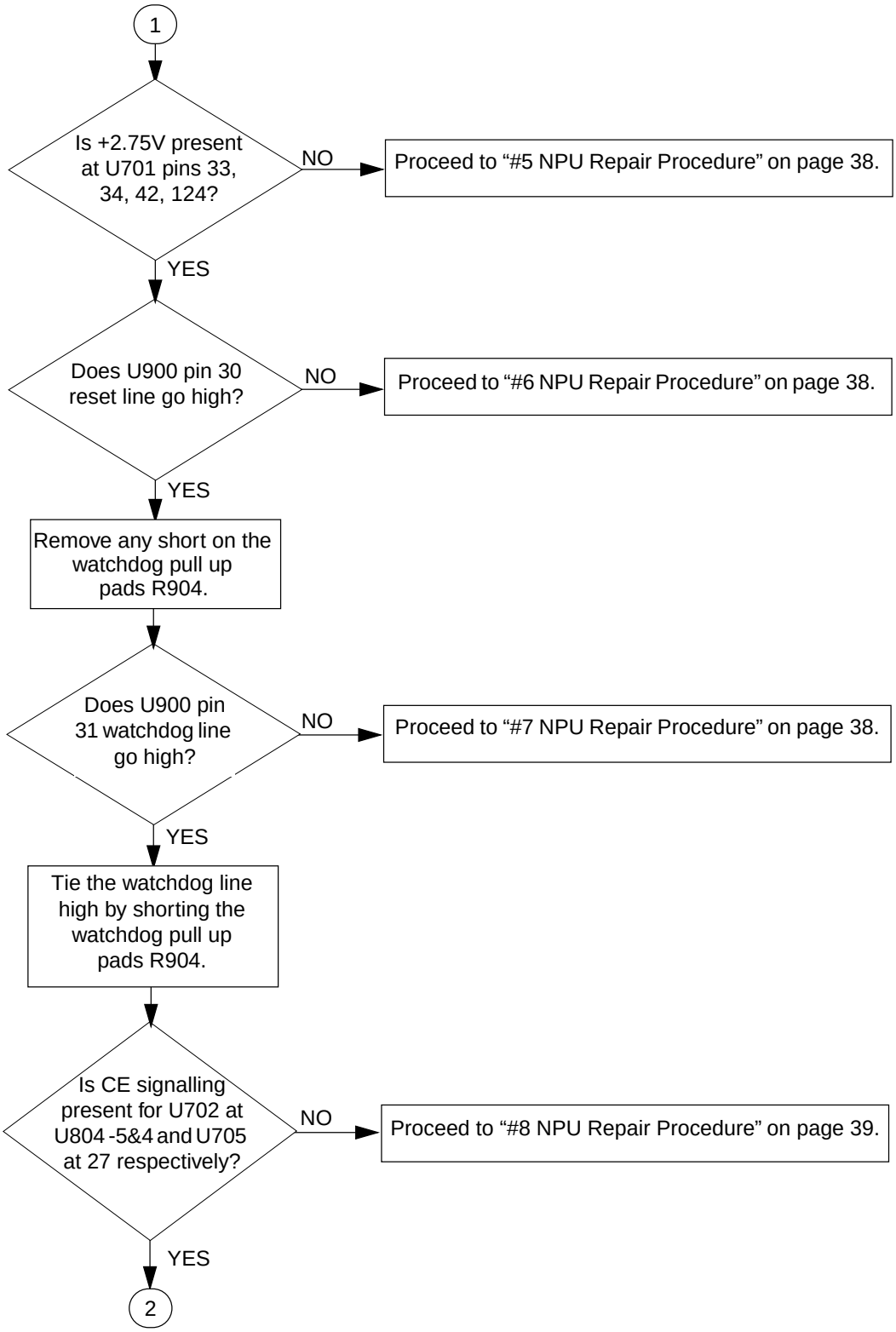
Table 9: Logic/Processing Troubleshooting and Repair Chart

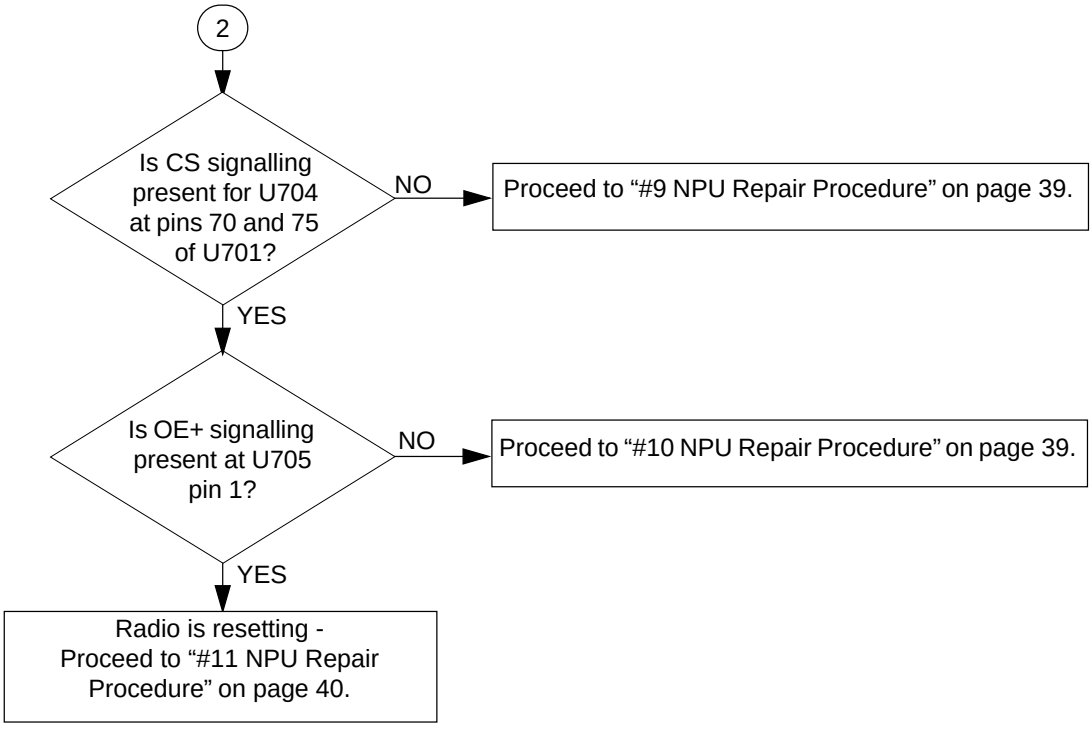
Logic/Processing Symptom	*Probable Cause*	*Verification and Remedy*
5. Hinged mouthpiece does not go on/off hook correctly (usually indicated by inability to answer incoming calls by flipping the mouthpiece down, or inability to make outgoing calls).	a) Reed switch defective.	1. Gain access to Key board as described in "Disassembly" on page 19. 2. Unsolder the reed switch and replace with a known good one. 3. Reassemble unit. 4. Place call to portable phone and verify ability to answer by opening flip. 5. If fault still present, replace original reed switch and proceed to b.
5. Hinged mouthpiece does not go on/off hook correctly.	b) Magnet in flip defective.	1. Replace flip assembly with known good one. 2. Place call to portable phone and verify ability to answer by opening flip. 3. If fault still present, replace original flip assembly and proceed to c.
	c) Key board defective.	1. Replace the Key board with a known good one. 2. Place call to portable phone and verify that the fault has been eliminated. 3. If original Key board is at fault, examine it for improper solder and/or connections.
	d) Logic/RF Board Assembly defective.	1. Replace the Logic/RF board with a known good one. 2. Place call to phone and verify that the fault has been eliminated. 3. If original Logic/RF Board Assembly is at fault, examine it for improper solder and/or connections. Likely fail component: J101.

Troubleshooting Supplements

Logic/Processing Supplement 1 - Unit Doesn't Power Up (NPU)




1
Is +2.75V present at U701 pins 33, 34, 42, 124?
NO
Proceed to “#5 NPU Repair Procedure” on page 38.
YES
Does U900 pin 30 reset line go high?
NO
Proceed to “#6 NPU Repair Procedure” on page 38.
YES
Remove any short on the watchdog pull up pads R904.
Does U900 pin 31 watchdog line go high?
NO
Proceed to “#7 NPU Repair Procedure” on page 38.
YES
Tie the watchdog line high by shorting the watchdog pull up pads R904.
Is CE signalling present for U702 at U804 -5&4 and U705 at 27 respectively?
NO
Proceed to “#8 NPU Repair Procedure” on page 39.
YES
2


2
Is CS signalling present for U704 at pins 70 and 75 of U701?
NO
Proceed to “#9 NPU Repair Procedure” on page 39.
YES
Is OE+ signalling present at U705 pin 1?
NO
Proceed to “#10 NPU Repair Procedure” on page 39.
YES
Radio is resetting - Proceed to “#11 NPU Repair Procedure” on page 40.

#1 NPU Repair Procedure

No +3.36V dc battery supply voltage present at pin 40 of U900.

- Check the PCB battery contact assembly for dry joints to the PCB, or broken contacts. Resolder any dry joints, or replace the battery contact assembly if any of the contacts are broken.
- Check the PCB external connector J600 socket on or around pin 14 for dry joints to the PCB or broken contacts.
- Check for +3.36Vdc at pin 40, U900 with both batteries and external power. If no B+ with main battery check Q1008. If no B+ with auxiliary battery, check Q999. If no B+ with external power, check CR903 and Q1007.

If replacing the above components does not eliminate the fault, return the PCB to a Motorola Hi Tech Center.

#2 NPU Repair Procedure

No regulated +2.75V dc voltage present at U900 pins 22 and 28.

The components that will most likely affect the regulated +2.75V supply are the B+ supply, and U900. Check that B+ related components are not physically damaged, have no dry joints, and are positioned correctly.

If none of the above mentioned problems are apparent, you can either take measurements on the defective PCB to decipher which component(s) you feel should be replaced, or replace the following components in the order shown:

1st - Replace T902

2nd - Replace U900

- Check the PCB after each component change to verify fault elimination.

If replacing the above components does not eliminate the fault, return the PCB to a Motorola Hi Tech Center.

#3 NPU Repair Procedure

No 13MHz reference clock signal at pin 57 of U201.

The components that will most likely affect the 13MHz reference clock are C201, C203, CR201, U201, and Y201. Check that the mentioned components are not physically damaged, have no dry joints, and are positioned correctly.

If none of the mentioned problems are apparent, take measurements on the defective PCB to decipher which component(s) you feel should be replaced, or replace the following components in the order shown:

1st - Replace Y201

2nd - Replace C203

3rd - Replace CR201

4th - Replace C201

- Check the PCB after each component change to verify fault elimination.

If replacing the above components does not eliminate the fault, return the PCB to a Motorola Hi Tech Center.

#4 NPU Repair Procedure

No 13MHz reference clock signal at pin 17 of U703.

- Review the audio logic block diagram which shows the path of the 13MHz clock.
- Confirm 13MHz clock signal presence at U703, pin 37.
- Confirm 13MHz clock signal presence at U500, pin 40.
- Confirm 13MHz clock signal presence at U701 pin 38.

If the 13MHz clock enters U703 but does not appear at the output (pin 37), inspect the chip for physical damage, dry joints and correct position. If none of the mentioned problems are apparent, ensure that the supply voltage to the chip is present (see appropriate chip diagram). If present, replace the chip.

If the clock signal is present at U703 pin 37, but not present at any of the other aforementioned chips, ohm the path from that chip back to U703 pin 37. If the trace is functional, check the chip in question for supply voltage.

If no supply voltage to the chip, trace its B+ path and/or replace the chip. If after replacing all of the above components the fault is not eliminated, return the PCB to a Motorola Hi Tech Center.

#5 NPU Repair Procedure

The +2.75V dc supply is missing at one or more of pins 33, 34, 42 and 124 of U701.

Pins 33, 34, 42, and 124 are each fed via pull up resistors R702, R706, R701, and R702 respectively.

- Check that all the pull up resistors are present, not physically damaged and that there are no dry joints on either the resistors or U701.

If after replacing the above components the fault is not eliminated, return the PCB to a Motorola Hi Tech Center.

#6 NPU Repair Procedure

The reset line at pin 30 of U900 does not go high to +2.75V dc.

- Check that U900 is not physically damaged, has no dry joints, and is positioned correctly. If none of the mentioned problems are apparent replace U900.

If replacing U900 the fault is still apparent return PCB to a Motorola Hi Tech Center.

#7 NPU Repair Procedure

The watchdog line at pin 31 of U900 does not go high to +2.75V dc.

The watchdog line is pulled high by U701 when it receives and executes the initial blocks of software from the PROM's U702 and U705. If there is a problem with either U701, U702, U704, or U705 the watchdog will not be pulled high. This will cause U900 to power down the +2.75V regulator's and halt the power up process.

- Check the CE lines at U701, U804, U702, and U705 for activity.
- If there is no activity, proceed to NPU repair procedure 8.
- If above activity is present, check for activity at pin 42 and 43 of U704.
- If there is no activity, proceed to NPU repair procedure 9.
- If above activity is present, check the OE+ line at pin 1 of U705 for activity.
- If there is no activity, proceed to NPU repair procedure 10.

If the above procedures don't eliminate the fault, return the PCB to a Motorola Hi Tech Center.

#8 NPU Repair Procedure

No CE signalling present at pin 26 and 27 of U702 and U705 respectively.

If there are no CE (chip enable) pulses being sent from U701 to the software chips U702 and U705 it means that U701 is not trying to communicate with the EPROMs.

- Check that U701, U702 and U705 are not physically damaged, have no dry joints and are positioned correctly. If none of the mentioned problems are apparent, replace U702 and U705.

If replacing the above components does not eliminate the fault, return the PCB to a Motorola Hi Tech Center.

#9 NPU Repair Procedure

No signals present for pins 42 and 43 of U704.

If there are no RAM1CS or RAM2CS (1&2 chip select) pulses being sent from U701 to the SRAM chip U704, it means that there is a problem in communication between U701 and the RAM.

- Check that U701, and U704 are not physically damaged, have no dry joints and are positioned correctly. If none of the mentioned problems are apparent, replace U704.

If after replacing all the above components the fault is still apparent, return PCB to a Motorola Hi Tech Center.

#10 NPU Repair Procedure

No OE+ signalling present at pin 1 U705.

If there are no ROM2OE pulses being sent to the EEPROM U705, it means that there is a problem in communication between U701 and the EEPROM.

- Check that U701 and U705 are not physically damaged, have no dry joints, and are positioned correctly. If none of the mentioned problems are apparent, replace U705.

If after replacing the mentioned chips the fault is still apparent return the PCB to a Motorola Hi Tech Center.

#11 NPU Repair Procedure

Radio is resetting.

If the radio executes external device communication and then powers itself down very shortly after attempting power up, it is resetting. A reset can be caused by a fault on either U703, U701 or U500.

- Check that U103, U701 and U500 are not physically damaged, have no dry joints, and are positioned correctly. If none of the mentioned problems are apparent.
- Ensure that the watchdog pull up pads R904 are shorted together, and monitor U703, U701 and U500 to see if any become warmer than the other components (U703 and U500 are the most likely). Should any of the mentioned components become warmer— replace it.

If the above information does not pin point a specific component, replace the following components in the order shown:

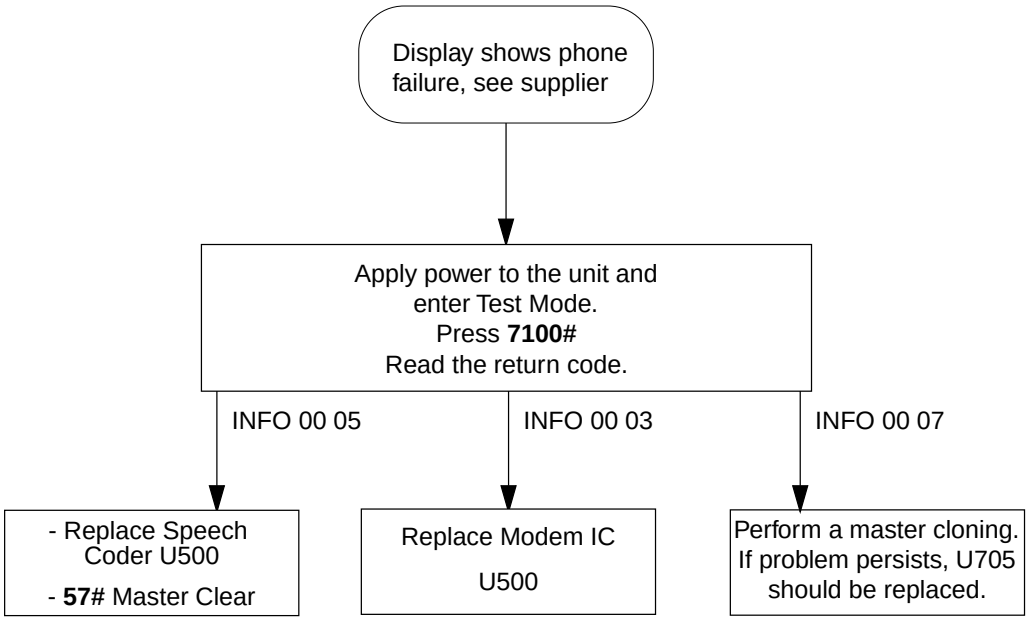
1st - Replace U500

2nd - Replace U701

- Check the PCB after each component change, to verify whether or not the fault has been eliminated.

If after replacing the two components the fault is still apparent return PCB to a Motorola Hi Tech Center.

Logic/Processing Supplement 3 - Phone Failure “See Supplier”



If problem still exists, replace the RF / Logic Board**.**

Logic/Processing Supplement 4 - Unit Powers Down When Twisted

This indicates possibilities of a dry/cold solder joint that normally makes contact. However, when the PCB is twisted or flexed the contact is broken causing power down. Inspect the following components for dry joints:

- J101 connector to Display board
- Battery contact assembly
- External device connector assembly (J600)
- Flex strip
- J601 flex connector

If the above analysis does not identify the fault, return the PCB to a Motorola Hi Tech Center.

Logic/Processing Supplement 5 - PCB Draws Current When Off

- Ensure that the 4.4 V DC power supply is being applied to the PCB, and that the PCB is switched off.
- Spray the top RF/Logic circuitry with freezer spray until the PCB is frosted white. If the frost melts on a specific component(s) before the normal defrost process occurs, replace the component(s).
- If the above process does not eliminate the fault, spray the bottom RF/Logic circuitry with freezer spray until the PCB is frosted white. Once again, if the frost melts on a specific component(s) before the normal defrost process occurs, replace the component(s).
- If steps 2 and 3 fail to eliminate the fault, or the defective component(s) are not covered by this level of repair, return the PCB to a Motorola Hi Tech Center.

Figure 7: Audio/Logic Block Diagram

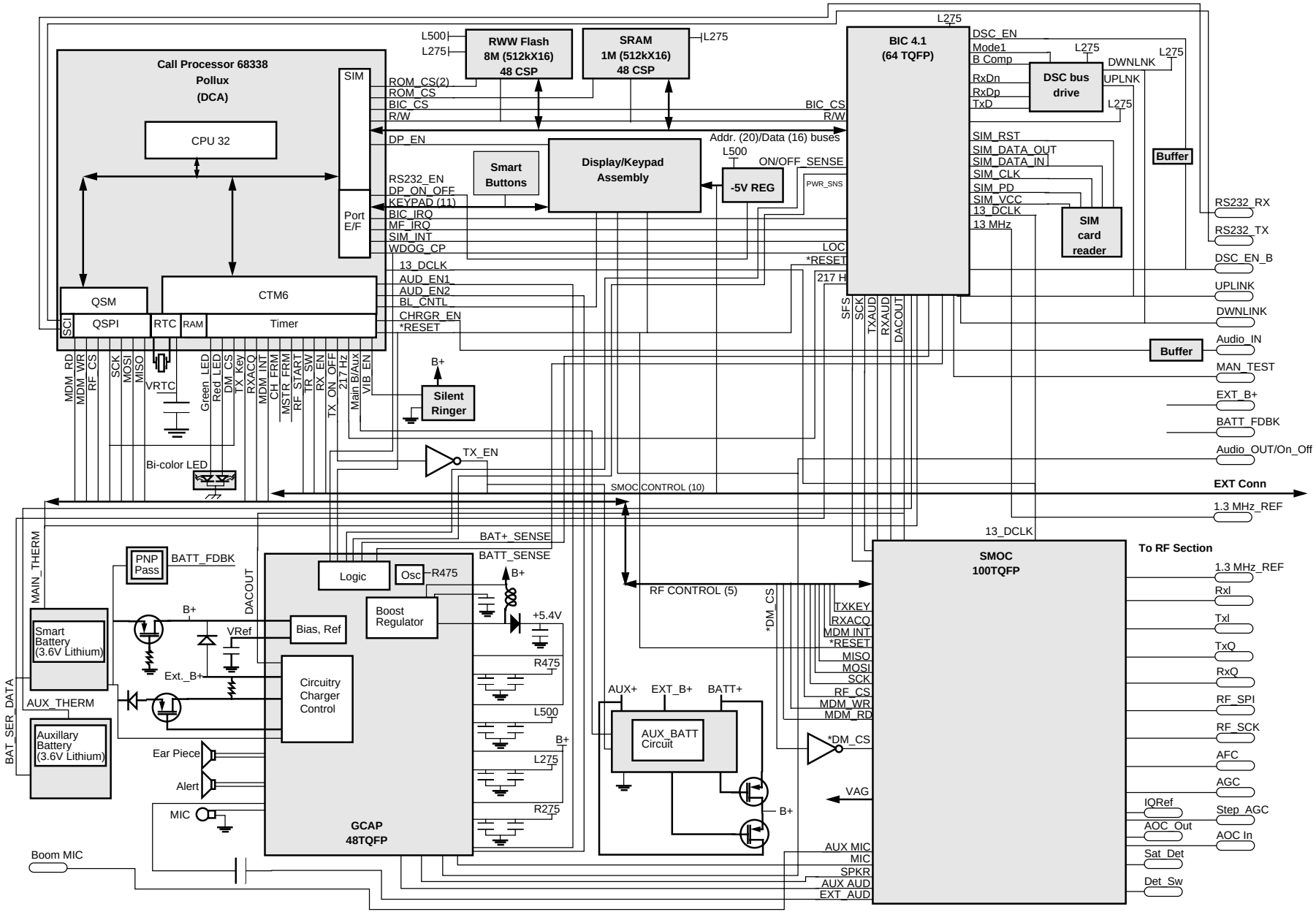
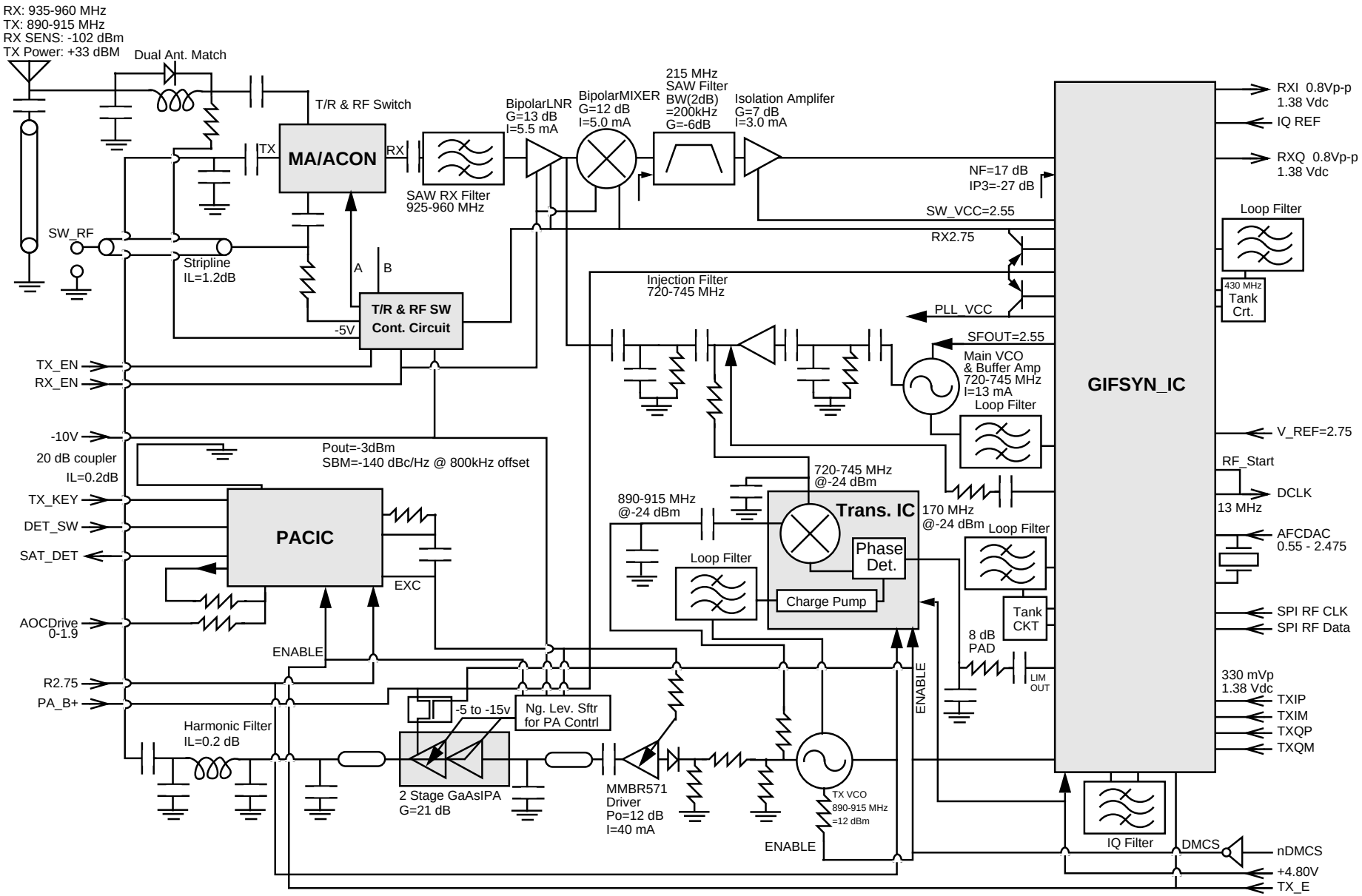


Figure 8:

Figure 9: RF Block Diagram



Replacement Parts

Mechanical

The replacement parts listed in this section are applicable to the following StarTAC:

NOTE

Replacement transceivers are **NOT** normally available to distributors.

The mechanical parts are pictured in the diagram in Figure 27: “StarTAC Parts Illustration” on page 58.

The Level 3 parts lists are for:

Transciever : SWF2953A
Schematic: 8409253M01

Keyboard: SYN6812A
Schematic: 8409024T01

Table 10: Level 1 Xcvr/Keyboard

ITEM #	*DESCRIPTION*
0509440M01	GROMMET MIC KRUNCH
0509441M01	GROMMET ALERT KRUNCH
0709301R01	2MM SPACER SUPPORT .5MM
0909059E01	RECPT ZIF 16 POS SMD
0909195E01	SKT BOT ENTRY 2 POS
0909449B04	RECEPT MOD 15PIN INSMLD
0909453C02	RECPT LO PROFILE SMD 32 POS
0909564M07	RECEPT SMD ZIF 19PIN .5MM BOT
1109155J01	ADHESIVE DCA COVER
1509237S01	HSNG FLEX COVER
2809454C02	PLUG LO PROFILE SMD 32 POS

Table 10: Level 1 Xcvr/Keyboard

ITEM #	*DESCRIPTION*
3709068T01	TUBE ANTENNA
3809326D13	ACTR KEYPAD KRUNCH
3909101E01	CNTCT ANT UPPER RAE
3909156T01	CNTCT BASE SIM
3909578M01	CONTACT BATT SMT
4003745K01	SW ARRAY KYPD MTL DOMES
4009060E01	SW TACTILE SMD
4009379M01	8600 KYPD SNAP DOMES
4009497D02	SW REED SMD ENCAPSULATED
4209038E01	CLIP GRND/SIGNAL
4209110T01	CLIP ANTENNA TUBE
4209480E01	CLIP ANTENNA
4709050R01	SHAFT GSM RIGHT
5009135L07	MIC ELECT 6MM PINS
5009473S01	ALERT EM 5V SMD
5509242E01	HINGE GSM
7209257T01	LCD DSPL MOD 96X32 PIX KRUNCH
8509098E01	ANT DIRECT CONN 900MHZ

Table 11: Level 3 Keyboard

REF DES	*ITEM #*	*DESCRIPTION*
C00604	2113743E20	CAP CHIP .10 UF 10%
C00605	2113743E20	CAP CHIP .10 UF 10%
C00608	2113743E20	CAP CHIP .10 UF 10%
CR1000	4809606E02	DIODE DUAL ARRAY DAN222
DS0970	4809496B04	LED CHIP CL 190YG 1608
DS0971	4809496B04	LED CHIP CL 190YG 1608
DS0972	4809496B04	LED CHIP CL 190YG 1608
DS0973	4809496B04	LED CHIP CL 190YG 1608
DS0974	4809496B04	LED CHIP CL 190YG 1608
DS0975	4809496B04	LED CHIP CL 190YG 1608

Table 11: Level 3 Keyboard

REF DES	*ITEM #*	*DESCRIPTION*
J00101	0909453C02	RECPT LO PROFILE SMD 32 POS
J00970	0909564M07	RECEPT SMD ZIF 19PIN .5MM BOT
Q00103	5109781E41	IC 2.7V REG TC55RP2702EMB
Q00604	4809607E04	TSTR SIG PNP 2SB1132 SOT89
Q00605	4809605E02	TSTR SIG NPN 2SC4617
Q00606	4813824A17	XSTR PNP40V .2A GENP B=100-300
R00110	0611079A74	RES FIXED CHIP 1000 5 1/10 A/P
R00606	0662057A97	CHIP RES 100K OHMS 5%
R00607	0662057A85	CHIP RES 33K OHMS 5%
R00608	0660076N75	RES CHIP 12 K OHM 1/ 16 W
R00970	0660076N13	RES CHIP 33 OHM 5 1/ 16
R00971	0660076N13	RES CHIP 33 OHM 5 1/ 16
R00972	0660076N13	RES CHIP 33 OHM 5 1/ 16
R00973	0660076N13	RES CHIP 33 OHM 5 1/ 16
R00974	0660076N13	RES CHIP 33 OHM 5 1/ 16
R00975	0660076N13	RES CHIP 33 OHM 5 1/ 16
R00976	0662057A55	CHIP RES 1800 OHMS 5%
R00977	0662057B47	CHIP RES 0 OHMS +- .050 OHMS
S00970	4009497D02	SW REED SMD ENCAP-SULATED
SPC002	0709301R01	2MM SPACER SUPPORT .5MM
SPC003	0709301R01	2MM SPACER SUPPORT .5MM
U00600	5109522E23	IC SNGL INV GATE TC7SH04FU
U00601	5109920D22	IC DC-DC CONV TCM828 SOT23A5

Table 12: Level 3 Xcvr

REF DES	*ITEM #*	*DESCRIPTION*
A00001	3909101E01	CNTCT ANT UPPER RAE
A00002	4209480E01	CLIP ANTENNA
A00003	4209110T01	CLIP ANTENNA TUBE
A00004	4209038E01	CLIP GRND/SIGNAL
AL0800	5009473S01	ALERT EM 5V SMD
C00201	2113743N46	CAP CHIP 68.0 PF 5% COG
C00202	2113743N46	CAP CHIP 68.0 PF 5% COG
C00203	2113743L41	CAP CHIP 10000 PF 10% X7R
C00204	2113743L41	CAP CHIP 10000 PF 10% X7R
C00205	2311049A56	CAP TAN CHIP A/P 4.7 20 10
C00206	2113743N34	CAP CHIP 22.0 PF 5% COG
C00208	2109622N16	CAP CER CHIP NPO CLASS I
C00209	2113740A79	CAP CHIP REEL CL1 +/- 30 1000
C00210	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C00211	2113743L41	CAP CHIP 10000 PF 10% X7R
C00212	2113743G26	CAP CHIP 4.7 UF 16V +80-20%
C00213	2113743L41	CAP CHIP 10000 PF 10% X7R
C00214	2113743G26	CAP CHIP 4.7 UF 16V +80-20%
C00216	2113743N34	CAP CHIP 22.0 PF 5% COG
C00220	2113743L41	CAP CHIP 10000 PF 10% X7R
C00221	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00222	2113743N34	CAP CHIP 22.0 PF 5% COG
C00223	2311049A56	CAP TAN CHIP A/P 4.7 20 10
C00224	2113743N50	CAP CHIP 100 PF 5% COG
C00227	2113743N30	CAP CHIP 15.0 PF 5% COG

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00228	2113743N30	CAP CHIP 15.0 PF 5% COG
C00229	2113743N48	CAP CHIP 82.0 PF 5% COG
C00230	2113740B81	CAP CHIP REEL CL1 +/- 30 2400
C00231	2113740F61	CAP CHIP REEL CL1 +/ 130 270
C00232	2113743L17	CAP CHIP 1000 PF 10% X7R
C00234	2113743L41	CAP CHIP 10000 PF 10% X7R
C00236	2113743N42	CAP CHIP 47.0 PF 5% COG
C00237	2109622N16	CAP CER CHIP NPO CLASS I
C00242	2113743L17	CAP CHIP 1000 PF 10% X7R
C00243	2113743L17	CAP CHIP 1000 PF 10% X7R
C00244	2113743L17	CAP CHIP 1000 PF 10% X7R
C00246	2113743L17	CAP CHIP 1000 PF 10% X7R
C00247	2113743N03	CAP CHIP 1.0 PF +-.25PF COG
C00250	2113743N34	CAP CHIP 22.0 PF 5% COG
C00251	2113743N50	CAP CHIP 100 PF 5% COG
C00252	2113743L17	CAP CHIP 1000 PF 10% X7R
C00253	2113743N36	CAP CHIP 27.0 PF 5% COG
C00254	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00255	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00256	2113743N26	CAP CHIP 10.0 PF 5% COG
C00257	2113743N50	CAP CHIP 100 PF 5% COG
C00258	2113743N10	CAP CHIP 2.2 PF +-.25PF COG
C00259	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C00260	2113743N18	CAP CHIP 4.7 PF +-.25PF COG

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00261	2113743N22	CAP CHIP 6.8 PF + -.5PF COG
C00262	2113740A67	CAP CHIP REEL CL1 +/- 30 330
C00263	2113743N34	CAP CHIP 22.0 PF 5% COG
C00264	2113743N21	CAP CHIP 6.2 PF + -.5PF COG
C00265	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00266	2113743N10	CAP CHIP 2.2 PF +-.25PF COG
C00270	2113743N26	CAP CHIP 10.0 PF 5% COG
C00289	2113743N34	CAP CHIP 22.0 PF 5% COG
C00290	2113743N42	CAP CHIP 47.0 PF 5% COG
C00300	2113743N50	CAP CHIP 100 PF 5% COG
C00301	2113743L41	CAP CHIP 10000 PF 10% X7R
C00302	2113743N50	CAP CHIP 100 PF 5% COG
C00303	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00304	2113743N30	CAP CHIP 15.0 PF 5% COG
C00305	2113743N22	CAP CHIP 6.8 PF + -.5PF COG
C00306	2113743N07	CAP CHIP 1.5 PF +-.25PF COG
C00307	2113743L41	CAP CHIP 10000 PF 10% X7R
C00309	2113741A37	CAP CHIP CL2 X7R REEL 4700
C00310	2113743L17	CAP CHIP 1000 PF 10% X7R
C00311	2113743N34	CAP CHIP 22.0 PF 5% COG
C00312	2113743L41	CAP CHIP 10000 PF 10% X7R
C00313	2113743N26	CAP CHIP 10.0 PF 5% COG
C00314	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C00315	2113740F55	CAP CHIP REEL CL1 +/- 30 150

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00316	2113743N14	CAP CHIP 3.3 PF +-.25PF COG
C00317	2113743N30	CAP CHIP 15.0 PF 5% COG
C00318	2113743N50	CAP CHIP 100 PF 5% COG
C00320	2113740F19	CAP CHIP REEL CL1 +/- 30 4.7
C00324	2113743N26	CAP CHIP 10.0 PF 5% COG
C00325	2113743L41	CAP CHIP 10000 PF 10% X7R
C00326	2113743N42	CAP CHIP 47.0 PF 5% COG
C00327	2113740F15	CAP CHIP REEL CL1 +/- 30 3.3
C00328	2113743N50	CAP CHIP 100 PF 5% COG
C00329	2113740F21	CAP CHIP REEL CL1 +/- 30 5.6
C00330	2113743N50	CAP CHIP 100 PF 5% COG
C00331	2113743L17	CAP CHIP 1000 PF 10% X7R
C00335	2113743L41	CAP CHIP 10000 PF 10% X7R
C00338	2113743L17	CAP CHIP 1000 PF 10% X7R
C00339	2113743L17	CAP CHIP 1000 PF 10% X7R
C00343	2113743N23	CAP CHIP 7.5 PF + -.5PF COG
C00351	2113743L41	CAP CHIP 10000 PF 10% X7R
C00352	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C00353	2113743N69	CAP CHIP 1.8PF 16V +/- .25PF
C00357	2113743L09	CAP CHIP 470 PF 10% X7R
C00358	2113743N50	CAP CHIP 100 PF 5% COG
C00360	2113743N50	CAP CHIP 100 PF 5% COG
C00361	2113741F13	CAP CHIP CL2 X7R REEL 330
C00362	2113743N34	CAP CHIP 22.0 PF 5% COG

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00365	2113743L17	CAP CHIP 1000 PF 10% X7R
C00366	2113740A55	CAP CHIP REEL CL1 +/- 30 100
C00368	2113741F17	CAP CHIP CL2 X7R REEL 470
C00383	2113743L05	CAP CHIP 330 PF 10% X7R
C00384	2113740F24	CAP CHIP REEL CL1 +/- 30 7.5
C00385	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C00387	2113743N42	CAP CHIP 47.0 PF 5% COG
C00388	2113743L41	CAP CHIP 10000 PF 10% X7R
C00392	2113743N26	CAP CHIP 10.0 PF 5% COG
C00401	2113743L05	CAP CHIP 330 PF 10% X7R
C00403	2113743L17	CAP CHIP 1000 PF 10% X7R
C00406	2113743L17	CAP CHIP 1000 PF 10% X7R
C00407	2113743N50	CAP CHIP 100 PF 5% COG
C00408	2113743N69	CAP CHIP 1.8PF 16V +/- .25PF
C00411	2113743N10	CAP CHIP 2.2 PF +-.25PF COG
C00412	2113743L11	CAP CHIP 560 PF 10% X7R
C00414	2113743N36	CAP CHIP 27.0 PF 5% COG
C00415	2113743N54	CAP CHIP 150 PF 5% COG
C00417	2113743L41	CAP CHIP 10000 PF 10% X7R
C00418	2113743N16	CAP CHIP 3.9 PF +-.25PF COG
C00419	2113743L41	CAP CHIP 10000 PF 10% X7R
C00420	2113743L17	CAP CHIP 1000 PF 10% X7R
C00421	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C00422	2113743L17	CAP CHIP 1000 PF 10% X7R

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00423	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C00424	2113743L17	CAP CHIP 1000 PF 10% X7R
C00426	2113743N22	CAP CHIP 6.8 PF + -.5PF COG
C00427	2113743L41	CAP CHIP 10000 PF 10% X7R
C00432	2113743L17	CAP CHIP 1000 PF 10% X7R
C00433	2113743L41	CAP CHIP 10000 PF 10% X7R
C00434	2113743N34	CAP CHIP 22.0 PF 5% COG
C00435	2113743N30	CAP CHIP 15.0 PF 5% COG
C00436	2113743N26	CAP CHIP 10.0 PF 5% COG
C00437	2113740F57	CAP CHIP REEL CL1 +/-30 180
C00438	2113740B78	CAP CHIP REEL CL1 +/-30 1800
C00440	2113743N50	CAP CHIP 100 PF 5% COG
C00441	2113743L41	CAP CHIP 10000 PF 10% X7R
C00442	2113743N50	CAP CHIP 100 PF 5% COG
C00443	2113743L17	CAP CHIP 1000 PF 10% X7R
C00444	2113743N26	CAP CHIP 10.0 PF 5% COG
C00445	2113743N69	CAP CHIP 1.8PF 16V +/-.25PF
C00446	2113743N14	CAP CHIP 3.3 PF +-.25PF COG
C00448	2113743N37	CAP CHIP 30.0 PF 5% COG
C00449	2113743N50	CAP CHIP 100 PF 5% COG
C00450	2113743N50	CAP CHIP 100 PF 5% COG
C00451	2113743N07	CAP CHIP 1.5 PF +-.25PF COG
C00453	2113743N26	CAP CHIP 10.0 PF 5% COG
C00454	2113743N26	CAP CHIP 10.0 PF 5% COG

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00455	2113743N36	CAP CHIP 27.0 PF 5% COG
C00501	2113743N54	CAP CHIP 150 PF 5% COG
C00502	2113743N54	CAP CHIP 150 PF 5% COG
C00507	2113743L17	CAP CHIP 1000 PF 10% X7R
C00508	2113743L05	CAP CHIP 330 PF 10% X7R
C00509	2113741F25	CAP CHIP CL2 X7R REEL 1000
C00510	2113743L05	CAP CHIP 330 PF 10% X7R
C00512	2113741F49	CAP CHIP CL2 X7R REEL 10000
C00550	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00551	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00552	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00553	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00554	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00555	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00556	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00557	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00558	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00559	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00560	2311049A62	CAP TAN CHIP A/P 4.7 10 10
C00561	2311049A62	CAP TAN CHIP A/P 4.7 10 10
C00562	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00563	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00564	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00600	2113743N34	CAP CHIP 22.0 PF 5% COG

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00601	2113743N38	CAP CHIP 33.0 PF 5% COG
C00602	2113743N38	CAP CHIP 33.0 PF 5% COG
C00603	2113743N38	CAP CHIP 33.0 PF 5% COG
C00604	2113743N38	CAP CHIP 33.0 PF 5% COG
C00606	2113743N50	CAP CHIP 100 PF 5% COG
C00607	2113743N38	CAP CHIP 33.0 PF 5% COG
C00608	2113743N38	CAP CHIP 33.0 PF 5% COG
C00610	2113743N38	CAP CHIP 33.0 PF 5% COG
C00611	2113743N38	CAP CHIP 33.0 PF 5% COG
C00612	2113743N38	CAP CHIP 33.0 PF 5% COG
C00613	2113743N38	CAP CHIP 33.0 PF 5% COG
C00614	2113743N38	CAP CHIP 33.0 PF 5% COG
C00620	2113743L21	CAP CHIP 1500 PF 10% X7R
C00701	2113743N26	CAP CHIP 10.0 PF 5% COG
C00704	2113743E12	CAP CHIP .047 UF 10% X7R
C00705	2113743E12	CAP CHIP .047 UF 10% X7R
C00709	2113743M08	CAP CHIP 22000 PF +80-20% Y5V
C00710	2113743N54	CAP CHIP 150 PF 5% COG
C00711	2113743E12	CAP CHIP .047 UF 10% X7R
C00712	2113743M08	CAP CHIP 22000 PF +80-20% Y5V
C00751	2113743E12	CAP CHIP .047 UF 10% X7R
C00753	2113743E12	CAP CHIP .047 UF 10% X7R
C00754	2113743E12	CAP CHIP .047 UF 10% X7R
C00755	2113743E12	CAP CHIP .047 UF 10% X7R

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00759	2113743E12	CAP CHIP .047 UF 10% X7R
C00760	2113743E12	CAP CHIP .047 UF 10% X7R
C00761	2113743E12	CAP CHIP .047 UF 10% X7R
C00762	2113743L41	CAP CHIP 10000 PF 10% X7R
C00791	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C00792	2113743N14	CAP CHIP 3.3 PF +-.25PF COG
C00801	2113743N38	CAP CHIP 33.0 PF 5% COG
C00802	2113743N38	CAP CHIP 33.0 PF 5% COG
C00803	2113743E20	CAP CHIP .10 UF 10%
C00804	2113743E07	CER CHIP CAP .022UF
C00806	2113743N38	CAP CHIP 33.0 PF 5% COG
C00808	2113743N38	CAP CHIP 33.0 PF 5% COG
C00809	2113743N38	CAP CHIP 33.0 PF 5% COG
C00810	2113743A27	CAP CHIP .470 UF 10% 16V
C00811	2113743N38	CAP CHIP 33.0 PF 5% COG
C00812	2311049A65	CAP TANT CHIP A/P 22 10 6
C00813	2113743N38	CAP CHIP 33.0 PF 5% COG
C00814	2113743N38	CAP CHIP 33.0 PF 5% COG
C00815	2109622N06	CAP CER CHIP NPO CLASS I
C00816	2113743E20	CAP CHIP .10 UF 10%
C00820	2113743N34	CAP CHIP 22.0 PF 5% COG
C00825	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00833	2113743N38	CAP CHIP 33.0 PF 5% COG
C00850	2113743N38	CAP CHIP 33.0 PF 5% COG
C00858	2113743N38	CAP CHIP 33.0 PF 5% COG

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00859	2113743N38	CAP CHIP 33.0 PF 5% COG
C00860	2113743N38	CAP CHIP 33.0 PF 5% COG
C00861	2113743N38	CAP CHIP 33.0 PF 5% COG
C00862	2113743N38	CAP CHIP 33.0 PF 5% COG
C00863	2113743N38	CAP CHIP 33.0 PF 5% COG
C00901	2309121D19	CAP CHIP TANT 10 UF 10% 10 V
C00902	2113743H14	CAP CHIP 10.0 UF 16V +80-20%
C00903	2113743H14	CAP CHIP 10.0 UF 16V +80-20%
C00904	2113743N26	CAP CHIP 10.0 PF 5% COG
C00906	2309121D19	CAP CHIP TANT 10 UF 10% 10 V
C00907	2113928J06	CAP CER CHIP 4.7 UF 10% 10V
C00908	2113743H14	CAP CHIP 10.0 UF 16V +80-20%
C00909	2113743E20	CAP CHIP .10 UF 10%
C00910	2113928J06	CAP CER CHIP 4.7 UF 10% 10V
C00911	2311049A56	CAP TAN CHIP A/P 4.7 20 10
C00912	2113743L41	CAP CHIP 10000 PF 10% X7R
C00913	2113928J06	CAP CER CHIP 4.7 UF 10% 10V
C00914	2113928J06	CAP CER CHIP 4.7 UF 10% 10V
C00915	2309121D23	CAP CHIP TANT 68 UF 10% 10 V
C00916	2113743N38	CAP CHIP 33.0 PF 5% COG
C00917	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C00918	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C00919	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C00920	2311049A54	CAP TAN CHIP A/P 3.3 20 16
C00921	2311049A54	CAP TAN CHIP A/P 3.3 20 16

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
C00922	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00923	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C00924	2113928J06	CAP CER CHIP 4.7 UF 10% 10V
C00933	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C00960	2113741F49	CAP CHIP CL2 X7R REEL 10000
C00962	2113743N54	CAP CHIP 150 PF 5% COG
C00963	2113743A23	CAP CHIP .220 UF 10% X7R
C00966	2113743N36	CAP CHIP 27.0 PF 5% COG
C01002	2113743L05	CAP CHIP 330 PF 10% X7R
C01020	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01021	2113743L17	CAP CHIP 1000 PF 10% X7R
C01022	2113743A27	CAP CHIP .470 UF 10% 16V
C01023	2113743L41	CAP CHIP 10000 PF 10% X7R
C01025	2113743E20	CAP CHIP .10 UF 10%
C01026	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C01027	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
CR0201	4809641F04	DIODE VCTR SMV1204-70 SOT23
CR0604	4809788E06	DIODE ZENER 6.8V UDZ6.8B
CR0605	4809653F03	DIODE SCHOTTKY 1A 10BQ040 SMD
CR0606	4809606E02	DIODE DUAL ARRAY DAN222
CR0607	4809606E08	DIODE DUAL SCHOT-TKEY RB715F
CR0608	4809606E08	DIODE DUAL SCHOT-TKEY RB715F
CR0711	4809606E07	DIODE DUAL ARRAY DA221
CR0901	4809924D06	DIODE SCHTTKY DUAL BAT54S
CR0902	4809606E02	DIODE DUAL ARRAY DAN222

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
CR0903	4809653F03	DIODE SCHOTTKY 1A 10BQ040 SMD
CR0904	4809788E06	DIODE ZENER 6.8V UDZ6.8B
CR0908	4809118D01	LED BICOLOR LNJ107W5PRA1
CR0910	4809653F02	RECT SCHOTTKY 1.0A UPS5817
CR0999	4809788E06	DIODE ZENER 6.8V UDZ6.8B
CR1001	4809788E06	DIODE ZENER 6.8V UDZ6.8B
FL0420	9109035M01	FLTR SAW BP 215MHZ SMD
FL0452	9109247M01	FLTR SAW BP 947MHZ 3X3MM SMD
J00060	3909578M01	CONTACT BATT SMT
J00061	3909578M01	CONTACT BATT SMT
J00062	3909578M01	CONTACT BATT SMT
J00063	3909578M01	CONTACT BATT SMT
J00101	2809454C02	PLUG LO PROFILE SMD 32 POS
J00601	0909059E01	RECPT ZIF 16 POS SMD
J00802	0909195E01	SKT BOT ENTRY 2 POS
J00900	3909156T01	CNTCT BASE SIM
L00203	2409646M95	IN CER MULTILYR
L00210	2409646M08	IND CER MULTILYR 15NH 1608
L00211	2409646M07	IND CER MULTILYR 12NH 1608
L00258	2409646M76	IN CER MULTILYR 3.9NH 1608
L00263	2409646M76	IN CER MULTILYR 3.9NH 1608
L00267	2409646M84	IN CER MULTILYR 18 NH 1608
L00300	2409646M56	IN CER MULTILYR 10 NH 1608
L00301	2409646M56	IN CER MULTILYR 10 NH 1608
L00302	2409646M62	IN CER MULTILYR 33 NH 1608
L00350	2409646M77	IN CER MULTILYR 4.7NH 1608
L00401	2462587Q36	IND CHIP 120 NH 10%
L00410	2409646M28	IND CER MULTILYR 5.6NH 1608

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
L00412	2409646M07	IND CER MULTILYR 12NH 1608
L00413	2409646M83	IN CER MULTILYR 15 NH 1608
L00414	2409704K10	IND CHIP MULTILYR 47NH 2012
L00421	2409646M19	IN CER MULTILYR
L00422	2409350L20	IND CER LZRETCH 56 NH 2 1608
L00431	2462587Q36	IND CHIP 120 NH 10%
L00433	2409646M84	IN CER MULTILYR 18 NH 1608
L00440	2462587Q38	IND CHIP 180 NH 10%
L00442	2409646M13	IND CER MULTILYR 39NH 1608
L00445	2409646M88	IN CER MULTILYR 39 NH 1608
L00450	2409646M01	IND CER MULTILYR 3.9NH 1608
L00501	2462587P36	CHIP IND 100000 NH
L00502	2409646M83	IN CER MULTILYR 15 NH 1608
Q00102	4809579E09	TSTR MOSFET P-CHAN 2SJ346
Q00104	4809579E02	TSTR MOSFET N-CHAN 25K1830
Q00202	4809579E18	TSTR MOSFET P-CHAN TP0101T
Q00203	4809579E18	TSTR MOSFET P-CHAN TP0101T
Q00250	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00251	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00252	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00300	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00301	4809579E17	TSTR MOSFET P-CHAN SI9424
Q00303	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00305	4809605E02	TSTR SIG NPN 2SC4617
Q00330	4809605E02	TSTR SIG NPN 2SC4617
Q00331	4809607E02	TSTR SIG PNP 25A1774
Q00332	4809605E02	TSTR SIG NPN 2SC4617

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
Q00418	4809527E20	TSTR NPN RF 2SC4784 SC70
Q00420	4809527E20	TSTR NPN RF 2SC4784 SC70
Q00421	4809527E24	TSTR NPN RF MRF949LT1 SC-90
Q00440	4809605E02	TSTR SIG NPN 2SC4617
Q00441	4809607E02	TSTR SIG PNP 25A1774
Q00442	4809939C08	TSTR DUAL PNP/PNP UMA6NTL
Q00443	4809939C08	TSTR DUAL PNP/PNP UMA6NTL
Q00446	4809608E03	TSTR DIG PNP DTA114YE
Q00501	4809607E05	TSTR PNP DTA143EE
Q00502	4809607E05	TSTR PNP DTA143EE
Q00601	4809579E17	TSTR MOSFET P-CHAN SI9424
Q00602	4809939C04	TSTR DUAL PNP/NPN UMC3
Q00606	4809605E02	TSTR SIG NPN 2SC4617
Q00607	5109522E13	IC BILAT SW TC7S66FU
Q00608	5109522E13	IC BILAT SW TC7S66FU
Q00609	5109522E13	IC BILAT SW TC7S66FU
Q00610	5109522E13	IC BILAT SW TC7S66FU
Q00613	4809940E03	TSTR DIG NPN DTC114TE
Q00703	4813824A21	XSTR PNP 60V .6A GENP B=100
Q00803	4809608E03	TSTR DIG PNP DTA114YE
Q00903	4809607E02	TSTR SIG PNP 25A1774
Q00904	4809607E02	TSTR SIG PNP 25A1774
Q00922	4809579E11	TSTR MOSFET P-CHAN NDS0601
Q00999	4809807C24	TSTR FET P-CHAN 2.5W SI4463DY
Q01001	4809939C04	TSTR DUAL PNP/NPN UMC3
Q01002	4809579E08	TSTR FET DUAL P-CHAN IRF7504
Q01005	4809579E08	TSTR FET DUAL P-CHAN IRF7504
Q01007	4809807C24	TSTR FET P-CHAN 2.5W SI4463DY
Q01008	4809807C24	TSTR FET P-CHAN 2.5W SI4463DY
Q01009	4809579E02	TSTR MOSFET N-CHAN 25K1830

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
Q01010	4809939C05	TSTR DUAL NPN/PNP UMH 5
Q01011	4809579E18	TSTR MOSFET P-CHAN TP0101T
Q01012	4809579E16	TSTR MOSFET N-CHAN TN0200T
Q01013	4809579E18	TSTR MOSFET P-CHAN TP0101T
Q01014	4809579E16	TSTR MOSFET N-CHAN TN0200T
Q01015	4809607E02	TSTR SIG PNP 25A1774
Q01016	4809608E03	TSTR DIG PNP DTA114YE
R00103	0662057N39	RES CHIP 470K 5% 20X40
R00104	0662057N23	RES. CHIP 100K 5% 20X40
R00201	0662057N13	RES. CHIP 39K 5% 20X40
R00202	0662057N29	RES CHIP 180K 5% 20X40
R00203	0662057M38	RES CHIP 33 5% 20X40
R00204	0662057M84	RES. CHIP 2700 5% 20X40
R00205	0662057M98	RES. CHIP 10K 5% 20X40
R00206	0662057M50	RES. CHIP 100 5% 20X40
R00210	0662057M36	RES. CHIP 27 5% 20X40
R00214	0662057M01	RES. CHIP 0 5% 20X40
R00215	0662057N13	RES. CHIP 39K 5% 20X40
R00221	0662057M54	RES. CHIP 150 5% 20X40
R00226	0662057N03	RES. CHIP 15K 5% 20X40
R00228	0662057M38	RES CHIP 33 5% 20X40
R00229	0662057M38	RES CHIP 33 5% 20X40
R00250	0662057M60	RES. CHIP 270 5% 20X40
R00251	0662057M78	RES. CHIP 1500 5% 20X40
R00252	0662057M80	RES. CHIP 1800 5% 20X40
R00253	0662057M74	RES. CHIP 1000 5% 20X40
R00255	0662057M58	RES. CHIP 220 5% 20X40
R00257	0662057M43	RES. CHIP 51 5% 20X40
R00258	0662057M34	RES. CHIP 22 5% 20X40
R00259	0662057M50	RES. CHIP 100 5% 20X40
R00260	0662057M82	RES. CHIP 2200 5% 20X40

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
R00261	0662057M86	RES. CHIP 3300 5% 20X40
R00262	0662057M01	RES. CHIP 0 5% 20X40
R00264	0662057M54	RES. CHIP 150 5% 20X40
R00266	0662057N10	RES. CHIP 30K 5% 20X40
R00300	0662057M74	RES. CHIP 1000 5% 20X40
R00301	0662057M82	RES. CHIP 2200 5% 20X40
R00302	0662057M26	RES. CHIP 10 5% 20X40
R00303	0662057M68	RES. CHIP 560 5% 20X40
R00304	0662057M56	RES. CHIP 180 5% 20X40
R00305	0662057M58	RES. CHIP 220 5% 20X40
R00307	0662057M74	RES. CHIP 1000 5% 20X40
R00325	0662057M98	RES. CHIP 10K 5% 20X40
R00326	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R00328	0662057M74	RES. CHIP 1000 5% 20X40
R00330	0662057M78	RES. CHIP 1500 5% 20X40
R00331	0662057M74	RES. CHIP 1000 5% 20X40
R00332	0662057M86	RES. CHIP 3300 5% 20X40
R00333	0662057M98	RES. CHIP 10K 5% 20X40
R00334	0662057M98	RES. CHIP 10K 5% 20X40
R00350	0662057M43	RES. CHIP 51 5% 20X40
R00354	0662057M98	RES. CHIP 10K 5% 20X40
R00357	0662057N19	RES. CHIP 68K 5% 20X40
R00358	0662057M50	RES. CHIP 100 5% 20X40
R00361	0662057M98	RES. CHIP 10K 5% 20X40
R00380	0662057M74	RES. CHIP 1000 5% 20X40
R00390	0662057M74	RES. CHIP 1000 5% 20X40
R00393	0662057M32	RES. CHIP 18 5% 20X40
R00395	0662057M50	RES. CHIP 100 5% 20X40
R00398	0662057M26	RES. CHIP 10 5% 20X40

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
R00412	0662057M90	RES. CHIP 4700 5% 20X40
R00413	0662057M92	RES. CHIP 5600 5% 20X40
R00415	0662057M50	RES. CHIP 100 5% 20X40
R00417	0662057M84	RES. CHIP 2700 5% 20X40
R00419	0662057M84	RES. CHIP 2700 5% 20X40
R00421	0662057M82	RES. CHIP 2200 5% 20X40
R00422	0662057M76	RES. CHIP 1200 5% 20X40
R00423	0662057M60	RES. CHIP 270 5% 20X40
R00424	0662057M50	RES. CHIP 100 5% 20X40
R00432	0662057M30	RES. CHIP 15 5% 20X40
R00433	0662057M98	RES. CHIP 10K 5% 20X40
R00434	0662057N06	RES. CHIP 20K 5% 20X40
R00435	0662057M82	RES. CHIP 2200 5% 20X40
R00436	0662057M56	RES. CHIP 180 5% 20X40
R00439	0662057M81	RES. CHIP 2000 5% 20X40
R00440	0609591M37	RES CHIP DUAL 10K 5% 0.63W
R00441	0609591M37	RES CHIP DUAL 10K 5% 0.63W
R00442	0662057N15	RES. CHIP 47K 5% 20X40
R00445	0662057N15	RES. CHIP 47K 5% 20X40
R00446	0662057M82	RES. CHIP 2200 5% 20X40
R00447	0662057N29	RES CHIP 180K 5% 20X40
R00501	0662057M60	RES. CHIP 270 5% 20X40
R00502	0662057M74	RES. CHIP 1000 5% 20X40
R00503	0662057N03	RES. CHIP 15K 5% 20X40
R00505	0662057N03	RES. CHIP 15K 5% 20X40
R00508	0662057M74	RES. CHIP 1000 5% 20X40
R00513	0662057N15	RES. CHIP 47K 5% 20X40

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
R00514	0662057M74	RES. CHIP 1000 5% 20X40
R00516	0660076N89	RES CHIP 47 K OHM 1/16 W
R00555	0660076N89	RES CHIP 47 K OHM 1/16 W
R00602	0680195M64	RES 0.24 OHM 1/2W
R00603	0662057N15	RES. CHIP 47K 5% 20X40
R00609	0662057M98	RES. CHIP 10K 5% 20X40
R00611	0662057M98	RES. CHIP 10K 5% 20X40
R00612	0662057N29	RES CHIP 180K 5% 20X40
R00613	0662057M98	RES. CHIP 10K 5% 20X40
R00614	0662057M98	RES. CHIP 10K 5% 20X40
R00615	0662057N39	RES CHIP 470K 5% 20X40
R00617	0662057N39	RES CHIP 470K 5% 20X40
R00650	0662057M90	RES. CHIP 4700 5% 20X40
R00701	0662057N03	RES. CHIP 15K 5% 20X40
R00702	0609591M39	RES CHIP DUAL 15K 5% 0.63W
R00703	0609591M39	RES CHIP DUAL 15K 5% 0.63W
R00705	0609591M39	RES CHIP DUAL 15K 5% 0.63W
R00706	0662057N03	RES. CHIP 15K 5% 20X40
R00708	0609591M39	RES CHIP DUAL 15K 5% 0.63W
R00710	0662057N03	RES. CHIP 15K 5% 20X40
R00711	0662057N03	RES. CHIP 15K 5% 20X40
R00712	0662057N03	RES. CHIP 15K 5% 20X40
R00713	0662057N03	RES. CHIP 15K 5% 20X40
R00714	0662057M50	RES. CHIP 100 5% 20X40
R00715	0662057N03	RES. CHIP 15K 5% 20X40
R00716	0662057M74	RES. CHIP 1000 5% 20X40

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
R00717	0662057M78	RES. CHIP 1500 5% 20X40
R00718	0662057M74	RES. CHIP 1000 5% 20X40
R00719	0662057M50	RES. CHIP 100 5% 20X40
R00720	0662057N07	RES. CHIP 22K 5% 20X40
R00721	0662057M58	RES. CHIP 220 5% 20X40
R00722	0662057M98	RES. CHIP 10K 5% 20X40
R00723	0662057M74	RES. CHIP 1000 5% 20X40
R00724	0662057M50	RES. CHIP 100 5% 20X40
R00725	0662057M90	RES. CHIP 4700 5% 20X40
R00726	0609591M45	RES CHIP DUAL 47K 5% 0.63W
R00727	0609591M45	RES CHIP DUAL 47K 5% 0.63W
R00728	0609591M45	RES CHIP DUAL 47K 5% 0.63W
R00729	0609591M45	RES CHIP DUAL 47K 5% 0.63W
R00730	0662057M50	RES. CHIP 100 5% 20X40
R00734	0609591M45	RES CHIP DUAL 47K 5% 0.63W
R00736	0662057N03	RES. CHIP 15K 5% 20X40
R00737	0662057N03	RES. CHIP 15K 5% 20X40
R00740	0662057M98	RES. CHIP 10K 5% 20X40
R00741	0662057M74	RES. CHIP 1000 5% 20X40
R00742	0662057N03	RES. CHIP 15K 5% 20X40
R00743	0662057N03	RES. CHIP 15K 5% 20X40
R00747	0662057N23	RES. CHIP 100K 5% 20X40
R00748	0662057N23	RES. CHIP 100K 5% 20X40
R00749	0662057N23	RES. CHIP 100K 5% 20X40
R00750	0662057N03	RES. CHIP 15K 5% 20X40
R00752	0662057N23	RES. CHIP 100K 5% 20X40

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
R00761	0662057N15	RES. CHIP 47K 5% 20X40
R00763	0662057N15	RES. CHIP 47K 5% 20X40
R00781	0662057M98	RES. CHIP 10K 5% 20X40
R00791	0662057N15	RES. CHIP 47K 5% 20X40
R00798	0662057M50	RES. CHIP 100 5% 20X40
R00799	0662057M50	RES. CHIP 100 5% 20X40
R00800	0662057N09	RES. CHIP 27K 5% 20X40
R00801	0662057N05	RES. CHIP 18K 5% 20X40
R00802	0662057N05	RES. CHIP 18K 5% 20X40
R00803	0662057N05	RES. CHIP 18K 5% 20X40
R00804	0662057N15	RES. CHIP 47K 5% 20X40
R00805	0662057N15	RES. CHIP 47K 5% 20X40
R00806	0662057M68	RES. CHIP 560 5% 20X40
R00807	0662057M68	RES. CHIP 560 5% 20X40
R00808	0662057M90	RES. CHIP 4700 5% 20X40
R00809	0662057M68	RES. CHIP 560 5% 20X40
R00810	0662057N05	RES. CHIP 18K 5% 20X40
R00846	0662057M98	RES. CHIP 10K 5% 20X40
R00847	0662057M74	RES. CHIP 1000 5% 20X40
R00850	0662057M26	RES. CHIP 10 5% 20X40
R00851	0662057M26	RES. CHIP 10 5% 20X40
R00852	0660076N01	RES CHIP 10 OHM 5 1/ 16W
R00853	0660076N01	RES CHIP 10 OHM 5 1/ 16W
R00901	0662057M90	RES. CHIP 4700 5% 20X40
R00902	0662057M90	RES. CHIP 4700 5% 20X40
R00907	0662057N06	RES. CHIP 20K 5% 20X40
R00908	0662057M61	RES CHIP 300 5% 20X40
R00909	0662057M50	RES. CHIP 100 5% 20X40

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
R00910	0662057M98	RES. CHIP 10K 5% 20X40
R00911	0662057N33	RES. CHIP 270K 5% 20X40
R00912	0662057N39	RES CHIP 470K 5% 20X40
R00920	0662057M74	RES. CHIP 1000 5% 20X40
R00989	0662057N06	RES. CHIP 20K 5% 20X40
R01010	0662057N23	RES. CHIP 100K 5% 20X40
R01011	0662057M98	RES. CHIP 10K 5% 20X40
R01013	0662057M98	RES. CHIP 10K 5% 20X40
R01014	0662057N23	RES. CHIP 100K 5% 20X40
R01015	0662057M90	RES. CHIP 4700 5% 20X40
R01016	0662057N33	RES. CHIP 270K 5% 20X40
R01017	0662057N33	RES. CHIP 270K 5% 20X40
R01018	0662057N39	RES CHIP 470K 5% 20X40
R01019	0662057N29	RES CHIP 180K 5% 20X40
R01020	0662057N15	RES. CHIP 47K 5% 20X40
R01021	0662057N23	RES. CHIP 100K 5% 20X40
R01022	0662057N31	RES CHIP 220K 5% 20X40
R01023	0662057M90	RES. CHIP 4700 5% 20X40
R01024	0662057N33	RES. CHIP 270K 5% 20X40
R01027	0662057M92	RES. CHIP 5600 5% 20X40
R01028	0662057M92	RES. CHIP 5600 5% 20X40
R01100	0609591M45	RES CHIP DUAL 47K 5% 0.63W
R01103	0662057M26	RES. CHIP 10 5% 20X40
R01105	0662057M26	RES. CHIP 10 5% 20X40
R01107	0662057M74	RES. CHIP 1000 5% 20X40
R01108	0662057N23	RES. CHIP 100K 5% 20X40
R01109	0662057N07	RES. CHIP 22K 5% 20X40

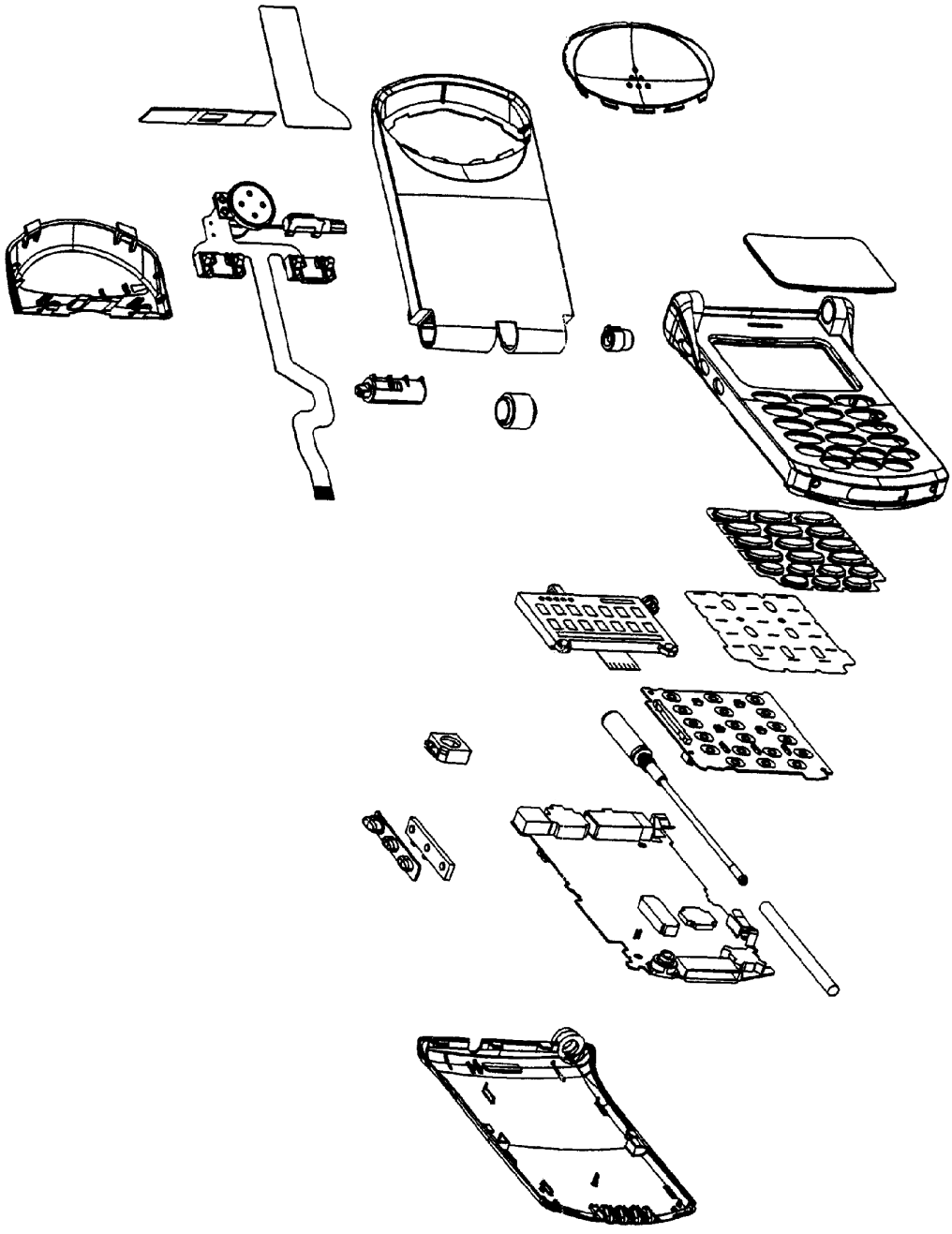
Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
R01110	0662057M98	RES. CHIP 10K 5% 20X40
R01111	0662057M74	RES. CHIP 1000 5% 20X40
R01112	0662057N23	RES. CHIP 100K 5% 20X40
R01113	0662057N23	RES. CHIP 100K 5% 20X40
R01114	0662057M74	RES. CHIP 1000 5% 20X40
S00001	4009060E01	SW TACTILE SMD
S00002	4009060E01	SW TACTILE SMD
S00003	4009060E01	SW TACTILE SMD
SH0101	2609827G03	SHIELD SPACER
SH0102	2609827G03	SHIELD SPACER
SH0103	2609827G03	SHIELD SPACER
SH0104	2609827G03	SHIELD SPACER
SH0105	2609827G03	SHIELD SPACER
SH0201	2609053T01	SHIELD MAIN VCO
SH0202	2609058T01	SHIELD GIFSYN
SH0203	2609059T01	SHIELD CRYSTAL
SH0301	2609054T01	SHIELD TIC
SH0302	2609055T01	SHIELD PA
SH0401	2609056T01	SHIELD IF
SH0402	2609060T01	SHIELD RF
SH0501	2609057T01	SHIELD SMOC
T00902	2509306J01	CHOKE 15 UH SMD
U00201	5109632D73	IC CUST GIFSYN SILXC7786FB
U00300	5109632D90	IC CUST TIC BIPOLAR SC79989DTB
U00301	5109908K25	IC RF PA GAAS 3.5W PFP-16
U00310	5109632D91	IC CUST PAC SC79948DTB 14TSSOP
U00401	5109572E04	IC GAAS RF SW DPDT MS098
U00500	5199332C04	IC MASK SMOC 2.7V 390236B
U00701	5109841C30	IC MCU SCSF416776
U00702	5199333A01	IC FLASH ROM 1MX8 29LV800BGA
U00703	5109743E13	IC ASIC BIC 4.01 S38138EC10
U00704	5109509A16	IC SRAM 64KX16 KM616FS1000 BGA

Table 12: Level 3 Xcvr

REF DES	ITEM #	DESCRIPTION
U00705	5199301A01	IC EEPROM SPCL 8KX8 28BV64
U00804	5109522E10	IC 3-INV LMOS TC7W04FU
U00900	5109632D75	IC CUST BICMOS GCAP LT 48QFP
U00902	5109781E50	IC LIN 5V REG LM2980 SOT23
U00903	5109781E57	IC LIN VOLT DECT 3V PST995MNR
U00904	5109522E25	IC SNGL NOR GATE TC7SH02FU
U00905	5109781E77	IC VOLT DECT 3.6V PST995NNR
U00907	5109522E23	IC SNGL INV GATE TC7SH04FU
U00908	5109522E25	IC SNGL NOR GATE TC7SH02FU
U00909	5109522E25	IC SNGL NOR GATE TC7SH02FU
U00910	5109522E22	IC SNGL AND GATE TC7S08FU
U00911	5109512F02	IC VOLT REG 2.7V LP2981 5SOT
VR0602	4809788E06	DIODE ZENER 6.8V UDZ6.8B
VR0603	4809788E06	DIODE ZENER 6.8V UDZ6.8B
VR0604	4809788E06	DIODE ZENER 6.8V UDZ6.8B
VR0605	4809788E06	DIODE ZENER 6.8V UDZ6.8B
VR0606	4809788E06	DIODE ZENER 6.8V UDZ6.8B
VR0607	4809788E06	DIODE ZENER 6.8V UDZ6.8B
VR0609	4809788E06	DIODE ZENER 6.8V UDZ6.8B
VR0901	4809788E08	DIODE ZENER 8.2V UDZTE178.2B
VR0902	4809788E08	DIODE ZENER 8.2V UDZTE178.2B
Y00201	4809612J20	XTAL 13MHZ 20PPM SMD 5X7 MM

Figure 27: StarTAC Parts Illustration



Service Tools for StarTAC

Part No.	Description	Source
SLN6625	MCEL200 Test Interface	Intl. Parts Dept., USA
66-80343A25	Pocket Scriber	WSAPD, Singapore
SKN4800A	DB15 Test Cable with Coax	Intl. Parts Dept., USA
SYN5233A	Antenna Tool	Intl. Parts Dept., USA
SYN5367A	Housing Opener	Intl. Parts Dept., USA
SKN4856A	Rigid extender board	Intl. Parts Dept., USA
SLN3586	3 to -5V converter box for WinNAM, Win MSR	Intl. Parts Dept., USA
SKN4808A	Cable that connects 3 to -5V box to MCEL200 and WinNAM interface.	Intl. Parts Dept., USA
SKN4809A	Cable that connects 3 to -5V box to StarTAC™	Intl. Parts Dept., USA
SLN3587A	Express Exchange transfer box	Intl. Parts Dept., USA
SKN4780A	Express Exchange cable (2 required)	Intl. Parts Dept., USA
Tohnichi RTD24Z or equivalent	Adjustable torque driver	Local
Leica SZ4 or equivalent	Microscope	Local

Glossary

Those marked ** are Motorola specific abbreviations.

A

A Interface	Interface between MSC and BSS
A3	Authentication algorithm
A5	Stream cipher algorithm
A8	Ciphering key generating algorithm
AB	Access Burst
A-bis	Interface between BSC and BTS
ACCH	Associated Control CHannel
ACSE	Association Control Service Element
AGCH	Access Grant CHannel
AOC	Advice of charge
ARFCN	Absolute Radio Frequency Channel Number
ARQ	Automatic Request for retransmission
ASIC	Application Specific Integrated Circuit
AUC	Authentication Center
AUT(H)	Authentication

B

BA	BCCH Allocation
BAIC	Barring of All Incoming Calls
BAOC	Barring of all Outgoing Calls
BCC	Base Transceiver Station (BTS) Color Code
BCCH	Broadcast Control CHannel
BCD	Binary Coded Decimal
BCU	BTS Control Unit **
Bm	Full-rate traffic channel
BN	Bit Number
BS	Base Station
BSC	Base Station Controller
BSIC	Base Transceiver Station Identity Code
BSS	Base Station System
BSSAP	BSS Application Part (DTAP and BSSMAP)
BSSC	Base Station System Control Cabinet **
BSSMAP	Base Station Systems Management Application Part
BSSOMAP	BSS Operation and Maintenance Application Part
BSU	Base Site Controller Unit **

BTS	Base Transceiver Station

C

CA	Call Allocation
CBCH	Call Broadcast CHannel
cc	Call Control
cc	Country Code
CCBS	Completion of Calls to Busy Subscribers
CCH	Control CHannel
CCCH	Common Control CHannel
CFS	Call Forwarding on mobile Subscriber busy
CFU	Call Forwarding Unconditional
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
CM	Connection Management
COLP	Connected Line identification Presentation
COLR	Connected Line identification Restriction
CONF	Conference Call add on
CSPDN	Circuit Switched Public Data Network
CUG	Closed User Group
CW	Call Waiting

D

DB	Dummy Burst
DBS	Distributed Base Station **
DCCH	Dedicated Control CHannel
DET	Detach
DFE	Decision Feedback Equalizer
DISC	DISConnect
DL	Data Link (layer)
Dm	Control Channel (ISDN terminology applied to mobile service)
Dm	Signalling channel
Dp	Dialled Pulse
DRCU	Diversity Radio Channel Unit**
DRX	Discontinuous Reception
DTAP	Direct Transfer Application Part
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-Frequency (tone signalling type)
DTX	Discontinuous Transmission

E

E	erlang
Eb/No	Energy per Bit / Noise floor
EC	Echo Canceller
Ec/No	Ratio of energy per modulating bit to the noise spectral density
EIR	Equipment Identity Register
EIRP	Effective Isotropic Radiated Power
EMC	Electromagnetic Compatibility
EMX	Electronic Mobile Exchange **
ETSI	European Telecommunications Standards Institute

F

FACCH	Fast Associated Control CHannel
FACCH/F	Full rate Fast Associated Control CHannel
FACCH/H	Half rate Fast Associated Control CHannel
FB	Frequency correction Burst
FCCH	Frequency Correction CHannel
FEC	Forward Error Correction
FN	Frame Number
FTAM	File Transfer Access Management

G

GMSC	Gateway Mobile Services Switching Center
GMSK	Gaussian Minimum Shift Keying
GSM	Group Special Mobile
GSM MS	GSM Mobile Station
GSM PLMN	GSM Public Land Mobile Network

H

HANDO	Handover
HDLC	High Level Data Link Control
HLR	Home Location Register
HOLD	Call Hold (Supplementary Service)
HPLMN	Home PLMN
HPU	Hand Portable Unit
HSN	Hopping Sequence Number

I

I	Information (frames)
IA5	International Alphanumeric 5
ID	IDentification
IMEI	International Mobile Equipment Identity
IMM	IMMediate assignment message
IMSI	International Mobile Subscriber Identity
IN	Intelligent Network
ISC	International Switching Center
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IWF	Interworking Function

J

K

Kc	ciphering Key
Ki	Individual subscriber authentication key

L

LAC	Location Area Code
LAI	Location Area Identification (Identity)
LAPB	Link Access Procedure ‘B’ (balanced) channel
LAPDm	Link Access Procedure ‘DM’ (mobile ‘D’) channel
Lm	Traffic channel (with capacity lower than Bm)
LPC	Linear Predictive Code

LR	Location Register

M

MA	Mobile Allocation
MAH	Mobile Access Hunting
MAI	Mobile Allocation Index
MAIO	Mobile Allocation Index Offset
MAP	Mobile Application Part
MCC	Mobile Country Code
MCI	Malicious Call Identification
MD	Mediation Device
ME	Mobile Equipment
MF	Multi-Frequency (tone signalling type)
MLSE	Maximum Likelihood Sequence Estimator
MM	Mobility Management
MMI	Man Machine Interface
MNC	Mobile Network Code
MO	Mobile Originated
MO/PP	Mobile Originated Point to Point messages
MoU	Memorandum of Understanding
MRN	Mobile Roaming Number
MS	Mobile Station
MSC	Mobile Services Switching Center
MSCM	Mobile Station Class Mark
MSIN	Mobile Station Identification Number
MSISDN	Mobile Station international ISDN number
MSRN	Mobile Station Roaming Number
MT	Mobile Termination
MTP	Message Transfer Part
MT/PP	Mobile Terminated Point to Point messages

N

NB	Normal Burst
NE	Network Elements
NET	Norme European de Telecommunications
NM	Network Management
NHC	Network Management Center

O

O&M	Operations and Maintenance
OACSU	Off Air Call Set-Up
OCB	Outgoing Calls Barred
OMAP	Operations and Maintenance Application Part (previously was OAMP)
OMC	Operations and Maintenance Center
OMCR	Operations and Maintenance Center -Radio Part
OMCS	Operations and Maintenance Center -Switch Part
OSI	Open System Interconnection

P

PAD	Packet Assembly Disassembly facility
PCH	Paging CHannel
PDN	Public Data Networks
PIN	Personal Identification Number
PLMN	Public Land Mobile Network
POTS	Plain Old Telephone Service (basic telephone services)

PSPDN	Public Switched Packet Data Network
PSTN	Public Switched Telephone
PTO	Public Telecommunications Operator

Q

QOS	Quality of Service

R

RAB	Random Access Burst
RACH	Random Access CHannel
RBDS	Remote BSS Diagnostic Subsystem **
RBU	Remote Base Station Unit (PCN) **
RCU	Radio Channel Unit **
REC	RECommendation
REL	RELease
RELP-LTP	Regular Pulse Excitation - Long Term Prediction
REQ	REQuest
RFCH	Radio Frequency CHannel
RFN	Reduced TDMA Frame Number
RLP	Radio Link Protocol
ROSE	Remote Operations Service Element (a CCITT specification for O&M)
RXCDR	Remote Transcoder Unit **
RXLEV	Received signal level
RXQUAL	Received signal quality

S

SABM	Set Asynchronous Balance Model
SACCH	Slow Associated Control CHannel
SAPI	Service Access Point Indicator (Identifier)
SB	Synchronization Burst
SC	Service Center
SCCP	Signalling Connection Control Part
SCH	Synchronization CHannel
SCP	Service Control Point - an intelligent network entity
SDCCH	Stand-alone Dedicated Control CHannel
SDL	Specification Description Language
SFH	Slow Frequency Hopping
SIM	Subscriber Identity Module
SMS	Short Message Service
SMSCB	Short Message Service Call Broadcast
SND	SeND
SP	Signalling Point
SRES	Signed RESponse (authentication)
SS	Supplementary Service
SS	System Simulator
STP	Signalling Transfer Point
SYSGEN	SYStem GENeration

T

TA	Terminal Adaptor
TA	Timing Advance
TCAP	Transaction Capabilities Application Part
TCH	Traffic CHannel
TCH/F	A full rate TCH
TCH/FS	A full rate speech TCH
TCH/HS	A half rate speech TCH
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TMN	Telecommunications Management Network
TMSI	Temporary Mobile Subscriber Identity
TN	Timeslot Number
TRX	Transceivers
TTY	TeleTYpe (refers to any terminal)
TS	Time Slot
TUP	Telephone Users Part

U

UI	Unnumbered Information frame
Um	Air Interface

V

VAD	Voice Activity Detection
VLR	Visited Location Register
VLSI	Very Large Scale Integration (IC)
VPLMN	Visited PLMN

W

X

XC	Transcoder
XCDR	Transcoder **

Y

Z

3PTY	Three ParTY service

MOTOROLA
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