MOTOROLA

Level 3 Service Manual

Dual Band Personal Communicator

Motorola V200
CDMA 800/1900 MHz Technology

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Introduction

Motorola® Inc. maintains a worldwide organization that is dedicated to provide responsive, full-service customer support. Motorola products are serviced by an international network of company-operated product care centers as well as authorized independent service firms.

Available on a contract basis, Motorola Inc. offers comprehensive maintenance and installation programs which enable customers to meet requirements for reliable, continuous communications.

To learn more about the wide range of Motorola service programs, contact your local Motorola products representative or the nearest Customer Service Manager.

Product Identification

Motorola products are identified by the model number on the housing. Use the entire model number when inquiring about the product. Numbers are also assigned to chassis and kits. Use these numbers when requesting information or ordering replacement parts.

Product Names

Product names included in V200 Personal Communicators
are listed on the front cover. Product names are subject to change without notice. Some product names, as well as some frequency bands, are available only in certain markets.

Product Changes

When electrical, mechanical, or production changes are incorporated into Motorola products, a revision letter is assigned to the chassis or kit affected, for example; -A, -B, or -C, and so on.

The chassis or kit number, complete with revision number, is imprinted during production. The revision letter is an integral part of the chassis or kit number and is also listed on schematic diagrams and printed circuit board layouts.

Regulatory Agency Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

1. This device may not cause any harmful interference, and
2. this device must accept interference received, including interference that may cause undesired operation.

This class B device also complies with all requirements of the Canadian Interference-Causing Equipment Regulations (ICES-003).

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Computer Program Copyrights

About This Service Manual

Using this service manual and the many suggestions contained in it assures proper installation, operation, and maintenance of CDMA V200 communicators.
Refer any questions about this manual to the nearest Customer Service Manager.

A product family is the group of products having the same Account Product Code (APC). To locate the APC on a device, refer to the “Mechanical Serial Number (MSN)” section in the CDMA V200 Level 2 Service manual.

Audience

This document provides assistance to service personnel in testing and repairing CDMA V200 communicators. Service personnel should be familiar with electronic assembly, testing, and troubleshooting methods, and with the operation and use of associated test equipment.

Use of this document assures proper installation, operation, and maintenance of Motorola products and equipment. It contains all service information required for the equipment described and is current as of the printing date.

Scope

The scope of this document is to provide the reader with basic information relating to CDMA V200 communicators, and also to provide procedures and processes for repairing the units at Level 3 service centers including:

- Component-level troubleshooting
- Limited PCB component repair requiring unsoldering and soldering
- Testing and verification of unit functionality
- Initiating warranty claims and sending faulty modules to Level 4 repair centers.

Conventions

Special characters and typefaces, listed and described below, are used in this publication to emphasize certain types of information.

Note: Emphasizes additional information pertinent to the subject matter.

Caution: Emphasizes information about actions which may result in equipment damage.

Warning: Emphasizes information about actions which may result in personal injury.

Keys to be pressed are represented graphically. For example, instead of “Press the Enter Key”, you will see “Press Enter”.

Information from a screen is shown in text as similar as possible to what appears in the display. For example, ALERTS or ALERTS or ALERTS.

Information that you need to type is printed in **boldface type**

Revisions

Any changes that occur after manuals are printed are described in publication revision bulletins (PMRs). These bulletins provide change information that can include new parts listing data, schematic diagrams, and printed board layouts.

Warranty Service Policy

The product will be sold with the standard 12 months warranty terms and conditions. Accidental damage, misuse, and extended warranties offered by retailers are not supported under warranty. Non warranty repairs are available at agreed fixed repair prices.

Out of Box Failure Policy

The standard out of box failure criteria applies. Customer units that fail very early on, after the date of sale, are to be returned to Manufacturing for root cause analysis, to guard against epidemic criteria. Manufacturing to bear the costs of early life failure.

Product Support

Customer’s original units will be repaired but not refurbished as standard. Appointed Motorola Service Hubs will perform warranty and non-warranty field service for level 2 (assemblies) and level 3 (limited PCB component). The Motorola Hi-Tech Centers will perform level 4 (full component) repairs.

Customer Support

Customer support is available through dedicated call centers and in-country help desks. Product service training should be arranged through the local Motorola Support Center.

Parts Replacement

When ordering replacement parts or equipment, include the Motorola part number and description used in the service manual or supplement.

When ordering crystals or channel elements, specify the Motorola part number, description, crystal frequency, and operating frequency desired.

When the Motorola part number of a component is not known, use the product model number or other related major assembly along with a description of the related major assembly and of the component in question.

In the U.S.A., to contact Motorola, Inc. on your TTY, call: 800-793-7834

Accessories and Aftermarket Division (AAD)

Replacement parts, test equipment, and manuals can be ordered from AAD.

U.S.A	Outside U.S.A.
Phone: 800-422-4210	Phone: 847-538-8023
FAX: 800-622-6210	FAX: 847-576-3023

Circuit Description

Overview

Controller (Audio/Logic Circuit)

The CDMA V200 Personal Communicator chip set includes Motorola proprietary call processor and audio/power controller ICs, with on-board flash EEPROM and SRAM memory. See Figure 1 for a functional block diagram.

The 32-bit call processor IC includes the functionality of CPU, DSP, CSP, and CIA. The audio/power controller IC works in buck mode with no 5V supply, controls the 32Khz crystal, and interfaces with the call processor over an 8-bit parallel bus. Communication with accessories is through the CE bus connector through the audio/power controller IC. Audio through the external connector is analog.

The V200 has an integrated speakerphone that also serves as the alert transducer. The audio/power controller IC handles all the audio functions including alert/speakerphone and headset speaker/microphone.

Key features of the Motorola call processor IC include:

- Motorola proprietary integer processor with 32-bit RISC architecture,
- 56600 NDE-UL DSP core running at up to 70 Mhz @ 1.8V,
- MCU-DSP interface,
- CDMA signal processor (CSP3) ASIC,
- 16-bit external memory interface for the MCU,
- 8-bit parallel interface for the audio/power controller IC,
- 32-input interrupt controller for the MCU,
- internal MCU ROM and RAM,
- special modules for CDMA mode (all are MCU peripherals),
- dual 9.8304 Msamples/sec 4-bit ADCs (RX I/Q with Receive AGC),
- dual 4.9152 Msamples/sec 9-bit DACs,
- 13-bit linear CODEC,
- 1 8-bit, 2 10-bit, and 1 12-bit measurement DAC,
- 8-bit measurement ADC with 6 multiplexed inputs,
- 10-bit AOC loop control ADC and DAC (DSP peripheral),
- a UART with auto baud detection,
- universal serial bus (USB) interface module, and
- serial audio port interface.

Key features of the audio/power controller IC include:

- 8-bit parallel interface from the call processor IC,
- buck and boost converters,
- 8 Linear voltage regulators,
- 2 high end linear regulators with common reference (PA drain regulators),
- external B+ clamp regulator,
- 3 microphone amplifiers,
- differential audio interfaces to and from the call processor IC,
- audio amplifiers, multiplexers, and speaker and alert drivers,
- headset and send/end key detection,
- battery charger,
- 6-input 8-bit ADC,

- real time clock (RTC) with coin cell backup supply and coin cell charger,
- timer circuits,
- CE bus interface, and
- vibrator and backlight regulator inside the IC.

The external memory consists of

- 32Mb 1.8V flash EEPROM and
- 4Mb 1.8V SRAM.

Additional V200 controller features include:

- a 17-pin CE bus connector (butt plug) supporting USB and RS232 serial communications and running at 2.7V,
- 32 Khz crystal controlled by the audio/power controller IC for RTC and slotted mode operation,
- fast charge battery charging circuit, and
- all controller parts and ICs placed on one board and all RF parts and ICs placed on another PCB.

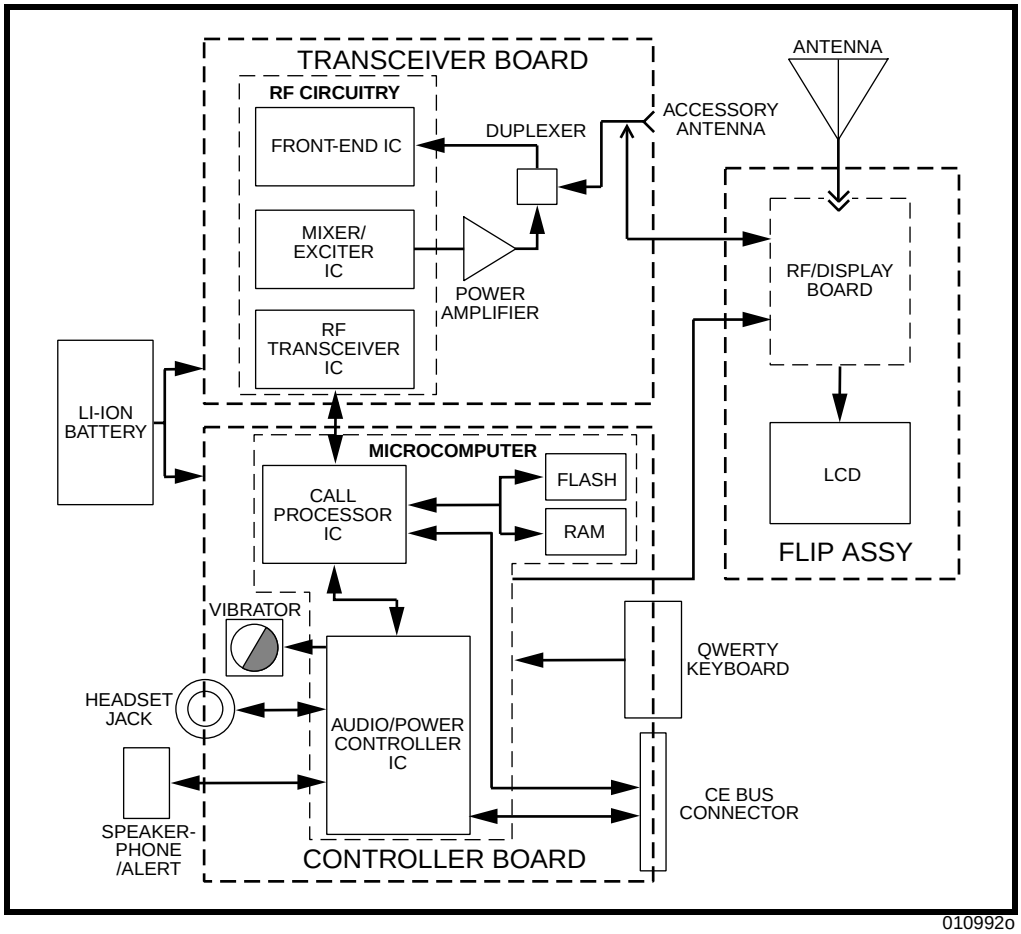

Figure 1. V200 simplified block diagram

Transceiver (RF Circuit)

The V200 transceiver chip set includes Motorola front-end (FE), mixer/exciter (ME), and RF transceiver ICs. Refer to Figure 1.

Switching between the antenna and accessory antenna port is mechanical, having a normally-closed circuit with the antenna connector. When an accessory RF plug is inserted, the switch opens the antenna circuit and closes the accessory port circuit.

The receiver contains two complete receiver paths. An 800 Mhz path is used for 800 Mhz cellular signals and a 1900 Mhz path for PCS signals. The two paths have different RF, LO, and IF frequencies.

The FE IC contains LNAs, interstage filtering, and mixers. Switching and gain of the LNAs are controlled by control signals from the call processor IC on the controller board.

The RF transceiver IC extracts the broadband signal from the IF, demodulates the analog signal, and sends it to the controller for further processing.

The RF transceiver IC controls the main LO, the second LO, and the transmit offset VCO. The main LO uses 2 VCO modules, one for the 800 MHz cellular band and the other for the 1900 MHz PCS band. The output is split into receive LO and transmit LO signals for both bands.

During transmit, the ME IC controls the RF output power. The ME IC requires two LOs, one for 1900 MHz PCS band and the other for the 800 MHz cellular band. The IF pins (input to the ME IC) are the same for both bands. A control signal at the AGC pins control the gain of the ME IC. An external interstage RF filter exists between the mixer and exciter. From the mixer, the outputs take 2 different paths, one for PCS 1900 MHz band and another for 800 MHz cellular band.

The ME IC has 50 dB of attenuator control (input IF level= -23dBm, maximum output transmit level= 25dBm). Band pass filters are used at the output of the ME IC and, in the PCS path, two split-band filters are used.

The power amplifier (PA) consists of two stages in 800 MHz cellular band and three stages in the 1900 MHz PCS band. The PA operates in enhanced mode which requires a positive gate voltage. Because the PA has adjustable bias for both the gate and drain, its output power can be regulated by control signals from the audio/power controller IC, the call processor IC, and the mixer/exciter IC.

Controller

Detailed functional block diagrams, schematics, and parts lists for the controller board are provided in the Supplement listed in Related Publications section of this manual.

Receive

The baseband signal from RF transceiver IC ***U700*** on lines RXIP, RXIM, RXQP, and RXQM, is applied to call processor IC ***U1100*** where it is digitized to produce a 1.2288 Mb/sec Rx data stream. The data stream is decoded by the CSP inside ***U1100*** to generate a signal containing only the desired data. The digital speech data is further decoded by the CELP vocoder, a part of DSP within ***U1100***, and then converted back into analog receive audio which is routed to audio/power controller

IC ***U1200*** via signals AUDIO_P and AUDIO_M. ***U1200*** amplifies and routes the received audio signal to the speakerphone or headset.

The alert tone originates in call processor IC ***U1100*** and follows the same path as the receive audio, except it is sent only to the speakerphone.

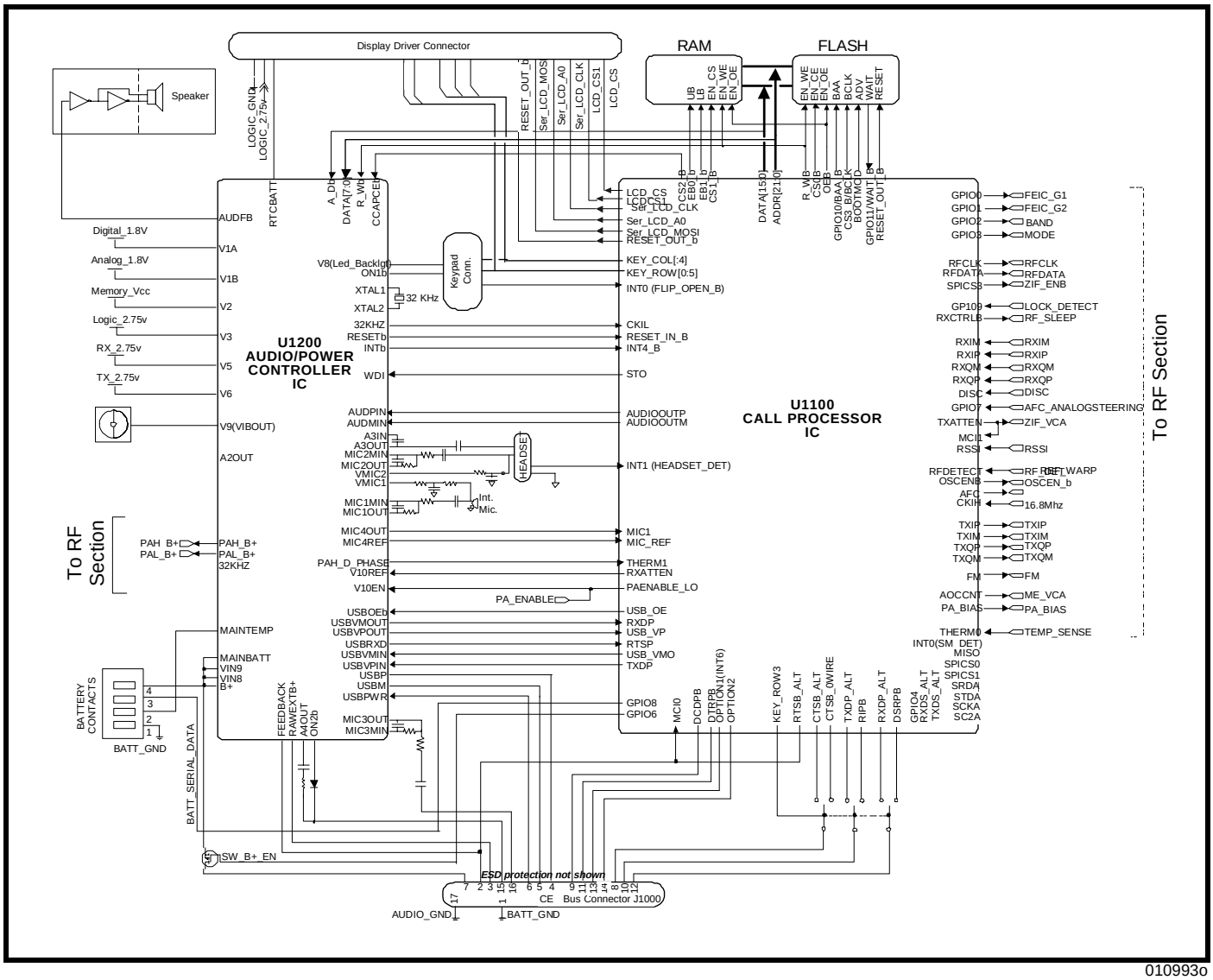

Figure 2. V200 controller block diagram

Transmit

Audio from the internal speakerphone microphone or headset microphone is routed through, and amplified by, audio/power controller IC ***U1200***. From ***U1200***, the transmit audio is sent to call processor IC ***U1100*** on the MIC1 and MICREF lines. MIC1 and MICREF signals are digitized by the CODEC inside ***U1100***, then processed by the DSP CELP variable rate vocoder, and then processed further by the modem (CSP), all also within the call processor IC ***U1100***, to produce the

1.2288Mb/sec CDMA data stream. This stream is then converted to analog signals and sent to RF transceiver IC ***U700*** as TXIP, TXIM, TXQP, and TXQM.

Keyboard Interface

The keypad interface consists of 7 8-row and 2 3-column input pins.

The keypad port generates a CPU interrupt any time a key press is detected. This interrupt is capable of taking the processor out of low power mode.

For each key press, 2 GPIO will be asserted. At least 1 of the 2 GPIO will be an interruptible ROW control line. The key is derived from the interrupt and the identification of the 2 control lines that are pulled low.

Glitch suppression circuit qualifies the keypad input to prevent noise from inadvertently interrupting the CPU.

The circuit is a 4-state synchronizer clocked at 32kHz. An interrupt is not generated until all 4 synchronizer stages have latched a valid key assertion, effectively filtering out any noise less 122 us in duration. The debounce time is about 32 ms.

Figure 3 is a simplified diagram of the keypad logic.

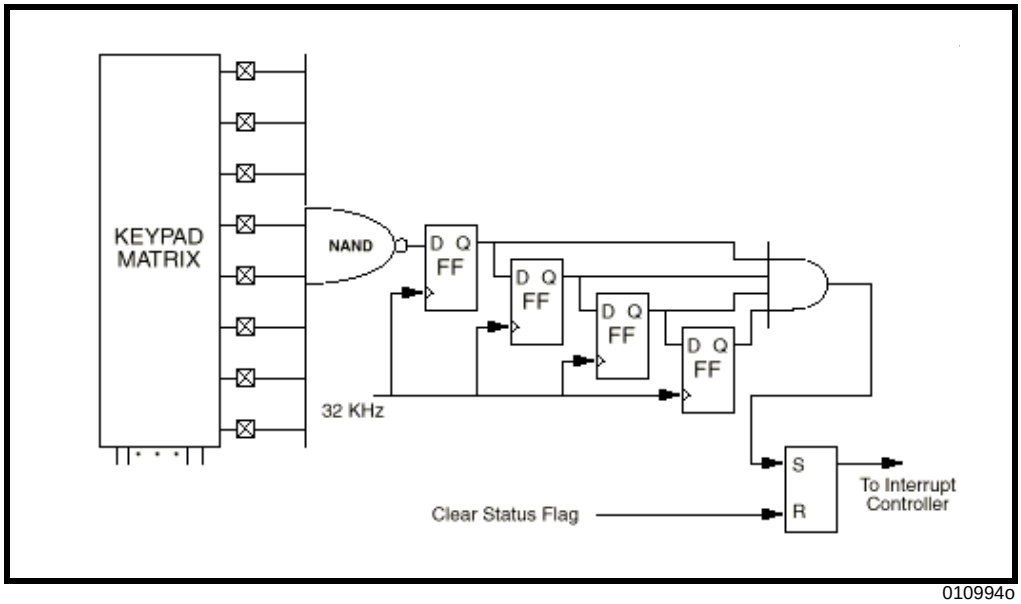

Figure 3. V200 keypad logic

The keys on the PCB use a three contact design. One of the contacts is tied to ground while the other two are pulled high (2.7 V) and connected to the rows and columns inputs. When a key is pressed, all three of its pads are shorted and therefore grounded. Each key is uniquely distinguished by the two lines pulled low. No strobing of the keypad is necessary.

The Figure 4 shows The V200 keypad mapping.

Unshifted Keyname	Shifted Keyname	Phone Mode	U1100 INPUT	Keycode HEX	COL 76543210	ROW 76543210
q	Q		ROW2,ROW4	0xffeb	11111111	11101011
w	W		ROW2,ROW3	0xfff3	11111111	11110011
e	E		ROW2,COL1	0xfdfb	11111101	11111011
r	R		ROW2,ROW5	0xffdb	11111111	11011011
t	T		ROW2,COL0	0xfefb	11111110	11111011
y	Y		ROW2,ROW1	0xfff9	11111111	11111001
u	U		ROW2,ROW6	0xffbb	11111111	10111011
i	I	1	ROW2,ROW0	0xfffa	11111111	11111010
o	O	2	ROW2,ROW7	0xff7b	11111111	01111011
p	P	3	ROW2,COL5	0xdffb	11011111	11111011
a	A		ROW4,ROW3	0xffe7	11111111	11100111
s	S		ROW4,COL1	0xfdef	11111101	11101111
d	D		ROW4,ROW5	0xffcf	11111111	11001111
f	F		ROW4,COL0	0xfeef	11111110	11101111
g	G		ROW4,ROW1	0xffed	11111111	11101101
h	H		ROW4,ROW6	0xffaf	11111111	10101111
j	J		ROW4,ROW0	0xffee	11111111	11101110
k	K	4	ROW4,ROW7	0xff6f	11111111	01101111
l	L	5	ROW4,COL5	0xdfef	11011111	11101111
;	:	6	ROW3,COL1	0xfdf7	11111101	11110111
z	Z		ROW3,ROW5	0xffd7	11111111	11010111
x	X		ROW3,COL0	0xfef7	11111110	11110111
c	C		ROW3,ROW1	0xfff5	11111111	11110101
v	V		ROW3,ROW6	0xffb7	11111111	10110111
b	B		ROW3,ROW0	0xfff6	11111111	11110110
n	N		ROW3,ROW7	0xff77	11111111	01110111
m	M		ROW3,COL5	0xdff7	11011111	11110111
,	@	7	COL1,ROW5	0xfddf	11111101	11011111
'	"	8	ROW1,ROW0	0xfffc	11111111	11111100
.	!	9	COL1,ROW1	0xfdfd	11111101	11111101
Shift	NA		COL1,ROW6	0xfdbf	11111101	10111111
Space	NA		COL1,ROW0	0xfdfe	11111101	11111110
Joystick_Left	NA		COL1,ROW7	0xfd7f	11111101	01111111
Joystick_Up	NA		ROW1,ROW7	0xff7d	11111111	01111101
Joystick_Right	NA		ROW5,COL0	0xfedf	11111110	11011111
?	/	#	ROW5,ROW1	0xffdd	11111111	11011101
)	(	0	ROW5,ROW6	0xff9f	11111111	10011111
-	_	*	ROW5,ROW0	0xffde	11111111	11011110
Symbol	NA		ROW5,ROW7	0xff5f	11111111	01011111
Alt	NA		ROW5,COL5	0xdfdf	11011111	11011111
Joystick_Down	NA		COL0,ROW1	0xfefd	11111110	11111101
End	NA		COL0,ROW6	0xfebf	11111110	10111111
Send	NA		COL0,ROW0	0xfefe	11111110	11111110
Softkey_L	NA		COL0,ROW7	0xfe7f	11111110	01111111
Menu	NA		ROW1,COL5	0xdffd	11011111	11111101
Softkey_R	NA		ROW1,ROW6	0xffbd	11111111	10111101
Volume_Down	NA		ROW6,COL5	0xdfbf	11011111	10111111
Volume_Up	NA		ROW0,ROW7	0xff7e	11111111	01111110
VA/VR	NA		ROW0,COL5	0xdffe	11011111	11111110
Smart	NA		ROW7,COL5	0xdf7f	11011111	01111111
CAPSLOCK	Alt + Shift					
HOME	Alt + End					
NUMLOCK	Alt + Symbol					
1	Alt + i					
2	Alt + o					
3	Alt + p					
4	Alt + k					
5	Alt + l					
6	Alt + ;					
7	Alt + ,					
8	Alt + '					
9	Alt + .					
0	Alt +)					
#	Alt + ?					
*	Alt + -					

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Figure 4. V200 keypad mapping

Memory Interface

The call processor IC ***U1100*** has access, via its parallel data bus, to 1 SRAM (256k X 16) ***U1400*** in a 48-ball uBGA and 1 32 Mbit (2 Mbit x 16) Read-While-Write capable burst flash EPROM ***U1300*** in a 56-ball uBGA/FBGA (this part combines EEPROM and Flash ROM functionality). Each of these devices is assigned specific chip selects from the call processor IC. Within the call processor IC chip select control register, the wait states are defined for each device. Each wait state is the equivalent of one clock cycle; i.e., 1/16.8 MHz = 59.5 ns. The burst flash can read sequential data at a maximum clock rate of 34.5 MHz. (29 nS). The SRAM operates at a maximum rate of 11.76 MHz (85 nS).

Board-to-Board Interface

Interface between the controller and transceiver boards is through connectors ***JBB1*** and ***P1*** (controller and transceiver board, respectively). Table 1 provides a description of the signals on these connectors. Refer to Table 25 for detailed connector pinouts.

Table 1. Board-to-Board Interface Signal Functions

Pin(s)	Signal Name	Function
1,3,5	RX_2.75V / RX_2.75V_UN	2.75V supply voltage.
2,4,6,8,10	PAH_B+	PA high (PCS) B+ voltage.
7,11,13,15,25,26, 27,28,33,34,35, 36,39,43,47,48, 50,51,53,57,59, 60,61,62,67,68, 69,70,71,72,74, 75,76,79	Ground / RF_GND	Ground.
9	REF_WARP	Analog output from AFC DAC to control the 16.8 MHz reference oscillator.
12,14,16,18,20	PAL_B+	PA low (CDMA) B+ voltage.
17	BAND	RF band select.
19	MODE	Analog/digital mode selection. Always digital.
21	FEIC_G1	Receive supply control.
22	PA_BIAS	Controls negative bias for PA.
23	FEIC_G2	GPIO for PA bypass (controlled by MCU or DSP).
24	RF_DETECT	Analog signal from transmit power diode.
29	RXQM	Differential inputs of RX baseband analog Q-channel (-).
30	RXIM	Differential inputs of RX baseband analog I-channel (-).
31	RXQP	Differential inputs of RX baseband analog Q-channel (+).
32	RXIP	Differential inputs of RX baseband analog I-channel (+).
37	RSSI	Receive signal strength indicator.
38	TX_2.75V	2.75V supply voltage.
40	TX_2.75V	2.75V supply voltage.
41	RF_SLEEP	Control of RF circuits in slotted sleep mode.
42	TX_2.75V	2.75V supply voltage.
44	ME_VCA	Analog control voltage for voltage-controlled attenuator in Mixer/Exciter IC.

Table 1. Board-to-Board Interface Signal Functions (Continued)

Pin(s)	Signal Name	Function
45	AFC_ANALOGSTEERING	GPIO or analog steering sense (AFC out).
46	PA_ENABLE	Enable control signal for TX PA.
49	DISC	Discriminator input for analog mode.
52	LOCK_DETECT	Spare GPIO or timer input capture.
54	RF_SPI(2)	SPI clock in.
55	16.8MHZ	Reference clock (16.8 MHz square wave).
56	RF_SPI(0)	SPI data in.
58	RF_SPI(1)	SPI data out.
63	TXQM	Digital mode, TX baseband analog Q-channel (-).
64	TXIP	Digital mode, TX baseband analog I-channel (-).
65	TXQP	Digital mode, TX baseband analog Q-channel (+).
66	TXIM	Digital mode, TX baseband analog I-channel (+).
73	ZIF_VCA	Analog control voltage for voltage-controlled attenuator in RF Transceiver IC.
77	FM	Frequency modulation output from Call Processor IC to Call Processor IC. Held at ground during CDMA.
78	OSCEN_b	Enable control signal for reference oscillator.
80	TEMP_SENSE	Input to the measurement ADC from thermistor.

CE Bus Connector

V200 Personal Communicators have the Motorola CE Bus interface. The bus incorporates RS232 serial communication and universal serial bus (USB) into one connector.

The CE Bus supports connection to accessories, personal computers, and test systems. The bus connector has a total of 17 pins, 9 of which have multiple functions.

For signal name and function details, refer to Table 27 in this manual and the V200Level 3 Supplement listed in the Related Publication section, later in this manual.

The bus has six basic modes of operation:

- Normal (also No Accessory Connected),
- USB Mode,
- Analog Audio Mode,
- Phone Powered USB Mode,
- RS-232 Mode, and
- RS-232/SSI Mode.

There are also three additional non-standard modes, DSC, FLASH, and JTAG, which are used only for development, factory programming, and debugging.

Eight of the 17 pins have different functions depending on which mode is selected. The other nine pins always have the same function regardless of mode. The mode is selected by applying appropriate logic levels to the Option Select pins, named OPTION1 and OPTION2. Some of the modes listed above are selected by the additional application of a level on the USB POWER and AUDIO-IN pins as well.

USB and RS232 (3 wire) communications take place through the audio/power controller IC. For V200 phones, USB mode is used for flashing. USB requires a Motorola USB accessory cable to interface with a personal computer (PC). RS232 is used for testing, phasing, and flashing the phone. RS232 requires a Motorola RS232 data head to interface to a PC.

In the V200 CE Bus pin 2 serves the dual functions of BATTFDBK and MANTST. BATTFDBK is used for controlled power dissipation by the charger. MANTST is used to detect the type of charger (Full rate, Mid rate, and Invalid). Initially, the audio/power controller IC reads the voltage on this pin to determine the charger type, then the BATTFDBK signal is active.

Transceiver

Detailed functional block diagrams, schematics, and parts lists for the transceiver board are provided in the Supplement listed in Related Publications section of this manual.

Receive CDMA Cellular 800 MHz (PCS 1900 MHz)

The communicator receives the RF signal from antenna connector ***J9001*** or RF test port ***J9000***. The received RF signal is routed through diplexer ***FL53*** to mono-block duplex SAW filter ***FL51*** (mono-block duplex ceramic filter ***FL50*** for PCS 1900 MHz). The RF signal is then routed to the front-end (FE) IC ***U9917***, which contains LNAs providing three stages of gain to the received RF signal based on its strength, and interstage filtering. ***U9917*** also contains a mixer which down converts the signal to an IF of 109.8 MHz. FE IC ***U9917*** is controlled by the call processor IC ***U1100*** on the controller board via signals FEIC_G1, FEIC_G2, and MODE. The local oscillator signal RX_LO_800 (RX_LO_PCS for PCS 1900 MHz) is 978 – 1004 MHz (2039-2100 MHz for PCS 1900 MHz). VCO module ***U626*** is controlled by the RF transceiver IC ***U700***. The 109.8 MHz IF signal out of the mixer is routed through IF filter ***FL150*** into the RF transceiver IC ***U700*** for mixing with the second LO, filtering and demodulation. The received QPSK data is gain-controlled and converted to a digital baseband signal within RF transceiver IC ***U700***. The baseband signal

is output from ***U700*** to call processor IC ***U1100*** via signals RXIP, RXIM, RXQP, and RXQM.

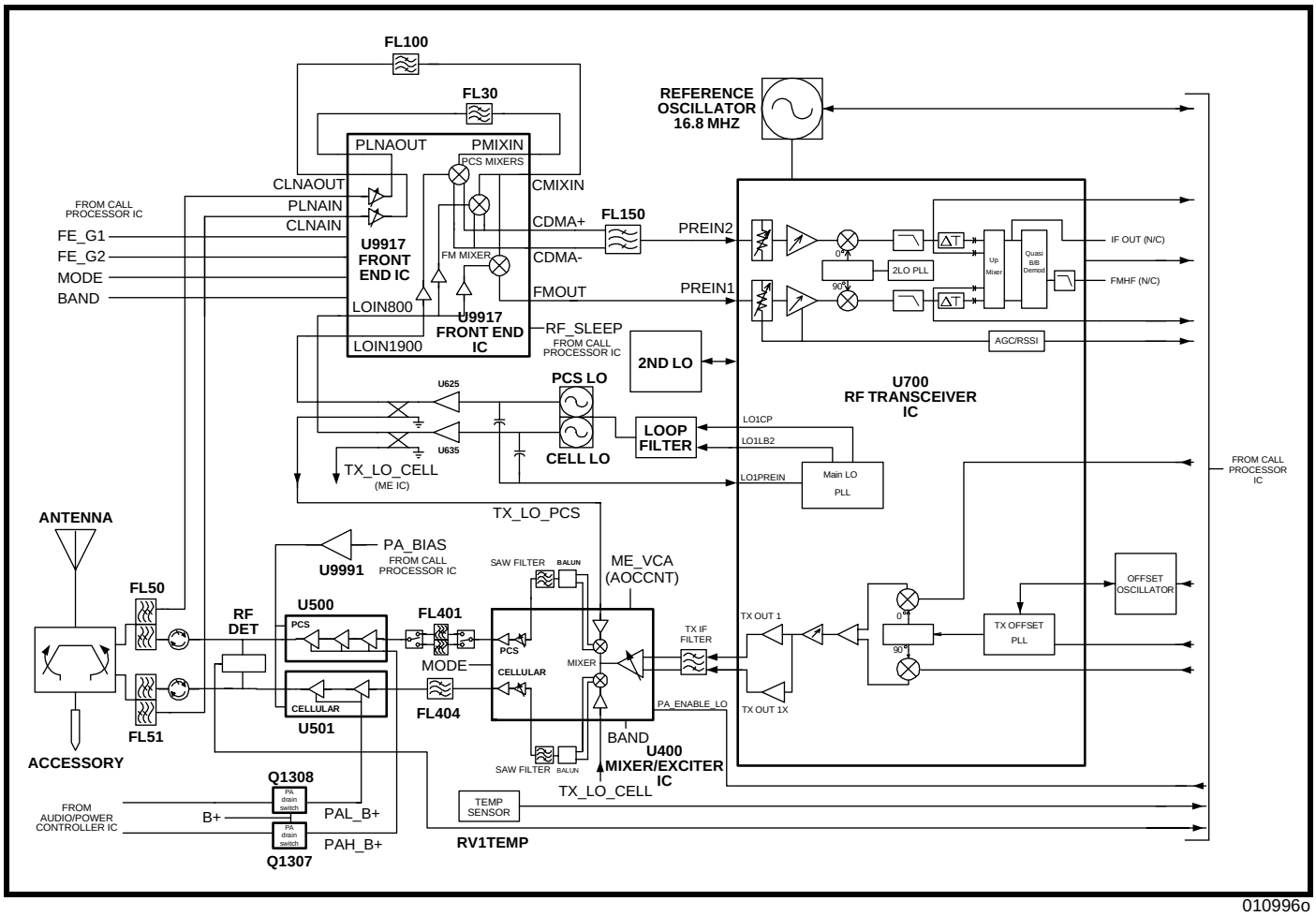

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Figure 5. V200 transceiver block diagram

Transmit CDMA Cellular 800 MHz (PCS 1900 MHz)

TXIP, TXIM, TXQP, and TXQM from call processor IC ***U1100*** modulate the transmit offset VCO (***Q652***) signal which is external to, but controlled by, RF transceiver IC ***U700***. The transmit IF modulated TX_MIX_IN1 signal of 154.8MHz (TX_MIX_IN2, 189.8 MHz for PCS 1900 MHz) is input to the mixer/exciter (ME) IC ***U400*** where it is mixed with TX_LO_800, the 979-1004 MHz (TX_LO_PCS, 2039-2100 MHz for PCS 1900 MHz) local oscillator signal. The transmit signal EXCITE_OUT_CELL is then passed through bandpass filter ***FL404*** (EXCITE_OUT_PCS, split-band SAW filter ***FL401*** for PCS 1900 MHz) into power amplifier (PA) ***U501*** (***U500*** for PCS 1900 MHz). The output of the PA is passed through isolator ***U550*** (***U551*** for PCS 1900 MHz), through transmit bandpass mono-block duplex SAW filter ***FL51*** (bandpass mono-block duplex ceramic filter ***FL50*** for PCS 1900 MHz) and, finally, through diplexer ***FL53*** to the antenna or RF test port.

Frequency Synthesizer Circuitry

V200 transceivers contain 4 oscillators controlled by 3 PLLs located within RF transceiver IC ***U700***. All the PLLs obtain their reference frequency from the 16.8 MHz reference oscillator.

- Main LO consists of 2 VCO modules external to ***U700***.
  - A PLL controls a tunable 979-1004 MHz main LO ***U626***, which is active during cellular 800 MHz operation.
  - The same PLL controls a tunable 2039-2100 MHz main LO ***U636***, which is active during PCS 1900 MHz operation.
- Second LO. The second local oscillator uses a single external tank circuit operating at 219.8 MHz for both cellular 800 MHz and PCS 1900 MHz bands. Its output is divided by 2 before being fed into the mixer.
- Transmit offset VCO. This oscillator (***Q652***), also controlled by a PLL internal to ***U700***, operates on two different frequencies depending on the band of operation. Its output frequency is divided by 2 before being fed into the mixer. The transmit offset VCO has two external tank circuits as follows:
  - 309.6 MHz frequency for cellular 800 MHz and
  - 379.6 MHz frequency for PCS 1900 MHz.

Transmit Power Control Circuitry

RF output power is controlled by the three control signals

- ZIF_VCA from call processor IC ***U1100,***
- ME_VCA also from call processor IC ***U1100***, and
- PA_BIAS from audio/power controller IC ***U1200***.

Output power is controlled at three places:

- RF transceiver IC ***U700*** which has a maximum gain control of 40 dB,
- mixer/exciter (ME) IC ***U400*** which has a total maximum gain of 36 dB, and
- Power amplifier IC ***U501*** (cellular) and ***U500*** (PCS) have a maximum gain of 27-32 dB.

The RF power range is from –50 dBm to +23 dBm with power control operating in both open-loop and closed-loop modes.

In open-loop mode (when first registering with the cell site – access probe) the power level is proportional to the received signal level. In closed-loop mode, the power level is controlled by the CDMA cell based on the received signal strength at the cell site.

Tools and Test Equipment

The following table lists the tools and test equipment used to test and troubleshoot V200 communicators. Use either the listed items or equivalent.

Table 2. General Test Equipment and Tools

Motorola Model Number[1]	Description	Application
—[2]	Personal Computer with the following minimum specifications: 1. Operating system: Windows 98SE, NT4.0 SP5, and 2000 Professional. 2. CPU speed: 133 MHz. 3. Memory/system RAM: 64 MB. 4. Hard disk space: 35 MB available space. 5. CD-ROM drive. 6. Related application: Microsoft Access 7. Communication ports: LPT1 parallel port, serial port, one available USB port. 8. Display/user interface: VGA graphics, Mouse or equivalent pointing device.	Runs PST and/or CDMACOMM software for testing and setup of UUT. USB interconnect cable for PST, serial cable for CDMACOMM.
99-97529L01	Software, Motorola PST application (CDROM)	Used for NAM programming and flashing. Runs on PC. Requires WIBU key.
01-09742L73	WIBU key (external dongle)	Parallel port security key for PST software. Allows following tasks: 1. Datalog non-Motorola confidential proprietary information. 2. Program NAM. 3. Program phonebook 4. Flash 2 code groups (not the boot loader). 5. Test command interface.
—[4]	Software, Motorola CDMACOMM	Computer test mode software for audio and RF test and setup. Runs on PC.
SYN8400	Test interface adapter (junior box)	Interconnects UUT with test equipment. Used with CDMACOMM.
SPN4029	Wall transformer	Powers junior box interface. Used with CDMACOMM.
—[2]	Power supply, 4.2V @ 1.5A	Powers unit under test. Used with CDMACOMM.
HP8924C[3]	Test set, communications analyzer	Used for RF and audio test and setup. Used with CDMACOMM.
SKN6304	CE bus data and audio cable	Connects UUT to junior box interface. Used with CDMACOMM.
SKN4996	Power supply cable	Connects power supply to junior box interface. Used with CDMACOMM.

1. To order in North America, contact Motorola Aftermarket and Accessories Division (AAD) by phone at (800) 422-4210 or FAX (800) 622-6210; Internationally, AAD can be reached by calling (847) 538-8023 or faxing (847) 576-3023.
2. Not available from Motorola.
3. Not available from Motorola. To order, contact Hewlett Packard at 1-800-452-4844.
4. Download from Motorola Global CDMA Service Support Engineering web site http://cdmawwss.css.mot.com/.

Table 2. General Test Equipment and Tools (Continued)

Motorola Model Number[1]	Description	Application
2888482K03	RF cable	Connects UUT to communications analyzer. Used with CDMACOMM.
—[2]	Serial cable	Connects PC to junior box interface. Used with CDMACOMM.
SKN6311	USB cable, type B	Connects UUT to PC and wall power supply. Used with PST.
SPN4716	Wall power supply	Powers UUT. Used with PST.

1. To order in North America, contact Motorola Aftermarket and Accessories Division (AAD) by phone at (800) 422-4210 or FAX (800) 622-6210; Internationally, AAD can be reached by calling (847) 538-8023 or faxing (847) 576-3023.
2. Not available from Motorola.
3. Not available from Motorola. To order, contact Hewlett Packard at 1-800-452-4844.
4. Download from Motorola Global CDMA Service Support Engineering web site http://cdmawwss.css.mot.com/.

Programming

Number Assignment Module (NAM) Programming

The NAM is a portion of the communicator's non-volatile memory (NVM) containing user and network-specific settings. NAM programming can be performed at all levels of service authorization including the carrier and, in some cases, the user.

NAM programming can be done via the programming menu (manual test mode) through the unit's keyboard or by use of Product Support Tool (PST) software.

Flashing

V200 communicator's operating system (OS) software can be upgraded by programming (flashing) the flash electrically-erasable programmable read-only memory (flash EEPROM). Flashing is authorized at Level 3 and higher service centers and carriers.

Motorola PST software is used for flashing at Level 3.

Phasing

Phasing is performed at Level 3 and above service centers and by carriers. It includes alignment of the communicator's RF circuitry.

The computer test mode via Motorola CDMACOMM software is used by Level 3 centers for phasing V200 communicators.

Flexing

Flexing involves configuring the communicator's features and functionality. Since flexing is performed only at Motorola factory service centers, any unit requiring this programming should be referred to a factory service center.

Test Methods

Manual Test Mode (Handset Test Commands)

Handset test commands are used by all levels of service authorization to check audio and RF functionality and for NAM programing. All tests are performed directly from the communicator's keyboard without need for additional test equipment.

For detailed information about manual test mode, refer to the V200 Level 2 Service Manual listed in the Related Publications section toward the end of this manual.

Product Support Tool (PST)

The PST (also referred to as a flashing station) is used by Level 3 and up authorized service facilities to perform NAM programming and to flash the communicator. A personal computer (PC) running Motorola PST software enables data logging of certain (non-proprietary) information, NAM and phonebook programming, flashing (excluding boot loader), and test command interface.

A WIBU security key (parallel-port dongle), power supply, and interconnect cables are required with the PST.

Detailed instructions for use of the PST are provided in the PST User's Guide listed in the Related Publications section toward the end of this manual.

Computer Test Mode (Computer Test Commands)

Audio and RF characteristics are tested and adjusted by use of computer test mode. Level 3 or higher service authorization is required to perform these tests. A PC with Motorola CDMACOMM software, a communications analyzer, bench power supply, wall transformer, junior box test interface adapter (TIA), serial cable, and butt plug cable are needed to set up computer test mode.

Refer to the Troubleshooting section, later in this manual, for computer test mode procedures.

GATE24

The generic automated test environment (GATE) system is used at Motorola factory service centers to perform flashing, flexing, and phasing of V200 communicators. Use of the GATE system is beyond the scope of this publication. Refer questions to the nearest Motorola Service Support Engineer.

Troubleshooting

Introduction

Known good replacement parts and assemblies should be available for troubleshooting by substitution, and for replacement of defective parts or assemblies. Defective circuit boards should be forwarded to the appropriate Motorola service facility for repair. Refer to the V200 Level 3 Supplements listed in the Related Publications section of this manual for a list of replacement part descriptions and part numbers.

Refer to the disassembly instructions located in the V200 Level 2 Service Manual, listed in the Related Publications section of this manual, for instructions on removing parts and assemblies.

Many of the integrated devices used in this equipment are vulnerable to damage from electrostatic discharge (ESD). Ensure adequate static protection is in place when handling, shipping, and servicing the internal components of this equipment.

Testing After Repair

After any repair work, the unit should be thoroughly tested to ensure that it operates correctly. This is especially important if the controller or transceiver boards are replaced.

For general repairs which do not include replacing the controller or transceiver boards, simply placing a call and checking signal strength, and transmit and receive audio quality is normally sufficient.

When a controller or transceiver board is replaced, the unit must have a comprehensive test on a CDMA cellular/PCS compatible communications analyzer. See the following section of this manual for further details. Placing a call on air is usually carried out at this stage to complete the testing procedure.

Computer Test Mode

Initial Setup

- Connect RF and CE BUS connectors to UUT and set power supply to level specified in the individual procedures.
- Refer to Figure 6 for computer test mode equipment setup.
- Before selecting Suspend or other suspended commands for the communicator, Data Mode must be selected first. Select Data Mode. If Data Mode step was successful, a message displaying “Returned From Radio: data stream xxx” will appear in the status window. Only then, can you proceed with entering the Suspend command.
- Select the Suspend command. If the Suspend command was successful, the status window will turn green and display data sent and returned from the UUT. The window will also display a message “P2K HEAD COMMAND =SUSPEND = = >SUCCESSFUL”.
- If the SUSPEND command was unsuccessful, the status window will turn red and display “Failed. Response = 0000,0”. If any subsequent suspended commands sent to the UUT fail, the status window will turn red and display a failed message.

- After the successful entry of Data Mode and Suspend, select and/or set the fields highlighted in yellow (white) as shown in the screen image corresponding to the procedure being performed.

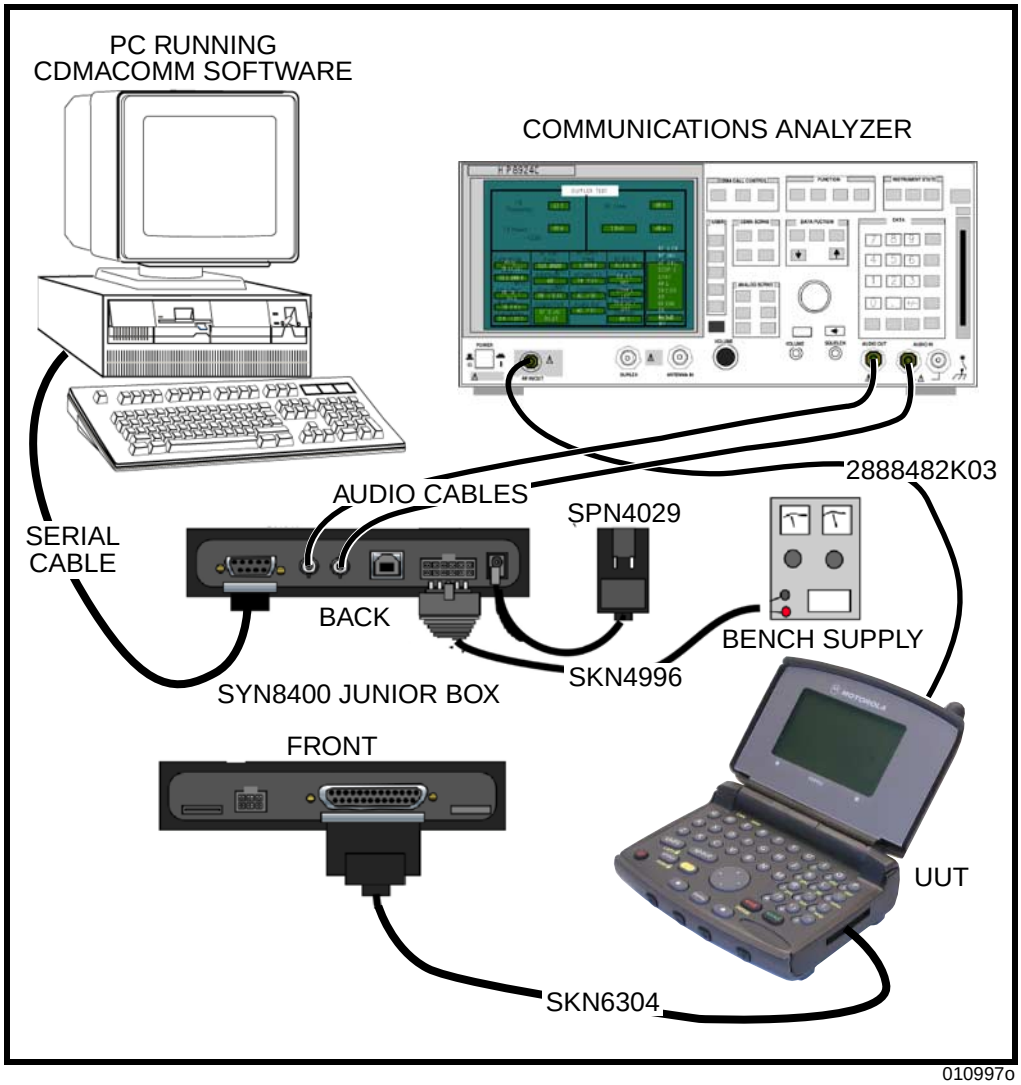


Figure 6. Computer test mode equipment setup

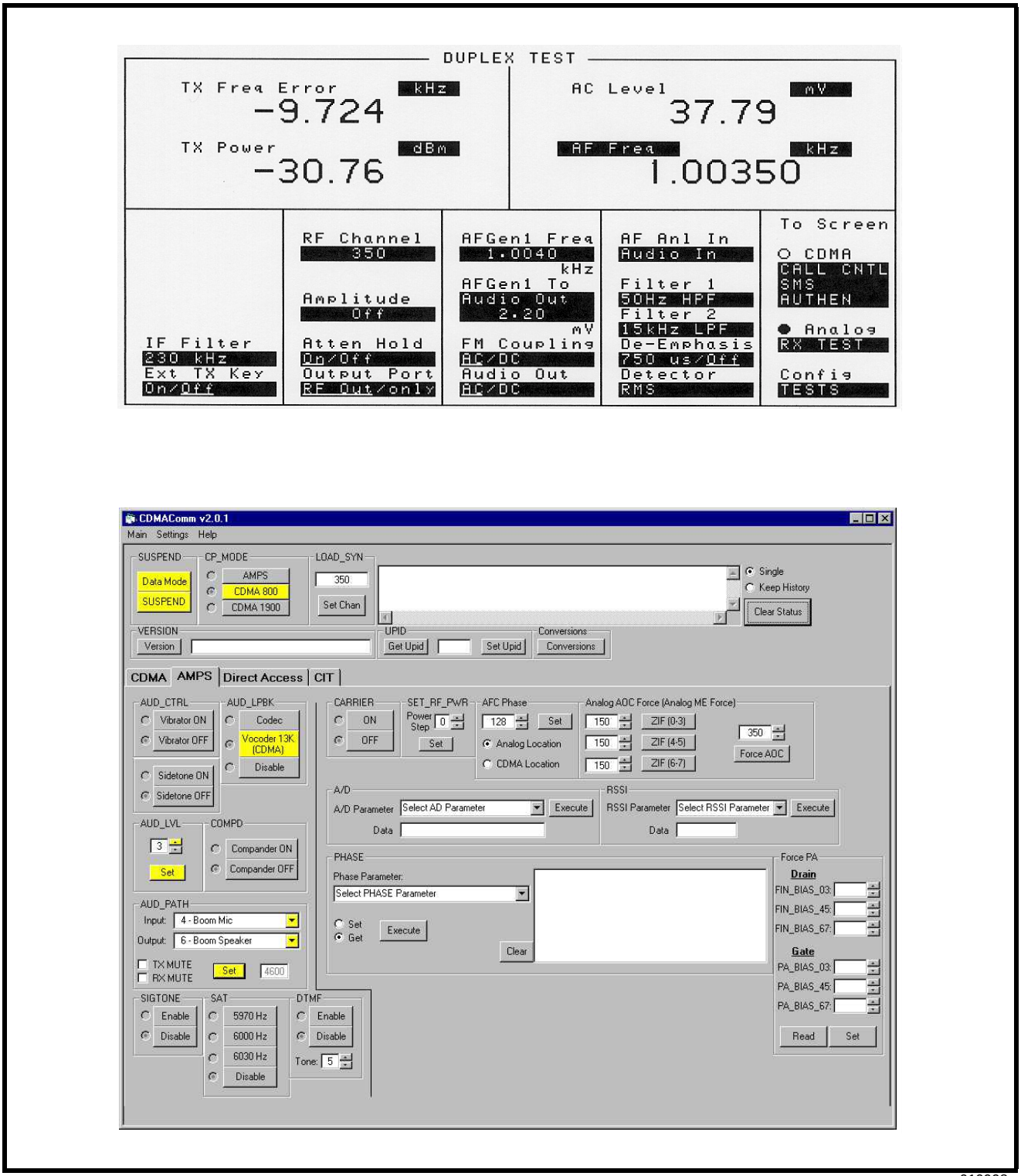
Loopback (Boom Mic Speaker)

- Select the SUSPEND button to put the phone into Suspend Mode.
- Select CDMA 800 button under CP_MODE to put the UUT in 800 CDMA Mode.
- Under AUD_PATH command, set Input to 4 and Output to 6 to route Audio to/ from Headset Jack. Under the AUD_LPB heading, select Vocoder 13K (CDMA) button to put the phone into full rate loopback mode.
- Set AUD_LVL to level 3.
- See Figure 7.
- Connect the audio out (boom speaker) of the boom/audio plug through a 32 Ohm resistor to boom ground.
- Inject an audio tone of 1004Hz at 2.2 mVrms into the audio in (boom mic). within the specifications listed in Table 3.

Table 3. Loopback Test Values

Parameter	Lower Limit	Upper limit
Mic bias	2.0 Vdc	2.6 Vdc
Loopback	28.2 mVac	56.4 mVac
Jack sense	1	1
Headset jack ground sense	1	1

- Set test set to 50Hz High Pass, 15KHz Low Pass filtering with de-emphasis turned OFF. Measure the RMS audio signal at the audio out (boom speaker). The result should be within the specifications listed in Table 3.



010998o

Figure 7. Loopback

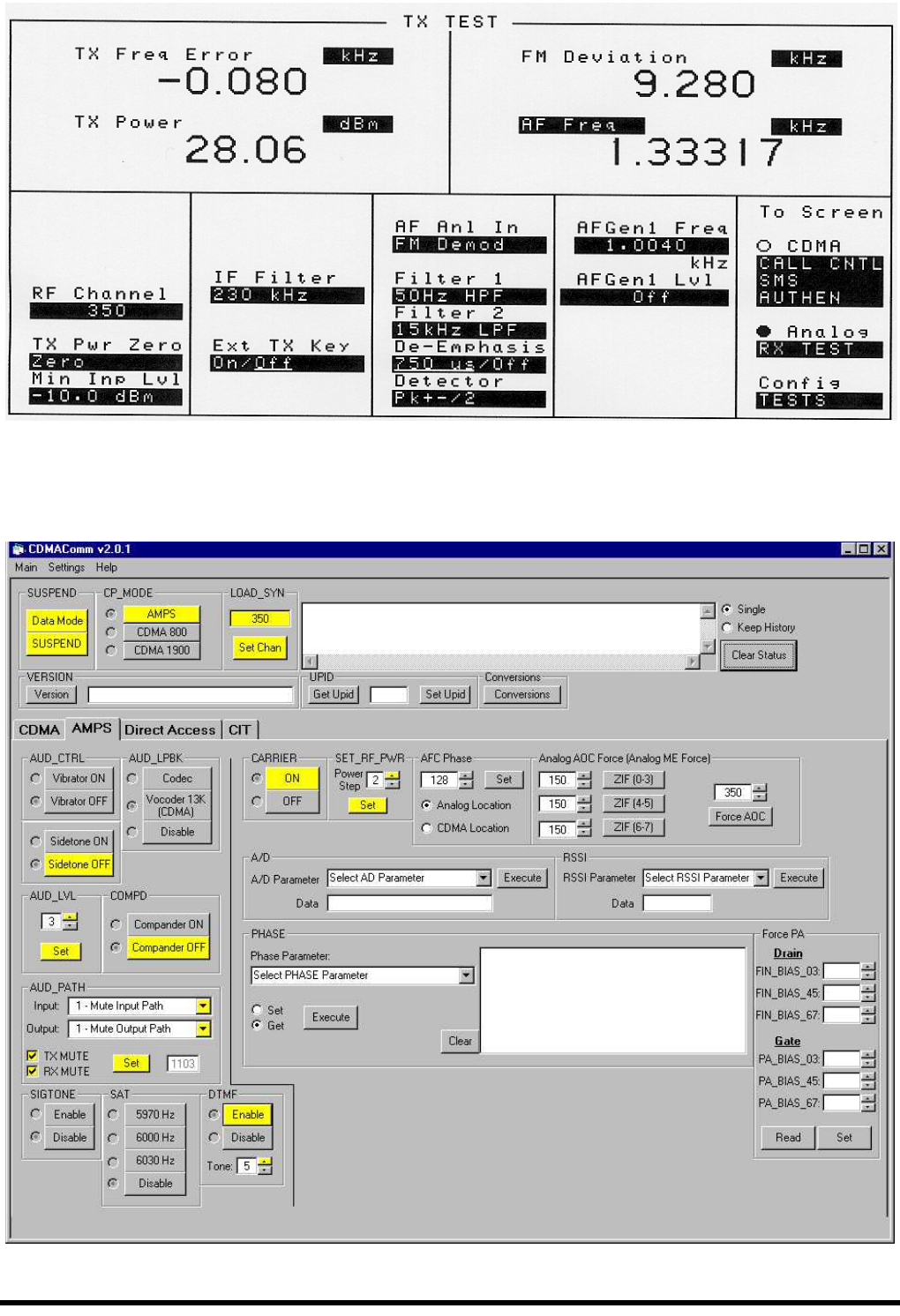
DTMF Deviation

This phasing procedure is used to phase the deviation that results from normal audio levels.

Table 4. DTMF Deviation Test Values

Parameter	Value
Test Voltage at Battery Terminals	3.60V
Test Voltage at Acc. Connector	4.40V
TEST_CHANNEL	350
MINIMUM_GAIN_SETTING	0
MAXIMUM_GAIN_SETTING	15
LOW_LIMIT	8.60kHz
TARGET	9.00kHz
HIGH_LIMIT	9.50kHz

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL
- Under AUD_PATH heading, set Input to 1 and Output to 1, TX MUTE, RX MUTE and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander OFF.
- Under DTMF, select Enable and choose DTMF tone 5.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 8.
- The test set should be configured as follows: 50 Hz HPF, 15 kHz LPF, 750 µSec de-emphasis. Set equipment to measure FM Deviation.
- Measure the peak frequency deviation in kHz.



010999o

Figure 8. DTMF deviation

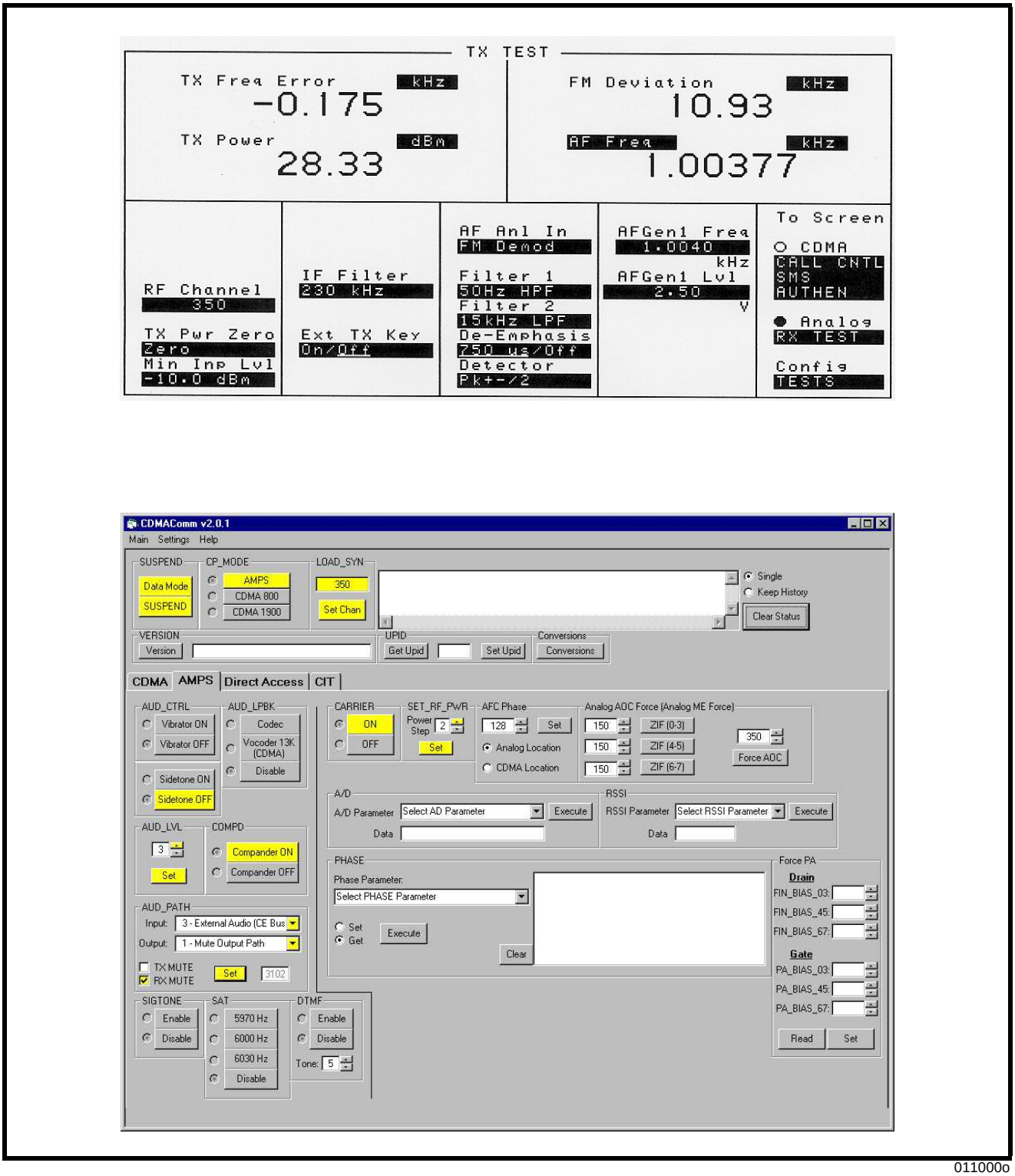
Maximum Deviation

This phasing procedure is used to insure that the communicator will produce an FM deviation no greater than a specified amount, even in the event that the communicator modulator is presented with a large audio signal.

Table 5. Maximum Deviation Test Values

Parameter	Value
Test Voltage at Battery Terminals	3.60V
Test Voltage at Acc. Connector	4.40V
TEST_CHANNEL	350
MINIMUM_GAIN_SETTING	0
MAXIMUM_GAIN_SETTING	15
LOW_LIMIT	10.5kHz
TARGET	11.0kHz
HIGH_LIMIT	11.5kHz

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 3 and Output to 1, RX MUTE and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander ON.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 9.
- The test set should be configured as follows: 15 kHz LPF, 50Hz HPF, 750 µSec de-emphasis. Inject a 1004 Hz, 2.5V rms audio signal into the audio in pin of the accessory connector. Set equipment to measure FM deviation.
- Measure the peak frequency deviation in kHz (deviation).



011000o

Figure 9. Maximum deviation

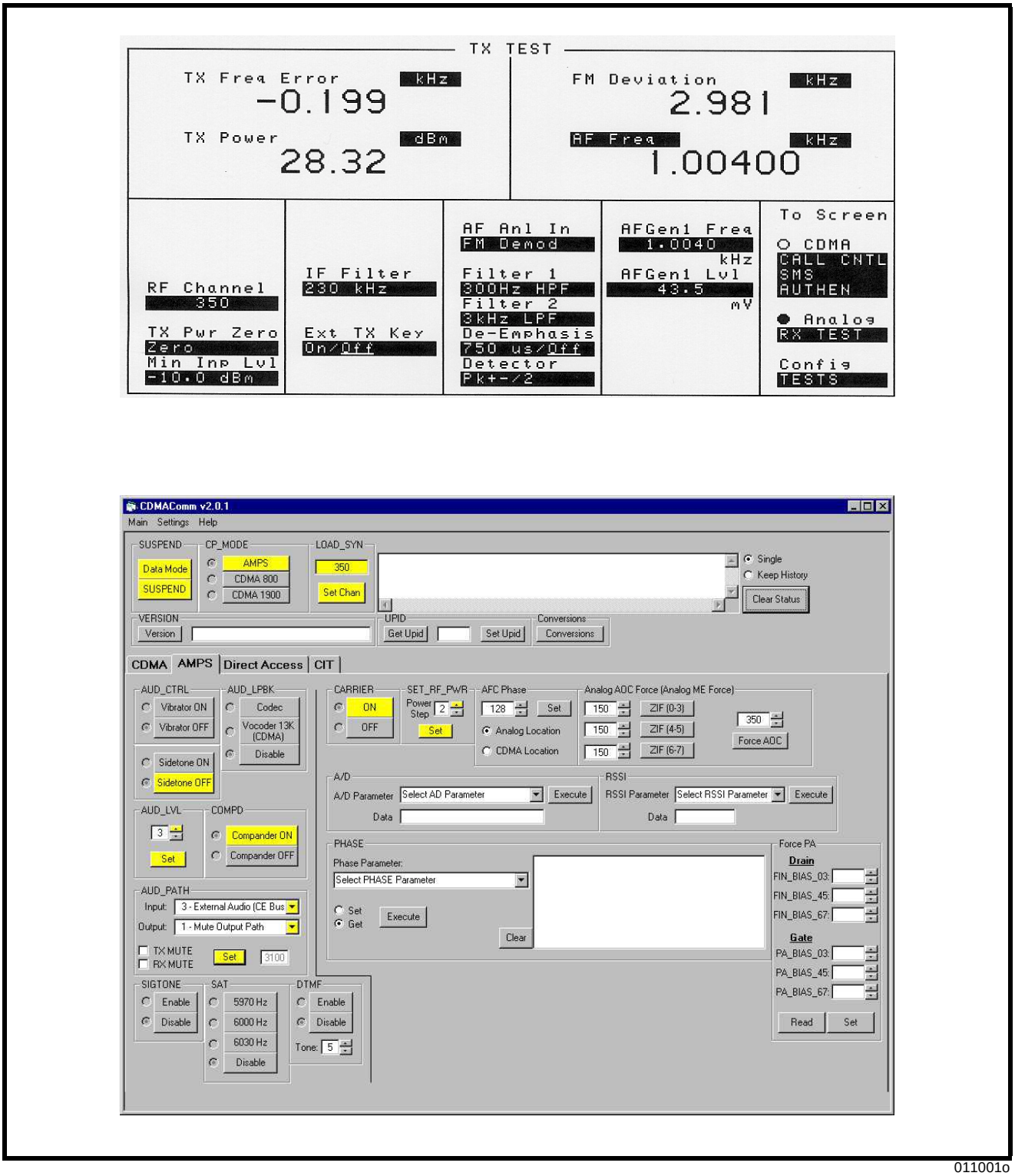
Microphone Audio Deviation

This phasing procedure is used to phase the deviation that results from normal audio levels.

Table 6. Microphone Audio Deviation Test Values

Parameter	Value
Test Voltage at Battery Terminals	3.60V
Test Voltage at Acc. Connector	4.40V
TEST_CHANNEL	350
MINIMUM_GAIN_SETTING	0
MAXIMUM_GAIN_SETTING	15
LOW_LIMIT	2.8kHz
TARGET	2.95kHz
HIGH_LIMIT	3.1kHz

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL
- Under AUD_PATH heading, set Input to 3 and Output to 1, RX MUTE and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander ON.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 10.
- The test set should be configured as follows: 300 Hz HPF, 3 kHz LPF, de-emphasis OFF. Inject a 1004 Hz, 43.5 mV rms audio signal in to the audio in pin on the accessory connector. Set equipment to measure FM deviation.
- Measure the peak frequency deviation in kHz.



011001o

Figure 10. Microphone audio deviation

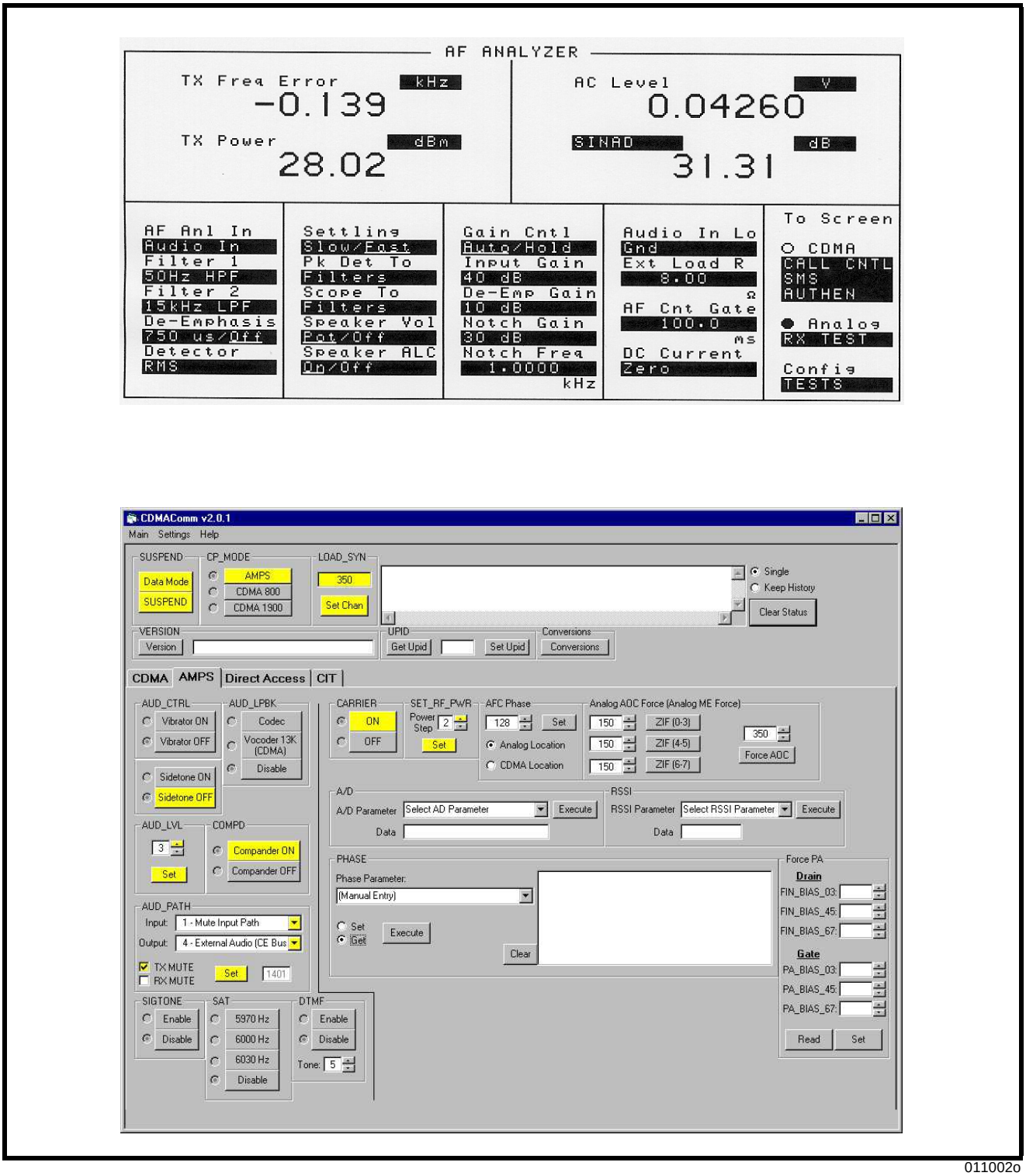
RX Audio Gain

This phasing procedure is used to phase the deviation that results from normal audio levels.

Table 7. RX Audio Gain Test Values

Parameter	Value
Test Voltage at Battery Terminals	3.60V
Test Voltage at Acc. Connector	4.40V
TEST_CHANNEL	350
MINIMUM_GAIN_SETTING	0
MAXIMUM_GAIN_SETTING	7
LOW_LIMIT	34.4mV
TARGET	40mV
HIGH_LIMIT	45.6mV

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL
- Under AUD_PATH heading, set Input to 1 and Output to 4, RX MUTE and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander ON.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 11.
- The test set should be configured as follows: 15 kHz LPF, 50 Hz HPF, 750 µSec de-emphasis. Input a -50 dBm signal modulated with a 1 kHz audio tone at 2.9 kHz peak deviation into the UUT receiver. Set the audio analyzer to measure RMS audio input
- Measure the audio level from the audio out pin of the accessory connector.



011002o

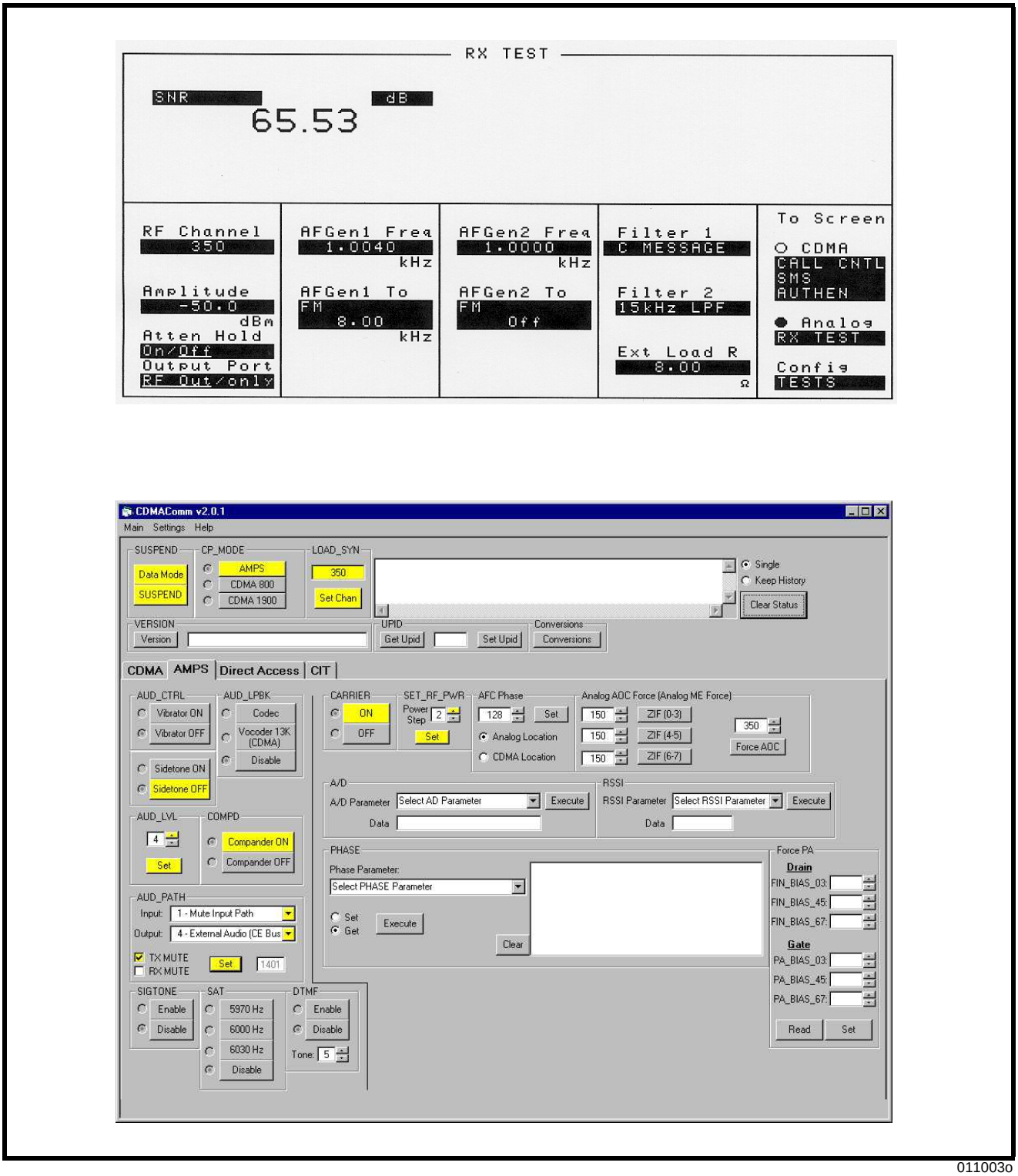
Figure 11. RX audio gain

RX Audio Muting

Table 8. RX Audio Muting Test Values

Test Limits	Level (dB)
Upper limit	-40.0
Lower limit	-90.0

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 1 and Output to 4, TX MUTE and select SET.
- Set AUD_LVL to level 4.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander ON.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 12.
- Set up the test set as follows: apply an analog RF input signal at -50 dBm modulated with a 1004 Hz tone at 8 kHz peak deviation. Set the audio analyzer for 15 kHz LPF, C-message filtering, de-emphasis OFF, and RMS detector.
- Measure the received audio signal at the audio out pin of the accessory connector. Reference the audio analyzer to the 1004 Hz tone. Use AUD_PATH to select path “1103h”. Measure the change in received audio level in dB with respect to the reference. The measured change in signal level must meet specifications in Table 8.



011003o

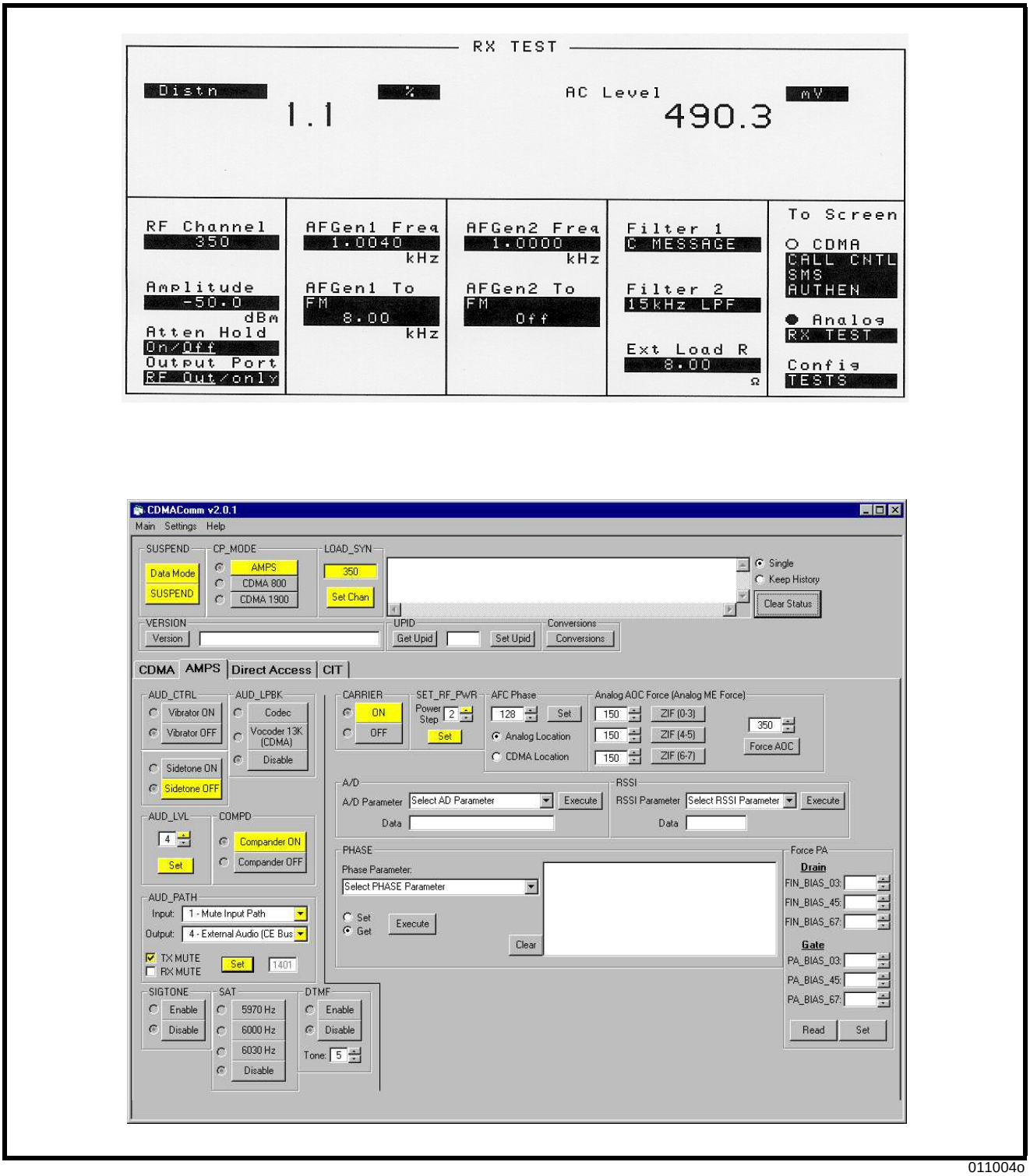
Figure 12. RX audio muting

RX Distortion

Table 9. RX Distortion Test Values

Test Limits	Distortion Level (%)	Distortion Level (dB)
Upper limit	5.0	-26.0
Lower limit	0.1	-60.0

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 1 and Output to 4, TX MUTE and select SET.
- Set AUD_LVL to level 4.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander ON.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 13.
- Set up the test set as follows: apply an analog RF input signal at -50 dBm modulated with a 1004 Hz tone at 8 kHz peak deviation. Set the audio analyzer for 15 kHz LPF, C-message filtering, de-emphasis OFF, and RMS detector. Measure the distortion of the received audio signal at the audio out pin on the accessory connector. Distortion must not exceed the specifications defined in Table 9.



011004o

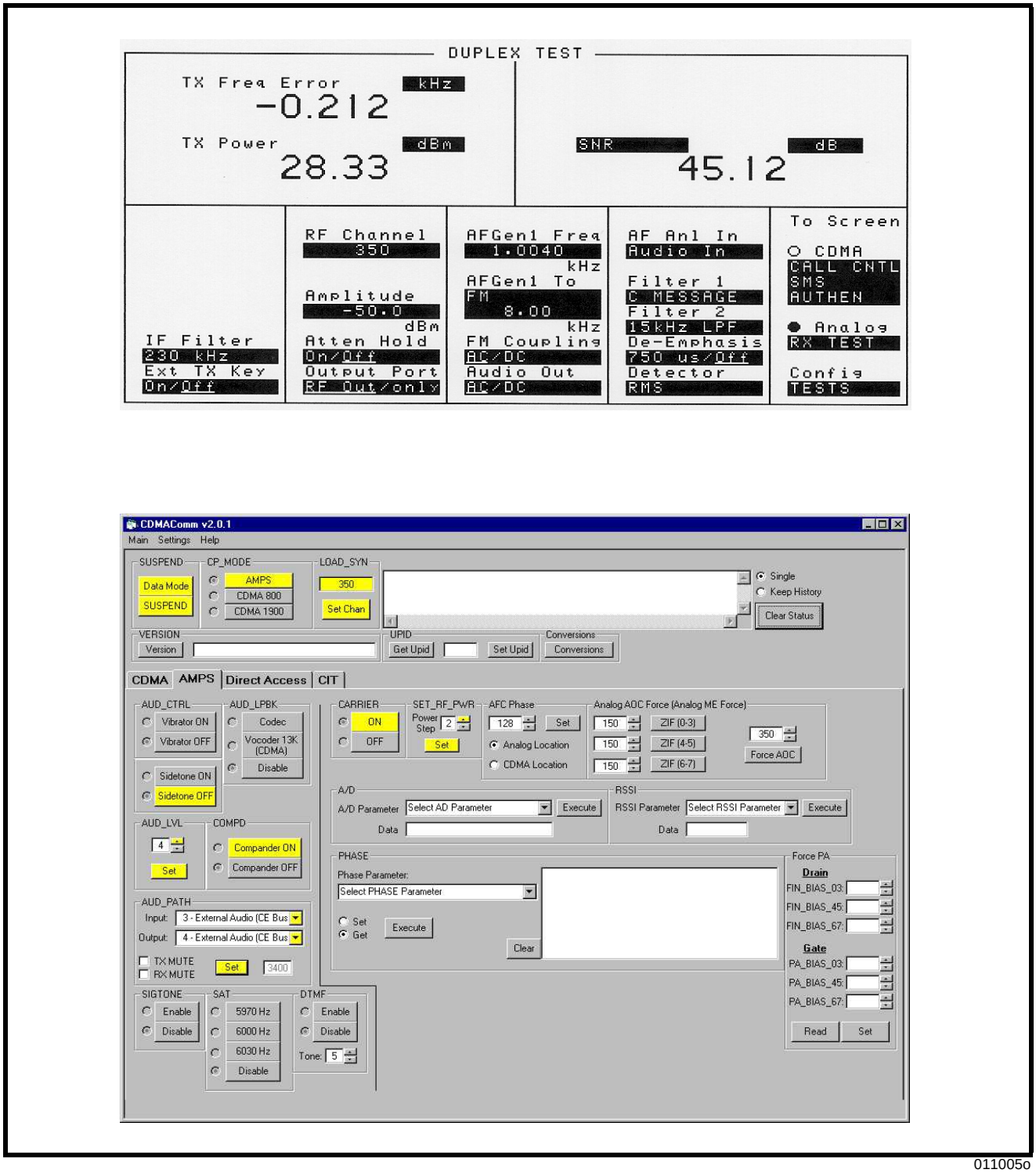
Figure 13. RX distortion

RX Hum and Noise

Table 10. RX Hum and Noise Test Values

RX Hum & Noise	Level (dB)
Upper limit	-38
Lower limit	-99

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL
- Under AUD_PATH heading, set Input to 3 and Output to 4, and select SET.
- Set AUD_LVL to level 4.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander OFF.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 14.
- Set up the test set as follows: apply an analog RF input signal at -50 dBm modulated with a 1004 Hz at 8 kHz deviation. Set the audio analyzer for 15 kHz LPF, C-message filtering, de-emphasis OFF, and RMS detector.
- Measure the received audio signal at the audio out pin of the accessory connector. Reference the audio analyzer to the 1004 Hz tone. Remove the 1004Hz modulated tone from the RF input signal. Measure the change in received audio level in dB with respect to the reference. The measured change in signal level must meet the specifications defined in Table 10.



011005o

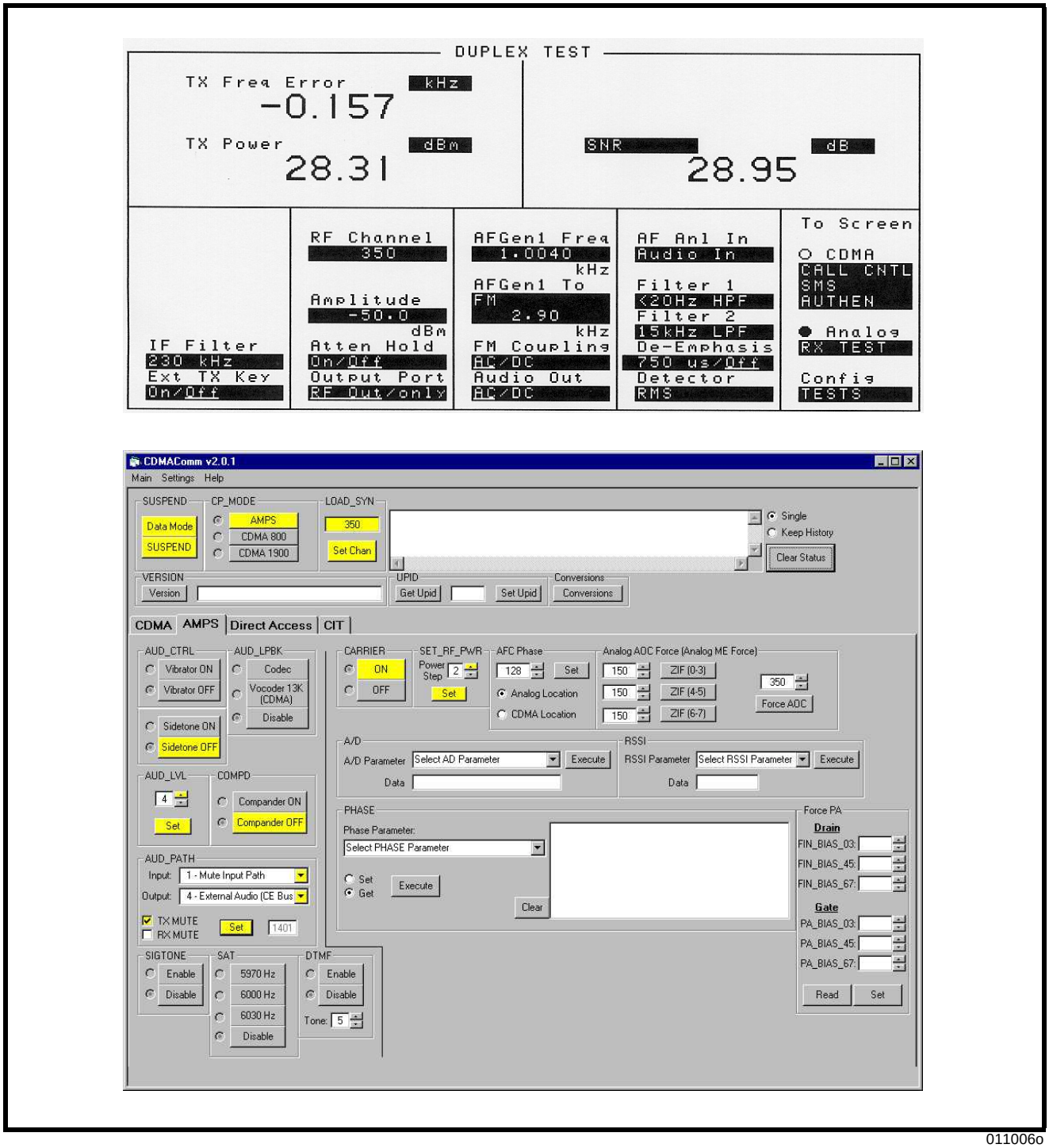
Figure 14. RX hum and noise

RX Response

Table 11. RX Response Test Values

Test Limits	Level at 300 Hz	Level at 300 kHz
Upper limit	11.5	-8.5
Lower limit	4.4	-15.6

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL
- Under AUD_PATH heading, set Input to 1 and Output to 4, TX MUTE and select SET.
- Set AUD_LVL to level 4.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander OFF.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 15.
- Set up the test set as follows: apply an analog RF input signal at amplitude -50 dBm modulated with a 1004 Hz tone at 2.9 kHz peak deviation. Set the audio analyzer for 15 kHz LPF, 20 Hz HPF, de-emphasis OFF, and RMS Detector.
- Measure the received audio at the audio out pin on the accessory connector. Reference the audio analyzer to the 1004 Hz tone. Vary the RF input signal modulation frequency to 300 Hz and 3 kHz. Measure the change in received signal level with respect to the reference. The measured change in signal level must be within the specifications defined in Table 11.



011006o

Figure 15. RX response

SAT Deviation

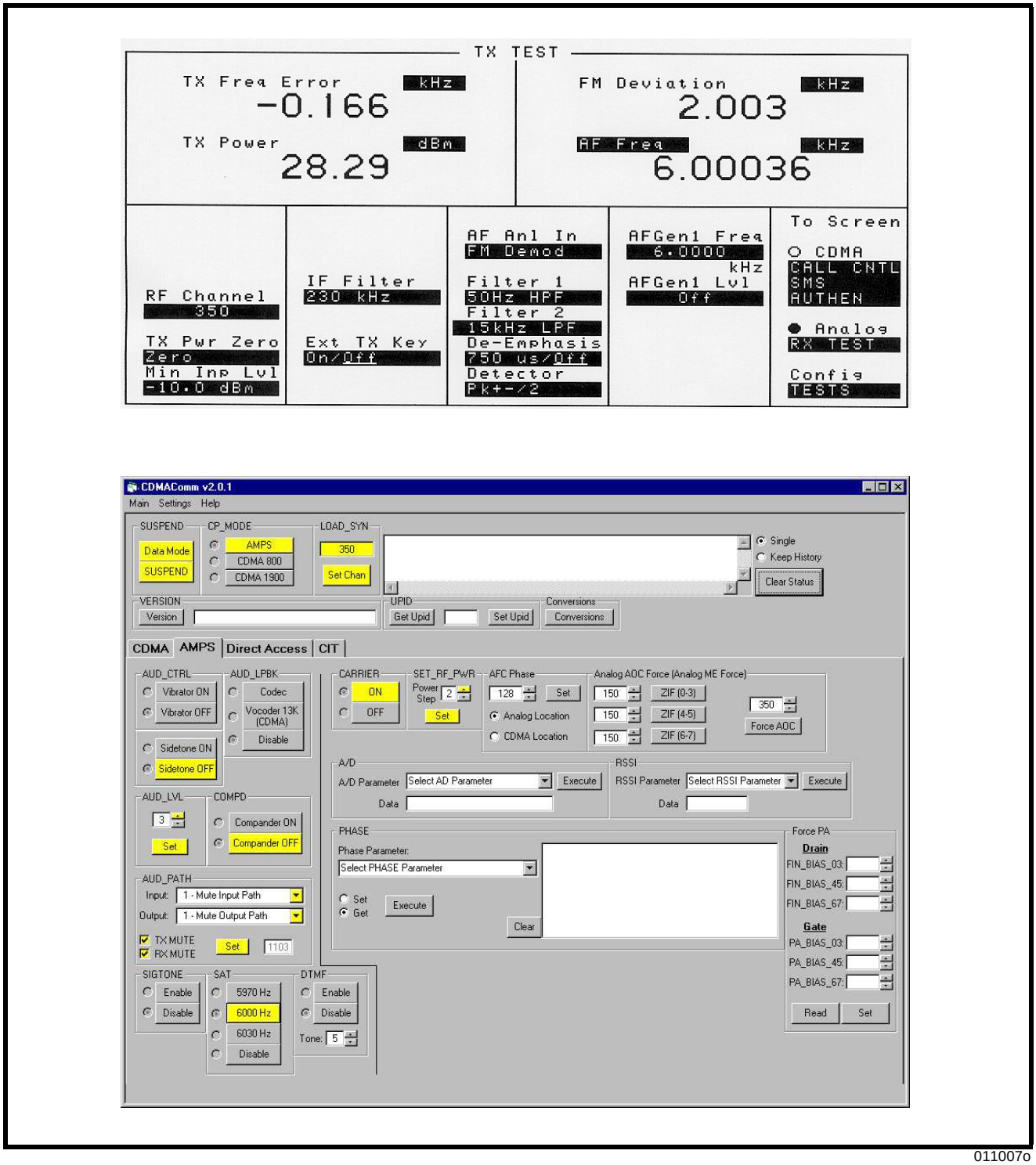
This phasing procedure is used to phase the deviation that results from normal audio levels.

Table 12. SAT Deviation Test Values

Parameter	Value
Test Voltage at Battery Terminals	3.60V
Test Voltage at Acc. Connector	4.40V
TEST_CHANNEL	350
MINIMUM_GAIN_SETTING	0
MAXIMUM_GAIN_SETTING	15
LOW_LIMIT	1.9kHz
TARGET	2.0kHz
HIGH_LIMIT	2.1kHz

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL
- Under AUD_PATH heading, set Input to 1 and Output to 1, TX MUTE, RX MUTE and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander OFF.
- Under SAT heading, select 6000 Hz SAT Tone.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 16.
- The test set should be configured as follows: 6 kHz BPF filtering, de-emphasis OFF. Input a -50 dBm signal modulated with a 6kHz tone at 2 kHz peak deviation into the audio-in pin of the UUT. Measure the peak frequency deviation in kHz.

Different test sets may require different filter settings for this test due to their internal filtering. The HP8924 requires calibration for this test due to the tolerances of the 6 kHz BPF.



011007o

Figure 16. SAT deviation

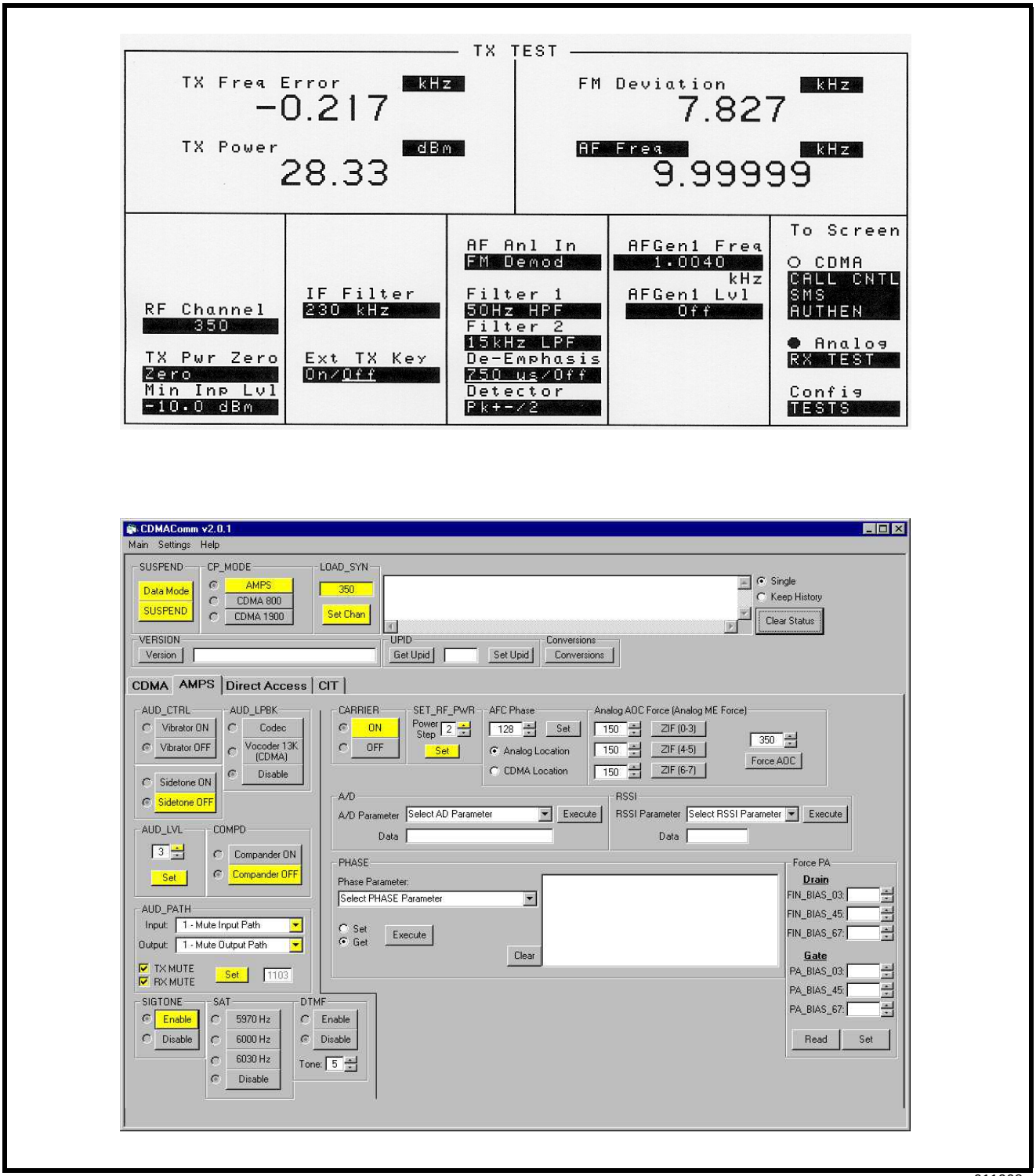
Signaling Tone Deviation

This phasing procedure is used to phase the deviation that results from normal audio levels.

Table 13. Signaling Tone Deviation Test Values

Parameter	Value
Test Voltage at Battery Terminals	3.60V
Test Voltage at Acc. Connector	4.40V
TEST_CHANNEL	350
MINIMUM_GAIN_SETTING	0
MAXIMUM_GAIN_SETTING	15
LOW_LIMIT	7.6kHz
TARGET	8.0kHz
HIGH_LIMIT	8.4kHz

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 1 and Output to 1, TX MUTE RX MUTE and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander OFF.
- Under SIGTONE heading, select Enable.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 17.
- The test set should be configured as follows: 15 kHz LPF, 50Hz HPF, 750 µSec de-emphasis. Set equipment to measure FM deviation.
- Measure the peak frequency deviation in kHz.



011008o

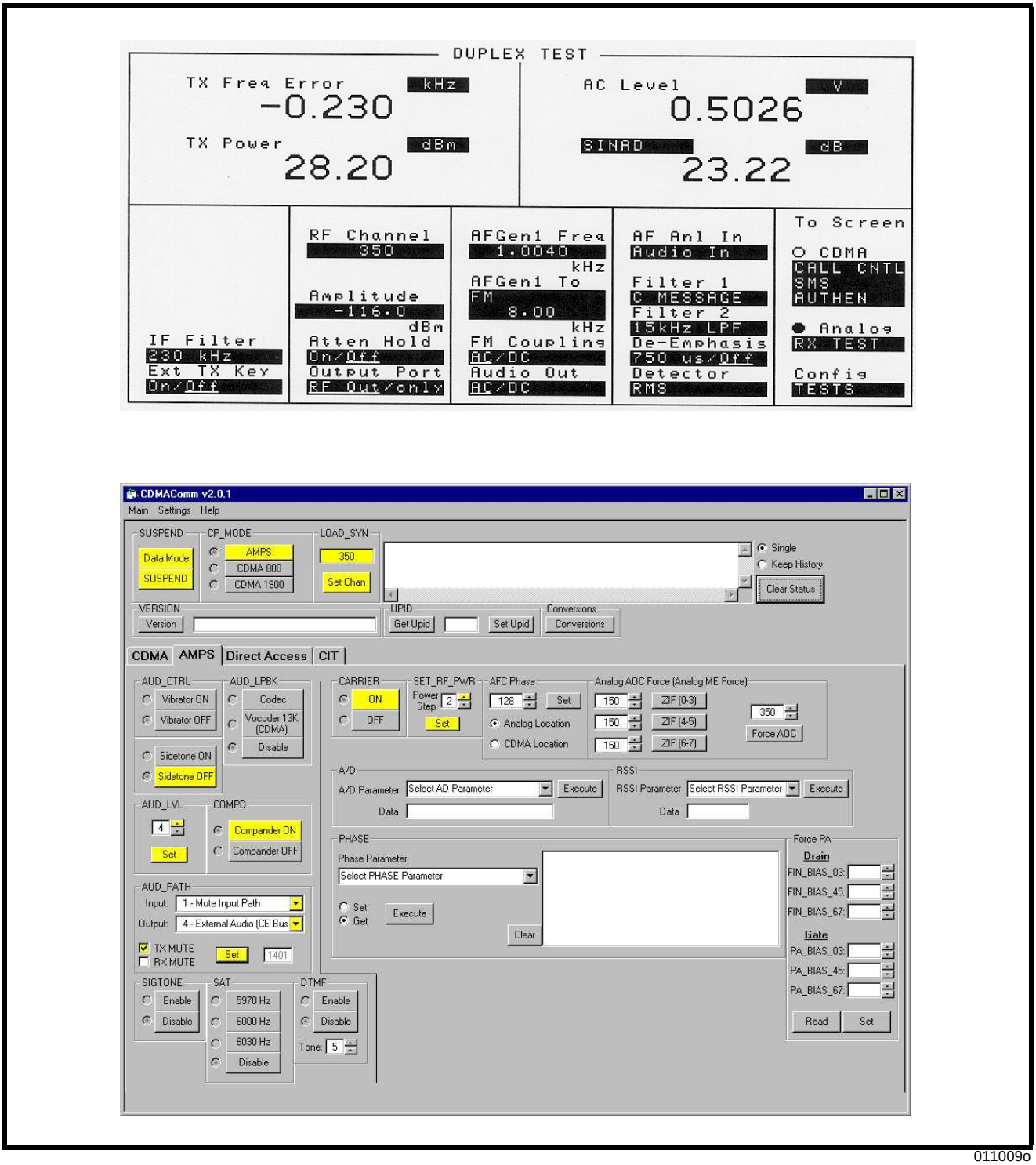
Figure 17. Signaling tone deviation

RX Sensitivity (SINAD)

Table 14. RX Sensitivity (SINAD) Test Values

Parameter	Value
Lower limit	12
Upper limit	35
Channel (1)	991
Channel (2)	350
Channel (3)	799

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 1 and Output to 4, TX MUTE and select SET.
- Set AUD_LVL to level 4.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander ON.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 18.
- Set up the test set as follows: apply an analog RF input signal at -116 dBm modulated with a 1004 Hz tone at 8 kHz peak deviation. Set the audio analyzer for 15 kHz LPF, C-message filtering, de-emphasis OFF, and RMS detector.
- Measure SINAD of the received audio signal at the audio out pin on the accessory connector. The measured SINAD must meet the specifications defined in Table 14.



011009o

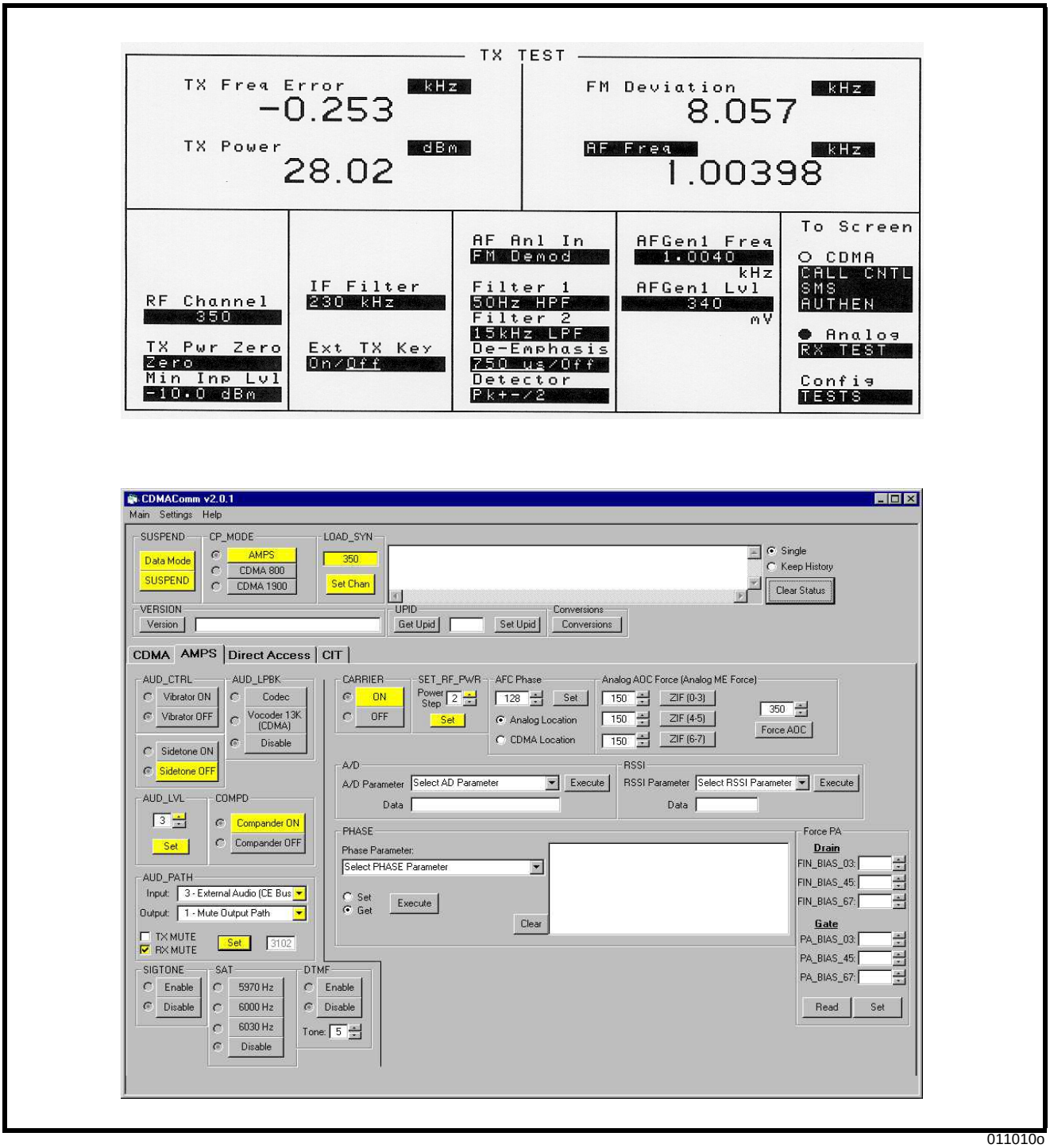
Figure 18. RX sensitivity (SINAD)

TX Audio Muting

Table 15. TX Audio Muting Test Values

Test Limits	Level (dB)
Upper limit	-40.0
Lower limit	-90.0

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 3 and Output to1, RX MUTE and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander ON.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 19.
- Set up the test set as follows: set the analyzer to 750 µSec de-emphasis, 15 kHz LP filtering.
- Detector: Peak (+/-) /2
- Input a 1004 Hz TX modulation signal to the audio in pin of the accessory connector at a level to get 8 kHz peak deviation. Set the audio analyzer for C-message filtering and RMS detector.
- Measure the demodulated output from the modulation analyzer. Reference the audio analyzer to the 1004 Hz tone.
- Use AUD_PATH to select path “1103h”.
- Measure the change in dB level on the audio analyzer with respect to the reference. Measured change must meet the specification defined in Table 15.



011010o

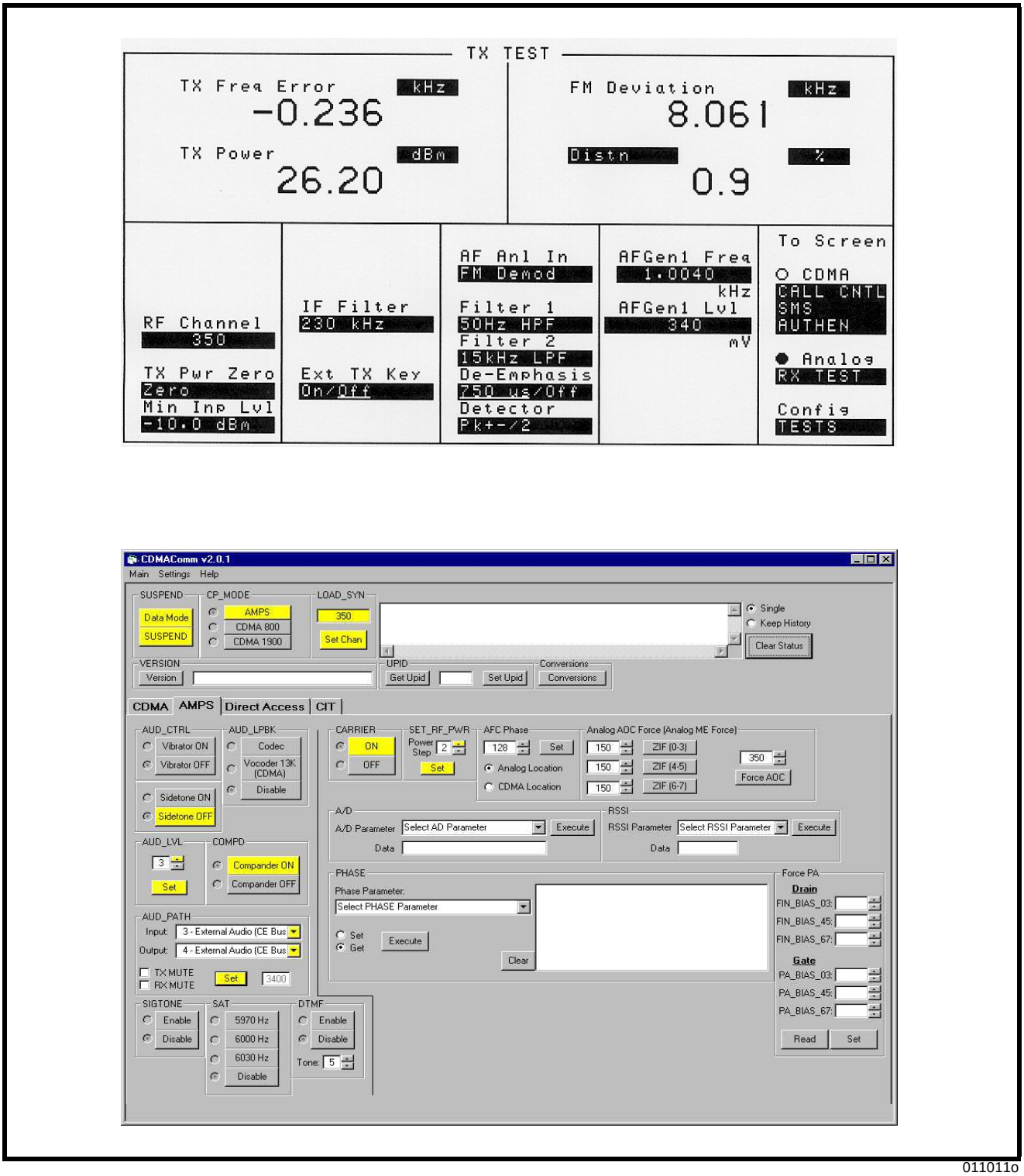
Figure 19. TX audio muting

TX Distortion

Table 16. TX Distortion Test Values

Test Limits	Distortion Level (%)	Distortion Level (dB)
Upper limit	5.0	-26.0
Lower limit	0.1	-60.0

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 3 and Output to 4 and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander ON.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 20.
- Set up the test set as follows: Set the Analyzer for 50 Hz HPF, 15 kHz LPF, and 750 µSec de-emphasis.
- Detector: Peak (+/-) /2
- Input a 1004 Hz modulating signal to the audio in pin of the Accessory connector at a level to get 8 kHz peak deviation. Set the analyzer to C-message filtering and the detector to RMS. Measure the distortion.
- The measured distortion must be less than the specifications defined in Table 16.



011011o

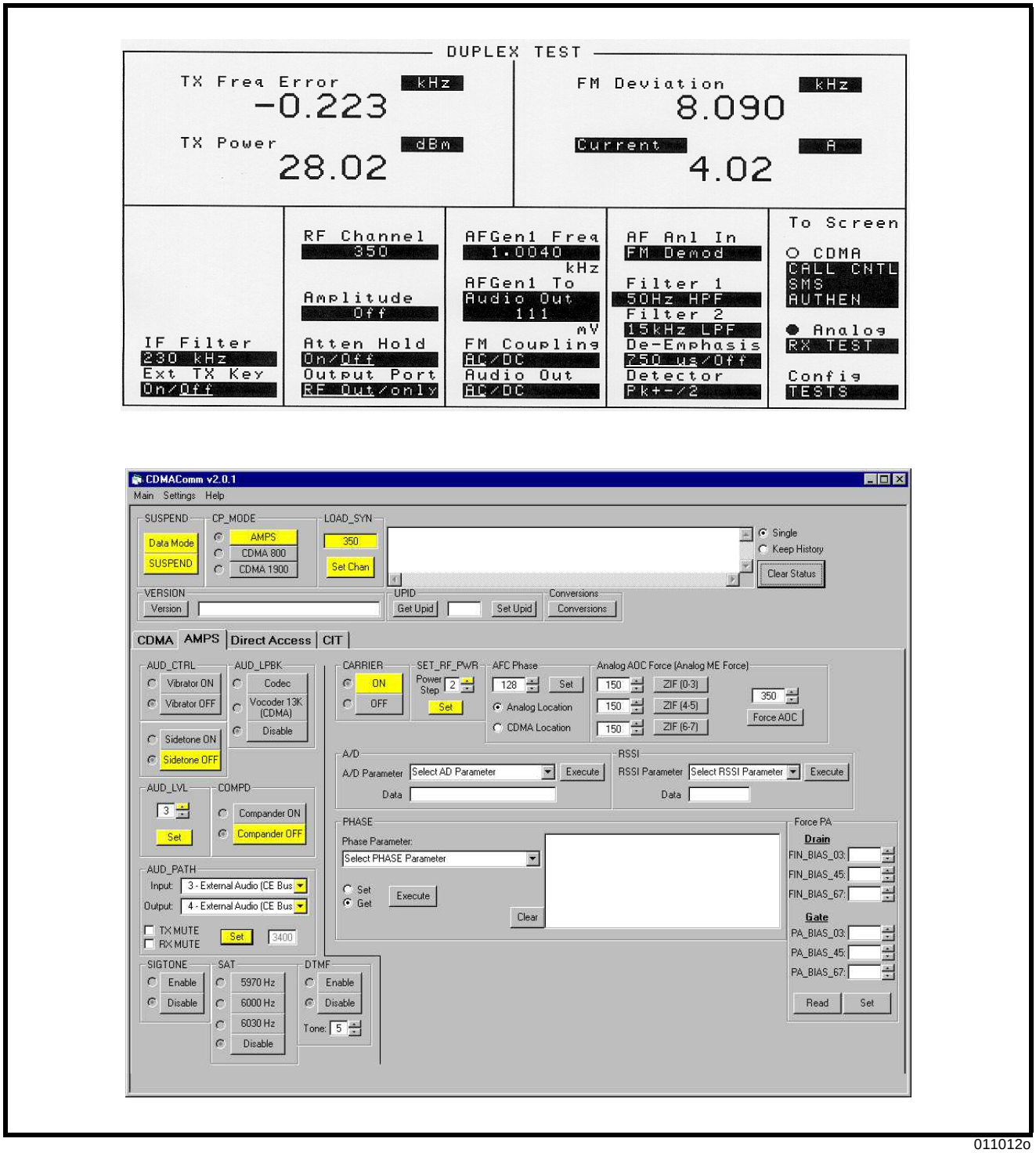
Figure 20. TX distortion

TX Hum and Noise

Table 17. TX Hum and Noise Test Values

TX Hum and Noise	Level (dB)
Upper limit	-38
Lower limit	-90

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 3 and Output to 4 and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.
- Under COMPD, select Compander OFF.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 21.
- Set up the test set as follows: 750 µSec de-emphasis, 50 Hz HPF, 15 kHz LPF
- Detector: Peak (+/-) /2.
- Input a 1004Hz modulation signal to the audio-in pin of the accessory connector at a level to get 8 kHz peak deviation.
- Change the analyzer for C-message filtering and RMS detector.
- Measure the FM deviation. Reference the audio analyzer to the 1004 Hz tone. Remove the TX modulation signal from the audio in pin of the accessory connector and measure the change in dB level on the audio analyzer with respect to the reference. The measured change in signal level must meet the specifications defined in Table 17.



011012o

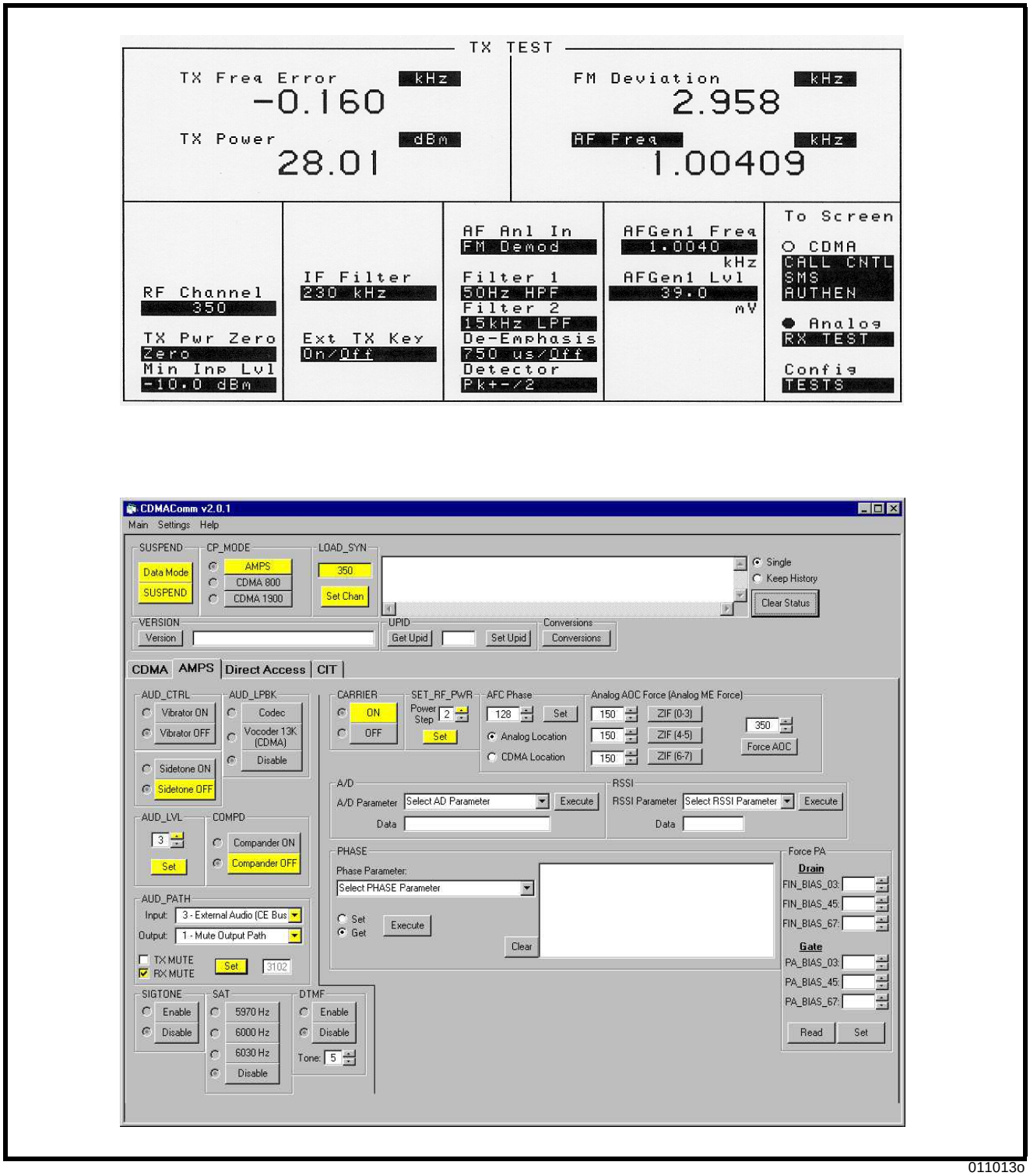
Figure 21. TX hum and noise

TX Response

Table 18. TX Response Test Values

Test Limits	Level at 300 Hz (dB)	Level at 3 kHz (dB)
Upper limit		10.5
Lower limit	-13.5	4.9

- Select the SUSPEND button to put the phone into Suspend Mode.
- Under CP_MODE, select the AMPS button to place the transceiver into Analog call processing mode.
- Under the LOAD_SYN heading, enter desired channel and select the Set Chan button to tune the UUT to the TEST_CHANNEL.
- Under AUD_PATH heading, set Input to 3 and Output to 1, RX MUTE and select SET.
- Set AUD_LVL to level 3.
- Under AUD_CTRL, select Sidetone OFF.Under COMPD, select Compander OFF.
- Under SET_RF_PWR, set transceiver to power step 2.
- Under CARRIER, select ON to enable the analog carrier.
- See Figure 22.
- Set up the test set as follows: set the analyzer for 50 Hz HPF and 15 kHz LPF
- Detector: Peak (+/-) /2.
- Input a 1004Hz modulating signal to the audio in pin of the accessory connector at a level to get 2.9 kHz peak deviation. Measure the FM deviation.
- Change the analyzer detector to RMS.
- Reference the audio analyzer to the 1004 Hz tone. Vary the TX modulation frequency to 300 Hz and 3 kHz.
- Measure the change in dB level on the audio analyzer with respect to the reference. The measured change must meet the specifications defined in Table 18.



011013o

Figure 22. TX response

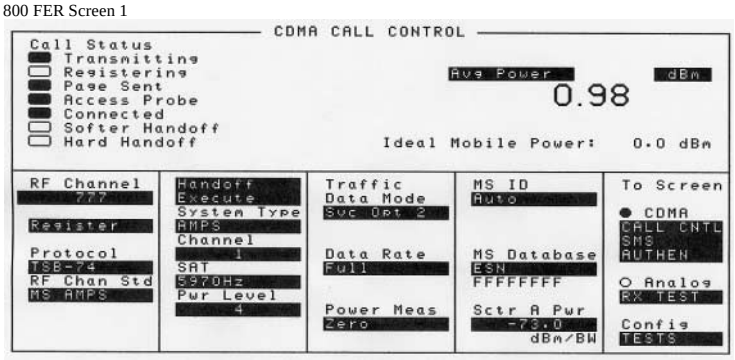
Receiver Sensitivity (FER)

Table 19. Receiver Sensitivity (FER) Test Values

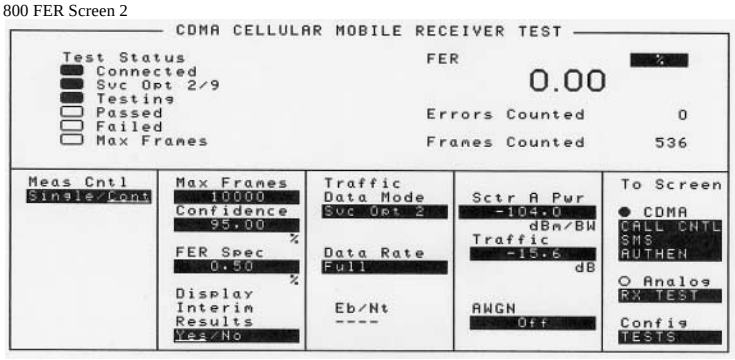
Parameter	CDMA	PCS
LOW_CHANNEL	1013	25
MID_CHANNEL	350	650
HIGH_CHANNEL	735	1175
13K_DATA_TRAF_LEVEL	-12.3 dB	-12.3 dB
RX_LEVEL	-104 dBm (-102 dBm @ HOT thermal)	-104 dBm (-102 dBm @ HOT thermal)
FER_LIMIT	0.5% FER	0.5% FER

- Phone should be powered on and in a 13K/RateSet1 CDMA Full Rate Data Call.
- Depending on which Data Rate, set the Traffic Level accordingly to either 13KDATA_TRAF_LEVEL.
- See Figure 23, Screen 1.
- When the call is established, reduce the RF amplitude to RX_LEVEL.
- See Figure 23, Screen 2.
- Measure FER over a maximum of 10000 frames to a confidence level of 95%.
- The Frame Error Rate (FER) may not exceed FER_LIMIT as specified in Table 19.

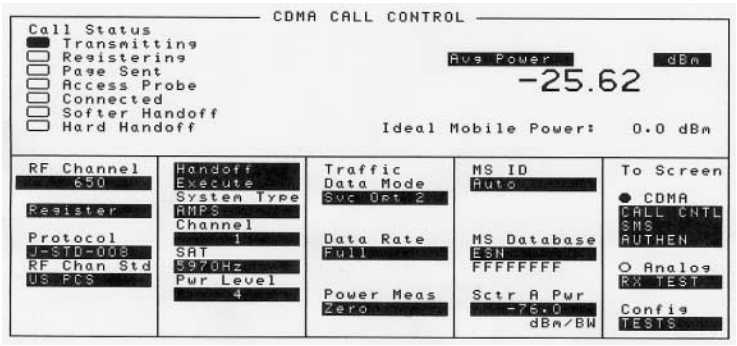
800 FER Screen 1



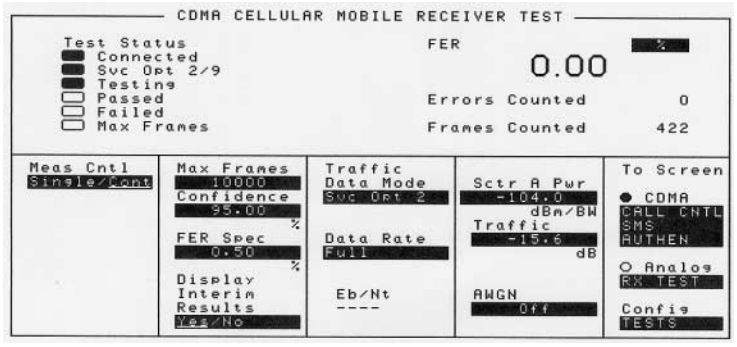
800 FER Screen 2



PCS FER Screen 1



PCS FER Screen 2



011014o

Figure 23. Receiver sensitivity (FER)

Receiver Sensitivity in the Presence of Noise (FER in AWGN)

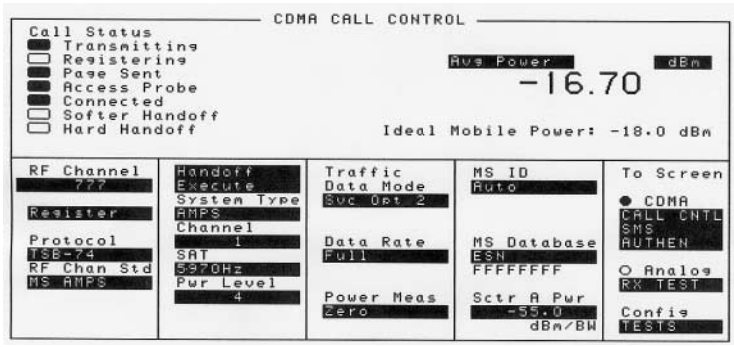
The test channels are given below.

Table 20. Receiver Sensitivity in the Presence of Noise Test Values

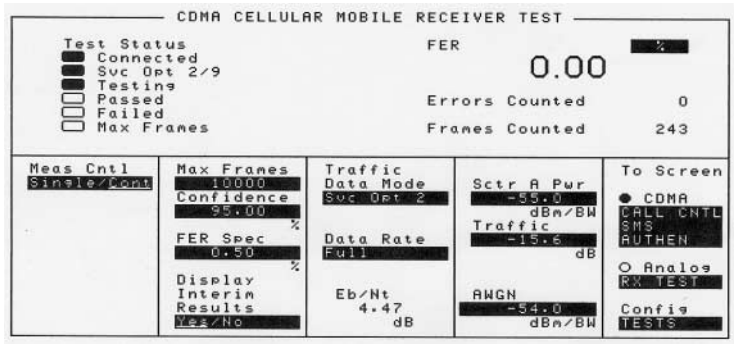
Parameter	CDMA	PCS
Test voltage at battery terminals	3.60V	3.60V
Test voltage at accessory connector	4.40V	4.40V
FER_LIMIT	0.5% FER	0.5% FER
RX_TEST_LEVEL	-55 dBm	-55 dBm
AWGN_LEVEL	-54 dBM	-54 dBm
13KDATA_TRAF_LEVEL	-12.4 dB	-12.3 dB
Low test channel	1013	25
Middle test channel	350	650
High test channel	735	1175

- Phone should be powered on and in a 13K/RateSet1 CDMA Full Rate Data Call.
- Depending on which Data Rate, set the Traffic Level accordingly to either 13KDATA_TRAF_LEVEL.
- See Figure 24, Screen 1.
- Set the total Forward CDMA Channel power to RX_TEST_LEVEL.
- Set the AWGN generator power to AWGN_LEVEL.
- See Figure 24, Screen 2.
- Measure FER over a maximum of 10000 frames to a confidence level of 95%.
- Measured FER must be within the limits defined above in table 20.

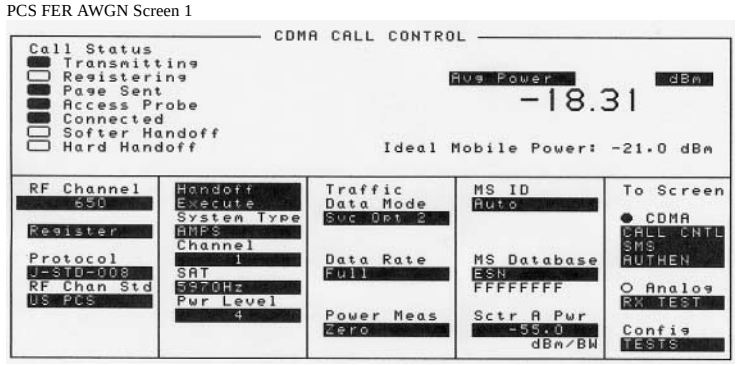
800 FERAWGN Screen 1



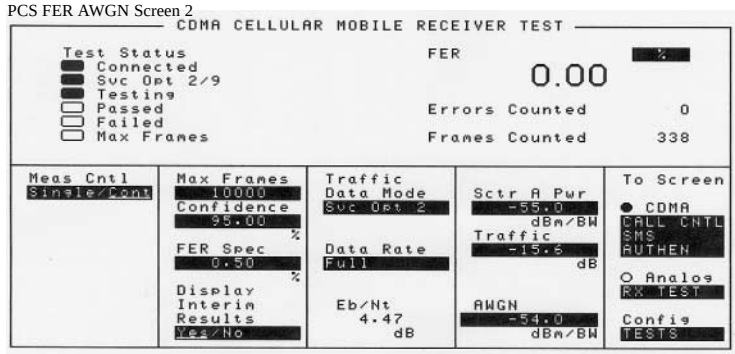
800 FER AWGN Screen 2



PCS FER AWGN Screen 1



PCS FER AWGN Screen 2



011015o

Figure 24. Receiver sensitivity in the presence of noise

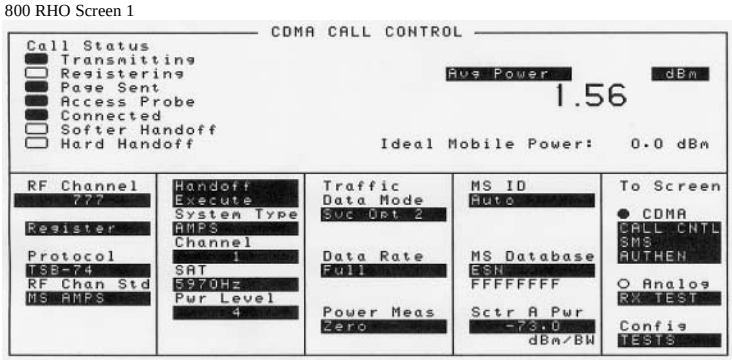
Quality (Rho)

Table 21. Quality (Rho) Test Values

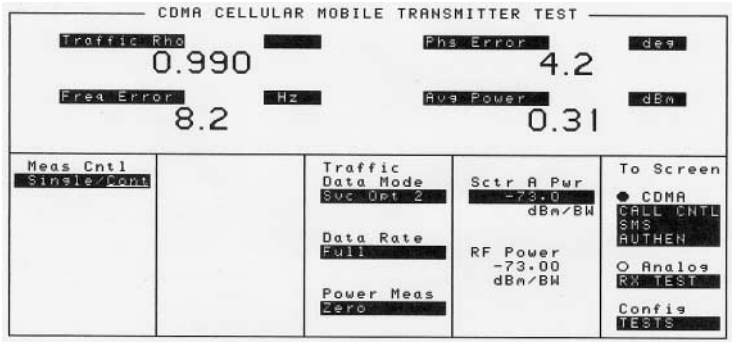
Parameter	CDMA	PCS
RF_LEVEL	-73 dBm	-76 dBm
Upper limit	1.000	1.000
Lower limit	0.944	0.944

- Phone should be powered on and in a 13K/RateSet2 CDMA Full Rate Data Call.
- Use an RF communications test system to provide a CDMA RF channel at amplitude RF_LEVEL.
- See Figure 25, Screen 1.
- Measure the transmitter waveform quality (Rho).
- The transmitter quality should be within the limits given in Table 21.
- See Figure 25, Screen 2.

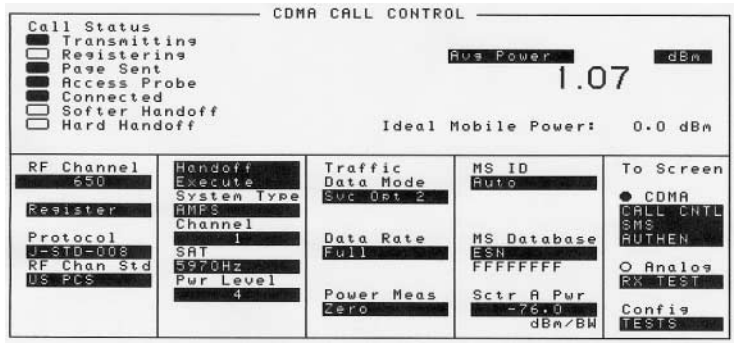
800 RHO Screen 1



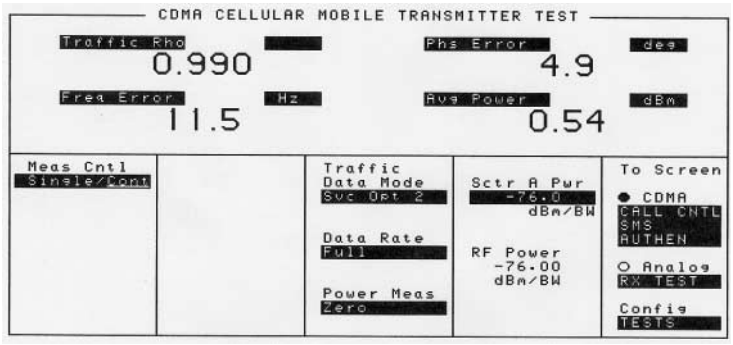
800 RHO Screen 2



PCS RHO Screen 1



PCS RHO Screen 2



011016o

Figure 25. Quality (Rho)

Splatter at Maximum Output Power

Table 22. Splatter Test Values

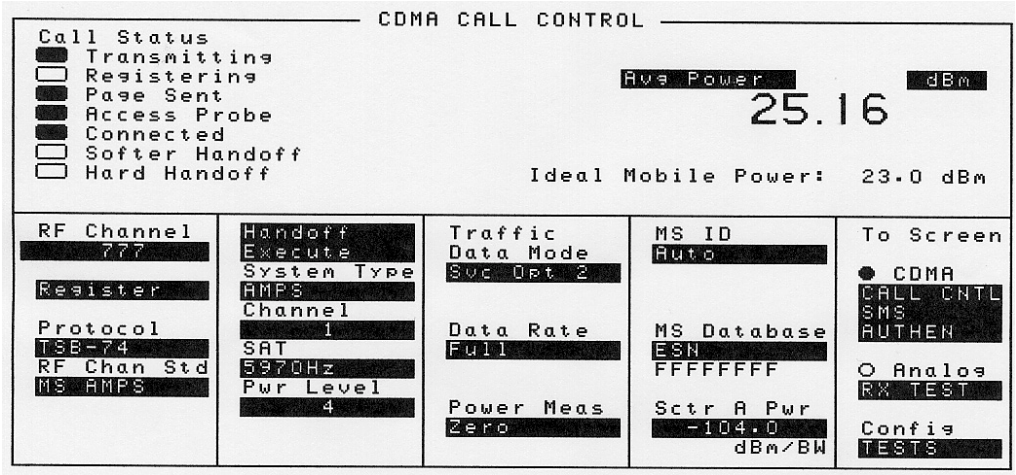
Parameter	CDMA	PCS
Test voltage at battery terminals	3.60V	3.60V
Test voltage at accessory connector	4.40V	4.40V
RX_LEVEL	-104 dBm	-104 dBm
SPLATTER_LIMIT	-42 dBc / 30 kHz	-42 dBc / 30 kHz
FREQUENCY_OFFSET_HIGH	+0.885 MHz	+1.25 MHz
FREQUENCY_OFFSET_LOW	-0.885 MHz	-1.25 MHz
Test channel 1	1013	25
Test channel 2	350	600
Test channel 3	777	1175

- Phone should be powered on and in a 13K/RateSet2 CDMA Full Rate Data Call.
- See Figure 26, Screen 1.

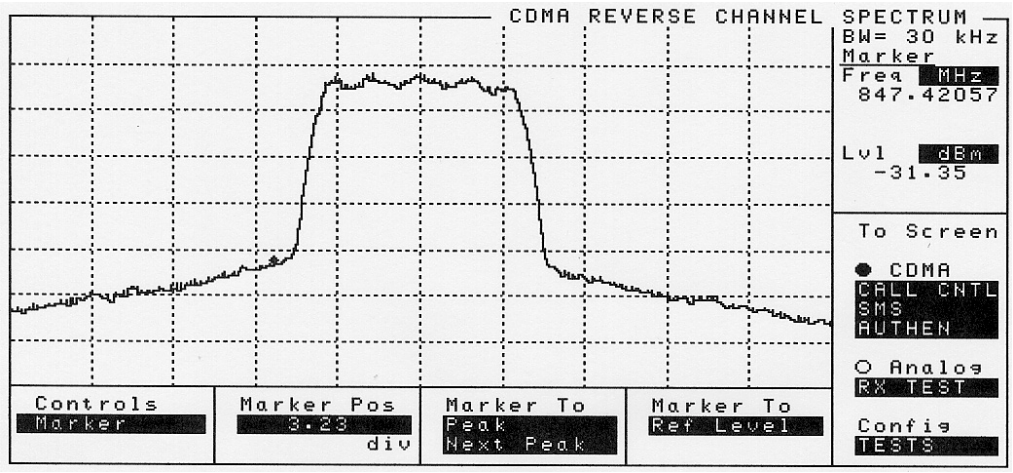
For a CMD80 test set which does not have a built in spectrum analyzer and cannot do splatter measurements while in a call, the UUT can be in Test Mode. The receiver is forced by using a Force RSSI_C_FILT to RX_LEVEL.

- Set the RX_ALG_CTL by using the PHASE command, Parameter “28” with data 0x0010. Then use the PHASE command, Parameter “21” with data RX_LEVEL in 11.4 format.
- Set the channel to TEST_CHANNEL.
- Adjust the RX level into the UUT to RX_LEVEL.
- Force the UUT to transmit full output power by sending power-control-up bits continuously.
- Begin by measuring the total output power in a 1.23 MHz bandwidth. The total output power is then REFERENCE_POWER.
- Check to make sure that REFERENCE_POWER > MAX_POWER.
- Switch the power measurement instrument to measure in a 30 kHz bandwidth.
- Offset by FREQUENCY_OFFSET_HIGH and FREQUENCY_OFFSET_LOW and measure the power at each.
- ADJ_CHANNEL_POWER is the higher of the two measured powers in dBm.
- See Figure 26, Screen 2.

800 Splatter Screen 1



800 Splatter Screen2



011017o

Figure 26. Splatter

Troubleshooting Procedures

The goal in troubleshooting is to quickly narrow down the possibilities to isolate a failure to a single faulty component. This is especially important before deciding to replace a multi-pin IC, filter, or other component that is difficult or risky to replace. Sometimes the problem will be visually obvious; such as a cold solder joint, cracked chip, or tombstone. At other times, it will be necessary to measure a voltage. Board-level repair requires the equipment specified in Table 2.

No Turn-On

1. Turn on failed.
2. Visually check for damaged parts.
3. Check for shorts.
   - Apply 4.4V with 1A current limiting to CE bus connector ***J1000 pin 3***.
   - If the UUT draws more than 0.5A, check all ***U1200*** regulators. Make sure they are not shorted to ground.
   - If problem still exists, go to step 4.
4. Switch ***R9972*** to ***R9952*** to force WDG high.
5. Check for the power route for ***U1200*** B+.
   - If B+ is present, go to step 6.
   - If problem still exists, check ***VR1202 pin 1***.
   - If there isn't 4.4V on ***VR1202 pin 1***, check ***J1000*** and make sure it is placed correctly.
   - If there isn't a 4.4V on ***CR1050 pin 2***, replace ***Q1305*** or reflow ***U1200*** if needed.
   - If problem still exists, check ***CR1050*** and ***Q1306***. Make sure they are placed correctly.
6. Check ***U1200*** regulator output voltages.
   - If the voltages on the following regulators are correct, go to step 7.
     - ANALOG_1.8V = 1.875V
     - DIGITAL_1.8V = 1.875V
     - MEMORY_VCC = 1.875V
     - LOGIC_2.75V = 2.775V
     - V4 = 2.775V
     - RX_2.75V = 2.775V
   - If problem still exists, reflow ***U1200***, or replace ***U1200*** if reflow does not work.
7. Check the RTC clock from ***U1200***.
   - If there is a 32.768 KHz clock on ***U326 pin 2***, go to step 8.
   - If there is no clock on ***U326 pin 2***, reflow ***U1200***.
   - If problem still exists (the phone's internal clock is running at 32.768 kHz +/- 50%), check the RTC crystal ***Y1170***
   - If there is no 32 KHz sine wave on ***Y1170***, check ***C1171*** and ***C1172***, make sure they are placed correctly before replacing ***Y1170***.
   - If problem still exists, go to step 8.
8. Check the 16.8 MHz clock going into ***U1100 pin M1***.
   - If there is a 16.8 MHz clock at ***C1173***, go to step 9.
   - If problem still exists, make sure the voltage on ***Q325 pin 2*** and ***pin 3*** are both 2.75V.
9. Flash EEPORM troubleshooting.
   - If the Flash_CS is toggling, go to step 10.
   - If problem still exists, reflow flash ***U1300***, or replace ***U1300*** if reflow

does not work.

10. SRAM troubleshooting.
    - IF SRAM_CS is toggling, go to step 11.
    - If problem still exists, reflow SRAM ***U1400***, or replace ***U1400*** if reflow does not work.
11. Audio/power controller IC ***U1200*** troubleshooting.
    - If CCAP_CS is toggling, reflow call processor IC ***U1100***, or replace ***U1100*** if reflow does not work.
    - If problem still exists, reflow ***U1200***, or replace ***U1200*** if reflow does not work.
12. Switch ***R9952*** back to ***R9972***.

If the UUT turns on the first time during the debug process, wait 30 seconds to insure the software has fully initialized the flash SEEM.

General Charging Failures

The following tips may be helpful for troubleshooting charging problems.

Charging icon not flashing

- ***J1000 pins 1***, ***2***, or ***3*** not connected.
- EXTB+ pin of audio/power controller IC ***U1200 pin D1*** not making contact.
- ***Q1305*** may be missing or misplaced.
- EXTBDRV pin of audio/power controller IC ***U1200 pin E4*** not making contact.

Charging icon flashing but no charge current

- ***R1052***, ***Q1050***, or ***CR1051*** misplaced, missing, or defective.
- CHRGC ***U1200 pin A2*** not making connection.
- ISENSE ***U1200 pin B2*** shorted or not connected.
- Battery connector BATT+terminal ***J870 pin 4*** intermittent.

Charging icon flashing but charge current always greater than 500 mA

- ***R1052*** or ***Q1050*** shorted, misplaced or defective.
- CHRGC ***U1200 pin A2*** not making connection or shorted to ground.
- ISENSE ***U1200 pin B2*** shorted or not connected.
- ***U1200*** charge current register always > 90 hex. Replace ***U1200***.

Charging icon flashing but charge current unstable

- ***Q1306***, ***R20214***, or ***Q1309*** misplaced, shorted, or defective.
- CHRGC ***U1200 pin A2*** not making connection or shorted.
- ISENSE ***U1200 pin B2*** shorted or not connected.

Charging Icon always shows fully charged

- Battery connector BATT+terminal ***J870 pin 4*** not connected properly.
- MAINBATT pin ***U1200 pin C3*** not connected properly.

No battery/charging Icon

- Battery connector BATT+terminal ***J870 pin 4*** or ground terminal ***J870 pin 1*** not connected properly.
- MAINBATT pin ***U1200 pin C3*** not connected properly.
- MAINTEMP pin ***U1200 pin D4*** not connected properly.

- TEMPBIAS pin ***U1200 pin B1*** not connected properly.
- ***R9976*** or ***R1244*** not connected properly.

Invalid battery message

- BATT_SERIAL_DATA ***J870 pin 3*** not connected properly.
- GPIO8_OWIRE ***U1100 pin C9*** not connected properly.
- ***R1155*** or ***R9917*** not connected properly.
- BATT+ or ground ***J870 pins 4*** or ***1*** not connected properly.
- MAINBATT pin ***U1200 pin C3*** not connected properly.

Troubleshooting the Internal Speaker

No Receive Audio.

- Test commands: Suspend, Internal speaker, Volume level, Speakerphone tone.

300000090000003600010000000

3000000A00000006000200002200

300000090000000500010000003

3000000B0000000000030000000002A

- Send the above test commands to generate a speakerphone tone to the speaker. If there is no audio, probe ***J7000 pin 1*** and ***J7000 pin 2***. If the signal is there yet no audio then check the speaker.
- No signal at the ***J7000 pin 1*** and ***J7000 pin 2***. Check signal at ***C1221*** and ***C1212***.
- If signal is coming out of AUDIOOUTP and AUDIOOUTM, then check ***U1200*** and the parts associated with internal ***U1200*** speaker amplifiers.
- If no signal is present at ***C1221*** and ***C1212*** then either defective ***U1100*** or cold solder / missing power supply to ***U1100***.

Tones present but no voice

- Send the following test commands: 13K Loop back with internal speaker and internal Mic (suspend, CP mode CDMA, AUD_LPB, Handset path UN-muted, Aud_Lvl 3).

300000090000003600010000000

300000090000000A0001000001

300000090000000400010000003

3000000A00000006000200003200

300000090000000500010000003

- Inject 43.5 mVrms, 1kHz signal to the CE bus connector analog audio input ***J1000 pin 16***. Check ***U1100 pins P14*** and ***N15*** AUDIOOUTP and AUDIOOUTM.
- If no signal, check ***U1100*** (ensure ***U1100 pin P15*** MIC1 has the same signal as the CE bus AUDIO_IN).
- If there is signal (+/-19 mVrms) and the tone can be heard through the speaker, place the UUT into call with test set (HP8924) with service option 1 with 1Khz tone enabled. If there is no tone, it could be defective ***U1100*** CSP or RF section.

Troubleshooting the Headset Speaker

*Prior to troubleshooting, make sure headset is working. Check headset jack **J600**, call processor IC INT1 **U1100 pin E8**, and **R20212**.*

No Receive Audio.

- Test commands: Suspend, Headset speaker, Volume level, Speakerphone tone.

300000090000003600010000000

3000000A00000006000200004600

300000090000000500010000003

3000000B000000000003000000002A

- Send the above test commands to generate a tone to the headset speaker. If there is no audio, probe ***J600 pin 3***. If the signal is there yet no audio, replace ***J600***.
- No signal at the ***J600 Pin 3***, check signal at ***C1221*** and ***C1212***.
- If the signal is coming out of AUDIOOUTP and AUDIOOUTM, check ***U1200*** and the parts associated with A0A, A0B, A3 ***U1200*** amplifiers.
- If no signal is present at ***C1221*** and ***C1212***, either defective ***U1100*** or cold solder / missing power supply to ***U1100***.

Tones Present but No Voice

- Send the following test commands. 13K Loop back with internal speaker and internal Mic (suspend, CP mode CDMA, AUD_LPB, Headset path UN-muted, Aud_Lvl 3)

300000090000003600010000000

300000090000000A0001000001

300000090000000400010000003

3000000A00000006000200003600

300000090000000500010000003

- Inject 43.5 mVrms, 1kHz signal to the CE bus connector analog audio input ***J1000 pin 16***. Check ***U1100 pins P14*** and ***N15*** AUDIOOUTP and AUDIOOUTM.
- If no signal, check ***U1100*** (ensure ***U1100 pin P15*** MIC1 has the same signal as the CE bus AUDIO_IN).
- If there is signal (+/-19 mVrms) and the tone can be heard through the speaker, place the UUT into call with test set (HP8924) with service option 1 with 1Khz tone enabled. If there is no tone, it could be defective ***U1100*** CSP or RF section.

Troubleshooting the CE Bus AUDIO_OUT

No Receive Audio on the Hands-Free Device

Prior to troubleshooting, make sure the accessory is working.

- Test commands: Suspend, Headset speaker, Volume level, Speakerphone tone.

300000090000003600010000000

3000000A00000006000200003400

300000090000000500010000003

3000000B00000000000300000002A

• Send the above test commands to generate a tone to CE bus connector AUDIO_OUT ***J1000 pin 15***. If the signal is present on ***J1000 pin 15*** but no audio, ***J1000*** may be defective.

• No signal at the ***J1000 pin 15***, check signal at ***C1221*** and ***C1212***.
  - If the signal is coming out of AUDIOOUTP and AUDIOOUTM, check ***U1200*** and the parts associated with A0A, A1 and A4 ***U1200*** amplifiers.
  - If no signal is present at ***C1221*** and ***C1212***, either defective ***U1100*** or cold solder / missing power supply to ***U1100***.

Tones Present but No Voice

• Send the following test commands. 13K Loop back with internal speaker and internal Mic (suspend, CP mode CDMA, AUD_LPB, Headset path UN-muted, Aud_Lvl 3).

300000090000003600010000000

300000090000000A0001000001

300000090000000400010000003

3000000A00000006000200003400

300000090000000500010000003

- Inject 43.5 mVrms, 1kHz signal to the CE bus connector analog audio input ***J1000 pin 16***. Check ***U1100 pins P14*** and ***N15*** AUDIOOUTP and AUDIOOUTM.
- If no signal, check ***U1100*** (ensure ***U1100 pin P15*** MIC1 has the same signal as the CE bus AUDIO_IN).
- If there is signal (+/-17 mVrms) and the tone is present on the CE bus AUDIO_OUT, place the UUT into call with test set (HP8924) with service option 1 with 1kHz tone enabled. If there is no tone, it could be defective ***U1100*** CSP.

Troubleshooting the Speakerphone

No or Low Speakerphone Tones

• Test commands: Suspend, Headset speaker, Volume level, Speakerphone tone.

300000090000003600010000000

3000000A00000006000200002300

300000090000000500010000007

3000000B00000000000300000002A

- Send the above test commands to generate a speakerphone tone to the speakerphone.
  - If the signal is on the ***U9925 pin 1***, but no audible speakerphone or low speakerphone, inspect the speakerphone connections and check ***U9925 pin 6*** for DC voltage.
  - Otherwise, replace ***U9925***.
- No signal at ***U9925 pin 1***, check signal at ***C1221*** and ***C1212***.

- If signal is coming out of AUDIOOUTP and AUDIOOUTM, check ***U1200*** and the parts associated with A0A, A1 and A2 ***U1200*** amplifiers.
- If no signal is present at ***C1221*** and ***C1212***, either defective ***U1100*** or cold solder / missing power supply to ***U1100***.

Troubleshooting the Internal Microphone

No TX audio with Internal Microphone

Prior to troubleshooting, check the microphone for proper connection. Temporarily replace the microphone.

- Send the following test commands: 13K Loop back with internal speaker (suspend, CP mode CDMA, AUD_LPB, Handset path, Audio_Level 3).

30000009000000360001000000

300000090000000A0001000001

30000009000000040001000003

3000000A00000006000200002200

30000009000000050001000003.

This is voice loop back enabling the internal microphone audio to be heard through the internal speaker.

- If this test is passed, originate CDMA voice loop back call with the test set.
- If voice can't be heard while talking in to the microphone, ***U1100*** or the modulator/demodulator may be defective.

Troubleshooting the Headset Microphone

No Tx audio with Headset Microphone

*Check the headset and **J600** for proper connection.*

- Send the following test commands: 13K Loop back with internal speaker (suspend, CP mode CDMA, AUD_LPB, Handset path, Audio_Level 3)

30000009000000360001000000

300000090000000A0001000001

30000009000000040001000003

3000000A00000006000200004600

30000009000000050001000003.

This is voice loop back enabling the headset microphone audio to be heard through the headset speaker.

- If this test is passed originate CDMA voice loop back call with the test set.
- If voice can't be heard while talking in to the microphone, ***U1100*** or the modulator/demodulator may be defective.

Test Points

Controller Board

Refer to Table 23, Table 24, and the appropriate V200 Level 3 Supplement for test point locations and functions.

Table 23. V200 Controller Board Test Points

Test Point	Name	Description
TPWD001	WATCHDOG	Watchdog
TPINT4	INT	Audio/Power Controller IC interrupt
TPTCK1	TCK	JTAG (for Development purposes only)
TPTRSTB	TRST_B	JTAG (for Development purposes only)
TPTDI1	TDI	JTAG (for Development purposes only)
TPTDO1	TDO	JTAG (for Development purposes only)
TPTMS1	TMS	JTAG (for Development purposes only)
TPMCU1	MCU_DE_B	JTAG (for Development purposes only)
TPPWR1	PWR_1	JTAG power (for Development purposes only)
TPGND1	GND_1	JTAG ground (for Development purposes only)
TPRESETB1	RESETB	JTAG (for Development purposes only)
TPDIAG01	DIAGBUS0	CSP diagnostic bus output
TPDSP7	DIAGBUS1	CSP diagnostic bus output
TPDSP8	DIAGBUS2	CSP diagnostic bus output
TPDSP9	DIAGBUS3	CSP diagnostic bus output
TPDSP10	DIAGBUS4	CSP diagnostic bus output
TPDSP11	DIAGBUS5	CSP diagnostic bus output
TPDSP12	DIAGBUS6	CSP diagnostic bus output

Transceiver Board

Table 24. V200 Transceiver Board Test Points

Test Point	Name	Description
TP11	RF_SPI(1)	SPI data out.
TP12	RF_SPI(2)	SPI clock in.
TP13	AFC_ANALOGSTEERING	GPIO or analog steering sense (AFC out).
TP14	LOCK_DETECT	Spare GPIO or timer input capture.
TP15	RSSI	Receive signal strength indicator.
TP16	RF_SLEEP	Control of RF circuits in slotted sleep mode.
TP17	TXIM	Digital mode, TX baseband analog I-ch (+).
TP18	TXIP	Digital mode, TX baseband analog I-ch (-).
TP19	TXQM	Digital mode, TX baseband analog Q-ch (-).

Table 24. V200 Transceiver Board Test Points (Continued)

Test Point	Name	Description
TP20	TXQP	Digital mode, TX baseband analog Q-ch (+).
TP21	RXIM	Differential inputs of RX baseband analog I-ch (-).
TP22	RXIP	Differential inputs of RX baseband analog I-ch (+).
TP23	RXQP	Differential inputs of RX baseband analog Q-ch (+).
TP24	RXQM	Differential inputs of RX baseband analog Q-ch (-).
TP25	FM	Frequency modulation output from Call Processor IC to Call Processor IC. Held at ground during CDMA.
TP26	DISC	Discriminator input for analog mode.
TP27	ZIF_VCA	Analog control voltage for voltage-controlled attenuating in RF Transceiver IC.
TP31	RX_2.75V	2.75V supply voltage.
TP34	ME_VCA	Analog control voltage for voltage-controlled attenuating in Mixer/Exciter IC.
TP35	PA_ENABLE	Enable control signal for TX PA.
TP38	RF_DETECT	Analog signal from transmit power diode.
TP39	RF_SPI(0)	SPI data in.
TP40	FEIC_G1	Receive supply control.
TP41	FEIC_G2	GPIO for PA bypass (controlled by MCU or DSP).
TP42	MODE	Analog/digital mode selection. Always digital.
TP43	BAND	RF band select.
TP44	PA_BIAS	Controls negative bias for PA.
TP45	OSCEN_b	Enable control signal for reference oscillator.
TP46	TEMP_SENSE	Input to the measurement ADC from thermistor.
TP47	REF_WARP	Analog output from AFC DAC to control the 16.8 MHz reference oscillator.
TP48	TX_2.75V	2.75V supply voltage.
TP49	PAH_B+	PA high (PCS) B+ voltage.
TP50	PAL_B+	PA low (CDMA) B+ voltage.
TP51	16.8MHZ	Reference clock (16.8 MHz square wave).

Connector Signals and Pin Assignments

Board-to-Board Connectors JBB1 and P1

Interface between the controller and transceiver boards is through connectors ***JBB1*** and ***P1*** (controller and transceiver board, respectively). Table 25 shows the signal associated with each connector pin. For connector and pin locations, refer to the V200 Level 3 Supplement listed in the Related Publications section toward

the end of this manual. Refer to Table 1 for a description of the signal names shown in Table 25.

Table 25. Board-to-Board Interface Pin Assignments

Pin	Controller JBB1	Transceiver P1	Pin	Controller JBB1	Transceiver P1
1	RX_ 2.75V	RX_ 2.75V_UN	2	PAH_ B+	
3	RX_ 2.75V	RX_ 2.75V_UN	4	PAH_ B+	
5	RX_ 2.75V	RX_ 2.75V_UN	6	PAH_ B+	
7	Ground	RF_GND	8	PAH_ B+	
9	REF_ WARP		10	PAH_ B+	
11	Ground	RF_GND	12	PAL_ B+	
13	Ground	RF_GND	14	PAL_ B+	
15	Ground	RF_GND	16	PAL_ B+	
17	BAND		18	PAL_ B+	
19	MODE		20	PAL_ B+	
21	FEIC_ G1		22	PA_ BIAS	
23	FEIC_ G2		24	RF_ DETECT	
25	Ground	RF_GND	26	Ground	RF_GND
27	Ground	RF_GND	28	Ground	RF_GND
29	RXQM		30	RXIM	
31	RXQP		32	RXIP	
33	Ground	RF_GND	34	Ground	RF_GND
35	Ground	RF_GND	36	Ground	RF_GND
37	RSSI		38	TX_ 2.75V	
39	Ground	RF_GND	40	TX_ 2.75V	
41	RF_ SLEEP		42	TX_ 2.75V	
43	Ground	RF_GND	44	ME_ VCA	
45	AFC_ ANALOGSTEERING		46	PA_ ENABLE	
47	Ground	RF_GND	48	Ground	RF_GND
49	DISC		50	Ground	RF_GND
51	Ground	RF_GND	52	LOCK_ DETECT	
53	Ground	RF_GND	54	RF_ SPI(2)	
55	16.8MHZ		56	RF_ SPI(0)	
57	Ground	RF_GND	58	RF_ SPI(1)	
59	Ground	RF_GND	60	Ground	RF_GND
61	Ground	RF_GND	62	Ground	RF_GND
63	TXQM		64	TXIP	
65	TXQP		66	TXIM	
67	Ground	RF_GND	68	Ground	RF_GND
69	Ground	RF_GND	70	Ground	RF_GND
71	Ground	RF_GND	72	Ground	RF_GND
73	ZIF_ VCA		74	Ground	RF_GND

Table 25. Board-to-Board Interface Pin Assignments (Continued)

Pin	Controller JBB1	Transceiver P1	Pin	Controller JBB1	Transceiver P1
75	Ground	RF_GND	76	Ground	RF_GND
77	FM		78	OSCEN_b	
79	Ground	RF_GND	80	TEMP_ SENSE	

Controller Board Connectors JDIS1, J1000, J600, J870, and J7000

Tables 26 through 30 show signals associated with the connectors located on the controller board. For connector and pin locations, refer to the Level 3 Supplement listed in the related Publications section later in this manual.

Table 26. Display Connector JDIS1 (Flex) Pin Assignments

Pin(s)	Signal Name	Function
1	—	No connection
2	G2	Ground
3	LOGIC_2.75V	
4	LCD_CS	
5	RESET_B	
6	SERIAL_LCD_A0	
7	G2	Ground
8	LOGIC_2.75V	
9	—	No connection
10	—	No connection
11	—	No connection
12	—	No connection
13	—	No connection
14	—	No connection
15	SERIAL_LCD_CLK	
16	SERIAL_LCD_MOSI	
17	LOGIC_2.75V	
18	LOGIC_2.75V	
19	G2	Ground
20	LOGIC_2.75V	
21	—	No connection
22	—	No connection
23	—	No connection
24	—	No connection
25	—	No connection
26	G2	Ground
27	BACKLIGHT_LED	

Table 27. CE Bus Connector J1000 Pin Assignments

Pin(s)	Signal Name	Function
1	BATT_ GND	Power ground
2	BATT_FDBK RTS	Default, battery feedback USB / RS232 (6 wire)
3	RAWEXTB+	External power
4	USB+ TXD (D+) TDO	Default USB, RS232 (8 wire), USB / RS232 (6 wire), Smart Audio JTAG
5	USB- RXD (D-) TDI	Default USB, RS232 (8 wire), USB / RS232 (6 wire), Smart Audio JTAG
6	RTS USB_PWR RESET_IN	RS232 (8 wire), Smart Audio USB, USB / RS232 (6 wire) JTAG FM radio headset send/end
7	SWB+	Switched battery
8	CTS FM_ DATA HKSW Mcu_DE	RS232 (8 wire), USB / RS232 (6 wire), Smart Audio FM radio headset USB hookswitch JTAG
9	DCD FS MUTE* Dsp_DE	RS232 (8 wire), USB / RS232 (6 wire) Smart Audio (DAI test box) FM radio headset, Smart Audio (Telematics) JTAG
10	DSCEN RI TXD DSEL2 SCK TCK	Default, USB RS232 (8 wire) USB / RS232 (6 wire) FM radio headset, Smart Audio Smart Audio (DAI test box) JTAG
11	DTR DSEL1 FM_CLK SRDA TMS	RS232 (8 wire), USB / RS232 (6 wire) FM radio headset, Smart Audio FM radio headset Smart Audio (DAI test box) JTAG
12	DSR RXD DSEL0 FM_EN STDA TRST	RS232 (8 wire) USB / RS232 (6 wire) FM radio headset, Smart Audio FM radio headset Smart Audio (DAI test box) JTAG
13	UPLink OPT1 OPT2	Default, USB RS232 (8 wire), USB / RS232 (6 wire), JTAG, FM radio headset Smart Audio
14	DNLink OPT2 OPT1	Default, USB RS232 (8 wire), USB / RS232 (6 wire), JTAG, FM radio headset Smart Audio
15	AUDIO_OUT	Audio out on / off
16	AUDIO_IN	Audio In
17	AUD_GND	Audio ground

Table 28. Headset Jack J600 Pin Assignments

Pin(s)	Signal Name	Function
1	GND	Ground
2	SWI	
3	SP	Speaker
4	MIC	Microphone
5	BRK	

Table 29. Battery Connector J870 Pin Assignments

Pin(s)	Signal Name	Function
1		Ground
2	BATT_TEMP	
3	BATT_SERIAL_DATA	
4	BATT+	

Table 30. Speaker Connector J7000 Pin Assignments

Pin(s)	Signal Name	Function
1	SPKPH+	Speakerphone speaker positive terminal
2	SPKPH-	Speakerphone speaker negative terminal

Transceiver Board J9001 and J9000

Table 31. SMT Coax Connector J9001 Pin Assignments

Pin(s)	Name	Function
1		Antenna
2	RF_GND	RF ground
3	RF_GND	RF ground

Table 32. Accessory Antenna Connector J9000 Pin Assignments

Pin(s)	Name	Function
1	IN	To transceiver circuitry
2	OUT	To SMT antenna connector
3	RF_GND	RF ground
4	RF_GND	RF ground

Part Numbers

The following charts show the transceivers and related publications associated with V200 communicator models currently available.

Related Publications

V200 Level 1 and 2 Service Manual	6881039B05
V200 Level 3 Controller Supplement	6881104B88
V200 Level 3 Transceiver Supplement	6881111B09
V200 Personal Communicator User Guide	6881039B35
P2K Product Support Tool (PST) User's Guide	6881038B76
SYN8400A Test Interface Adapter Instructional Guide	SJN9779

Model Chart

Use Table 33 to identify the specific board assemblies used in each model V200 communicator.

Table 33. V200 Personal Communicator Model Chart

MODEL	
82701GHESA V200 CDMA Sales Model	
82702GHESA V200 CDMA Sales Model (replace with S9619 Field Replacement Unit)	
82703GHESA V200 CDMA Sales Model (replace with S9622 Field Replacement Unit)	
82704GHESA V200 CDMA Sales Model (replace with S9620 Field Replacement Unit)	
82705GHESA V200 CDMA Sales Model (replace with S9621 Field Replacement Unit)	
S9619 V200 CDMA Field Replacement Unit (FRU) (replaces 82702GHESA)	
S9620 V200 CDMA Field Replacement Unit (FRU) (replaces 82704GHESA)	
S9621 V200 CDMA Field Replacement Unit (FRU) (replaces 82705GHESA)	
S9622 V200 CDMA Field Replacement Unit (FRU) (replaces 82703GHESA)	
ITEM NUMBER	**TRANSCEIVER**
SUG2339	Transceiver CDMA Shadow Bronze
ITEM NUMBER	**BOARD ASSEMBLY**
SYN9425	Controller board
SYN9426	Transceiver board

KEY: X = ITEM INCLUDED A = ALTERNATE ITEM SUPPLIED

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