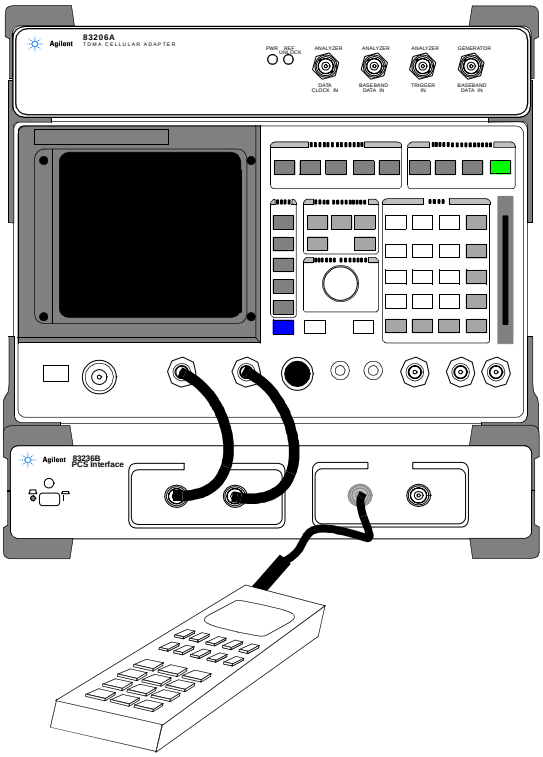
TDMA Mobile Test Application Guide

Manual and Automated IS-137 Mobile Testing with the Agilent Technologies 8920B Option 801 Test System



Manufacturing Part Number: 08920-90240

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Revision C

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All Editions and Updates of this manual and their creation dates are listed below.

Rev. A August 1999

Rev. B October 1999

Rev. C April 2000

Safety Summary

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Agilent Technologies Inc. assumes no liability for the customer's failure to comply with these requirements.

GENERAL

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

All Light Emitting Diodes (LEDs) used in this product are Class 1 LEDs as per IEC 60825-1.

This product has been designed and tested in accordance with *IEC Publication 1010*, "Safety Requirements for Electronic Measuring Apparatus," and has been supplied in a safe condition. This instruction documentation contains information and warnings which must be followed by the user to ensure safe operation and to maintain the product in a safe condition.

ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category II, pollution degree 2 environment. It is designed to operate at a maximum relative humidity of 95% and at altitudes of up to 2000 meters. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

Ventilation Requirements: When installing the product in a cabinet, the convection into and out of the product must not be restricted. The ambient temperature (outside the cabinet) must be less than the maximum operating temperature of the product by 4° C for every 100 watts dissipated in the cabinet. If the total power dissipated in the cabinet is greater than 800 watts, then forced convection must be used.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage, the correct fuse is installed, and all safety precautions are taken. Note the instrument's external markings described under Safety Symbols.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cover must be connected to an electrical protective earth ground. The instrument must be connected to the ac power mains through a grounded power cable, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short-circuited fuse holders. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes.

DO NOT REMOVE THE INSTRUMENT COVER

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made only by qualified service personnel.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

WARNING	**The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.**

CAUTION	The CAUTION sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Safety Symbols


Caution, refer to accompanying documents


Warning, risk of electric shock


Earth (ground) terminal

Alternating current


Frame or chassis terminal


Standby (supply). Units with this symbol are not completely disconnected from ac mains when this switch is off.

To completely disconnect the unit from ac mains, either disconnect the power cord, or have a qualified electrician install an external switch.

Product Markings

CE - the CE mark is a registered trademark of the European Community. A CE mark accompanied by a year indicated the year the design was proven.

CSA - the CSA mark is a registered trademark of the Canadian Standards Association.

CERTIFICATION

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members

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Agilent Technologies 8920B Option 801

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Manufacturer's Declaration

This statement is provided to comply with the requirements of the German Sound Emission Directive, from 18 January 1991.

This product has a sound pressure emission (at the operator position) < 70 dB(A).

- Sound Pressure Lp < 70 dB(A).
- At Operator Position.
- Normal Operation.
- According to ISO 7779:1988/EN 27779:1991 (Type Test).

Herstellerbescheinigung

Diese Information steht im Zusammenhang mit den Anforderungen der Maschinenlärminformationsverordnung vom 18 Januar 1991.

- Schalldruckpegel Lp < 70 dB(A).
- Am Arbeitsplatz.
- Normaler Betrieb.
- Nach ISO 7779:1988/EN 27779:1991 (Typprüfung).

Contents

Making Measurements

Contents

1 Making Measurements

This application guide describes manual and automated procedures for testing Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA) Standard 136 mobile phones with the Agilent Technologies 83206A Cellular Adapter, Agilent Technologies 8920B Test Set, and the Agilent Technologies 83236B PCS Interface (if PCS mobiles are being tested). Each topic includes a description, test conditions, a manual procedure and a sample HP® BASIC program.

This document is intended to be used as a tutorial and a quick reference document. The tests and procedures shown are those most commonly used by mobile manufacturers.

About the TIA/EIA 136 and 137 Standards

These standards describes a Time Division Multiple Access (TDMA) cellular communications system. The major feature that distinguishes the TIA/EIA 136 and IS-137 standards from its predecessors, TIA/EIA-54B and 55, is the addition of a Digital Control Channel (DCCH).

About the Agilent Technologies 83206A Cellular Adapter

The Agilent 83206A works with the Agilent 8920B to perform call processing, transmitter tests, and receiver tests on DAMPS (TIA/EIA 54) and DCCH (TIA/EIA 136) mobiles. See IS-137 Test Descriptions on page 113.

The Agilent 83206A is controlled by the host Agilent 8920B Test Set. Once installed, the adapter becomes part of the measurement path for the Test Set.

Without the Cellular Adapter, the Test Set can still test mobiles using standard analog modulation schemes, such as AMPS and NAMPS.

About the Agilent Technologies 83236B PCS Interface

The PCS Interface extends the mobile test frequency range into the PCS band of 1.7 GHz to 2.0 GHz. The interface is controlled entirely by the Test Set using a serial cable connection between the instruments.

The Test Set detects the presence of the PCS Interface when the Test Set is powered-up. However, the PCS Interface is not automatically *enabled* at power up. Therefore, ***you must enable the PCS Interface on the Test Set's CONFIGURE screen before making PCS or cellular band measurements through the interface***. Enabling the interface tells the Test Set that all measurements will be made through the interface and not through the Test Set's own RF IN/OUT port.

Measuring High Level Analog Carriers

If you need to make high level power measurements (>1 Watt) on an analog carrier, disable the interface on the CONFIGURE screen and connect your signal directly to the Test Sets RF IN/OUT port. Do not exceed the level printed under the port.

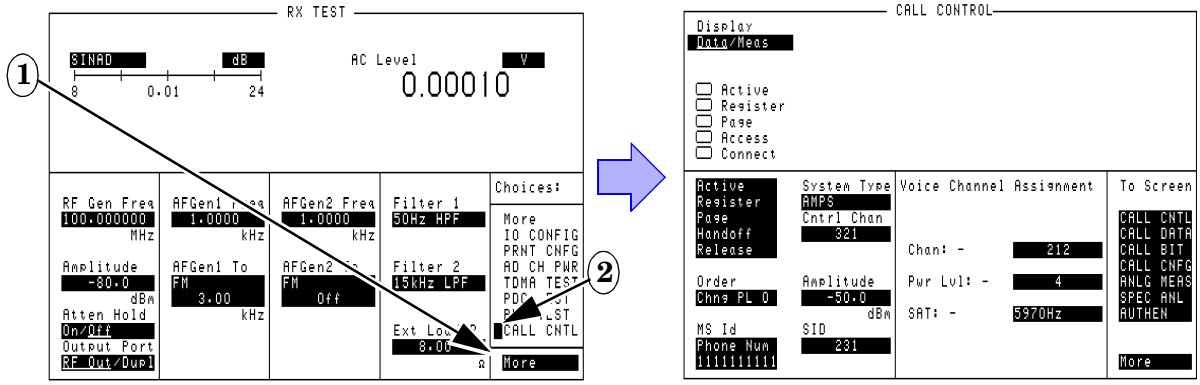
Figure 1-1. Accessing the Agilent 8920B Screens Used for IS-137 Tests

To access the CONFIGURE screen to enable the PCS Interface (see page 18)...

Press the **SHIFT** key, then press the **DUPLEX** key.

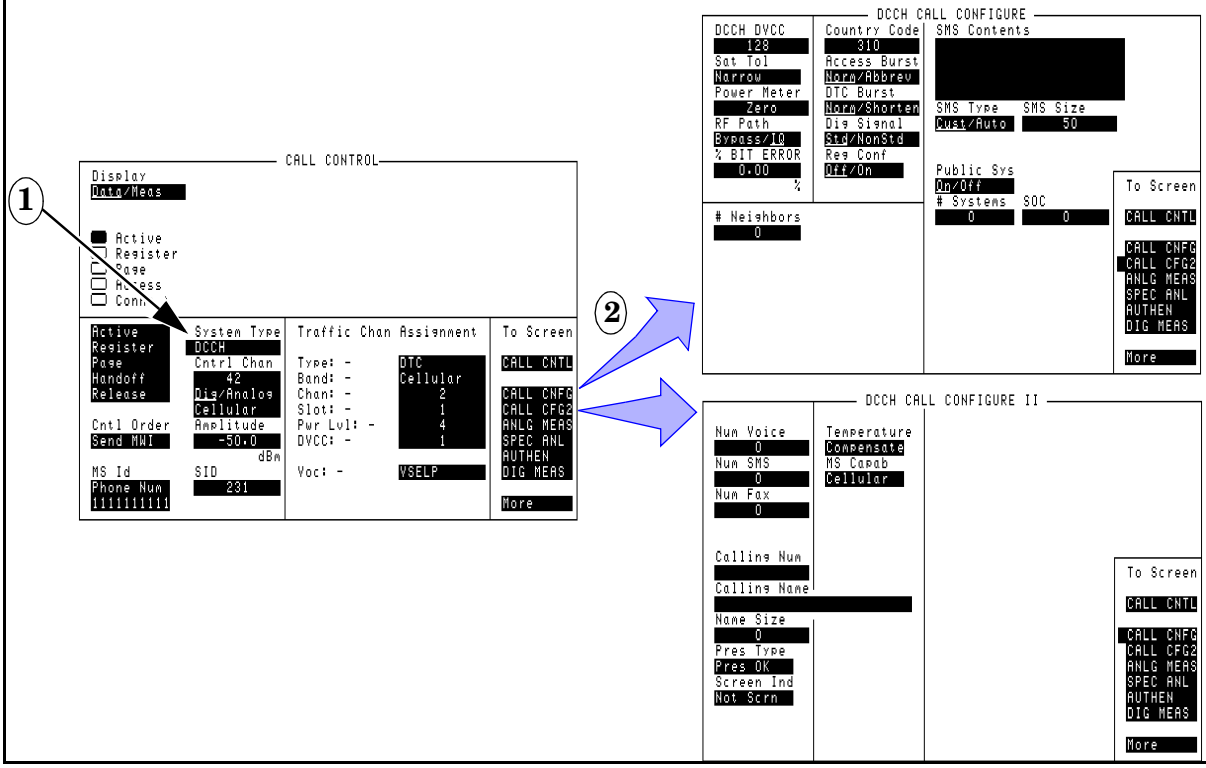
To access the CALL CONTROL screen (to setup and perform mobile tests)...

Select the **More** field in the bottom-right corner of the screen, and choose **CALL CNTL**.



To access the DCCH CALL CONFIGURE and DCCH CALL CONFIGURE II screens for DCCH call processing operations and temperature compensation...

Set the **System Type** field to **DCCH** on the CALL CONTROL screen, then select the desired configuration screen.



Using the PCS Interface

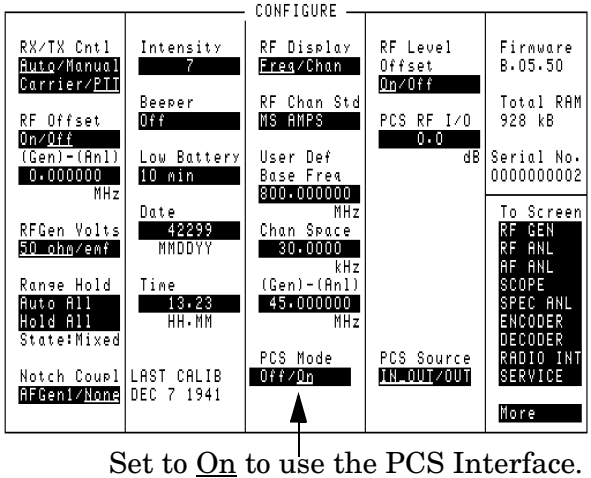
The PCS Interface must first be connected to the test set as shown in the instructions for TDMA subscriber (mobile) testing in the Agilent 83236B Operating Manual.

The test set looks for the PCS Interface through its serial control connection *when the test set is first turned on*. Always turn the PCS Interface and test set on at the same time, or turn the PCS Interface on before turning on the test set.

IMPORTANT! The PCS Interface is disabled if test set power is cycled or if the **PRESET** key is pressed. To enable the use of the interface, you must set the PCS Mode field in the CONFIGURE screen to On.

The Analog Registration program listing contains an example of how to automatically detect the presence of the PCS interface and enable it if present.

If you are using the PCS Interface and cannot get the mobile to find a control channel or make any measurements, make sure you have enabled the interface before trying to find another cause.



Set to On to use the PCS Interface.

Compensating for Temperature Changes in the Interface

Operation varies over time as the interface warms up. To compensate for the change, select the Temperature field on the DCCH CALL CONFIGURE II screen after the interface has been on for 30 minutes. If the temperature has changed enough to require compensation, the interface will begin a compensation routine that lasts several seconds (you will hear the interface making several clicking sounds during the procedure). If compensation is not needed, the interface will not start the compensation routine.

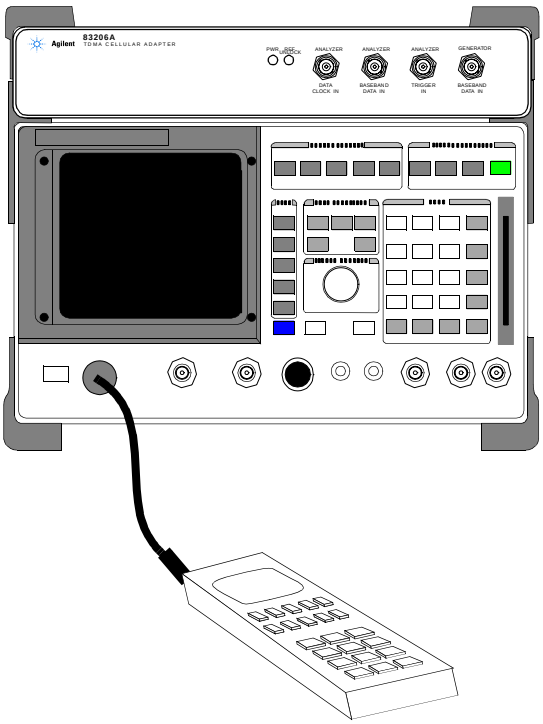
You can query the need to compensate first (optional), or just issue the compensation command periodically. Compensation occurs only if needed after issuing the command:

```
SERV:LATCH:SEL 'pcs_temp_comp_status' !Select compensation status latch.
SERV:LATCH:VAL?  !Query latch value. Returns 1 if needed, 0 if not needed.
CALLP:DCCH:PCS:TEMP:COMP !Start the compensation process.
```

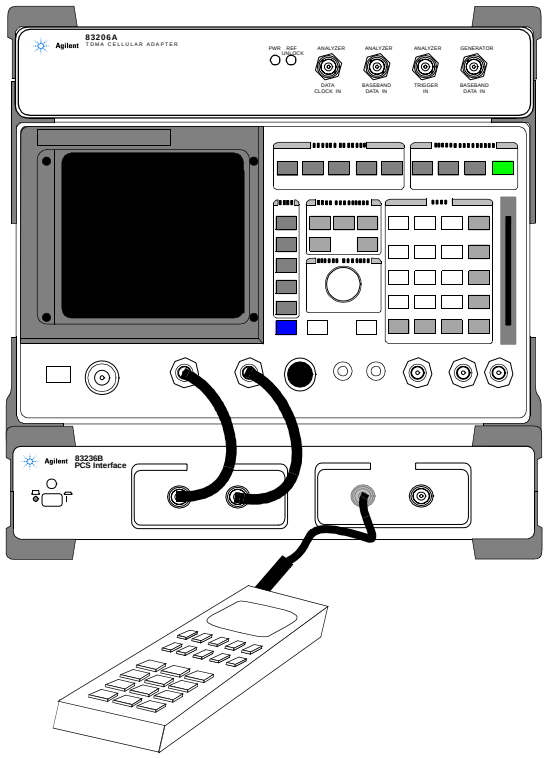
Connections

All of the tests described in this document use a single connection from the mobile's antenna connector (or test port) to the RF IN/OUT port on the Test Set or PCS Interface. No separate audio connections are used.

Cellular Band (800 MHz) Testing Without the PCS Interface



Dual-Band PCS (1900 MHz) and Cellular (800 MHz) Testing With the PCS Interface



Analog Registration

Description

This function causes the mobile station to “register” with the test set. This function causes the phone to send data such as Mobile Identification Number, Electronic Serial Number, and phone type (Station Class Mark).

Simulating this with the test set requires placing the test set into an analog “active” mode to simulate an active analog cell site. When the phone locks onto the test set and indicates service, the registration function is selected on the test set. The test set sends a series of alternating registration messages over the air until the mobile phone detects the messages and responds. The test set then decodes and displays the registration data sent from the mobile.

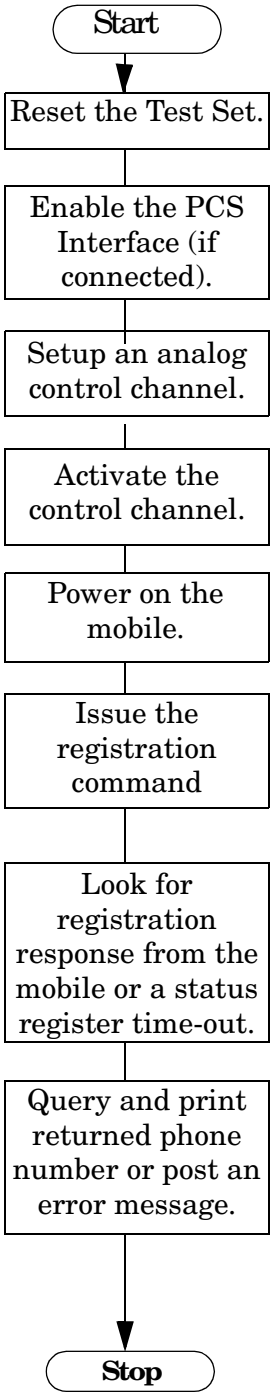
Test Conditions

- CALL CONTROL screen
- System Type = DCCH
- Control Channel = Analog, Channel Number 321
- RF Amplitude = –50 dBm (default)

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type field to DCCH.
- ❑ For PCS mobiles:
  - ❑ Set the MS Capab field (DCCH CALL CONFIGURE II screen) to US PCS.
  - ❑ Set the Voc: field (CALL CONTROL screen) to match the mobile's vocoder (typically ACELP).
- ❑ Set the Cntrl Chan field to Analog. The default channel number is 42; change it as needed for your mobile to find service (camp).
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Select the Register field.

Automated Test Flowchart



Example Program

NOTE This program contains subroutines for time-out protection and PCS interface detection. These routines should be used in all TIA/EIA 136 call processing programs, but are not shown in the remaining programming examples in this document in order to highlight specific call processing procedures.

```
10    ! This program implements Analog Registration.
20    ! Monitors the 'Register' LED to determine when
30    ! registration is complete. Automatic enabling of
40    ! a connected and powered on PCS interface is provided.
50    ON TIMEOUT 7,8 CALL Escape  !Recover from bus hangup.
60    COM Ts
70    CLEAR SCREEN
80    Ts=714
90    Reset_ts
100   Check_pcs
110   Setup_acc
120   Set_to_active
130   PRINT "Instructions: Turn the phone on now."
140   Register_mobile
150   END
160 Set_to_active: SUB Set_to_active
170     COM Ts
180     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
190     OUTPUT Ts;"*CLS"! Clear Status Event Registers
200     OUTPUT Ts;"CALLP:ACTIVE"
210     REPEAT
220       OUTPUT Ts;"STAT:CALLP:EVENT?"
230       ENTER Ts;Register
240       WAIT .2 ! Gives the testset time to service other processes
250     UNTIL Register ! Returns 0 until one of the bits is set
260   SUBEND
270 Reset_ts: SUB Reset_ts
280     COM Ts
290     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
300     ENTER Ts;Done
```

```
310     OUTPUT Ts;"DISP ACNT"! Analog Call Control Screen
320     OUTPUT Ts;"CALLP:CSYS 'DCCH'" ! Select the TIA/EIA 136 standard.
330   SUBEND
340 Register_mobile: SUB Register_mobile
350     COM Ts
360     OUTPUT Ts;"STAT:CALLP:PTR 0"! Don't latch positive transitions
370     OUTPUT Ts;"STAT:CALLP:NTR 2"! Latch "Register" LED turning off
380     OUTPUT Ts;"*CLS"! Clear Status Event Registers
390     OUTPUT Ts;"CALLP:TIM REG,30" !Optional: registration timeout 30secs.
400     OUTPUT Ts;"CALLP:REGISTER"
410     REPEAT
420       OUTPUT Ts;"*ESR?;:STAT:CALLP:EVENT?"
430       ENTER Ts;Esr,Register
440       WAIT .2 ! Gives the testset time to service other processes
450     UNTIL Register OR Esr  ! Returns 0 until one of the bits is set
460     IF Esr THEN
470       PRINT "Error with Registration"
480       STOP
490     ELSE
500       OUTPUT Ts;"CALLP:PNUM?"
510       ENTER Ts;Phone_num$
520       PRINT
530       PRINT "Registration Successful!"
540       PRINT "Phone number is ";Phone_num$
550     END IF
560     SUBEND
570 Check_pcs:     SUB Check_pcs
580       COM Ts
590       OUTPUT Ts;"CALLP:DCCH:PCS:CONN?"
600       ENTER Ts;Pcs_detect$
610     IF Pcs_detect$<>""""PRES"""" THEN
620       SUBEXIT
630     ELSE !If PCS Interface is present.
640       OUTPUT Ts;"CALLP:DCCH:PCS:MODE 'ON'"
650       OUTPUT Ts;"CALLP:DCCH:VOC 'ACELP'"
660       OUTPUT Ts;"CALLP:DCCH:MSCapability:BAND 'US PCS'" !Select PCS MS.
```

```
670     END IF
680     SUBEND
690 Escape: SUB Escape
700     COM Ts
710     CLEAR 7
720     LOCAL Ts
730     PRINT “Measurement Query Failed”
740     SUBEND
750 Setup_acc: SUB Setup_acc !Setup an analog control channel.
760     COM Ts
770     OUTPUT Ts;”CALLP:CSYS ‘DCCH’”          !System Type
780     OUTPUT Ts;”CALLP:DCCH:CCTY ‘ANALOG’”  !Control Channel type.
790     OUTPUT Ts;”CALLP:DCCH:CCH 321” !Cntrl Chan number - set as needed.
800     SUBEND
```

Analog Mobile Origination

Description

This function causes the mobile station to initiate a call to the test set. This function simulates an actual origination that would normally happen when a cellular phone user places a call with the local cellular system. The end result of this function is that a voice channel is established between the test set and the mobile.

Simulating this with the test set requires placing the test set into an analog "active" mode. This causes the test set to simulate an active analog cell site. When the phone locks onto the test set and indicates service, the user dials a phone number on the mobile phone and presses SEND. The test set receives the request from the mobile and assigns the mobile to a voice channel.

The Traffic Chan Assignment group on the CALL CONTROL screen determines the settings for the voice channel the mobile is told to go to.

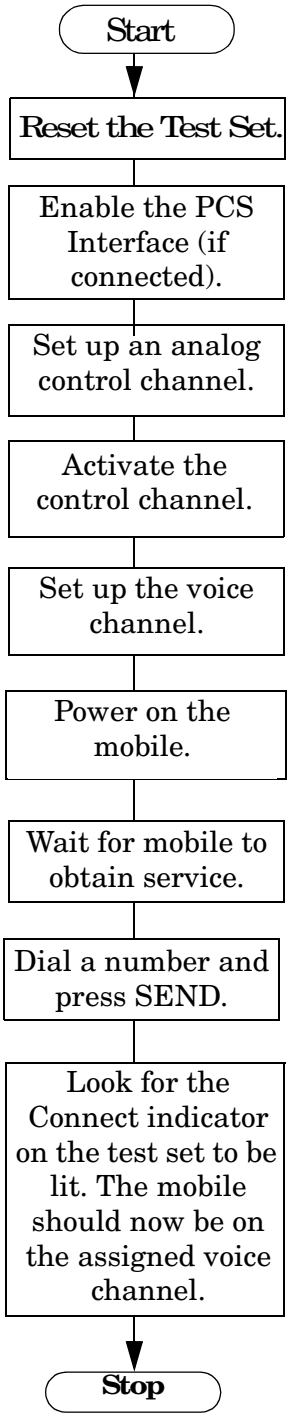
Test Conditions

- Control Channel = Analog, Channel Number 321
- RF Amplitude = –50 dBm (default)

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type field to DCCH.
- ❑ For PCS mobiles:
  - ❑ Set the MS Capab field (DCCH CALL CONFIGURE II screen) to US PCS.
  - ❑ Set the Voc: field (CALL CONTROL screen) to match the mobile's vocoder (typically ACELP).
- ❑ Set the Cntrl Chan type to Analog. The default channel number is 42; change it as needed for your mobile to find service (camp).
- ❑ In the Traffic Chan Assignment area:
  - ❑ Set the Type to AVC.
  - ❑ Set the Chan to 777.
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Dial a number on the mobile and press **SEND**.
- ❑ The mobile should connect, shown by the lit Connect indicator on the test set.

Automated Test Flowchart



Example Program

For simplicity, the following program listing assumes a PCS Interface is present (and enables it) and does not contain an error handling routine.

```
10    ! This uses the built-in analog call processing.
20    ! This program implements Active and Origination.
30    ! Monitors the 'Connect' LED to determine if page is successful.
40    ! Monitors ESR to trap errors during the origination.
50    COM Ts
60    CLEAR SCREEN
70    Ts=714
80    CALL Reset_ts
90    CALL Enable_pcs
100   CALL Setup_acc
110   CALL Set_to_active
120   CALL Setup_trafchan
130   CALL Originate
140   END
150 Set_to_active: SUB Set_to_active
160     COM Ts
170     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
180     OUTPUT Ts;"*CLS"! Clear Status Event Registers
190     OUTPUT Ts;"CALLP:ACTIVE"
200     REPEAT
210       OUTPUT Ts;"STAT:CALLP:EVENT?"
220       ENTER Ts;Active
230       WAIT .2 ! Gives the testset time to service other processes
240     UNTIL Active ! Returns 0 until one of the bits is set
250   SUBEND
260 Reset_ts: SUB Reset_ts
270     COM Ts
280     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
290     ENTER Ts;Done
300     OUTPUT Ts;"DISP ACNT"! Analog Call Control Screen
310   SUBEND
320 !
```

```
330 Originate: SUB Originate
340     COM Ts
350     PRINT “Instructions: Turn the phone on now”
360     PRINT “When the phone shows service, dial a number and press SEND”
370     OUTPUT Ts;”STAT:CALLP:PTR 32” ! Latch “Connect” LED
380     OUTPUT Ts;”STAT:CALLP:NTR 0” ! Ignore All Negative Transitions
390     OUTPUT Ts;”*CLS”! Clear Status Event Registers
400     REPEAT
410       OUTPUT Ts;”*ESR?;:STAT:CALLP:EVENT?”
420       ENTER Ts;Esr,Connect
430       IF Esr<>0 THEN
440         PRINT “Error during origination”
450         STOP
460       END IF
470       WAIT .2 ! Gives the testset time to service other processes
480     UNTIL Connect ! Returns 0 until one of the bits is set
490     PRINT “Origination Successful!”
500   SUBEND
510 Enable_pcs:   SUB Enable_pcs
520     COM Ts
530     OUTPUT Ts;”CALLP:DCCH:PCS:MODE ‘ON’”
540     OUTPUT Ts;”CALLP:DCCH:VOC ‘ACELP’”
550     OUTPUT Ts;”CALLP:DCCH:MSCapability:BAND ‘US PCS’”
560     SUBEND
570 Setup_acc: SUB Setup_acc !Setup an analog control channel.
580     COM Ts
590     OUTPUT Ts;”CALLP:CSYS ‘DCCH’” !Set the System Type to DCCH.
600     OUTPUT Ts;”CALLP:DCCH:CCTY ‘ANALOG’”  !Select Analog control channel.
610     OUTPUT Ts;”CALLP:DCCH:CCH 321” !Change Cntrl Chan number as needed.
620     SUBEND
630 Setup_trafchan: SUB Setup_trafchan !Setup Analog Voice (traffic) Channel.
640     COM Ts
650     OUTPUT Ts;”CALLP:DCCH:VTYPe ‘AVC’” !Go to an Analog Voice Channel.
660     OUTPUT Ts;”CALLP:DCCH:AVCHannel:VCHannel 777” !AVC number.
670     SUBEND
```

Analog Page

Description

This function causes the base station to initiate a call to the mobile station. This function simulates an actual page that would normally happen when a base station is trying to set up a call with a cellular phone user operating within the base station cell area. The end result of this function is that a voice channel is established between the test set and the mobile.

Before attempting a page, it is necessary for the test set to know the phone number or MIN of the mobile it is trying to page. If you know the phone number or MIN, you can enter the number into the MS ID field before paging. If you do not know the phone number or MIN, you can get them by having the mobile find service on an active control channel and then registering the mobile. Registering the mobile automatically enters the phone number into the MS ID field.

When the mobile locks onto the test set and indicates service, the Page function is selected on the test set to alert the mobile that someone is trying to call. The mobile responds by ringing. To answer (complete) the call, the user typically presses the mobile's SEND key. When the call is competed, the test set indicates that it is in the Connect state.

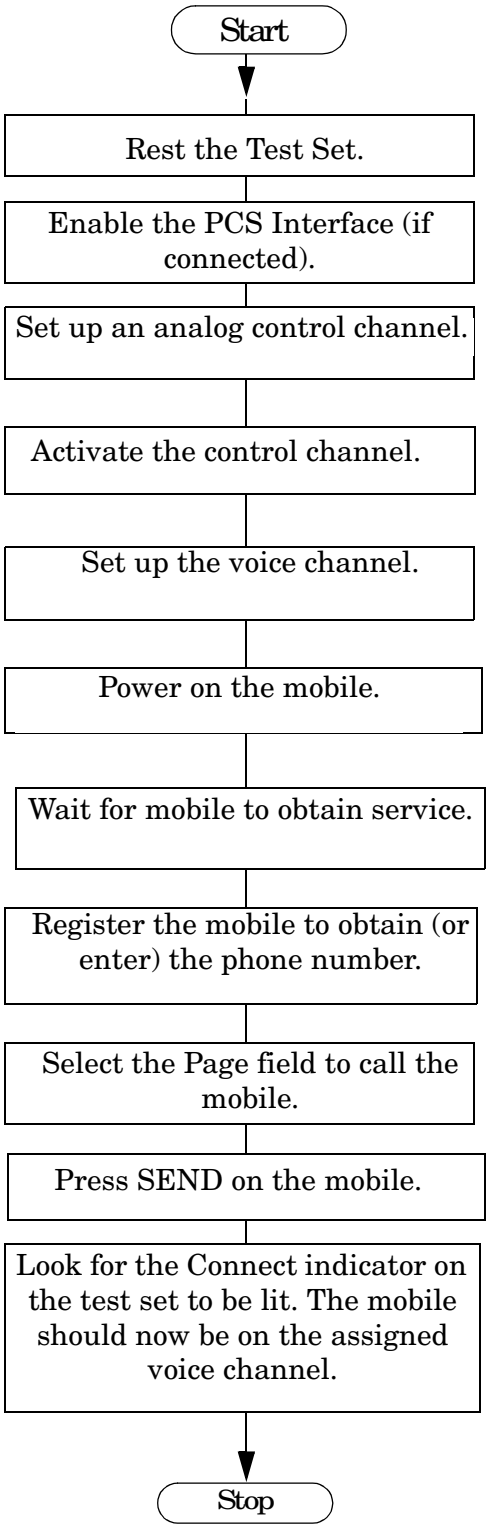
Test Conditions

- System Type = DCCH
- Control Channel = Analog, Channel 321
- RF Amplitude = –50 dBm (default)

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type field to DCCH.
- ❑ For PCS mobiles:
  - ❑ Set the MS Capab field (DCCH CALL CONFIGURE II screen) to US PCS.
  - ❑ Set the Voc: field (CALL CONTROL screen) to match the mobile's vocoder (typically ACELP).
- ❑ Set the Cntrl Chan type to Analog. The default channel number is 42; change it as needed for your mobile to find service (idle).
- ❑ In the Traffic Chan Assignment area:
  - ❑ Set the Type to AVC.
  - ❑ Set the Chan to 777.
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Enter the mobile's MIN or phone number in the MS Id field, OR select the Register field and wait for the phone to register and automatically enter the phone number.
- ❑ Select the Page field. The mobile should respond by going to the assigned voice channel and alerting the user (ringing).
- ❑ Press the SEND key on the mobile to complete the call.
- ❑ The mobile should connect, shown by the lit Connect indicator on the test set.

Automated Test Flowchart



Example Program

For simplicity, the following program listing assumes a PCS Interface is present and enables it.

```
10    ! This program implements AMPS Registration and Page
20    ! Monitors the 'Register' LED and 'Connect' LED
30    ! to determine when successful.
40    ! Includes error checking with ESR register.
50    COM Ts
60    CLEAR SCREEN
70    Ts=714
80    Reset_ts
90    Enable_pcs
100   Setup_acc
110   Set_to_active
120   Setup_trafchan
130   PRINT "Instructions: Turn the phone on now"
140   Register_mobile
150   Page
160   END
170 Set_to_active: SUB Set_to_active
180     COM Ts
190     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
200     OUTPUT Ts;"*CLS"! Clear Status Event Registers
210     OUTPUT Ts;"CALLP:ACTIVE"
220     REPEAT
230       OUTPUT Ts;"STAT:CALLP:EVENT?"
240       ENTER Ts;Active
250       WAIT .2 ! Gives the testset time to service other processes
260     UNTIL Active ! Returns 0 until one of the bits is set
270   SUBEND
280 Reset_ts: SUB Reset_ts
290     COM Ts
300     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
310     ENTER Ts;Done
320     OUTPUT Ts;"DISP ACNT"! Analog Call  Control Screen
330   SUBEND
```

```
340 Register_mobile: SUB Register_mobile
350     COM Ts
360     OUTPUT Ts;”STAT:CALLP:PTR 0”! Don’t latch positive transitions
370     OUTPUT Ts;”STAT:CALLP:NTR 2”! Latch “Register” LED turning off
380     OUTPUT Ts;”*CLS”! Clear Status Event Registers
390     OUTPUT Ts;”CALLP:TIM REG,30” !Registration timeout 30 secs (option).
400     OUTPUT Ts;”CALLP:REGISTER”
410     REPEAT
420       OUTPUT Ts;”*ESR?;:STAT:CALLP:EVENT?”
430       ENTER Ts;Esr,Register
440       WAIT .2 ! Gives the testset time to service other processes
450     UNTIL Register OR Esr  ! Returns 0 until one of the bits is set
460     IF Esr THEN
470       PRINT “Error with Registration”
480       STOP
490     ELSE
500       OUTPUT Ts;”CALLP:PNUM?”
510       ENTER Ts;Phone_num$
520       PRINT
530       PRINT “Registration Successful!”
540       PRINT “Phone number is “;Phone_num$
550     END IF
560   SUBEND
570 Page: SUB Page
580     COM Ts
590     PRINT “When the phone rings, press send”
600     OUTPUT Ts;”STAT:CALLP:PTR 32” ! Latch ‘Connect’ LED
610     OUTPUT Ts;”STAT:CALLP:NTR 0”
620     OUTPUT Ts;”*CLS”! Clear Status Event Registers
630     OUTPUT Ts;”CALLP:PAGE”
640     REPEAT
650       OUTPUT Ts;”*ESR?;:STAT:CALLP:EVENT?”
660       ENTER Ts;Esr,Page
670       WAIT .2 ! Gives the testset time to service other processes
680     UNTIL Page OR Esr  ! Returns 0 until one of the bits is set
690     IF Esr THEN
```

```
700       PRINT “Error with Page”
710       STOP
720     END IF
730     PRINT “Page was Successful!”
740     SUBEND
750 Enable_pcs:    SUB Enable_pcs
760     COM Ts
770     OUTPUT Ts;”CALLP:DCCH:PCS:MODE ‘ON’”
780     OUTPUT Ts;”CALLP:DCCH:VOC ‘ACELP’”
790     OUTPUT Ts;”CALLP:DCCH:MSCapability:BAND ‘US PCS’”
800     SUBEND
810 Setup_acc: SUB Setup_acc
820     COM Ts
830     OUTPUT Ts;”CALLP:CSYS ‘DCCH’”  !Set System Type to DCCH.
840     OUTPUT Ts;”CALLP:DCCH:CCTY ‘ANALOG’” !Select Analog control channel.
850     OUTPUT Ts;”CALLP:DCCH:CCH 321” !Change Cntrl Chan number as needed.
860     SUBEND
870 Setup_trafchan: SUB Setup_trafchan
880     COM Ts
890     OUTPUT Ts;”CALLP:DCCH:VTYP ‘AVC’”
900     OUTPUT Ts;”CALLP:DCCH:AVCHannel:VCHannel 777”
910     SUBEND
```

Analog Release

Description

This function causes the base station to release an active call on a voice channel. When the release is sent to the mobile, the test set returns to the “active” state and begin transmitting on the control channel. The mobile returns to scanning for control channels, and should eventually lock back onto the control channel the test set is sending.

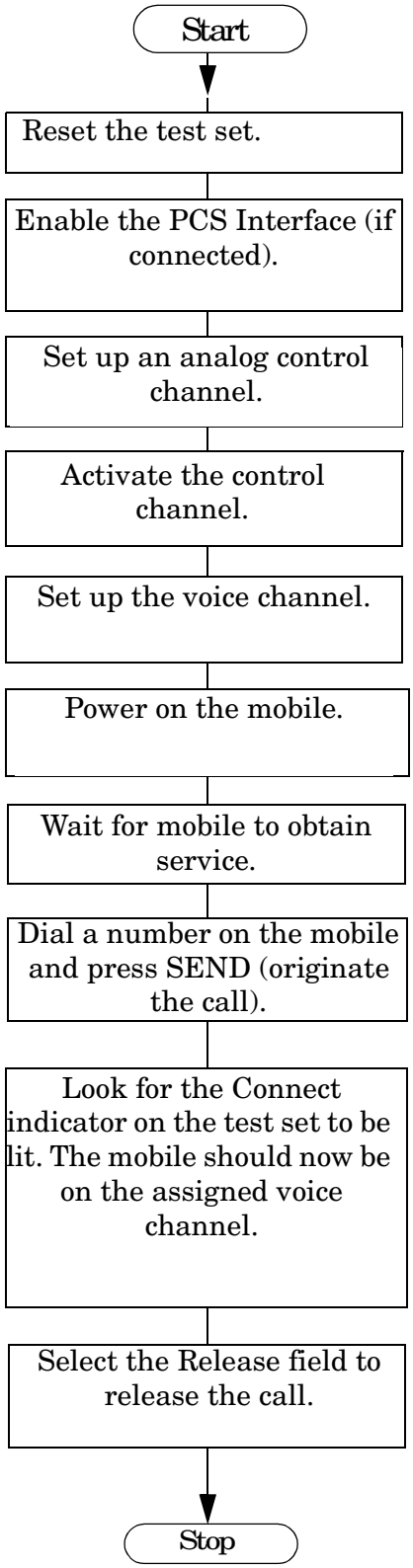
Test Conditions

- System Type = DCCH
- Control Channel = Analog, Channel Number 321
- RF Amplitude = –50 dBm (default)

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type to DCCH.
- ❑ For PCS mobiles:
  - ❑ Set the MS Capab field (DCCH CALL CONFIGURE II) screen to US PCS.
  - ❑ Set the Voc: field (CALL CONTROL screen) to match the mobile's vocoder (typically ACELP).
- ❑ Set the Cntrl Chan type to Analog. The default channel number is 42; change it as needed for your mobile to find service (camp).
- ❑ In the Traffic Chan Assignment area:
  - ❑ Set the Type to AVC.
  - ❑ Set the Chan to 777.
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Dial a phone number on the mobile and press **SEND** (originate a call).
- ❑ The mobile should connect, shown by the lit Connect indicator on the test set.
- ❑ Select the Release field (on the Test Set) to release the call.

Automated Test Flowchart



Example Program

For simplicity, the following program listing assumes a PCS Interface is present and enables it.

```
10    ! This program implements the Active, Registration, Originate,
20    ! and Release states. It monitors the 'Connect' LED to determine
30    ! if page is successful, monitors ESR to trap origination errors, and
40    ! monitors the 'Active' LED to determine if release was successful.
50    COM Ts
60    CLEAR SCREEN
70    Ts=714
80    CALL Reset_ts
90    CALL Enable_pcs
100   CALL Setup_acc
110   CALL Set_to_active
120   CALL Setup_trafchan
130   CALL Originate
131   CALL Release
140   END
150 Set_to_active: SUB Set_to_active
160     COM Ts
170     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
180     OUTPUT Ts;"*CLS"! Clear Status Event Registers
190     OUTPUT Ts;"CALLP:ACTIVE"
200     REPEAT
210       OUTPUT Ts;"STAT:CALLP:EVENT?"
220       ENTER Ts;Active
230       WAIT .2 ! Gives the testset time to service other processes
240     UNTIL Active ! Returns 0 until one of the bits is set
250   SUBEND
260 Reset_ts: SUB Reset_ts
270     COM Ts
280     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
290     ENTER Ts;Done
300     OUTPUT Ts;"DISP ACNT"! Analog Call Control Screen
310   SUBEND
320 !
```

```
330 Originate: SUB Originate
340     COM Ts
350     PRINT “Instructions: Turn the phone on now”
360     PRINT “When the phone shows service, dial a number and press SEND”
370     OUTPUT Ts;”STAT:CALLP:PTR 32” ! Latch “Connect” LED
380     OUTPUT Ts;”STAT:CALLP:NTR 0” ! Ignore All Negative Transitions
390     OUTPUT Ts;”*CLS”! Clear Status Event Registers
400     REPEAT
410       OUTPUT Ts;”*ESR?;:STAT:CALLP:EVENT?”
420       ENTER Ts;Esr,Originate
430       IF Esr<>0 THEN
440         PRINT “Error during origination”
450         STOP
460       END IF
470       WAIT .2 ! Gives the testset time to service other processes
480     UNTIL Originate ! Returns 0 until one of the bits is set
490     PRINT “Origination Successful!”
500   SUBEND
510 Enable_pcs:   SUB Enable_pcs
520     COM Ts
530     OUTPUT Ts;”CALLP:DCCH:PCS:MODE ‘ON’”
540     OUTPUT Ts;”CALLP:DCCH:VOC ‘ACELP’”
550     OUTPUT Ts;”CALLP:DCCH:MSCapability:BAND ‘US PCS’”
560     SUBEND
570 Setup_acc: SUB Setup_acc
580     COM Ts
590     OUTPUT Ts;”CALLP:CSYS ‘DCCH’” !Set the System Type to DCCH.
600     OUTPUT Ts;”CALLP:DCCH:CCTY ‘ANALOG’”  !Select Analog control channel.
610     OUTPUT Ts;”CALLP:DCCH:CCH 321” !Change Cntrol Chan number as needed.
620     SUBEND
630 Setup_trafchan: SUB Setup_trafchan !Setup AVC channel 777.
640     COM Ts
650     OUTPUT Ts;”CALLP:DCCH:VTYPe ‘AVC’” !Go to an Analog Voice Channel.
660     OUTPUT Ts;”CALLP:DCCH:AVCHannel:VCHannel 777” !AVC number.
670     SUBEND
```

```
680 Release: SUB Release
690     COM Ts
700     PRINT “Getting ready to release the call...”
710     WAIT 3
720     OUTPUT Ts;”STAT:CALLP:PTR 1” !Latch “Active” LED
730     OUTPUT Ts;”STAT:CALLP:NTR 0” !Ignore All Negative Transitions
740     OUTPUT Ts;”*CLS” !Clear the Event Status Registers (ESR)
750     OUTPUT Ts;”CALLP:RELease” !Release the call.
760     REPEAT
770      OUTPUT Ts;”*ESR?;:STAT:CALLP:EVENT?”
780      ENTER Ts;Esr,Release
790      IF Esr<>0 THEN
800       PRINT “Error during RELEASE”
810       STOP
820      END IF
830      WAIT .2 ! Gives the test set time to service other processes.
831     UNTIL Release ! Returns 0 until one of the bits is set.
840     PRINT “Release Successful!”
850     SUBEND
```

Analog Measurements: Call Control Screen

Description

This section demonstrates using the analog measurement functions on the CALL CONTROL screen. The CALL CONTROL screen can be used for making Tx Frequency Error and Tx Power measurements, as well as analog modulation measurements. Whenever possible, it is desirable to use the CALL CONTROL screen for making these measurements. This allows call processing functions (like handoffs) to be intermixed with measurements. By intermixing measurements and call processing, this will save the time and programming associated with switching to the ANALOG MEASUREMENTS screen.

To make measurement's on the CALL CONTROL screen, set up the voice channel as usual with either an origination or a page. On the CALL CONTROL screen, change the display from 'data' to 'meas' to display four measurements at the top of the screen. In addition to Tx Frequency Error and Tx Power measurements, the measurements for FM deviation and AF frequency are available. The limitation of using these latter two measurements is that the filters and inputs associated with these measurements should not be changed.

The proper settings for audio filters 1 and 2, de-emphasis, audio analyzer input, and IF filter bandwidth are necessary for the CALL CONTROL functionality to work correctly. They are *automatically* configured each time the CALL CONTROL screen is accessed. When the test set is in the Active state (sending a control channel), the automatic settings for these are:

- Filter 1, <20Hz HPF
- Filter 2, >99kHz LPF
- De-emphasis OFF
- AF Analyzer Input (AF Anl In) is set to FM Demod
- IF Filter, 230 kHz

When the test set is in the Connect state (on an analog voice channel), the audio filter settings automatically change to:

- Filter 1, 300Hz HPF
- Filter 2, 15kHz LPF

The rest of the audio and IF settings remain where they were set for the Active state.

Test Conditions

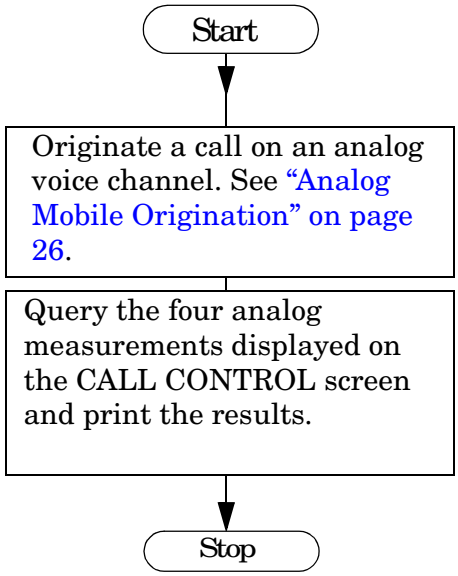
- System Type = DCCH
- Control Channel = Analog, Channel Number 321
- RF Amplitude = –50 dBm (default)

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type to DCCH.
- ❑ For PCS mobiles:
  - ❑ Set the MS Capab field (DCCH CALL CONFIGURE II) screen to US PCS.
  - ❑ Set the Voc: field (CALL CONTROL screen) to match the mobile's vocoder (typically ACELP).
- ❑ Set the Cntrl Chan type to Analog. The default channel number is 42; change it as needed for your mobile to find service (camp).
- ❑ In the Traffic Chan Assignment area:
  - ❑ Set the Type to AVC.
  - ❑ Set the Chan to 777.
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Dial a number on the mobile and press **SEND** (originate a call).
- ❑ The mobile should connect, shown by the lit Connect indicator on the test set.
- ❑ Select the Display field on the CALL CONTROL screen to underline Meas.
- ❑ Read the TX Freq Error and TX Power (Avg) RF measurements.
- ❑ With the mobile's microphone muted[1], read the SAT tone's FM Deviation and AF Freq AF measurements.

1. The mobile's microphone must be muted so that unintended audio modulation does not combine with the SAT signal and create SAT measurement errors.

Automated Test Flowchart



Example Program

```
10    ! This uses the built-in analog call processing.
20    ! This program implements Active and Origination.
30    ! Monitors the 'Connect' LED to determine if page is successful.
40    ! Monitors ESR to trap errors during the origination.
50    ! Queries and prints analog measurement results.
60    COM Ts
70    CLEAR SCREEN
80    Ts=714
90    CALL Reset_ts
100   CALL Enable_pcs
110   CALL Setup_acc
120   CALL Set_to_active
130   CALL Setup_trafchan
140   CALL Originate
150   CALL Enable_meas
160   CALL Meas_freqerr
170   CALL Meas_fmdev
180   CALL Meas_affreq
190   CALL Meas_txpower
200   END
210 Set_to_active: SUB Set_to_active
220     COM Ts
230     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
240     OUTPUT Ts;"*CLS"! Clear Status Event Registers
250     OUTPUT Ts;"CALLP:ACTIVE"
260     REPEAT
270       OUTPUT Ts;"STAT:CALLP:EVENT?"
280       ENTER Ts;Register
290       WAIT .2 ! Gives the testset time to service other processes
300     UNTIL Register ! Returns 0 until one of the bits is set
310   SUBEND
320 Reset_ts: SUB Reset_ts
330     COM Ts
340     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
```

```
350     ENTER Ts;Done
360     OUTPUT Ts;"DISP ACNT"! Analog Call Control Screen
370   SUBEND
380 !
390 Originate: SUB Originate
400     COM Ts
410     PRINT "Instructions: Turn the phone on now"
420     PRINT "When the phone shows service, dial a number and press SEND"
430     OUTPUT Ts;"STAT:CALLP:PTR 32" ! Latch "Connect" LED
440     OUTPUT Ts;"STAT:CALLP:NTR 0" ! Ignore All Negative Transitions
450     OUTPUT Ts;"*CLS"! Clear Status Event Registers
460     REPEAT
470       OUTPUT Ts;"*ESR?;:STAT:CALLP:EVENT?"
480       ENTER Ts;Esr,Register
490       IF Esr<>0 THEN
500         PRINT "Error during origination"
510         STOP
520       END IF
530       WAIT .2 ! Gives the testset time to service other processes
540     UNTIL Register ! Returns 0 until one of the bits is set
550     PRINT "Origination Successful!"
560   SUBEND
570 Enable_pcs:   SUB Enable_pcs
580     COM Ts
590     OUTPUT Ts;"CALLP:DCCH:PCS:MODE 'ON'"
600     OUTPUT Ts;"CALLP:DCCH:VOC 'ACELP'"
610     OUTPUT Ts;"CALLP:DCCH:MSCapability:BAND 'US PCS'"
620     SUBEND
630 Setup_acc: SUB Setup_acc
640     COM Ts
650     OUTPUT Ts;"CALLP:CSYS 'DCCH'" !Set the System Type to DCCH.
660     OUTPUT Ts;"CALLP:DCCH:CCTY 'ANALOG'"  !Select Analog control channel.
670     OUTPUT Ts;"CALLP:DCCH:CCH 325" !Change control chan number as needed.
680     SUBEND
690 Setup_trafchan: SUB Setup_trafchan !Setup AVC channel 777.
700     COM Ts
```

```
710     OUTPUT Ts;"CALLP:DCCH:VTYPe 'AVC'" !Go to an Analog Control Channel.
720     OUTPUT Ts;"CALLP:DCCH:AVCHannel:VCHannel 777" !AVC number.
730     SUBEND
740 Meas_freqerr: SUB Meas_freqerr  !Measure RF Frequency Error
750     COM Ts
760     OUTPUT Ts;"MEAS:RFR:FREQ:ERR?" !Query the TX Freq Error.
770     ENTER Ts;Freq_err
780     PRINT "RF Frequency Error is ";DROUND(Freq_err,3);"Hz" !Round
781      !the measurement to 3 digits and print the value.
790     SUBEND
800 Meas_fmdev: SUB Meas_fmdev
810     COM Ts
820     OUTPUT Ts;"MEAS:AFR:FM?"
830     ENTER Ts;Fm_dev
840     PRINT "FM Deviation is ";DROUND((Fm_dev/1.E+3),3);"kHz" !Round
841      !the measurement to 3 digits and display in kHz (default=Hz).
850     SUBEND
```

```
860 Meas_affreq: SUB Meas_affreq
870     COM Ts
880     OUTPUT Ts;"Meas:AFR:FREQ?"
890     ENTER Ts;Af_freq
900     PRINT "Audio Frequency is ";DROUND((Af_freq/1.E+3),4);"kHz"
910     SUBEND
920 Meas_txpower: SUB Meas_txpower
930     COM Ts
940     OUTPUT Ts;"MEAS:RFR:POW:UNIT DBM" !Change the RETURNED GPIB
941      !MEASUREMENT value unit from Watts to dBm.
943     OUTPUT Ts;"MEAS:RFR:POW:DUN DBM" !Change the DISPLAY units
944      !on the test set from the default (Watts) to dBm.
950     OUTPUT Ts;"MEAS:RFR:POW?" !Measure RF power with PCS Interface.
960     ENTER Ts;Tx_pow
970     PRINT "TX Power (Avg) is  ";DROUND(Tx_pow,3);"dBm"
980     SUBEND
990 Enable_meas: SUB Enable_meas
1000    COM Ts
1010    OUTPUT Ts;"CALLP:MODE 'MEAS'" !Select Meas on CALL CONTROL screen.
1020    SUBEND
```

Analog Measurements: Analog Measurements Screen

Description

This section demonstrates using the analog measurement functions on the ANALOG MEAS screen. The ANALOG MEAS screen is generally used in conjunction with the CALL CONTROL screen. Usually the CALL CONTROL screen is used to set up a call and perform call processing. For making measurements on the voice channel, the display is switched to the ANALOG MEAS screen and the filters, audio inputs, and de-emphasis can be adjusted as needed for making the measurement. When it is necessary to perform more call processing, the CALL CONTROL screen is displayed (which automatically re-configures filters, etc.) and functions like handoffs can be performed.

The ANALOG MEAS screen can also be used to make measurements on a mobile that is in a test mode where the mobile is generating a reverse analog voice channel without using the call processing overhead messages.

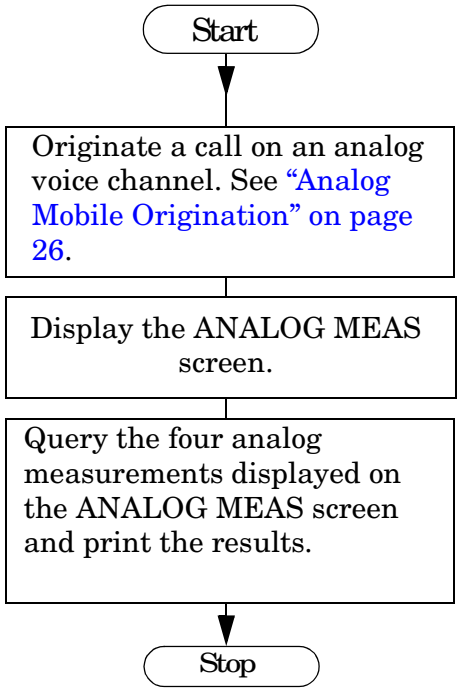
Test Conditions

- System Type = DCCH
- Control Channel = Analog, Channel Number 321
- RF Amplitude = –50 dBm (default)

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type to DCCH.
- ❑ For PCS mobiles:
  - ❑ Set the MS Capab field (DCCH CALL CONFIGURE II) screen to US PCS.
  - ❑ Set the Voc: field (CALL CONTROL screen) to match the mobile's vocoder (typically ACELP).
- ❑ Set the Cntrl Chan type to Analog. The default channel number is 42; change it as needed for your mobile to find service (Idle).
- ❑ In the Traffic Chan Assignment area:
  - ❑ Set the Type to AVC.
  - ❑ Set the Chan to 777.
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Dial a number on the mobile and press **SEND** (originate a call).
- ❑ The mobile should connect, shown by the lit Connect indicator on the test set.
- ❑ Display the ANALOG MEAS screen.
- ❑ Make any desired changes to the analyzer settings (arranged below the measurements).
- ❑ Read the TX Freq Error and TX Power (Avg) RF measurements, and the SAT tone's FM Deviation and AF Freq AF measurements.

Automated Test Flowchart



Example Program

```
10    ! This uses the built-in analog call processing.
20    ! This program implements Active and Origination.
30    ! Monitors the 'Connect' LED to determine if page is successful.
40    ! Monitors ESR to trap errors during the origination.
50    ! Queries the measurements on the ANALOG MEAS screen.
60    ! Prints the measurement results.
70    COM Ts
80    CLEAR SCREEN
90    Ts=714
100   CALL Reset_ts
110   CALL Enable_pcs
120   CALL Setup_acc
130   CALL Set_to_active
140   CALL Setup_trafchan
150   CALL Originate
160   CALL Anlmeas_screen
170   CALL Meas_freqerr
```

```
180   CALL Meas_fmdev
190   CALL Meas_affreq
200   CALL Meas_txpower
210   END
220 Set_to_active: SUB Set_to_active
230     COM Ts
240     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
250     OUTPUT Ts;"*CLS"! Clear Status Event Registers
260     OUTPUT Ts;"CALLP:ACTIVE"
270     REPEAT
280       OUTPUT Ts;"STAT:CALLP:EVENT?"
290       ENTER Ts;Active
300       WAIT .2 ! Gives the testset time to service other processes
310     UNTIL Active ! Returns 0 until one of the bits is set
320   SUBEND
330 Reset_ts: SUB Reset_ts
340     COM Ts
350     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
360     ENTER Ts;Done
370     OUTPUT Ts;"DISP ACNT"! Analog Call Control Screen
380   SUBEND
390 !
400 Originate: SUB Originate
410     COM Ts
420     PRINT "Instructions: Turn the phone on now"
430     PRINT "When the phone shows service, dial a number and press SEND"
440     OUTPUT Ts;"STAT:CALLP:PTR 32" ! Latch "Connect" LED
450     OUTPUT Ts;"STAT:CALLP:NTR 0" ! Ignore All Negative Transitions
460     OUTPUT Ts;"*CLS"! Clear Status Event Registers
470     REPEAT
480       OUTPUT Ts;"*ESR?;:STAT:CALLP:EVENT?"
490       ENTER Ts;Esr,Originate
500       IF Esr<>0 THEN
510         PRINT "Error during origination"
520         STOP
530       END IF
```

```
540       WAIT .2 ! Gives the testset time to service other processes
550     UNTIL Originate ! Returns 0 until one of the bits is set
560     PRINT “Origination Successful!”
570   SUBEND
580 Enable_pcs:   SUB Enable_pcs
590     COM Ts
600     OUTPUT Ts;”CALLP:DCCH:PCS:MODE ‘ON’”
610     OUTPUT Ts;”CALLP:DCCH:VOC ‘ACELP’”
620     OUTPUT Ts;”CALLP:DCCH:MSCapability:BAND ‘US PCS’”
630     SUBEND
640 Setup_acc: SUB Setup_acc
650     COM Ts
660     OUTPUT Ts;”CALLP:CSYS ‘DCCH’” !Set the System Type to DCCH.
670     OUTPUT Ts;”CALLP:DCCH:CCTY ‘ANALOG’”  !Select Analog control channel.
680     OUTPUT Ts;”CALLP:DCCH:CCH 325” !Change control channel number as
needed.
690     SUBEND
700 Setup_trafchan: SUB Setup_trafchan !Setup AVC channel 777.
710     COM Ts
720     OUTPUT Ts;”CALLP:DCCH:VTYPe ‘AVC’” !Go to an Analog Control Channel.
730     OUTPUT Ts;”CALLP:DCCH:AVCHannel:VCHannel 777” !AVC number.
740     SUBEND
750 Meas_freqerr: SUB Meas_freqerr  !Measure RF Frequency Error
760     COM Ts
770     OUTPUT Ts;”MEAS:RFR:FREQ:ERR?” !Query the TX Freq Error.
780     ENTER Ts;Freq_err
790     PRINT “RF Frequency Error is “;Freq_err;”Hz”
800     SUBEND
810 Meas_fmdev: SUB Meas_fmdev
820     COM Ts
830     OUTPUT Ts;”MEAS:AFR:FM?”
840     ENTER Ts;Fm_dev
850     PRINT “FM Deviation is “;Fm_dev;”Hz”
860     SUBEND
```

```
870 Meas_affreq: SUB Meas_affreq
880     COM Ts
890     OUTPUT Ts;”Meas:AFR:FREQ?”
900     ENTER Ts;Af_freq
910     PRINT “Audio Frequency is “;Af_freq;”Hz”
920     SUBEND
930 Meas_txpower: SUB Meas_txpower
940     COM Ts
950     OUTPUT Ts;”MEAS:RFR:POW?”
960     ENTER Ts;Tx_pow
970     PRINT “TX Power (Avg) is  “;Tx_pow;”Watts”
980     SUBEND
990 Anlmeas_screen: SUB Anlmeas_screen
1000    COM Ts
1010    OUTPUT Ts;”DISP CMEasure” !Display Analog Measurement screen.
1020    SUBEND
```

Digital (TDMA) Call Processing

Description

This section demonstrates how to handoff calls between traffic/voice channel types. In the example, handoffs are made between an analog voice channel to a cell band digital traffic channel, then to a PCS band digital traffic channel, and back to an analog voice channel. The call is then released. This simulates what might happen when a driver moves between areas with systems that support different levels of digital call processing abilities.

Test Conditions

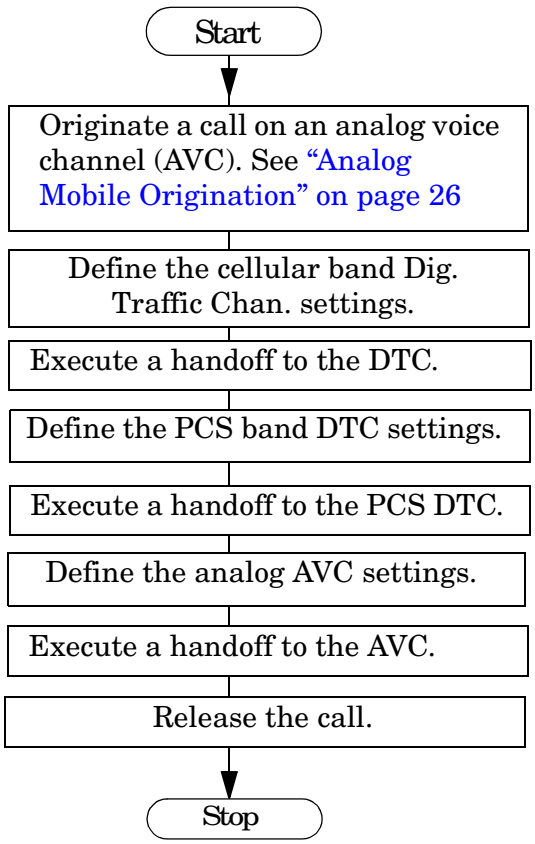
- Phone = Connect Mode
- System Type = DCCH
- Control Channel = Analog, Channel Number 321
- RF Amplitude = –50 dBm (default)

Manual Operation

- ❑ Originate a call (see "Analog Mobile Origination" on page 26) to get the mobile on an analog voice channel. If you turn up the test set's volume with the mobile close to the test set, you will probably hear the "squealing" SAT tone feedback through the test set's speaker.
- ❑ Change the fields under `Voice Chan Assignment`[1] as follows:
  - ❑ `Type:` = DTC
  - ❑ `Band:` = Cellular
  - ❑ `Chan:` = 789
  - ❑ `Voc:` = ACELP
- ❑ Select the `Handoff` field. The `Connect` indicator will go out, the `Access` indicator should light for a second or two and then go out, and the `Connect` indicator should be lit again. The mobile is now on a cellular band digital traffic channel. If you turn up the test set's volume, you will hear a "motor boating" or buzzing sound through the test set's speaker. The sound is the digital traffic channel being routed through the test set's FM discriminator.
- ❑ Change these fields under `Traffic Chan Assignment` as follows:
  - ❑ `Band:` = US PCS
  - ❑ `Channel:` = 1099
- ❑ Select the `Handoff` field to tell the mobile to go to the new PCS band digital traffic channel assignment. As before, the `Connect` indicator should be lit after a few seconds if the handoff was successful.
- ❑ Change these fields under `Traffic Chan Assignment` as follows:
  - ❑ `Type:` = AVC
  - ❑ `Channel:` = 777
- ❑ Select the `Handoff` field to tell the mobile to go back to an analog voice channel.
- ❑ Select the `Release` field (on the test set) to end the call. The `Active` indicator should be lit after the call is released.

1. The label "Voice Channel Assignment" is displayed because the Type: field was set to AVC when the call was originated (to differentiate a digital traffic channel from an analog voice channel). When you change the Type: field from AVC to DTC, the label over this section of fields changes from "Voice Channel Assignment" to "Traffic Channel Assignment".

Automated Test Flowchart



Example Program

```
10    ! This uses the built-in analog call processing.
20    ! This program implements Active and Origination.
30    ! Monitors the 'Connect' LED to determine if page
40    ! and Handoffs are successful between AVC, DTC, and PCS DTC.
50    ! Monitors ESR to trap errors during the origination.
60    COM Ts
70    CLEAR SCREEN
80    Ts=714
90    CALL Reset_ts
100   CALL Enable_pcs
110   CALL Setup_acc
120   CALL Set_to_active
130   CALL Setup_avc
140   CALL Originate
150   CALL Setup_dtc
```

```
160   CALL Handoff
170   CALL Setup_pcs
180   CALL Handoff
190   CALL Setup_avc
200   CALL Handoff
210   CALL Release
220   END
230 Set_to_active: SUB Set_to_active
240     COM Ts
250     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
260     OUTPUT Ts;"*CLS"! Clear Status Event Registers
270     OUTPUT Ts;"CALLP:ACTIVE"
280     REPEAT
290       OUTPUT Ts;"STAT:CALLP:EVENT?"
300       ENTER Ts;Active
310       WAIT .2 ! Gives the testset time to service other processes
320     UNTIL Active  ! Returns 0 until one of the bits is set
330   SUBEND
340 Reset_ts: SUB Reset_ts
350     COM Ts
360     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
370     ENTER Ts;Done
380     OUTPUT Ts;"DISP ACNT"! Analog Call Control Screen
390   SUBEND
400 !
410 Originate: SUB Originate
420     COM Ts
430     PRINT "Instructions: Turn the phone on now"
440     PRINT "When the phone shows service, dial a number and press SEND"
450     OUTPUT Ts;"STAT:CALLP:PTR 32" ! Latch "Connect" LED
460     OUTPUT Ts;"STAT:CALLP:NTR 0" ! Ignore All Negative Transitions
470     OUTPUT Ts;"*CLS"! Clear Status Event Registers
480     REPEAT
490       OUTPUT Ts;"*ESR?;:STAT:CALLP:EVENT?"
500       ENTER Ts;Esr,Originate
510       IF Esr<>0 THEN
```

```
520         PRINT “Error during origination”
530         STOP
540       END IF
550       WAIT .2 ! Gives the testset time to service other processes
560     UNTIL Originate ! Returns 0 until one of the bits is set
570     PRINT “Origination Successful!”
580   SUBEND
590 Enable_pcs:   SUB Enable_pcs
600     COM Ts
610     OUTPUT Ts;”CALLP:DCCH:PCS:MODE ‘ON’”
620     OUTPUT Ts;”CALLP:DCCH:VOC ‘ACELP’”
630     OUTPUT Ts;”CALLP:DCCH:MSCapability:BAND ‘US PCS’”
640     SUBEND
650 Setup_acc: SUB Setup_acc
660     COM Ts
670     OUTPUT Ts;”CALLP:CSYS ‘DCCH’” !Set the System Type to DCCH.
680     OUTPUT Ts;”CALLP:DCCH:CCTY ‘ANALOG’”  !Select Analog control channel.
690     OUTPUT Ts;”CALLP:DCCH:CCH 321” !Change control chan number as needed.
700     SUBEND
710 Setup_avc: SUB Setup_avc !Setup AVC channel 777.
720     COM Ts
730     OUTPUT Ts;”CALLP:DCCH:VTYPe ‘AVC’” !Go to an Analog Control Channel.
740     OUTPUT Ts;”CALLP:DCCH:AVCHannel:VCHannel 777” !AVC number.
750     SUBEND
760 Setup_dtc: SUB Setup_dtc !Setup DTC channel 789.
770     COM Ts
780     OUTPUT Ts;”CALLP:DCCH:VTYPe ‘DTC’” !Go to a Digital Traffic Channel.
790     OUTPUT Ts;”CALLP:DCCH:VTYPe:BAND ‘Cellular’” !Select Cellular band.
800     OUTPUT Ts;”CALLP:DCCH:DTCHannel:TCHannel 789” !DTC number.
820     SUBEND
830 Setup_pcs: SUB Setup_pcs!Setup a PCS band DTC channel 1099.
840     COM Ts
850     OUTPUT Ts;”CALLP:DCCH:VTYPe:BAND ‘US PCS’” !Select PCS band.
860     OUTPUT Ts;”CALLP:DCCH:DTCHannel:TCHannel 1099” !PCS DTC number.
870     SUBEND
```

```
880 Handoff: SUB Handoff !Select handoff function & check for Connect state.
890     COM Ts
900     OUTPUT Ts;”STAT:CALLP:PTR 32”
910     OUTPUT Ts;”STAT:CALLP:NTR 0”
920     OUTPUT Ts;”*CLS”
930     OUTPUT Ts;”CALLP:HANDoff”
940     REPEAT
950       OUTPUT Ts;”*ESR?;:STAT:CALLP:EVENT?”
960       ENTER Ts;Esr,Connect
970       WAIT .2
980     UNTIL Connect OR Esr
990     IF Esr THEN
1000    PRINT “Call failed to handoff properly”
1010    STOP
1020    END IF
1030    PRINT “HANDOFF SUCCESSFUL!”
1040    SUBEND
1050 Release: SUB Release
1060    COM Ts
1070    PRINT “Attempting to release the call...”
1080    OUTPUT Ts;”STAT:CALLP:PTR 1” !Latch “Active” indicator (LED).
1090    OUTPUT Ts;”STAT:CALLP:NTR 0” !Ignore negative transitions.
1100    OUTPUT Ts;”*CLS” !Clear the Even Status Registers (ESR).
1110    OUTPUT Ts;”CALLP:RELease” !Release the call.
1120    REPEAT
1130      OUTPUT Ts;”*ESR?;:STAT:CALLP:EVENT?”
1140      ENTER Ts;Esr,Release
1150      IF Esr<>0 THEN
1160       PRINT “Error during Release”
1170       STOP
1180      END IF
1190      WAIT .2 !Wait to test set processing.
1200      UNTIL Release !Returns 0 until one of the bits is set.
1210      PRINT “Mobile has been released successfully.”
1220      SUBEND
```

TDMA Transmitter Measurements

Description

The mobile's transmitter is modulated with random data. A burst (or 10 bursts) is captured and analyzed by the test set. The following measurement results are returned:

- Droop: Burst amplitude over time. It is the ratio (dB) between the amplitude at the beginning of the burst and the amplitude at the end of the burst.
- Frequency Error: Frequency difference between the mobile's carrier and the Test Set's receive frequency. It is derived from accumulated phase error measured as part of the EVM measurement.
- Origin Offset: Ratio of unmodulated carrier feedthrough to the magnitude of the modulated carrier. An ideal modulator, one that is perfectly balanced, would have no carrier feedthrough. The measurement is called origination offset because the IQ constellation diagram of a signal with carrier feedthrough would show the origin offset from zero.
- Error Vector Magnitude (EVM): Overall Modulation accuracy. It is a measure, in %, of how close the mobile transmitter's modulation vector is to the ideal modulation vector. A perfect modulator would have zero EVM. The IS-137 standard for EVM is a maximum of 12.5%.
- Magnitude Error: Modulation amplitude accuracy. It is a measure, in %, of how close the magnitude of the mobile transmitter's modulation vector is to the ideal vector's magnitude.
- Phase Error: Modulation phase accuracy. It is a measure, in degrees, of how close the phase of the mobile transmitter's modulation vector is to the ideal vector's phase.

This test corresponds to the IS-137 Modulation Type and Accuracy Test (3.3.2.1).

Test Conditions

Mobile = Test Mode.

Transmitter measurements can be made either on the CALL CONTROL screen with the mobile on a call, or on the DIGITAL MEASUREMENTS screen with the mobile transmitting in test mode.

The example procedure assumes the mobile is placed in the test mode, eliminating the need to wait for call processing to establish an active DTC.

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type to DCCH.
- ❑ Display the DIGITAL MEASUREMENTS screen. Note: Error messages warning you about correlation and synchronization problems appear until your mobile is in test mode and synchronized with the test set.
- ❑ Set the Traffic Chan field to match the channel number your mobile uses in test mode.
- ❑ If your mobile does not use Slot 1 and DVCC 1 in test mode, change these test set settings to match your mobile's needs.
- ❑ Put your mobile in its test mode (making sure to match the Traffic Chan setting).
- ❑ Read the EVM, Frequency Error, and Peak EVM measurements.
- ❑ Change the Dig Meas field from EVM 1 to EVM 10 to display the Error Vector Magnitude for 10 bursts. Since the measurement is now made on groups of 10 bursts (instead of after every burst), the measurement value changes more slowly than for EVM 1.
- ❑ Select the EVM measurement heading to display the following list of additional measurements to choose from: Peak EVM, Phase Error, Magnitude Error, Origin Offset, Droop, Sync Location, Maximum Absolute ADC level. Refer to the *Agilent Technologies 83206A TIA/EIA 136 Cellular Adapter User's Guide* for descriptions of these measurements.
- ❑ Change the Dig Meas field from EVM 10 to Avg Power to display the TX Power (Avg) measurement. This is the average RF power in Watts (W).

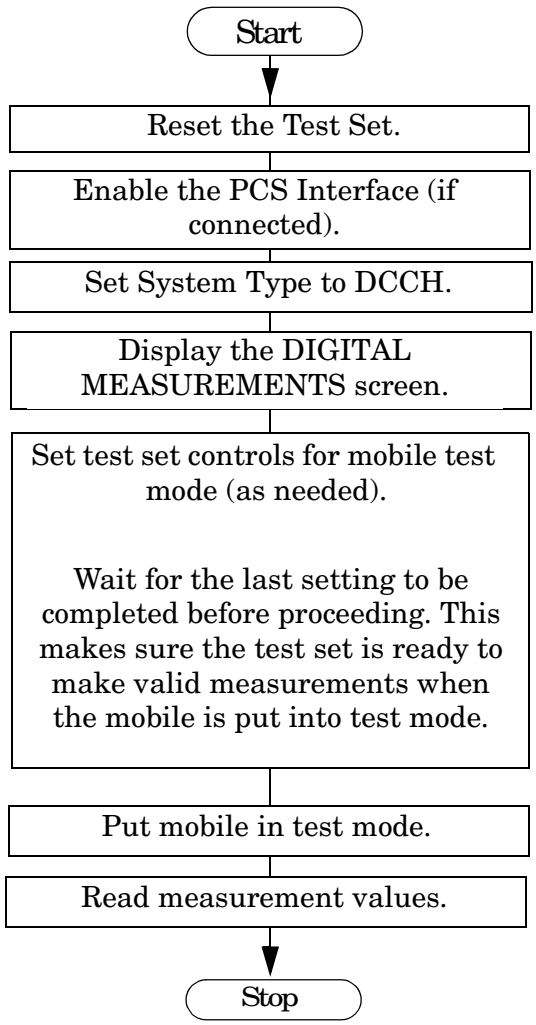
  Don't confuse the TX Power(Avg) [Watts] measurement you just selected with the TX Power [dB] measurement that is displayed when measuring EVM.

  — The TX Power(Avg) [Watts] measurement indicates an absolute signal level; what you typically would expect to measure with a power meter. This is the measurement you would normally use to measure transmitter power.

  — The TX Power [dB] measurement displayed while measuring EVM is *relative* to the level of an external reference signal that you must provide. The main benefit to this measurement is its ability to measure very low level signals. However, you must run an internal calibration program and provide a TDMA signal of a known level to calibrate the measurement before any power measurements can be made.

  Refer to the *Agilent Technologies 83206A TIA/EIA 136 Cellular Adapter User's Guide*, or the product note *Power Measurements using Agilent Technologies 8920B Solutions for AMPS, NAMPS, and TDMA Mobile Phones* (Agilent Technologies p/n 5966-2557E), for more information on power measurements.

Automated Test Flowchart



Example Program

```
10    ! This program shows how to make TDMA transmitter
20    ! quality measurements on a digital traffic channel.
30    ! with the mobile in test mode.
40    COM Ts
50    Ts=714
60    CLEAR SCREEN
70    Initialize_ts
80    Enable_pcs
90    Init_dcch
100   Disp_dig_meas
110   Setup_tst_mode
120   DISP “Put the mobile in test mode, then press CONTINUE.”
130   PAUSE
140   Meas_tx_qual
150   DISP “Program Ended”
160   END
170 !
180 Initialize_ts: SUB Initialize_ts
190     ! Reset Test Set
200     COM Ts
210     CLEAR Ts  ! Device clear to clean up any pending GPIB
220     OUTPUT Ts;”*RST;*OPC?”  ! Good reset technique
230     ENTER Ts;Done
240     OUTPUT Ts;”TRIG:MODE:RETR REP”! Repetitive Trigger
250   SUBEND
260 !
270 Init_dcch: SUB Init_dcch
280     COM Ts
290     OUTPUT Ts;”DISP ACNT” ! Display analog Call Control screen.
300     OUTPUT Ts;”CPR:CSYS ‘DCCH’” ! Set System Type to DCCH.
310   SUBEND
320  !
```

```
330 Meas_tx_qual: SUB Meas_tx_qual
340     ! This routine measures a Digital Traffic Channel
350     ! for Droop, Frequency Error, Origin Offset, Magnitude
360     ! Error, Phase Error, and EVM.
370     COM Ts
380     ON TIMEOUT 7,10 GOTO Error_handler
390     OUTPUT Ts;"MEAS:RESet" !Reset measurement process in case
400     ! squelch interupt overflow occurs while putting mobile
410     ! in test mode.
420     OUTPUT Ts;"MEAS:DCCH:MTYPE 'EVM 1'"
430     OUTPUT Ts;"TRIG:MODE:RETR SINGLE" ! Single Trigger
440     OUTPUT Ts;"TRIG"  ! Trigger all measurements
450     OUTPUT Ts;"MEAS:DCCH:EVMM:DROOP?"
460     ENTER Ts;Droop
470     OUTPUT Ts;"MEAS:DCCH:EVMM:FERR?"
480     ENTER Ts;Freq_error
490     OUTPUT Ts;"MEAS:DCCH:EVMM:OOFF?"
500     ENTER Ts;Origin_offset
510     OUTPUT Ts;"MEAS:DCCH:EVMM:MERR?"
520     ENTER Ts;Mag_error
530     OUTPUT Ts;"MEAS:DCCH:EVMM:PERR?"
540     ENTER Ts;Phase_error
550     OUTPUT Ts;"MEAS:DCCH:EVMM:EVM?"
560     ENTER Ts;Evm1
570     OUTPUT Ts;"MEAS:RFRequency:POWer?"
580     ENTER Ts;Power
590     PRINT "Droop       ",PROUND(Droop,-3),"dB"
600     PRINT "Freq Error ",PROUND(Freq_error,-3),"Hz"
610     PRINT "Origin Offset",PROUND(Origin_offset,-3),"dB"
620     PRINT "Magnitude Error",PROUND(Mag_error,-3),"%"
630     PRINT "Phase Error",PROUND(Phase_error,-3),"deg"
640     PRINT "EVM 1 Burst",PROUND(Evm1,-3),"%"
650     PRINT "Average Power",PROUND(Power,-3),"Watts"
660     GOTO Exit_sub
```

```
670 Error_handler: !
680     PRINT “Unable to read Tx Qualilty Measurement”
690 Exit_sub: !
700     OUTPUT Ts;”TRIG:MODE:RETR REP”! Repetitive Trigger
710   SUBEND
720 Enable_pcs: SUB Enable_pcs
730     COM Ts
740     OUTPUT Ts;”CALLP:DCCH:PCS:MODE ‘ON’”
750     SUBEND
760 Disp_dig_meas:  SUB Disp_dig_meas
770     COM Ts
780     OUTPUT Ts;”DISP DME” !Display the DIGITAL MEASUREMENTS screen.
790   SUBEND
800 Setup_tst_mode:  SUB Setup_tst_mode !Setup test mode conditions.
810     COM Ts
820     INTEGER Settled
830     Slot_val=1 !Enter the Slot number to use for test mode setup.
840     ! The following default values may need to be changed to match the
850     ! mobile’s test mode settings. (Examples use default values)
860     OUTPUT Ts;”CALLP:DCCH:DTCH:TCHannel 2” !Set Traffic Chan number.
870     OUTPUT Ts;”CALLP:DCCH:DTCH:DVCCode 1”  !Set value for DVCC field.
880     OUTPUT Ts;”CALLP:DCCH:DTCH:SLOT “;Slot_val  !Set value for Slot
field.
890     LOOP
900       OUTPUT Ts;”CALLP:DCCH:DTCH:SLOT?” !Query the Slot value
910       ENTER Ts;Settled          !to see if it has changed yet.
920       EXIT IF Settled=Slot_val !Exit loop if Slot command executed.
930     END LOOP
940     SUBEND
```

TDMA Receiver Sensitivity: BER & WER

Description

Two tests measure the RF Sensitivity of the mobile receiver in digital mode: Bit Error Rate (BER) and Word Error Rate (WER). In both measurements, the test set's RF carrier is modulated by a bit stream. The mobile demodulates the signal and loops the bits back to the transmitter. The test set demodulates the mobile's signal and compares the data sent to the mobile with the data transmitted back from the mobile. Amplitude is set to a low level and a high level (overload condition) for each measurement.

- For BER, a pseudo-random bit stream is used on a Digital Traffic Channel (DTC) with the mobile in test mode. Bit error rate (BER) is calculated by taking the ratio of bit error to total bits and converting to a percentage (<3% specified in standard).

  The test set can be set to create a signal with a known BER to test Mobile Assisted Hand Off (MAHO). This is done by setting the % BIT ERROR field (on the DCCH CALL CONFIGURE screen) to the desired value *after* a call has been connected on a DTC. MAHO must be measured with the mobile on an active traffic channel.
- For DCCH WER, data is sent in the Broadcast Control Channel (BCCH) information. This measurement must be made with the mobile in test mode.
- For DTC WER, a pseudo-random bit stream is used on a DTC using SPEECH, SACCH, or FACCH data words. This measurement must be made with the mobile in test mode.

This test corresponds to the IS-137, RF Sensitivity Test (2.3.2.1).

This test is similar to the Co-channel Performance test (2.3.2.6), where a second signal source is used to test the receiver's ability to receive a modulated signal in the presence of a second signal on the same channel frequency (determined by measuring BER &WER).

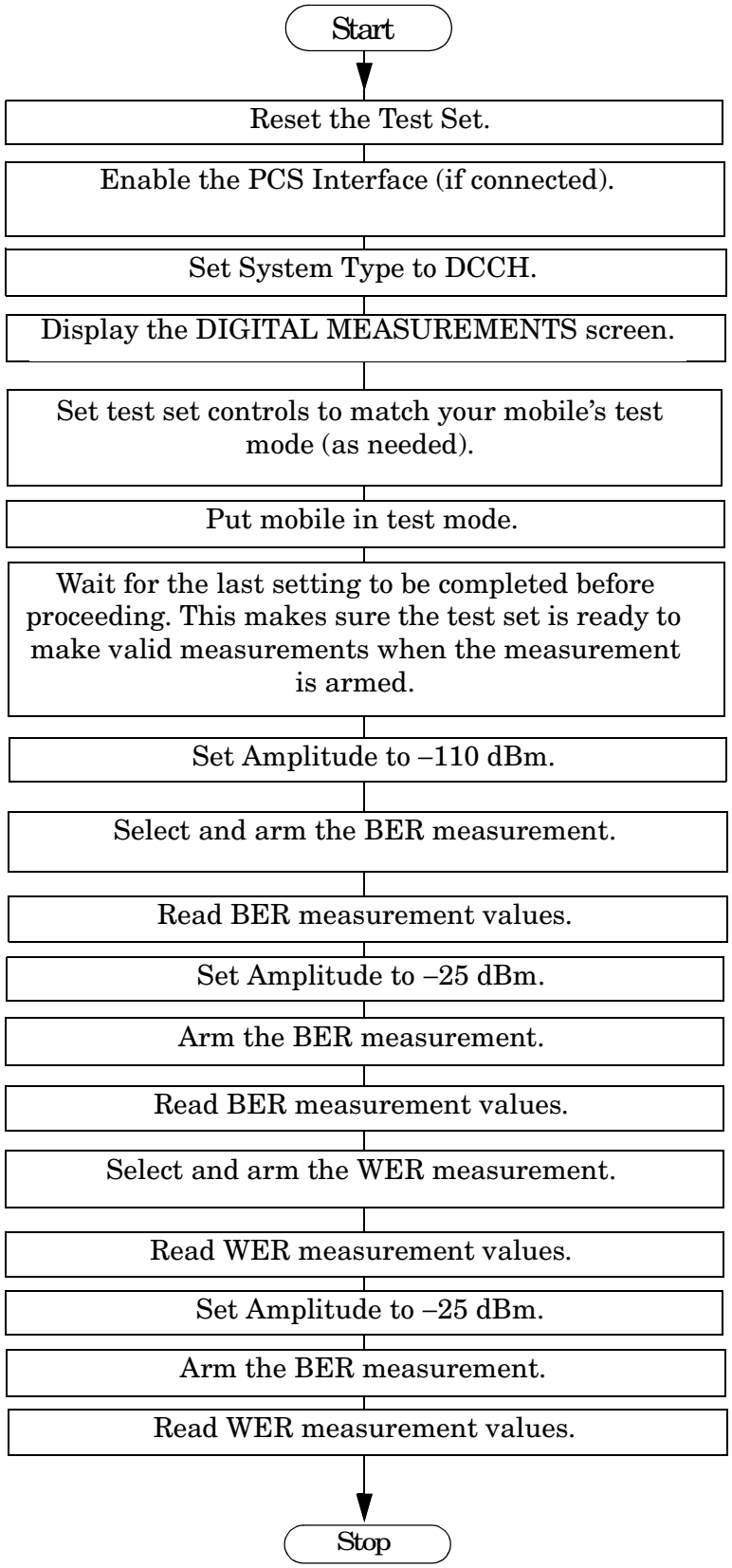
Test Conditions

- Phone = Test Mode
- RF Amplitude = –110 dBm & –25 dBm(BER), –111 dBm & –25 dBm (WER).

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type to DCCH.
- ❑ Display the DIGITAL MEASUREMENTS screen. Note: Error messages warning you about correlation and synchronization problems appear until your mobile is in test mode and synchronized with the test set.
- ❑ Set the Traffic Chan field to match the channel number your mobile uses in test mode.
- ❑ If your mobile does not use (time)Slot 1 and DVCC 1 in test mode, change these fields as needed on the test set.
- ❑ Put your mobile in its test mode.
- ❑ Change the Dig Meas field from EVM 1 to BER.
- ❑ Set the Amplitude to –110 dBm.
- ❑ Select Arm (under the Dig Meas field) to make the measurement.
- ❑ Read low level Loopback BER in %.
- ❑ Set the Amplitude to –25 dBm.
- ❑ Select Arm.
- ❑ Read high level Loopback BER in %.
- ❑ Change the Dig Meas field from BER to DTC WER.
- ❑ Select Arm.
- ❑ Read high level Loopback WER in %.
- ❑ Select Arm.
- ❑ Set the Amplitude to –111 dBm.
- ❑ Read low level Loopback WER in %.

Automated Test Flowchart



Example Program

```
10    ! This program shows how to make TDMA receiver
20    ! quality measurements on a digital traffic channel.
30    ! with the mobile in test mode.
40    COM Ts
50    Ts=714
60    CLEAR SCREEN
70    Initialize_ts
80    Enable_pcs
90    Init_dcch
100   Disp_dig_meas
110   Setup_tst_mode
120   DISP “Put the mobile in test mode, then press CONTINUE.”
130   PAUSE
140   Ber_ampl_low
150   Meas_ber
160   Ampl_high
170   Meas_ber
180   Meas_wer
190   Wer_ampl_low
200   Meas_wer
210   DISP “Program Ended”
220   END
230 !
240 Initialize_ts: SUB Initialize_ts
250     ! Reset Test Set
260     COM Ts
270     CLEAR Ts  ! Device clear to clean up any pending GPIB
280     OUTPUT Ts;”*RST;*OPC?”  ! Good reset technique
290     ENTER Ts;Done
300     OUTPUT Ts;”TRIG:MODE:RETR REP”! Repetitive Trigger
310   SUBEND
```

```
320 Init_dcch: SUB Init_dcch
330     COM Ts
340     OUTPUT Ts;"DISP ACNT" ! Display analog Call Control screen.
350     OUTPUT Ts;"CPR:CSYS 'DCCH'" ! Set System Type to DCCH.
360   SUBEND
370 Enable_pcs: SUB Enable_pcs
380     COM Ts
390     OUTPUT Ts;"CALLP:DCCH:PCS:MODE 'ON'"
400     SUBEND
410 Disp_dig_meas:  SUB Disp_dig_meas
420     COM Ts
430     OUTPUT Ts;"DISP DME" !Display the DIGITAL MEASUREMENTS screen.
440   SUBEND
450 Setup_tst_mode:  SUB Setup_tst_mode !Setup test mode conditions.
460     COM Ts
470     INTEGER Settled
471     Slot_val=1  !Enter the Slot value to use for test mode setup.
480     ! The following default values may need to be changed to match the
490     ! mobile's test mode settings.
500     OUTPUT Ts;"CALLP:DCCH:DTCH:TCHannel 2" !Set Traffic Chan number.
510     OUTPUT Ts;"CALLP:DCCH:DTCH:DVCCode 1"  !Set value for DVCC field.
520     OUTPUT Ts;"CALLP:DCCH:DTCH:SLOT ";Slot_val !Set value for Slot field
540     LOOP
550       OUTPUT Ts;"CALLP:DCCH:DTCH:SLOT?"  !Query the slot value to
560       ENTER Ts;Settled  !see if the last command has executed yet.
570       EXIT IF Settled=Slot_val !Exit loop  if Slot command executed.
580     END LOOP
590     SUBEND
600 Ampl_high: SUB Ampl_high
610    COM Ts
620    OUTPUT Ts;"RFG:AMPL -25 dbm" !Set test set carrier amplitude.
630    SUBEND
640 Ber_ampl_low: SUB Ber_ampl_low
650    COM Ts
660    OUTPUT Ts;"RFG:AMPL -110 dBm" !Set BER low amplitude.
670    SUBEND
```

```
680 Wer_ampl_low: SUB Wer_ampl_low
690    COM Ts
700    OUTPUT Ts;"RFG:AMPL –111 dBm" !Set WER low amplitude.
710    SUBEND
720 Meas_ber:  SUB Meas_ber
730    COM Ts
740    ON TIMEOUT 7,10 CALL Failed
750    OUTPUT Ts;"CALLP:DCCH:DMTYpe 'BER'" !Select BER measurement.
760    OUTPUT Ts;"MEAS:DCCH:BER:ARM" !Arm the BER measurement.
770    OUTPUT Ts;"MEAS:DCCH:BER:VALue?" !Query the BER.
780    ENTER Ts;Ber_meas
790    OUTPUT Ts;"RFG:AMPL?" !Query the Amplitude setting.
800    ENTER Ts;Amplitude
810    PRINT "BER at ";Amplitude;" dBm = ";PROUND(Ber_meas,–3);"%"
820    SUBEND
830 Meas_wer:  SUB Meas_wer
840    COM Ts
850    ON TIMEOUT 7,10 CALL Failed
860    OUTPUT Ts;"CALLP:DCCH:DMTYpe 'DTC WER'" !Select DTC WER measurement.
870    OUTPUT Ts;"MEAS:DCCH:WER:ARM" !Arm the WER measurement.
880    OUTPUT Ts;"MEAS:DCCH:WER:VALue?" !Query the WER.
890    ENTER Ts;Wer_meas
900    OUTPUT Ts;"RFG:AMPL?" !Query the Amplitude setting.
910    ENTER Ts;Amplitude
920    PRINT "WER at ";Amplitude;" dBm = ";PROUND(Wer_meas,–3);"%"
930    SUBEND
940 Failed:  SUB Failed
950    COM Ts
960    CLEAR 7
970    PRINT "MEASUREMENT FAILED. A valid measurement is not displayed."
980    STOP
990    SUBEND
```

TDMA Receiver RSSI

Description

The mobile is presented with various RF carrier levels. It measures the signal level and reports RSSI (Received Signal Strength Indicator) to the Test Set. There is no corresponding IS-137 test.

When displaying RSSI for the current channel, the test set also displays the channel's MAHO Bit Error Rate (BER) and the RSSI for any neighbor channels specified on the DCCH CALL CONFIGURE screen's `# Neighbors` field.

NOTE After the RF carrier level is changed, it can take a few seconds for the mobile's power measurement to settle before reporting the *final* RSSI measurement to the test set. Measurements viewed before the settling period is over may not be accurate.

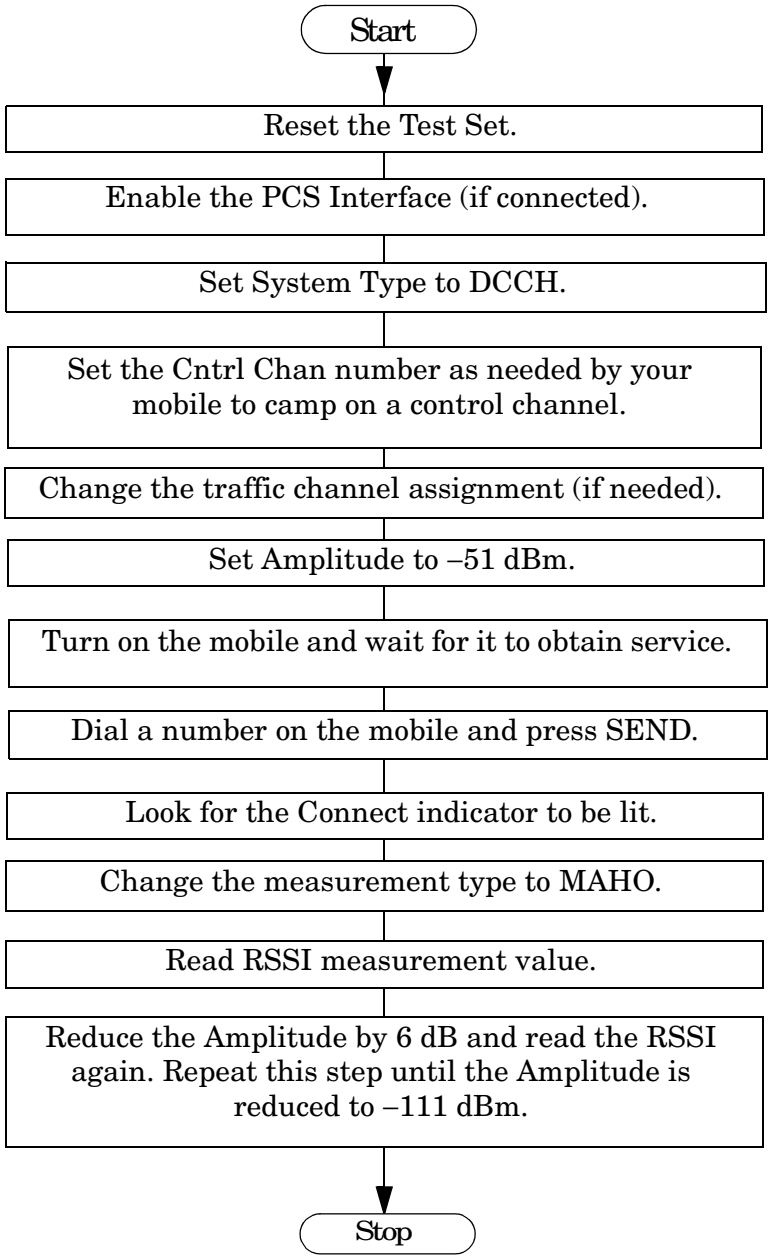
Test Conditions

- Phone = Connect Mode
- System Type = DCCH
- Traffic Channel = DTC
- RF Amplitude: From –51 dBm to –111 dBm in 6 dB steps.

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type to DCCH.
- ❑ For PCS mobiles:
  - ❑ Set the MS Capab field (DCCH CALL CONFIGURE II) screen to US PCS.
  - ❑ Set the Voc: field (CALL CONTROL screen) to match the mobile's vocoder (typically ACELP).
- ❑ Set the Cntrl Chan number to a control channel your mobile will camp on.
- ❑ In the Traffic Chan Assignment area, set the Chan to 777 if your mobile will not work at the default traffic channel assignment (channel 2).
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Dial a number on the mobile and press **SEND** (originate a call).
- ❑ The mobile should connect, shown by the lit Connect indicator on the test set.
- ❑ Change the Display field from Data to Meas.
- ❑ Change the Display setting from EVM1 to MAHO.
- ❑ Read the RSSI-Curr Chan dBm value.
- ❑ Change the Amplitude to –51 dBm and read the RSSI value.
- ❑ Decrease the Amplitude in 6 dB steps until the level is down to –111 dBm, reading the RSSI value at each amplitude change.

Automated Test Flowchart



Example Program

```
10    ! This uses the built-in digital call processing to measure RSSI.
20    ! This program implements Active and Origination.
30    ! Monitors the ‘Connect’ LED to determine if page is successful.
40    ! Monitors ESR to trap errors during the origination.
50    COM /Settings/Ts,Amplitude
60    CLEAR SCREEN
70    Ts=714
80    Amplitude=–51
90    CALL Reset_ts
100   CALL Enable_pcs
110   CALL Setup_dcch
120   CALL Set_to_active
130   CALL Setup_trafchan
140   CALL Originate
150   Setup_rssi
160   Meas_rssi
170   END
180 Set_to_active: SUB Set_to_active
190     COM /Settings/Ts,Amplitude
200     OUTPUT Ts;”STAT:CALLP:PTR 1”! Arm Bit 0 of the PTR register
210     OUTPUT Ts;”*CLS”! Clear Status Event Registers
220     OUTPUT Ts;”CALLP:ACTIVE”
230     REPEAT
240       OUTPUT Ts;”STAT:CALLP:EVENT?”
250       ENTER Ts;Register
260       WAIT .2 ! Gives the testset time to service other processes
270     UNTIL Register ! Returns 0 until one of the bits is set
280   SUBEND
290 Reset_ts: SUB Reset_ts
300     COM /Settings/Ts,Amplitude
310     OUTPUT Ts;”*RST;*OPC?”! Good reset technique
320     ENTER Ts;Done
330     OUTPUT Ts;”DISP ACNT”! Analog Call Control Screen
340   SUBEND
```

```
350 !
360 Originate: SUB Originate
370     COM /Settings/Ts,Amplitude
380     PRINT “Instructions: Turn the phone on now”
390     PRINT “When the phone shows service, dial a number and press SEND”
400     OUTPUT Ts;”STAT:CALLP:PTR 32” ! Latch “Connect” LED
410     OUTPUT Ts;”STAT:CALLP:NTR 0” ! Ignore All Negative Transitions
420     OUTPUT Ts;”*CLS”! Clear Status Event Registers
430     REPEAT
440       OUTPUT Ts;”*ESR?;:STAT:CALLP:EVENT?”
450       ENTER Ts;Esr,Register
460       IF Esr<>0 THEN
470         PRINT “Error during origination”
480         STOP
490       END IF
500       WAIT .2 ! Gives the testset time to service other processes
510     UNTIL Register ! Returns 0 until one of the bits is set
520     PRINT “Origination Successful!”
530   SUBEND
540 Enable_pcs:   SUB Enable_pcs
550     COM /Settings/Ts,Amplitude
560     OUTPUT Ts;”CALLP:DCCH:PCS:MODE ‘ON’”
570     OUTPUT Ts;”CALLP:DCCH:VOC ‘ACELP’”
580     OUTPUT Ts;”CALLP:DCCH:MSCapability:BAND ‘US PCS’”
590     SUBEND
600 Setup_dcch: SUB Setup_dcch
610     COM /Settings/Ts,Amplitude
620     OUTPUT Ts;”CALLP:CSYS ‘DCCH’” !Set the System Type to DCCH.
630     OUTPUT Ts;”CALLP:DCCH:CCH 1012” !Change Cntrl Chan number as needed.
640     SUBEND
650 Setup_trafchan: SUB Setup_trafchan !Setup DTC channel 777.
660     COM /Settings/Ts,Amplitude
670     OUTPUT Ts;”CALLP:DCCH:DTCH:TCHannel 777” !DTC number.
680     SUBEND
```

```
690 Setup_rssi: SUB Setup_rssi
700     COM /Settings/Ts,Amplitude
710     OUTPUT Ts;"CALLP:DCCH:DMODe 'Meas'" !Select Measurements display.
720     OUTPUT Ts;"CALLP:DCCH:MTYPe 'MAHO'" !Select the MAHO measurement.
730     SUBEND
740 Meas_rssi: SUB Meas_rssi
750     COM /Settings/Ts,Amplitude
760     LOOP
770     OUTPUT Ts;"CALLP:DCCH:AMPLitude ";VAL$(Amplitude)
780     WAIT 3 !Wait for RSSI measurement to settle in the mobile.
790     OUTPUT Ts;"MEAS:DCCH:MAHandoff:CRSStrength?"
800     ENTER Ts;Rssi_val
810     PRINT "RSSI at ";Amplitude;" dBm =";Rssi_val
820     Amplitude=Amplitude-6
830     EXIT IF Amplitude=-117
840     END LOOP
850     PRINT "Measurements Completed."
860     SUBEND
```

Testing Message Waiting Indicator Operation

Description

Message Waiting Indicator (MWI) alerts the mobile that Voice, Short Message Service, or Fax messages are waiting for attention. When the test set sends the message, it reports whether the mobile sent the correct response. The mobile alerts the user that a message (or messages) is waiting. Messages can be sent on a DTC (in the connect mode) or on a DCCH with the mobile having found service ("camped").

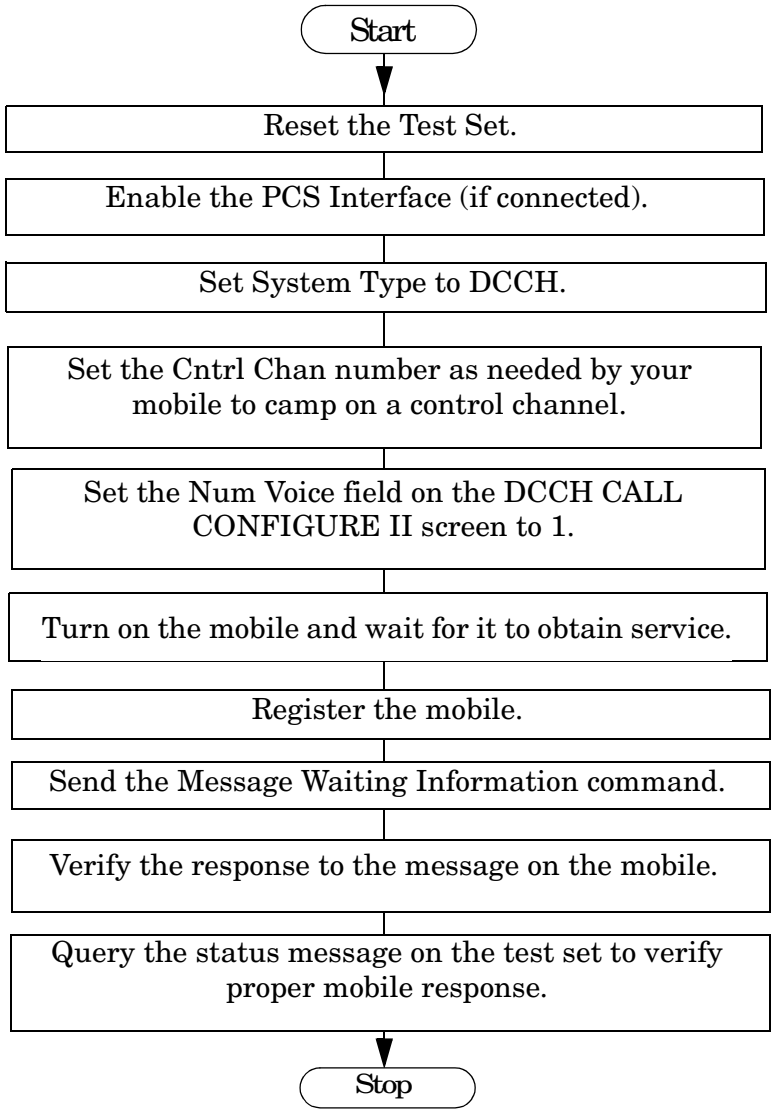
Test Conditions

- System Type = DCCH
- Control Channel = Digital, Channel number as needed by your mobile.
- Phone = Camping on the DCCH (not connected).
- RF Amplitude = –50 dBm

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the `PCS Mode` field on the CONFIGURE screen to `On`.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the `System Type` to `DCCH`.
- ❑ Set the `Cntrl Chan` number to a digital control channel (DCCH) your mobile will camp on.
- ❑ Set the `Num Voice` field on the DCCH CALL CONFIGURE II screen to `1`. When the MWI command is sent, the phone is told that 1 voice message is waiting.
- ❑ Return to the CALL CONTROL screen.
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Select Register to register the mobile and automatically enter its phone number into the `MS ID` field.
- ❑ Select the `Cntl Order` field and choose `Send MWI`. *This is the default setting, but it must be re-selected to send the command.*
- ❑ The mobile should respond to indicate that a voice message is waiting.
- ❑ If the mobile correctly processed the command, the test set very briefly displays “MWI Acknowledged Correctly”, and then displays the phone number of the mobile. If the process failed, the message “MWI Failed: Acknowledgment not received” is displayed.

Automated Test Flowchart



Example Program

```
10    ! This program implements Analog Registration.
20    ! Monitors the 'Register' LED to determine when
30    ! registration is complete. Configures the Message Waiting
40    ! Information command, sends the MWI command, monitors the
50    ! Active LED to see when the call processing state goes from
60    ! Active to Access (when MWI command is issued) and returns to
70    ! Active before querying to see if the mobile responded correctly.
80    ON TIMEOUT 7,8 CALL Escape  !Recover from bus hangup.
90    COM Ts
100   CLEAR SCREEN
110   Ts=714
120   Reset_ts
130   Enable_pcs
140   Setup_dtc
150   Set_to_active
160   PRINT "Instructions: Turn the phone on now."
170   Register_mobile
180   WAIT 3  !Wait for mobile to stabilize before issuing MWI command.
190   Setup_mwi
200   Send_mwi
210   Test_response
220   END
230 Set_to_active: SUB Set_to_active
240     COM Ts
250     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
260     OUTPUT Ts;"*CLS"! Clear Status Event Registers
270     OUTPUT Ts;"CALLP:ACTIVE"
280     REPEAT
290       OUTPUT Ts;"STAT:CALLP:EVENT?"
300       ENTER Ts;Register
310       WAIT .2 ! Gives the testset time to service other processes
320     UNTIL Register ! Returns 0 until one of the bits is set
330   SUBEND
```

```
340 Reset_ts: SUB Reset_ts
350     COM Ts
360     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
370     ENTER Ts;Done
380     OUTPUT Ts;"DISP ACNT"! Analog Call Control Screen
390     OUTPUT Ts;"CALLP:CSYS 'DCCH'" ! Select the TIA/EIA 136 standard.
400   SUBEND
410 Register_mobile: SUB Register_mobile
420     COM Ts
430     OUTPUT Ts;"STAT:CALLP:PTR 0"! Don't latch positive transitions
440     OUTPUT Ts;"STAT:CALLP:NTR 2"! Latch "Register" LED turning off
450     OUTPUT Ts;"*CLS"! Clear Status Event Registers
460     OUTPUT Ts;"CALLP:REGISTER"
470     REPEAT
480       OUTPUT Ts;"*ESR?;:STAT:CALLP:EVENT?"
490       ENTER Ts;Esr,Register
500       WAIT .2 ! Gives the testset time to service other processes
510     UNTIL Register OR Esr  ! Returns 0 until one of the bits is set
520     IF Esr THEN
530       PRINT "Error with Registration"
540       STOP
550     ELSE
560       PRINT "Mobile Registration Successful!"
570     END IF
580     SUBEND
590 Enable_pcs:     SUB Enable_pcs
600       COM Ts
610       OUTPUT Ts;"CALLP:DCCH:PCS:MODE 'ON'"
620     SUBEND
630 Escape: SUB Escape
640     COM Ts
650     CLEAR 7
660     LOCAL Ts
670     PRINT "Query Error or other bus problem occurred."
680     STOP
690     SUBEND
```

```
700 Setup_dtc: SUB Setup_dtc !Setup an digital control channel.
710     COM Ts
720     OUTPUT Ts;"CALLP:CSYS 'DCCH'"          !System Type
730     OUTPUT Ts;"CALLP:DCCH:CCH 1012"  !Set Cntrl Chan number as needed.
740     SUBEND
750 Setup_mwi: SUB Setup_mwi
760     COM Ts
770     OUTPUT Ts;"CALLP:DCCH:MWI:NVO 1" !Set Num Voice field to 1.
780     SUBEND
790 Send_mwi: SUB Send_mwi
800     COM Ts
810     WAIT 3
820     OUTPUT Ts;"CALLP:DCCH:CORD 'Send MWI'" !Send MWI command to mobile.
830     SUBEND
840 Test_response: SUB Test_response
850     COM Ts
860     DIM Response_1$[256]
870     OUTPUT Ts;"STAT:CALLP:PTR 1" !Enable pos-going transistion register
880     OUTPUT Ts;"STAT:CALLP:NTR 0" !for the Active indicator to tell when
890     OUTPUT Ts;"*CLS"  !the test set has gone from Active, to Access, and
900     REPEAT            !back to Active, before reading the result.
910       OUTPUT Ts;"STAT:CALLP:EVENt?"
920       ENTER Ts;Active_again
930       UNTIL Active_again<>0
940     OUTPUT Ts;"CALLP:DCCH:RCDD1?" !Query the mobile's response.
950     ENTER Ts;Response_1$
960     IF Response_1$=""""MWI FAILED:"""" THEN
970     PRINT "Message Waiting FAILED! No mobile acknowledgement."
980     ELSE
990     PRINT "Message Waiting Indicator WORKED! Mobile acknowledged."
1000    END IF
1010    SUBEND
```

Testing Short Message Service Operation

Description

Short Message Service is used to send short text messages to a mobile (similar to a pager). When the test set sends the message, it reports whether the mobile sent the correct response. The mobile alerts the user that a message (or messages) is waiting. Messages can be sent on a DTC (in the connect mode) or on a DCCH with the mobile having found service (“camped”).

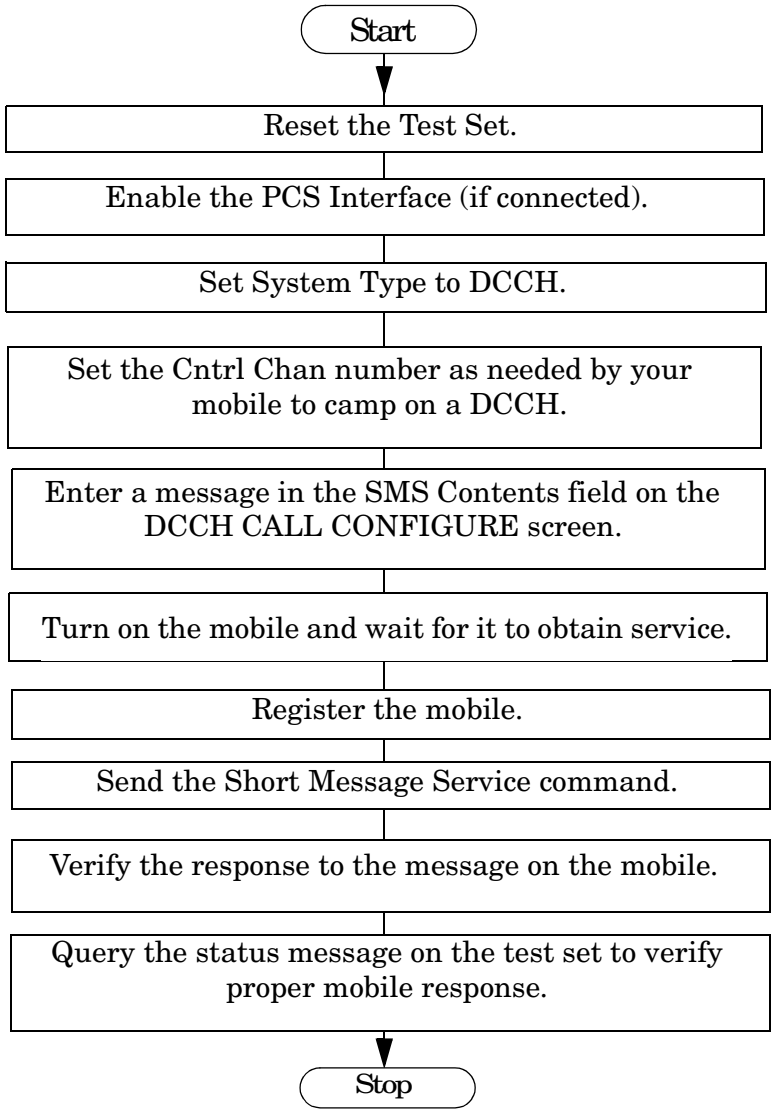
Test Conditions

- System Type = DCCH
- Control Channel = Digital, Channel number as needed by your mobile.
- Phone = Camping on the DCCH (not connected).
- RF Amplitude = –50 dBm

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type to DCCH.
- ❑ Set the Cntrl Chan number to a digital control channel (DCCH) your mobile will camp on.
- ❑ Go to the DCCH CALL CONFIGURE screen, and select the SMS Contents field. Enter several characters to send to the mobile.
- ❑ Return to the CALL CONTROL screen.
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Select Register to register the mobile and automatically enter its phone number into the MS ID field.
- ❑ Set the Cntl Order field to Send SMS.
- ❑ The mobile should respond to indicate that an SMS message is waiting.
- ❑ If the mobile correctly processed the command, the test set displays “SMS Acknowledged Correctly: MS Indicates RDATA Accepted”, and then displays the phone number of the mobile. If the process failed, the message “SMS Failed: Acknowledgment not received” is displayed.

Automated Test Flowchart



Example Program

```
10    ! This program implements Analog Registration.
20    ! Monitors the 'Register' LED to determine when
30    ! registration is complete. Configures the Message Waiting
40    ! Information command, sends the MWI command, monitors the
50    ! Active LED to see when the call processing state goes from
60    ! Active to Access (when MWI command is issued) and returns to
70    ! Active before querying to see if the mobile responded correctly.
80    ON TIMEOUT 7,8 CALL Escape  !Recover from bus hangup.
90    COM Ts
100   CLEAR SCREEN
110   Ts=714
120   Reset_ts
130   Enable_pcs
140   Setup_dtc
150   Set_to_active
160   PRINT "Instructions: Turn the phone on now."
170   Register_mobile
180   WAIT 3  !Wait for mobile to stabilize before issuing MWI command.
190   Setup_sms
200   Send_sms
210   Test_response
220   END
230 Set_to_active: SUB Set_to_active
240     COM Ts
250     OUTPUT Ts;"STAT:CALLP:PTR 1"! Arm Bit 0 of the PTR register
260     OUTPUT Ts;"*CLS"! Clear Status Event Registers
270     OUTPUT Ts;"CALLP:ACTIVE"
280     REPEAT
290       OUTPUT Ts;"STAT:CALLP:EVENT?"
300       ENTER Ts;Register
310       WAIT .2 ! Gives the testset time to service other processes
320     UNTIL Register ! Returns 0 until one of the bits is set
330   SUBEND
340 Reset_ts: SUB Reset_ts
```

```
350     COM Ts
360     OUTPUT Ts;"*RST;*OPC?"! Good reset technique
370     ENTER Ts;Done
380     OUTPUT Ts;"DISP ACNT"! Analog Call Control Screen
390     OUTPUT Ts;"CALLP:CSYS 'DCCH'" ! Select the TIA/EIA 136 standard.
400   SUBEND
410 Register_mobile: SUB Register_mobile
420     COM Ts
430     OUTPUT Ts;"STAT:CALLP:PTR 0"! Don't latch positive transitions
440     OUTPUT Ts;"STAT:CALLP:NTR 2"! Latch "Register" LED turning off
450     OUTPUT Ts;"*CLS"! Clear Status Event Registers
460     OUTPUT Ts;"CALLP:REGISTER"
470     REPEAT
480       OUTPUT Ts;"*ESR?;:STAT:CALLP:EVENT?"
490       ENTER Ts;Esr,Register
500       WAIT .2 ! Gives the testset time to service other processes
510     UNTIL Register OR Esr  ! Returns 0 until one of the bits is set
520     IF Esr THEN
530       PRINT "Error with Registration"
540       STOP
550     ELSE
560       PRINT "Mobile Registration Successful!"
570     END IF
580     SUBEND
590 Enable_pcs:     SUB Enable_pcs
600       COM Ts
610       OUTPUT Ts;"CALLP:DCCH:PCS:MODE 'ON'"
620     SUBEND
630 Escape: SUB Escape
640     COM Ts
650     CLEAR 7
660     LOCAL Ts
670     PRINT "Query Error or other bus problem occurred."
680     STOP
690     SUBEND
700 Setup_dtc: SUB Setup_dtc !Setup an digital control channel.
```

```
710     COM Ts
720     OUTPUT Ts;"CALLP:CSYS 'DCCH'"          !System Type
730     OUTPUT Ts;"CALLP:DCCH:CCH 1012"  !Set Cntrl Chan number as needed.
740     SUBEND
750 Setup_sms: SUB Setup_sms
760     COM Ts
770     OUTPUT Ts;"CALLP:DCCH:SMS:CONT 'NewCo ISP has been announced!'"
780     SUBEND
790 Send_sms: SUB Send_sms
800     COM Ts
810     WAIT 3
820     OUTPUT Ts;"CALLP:DCCH:CORD 'Send SMS'" !Send MWI command to mobile.
830     SUBEND
840 Test_response: SUB Test_response
850     COM Ts
860     DIM Response_1$[256]
870     OUTPUT Ts;"STAT:CALLP:PTR 1" !Enable pos-going transistion register
880     OUTPUT Ts;"STAT:CALLP:NTR 0" !for the Active indicator to tell when
890     OUTPUT Ts;"*CLS"  !the test set has gone from Active, to Access, and
900     REPEAT            !back to Active, before reading the result.
910       OUTPUT Ts;"STAT:CALLP:EVENt?"
920       ENTER Ts;Active_again
930       UNTIL Active_again<>0
940     OUTPUT Ts;"CALLP:DCCH:RCDD1?" !Query the mobile's response.
950     ENTER Ts;Response_1$
960     PRINT Response_1$
970     SUBEND
```

Caller ID

Description

Caller ID sends caller information to the mobile when paged. Depending on the mobile's caller ID abilities, the data displayed can be the name and phone number of the calling person.

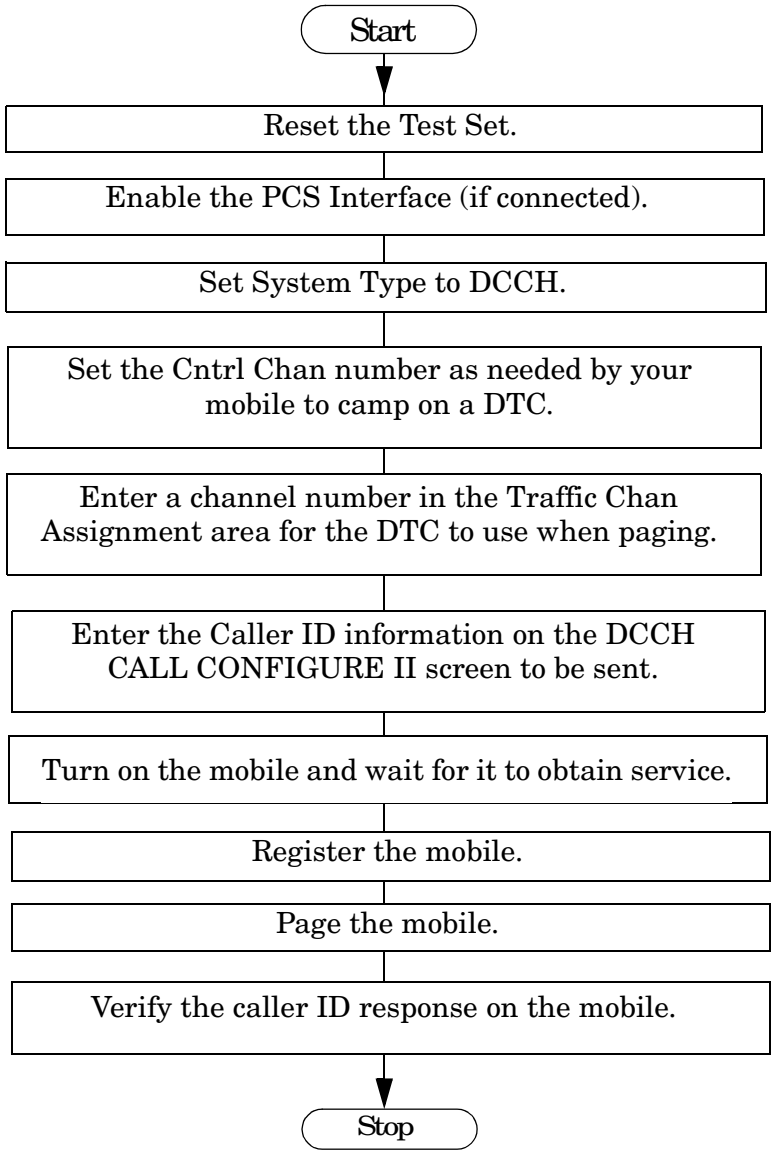
Test Conditions

- System Type = DCCH
- Control Channel = Digital, Channel number as needed by your mobile for service.
- Traffic Channel Assignment = DTC, 777.

Manual Operation

- ❑ Press **PRESET**.
- ❑ If a PCS Interface is used, set the PCS Mode field on the CONFIGURE screen to On.
- ❑ Display the CALL CONTROL screen.
- ❑ Set the System Type to DCCH.
- ❑ For PCS mobiles:
  - ❑ Set the MS Capab field (DCCH CALL CONFIGURE II) screen to US PCS.
  - ❑ Set the Voc: field (CALL CONTROL screen) to match the mobile's vocoder (typically ACELP).
- ❑ In the Traffic Chan Assignment area, set the Chan to 777.
- ❑ Display the DCCH CALL CONFIGURE II screen.
  - ❑ Enter the phone number of the calling party in the Calling Num field.
  - ❑ Enter a name in the Calling Name field.
  - ❑ In the Name Size field, enter the number of characters from the Calling Name field to send to the mobile.
- ❑ Display the CALL CONTROL screen.
- ❑ Power on the mobile and wait until it indicates service.
- ❑ Enter the mobile's MIN or phone number in the MS Id field, OR select the Register field and wait for the mobile to register and automatically enter the phone number.
- ❑ Select the Page field.
- ❑ The mobile should connect and the caller ID information should be displayed on the mobile.

Automated Test Flow Chart



Example Program

```
10    ! This program implements AMPS Registration and Page
20    ! Monitors the ‘Register’ LED and ‘Connect’ LED
30    ! to determine when successful.
40    ! Includes error checking with ESR register.
50    ! Enters caller ID information to send when paging.
60    COM Ts
70    CLEAR SCREEN
80    Ts=714
90    Reset_ts
100   Enable_pcs
110   Setup_dcch
120   Set_to_active
130   Setup_trafchan
140   PRINT “Instructions: Turn the phone on now”
150   Register_mobile
160   Page_with_id
170   END
180 Set_to_active: SUB Set_to_active
190     COM Ts
200     OUTPUT Ts;”STAT:CALLP:PTR 1”! Arm Bit 0 of the PTR register
210     OUTPUT Ts;”*CLS”! Clear Status Event Registers
220     OUTPUT Ts;”CALLP:ACTIVE”
230     REPEAT
240       OUTPUT Ts;”STAT:CALLP:EVENT?”
250       ENTER Ts;Register
260       WAIT .2 ! Gives the testset time to service other processes
270     UNTIL Register ! Returns 0 until one of the bits is set
280   SUBEND
290 Reset_ts: SUB Reset_ts
300     COM Ts
310     OUTPUT Ts;”*RST;*OPC?”! Good reset technique
320     ENTER Ts;Done
330     OUTPUT Ts;”DISP ACNT”! Analog Call  Control Screen
340   SUBEND
```

```
350 Register_mobile: SUB Register_mobile
360     COM Ts
370     OUTPUT Ts;"STAT:CALLP:PTR 0"! Don't latch positive transitions
380     OUTPUT Ts;"STAT:CALLP:NTR 2"! Latch "Register" LED turning off
390     OUTPUT Ts;"*CLS"! Clear Status Event Registers
400     WAIT 5
410     OUTPUT Ts;"CALLP:REGISTER"
420     REPEAT
430       OUTPUT Ts;"*ESR?;:STAT:CALLP:EVENT?"
440       ENTER Ts;Esr,Register
450       WAIT .2 ! Gives the testset time to service other processes
460     UNTIL Register OR Esr  ! Returns 0 until one of the bits is set
470     IF Esr THEN
480       PRINT "Error with Registration"
490       STOP
500     ELSE
510       OUTPUT Ts;"CALLP:PNUM?"
520       ENTER Ts;Phone_num$
530       PRINT "Registration Successful!"
540       PRINT "Phone number is ";Phone_num$
550     END IF
560   SUBEND
570 Page_with_id: SUB Page_with_id
580     COM Ts
590     PRINT "When the phone rings, press the SEND key."
600     OUTPUT Ts;"STAT:CALLP:PTR 32" ! Latch 'Connect' LED
610     OUTPUT Ts;"STAT:CALLP:NTR 0"
620     OUTPUT Ts;"*CLS"! Clear Status Event Registers
630     OUTPUT Ts;"CALLP:DCCH:CID:CNUM '5099224001'" !Calling Number
640     OUTPUT Ts;"CALLP:DCCH:CID:CNAM 'R. Heinlein'" !Calling Name
650     OUTPUT Ts;"CALLP:DCCH:CID:NSIZ 11" !Name Size
660     WAIT 5
670     OUTPUT Ts;"CALLP:PAGE"
680     REPEAT
690       OUTPUT Ts;"*ESR?;:STAT:CALLP:EVENT?"
700       ENTER Ts;Esr,Register
```

```
710       WAIT .2 ! Gives the testset time to service other processes
720     UNTIL Register OR Esr  ! Returns 0 until one of the bits is set
730     IF Esr THEN
740       PRINT “Error with Page”
750       STOP
760     END IF
761     PRINT “”
770     PRINT “Page was Successful! Verify that the mobile shows”
771     PRINT “the correct Caller ID information.”
780     SUBEND
790 Enable_pcs:    SUB Enable_pcs
800     COM Ts
810     OUTPUT Ts;”CALLP:DCCH:PCS:MODE ‘ON’”
820     OUTPUT Ts;”CALLP:DCCH:VOC ‘ACELP’”
830     OUTPUT Ts;”CALLP:DCCH:MSCapability:BAND ‘US PCS’”
840     SUBEND
850 Setup_dcch: SUB Setup_dcch
860     COM Ts
870     OUTPUT Ts;”CALLP:CSYS ‘DCCH’”  !Set System Type to DCCH.
880     OUTPUT Ts;”CALLP:DCCH:CCH 1012” !Change Cntrl Chan number as needed.
890     SUBEND
900 Setup_trafchan: SUB Setup_trafchan
910     COM Ts
920     OUTPUT Ts;”CALLP:DCCH:DTCH:TCHannel 777”
930     SUBEND
```

2 Agilent 8920B Programming Concepts

This chapter contains general information on writing programs for the Agilent 8920B test set. Detailed programming information is in the *Agilent Technologies 8920B Programmer's Guide* (p/n 08920-90222).

Basic Input and Output Operations

Overview

Sometimes the most difficult part of controlling the test set is just getting started with your first measurement. Before attempting to automate a measurement, it is generally recommended to first perform the set up and make measurements manually, then duplicate the manual procedure with GPIB command strings and programming algorithms.

There are two fundamental processes for communicating with the Agilent 8920B test set over the GPIB bus. The first process is sending data (like commands) to the instrument. In HP® BASIC, the command to send data to the instrument is the OUTPUT statement. The second process for communicating with the test set is reading data back from the instrument. In HP® BASIC, the command to read data from the instrument is the ENTER statement.

Using the OUTPUT Statement to Send Commands

This two line program example sends a command to the test set:

```
10 OUTPUT 714;"*RST"
20 END
```

- Line 10 sends a command to the instrument at address 714. The command is "*RST" which instructs the instrument to reset.
- Line 20 is the END statement, which is always required in any HP® BASIC program. This line has no effect on the instrument.

General Process for Changing Settings

To perform the initial setup for changing settings on the test set, the general process is:

1. Use the OUTPUT statement to display the correct screen.
2. Use the OUTPUT statement for changing the settings on that screen.

For example:

```
10 OUTPUT 714;"DISP RFG"
20 OUTPUT 714;"RFG:FREQ 825 MHZ"
30 END
```

- Line 10 displays the RF Generator Screen.
- Line 20 sets the RF Generator frequency to 825 MHz.

This process is repeated until all necessary settings are changed.

Using the ENTER Statement Read Back Values

When the instrument settings are made and the radio under test is configured, the next step is to read a measurement from the instrument. In HP® BASIC the ENTER statement is used to read data from an instrument. The ENTER statement is always preceded by an OUTPUT statement that tells the instrument which measurement the program wants to read.

This short program uses the ENTER statement to return a value:

```
10 OUTPUT 714;"MEAS:RFR:POW?"
20 ENTER 714;Data
30 END
```

- Line 10, the OUTPUT statement is used to instruct the instrument to measure RF power. This line contains a question mark '?' and is called a query. In this case, the program is querying the RF Power measurement.
- Line 20 is the ENTER statement that will actually read the result back from the test set (entering the returned value into a variable called “Data”). The program will stay on line 20 until the test set responds with data. You must always follow a query with an ENTER statement on the next program line to read the data back from the instrument. You should include some type of time out statement in your program to handle the situation when the test set cannot make the measurement.

General Process for Reading Back (Querying) Values

The basic concept of reading measurements from the test set is quite simple, however there are many factors that makes reading data one of the most difficult automated processes. When making measurements, you need to consider measurement settling, measurement triggering, and error handling if the measurement doesn't complete. An automated procedure for setting up and making measurements should include the following steps:

1. Configure the test set and the radio.
2. Display and Activate the measurement on the test set.
3. Wait until the test set and radio have 'settled'.
4. Trigger the measurement.
5. Output a query to the test set to tell it which result you want.
6. Enter the data from the test set into a variable.
7. If the data doesn't come back from the test set, send a device clear to the test set so that the query is not still pending.

If any of these steps are not done properly, you will receive "Query Error" messages on the test set and it is possible to lock-up the test set if errors are not handled correctly.

A More Complete Example Program

The following program is a more complete example that includes everything except error handling. More details on triggering and error handling are included later in this document.

```
10    OUTPUT 714;"TRIG:MODE:RETR SINGLE"
20    OUTPUT 714;"DISP RFG"
30    OUTPUT 714;"RFG:FREQ 825 MHZ"
40    OUTPUT 714;"RFG:AMPL –10 DBM"
50    OUTPUT 714;"DISP RFAN"
60    OUTPUT 714;"MEAS:RFR:POW:STATE ON"
70    WAIT 2
80    OUTPUT 714;"TRIG"
90    OUTPUT 714;"MEAS:RFR:POW?"
100   ENTER 714;Data
110   PRINT Data
120   END
```

- Line 10 set the instrument for single triggering.
- Line 20 displays the RF Generator screen to allow settings.
- Lines 30 and 40 set the RF Generator frequency and amplitude.
- Line 50 displays the RF Analyzer screen.
- Line 60 enables the RF power measurement. Once the measurement is enabled, it will remain active whenever a screen is displayed that contains the RF power measurement.
- Line 70 is a wait statement that allows settling for the test set and the radio under test.
- Line 80 triggers the measurement.
- Line 90 instructs the instrument to put the RF power result in the output queue to be read back by the controlling program.
- Line 100 enters the data from the test set output queue.
- Line 110 prints the result to the computer screen.

Using Status Registers for Call Processing

Overview

Cellular call processing refers to registrations, originations, pages, and handoffs for cellular mobiles. Because executing these functions will take an unknown amount of time, it is necessary for the control program to use special techniques for monitoring the state of the test set and taking special care to keep the control program synchronized with the test set. This is accomplished by monitoring the status registers which indicate the current state of the test set. Each bit of the status registers corresponds to a unique state or process in the instrument. For a very detailed explanation of the capabilities, refer to the *Agilent Technologies 8920B Programmer's Guide* (p/n 08920-90222).

The concept of writing programs that use status registers is quite simple, but since many users have never programmed the status registers it may seem a little difficult at first. The general procedure is to execute a call processing function (such as a PAGE), and then monitor one of the bits in the call processing status register group until the bit indicates that the function has completed. For instance, when executing a page, your control program can monitor the 'connected' bit to indicate that the page was successful and the control program can continue.

In these programming examples the call processing condition register is monitored. This register indicates the current instantaneous state of the call processing system. In some programming situations, it is desirable to monitor the call processing event register. The event register latches changes in the condition register.

The following program demonstrates this technique:

```
10      OUTPUT 714;"DISP ACNT"
20      OUTPUT 714;"*CLS"
30      OUTPUT 714;"CALLP:PAGE"
40      REPEAT
50        OUTPUT 714;"STAT:CALLP:COND?"
60        ENTER 714;Status_register
70        WAIT .2
80      UNTIL BIT(Status_register,5)
90      PRINT "Page was Successful!"
100     END
```

- Line 10 displays the Analog Call Control screen. This is the screen where call processing functions take place.
- Line 20 is a command to "Clear Status Registers". This is important because the program will monitor these registers to determine the instrument state.
- Line 30 commands the test set to PAGE the mobile.
- Lines 40 and 80 create a loop to monitor the call processing status condition register.
- Line 50 queries the Agilent 8020B for the call processing status condition register.
- Line 60 reads the value back from the test set and stores the data in a variable called Status_register.
- Line 70 is a short wait (200 milliseconds) which allows the test set some time to process other tasks. This is important because the GPIB queries have a high priority and if the loop doesn't have any delays, the test set is so busy reporting to the external computer that the other processes (like the page) may not complete.
- Line 80 examines bit 5 of the variable Status_register. When bit 5 is set, it indicates the mobile is connected and only then should the control program continue on and make measurements.

Adding Error Trapping

The previous short program to page the mobile is complete except for any error trapping. If the mobile doesn't connect, the program will stay in a continuous loop. There are two techniques that are commonly used for this situation.

The first technique involves monitoring the "Event Status Register", which is where error conditions are reported. The second technique involves putting a timer into the loop and if the call processing function doesn't complete in a specified time, the control program can exit the loop and continue with some type of error trapping routine.

The following example monitors the Event Status Register for errors and stops the program if an error occurs.

```
10    OUTPUT 714;"DISP ACNT"
20    OUTPUT 714;"*CLS"
30    OUTPUT 714;"CALLP:PAGE"
40    REPEAT
50      OUTPUT 714;"STAT:CALLP:COND?"
60      ENTER 714;Status_register
70      OUTPUT 714;"*ESR?"
80      ENTER 714;Error_register
90      IF Error_register<>0 THEN
100       PRINT "Error during page"
110       STOP
120     END IF
130     WAIT .2
140   UNTIL BIT(Status_register,5)
150   PRINT "Page was Successful!"
160 END
```

- Lines 70 and 80 are used to read the event status register.
- Lines 90 checks if the variable Error_register is not equal to zero, which would indicate an error.
- Lines 100-120 prints an error message and stops the program.

The following program is an example of the technique that uses a loop counter as a timer to detect the page failure:

```
10  ! re-save "sample1.pgm"
20    OUTPUT 714;"DISP ACNT"
30    OUTPUT 714;"*CLS"
40    OUTPUT 714;"CALLP:PAGE"
50    Loop_count=0
60    REPEAT
70    Loop_count=Loop_count+1
80      OUTPUT 714;"STAT:CALLP:COND?"
90      ENTER 714;Status_register
100     IF Loop_count=50 THEN
110       PRINT "Error during page"
120       STOP
130     END IF
140     WAIT .2
150   UNTIL BIT(Status_register,5)
160   PRINT "Page was Successful!"
170 END
```

The process to use status registers for performing registrations, pages, originations, and handoffs are all similar. The following example shows how to perform a registration. One small difference you may notice in this example is the monitoring loop is looking for the test set to leave the registration condition (indicating the registration is finished). In the example program for a page, the monitoring loop was waiting for the test set to enter the connected condition (indicating that the page state was finished).

```
10  ! re-save "sample2.pgm"
20    OUTPUT 714;"DISP ACNT"
30    OUTPUT 714;"*CLS"
40    OUTPUT 714;"CALLP:REGISTER"
50    WAIT 2
60    Loop_count=0
70    REPEAT
80    Loop_count=Loop_count+1
90      OUTPUT 714;"STAT:CALLP:COND?"
100     ENTER 714;Status_register
110     IF Loop_count=50 THEN
120       PRINT "Error during registration"
130       STOP
140     END IF
150     WAIT .2
160   UNTIL NOT BIT(Status_register,1)
170   PRINT "Registration was Successful!"
180 END
```

- Line 20 displays the Analog Call Control screen. This is the screen where call processing functions take place.
- Line 30 is a command to "Clear Status Registers". This is important because the program will monitor these registers to determine the instrument state.
- Line 40 commands the test set to REGISTER the mobile.
- Line 50 is a 2 second wait that allows the test set to enter the 'registration' state.
- Lines 60 to 160 create a loop to monitor the call processing status condition register.
- Line 80 is a loop counter to know when to exit because of a time out.
- Line 90 and 100 queries the test set for the call processing status condition register.
- Lines 110-140 checks the loop counter and stops the program if the count = 50.
- Line 150 is a short wait (200 milliseconds) which allows the test set some time to process other tasks.
- Line 160 monitors the 'registration bit' until the test set leaves the registration state. This is indicated by the bit being set to zero (false).

Triggering Measurements

Overview

There are two types of triggering modes for remote (automated) operation. When the test set is in remote mode, the trigger is set to either repetitive (continuous) or single. In repetitive triggering mode, all active measurements are continuously triggered. When the control program queries the test set for a measurement result, the test set triggers a new measurement and places the last completed measurement result in the output queue for the control program to read.

When using single trigger, the control program must send a 'TRIG' command to the test set. This flushes all the current measurement results and causes the test set to begin a new measurement. The new measurement will update the results for all the active measurements. After the measurement results are updated, the control program can query the test set for results. This causes the test set to place the requested results in the output queue where the control program can then retrieve the measurement results.

Using Repetitive Triggering

The following program example uses repetitive triggering:

```
10    OUTPUT 714;"TRIG:MODE:RETR REPETITIVE"
20    OUTPUT 714;"DISP RFAN"
30    OUTPUT 714;"MEAS:RFR:POW?"
40    ENTER 714;Result
50    PRINT Result
60    END
```

- Line 10 sets the remote triggering mode to repetitive (continuous).
- Line 20 displays the RF Analyzer screen. This will automatically start triggering for all the active measurements on that screen.
- Line 30 queries the test set for the RF Power measurement. This causes the last result to be put into the output queue.
- Line 40 enters the data from the output queue into the variable called 'Result'.
- Line 50 prints the measurement value.

Using Single Triggering

The following program example uses single triggering:

```
10    OUTPUT 714;"TRIG:MODE:RETR SINGLE"
20    OUTPUT 714;"DISP RFAN"
30    OUTPUT 714;"TRIG"
40    OUTPUT 714;"MEAS:RFR:POW?"
50    ENTER 714;Result
60    PRINT Result
70    END
```

- Line 10 sets the remote triggering mode to single.
- Line 20 displays the RF Analyzer screen. No measurements will appear.
- Line 30 triggers all the active measurements on the RF Analyzer screen.
- Line 40 queries the test set for the RF Power measurement. This causes the result from the previous trigger to be put into the output queue.
- Line 50 enters the data from the output queue into the variable called 'Result'.
- Line 60 prints the measurement value.

Handling GPIB Query Errors

Overview

Under certain conditions, it may not be possible for the test set to make a measurement. If this happens, the control program must properly clear the GPIB buffer before proceeding with any other program statements. A common mistake is when a measurement doesn't complete and the control program is stopped and re-run. Quite often the first command sent to the instrument is "*RST" for an instrument reset. This is not the correct way to handle the query error and it can lock-up the test set under certain conditions. The correct technique would be to send a "device clear" to the instrument before any commands are sent. It is a good idea to have the very first statement in any GPIB control program to be a device clear.

The device clear (or selected device clear) command is defined in IEEE 488 and it instructs the instrument to clear any pending GPIB operations. The device clear statement is unique for each different interface card and programming language. As an example, in Agilent BASIC the command "CLEAR 714" sends a selected device clear to the instrument at address 714. In a language like C or Pascal, the command could be "IOCLEAR (714)" or "IOCLEAR (714L)". Refer to the documentation for your programming language and GPIB interface card.

Here is a good way to start your program:

```
10  CLEAR 714
20  OUTPUT 714;"*RST"
```

By starting the program with a device clear, any pending GPIB operations are cleared and there won't be any chance of locking up the test set. Typically the control program has some type of error trapping to clean up the GPIB queue in case of measurement errors or measurements that don't complete. A simple example can illustrate how a programmer could implement this in HP® BASIC.

```
10 Start_meas: !
20    ON TIMEOUT 7,15 GOTO Clean_up_hpib
30    OUTPUT 714;"TRIG:MODE:RETR SINGLE"
40    OUTPUT 714;"DISP RFAN"
50    OUTPUT 714;"TRIG"
60    OUTPUT 714;"MEAS:RFR:POW?"
70    ENTER 714;Result
80    PRINT Result
90   STOP
100 Clean_up_hpib:!
110   CLEAR 714
120   PRINT "Measurement was aborted"
130   GOTO Start_meas
140   END
```

Line 20 is an HP® BASIC statement that sets up a time-out. This statement instructs HP® BASIC to go to the line labeled "Clean_up_hpib" if any instrument on the GPIB bus 7 doesn't respond for 15 seconds. (In this example, 7 is the interface select code). If the power measurement doesn't complete, the program will hang up on line 80 for 15 seconds while it is waiting for data back from the test set. After the 15 second "ON TIMEOUT" timer expires, the program jumps to line 100, then executes line 110 to clear the GPIB operations. Line 120 prints an error message and line 130 causes the program to go to the beginning (Line 10) and starts over.

This is a simple technique that can be implemented in almost any programming language. It is a good programming practice that whenever data is to be sent to the instrument or read from the instrument, some type of error handling routine should be used. One implementation would be to write general purpose subroutines like "To_testset" or "From_testset" that would send data back and forth between the computer and the test set. These general purpose routines would be a good location in the code to include the proper error handling routines.

Reducing Test Time

Overview

Writing the fastest possible test software involves efficient programming, understanding the device-under-test, and optimizing set ups and measurements with the test equipment. This section of this document focuses the test set, and particularly on helping the programmer understand and avoid some of the slower (and often unnecessary) processing in the test set.

Some of the processes that can slow down your program when using the test set include:

- Changing screens when it isn't necessary.
- Auto-ranging and auto-tuning.
- Making unnecessary measurements.

Changing Screens

Changing screens on the test set takes approximately 1 second. For making measurements it is generally necessary to be on the correct screen. However, many settings (such as the RF Generator) can be made from almost any screen. For analog measurements, try to use the DUPLEX screen because it contains Generator and Analyzer functions. Avoid the Analog RX and TX screens because they auto-configure many settings in the test set, slowing operation.

Auto-ranging and Auto-tuning

Auto-ranging and auto-tuning for the analyzer are two processes that should definitely be avoided. Auto-ranging is the process where the test set analyzer automatically sets the correct gain and attenuation setting for a measurement. Auto-tuning is where the RF analyzer will automatically find, and tune to, the largest RF signal. If you know the frequency and level of the signal-under-test, set the test set tuning mode to 'manual' and set the input attenuators to 'hold'. Write your program to directly control the analyzer frequency and input attenuation. To find the correct attenuation, you may want to manually allow the test set to auto-range on a particular signal, then in your automated application you can set the gain correctly under program control.

Unnecessary Measurements

Making unnecessary measurements takes additional time, and should always be avoided. However, many programmers don't realize that their application software is often causing the test set to make unnecessary measurements. There are two situations that cause unnecessary measurements. The first situation is when the displayed screen has more measurements activated than necessary. For instance, the RF Analyzer screen may have Frequency Error, TX Power, FM Deviation, and AF Frequency all active. Whenever a trigger command is issued, the test set automatically makes all the active measurements. You can save a significant amount of time by disabling the un-used measurements.

The following command turns off the FM Deviation measurement:

OUTPUT 714;"MEAS:AFR:FM:STATE OFF"

A second situation that often generates unnecessary measurements is during repetitive triggering. When making multiple measurements with a single setting, use single triggering, and read back the results from all the measurements. This technique does not cause the test set to re-trigger measurements each time a new query is sent to the test set.

The following examples uses repetitive triggering to make two measurements: FM deviation and RF power. In this example, line 30 triggers all the active measurements, and lines 40 to 70 reads back results.

```
10    ! re-save "fast1.pgm"
20    OUTPUT 714;"TRIG:MODE:RETR REPETITIVE"
30    OUTPUT 714;"TRIG"
40    OUTPUT 714;"MEAS:RFR:POW?"
50    ENTER 714;Pow_result
60    OUTPUT 714;"MEAS:AFR:FM?"
70    ENTER 714;Fm_result
80    PRINT Pow_result,Fm_result
90    END
```

The following example makes the same measurements, but uses single triggering:

```
10    ! re-save "fast2.pgm"
20    OUTPUT 714;"TRIG:MODE:RETR SINGLE"
30    OUTPUT 714;"TRIG"
40    OUTPUT 714;"MEAS:RFR:POW?;:MEAS:AFR:FM?"
50    ENTER 714;Pow_result,Fm_result
60    PRINT Pow_result,Fm_result
70    END
```

This program saves some GPIB traffic and reads back multiple measurements by combining two queries and two Enters on the same line. (This technique may be more difficult to implement in languages other than HP® BASIC).

3 IS-137 Test Descriptions

This chapter contains brief descriptions of the IS-137 tests that are normally done in production using the Agilent Technologies 8920B Option 801. Tests and minimum standards are identified by title and by paragraph number in the standards. An exception is the call processing tests. The Agilent 8920B Option 801 does them, but they are not described here.

Tests can be performed manually, using your own programs, or by using the Agilent Technologies 11807E Option 024 AMPS/NAMPS/DAMPS/DCCH/PCS Mobile Test Software.

2.3.2.1 Receiver Signal Level Range Capability (RF Sensitivity)

Error rate under fading and static (no fading) conditions. BER (Bit Error Rate) is used for the DTC (Digital Traffic Channel) and WER (Word Error Rate) is used for the BCCH (Broadcast Control Channel). Sensitivity to very low level and very high level (overload) signals are measured.

Procedure Summary

Synchronize the mobile to the test set on a Digital Traffic Channel (DTC) by putting the mobile in loop-back mode with the TDMAON command. Set the test set generator level to –110 dBm (for BER on the DTC) and –111 dBm (for WER on the BCCH). For the DTC send pseudo-random data bits to the mobile and measure BER on the transponded bits. For the BCCH send SCF and CRC data in the RACH L3 data field and measure WER on the looped-back RACH burst. Repeat the test, using an amplitude of –25 dBm (overload condition).

Agilent Technologies 8920B Option 801 Method

Same as specified in standard under static conditions (unable to perform fading tests). The test must be performed with the mobile in loopback mode; it cannot be performed in the connect state. Measurements are made on the DIGITAL MEASUREMENTS screen with the `Dig Meas` field set to `BER`, `DTC WER`, or `DCCH WER`.

2.3.2.1.1.3 Minimum Standard

- BER: ≤ 3% at all test levels.
- WER: ≤ 9% at all test levels.

2.3.2.5 Mobile Assisted Handoff / Mobile Assisted Channel Allocation Bit Error Rate

The mobile estimates bit error rate of the received signal on the DTC.

Procedure Summary

Set up a call between the test set and the mobile. Induce various bit error rates into the data field bits of the test signal and instruct the mobile to report the bit error rates it measures.

Agilent Technologies 8920B Option 801 Method

Use the CALL CONTROL screen and get the mobile up on a call (connect state) using a Page or Originate; it cannot be performed in test mode. Set the `Display` field to `Meas`, then change the measurement to `MAHO`. The phone's estimate of RSSI for the neighbor channels and the RSSI and BER of the current traffic channel is displayed.

The DCCH CALL CONFIGURE screen allows you to change the Neighbor Channel List using the `# Neighbors` field, and to introduce Bit errors using the % BIT ERROR field.

The test set stays on one DTC, but it tells the phone to monitor several channels and report RSSI. The channels do not have a signal on them so the phone is actually measuring the noise level. The test set also tells the phone to report BER and RSSI on the DTC.

2.3.2.5.3 Minimum Standard

For a known level of induced BER, the mobile shall report a BER that is within a specific range listed in the following table.

Table 3-1. MAHO/MACA Bit Error Rate

TX Induced BER (%)	RX Report BER Interval (%)
0	< 0.01
0.013 to 0.08	0.01 to < 0.1
0.133 to 0.4	0.1 to < 0.5
0.667 to 0.8	0.5 to < 1.0
1.333 to 1.6	1.0 to < 2.0
2.667 to 3.2	2.0 to < 4.0
5.333 to 6.4	4.0 to < 8.0
10.667	> 8.0

3.1.2.2 Digital Frequency Stability

Ability of the transmitter to maintain an assigned carrier frequency.

Procedure Summary

Put the transmitter on a digital traffic channel at an amplitude of –60 dBm. Modulate it with pseudo-random data bits. Measure frequency offset over one burst (between symbols 6 and 162). Frequency offset is determined with respect to a frequency value 45 MHz lower than the test base station signal, as measured at the mobile's transmitter output (80.04 MHz lower for 1900 MHz equipment).

Stability should also be checked with the base station frequency ± 300 Hz (for 800 MHz operation) or ± 200 Hz (for 1900 MHz operation) from the standard channel assignment (see paragraph 3.1.2.2.2 in IS-137).

Agilent Technologies 8920B Option 801 Method

Absolute frequency error is measured. It is derived from the accumulated phase error as part of the EVM (Error Vector Magnitude) measurement.

- Mobile in the **Connect** state: Use the CALL CONTROL screen and get the phone up on a call on a digital traffic channel. Select either the EVM1 or the EVM10 measurement. Frequency error is displayed along with EVM
- Mobile in the **Test Mode**: Use the DIGITAL MEASUREMENT screen and put the phone in test mode (TDMAON). Select either the EVM1 or the EVM10 measurement. Frequency error is displayed along with EVM.

3.1.1.2.3 Minimum Standard

The frequency offset during any burst must be less than ±200 Hz. Stability must be maintained over a temperature range of –30°C to 60°C, or over a smaller temperature range as long as the transmitter is automatically prohibited from operating outside the smaller temperature range. In all cases, frequency stability must be maintained over the entire temperature and frequency range that the transmitter is operating at, even when the supply voltage is varied ±15% from its nominal value.

3.2.1.2 & 3.2.2 Digital RF Power Output

Mean power during a burst into a nominal load impedance.

Procedure Summary

Put transmitter on a traffic channel. Modulate it with pseudo-random data field bits. Measure mean burst power over at least 140 consecutive symbols between symbol 6 and symbol 162.

Agilent Technologies 8920B Option 801 Method

Same as described in IS-137. The 140 symbols in the middle of the burst are measured.

- Mobile in the **Connect** state: Use the CALL CONTROL screen and get the phone up on a call on a digital traffic channel. Set the `Display` field to `Meas`. Select the `EVM 1` measurement to read the `TX Power (Avg)`.
- Mobile in the **Test Mode**: Use the DIGITAL MEASUREMENT screen and put the phone in test mode (TDMAON). Set the `Dig Meas` field to `Avg Power` to read the `TX Power (Avg) in Watts or dBm`. Relative `TX Power` (in dB) can also be measured when the `Dig Meas` field is set to EVM1 or EVM10, but requires a calibrated TDMA source to provide a reference signal (see *Power Measurements* in the *Agilent Technologies 83206A User's Guide*).

3.2.1.2.3 Minimum Standard for 800 MHz Equipment

The transmitter must be capable of transmitting at eight distinct power levels for Power Class I, II, or III, and eleven distinct power levels for class IV. Refer to Table 3.2.1-1 in the TIA/EIA standard for information on acceptable Effective Radiated Power (ERP) levels for the different mobile station power levels and classes.

3.2.2 Minimum Standard for 1900 MHz Equipment

The transmitter must be capable of transmitting at the ERP levels specified in Table 3.2.2-1 in the TIA/EIA standard.

3.3.2.1 Digital Modulation Type and Accuracy

RMS Error Vector Magnitude (EVM) over one time slot (157 symbols).

Procedure Summary

Put the mobile on a traffic channel. Modulate a test source with pseudo-random data field bits. Have the mobile transpond the bits using the TDMAON command. Measure EVM with a standard EVM instrument.

Agilent Technologies 8920B Option 801 Method

Same as described in IS-137.

- Mobile in the **Connect** state: Use the CALL CONTROL screen and get the phone up on a call on a digital traffic channel. Set the `Display` field to `Meas`. Select the `EVM 1` measurement to read the EVM (%) over 1 burst; select `EVM 10` to measure EVM over 10 bursts. Measure origin offset by changing the `Peak EVM` measurement to `Orgin Ofs`.
- Mobile in the **Test Mode**: Use the DIGITAL MEASUREMENT screen and put the phone in test mode (TDMAON). Set the `Dig Meas` field to `EVM 1` to read the EVM (%) over 1 burst; select `EVM 10` to measure EVM over 10 bursts. Measure origin offset by changing the `Peak EVM` measurement to `Orgin Ofs`.

3.3.2.1.3 Minimum Standard

The RMS vector error in any burst must be less than 12.5%. Also, the normalized EVM during the first 10 symbols of a burst after the ramp-up must be less than 25% RMS when averaged over 10 bursts within a 1 minute interval. Also, the origin offset in any burst must be less than –20 dBc.

3.4.1.2.1 Digital Adjacent and Alternate Channel Power Due to Modulation

Mean transmitted power (resulting from modulation and noise) which falls into the adjacent (+/– 30 kHz), first alternate (+/– 60 kHz), or second alternate (+/– 90 kHz) channels.

Procedure Summary

Put the transmitter on a digital traffic channel. Modulate it with pseudo-random data field bits. Transmit filler code on the SACCH. Set DVCC to binary 1. Set a reference by measuring mean power in the traffic channel. Measure relative mean power in the adjacent and alternate channels over at least 50% of the symbols in a time slot. Gate the measuring receiver so that only the part of the spectrum resulting from modulation is measured.

Agilent Technologies 8920B Option 801 Method

Same as described in IS-137.

- Mobile in the **Connect** state: Use the CALL CONTROL screen and get the phone up on a call on a digital traffic channel. Set the `Display` field to `Meas`. Select the `Ad Ch Pwr` measurement.
- Mobile in the **Test Mode**: Use the DIGITAL MEASUREMENT screen and put the phone in test mode (TDMAON). Set the `Dig Meas` field to `Ad Ch Pwr`.

3.4.1.2.1.3 Minimum Standard

Adjacent channel power, centered ± 30 kHz from the center frequency, must not exceed a level of 26 dB below the mean output power. First alternate channel power, centered ± 60 kHz from the center frequency, must not exceed a level of 45 dB below the mean output power. Second alternate channel power, centered ± 90 kHz from the center frequency, must not exceed a level of 45 dB below the mean output power or –13 dBm, whichever is the lower power.

3.6 Time Alignment

The mobile adjusts its TDMA transmit timing to prevent bursts from other mobiles on the same RF channel from colliding at the base station.

Procedure Summary

The Agilent 8920B Option 801 performs this test using a software routine contained in the Agilent 11807E Option 024 software package.

Tests Supported Using the Agilent Technologies 8920B Option 801 and 11807E Option 024 Software

The following tables list the IS-137 tests, whether they can be performed using the Agilent 8920B Option 801 hardware, and if they are included in the Agilent 11807E Option 024 software (which can only be run on an Agilent 8920B Option 801 system).

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
2.	**Receiver Minimum Standards**			
2.1	**Frequency Requirements**			
2.1.1	Frequency coverage, the entire channel plan in Tables 1.5-1 (cellular band) and 1.5-2 (PCS)	Yes	Yes	Agilent 8920B also covers downband 806 to 824 MHz with TIA/EIA-136 format.
2.1.2	Synchronization Acquisition Time (Digital Mode)	No	No	Requires 2 sources and a fader with the second generator.
2.2	**Demodulation Requirements**			
2.2.1	**Type of Modulation**			
2.2.1.1	Analog (Demodulation, FM, Simultaneous Voice and SAT of ±14 kHz	Yes	Definition	Definition only, no measurement defined.
2.2.1.2	Digital (Demodulation, π/4 DQPSK 0.35 roll-off factor @24.3 kSymbols/sec.	Yes	Definition	Definition only, no measurement defined.
2.2.2	**Demodulated Analog Voice Signals**			
2.2.2.1	Electrical Audio Frequency Response	Yes	RXA Audio Frequency Response	

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
2.2.2.2	Audio Muting	Yes	No	Requires control to mute the audio in the phone. See Para. 3.3.1.2.4 Analog Voice - Path muting.
2.2.2.3	Analog Voice Expandor	Yes	RXA Expandor	No attack/delay time in software.
2.2.2.4	Analog Voice Hum and Noise	Yes	RXA Hum and Noise	
2.2.2.5	Analog Voice Audio Harmonic Distortion	Yes	RXA Audio Distortion	
2.2.2.6	Receive Audio Sensitivity	Partial	No	Acoustic test Vs. voltage input. The Agilent 8920B can be a stimulus, but requires acoustical coupler (calibrated ear). Sound pressure measurements are not supported on the Agilent 8920B.
2.2.2.7	Receive Audio Frequency Response	No	No	Acoustic test Vs. frequency. The Agilent 8920B can be a stimulus, but requires acoustical coupler (calibrated ear). Sound pressure measurements are not supported by the Agilent 8920B.
2.2.3	**Demodulated Data and Control Signals**			
2.2.3.1	Manchester Decoding Definition	See notes	See Notes for Paragraph 2.3.1.5	Definition. Test for bit error rate is in Paragraph 2.3.1.5. It requires a Fader (Agilent 11759B) and coder/decoder.

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
2.2.3.2	Sat Decoding	Partial, SAT tone generated.	No	Section 3.3.1.4 contains SAT tone measurement. Agilent 8920B generates SAT tones.
2.2.4	**Demodulated Digital Voice Signals**			
2.2.4.1	Receive Audio Sensitivity	Partial	No	Requires a reference encoder and an acoustic measurement. Sound pressure test is not supported on the Agilent 8920B.
2.2.4.2	D/A Converter and Reconstruction Filter	No	No	Measurement of receiver internal test points is not supported.
2.2.4.3	Audio Frequency Response	No	No	Requires a reference encoder and an acoustic measurement. Sound pressure test is not supported on the Agilent 8920B.
2.3	**Receiver Performance**			
2.3.1	**Analog**			
2.3.1.1	RF Sensitivity	Yes	RXA RF Sensitivity	12 dB SINAD RF level.
2.3.1.2	Adjacent and Alternate Channel Desensitization	See Notes	No	Requires 2 Signal Generators (Agilent 8920B) plus manual testing.
2.3.1.3	Intermodulation Spurious Response Attenuation	See Notes	No	Requires 3 Signal Generators (Agilent 8920B) plus manual testing.

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
2.3.1.4	Protection Against Spurious Response Interference	See Notes	No	Requires 2 Signal Generators (or 1, Agilent 8920B with 2nd Sig Gen with 10 to 2600 MHz range).
2.3.1.5	Bit-Error Rate	See Notes	RXA FVC Order Message Rate	Requires Fader (Agilent 11759B) and Coder/Decoder. The SW sends order messages and counts the correct messages received by the Mobile. This is an alternative to BER test.
2.3.2	**Digital**			
2.3.2.1	**Receiver Signal Level Range Capability**			
2.3.2.1.1	Static and Faded (Loopback BER and WER)	Partial Yes for static BER Yes with fader for dynamic test See Notes	Partial Yes for Raw Loopback BER test No on faded See Notes	DTC Data Field (BER). Faded, 100 and 8 requires Fader. Static, –110 and –25 dBm Yes in loopback. BCCH (WER) Faded, 100, 8 requires Fader. Static, –111 and –25 Yes with FW B.05.07. Requires the phone to be in the proper TDMAON command for BER or WER. Faded tests require signal Fader (Agilent 11759B).

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
2.3.2.2	Adjacent and Alternate channel Desensitization	See Notes	No	Requires 2 π/4 digital Signal Generators (Agilent 8920B) and Mobile Receiver in TDMAON mode.
2.3.2.3	Intermodulation Spurious Response Attenuation	See Notes	No	Requires 3 Sources, 2 π/4 digital (Agilent 8920B) and 1 CW with Mobile Receiver in TDMAON mode.
2.3.2.4	Blocking and Spurious-Response Rejection	See Notes	No	Requires 2 π/4 Signal Generators (1, Agilent 8920B and the 2nd SG with 10 to 6000 MHz range) and Mobile Receiver in TDMAON mode.
2.3.2.5	Mobile Assisted Handoff/Mobile Assisted Channel Allocation Bit Error Rate	Yes, see Note	Partial Yes, see Note	The Agilent 8920B provides protocol to get to active call status. Mobile returns RSSI, BER, % and neighbor reports. Amplitude can be at low levels (<–110 dBm) to measure BER%. After B.05.07, Agilent 8920B will generate known random bit errors at high levels (–60 dBm) per spec.
2.3.2.6	Co-channel Performance	Yes, with Fader See Notes	No	Requires 2 π/4 Signal Generators (Agilent 8920B) and 1 Fader plus FAACH words appended with CRC.

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
2.3.2.7	Delay Interval	Yes with Fader See Note	No	Requires 2 generators with Fading and Mobile Receiver in TDMAON mode.
2.4	Conducted Spurious Emission	No See Note	No	Requires frequency selective voltmeter from 10 to 2600 MHz for 800 MHz mobile receiver, and 10 to 6000 MHz for 1900 MHz mobile receiver.
2.5	Radiated Spurious Emission	No	No	Environmental testing, with Spectrum Analyzer/screen room.
2.6	**Received Signal Strength Indicator (RSSI)**			
2.6.1	Analog	Partial	No	RF source is capable of 60 dB of dynamic range input to the receiver. The RSSI indication is a function of the mobile.
2.6.2	Digital	Partial, yes with 2nd π/4 digital source	Partial, RXD Receiver Sensitivity (BER/RSSI) for one channel	Agilent 8920B measures mobile-reported RSSI on 1 channel. Requires 2 π/4 digital Test Sets, one to maintain a link, the 2nd varies the RF level from –118 to –51 dBm.

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
3.	**Transmitter Minimum Standards**			
3.1	**Frequency Requirements**			
3.1.1	**Analog**			
3.1.1.2	Frequency Stability	Yes	TXA Frequency Accuracy	±2.5 ppm of any assigned channel frequency.
3.1.1.3	Carrier Switching Time (Attack, Release)	No	No	
3.1.1.4	Channel Switching Time	No	No	Requires Triggering Oscilloscope.
3.1.2	**Digital**			
3.1.2.2	Frequency Stability	Yes	TXD Frequency Accuracy	±300 Hz for 800 MHz, ±200 Hz for 1900 MHz operation
3.1.2.3	Carrier Switching Time (Attack, Release)	No	No	Spectrum Analyzer zero span test.
3.2	**RF Power Output Requirements**			
3.2.1	**RF Power Output 800 MHz Equipment**			
3.2.1.1	Analog RF Power Output	Yes	TXA RF Power Output	8 levels, 0 to 7
3.2.1.2	Digital RF Power Output	Yes	TXD RF Power Output	11 levels, 0 to 10 from +28 to –4 dBm ±9 dB
3.2.2	RF Power Output 1900 MHz Equipment	Yes	TXD RF Power Output	11 levels, 0 to 10 from +28 to –8 dBm ±6 dB

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
3.2.3	**RF Power Transition Time**			
3.2.3.1	Analog	No	No	Spectrum Analyzer with peak carrier detector.
3.2.3.2	Digital	No	No	Spectrum Analyzer (Agilent 859X with TDMA downloadable personality).
3.2.4	Carrier-On State (Analog and Digital)	No	No	Spectrum Analyzer with range between –60 dBm and the required output (mobile PL).
3.2.5	Protection Against False Transmission	No	No	Mobile protection circuit.
3.3	**Modulation Requirements**			
3.3.1	**Analog**			
3.3.1.1	Modulation Type and Modulation Stability	Yes	3 separate tests: 1. TXA Wideband Data Deviation 2. TXA Signaling Tone freq. and deviation 3. TXA SAT frequency error and deviation	Done for all 3 SAT tones.
3.3.1.2.1	Compressor	Partial Yes, see Notes	TXA compressor response	No attack time test in software.
3.3.1.2.2	Transmit Electrical Audio Response	Yes	TXA audio Frequency Response	

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
3.3.1.2.3	Modulation Deviation Limiting	Yes	TXA Modulation Deviation Limiting on Analog Voice Channel	
3.3.1.2.4	Audio Voice-Path Muting	Yes See Notes	No	Requires control to mute the audio in the phone.
3.3.1.2.5	Transmit Audio Frequency response	No	No	Sound pressure measurements are not supported by the Agilent 8920B.
3.3.1.2.6	Transmit Audio Sensitivity	No	No	Sound pressure measurements are not supported by the Agilent 8920B.
3.3.1.3	Wideband Data	Yes	TXA Wideband Deviation	
3.3.1.4	Supervisory Audio Tone (SAT)	Yes	TXA Supervisory Audio Tone Frequency Error and Deviation	
3.3.1.5	Signaling Tone	Yes	TXA Signaling Tone Frequency and Deviation	
3.3.1.6	FM Hum and Noise	Yes	TXA FM Hum and Noise	
3.3.1.7	Residual Amplitude Modulation	Yes		
3.3.1.8	Modulation Distortion and Noise	Yes	TXA audio distortion	
3.3.2	**Digital Modulation**			
3.3.2.1	Modulation Type and Accuracy	Yes	TXD Modulation Accuracy	

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
3.3.2.2	**Modulated Digital Voice Signals**			
3.3.2.2.1	Input Filter and A/D Converter	No	No	Internal measurements on the Mobile Receiver.
3.3.2.2.2	Transmit Audio Frequency Response	No	No	Ratio of reference decoder output/TX acoustic input Vs. frequency.
3.3.2.2.3	Transmitter Audio Sensitivity	No	No	Acoustic input to microphone Vs. electrical output of reference base station.
3.3.3	Loudness Contrast	No	No	TOLR and ROLR ratings don't vary >3 dB between analog and digital modes.
3.4	**Limitation on Emissions**			
3.4.1	**Spectrum Noise Suppression - Broadband**			
3.4.1.1	Analog	No	No	Requires Spectrum Analyzer.
3.4.1.2	**Digital**			
3.4.1.2.1	Adjacent and Alternate Channel Power due to Modulation	Yes	TXD Adjacent Channel	Use Agilent 8920B ACP on active call or use a Spectrum Analyzer (Agilent 859X).
3.4.1.2.2	Out of Band Power Arising from Switching Transients	No	No	Requires Spectrum Analyzer (Agilent 859X) with TDMA downloadable personality.

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
3.4.2	**Harmonic and Spurious Emissions (Conducted) - Discrete**			
3.4.2.1	Analog	No	No	Requires Spectrum Analyzer with 30 kHz bandwidth and frequency range from minimum RF signal to the tenth harmonic of carriers in 800 MHz band, (869 to 894 MHz), to 10 GHz.
3.4.2.2	Digital	No	No	Requires Spectrum Analyzer with 30 kHz bandwidth and frequency range from minimum RF signal to the tenth harmonic of carriers in 800 & 1900 MHz bands (1930 to 1990 MHz), to 20 GHz.
3.4.3	**Harmonic and Spurious Emissions (Radiated) - Discrete**			
3.4.3.1	Analog	No	No	Requires Spectrum Analyzer with 30 kHz bandwidth.
3.4.3.2	Digital	No	No	Requires Spectrum Analyzer with 30 kHz bandwidth.
3.5	**Acoustic Echo Path Loss - Analog and Digital**	No	No	Acoustic measurement.
3.6	**Time Alignment**	See Notes	TXD Time Alignment	Software only, Agilent 11807E Option 024 Time alignment test.

Table 3-2.

TEST	TIA/EIA Test Title	Agilent 8920B Opt. 801	In Agilent 11807E Opt. 024	Notes
10.1.3.1	**DTMF**	Yes	TXA DTMF Key Pad and DTMF Frequency Error	