Agilent Technologies 8960 Series 10 E5515B Wireless Communications Test Set

Agilent Technologies E1961A AMPS/136 Mobile Test Application

Test Mode Programming Guide

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Agilent Technologies

Edition/Print Date

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

February 2000

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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.

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Agilent Technologies 8960 Series 10 E5515B Wireless Communications Test Set, E1961A AMPS/136 Mobile Test Application

Duration of Warranty: 1 year

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DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN45014

Manufacturer's Name:	**Agilent Technologies UK Ltd.**	**Agilent Technologies, Inc.**
Manufacturer's Address:	**Electronic Products & Solutions** **Group - Queensferry** **South Queensferry** **West Lothian, EH30 9TG** **Scotland, United Kingdom**	**24001 E. Mission Avenue** **Liberty Lake** **Washington** **99019-9599** **USA**

Declares that the product

Product Name: 8960 Series 10 Wireless Communications Test Set

Model Number: E5515A,B

Product Options: This declaration covers all options of the above product.

EMC:

Conforms with the following product specifications:

Standard:	**Limit:**
CISPR11:1990 / EN55011:1991	Group 1 Class A
IEC 801-2:1991 / EN 50082-1:1992	4kV CD, 8kV AD
IEC 801-3:1984 / EN 50082-1:1992	3V/m, 27-500 MHz
IEC 801-4:1988 / EN 50082-1:1992	0.5kV signal lines, 1kV power lines

Safety:

The product conforms to the following safety standards:

IEC 61010-1(1990) +A1(1992) +A2(1995) / EN 61010-1:1993
Canada / CSA-C22.2 No. 1010.1-93

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC, and the EMC Directive 89/336/EEC, and carries the CE mark accordingly.

South Queensferry, Scotland. ***04 May 2000***

R M Evans

R.M. Evans / Quality Manager

Spokane, Washington, USA. ***04 May 2000***

W.V. Roland

W.V.Roland / Reliability & Regulatory Engineering Manager

For further information, please contact your local Agilent Technologies sales office, agent, or distributor.

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).

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Comprehensive Program Example

1 Programming the Agilent Technologies 8960 Series 10 for TIA/EIA-136 Mobile Testing in Test Mode

Introduction

Conventions Used in This Programming Guide

Throughout this Programming Guide the term “test set” refers to an Agilent Technologies 8960 Series 10 wireless communications test set with the E1961A AMPS/136 mobile test application installed.

Purpose of This Programming Guide

The test capabilities of the test set are accessible through easy-to-use GPIB programming commands. The purpose of this Programming Guide is to teach you how to write a basic control program, using the test set’s GPIB command set. This program will perform fundamental manufacturing tests on a 136 mobile station with the test set operating in test mode.

About the Programming Examples Presented in This Programming Guide

Programming Language:

Programming examples presented in this Programming Guide are written in the HP BASIC programming language, also known as RMB or Rocky Mountain BASIC.

Syntax Used in Programming Examples:

1. Programming examples use the shortened form of the command syntax to minimize GPIB bus transactions. The shortened form of a command is defined by use of capital letters in the command syntax.

   Example 1. Command Syntax:

   ```
   RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO?
   ```

   Example 2. Shortened Form:

   ```
   RFAN:CONT:MEAS:FREQ:AUTO?
   ```

2. Programming examples do not include default nodes. Default nodes in the command syntax are defined by enclosing the node inside the [ ] brackets.

   Example 3. Command Syntax:

   ```
   CALL[:CELL]:POWer[:SAMPlitude] -80dBm
   ```

   Example 4. Command Syntax without Default Nodes:

   ```
   CALL:POW -80dBm
   ```

3. Programming examples make extensive use of compound commands using the ; and the ;: separators. Refer to the test set’s reference information for information on the definition and use of these command separators.

Complex Commands

Complex commands are used to configure the state and assign values to parameters simultaneously. Complex commands can be used to save programming steps.

Example 5. Configuring a Parameter State

```
OUTPUT Test_set;"SET:DTXP:TIM:STAT ON"
```

turns the state of the parameter on.

Example 6. Configuring a Parameter Value

```
OUTPUT Test_set;"SET:DTXP:TIM:TIME 10 S"
```

assigns a value to the parameter.

Example 7. Single Complex Command to Configure a Parameter

```
OUTPUT Test_set;"SET:DTXP:TIM:STIM 10 S"
```

would set the parameter state to ON and set the value of the parameter to 10 seconds. Note that in this example the optional command mnemonic :STIMe has been included to clarify that this complex command was used to set both the state and the value.

Example 8. Shortened Complex Command

```
OUTPUT Test_set;"SET:DTXP:TIM 10 S"
```

would also set the state to ON and set the value to 10 seconds. Note that in this example, the optional command mnemonic :STIMe has been left off to shorten the complex command. This is the format that will be used throughout this programming guide.

How This Programming Guide Is Organized

The Programming Guide is organized around a typical set of tasks a control program would normally perform when testing a 136 mobile station in test mode in a manufacturing environment. The set of tasks is shown in "Figure 1. Typical Flow of Tasks Performed by Control Program" on page 17.

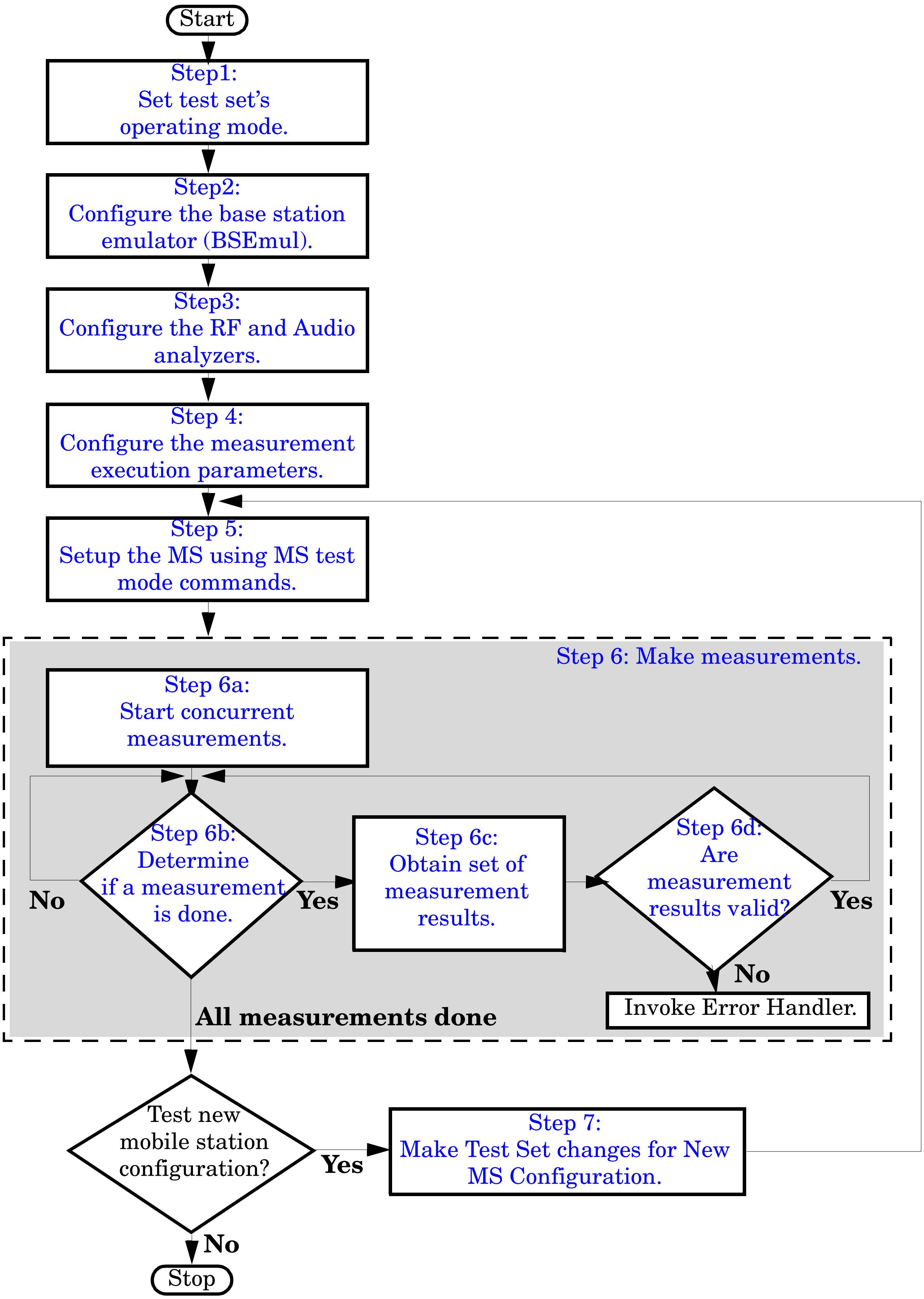
Typically in a manufacturing environment, step 4 is done once each time a production run is started and steps 5, 6, and 7 are done iteratively for each mobile tested during a production run. The number of iterations for steps 5, 6, and 7 is dependent upon how many mobile station operating conditions are being tested (that is, number of channels, number of power levels, and so fourth). Steps 1, 2, and 3 may or may not be repeated during any iteration of step 7.

How to Use This Programming Guide

This Programming Guide is divided into 8 sections. Sections 1 through 7 (step 1 through 7) should be read in sequence. Each section, in order, discusses one of the tasks to be performed by the control program, showing how to accomplish that task using the test set's GPIB command set. As you progress through each section your understanding of how the test set's GPIB interface operates will increase as you see the control program evolve.

The last section of the Programming Guide presents a "Comprehensive Program Example" on page 55 which uses all of the topics discussed in sections 1 through 7 together in one program to give the programmer a sense of how to tie everything together.

Figure 1. Typical Flow of Tasks Performed by Control Program



Step 1: Set the Test Set's Operating Mode

Background

The test set contains a TIA/EIA-136 base station emulator. The base station emulator's primary purpose is to provide the call processing necessary for parametric measurements on the RF and audio signals of a 136 mobile station.

An important characteristic of the test set's base station emulator is its operating mode. The operating mode sets the way in which the base station emulator interacts with the mobile station. The base station emulator has four operating modes; CW mode, DTC test mode, AVC test mode, and active cell mode.

When the mobile station is operating in test mode, the test set should also be operated in DTC Test Mode, AVC Test Mode or CW Mode. The test being performed, the setup of the mobile, and the testing environment will determine which one should be used. While operating in a test mode, the base station emulator provides necessary forward channel stimulus and makes reverse channel measurements. It does not provide over-the-air signaling.

This Programming Guide focuses on programming the test set's base station emulator in DTC test mode, AVC test mode and CW mode.

Overview of Test Mode Operating Modes

In the two test mode operating modes, the test set's base station emulator generates a traffic channel, but does no signaling with the mobile station.

General Test Mode Features The basic features provided by the base station emulator when the operating mode is set to a test mode are:

- All measurements supported in the test application are available.
- No over-the-air signaling is available.
- The base station emulator automatically controls the test set's receivers, unless the user sets receiver control to manual.
- The forward channel frequency setting may be specified by the user if downlink frequency control is set to manual.

DTC Test Mode Features The basic features specific to DTC Test Mode are:

- A DTC (Digital Traffic Channel) is generated on the forward channel.
- A "forced call" can be established. See "Establishing a "Forced Call" in DTC Test Mode" on page 39.
- The Loopback BER measurement is available.
- A user specified bit error ratio can be inserted into the data sent to the mobile station while on a digital traffic channel.

AVC Test Mode Features

The basic features specific to AVC Test Mode are:

- An AVC (Analog Voice Channel) is generated on the forward channel.
- SAT can be turned on and off.
- External and Internal FM are available.

Setting the Test Set's Operating Mode to DTC and AVC Test Mode

The test set's operating mode is set using the CALL:OPERating:MODE command.

Example 1. Command Syntax

```
CALL:OPERating:MODE <CALL|DTCTest|AVCTest|CW>
```

Example 2. Programming Example for DTC Test Mode

```
!****************************************************************
! Step 1: Set Test Set Cell Operating Mode To DTC Test Mode
!****************************************************************
!
OUTPUT Test_set;"CALL:OPER:MODE DTCT"
```

Example 3. Programming Example for AVC Test Mode

```
!****************************************************************
! Step 1: Set Test Set Cell Operating Mode To AVC Test Mode
!****************************************************************
!
OUTPUT Test_set;"CALL:OPER:MODE AVCT"
```

Overview of CW Mode

CW Mode uses the base station emulator's forward link as a basic signal generator with level and frequency control.

CW Mode Features The basic features provided when the operating mode is set to CW Mode are:

- A CW signal is generated on the forward channel.
- Receiver control is set to manual upon entering CW Mode and set to auto when exited.
- No reverse demodulation or channel decoding is available.
- All the measurements shall be accessible, although some may appear to hang if they are waiting on a trigger from protocol or may return invalid results.

Setting the Test Set's Operating Mode to CW Mode

Example 4. Programming Example for CW Mode

```
!*****************************************************************
! Step 1: Set Test Set Cell Operating Mode To CW Mode
!*****************************************************************
!
OUTPUT 714;"CALL:OPER:MODE CW"
```

Step 2: Configure the Base Station Emulator

Background

When operating in DTC and AVC test modes, the base station emulator, using the test set's $\pi/4$ DQPSK-modulated source, generates a forward channel (base station emulator to mobile station direction) digital traffic channel (DTC) or an analog voice channel (AVC). This forward channel stimulus is necessary for the mobile station (operating in test mode) to transmit so reverse channel measurements can be made.

The base station emulator can emulate a cell in any one of the following TIA/EIA-136 frequency bands and modes:

- Cellular Analog (800 MHz)
- Cellular Digital (800 MHz)
- PCS Digital (1900 MHz)

The task of configuring the base station emulator for DTC and AVC test modes consists of configuring the traffic channels. There are numerous parameters that can be configured for the traffic channels.

In a manufacturing environment it may be desirable to explicitly configure all parameters to ensure that the settings have not been corrupted by someone setting a parameter's value through the test set's front panel.

Configuring the Traffic Channel Parameters

The traffic channel parameters are configured using the CALL processing subsystem commands shown in the following table.

Table 1. Traffic Channel Settable Parameters

<table>
<tr><th>Parameter</th><th>Command Syntax</th><th>Footnotes</th></tr>
<tr><td>Cell Power</td><td>CALL[:CELL[1]]:POWer:AMPlitude<numeric value>[<suffix>]</td><td></td></tr>
<tr><td>Cell Power State</td><td>CALL[:CELL[1]]:POWer:STATe <ON|1|OFF|0></td><td></td></tr>
<tr><td>Cell Power and State</td><td>CALL[:CELL[1]]:POWer[:SAMPlitude]<numeric value>[<suffix>]</td><td>1</td></tr>
<tr><td>Digital Traffic Channel Band</td><td>CALL:SETup:DTC:BAND <CELLular|PCS></td><td>2</td></tr>
<tr><td>Digital Traffic Channel Number</td><td>CALL:SETup:DTC[:CHANnel][:SELected] <numeric value>
OR
CALL:SETup:DTC[:CHANnel]:<CELLular|PCS> <numeric value></td><td>3</td></tr>
<tr><td>Digital Traffic Channel Timeslot</td><td>CALL:SETup:DTC:TSLot <numeric value></td><td></td></tr>
<tr><td>Digital Verification Color Code</td><td>CALL:SETup:DTC:DVCCode <numeric value></td><td></td></tr>
<tr><td>Digital Traffic Channel Induced Bit Error Rate</td><td>CALL:DTC:IBERror:RATio <numeric value></td><td>4</td></tr>
</table>

Table 1. Traffic Channel Settable Parameters (Continued)

Parameter	Command Syntax	Footnotes
Digital Traffic Channel Induced Bit Error Rate State	CALL:DTC:IBERror:STATe <ON|1|OFF|0>	4
Digital Traffic Channel Induced Bit Error Rate and State	CALL:DTC:IBERror[:SRATio] <numeric value>	4,5
Analog Voice Channel Number	CALL:SETup:AVC[:CHANnel][:SELected] <numeric value> OR CALL:SETup:AVC[:CHANnel]:CELLular <numeric value>	6
SAT Frequency	CALL:SETup:AVC:SATone[:CCODE] <SAT1|SAT2|SAT3>	7
Internal FM Source State and Deviation	CALL:FM:INTernal[:SDEViation] <numeric value>[<suffix>]	7,8
Internal FM Source State	CALL:FM:INTernal:STATe <ON|1|OFF|0>	
Internal FM Source Deviation	CALL:FM:INTernal:DEViation <numeric value>[<suffix>]	7
Internal FM Source Frequency	CALL:FM:INTernal:FREQuency <numeric value>[<suffix>]	
External FM Input State	CALL:FM:EXTernal:STATe <ON|1|OFF|0>	7,9

Table Footnotes

1 Complex command to set the amplitude to <numeric value> and state to ON in one command.

2 The DTC band setting becomes the selected band (see Note 3).

3 Sets the DTC channel for the DTC band selected with the DTC Band command (see Note 2).

4 This parameter is available in Active Cell operating mode when generating a DTC, or in DTC Test operating mode.

5 Complex command to set the DTC induced bit error rate and to turn the DTC induced bit error rate to ON in one command

6 The selected (:SELected) band is Cellular, the only available band for an AVC.

7 Make sure that the sum of the 3 FM sources (Internal FM, External FM, and SAT) does not exceed 20kHz deviation.

8 Complex command to set the internal FM source deviation and to turn the internal FM source state to ON in one command.

9 The FM deviation is fixed at 20kHz/volt with a 1 volt maximum input voltage.

Example 5. Programming Example:

```
!**********************************************************************
! Step 2: Configure the Base Station Emulator
!**********************************************************************
OUTPUT Test_set;"CALL:POW -50"
OUTPUT Test_set;"CALL:SET:DTC:BAND CELL"
OUTPUT Test_set;"CALL:SET:DTC:CHAN 1"
```

Step 3: Configure the RF and Audio Analyzers

RF Analyzer

Normally, the base station emulator internal receiver parameters are controlled automatically based on what protocol expects the mobile station to be transmitting. However, there are times when this does not offer sufficient control for some measurement scenarios. The following internal parameters sometimes require manual control:

- Internal Measurement Frequency
- Internal Receiver Power

Measurement Receiver Frequency Controls

These Receiver Frequency Controls define whether the base station emulator's frequency tuning of the measurement receivers is controlled automatically by the base station emulator or manually by the user.

NOTE

Measurement Receiver Frequency Control is always set to manual when operating mode in CW Mode.

Configuring the Measurement Receiver Frequency Parameters When the user sets the Measurement Receiver Frequency Control to "Manual", the measurement receiver frequency is tuned to the value of the Manual Measurement Frequency.

Table 1. Measurement Receiver Frequency Control and Settable Parameters

Parameter	Command Syntax	Footnotes
Measurement Receiver Frequency Control	RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO <1|ON|0|OFF>	
Manual Measurement Frequency	RFANalyzer:MANual:MEASurement:FREQuency <numeric value>[<suffix>]	
Manual Measurement Frequency and Control	RFANalyzer:MANual:MEASurement[:MFREQuency] <numeric value>[<suffix>]	1

Table Footnotes

1 Sets frequency to <numeric value> and control to manual in one command.

Measurement Receiver Input Power Level Controls

The Receiver Power Level Controls define whether the Internal Receiver Power parameter shall automatically be determined by the value of the MS Power Level parameter or if it shall be set manually by the user.

Configuring the Manual Receiver Power Level There are four Manual Receiver Power Level parameters:

- Manual Digital Receiver Power Level <Cellular>
- Manual Digital Receiver Power Level <PCS>
- Manual Analog Receiver Power Level <Cellular>
- Manual CW Power Level

These parameters store the Manual Receiver Power Level in units of dBm. They are applied when the Receiver Input Power Control is set to Manual.

NOTE

When operating in CW Mode, the value of the Manual CW Power Level parameter is always used, even if the Receiver Input Power Control is set to Auto.

Table 2. Manual Receiver Input Power Control and Settable Parameters

Parameter	Command Syntax
Receiver Input Power Control	RFANalyzer:CONTrol:POWer:AUTO <1|ON|0|OFF>
Manual Analog Receiver Power Level <Cellular>	RFANalyzer:MANual:ANALog:POWer[:SELected] <numeric value>[<suffix>] OR RFANalyzer:MANual:ANALog:POWer:CELLular <numeric value>[<suffix>]
Manual Digital Receiver Power Level	RFANalyzer:MANual:DIGital:POWer[:SELected] <numeric value>[<suffix>] OR RFANalyzer:MANual:DIGital:POWer:<CELLular|PCS> <numeric value>[<suffix>]
Manual CW Power Level	RFANalyzer:CW:EXPected:POWer <numeric value>[<suffix>]

The range of the Manual Receiver Power Level parameters (-60 dBm to +53 dBm) is beyond the capability of the hardware to support. (The hardware range is -25 dBm to +43 dBm.) This is because these parameters are intended to reflect the potential range of RF power at the DUT plane. This larger range of DUT plane power levels can then be accommodated by the use of a gain or loss network between the DUT and the instrument, in conjunction with the Amplitude Offset setting.

Table 3. How to determine Test Set's Expected Receiver Power value

Operating Mode	Receiver Input Power Control	Expected Receiver Power	Range
DTC and AVC Test Modes	Auto	(Analog or Digital) MS Power Level (in cellular or PCS bands) + Amplitude Offset	-25 dBm to +43dBm
	Manual	Manual (Analog or Digital) Receiver Power Level + Amplitude Offset	
CW Mode	Manual (default) or Auto	Manual CW Power Level + Amplitude Offset	

NOTE

The Manual Receiver Power Level parameters are never overwritten by settings made to the corresponding MS TX Level parameter.

Example 6. Programming Example

```
!***********************************************************************
! Step 3: Configure the RF and Audio Analyzers
!***********************************************************************
OUTPUT Test_set;"RFAN:MAN:MEAS 870 MHZ"
OUTPUT Test_set;"RFAN:CONT:POW:AUTO OFF"
OUTPUT Test_set;"RFAN:MAN:DIG:POW 25 DBM"
```

Audio Analyzer

The Audio Analyzer Function is implemented as an “instrument” rather than a “measurement.” Therefore, from the user’s perspective, some parameters used for configuration are more like those associated with the base station emulator than those used by measurements.

Refer to the reference material for the additional parameters and functions associated with the Audio Analyzer.

Step 4: Configure the Measurement Execution Parameters

Background

Measurement execution parameters control the conditions under which a measurement operates. The general set of measurement execution parameters and their generic categories are as follows:

- Statistical Measurement Results (used by most measurements)

  Multi-Measurement Count State
  Multi-Measurement Count Number

- Measurement Timeouts (used by all measurements)

  Measurement Timeout
  Measurement Timeout State

- Measurement Triggering (used by most measurements)

  Trigger Arm (used by all measurements)
  Trigger Source (not used by AVC Test Mode)
  Trigger Delay (not used by AVC Test Mode)

NOTE Not all measurements use all the execution parameters shown above. Additionally, some measurements have parameters that are specific to the measurement. Each measurement has its own set of parameters that are unique to it and have no effect on the execution of other measurements. Refer to the GPIB syntax listing for a detailed list of execution parameters for individual measurements.

Overview

The SETup subsystem is used to configure measurement parameters. Each individual measurement parameter can be set and queried using the associated SETup subsystem command. The general hierarchy of the SETup subsystem command structure is as follows:

```
SETup:<meas-mnemonic>:<measurement parameter><parameter setting/value>
```

The following table shows the measurements available in the Agilent Technologies E1961A 136/AMPS mobile test application and their associated <meas-mnemonic> used in the SETup command syntax.

Table 1. Measurement Mnemonics Used In The SETup Subsystem

Measurement	<meas-mnemonic>
Adjacent Channel Power	ACPower
Analog Transmit Power	ATXPower
Audio Analyzer	AFANalyzer
Digital Transmit Power	DTXPower
Dynamic Transmit Power	DPOWer
Frequency Modulation	FM
Frequency Stability	FSTability
IQ Tuning	IQTuning
Loopback BER	LBERror
Modulation Accuracy	MACCuracy

Configuring Statistical Measurement Results Parameters

Table 2. Statistical Measurement Results Parameters

Parameter	Command Syntax
Measurement Count Number and State	`SETup:<meas-mnemonic>:COUNt[:SNUMber] <numeric value>`
Measurement Count State	`SETup:<meas-mnemonic>:COUNt:STATe <ON|1|OFF|0>`
Measurement Count Number	`SETup:<meas-mnemonic>:COUNt:NUMBer <numeric value>`

Configuring Multi-Measurement Count State and Count Number Simultaneously The multi-measurement count state can be set to ON and the multi-measurement count number can be set to some value using a single complex command (See “Complex Commands” on page 15.)

Example 7. Programming Example:

```
OUTPUT Test_set;”SET:DTXP:COUN 10”
```

would set the multi-measurement count state to ON and set the number of averages to 10 for the digital transmit power measurement.

Multi-Measurement Count State Parameter The Multi-Measurement Count State parameter is used to turn measurement averaging on and off.

Multi-Measurement Count Number Parameter The Multi-Measurement Count Number parameter sets the number of measurement samples taken during each measurement cycle when the COUNt:STATe parameter is set to ON.

Configuring Measurement Triggering Parameters

Table 3. Measurement Triggering Parameters

Parameter	Command Syntax
Trigger Arm	`SETup:<meas-mnemonic>:CONTinuous <ON|1|OFF|0>`
Trigger Source	`SETup:<meas-mnemonic>:TRIGger:SOURce <AUTO|IMMediate|PROTocol|RISE>`
Trigger Delay	`SETup:<meas-mnemonic>:TRIGger:DELay <numeric value>[<suffix>]`

Trigger Arm Parameter The Trigger Arm parameter determines whether a measurement will make one measurement then stop (single), or automatically re-arm upon completion of one measurement and repeat the process (continuous).

NOTE The recommended trigger arm setting for all measurements when programming the test set is single (CONTinuous OFF).

Example 8. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:CONT OFF"
```

would set the trigger arming to single for the digital transmit power measurement.

Trigger Source Parameter The Trigger Source parameter selects the source of the measurement trigger signal.

NOTE The recommended trigger source setting for all measurements when programming the test set is AUTO.

Example 9. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:TRIG:SOUR AUTO"
```

would set the trigger source to AUTO for the digital transmit power measurement.

NOTE Trigger Source is always IMMediate for measurements in AVC Test Mode and cannot be changed by the user.

Trigger Delay Parameter

The Trigger Delay parameter controls the delay between the trigger event (the point in time at which the trigger signal is received) and the start of sampling. Negative values indicate that the sampling should occur prior to the trigger event.

Example 10. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:TRIG:DEL 10 US"
```

would set the trigger delay to 10 μs for the digital transmit power measurement.

NOTE Trigger Delay is not applicable to measurements in AVC Test Mode.

Configuring Measurement Timeout Parameters

Table 4. Measurement Timeout Parameters

Parameters	Command Syntax
Measurement Timeout Time and State	`SETup:<meas-mnemonic>:TIMeout[:STIMe] <numeric value>[<suffix>]`
Measurement Timeout State	`SETup:<meas-mnemonic>:TIMeout:STATe <ON|1|OFF|0>`
Measurement Timeout Time	`SETup:<meas-mnemonic>:TIMeout:TIME <numeric value>[<suffix>]`

Configuring Measurement Timeout State and Timeout Time Simultaneously The measurement timeout state can be set to ON and the measurement timeout time can be set to some value using a single complex command (See “Complex Commands” on page 15.)

Example 11. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:TIM 10"
```

would set the measurement timeout state to ON and set the measurement timeout time to 10 seconds for the digital transmit power measurement.

Measurement Timeout State Parameter The Measurement Timeout State parameter is used to enable or disable measurement timeout functionality.

Example 12. Programming Example:

```
OUTPUT Test_set;"SET:MACC:TIM:STAT ON"
```

would enable measurement timeouts for the modulation accuracy measurement.

Measurement Timeout Time Parameter

The Measurement Timeout Time parameter sets the maximum time that a measurement will execute before failing with a timeout error (when the TIMEout:STATe parameter is set to ON).

Example 13. Programming Example:

```
OUTPUT Test_set;"SET:DTXP:TIM:TIME 10 S"
```

would set the measurement timeout time to 10 seconds for the digital transmit power measurement.

Example 14. Programming Example

```
!*****************************************************************
! Step 4: Configure Measurement Execution Parameters
!*****************************************************************
!
!  Configure Modulation Accuracy Measurement:
!
OUTPUT Test_set;"SET:MACC:COUN 5"  ! Example of using a complex
                                   ! command to set multi-meas
                                   ! state and count at same time.
OUTPUT Test_set;"SET:MACC:TRIG:SOUR AUTO"! Set trig source Auto.
OUTPUT Test_set;"SET:MACC:CONT OFF"   ! Set trig mode to single.
OUTPUT Test_set;"SET:MACC:TIM 15"     ! Set timeout time 15 sec.
OUTPUT Test_set;"SET:MACC:EVM10:STAT ON"! Turn EVM10 State ON
!
!  Configure Digital TX Power Measurement:
!
OUTPUT Test_set;"SET:DTXP:COUN 5"
OUTPUT Test_set;"SET:DTXP:TRIG:SOUR AUTO"
OUTPUT Test_set;"SET:DTXP:CONT OFF"
OUTPUT Test_set;"SET:DTXP:TIM 15"
!
!  Configure the Loopback BER Measurement
!
OUTPUT Test_set;"SET:LBER:CONT OFF;TIM 5"
OUTPUT Test_set;"SET:LBER:COUN 12000"
!
!  Configure Analog TX Power Measurement
!
OUTPUT Test_set;"SET:ATXP:COUN 5"
OUTPUT Test_set;"SET:ATXP:CONT OFF"
OUTPUT Test_set;"SET:ATXP:TIM 15"
```

Step 5: Setup the MS Using MS Test Mode Commands

Background

In DTC test mode, AVC test mode and CW mode, the test set provides forward channel stimulus but has no control over or communication with the mobile station. At this point, either the control program via a serial bus or other interface, or the user with the mobile's keypad, must set up the mobile station in order for the test set to make measurements.

Establishing a "Forced Call" in DTC Test Mode

The user may manually synchronize the mobile station with the test set's DTC, and then turn on the mobile station's own DTC. If both the reverse and forward channels use the same channel number, band, DVCC, MS Tx Power Level and timeslot, what is sometimes known as a "forced call" is in progress.

Characteristics of a "Forced Call"

- Demodulation and channel decoding of the reverse channel are available, although no messages will be decoded.
- The DTC burst contains a repeating random pattern.
- No voice echo is supported with a "forced call".

Mobile station and test set parameters which must be the same for a "forced call" to be established

- Band
- Channel Number
- Timeslot
- DVCC
- MS Transmit Power Level

NOTE

The method used to synchronize the mobile station with the test set is proprietary to the mobile station manufacturer. The base station emulator has no direct control of synchronization when the mobile station is operating in test mode.

Step 6: Make Measurements

Background

The multiple signal path, DSP-based, multiple-processor architecture of the test set allows the test set to make concurrent measurements. This means that:

- multiple measurements can execute and finish at the same time (concurrently)
- individual measurement completion is not influenced by other measurement processes
- availability of measurement results is not dependent upon the sequence that the measurements were requested in
- results from measurements that take few processor cycles are available without having to wait for measurements that take many processor cycles

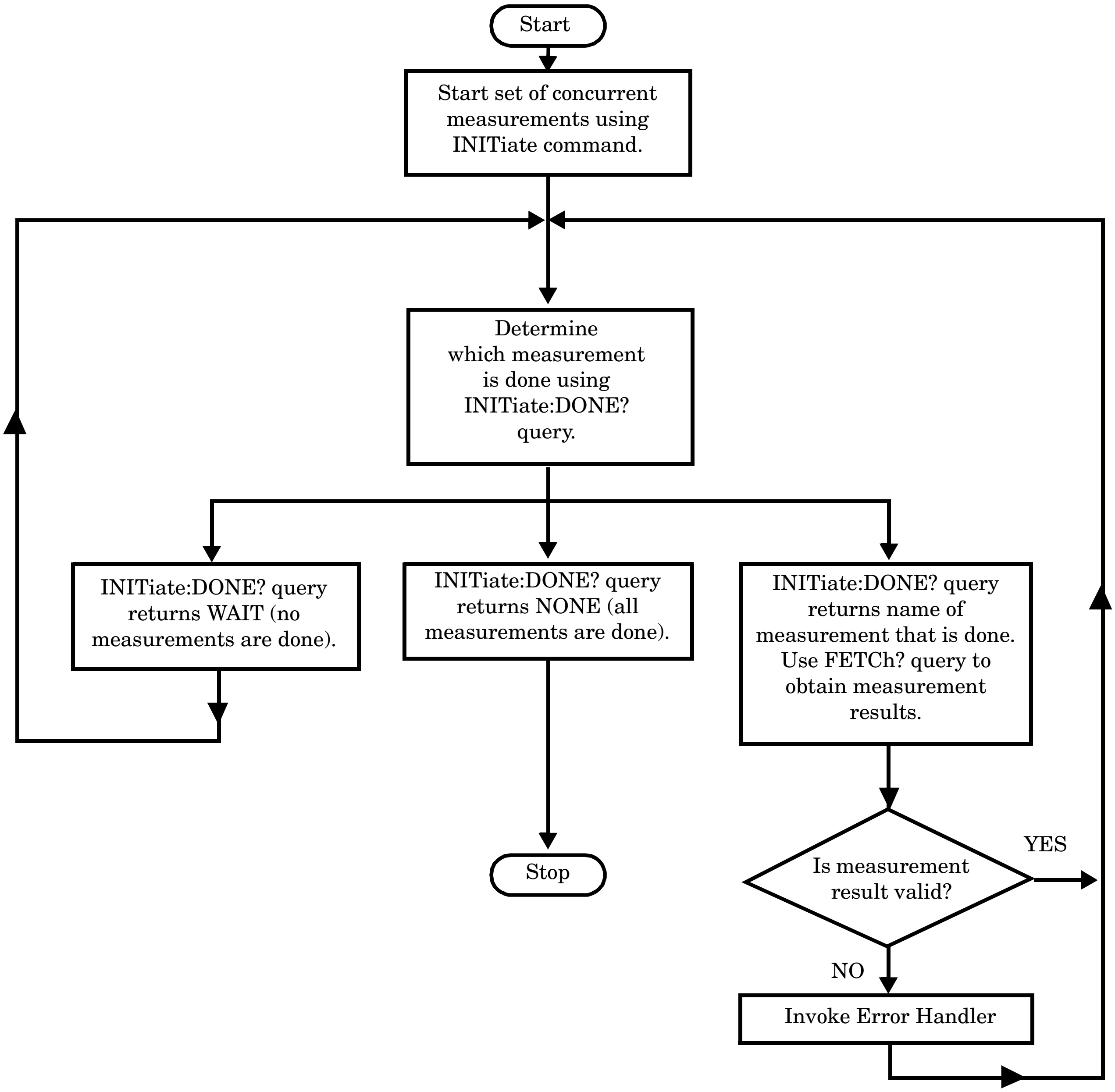
There are no special programming commands required to implement measurement concurrency.

"Step 6: Figure 1. Process for Making Concurrent Measurements" on page 42 shows the recommended process for making concurrent measurements using the test set's command set.

Making Sequential Measurements

Step 6 explains how to initiate measurements concurrently and what process to use when fetching results. These can be applied to sequential measurements. It is unnecessary to use the commands in Step 6b when performing sequential measurements.

Step 6: Figure 1. Process for Making Concurrent Measurements



Example 15. Programming Example:

The following program segment illustrates making a loopback BER measurement and a digital transmit power measurement concurrently using the recommended process shown in “Step 6: Figure 1. Process for Making Concurrent Measurements” on page 42.

```
810    !*****************************************************************
820    !  Step 6:  Make Measurements
830    !*****************************************************************
840    !
850    !  Step 6a: Start Set of Concurrent Measurements:
860    !
870    OUTPUT Test_set;”INIT:LBER;DTXP”
880    !
890    !  Step 6b:  Determine if A Measurement Is Done:
900    !
910    LOOP
920       OUTPUT Test_set;”INIT:DONE?”
930       ENTER Test_set;Meas_done$
940    !
950    !  Step 6c: Obtain Measurement Results
960    !
970       SELECT Meas_done$
980       CASE “DTXP”
990          OUTPUT Test_set;”FETC:DTXP:INT?;POW?”
1000         ENTER Test_set;Integrity,Avg_dig_pow
1010   !  Step 6d:  Are Measurement Results Valid?
1020         IF Integrity=0 THEN
1030            PRINT “AVG DIG POW= “,Avg_dig_pow
1040         ELSE
1050            GOSUB Bad_int_ind ! Go to error handling subroutine
1060         END IF
1070      CASE “LBER”
1080         OUTPUT Test_set;”FETC:LBER?”
1090         ENTER Test_set;Integrity,Bits_tested,Ber_ratio,Ber_count
1100   !  Step 6d: Are Measurement Results Valid?
1110         IF Integrity=0 THEN
1120            PRINT “BITS TESTED = “;Bits_tested
1130            PRINT “BER = “;Ber_ratio
1140            PRINT “ERROR COUNT = “;Ber_count
1150         ELSE
1160            GOSUB Bad_int_ind ! Go to error handling subroutine
1170         END IF
1180      END SELECT
1190   EXIT IF Meas_done$=”NONE”
1200   END LOOP
```

Things That Can Go Wrong

Measurement Integrity Always Returns a Value of 6

Background A measurement integrity value of 6 indicates that some characteristic of the input signal is under range. Typically this will be the amplitude (power) of the DUT signal. This low amplitude will cause the level of the DSP sampler to be below a threshold required by the measurement algorithm to produce results of specified accuracy.

Possible Cause One of the most likely causes of a measurement underrange condition is DUT signal loss caused by fixture loss or cable loss.

Suggested Workaround You can compensate for fixture or cable loss by using the RF IN/OUT port's amplitude offset parameters. Twenty different offsets can be set up for twenty different frequencies. To set the frequencies use the command:

```
SYSTem:CORRection:SFRequency (comma separated numeric values)<suffix>
```

Similarly, to then set the offsets for these frequencies, use the following command syntax:

```
SYSTem:CORRection:SGAin (comma separated numeric values)<suffix>
```

Refer to the reference documentation for details about how to use these commands properly.

Step 6a: Start Set Of Concurrent Measurements

Starting Measurements

Each measurement in a test application can be started using the INITiate command. The syntax of the INITiate command is as follows:

Example 1. Command Syntax:

```
INITiate:<meas-mnemonic>[:ON]
```

The following table shows the measurements available in the Agilent Technologies E1961A AMPS/136 mobile test application and their associated <meas-mnemonic> used in the INITiate command syntax.

Table 5. Measurement Mnemonics Used In The INITiate Subsystem

Measurement	<meas-mnemonic>
Adjacent Channel Power	ACPower
Analog Transmit Power	ATXPower
Audio Analyzer	AFANalyzer
Digital Transmit Power	DTXPower
Dynamic Transmit Power	DPOWer
Frequency Modulation	FM
Frequency Stability	FSTability
Loopback BER	LBERror
IQ Tuning	IQTuning
Modulation Accuracy	MACCuracy

NOTE The Dynamic Transmit Power measurement closes all other active measurements when it is activated, therefore it should not be used concurrently with other measurements. Refer to the user documentation for more information.

Example 16. Programming Example:

```
OUTPUT Test_set;"INIT:DTXP"
```

would start the digital transmitter power measurement.

Using Compound Commands to Start Concurrent Measurements

More than one measurement can be started using a single INITiate command. For example:

```
OUTPUT Test_set;"INIT:DTXP;LBER"
```

would start the digital transmit power measurement and the loopback BER measurement. These measurements would then run concurrently.

Step 6b: Determine if a Measurement Is Done

Background

After a set of concurrent measurements has been started, it is desirable that the control program be able to determine when individual measurement results are available. This enables the control program to request results for a completed measurement without having to wait for other measurements to finish.

NOTE Step 6b applies only to measurements that have been initiated concurrently. When measurements have been initiated one at a time (sequential measurements) it is unnecessary to use the INITiate:DONE? query command. Step 6b can be skipped for sequential measurements.

Overview

The INITiate:DONE? query command is used to determine which measurement is finished.

As the name implies, the query returns the name of whichever active measurement is done so that the control program can request that measurement's results.

This command is query only and returns only one response per query. The responses returned and their meaning are shown in the table on the following page.

Once a measurement is reported as being done via the INITiate:DONE? query it is removed from the done list (measurements are only reported as being done once). The design of the INITiate:DONE? query assumes the control program immediately fetches a measurement's results once it is reported as being done.

Table 6. Responses Returned from INITiate:DONE? Query

Response	Meaning
ACP	The adjacent channel power measurement is done.
ATXP	The analog transmit power measurement is done.
AFAN	The audio analyzer measurement is done.
DPOW	The dynamic transmit power measurement is done.
DTXP	The digital transmit power measurement is done.
FM	The frequency modulation measurement is done.
FST	The frequency stability measurement is done.
IQT	The IQ Tuning measurement is done.
LBER	The loopback BER measurement is done.
MACC	The modulation accuracy measurement is done.
WAIT	There are one or more measurements that are in progress, but none of those measurements are done yet.
NONE	No measurements are in progress.

Example 17. Command Syntax:

```
INITiate:DONE?
```

Step 6c: Obtain a Set of Measurement Results

Background

In order to minimize bus traffic in the manufacturing environment, the test set's high-level measurements have been designed to return multiple measured values in response to a single measurement request.

For example, if a digital transmit power measurement with statistical measurement results is initiated, there will be five measurement results available as follows:

1. Measurement integrity value
2. Average value
3. Minimum value
4. Maximum value
5. Standard deviation value

The test set has been designed with the capability to return the measurement results in a variety of formats to suit the needs of the measurement environment. For example, the digital transmitter power measurement results can be returned as:

- Measurement integrity and average value

  OR

- Average value and minimum value and maximum value and standard deviation value

  OR

- Average value only

  OR

- Minimum value only

  OR

- Maximum value only

  OR

- Standard deviation value only

  OR

- Measurement integrity value only

The formats available for individual measurements can be found in the test set's FETCh subsystem's GPIB command syntax reference information.

Overview

The measurement results from each measurement in a test application can be queried using the FETCh subsystem. The general hierarchy of the FETCh command structure is as follows:

```
FETCh:<meas-mnemonic>:<result format>?
```

The following table shows the measurements available in the Agilent Technologies E1961A AMPS/136 mobile test application and their associated <meas-mnemonic> used in the FETCh command syntax.

The command syntax used to obtain the various measurement result formats (<result format>) for each measurement can be found in the test set's FETCh subsystem's GPIB command syntax reference information.

Table 7. Measurement Mnemonics Used In The FETCh Subsystem

Measurement	<meas-mnemonic>
Adjacent Channel Power	ACPower
Analog Transmit Power	ATXPower
Audio Analyzer	AFANalyzer
Digital Transmit Power	DTXPower
Dynamic Transmit Power	DPOWer
Frequency Modulation	FM
Frequency Stability	FSTability
IQ Tuning	IQTuning
Loopback BER	LBERror
Modulation Accuracy	MACCuracy

Example 1. Command Syntax:

```
FETCh:<meas-mnemonic>:<result format>?
```

Example 2. Programming Example:

```
OUTPUT Test_set;"FETC:DTXP:POW:MIN?"
```

would return the minimum value from the set of samples taken during the digital transmit power measurement (when statistical measurement results are turned on and number of samples taken >1). The returned value can be assigned to a variable using the following HP Basic command:

```
ENTER Test_set;Min_dig_pow
```

Step 6d: Validate Measurement Results

Background

Validating measurement results is extremely important when using test modes. The test set will return a result if it is capable of making a measurement, even if this result was obtained under adverse conditions. The lack of signaling between the mobile and the test set prevents the test set from knowing the condition of the link. Therefore, the only indicator provided by the test set that the measurement conditions were unacceptable becomes the integrity indicator. It is essential to check the value returned for the integrity indicator of each measurement.

For example, when a “forced call” is established the MS should be synchronized with the test set. In some cases, the MS may not successfully synchronize to the test set but will still begin to transmit. The test set will make measurements, but they will be triggered in the wrong place and the results will most likely be invalid. When making measurements in DTC test mode, it is possible to set up the mobile on the correct channel and the wrong timeslot and still have the mobile’s transmitter turn on. The test set WILL return values for the measurements but will also return integrity indicators other than 0.

Overview

The integrity indicator is a measurement result and therefore is queried using the FETCh subsystem. A value of 0 indicates that the measurement is valid. A value other than 0 indicates that an error occurred during the measurement process.

Table 2. Integrity Indicators

Value Returned	Description (Message also appears on Test Set)
0	Normal
1	No Result Available
2	Measurement Timeout
3	Hardware Not Installed
4	Hardware Error
5	Over Range
6	Under Range
7	Burst Short
8	Trigger Early or Fall Early
9	Trigger Late or Rise Late
10	Signal Too Noisy
11	Sync Not Found
12	Oven Out of Range
13	Unidentified Error

Example 18. Programming Example

```
OUTPUT Test_set;”FETC:DTXP?”
ENTER Test_set;Integrity,Avg_dig_pow
IF Integrity=0 THEN
   PRINT “AVG DIG POW= “;Avg_dig_pow
ELSE
   PRINT “DTXP Measurement Error”
   PRINT “DTXP Measurement Integrity is “;Integrity
END IF
```

Step 7: Make Test Set Changes for New MS Configuration

Background

The test set must be put into any new configuration before the mobile station in order for the mobile station to be able to synchronize to the test set. This involves repeating steps 1, 2, or 3 or any combination of the three. It is only necessary to perform step 4 once. Therefore, it is possible to set up both digital and analog measurements all at once and later initiate them when the test set is in the appropriate operating mode.

Possible Test Set Changes

Repeat Step 1: Set the Test Set's Operating Mode

This step would be appropriate if all tests in one operating mode have been completed and more tests need to be performed in a different operating mode. There are four operating modes: DTC Test Mode, AVC Test Mode, CW Mode, and Active Cell Mode.

Repeat Step 2: Configure the Base Station Emulator

This step would be appropriate if testing at a new power level, channel, timeslot, or band.

Repeat Step 3: Configure the RF and Audio Analyzers

This step would be appropriate if testing at a new power level, frequency, timeslot, or band and control of the receiver was manual. Another instance would be if audio tests were to be performed.

Comprehensive Program Example

This section presents two example programs for making measurements using the test set in DTC and AVC test modes. The first program follows the task flow presented at the beginning of this programming guide and illustrates how each step presented throughout the guide fits together into a single program. The second program is an example of more efficient programming techniques.

Example Program 1

```
10    !*****************************************************************
20    !  Program: PROG_EX.TXT                            October 9, 2000
30    !  Purpose:  Comprehensive Example of programming measurements on
40    !            the Agilent Technologies 8960 using DTC and AVC
50    !            test modes.
60    !            This example is written in HP BASIC.
70    !*****************************************************************
80    !
90    !  Configure the HP BASIC environment.
100   !  These actions are unrelated to configuring or performing tests
110   !     with the 8960.
120   !
130   OPTION BASE 1
140   COM Test_set
150   Test_set=714!  Test set's GPIB address
160   PRINTER IS CRT
170   CLEAR SCREEN
180   ON TIMEOUT 7,10 GOTO Timeout_routine
190   !
200   !  Turn on the GPIB debugger. This is for development purposes and
210   !  should be turned off after development is completed.
220   OUTPUT Test_set;"SYST:COMM:GPIB:DEB:STAT ON"
230   !
240   !*****************************************************************
250   ! Step 1: Set Test Set Cell Operating Mode To DTC Test Mode
260   !*****************************************************************
270   !
280   OUTPUT Test_set;"CALL:OPER:MODE DTCT"
290   !*****************************************************************
300   ! Step 2: Configure the Base Station Emulator
310   !*****************************************************************
320   OUTPUT Test_set;"CALL:POW -50"! Set cell power to -50 dBm and turn
330                                  ! power state ON with complex command
340   OUTPUT Test_set;"CALL:SET:DTC:BAND CELL"! Set active band to cell
350   OUTPUT Test_set;"CALL:SET:DTC:CHAN 42"! Set traffic channel to 42
360   !
370   !*****************************************************************
380   ! Step 3: Configure the RF and Audio Analyzers
390   !*****************************************************************
400   !
410   OUTPUT Test_set;"RFAN:CONT:POW:AUTO OFF"
420   OUTPUT Test_set;"RFAN:MAN:DIG:POW 25 DBM"
430   OUTPUT Test_set;"RFAN:MAN:ANAL:POW 25 DBM"
440   !*****************************************************************
450   ! Step 4: Configure Measurement Execution Parameters
460   !*****************************************************************
470   !
480   !  Configure Modulation Accuracy Measurement:
490   !
500   OUTPUT Test_set;"SET:MACC:COUN 5"  ! Example of using a complex
510                                      ! command to set multi-meas
```

```
520                                 ! state and count at same time.
530   OUTPUT Test_set;"SET:MACC:TRIG:SOUR AUTO"! Set trig source Auto.
540   OUTPUT Test_set;"SET:MACC:CONT OFF"   ! Set trig mode to single.
550   OUTPUT Test_set;"SET:MACC:TIM 15"     ! Set timeout time 15 sec.
560   OUTPUT Test_set;"SET:MACC:EVM10:STAT ON"! Turn EVM10 State ON
570   !
580   !  Configure Digital TX Power Measurement:
590   !
600   OUTPUT Test_set;"SET:DTXP:COUN 5"
610   OUTPUT Test_set;"SET:DTXP:TRIG:SOUR AUTO"
620   OUTPUT Test_set;"SET:DTXP:CONT OFF"
630   OUTPUT Test_set;"SET:DTXP:TIM 15"
640   !
650   !  Configure Analog TX Power Measurement
660   !
670   OUTPUT Test_set;"SET:ATXP:COUN 5"
680   OUTPUT Test_set;"SET:ATXP:CONT OFF"
690   OUTPUT Test_set;"SET:ATXP:TIM 15"
700   !
710   !  Configure Frequency Stability Measurement
720   !
730   OUTPUT Test_set;"SET:FST:CONT OFF;COUN 10;TIM 15"
740   !
750   !*************************************************************
760   !  Step 5:  Set Up The MS Using MS Test Mode Commands
770   !*************************************************************
780   PRINT "PUT THE MS INTO DIGITAL TEST MODE NOW"
790   PRINT "PRESS CONTINUE"
800   PAUSE
810   !*************************************************************
820   !  Step 6:  Make Measurements
830   !*************************************************************
840   !
850   !  Step 6a: Start Set of Concurrent Measurements:
860   !
870   OUTPUT Test_set;"INIT:DTXP;MACC"
880   !
890   !  Step 6b:  Determine if A Measurement Is Done:
900   !
910   LOOP
920      OUTPUT Test_set;"INIT:DONE?"
930      ENTER Test_set;Meas_done$
940   !
950   !  Step 6c: Obtain Measurement Results
960   !
970      SELECT Meas_done$
980      CASE "MACC"
990         GOSUB Mod_acc  !Example of using a subroutine to query
1000     CASE "DTXP"
1010        OUTPUT Test_set;"FETC:DTXP:INT?;POW?"
1020        ENTER Test_set;Integrity,Avg_dig_pow
1030        IF Integrity=0 THEN
1040           PRINT "AVG DIG POW= ",Avg_dig_pow
```

```
1050       ELSE
1060          GOSUB Bad_int_ind
1070  !
1080  !  Step 6d: Are Measurement Results Valid?
1090  !
1100       END IF
1110    END SELECT
1120  EXIT IF Meas_done$="NONE"
1130  END LOOP !  If 'WAIT' is returned from the 'INIT:DONE?' query, it
1140            !  will fall through the loop
1150  !*****************************************************************
1160  !  Step 7:  Make Test Set Changes for New MS Configuration
1170  !*****************************************************************
1180  !
1190  !  Proceed to analog tests
1200  !
1210  !*****************************************************************
1220  ! Step 1(REPEATED): Set Test Set Cell Operating Mode AVC Test Mode
1230  !*****************************************************************
1240  !
1250  OUTPUT Test_set;"CALL:OPER:MODE AVCT"
1260  !*****************************************************************
1270  ! Step 2: Configure the Base Station Emulator (BSEmul)
1280  !*****************************************************************
1290  OUTPUT Test_set;"CALL:SET:AVC:CELL 42"! Set channel number
1300  !*****************************************************************
1310  !  Step 5(REPEATED):  Set Up The MS Using MS Test Mode Commands
1320  !*****************************************************************
1330  PRINT " "
1340  PRINT "PUT THE MS INTO ANALOG TEST MODE NOW"
1350  PRINT "PRESS CONTINUE"
1360  PAUSE
1370  !
1380  !*****************************************************************
1390  !  Step 6(REPEATED):  Make Measurements
1400  !*****************************************************************
1410  !
1420  !  Step 6a: Start Set of Concurrent Measurements:
1430  !
1440  OUTPUT Test_set;"INIT:ATXP;FST"
1450  !
1460  !
1470  !  Step 6b:  Determine if a measurement is done:
1480  LOOP
1490    OUTPUT Test_set;"INIT:DONE?"
1500    ENTER Test_set;Ana_meas_done$
1510  !
1520  !  Step 6c: Obtain Measurement Results
1530  !
1540    SELECT Ana_meas_done$
1550  !
1560    CASE "ATXP"
1570       OUTPUT Test_set;"FETC:ATXP?"
```

```
1580         ENTER Test_set;Integrity,Avg_ana_pow
1590         IF Integrity=0 THEN
1600            PRINT “AVG ANALOG POW= “,Avg_ana_pow
1610         ELSE
1620            GOSUB Bad_int_ind
1630         END IF
1640      CASE “FST”
1650         OUTPUT Test_set;”FETC:FST?”
1660         ENTER Test_set;Integrity,Wfreq_err,Avg_freq
1670         IF Integrity=0 THEN
1680            PRINT
1690            PRINT “Analog Frequency Stability Measurement Results”
1700            PRINT “Worst Frequency Error = “;Wfreq_err
1710            PRINT “Average Frequency = “;Avg_freq
1720         ELSE
1730            GOSUB Bad_int_ind
1740         END IF
1750      END SELECT
1760   EXIT IF Ana_meas_done$=”NONE”
1770   END LOOP
1780   !*****************************************************************
1790   !  Step 7(REPEATED):  Test Set Changes for New MS Configuration
1800   !*****************************************************************
1810   !
1820   !  Proceed to audio tests
1830   !
1840   !*****************************************************************
1850   ! Step 2: Configure the Base Station Emulator (BSEmul)
1860   !*****************************************************************
1870   !
1880   OUTPUT Test_set;”CALL:POW -116 DBM”
1890   OUTPUT Test_set;”CALL:SET:AVC 600”
1900   !
1910   !*****************************************************************
1920   ! Step 3(REPEATED): Configure the RF and Audio analyzers
1930   !*****************************************************************
1940   OUTPUT Test_set;”CALL:FM:INT:FREQ 1004 HZ;SDEV 8 KHZ”
1950   OUTPUT Test_set;”CALL:AVCT:AVC:SAT:STAT OFF”
1960   OUTPUT Test_set;”SET:AFAN:CONT OFF;TIM 15”
1970   OUTPUT Test_set;”SET:AFAN:PEAK:VOLT 3V”
1980   OUTPUT Test_set;”SET:AFAN:SDIS:STAT ON”
1990   OUTPUT Test_set;”SET:AFAN:SDIS:FREQ 1004 HZ”
2000   OUTPUT Test_set;”SET:AFAN:FILT CMES”
2010   OUTPUT Test_set;”SET:AFAN:DEMP:STAT OFF”
2020   OUTPUT Test_set;”SET:AFAN:EXP:STAT OFF”
2030   !*****************************************************************
2040   !  Step 5(REPEATED):  Set Up The MS Using MS Test Mode Commands
2050   !*****************************************************************
2060   PRINT “ “
2070   PRINT “CONFIGURE THE MS FOR RECEIVER SENSITIVITY TESTING”
2080   PRINT “SET THE PHONE FOR A MIDDLE CHANNEL IN THE CELL BAND”
2090   PRINT “POWER LEVEL OF 0”
2100   PRINT “PRESS CONTINUE”
```

```
2110  PAUSE
2120  !
2130  !*****************************************************************
2140  !  Step 6(REPEATED):  Make Measurements
2150  !*****************************************************************
2160  !
2170  OUTPUT Test_set;”INIT:AFAN”
2180  OUTPUT Test_set;”FETC:AFAN:INT?;SINAD?”
2190  ENTER Test_set;Integrity,Avg_sinad
2200  IF Integrity=0 THEN
2210     PRINT
2220     PRINT “Receiver Sensitivity Results”
2230     PRINT “SINAD = “;Avg_sinad;”dBm”
2240  ELSE
2250     PRINT “MEASUREMENT FAILED”
2260     PRINT “INTEGRITY = “;Integrity
2270  END IF
2280  !
2290  !  Change power for Distortion measurement
2300  !
2310  OUTPUT Test_set;”CALL:POW -50 DBM”
2320  !
2330  !  Measure Distortion
2340  !
2350  OUTPUT Test_set;”INIT:AFAN”
2360  OUTPUT Test_set;”FETC:AFAN:INT?;DIST?”
2370  ENTER Test_set;Integrity,Avg_distortion
2380  IF Integrity=0 THEN
2390     PRINT
2400     PRINT “Average Distortion Results”
2410     PRINT “Distortion = “;Avg_distortion;”%”
2420  ELSE
2430     PRINT “MEASUREMENT FAILED”
2440     PRINT “INTEGRITY = “;Integrity
2450  END IF
2460  STOP
2470  !
2480  !  Subroutines
2490  !
2500 Mod_acc:!  Query and output results for MACC
2510  OUTPUT Test_set;”FETC:MACC:INT?;EVM10?”
2520  ENTER Test_set;Integrity,Max_evm10
2530  IF Integrity=0 THEN
2540     PRINT “MAX EVM10 = “,Max_evm10
2550  ELSE
2560     GOSUB Bad_int_ind
2570  END IF
2580  RETURN
2590 Bad_int_ind: !
2600  PRINT Meas_done$&” Measurement Error”
2610  PRINT “Measurement Integrity Indicator: “,Integrity
2620  RETURN
2630 Timeout_routine: !
```

```
2640  PRINT "GPIB timeout has occurred."
2650  END
```

Example Program 2

```
10    !***************************************************************
20    ! Comprehensive Example Program
30    ! 8960 AMPS/136 Test Mode
40    !
50    ! This is an example program to demonstrate the use of Momentum
60    ! with AMPS/136 TA testing a dual-mode TDMA phone in Test Mode.
70    ! The program makes Digital Cellular, Digital PCS, and Analog
80    ! measurements in Test (no call processing) Mode.
90    !***************************************************************
100   !
110   COM /Address/ INTEGER Testset
120   Testset=714
130   ON TIMEOUT 7,20 GOSUB Timeout
140   Rf_level=-50
150   Ber_level=-110
160   Sinad_level=-116
170   CLEAR SCREEN
180   !
190   !***************************************************************
200   ! Configure Testset Parameters
210   !***************************************************************
220   !
230   OUTPUT Testset;”*RST”
240   OUTPUT Testset;”SYST:COMM:GPIB:DEB:STAT ON”
250   ! Remove after development is finished.
260   !
270   !***************************************************************
280   ! Configure Base Station Emulator Parameters
290   !***************************************************************
300   !
310   OUTPUT Testset;”CALL:CELL:OPER:MODE DTCT”
320   OUTPUT Testset;”SYST:CORR -0.7DB”
330   OUTPUT Testset;”CALL:POW “;Rf_level
340   OUTPUT Testset;”CALL:SET:AVC 400”
350   OUTPUT Testset;”CALL:SET:DTC:BAND CELL”
360   OUTPUT Testset;”CALL:SET:DTC:CHAN:CELL 42”
370   OUTPUT Testset;”CALL:SET:DTC:CHAN:PCS 1000”
380   OUTPUT Testset;”RFAN:CONT:POW:AUTO OFF”
390   OUTPUT Testset;”RFAN:MAN:ANAL:POW 25”
400   OUTPUT Testset;”RFAN:MAN:DIG:POW:CELL 25”
410   OUTPUT Testset;”RFAN:MAN:DIG:POW:PCS 25”
420   OUTPUT Testset;”CALL:FM:INT:STATE OFF;DEV 8KHZ;FREQ 1004HZ”
430   !
440   !***************************************************************
450   ! Configure Measurement Parameters
460   !***************************************************************
470   !
480   OUTPUT Testset;”SET:CONT:OFF”
490   OUTPUT Testset;”SET:DTXP:TIM 3”
500   OUTPUT Testset;”SET:MACC:TIM 3”
510   OUTPUT Testset;”SET:ACP:TIM 3”
```

```
520   OUTPUT Testset;”SET:LBER:COUN 10000;TIM 3”
530   OUTPUT Testset;”SET:FST:TIM 3”
540   OUTPUT Testset;”SET:ATXP:TIM 3”
550   OUTPUT Testset;”SET:AFAN:TIM 3”
560   OUTPUT Testset;”SET:FM:TIM 3”
570   OUTPUT Testset;”SET:MACC:EVM10:STAT OFF”
580   OUTPUT Testset;”SET:AFAN:PEAK:VOLT 1”
590   OUTPUT Testset;”SET:AFAN:SDIS:STAT ON”
600   OUTPUT Testset;”SET:AFAN:FILT CMES”
610   OUTPUT Testset;”SET:AFAN:SDIS:STATE ON;FREQ 1004”
620   OUTPUT Testset;”SET:FM:DIST:STATE ON;FREQ 6000”
630   OUTPUT Testset;”SET:FM:DETECTOR:TYPE PPEAK”
640   OUTPUT Testset;”SET:FM:FILT:TBP 6000”
650   OUTPUT Testset;”SET:FM:FILT TBP”
660   !
670   !*************************************************************
680   ! Put Mobile in Test Mode (Digital Cellular)
690   !*************************************************************
700   !
710   PRINT “Put phone in DTC Test Mode, Channel 42, Slot 1, DVCC 1.”
720   PRINT “Press ‘F2’ to continue.”
730   PAUSE
740   CLEAR SCREEN
750   PRINT “Cellular Results: “
760   !
770   !*************************************************************
780   ! Make Measurements (Digital Cellular and PCS)
790   !*************************************************************
800   !
810   FOR I=1 TO 2
820     OUTPUT Testset;”CALL:POW “;Ber_level
830     OUTPUT Testset;”INIT:LBER;DTXP;MACC;ACP”
840     REPEAT
850       OUTPUT Testset;”INIT:DONE?”
860       ENTER Testset;Measdone$
870       SELECT Measdone$
880       CASE “LBER”
890         OUTPUT Testset;”FETC:LBER:INT?;RAT?”
900         ENTER Testset;Integrity,Ber
910         IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
920         Print_results(Measdone$,Ber)
930       CASE “DTXP”
940         OUTPUT Testset;”FETC:DTXP?”
950         ENTER Testset;Integrity,Power
960         IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
970         Print_results(Measdone$,Power)
980       CASE “MACC”
990         OUTPUT Testset;”FETC:MACC?”
1000        ENTER Testset;Integrity,Evm,Ferr,Ooff,Perr,Mag
1010        IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1020        Print_results(Measdone$,Evm,Ferr,Ooff,Perr,Mag)
1030      CASE “ACP”
1040        OUTPUT Testset;”FETC:ACP?”
```

```
1050        ENTER Testset;Integrity,Adjl,Adjh,Alt1l,Alt1h,Alt2l,Alt2h
1060        IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1070        Print_results(Measdone$,Adjl,Adjh,Alt1l,Alt1h,Alt2l,Alt2h)
1080      END SELECT
1090    UNTIL Measdone$=”NONE”
1100    OUTPUT Testset;”CALL:POW “;Rf_level
1110  !
1120  !***************************************************************
1130  ! Make Test Set Changes (Change to PCS, then Analog)
1140  !***************************************************************
1150  !
1160  !
1170    IF I=1 THEN ! Just did Digital 800, get ready for Digital 1900
1180      OUTPUT Testset;”CALL:SET:DTC:BAND PCS”
1190    ELSE   ! Done doing Digital 1900, get ready for Analog
1200      OUTPUT Testset;”CALL:CELL:OPER:MODE AVCT”
1210    END IF
1220  !
1230  !***************************************************************
1240  ! Change Phone’s Test Mode (Digital PCS first, Analog Second)
1250  !***************************************************************
1260  !
1270    !
1280    IF I=1 THEN           !Finished with 800MHz, Change to 1900MHz
1290      PRINT “Change phone’s channel to 1000 PCS, DVCC 1, Slot 1.”
1300      PRINT “Press Continue.”
1310      PAUSE
1320      PRINT
1330      PRINT “PCS Results:”
1340    ELSE        !Finished with Digital, change to analog test mode
1350      PRINT “Put phone in Analog Test Mode, Channel 400, SAT ON.”
1360      PRINT “Press Continue.”
1370      PAUSE
1380      PRINT
1390      PRINT “Analog Results:”
1400    END IF
1410  NEXT I
1420  !
1430  !***************************************************************
1440  ! Make Measurements (Analog RF,Audio,FM)
1450  !***************************************************************
1460  !
1470  OUTPUT Testset;”CALL:FM:INT:STATE ON”
1480  OUTPUT Testset;”CALL:POW “;Sinad_level
1490  OUTPUT Testset;”INIT:ATXP;FST;AFAN;FM”
1500  REPEAT
1510    OUTPUT Testset;”INIT:DONE?”
1520    ENTER Testset;Measdone$
1530    SELECT Measdone$
1540    CASE “ATXP”
1550      OUTPUT Testset;”FETC:ATXP?”
1560      ENTER Testset;Integrity,Power
1570      IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
```

```
1580       Print_results(Measdone$,Power)
1590     CASE “FST”
1600       OUTPUT Testset;”FETC:FST?”
1610       ENTER Testset;Integrity,Ferr,Freq
1620       IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1630       Print_results(Measdone$,Ferr,Freq)
1640     CASE “AFAN”
1650       OUTPUT Testset;”FETC:AFAN?”
1660       ENTER Testset;Integrity,Level,Sinad,Dist
1670       IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1680       Print_results(Measdone$,Level,Dist,Sinad)
1690     CASE “FM”
1700       OUTPUT Testset;”FETC:FM?”
1710       ENTER Testset;Integrity,Dev,Dist
1720       IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1730       Print_results(Measdone$,Dev,Dist)
1740     END SELECT
1750   UNTIL Measdone$=”NONE”
1760   !
1770   !****************************************************************
1780   ! Finish Testing
1790   !****************************************************************
1800   !
1810   PRINT “Testing Complete.”
1820   PRINT
1830   OUTPUT Testset;”CALL:POW “;Rf_level
1840   STOP
1850 Timeout:   !Comes here only when program times out
1860   PRINT “Program time out.”
1870   END
1880   !
1890   !*****************************************************************
1900   ! Subroutine Section
1910   !*****************************************************************
1920   SUB Print_results(Meas_name$,Res1,OPTIONAL Res2,Res3,Res4,Res5,Res6)
1930     SELECT Meas_name$
1940     CASE “LBER”
1950       PRINT USING “5X,””Loopback BER:””,10X,M2D.2D,”” %”””;Res1
1960     CASE “DTXP”
1970       PRINT USING “5X,””Ave Digital Power:””,5X,M2D.2D,”” dBm”””;Res1
1980     CASE “MACC”
1990       PRINT USING “5X,””Max EVM1:””,14X,M2D.2D,”” %”””;Res1
2000       PRINT USING “5X,””Worst Freq Error:””,5X,M3D.2D,”” Hz”””;Res2
2010       PRINT USING “5X,””Max Mag. Error:””,8X,M2D.2D,”” %”””;Res5
2020       PRINT USING “5X,””Max Origin Offset:””,5X,M2D.2D,”” dB”””;Res3
2030       PRINT USING “5X,””Max Phase Error:””,7X,M2D.2D,”” Deg”””;Res4
2040     CASE “ACP”
2050       PRINT USING “5X,””ACP Adj Lo:””,12X,M2D.2D,”” dBc”””;Res1
2060       PRINT USING “5X,””ACP Adj Hi:””,12X,M2D.2D,”” dBc”””;Res2
2070       PRINT USING “5X,””ACP Alt1 Lo:””,11X,M2D.2D,”” dBc”””;Res3
2080       PRINT USING “5X,””ACP Alt1 Hi:””,11X,M2D.2D,”” dBc”””;Res4
2090       PRINT USING “5X,””ACP Alt2 Lo:””,11X,M2D.2D,”” dBc”””;Res5
2100       PRINT USING “5X,””ACP Alt2 Hi:””,11X,M2D.2D,”” dBc”””;Res6
```

```
2110    CASE “ATXP”
2120      PRINT USING “5X,””Ave Analog Power:””,6X,M2D.2D,”” dBm”””;Res1
2130    CASE “FST”
2140      PRINT USING “5X,””Worst Freq Error:””,5X,M3D.2D,”” ppm”””;Res1
2150      PRINT USING “5X,””Average Freq:””,6X,M3D.2DESZ,”” Hz”””;Res2
2160    CASE “FM”
2170      PRINT USING “5X,””SAT Deviation:””,9X,M5D,”” Hz”””;Res1
2180      PRINT USING “5X,””Distortion:””,11X,M3D.2D,”” %”””;Res2
2190    CASE “AFAN”
2200      PRINT USING “5X,””Audio Level:””,10X,M3D.2D,”” V”””;Res1
2210      PRINT USING “5X,””Audio Distortion:””,5X,M3D.2D,”” %”””;Res2
2220      PRINT USING “5X,””SINAD:””,16X,M3D.2D,”” dB”””;Sinad
2230    END SELECT
2240  SUBEND
2250  SUB Bad_measurement(Integrity,Meas_name$)
2260    PRINT “     Measurement warning: “;Meas_name$
2270    PRINT “     Integrity =”;Integrity
2280  SUBEND
```