Programming: Getting Started Guide

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**Programming: Getting Started Guide for E1963A W-CDMA**

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- Conventions used in this Getting Started Guide
- How to use this Getting Started Guide
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- About the Programming Examples Presented in this Guide

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Programming: Getting Started Guide for AMPS/136 Mobile Test
Introduction

The Getting Started Guide is organized around the basic set of tasks a control program normally performs when testing a mobile station in a manufacturing environment.

Conventions used in this Getting Started Guide

Throughout this Getting Started 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.

The variable Testset used in the steps of the Getting Started Guide refers to the test set’s GPIB address.

How to use this Getting Started Guide

The most effective way to use this Getting Started Guide is with the Programming Flowchart included in the front inside pocket of this guide and the 8960 User Documentation. This documentation is found in two locations:

- the 8960 Family Support Site (updated frequently) on the Internet, or
- the User Documentation CD-ROM shipped with your test application.

Each step on the Programming Flowchart is illustrated with example program code in this guide. Using this Getting Started Guide, the Programming Flowchart, and the on-line information about 8960 programming, you will be able to generate a control program to perform fundamental mobile station manufacturing tests.

Useful on-line links

Go to the 8960 Family Support Site on either the CD-ROM or the Internet. The CD-ROM should self-launch to its home page. The URL for the website is:

www.agilent.com/find/8960support/

Navigate to the Programming page for this test application. The illustrations on the back of the Programming Flowchart show you how to navigate to this page.

The following links are under the heading Getting Started on the Programming page:
Programming: Getting Started Guide

Introduction

- Programming: Getting Started Guide
  - This online version of this guide contains links to more detailed information about each step which may be useful as you develop your control program.

- Control Program Examples
  - These examples are for you to download. You may want to use these as templates for your own control program or to execute.
  - The control program explained in the Getting Started Guide is also available here for you to download. It is a fully functional control program.

About the Programming Examples Presented in this Guide

Programming Language:

Programming examples presented in this guide are written in the HP BASIC programming language, also known as RMB or Rocky Mountain BASIC. The use of HP BASIC is not an endorsement of the HP BASIC product.

Line Numbers

All of the programming examples in the guide with line numbers are sections from a control program example available on-line for you to download.

Code that is not part of the download control program example does not have line numbers. This code may represent an alternate method of performing the task or may illustrate a feature not used by the control program example.

Syntax used in Programming Examples:

- The 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. For the command syntax:

  RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO?

  the shortened form would be:

  RFAN:CONT:MEAS:FREQ:AUTO?

- The programming examples do not include optional nodes. Optional nodes in the command syntax are defined by enclosing the node inside the [ ] brackets. For example, the command syntax:
Programming: Getting Started Guide for AMPS/136 Mobile Test

Introduction

CALL[:CELL]:POWer[:SAMPlitude] -80dBm
appears in the programming examples as:
CALL:POW -80dBm

• Programming examples make extensive use of compound commands using the ;
  and the :: separators. Refer to the on-line information for 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 and
minimize GPIB bus transactions.

• The syntax below turns the state of the parameter on.
  OUTPUT Test_set;"SET:DTXP:TIM:STAT ON"

• The syntax below is used to assign a value to the parameter.
  OUTPUT Test_set;"SET:DTXP:TIM:TIME 10 S"

• Both of the above actions can be accomplished with one syntax command:
  OUTPUT Test_set;"SET:DTXP:TIM:STIM 10 S"

  The command above sets the parameter state to ON and 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.

• This command can be shortened further by removing the optional command
  mnemonic :STIME, as shown below.
  OUTPUT Test_set;"SET:DTXP:TIM 10 S"

  This is the format that will be used throughout this guide.
Step 1: Set up the Test Set

This step explains how to:

- "Fully Preset the Test Set"
- "Turn on the GPIB Debugger"
- "Set Test Set's Operating Mode"
- "Set Amplitude Offsets"

### Fully Preset the Test Set

To set up the test set, you begin by sending the *RST command. *RST is used to perform a full preset of the test set, restoring the majority of settings to their default values. *RST also sets all measurements to single trigger. More information about presets is available on the Internet.

```plaintext
300  OUTPUT Testset;"*RST"
310  !
360  OUTPUT Testset;"SYST:COMM:GPIB:DEB:STAT ON"
370  !
380  OUTPUT Testset;"CALL:OPER:MODE CALL"
390  !
420  OUTPUT Testset;"SYST:CORR:FREQ 800MHZ,900MHZ,1900MHZ"
430  OUTPUT Testset;"SYST:CORR -1,-1.1,-1.5"
```
Step 1: Set up the Test Set

Turn on the GPIB Debugger

Another useful tool that you may want to turn on at this time is the GPIB command debugger. While turned on, error messages appear on the test set’s screen when the test set receives an unknown GPIB command. The message contains information about what type of error was caused and indicates where in the syntax the error occurred. Troubleshooting, like locating and fixing typing errors for example, becomes easier using the GPIB command debugger.

NOTE The SYST:COMM:GPIB:DEB:STAT ON command assists you when debugging code. This command should be taken out of your code once development is completed.

Set Test Set’s Operating Mode

The CALL:OPER:MODE command in the diagram is used to set the test set’s operating mode to active cell. This means call processing is used to maintain a link between the test set and the mobile station.

There are also three test mode operating modes available. These modes are useful when you are operating the mobile station in test mode.

Set Amplitude Offsets

You can compensate for fixture loss or cable loss by using the RF IN/OUT port’s amplitude offset parameter. It is possible to set twenty offsets corresponding to twenty frequencies. Use the SYST:CORR:FREQ command to specify frequencies. Then, use the SYST:CORR complex command to set the offset values for the respective frequencies and turn the amplitude state to ON. The amplitude offset for frequencies not specified is determined by linear interpolation.

NOTE The amplitude offset state is not turned OFF when you cycle power or sent the *RST command. Therefore, when you set amplitude offset values in a test set, you must turn this state off either manually or via GPIB if you no longer want to use the offsets.
Step 2: Configure the Test Set and Mobile Station Parameters

This step explains how to:

- “Configure the Control Channel Parameters”
- “Configure the Traffic Channel Parameters”
- “Configure the Mobile Station Parameters”

**NOTE** Many of the parameters configured below are being configured to their default values. In a manufacturing environment it may be desirable to explicitly configure these parameters to ensure that the required settings have not been changed by someone setting a parameter’s value through the test set’s front panel. However, greater code efficiency can be achieved by not configuring them.

**Configure the Control Channel Parameters**

The programming example below illustrates setting the cell power to -75 dBm, specified at the beginning of the program in the variable `Rf_level`, setting the control channel type to a Digital Control Channel (DCCH), setting the DCCH band to the 800MHz band, and specifying the DCCH channel to be 1013.

Many other control channel parameters can also be configured. Refer to the User Documentation, either on the Internet or the CD-ROM, or the GPIB syntax guide for information about these parameters.

500 OUTPUT Testset;"CALL:POW ";Rf_level! Set the cell power to -75 dBm
510 OUTPUT Testset;"CALL:CCH:TYPE DCCH"! Set the Control Channel Type
520 OUTPUT Testset;"CALL:DCCH:BAND CELL"! Set the DCCH band to 800 MHz
530 OUTPUT Testset;"CALL:DCCH 1013" ! Set the DCCH channel to 1013

**Configure the Traffic Channel Parameters**

The example below illustrates how you can set some of the traffic channel parameters. In this example, the traffic channel type is being set to a Digital Traffic Channel (DTC). This command is also used when you want to perform a handoff to an Analog Voice Channel (AVC). The DTC band is set to the 800MHz band and the
Step 2: Configure the Test Set and Mobile Station Parameters

Configure the Mobile Station Parameters

The example below illustrates how to assign mobile station transmit levels. In this example, the mobile station is being assigned to Level 2 for digital tests in both bands and for analog testing.

```
690 OUTPUT Testset;"CALL:SET:MS:DIG:TXL:CELL 2"
700 OUTPUT Testset;"CALL:SET:MS:DIG:TXL:PCS 2"
710 OUTPUT Testset;"CALL:SET:MS:ANAL:TXL 2"
```
Step 3: Set the Measurement Parameters

This step gives an example of how you can configure measurement parameters. Notice both digital and analog measurement parameters can be configured simultaneously. For more information about measurement parameters being configured, refer to the additional details about this step available on the Internet.

```
770   ! Set the trigger to single for all measurements
780   OUTPUT Testset;"SET:CONT:OFF"
790   !
800   ! Configure the Digital Measurements
810   OUTPUT Testset;"SET:DTXP:TIM 3"
820   OUTPUT Testset;"SET:MACC:TIM 3;EVM10:STAT OFF"
830   OUTPUT Testset;"SET:ACP:TIM 3"
840   !
850   ! Configure the Analog Measurements
860   OUTPUT Testset;"SET:FST:TIM 3"
870   OUTPUT Testset;"SET:ATXP:TIM 3"
880   OUTPUT Testset;"SET:FM:TIM 3"
890   OUTPUT Testset;"SET:FM:DIST:STAT ON;FREQ 6000"
900   OUTPUT Testset;"SET:FM:DET PPE"
910   OUTPUT Testset;"SET:FM:FILT TBP"
920   !OUTPUT Testset;"SET:FM:FILT:TBP 6000"
930   !
940   ! Configure the Audio Measurements
950   OUTPUT Testset;"SET:AFAN:FILT CMES;TIM 3;COUN 5;PEAK:VOLT 1"
960   OUTPUT Testset;"SET:AFAN:SDIS:STATE ON;FREQ 1004"
```
Step 4: Make a Connection

There are several ways to establish a connection with the mobile station.

- "Originating a Call from the Mobile Station"
- "Originating a Call from the Test Set"
- "Make a Connection using Test Mode Commands"

Originating a Call from the Mobile Station

The code below illustrates how to make a connection by originating a call with the mobile station.

Synchronization between the control program and the test set is maintained by querying the test set for the state of the connection between it and the mobile station. When a Mobile Station origination occurs, the CALL:CONN? hanging query is used. It will return a 1 when the call is connected and a 0 otherwise. A state change detector is also armed to ensure the query does not stop hanging before the state transition from IDLE to CONNECTed is able to begin. Finally, to prevent the query from hanging indefinitely, which could occur if the mobile station is not turned on, badly broken, or no one pushes the “send” button on the mobile, a timeout is set for this query. In this example, 15 seconds is the value assigned to the timeout. After 15 seconds, the change detector is disarmed and the query returns either a 1 or 0. For more information about call synchronization, refer to the additional information about this step available on the Internet.

1050  PRINT “Turn the phone on now.”
1060  PRINT “When the phone camps on DCCH 1013, press F2 to continue.”
1070  PAUSE
1080  CLEAR SCREEN
1090  PRINT “Originate a call on the Mobile now.”
1100  OUTPUT TestSet;“CALL:CONN:TIM 15”
1110  OUTPUT TestSet;“CALL:CONN:ARM”!Arm Call-State-Change Detector
1120  OUTPUT TestSet;“CALL:CONN?”!Query State
1130  ENTER TestSet;Callstate
1140  IF NOT Callstate THEN Orig_failed

Originating a Call from the Test Set

The code below illustrates how to make a connection by originating a call from the test set.
Step 4: Make a Connection

Synchronization for a test set origination is very similar to that for a mobile station originated call. The primary difference is the default timeout value associated with test set originated events and the automatic arming of the timer when a command is sent to originate an event from the test set.

```
OUTPUT Testset;"CALL:PAG:PNUM '0000574016'" ! Set paging number
OUTPUT Testset;"CALL:PAG:REP ON" ! Set paging repeat state
OUTPUT Testset;"CALL:ORIG" ! Start a base station originated call
OUTPUT Testset;"CALL:CONN?" ! Hanging GPIB query
ENTER Testset;Call_connected      ! Program will hang here until
                                ! origination passes or fails
IF NOT Call_connected THEN
  OUTPUT Test_set;"CALL:END"
  Orig_failed
END IF
```

Make a Connection using Test Mode Commands

When both the mobile station and the test set are operating in test 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.

**NOTE** The method used to synchronize the mobile station with the test set is proprietary to the mobile station manufacturer. The test set has no direct control of synchronization when the mobile station is operating in test mode.
Step 5: INITiate and FETCH Measurements

Step 5: INITiate and FETCH Measurements

- “Digital Measurements”
- “Analog Measurements”
- “Validate Measurement Results”
- “Printing Results”

Digital Measurements

The programming example below illustrates how to make a transmitter and receiver measurement simultaneously. First, set up the test set to begin a mobile-reported receiver measurement. Then initiate and fetch the transmitter measurements. After the transmitter testing is complete, the receiver measurements are queried. These are Mobile Assisted Hand Off (MAHO) values. Performing the digital measurements in this manner allows the mobile receiver measurements to be performed at the same time as the transmitter measurements. You may want to take advantage of opportunities like this to shorten test time and make test code more efficient.

For more information about using INIT:DONE? to perform concurrent measurements, refer to the additional details about the step available on the Internet.

1260 OUTPUT Testset;"CALL:MS:REP:MAHO ON"
1270 OUTPUT Testset;"CALL:POW";Maho_level
1280 !
1290 OUTPUT Testset;"INIT:DTXP;MACC;ACP"
1300 REPEAT
1310 OUTPUT Testset;"INIT:DONE?"
1320 ENTER Testset;Measdone$
1330 SELECT Measdone$
1340 CASE “DTXP”
1350 OUTPUT Testset;”FETC:DTXP?”
1360 ENTER Testset;Integrity,Power
1370 IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1380 Print_res(Measdone$,Power)
1390 CASE “MACC”
1400 OUTPUT Testset;”FETC:MACC?”
1410 ENTER Testset;Integrity,Evm,Ferr,Ooff,Perr,Mag
Step 5: INITiate and FETCH Measurements

1420 IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1430 Print_res(Measdone$,Evm,Ferr,Ooff,Perr,Mag)
1440 CASE "ACP"
1450 OUTPUT Testset;"FETC:ACP?"
1460 ENTER Testset;Integrity,Adjl,Adjh,Alt1l,Alt1h,Alt2l,Alt2h
1470 IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
1480 Print_res(Measdone$,Adjl,Adjh,Alt1l,Alt1h,Alt2l,Alt2h)
1490 END SELECT
1500 UNTIL Measdone$="NONE"
1510 !
1520 OUTPUT Testset;"CALL:MS:REP:MAHO:BERR:NEW?"!First MAHO Report
1530 ENTER Testset;Discard$ !Discard the first mobile report.
1540 OUTPUT Testset;"CALL:MS:REP:MAHO:BERR:NEW?"!Get NEXT MAHO Report
1550 ENTER Testset;Ber$ !These values are more stable than the first
1560 OUTPUT Testset;"CALL:MS:REP:MAHO:RSSI?"
1570 ENTER Testset;Rssi
1580 Print_maho(Ber$,Rssi,Maho_level)
1590 OUTPUT Testset;"CALL:POW \;Rf_level"
1600 OUTPUT Testset;"CALL:MS:REP:MAHO OFF"

Analog Measurements

The example below for analog measurements illustrates the same technique used above for digital measurements. Again, the test set is set up for receiver measurements, allowing the measurements to settle while initiating and fetching transmitter measurements.

For more information about using INIT:DONE? to perform concurrent measurements, refer to the additional details about the step available on the Internet.

1890 OUTPUT Testset;"CALL:FM:INT:STAT ON"
1900 OUTPUT Testset;"CALL:POW \;Sinad_level"
1910 OUTPUT Testset;"INIT:ATXP;FST;AFAN;FM"
1920 REPEAT
1930 OUTPUT Testset;"INIT:DONE?"
1940 ENTER Testset;Measdone$
1950 SELECT Measdone$
1960 CASE "ATXP"
1970 OUTPUT Testset;"FETC:ATXP?"
1980 ENTER Testset;Integrity,Power
1990 IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
Step 5: INITiate and FETCh Measurements

2000 Print_res(Measdone$,Power)
2010 CASE “FST”
2020 OUTPUT Testset;“FETC:FST?”
2030 ENTER Testset;Integrity,Ferr,Freq
2040 IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
2050 Print_res(Measdone$,Ferr,Freq)
2060 CASE “AFAN”
2070 OUTPUT Testset;“FETC:AFAN?”
2080 ENTER Testset;Integrity,Level,Sinad,Dist
2090 IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
2100 Print_res(Measdone$,Level,Dist,Sinad)
2110 CASE “FM”
2120 OUTPUT Testset;“FETC:FM?”
2130 ENTER Testset;Integrity,Dev,Dist
2140 IF Integrity<>0 THEN CALL Bad_measurement(Integrity,Measdone$)
2150 Print_res(Measdone$,Dev,Dist)
2160 END SELECT
2170 UNTIL Measdone$=”NONE”

Validate Measurement Results

Validating measurement results is extremely important. The test set will return a result if it is capable of making a measurement, even if this result is obtained under adverse conditions.

The test set provides an integrity indicator to inform you if any errors occurred during the measurement process. You can query the integrity indicator as a measurement result, using the FETC? query. A value of 0 indicates that the measurement is valid. See your GPIB syntax guide for ways to query the integrity indicator and the User Documentation on the Internet for possible returned values and the error they indicate.

Printing Results

The example below shows how you might create a subroutine to handle processes that are repeated. The variable Meas_name$ is used to pass the name of the measurement to the subroutine. Res1 contains measurement results. Res2, Res3, Res4, Res5, and Res6 can contain measurement results if there are more than one for a particular measurement.

Step 5: INITiate and FETCH Measurements

2430 SELECT Meas_name$
2440 CASE "DTXP"
2450 PRINT USING "5X,""Ave Digital Power:"",5X,M2D.2D,"" dBm"""";Res1
2460 CASE "MACC"
2470 PRINT USING "5X,""Max EVM1:"",14X,M2D.2D,"" %"""";Res1
2480 PRINT USING "5X,""Max Mag. Error:"",8X,M2D.2D,"" %"""";Res5
2490 PRINT USING "5X,""Max Origin Offset:"",5X,M2D.2D,"" dB"""";Res3
2500 PRINT USING "5X,""Max Phase Error:"",7X,M2D.2D,"" Deg"""";Res4
2510 CASE "ACP"
2520 PRINT USING "5X,""ACP Adj Lo:"",12X,M2D.2D,"" dBc"""";Res1
2530 PRINT USING "5X,""ACP Adj Hi:"",12X,M2D.2D,"" dBc"""";Res2
2540 PRINT USING "5X,""ACP Alt1 Lo:"",11X,M2D.2D,"" dBc"""";Res3
2550 PRINT USING "5X,""ACP Alt1 Hi:"",11X,M2D.2D,"" dBc"""";Res4
2560 PRINT USING "5X,""ACP Alt2 Lo:"",11X,M2D.2D,"" dBc"""";Res5
2570 PRINT USING "5X,""ACP Alt2 Hi:"",11X,M2D.2D,"" dBc"""";Res6
2580 CASE "ATXP"
2590 PRINT USING "5X,""Ave Analog Power:"",6X,M2D.2D,"" dBm"""";Res1
2600 CASE "FST"
2610 PRINT USING "5X,""Worst Freq Error:"",5X,M3D.2D,"" ppm"""";Res1
2620 PRINT USING "5X,""Average Freq:"",6X,M3D.2DES2,"" Hz"""";Res2
2630 CASE "FM"
2640 PRINT USING "5X,""SAT Deviation:"",9X,M5D,"" Hz"""";Res1
2650 PRINT USING "5X,""Distortion:"",11X,M3D.2D,"" %"""";Res2
2660 CASE "AFAN"
2670 PRINT USING "5X,""Audio Level:"",11X,M3D.2D,"" V"""";Res1
2680 PRINT USING "5X,""Audio Distortion:"",6X,M3D.2D,"" %"""";Res2
2690 PRINT USING "5X,""SINAD:"",16X,M3D.2D,"" dB"""";Res3
2700 END SELECT
2710 SUBEND
Step 6: Reconfigure Test Set and Mobile Station Parameters

There are multiple ways that you may want to reconfigure the connection parameters. Some examples are:

- “Reconfigure the Connection to a New Channel”
- “Reconfigure the Connection to a New Band”
- “Reconfigure the Connection to a New Traffic Channel Type”
- “Reconfigure the Connection when using Test Mode”

Reconfigure the Connection to a New Channel

The example below illustrates how to change the digital traffic channel to 556. It also illustrates changing the mobile station transmit level to 4. The process used to reconfigure the connection is to first change the parameter settings with CALL:SET commands. These new parameters are activated when the CALL:HAND command is sent. The CALL:STAT:STAT? query is used to ensure that the call is still connected. If the connection is compromised, the subroutine Dropped_call is called.

```
OUTPUT Testset;"CALL:SET:DTC 556"
OUTPUT Testset;"CALL:SET:MS:DIG:TXL 4"
OUTPUT Testset;"CALL:HAND"
!
OUTPUT Testset;"CALL:STAT:STAT?"
ENTER Testset;Call_state$
IF Call_state$<>"CONN" THEN Dropped_call
```

Reconfigure the Connection to a New Band

Again, the process for changing the connection parameters involves using the CALL:SET commands to set the DTC to a new band and then the CALL:HAND command to activate them.

```
1630  OUTPUT Testset;"CALL:SET:DTC:BAND PCS"
1730  !
```
Step 6: Reconfigure Test Set and Mobile Station Parameters

```plaintext
1740  OUTPUT Testset;"CALL:HAND"
1750  OUTPUT Testset;"CALL:STAT:STAT?"
1760  ENTER Testset;Connected$
1770  IF Connected$<>"CONN" THEN
1780     Dropped_call
1790  END IF
```

Reconfigure the Connection to a New Traffic Channel Type

If you want to reconfigure the connection from a DTC to an AVC or from an AVC to a DTC, you must specify the new channel type. The example below illustrates how to reconfigure the connection to an AVC.

```plaintext
1670  OUTPUT Testset;"CALL:TCH:TYPE AVC"
1730  !
1740  OUTPUT Testset;"CALL:HAND"
1750  OUTPUT Testset;"CALL:STAT:STAT?"
1760  ENTER Testset;Connected$
1770  IF Connected$<>"CONN" THEN
1780     Dropped_call
1790  END IF
```

Reconfigure the Connection when using Test Mode

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 or 2 or both. It is not necessary to use the CALL:HAND command used when the mobile station is on an active call.
Step 7: End the Connection

You can end the connection in one of two ways:

- **“Ending the Connection from the Test Set”**
- **“Ending the Connection from the Mobile Station”**

### Ending the Connection from the Test Set

Before you can end the connection, the power level must be returned to its normal level to ensure the mobile station receives the signals to end the call correctly. The CALL:END command is used to end the connection. Here you use the CALL:CONN? query for call synchronization. This query returns a 0 if the call ended successfully and a 1 if the call is not ended.

```
2280  OUTPUT Testset;"CALL:POW \";Rf_level
2290  OUTPUT Testset;"CALL:END"
2300  OUTPUT Testset;"CALL:CONN?"
2310  ENTER Testset;Callstate
2320  IF Callstate=1 THEN
2330    PRINT "Make sure the phone has released the call."
2340    OUTPUT Testset;"SYST:PRES3"
2350  END IF
```

### Ending the Connection from the Mobile Station

Because the connection is being ended from the mobile station, it is important to set a timeout value and arm the change detector. More information about using these commands to achieve call synchronization is available in the additional details about this step available on the Internet.

```
OUTPUT Testset;"CALL:CONN:TIM 5" !Set timeout time to 5 seconds.
OUTPUT Testset;"CALL:CONN:ARM" !Arm the change detector.
DISP "Terminate the call from the mobile station."
OUTPUT Testset;"CALL:CONN?" !Initiate call connect state query.
ENTER Testset;Call_connected !Program will hang here until state change or timer expires.
!
IF Call_connected THEN OUTPUT Testset;"SYST:PRES3"
```
Programming: Getting Started Guide for cdma2000 Mobile Test
Introduction

The Getting Started Guide is organized around the basic set of tasks a control program normally performs when testing a mobile station in a manufacturing environment.

Conventions used in this Getting Started Guide

Throughout this Getting Started Guide the term “test set” refers to an Agilent Technologies 8960 Series 10 wireless communications test set with the E1962B cdma2000 mobile test application installed.

The variable Test_set used in the steps of the Getting Started Guide refers to the test set’s GPIB address.

How to use this Getting Started Guide

The most effective way to use this Getting Started Guide is with the Programming Flowchart included in the front inside pocket of this guide and the 8960 User Documentation. This documentation is found in two locations:

- the 8960 Family Support Site (updated frequently) on the Internet, or
- the User Documentation CD-ROM shipped with your test application.

Each step on the Programming Flowchart is illustrated with example program code in this guide. Using this Getting Started Guide, the Programming Flowchart, and the on-line information about 8960 programming, you will be able to generate a control program to perform fundamental mobile station manufacturing tests.

Useful on-line links

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www.agilent.com/find/8960support/

Navigate to the Programming page for this test application. The illustrations on the back of the Programming Flowchart show you how to navigate to this page.

The following links are under the heading Getting Started on the Programming page:
• Programming: Getting Started Guide
  — This online version of this guide contains links to more detailed information about each step which may be useful as you develop your control program.

• Control Program Examples
  — These examples are for you to download. You may want to use these as templates for your own control program or to execute.
  — The control program explained in the Getting Started Guide is also available here for you to download. It is a fully functional control program.

About the Programming Examples Presented in this Guide

Programming Language:
Programming examples presented in this guide are written in the HP BASIC, also known as RMB or Rocky Mountain BASIC, and C programming languages. The use of HP BASIC is not an endorsement of the HP BASIC product.

Line Numbers
All of the programming examples in the guide with line numbers are sections from a control program example available on-line for you to download.

Code that is not part of the download control program example does not have line numbers. This code may represent an alternate method of performing the task or may illustrate a feature not used by the control program example.

Syntax used in Programming Examples:
• The 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. For the command syntax:
  \[ \text{RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO?} \]
  the shortened form would be:
  \[ \text{RFAN:CONT:MEAS:FREQ:AUTO?} \]
• The programming examples do not include optional nodes. Optional nodes in the command syntax are defined by enclosing the node inside the [ ] brackets. For example, the command syntax:
Programming: Getting Started Guide for cdma2000 Mobile Test

Introduction

CALL[:CELL]:POWER[:AMPLITUDE] -80dBm

appears in the programming examples as:

CALL:POWER -80dBm

- Programming examples make extensive use of compound commands using the ;
  and the ;: separators. Refer to the on-line information for 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 and
minimize GPIB bus transactions.

- The syntax below turns the state of the parameter on.

  OUTPUT Test_set;"SET:CPW:TIM:STAT ON"

- The syntax below is used to assign a value to the parameter.

  OUTPUT Test_set;"SET:CPW:TIM:TIME 10 S"

- Both of the above actions can be accomplished with one syntax command:

  OUTPUT Test_set;"SET:CPW:TIM:STIM 10 S"

  The command above sets the parameter state to ON and 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.

- This command can be shortened further by removing the optional command
  mnemonic :STIME, as shown below.

  OUTPUT Test_set;"SET:CPW:TIM 10 S"

  This is the format that will be used throughout this guide.
Step 1: Set up the Test Set

This step explains how to:

- “Fully Preset the Test Set”
- “Declare Variables, Set Path Losses and Timeouts, Activate GPIB Debugger”

**Fully Preset the Test Set**

To set up the test set, you begin by sending the *RST and *OPC commands along with a global timeout. The *RST command is used to perform a full reset of the test set, returning it to a known state. The *OPC command clears all status registers to assure accurate query functionality.

```
31       CLEAR SCREEN
40       Testset=714
41 !
42 !*****************************************************************
43 ! PRESET TEST SET
44 !*****************************************************************
45 !
46       OUTPUT Testset;"*RST"
47       OUTPUT Testset;"*OPC?"
48       ENTER Testset;Opc$
49 !
```

**Declare Variables, Set Path Losses and Timeouts, Activate GPIB Debugger**

Another useful tool that you may want to turn on at this time is the system command GPIB debugger. When on, error messages appear on the test set’s screen when the test set receives an unknown GPIB command.

```
51 !*****************************************************************
52 ! VARIABLE DECLARATIONS FOR CALL SET UP - MOBILE SPECIFIC
53 !*****************************************************************
54 !
55       Systype$="DIGITAL2000"
60       Band$="USCELLULAR"
```
Step 1: Set up the Test Set

80       Channel=384
81       Handoffchan=500
90       Sid=1
100      Nid=1
110      Radio_config$="F3R3"
120      Service_opt$="SO2"

142 !
143 !*****************************************************************
144 ! SET PATH LOSS VALUES
145 !*****************************************************************
146 !
150       Loss_frequency$=" 851 MHZ, 896 MHZ"
160       Expected_loss$=" -2, -2"
170       OUTPUT Testset;"SYST:CORR:FREQ";Loss_frequency$
180       OUTPUT Testset;"SYST:CORR";Expected_loss$
200 !
210 !*****************************************************************
211 ! SET UP TIMEOUTS
212 !*****************************************************************
213 !
214       ON TIMEOUT 7,20 CALL Timeout
220 !
233 !*****************************************************************
234 ! TURN ON 8960 GP-IB DEBUGGER - COMMENT OUT WHEN DONE DEBUGGING
235 !*****************************************************************
236 !
237       OUTPUT Testset;"SYST:COMM:GPIOB:DEB:STAT ON"
Step 2: Configure Test Set and Mobile Station Parameters

Configure the Test Set Parameters

The programming example below illustrates several cell configurations along with specifications to the setup of the generated code channels.

```
!*****************************************************************
! SET UP CALL PARAMETERS
!*****************************************************************
!
256 DISP "Setting up Test Set Parameters"
257 OUTPUT Testset;"DISP:MODE FAST"
258 OUTPUT Testset;"CALL:OPER:MODE CALL"
259 OUTPUT Testset;"CALL:SYST ";Systype$
260 OUTPUT Testset;"CALL:BAND ";Band$
261 OUTPUT Testset;"CALL:CHAN ";Channel
262 OUTPUT Testset;"CALL:POW -50"
263 OUTPUT Testset;"CALL:SID ";Sid
264 OUTPUT Testset;"CALL:NID ";Nid
265 OUTPUT Testset;"CALL:RCON ";Radio_config$
266 OUTPUT Testset;"CALL:SOFT ";Service_opt$
267 OUTPUT Testset;"CALL:PROT PREV6"
268 OUTPUT Testset;"CALL:PAG:DRAT FULL"
269 OUTPUT Testset;"CALL:PIL -7"
270 OUTPUT Testset;"CALL:SYNC -16"
271 OUTPUT Testset;"CALL:PAG -12"
272 OUTPUT Testset;"CALL:FCH -15.6"
273 !
274 OUTPUT Testset;"SYST:SYNC?"
275 ENTER Testset;Syst_sync$
276
```

Configure the Mobile Station Parameters

There are no mobile station parameters configured in this program example.
Step 3: Set Measurement Parameters

This step gives an example of how you can configure measurement parameters. For more information about measurement parameters, refer to the Introduction to Programming the Agilent Technologies 8960, Step 3.

10 OUTPUT Testset;"SET:CONT OFF"
20 OUTPUT Testset;"SET:WQU:TIM:STIM 10"
30 OUTPUT Testset;"SET:DAP:TIM:STIM 5"
40 OUTPUT Testset;"SET:CPOW:TIM:STIM 5"
50 !
Step 4: Make a connection

Select an example

The mobile station (MS) must be connected with the test set in order to perform measurements. The origination of this connection can either be the mobile station or the test set. Use one of two sections of code below to fit your testing need.

Test Set initiated connection

The following code queries the test set for the connection status and then stops the program if a connection is not established. A hard handoff is also performed.

```
513  !*****************************************************************
514  ! CONNECT CALL
515  !*****************************************************************
516  !
526   !***Page the mobile station***
527   !
528      DISP "Paging mobile station..."
529      OUTPUT Testset;"CALL:ORIG"
530      OUTPUT Testset;"CALL:CONN:STAT?"
531      ENTER Testset;Call_connected
532      IF NOT Call_connected THEN
533          PRINT "Call attempt failed"
534      STOP
535      ELSE
536          PRINT "Call connected"
537          PRINT
538          END IF
539      Tot_timer=TIMEDATE
```

Mobile Station initiated connection

In this case, there is no need to use atimeout or arm the state change detector. These two functions occur automatically when attempting a test set originated call.

```
1 PRINT “Originate a call on the mobile now.”
10 OUTPUT Testset;”CALL:CONN:ARM” !Arm the Call-State-Change Detector
20 OUTPUT Testset;”CALL:CONN?” !Query state
```
Step 4: Make a connection

30 ENTER Testset;Callstate
40 IF NOT Callstae THEN
41 PRINT "Call Attempt Failed"
42 STOP
43 ELSE
44 PRINT "Call Connected"
45 END IF
50 !
Step 5: INITiate and FETCH Measurements

INITiate measurements and FETCH results

Below are examples of performing tests and retrieving their results. Refer to the Introduction to 8960 Programming for more information about the different measurement results that are available and how to fetch them.

!********************
! WAVEFORM QUALITY TEST*
!********************

***Specify test parameters for waveform quality test***

Ior=-75
Pilot=-7
Traffic=-7.4

***Set up measurement parameters***

OUTPUT Testset;"CALL:POW ";Ior
OUTPUT Testset;"CALL:PIL ";Pilot
OUTPUT Testset;"CALL:FCH ";Traffic

***Obtain and display measurement results***

OUTPUT Testset;"SYST:SYNC?"
ENTER Testset;Syst_sync$!
Wqu_timer=TIMEDATE
OUTPUT Testset;"INIT:WQU"
LOOP
OUTPUT Testset;"INIT:DONE?"
ENTER Testset;Meas_done$
EXIT IF Meas_done$="WQU"
END LOOP
OUTPUT Testset;"FETC:WQU?"
ENTER
Testset;Integrity,Rho,Freq_error,Time_error,Carr_feed,Phase_err,Mag_err,Evm
Step 5: INITiate and FETCh Measurements

921 !
930 !***Print Waveform Quality Results
931 !
932 DISP "Waveform Quality Test complete"
933 PRINT "Waveform Quality Test Results:
934 !
935 PRINT "  Integrity indicator = ",Integrity
936 Print_results("Rho = ",Rho,"")
937 Print_results("Frequency error = ",Freq_error,"Hz")
938 Print_results("Time error = ",Time_error,"us")
939 Print_results("Carrier feedthrough = ",Carr_feed,"dBc")
940 Print_results("Phase error = ",Phase_err,"deg")
941 Print_results("Magnitude error = ",Mag_err,"%)"
942 Print_results("Error vector magnitude = ",Evm,"%)"
943 PRINT
944 Wqu_time=PROUND(TIMEDATE-Wqu_timer,-2)
945 PRINT_results("WQU Test Time= ",Wqu_time,"secs")
946 PRINT
947 !
948 !******************************
949 ! FRAME ERROR RATE TEST*
950 !******************************
951 !**Set up measurement parameters**
952 !
953 Ior=-70
954 Pilot=-7
955 Traffic=-15.6
956 !
957 OUTPUT Testset;"CALL:POW ";Ior
958 OUTPUT Testset;"CALL:PIL ";Pilot
959 OUTPUT Testset;"CALL:FCH ";Traffic
960 !
961 !**Obtain measurement results**
962 Fer_timer=TIMEDATE
963 OUTPUT Testset;"INIT:CFER"
964 DISP "Measuring FER"
965 LOOP
966 OUTPUT Testset;"INIT:DONE?"
967 ENTER Testset;Meas_done$
968 EXIT IF Meas_done$="CFER"
Step 5: INITiate and FETCH Measurements

1009    END LOOP
1010    OUTPUT Testset;"FETC:CFER"
1012    ENTER
Testset;Integrity,Fer_test,Fer_ratio,Fer_count,Frames_tested
1013    !
1014    SELECT Fer_test
1015    CASE 0
1016        Pass_fail$="PASSED"
1017    CASE 1
1018        Pass_fail$="FAILED"
1019    CASE 2
1020        Pass_fail$="MAXIMUM NUMBER OF FRAMES WERE TESTED"
1021    CASE 3
1022        Pass_fail$="UNKNOWN"
1023    END SELECT
1024    !
1025    ***Print FER Results***
1026    !
1027    DISP "FER Test complete"
1028    !
1029    PRINT "Frame Error Rate Test Results:
1030    !
1031    PRINT "  Integrity indicator = ",Integrity
1032    Print_res_str("FER Test Results",Pass_fail$)
1033    Print_results("FER Ratio",Fer_ratio,"%")
1034    Print_results("FER Errors Count",Fer_count,"frames")
1035    Print_results("Frames Tested",Frames_tested,"")
1036    PRINT
1037    !
1039    Fer_time=PROUND(TIMEDATE-Fer_timer,-2)
1040    Print_results("FER Test Time= ",Fer_time,"secs")
1041    PRINT
1042    !
1043    ****************************
1044    !Max Power Test*
1045    ****************************
1046    !
1047    ***Set up measurement parameters***
1048    !
1049    Ior=-70
1051    Pilot=-7
1052    Traffic=-7.4
Step 5: INITiate and FETCh Measurements

1053 !
1055 OUT PUT Testset;"CALL:POW ";Ior
1056 OUT PUT Testset;"CALL:PIL ";Pilot
1057 OUT PUT Testset;"CALL:FCH ";Traffic
1058 OUT PUT Testset;"CALL:CLPC:REV:MODE UP"
1060 !***Obtain measurement results***
1061 !
1062 WAIT 1!Settling time
1063 Max_timer=TIMEDATE
1064 OUT PUT Testset;"INIT:DAP"
1065 LOOP
1066 OUT PUT Testset;"INIT: DONE?"
1067 ENTER Testset;Meas_done$
1068 EXIT IF Meas_done$="DAP"
1069 END LOOP
1070 OUT PUT Testset;"FETC:DAP?"
1071 ENTER Testset;Integrity,Avg_power_dbm
1072 !
1073 Avg_power_dbw=Avg_power_dbm-30
1074 !
1075 !***Display measurements if the mobile station did not drop the call***
1076 !
1077 OUT PUT Testset;"CALL:STAT?"
1078 ENTER Testset;Call_status$
1079 IF Call_status$<>"CONN" THEN
1080 PRINT "Mobile station dropped call, invalid results"
1081 END IF
1082 !
1083 !***Print Max Power Test Results
1084 !
1085 DISP "Max Power Test complete"
1086 PRINT "Max Power Test Results:"
1087 !
1088 !
1089 PRINT " Integrity indicator = ",Integrity
1090 Print_results("Maximum Power dBm:" ,Avg_power_dbm,"dBm")
1091 Print_results("Maximum Power dBW:" ,Avg_power_dbw,"dBW")
1095 PRINT
1097 !
1098 Max_time=PROUND(TIMEDATE-Max_timer,-2)
1099 Print_results("Max Power Test Time= ",Max_time,"secs")
Step 5: INITiate and FETCH Measurements

1100 PRINT
1101 !
1102 !***Post Test clean up***
1103 !
1104 OUTPUT Testset;“CALL:CLPC:REV:MODE ACT”
1105 !
1106 !********************
1107 !Minimum Power Test*
1108 !********************
1109 !
1110 !
1111 !***Set up measurement parameters***
1112 !
1113 Ior=-25
1114 Pilot=-7
1115 Traffic=-7.4
1116 !
1117 OUTPUT Testset;“CALL:CONN:DROP:TIM 0”
1118 OUTPUT Testset;“CALL:POW “;Ior
1119 OUTPUT Testset;“CALL:PIL “;Pilot
1120 OUTPUT Testset;“CALL:FCH “;Traffic
1121 OUTPUT Testset;“CALL:CLPC:REV:MODE DOWN”
1122 !
1123 !***Obtain measurement results***
1124 !
1125 WAIT 1
1126 Min_timer=TIMEDATE
1127 LOOP
1128 OUTPUT Testset;“INIT:CPOW”
1129 END LOOP
1130 IF Integrity=6 THEN
1131 OUTPUT Testset;“RFAN:CONT:POW:AUTO OFF”
1132 OUTPUT Testset;“RFAN:MAN:POW “;INT(Channel_power);”
1133 DBM”
Step 5: INITiate and FETCh Measurements

END IF
EXIT IF Meas_done$="CPow" AND Integrity=0
END LOOP
!
***Print measurement results
!
DISP “Min Power Test complete”
PRINT “Min Power Test Results:"
PRINT ” Integrity indicator = ”,Integrity
Print_results(“Maximum Power dBm:”,Channel_power,”dBm/1.23 MHz”)}
PRINT
Min_time=PROUND(TIMEDATE-Min_timer,-2)
Print_results(“Min Power Test Time= “,Min_time,”secs”)}
PRINT
!
***Post Minimum Power Test Cleanup***
!
OUTPUT Testset;”CALL:CLPC:REV:MODE ACT”
OUTPUT Testset;”CALL:CONN:DROP:TIM:STAT 1”
OUTPUT Testset;”RFAN:CONT:POW:AUTO ON”
Step 6: Reconfigure Test Set and Mobile Station Connection Parameters

Reconfigure the Test Set

The example below contains the code appropriate for handing the call off to a different channel.

```c
600    !***Set up a hard handoff***
610       OUTPUT Testset;"CALL:SET:BAND USC"
620       OUTPUT Testset;"CALL:SET:CHAN ";Handoffchan
630 !
640    !***Perform a hard handoff***
650       OUTPUT Testset;"CALL:HAND"
660       OUTPUT Testset;"CALL:CONN:STAT?"
670       ENTER Testset;Call_connected
680       IF NOT Call_connected THEN
690           DISP "Handoff attempt failed, program stopped"
700           STOP
710       ELSE
720           PRINT "Handoff completed"
730           DISP "Call connected"
731           PRINT
740       END IF
784 !
```

Reconfigure the MS

There are no MS parameters reconfigured in this program example.
Step 7: End the Connection

End the Connection

The CALL:END command ends the mobile connection. Subroutines which are called in the program are also shown.

1172 !********************************************************************
1173 ! End of All Testing
1174 !********************************************************************
1175 !
1176 !***End Call and Return to default call processing settings***
1177 !
1178       OUTPUT Testset;"CALL:POW: DIG2000 -50"
1179       OUTPUT Testset;"CALL:END"
1180       OUTPUT Testset;"CALL:STAT: STAT?"
1181       ENTER Testset;Call_status$
1182       PRINT “Call Ended, Status:”,Call_status$
1183       Tot_time=ROUND (TIMEDATE-Tot_timer, -2)
1184       PRINT
1185       Print_results("Test Time=\",Tot_time,”secs")
1186       PRINT
1187       !
1188       !***End Program***
1189       End_program: ! Secondary timeout handler
1190       DISP “End of Program”
1191       END
1192 !
1193 !********************************************************************
1194 ! Subroutine Section*
1195 !********************************************************************
1196 !
1197 Timeout: SUB Timeout
1198       PRINT “Program timed out”
1199       CLEAR 7
1200       CLEAR 714
1201       STOP
1202       SUBEND
1203       Print_results: SUB Print_results(Meas_name$, Res1, Units$)
1204 !
Step 7: End the Connection

1205 PRINT USING
“5X,20A,5X,M4D.2D,1X,5A”;Meas_name$;Res1;Units$
1206 !
1404 SUBEND
1414 Print_res_str: SUB Print_res_str(String_name$,Results$)
1415 !
1424 PRINT USING “5X,20A,5X,20A”;String_name$;Results$
1425 !
1444 SUBEND
Step 7: End the Connection
Programming: Getting Started Guide for:

E1964A GPRS Mobile Test Application

E6701A GPRS Lab Application
Introduction

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Programming examples presented in this guide are written in the HP BASIC programming language, also known as RMB or Rocky Mountain BASIC. The use of HP BASIC is not an endorsement of the HP BASIC product.

Line Numbers
All of the programming examples in the guide with line numbers are sections from a control program example available on-line for you to download.

Code that is not part of the download control program example does not have line numbers. This code may represent an alternate method of performing the task or may illustrate a feature not used by the control program example.

Syntax used in Programming Examples:
• The 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. For the command syntax:
  
  RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO?

  the shortened form would be:
  
  RFAN:CONT:MEAS:FREQ:AUTO?

• The programming examples do not include optional nodes. Optional nodes in the command syntax are defined by enclosing the node inside the [ ] brackets. For example, the command syntax:
E6701A GPRS Lab Application

Introduction

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

appears in the programming examples as:

CALL:POW -80dBm

• Programming examples make extensive use of compound commands using the ;
and the :: separators. Refer to the on-line information for 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 and
minimize GPIB bus transactions.

• The syntax below turns the state of the parameter on.

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

• The syntax below is used to assign a value to the parameter.

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

• Both of the above actions can be accomplished with one syntax command:

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

  The command above sets the parameter state to ON and 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.

• This command can be shortened further by removing the optional command
  mnemonic :STIME, as shown below.

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

  This is the format that will be used throughout this guide.
Step 1: Set up the Test Set

This step explains how to:

- "Fully Preset the Test Set"
- "Turn on the GPIB Debugger"
- "Set Test Set's Operating Mode"

**Fully Preset the Test Set**

To set up the test set, you begin by sending the *RST command. The *RST is used to perform a full preset of the test set, returning it to a known state. *RST also sets all measurements to single trigger.

**Turn on the GPIB Debugger**

Another useful tool that you may want to turn on at this time is the GPIB command debugger. While turned on, error messages appear on the test set's screen when the test set receives an unknown GPIB command. The message contains information about what type of error was caused and indicates where in the syntax the error occurred. Troubleshooting, like locating and fixing typing errors for example, becomes
Step 1: Set up the Test Set

easier using the GPIB command debugger.

NOTE The SYST:COMM:GPIB:DEB:STAT ON command assists you when debugging code. This command should be taken out of your code once development is completed.

Set Test Set’s Operating Mode

The CALL:OPER:MODE command in the diagram is used to set the test set’s operating mode to active cell. This means call processing is used to maintain a link between the test set and the mobile station.

There are also three test mode operating modes available. These test modes are useful when you are operating the mobile station in test mode. See the 8960 Family Support Site on the Internet for more information on test modes.
Step 2: Configure Test Set and Mobile Station Parameters

This step explains how to:

- “Set up data connection synchronization parameters”
- “Configure the Broadcast Channel Parameters”
- “Configure the Packet Data Traffic Channel Parameters”
- “Configure the Mobile Station Operating Conditions”

Set up data connection synchronization parameters

You may choose to set the data connection synchronization timeout parameter at this point in the program. The data connection synchronization command associated with this timeout parameter is used in “Step 4: Make a connection” on page 56 and “Step 7: End the Connection” on page 64.

```
490   OUTPUT Test_set;"CALL:DCON:TIM 10"
```

**NOTE**  Many of the parameters are being configured to their default values. In a manufacturing environment it may be desirable to explicitly configure these parameters to ensure that the required settings have not been changed by someone setting a parameter’s value through the test set’s front panel. However, greater code efficiency can be achieved by not configuring them.

Configure the Broadcast Channel Parameters

The programming example below illustrates configuring the active band to PGSM and setting the cell power to -80 dBm.

```
520   OUTPUT Test_set;"CALL:BAND PGSM" ! Set active broadcast band
530   OUTPUT Test_set;"CALL:POW -80" ! Set cell power to -80 dBm.
```

Configure the Packet Data Traffic Channel Parameters

In the next example, several packet data traffic channel parameters are specified. Note that the PDTCH ARFCN is set to 45. This is on a different ARFCN than the
Step 2: Configure Test Set and Mobile Station Parameters

broadcast channel (20 is the default broadcast channel ARFCN for PGSM), allowing the use of the power reduction levels specified and assigned to the downlink bursts.

550   ! Set the Packet Data Traffic Channel Parameters
560 OUTPUT Test_set;”CALL:PDTCH 45” ! Set packet data traffic channel
570   ! Set Data Connection Type to BLER
580 OUTPUT Test_set;”CALL:FUNC:DATA:TYPE BLER”
590   !
600   ! The following commands are helpful in enabling the test set to
610   ! establish a data connection with mobiles which cannot establish
620   ! a BLER data connection under normal conditions. These are
630   ! commented out. If you wish to use them, remove “!”.  
640   !
650   ! Set the test set to send an invalid FCS to the mobile
660 !OUTPUT Test_set;”CALL:FUNC:DATA:BLER:LLC:FCS CORR”!
670   ! Set the block polling interval used during BLER connection
rate
690   ! Set the type of frame numbering scheme used during attach.
700 !OUTPUT Test_set;”CALL:FUNC:DATA:FRAM:STAR ABS”! Absolute attach
710  !
720   ! Set Multi-slot Configuration to two downlinks and one uplinks.
730 OUTPUT Test_set;”CALL:PDTCH:MSL:CONF D2U1”
740 OUTPUT Test_set;”CALL:PDTCH:CSCH CS2”! Set Coding Scheme to CS2
750  !
760   ! Assign values to the power reduction levels
770 OUTPUT Test_set;”CALL:PDTCH:PZER:LEV 18”  ! Assign a value to P0
780 OUTPUT Test_set;”CALL:PDTCH:PRED:LEV2 6”! Set PRL2 to 6 dB
790   !
800   ! Assign power reduction levels to the downlink bursts
810   ! Assign Burst 2 a PRL of 6 dB
820 OUTPUT Test_set;”CALL:PDTCH:PRED:BURS2 PRL2”

Configure the Mobile Station Operating Conditions

The example below illustrates how to assign mobile station transmit levels to one uplink burst.

850 OUTPUT Test_set;”CALL:PDTCH:MS:TXL:BURS 5”
Step 3: Set Measurement Parameters

This step gives an example of how you can configure measurement parameters. For more information about measurement parameters, refer to the additional details about this step available on the Internet.

910  ! Configure ORFS Measurement:
920  
930  ! The lines below are examples of using complex commands to set
940  ! multi-meas state and count at the same time.
950  OUTPUT Test_set;"SET:ORFS:SWIT:COUN 5"
960  OUTPUT Test_set;"SET:ORFS:MOD:COUN 10"
970  
980  OUTPUT Test_set;"SET:ORFS:TRIG:SOUR AUTO"! Set trig source to AUTO.
990  OUTPUT Test_set;"SET:ORFS:CONT OFF"  ! Set trig mode to single.
1000 OUTPUT Test_set;"SET:ORFS:TIM 60"    ! Set timeout time.
1010  ! Put switching and modulation offsets to be tested into string
1020  ! variables. Swit$ contains switching offsets. Mod$ contains
1030  ! modulation offsets.
1040  Swit$=".4MHZ,-.4MHZ,.6MHZ,-.6MHZ,1.2MHZ,-1.2MHZ,1.8MHZ,-1.8MHZ"
1050  Mod$=".4MHZ,-.4MHZ,.6MHZ,-.6MHZ,1.2MHZ,-1.2MHZ,1.8MHZ,-1.8MHZ"
1060  OUTPUT Test_set;"SET:ORFS:SWIT:FREQ &Swit$"
1070  OUTPUT Test_set;"SET:ORFS:MOD:FREQ &Mod$"
1080  
1090  ! Configure TX Power Measurement:
1100  
1110  OUTPUT Test_set;"SET:TXP:COUN 3;CONT OFF;TIM 20"
1120  OUTPUT Test_set;"SET:TXP:TRIG:SOUR AUTO;QUAL ON"
1130  
1140  ! Configure Phase & Frequency Error Measurement:
1150  
1160  OUTPUT Test_set;"SET:PFER:COUN 8;CONT OFF;TIM 30;SYNC MID"
1170  OUTPUT Test_set;"SET:PFER:TRIG:SOUR AUTO"
1180  
1190  ! Configure BLER Measurement
1200  OUTPUT Test_set;"SET:BLER:COUN 2000;TIM 25"
Step 4: Make a connection

This step explains how to make a connection with the mobile station. The two actions you must perform to accomplish this are:

- "Mobile Station performs a GPRS Attach"
- "Start a Data Connection"

Mobile Station performs a GPRS Attach

The mobile station must initiate a GPRS attach. It is assumed the phone is turned on and is attempting a GPRS attach. The following code queries the test set for the connection status and then stops the program if an attached state is not reached within one minute. This gives adequate time for the mobile station to attach.

Synchronization between the control program and the test set is maintained by querying the test set for the state of the connection between it and the mobile station. When a GPRS Attach is being performed, the CALL:ATT? hanging query is the appropriate query to use. It will return a “1” when the mobile station is attached and a “0” otherwise. A state change detector is also armed to ensure the query does not stop hanging before the state transition from “IDLE” to “ATTached” is able to begin. Finally, to prevent the query from hanging indefinitely, which could occur if the mobile station is not turned on or not sent the correct commands, a timeout is set for this query. In this example, 10 seconds is the value assigned to the timeout. After 10 seconds, the change detector is disarmed and the query returns either a “1” or “0”.

```
1320  DISP "Turn the phone on now. Make the phone perform a GPRS attach."
1330  Start_time=TIMEDATE
1340  LOOP
1350  OUTPUT Test_set;"CALL:DCON:ARM"
1360  OUTPUT Test_set;"CALL:ATT?"
1370  ENTER Test_set;Att_state
1380  EXIT IF Att_state
1390  Current_time=TIMEDATE-Start_time
1400  IF Current_time>=Timer THEN ! Timer value is 1 minute
1410    BEEP
1420  DISP ""
1430  PRINT "GPRS attach did not complete. Program terminated."
```
Step 4: Make a connection

Start a Data Connection

Once the mobile station has successfully attached, you can start the data connection using the \texttt{CALL:FUNC:DATA:STAR} command. The \texttt{CALL:FUNC:DATA:STAR} command is an overlapped command, meaning the test set accepts other commands before completely processing this command. Because this is an overlapped command, synchronization is maintained by using the \texttt{CALL:TRAN?} hanging query. It allows the test set to initiate the data connection and then returns a “1” if the data connection starts successfully and a “0” if the state of the connection returns to either “IDLE” or “ATTached”. Because the test set originated the data connection, it is not necessary to assign a timeout value or arm the change detector for this query. Instead, there is a default timer associated with this query and the change detector is armed automatically.

1490  OUTPUT Test_set;"CALL:FUNC:DATA:STAR"
1500  OUTPUT Test_set;"CALL:TRAN?"
1510  ENTER Test_set;Tran_state
1520  IF NOT Tran_state THEN
1530    DISP ""
1540    DISP “Data connection failed. Trying again.”
1550  OUTPUT Test_set;"CALL:FUNC:DATA:STAR"
1560  OUTPUT Test_set;"CALL:TRAN?"
1570  ENTER Test_set;Tran_state
1580  IF NOT Tran_state THEN
1590    BEEP
1600    DISP ""
1610    PRINT "Data connection failed. Program terminated."
1620  STOP
1630  END IF
1640  DISP “Data connection started sucessfully.”
1650  END IF
Step 5: INITiate and FETCh Measurements

This step explains how to:

- "INITiate a set of measurements"
- "FETCh measurement results"

INITiate a set of measurements

The example below demonstrates how to start four measurements running concurrently.

```
1720  OUTPUT Test_set;"INIT:BLER;ORFS;TXP;PFER"
```

FETCh measurement results

In a typical control program, measurements are repeated on various frequencies and power levels. Therefore, it is desirable to have a subroutine capable of fetching multiple measurement results. The example code below demonstrates how you might create a subroutine for fetching the measurement results. The variable Pdtch contains the ARFCN the measurement is being made on. The variable Ms_pwr_bs1 refers to the current power level assigned to the uplink burst. Refer to the additional details about this step available on the Internet for more information about the different measurement results that are available and how to fetch them.

```
1760  CALL Global_fetch
2920  SUB Global_fetch
2930    OPTION BASE 1
2940    COM /Address/Test_set
2950    OUTPUT Test_set;"CALL:PDTCH:BAND?"
2960    ENTER Test_set;Pdtch_band$
2970    OUTPUT Test_set;"CALL:PDTCH?"
2980    ENTER Test_set;Pdtch
2990    OUTPUT Test_set;"CALL:PDTCH:MS:TXL:BURS?"
3000    ENTER Test_set;Ms_pwr_bs1
3010    OUTPUT Test_set;"CALL:PDTCH:CSCH?"
3020    ENTER Test_set;Cs
3030  !
3040  !  Determine if a measurement is done:
```
Step 5: INITiate and FETCH Measurements

3050  ! LOOP
3060  OUTPUT Test_set;"INIT: DONE?"
3070  ENTER Test_set;Meas_done$
3090  !
3100  Obtain measurement results: Each measurement illustrates a
different way of reading in results. There is no one right way.
The method used is application dependent. Note that the examples
do not show all possible ways.
3140  !
3150  SELECT Meas_done$
3160  !
3170  CASE "TXP"  ! TX Power measurement done.
3180   ALLOCATE Txpower(4)
3190   OUTPUT Test_set;"FETC:TXP:INT?;POW:ALL?"
3200  ENTER Test_set;Integrity,Txpower(*)
3210  IF (Integrity=0) THEN  ! Always check integrity value.
3220   PRINT "TX Power results: ";Pdtch_band$;","Pdtch
3230   PRINT " Burst1 TXL="";Ms_pwr_bs1
3240   PRINT USING "5X,""Minimum:""",M2D.2D,"" dBm"";Txpower(1)
3250   PRINT USING "5X,""Maximum:""",M2D.2D,"" dBm"";Txpower(2)
3260   PRINT USING "5X,""Average:""",M2D.2D,"" dBm"";Txpower(3)
3270   PRINT USING "5X,""Std Dev:""",M2D.2D,"" dB"";Txpower(4)
3280   DEALLOCATE Txpower(*)
3290  ELSE
3300   GOSUB Bad_measurement
3310  END IF
3320  !
3330  CASE "PFER"  ! Phase & Frequency Error measurement done.
3340  OUTPUT Test_set;"FETC:PFER:ALL?"
3350  ENTER Test_set;Integrity,Rms_ph_er,Peak_ph_er,Worst_frq_er
3360  IF (Integrity=0) THEN
3370   PRINT "PFERror results: ";Pdtch_band$;","Pdtch
3380   PRINT " Burst1 TXL="";Ms_pwr_bs1
3390   PRINT "RMS Phase Error: ";Rms_ph_er;" deg"
3400   PRINT "Peak Phase Error: ";Peak_ph_er;" deg"
3410   PRINT "Worst Freq Error: ";Worst_frq_er;" Hz"
3420  ELSE
3430   GOSUB Bad_measurement
3440  END IF
3450  !
3460  CASE "ORFS"  ! ORFS measurement done.

59
Step 5: INITiate and FETCH Measurements

3470 !
3480 ! This code illustrates a more 'generic' approach to reading
3490 ! measurement results. By using the capabilities designed into
3500 ! high-level measurements, routines that access measurement
3510 ! results do not have to explicitly know what the measurement
3520 ! execution conditions were. That information can be determined
3530 ! at the time the measurement results are queried.
3540 !
3550        OUTPUT Test_set;"FETC:ORFS:INT?"    ! Check integrity.
3560        ENTER Test_set;Integrity
3570        IF (Integrity=0) THEN
3580          ! Get the number of offsets tested.
3590          OUTPUT Test_set;"SET:ORFS:SWIT:FREQ:POIN?"
3600          ENTER Test_set;Points
3610          IF Points THEN  ! Only query if one or more offsets tested.
3620            ALLOCATE Swit_res(Points),Swit_offs(Points)
3630            ! Get measurement offsets.
3640            OUTPUT Test_set;"SET:ORFS:SWIT:FREQ?"
3650            ENTER Test_set;Swit_offs(*)
3660            ! Get results
3670            OUTPUT Test_set;"FETC:ORFS:POW?;:FETC:ORFS:SWIT?"
3680            ENTER Test_set;Tx_power,Swit_res(*)
3690            PRINT "ORFS Swit Results: ";Pdtch_band$;"PDTCH="";Pdtch
3700            PRINT "Burst1 TXL="";Ms_pwr_bsl
3710            PRINT USING "19X","";"";Ms_pwr_bsl
3720            PRINT "Offset(kHz) Level(dBm)"
3730            PRINT "--------- "
3740 Orfs_image: IMAGE 6X,M4D.2D,12X,M4D.2D
3750 FOR J=1 TO Points
3760            PRINT USING Orfs_image;(Swit_offs(J)/1.E+3),Swit_res(J)
3770 NEXT J
3780 DEALLOCATE Swit_res(*),Swit_offs(*)
3790 END IF
3800 ! Get the number of offsets tested.
3810 OUTPUT Test_set;"SET:ORFS:MOD:FREQ:POIN?"
3820 ENTER Test_set;Points
3830 IF Points THEN  ! Only query if one or more offsets tested.
3840         ALLOCATE Mod_res(Points),Mod_offs(Points)
3850         ! Get measurement offsets
3860         OUTPUT Test_set;"SET:ORFS:MOD:FREQ?"
3870         ENTER Test_set;Mod_offs(*)
3880         ! Get results
Step 5: INITiate and FETCh Measurements

3890 OUTPUT Test_set; "FETC:ORFS:POW?;FETC:ORFS:MOD?"
3900 ENTER Test_set; Tx_power, Pwr_30khz, Mod_res(*)
3910 PRINT "ORFS Mod Results:"
3920 PRINT "30 KHz BW Power = " Pwr_30khz dBm"
3930 PRINT " Offset (kHz) Level (dB)"
3940 PRINT " Offset(dB) Level(dB)"
3950 FOR J=1 TO Points
3960 PRINT USING Orfs_image; (Mod_offs(J)/1.E+3), Mod_res(J)
3970 NEXT J
3980 DEALLOCATE Mod_res(*), Mod_offs(*)
3990 END IF
4000 ELSE
4010 GOSUB Bad_measurement
4020 END IF
4030 CASE "BLER"
4040 OUTPUT Test_set; "FETC:BLER?"
4050 ENTER Test_set; Integrity, Blocks, Bler, Error_num
4060 IF Integrity=0 THEN
4070 PRINT "BLER results: ", Pdtch="Pdtch"
4080 PRINT " Burst1 TXL=" Ms_pwr_bsl
4090 PRINT " Coding Scheme = ", Cs
4100 PRINT " Number of Blocks: ", Blocks
4110 PRINT " Block Error Rate: ", Bler
4120 PRINT " Number of Blocks in Error: ", Error_num
4130 ELSE
4140 GOSUB Bad_measurement
4150 END IF
4160 END SELECT
4170 EXIT IF Meas_done$="NONE"
4180 END LOOP ! If 'WAIT' is returned from 'INIT:DONE?' query, it
4190 ! just falls through the loop.
4200 SUBEXIT
Step 6: Reconfigure Test Set and Mobile Station Connection Parameters

There are several ways you may want to reconfigure the connection parameters when you reach this step. Some examples are:

- “Reconfigure the Mobile Station Parameters”
- “Reconfigure the connection to a new PDTCH ARFCN”
- “Reconfigure the connection to a new PDTCH ARFCN in a different band”

Reconfigure the Mobile Station Parameters

The example below illustrates how to change the mobile station’s transmit level for burst 1 to level 10. The default burst for this command is burst 1.

```
1830  OUTPUT Test_set;"CALL:PDTCH:MS:TXL:TURES 10"
```

Reconfigure the connection to a new PDTCH ARFCN

When reconfiguring the connection to a new packet data traffic channel ARFCN, you may also want to change other parameters at the same time. In this case, using deferred parameter commands would create the most efficient code. The code below shows how to set a new mobile station TX level, PDTCH ARFCN, and coding scheme with deferred parameter commands, and then use the CALL:HAND command to apply the new parameters. The code also shows you how to use the CALL:STAT:DATA? synchronization command to make sure the connection was maintained. The CALL:STAT:DATA? query returns the current state of the connection. In this case, “TRAN” should be returned, indicating the connection is still in the transferring state and the handover was successful. This query can be used because the CALL:HAND command is sequential, meaning its operation completes before the test set accepts a new command.

```
2000  OUTPUT Test_set;"CALL:SET:PDTCH:MS:TXL:TURES 5"
2010  OUTPUT Test_set;"CALL:SET:PDTCH 120"
2020  OUTPUT Test_set;"CALL:SET:PDTCH:CSCH CS2"
2030  OUTPUT Test_set;"CALL:HAND"
2040  ! Use a call synchronization command to ensure the
2050  ! reconfiguration succeeded.
```
Step 6: Reconfigure Test Set and Mobile Station Connection Parameters

2060 OUTPUT Test_set;"CALL:STAT:DATA?"
2070 ENTER Test_set;Conn_status$
2080 IF Conn_status$<>"TRAN" THEN
2090 PRINT "Data connection failed to reconfigure properly."
2100 PRINT "Program terminated."
2110 STOP
2120 END IF

Reconfigure the connection to a new PDTCH ARFCN in a different band

When configuring the connection to a new band, remember to specify the band for the new mobile station TX level and PDTCH ARFCN. In the code below, DCS has been added to the commands for reconfiguring both these parameters. The result is that those parameters are stored until the DCS band is made active by the CALL:HAND command. If they are not specified as DCS band parameters, they become active immediately.

Note that reconfiguring the connection to a new band uses the same synchronization method as changing to a new PDTCH.

2280 OUTPUT Test_set;"CALL:PDTCH:MS:TXL:DCS:BURS 15"
2290 OUTPUT Test_set;"CALL:PDTCH:DCS 665"
2300 OUTPUT Test_set;"CALL:PDTCH:BAND DCS"
2310 ! Use a call synchronization command to ensure the reconfiguration succeeded.
2320 !
2330 OUTPUT Test_set;"CALL:STAT:DATA?"
2340 ENTER Test_set;Conn_status$
2350 IF Conn_status$<>"TRAN" THEN
2360 PRINT "Data connection failed to reconfigure properly."
2370 PRINT "Program terminated."
2380 STOP
2390 END IF
Step 7: End the Connection

This step explains how to end the connection with the mobile station. The two actions you perform to accomplish this are:

- “End the Data Connection”
- “GPRS Detach”

End the Data Connection

The `CALL:FUNC:DATA:STOP` command ends the data connection. As in “Step 4: Make a connection” on page 56, synchronization with the control program is important. The `CALL:FUNC:DATA:STOP` command is a sequential command, meaning its operation is completed before the test set accepts another command. Therefore, it is only necessary to use the `CALL:STAT:DATA?` query to ensure the data connection has ended and the connection is in the “ATTached” state.

```
2550  OUTPUT Test_set;"CALL:FUNC:DATA:STOP"
2560  OUTPUT Test_set;"CALL:STAT:DATA?"
2570  ENTER Test_set;Conn_status$
2580  IF Conn_status$<>"ATT" THEN
2590    PRINT "Unable to terminate data connection correctly."
2600    PRINT "PROGRAM TERMINATED."
2610    STOP
2620  END IF
```

GPRS Detach

The test set does not require you to perform a GPRS detach. No errors are generated if a GPRS detach is not performed. Therefore, you may choose to remove the tested phone after the data connection has ended.

There are two ways to initiate a GPRS Detach.

- “Initiating the GPRS Detach from the Test Set”
- “Mobile Station initiated GPRS Detach”
Step 7: End the Connection

Initiating the GPRS Detach from the Test Set

The example below illustrates initiating a GPRS Detach from the Test Set.

```
2680  OUTPUT Test_set;"CALL:FUNC:DATA:DET"
2690  !
2700  Start_time=TIMEDATE
2710  LOOP
2720  OUTPUT Test_set;"CALL:DCON:ARM"
2730  OUTPUT Test_set;"CALL:ATT?"
2740  ENTER Test_set;Att_state
2750  EXIT IF NOT Att_state
2760  Current_time=TIMEDATE-Start_time
2770  IF Current_time>=Timer THEN
2780    DISP ""
2790    PRINT "GPRS detach did not occur. Program terminated"
2800    STOP
2810  END IF
2820  IF Conn_state$="DET" THEN
2830    DISP "GPRS detach is in process."
2840  END IF
2850  END LOOP

Mobile Station initiated GPRS Detach

The example below illustrates initiating a GPRS Detach from the mobile station.

```
DISP "Initiate a GPRS Detach"
Start_time=TIMEDATE
LOOP
  OUTPUT Test_set;"CALL:STAT:DATA?"
  ENTER Test_set;Conn_state$
  EXIT IF Conn_state$="IDLE"
  Current_time=TIMEDATE-Start_time
  IF Current_time>=Timer THEN
    DISP ""
    PRINT "GPRS detach did not occur. Program terminated"
    STOP
  END IF
  IF Conn_state$="DET" THEN
    DISP "GPRS detach is in process."
  END IF
END LOOP
```
Step 7: End the Connection
Programming: Getting Started Guide for E1960A GSM Mobile Test Application
Programming: Getting Started Guide for E1960A GSM Mobile Test Application

Introduction

The Getting Started Guide is organized around the basic set of tasks a control program normally performs when testing a mobile station in a manufacturing environment.

Conventions used in this Getting Started Guide

Throughout this Getting Started Guide the term “test set” refers to an Agilent Technologies 8960 Series 10 wireless communications test set with the E1960A GSM mobile test application installed.

The variable Test_set used in the steps of the Getting Started Guide refers to the test set’s GPIB address.

How to use this Getting Started Guide

The most effective way to use this Getting Started Guide is with the Programming Flowchart included inside this guide and the 8960 User Documentation. This documentation is found in two locations:

- the 8960 Family Support Site (updated frequently) on the Internet, or
- the User Documentation CD-ROM shipped with your test application.

Each step on the Programming Flowchart is illustrated with example program code in this guide. Using this Getting Started Guide, the Programming Flowchart, and the on-line information about 8960 programming, you will be able to generate a control program to perform fundamental mobile station manufacturing tests.

Useful on-line links

Go to the 8960 Family Support Site on either the CD-ROM or the Internet. The CD-ROM should self-launch to its home page. The URL for the website is:

www.agilent.com/find/8960support/

Navigate to the Programming page for this test application. The illustrations on the back of the Programming Flowchart show you how to navigate to this page.

The following links are under the heading Getting Started on the Programming page:
Introduction

- Programming: Getting Started Guide
  - This online version of this guide contains links to more detailed information about each step which may be useful as you develop your control program.

- Control Program Examples
  - These examples are for you to download. You may want to use these as templates for your own control program or to execute.
  - The control program explained in the Getting Started Guide is also available here for you to download. It is a fully functional control program.

About the Programming Examples Presented in this Guide

Programming Language:

Programming examples presented in this guide are written in the HP BASIC programming language, also known as RMB or Rocky Mountain BASIC. The use of HP BASIC is not an endorsement of the HP BASIC product.

Line Numbers

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- The 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. For the command syntax:
  
  RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO?

  the shortened form would be:

  RFAN:CONT:MEAS:FREQ:AUTO?

- The programming examples do not include optional nodes. Optional nodes in the command syntax are defined by enclosing the node inside the [ ] brackets. For example, the command syntax:
CALL[:CELL]:POWer[:SAMPlitude] -80dBm

appears in the programming examples as:

CALL:POW -80dBm

- Programming examples make extensive use of compound commands using the ;
  and the :: separators. Refer to the on-line information for 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 and
minimize GPIB bus transactions.

- The syntax below turns the state of the parameter on.
  OUTPUT Test_set;"SET:DTXP:TIM:STAT ON"

- The syntax below is used to assign a value to the parameter.
  OUTPUT Test_set;"SET:DTXP:TIM:TIME 10 S"

- Both of the above actions can be accomplished with one syntax command:
  OUTPUT Test_set;"SET:DTXP:TIM:STIM 10 S"

The command above sets the parameter state to ON and 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.

- This command can be shortened further by removing the optional command
  mnemonic :STIME, as shown below.
  OUTPUT Test_set;"SET:DTXP:TIM 10 S"

This is the format that will be used throughout this guide.
Step 1: Set up the Test Set

This step explains how to:

- "Fully Preset the Test Set"
- "Turn on the GPIB Debugger"
- "Set the Test Set's Operating Mode"

Fully Preset the Test Set

To set up the test set, you begin by sending the *RST command. The *RST is used to perform a full preset of the test set, returning it to a known state. *RST also sets all measurements to single trigger.

Turn on the GPIB Debugger

Another useful tool that you may want to turn on at this time is the GPIB command debugger. While turned on, error messages appear on the test set's screen when the test set receives an unknown GPIB command. The message contains information about what type of error was caused and indicates where in the syntax the error occurred. Troubleshooting, like locating and fixing typing errors for example, becomes easier using the GPIB command debugger.
Step 1: Set up the Test Set

**NOTE** The `SYST:COMM:GPIB:DEB:STAT ON` command assists you when debugging code. This command should be taken out of your code once development is completed.

Set the Test Set's Operating Mode

The `CALL:OPER:MODE` command in the diagram is used to set the test set's operating mode to active cell. This means call processing is used to maintain a link between the test set and the mobile station.

There are also three test mode operating modes available. These test modes are useful when you are operating the mobile station in test mode.
Step 2: Configure Test Set and Mobile Station Parameters

This step explains how to:

- “Configure the Broadcast Channel Parameters”
- “Configure the Traffic Channel Parameters”
- “Configure the Mobile Station Operating Parameters”

**NOTE**
Many of the parameters configured below are being configured to their default values. In a manufacturing environment it may be desirable to explicitly configure these parameters to ensure that the required settings have not been changed by someone setting a parameter’s value through the test set’s front panel. However, greater code efficiency can be achieved by not configuring them.

### Configure the Broadcast Channel Parameters

The example below illustrates how to set up the broadcast channel parameters.

You must deactivate the cell, as shown in line 530 below, before setting the network parameters in line 550. If you do not deactivate the cell, the test set generates the following error:

GSM operation rejected; Attempting to set <MCC|MNC|LAC|NCC|BCC> while generating a BCH.

500 ! Set the broadcast channel parameters
510 OUTPUT Test_set;"CALL:BAND PGSM" ! Set active broadcast band.
520 ! Deactivate cell to set network parameters.
530 OUTPUT Test_set;"CALL:ACT OFF"
540 ! Set network parameters
550 OUTPUT Test_set;"CALL:MCC 1;LAC 1;MNC 1;NCC 1;BCC 5"
560 !
570 OUTPUT Test_set;"CALL:ACT ON" ! Reactivate the cell.
580 OUTPUT Test_set;"CALL:BCH 20" ! Set broadcast channel to 20.
590 OUTPUT Test_set;"CALL:POW -85" ! Set cell power to -85 dBm and
600 ! cell power state to ON with
610 ! a complex command.
Step 2: Configure Test Set and Mobile Station Parameters

Configure the Traffic Channel Parameters

The following example illustrates setting the traffic channel ARFCN and timeslot. Refer to the User Documentation, either on the Internet or the CD-ROM, or the GPIB syntax guide for other traffic channel parameters you can configure.

640    OUTPUT Test_set;"CALL:TCH 45" ! Set traffic channel to 45.
650    OUTPUT Test_set;"CALL:TCH:TSL 4" ! Set timeslot to 4

Configure the Mobile Station Operating Parameters

The example below illustrates how to configure the mobile station's parameters. In this example, you can see how to set the discontinuous transmission state and how to set the mobile station's transmit level.

680    OUTPUT Test_set;"CALL:MS:DTX OFF"! Turn DTX off for all MS tests.
690    OUTPUT Test_set;"CALL:MS:TXL 5" ! Set the MS Transmit Level
Step 3: Set the Measurement Parameters

This step gives an example of how you can configure measurement parameters. For more information about measurement parameters, refer to the additional details about this step available on the Internet.

750 ! Configure ORFS Measurement:
760 !
770 ! The lines below are examples of using complex commands to set
780 ! multi-meas state and count at the same time.
790 OUTPUT Test_set;"SET:ORFS:SWIT:COUN 5"
800 OUTPUT Test_set;"SET:ORFS:MOD:COUN 10"
810 !
820 OUTPUT Test_set;"SET:ORFS:TRIG:SOUR AUTO" ! Set trig source to AUTO.
830 OUTPUT Test_set;"SET:ORFS:CONT OFF" ! Set trig mode to single.
840 OUTPUT Test_set;"SET:ORFS:TIM 60" ! Set timeout time.
850 ! Put switching and modulation offsets to be tested into string
860 ! variables. Swit$ contains switching offsets. Mod$ contains
870 ! modulation offsets.
880 Swit$=".4MHZ,-.4MHZ,.6MHZ,-.6MHZ,1.2MHZ,-1.2MHZ,1.8MHZ,-1.8MHZ"
890 Mod$=".4MHZ,-.4MHZ,.6MHZ,-.6MHZ,1.2MHZ,-1.2MHZ,1.8MHZ,-1.8MHZ"
900 OUTPUT Test_set;"SET:ORFS:SWIT:FREQ &Swit$"
910 OUTPUT Test_set;"SET:ORFS:MOD:FREQ &Mod$"
920 !
930 ! Configure TX Power Measurement:
940 !
950 OUTPUT Test_set;"SET:TXP:COUN 3"
960 OUTPUT Test_set;"SET:TXP:TRIG:SOUR RISE;QUAL ON"
970 OUTPUT Test_set;"SET:TXP:CONT OFF"
980 OUTPUT Test_set;"SET:TXP:TIM 20"
990 !
1000 ! Configure Phase & Frequency Error Measurement:
1010 !
1020 OUTPUT Test_set;"SET:PFER:COUN 8"
1030 OUTPUT Test_set;"SET:PFER:TRIG:SOUR PROT;QUAL ON"
1040 OUTPUT Test_set;"SET:PFER:CONT OFF"
1050 OUTPUT Test_set;"SET:PFER:TIM 30"
1060 OUTPUT Test_set;"SET:PFER:BSYN MID"
**Step 4: Make a Connection**

There are two possible ways to make a connection with the mobile station.

- "Originating a Call from the Test Set"
- "Originating a Call from the Mobile Station"

**Originating a Call from the Test Set**

The code below illustrates how to make a connection by originating a call from the test set.

Synchronization for a test set origination is very similar to that for a mobile station originated call. However, as a programming convenience the test set automatically arms the state change detector with a fixed timeout value of 60 seconds for test set initiated events. Therefore, there is no need for you to specify a timeout value or arm the change detector when originating a call from the test set.

```plaintext
1120  ! Set the paging IMSI
1130  OUTPUT Test_set;"CALL:PAG:IMSI '001012345678901'
1140  OUTPUT Test_set;"CALL:PAG:REP OFF" ! Set the paging repeat state.
1150  !
1170  Tries=1
1250  LOOP
1170  Tries=1
1250  LOOP
1300  OUTPUT Test_set;"CALL:ORIG" ! Originate a call.
1320  ENTER Test_set;Call_connected
1330  ! Program will hang here until origination process completes. If
1340  ! successful and the call is connected the query will return a 1.
1350  ! If unsuccessful and the call is not connected, the query
1360  ! returns 0.
1370  !
1380  EXIT IF Call_connected
1390  OUTPUT Test_set;"CALL:END"
1400  IF Tries=50 THEN
1410    BEEP
1420    DISP ""
1430    PRINT "Call did not connect after";Tries;".";
1440    PRINT "Program terminated."
1450    STOP
```

---

S:\Hp8960\Generic Documents\Programming Getting Started Guide\3.3_program getting started guide\chapters\prog_getting_started_step4.fm
Step 4: Make a Connection

1460   END IF
1470   DISP "Call has not connected after";Tries;"attempts."
1480   Tries=Tries+1
1490  END LOOP

Originating a Call from the Mobile Station

The code below illustrates how to make a connection by originating a call with the mobile station. This code is not included in the control program available on-line for you to download. That example originates the connection from the test set.

Synchronization between the control program and the test set is maintained by querying the test set for the state of the connection between it and the mobile station. When a Mobile Station origination occurs, the CALL:CONN? hanging query is used. It will return a “1” when the call is connected and a “0” otherwise. A state change detector is also armed to ensure the query does not stop hanging before the state transition from “IDLE” to “CONNECTED” is able to begin. Finally, to prevent the query from hanging indefinitely, which could occur if the mobile station is not turned on, badly broken, or no one pushes the “send” button on the mobile, a timeout is set for this query. In this example, 15 seconds is the value assigned to the timeout. After 15 seconds, the change detector is disarmed and the query returns either a “1” or “0”. For more information about call synchronization, refer to the Internet.

OUTPUT Test_set;"CALL:CONN:TIM 15"  ! Set timeout time to 15 seconds
OUTPUT Test_set;"CALL:CONN:ARM"  ! Arm the change detector
OUTPUT Test_set;"CALL:CONN:STAT?"  ! Initiate call connect state query
DISP "Originate call from mobile station."
ENTER Test_set;Call_connected  ! Program will hang here until
    ! origination passes or fails
IF NOT Call_connected THEN
    OUTPUT Test_set;"CALL:END"
    PRINT "Origination failed. Program terminated."
    STOP
END IF
Step 5: INITiate and FETCH Measurements

This step explains how to:

- "INITiate a set of measurements"
- "FETCH measurement results using a subroutine"

**INITiate a set of measurements**

The example below illustrates how to start three measurements running concurrently.

```
1560  ! Start a set of concurrent measurements:
1570  !
1580  OUTPUT Test_set;"INIT;TXP;PFER;ORFS"
```

**FETCH measurement results using a subroutine**

In a typical control program, measurements are repeated on various frequencies and power levels. Therefore, it is desirable to have a subroutine capable of fetching multiple measurement results. The example code below demonstrates how you might create a subroutine for fetching the measurement results. The variable Tch contains the ARFCN the measurement is being made on. The variable Ms_pwr_lvl refers to the current power level assigned to the phone. Refer to the additional details on the Internet for more information about the different measurement results that are available and how to fetch them.

```
2470  SUB Global_fetch
2480   OPTION BASE 1
2490   COM /Address/Test_set
2500   OUTPUT Test_set;"CALL:TCH?:MS:TXL?"
2510   ENTER Test_set;Tch,Ms_pwr_lvl
2520  !
2530  ! Determine if a measurement is done:
2540  !
2550   LOOP
2560   OUTPUT Test_set;"INIT:DONE?"
2570   ENTER Test_set;Meas_done$
2580  !
```
Step 5: INITiate and FETCH Measurements

! Obtain measurement results: Each measurement illustrates a different way of reading in results. There is no one right way. ! The method used is application dependent. Note that the examples ! do not show all possible ways.

SELECT Meas_done$

CASE "TXP" ! TX Power measurement done.
ALLOCATE Txpower(4)
OUTPUT Test_set;"FETC:TXP:INT?;POW:ALL?"
Enter Test_set;Integrity,Txpower(*)
IF (Integrity=0) THEN ! Always check integrity value.
PRINT "TX Power results: TCH=";Tch;"and TXL=";Ms_pwr_lvl
PRINT USING "5X,""Minimum:","M2D.2D,"" dBm"";Txpower(1)
PRINT USING "5X,""Maximum:","M2D.2D,"" dBm"";Txpower(2)
PRINT USING "5X,""Average:","M2D.2D,"" dBm"";Txpower(3)
PRINT USING "5X,""Std Dev:","M2D.2D,"" dB"";Txpower(4)
DEALLOCATE Txpower(*)
ELSE
GOSUB Bad_measurement
END IF

CASE "PFER" ! Phase & Frequency Error measurement done.
OUTPUT Test_set;"FETC:PFER:ALL?"
Enter Test_set;Integrity,Rms_ph_er,Peak_ph_er,Worst_frq_er
IF (Integrity=0) THEN
PRINT "PFERror results: TCH=";Tch;"and TXL=";Ms_pwr_lvl
PRINT "RMS Phase Error: ";Rms_ph_er;" deg"
PRINT "Peak Phase Error: ";Peak_ph_er;" deg"
PRINT "Worst Freq Error: ";Worst_frq_er;" Hz"
ELSE
GOSUB Bad_measurement
END IF

CASE "ORFS" ! ORFS measurement done.

This code illustrates a more 'generic' approach to reading measurement results. By using the capabilities designed into high-level measurements, routines that access measurement results do not have to explicitly know what the measurement execution conditions were. That information can be determined at the time the measurement results are queried.
Step 5: INITiate and FETCh Measurements

3010  !
3020  OUTPUT Test_set;"FETC:ORFS:INT?"  ! Check integrity.
3030  ENTER Test_set;Integrity
3040  IF (Integrity=0) THEN
3050  ! Get the number of offsets tested.
3060  OUTPUT Test_set;"SET:ORFS:SWIT:FREQ:POIN?"
3070  ENTER Test_set;Points
3080  IF Points THEN ! Only query if one or more offsets tested.
3090  ALLOCATE Swit_res(Points),Swit_offs(Points)
3100  ! Get measurement offsets.
3110  OUTPUT Test_set;"SET:ORFS:SWIT:FREQ?"
3120  ENTER Test_set;Swit_offs(*)
3130  ! Get results
3140  OUTPUT Test_set;"FETC:ORFS:POW?;:FETC:ORFS:SWIT?"
3150  ENTER Test_set;Tx_power,Swit_res(*)
3160  PRINT "ORFS Swit Results: TCH=";Tch;" and TXL=";Ms_pwr_lvl
3170  PRINT USING "19X,";"TX Power ="",M2D.2D,"" dBm";";Tx_power
3180  PRINT " Offset(kHz) Level(dBm)"
3190  PRINT " "
3200 Orfs_image: IMAGE 6X,M4D.2D,12X,M4D.2D
3210  FOR J=1 TO Points
3220   PRINT USING Orfs_image;(Swit_offs(J)/1.E+3),Swit_res(J)
3230  NEXT J
3240  DEALLOCATE Swit_res(*),Swit_offs(*)
3250  END IF
3260  ! Get the number of offsets tested.
3270  OUTPUT Test_set;"SET:ORFS:MOD:FREQ:POIN?"
3280  ENTER Test_set;Points
3290  IF Points THEN ! Only query if one or more offsets tested.
3300  ALLOCATE Mod_res(Points),Mod_offs(Points)
3310  ! Get measurement offsets.
3320  OUTPUT Test_set;"SET:ORFS:MOD:FREQ?"
3330  ENTER Test_set;Mod_offs(*)
3340  ! Get results
3350  OUTPUT Test_set;"FETC:ORFS:POW?;:FETC:ORFS:MOD?"
3360  ENTER Test_set;Tx_power,Pwr_30khz,Mod_res(*)
3370  PRINT "ORFS Mod Results: TCH=";Tch;" and TXL=";Ms_pwr_lvl
3380  PRINT "30 KHz BW Power =";Pwr_30khz;" dBm"
3390  PRINT " Offset(kHz) Level(dB)"
3400  PRINT " "
3410  FOR J=1 TO Points
3420   PRINT USING Orfs_image;(Mod_offs(J)/1.E+3),Mod_res(J)
Step 5: INITiate and FETCH Measurements

3430          NEXT J
3440          DEALLOCATE Mod_res(*),Mod_offs(*)
3450          END IF
3460          ELSE
3470            GOSUB Bad_measurement
3480          END IF
3490        END SELECT
3500      EXIT IF Meas_done$="NONE"
3510    END LOOP  ! If ‘WAIT’ is returned from ‘INIT:DONE?’ query, it
3520        ! just falls through the loop.
3530  SUBEXIT
3540 Bad_measurement: !
3550       PRINT “Measurement error: “&Meas_done$
3560       PRINT “Measurement Integrity value =”;Integrity
3570     RETURN
3580   !
3590  SUBEND
Step 6: Reconfigure Test Set and Mobile Station Connection Parameters

There are several ways you may want to reconfigure the connection parameters. Some examples are:

- “Reconfigure the Mobile Station Parameters”
- “Reconfigure the Connection to a New ARFCN”
- “Reconfigure the Connection to a New ARFCN in a Different Band”

Reconfigure the Mobile Station Parameters

The example below illustrates how to change the mobile station’s transmit level. The :SEQuential synchronization command appended to the end of the command ensures that the command has executed before the test set accepts any other commands. This is important because the mobile station needs to have received the command to be on the new power level before transmitter measurements can be made accurately.

1650  ! Assign a new power level to the Mobile Station
1660  OUTPUT Test_set;"CALL:MS:TXL:SEQ 10"

Reconfigure the Connection to a New ARFCN

The example below illustrates how to reconfigure the connection to a new ARFCN. You may also want to change the mobile station transmit level at this time as well. The recommended process for reconfiguring the mobile station transmit level and the ARFCN at the same is shown in the example below.

The example below also shows you how to use the CALL:STAT:STAT? query to determine if the connection was maintained. The CALL:STAT:STAT? query returns the current state of the connection. In this case, “CONN” is returned if the connection is still in the connected state, indicating the handover succeeded. This query can be used in this instance because the :SEQuential command forced the CALL:TCH command to operate sequentially.

1810  OUTPUT Test_set;"CALL:MS:TXL 5"
1820  OUTPUT Test_set;"CALL:TCH:SEQ 120" ! Use :SEQ to force sequential
Step 6: Reconfigure Test Set and Mobile Station Connection Parameters

1830                                      ! execution of the TCH command.
1840  OUTPUT Test_set;"CALL:STAT:STAT?"  ! Verify that the call is still
1850  ENTER Test_set;Call_status$        ! in the connected state after
1860                                      ! handover.
1870  IF Call_status$<>"CONN" THEN
1880  PRINT "Call handover failed. New channel assignment =";Tch
1890  PRINT "Program terminated."
1900  STOP
1910  END IF

Reconfigure the Connection to a New ARFCN in a Different Band

The recommended process for reconfiguring the connection to a new band is illustrated in the example below. DCS is added to the commands for reconfiguring the mobile station transmit level parameter and the TCH ARFCN. This results in the new parameter values being stored until the DCS band is made active by the CALL:TCH:BAND command. If they are not specified as DCS band parameters, they become active immediately.

Note that reconfiguring the connection to a new band uses the same synchronization method as changing to a new TCH ARFCN.

2060  OUTPUT Test_set;"CALL:MS:TXL:DCS 5"
2070  OUTPUT Test_set;"CALL:TCH:DCS 600"
2080  OUTPUT Test_set;"CALL:TCH:BAND DCS"
2090  !
2100  OUTPUT Test_set;"CALL:STAT:STAT?"  ! Verify that the call is still
2110  ENTER Test_set;Call_status$        ! in the connected state after
2120                                      ! handover.
2130  IF Call_status$<>"CONN" THEN
2140  PRINT "Call handover failed. New channel assignment =";Tch
2150  PRINT "Program terminated."
2160  STOP
2170  END IF
Step 7: End the Connection

You can end the connection in one of two ways:

- "Ending the Connection from the Test Set"
- "Ending the Connection from the Mobile Station"

Ending the Connection from the Test Set

When you are ending the connection from the test set use the CALL:END command. The example below illustrates how you use the CALL:CONN:STAT? query for call synchronization. This query returns a “0” if the call ended successfully and a “1” if the call is not ended. It is not necessary for you to arm the change detector or set a change detector timeout when using the test set to terminate a call. The test set automatically arms the change detector and uses a default timeout in this situation.

```
2320 OUTPUT Test_set;"CALL:END"
2330 OUTPUT Test_set;"CALL:CONN:STAT?"
2340 ENTER Test_set;Call_connected
2350 IF Call_connected THEN
2360 BEEP
2370 PRINT "Unable to complete BS termination. Program terminated."
2380 STOP
2390 END IF
```

Ending the Connection from the Mobile Station

When the connection is being ended from the mobile station, it is important to set a timeout value and arm the change detector. More information about using these commands to achieve call synchronization is available in the additional details about this step found on the Internet.

This code is not included in the control program available on-line for you to download. That example ends the connection from the test set.

```
OUTPUT Test_set;"CALL:CONN:TIM 5" !Set timeout time to 5 seconds.
OUTPUT Test_set;"CALL:CONN:ARM" !Arm the change detector.
OUTPUT Test_set;"CALL:CONN:STAT?" !Initiate call connect state query.
DISP "Terminate the call from the mobile station."
ENTER Test_set;Call_connected !Program will hang here until state
```
Step 7: End the Connection

IF Call_connected THEN         !Check if disconnect successful.
  OUTPUT Test_set;"CALL:END"
  PRINT "Call failed to end correctly. Program terminated."
  STOP
END IF
Step 7: End the Connection
Programming: Getting Started Guide for GSM_AMPS/136_GPRS Mobile Test
Introduction

The Getting Started Guide is organized around the basic set of tasks a control program normally performs when testing a mobile station in a manufacturing environment.

How to use the programming flowchart for switching between formats

It is important for you to understand how to utilize the programming flowchart when designing a control program to switch between multiple formats. In steps 1, 2, and 3 of the programming flowchart, you set up the test set and configure parameters for each applicable format all at once. In contrast, you implement steps 4-7 for only one format at a time. Figure 1 on page 89 illustrates in greater detail how to perform these steps for each format. Example code for multiple formats is contained in steps 4-7 of this guide.
Conventions used in this Getting Started Guide

Throughout this Getting Started Guide the term “test set” refers to an Agilent Technologies 8960 Series 10 wireless communications test set with the E1985A GSM_AMPS/136_GPRS mobile test application installed.

The variable Testset used in the steps of the Getting Started Guide refers to the test set’s GPIB address.
Programming: Getting Started Guide for GSM_AMPS/136_GPRS Mobile Test

Introduction

How to use this Getting Started Guide

The most effective way to use this Getting Started Guide is with the Programming Flowchart included inside this guide and the 8960 User Documentation. This documentation is found in two locations:

- the 8960 Series 10 Support Site (updated frequently) on the Internet, or
- the User Documentation CD-ROM shipped with your test application.

Each step on the Programming Flowchart is illustrated with example program code in this guide. Using this Getting Started Guide, the Programming Flowchart, and the on-line information about 8960 programming, you will be able to generate a control program to perform fundamental mobile station manufacturing tests.

Useful on-line links

Go to the 8960 Series 10 Support Site on either the CD-ROM or the Internet. The CD-ROM should self-launch to its home page. The URL for the website is:

http://www.agilent.com/find/8960support/

Navigate to the Programming page for this test application. The illustrations on the back of the Programming Flowchart show you how to navigate to this page.

The following links are under the heading Getting Started on the Programming page:

- Programming: Getting Started Guide
  - This on-line version of this guide contains links to more detailed information about each step which may be useful as you develop your control program.

- Control Program Examples
  - These examples are for you to download. You may want to use these as templates for your own control program or to execute.
  - The control program explained in the Getting Started Guide is also available here for you to download. It is a fully functional control program.
About the Programming Examples Presented in this Guide

Programming Language:
Programming examples presented in this guide are written in the HP BASIC programming language, also known as RMB or Rocky Mountain BASIC. The use of HP BASIC is not an endorsement of the HP BASIC product.

Line Numbers
All of the programming examples in the guide with line numbers are sections from a control program example available on-line for you to download.
Code that is not part of the download control program example does not have line numbers. This code may represent an alternate method of performing the task or may illustrate a feature not used by the control program example.

Syntax used in Programming Examples:
• The 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. For the command syntax:
  
  RFAnalyzer:CONTrol:MEASurement:FREQuency:AUTO?

  the shortened form would be:
  
  RFAN:CONT:MEAS:FREQ:AUTO?

• The programming examples do not include optional nodes. Optional nodes in the command syntax are defined by enclosing the node inside the [ ] brackets. For example, the command syntax:
  
  CALL[:CELL]:POWer[:SAMP]itude] -80dBm

  appears in the programming examples as:
  
  CALL:POW -80dBm

• Programming examples make extensive use of compound commands using the ; and the ;: separators. Refer to the on-line information for the definition and use of these command separators.
Programming: Getting Started Guide for GSM_AMPS/136_GPRS Mobile Test

Introduction

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 and minimize GPIB bus transactions.

- The syntax below turns the state of the parameter on.
  
  OUTPUT Test_set;"SET:DTXP:TIM:STAT ON"

- The syntax below is used to assign a value to the parameter.
  
  OUTPUT Test_set;"SET:DTXP:TIM:TIME 10 S"

- Both of the above actions can be accomplished with one syntax command:
  
  OUTPUT Test_set;"SET:DTXP:TIM:STIM 10 S"

  The command above sets the parameter state to ON and 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.

- This command can be shortened further by removing the optional command mnemonic :STIMe, as shown below.
  
  OUTPUT Test_set;"SET:DTXP:TIM 10 S"

  This is the format that will be used throughout this guide.
Step 1: Set up the Test Set

This step explains how to:

- “Fully Preset the Test Set”
- “Turn on the GPIB Debugger”
- “Select the Active Format”

### Fully Preset the Test Set

To set up the test set, you begin by sending the *RST command. *RST is used to perform a full preset of the test set, returning it to a known state. *RST also sets all measurements to single trigger.

**NOTE** All measurement triggers are set to single in all the test formats supported by the test application when the *RST command is sent.

### Turn on the GPIB Debugger

A useful tool that you may want to turn on at this time is the GPIB command debugger. While turned on, error messages containing debugging information appear on the test set’s screen when the test set receives an unknown GPIB command. The
Step 1: Set up the Test Set

Information indicates what type of error was caused and where in the syntax the error occurred. Troubleshooting, like locating and fixing typing errors for example, becomes easier using the GPIB command debugger.

NOTE This command should be taken out of your code once development is completed. It does increase your test time. The SYST:COMM:GPIB:DEB:STAT ON command only assists you when debugging code.

Select the Active Format

The SYST:APPL:FORM command used in the diagram switches the test set to the correct format. This is a very fast switch because it occurs within the test application. Switches to other test applications use a different command and take much longer. Refer to user documentation on your CD-ROM or the Internet for more information about fast switching.
Step 2: Configure Test Set and Mobile Station Parameters

NOTE Many of the parameters configured in this step are being set to their default values. In a manufacturing environment it may be desirable to explicitly configure these parameters to ensure that the required settings have not been changed by someone setting a parameter’s value through the test set’s front panel. However, greater code efficiency can be achieved by not configuring them.

Configure test set and mobile station parameters

It is possible for you to configure the test set and mobile station parameters for all test formats supported by the test application at the beginning of your program. The following examples illustrate how to set up parameters for all available formats after having selected the GSM format as the active format in “Step 1: Set up the Test Set” on page 93.

- “Set up parameters for GSM”
- “Set up parameters for AMPS/136”
- “Set up parameters for GPRS”

Set up parameters for GSM

Notice the use of the :GSM identifier appended to the CALL:POW:AMPL command. Identifiers are used with commands or queries that are shared by test formats. They enable you to send commands to an inactive test format. Therefore, it is not necessary to use the :GSM format identifier below because GSM is the active test format. It is included here to demonstrate the use of format identifiers.

670  OUTPUT Testset;"CALL:POW:AMPL:GSM ";Gsm_level
680  OUTPUT Testset;"CALL:BAND EGSM"
690  OUTPUT Testset;"CALL:TCH 5;BCH 32;:CALL:MS:TXL 0;TADV 0”

Set up parameters for AMPS/136

Notice the use of the format identifier appended to the CALL:POW:AMPL command. The format identifier for the AMPS/136 Mobile Test format is :TA136. The format
Step 2: Configure Test Set and Mobile Station Parameters

Identifier for the digital system in AMPS/136 format is :DIG136. None of the other commands sent below require this format identifier because they are unique to the AMPS/136 test format.

720 OUTPUT Testset;"CALL:OPER:MODE CALL"
730 OUTPUT Testset;"CALL:POW:AMPL:TA136 \;Tdma_level"
740 OUTPUT Testset;"CALL:DCCH 1013"
750 OUTPUT Testset;"CALL:SET:AVC 387"
760 OUTPUT Testset;"CALL:SET:DTC:BAND CELL"
770 OUTPUT Testset;"CALL:SET:DTC:CHAN:CELL 542"
780 OUTPUT Testset;"CALL:SET:DTC:CHAN:PCS 1000"
790 OUTPUT Testset;"CALL:TCH:TYPE DTC"
800 OUTPUT Testset;"CALL:SET:MS:ANAL:TXL 2"
810 OUTPUT Testset;"CALL:SET:MS:DIG:TXL:CELL 2"
820 OUTPUT Testset;"CALL:SET:MS:DIG:TXL:PCS 2"
830 ! Set up the AVC for the SINAD measurement.
840 ! Turn off the internal FM until connection is on an AVC.
850 OUTPUT Testset;"CALL:FM:INT:STAT OFF;DEV 8KHZ;FREQ 1004HZ"

Set up parameters for GPRS

You can see the use of the format identifier for the GPRS Mobile Test format, :GPRS, in the following example code.

! Configure GPRS parameters
OUTPUT Test_set;"CALL:BAND:GPRS PGSM"! Set broadcast band
OUTPUT Test_set;"CALL:POW:GPRS -80"! Set cell power to -80 dBm.
OUTPUT Test_set;"CALL:PDTCH 45"! Set packet data traffic channel
OUTPUT Test_set;"CALL:FUNC:DATA:TYPE BLER"! Data connection type!
! Set Multi-slot Configuration to two downlinks and one uplink.
OUTPUT Test_set;"CALL:PDTCH:MSL:CONF D2U1"
OUTPUT Test_set;"CALL:PDTCH:CSCH CS4"! Set Coding Scheme to CS4!
! Assign values to the power reduction levels
OUTPUT Test_set;"CALL:PDTCH:PEZER:LEV16"! Assign a value to P0
OUTPUT Test_set;"CALL:PDTCH:PRED:LEV2 6"! Set PRL2 to 6dB!
! Assign power levels to the downlink bursts
OUTPUT Test_set;"CALL:PDTCH:PRED:BURS2 PRL2"
!
! Assign a power level to the uplink burst
OUTPUT Test_set;"CALL:PDTCH:MS:TXL:BURS 5"
Step 3: Set Measurement Parameters

- “Set trigger to single for all measurements”
- “Set measurement parameters”

Set trigger to single for all measurements

You can send either the *RST command, as discussed in “Fully Preset the Test Set” on page 93, or the following command to set the trigger to single for all measurements in all the test formats supported by the test application. In the example below, the command is commented out (by preceding it with an !) because in the control program example utilized throughout this guide, the *RST command is used, making the SET:CONT:OFF command unnecessary. If you choose to not send the *RST command, make sure to uncomment this line.

950 ! OUTPUT Testset;”SET:CONT:OFF”

Set measurement parameters

The most efficient use of a test application supporting multiple test formats is to complete measurement setups at times when the test system is doing something else. This example illustrates setting up measurement parameters for the test formats at the beginning of the program, presumably while a phone is being prepared for RF test.

For more information about the measurement parameters, refer to the additional details about this step available on your CD-ROM or the Internet.

- “Set GSM measurement parameters”
- “Set AMPS/136 measurement parameters”
- “Set GPRS measurement parameters”

Set GSM measurement parameters

For more details about specific GSM measurement parameters, refer to the 8960 User Documentation for the GSM Mobile Test Application available on your CD-ROM or the Internet.
Step 3: Set Measurement Parameters

980  OUTPUT Testset;"SET:PFER:TIM 5;COUN 1"
990  OUTPUT Testset;"SET:PVT:TIM 5;COUN 10"
1000 OUTPUT Testset;"SET:PVT:TIME -28us,-10us,321.2us,552.8us,570.8us"
1010 OUTPUT Testset;"SET:ORFS:TIM 7;COUN:STAT OFF"
1020  
1030  ! This example puts the switching and modulation offsets to be
1040  ! tested into string variables. Mod$ contains the modulation
1050  ! offsets while Swit$ contains the switching offsets.
1060  Mod$="200KHZ,-200KHZ,400KHZ,-400KHZ"
1070  Swit$="400KHZ,-400KHZ,600KHZ,-600KHZ"
1080  OUTPUT Testset;"SET:ORFS:MOD:COUN 10;FREQ "&Mod$
1090  OUTPUT Testset;"SET:ORFS:SWIT:COUN 20;FREQ "&Swit$
1100  OUTPUT Testset;"SET:FBER:COUN 10000"

Set AMPS/136 measurement parameters

For more details about specific AMPS/136 measurement parameters, refer to the
8960 User Documentation for the AMPS/136 Mobile Test Application available on
your CD-ROM or the Internet.

1140  ! Digital Measurement Parameters
1150  OUTPUT Testset;"SET:DTXP:TIM 3;COUN 1"
1160  OUTPUT Testset;"SET:MACC:TIM 3;COUN 1"
1170  OUTPUT Testset;"SET:MACC:EVM10:STAT ON"
1180  OUTPUT Testset;"SET:ACP:TIM 3;COUN 1"
1190  
1200  ! Analog Measurement Parameters
1210  OUTPUT Testset;"SET:FST:TIM 3;COUN 1"
1220  OUTPUT Testset;"SET:ATXP:TIM 3;COUN 10"
1230  OUTPUT Testset;"SET:FM:TIM 3;COUN 1"
1240  OUTPUT Testset;"SET:FM:FREQ:STAT ON"
1250  OUTPUT Testset;"SET:FM:DIST:STAT ON;FREQ 6000"
1260  OUTPUT Testset;"SET:FM:DET PPE"
1270  OUTPUT Testset;"SET:FM:FILT:TBP 6000"
1280  OUTPUT Testset;"SET:FM:FILT TBP"
1290  
1300  ! Audio Measurement Parameters
1310  OUTPUT Testset;"SET:AFAN:FREQ:STAT ON"
1320  OUTPUT Testset;"SET:AFAN:FILT CMES;TIM 3;COUN 5;PEAK:VOLT 1"
1330  OUTPUT Testset;"SET:AFAN:SDIS:STAT ON;FREQ 1004"
Step 3: Set Measurement Parameters

Set GPRS measurement parameters
For more details about specific GPRS measurement parameters, refer to the 8960 User Documentation for the GPRS Mobile Test Application available on your CD-ROM or the Internet.

! Configure ORFS Measurement

Swit$=".4MHZ,-.4MHZ,.6MHZ,-.6MHZ,1.2MHZ,-1.2MHZ,1.8MHZ,-1.8MHZ"
OUTPUT Test_set;"SET:ORFS:SWIT:COUN:GPRS 20"
OUTPUT Test_set;"SET:ORFS:SWIT:FREQ:GPRS "&Swit$ !
! Configure Power vs. Time Measurement for GSM and GPRS:

Pvt$="-28us,-10us,321.2us,552.8us,570.8us"
OUTPUT Test_set;"SET:PVT:TIM:GPRS 10"
OUTPUT Test_set;"SET:PVT:COUN:GPRS 5"
OUTPUT Test_set;"SET:PVT:TIME:GPRS "&Pvt$ !
! Configure Phase & Frequency Error Measurement for GSM and GPRS:

OUTPUT Test_set;"SET:PFER:COUN 10;TIM 5"
OUTPUT Test_set;"SET:PFER:TIM:GPRS 5"
OUTPUT Test_set;"SET:PFER:COUN:GPRS 10"
OUTPUT Test_set;"SET:PFER:SYNC MID;SYNC:GPRS MID"
Step 4: Make a Connection

NOTE For more information about various ways to make a connection with the mobile station, refer to the Programming: Getting Started Guide for the specific mobile test technologies.

In this control program example, a GSM call is established first. After you switch formats at the end of “Step 7: End the Connection” on page 108, it will again be necessary to establish a call. (See the fast switching test application flowchart, Figure 1. on page 89 to see the process for using multiple formats.) Following are code examples for making a connection in different formats.

- “Subroutine for making GSM and AMPS/136 connections”
- “Make a GSM connection”
- “Make an AMPS/136 connection”

Subroutine for making GSM and AMPS/136 connections

A subroutine for making connections is used because this same code is used more than once. This provides greater code efficiency.

The code for the subroutine is below:

```
3870  SUB Orig_call(Format$)
3880    COM INTEGER Testset
3890    PRINT "Turn the ";Format$;" phone on now."
3900    PRINT "When the phone camps, press ‘F2’ to continue."
3910    PAUSE
3920    CLEAR SCREEN
3930    PRINT "Originate a call on the ";Format$;" Mobile now."
3940    OUTPUT Testset;"CALL:CONN:TIM 10"
3950    OUTPUT Testset;"CALL:CONN:ARM"!Arm the Call-State-Change Detector
3960    OUTPUT Testset;"CALL:CONN?"!Query State
3970    ENTER Testset;Callstate
3980    IF NOT Callstate THEN
3990      Orig_failed
4000    END IF
4010  END IF
```
Step 4: Make a Connection

Make a GSM connection
The subroutine to establish the GSM connection is called using the code below.

```plaintext
1390  Orig_call("GSM") ! Subroutine for originating a call from the MS
```

Make an AMPS/136 connection
After performing all GSM measurements, ending the GSM connection, and switching the test set to the AMPS/136 format, you can establish an AMPS/136 connection by calling the subroutine again. See Figure 1. on page 89 illustrates this process for making use of the multiformat capability.

```plaintext
2020  Orig_call("AMPS/136")
```
Step 5: INITiate and FETCH Measurements

This step explains how to:

- “INITiate a set of measurements”
- “FETCH measurement results using a subroutine”
- “Measurement Integrity Indicators”

INITiate a set of measurements

The current active format is GSM. Therefore, GSM measurements are INITiated and FETCHed first. Figure 1. on page 89 diagrams the process for using multiple formats.

- “INITiating GSM measurements”
- “INITiating AMPS/136 measurements”

INITiating GSM measurements

The example below illustrates how to start four GSM measurements running concurrently. The FBER (Fast Bit Error Rate) measurement is a receiver measurement. This makes use of the test set’s ability to make transmitter and receiver measurements at the same time.

```
1510 OUTPUT Testset;"INIT:FBER;PFER;PVT;ORFS"
```

INITiating AMPS/136 measurements

The sections below contain examples illustrating how to start AMPS/136 digital and analog measurements.

Digital

```
2110 OUTPUT Testset;"CALL:MS:REP:MAHO ON"
2120 OUTPUT Testset;"CALL:POW:TA136 ";Maho_level
2130 OUTPUT Testset;"INIT:DTXP;MACC;ACP"
```

Analog

```
2410 OUTPUT Testset;"CALL:FM:INT:STATE ON"
```
Step 5: INITiate and FETCh Measurements

2420 OUTPUT Testset;"CALL:POW ";Sinad_level
2430 OUTPUT Testset;"INIT:ATXP:FST;AFAN;FM"

FETCh measurement results using a subroutine

In a typical control program, measurements are repeated on various frequencies and power levels. Therefore, it is desirable to have a subroutine capable of fetching multiple measurement results. The example code below demonstrates how you might create a subroutine for fetching the measurement results. Refer to the additional details available on your CD-ROM or the Internet for more information about the different measurement results that are available and how to fetch them.

4100 SUB Fetch_results
4110 COM INTEGER Testset
4120 REPEAT
4130 OUTPUT Testset;"INIT:DONE?"
4140 ENTER Testset;Measdone$
4150 SELECT Measdone$
4160 CASE "DTXP"
4170 OUTPUT Testset;"FETC:DTXP?"
4180 ENTER Testset;Integrity,Power
4190 IF Integrity<>0 THEN CALL Bad_integrity(Integrity,Measdone$)
4200 Print_results(Measdone$,Power)
4210 CASE "MACC"
4220 OUTPUT Testset;"FETC:MACC?"
4230 ENTER Testset;Integrity,Evm,Ferr,Ooff,Perr,Mag,Evm10
4240 IF Integrity<>0 THEN CALL Bad_integrity(Integrity,Measdone$)
4250 Print_results(Measdone$,Evm,Ferr,Ooff,Perr,Mag,Evm10)
4260 CASE "ACP"
4270 OUTPUT Testset;"FETC:ACP?"
4280 ENTER Testset;Integrity,Adjl,Adjh,Alt1l,Alt1h,Alt2l,Alt2h
4290 IF Integrity<>0 THEN CALL Bad_integrity(Integrity,Measdone$)
4300 Print_results(Measdone$,Adjl,Adjh,Alt1l,Alt1h,Alt2l,Alt2h)
4310 CASE "ATXP"
4320 OUTPUT Testset;"FETC:ATXP?"
4330 ENTER Testset;Integrity,Power
4340 IF Integrity<>0 THEN CALL Bad_integrity(Integrity,Measdone$)
4350 Print_results(Measdone$,Power)
4360 CASE "FST"
4370 OUTPUT Testset;"FETC:FST?"
4380 ENTER Testset;Integrity,Ferr,Freq
4390 IF Integrity<>0 THEN CALL Bad_integrity(Integrity,Measdone$)
Step 5: INITiate and FETCh Measurements

4400    Print_results(Measdone$, Ferr, Freq)
4410    CASE "AFAN"
4420        OUTPUT Testset;"FETC:AFAN?"
4430        ENTER Testset;Integrity,Level,Sinad,Dist
4440        IF Integrity<>0 THEN CALL Bad_integrity(Integrity, Measdone$)
4450        OUTPUT Testset;"FETC:AFAN:FREQ?"
4460        ENTER Testset;Freq
4470        Print_results(Measdone$, Level, Dist, Sinad, Freq)
4480    CASE "FM"
4490        OUTPUT Testset;"FETC:FM?"
4500        ENTER Testset;Integrity,Dev,Dist,Freq
4510        IF Integrity<>0 THEN CALL Bad_integrity(Integrity, Measdone$)
4520        Print_results(Measdone$, Dev, Dist, Freq)
4530    CASE "PVT"
4540        OUTPUT Testset;"FETC:PVT?"
4550        ENTER Testset;Integrity,Mask,Power,Pvt1,Pvt2,Pvt3,Pvt4,Pvt5
4560        IF Integrity<>0 THEN CALL Bad_integrity(Integrity, Measdone$)
4570        Print_results(Measdone$, Mask, Power, Pvt1, Pvt2, Pvt3, Pvt4, Pvt5)
4580    CASE "PFER"
4590        OUTPUT Testset;"FETC:PFER?"
4600        ENTER Testset;Integrity,Rmsperr,Peakperr,Ferr
4610        IF Integrity<>0 THEN CALL Bad_integrity(Integrity, Measdone$)
4620        Print_results(Measdone$, Rmsperr, Peakperr, Ferr)
4630    CASE "ORFS"
4640        OUTPUT Testset;"FETC:ORFS:INT?"
4650        ENTER Testset;Integrity
4660        IF Integrity<>0 THEN CALL Bad_integrity(Integrity, Measdone$)
4670        OUTPUT Testset;"FETC:ORFS:SWIT?"
4680        ENTER Testset;S1,S2,S3,S4
4690        OUTPUT Testset;"FETC:ORFS:MOD?"
4700        ENTER Testset;Pow_30khz,M1,M2,M3,M4
4710        Print_results(Measdone$, S1,S2,S3,S4,M1,M2,M3,M4,Pow_30khz)
4720    CASE "FBER"
4730        OUTPUT Testset;"FETC:FBER:INT?;RAT?"
4740        ENTER Testset;Integrity,Fber
4750        IF Integrity<>0 THEN CALL Bad_integrity(Integrity, Measdone$)
4760        Print_results(Measdone$, Fber)
4770    END SELECT
4780    UNTIL Measdone$="NONE"
4790    SUBEND
Step 5: INITiate and FETCH Measurements

Measurement Integrity Indicators

When the test set performs a measurement, it always returns a measurement result even when the measurement was made under adverse conditions. Therefore, you should check the measurement integrity indicator value to ensure it is zero. If the value is something other than zero, the returned measurement result is not valid. Refer to the user documentation on your CD-ROM or the Internet for more information about integrity indicators.

3380  SUB Bad_integrity(Integrity,Meas_name$)
3390    IF Integrity<>0 THEN
3400       PRINT "Warning: \";Meas_name$\" Integrity =\";Integrity
3410    END IF
3420  SUBEND
Step 6: Reconfigure Test Set and Mobile Station Connection Parameters

There are several ways you may want to reconfigure the connection parameters. For more information refer to the Programming: Getting Started Guide for the specific mobile test technologies.

The first active format in the control program example is GSM. Figure 1. on page 89 diagrams the process for using multiple formats.

Below are examples of reconfiguring parameters from the control program example for:

- “GSM”
- “AMPS/136”

GSM

Here, the GSM call is reconfigured to a new channel, a new mobile station transmit level, and a new band. The state of the call is checked after the reconfiguration to ensure the call is maintained.

```
1640 OUTPUT Testset;"CALL:TCH 25;:CALL:MS:TXL 0"
1650 OUTPUT Testset;"CALL:TCH:BAND DCS"
1660 OUTPUT Testset;"CALL:STAT?"
1670 ENTER Testset;Callstat$
1680 IF Callstat$<>"CONN" THEN Dropped_call
```

AMPS/136

The code below illustrates using a loop to reconfigure the connection first to a different band and then to an analog voice channel.

```
2220 IF I=1 THEN ! Just did TDMA 800, get ready for TDMA 1900
2230 OUTPUT Testset;"CALL:SET:DTC:BAND PCS"
2240 PRINT ""
2250 PRINT "TDMA PCS Results:"
2260 ELSE ! Done doing TDMA 1900, get ready for Analog
2270 OUTPUT Testset;"CALL:TCH:TYPE AVC"
2280 PRINT ""
```
Step 6: Reconfigure Test Set and Mobile Station Connection Parameters

2290 PRINT “Analog Results:”
2300 END IF
2310 OUTPUT Testset;“CALL:HAND”
2320 OUTPUT Testset;“CALL:STAT?”
2330 ENTER Testset;Callstat$
2340 IF Callstat$<>“CONN” THEN Dropped_call
2350 NEXT I
Step 7: End the Connection

End the connection for GSM and AMPS/136

NOTE For more information about ways to end the connection with the mobile station, refer to the Programming: Getting Started Guide for the specific mobile technologies.

The example below illustrates how to end the connection from the test set. The commands needed to perform this function are the same for both GSM and AMPS/136 formats. They are different for other formats supported by the test application.

```
1780  OUTPUT Testset;"CALL:END"
1790  OUTPUT Testset;"CALL:CONN?"
1800  ENTER Testset;Callstate
1810  IF Callstate=1 THEN
1820   PRINT "Make sure the GSM phone has released the call."
1830   OUTPUT Testset;"SYST:PRES3"
1840  END IF
```

Switch formats

At this point in your control program, you can switch to a new format. The process for using multiple formats of the test application is diagramed in Figure 1 on page 89. The example code below illustrates activating the AMPS/136 format.

```
1960  OUTPUT Testset;"SYST:APPL:FORM 'AMPS/136'"
```

Similarly, to activate the GPRS format, use the following example code.

```
OUTPUT Test_set;"SYST:APPL:FORM 'GPRS'"
```
Step 7: End the Connection

Make a new connection

It is possible for you to begin testing in a new format immediately. All the set up has already been done. Testing can begin by repeating steps 4, 5, and 6 as illustrated in Figure 1. on page 89. To establish the new connection, see “Step 4: Make a Connection” on page 100.
Step 7: End the Connection
Programming: Getting Started Guide for E1963A W-CDMA Mobile Test Application
Introduction

The Getting Started Guide is organized around the basic set of tasks a control program normally performs when testing a mobile station in a manufacturing environment.

Conventions used in this Getting Started Guide

Throughout this Getting Started Guide the term “test set” refers to an Agilent Technologies 8960 Series 10 wireless communications test set with the E1963A W-CDMA mobile test application installed.

The variable TestSet used in the steps of the Getting Started Guide refers to the test set’s GPIB address.

How to use this Getting Started Guide

The most effective way to use this Getting Started Guide is with the Programming Flowchart included in the front inside pocket of this guide and the 8960 User Documentation. This documentation is found in two locations:

- the 8960 Family Support Site (updated frequently) on the Internet, or
- the User Documentation CD-ROM shipped with your test application.

Each step on the Programming Flowchart is illustrated with example program code in this guide. Using this Getting Started Guide, the Programming Flowchart, and the on-line information about 8960 programming, you will be able to generate a control program to perform fundamental mobile station manufacturing tests.

Useful on-line links

Go to the 8960 Family Support Site on either the CD-ROM or the Internet. The CD-ROM should self-launch to its home page. The URL for the website is:

http://www.agilent.com/find/8960support/

Navigate to the Programming page for this test application. The illustrations on the back of the Programming Flowchart show you how to navigate to this page.

The following links are under the heading Getting Started on the Programming page:
Introduction

- Programming: Getting Started Guide
  - This online version of this guide contains links to more detailed information about each step which may be useful as you develop your control program.

- Control Program Examples
  - These examples are for you to download. You may want to use these as templates for your own control program or to execute.
  - The control program explained in the Getting Started Guide is also available here for you to download. It is a fully functional control program.

About the Programming Examples Presented in this Guide

Programming Language:
Programming examples presented in this guide are written in the HP BASIC programming language, also known as RMB or Rocky Mountain BASIC. The use of HP BASIC is not an endorsement of the HP BASIC product.

Line Numbers
All of the programming examples in the guide with line numbers are sections from a control program example available on-line for you to download.

Code that is not part of the download control program example does not have line numbers. This code may represent an alternate method of performing the task or may illustrate a feature not used by the control program example.

Syntax used in Programming Examples:
- The 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. For the command syntax:
  \[ RFANalyzer:CONTrol:MEASurement:FREQuency:AUTO? \]

  the shortened form would be:

  \[ RFAN:CONT:MEAS:FREQ:AUTO? \]

- The programming examples do not include optional nodes. Optional nodes in the command syntax are defined by enclosing the node inside the \([\ ]\) brackets. For example, the command syntax:
Programming: Getting Started Guide for E 1963A W-CDMA Mobile Test Application

Introduction

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

appears in the programming examples as:

CALL:POW -80dBm

Programming examples make extensive use of compound commands using the ;
and the :: separators. Refer to the on-line information for 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 and
minimize GPIB bus transactions.

- The syntax below turns the state of the parameter on.
  OUTPUT Test_set;"SET:DTXP:TIM:STAT ON"

- The syntax below is used to assign a value to the parameter.
  OUTPUT Test_set;"SET:DTXP:TIM:TIME 10 S"

- Both of the above actions can be accomplished with one syntax command:
  OUTPUT Test_set;"SET:DTXP:TIM:STIM 10 S"

  The command above sets the parameter state to ON and 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.

- This command can be shortened further by removing the optional command
  mnemonic :STIME, as shown below.
  OUTPUT Test_set;"SET:DTXP:TIM 10 S"

This is the format that will be used throughout this guide.
Step 1: Set Up the Test Set

In this step you initialize the test set and set up general operating conditions.

- “Initialize the Test Set”
- “Set Up General Operating Conditions”

Initialize the Test Set

Fully Preset the Test Set
It is important to start each production session with the test set in a known state. Sending the *RST command resets all parameters to their default values, ends all measurement processes, and sets all measurement triggers to single.

Clear the Error Queue
At the start of each production session it is useful to clear the error queue so that you know any messages logged are relevant to the current production session.

Programming Example

```
250   ! Fully preset the test set
260   OUTPUT Testset;"*RST"
270   ! Clear the error queue
280   OUTPUT Testset;"*CLS"
```

Set Up General Operating Conditions

Turn Debugger On
The debugger is useful while you are developing code. When it is on, the test set alerts you when you send an incorrect command. You should turn it off once your code is complete.

Set Operating Mode
You must set the operating mode to FDD Test Mode.
Step 1: Set Up the Test Set

Set Amplitude Offsets
You can account for path loss in your system by setting amplitude offsets. You can specify up to 20 frequency/amplitude pairs.

Programming Example

```
320   ! Turn debugger on
330   OUTPUT Testset;"SYST:COMM:GPIB:DEB ON"
340   ! Set operating mode to FDD Test Mode
350   OUTPUT Testset;"CALL:OPER:MODE FDDT"
360   ! Set amplitude offsets
370   OUTPUT Testset;"SYST:CORR:FREQ 800MHZ,900MHZ,1900MHZ,2000MHZ"
380   OUTPUT Testset;"SYST:CORR:SGA -0.7,-0.8,-1.0,-1.1"
```
Step 1: Set Up the Test Set
Step 2: Configure Test Set and Mobile Station Parameters

In this step you configure the parameters that allow a connection to be made between the test set and user equipment.

- “Set Up the Downlink”
- “Set Up the Uplink”

Set Up the Downlink

Set Downlink Power
You must set the downlink power (cell power).

Set Downlink Frequency
You must set the frequency at which the downlink will transmit, by specifying either the channel or the frequency.

To specify the downlink channel, send the following command:

CALL:CHAN <>

If you choose to specify the downlink frequency rather than channel, you must first set control of the downlink output frequency to manual (automatic off), and then set the downlink frequency, as shown in the programming example below.

Set Downlink Primary Scrambling Code
You can set the downlink primary scrambling code.

Set Up Downlink Physical Channels
There are several downlink physical channels and an AWGN (Additive White Gaussian Noise) source which you can configure. You can set the power level of each physical channel (relative to cell power) and the absolute power level of the AWGN source. For some of the physical channels you can also specify the channelization code. You can specify the downlink DPCH type (12.2k RMC is the only option at this time) and data type (such as PRBS15).
**Step 2: Configure Test Set and Mobile Station Parameters**

**Programming Example**

470 ! Set downlink power  
480 OUTPUT Testset;"CALL:POW ";Rf_level  
490 ! Set downlink frequency  
500 OUTPUT Testset;"CALL:CONT:DOWN:FREQ:AUTO OFF"  
510 OUTPUT Testset;"CALL:RFG:FREQ 2.0 GHZ"  
520 ! Set downlink primary scrambling code  
530 OUTPUT Testset;"CALL:SCOD:PRIM 1"  
540 ! Set up DPCH  
550 OUTPUT Testset;"CALL:DPCH:TYP RMC12"  
560 OUTPUT Testset;"CALL:DPCH:RMC12:CCOD CODE9"  
570 OUTPUT Testset;"CALL:FDDT:DPCH -10.3"  
580 OUTPUT Testset;"CALL:DTCH:DATA PRBS15"  
590 ! Set up CPICH  
600 OUTPUT Testset;"CALL:FDDT:CPIC -3.3"  
610 ! Set up P-CCPCH  
620 OUTPUT Testset;"CALL:FDDT:CCPC:PRIM -5.35"  
630 ! Set up PICH  
640 OUTPUT Testset;"CALL:PICH:CCOD CODE16"  
650 OUTPUT Testset;"CALL:FDDT:PICH -8.35"  
660 ! Set up AWGN  
670 OUTPUT Testset;"CALL:AWGN:POW:STAT OFF"

**Set Up the Uplink**

**Set Power Control Bits**

You can specify which closed loop power control bit sequence is sent on the downlink DPCCH.

**Set Expected Uplink Power**

You must specify what uplink power level the test set should expect. You can do this one of two ways.

You can set the MS Target Power (once Active Cell mode is implemented in the test set, this command will force the user equipment to the specified output power. In FDD Test Mode, since the 8960 is not performing active closed loop power control of the uplink, this command does not change the user equipment’s output power). Setting the MS Target Power automatically sets the receiver’s expected power accordingly.
Step 2: Configure Test Set and Mobile Station Parameters

CALL:MS:POW:TARG <>

You can also set the receiver’s expected power by setting control of the expected power to manual (automatic off) and then setting the expected power value, as shown in the programming example below.

Set Expected Uplink Frequency

You must indicate to the 8960 at what frequency the user equipment will transmit. (Unlike other technologies, in W-CDMA the uplink channel is not automatically determined based on the downlink channel. The offset between the uplink and downlink may vary based upon which band class you are operating in. So, you must specify the uplink frequency.) You can specify the expected uplink frequency by channel or by frequency.

To specify the expected uplink channel, send the following command:

CALL:UPL:CHAN <>

If you choose to specify the frequency rather than the channel, you must first set control of the expected frequency to manual (automatic off), and then set the uplink frequency, as shown in the programming example below.

For some testing scenarios you may choose to perform measurements on a frequency other than that which the user equipment is using for its signaling link. To accommodate this, in addition to the commands to set expected uplink channel or frequency, there is a command to set the measurement frequency. To set the measurement frequency you must set measurement frequency control to manual (automatic off) and then set the measurement frequency, as shown in the programming example below. This is only necessary if you want to perform measurements on a frequency other than the uplink channel or frequency.

Set Expected Uplink Primary Scrambling Code

You must indicate to the 8960 what primary scrambling code the user equipment is using.

Programming Example

710   ! Set power control bits to all up to force UE to max power
720   OUTPUT Testset;"CALL:FDDT:CLPC:UPL:MODE UP"
730   ! Set expected uplink power
740   OUTPUT Testset;"RFAN:CONT:POW:AUTO OFF"
750   OUTPUT Testset;"RFAN:MAN:POW:FDD 0"
Step 2: Configure Test Set and Mobile Station Parameters

760 ! Set expected uplink frequency and measurement frequency
770 OUTPUT Testset;"RFAN:CONT:UPL:FREQ:AUTO OFF"
780 OUTPUT Testset;"RFAN:MAN:UPL:FREQ 1.9 GHz"
790 OUTPUT Testset;"RFAN:CONT:MEAS:FREQ:AUTO OFF"
800 OUTPUT Testset;"RFAN:MAN:MEAS:FREQ 1.9 GHz"
810 ! Set expected uplink primary scrambling code
820 OUTPUT Testset;"CALL:UPL:DPCH:SCOD 0"
Step 3: Set Measurement Parameters

In this step you set up measurement parameters. This configures the measurements so that they are ready to execute in step 5.

Many of the measurements have only generic measurement parameters available, such as measurement count, timeout, trigger arm and trigger source.

There is a command available to set all measurement triggers to single (SET:CONT:OFF), which is the recommended trigger arm configuration for remote use of the test set. However, if you sent the *RST command in step 1, all measurement triggers will already be set to single.

Some measurements have measurement-specific parameters available. Consult the programming reference material available on the Internet to find out more about measurement-specific parameters.

**Programming Example**

```
880  ! Set all measurement triggers to single
890  OUTPUT Testset;"SET:CONT:OFF"
900  ! Set up thermal power
910  OUTPUT Testset;"SET:WTP:TIM 3;COUN 1"
920  ! Set up channel power
930  OUTPUT Testset;"SET:WCP:TIM 3;COUN 1;TRIG:SOUR IMM"
940  OUTPUT Testset;"SET:WCP:INT:TIME 10 MS"
950  ! Set up waveform quality
960  OUTPUT Testset;"SET:WWQ:TIM 3;COUN 1;TSL 1"
970  ! Set up ACIR
980  OUTPUT Testset;"SET:WACL:TIM 3;COUN 1;TRIG:SOUR IMM"
990  ! Set up Loopback BER
1000 OUTPUT Testset;"SET:WBER:TIM 10;COUN 15000"
```
Step 4: Make a Connection

In this step you establish communication between the test set and user equipment such that measurements can be made.

When the test set is operating in FDD Test Mode, you do not send any commands to the test set for this step. From the previous steps, the test set should already be properly configured and transmitting its downlink signal so that the user equipment can detect and synchronize to it. In this step you either implement a pause in your program and wait for the user equipment to be manually configured and begin transmitting, or send appropriate test mode commands to configure the user equipment and begin its transmission.

During this step, the user equipment must begin transmission of a 12.2k RMC DPCH at the proper power level, frequency and primary scrambling code. It must be synchronized to the test set for waveform quality and transmit in loopback mode 1 for loopback BER.

Programming Example

```plaintext
1060 PRINT "Configure UE for 12.2k RMC Now."
1070 PRINT
1080 PRINT "UE Synchronization required for Waveform Quality."
1090 PRINT "UE loopback Mode 1 required for loopback BER."
1100 PRINT
1110 PRINT "8960 DL is 2.0 GHz"
1120 PRINT "8960 UL Expected Frequency: 1.9 GHz"
1130 PRINT "8960 UL Expected Power: 0 dBm"
1140 PRINT "8960 UL Expected Primary Scrambling Code: 0"
1150 PRINT
1160 PRINT "When UE is configured and transmitting, press 'F2'."
1170 PAUSE
```
Step 5: INITiate and FETCH Measurements

In this step you INITiate measurements, FETCH the results, and verify the results are valid.

- "INITiate a Set of Concurrent Measurements"
- "FETCH Measurement Results"

INITiate a Set of Concurrent Measurements

The test set is capable of performing concurrent measurements. To start the measurement process you INITiate a set of concurrent measurements.

FETCH Measurement Results

To retrieve measurement results as they complete, you must set up a loop using the INIT:DONE? query. Depending upon the output of the query, the program will either wait for a measurement to complete, FETCH the result of a completed measurement, or continue the program once all measurements are complete. Once a measurement result is FETCHed, you should check its integrity indicator to verify that the result is valid.

Programming Example

1280  ! INITiate a set of concurrent measurements
1290    OUTPUT Testset;"INIT:WTP;WWQ;WACL;WBER"
1300  ! FETCH the measurement results (using a subroutine)
1310    Fetch_results
1780  SUB Fetch_results
1790    REPEAT
1800  ! Determine if any measurements are done
1810      OUTPUT 714;"INIT:DONE?"
1820      ENTER 714;Measdone$
1830      SELECT Measdone$
1840      CASE "WTP"
1850  ! FETCH measurement result
1860      OUTPUT 714;"FETCH:WTP:INT?;POW?"
1870      ENTER 714;Integrity,Power
Step 5: INITiate and FETCH Measurements

1880 ! Verify measurement result is valid
1890 IF Integrity=0 THEN
1900 ! For valid result, print result to screen (using a subroutine)
1910   Print_results(Measdone$,Power)
1920 ELSE
1930 ! For invalid result, invoke error handler (using a subroutine)
1940   Meas_error(Measdone$,Integrity)
1950 END IF
1960 CASE "WCP"
1970   OUTPUT 714;"FETC:WCP:INT?;POW?"
1980   ENTER 714;Integrity,Power
1990 IF Integrity=0 THEN
2000   Print_results(Measdone$,Power)
2010 ELSE
2020   Meas_error(Measdone$,Integrity)
2030 END IF
2040 CASE "WWQ"
2050   OUTPUT 714;"FETC:WWQ?"
2060   ENTER 714;Integrity,Evm,Ferr,Ooff,Perr,Merr
2070 IF Integrity=0 THEN
2080   Print_results(Measdone$,Evm,Ferr,Ooff,Perr,Merr)
2090 ELSE
2100   Meas_error(Measdone$,Integrity)
2110 END IF
2120 CASE "WACL"
2130   OUTPUT 714;"FETC:WACL:INT?;AVER?"
2140   ENTER 714;Integrity,Negfive,Posfive,Negten,Postsen
2150 IF Integrity=0 THEN
2160   Print_results(Measdone$,Negfive,Posfive,Negten,Postsen)
2170 ELSE
2180   Meas_error(Measdone$,Integrity)
2190 END IF
2200 CASE "WBER"
2210   OUTPUT 714;"FETC:WBER?:WBER:INT?"
2220   ENTER 714;Ber,Integrity
2230 IF Integrity=0 THEN
2240   Print_results(Measdone$,Ber)
2250 ELSE
2260   Meas_error(Measdone$,Integrity)
2270 END IF
2280 END SELECT
2290 ! Exit loop when all measurements are complete
Step 5: INITiate and FETCh Measurements

2300    UNTIL Measdone$="NONE"
2310    SUBEND
Step 6: Reconfigure Test Set and Mobile Station Connection Parameters

In this step you change characteristics of the link between the test set and user equipment.

For example, to change the uplink frequency, you must pause the program to wait for the user equipment to be configured to transmit at the new frequency. You must also change the expected uplink frequency and measurement frequency accordingly, as shown in the programming example below.

If you change the test set configuration, such as downlink frequency or primary scrambling code, you must configure the test set and then allow the user equipment to find the new configuration and synchronize to it before proceeding with measurements.

Programming Example

1410 PRINT "Change UE UL Frequency to 1.850 GHZ."
1420 PRINT
1430 PRINT "UE Synchronization required for Waveform Quality."
1440 PRINT "UE loopback Mode 1 required for loopback BER."
1450 PRINT
1460 PRINT "When UE is configured and transmitting, press 'F2'."
1470 PAUSE
1480 ! Change expected uplink frequency
1490 OUTPUT Testset;"RFAN:MAN:MEAS:FREQ 1.85 GHZ"
1500 OUTPUT Testset;"RFAN:MAN:UPL:FREQ 1.85 GHZ"
Step 7: End the Connection

In this step you end the communication between the test set and user equipment, and prepare for the next program action.

Once you have ended the user equipment transmission, to prepare for testing the next user equipment, you should partially preset the test set. This stops all measurement processes but does not reset all parameters to their default values. That way you do not need to reset the parameters which are constant for all user equipment in the test batch.

Programming Example

1630 PRINT “Testing complete, end UE transmission.”
1640 ! Partially preset the test set
1650 OUTPUT Testset;”SYST:PRES3”