HP 83201B TDMA Cellular Adapter

User Guide

HP Part No. 83201-90034
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Rev. C

Notice

Information contained in this document is subject to change without notice.

Hewlett-Packard Company
Learning Products Department
24001 E. Mission
Liberty Lake, WA 99019-9599
U.S.A.

Manufacturer's Declaration

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

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

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

Herstellerbescheinigung

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

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

Safety Considerations

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

SAFETY EARTH GROUND

A uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

CHASSIS GROUND TERMINAL

To prevent a potential shock hazard, always connect the rear-panel chassis ground terminal to earth ground when operating this instrument from a dc power source.

SAFETY SYMBOLS


Indicates instrument damage can occur if indicated operating limits are exceeded.


Indicates hazardous voltages.


Indicates earth (ground) terminal

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

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

Safety Considerations for this Instrument

WARNING:

This product is a Safety Class 1 instrument (provided with a protective earthing ground incorporated in the power cord) The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

If this instrument is to be energized via an autotransformer (for voltage reduction), make sure the common terminal is connected to the earth terminal of the power source.

If this product is not used as specified, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for proctection are intact) only.

No operator serviceable parts in this product. Refer servicing to qualified personnel. To prevent electrical shock, do not remove covers.

Servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing unless you are qualified to do so.

The opening of covers or removal of parts is likely to expose dangerous voltages. Disconnect the product from all voltage sources while it is being opened.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

The power cord is connected to internal capacitors that my remain live for 5 seconds after disconnecting the plug from its power supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250 V fuse(s) or the same current rating and type (for example, normal blow or time delay). Do not use repaired fuses or short circuited fuseholders.

WARNING:

Always use the three-prong ac power cord supplied with this product. Failure to ensure adequate earth grounding by not using this cord may cause product damage

This product is designed for use in Installation Category II and Pollution Degree 2 per IEC 1010 and IEC 664 respectively. For indoor use only.

To prevent electrical shock, disconnect instrument from mains (line) before cleaning. Use a dry cloth or one slightly dampened with water to clean the external case parts. Do not attempt to clean internally.

This product has autoranging line voltage input, be sure the supply voltage is within the specified range.

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

Product Markings

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

CSA - the CSA mark is a registered trademark of the Canadian Standards Associaton

Sales and Service Offices

Table 1 Regional Sales and Service Offices

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Southern USA Sales and Service Hewlett-Packard Company 1995 North Park Place Atlanta, GA 30339 Sales Tel: (404) 955-1500 Fax: (404) 980-7292 Service Tel: (404) 850-2544 Fax: (404) 980-7292	Southern USA Service Center Hewlett-Packard Company 930 E. Campbell Road Richardson, TX 75081 Tel: (214) 699-4331	Western USA Service Center Hewlett-Packard Company 301 E. Evelyn Avenue Mountain View, CA 94041 Tel: (415) 694-2000 Fax: (415) 694-0601
Western USA Sales and Service Hewlett-Packard Company 24 Inverness Place East Englewood, CO 80112 Sales Tel: (303) 649-5000 Fax: (303) 649-5787 Service Tel: (303) 649-5512 Fax: (303) 649-5787	Western USA Sales and Service Hewlett-Packard Company 1421 South Manhattan Avenue Fullerton, CA 92631 Sales Tel: (714) 999-6700 Fax: (714) 778-3033 Service Tel: (714) 758-5490 Fax: (714) 778-3033	United States of America Customer Information Center Hewlett-Packard Company Tel: (800) 752-0900 6:00 am to 5:00 pm Pacific Time Parts Direct: 1-800-227-8164

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Australia, New Zealand Sales and Service Hewlett-Packard Ltd. P.O. Box 221 31-41 Joseph Street Blackburn, Victoria 3130 Telephone: (61/3) 895-2895 Fax: (61/3) 898-9257	Canada Sales and Service Hewlett-Packard (Canada) Ltd. 5150 Spectrum Way Mississauga, Ontario L4W 5G1 Canada Telephone: (416) 206-4725 Fax: (416) 206-4739	Canada Service Center Hewlett-Packard Company 17500 Transcanada Highway S. Serv Road Kirkland, Quebec H9J 2X8 Canada Telephone: (416) 206-3295
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CERTIFICATION

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

Hewlett-Packard Warranty Statement for Commercial Products

HP 83201B TDMA Cellular Adapter

Duration of Warranty: 1 Year

1. HP warrants HP hardware, accessories and supplies against defects in materials and workmanship for the period specified above. If HP receives notice of such defects during the warranty period, HP will, at its option, either repair or replace products which prove to be defective. Replacement products may be either new or like-new.

2 HP warrants that HP software will not fail to execute its programming instructions, for the period specified above, due to defects in material and workmanship when properly installed and used. If HP receives notice of such defects during the warranty period, HP will replace software media which does not execute its programming instructions due to such defects.

3. HP does not warrant that the operation of HP products will be uninterrupted or error free. If HP is unable, within a reasonable time, to repair or replace any product to a condition as warranted, customer will be entitled to a refund of the purchase price upon prompt return of the product.

4 HP products may contain remanufactured parts equivalent to new in performance or may have been subject to incidental use.

5. The warranty period begins on the date of delivery or on the date of installation if installed by HP. If customer schedules or delays HP installation more than 30 days after delivery, warranty begins on the 31st day from delivery.

6 Warranty does not apply to defects resulting from (a) improper or inadequate maintenance or calibration, (b) software, interfacing, parts or supplies not supplied by HP, (c) unauthorized modification or misuse, (d) operation outside of the published environmental specifications for the product, or (e) improper site preparation or maintenance.

7 TO THE EXTENT ALLOWED BY LOCAL LAW, THE ABOVE WARRANTIES ARE EXCLUSIVE AND NO OTHER WARRANTYOR CONDITION, WHETHER WRITTEN OR ORAL IS EXPRESSED OR IMPLIED AND HP SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OR CONDITIONS OR MERCHANTABILITY, SATISFACTORY QUALITY, AND FITNESS FOR A PARTICULAR PURPOSE.

8 HP will be liable for damage to tangible property per incident up to the greater of $300,000 or the actual amount paid for the product that is the subject of the claim, and for damages for bodily injury or death, to the extent that all such damages are determined by a court of competent jurisdiction to have been directly caused by a defective HP product.

9. TO THE EXTENT ALLOWED BY LOCAL LAW, THE REMEDIES IN THIS WARRANTY STATEMENT ARE CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES. EXCEPT AS INDICATED ABOVE, IN NO EVENT WILL HP OR ITS SUPPLIERS BE LIABLE FOR LOSS OF DATA OR FOR DIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL (INCLUDING LOST PROFIT OR DATA), OR OTHER DAMAGE, WHETHER BASED IN CONTRACT, TORT, OR OTHERWISE.

FOR CONSUMER TRANSACTIONS IN AUSTRALIA AND NEW ZEALAND: THE WARRANTY TERMS CONTAINED IN THIS STATEMENT, EXCEPT TO THE EXTENT LAWFULLY PERMITTED, DO NOT EXCLUDE RESTRICT OR MODIFY AND ARE IN ADDITION TO THE MANDATORY STATUTORY RIGHTS APPLICABLE TO THE SALE OF THIS PRODUCT TO YOU.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products. For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

DECLARATION OF CONFORMITY

according to ISO/IEC Guide 22 and EN 45014

Manufacturer's Name:	**Hewlett-Packard Co.**
Manufacturer's Address:	**Spokane Division** **24001 E. Mission Avenue** **Liberty Lake, Washington 99019-9599** **USA**

declares that the product

Product Name:	Dual Mode/TDMA Cellular Adapter
Model Number:	HP 83201A and B
Product Options:	This declaration covers all options of the above product.

conforms to the following Product specifications:

Safety: IEC 1010-1990+A1 / EN 61010-1:1993

EMC: CISPR 11:1990/EN 55011:1991 Group 1, Class A
EN 50082-1 : 1992
IEC 801-2:1981 - 4 kV CD, 8 kV AD
IEC 801-3:1984 - 3V/m
IEC 801-4:1988 - 0.5 kV Sig. Lines, 1 kV Power Lines

Supplementary Information:

This product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC and carries the CE-marking accordingly .

Spokane, Washington USA November 5, 1996
Date

Vince Roland/Quality Manager

European Contact: Your local Hewlett-Packard Sales and Service Office or Hewlett-Packard GmbH
Department ZQ/Standards Europe, Herrenberger Strasse 130, D-71034 Böblinger, Germany (FAX+49-7031-14-3143)

In this Book

Chapter 1, *Screen Descriptions*, contains information about each control and measurement on the Test Set's TDMA, PDC, and PHP test screens.

Chapter 2, *Connectors, Indicators, and Fuse*, describes the function and operating characteristics of the Cellular Adapter's connectors.

Chapter 3, *HP-IB Syntax*, contains syntax diagrams for remote programming reference.

Chapter 4, *Specifications*, lists specifications for the Test System's TDMA generator and TDMA analyzer. (The Test System is the Test Set and Cellular Adapter together.)

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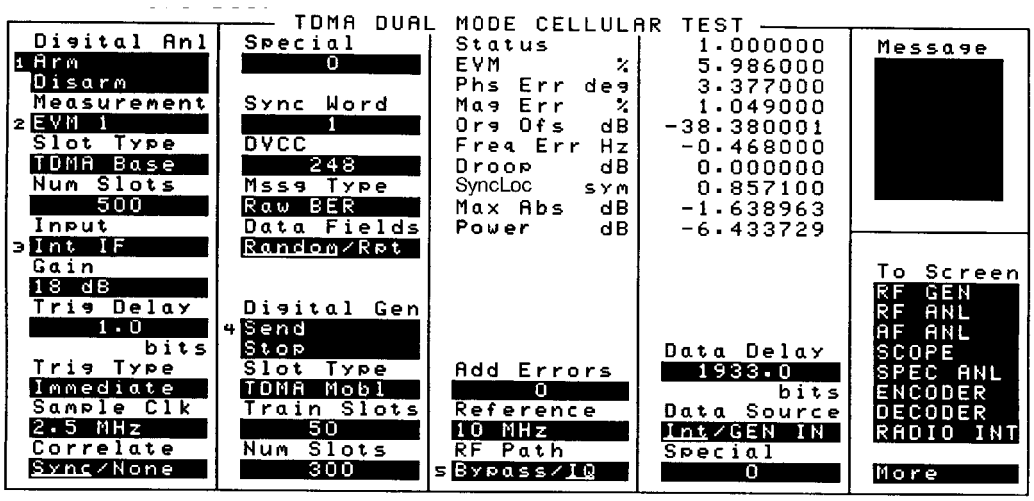
Screen Descriptions

TDMA Dual Mode Cellular Test Screen



All controls and measurements for the Digital Test Systems are displayed on the TDMA DUAL MODE CELLULAR TEST screen of the Test Set. This screen is accessed by selecting the **More** field in the bottom-right corner of the displayed screen and selecting **TDMA TEST**.

The Digital Analyzer's controls are used to prepare the analyzer to make Pi/4 DQPSK transmitter measurements. The Digital Generator's controls are used to generate a Pi/4 DQPSK signal to test TDMA digital cellular receivers. They are also used to specify the Cellular Adapter's reference frequency. The Common controls are used to specify information that the Digital Analyzer and Digital Generator share for tests. The Standard Setup field is used to automatically configure controls on the TDMA DUAL MODE CELLULAR TEST screen for specific tests.

AdcMaxAbs

This measurement field indicates the absolute value of the peak sample at the ADC input of the Digital Analyzer for Adjacent Channel Power measurements.

See Also

Max Abs field description, on page 33

Add Errors

This field specifies the number of bit errors the Digital Generator includes in the data pattern each time it sends its output data.

The errors can be used to validate a bit error measurement. The number of errors detected by the analyzer can be compared to the number of errors specified to verify that a valid measurement has been made.

Up to 15 errors can be added.

Other Considerations

Adding a known number of errors to the data can be useful for verifying that the measurement results reflect the actual conditions of the input signal.

Adj Lo Adj Hi

These measurement fields indicate the power levels measured (in dB) for the adjacent channels below and above the carrier channel.

Alt Lo Alt Hi

These measurement fields indicate the power levels measured (in dB) for the first alternate channels (two channel spacings below and two channel spacings above the carrier channel).

Alt2 Lo Alt2 Hi

These measurement fields indicate the power levels measured (in dB) for the second alternate channels (three channel spacings below and three channel spacings above the carrier channel).

BERT

This measurement field specifies the difference between the bit stream demodulated by the Digital Analyzer and the actual bit pattern output by the Digital Generator (or by a mobile radio when it is set up to loop-back to the Test Set).

This parameter indicates the receiver's ability to correctly demodulate data. The EIA standard specifies ≤ 3% error at –110 dBm.

Correlate

This field determines whether the data measured by the Digital Analyzer will be aligned with the sync word in the time slot or not.

Selecting **Sync** enables the Digital Analyzer to identify the beginning of the time slot from the total data captured.

Selecting **None** causes base station measurements to be made beginning at an arbitrary point within the captured data. If **TDMA Mobl** in the analyzer's **Slot Type** field, the analyzer will not be able to make a valid measurement. An error condition will be indicated in the measurement **Status** field when a measurement is attempted.

Other Considerations

Sync should be selected for all measurements where specific data must be measured, such as bit error measurements. It should be selected for all measurements on mobile radios.

The Digital Analyzer will make accurate transmitter measurements on a base station where a continuous stream of data is present with **None** selected.

Data Delay

This field specifies the number of bits that the Digital Generator will wait to send its baseband data after **Send** has been selected in the Digital Gen field and the frame clock goes high. This delay is valid only for internal data; external data is not affected. The range of acceptable settings for this field is from 0 to 1943 bits.

When **Int** is selected in the Data Source field, the delay affects the baseband signal sent to the instrument's IQ Modulator, Digital Analyzer, and GEN BB DATA OUT connector located on the rear panel.

Other Considerations

The data delay setting is important when you are trying to align the Test Set's data pattern to a base station that requires proper time alignment.

The appropriate amount of delay depends on the particular base station that you are testing.

Mobile radios will adjust to the Test Set, so the delay is not required for a mobile radio test.

Data Fields

This field determines whether the data output by the Digital Generator and measured by the Digital Analyzer will be a random or repeating sequence of data.

Selecting **Random** causes the Digital Generator to output a random data pattern over the number of bursts selected. It also causes the Digital Analyzer to use the same data pattern output by the generator for measuring BER.

Selecting **Rpt** causes the data pattern selected in the **Mssg Type** field to be repeated in each slot.

Other Considerations

Random is generally the best solution for making BERT measurements.

Rpt (Repeat) is useful when you want a stable data pattern for troubleshooting, for repeatable power measurements, or for error vector magnitude (EVM) measurements using the Test Set's generator.

Data Source

This field selects which baseband data source is sent to the instrument's IQ Modulator, Digital Analyzer, and GEN BB DATA OUT connector located on the rear panel. **Int** selects the baseband signal provided by the instrument's Digital Generator. **GEN IN** selects the GENERATOR BASEBAND DATA IN connector located on the front panel.

Digital Anl

This field determines whether the Digital Analyzer is armed to make a measurement or not.

Selecting **Arm** sets the analyzer to make a measurement as soon as it is triggered. **Arm** must be selected once the analyzer fields have been set up to begin a measurement. Making changes to any field setting after **Arm** has been selected will cause the Digital Analyzer to terminate the current measurement and re-arm to begin another measurement using the new setting. However, if the Digital Generator is also being used, changing field settings will cause the generator to stop sending data. **Send** must be selected in the **Digital Gen** field to begin sending data again.

Selecting **Single** causes the analyzer to make a single measurement each time it is armed. When **Cont** is selected, the analyzer continuously repeats the measurement and updates the displayed results as the measurement data becomes available.

Selecting **Disarm** affects operation only when the analyzer has been armed but measurements have not been displayed yet.

Other Considerations

When making measurements on the instrument's Digital Generator, it is generally best to select **Send** in the **Digital Gen** field, then select **Arm**.

Selecting **Arm** while the Digital Analyzer is making a measurement will cause it to re-arm for another measurement.

Digital Gen

This field causes the Digital Generator to begin sending or stop sending data.

Selecting **Send** causes the Digital Generator to begin sending its output data immediately unless a delay value greater then 0 has been specified in the **Data Delay** field.

Selecting **Stop** causes the generator to stop sending its output data. Making changes to field settings on the display can also cause the generator to stop sending its data.

Other Considerations

When using the Digital Analyzer to measure the output of the Digital Generator during a BERT measurement, it is generally best to select **Send** in the **Digital Gen** field, then select **Arm** in the **Digital Anl** field. It is only necessary to select **Send** once when making EVM measurements. When making BERT measurements, **Send** should be selected just prior to selecting **Arm** to align the training slots and transmitted data with the analyzer.

Droop

This measurement field specifies the difference, in dB-per-symbol, between the level of the first symbol and the level of the last symbol captured by the Digital Analyzer.

This parameter is most significant for pulsed signals. A high number would indicate a problem with the pulse modulation process.

For battery powered mobiles, output power can drop over the burst when the battery is low.

DVCC

This field specifies the Digital Verification Color Code to be used by the Digital Analyzer and Digital Generator. The range of acceptable values is 0 to 255.

Other Considerations

The appropriate setting is determined by the unit-under-test.

It should be set when performing BERT measurements on mobile or base stations that require a particular DVCC.

Err

This field indicates the number of bit errors detected during the BERT measurement.

Err Rate

This field indicates the number of bit errors detected per slot as a percentage of the number of data bits transmitted per slot (260). This value is calculated as follows:

(number of errors × 100) ÷ (number of slots × 260)

EVM

This measurement field specifies the magnitude of the error vector which connects the ideal signal trajectory on the unity circle to the measured signal trajectory at the detection decision point. The RMS value of the error vector is calculated by taking the square root of the sum of the squares of the individual error vector magnitudes at each detection decision point over the measured burst. The magnitude error and the phase error are the two components which determine the over-all error vector magnitude.

EVM Peak

This measurement field specifies the worst case EVM measured for a symbol over the measurement burst.

Freq Err

This measurement field specifies the frequency error between the measured RF signal and the RF frequency that the Test Set is tuned to.

This measurement can be affected by timebase errors in the unit-under-test or in the Test Set.

Gain

This field sets the gain of the Digital Analyzer's RF input path.

This setting affects the signals connected to the analyzer via the 114.3 MHz IF IN and the EXT IF IN connectors located on the instrument's rear panel.

Other Considerations

This setting affects all Digital Analyzer measurements except when digital data is being measured using the ANALYZER BASEBAND DATA IN connector, such as for a receiver looped-back to the Test Set for bit error rate testing.

Use as much gain as possible without overdriving the ADC (indicated (in dB) by the **Max Abs** measurement field for the EVM measurement).

See Also

Max Abs field description, on page 33

Input

This field selects the input path for the Digital Analyzer.

Int IF selects the input path for using the RF IN/OUT connector on the front panel of the Test Set. The RF input signal is converted to an IF and sent from the 114.3 MHz IF OUT connector to the 114.3 MHz IF IN connector on the Test Set's rear panel.

EXT IF IN selects the EXT IF IN connector on the rear panel. This connector provides a path for connecting an external 700 kHz or 220 kHz IF signal (30 to 40 mV peak) to the analyzer.

ANL DT IN selects the ANALYZER BASEBAND DATA IN connector located on the front panel of the Test Set. This connector provides a path for connecting a demodulated TDMA data stream (TTL) to the analyzer.

IQ Mod selects an internal path that connects the output of the Test Set's Digital Generator to the data input on the Digital Analyzer. The output of the Digital Generator is also available at the GEN BB DATA OUT connector on the Test Set's rear panel.

Mag Err

This measurement field specifies the difference in amplitude at the detection decision point between the received signal and an ideal signal generated with the same data pattern. The difference in amplitude is referenced to the amplitude of the ideal signal on the unity circle to obtain the percent difference.

Magnitude Error is an indicator of the quality of the amplitude component of the π/4 DQPSK signal. For example, a very high magnitude error might indicate high incidental AM modulation on the signal. This error can also be caused by a faulty linear power amplifier or modulator, or when data is not aligned with the RF burst on a mobile radio.

The magnitude error, when converted to a phasor, is one of the components of the error vector magnitude.

Max Abs

This measurement field specifies the absolute value of the peak sample from the middle 145 symbols of a timeslot after IF digital filtering. The measured level is affected by the RF input signal level, the input attenuator setting, and the level set in the **Gain** field.

Other Considerations

When a measurement is made, difference between the maximum signal level seen at the Digital Analyzer's input and the full-scale level needed for the measurement is displayed (in dB) in the **Max Abs** measurement field. For valid measurements, this value should be between 0 and –23 dB. (The closer to 0 dB (full-scale) the better, as long as the level never reaches 0.) This level is affected by three values:

- The amplitude of the TDMA signal connected to the Test Set.
- The RF ANALYZER screen's **Input Atten** setting.
- The TDMA DUAL MODE CELLULAR TEST screen's **Gain** setting.

Table 2 on page 34 lists the recommended **Input Atten** and **Gain** settings for measuring input signals < 17 dBm at the ANT IN port.

For measuring signals > +17 dBm, use the RF IN/OUT port. When using the RF IN/OUT port, subtract 36 dB from the input signal level to determine the input level to use in the table. For example, if the signal level at the RF IN/OUT port is +35 dBm, use –1 dBm as the Input Level in the table.

Table 2 Recommended Input Attenuation and Gain Settings

Input Level at Ant In (RMS)	Digital Anl Gain Setting	Input Atten Setting
+17 dBm	0 dB	40 dB
+11 dBm	6 dB	40 dB
+5 dBm	12 dB	40 dB
–1 dBm	18 dB	40 dB
–3 dBm	0 dB	20 dB
–9 dBm	6 dB	20 dB
–15 dBm	12 dB	20 dB
–21 dBm	18 dB	20 dB
–23 dBm	0 dB	0 dB
–29 dBm	6 dB	0 dB
–35 dBm	12 dB	0 dB
–41 dBm	18 dB	0 dB

Measurement

This field selects the measurement mode for the Digital Analyzer.

EVM1 sets the analyzer to make its measurements on 1 timeslot after it is triggered. The analyzer is set up to make the following measurements.

- Status
- Error Vector Magnitude (%)
- Peak Error Vector Magnitude (%)
- Phase Error (Degrees)
- Magnitude Error (%)
- Origin Offset (dB)
- Frequency Error (Hz)
- Droop (dB)
- SyncLoc (Sym)
- Maximum Absolute Power (dB)
- Power (dB)

NOTE: The **Status** field does not provide measurement results. It indicates the operating status of the analyzer for the measurement. For additional information **Status field description, on page 43**.

EVM10 sets up the analyzer to make the same measurements listed for **EVM1**. However, the first three measurements shown in the list are made using the first ten symbols from the first ten time slots used by the analyzer for its measurements. The remaining measurements are made using data from the tenth time slot only.

BERT sets the analyzer to make the following measurements for Bit Error Rate Testing:

- Status
- Training Slots
- Sync Word Errors
- Slots
- Errors
- Sync Loc
- Error Rate (%)

Measurement (continued)

Ad Ch Pwr sets the analyzer to make the following adjacent channel power measurements:

- ADC Maximum Absolute Power (dB)
- Second Low-Side Alternative Channel Power (dB)
- First Low-Side Alternative Channel Power (dB)
- Low-Side Adjacent Channel Power (dB)
- High-Side Adjacent Channel Power (dB)
- First High-Side Alternative Channel Power (dB)
- Second High-Side Alternative Channel Power (dB)

Sync Srch sets the analyzer to measure the number of symbols between when the analyzer is triggered and when the code specified in the DVCC field occurs in the slot.

Other Considerations

Select **EVM10** to make the ten burst average measurement for mobile stations as specified in IS55 3.3.2.1.3.

MAHO (Mobile Assisted Hand-Off) prepares the Digital Analyzer to receive and report SACCH channel quality measurements (BER and RSSI) from a mobile. Measurements are reported for the *current channel only*.

Before the measurements are returned, you must first request the channel quality values from your mobile by sending a Measurement Order Message command (or by some other means available with your mobile). Refer to the EIA/TIA IS-54 standard, paragraphs 2.4.5.1, 2.4.5.4.1.1.1, 2.4.5.4.1.2.1, and 3.7.3.1.3.2.2, and tables 2.4.5.1-1 and 2.4.5.1-2.

The values for BER and RSSI are returned as integer numbers representing the bit pattern defined in the IS-54 standard.

When using this measurement setup, the **Mssg Type** should be set to **SACCH**, the two **Num Slots** fields should have the same values, the **Data Fields** field should be set to **Random**, the **Train Slots** field should be **0**, and the rest of the fields should be set as they would for a BERT measurement.

The measurements returned from the mobile are labeled:

- BerRange
- RssiRange

Mssg Type

This fields specifies the type of data the Digital Generator will transmit. It also specifies the type of data the Digital Analyzer will expect to receive for a BERT measurement.

Raw BERT selects uncoded (non-convolutional encoded) data.

FACCH selects a Fast Associated Control Channel data pattern.

SACCH selects a Slow Associated Control Channel data pattern.

Speech selects encoded speech.

Call Proc selects a FACCH data pattern, supplied by the user, and outputs it on a specified slot number. This FACCH pattern and the slot number must be defined via HP-IB.

Talk Back selects a mode in which the instrument echoes back what is spoken into the radio.

Ericsson selects the data pattern for making a bit error rate measurement on Ericsson base station transceivers.

Custom 1-3 are provided for selecting other custom data patterns that have been installed.

Num Slots

Two **Num Slots** fields are provided; one for the Digital Analyzer and one for the Digital Generator. The **Num Slots** field in the first column on the left side of the screen specifies the number of slots from which the Digital Analyzer will calculate its measurement. The **Num Slots** field in the second column from the left specifies the total number of slots of data (not including training slots) that the Digital Generator will output when **Send**, in the **Digital Gen** field, is selected.

Other Considerations

Num Slots for the Digital Analyzer is used only for BERT measurements.

For the Digital Generator, the number of slots determines the number of bits over which a BERT measurement is made and, as a result, the length of time it takes to compute data before it is sent.

Org Ofs

This measurement field (origin offset) specifies the magnitude of RF carrier feedthrough relative to the magnitude of the modulated carrier at the detection decision points (data clock edges).

Carrier feedthrough is an indication of the balance of the I-Q modulator. If the modulator is balanced, the carrier is nulled in the RF spectrum. Imbalance in the I-Q modulator will result in carrier feedthrough and will appear as a dc offset on the demodulated I-Q signal.

Phase Error

This measurement field specifies the difference in phase, at the detection decision points, between the received signal and an ideal signal generated from the same data pattern.

The magnitude of this error is an indicator of the quality of the phase component of the $\pi/4$ DQPSK signal. For example, a very high phase error might indicate high incidental FM modulation on the signal.

The phase error, when converted to a phasor, is one of the components of the error vector magnitude measurement.

Power

This measurement field specifies the rms power level (in dB) seen by the Digital Analyzer. The measured level is affected by the RF input signal level, the input attenuator setting, and the vernier (gain) adjustment.

This is an uncalibrated measurement. To calibrate the RF path to the digitizer, make an initial power level measurement on a known power source using the Digital Analyzer. Determine the difference between the known source and the measured level. Apply the difference as the calibration factor for subsequent power measurements made with the Digital Analyzer.

Reference

This field specifies which reference frequency is to be used by the Digital Generator. This setting should be selected to match the frequency of the signal connected to the REF IN connector on the rear panel of the Test Set.

Other Considerations

For testing mobile radios, the REF IN connector is normally connected to the Test Set's 10 MHz output connector.

When making BERT measurements on base stations, the Test Set may be locked to a data clock (such as a bit, frame, or slot clock) provided by of the unit-under-test.

RF Path

This field determines whether the input signal connected to the CW RF IN connector on the rear panel is IQ modulated by the Test Set before it is sent to the IQ RF OUT connector (also on the rear panel).

If **IQ** is selected when **Send** is selected in the Digital Gen field, the signal will be IQ modulated.

If **Bypass** is selected, the signal will be sent directly from the CW RF IN connector to the IQ RF OUT connector without being modulated.

Sample Clk

This field sets the sample clock rate for the Digital Analyzer.

121.5 kHz, **1 MHz**, and **2.5 MHz** select internal clock sources provided by the Digital Generator.

ANL CK IN selects the ANALYZER DATA CLOCK IN connector on the instrument's front panel for connecting an external sample clock source. The frequency range for this signal is dc to 48.6 kHz at TTL levels.

Other Considerations

The primary considerations for selecting the sample clock rate are the type of measurement being made and the input selection in the **Input** field.

121.5 kHz should be selected when BERT is selected in the **Measurement** field for making real time demodulated measurements such as bit error rate.

1 MHz is the appropriate selection when EXT IF IN is selected in the **Input** field and the external RF signal is 220 kHz. **1 MHz** is also appropriate for compatibility with the HP 11847A/B or HP 8953DT 220 kHz IF for EVM measurements.

2.5 MHz is appropriate for making EVM measurements using the front panel connectors or when EXT IF IN is selected in the Input field and the signal connected to the EXT IF IN connector is 700 kHz.

ANL CLK IN should be selected when BERT is selected in the **Measurement** field and **ANL DT IN** or **IQ MOD** is selected in the **Input** field. The hold time of the data after the rising edge of the clock must be 5 µs.

Slots

This measurement field indicates the number of slots used for a BERT measurement. The value returned when the BERT measurement is complete should match the number specified in the **Num Slots** field.

Slot Type

Two **Slot Type** fields are provided; one for the Digital Analyzer and one for the Digital Generator. The **Slot Type** field in the first column on the left side of the screen specifies the type of TDMA slot (mobile or base station) that the Digital Analyzer is to measure. The **Slot Type** field in the second column from the left specifies the slot type to be output by the Digital Generator.

Other Considerations

Selecting the appropriate **Slot Type** is necessary when making BERT or EVM measurements when you are synchronizing to a sync word.

Special

Two **Special** fields are provided; one for the Digital Analyzer and one for the Digital Generator. The **Special** field in the second column from the left selects special operating modes available for the Digital Analyzer. The **Special** field in the fourth column from the left selects special operating modes available for the Digital Generator.

The special operating modes are not yet determined.

Status

This field indicates the status of the Digital Analyzer when making its measurements. The status result encodes any errors that might have occurred during the measurement. The status is a bit-mapped collection of the error conditions. A status of 0 means that no errors were reported.

EVM Measurement Status Codes

Table 3 on page 44 defines the status codes for EVM measurements.

Example

A status of 22 would be decoded as follows:

```
22 = 16 + 4 + 2
     |  |  | Sync even
     |  | Weak clock
     | ADC overdriven
```

Table 3 EVM Measurement Status Codes

Decimal	Bit	Description
1	0	Sync Error. The sync word contained an error or was not found. A measurement was made and results were returned.
2	1	Sync Even. The sync word began on the second bit of the symbol. A measurement was made and results were returned.
4	2	Weak Clock. The Test Set had difficulty to finding the data clock's phase, for example, when all zeros are transmitted. A measurement was made and results were returned, however, performance may be degraded.
8	3	ADC Underdriven. The absolute value of the peak sample was less than 30 dB below full scale of the ADC. A measurement was made and results were returned.
16	4	ADC Overdriven. The absolute value of the peak sample was at ADC full scale. A measurement was made and results were returned.
32	5	No Trigger or Clock Present. Not implemented.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted and zeros returned.
128	7	Sync Early. The sync word occurred too soon in the burst. The measurement is invalid and aborted, and zeros are returned.
256	8	Sync Late. The sync word occurred too late in the burst. The measurement is invalid and aborted, and zeros are returned.
512	9	Converge Error. The parameter estimator does not converge. The measurement is aborted and zeros are returned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned. Only EVM cases are coded at this time.
2147483648	31	Default. Specific error information is not available.

BERT Measurement Status Codes

Table 4 defines the status codes for BERT measurements.

Table 4 BERT Measurement Status Codes

Decimal	Bit	Description
1	0	Sync Error. Synchronization of the slots received with the first expected slot did not occur. All other measurement fields except SyncLoc are invalid.
2	1	Sync Even. The sync word began on the second bit of the symbol. A measurement was made and results were returned.
4	2	Weak Clock. The Test Set had difficulty finding the data clock's phase, for example, when all zeros are transmitted. Ameasurement was made and results were returned, however, performance may be degraded.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **`Status`** field for the user.
4096	12	SyncLoc bad. An error-free sync word was not found. The SyncLoc result is not valid.

Adjacent Channel Power Measurement Status Codes

Table 5 defines the status codes for Adjacent Channel Power measurements.

Table 5 Adjacent Channel Power Measurement Status Codes

Decimal	Bit	Description
8	3	ADC underdriven. The absolute value of the peak sample is less than 30 dB below full scale of the ADC. A measurement is made and results are returned. (30 dB applies only to EVM measurements.)
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results werereturned.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **`Status`** field for the user.
2147483648	31	Default. Specific error information is not available.

MAHO Status Codes

Mobile Assisted Hand-Off (MAHO) Status Codes

Table 6 MAHO Measurement Status Codes

Decimal	Bit	Description
16384	14	No channel quality message type was received from the mobile.
32768	15	No stable BER measurement was made; the last measured BER value is reported. Two identical successive measurements must be returned for a valid measurement to be recognized (200 to 300 slots are typically needed).

Sync Err

This measurement field indicates the number of times the sync word errors were detected during the BERT measurement. When the Digital Analyzer detects a sync-word error, it finds a best match and continues the measurement.

SyncLoc

This measurement field indicates the time in bit periods from when the Digital Analyzer was triggered to the beginning of the first sync word symbol detected for a base station. For a mobile radio measurement, it is the time from the trigger to the beginning of the first data symbol.

Other Considerations

This value can be useful for determining the position of the trigger relative to the designated timeslot positions.

Sync Word

This field specifies which sync word the Digital Generator will output as part of its time slot data when **Send** is selected in the **Digital Gen** field.

This field also specifies which sync word the Digital Analyzer will use to align its measurement with the appropriate time slots. For EVM measurements, the Digital Analyzer uses the sync word only if **Sync** is selected in the **Correlate** field. When **BERT** or **Sync Search** is selected in the **Measurement** field, the Digital Analyzer always uses the sync word to align its measurement.

1 specifies time slots 1 and 4
2 specifies time slots 2 and 5
3 specifies time slots 3 and 6
4, 5, and 6 are defined as specified in IS54.

Other Considerations

The correct sync word should be specified for all bit error measurements. It should also be specified for all error vector magnitude measurements made on mobile radios.

Only slot 1, 2, or 3 should be specified for the Digital Generator.

Train Slots

This field specifies the number of training slots the Digital Generator outputs before outputting the data to be measured. The training slots contain a pre-determined data pattern. Training slots are necessary to enable the analyzer to align its demodulated measurements such as BERT. From 0 to 500 slots can be specified.

When a BERT measurement has been made, a measurement field is displayed that indicates the number of training slots received before synchronization occurred.

Other Considerations

A sufficient number of training slots should be specified to allow the mobile radio to lock-up and start transmitting valid loopback data.

Trig Delay

The **`Trig Delay`** field specifies the number of bits that the trigger signal will be delayed before it is sent to the Digital Analyzer's trigger input. This delay is applied only when **`ANL TG IN`** or **`Dig Gen`** is selected as the trigger source in the **`Trig Type`** field.

The range of acceptable settings is from 1 to 1943 bits.

Other Considerations

Delaying the trigger can be useful when you need to capture a timeslot of data that is delayed relative to an external trigger.

Trig Type

This field specifies the trigger conditions for the Digital Analyzer.

Selecting **`Immediate`** causes the analyzer to be triggered immediately when **`Arm`** is selected in the of the **`Digital Anl`** field.

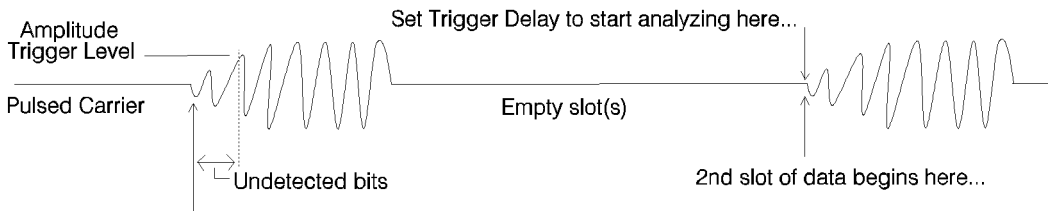
Selecting **`ANL TG IN`** causes the analyzer to be triggered by the signal at its ANALYZER TRIGGER IN connector.

Selecting **`2 × Frame`** causes the analyzer to be triggered by the 50 Hz, 2 × frame clock provided by the Test Set's Digital Generator.

Selecting **`Frame`** causes the analyzer to be triggered by the 2.5 Hz frame clock provided by the Test Set's Digital Generator.

Amplitude triggering uses low-to-high amplitude transitions in pulsed carriers as the trigger source. Trigger thresholds are at –6 dB (**`Amptd Hi`**), –12 dB (**`Amptd Mid`**), and –18 dB (**`AmptdLow`**) from the maximum AdcMaxAbs level. The **`Input`** field must be set to either **`Int IF`** or **`Ext IF IN`**.

If the initial amplitude of the carrier pulse is not high enough, the trigger will occur too late to analyze the first few bits, causing EVM or BERT errors. In that case, use the Trigger Delay field to capture the next full transmitted data pulse.



Other Considerations

Selecting the appropriate trigger is necessary when making BERT measurements and aligning the Digital Analyzer to timeslots for Power, Adjacent Channel Power, or EVM measurements.

PDC Cellular Test

The PDC CELLULAR TEST screen is used to test cellular telephones that use the Personal Digital Cellular format. This screen can only be displayed if an HP 83201B TDMA Cellular Adapter is connected to the Test Set. Both continuous and pulsed carriers can be generated and analyzed.

Accessing 'Hidden' Controls

Two **`Controls`** fields are used to access fields for the Digital Analyzer and Digital Generator that are not initially displayed on this screen. These controls are shown in **figure 4** on this page and **figure 5** and **figure 6 on page 95**. Refer to the **`Controls` field description, on page 59**.

Displaying Measurements

When this screen is first displayed, the measurement fields and values are not shown. Measurements are only displayed after the Digital Analyzer has been armed and triggered.

The above screen image shows the measurements returned for Error Vector Magnitude (EVM) after a valid measurement has been made.

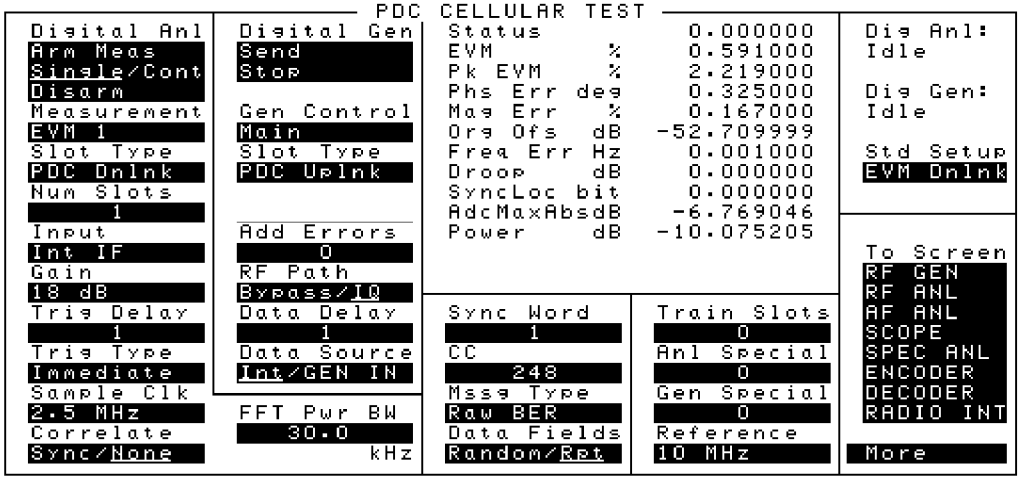


Figure 1 **Analyzer Controls Group 1, Main Digital Generator Controls**

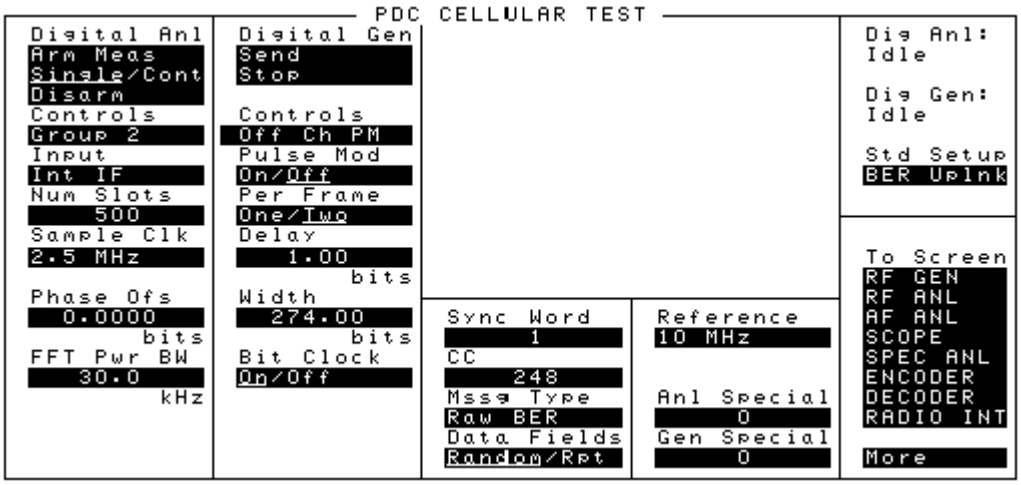


Figure 2 **Analyzer Control s Group, Off Ch PM Digital Generator Controls**

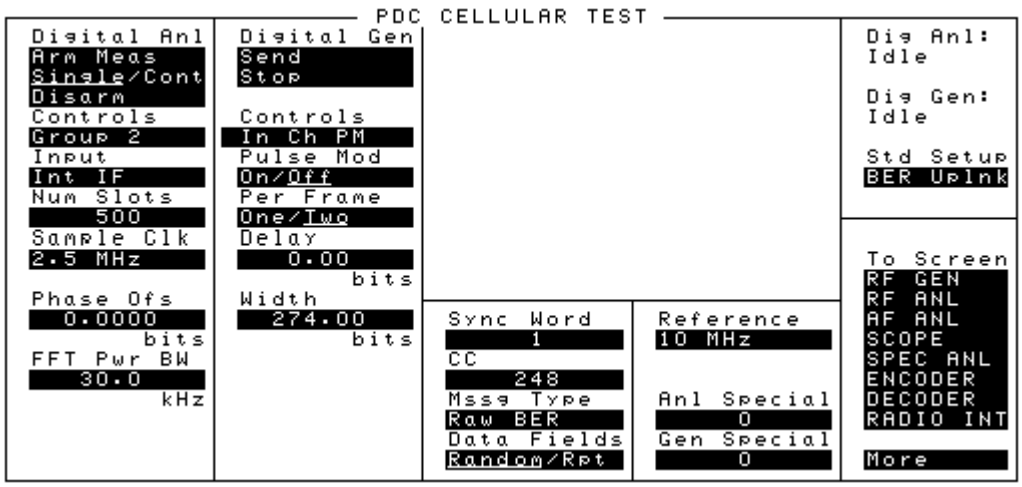


Figure 3 **Analyzer Controls Group 2, In Ch PM Digital Generator Controls**

Ad Ch Pwr

When selected for the **Measurement** field, this function prepares the Digital Analyzer to make an Adjacent Channel Power measurement. Refer to the **Measurement field description, on page 72**.

AdcMaxAbs

This measurement indicates the peak detected level into the Analog-to-Digital Converter (ADC) after IF filtering. The units are dB, relative to the maximum allowed ADC input level. This value is displayed for all **Measurement** field settings except BERT.

For valid measurements, this, value should be between 0 and –23 dB. (The closer to 0 dB (full-scale) the better, as long as the level never reaches 0.)

Operating Considerations

If the **Correlate** field is set to **SYNC** and a Sync Early or Sync Late Status error occurs, this measurement is aborted and zeros are returned.

The ADC input level is affected by three values:

- The amplitude of the PDC signal connected to the Test Set.
- The RF ANALYZER screen's **Input Atten** setting.
- The PDC CELLULAR TEST screen's **Gain** setting.

Table 7 on page 54 lists the recommended **Input Atten** and **Gain** settings for measuring input signals < 17 dBm at the ANT IN port.

For measuring signals > +17 dBm, use the RF IN/OUT port. When using the RF IN/OUT port, subtract 36 dB from the input signal level to determine the input level to use in the table. For example, if the signal level at the RF IN/OUT port is +35 dBm, use –1 dBm as the Input Level in the table.

Table 7 MAHO Measurement Status Codes

Input Level at Ant In (RMS)	Digital Anl Gain Setting	Input Atten Setting
+17 dBm	0 dB	40 dB
+11 dBm	6 dB	40 dB
+5 dBm	12 dB	40 dB

Table 7 MAHO Measurement Status Codes

Input Level at Ant In (RMS)	Digital Anl Gain Setting	Input Atten Setting
–1 dBm	18 dB	40 dB
–3 dBm	0 dB	20 dB
–9 dBm	6 dB	20 dB
–15 dBm	12 dB	20 dB
–21 dBm	18 dB	20 dB
–23 dBm	0 dB	0 dB
–29 dBm	6 dB	0 dB
–35 dBm	12 dB	0 dB
–41 dBm	18 dB	0 dB

Add Errors

This field specifies the number of bit errors the Digital Generator includes in each slot of data when sent. Up to 15 errors can be added. This field is only displayed when the **Gen Control** field is set to **Main**.

When the **Data Fields** field is set to **Random**, the same number of errors is used for each slot, but the bit positions change at random.

When the **Data Fields** field is set to **Rpt** (Repetitive), the same bits are changed in each slot.

The errors can be used to validate a bit error rate measurement. The number of errors detected by the analyzer can be compared to the number of errors specified to verify that a valid measurement has been made. Also, adding a known number of errors to the data can be useful for verifying that the measurement results reflect the actual conditions of the input signal.

Alt Lo Alt Hi

These measurement fields indicate the power levels measured (in dB) for the first alternate channels (50 kHz) below and above the carrier channel. **See "Adjacent Channel Power" in the Measurement field description, on page 72**.

Alt3 Lo Alt3 Hi

These measurement fields indicate the power levels measured (in dB) for the third alternate channels (100 kHz) below and above the carrier channel. **See "Adjacent Channel Power"** in the **`Measurement` field description, on page 72**.

Anl Special

This field selects special operating modes available for the Digital Analyzer. At this time, only special 102 “IQ Modulator Cal” has been defined. Under normal operation, this field should be set to **`0`**.

Operating Considerations

If special 102 is used, the **`Sample Clk`** must be set to **`105.0 kHz`**, and the Digital Generator should be stopped.

BERT

When selected for the **`Measurement`** field, this measurement indicates the difference between the TCH bit stream demodulated by the Digital Analyzer and the actual TCH bit pattern created by the Digital Generator.

This parameter indicates the receiver’s ability to correctly demodulate data.

Refer to the **`Measurement` field description, on page 72**.

Operating Considerations

The Digital Generator outputs all data bits in a slot, including TCH bits. To make a BERT measurement, your radio must be able to demodulate the TCH bits separately. The TCH data from your radio must be connected to the Cellular Adapter’s front-panel ANALYZER BASEBAND DATA IN connector. Your radio must also provide the necessary data clock on the ANALYZER DATA CLOCK IN connector to analyze the data.

The TCH data must be present on the ANALYZER BASEBAND DATA IN port for ≥100 ns. before the rising edge of the ANALYZER DATA CLOCK IN signal. The data must be stable on this input for ≥1.3 µs after being triggered by the Data Clock to correctly read the data.

Bit Clock

This field turns the bit clock on or off for Off Channel Pulse Modulation operation. This field is only displayed when the Digital Generator **`Controls`** field is set to **`Off Ch PM`**.

CC

This field specifies the Color Code to be used by the Digital Analyzer and Digital Generator. The range of acceptable values is 0 to 255.

Operating Considerations

The appropriate setting is determined by the unit-under-test.

This value should be set when performing BERT measurements on mobile or base stations that require a particular CC.

Clk Freq (Hz)

When making a Symbol Rate measurement, this field displays the measured Symbol Clock frequency. **See "Symbol Rate" in the `Measurement` field description, on page 72**.

Controls

Two **Controls** fields are used to access Digital Analyzer and Digital Generator fields. Some of these fields are not initially displayed when the PDC CELLULAR TEST screen is first accessed.

The Digital Analyzer **Controls** are divided into two groups to access all of the required analyzer settings.

- **Group 1** accesses the **Measurement**, **Slot Type**, **Gain**, **Trig Delay**, **Trig Type**, and **Correlate** fields.
- **Group 2** accesses the **Input**, **Num Slots**, **Sample Clk**, **Phase Ofs**, and **FFT Pwr BW** fields.

The Digital Generator **Controls** are divided into three groups, according to the type of carrier you want to generate:

- **Main** is used to create a continuously-modulated carrier.
- **Off Ch PM** is used to create Off Channel Pulse Modulated carriers.
- **In Ch PM** is used to create In Channel Pulse Modulated carriers.

Correlate

This field determines whether the data measured by the Digital Analyzer will be aligned with the sync word in the time slot or not. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 1**.

Selecting **Sync** enables the Digital Analyzer to identify the beginning of the time slot from the total data captured.

Selecting **None** causes measurements to be made beginning at a default point within the captured data.

Operating Considerations

Sync must be selected when measuring EVM on an UPLINK signal. For a DOWNLINK signal, **Sync** is only required to correlate EVM measurements with a particular time slot.

This field is ignored for all other measurements.

Data Delay

This field specifies the number of bits that the Digital Generator will wait to send its baseband data after **Send** has been selected in the Digital Gen field and the frame clock goes high. This delay is valid only for internal data; external data is not affected.

This field is only displayed when the **Gen Control** field is set to **Main**.

When **Int** is selected in the **Data Source** field, the delay affects the baseband signal sent to the instrument's IQ Modulator, Digital Analyzer, and GEN BB DATA OUT connector located on the rear panel.

Operating Considerations

The data delay setting is important when you are trying to align the Test Set's data pattern to a base station that requires proper time alignment.

The appropriate amount of delay depends on the particular base station that you are testing.

Mobile radios will adjust to the Test Set, so the delay is not required for a mobile radio test.

Data Fields

This field determines whether the data output by the Digital Generator and measured by the Digital Analyzer will be a random or repeating sequence of data.

Selecting **Random** causes the Digital Generator to output a 2^9-1 sequence. The Digital Analyzer then uses the same data pattern output by the generator for measuring BER (Bit Error Rate).

Selecting **Rpt** allows a BER measurement to be made with 1 timeslot of TCH data repeated for each timeslot.

With the exception of the Sync Word, the data for slots 1, 2, and 3 is the same for both cases.

Data Source

This field selects which baseband data source is sent to the instrument's IQ Modulator, Digital Analyzer, and GEN BB DATA OUT connector located on the rear panel. This field is only displayed when the **Gen Control** field is set to **Main**.

Int selects the baseband signal provided by the instrument's Digital Generator.

GEN IN selects the GENERATOR BASEBAND DATA IN connector located on the front panel.

Delay (Pulse Modulation)

This field defines the number of bits of data (or frame clock cycles) that are output by the Digital Generator (when **Send** is selected) before the IN-CHAN PLS MOD-OUT or OFF-CHAN PULSE MOD OUT connector goes high for pulsed carrier control.

This field is only displayed when the Digital Generator **Control** field is set to **Off Ch PM** or **In Ch PM** for pulsed carrier operation with an HP 83215A.

The range of acceptable values is 0.25 to 1680.0 bits in 0.25 bit increments.

Dig Anl:

This field indicates the state of the Digital Analyzer.

Idle indicates the Digital Analyzer is not armed and cannot make a measurement, even if an appropriate trigger is received.

Armed indicates the Digital Analyzer is ready to be triggered to make a measurement, or has been triggered and is computing measurement results.

See Also

Digital Anl field description (this page)

Digital Anl

This field selects how the Digital Analyzer is armed to make a measurement.

Selecting **Arm Meas** sets the analyzer to make a measurement as soon as it is triggered. **Arm Meas** must be selected once the analyzer fields have been set up to begin a measurement. Changing field settings *after* arming the measurement may cause the Digital Analyzer to terminate the current measurement and re-arm to begin another measurement using the new setting. If the Digital Generator is also being used, changing field settings may cause the generator to stop sending data. **Send** must then be selected in the **Digital Gen** field to begin sending data again.

Selecting **Single** causes the analyzer to make a single measurement each time it is armed. When **Cont** is selected, the analyzer continuously repeats the measurement and updates the displayed results as the measurement data becomes available.

Selecting **Disarm** affects operation only when the analyzer has been armed but measurements have not been displayed.

Operating Considerations

When making measurements on the instrument's Digital Generator, it is generally best to select **Send** in the **Digital Gen** field, then select **Arm**.

Selecting **Arm** while the Digital Analyzer is making a measurement will cause it to re-arm for another measurement.

Dig Gen:

This field indicates the status of the Digital Generator.

`Idle` indicates the generator is not sending the digital data defined in the various fields.

`Sending` indicates the generator is sending the digital data to the IQ modulator to modulate the carrier using the π/4 DQPSK format.

See Also

`Digital Gen` field description (this page)

Digital Gen

This field is used to start and stop the Digital Generator.

Selecting **`Send`** causes the Digital Generator to begin sending its output data immediately unless a delay value greater then 0 has been specified in the **`Data Delay`** field.

Selecting **`Stop`** causes the generator to stop sending its defined data, and to start sending an undefined data pattern (normally a series of zeros). Making changes to field settings on the display can also cause the generator to stop sending its data.

Droop

(Burst) Amplitude Droop is the difference in the measured level (dB-per-symbol) between the IQ decision points in the received signal. This measurement is displayed when measuring Error Vector Magnitude.

This parameter is most significant for pulsed signals. A high number would indicate a problem with the pulse modulation process.

For battery powered mobiles, output power can drop over the burst when the battery is low.

Err

This field indicates the number of bit errors detected during the BERT measurement.

Err Rate

This field indicates the number of bit errors detected per slot as a percentage of the number of data bits transmitted per slot (224). This value is calculated as follows:

(number of errors × 100) ÷ (number of slots × 224)

This value is only displayed for BERT measurements.

EVM

This measurement field specifies the magnitude of the error vector which connects an ideal signal trajectory to the compensated measured signal trajectory at the detection decision point. The measured signal is compensated for clock delay, carrier frequency, carrier phase, amplitude scale, amplitude droop, and IQ Origin Offset.

The RMS value of the error vector is calculated by taking the square root of the sum of the squares of the individual error vector magnitudes at each detection decision point over the measured burst. The magnitude error and the phase error are the two components which determine the over-all error vector magnitude.

FFT Pwr BW

The Fast Fourier Transform Power Bandwidth field sets the RF bandwidth for the Carrier Power and Carrier Leakage measurements. This value is centered around the center frequency, so the measured bandwidth is ± 1/2 this value from the center frequency.

Bandwidths from 1 to 300 kHz can be specified.

Freq Err

This measurement field specifies the frequency error between the measured RF signal and the expected RF frequency that the Test Set is tuned to. Errors in the carrier frequency, LO frequency, or digitizer clock rate (timebase) can all appear as a **`Freq Err`**.

Gain

This field sets the gain of the Digital Analyzer's RF input path. This field is displayed when the Digital Analyzer **`Controls`** field is set to **`Group 1`**.

This setting affects the signals connected to the analyzer via the 114.3 MHz IF IN and the EXT IF IN connectors located on the instrument's rear panel.

Operating Considerations

Although the gain steps are shown in 6 dB increments, the actual gain change is not exactly 6 dB.

This setting affects all Digital Analyzer measurements except when digital data is being measured using the ANALYZER BASEBAND DATA IN connector, such as for a receiver looped-back to the Test Set for bit error rate testing.

Use as much gain as possible without over-driving the Analog-to-Digital Converter (ADC). The input level into the ADC relative to the maximum allowed level is indicated (in dB) by the **`AdcMaxAbs`** measurement (displayed with all measurements except BERT).

See Also

A procedure for setting the gain and RF input attenuators for a given input level is provided in the **`AdcMaxAbs` field description, on page 21**.

Gen Control

This field selects how you want the Digital Generator to be output:

`Main` is used when a continuously-modulated carrier is required.

`Pulse Mod` is used to create a pulsed carrier.

When this field is changed, the other Digital Generator control fields below this field change to provide the appropriate controls.

Gen Special

In the future, this field will be used to select special Digital Generator operating modes. No special modes have been defined at this time.

This field should always be set to **`0`**.

Input

This field selects the input path for the Digital Analyzer. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 2**.

Int IF selects the input path for using the RF IN/OUT or ANT IN connectors on the front panel of the Test Set. The RF input signal is converted to an IF and sent from the 114.3 MHz IF OUT connector to the 114.3 MHz IF IN connector on the Test Set's rear panel.

EXT IF IN selects the EXT IF IN connector on the rear panel. This connector provides a path for connecting an external 700 kHz IF signal (30 to 40 mV peak) to the analyzer.

ANL DT IN selects the ANALYZER BASEBAND DATA IN connector located on the front panel of the Test Set. This connector provides a path for connecting a demodulated PDC data stream (TTL) to the analyzer.

IQ Mod selects an internal path that connects the output of the Test Set's Digital Generator to the data input on the Digital Analyzer. The output of the Digital Generator is also available at the GEN BB DATA OUT connector on the Test Set's rear panel.

Operating Considerations

Use **Int IF** or **EXT IF IN** unless you are performing a TTL BERT measurement.

TTL BERT uses only **ANL DT IN** or **IQ MOD**.

Mag Err

This measurement field specifies the difference in amplitude at the detection decision point between the received signal and an ideal signal generated with the same data pattern. The difference in amplitude is referenced to the amplitude of the ideal signal on the unity circle to obtain the percent difference. The rms value is calculated by summing the squares of the individual magnitude errors at each detection decision point over the measured burst, dividing by the number of points, and then taking the square root.

Magnitude Error is an indicator of the quality of the amplitude component of the π/4 DQPSK signal. For example, a very high magnitude error might indicate high incidental AM modulation on the signal. This error can also be caused by a faulty linear power amplifier or modulator, or when data is not aligned with the RF burst on a mobile radio.

The magnitude error, when converted to a phasor, is one of the components of the error vector magnitude.

The rms value is calculated by summing the squares of the individual magnitude errors at each detection decision point over the measured burst, dividing by the number of points, and then taking the square root.

Measurement

This field selects the measurement mode for the Digital Analyzer. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 1**.

When a measurement is completed, several associated measurements may also be displayed; such as the measured signal's power level into the Digital Analyzer (**AdcMaxAbs**). *Descriptions for each of these associated measurements are listed alphabetically in this chapter.*

NOTE: The **Status** field does not provide measurement results. It indicates the operating status of the analyzer for the measurement. A status value of "0" indicates no measurement errors were detected. For additional information, refer to the **Status field description, on page 85**.

Error Vector Magnitude

EVM 1 sets the analyzer to make its measurements on 1 timeslot after it is triggered. The analyzer is set up to make the following measurements.

- Status
- Error Vector Magnitude (%)
- Peak Error Vector Magnitude (%)
- Phase Error (Degrees)
- Magnitude Error (%)
- Origin Offset (dB)
- Frequency Error (Hz)
- Droop (dB)
- SyncLoc (bit)
- ADC Maximum Absolute Power (dB)
- Power (dB)

Bit Error Rate Test

BERT sets the analyzer to make the following measurements for Bit Error Rate Testing:

- Status
- Slots
- Errors
- Error Rate (%)

Adjacent Channel Power

Ad Ch Pwr sets the analyzer to make adjacent channel power measurements above (Hi) and below (Lo) the center frequency. Uplink signal measurements can only be made on a pulsed carrier. Downlink signals can be measured on both pulsed or continuously-modulated carriers.

The displayed measurements are:

- ADC Maximum Absolute Power (dB)
- Alternate Channel 3 Lo (dB)
- Alternate Channel Lo (dB)
- Alternate Channel Hi (dB)
- Alternate Channel 3 Hi (dB)
- Occupied Bandwidth (Hz)
- Power Point Low (Hz)
- Power Point Hi (Hz)

Carrier Power

Carr Pwr sets the Digital Analyzer to make a *relative* power measurement of the carrier. (The absolute power level is not measured.) The **FFT PWR BW** field is used to set the measurement bandwidth. Limiting the bandwidth improves the dynamic range of the measurement, allowing more accurate comparisons of carrier levels.

The measurement algorithm used by the Cellular Adapter depends on the type of signal being measured. When measuring an Uplink signal, the carrier is assumed to be pulsed. When measuring a Downlink signal, the carrier is assumed to be continuous.

The displayed measurements are:

- Status
- Adc Maximum Absolute Power (dB)
- Power (dB)

Carrier Leakage

Carrier Leakage prepares the Digital Analyzer to measure *low* RF power levels within the bandwidth specified in the **FFT PWR BW** field. The Cellular Adapter uses the same measurement operation by both Uplink and Downlink (pulsed and continuous) signals.

- Status
- Adc Maximum Absolute Power (dB)
- Power (dB)

Symbol Rate

`Sym Rate` prepares the Digital Analyzer to measure the Symbol Clock frequency (Hz) of a *continuously-modulated* carrier. This measurement cannot be made on a pulsed carrier because the analyzer needs multiple slots of data for this measurement. For best results, use a data pattern containing a large number of 1's.

The displayed measurements are:

- Status
- AdcMaxAbs (dB)
- Clk Freq (Hz)

Mssg Type

This fields specifies the type of data the Digital Generator will transmit. It also specifies the type of data the Digital Analyzer will expect to receive for a BERT measurement.

`Raw BERT` selects un-coded (non-convolutional encoded) data for making Bit Error Rate measurements. (No other measurements are affected by this field.)

`Custom 1-3` are provided for selecting other custom data patterns that may have been installed.

Num Slots

The **`Num Slots`** field in the Digital Analyzer specifies the number of slots of data the Digital Analyzer will use when performing a BERT measurement. This setting is ignored for all other measurements. This field is displayed when the Digital Analyzer **`Controls`** field is set to **`Group 2`**.

Occ BW

This measurement (Occupied Bandwidth) specifies the frequency bandwidth (Hz) containing 99% of the total measured power. This measurement is displayed when making Adjacent Channel Power measurements.

Org Ofs

This measurement field (Origin Offset) specifies the magnitude of RF carrier feed-through relative to the magnitude of the modulated carrier at the detection decision points (data clock edges).

Carrier feed-through is an indication of the balance of the I-Q modulator. If the modulator is balanced, the carrier is nulled in the RF spectrum. Imbalance in the I-Q modulator will result in carrier feed-through and will appear as a dc offset on the demodulated I-Q signal.

Per Frame (Pulse Modulation)

This field specifies the number of modulation pulses used per frame of data to allow half-rate codec (one pulse) or full-rate codec (two pulses).

When full rate (Two) is selected, the pulse width of all pulses are the same, and can be set using the **`Width`** field.

Phase Ofs

The Phase Offset field is used to alter the Symbol Clock phase relative to the measured data. (EVM measurements are higher if the IQ decision points for the incoming signal are not correctly aligned with the Symbol Clock.)

The value can be set for a positive or negative phase offset in the range of –2.0 to +2.0 bits. With a resolution of 0.0001 bits, each increment results in a change of ±0.015% EVM.

This value should be set to 0.0000 unless you suspect the Digital Analyzer is not measuring the EVM at the optimal symbol clock phase of the transmitted signal.

Pk EVM

This measurement field specifies the worst case EVM measured for a symbol over the measurement burst.

Phase Error

This measurement field specifies the difference in phase, at the detection decision points, between the received signal and an ideal signal generated from the same data pattern.

The magnitude of this error is an indicator of the quality of the phase component of the π/4 DQPSK signal. For example, a very high phase error might indicate high incidental FM modulation on the signal.

The phase error, when converted to a phasor, is one of the components of the error vector magnitude (EVM) measurement.

Power (For EVM Measurements)

When measuring EVM, this measurement field specifies the *rms* power level (in dB) seen by the Digital Analyzer relative to the maximum allowed (full scale) ADC input level. The value is calculated using the middle 100 symbols of a slot after IF filtering.

The measured level is affected by the RF input signal level, the input attenuator setting, and the **`Gain`** field setting.

Operating Considerations

The IF filter used has ≈90 kHz 1 dB bandwidth, and 120 kHz 3 dB bandwidth.

If the **`Correlate`** field is set to **`Sync`**, and a Sync Early or Sync Late status error occurs, this measurement is aborted and zeros are displayed.

This is an un-calibrated measurement. To calibrate the RF path to the digitizer, make an initial power level measurement on a known power source using the Digital Analyzer. Determine the difference between the known source and the measured level. Apply the difference as the calibration factor for subsequent power measurements made with the Digital Analyzer.

See Also

Refer to the **`AdcMaxAbs` field description, on page 54**, for information on setting the input attenuator and Gain settings for a given input level.

Power (For Carrier Power and Leakage Measurements)

When measuring Carrier Power or Carrier Leakage, this measurement returns a power value indicating *relative* Carrier Power levels: it does not directly indicate absolute carrier power. It is primarily intended for comparing signal levels, such as RF on/off values.

The measurement bandwidth is specified in the **`FFT PWR BW`** field. Limiting the bandwidth improves the dynamic range of the measurement.

The measured level is affected by the RF input signal level, the input attenuator setting, and the **`Gain`** field setting.

See Also

Refer to the **`AdcMaxAbs` field description, on page 54**, for information on setting the input attenuator and Gain settings for a given input level.

Pulse Mod

This field enables (On) or disables (Off) pulse modulation. This field is only displayed when the Digital Generator **`Controls`** field is set to **`In Ch PM`** or **`Off Ch PM`**.

Operating Considerations

When set to **`Off`**, the voltage level remains high at the IN-CHAN PLS MOD-OUT and OFF-CHAN PULSE MOD OUT connectors on the Cellular Adapter. This signal is normally connected to the HP 83215A Digital RF Interface to control the Pulse Modulator. A high level on this line causes the modulator in the HP 83215A to continually pass the connected carrier signal.

PowPtHi/PowPtLow

The Power Point Hi and Power Point Low measurements indicate the frequency offset from the carrier center frequency where the power levels were at 0.5% of the center frequency level. These measurements are displayed when making Adjacent Channel Power measurements.

Operating Considerations

If the values of these measurements are not equal, it indicates that the Test Set is not tuned to the exact center frequency of the desired channel.

Reference

This field specifies which reference frequency is to be used by the Digital Generator. This setting should be selected to match the frequency of the signal connected to the REF IN connector on the rear panel of the Test Set.

Operating Considerations

For testing mobile radios, the REF IN connector is normally connected to the Test Set's 10 MHz output connector.

When making BERT measurements on base stations, the Test Set may be locked to a data clock (such as a bit, frame, or slot clock) provided by of the unit-under-test.

RF Path

This field determines if the input signal connected to the CW RF IN connector on the rear panel is IQ modulated by the Test Set before it is sent to the IQ RF OUT connector (also on the rear panel). This field is only displayed when the **Gen Control** field is set to **Main**.

If **IQ** is selected, the signal will be IQ modulated when the Digital Generator is sending.

If **Bypass** is selected, the signal will be sent directly from the CW RF IN connector to the IQ RF OUT connector without being modulated.

Sample Clk

This field sets the sample clock rate for the Digital Analyzer. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 2**.

105.0 kHz is only used for the IQ modulator calibration, and is not used for any PDC measurements.

1 MHz is used for EVM measurements when **EXT IF IN** is selected in the **Input** field, and a 224 kHz external IF signal is connected to the EXT IF IN connector.

2.5 MHz can be used for all measurements *except BERT*. You can either use the 114.3 MHz IF from the Test Set, or set the **Input** field to **EXT IF IN** and connect a 700 kHz IF signal to the EXT IF IN connector. Adjacent Channel measurements can only be made using this selection.

Either **ANL CLK IN** or **INV CK IN** must be selected when BERT is selected in the **Measurement** field and **ANL DT IN** or **IQ MOD** is selected in the **Input** field. The hold time of the data after the rising edge (**ANL CLK IN**) or falling edge (**INV CK IN**) of the clock must be ≥ 1.3 µs to make a valid BERT measurement.

Operating Considerations

The 2.5 MHz selection must be used for Symbol Clock and Carrier Power measurements.

EVM can be measured using the 1 MHz or 2.5 MHz selection. The 1 MHz selection is used when an external 224 kHz IF is being measured.

Slots

This measurement field indicates the number of slots used for a BERT measurement. The value returned when the BERT measurement is complete should match the number specified in the **`Num Slots`** field.

Slot Type

`Slot Type` fields are provided for the Digital Analyzer and the Digital Generator.

The **`Slot Type`** field for the Digital Analyzer specifies the type of PDC slot (PDC Uplink or PDC Downlink) that the Digital Analyzer is to measure. This field is displayed when the Digital Analyzer **`Controls`** field is set to **`Group 1`**.

The **`Slot Type`** field for the Digital Generator specifies the slot type to be output. The **`Cnt2^9-1`** and **`Cnt2^15-1`** selections are for continuous data streams represented by the pseudo-random pattern of a 511-bit sequence and a 32767-bit sequence. This field is only displayed when the **`Gen Control`** field is set to **`Main`**.

Operating Considerations

Selecting the appropriate **`Slot Type`** is necessary when making BERT or EVM measurements when you are synchronizing to a sync word.

Std Setup

The Standard Setup field selects pre-defined control setups for several types of measurements. Selecting the appropriate setup automatically configured the different fields typically used for that measurement.

After selecting the desired measurement setup, you may have to make some adjustments for your particular test setup to make valid measurements. These adjustments will vary, depending on the test system, radio under test, and the type of measurement you are making.

Status

This field indicates the status of the Digital Analyzer when making its measurements. A status of 0 means that no errors were reported.

The status result encodes any errors that might have occurred during the measurement. The status is the sum of a bit-mapped collection of one or more error conditions.

For example, a status of 22 for an EVM measurement would be decoded as follows:

```
22 = 16 + 4 + 2
     |  |  | Sync even
     |  | Weak clock
     | ADC overdriven
```

Each **`Measurement`** field selection has its own associated **`Status`** conditions. The tables on the following pages list the status conditions for each measurement type.

Correcting ADC Drive Level Conditions

When a Status value >0 occurs, the first thing to do is make sure the Digital Analyzer is not being under-driven or over-driven. With the exception of BERT, all measurements return a power level as **`AdcMaxAbs`**. This value tells you if the signal into the Digital Analyzer is within its measurement range. If this value is less than ≈–30 dB, the analyzer may not be getting enough signal. If the returned value is ≥0, you are over-driving the analyzer.

Refer to the **`AdcMaxAbs` field description, on page 54**, for information on setting the input gain and attenuators for a known input level.

Table 8 EVM Measurement Status Codes

Decimal	Bit	Description
1	0	Sync Error. The sync word contained an error or was not found. A measurement was made and results were returned.
2	1	Sync Even. The sync word began on the second bit of the symbol. A measurement was made and results were returned.
4	2	Weak Clock. The Test Set had difficulty to finding the data clock's phase, for example, when all zeros are transmitted. Ameasurement was made and results were returned, however, performance may be degraded.

Table 8 EVM Measurement Status Codes

Decimal	Bit	Description
8	3	ADC Underdriven. The absolute value of the peak sample wasless than 30 dB below full scale of the ADC. A measurement wasmade and results were returned.
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results werereturned.
32	5	No Trigger or Clock Present. Not implemented.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted and zeros returned.
128	7	Sync Early. The sync word occurred too soon in the burst. The measurement is invalid and aborted, and zeros are returned.
256	8	Sync Late. The sync word occurred too late in the burst. The measurement is invalid and aborted, and zeros are returned.
512	9	Converge Error. The parameter estimator does not converge. The measurement is aborted and zeros are returned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned. It is intended to indicate errors like selecting a 1 MHz **Sample Clk** with the **Input** set to **Internal IF** for an EVM measurement.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **Status** field for the user.
2147483648	31	Default. Specific error information is not available.

Table 9 BERT Measurement Status Codes

Decimal	Bit	Description
1	0	Sync Error. Synchronization of the slots received with the first expected slot did not occur. All other measurement fields except SyncLoc are invalid. This result is only displayed when **Random** is selected for the **Data Fields** field.

Table 9 BERT Measurement Status Codes

Decimal	Bit	Description
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **Status** field for the user.
4096	12	Synchronization to the data pattern did not occur.
8192	13	The data acquisition time between any two bits was ≈ >50 ms. The measurement results are not valid.

Table 10 Adjacent Channel Power Measurement Status Codes

Decimal	Bit	Description
8	3	ADC underdriven. The absolute value of the peak sample is less than 30 dB below full scale of the ADC. A measurement is made and results are returned. (30 dB applies only to EVM measurements.)
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results werereturned.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted, and all zeros werereturned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **Status** field for the user.

Table 11 Carrier Power and Carrier Leakage Measurement Status Codes

Decimal	Bit	Description
8	3	ADC underdriven. The absolute value of the peak sample is less than 30 dB below full scale of the ADC. A measurement is made and results are returned. (Not used for Carrier Leakage measurements.)
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results wereреturned.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted, and all zeros wereреturned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **`Status`** field for the user.
2147483648	31	Default. Specific error information not available.

Table 12 Symbol Rate Measurement Status Codes

Decimal	Bit	Description
4	2	Weak Clock. The Test Set had difficulty to finding the data clock's phase, for example, when all zeros are transmitted. A measurement was made and results were returned, however, performance may be degraded.
8	3	ADC underdriven. The absolute value of the peak sample is less than 30 dB below full scale of the ADC. A measurement is made and results are returned. (30 dB applies only to EVM measurements.)
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results wereреturned.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted, and all zeros wereреturned.

Table 12 Symbol Rate Measurement Status Codes

Decimal	Bit	Description
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **`Status`** field for the user.
2147483648	31	Default. Specific error information not available.

SyncLoc

This measurement field indicates the time in bit periods from when the Digital Analyzer was triggered to the beginning of the first sync word symbol detected.

Operating Considerations

This value can be useful for determining the position of the trigger relative to the designated timeslot positions.

Sync Word

This field specifies which Sync Word the Digital Generator will output as part of its time slot data when **Send** is selected in the **Digital Gen** field.

This field also specifies which Sync Word the Digital Analyzer will use to align its measurement with the appropriate time slots. For EVM measurements, the Digital Analyzer uses the Sync Word only if **Sync** is selected in the **Correlate** field. When **BERT** is selected in the **Measurement** field, the Digital Analyzer always uses the sync word to align its measurement.

Operating Considerations

The correct Sync Word should be specified for all bit error measurements. It should also be specified for all error vector magnitude measurements made on mobile radios.

Only slot 1, 2, or 3 should be specified for the Digital Generator.

Trig Delay

The **Trig Delay** field specifies the number of bits that the trigger signal will be delayed before it is sent to the Digital Analyzer's trigger input. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 1**.

The range of acceptable settings is from 1 to 1679 bits.

Operating Considerations

Delaying the trigger can be useful when you need to capture a timeslot of data that is delayed relative to the trigger.

The trigger delay must be smaller than the period between triggers, or the RX DSP will never be triggered. For example, if the **Trig Type** is set to **2x Frame**, the **Trig Delay** must be set to <840 bits: 3 slots of data × 280 bits-per-slot = an 840 bit period between triggers.

This delay is not used when the **Trig Type** field is set to **Immediate**.

Trig Type

This field specifies the trigger conditions for the Digital Analyzer. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 1**.

Selecting **Immediate** causes the analyzer to be triggered immediately when **Arm** is selected in the of the **Digital Anl** field.

Selecting **ANL TG IN** causes the analyzer to be triggered on the rising edge of the signal connected to the ANALYZER TRIGGER IN port.

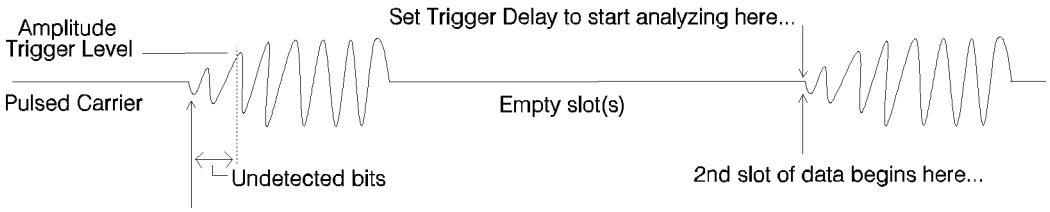
Selecting **Frame Clk** causes the analyzer to be triggered by the 25 Hz frame clock provided by the Test Set's Digital Generator.

Selecting **2 × Frame** causes the analyzer to be triggered by the 50 Hz, 2 × frame clock provided by the Test Set's Digital Generator.

Selecting **INV TG IN** causes the analyzer to be triggered on the falling edge of the signal connected to the ANALYZER TRIGGER IN port.

Amplitude triggering uses low-to-high amplitude transitions in pulsed carriers as the trigger source. Trigger thresholds are at –6 dB (**Amptd Hi**), –12 dB (**Amptd Mid**), and –18 dB (**Amptd Low**) from the maximum AdcMaxAbs level. The **Input** field must be set to either **Int IF** or **Ext IF IN**.

If the initial amplitude of the carrier pulse is not high enough, the trigger will occur too late to analyze the first few bits, causing EVM or BERT errors. In that case, use the Trigger Delay field to capture the next full transmitted data pulse.



Operating Considerations

Selecting the appropriate trigger is necessary when making BERT measurements and aligning the Digital Analyzer to timeslots for EVM measurements.

Width (Pulse Modulation)

This field defines how long the CHAN PLS MOD-OUT connector is high after **Send** is selected. The value entered is the number of data bits that are clocked by the frame clock.

The range of acceptable values is 0.25 to 1680.0 bits in 0.25 bit increments.

This field is only displayed when the Digital Generator **Controls** field is set to **In Ch PM** or **Off Ch PM**, and is only used for pulsed carrier operation with an HP 83215A.

PHP Cellular Test

The PHP CELLULAR TEST screen is used to test cellular telephones that use the Personal Handi Phone format. This screen can only be displayed if an HP 83201B TDMA Cellular Adapter is connected to the Test Set.

Accessing 'Hidden' Controls

Two **`Controls`** fields are used to access fields for the Digital Analyzer and Digital Generator that are not initially displayed on this screen. These controls are shown in **figure 1** on the page, and **figure 2** and **figure 3 on page 53**. Refer to the **`Controls` field description, on page 100**, for more information.

Displaying Measurements

When this screen is first displayed, the measurement fields and values are not shown. Measurements are only displayed after the Digital Analyzer has been armed and triggered.

The above screen image shows the measurements returned for Error Vector Magnitude (EVM) after a valid measurement has been made.

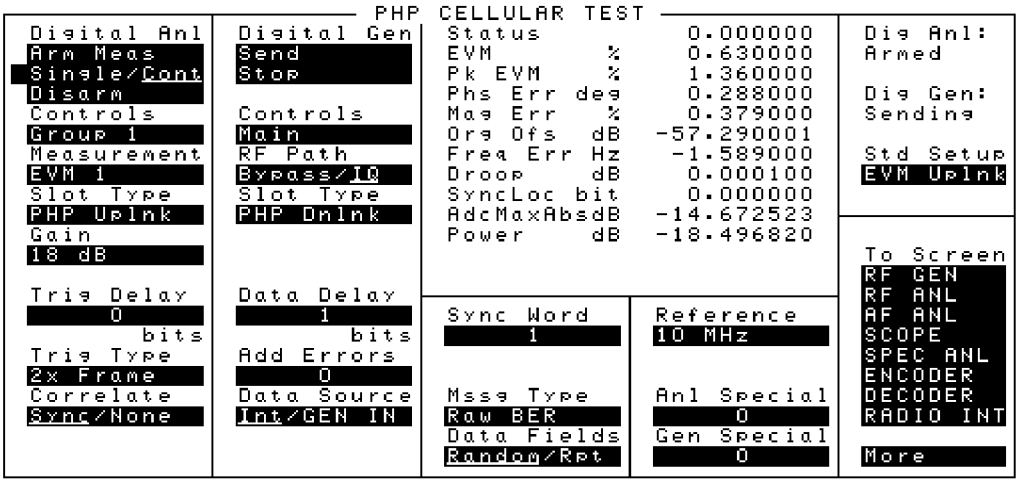


Figure 4 **Analyzer Controls Group 1, Main Digital Generator Control**

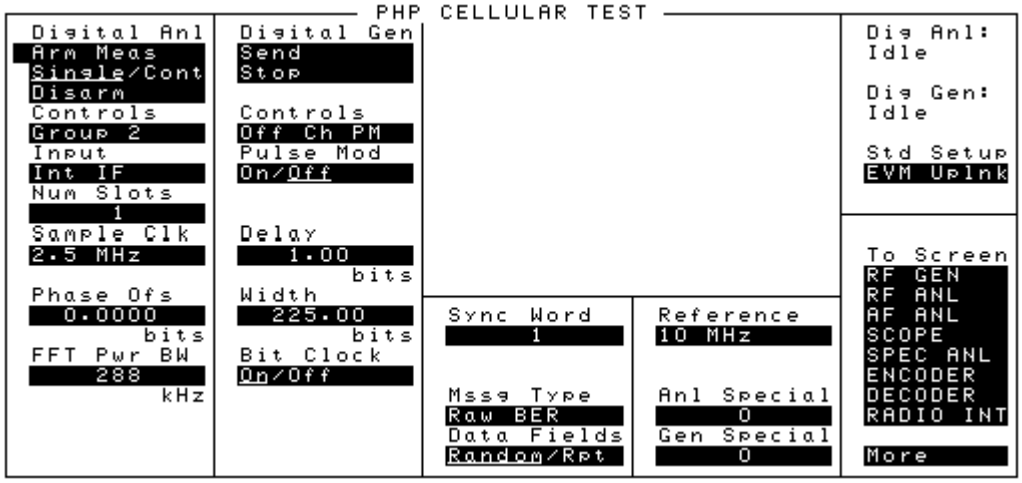


Figure 5 **Analyzer Controls Group 2, Off Ch PM Digital Generator Controls**

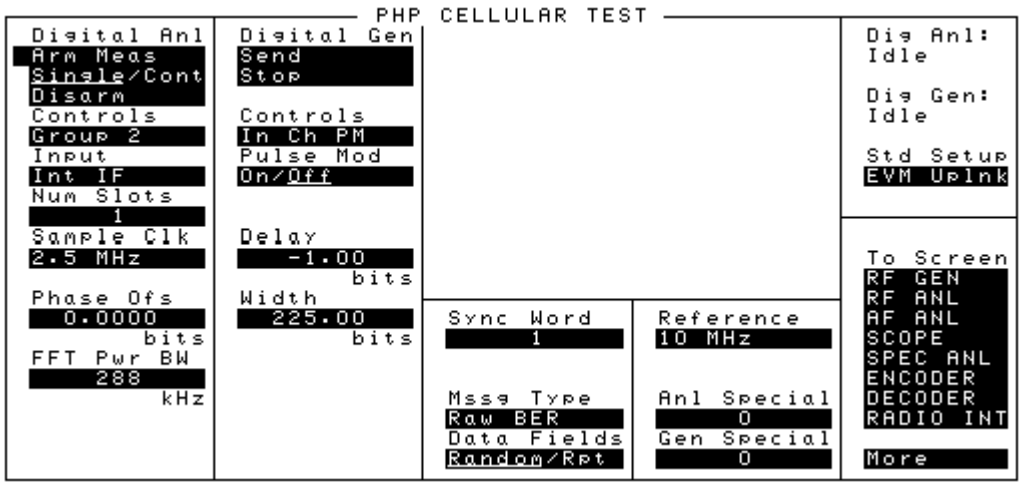


Figure 6 **Analyzer Controls Group 2, In Ch PM Digital Generator Controls**

Ad Ch Pwr

When selected for the **Measurement** field, this function prepares the Digital Analyzer to make an Adjacent Channel Power measurement. To measure adjacent channel power levels, the Test Set must be tuned to the desired adjacent channel and the measurement repeated to compare power levels.

Refer to the **Measurement field description, on page 112**.

AdcMaxAbs

This measurement indicates the peak detected level into the Analog-to-Digital Converter (ADC). The units are dB, relative to the maximum allowed ADC input level. This value is displayed for all **Measurement** field settings except BERT.

For valid EVM measurements, this, value should be between 0 and –23 dB. (The closer to 0 dB (full-scale) the better, as long as the level never reaches 0.) For power measurements, such as Adjacent Channel Power, Carrier Power, and Carrier Leakage, the power level can be lower for accurate measurements; typically -35 dB (with the **FFT Pwr BW** field set to 288 kHz).

Operating Considerations

If the **Correlate** field is set to **Sync** and a Sync Early or Sync Late Status error occurs, the AdcMaxAbs value is still returned but other measurement values may be set to all zeros.

The ADC input level is affected by three values:

- The amplitude of the PHP signal connected to the Test Set.
- The RF ANALYZER screen's **Input Atten** setting.
- The PHP CELLULAR TEST screen's **Gain** setting.

Table 13 lists the recommended **Input Atten** and **Gain** settings for measuring input signals < 17 dBm at the ANT IN port.

For measuring signals > +17 dBm, use the RF IN/OUT port. When using the RF IN/OUT port, subtract 36 dB from the input signal level to determine the input level to use in the table. For example, if the signal level at the RF IN/OUT port is +35 dBm, use –1 dBm as the Input Level in the table.

Table 13 Symbol Rate Measurement Status Codes

Input Level at Ant In (RMS)	Digital Anl Gain Setting	InputAtten Setting
+17 dBm	0 dB	40 dB
+11 dBm	6 dB	40 dB
+5 dBm	12 dB	40 dB
–1 dBm	18 dB	40 dB
–3 dBm	0 dB	20 dB
–9 dBm	6 dB	20 dB
–15 dBm	12 dB	20 dB
–21 dBm	18 dB	20 dB
–23 dBm	0 dB	0 dB
–29 dBm	6 dB	0 dB
–35 dBm	12 dB	0 dB
–41 dBm	18 dB	0 dB

Add Errors

This field specifies the number of bit errors the Digital Generator includes in each slot of data when sent. Up to 15 errors can be added. This field is only displayed when the **Gen Control** field is set to **Main**.

When the **Data Fields** field is set to **Random**, the same number of errors is used for each slot, but the bit positions change at random.

When the **Data Fields** field is set to **Rpt** (Repetitive), the same bits are changed in each slot.

The errors can be used to validate a bit error rate measurement. The number of errors detected by the analyzer can be compared to the number of errors specified to verify that a valid measurement has been made. Also, adding a known number of errors to the data can be useful for verifying that the measurement results reflect the actual conditions of the input signal.

Anl Special

This field selects special operating modes available for the Digital Analyzer.

When using the HP 83215A Digital Radio Interface in a system to measure EVM of a radio, set this field to **0**. When measuring EVM of the Test Set and Cellular Adapter without using the HP 83215A, set this field to **1** (this inverts the spectrum to allow proper demodulation of the sync word).

When measuring Carrier Power or Adjacent Channel Power, set this field to **1**.

Operating Considerations

If special 102, “IQ Modulator Cal”, is used for calibration, the **Sample Clk** must be set to **105.0 kHz**, and the Digital Generator should be stopped.

BERT

When selected in the **Measurement** field, this measurement indicates the difference between the TCH bit stream demodulated by the Digital Analyzer and the actual TCH bit pattern created by the Digital Generator.

This parameter indicates the receiver's ability to correctly demodulate data.

Refer to the **Measurement field description, on page 112**.

Operating Considerations

The Digital Generator outputs all data bits in a slot, including TCH bits. To make a BERT measurement, your radio must be able to demodulate the TCH bits separately. The TCH data from your radio must be connected to the Cellular Adapter's front-panel ANALYZER BASEBAND DATA IN connector. Your radio must also provide the necessary data clock on the ANALYZER DATA CLOCK IN connector to analyze the data.

The TCH data must be present on the ANALYZER BASEBAND DATA IN port for ≥100 ns. before the rising edge of the ANALYZER DATA CLOCK IN signal. The data must be stable on this input for ≥1.3 µs after being triggered by the Data Clock to correctly read the data.

Bit Clock

This field turns the bit clock on or off for Off Channel Pulse Modulation operation. This field is only displayed when the Digital Generator **Controls** field is set to **Off Ch PM**.

Clk Freq (Hz)

When making a Symbol Rate measurement, this field displays the measured Symbol Clock frequency. **See "Symbol Rate" in the `Measurement` field description, on page 112.**

Controls

Two **`Controls`** fields are used to access Digital Analyzer and Digital Generator fields. Some of these fields are not initially displayed when the PHP CELLULAR TEST screen is first accessed.

The Digital Analyzer **`Controls`** are divided into two groups to access all of the required analyzer settings.

- **`Group 1`** accesses the **`Measurement`**, **`Slot Type`**, **`Gain`**, **`Trig Delay`**, **`Trig Type`**, and **`Correlate`** fields.
- **`Group 2`** accesses the **`Input`**, **`Num Slots`**, **`Sample Clk`**, **`Phase Ofs`**, and **`FFT Pwr BW`** fields.

The Digital Generator **`Controls`** are divided into three groups, according to the type of carrier you want to generate:

- **`Main`** is used to create a continuously-modulated carrier.
- **`Off Ch PM`** is used to create Off Channel Pulse Modulated carriers.
- **`In Ch PM`** is used to create In Channel Pulse Modulated carriers.

Correlate

This field determines whether the data measured by the Digital Analyzer will be aligned with the sync word in the time slot or not. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 1**.

Selecting **Sync** enables the Digital Analyzer to identify the beginning of the time slot from the total data captured.

Selecting **None** causes measurements to be made beginning at a default point within the captured data.

Operating Considerations

Sync must be selected when measuring EVM.

This field is ignored for all other measurements.

Data Delay

This field specifies the number of bits that the Digital Generator will wait to send its baseband data after **Send** has been selected in the Digital Gen field and the Cellular Adapter's frame clock goes high. This delay is valid only for internal data; external data is not affected.

This field is only displayed when the **Gen Control** field is set to **Main**.

When **Int** is selected in the **Data Source** field, the delay affects the baseband signal sent to the instrument's IQ Modulator, Digital Analyzer, and GEN BB DATA OUT connector located on the rear panel.

Operating Considerations

The data delay setting is important when you are trying to align the Test Set's data pattern to a base station or control station that requires proper time alignment.

The appropriate amount of delay depends on the particular base station that you are testing.

Mobile radios will adjust to the Test Set, so the delay is not required for a mobile radio test.

Data Fields

This field determines whether the data output by the Digital Generator and measured by the Digital Analyzer will be a random or repeating sequence of data.

Selecting **Random** causes the Digital Generator to output a continuous 511-bit 2^9-1 random sequence. When the 511th bit is output in the middle of a timeslot, the sequence automatically re-starts to complete that slot and start the next. The Digital Analyzer then uses the same data pattern output by the generator for measuring BER (Bit Error Rate).

Selecting **Rpt** allows a BER measurement to be made with 1 timeslot of the same TCH data for every repeating frame.

Data Source

This field selects which baseband data source is sent to the instrument's IQ Modulator, Digital Analyzer, and GEN BB DATA OUT connector located on the rear panel. This field is only displayed when the **Gen Control** field is set to **Main**.

Int selects the baseband signal provided by the instrument's Digital Generator.

GEN IN selects the GENERATOR BASEBAND DATA IN connector located on the front panel.

Delay (Pulse Modulation)

This field defines the number of bits of data (or frame clock cycles) that are output by the Digital Generator (when **Send** is selected) before the IN-CHAN PLS MOD-OUT or OFF-CHAN PULSE MOD OUT connector goes high for pulsed carrier control.

This field is only displayed when the Digital Generator **Control** field is set to **Off Ch PM** or **In Ch PM** for pulsed carrier operation with an HP 83215A.

The range of acceptable values is 0.25 to 1680.0 bits in 0.25 bit increments.

Dig Anl:

This field indicates the state of the Digital Analyzer.

Idle indicates the Digital Analyzer is not armed and cannot make a measurement, even if an appropriate trigger is received.

Armed indicates the Digital Analyzer is ready to be triggered to make a measurement, or has been triggered and is computing measurement results.

See Also

Digital Anl field description (this page)

Digital Anl

This field selects how the Digital Analyzer is armed to make a measurement.

Selecting **`Arm Meas`** sets the analyzer to make a measurement as soon as it is triggered. **`Arm Meas`** must be selected once the analyzer fields have been set up to begin a measurement. Changing field settings *after* arming the measurement will cause the Digital Analyzer to terminate the current measurement and re-arm to begin another measurement using the new setting. If the Digital Generator is also being used, changing field settings may cause the generator to stop sending data. **`Send`** must then be selected in the **`Digital Gen`** field to begin sending data again.

Selecting **`Single`** causes the analyzer to make a single measurement each time it is armed. When **`Cont`** is selected, the analyzer continuously repeats the measurement and updates the displayed results as the measurement data becomes available.

Selecting **`Disarm`** affects operation only when the analyzer has been armed but measurements have not been displayed.

Operating Considerations

When making measurements on the instrument's Digital Generator, it is generally best to select **`Send`** in the **`Digital Gen`** field, then select **`Arm`**.

Selecting **`Arm`** while the Digital Analyzer is making a measurement will cause it to re-arm for another measurement.

Dig Gen:

This field indicates the status of the Digital Generator.

`Idle` indicates the generator is not sending the digital data defined in the various fields.

`Sending` indicates the generator is sending the digital data to the IQ modulator to modulate the carrier using the π/4 DQPSK format.

See Also

`Digital Gen` field description (this page)

Digital Gen

This field is used to start and stop the Digital Generator.

Selecting **`Send`** causes the Digital Generator to begin sending its output data immediately after the rising edge of the Frame Clock, unless a delay value greater then 0 has been specified in the **`Data Delay`** field.

Selecting **`Stop`** causes the generator to stop sending its defined data, and to start sending an undefined data pattern (normally a series of zeros). Making changes to field settings on the display can also cause the generator to stop sending its data.

Droop

(Burst) Amplitude Droop is the difference in the measured level (dB-per-symbol) between the IQ decision points in the received signal. This measurement is displayed when measuring Error Vector Magnitude.

This parameter is most significant for pulsed signals. A high number would indicate a problem with the pulse modulation process.

For battery powered mobiles, output power can drop over the burst when the battery is low.

Err

This field indicates the number of bit errors detected during the BERT measurement.

Err Rate

This field indicates the number of bit errors detected per slot as a percentage of the number of data bits transmitted per slot (160). This value is calculated as follows:

(number of errors × 100) ÷ (number of slots × 160)

This value is only displayed for BERT measurements.

EVM

This measurement field specifies the magnitude of the error vector which connects an ideal signal trajectory to the compensated measured signal trajectory at the detection decision point. The measured signal is compensated for clock delay, carrier frequency, carrier phase, amplitude scale, amplitude droop, and IQ Origin Offset.

The RMS value of the error vector is calculated by taking the square root of the sum of the squares of the individual error vector magnitudes at each detection decision point over the measured burst. The magnitude error and the phase error are the two components which determine the over-all error vector magnitude.

FFT Pwr BW

The Fast Fourier Transform Power Bandwidth field sets the RF bandwidth for the Adjacent Channel Power, Carrier Power, and Carrier Leakage measurements. This value is centered around the center frequency, so the measured bandwidth is ± 1/2 this value from the center frequency.

Bandwidths from 1 to 300 kHz can be specified.

Freq Err

This measurement field specifies the frequency error between the measured RF signal and the expected RF frequency that the Test Set is tuned to. Errors in the carrier frequency, LO frequency, or digitizer clock rate (timebase) can all appear as a **`Freq Err`**.

Gain

This field sets the gain of the Digital Analyzer's RF input path. This field is displayed when the Digital Analyzer **`Controls`** field is set to **`Group 1`**.

This setting affects the signals connected to the analyzer via the 114.3 MHz IF IN and the EXT IF IN connectors located on the instrument's rear panel.

Operating Considerations

Although the gain steps are shown in 6 dB increments, the actual gain change is not exactly 6 dB.

This setting affects all Digital Analyzer measurements except when digital data is being measured using the ANALYZER BASEBAND DATA IN connector, such as for a receiver looped-back to the Test Set for bit error rate testing.

Use as much gain as possible without over-driving the Analog-to-Digital Converter (ADC). The input level into the ADC relative to the maximum allowed level is indicated (in dB) by the **`AdcMaxAbs`** measurement (displayed with all measurements except BERT).

See Also

A procedure for setting the gain and RF input attenuators for a given input level is provided in the **`AdcMaxAbs` field description, on page 96**.

Gen Control

This field selects how you want the Digital Generator to be output:

`Main` is used when a continuously-modulated carrier is required.

`Pulse Mod` is used to create a pulsed carrier when an HP 83215A is connected.

When this field is changed, the other Digital Generator control fields below this field change to provide the appropriate controls.

Gen Special

In the future, this field will be used to select special Digital Generator operating modes. No special modes have been defined at this time.

This field should always be set to **`0`**.

Input

This field selects the input path for the Digital Analyzer. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 2**.

Int IF selects the input path for using the RF IN/OUT or ANT IN connectors on the front panel of the Test Set. The RF input signal is converted to an IF and sent from the 114.3 MHz IF OUT connector to the 114.3 MHz IF IN connector on the Test Set's rear panel.

EXT IF IN selects the EXT IF IN connector on the rear panel. This connector provides a path for connecting an external 700 kHz IF signal (30 to 40 mV peak) to the analyzer.

ANL DT IN selects the ANALYZER BASEBAND DATA IN connector located on the front panel of the Test Set. This connector provides a path for connecting a demodulated PHP data stream (TTL) to the analyzer.

IQ Mod selects an internal path that connects the output of the Test Set's Digital Generator to the data input on the Digital Analyzer. The output of the Digital Generator is also available at the GEN BB DATA OUT connector on the Test Set's rear panel.

Operating Considerations

Use **Int IF** or **EXT IF IN** unless you are performing a TTL BERT measurement.

TTL BERT uses only **ANL DT IN**.

Mag Err

This measurement field specifies the difference in amplitude at the detection decision point between the received signal and an ideal signal generated with the same data pattern. The difference in amplitude is referenced to the amplitude of the ideal signal on the unity circle to obtain the percent difference. The rms value is calculated by summing the squares of the individual magnitude errors at each detection decision point over the measured burst, dividing by the number of points, and then taking the square root.

Magnitude Error is an indicator of the quality of the amplitude component of the π/4 DQPSK signal. For example, a very high magnitude error might indicate high incidental AM modulation on the signal. This error can also be caused by a faulty linear power amplifier or modulator, or when data is not aligned with the RF burst on a mobile radio.

The magnitude error, when converted to a phasor, is one of the components of the error vector magnitude.

The rms value is calculated by summing the squares of the individual magnitude errors at each detection decision point over the measured burst, dividing by the number of points, and then taking the square root.

Measurement

This field selects the measurement mode for the Digital Analyzer. This field is displayed when the Digital Analyzer **`Controls`** field is set to **`Group 1`**.

When a measurement is completed, several associated measurements may also be displayed; such as the measured signal's power level into the Digital Analyzer (**`AdcMaxAbs`**). *Descriptions for each of these associated measurements are listed alphabetically in this chapter.*

NOTE: The **`Status`** field does not provide measurement results. It indicates the operating status of the analyzer for the measurement. A status value of "0" indicates no measurement errors were detected. For additional information, refer the **`Status` field description, on page 124**.

Error Vector Magnitude

`EVM 1` sets the analyzer to make its measurements on 1 timeslot after it is triggered. The analyzer is set up to make the following measurements.

- Status
- Error Vector Magnitude (%)
- Peak Error Vector Magnitude (%)
- Phase Error (Degrees)
- Magnitude Error (%)
- Origin Offset (dB)
- Frequency Error (Hz)
- Droop (dB)
- SyncLoc (bit)
- ADC Maximum Absolute Power (dB)
- Power (dB)

Bit Error Rate Test

BERT sets the analyzer to make the following measurements for Bit Error Rate Testing:

- Status
- Slots
- Errors
- Error Rate (%)

Adjacent Channel Power

Ad Ch Pwr sets the analyzer to make a power measurement over the total bandwidth specified in the **FFT Pwr BW** field. This measurement can only be made on a pulsed carrier.

The displayed measurements are:

- Status
- ADC Maximum Absolute Power (dB)
- Power (dB)

Carrier Power

Carr Pwr sets the Digital Analyzer to make a *relative* power measurement of a carrier. (The absolute power level is not measured.) The carrier is assumed to be pulsed.

The **FFT PWR BW** field is used to set the measurement bandwidth. Limiting the bandwidth improves the dynamic range of the measurement, allowing more accurate comparisons of carrier levels.

The displayed measurements are:

- Status
- Adc Maximum Absolute Power (dB)
- Power (dB)

Carrier Leakage

Carrier Leakage prepares the Digital Analyzer to measure *low* RF power levels within the bandwidth specified in the **FFT PWR BW** field. The returned value is a *relative* power level. (The absolute power level is not measured.)

- Status
- Adc Maximum Absolute Power (dB)
- Power (dB)

Symbol Rate

`Sym Rate` prepares the Digital Analyzer to measure the Symbol Clock frequency (Hz) of a *continuously-modulated* carrier that is present for ≥10 ms after triggering. This measurement cannot be made on a pulsed carrier. For best results, use a data pattern containing a large number of 1's and a signal level (AdcMaxAbs) as close to 0.000000 as possible.

The displayed measurements are:

- Status
- AdcMaxAbs (dB)
- Clk Freq (Hz)

Occ BW

The **`Occ BW`** (Occupied Bandwidth) **`Measurement`** selection prepares the Digital Analyzer to measure the frequency bandwidth (Hz) containing 99% of the total measured carrier power.

The displayed measurements are:

- Status
- AdcMaxAbs (dB)
- Occ BW (Hz)

Mssg Type

This fields specifies the type of data the Digital Generator will transmit. It also specifies the type of data the Digital Analyzer will expect to receive for a BERT measurement.

`Raw BER` selects un-coded (non-convolutional encoded) data for making Bit Error Rate measurements. (No other measurements are affected by this field.)

`Custom 1-3` are provided for selecting other custom data patterns that may have been installed.

Num Slots

The **`Num Slots`** field in the Digital Analyzer specifies the number of slots of data the Digital Analyzer will use when performing a BERT measurement. This setting is ignored for all other measurements. This field is displayed when the Digital Analyzer **`Controls`** field is set to **`Group 2`**.

Org Ofs

This measurement field (Origin Offset) specifies the magnitude of RF carrier feed-through relative to the magnitude of the modulated carrier at the detection decision points (data clock edges).

Carrier feed-through is an indication of the balance of the I-Q modulator. If the modulator is balanced, the carrier is nulled in the RF spectrum. Imbalance in the I-Q modulator will result in carrier feed-through and will appear as a dc offset on the demodulated I-Q signal.

Phase Ofs

The Phase Offset field is used to alter the Symbol Clock phase relative to the measured data. (EVM measurements are higher if the IQ decision points for the incoming signal are not correctly aligned with the Symbol Clock.)

The value can be set for a positive or negative phase offset in the range of –2.0 to +2.0 bits. With a resolution of 0.0001 bits, each increment results in a change of ±0.015% EVM.

This value should be set to 0.0000 unless you suspect the Digital Analyzer is not measuring the EVM at the optimal symbol clock phase of the transmitted signal.

Pk EVM

This measurement field specifies the worst case EVM measured for a symbol over the measurement burst.

Phase Error

This measurement field specifies the difference in phase, at the detection decision points, between the received signal and an ideal signal generated from the same data pattern.

The magnitude of this error is an indicator of the quality of the phase component of the π/4 DQPSK signal. For example, a very high phase error might indicate high incidental FM modulation on the signal.

The phase error, when converted to a phasor, is one of the components of the error vector magnitude (EVM) measurement.

Power (For EVM Measurements)

When measuring EVM, this measurement field specifies the *rms* power level (in dB) seen by the Digital Analyzer relative to the maximum allowed (full scale) ADC input level. The value is calculated using the middle 100 symbols of a slot after IF filtering.

The measured level is affected by the RF input signal level, the input attenuator setting, and the **`Gain`** field setting.

Operating Considerations

If the **`Correlate`** field is set to **`Sync`**, and a Sync Early or Sync Late status error occurs, this measurement is aborted and zeros are displayed.

This is an un-calibrated measurement. To calibrate the RF path to the digitizer, make an initial power level measurement on a known power source using the Digital Analyzer. Determine the difference between the known source and the measured level. Apply the difference as the calibration factor for subsequent power measurements made with the Digital Analyzer.

The IF filter used has ≈90 kHz 1dB bandwidth, and 120 kHz 3dB bandwidth.

See Also

Refer to the **`AdcMaxAbs` field description, on page 96**, for information on setting the input attenuator and Gain settings for a given input level.

Power

Displayed when making Adjacent Channel Power, Carrier Power, Carrier Leakage, and Occupied Bandwidth measurements.

This measurement returns a power value indicating *relative* carrier power levels: it does not directly indicate absolute carrier power. It is primarily intended for comparing signal levels, such as RF on/off values or Adjacent Channel Power levels.

The value is calculated using a Fast Fourier Transform algorithm. The measurement bandwidth is specified in the **`FFT PWR BW`** field. Limiting the bandwidth improves the dynamic range of the measurement.

The measured level is affected by the RF input signal level, the input attenuator setting, and the **`Gain`** field setting.

See Also

Refer to the **`AdcMaxAbs` field description, on page 96**, for information on setting the input attenuator and Gain settings for a given input level.

Pulse Mod

This field enables (On) or disables (Off) pulse modulation. This field is only displayed when the Digital Generator **`Controls`** field is set to **`In Ch PM`** or **`Off Ch PM`**.

Operating Considerations

When set to **`Off`**, the voltage level remains high at the IN-CHAN PLS MOD-OUT and OFF-CHAN PULSE MOD OUT connectors on the Cellular Adapter. This signal is normally connected to the HP 83215A Digital RF Interface to control the Pulse Modulator. A high level on this line causes the modulator in the HP 83215A to continually pass the connected carrier signal.

Reference

This field specifies which reference frequency is to be used by the Digital Generator. This setting should be selected to match the frequency of the signal connected to the REF IN connector on the rear panel of the Test Set.

Operating Considerations

For testing mobile radios, the REF IN connector is normally connected to the Test Set's 10 MHz output connector.

When making BERT measurements on base stations, the Test Set may be locked to a data clock (such as a bit, frame, or slot clock) provided by of the unit-under-test.

RF Path

This field determines if the input signal connected to the CW RF IN connector on the rear panel is IQ modulated by the Test Set before it is sent to the IQ RF OUT connector (also on the rear panel). This field is only displayed when the **`Gen Control`** field is set to **`Main`**.

If **`IQ`** is selected, the signal will be IQ modulated when the Digital Generator is sending.

If **`Bypass`** is selected, the signal will be sent directly from the CW RF IN connector to the IQ RF OUT connector without being modulated.

Sample Clk

This field sets the sample clock rate for the Digital Analyzer. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 2**.

2.5 MHz must be used for all measurements *except BERT*. The **Input** field must be set to **EXT IF IN**, and a 700 kHz external IF signal must be connected to the EXT IF IN port.

ANL CLK IN or **INV CK IN** must be selected for BERT test, and an external clock (≤ 384 kbit/s) must be connected to the ANALYZER DATA CLOCK IN port. The signal to be measured must be connected to the ANALYZER BASEBAND DATA IN port, and the **Input** field must be set to **ANL DT IN**. The data must be available at the ANALYZER BASEBAND DATA IN port for ≥ 100 ns before the rising edge (**ANL CLK IN**) or falling edge (**INV CK IN**) of the external clock. The hold time of the data after the rising edge (**ANL CLK IN**) or falling edge (**INV CK IN**) of the clock must be ≥ 1.3 µs to make a valid BERT measurement.

Operating Considerations

The 960.0 kHz clock rate is not currently used for any measurements.

Slots

This measurement field indicates the number of slots used for a BERT measurement. The value returned when the BERT measurement is complete should match the number specified in the **Num Slots** field.

Slot Type

`Slot Type` fields are provided for the Digital Analyzer and the Digital Generator.

The **`Slot Type`** field for the Digital Analyzer specifies the type of PHP slot (PHP Uplink or PHP Downlink) that the Digital Analyzer is to measure. This field is displayed when the Digital Analyzer **`Controls`** field is set to **`Group 1`**.

The **`Slot Type`** field for the Digital Generator specifies the slot type to be output. The **`Cnt2^9-1`** and **`Cnt2^15-1`** selections are for continuous data streams represented by the pseudo-random pattern of a 511-bit sequence and a 32767-bit sequence. This field is only displayed when the **`Gen Control`** field is set to **`Main`**.

Operating Considerations

Selecting the appropriate **`Slot Type`** is necessary when making BERT or EVM measurements when you are synchronizing to a sync word.

Std Setup

The Standard Setup field selects pre-defined control setups for several types of measurements. Selecting the appropriate setup automatically configured the different fields typically used for that measurement.

After selecting the desired measurement setup, you may have to make some adjustments for your particular test setup to make valid measurements. These adjustments will vary, depending on the test system, radio under test, and the type of measurement you are making.

Status

This field indicates the status of the Digital Analyzer when making its measurements. A status of 0 means that no errors were reported.

The status result encodes any errors that might have occurred during the measurement. The status is the sum of a bit-mapped collection of one or more error conditions.

For example, a status of 22 for an EVM measurement would be decoded as follows:

```
22 = 16 + 4 + 2
     |  |  | Sync even
     |  | Weak clock
     | ADC overdriven
```

Each **`Measurement`** field selection has its own associated **`Status`** conditions. The tables on the following pages list the status conditions for each measurement type.

Correcting ADC Drive Level Conditions

When a Status value >0 occurs, the first thing to do is make sure the Digital Analyzer is not being under-driven or over-driven. With the exception of BERT, all measurements return a power level as **`AdcMaxAbs`**. This value tells you if the signal into the Digital Analyzer is within its measurement range. If this value is less than ≈–30 dB, the analyzer may not be getting enough signal. If the returned value is ≥0, you are over-driving the analyzer.

Refer to the **`AdcMaxAbs` field description, on page 96**, for information on setting the input gain and attenuators for a known input level.

Table 14 EVM Measurement Status Codes

Decimal	Bit	Description
1	0	Sync Error. The sync word contained an error or was not found. A measurement was made and results were returned.
2	1	Sync Even. The sync word began on the second bit of the symbol. A measurement was made and results were returned.

Table 14 EVM Measurement Status Codes

Decimal	Bit	Description
4	2	Weak Clock. The Test Set had difficulty to finding the data clock's phase, for example, when all zeros are transmitted. Ameasurement was made and results were returned, however, performance may be degraded.
8	3	ADC Underdriven. The absolute value of the peak sample wasless than 30 dB below full scale of the ADC. A measurement wasmade and results were returned.
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results werereturned.
32	5	No Trigger or Clock Present. Not implemented.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted and zeros returned.
128	7	Sync Early. The sync word occurred too soon in the burst. The measurement is invalid and aborted, and zeros are returned.
256	8	Sync Late. The sync word occurred too late in the burst. The measurement is invalid and aborted, and zeros are returned.
512	9	Converge Error. The parameter estimator does not converge. The measurement is aborted and zeros are returned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned. It is intended to indicate errors like selecting a 1 MHz **Sample Clk** with the **Input** set to **Internal IF** for an EVM measurement.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **Status** field for the user.
2147483648	31	Default. Specific error information is not available.

Table 15 BERT Measurement Status Codes

Decimal	Bit	Description
1	0	Sync Error. Synchronization of the slots received with the first expected slot did not occur. All other measurement fields except SyncLoc are invalid. This result is only displayed when **Random** is selected for the **Data Fields** field.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **Status** field for the user.
4096	12	Synchronization to the data pattern did not occur.
8192	13	The data acquisition time between any two bits was ≈ >50 ms. The measurement results are not valid.

Table 16 Adjacent Channel Power Measurement Status Codes

Decimal	Bit	Description
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results werereturned.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted, and all zeros werereturned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **Status** field for the user.

Table 17 Carrier Power and Carrier Leakage Measurement Status Codes

Decimal	Bit	Description
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results werereturned.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted, and all zeros werereturned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **`Status`** field for the user.
2147483648	31	Default. Specific error information not available.

Table 18 Symbol Rate Measurement Status Codes

Decimal	Bit	Description
4	2	Weak Clock. The Test Set had difficulty to finding the data clock's phase, for example, when all zeros are transmitted. Ameasurement was made and results were returned, however, performance may be degraded.
8	3	ADC underdriven. The absolute value of the peak sample is less than 30 dB below full scale of the ADC. A measurement is made and results are returned. (30 dB applies only to EVM measurements.)
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results werereturned.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted, and all zeros werereturned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.

Table 18 Symbol Rate Measurement Status Codes

Decimal	Bit	Description
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **`Status`** field for the user.
2147483648	31	Default. Specific error information not available.

Table 19 Occupied Bandwidth Status Codes

Decimal	Bit	Description
8	3	ADC underdriven. The absolute value of the peak sample is less than 30 dB below full scale of the ADC. A measurement is made and results are returned. (30 dB applies only to EVM measurements.)
16	4	ADC Overdriven. The absolute value of the peak sample wasat ADC full scale. A measurement was made and results werereturned.
64	6	Memory Overflow. The memory of the RX DSP board was exceeded. The measurement was aborted, and all zeros werereturned.
1024	10	Parameter Error. The user selected incompatible pass parameters in the analyzer fields. No hardware is set and all zeros are returned.
2048	11	FIFO abort. The measurement was aborted due to communication with the DSP board while a measurement was armed. If the measurement is aborted due to communication with the DSP, the host will swallow the measurement and automatically re-arm another measurement. This error is only seen by the host firmware and is not reported to the **`Status`** field for the user.
2147483648	31	Default. Specific error information not available.

SyncLoc

This measurement field indicates the time in bit periods from when the Digital Analyzer was triggered to the beginning of the first sync word symbol detected.

Operating Considerations

This value can be useful for determining the position of the trigger relative to the designated timeslot positions.

Trig Delay

The **`Trig Delay`** field specifies the number of bits that the trigger signal will be delayed before it is sent to the Digital Analyzer's trigger input. This field is displayed when the Digital Analyzer **`Controls`** field is set to **`Group 1`**.

The range of acceptable settings is from 1 to 1919 bits.

Operating Considerations

Delaying the trigger can be useful when you need to capture a timeslot of data that is delayed relative to the trigger.

The trigger delay must be smaller than the period between triggers, or the RX DSP will never be triggered. For example, if the **`Trig Type`** is set to **`2x Frame`**, the **`Trig Delay`** must be set to ≤ 959 bits (≈1919 ÷ 2).

This delay is not used when the **`Trig Type`** field is set to **`Immediate`**.

Trig Type

This field specifies the trigger conditions for the Digital Analyzer. This field is displayed when the Digital Analyzer **Controls** field is set to **Group 1**.

Selecting **Immediate** causes the analyzer to be triggered immediately when **Arm** is selected in the of the **Digital Anl** field.

Selecting **ANL TG IN** causes the analyzer to be triggered on the rising edge of the signal connected to the ANALYZER TRIGGER IN port.

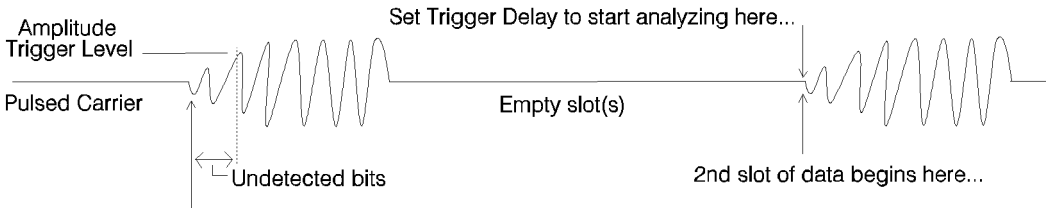
Selecting **Frame Clk** causes the analyzer to be triggered by the 200 Hz Frame Clock provided by the Test Set's Digital Generator.

Selecting **2 × Frame** causes the analyzer to be triggered by the 400 Hz, 2× Frame Clock provided by the Test Set's Digital Generator.

Selecting **INV TG IN** causes the analyzer to be triggered on the falling edge of the signal connected to the ANALYZER TRIGGER IN port.

Amplitude triggering uses low-to-high amplitude transitions in pulsed carriers as the trigger source. Trigger thresholds are at –6 dB (**Amptd Hi**), –12 dB (**Amptd Mid**), and –18 dB (**Amptd Low**) from the maximum AdcMaxAbs level. The **Input** field must be set to either **Int IF** or **Ext IF IN**.

If the initial amplitude of the carrier pulse is not high enough, the trigger will occur too late to analyze the first few bits, causing EVM or BERT errors. In that case, use the Trigger Delay field to capture the next full transmitted data pulse.



Operating Considerations

Selecting the appropriate trigger is necessary when making BERT measurements and aligning the Digital Analyzer to timeslots for EVM measurements.

Width (Pulse Modulation)

This field defines how long the CHAN PLS MOD-OUT connector is high after **Send** is selected. The value entered is the number of data bits that are clocked by the frame clock.

The range of acceptable values is 0.25 to 1680.0 bits in 0.25 bit increments.

This field is only displayed when the Digital Generator **Controls** field is set to **In Ch PM** or **Off Ch PM**, and is only used for pulsed carrier operation with an HP 83215A.

2

Connectors and Miscellaneous Hardware

In the following descriptions, *Cellular Adapter* refers to the HP 83201B. *Test Set* indicates the HP 8920 or HP 8921.

Connectors

10 MHz REF OUT

This rear-panel port outputs a 10 MHz reference. This signal is phase locked to the signal applied to the REF IN port. All clocks (Bit, Symbol, and Frame) are derived from or phase locked to this signal.

If the REF UNLOCK indicator is lit, the output frequency may not be accurate.

Operating Considerations

Nominal output level: >+5 dBm
Output impedance = 50Ω
Frequency stability = the same as the signal applied to the REF IN connector (typically needs to be within ±5 ppm of the selected **`Reference`** frequency).

See Also

REF UNLOCK indicator description **`Reference`** field description REF IN connector description

114.3 MHz IF IN

This rear-panel port is where the Cellular Adapter receives the 114.3 MHz IF from the Test Set's receiver section. It is usually connected to the Test Set's 114.3 MHz IF OUT port.

Operating Considerations

Input impedance = 50Ω
Input level range = –53 to –30 dBm
Input Bandwidth:

- For PHP Adjacent Channel Power measurements and all NADC and PDC measurements, the incoming signal goes through a 114.3 MHz bandpass filter with ≈400 kHz 3 dB bandwidth before down-conversion to 700 kHz. A 20 MHz LPF (Low Pass Filter) and 3 MHz LPF provide additional filtering before being analyzed.
- For all other PHP measurements, the bandpass filter is bypassed. The 114.3 MHz signal is down-converted directly to 700 kHz and sent to a 20 MHz LPF and 3 MHz LPF before being analyzed.

See Also

EXT IF IN connector description.

ANALYZER BASEBAND DATA IN

This front-panel port provides a direct input to the Digital Analyzer section for analyzing TDMA data streams. This port is enabled by selecting the **`Input`** field and choosing **`ANL DT IN`**.

Operating Considerations

The rising edge of the ANALYZER DATA CLOCK IN signal is used to trigger the Digital Analyzer to read the data.

The data must be present on the input for ≥100 ns before the rising edge of the clock. The data must be stable on this input for ≥1.3 µs after being triggered by the Data Clock to correctly read the data.

Input level = TTL Input impedance = 100 kΩ Data Rates:

- 42 kbit/s (PDC)
- 48.6 kbit/s (NADC)
- 384 kbit/s (PHP)

ANALYZER DATA CLOCK IN

The rising edge of the signal applied to this front-panel port causes the data on the ANALYZER BASEBAND DATA IN connector to be sampled by the Digital Analyzer. This port is enabled by selecting the **`Sample Clk`** field and choosing **`ANL CK IN`**.

Operating Considerations

Input level = TTL Input impedance = 100 kΩ
Expected Clock Frequency:

- 42 kHz (PDC)
- 48.6 kHz (NADC)
- 384 kHz (PHP)

ANALYZER TRIGGER IN

This front-panel port allows external signals to trigger the Digital Analyzer section to begin sampling the selected input. This port is enabled by selecting the **`Trig Type`** field and choosing **`ANL TG IN`**.

Operating Considerations

This signal is affected by the **`Trig Delay`** setting. If the **`Trig Delay`** setting is too large, the delay time overlaps the period of the triggering signal, preventing the analyzer from being triggered. Reduce the **`Trig Delay`** setting to prevent this overlap and allow the analyzer to be triggered. The minimum delay setting is 0 bits, resulting in a delay of ≈0.5 bit.

Input impedance = 100 kΩ
Input level = TTL (rising edge)

ANL TRIG OUT

The rear-panel Analyzer Trigger Output port outputs the signal used to synchronize external equipment to the Digital Analyzer. A rising edge indicates the Digital Analyzer was triggered.

The **`Trig Type`** field selects the desired signal.

A +5 Vdc level is present if **`Immediate`** is selected in the **`Trig Type`** field.

Operating Considerations

This signal is affected by the **`Trig Delay`** field setting. The minimum delay (**`Trig Delay`** set to 0 bits) is ≈1/2 bit time. Although you can enter fractional delay values, the actual delay will be rounded off to the nearest full bit.

Output level = CMOS Output impedance = 50 Ω

BIT CLK OUT

This rear-panel port outputs a square wave from the Digital Generator section's Bit Clock. This allows you to synchronize external equipment to the Digital Generator.

Operating Considerations

When using internally generated data, the GEN BB DATA OUT signal is stable before the rising edge of the BIT CLK OUT, allowing the Bit Clock to be used to strobe this data into your external equipment.

For PDC and PHP testing, the **`Bit Clock`** field can be used to turn this signal on and off. When set to **`Off`**, a +5 Vdc level is present at this port. This control is intended to turn off the π/4 DQPSK modulation of a connected off-channel signal generator without using the generator's modulation on/off switch.

Output frequencies = 48.6 kHz (NADC), 42 kHz (PDC), 384 kHz (PHP) Output level = CMOS Output impedance = 50Ω

CW RF IN

This rear-panel port is the RF carrier input to the Cellular Adapter. This signal is normally connected to the Test Set's CW RF Out port. Although not normally used when testing TDMA signals, the Test Set can use AFGen1 or AFGen2 to provide AM or FM before being connected to this port.

Operating Considerations

If the **RF Path** field is set to **IQ**, the signal gets π/4 DQPSK modulated before being routed to the rear-panel IQ RF OUT connector. If this field is set to **Bypass**, this signal is routed directly to the IQ RF OUT connector without being modulated.

Nominal input level = 0 dBm, ±4 dB Maximum input level = +12 dBm Input impedance = 50Ω
Frequency range:

- 500 to 1000 MHz without IQ modulation (may use AM or FM from the Test Set).
- 810 to 956 MHz with IQ modulation.

See Also

IQ RF OUT connector description.

CONTROL I/O

This connector provides data communication between the Test Set and the Cellular Adapter. The Cellular Adapter cannot be turned on without this cable attached to an operating Test Set.

DIAG OUT

This port provides various signals used to service the Cellular Adapter.

When servicing the Cellular Adapter, this port is connected directly to the Test Set's AUDIO IN (HI) connector. Diagnostic routines are then run using the Test Set's internal IBASIC computer to locate the faulty module.

EXT IF IN

This rear-panel port allows an external IF signal to be used in place of the 114.3 MHz IF that comes from the Test Set. This allows you to provide your own external down-conversion of the modulated carrier, bypassing the Test Set receiver down conversion to 114.3 MHz and Cellular Adapter down conversion to 700 kHz.

Operating Considerations

Input Frequency = 700 kHz, ± 1 kHz Input level range = 30 to 400 mV peak

Input impedance: The input impedance has changed due to design improvements. The first four numbers (serial prefix) of your Cellular Adapter's serial number indicate the version you have. (Example: **3315**A1234)

- Serial prefix 3315 and below ≈2 kΩ
- Serial prefix 3333 and above ≈1 kΩ

When testing NADC radios using the TDMA DUAL MODE CELLULAR TEST screen, set the **`Sample Clk`** to 2.5 MHz for a 700 kHz IF, and 1 MHz for a 220 kHz IF.

FRAME CLK OUT

This rear-panel port outputs a square wave from the Digital Generator section's Frame Clock. This allows you to synchronize external equipment to the Digital Generator.

Operating Considerations

Nominal output frequency = 25 Hz (NADC, PDC); 200 Hz (PHP) Output level = CMOS Output impedance = 50Ω

GEN BB DATA OUT

The rear-panel Generator BaseBand Data Output port monitors the digital signal applied to the Pre-modulation Filter/IQ Modulator. This signal is selected using the **Data Source** field, and comes from either of two sources:

- The internal Digital Generator section (**Int**).
- The front-panel GENERATOR BASEBAND DATA IN connector (**GEN IN**).

Operating Considerations

Modulation data consists of two-bit symbols (00, 01, 10, or 11) that are sent to a Pre-Modulation filter. The Pre-Modulation filter is just ahead of the IQ Modulator to properly shape the modulating waveform.

This signal is affected by the **Data Delay** field setting. If the Data Delay is '0', the first data of a valid time slot lines up with the rising edge of the frame clock. The nominal delay from the first data bit in a two-bit symbol to its peak RF response (decision point) after π/4 DQPSK modulation is 12 bits (6 symbols).

Output level = CMOS Output impedance = 50Ω
Nominal Data Rate:

- 42 Kb/s (PDC)
- 48.3 Kb/s (NADC)
- 384 Kb/s (PHP)

See Also

GENERATOR BASEBAND DATA IN

GENERATOR BASEBAND DATA IN

This front-panel port allows you to send external data to the Pre-modulation Filter/IQ Modulator. This port is enabled by selecting the **`Data Source`** field and choosing **`GEN IN`**.

Operating Considerations

When using an external reference, the same reference used to generate the Baseband data must also be connected to the Cellular Adapter's REF IN port to correctly clock-in the data.

Modulation data consists of two-bit symbols (00, 01, 10, or 11) that are sent to a Pre-Modulation filter. The Pre-Modulation filter is just ahead of the IQ Modulator to properly shape the modulating waveform. External data is clocked in on the rising edge of the Bit Clock. The first bit of a symbol is clocked in on the rising edge of the Symbol Clock, and the second bit of the symbol is clocked in on the falling edge of the Symbol Clock. Care must be taken to properly align the Baseband Data being input with the Symbol Clock to correctly modulate the Digital Generator.

This signal is not affected by the **`Data Delay`** field setting. The nominal delay from the first data bit in a two-bit symbol to its peak RF response (decision point) after π/4 DQPSK modulation is 12 bits (6 symbols).

Input level range = TTL Data rate = 48.6 Kb/s (NADC), 42 Kb/s (PDC), 384 Kb/s (PHP) Input impedance = 100 kΩ

See Also

`RF Path` field description in chapter 1. SYMBOL CLK OUT

IN-CHAN PLS MOD-OUT

The rear-panel In Channel Pulse Modulation Output port is normally connected to the HP 83215A's rear-panel PULSE INPUT port to control the RF modulator in the HP 83215A for pulse modulation. It is used for in-channel testing of PDC or PHP radios. (A CMOS high allows the modulator to pass the RF carrier from the connected signal generator; a CMOS low blocks the carrier.)

Pulse modulation can only be used when the **`Pulse Mod`** field is set to **`On`**. If the **`Pulse Mod`** field is set to **`Off`**, this signal stays high, allowing the HP 83215A's modulator to continuously pass the RF carrier.

The signal stays low for the number of bits entered in the **`In Channel: Delay`** field, and then goes high for the number of bits listed in the **`In Channel: Width`** field.

Operating Considerations

Output Level = CMOS Output Impedance = 50Ω
Pulse rate = Up to 200 Hz.

IQ RF OUT

This rear-panel port outputs the carrier applied to the rear-panel CW RF IN connector. The carrier may or may not be IQ modulated, depending on the **RF Path** field setting.

Although not normally used when testing TDMA signals, the Test Set can use AFGen1 or AFGen2 to provide AM or FM before being connected to the CW RF IN port and routed to this port.

This port is normally connected to the Test Set's rear-panel IQ RF IN connector.

Operating Considerations

When the **RF Path** field is set to **IQ**, the carrier is *always* IQ modulated. Even when the Digital Generator is not actively sending a message, the IQ Modulator still receives symbol data.

Output impedance = 50Ω
Nominal output level:

- –9.5 dBm (±1.5 dB) when IQ modulated.
- 0 dBm un-modulated (CW).

Frequency range:

- 500 to 1000 MHz without IQ modulation (may have AM or FM from the Test Set).
- 810 to 956 MHz with IQ modulation.

MAINS (LINE)

This connection furnishes AC Line power to the Cellular Adapter; however, the instrument is not turned on until the connected Test Set is turned on.

Operating Considerations

Line Voltage range: 100 V to 240 V Line Frequency range: 50 Hz to 60 Hz
Typical power consumption: < 80 VA over the entire range of line voltages and frequencies.

WARNING: Using line voltages and/or frequencies other than those listed can cause an electrical shock and/or fire hazard.

NOTE: The Test Set can be operated without the Cellular Adapter turned on if the I/O CONTROL and RF cables are still connected between the two instruments. If the I/O CONTROL cable is not connected, a cable must be connected between the Test Set's CW RF OUT and IQ RF IN ports to allow the Test Set to function by itself.

See Also

Refer to *Power Cables* in the Test Set's User's Guide for a list of available power cords.

OFF-CHAN PULSE MOD OUT

The front-panel OFF Channel Pulse Modulation Output port is normally connected to the HP 83215A's rear-panel PULSE INPUT port to control the RF modulator in the HP 83215A for pulse modulation. It is used for out-of-channel testing of PDC or PHP radios. (A CMOS high allows the modulator to pass the RF carrier from the connected signal generator; a CMOS low blocks the carrier.)

Pulse modulation can only be used when the **Pulse Mod** field is set to **On**. If the **Pulse Mod** field is set to **Off**, this signal stays high, allowing the HP 83215A's modulator to continuously pass the RF carrier.

The signal stays low for the number of bits entered in the **In Channel: Delay** field, and then goes high for the number of bits listed in the **In Channel: Width** field.

Output Level = CMOS Output Impedance = 50Ω
Pulse rate = Up to 200 Hz.

REF IN

This rear-panel connector provides a timing reference for the Digital Generator and Digital Analyzer sections. One of these frequencies must be used:

- NADC: 25 Hz, 50 Hz, 24.3 kHz, 48.6 kHz, 1 MHz, 2 MHz, 5 MHz, 10 MHz.
- PDC: 25 Hz, 50 Hz, 21.0 kHz, 42.0 kHz, 1 MHz, 2 MHz, 5 MHz, 10 MHz.
- PHP: 200 Hz, 400 Hz, 192.0 kHz, 384.0 kHz, 1 MHz, 2 MHz, 5 MHz, 10 MHz.

The Test Set's 10 MHz REF OUTPUT is normally used.

Operating Considerations

The reference frequency must be specified in the **Reference** field. The REF UNLOCK indicator is lit if the reference signal's frequency does not match this field setting.

NOTE: **Using a Frame or 2X Frame Reference**

It takes about 30 seconds to lock to a 25 or 50 Hz reference after connecting the reference signal and selecting the correct setting in the **Reference** field. (The 200 and 400 Hz selections are a little faster.) If the reference signal is disconnected and then reconnected, you must re-select the reference frequency in the **Reference** field to start the phase-locking process over again. If you do not re-select the reference frequency, it can take *hours* to re-establish phase lock with these very low frequency references.

Older versions of the HP 83201B require a 50% duty cycle when using a frame clock for the REF IN signal. If you are using an older instrument and the REF LOCK light does not go out after waiting the normal time for lockup to occur, reselect the reference frequency.

REF IN (continued)

Operating Considerations (continued)

If a signal other than the Test Set's 10 MHz REF OUT is used as the system reference, the Cellular Adapter's 10 MHz REF OUTPUT should be connected to the Test Set's 10 MHz REF INPUT to phase lock the Test Set to the same external reference. Any external reference must be spectrally pure (very low noise) to provide a noise-free 10 MHz REF OUT signal and allow the Cellular Adapter to achieve phase lock.

Frequency accuracy typically needed for phase lock: ±1 ppm

Input impedance:

- For 1 to 10 MHz signals: 50Ω
- For <1 MHz signals: 100 kΩ

Input level:

- For 1 to 10 MHz signals: –2.5 dBm to +23 dBm
- For <1 MHz signals: TTL

SYMBOL CLK OUT

This port provides an output for the Symbol Clock of the Digital Generator. This allows you to synchronize external equipment to the Digital Generator.

Operating Considerations

When using internally-generated data, and the **`Data Delay`** value is an even number, the first bit of a symbol is present on the rising edge of the Symbol Clock. If the delay is an odd number, the second bit of the symbol is present on the rising edge of the Symbol Clock.

When using externally-supplied data through the GENERATOR BASEBAND DATA IN port, the first bit of a symbol is always clocked in on the rising edge of the Symbol clock.

Nominal output frequency = 24.3 kHz (NADC), 21 kHz (PDC), 192 kHz (PHP).
Nominal output level = CMOS Output impedance = 50Ω

See Also

`Data Delay` field description.

Indicators and Fuse

PWR Indicator

This indicator lights when the Cellular Adapter is turned on. There is no separate POWER switch for the Cellular Adapter. After mains (line) power is supplied, the Cellular Adapter is turned on when the connected Test Set is turned on.

REF UNLOCK Indicator

This indicator lights when the Digital Generator cannot phase lock to the reference signal from the rear-panel REF IN connector. This condition exists when the frequency of the reference signal does not match the setting for the **`Reference`** field, or when the reference signal level is incompatible.

See Also

REF IN connector description.

FUSE

This fuse provides over-current protection for the Cellular Adapter.

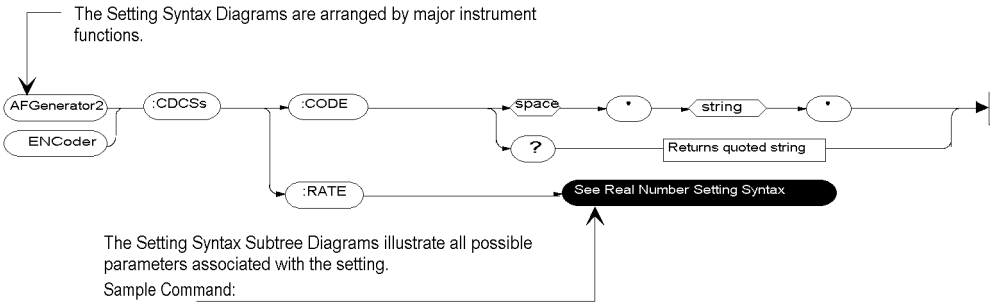
Operating Considerations

Rating: 2.0 Amp, 250 V Size: AGC Type: normal blow

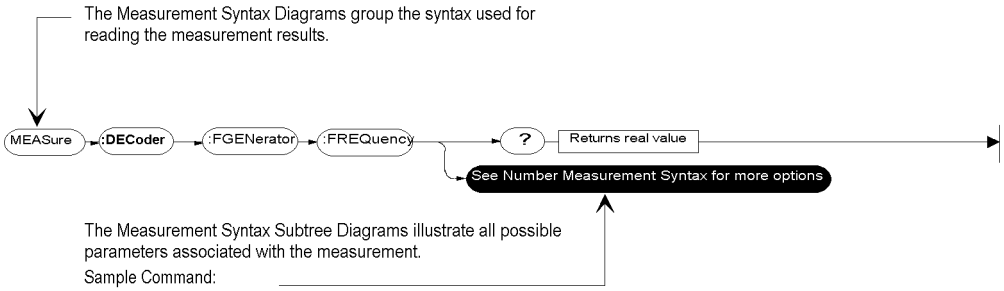
WARNING: Replacing a fuse with a different type, size, or rating than is supplied with the instrument can cause an electrical shock and/or fire hazard.

3

HP-IB Syntax Diagrams



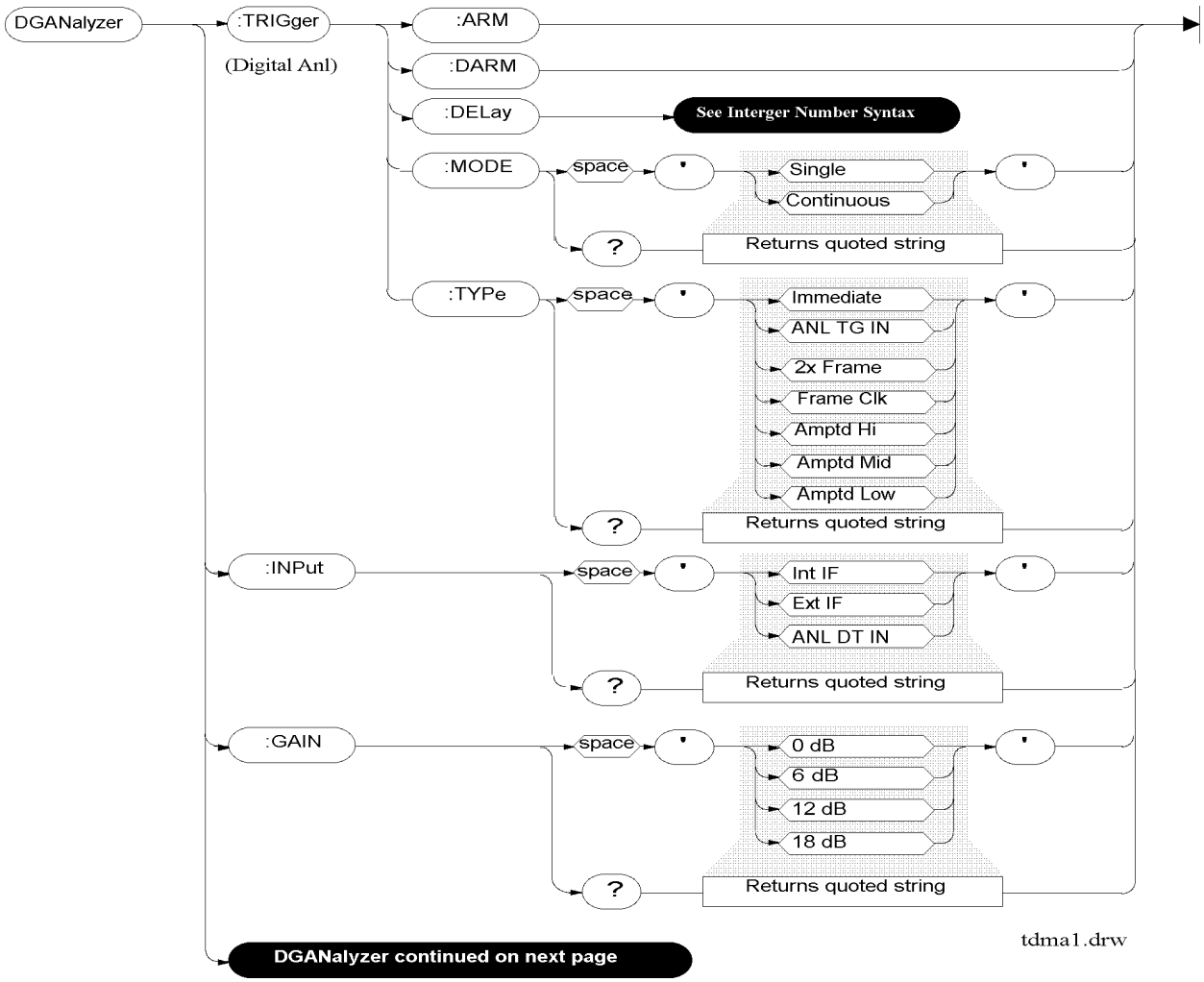

```
AFG2:CDCS:RATE 5
```

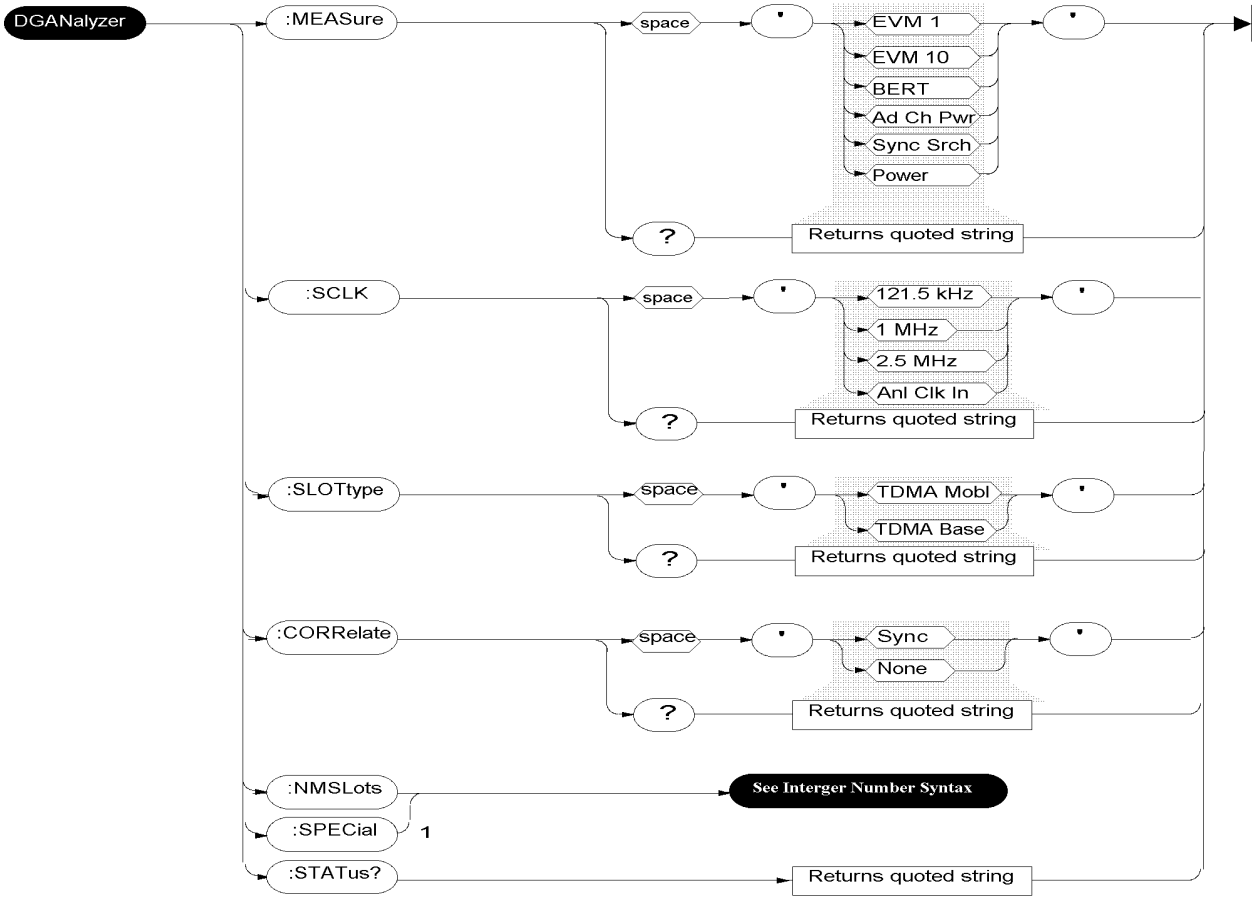



```
MEAS:DEC:FGEN:FREQ?
```

syntoc1.drw

TDMA Test


DGANalyzer
:TRIGger
(Digital Anl)
:ARM
:DARM
:DELay
See Interger Number Syntax
:MODE
space
'
Single
Continuous
'
?
Returns quoted string
:TYPe
space
'
Immediate
ANL TG IN
2x Frame
Frame Clk
Amptd Hi
Amptd Mid
Amptd Low
'
?
Returns quoted string
:INPut
space
'
Int IF
Ext IF
ANL DT IN
'
?
Returns quoted string
:GAIN
space
'
0 dB
6 dB
12 dB
18 dB
'
?
Returns quoted string
tdma1.drw
DGANalyzer continued on next page



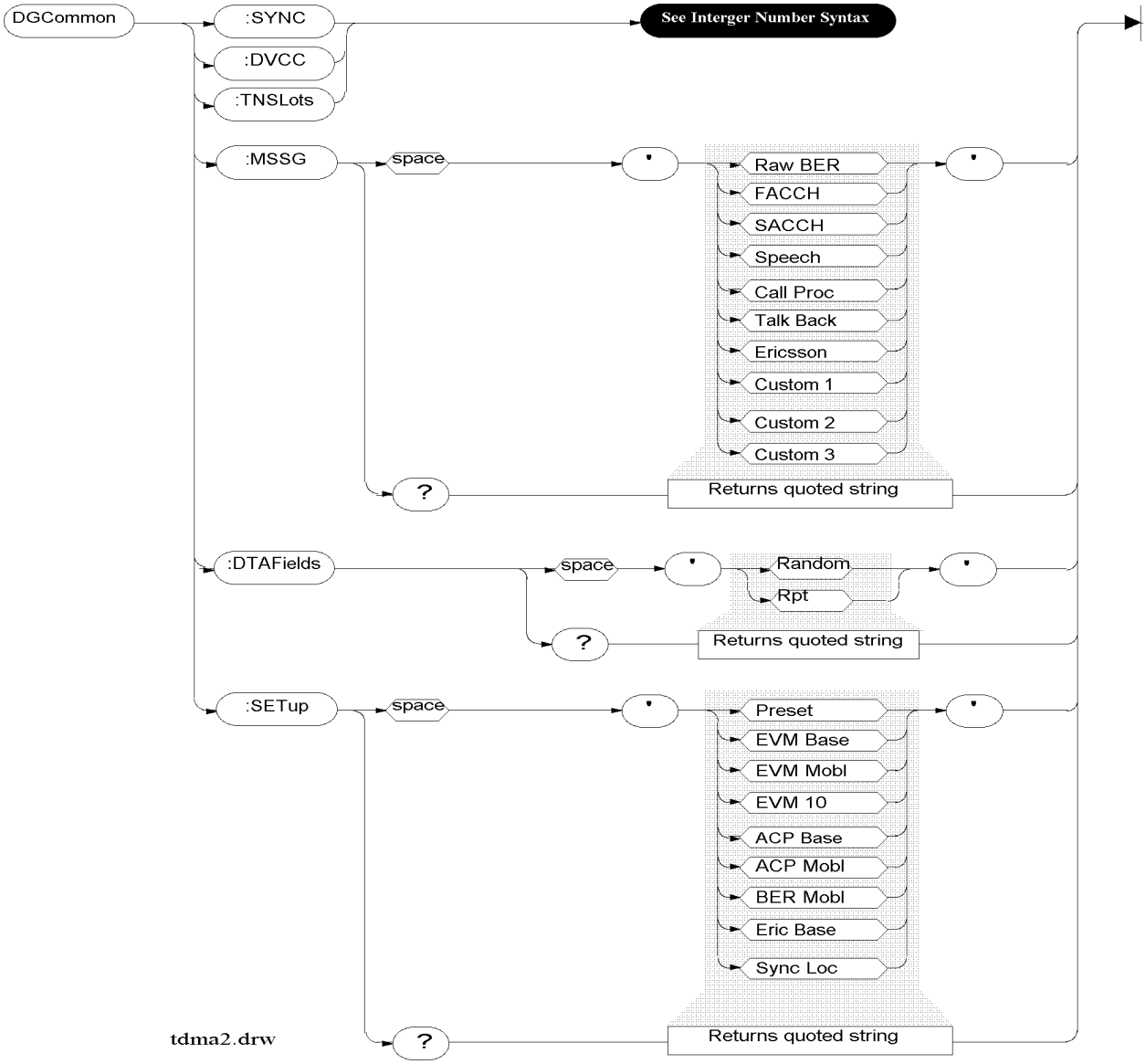
1. For future use-must be set to 0 at this time for the instrument to function correctly.

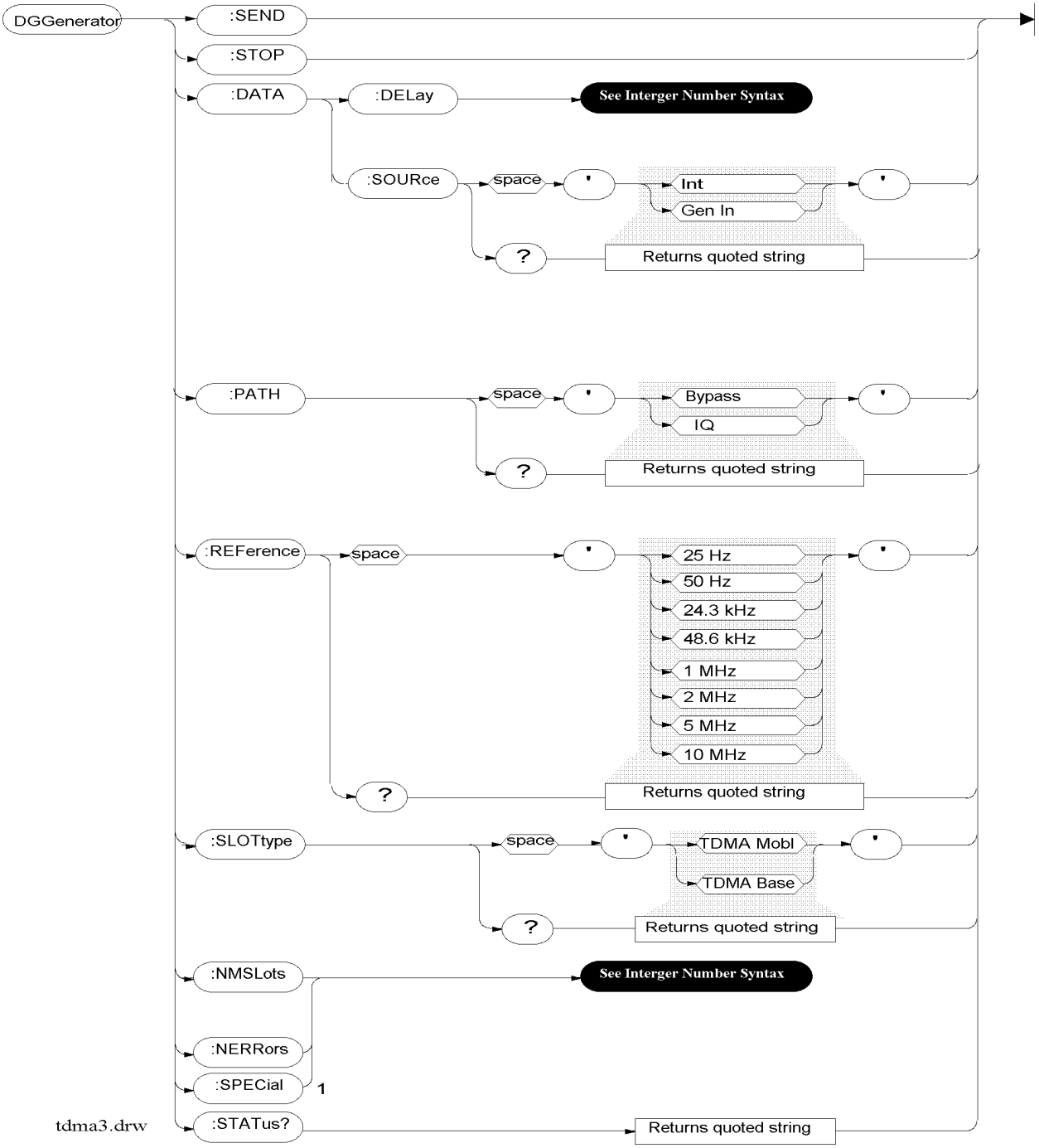
To read the HP 83201A REF UNLOCK indicator status:

Select the Latch = SERVice: LATCh: SELect 'ref_rx_ool_int_sense'
Read the status = SERVice: LATCh: VALue? Returns +0 (phase locked)
+1 (unlocked)

The Latch must be selected everytime the status is queried.

tdma4.drw

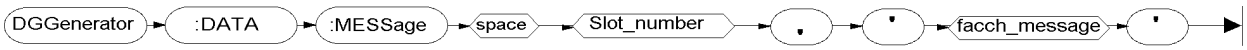

DGCommon
:SYNC
:DVCC
:TNSLots
See Interger Number Syntax
:MSSG
space
'
Raw BER
FACCH
SACCH
Speech
Call Proc
Talk Back
Ericsson
Custom 1
Custom 2
Custom 3
'
?
Returns quoted string
:DTAFields
space
'
Random
Rpt
'
?
Returns quoted string
:SETup
space
'
Preset
EVM Base
EVM Mobl
EVM 10
ACP Base
ACP Mobl
BER Mobl
Eric Base
Sync Loc
'
?
Returns quoted string
tdma2.drw



1. For future use-must be set to 0 at this time for the instrument to function correctly.

Sending FACCH Messages

FACCH messages can be pre-loaded into the Digital Generator for call processing before they are sent.



tdma5.drw

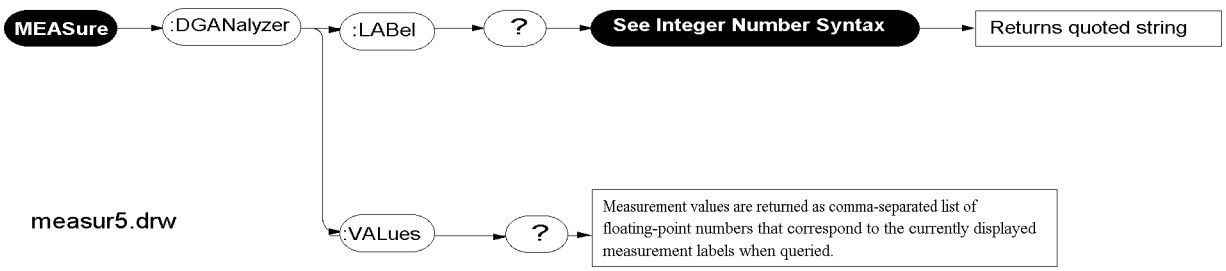
The first 12-digit hexadecimal message must be preceded by a zero (0). For example, to have the Digital Generator output the FACCH message 3c8230400383 in slot 200, send the command:

DGGenerator:DATA:MESSage 200,’03c8230400383’

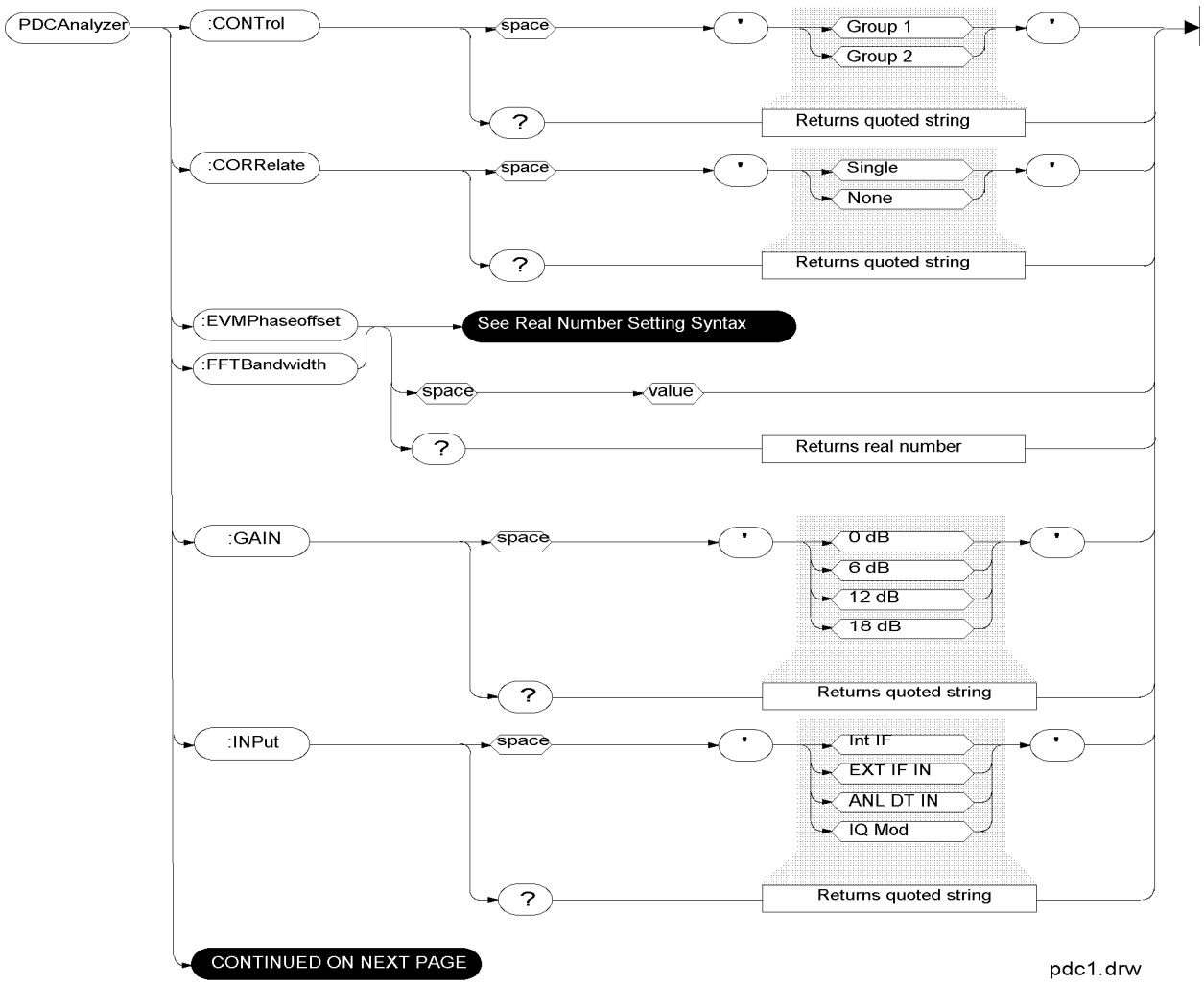
Up to four messages can be included in one command string. The second, third, and fourth messages must be preceded by a one (1). For example to output these three FACCH messages 0c50104050c0 000303233343 5363738393a0 starting at slot 250, send the command:

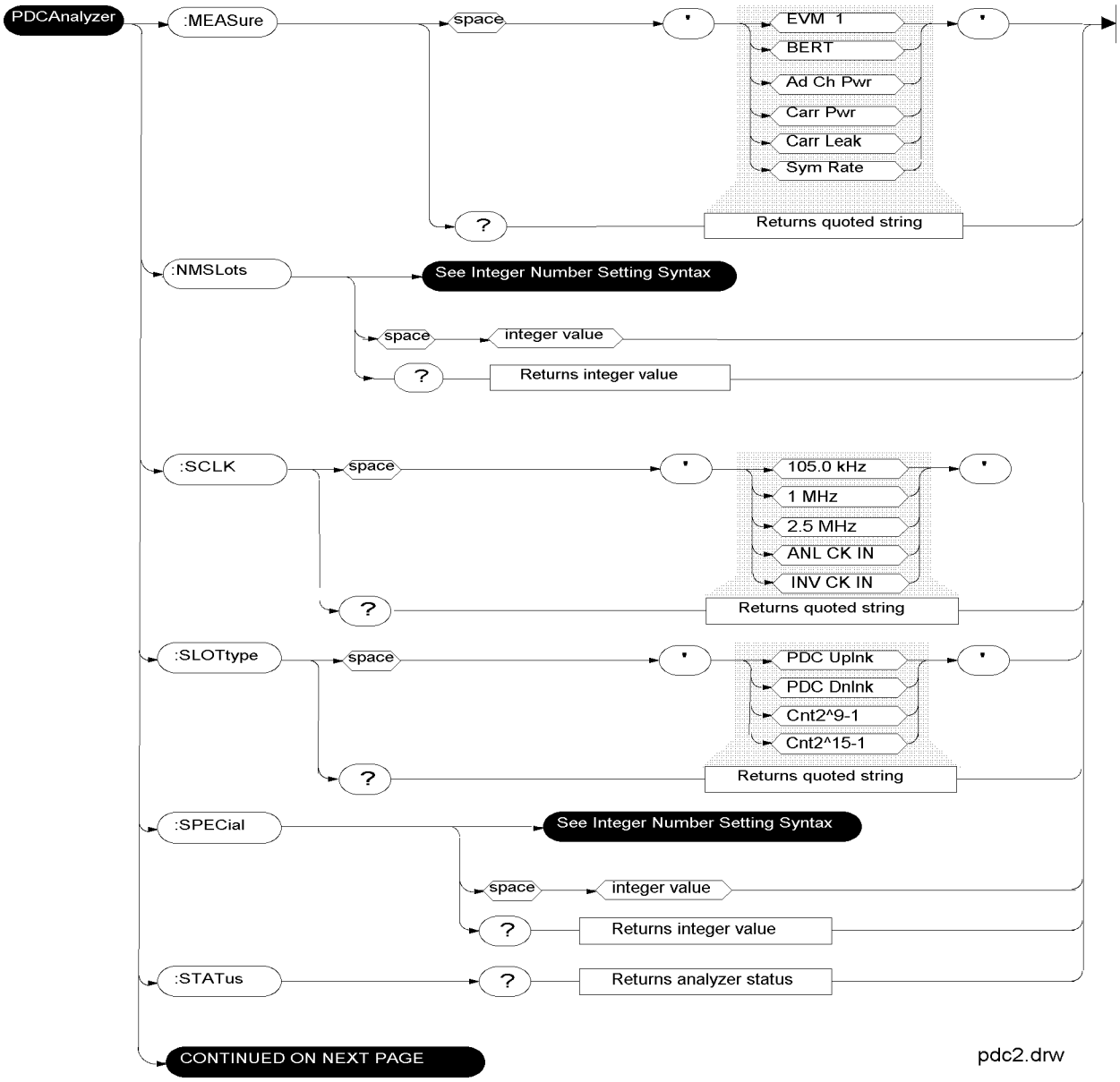
DGG:DATA:MESS 250,’00c50104050c0100030323334315363738393a0’

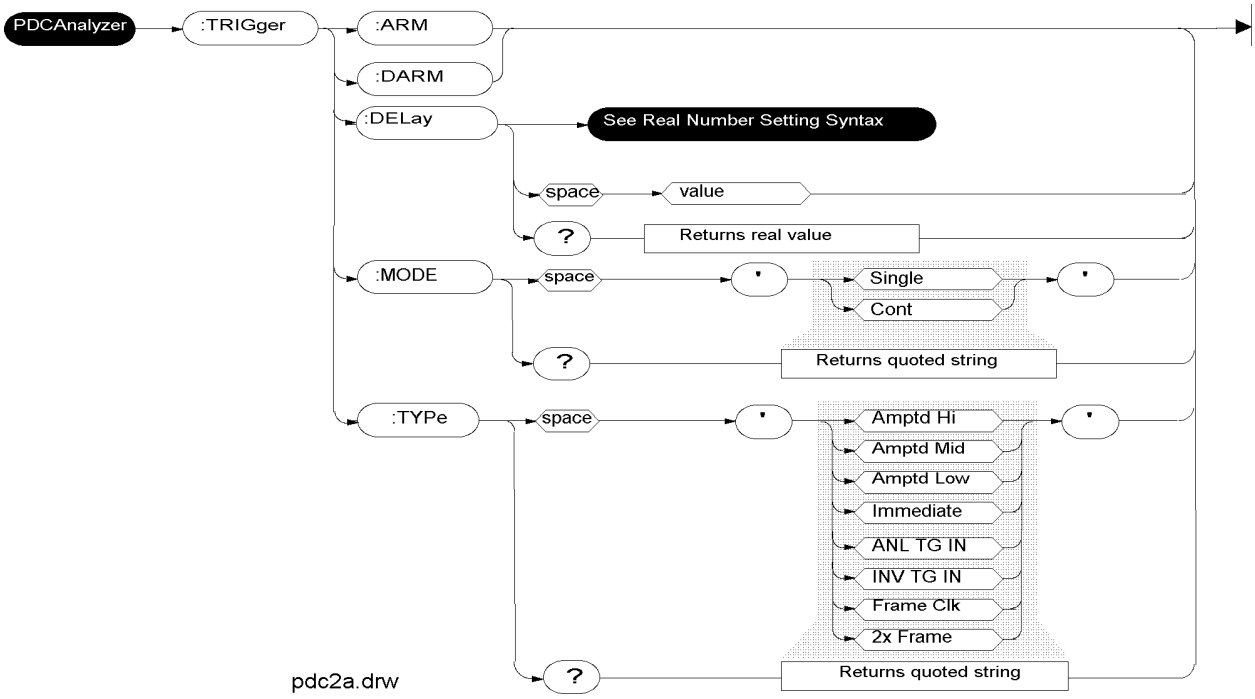
When multiple slots are pre-loaded, the slots must be sent in ascending order, or previous messages will be erased.

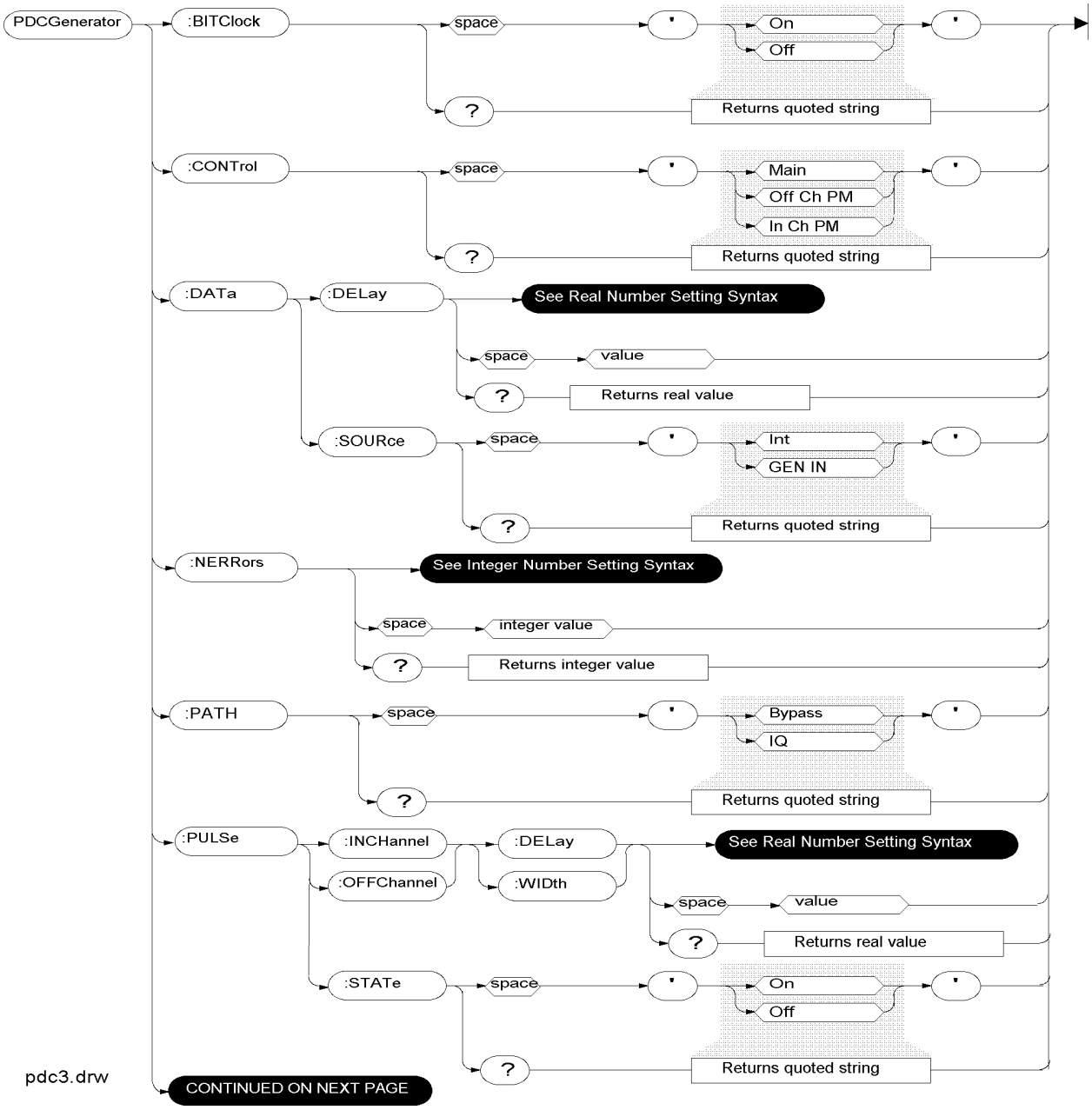

MEASure
:DGANalyzer
:LABel
?
See Integer Number Syntax
Returns quoted string
measur5.drw
:VALues
?
Measurement values are returned as comma-separated list of floating-point numbers that correspond to the currently displayed measurement labels when queried.

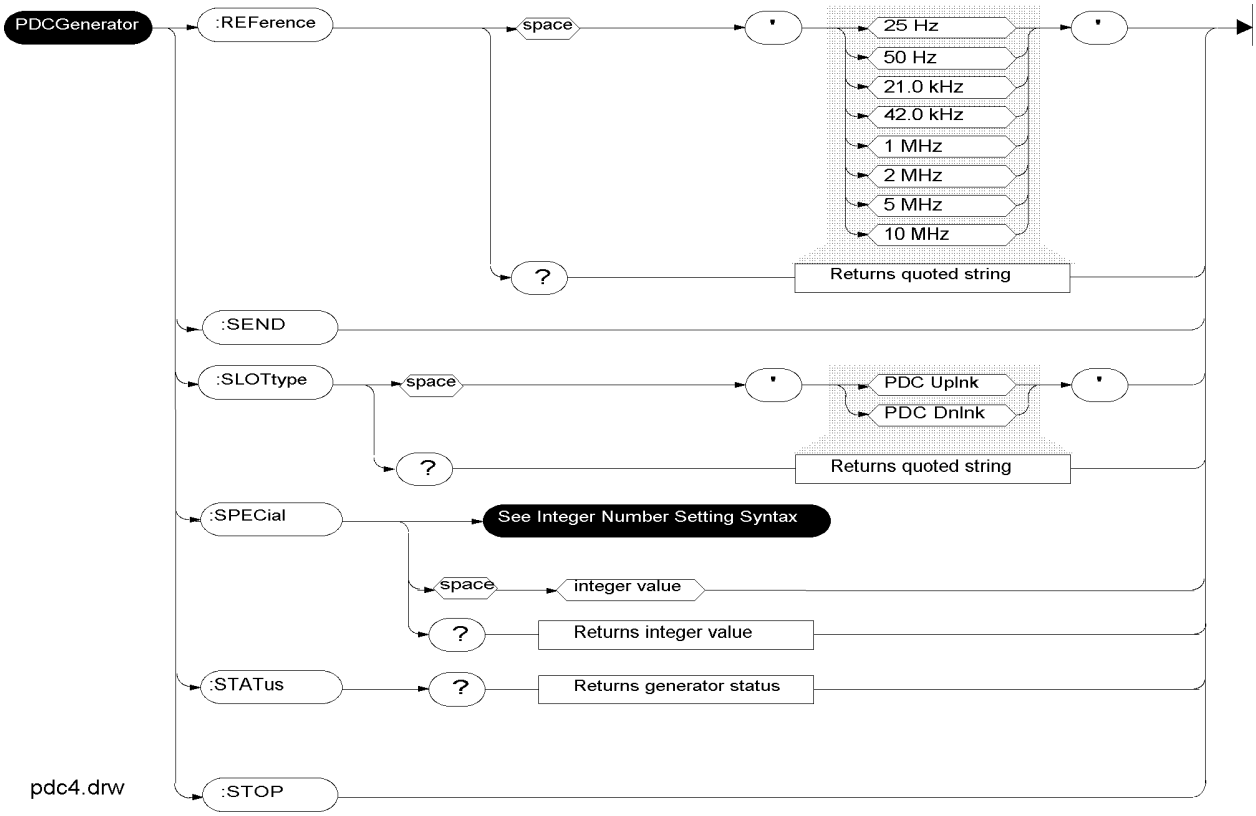
PDC Test

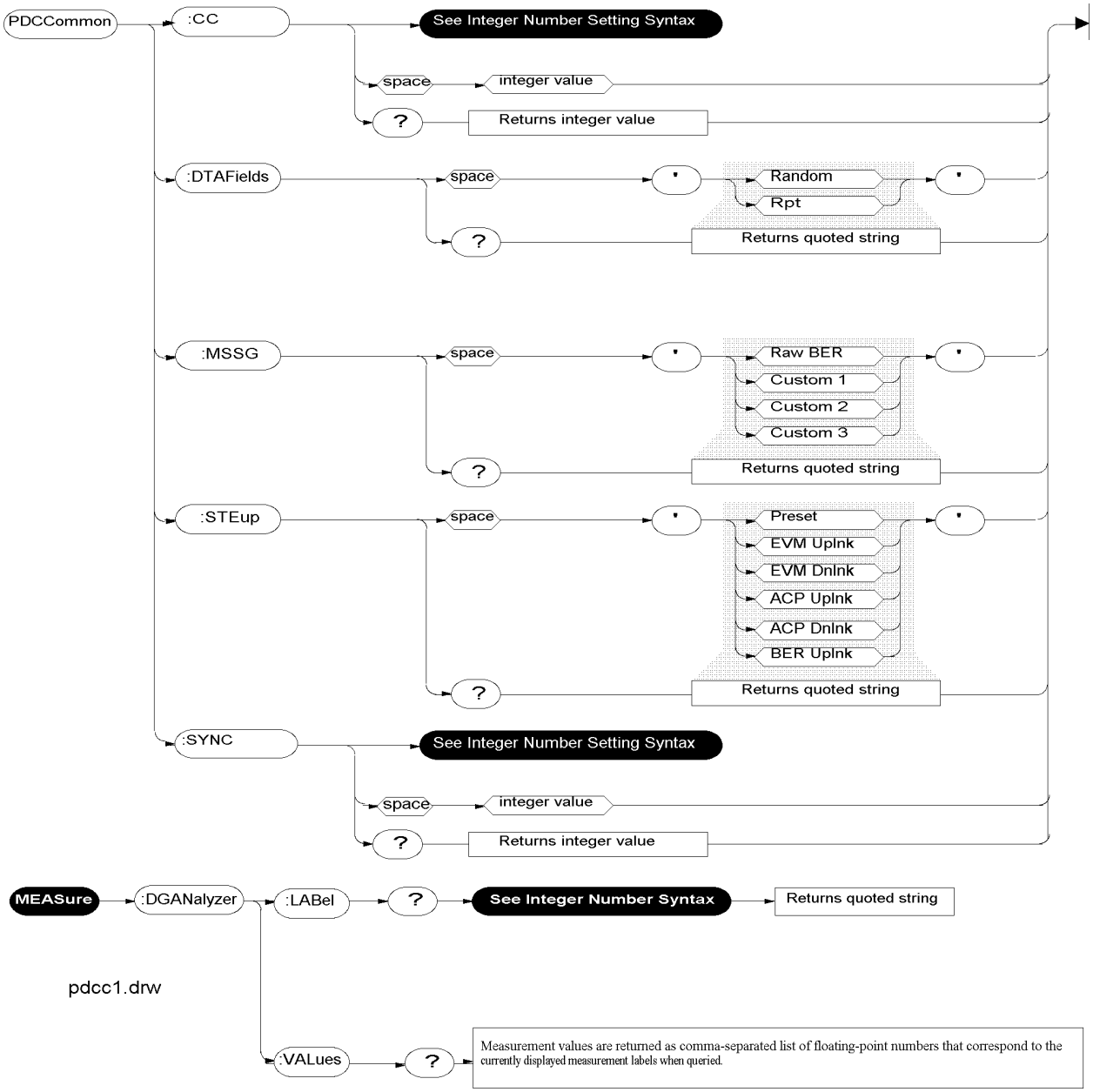

PDCAnalyzer
:CONTrol
space
'
Group 1
Group 2
'
?
Returns quoted string
:CORRelate
space
'
Single
None
'
?
Returns quoted string
:EVMPhaseoffset
:FFTBandwidth
See Real Number Setting Syntax
space
value
?
Returns real number
:GAIN
space
'
0 dB
6 dB
12 dB
18 dB
'
?
Returns quoted string
:INPut
space
'
Int IF
EXT IF IN
ANL DT IN
IQ Mod
'
?
Returns quoted string
CONTINUED ON NEXT PAGE
pdc1.drw


PDCAnalyzer
:MEASure
space
'
EVM 1
BERT
Ad Ch Pwr
Carr Pwr
Carr Leak
Sym Rate
'
?
Returns quoted string
:NMSLots
See Integer Number Setting Syntax
space
integer value
?
Returns integer value
:SCLK
space
'
105.0 kHz
1 MHz
2.5 MHz
ANL CK IN
INV CK IN
'
?
Returns quoted string
:SLOTtype
space
'
PDC Uplnk
PDC Dnlnk
Cnt2^9-1
Cnt2^15-1
'
?
Returns quoted string
:SPECial
See Integer Number Setting Syntax
space
integer value
?
Returns integer value
:STATus
?
Returns analyzer status
CONTINUED ON NEXT PAGE
pdc2.drw


PDCAnalyzer
:TRIGger
:ARM
:DARM
:DELay
See Real Number Setting Syntax
space
value
?
Returns real value
:MODE
space
'
Single
Cont
'
?
Returns quoted string
:TYPe
space
'
Amptd Hi
Amptd Mid
Amptd Low
Immediate
ANL TG IN
INV TG IN
Frame Clk
2x Frame
'
?
Returns quoted string
pdc2a.drw


PDCGenerator
:BITClock
space
'
On
Off
'
?
Returns quoted string
:CONTrol
space
'
Main
Off Ch PM
In Ch PM
'
?
Returns quoted string
:DATa
:DELay
See Real Number Setting Syntax
space
value
?
Returns real value
:SOURce
space
'
Int
GEN IN
'
?
Returns quoted string
:NERRors
See Integer Number Setting Syntax
space
integer value
?
Returns integer value
:PATH
space
'
Bypass
IQ
'
?
Returns quoted string
:PULSe
:INCHannel
:OFFChannel
:DELay
:WIDth
See Real Number Setting Syntax
space
value
?
Returns real value
:STATe
space
'
On
Off
'
?
Returns quoted string
pdc3.drw
CONTINUED ON NEXT PAGE

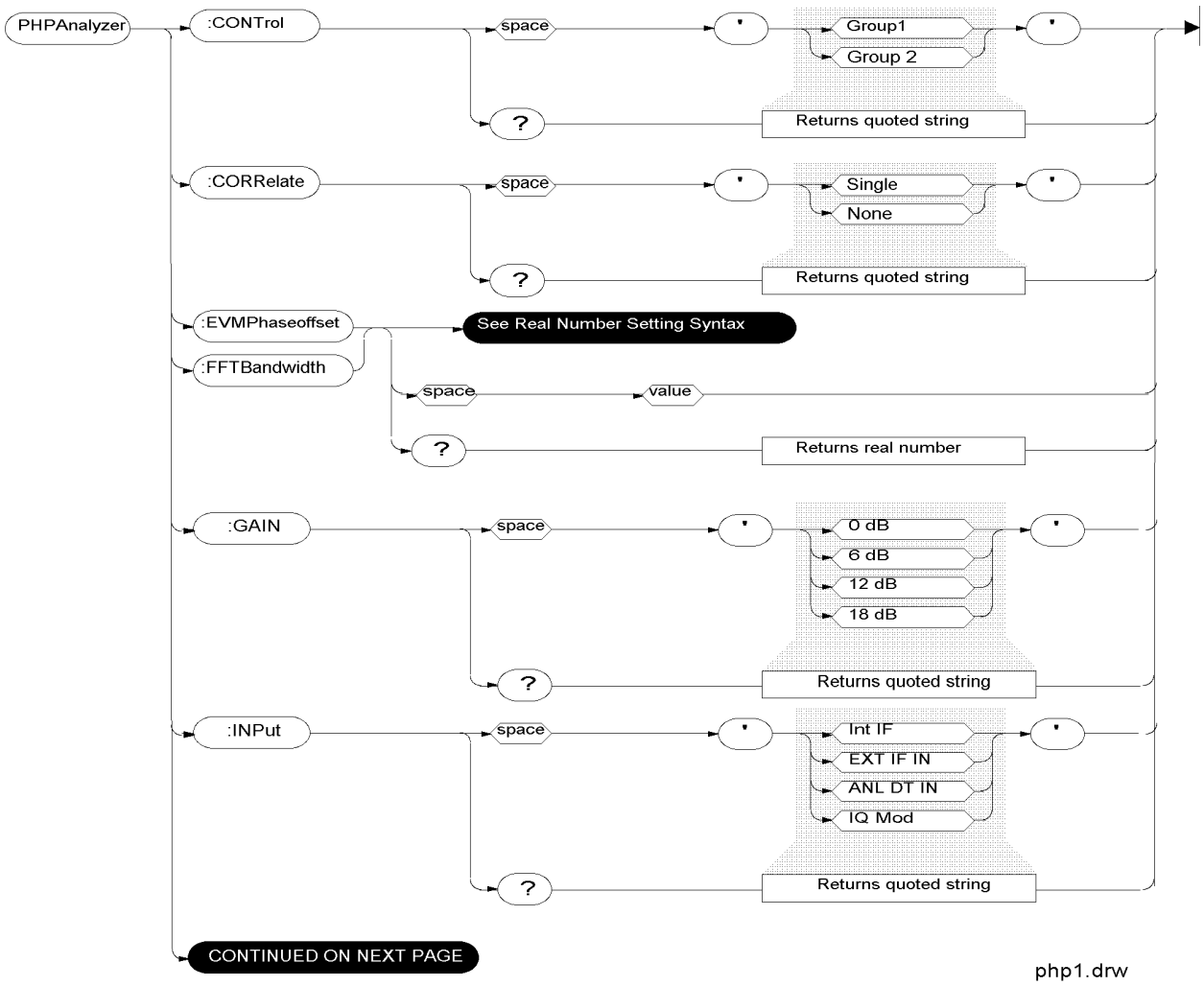

PDCGenerator
:REFerence
space
'
25 Hz
50 Hz
21.0 kHz
42.0 kHz
1 MHz
2 MHz
5 MHz
10 MHz
'
?
Returns quoted string
:SEND
:SLOTtype
space
'
PDC Uplnk
PDC Dnlnk
'
?
Returns quoted string
:SPECial
See Integer Number Setting Syntax
space
integer value
?
Returns integer value
:STATus
?
Returns generator status
:STOP
pdc4.drw

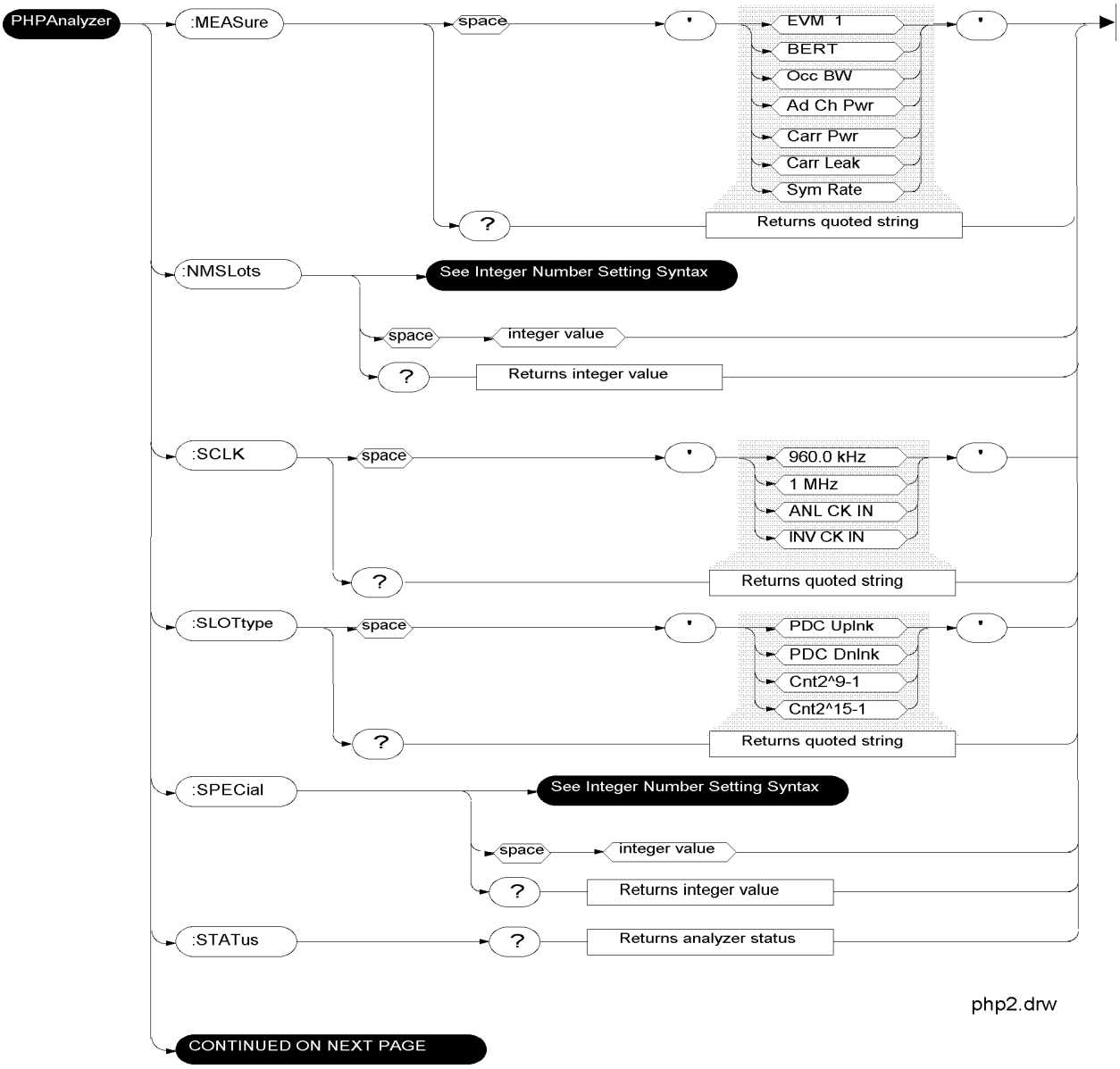


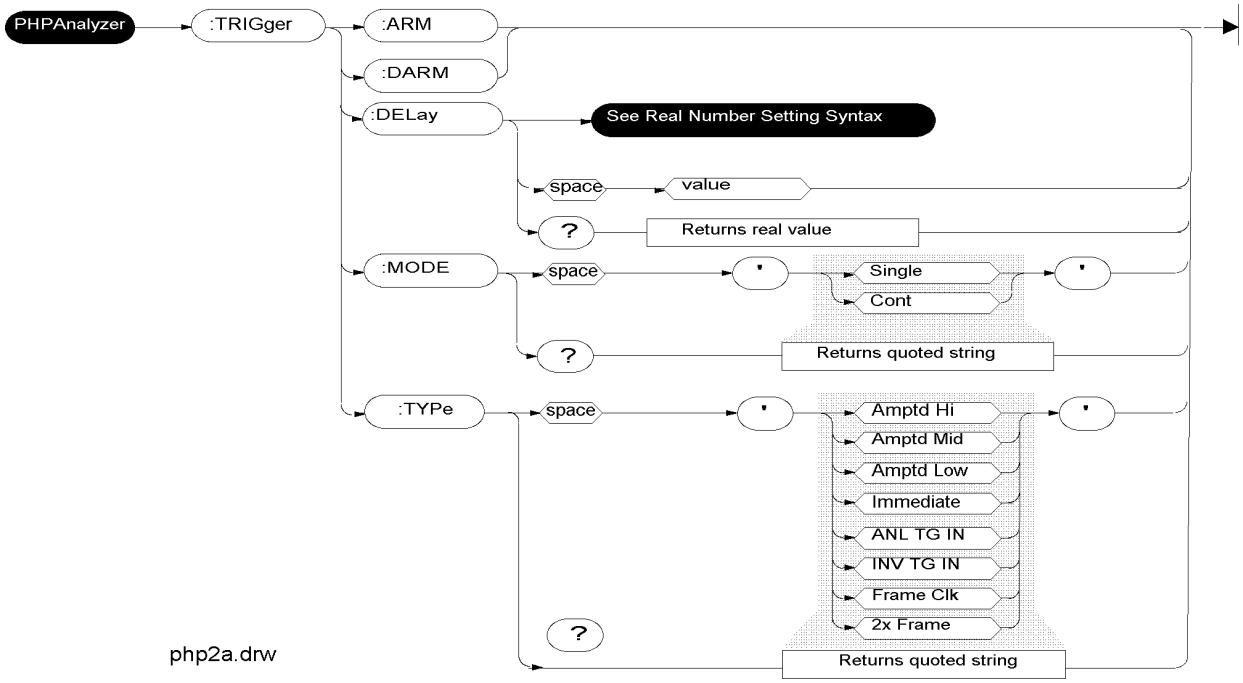
pdcc1.drw

Refer to the TDMA Sample Program to see how measurements are returned for TDMA, PDC, and PHP tests.

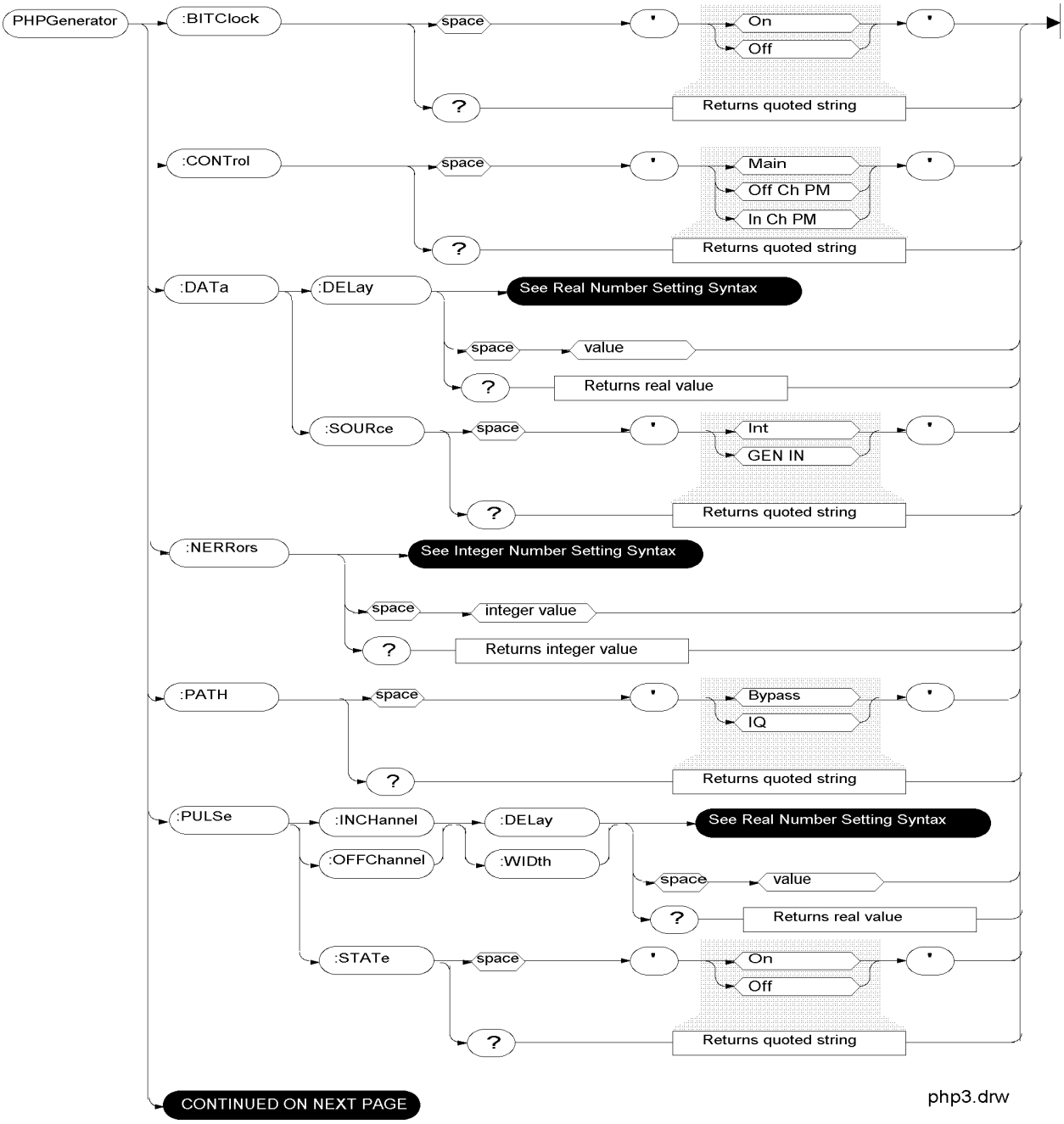
PHP Test

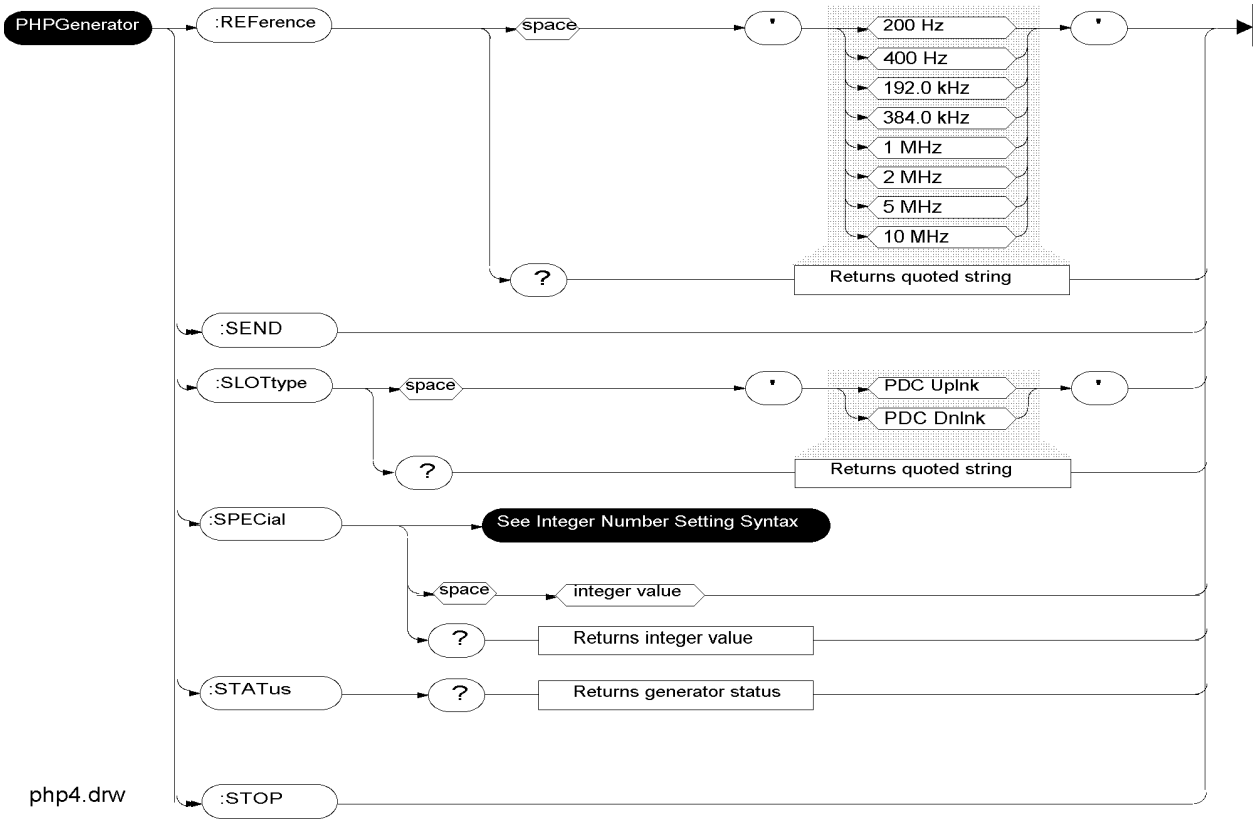

PHPAnalyzer
:CONTrol
space
'
Group1
Group 2
'
?
Returns quoted string
:CORRelate
space
'
Single
None
'
?
Returns quoted string
:EVMPhaseoffset
:FFTBandwidth
See Real Number Setting Syntax
space
value
?
Returns real number
:GAIN
space
'
0 dB
6 dB
12 dB
18 dB
'
?
Returns quoted string
:INPut
space
'
Int IF
EXT IF IN
ANL DT IN
IQ Mod
'
?
Returns quoted string
CONTINUED ON NEXT PAGE
php1.drw


PHPAnalyzer
:MEASure
space
'
EVM 1
BERT
Occ BW
Adj Ch Pwr
Carr Pwr
Carr Leak
Sym Rate
'
?
Returns quoted string
:NMSLots
See Integer Number Setting Syntax
space
integer value
?
Returns integer value
:SCLK
space
'
960.0 kHz
1 MHz
ANL CK IN
INV CK IN
'
?
Returns quoted string
:SLOTtype
space
'
PDC Uplnk
PDC Dnlnk
Cnt2^9-1
Cnt2^15-1
'
?
Returns quoted string
:SPECial
See Integer Number Setting Syntax
space
integer value
?
Returns integer value
:STATus
?
Returns analyzer status
php2.drw
CONTINUED ON NEXT PAGE

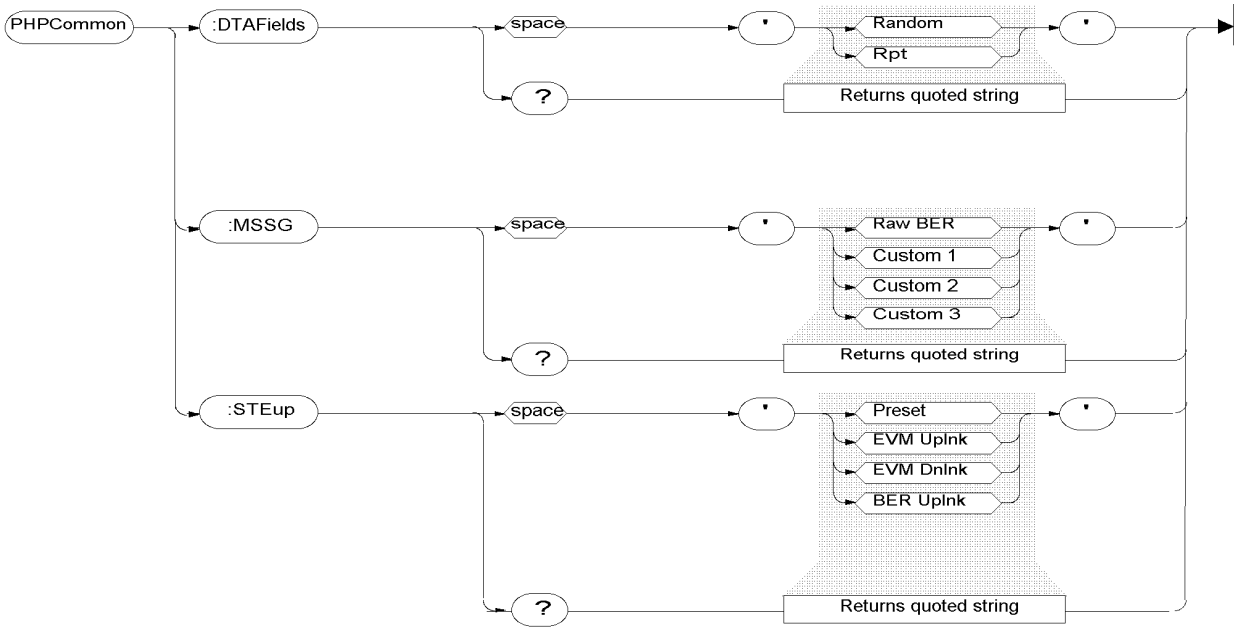

PHPAnalyzer
:TRIGger
:ARM
:DARM
:DELay
See Real Number Setting Syntax
space
value
?
Returns real value
:MODE
space
'
Single
Cont
'
?
Returns quoted string
:TYPe
space
'
Amptd Hi
Amptd Mid
Amptd Low
Immediate
ANL TG IN
INV TG IN
Frame Clk
2x Frame
'
?
Returns quoted string

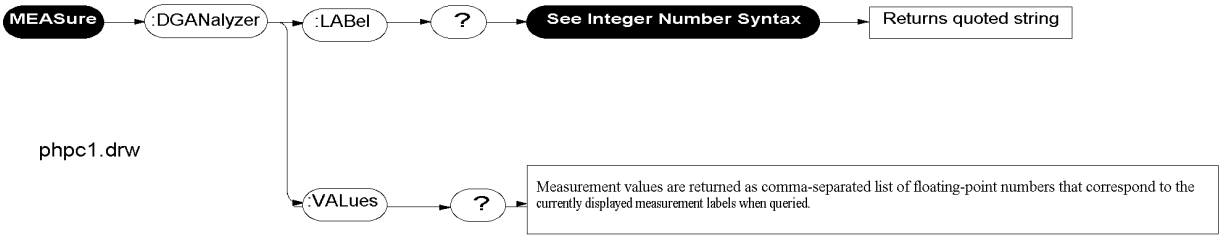
php2a.drw


PHPGenerator
:BITClock
space
'
On
Off
'
?
Returns quoted string
:CONTrol
space
'
Main
Off Ch PM
In Ch PM
'
?
Returns quoted string
:DATa
:DELay
See Real Number Setting Syntax
space
value
?
Returns real value
:SOURce
space
'
Int
GEN IN
'
?
Returns quoted string
:NERRors
See Integer Number Setting Syntax
space
integer value
?
Returns integer value
:PATH
space
'
Bypass
IQ
'
?
Returns quoted string
:PULSe
:INCHannel
:OFFChannel
:DELay
:WIDth
See Real Number Setting Syntax
space
value
?
Returns real value
:STATe
space
'
On
Off
'
?
Returns quoted string
CONTINUED ON NEXT PAGE
php3.drw


PHPGenerator
:REFerence
space
'
200 Hz
400 Hz
192.0 kHz
384.0 kHz
1 MHz
2 MHz
5 MHz
10 MHz
'
?
Returns quoted string
:SEND
:SLOTtype
space
'
PDC Uplnk
PDC Dnlnk
'
?
Returns quoted string
:SPECial
See Integer Number Setting Syntax
space
integer value
?
Returns integer value
:STATus
?
Returns generator status
:STOP

php4.drw

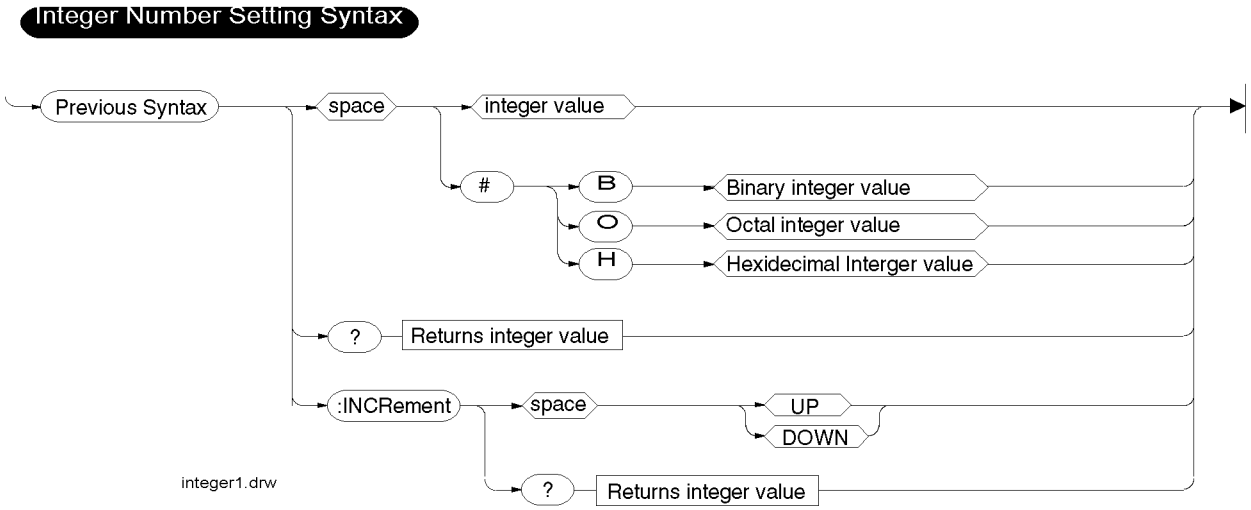




phpc1.drw

Refer to the TDMA Sample Program to see how measurements are returned for TDMA, PDC, and PHP tests.

Integer Setting Syntax



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Specifications

Specifications describe the instrument’s warranted performance and are valid over the entire operating/environmental range unless otherwise noted. Supplemental Characteristics are intended to provide additional information useful in applying the instrument by giving typical, but non-warranted performance parameters. These characteristics are shown in Italics or labeled as “typical”, “usable to”, or “nominal”.

The following specifications are for the Test System (Test Set plus the Cellular Adapter). Other specifications for the Test Set are given in the Test Set's documentation.

TDMA Signal Generator Specifications

Output Level Range:

RF In/Out: –22 dBm to –127 dBm

Duplex: +4 dBm to –127 dBm

Residual Error Vector Magnitude: <3.0%

Residual Phase Error: <3 degrees

Residual Magnitude Error: <3.0%

IQ Origin Offset: –30 dBc within ±15° C of last calibration

Frequency Error: ±4 Hz plus reference

TDMA Analyzer Specifications

Input Level Range:

RF In/Out: 1 mW to 60 W (0 to +47.78 dBm)

Antenna: –36 dBm to +17 dBm

Input Frequency Setting Error: 1 kHz

RXDSP Level Setting Range: 0 dB to –23 dB full scale

Residual Error Vector Magnitude: <2.0%

Error Vector Magnitude Measurement Accuracy: 0.4% + 2% of reading

Residual Phase Error: <1.5 degrees

Residual Magnitude Error: <1.4%

I/Q Origin Offset Accuracy: ±0.5 dB for values to –40 dBc

Frequency Error Accuracy: ±2 Hz plus reference

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