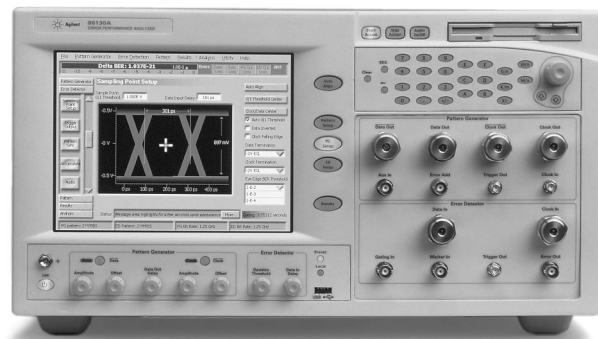


**Converting Code from the Agilent 71603B  
to the Agilent 86130A BitAnalyzer®  
Error Performance Analyzer**  
Product Note 86130-1



**Agilent Technologies**  
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# Introduction

The Agilent 86130A 3.6 Gb/s BitAlyzer® error performance analyzer offers many new features as well as improved performance and usability over the Agilent 71603B 3Gb/s error performance analyzer for bit error ratio (BER) testing. At the same time, several changes have been made to the remote programming commands. As such, upgrading an automated test system to the 86130A will require an update to any program that was used with the legacy 71603B. A list of 71603B commands and all changes that must be made for the 86130A is contained in Appendix A. Appendix B contains a list of all 86130A commands and any differences between these commands and those in the 71603B. Appendix C highlights the changes in the status registers between the two systems. Finally, Appendix D contains a brief description of SCPI (Standard Commands for Programmable Instruments, 1997) command structure and function trees. In addition to changes to the individual programming commands, the structure of the instrument has changed and programmers must also watch for changes in several small details, such as default settings, which could cause programmatic problems.

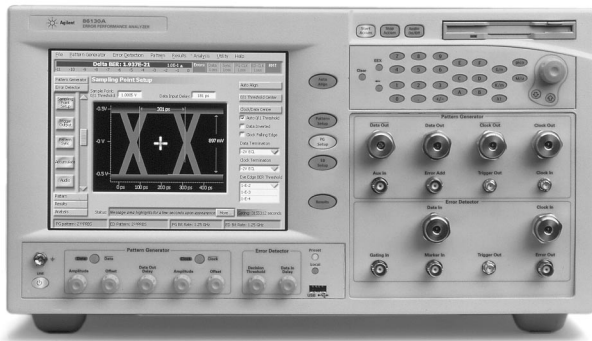


Figure 1. The 86130A 3.6Gb/s BitAlyzer Error Performance Analyzer



Figure 2. The 71603B 3Gb/s Error Performance Analyzer

## Master-Master-Slave Structure

The 71603B bit error ratio tester (BERT) actually consists of three separate instruments. First there is an error detector, a 70842B, which receives the signals and performs any calculations. The second instrument is the pattern generator, a 70841B that produces the actual bit patterns. Finally, the 71603B includes a system clock module, a 70311A that controls the frequency of the generated signal. These instruments are set up by default in what is called a Master-Master-Slave (MMS) configuration. That is, the error detector is a master to the pattern generator that in turn controls the clock. In this set up, remote commands to the pattern generator are sent through the error detector using a *SYSTEM:PTHRough* command. Using the passthrough command tells the master instrument to simply ignore the next command and pass it on to the slave instrument, which in turn executes the passed command. Similarly, commands to the clock must be sent through both the error detector and the pattern generator. Some examples of using passthrough commands are shown in Figure 3.

It is also possible to set up the individual members of a 71603B system such that remote commands can be sent directly to each instrument. In such a configuration, each instrument is assigned its own address on the GPIB (General Purpose Interface Bus). By default, the error detector is found at GPIB address 17, the

NOTE: This information is based on version A.0.102 of the 86130A firmware.

Change data pattern in the pattern generator module through the error detector:

***SYSTem:PTHRough "SOURCE1:PATtern:SElect:PRBS23"***

Query the clock ID through both the error detector and the pattern generator:

***SYST:PTHR? "SYST:PTHR? "IDN?"***

Figure 3. Examples of using the *SYSTem:PTHRough* commands

pattern generator at 18 and the clock at 19. Using this configuration eliminates the need for passthrough commands, but uncouples the instruments. For example, if the program changes the pattern on the pattern generator, it must also change it on the error detector. Another minor disadvantage of this configuration is that 3 of the 32 possible addresses are used for what is essentially one instrument, which could become a problem in very complex measurement systems as one could conceivably run out of GPIB addresses.

This complication is eliminated in the 86130A by treating the BERT as a single instrument at GPIB address 17. This removes the need for passthrough commands while still maintaining the link between the individual system components. That is, any change on the generated pattern is reflected on the error detector. This feature can be

turned off using the command *SENSe1:PATtern:TRACK OFF* which may be needed in certain specialized applications.

#### Minor Changes

Several small changes have been made in the 86130A, which may cause problems when using code converted over from a 71603B automated test system. One example is that on system power up, the 86130A's pattern and clock outputs are turned off, whereas they are turned on in the 71603B. The 86130A pattern and clock are easily turned on using the commands *OUTPut1:STATe ON* and *OUTPut2:STATe ON* respectively.

Another change is that the 86130A can have either an internal or an external clock. In the 71603B, the clock is always external, as it is a separate module. The 86130A's internal clock has a maximum frequency of 3.0 Gb/s but it can handle up

to 3.6 Gb/s from an external clock. The command *SOURCE9:OUTPut:[STATE] ON|OFF<sup>1</sup>* controls whether the internal or external clock is used, respectively. The external clock source is assigned to the *SENSe6* subsystem.

A third change is that the BitAlyzer allows the voltage levels and the terminations of the data bar and clock bar to be set independently from the data and clock outputs. As such, data bar is given its own source subsystem, *SOURCE10*, and output subsystem, *OUTPut10*. Similarly, clock bar is assigned *SOURCE11* and *OUTPut11*. Additionally, the trigger output is assigned to *SOURCE7*.

#### Conclusion

The 86130A offers several performance advantages over the 71603B. Some of the changes have affected the remote programming but with a minimum of effort, the BitAlyzer can easily replace its predecessor in any test system.

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<sup>1</sup> The brackets around "state" indicate that it is an optional parameter. The vertical line indicates that the argument can be either "ON" or "OFF" so the actual command can be any of the following:

*SOURCE9:OUTPut:STATe ON*  
*SOURCE9:OUTPut:STATe OFF*  
*SOURCE9:OUTPut ON*  
*SOURCE9:OUTPut OFF*

## Appendix A: Changes to Agilent 71603B Commands

Several changes have been made to the 71603B command tree. The following tables list the 70841B pattern generator and 70842B error detector commands and the changes, if any, which have been made for the 86130A. See Appendix D for a brief explanation of the symbols and syntax.

NC	No Change, this command can be used with the 86130A.
C	Changed, a minor change has been made to this command.
R	Replaced, this command has been replaced by another command with the same functionality.
NI	This command is not available in the 86130A.
NS	Not Supported, this command is not supported but still retains some functionality in the 86130A.

**Figure A-1. Command Status Abbreviations**

Table A-1. 70841B Pattern Generator Commands and Changes for the 86130A

Keyword	Parameter	Status	Comment
[SOURce[1]:]		-	-
PATtern		-	-
[:SElect]	PRBS<n>	NC	-
	ZSUBstitution<n>	NC	-
	MDENsity<n>	NC	-
	UPATtern<n>	NC	-
	AWORd	R	1
[:SElect]?	PRBS<n>	NC	-
	ZSUB<n>	NC	-
	MDEN<n>	NC	-
	UPAT<n>	NC	-
	AWORd	R	1
:ZSUBstitut		-	-
[:ZRUN]	<numeric value>	NI	2
[:ZRUN]?	<NR1>	NI	2
:MDENsity		-	-
[:DENsity]	<numeric value>	NC	-
[:DENsity]?	<NR3>	NC	-
:UPATtern<n>		-	-
[:LENGth]	<numeric value>	NC	-
[:LENGth]?	<NR1>	NC	-
:LABel	<string>	NC	-
:LABel?	<string>	NC	-
:USE	STRAight   APATtern	NC	-
:USE?	STR   APAT	NC	-
:DATA	[A B,]<block data>	NC	-
:DATA?	[A B,]<block data>	NC	-
:IDATa	[A B,]<start bit>,<length in bits>,<block data>	NC	-
:IDATa?	[A B,]<start bit>,<length in bits>	C	3
:FORMat		-	-
[:DATA]	PACKed,<numeric value>	NC	-
[:DATA]?	PACK,<NR1>	NC	-
:AWORd		-	-
:DATA<n>	<NRf>{,<NRf>}	NI	1
:DATA<n>?	<NRf>{,<NRf>}	NI	1
:APCHange		-	-
:SOURce	EXTernal   INTernal	NC	-
:SOURce?	EXT   INT	NC	-
:MODE	ALTERNate   ONEShot	C	4
:MODE?	ALT   ONES	C	4
:SElect	AHALf   BHALf	C	5
:SElect?	AHAL   BHAL	C	5
:IBHalf	ONCE	NC	-
:EADDition	ONCE   <boolean>	NC	-
:SOURce	EXTernal   FIXed	NC	-
:SOURce?	EXT   FIX	NC	-
:RATE	<numeric value>	NC	-
:RATE?	<NR3>	NC	-

Table A-1. 70841B Pattern Generator Commands and Changes for the 86130A (continued)

Keyword	Parameter	Status	Comment
VOLTage		-	-
[:LEVel]		-	-
[:IMMediate]		-	-
[:AMPLitude]	<numeric value>	NC	-
[:AMPLitude]?	<NR3>	NC	-
:HIGH	<numeric value>	NC	-
:HIGH?	<NR3>	NC	-
:ATTenuation	<numeric value>	NI	6
:ATTenuation?	<NR3>	NI	6
:ECL	---	NC	-
SOURce2		-	-
:FREQuency		-	-
[:CW :FIXed]?	<NR3>	C	7
:VOLTage		-	-
[:LEVel]		-	-
[:IMMediate]		-	-
[:AMPLitude]	<numeric value>	NC	-
[:AMPLitude]?	<NR3>	NC	-
:HIGH	<numeric value>	NC	-
:HIGH?	<NR3>	NC	-
:ATTenuation	<numeric value>	NI	6
:ATTenuation?	<NR3>	NI	6
:ECL	---	NC	-
SOURce3		-	-
:TRIGger		-	-
[:MODE]	PATtern DCLock	NC	-
[:MODE]?	PATT DCL	NC	-
:CTDRatio?	<NR3>	NI	8
:PRBS<n>	<Nrf>{,<Nrf>}	C	9
:PRBS<n>?	<Nrf>{,<Nrf>}	C	9
ZSUBstitut<n>	<numeric value>	NI	10
ZSUBstitut<n>?	<NR1>	NI	10
MDENsity<n>	<numeric value>	NC	-
MDENsity<n>?	<NR1>	NC	-
:UPATtern<n>	<numeric value>	NC	-
:UPATtern<n>?	<NR1>	NC	-
:APATtern<n>	ABCHange SOPattern	NC	-
:APATtern<n>?	ABCH SOP	NC	-
OUTPut[1]		-	-
[:STATe]	<boolean>	NC	-
[:STATe]?	<boolean>	NC	-
:POLarity	NORMal INVerted	NC	-
:POLarity?	NORM INV	NC	-
:DELay	<numeric value>	NC	-
:DELay?	<NR3>	NC	-
:TERMination	<numeric value>	C	11
:TERMination?	<NR1>	C	11
:OPTimize	DATA DADBar	NI	12
:OPTimize	DATA DADB	NI	12
OUTPut2		-	-
:TERMination	<numeric value>	C	11
:TERMination	<NR1>	C	11
MMEMory		-	13

Table A-1. 70841B Pattern Generator Commands and Changes for the 86130A (continued)

Keyword	Parameter	Status	Comment
:INITialize	---	NI	13
:DELeTe	<file name>	NI	13
:CATalog?	<NR3>, <NR3>{, <file entry>}	NI	13
:MPResent?	<boolean>	NI	13
:CPDisc	<NR1>	NI	13
:ICPDisc	<NR1>, <NR1>, <NR1>, <NR1>	NI	13
SYSTem		-	-
:BEEPer [:IMMediate]	[<freq>[, <time>[, <vol>]]]	R	14
:ERRor?	<NR1>, <string>	NC	-
:KLOCK	<boolean>	NI	15
:KLOCK?	<boolean>	NI	15
:PRESet   :PRESet<n>	---	NI	16
:PTHrough [:STRing] [:STRing]	<string> <string>	- NS NS	17 17 17
:VERsion?	<NR2>	NI	34
STATus		-	-
:QUEStionable [:EVENT]?	<NR1>	- NC	21 21
CONDition?	<NR1>	NC	21
:ENABle	<NRf>	NC	21
:ENABle?	<NR1>	NC	21
:PTRansition	<NRf>	NC	21
:PTRansition?	<NR1>	NC	21
:NTRansition	<NRf>	NC	21
:NTRansition?	<NR1>	NC	21
:PRESet	---	NI	18
:FAILure [:EVENT]?	<NR1>	- NI	19 19
:SSERvice [:EVENT]?	<NR1>	- NI	20 20
:ENABle	<NRf>	NI	20
:ENABle?	<NR1>	NI	20
*CLS	---	NC	-
*ESE	<NRf>	NC	21
*ESE?	<NR1>	NC	21
*ESR?	<NR1>	NC	21
*IDN?	<string>	NC	-
*OPC	---	NC	-
*OPC?	<NR1>	NC	-
*RST	---	NC	-
*SRE	<NRf>	NC	21
*SRE?	<NR1>	NC	21
*STB?	<NR1>	NC	-
*TST?	<NR1>	NI	22
*WAI	---	NC	-
*OPT?	<NR1>	NI	23
*PSC	<NRf>	NI	24
*PSC?	<NR1>	NI	24
*RCL	<NRf>	NC	-
*SAV	<NRf>	NC	-

Table A-2. 70842B Error Detector Commands and Changes for the 86130A

Keyword	Parameter	Status	Comment
[SENSe[1]:]		-	-
PATtern		-	-
[:SElect]	PRBS<n>	NC	-
	ZSUBstitution<n>	NC	-
	MDENsity<n>	NC	-
	UPATtern<n>	NC	-
[:SElect]?	PRBS<n>	NC	-
	ZSUB<n>	NC	-
	MDEN<n>	NC	-
	UPAT<n>	NC	-
:ZSUBstitut		-	-
[:ZRUN]	<numeric value>	NI	2
[:ZRUN]?	<NR1>	NI	2
:MDENsity		-	-
[:DENsity]	<numeric value>	NC	-
[:DENsity]?	<NR3>	NC	-
:UPATtern<n>		-	-
[:LENGth]	<numeric value>	NC	-
[:LENGth]?	<NR1>	NC	-
:LABel	<string>	NC	-
:LABel?	<string>	NC	-
:USE	STRAight APATtern	NC	-
:USE?	STR APAT	NC	-
:DATA	[A B,]<block data>	NC	-
:DATA?	[A B,]<block data>	NC	-
:IDATA	[A B,]<start bit>,<length in bits>,<block data>	NC	-
:IDATA?	[A B,]<start bit>,<length in bits>	C	3
:FORMat		-	-
[:DATA]	PACKed,<numeric value>	NC	-
[:DATA]?	PACK,<NR1>	NC	-
VOLTage		-	-
:ZOTHreshold	<numeric value>	NC	-
:ZOTHreshold?	<NR3>	NC	-
:AUTO	<boolean>	NC	-
:AUTO?	<boolean>	NC	-
GATE		-	-
[:STATe]	<boolean>	NC	-
[:STATe]?	<boolean>	NC	-
:MODE	MANual SINGle REPetitive	NC	-
:MODE?	MAN SING REP	NC	-
:MANNer	TIME ERRors BITS	NC	-
:MANNer?	TIME ERR BITS	NC	-
:PERiod		-	-
[:TIME]	<numeric value>	NC	-
[:TIME]?	<NR1>	NC	-
:ERRors	<numeric value>	NC	-
:ERRors?	<NR1>	NC	-
:BITS	<numeric value>	NC	-
:BITS?	<NR3>	NC	-
SYNChronisat	ONCE <boolean>	NC	-



Table A-2. 70842B Error Detector Commands and Changes for the 86130A (continued)

Keyword	Parameter	Status	Comment
SYNChronisat?	<boolean>	NC	-
:THReshold	<numeric value>	NC	-
:THReshold?	<NR3>	NC	-
LOGGing	ONCE   <boolean>	C	25, 26
LOGGing?	<boolean>	NC	25
:SQUelch	<boolean>	NI	25
:SQUelch?	<boolean>	NI	25
:ALARms	<boolean>	NI	25
:ALARms?	<boolean>	NI	25
:THReshold	<numeric parm>	NI	25
:THReshold?	<NR3>	NI	25
:DURing		-	25
[:EVENT]	NEVer   ESECond   ERGThrshld	NI	25
[:EVENT]?	NEV   ESEC   ERGT	NI	25
:END		-	25
[:EVENT]	NEVer   ALWays   NZECCount   TERGthrshld	NI	25
[:EVENT]?	NEV   ALW   NZEC   TERG	NI	25
:REPort	FULL   UREP	NI	25
:REPort?	FULL   UREP	NI	25
EYE		-	-
:TCenter   :TCENTre	ONCE   <boolean>	NC	-
:TCenter?   :TCENTre?	<boolean>	NC	-
:ACenter   :ACENTre	ONCE   <boolean>	NC	-
:ACenter?   :ACENTre?	<boolean>	NC	-
:WIDTh?	<NR3>	NC	-
:HEIGHt?	<NR3>	NC	-
:THReshold	<numeric value>	NC	-
:THReshold?	<NR3>	NC	-
SENSE2		-	-
:VOLTage		-	-
:EDGE	POSitive   NEGative	NC	-
:EDGE?	POS   NEG	NC	-
INPut[1]		-	-
:POLarity	NORMal   INVerted	NC	-
:POLarity?	NORM   INV	NC	-
:DELay	<numeric value>	NC	-
:DELay?	<NR3>	NC	-
:TERMination	<numeric value>	C	11
:TERMination?	<NR1>	C	11
INPut2		-	-
:TERMination	<numeric value>	C	11
:TERMination?	<NR1>	C	11
FETCh   PFETCh		-	-
[:SENSE[1]]		-	-
:ECOUNT		-	-
[:ALL]		-	-
[:TOTal]?	<NR3>	C	27
:DELta?	<NR3>	C	27
:ZASone		-	-
[:TOTal]?	<NR3>	NC	-
:OASZero		-	-
[:TOTal]?	<NR3>	NC	-

Table A-2. 70842B Error Detector Commands and Changes for the 86130A (continued)

Keyword	Parameter	Status	Comment
:ERATio		-	-
[:ALL]		-	-
[:TOTAl]?	<NR3>	C	27
:DELta?	<NR3>	C	27
:ZASone		-	-
[:TOTAl]?	<NR3>	NC	-
:OASZero		-	-
[:TOTAl]?	<NR3>	NC	-
:EINterval		-	-
:SEConds?	<NR3>	NC	-
:DSEConds?	<NR3>	NC	-
:CSEConds?	<NR3>	NI	28
:MSEConds?	<NR3>	NI	28
:EFINterval		-	-
:SEConds?	<NR3>	NC	-
:DSEConds?	<NR3>	NC	-
:CSEConds?	<NR3>	NI	28
:MSEConds?	<NR3>	NI	28
:LOSS		-	-
:POWer?	<NR3>	NC	-
:SYNChronisat?	<NR3>	NC	-
:G821		-	29
:AVAiability?	<NR3>	NI	29
:UNAValiabili?	<NR3>	NI	29
:SESeconds?	<NR3>	NI	29
:DMINutes?	<NR3>	NI	29
:ESEConds?	<NR3>	NI	29
:GATE		-	-
:ELAPsed?	<NR3>	NC	-
:LTEXT?	<string>	NI	30
:SENSe2		-	-
:FREQuency?	<NR3>	C	7
DISPlay		-	31
:SHOW	PGEnerator   EDEtector   BOTH	NI	31
:SHOW?	PGEN   EDET   BOTH	NI	31
:PAGE	USER   IStatus   MStatus   LStatus   MResults   IREsults   G821   ZOOZ results	NI	31
:PAGE?	USER   IST   MST   LST   MRES   IRES   G821   ZOOZ	NI	31
:REPort	PREVious   CURRent	NI	31
:REPort?	PREV   CURR	NI	31
:UPAGe		-	31
[:DEFine]	ECount   DCOUNT   ERATio   DRATio   GELapsed   BECOUNT   BEDCOUNT   BERatio   BEDRatio   BGELapsed   OECOUNT   ZECOUNT   OERatio   ZERatio   DTIME   PIDentity   ERSeconds   EDSeconds   ECSeconds   EMSeconds   CFrequency   EFSeconds   EFDSeconds   EFCSeconds   EFMSeconds   BLANK AVAiability   UNAVailabili   SESeconds   ERDSeconds   DMINutes   SMODE   ZOTMode   DTERmination   TERmination   DPOLarity   DIDelay   CEDGe   GMODE   GREPort   GPERiod   PLSeconds   SLSeconds   LGStatus   ALOGging   LDTRigger   LETRigger   LEReport   LTHReshold   SStatus   HCONtroller   EETHreshold   EWIDth   EHEight	NI	31

Table A-2. 70842B Error Detector Commands and Changes for the 86130A (continued)

Keyword	Parameter	Status	Comment
[ :DEFine]	<boolean>	NI	31
:CLEAr	---	NI	31
SYSTEM		-	-
:BEEPer		-	14
[ :IMMediate]	[<freq>[,<time>[,<vol>]]]	R	14
:STATe	<boolean>	NC	14
:STATe?	<boolean>	NC	14
:ERRor?	<NR1>,<string>	NC	-
:KLOCK	<boolean>	NI	15
:KLOCK?	<boolean>	NI	15
:PRESet   :PRESet<n>	---	NI	16
:PTHrough		-	17
[ :STRing]	<string>	NS	17
[ :STRing]	<string>	NS	17
:VERSIon?	<NR2>	NI	34
:DATE	<year>,<month>,<day>	NI	32
:DATE?	<year>,<month>,<day>	NI	32
:TIME	<hour>,<minute>,<second>	NI	32
:TIME?	<hour>,<minute>,<second>	NI	32
:FREVIision		-	-
:MPROcessor?	<string>	NI	33
STATUS		-	-
:OPERation		-	21
[ :EVENT]?	<NR1>	NC	21
CONDition?	<NR1>	NC	21
:ENABle	<NRf>	NC	21
:ENABle?	<NR1>	NC	21
:PTRansition	<NRf>	NC	21
:PTRansition?	<NR1>	NC	21
:NTRansition	<NRf>	NC	21
:NTRansition?	<NR1>	NC	21
:QUESTionable		-	21
[ :EVENT]?	<NR1>	NC	21
CONDition?	<NR1>	NC	21
:ENABle	<NRf>	NC	21
:ENABle?	<NR1>	NC	21
:PTRansition	<NRf>	NC	21
:PTRansition?	<NR1>	NC	21
:NTRansition	<NRf>	NC	21
:NTRansition?	<NR1>	NC	21
:PRESet	---	NI	18
:FAILure		-	19
[ :EVENT]?	<NR1>	NI	19
:SSERvice		-	20
[ :EVENT]?	<NR1>	NI	20
:ENABle	<NRf>	NI	20
:ENABle?	<NR1>	NI	20
*CLS	---	NC	-
*ESE	<NRf>	NC	21
*ESE?	<NR1>	NC	21
*ESR?	<NR1>	NC	21
*IDN?	<string>	NC	-

Table A-2. 70842B Error Detector Commands and Changes for the 86130A (continued)

Keyword	Parameter	Status	Comment
*OPC	---	NC	-
*OPC?	<NR1>	NC	-
*RST	---	NC	-
*SRE	<NRf>	NC	21
*SRE?	<NR1>	NC	21
*STB?	<NR1>	NC	-
*TST?	<NR1>	NI	22
*WAI	---	NC	-
*OPT?	<NR1>	NI	23
*PSC	<NRf>	NI	24
*PSC?	<NR1>	NI	24
*RCL	<NRf>	NC	-
*SAV	<NRf>	NC	-

## Comments for Tables A-1 and A-2.

1. :AWORD is not used in the 86130A. Work around by using *SOURCE1:PATTERN:UPATTERN<n>:USE APATTERN*.
2. The Zero Substitution commands have been removed.
3. The [A|B] parameter has been removed from the *:IDATA?* query.
4. The options *LLEVel* and *REDGe* have been added to the *APCHange:MODE* commands.
5. The option *ABHAlf* has been added to the *APCHange:SElect* commands.
6. The *ATTenuation* commands are not implemented on the 86130A.
7. This query has the optional parameter [*MINimum*|*MAXimum*] in the 86130A.
8. The 86130A does not compute the clock to trigger ratio.
9. The parameters are now *boolean* type.
10. The 86130A does not trigger on Zsub patterns.
11. The termination value of 1.3 (volts) is allowed in addition to 0 and -2 in the 86130A to accommodate the PECL Lite logic family. Caution, setting the wrong termination can damage the instrument. See the user's manual for more information.
12. The *:OPTimize* commands have been removed from the 86130A. Use the *:XOVer* commands instead.
13. The *MMEMory* commands are not implemented in the 86130A. Patterns can be recalled from disc in the 86130A using the *source1:pattern:select Filename, <character data>* command.
14. The *SYSTEM:BEEPer* commands have been changed for the 86130A.
15. The *SYSTEM:KLOCK* commands are not implemented in the 86130A.
16. The *System:PRESet* commands are not implemented.
17. The *SYSTEM:PASSthrough* commands are not supported in the 86130A as they do not serve any purpose, but should still work. See Section 2 for details.
18. The *STATus:PRESet* commands are not implemented in the 86130A.
19. The Failure Status Register is not used in the 86130A. See Appendix C for more information on status register changes.
20. The SSERvice Register is not present in the 86130A. See Appendix C for more information on status register changes.
21. Several changes have been made in the registers of the 86130A. See Appendix C for more info on status register changes.
22. The "self-test" (\*TST?) query is not implemented in the 86130A.
23. the "Option Identification" query is not implemented in the 86130A.
24. The "Power on Status Clear" commands are not implemented in the 86130A.
25. The data logging subsystem has been changed in the 86130A.
26. The parameter *ONCE* is not available in the 86130A.
27. The optional keyword *FULL* has been added after the keyword *ALL*.
28. The 86130A does not measure BER over centisecond nor millisecond periods.
29. The 86130A does not calculate G.821 specifications.
30. The *LTEXT* command has been removed as part of the overhaul of the data logging system.
31. The entire *DISPlay* subsystem has been removed in the 86130A.
32. The date and time queries are not used in the 86130A.
33. The *MPROCessor* query is not used in the 86130A.
34. The *SYSTEM:VERsion* command is not supported in the 86130A. The firmware version information can be obtained by using a *\*IDN?* query.

## Appendix B. Agilent 86130A Command Tree and Changes from the Agilent 71603B

With all of the new functionality of the 86130A, many new commands have been added and many of the commands from the 71603B have been changed. The tables below outline those new commands and changes.

NC	No Change, this command is the same as in the 71603B.
C	Changed, minor changes have been made in this command to reflect differences between the 71603B and the 86130A.
N	New, this command is new to the 86130A.

**Figure B-1. Command Status Abbreviations**

Table B-1. 86130A Commands and Changes from the 71603B

Keyword	Parameter	Status	Comment
FEtCh		-	-
[ :SENSe[1]]		-	-
:ECounT		-	-
[ :ALL]		-	-
[ :FULL]		-	1
[ :TOTal]?	<NR3>	C	1
:DELta?	<NR3>	C	1
:OASZero		-	-
[ :TOTal]?	<NR3>	NC	-
:ZASone		-	-
[ :TOTal]?	<NR3>	NC	-
:ERATio		-	-
[ :ALL]		-	-
[ :FULL]		-	1
[ :TOTal]?	<NR3>	C	1
:DELta?	<NR3>	C	1
:OASZero		-	-
[ :TOTal]?	<NR3>	NC	-
:ZASone		-	-
[ :TOTal]?	<NR3>	NC	-
:EFINterval		-	-
:SEConds?	<NR3>	NC	-
:DSEConds?	<NR3>	NC	-
:EINterval		-	-
:SEConds?	<NR3>	NC	-
:DSEConds?	<NR3>	NC	-
:LOSS		-	-
:POWer?	<NR3>	NC	-
:SYNchronizat?	<NR3>	NC	11
:GATE		-	-
:ELAPsed?	<NR3>	N	2
:SENSe2		-	-
:FREQuency		-	-
[ :CW   :FIXed]?	<NR3>	NC	-
:BCounT?	<NR3>	N	3
INPut[1]		-	-
:POLarity	NORMal   INVerted	NC	-
:POLarity?	NORM   INV	NC	-
:DELay	<numeric value>	NC	-
:DELay?	<NR3>	NC	-
:TERMination	0   -2   1.3	C	4
:TERMination?	<NR1>	C	4
INPut2		-	-
:TERMination	0   -2   1.3	C	4
:TERMination?	<NR1>	C	4
OUTPut1		-	-
[ :STATe]	0   1   ON   OFF	NC	-
[ :STATe]?	0   1   ON   OFF	NC	-
:COUPling	AC   DC	N	5

Table B-1. 86130A Commands and Changes from the 71603B (continued)

Keyword	Parameter	Status	Comment
:COUpling?	AC DC	N	5
:POLarity	NORMal INVerted	NC	-
:POLarity?	NORM INV	NC	-
:DELay	<numeric value>	NC	-
:DELay?	<NR3>	NC	-
:DATA		-	-
:XOVER	<numeric value>	N	6
:XOVER?	[MINimum MAXimum] <NR3>	N	6
:TERMination	0 -2 1.3	C	4
:TERMination?	<NR1>	C	4
OUTPut2			
:COUpling	AC DC	N	5
:COUpling?	AC DC	N	5
[ :STATe]	0 1 ON OFF	NC	-
[ :STATe]?	0 1 ON OFF	NC	-
:TERMination	0 -2 1.3	C	4
:TERMination?	<NR1>	C	4
OUTPut10		-	7
:COUpling	AC DC	N	5,7
:COUpling?	AC DC	N	5,7
:DATA		-	7
:XOVER	<numeric value>	N	6,7
:XOVER?	[MINimum MAXimum] <NR3>	N	6,7
[ :STATe]	0 1 ON OFF	N	7
[ :STATe]?	0 1 ON OFF	N	7
:TERMination	0 -2 1.3	N	4,7
:TERMination?	<NR1>	N	4,7
OUTPut11		-	8
:COUpling	AC DC	N	8
:COUpling?	AC DC	N	8
[ :STATe]	0 1 ON OFF	N	8
[ :STATe]?	0 1 ON OFF	N	8
:TERMination	0 -2 1.3	N	4,8
:TERMination?	<NR1>	N	4,8
SENSE[1]:		-	-
PATtern		-	-
[ :SElect]	PRBS<n>	NC	-
	PRBN<n>	N	13
	MDENsity<n>	NC	-
	UPATtern<n>	NC	-
	ZSUBstitut<n>	NC	-
	FILENAME, <character data>	N	14
[ :SElect]?	PRBS<n>	NC	-
	PRBN<n>	N	13
	MDEN<n>	NC	-
	UPAT<n>	NC	-
	ZSUB<n>	NC	-
	FILENAME, <character data>	N	14
:TRACK	<boolean>	N	9
:TRACK?	<boolean>	N	9
:MDENsity		-	-

Table B-1. 86130A Commands and Changes from the 71603B (continued)

Keyword	Parameter	Status	Comment
	[ :DENSity]	<numeric value>	NC -
	[ :DENSity]?	<NR3>	NC -
	:UPATtern	-	- -
	[ :LENGth]	<numeric value>	NC -
	[ :LENGth]?	<NR1>	NC -
	:DATA	[A B,] <block_data>	NC -
	:DATA?	[A B,] <block_data>	NC -
	:IDATA	[A B,] <statr_bit>, <length_in_bits>, <block_data>	NC -
	:IDATA?	<statr_bit>, <length_in_bits>	NC -
	:LABel	<string>	NC -
	:LABel?	<string>	NC -
	:USE	STRAight   APATtern	NC -
	:USE?	STR   APAT	NC -
	:FORMat	-	- -
	[ :DATA]	PACKed, <numeric value>	NC -
	[ :DATA]?	PACK, <NR1>	NC -
	VOLTage	-	- -
	:ZOTHreshold	<numeric value>	NC -
	:ZOTHreshold?	<NR3>	NC -
	:AUTO	<boolean>	NC -
	:AUTO?	<boolean>	NC -
	GATE	-	- -
	[ :STATe]	<boolean>	NC -
	[ :STATe]?	<boolean>	NC -
	:MODE	MANual   SINGle   REPetitive	NC -
	:MODE?	MAN   SING   REP	NC -
	:MANNer	TIME   ERRors   BITS	NC -
	:MANNer?	TIME   ERR   BITS	NC -
	:PERiod	-	- -
	[ :TIME]	<numeric value>	NC -
	[ :TIME]?	<NR1>	NC -
	:ERRors	<numeric value>	NC -
	:ERRors?	<NR1>	NC -
	:BITS	<numeric value>	NC -
	:BITS?	<NR3>	NC -
	LOGging	<boolean>	NC -
	LOGging?	<boolean>	NC -
	:FILename	<string>	N 12
	:FILename?	<string>	N 12
	SYNChronizat	ONCE   <boolean>	NC 11
	SYNChronizat?	<boolean>	NC 11
	:THReshold	<numeric value>	NC -
	:THReshold?	<NR3>	NC -
	EYE	-	- -
	:ALIGN:AUTO	<boolean>	N 10
	:ALIGN:AUTO?	<boolean>	N 10
	:TCenter   :TCENTre	ONCE   <boolean>	NC -
	:TCenter?   TCENTre?	<boolean>	NC -
	:ACenter   ACENTre	ONCE   <boolean>	NC -
	:ACenter?   ACENTre?	<boolean>	NC -
	:WIDTH?	<NR3>	NC -



Table B-1. 86130A Commands and Changes from the 71603B (continued)

Keyword	Parameter	Status	Comment
:HEIGHt?	<NR3>	NC	-
:THREshold	<numeric value>	NC	-
:THREshold?	<NR3>	NC	-
SENSE2		-	-
:FREQUency [:CW :FIXed]?	<NR3>	N	15
:VOLTage		-	-
:EDGE	POSitive NEGative	NC	-
:EDGE?	POS NEG	NC	-
SENSE6		-	16
:FREQUency [:CW :FIXed]?	<NR3>	N	16
[SOURce[1]:]		-	-
PATtern		-	-
[:SElect]	PRBS<n>   PRBN<n>   MDENsity<n>   UPATtern<n>   ZSUBstitut<n>   FILENAME, <character data>	NC N NC NC NC N	- 13 - - - 14
[:SElect]?	PRBS<n>   PRBN<n>   MDEN<n>   UPAT<n>   ZSUB<n>   FILENAME, <character data>	NC N NC NC NC N	- 13 - - - 14
:MDENsity		-	-
[:DENsity]	<numeric value>	NC	-
[:DENsity]?	<NR3>	NC	-
:UPATtern		-	-
[:LENGth]	<numeric value>	NC	-
[:LENGth]?	<NR1>	NC	-
:DATA	[A B,] <block_data>	NC	-
:DATA?	[A B,] <block_data>	NC	-
:IDATA	[A B,] <statr_bit>, <length_in_bits>, <blo ck_data>	NC	-
:IDATA?	<statr_bit>, <length_in_bits>	NC	-
:LABel	<string>	NC	-
:LABel?	<string>	NC	-
:USE	STRAight APATtern	NC	-
:USE?	STR APAT	NC	-
:FORMat		-	-
[:DATA]	PACKed, <numeric value>	NC	-
[:DATA]?	PACK, <NR1>	NC	-
APCHange		-	-
:SOURce	EXTernal INTernal	NC	-
:SOURce?	EXT INT	NC	-
:MODE	ALTErnate ONeshot LLEVel REDGe	NC	-
:MODE?	ALT ONES LLEV REDG	NC	-
:SElect	AHALf BHALf ABHALf	NC	-
:SElect?	AHAL BHAL ABHA	NC	-
:IBHalf	ONCE	NC	-

Table B-1. 86130A Commands and Changes from the 71603B (continued)

Keyword	Parameter	Status	Comment
EADDITION	ONCE   <boolean>	NC	-
EADDITION?	<boolean>	NC	-
:SOURCE	EXTERNAL   FIXED	NC	-
:SOURCE?	EXT   FIX	NC	-
:RATE	<numeric value>	NC	-
:RATE?	<NR3>	NC	-
VOLTAGE		-	-
[:LEVEL]		-	-
[:IMMEDIATE]		-	-
[:AMPLITUDE]	<numeric value>	NC	-
[:AMPLITUDE]?	<NR3>	NC	-
:HIGH	<numeric value>	NC	-
:HIGH?	<NR3>	NC	-
:LOW	<numeric value>	N	18
:LOW?	<NR3>	N	18
:OFFSET	<numeric value>	N	19
:OFFSET?	<NR3>	N	19
:LLEVEL	ECL   SCFL   LVPECL   LVTTTL   CUSTOM	N	17
:LLEVEL?	ECL   SCFL   LVPECL   LVTTTL   CUSTOM	N	17
:ECL	---	NC	-
SOURCE2		-	-
:FREQUENCY		-	-
[:CW :FIXED]?	[MINIMUM MAXIMUM] <NR3>	NC	-
:VOLTAGE		-	-
[:LEVEL]		-	-
[:IMMEDIATE]		-	-
[:AMPLITUDE]	<numeric value>	NC	-
[:AMPLITUDE]?	<NR3>	NC	-
:HIGH	<numeric value>	NC	-
:HIGH?	<NR3>	NC	-
:LOW	<numeric value>	N	18
:LOW?	<NR3>	N	18
:OFFSET	<numeric value>	N	19
:OFFSET?	<NR3>	N	19
:LLEVEL	ECL   SCFL   LVPECL   LVTTTL   CUSTOM	N	17
:LLEVEL?	ECL   SCFL   LVPECL   LVTTTL   CUSTOM	N	17
:ECL	---	NC	-
SOURCE3		-	-
:TRIGGER		-	-
[:MODE]	PATTERN   DCLock	NC	-
[:MODE]?	PATT   DCL	NC	-
:PRBS<n>	<boolean>{ , <boolean>}	NC	-
:PRBS<n>?	<NRF>{ , <NRF>}	NC	-
:MDENSITY<n>	<numeric value>	NC	-
:MDENSITY<n>?	<NR1>	NC	-
:UPATTERN<n>	<numeric value>	NC	-
:UPATTERN<n>?	<NR1>	NC	-
:APATTERN<n>	ABCHange   SOPattern	NC	-
:APATTERN<n>?	ABCH   SOP	NC	-
:PRBN<n>	<numeric value>	N	13
:PRBN<n>?	<numeric value>	N	13
SOURCE7		-	20

Table B-1. 86130A Commands and Changes from the 71603B (continued)

Keyword	Parameter	Status	Comment
:TRIGger		-	20
[:MODE]	PATtern DCLock	N	20
[:MODE]?	PATT DCL	N	20
SOURce9		-	21
:FREQuency		-	21
[:CW FIXed]	[MINimum MAXimum] <NR3>	N	21
[:CW FIXed]?	[MINimum MAXimum] <NR3>	N	21
:OUTPut		-	21
[:STATe]	<boolean>	N	21
[:STATe]?	<boolean>	N	21
SOURce10		-	22
:VOLTagE		-	22
[:LEVel]		-	22
[:IMMediate]		-	22
[:AMPLitude]	<numeric value>	N	22
[:AMPLitude]?	<NR3>	N	22
:HIGH	<numeric value>	N	22
:HIGH?	<NR3>	N	22
:LOW	<numeric value>	N	18, 22
:LOW?	<NR3>	N	18, 22
:OFFSet	<numeric value>	N	19, 22
:OFFSet?	<NR3>	N	19, 22
:LLEVel	ECL SCFL LVPECL LVTTTL CUSTOM	N	17, 22
:LLEVel?	ECL SCFL LVPECL LVTTTL CUSTOM	N	17, 22
:TRACk	<boolean>	N	22, 23
:TRACk?	<NRf>	N	22, 23
:ECL	---	N	22
SOURcell		-	24
:VOLTagE		-	24
[:LEVel]		-	24
[:IMMediate]		-	24
[:AMPLitude]	<numeric value>	N	24
[:AMPLitude]?	<NR3>	N	24
:HIGH	<numeric value>	N	24
:HIGH?	<NR3>	N	24
:LOW	<numeric value>	N	18, 24
:LOW?	<NR3>	N	18, 24
:OFFSet	<numeric value>	N	19, 24
:OFFSet?	<NR3>	N	19, 24
:LLEVel	ECL SCFL LVPECL LVTTTL CUSTOM	N	17, 24
:LLEVel?	ECL SCFL LVPECL LVTTTL CUSTOM	N	17, 24
:TRACk	<boolean>	N	23, 24
:TRACk?	<NRf>	N	23, 24
:ECL	---	N	24
STATus		-	25
:OPERation		-	25
[:EVENT]?	<NR1>	NC	25
CONDition?	<NR1>	NC	25
:ENABle	<NRf>	NC	25
:ENABle?	<NR1>	NC	25
:PTRansition	<NRf>	NC	25
:PTRansition?	<NR1>	NC	25

Table B-1. 86130A Commands and Changes from the 71603B (continued)

Keyword	Parameter	Status	Comment
:NTRansition	<NRf>	NC	25
:NTRansition?	<NR1>	NC	25
:QUESTionable		-	25
[:EVENT]?	<NR1>	NC	25
CONDition?	<NR1>	NC	25
:ENABle	<NRf>	NC	25
:ENABle?	<NR1>	NC	25
:PTRansition	<NRf>	NC	25
:PTRansition?	<NR1>	NC	25
:NTRansition	<NRf>	NC	25
:NTRansition?	<NR1>	NC	25
:CLOSS		-	25,26
[:EVENT]?	<NR1>	N	25,26
CONDition?	<NR1>	N	25,26
:ENABle	<NRf>	N	25,26
:ENABle?	<NR1>	N	25,26
:PTRansition	<NRf>	N	25,26
:PTRansition?	<NR1>	N	25,26
:NTRansition	<NRf>	N	25,26
:NTRansition?	<NR1>	N	25,26
SYSTEM		-	-
:BEEPer		-	-
:STATe	<boolean>	N	27
:STATe?	<NRf>	N	27
:MODE	BERAlarm TONes	N	28
:MODE?	BER TON	N	28
:THReshold	<numeric value>	N	29
:THReshold?	<NR3>	N	29
:VOLume	<numeric value>	N	30
:VOLume?	<NR3>	N	30
:ERRor?	<NR1>,<string>	NC	-
:HELP?		N	31
*CLS	---	NC	-
*ESE	<NRf>	C	25
*ESE?	<NR1>	C	25
*ESR?	<NR1>	C	25
*IDN?	<string>	NC	-
*OPC	---	NC	-
*OPC?	<NR1>	NC	-
*RST	---	NC	-
*SRE	<NRf>	NC	-
*SRE?	<NR1>	NC	-
*STB?	<NR1>	NC	-
*WAI	---	NC	-
*RCL	<NRf>	NC	-
*SAV	<NRf>	NC	-

**Comments for Table B-1.**

1. The optional keyword *FULL* is used in the 86130A.
2. This command returns information on the progress of the measurement period.
3. This command returns the total bit count in the accumulation.
4. The termination value of 1.3 (Volts) is available as a parameter in the 86130A for the PECL lite logic family in addition to 0 and -2.
5. The 86130A allows AC or DC coupling.
6. Allows the crossover voltage to be set between 25% and 75%.
7. The *OUTPut10* subsystem contains commands for data bar.
8. The *OUTPut11* subsystem contains commands for clock bar.
9. Pattern track command links the PG and ED so that the pattern need only be specified for one or the other. See section 3 for details.
10. The Auto Align command starts the Auto Align subroutine which finds the optimal sampling point. This may take several seconds.
11. The key word *SYNChronisat* has been replaced with *SYNChronizat* but the old keyword is retained for backwards compatibility.
12. The filename feature has been added to the logging system.
13. 2n PRBS are new to the 86130A.
14. The filename pattern allows a previously pattern to be loaded from memory.
15. The 86130A allows clock frequency to be measured using this command.
16. The *SENSe6* subsystem measures clock frequency at the clock input port .
17. The *LLEVel* commands allow all voltage levels to be set to match a common logic family.
18. This command sets the low voltage on the 86130A.
19. This command sets the mean voltage on the 86130A.
20. The *SOURce7* subsystem configures the trigger output port.
21. The *SOURce9* subsystem configures the output clock.
22. The *SOURce10* subsystem sets up the data bar output
23. The *TRACK* commands link the data and data bar or clock and clock bar such that their voltage levels are the same.
24. The *SOURce11* subsystem sets up the data bar output.
25. The status registers are different between the 86130A and the 71603B. See Appendix C for details.
26. The Clock Loss register is not present in the 71603B.
27. The beeper state is a new feature in the 86130A.
28. The beeper mode is a new feature in the 86130A.
29. The beeper volume is a new feature in the 86130A.
30. The beeper threshold is a new feature in the 86130A.
31. The *SYSTem:HELP?* command is not available in the 71603B.

## Appendix C. Status Register Changes

Although the status registers of the 86130A closely resemble those of the 71603B error detector, several changes have been made to the status register system. The most important change is that just as the instrument components have been combined, the status register system has been consolidated. That is, the pattern generator and error detector of the 71603B each had their own status registers whereas there is only one register group for the 86130A. One change that has been made to compensate for this is that a new register, the clock loss status register, has been added so that the user can determine whether the clock signal has been lost at the error detector, the pattern generator, or both. Another major change is that the failure status register although present, is not used in the 86130A. The following figures illustrate the status registers of and highlight the differences between the 71603B and the 86130A.

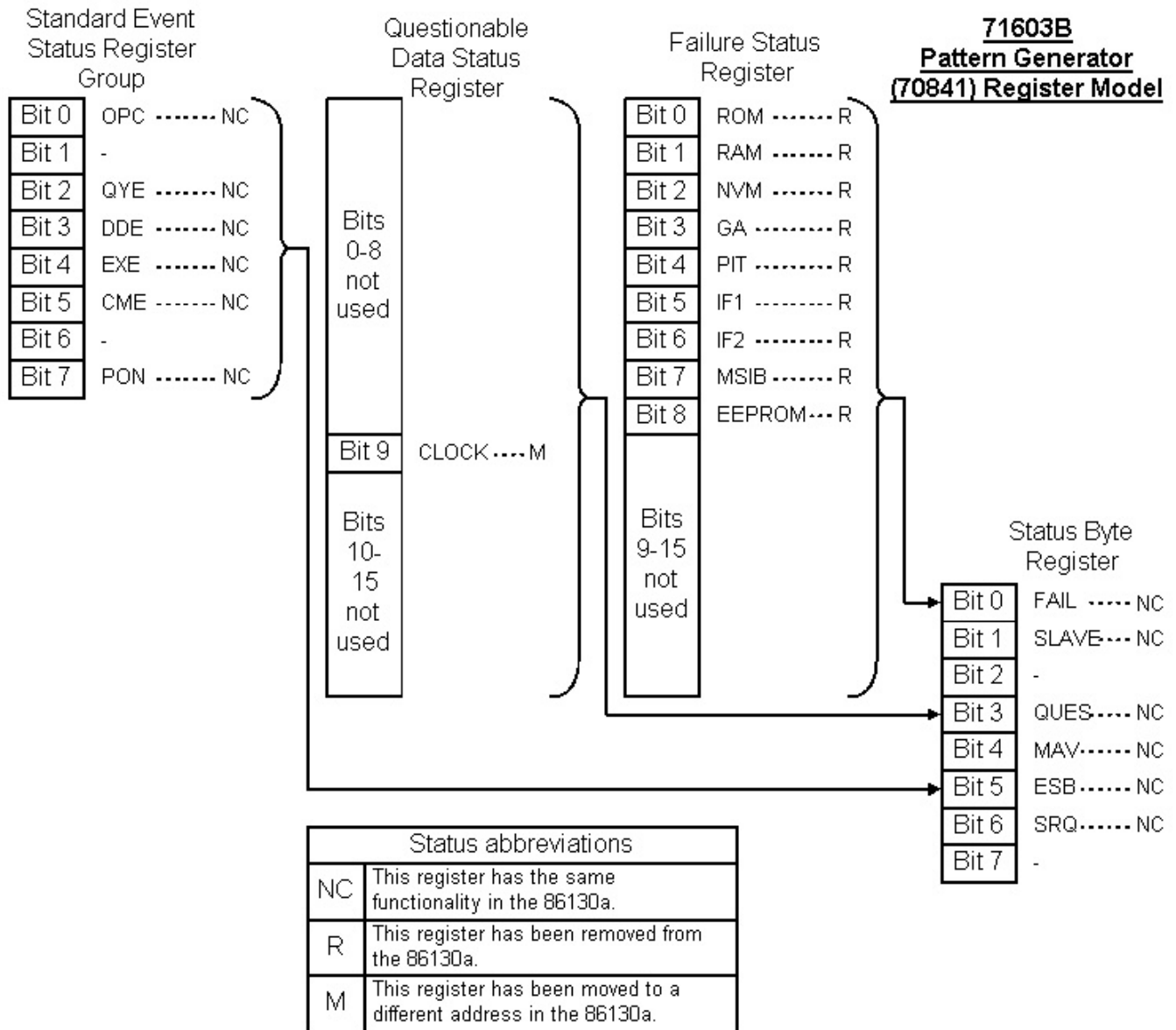
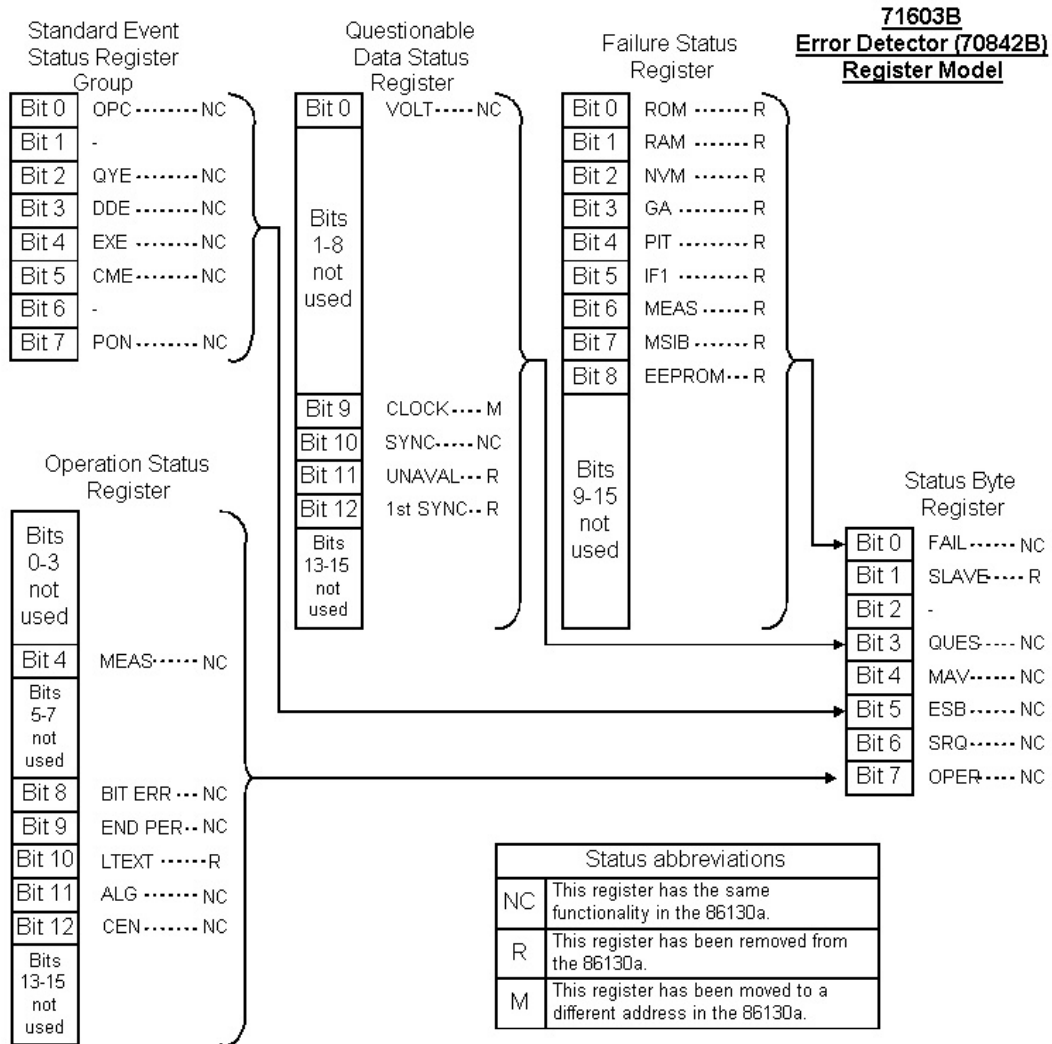


Figure C-1. 71603B Pattern Generator Status Register Map



**Figure C-2. 71603B Error Detector Status Register Map**



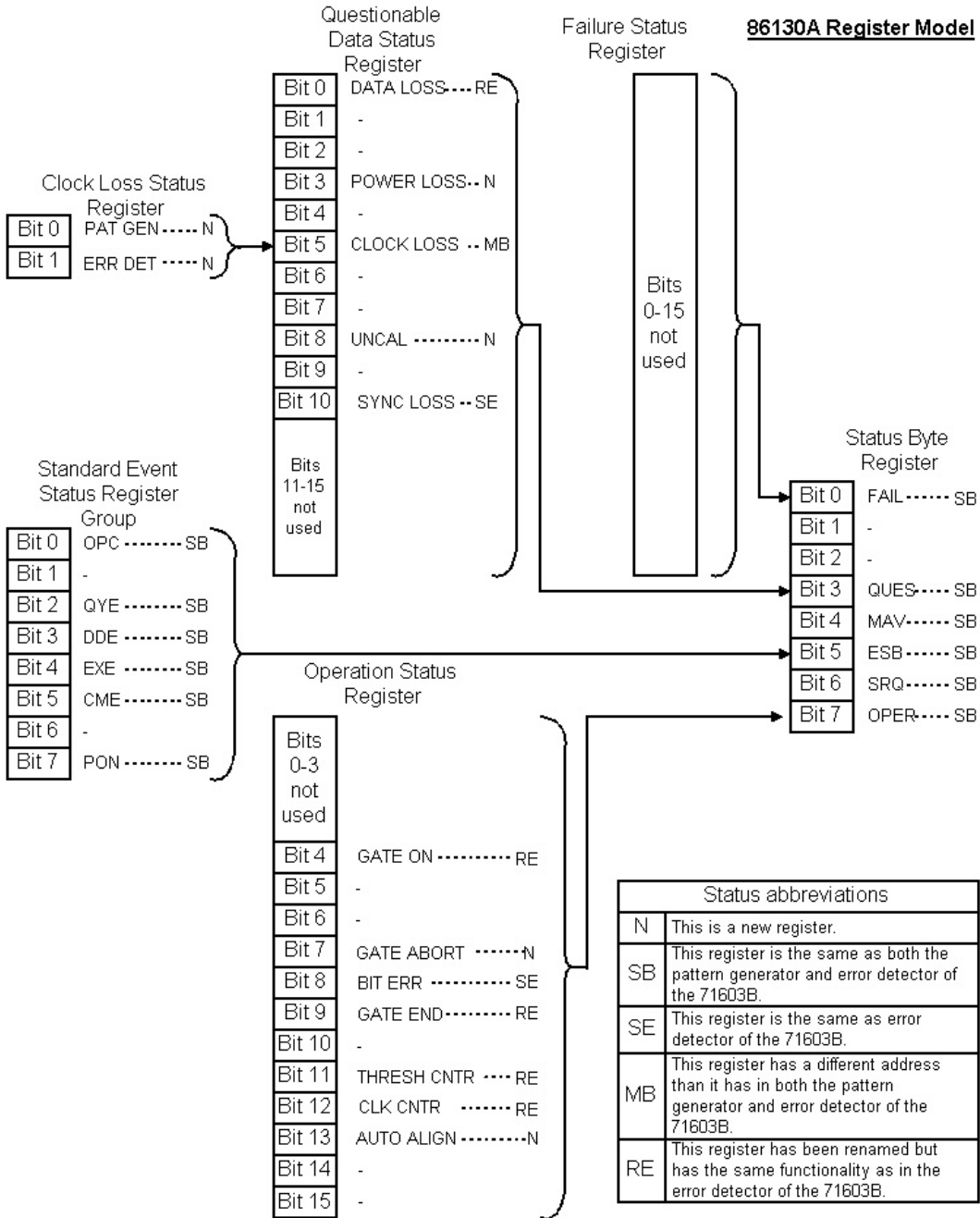


Figure C-3. 86130A Status Register Map

## Appendix D. Remote Programming Basics

This section briefly explains the command structure of the 71603B and 86130A as well as the command trees in Appendices A and B. The BitAnalyzer complies with SCPI<sup>2</sup> standards.

Commands are either *events*, which tell the instrument to perform some task, or *queries*, which retrieve some data from the instrument. Queries are easy to identify as they always end in a question mark. The commands consist of two parts, a series of keywords followed by one or more parameters. However, a few event commands do not require any parameters. A colon is used to separate individual keywords within a command.

Keywords may be used in either long or abbreviated form. Also, a command can consist of both the long and short versions of a keyword. The abbreviated form almost always consists of the first four letters of the keyword, unless the fourth letter is a vowel, in which case only the first three letters are used. These forms are distinguished in documentation by using capitalization where the entire keyword is written, but only the abbreviated form is capitalized. For example the keyword *CONDition* has the abbreviated form *COND*. Actual commands are not case sensitive. This means that *COND*, *cond*, *CoNd*, *ConDition*, and *CONDition* are all perfectly valid. Commands are arranged in a hierarchy such that each keyword represents a subsection of the last. For example, in the command *SOURce1:PATtern:MDENsity:DENSity?*, *density* is one of the commands in the *mdensity* group of the

*pattern* commands in the *source1* subsystem.

Understandably, only the bottom level commands are valid. Therefore, in the previous example, *SOURce1?* is not a valid query as the instrument does not know what data about *source1* to return from the instrument. In Appendices A and B, valid commands are indicated by the presence of parameter, parameter types, or a triple dash indicating that no parameters are needed. Many times keywords are optional in order to shorten the overall length of the command. For example, the keyword *DENSity* in the above example is optional, *SOURce1:PATtern:MDENsity?* is a valid query, since the instrument assumes that the user wants to know the density. The parameters pass data to the instrument, for example the termination voltage for a given input. In query commands, the parameters indicate the format in which the data is returned. Many commands allow only a small set of parameters, such as *OUTPut1:COUPling*, which chooses either an *AC* or *DC* coupling. Fixed parameters also have long and abbreviated forms, just like keywords. Table D-1 describes the symbols used in Appendices A and B. Table D-2 describes the number formats used in parameters.

<sup>1</sup> For more information see the Standard Commands for Programmable Instruments SCPI Consortium, *SCPI-Standard Commands for Programmable Instruments*, 1997

Table D-1. Symbol Definitions Used in SCPI Instruments

Symbol	Meaning
	A vertical bar represents an exclusive “or.”
[]	Brackets indicate an optional keyword or parameter.
{}	Braces represent a parameter that may be repeated 0 or more times.
<>	Angle brackets are used to enclose a parameter type or description to distinguish it from a literal parameter.
---	The triple dash indicates an event command that does not require any parameters.

Table D-2. Parameter Types in SCPI Instruments

Parameter Type	Description
<NRf>	Number can only be 1 or 0
<NR1>	A signed integer number
<NR2>	A signed number which may have a decimal
<NR3>	A signed number which may have a decimal and exponent
<boolean>	Can be the number “1”, the number “0”, the string “ON”, or the string “OFF”
<string>	Any string
<block data>	Block data as defined in the IEEE 488.2 standard. The first character is a “#” followed by a one-digit number representing the length of number which specifies the length of the data in bytes. For instance to send 1000 bytes of data, the block data representation would be #41000<1000 bytes of data>.

## **Agilent Technologies'**

### **Test and Measurement Support, Services, and Assistance**

Agilent Technologies aims to maximize the value you receive, while minimizing your risk and problems. We strive to ensure that you get the test and measurement capabilities you paid for and obtain the support you need. Our extensive support resources and services can help you choose the right Agilent products for your applications and apply them successfully. Every instrument and system we sell has a global warranty. Support is available for at least five years beyond the production life of the product. Two concepts underlie Agilent's overall support policy: "Our Promise" and "Your Advantage."

#### **Our Promise**

Our Promise means your Agilent test and measurement equipment will meet its advertised performance and functionality. When you are choosing new equipment, we will help you with product information, including realistic performance specifications and practical recommendations from experienced test engineers. When you use Agilent equipment, we can verify that it works properly, help with product operation, and provide basic measurement assistance for the use of specified capabilities, at no extra cost upon request. Many self-help tools are available.

#### **Your Advantage**

Your Advantage means that Agilent offers a wide range of additional expert test and measurement services, which you can purchase according to your unique technical and business needs. Solve problems efficiently and gain a competitive edge by contracting with us for calibration, extra-cost upgrades, out-of-warranty repairs, and on-site education and training, as well as design, system integration, project management, and other professional engineering services. Experienced Agilent engineers and technicians worldwide can help you maximize your productivity, optimize the return on investment of your Agilent instruments and systems, and obtain dependable measurement accuracy for the life of those products.

**By internet, phone, or fax, get assistance with all your test & measurement needs.**

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##### **New Zealand:**

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