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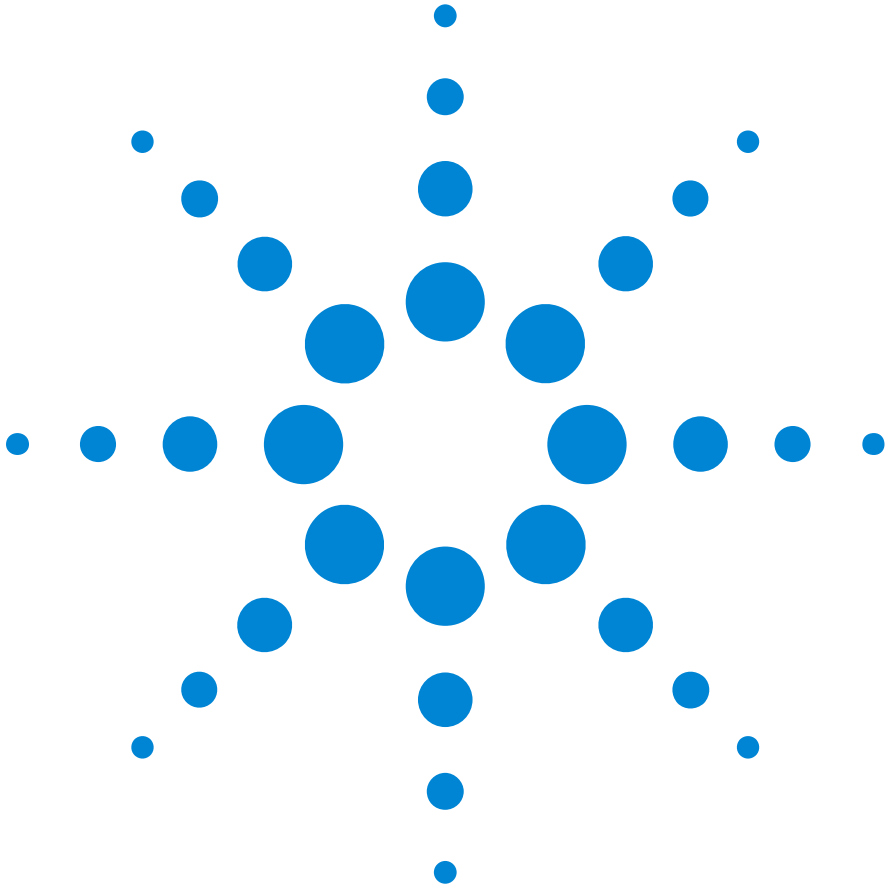
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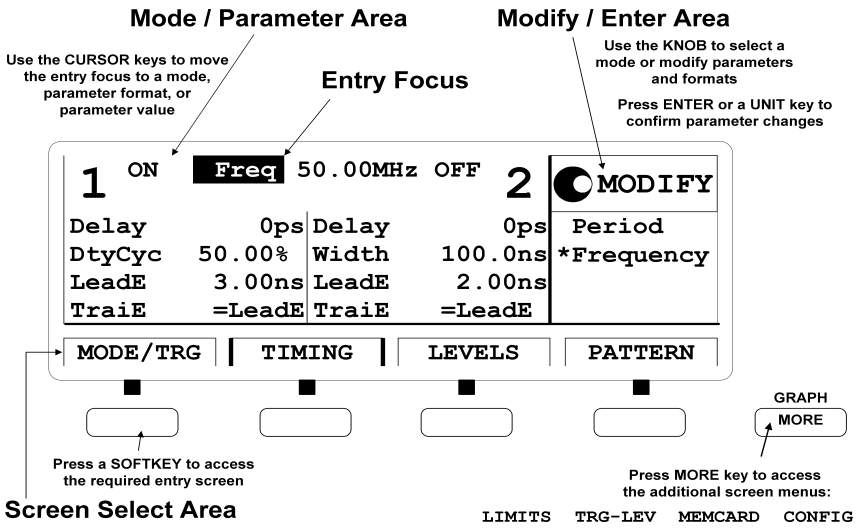
Agilent 81110A 165/330MHz
Agilent 81104A 80 MHz Pulse/Data Generator

Reference Guide



Agilent Technologies

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Reference Guide

Agilent 81110A 165/330 MHz, Agilent 81104A 80 MHz Pulse/Pattern Generators

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About this book

This guide provides reference information primarily for programming the Agilent 81104A and Agilent 81110A via remote control.

Chapter 1 "General Programming Aspects" on page 13 gives general hints for programming instruments like the Agilent 81110A using SCPI commands.

Chapter 2 "Programming Reference" on page 25 provides detailed information on the SCPI commands supported by the instrument.

Chapter 3 "Specifications" on page 101 lists the instrument's technical specifications and provides exact definitions for the instrument's parameters.

For an introduction and information on the Agilent 81110A's user interface, please refer to the *Quick Start Guide*, *p/n 81110-91020*.

The information is valid for Agilent 81104A and Agilent 81110A. Where required the differences are explicitly mentioned. Possible configurations are:

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Output Modules

Both the Agilent 81110A and Agilent 81104A mainframes can be configured with either one or two output modules. These output modules must be of the same type.

The standard mainframe configuration is with one output module only. This manual describes the configuration with two output modules. Some of the features described here are not available for the standard configuration.

Output Modules for Agilent 81104A Mainframes

Module	Description	Max. Quantity
Agilent 81105A	10V/ max.80 MHz Output Channel	2

Output Modules for Agilent 81110A Mainframes

Module	Description	Max. Quantity
Agilent 81111A	10V/ max. 165 MHz Output Channel	2
Agilent 81112A	3.8V/ max. 330 MHz Output Channel	2

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Safety Information

Safety

This is a Safety Class 1 instrument (provided with terminal for protective earthing). Before applying power, verify that the correct safety precautions are taken (see the following warnings). In addition, note the external markings on the instrument that are described under Safety Symbols. Do not operate the instrument with its covers removed. Replace fuse only with specified type.

Warning

Before turning on the instrument, you must connect the protective earth terminal of the instrument to the protective earth conductor of the (mains) power cord. The mains plug must only be inserted in a socket outlet with a protective earth contact. Do not negate the protective action by using an extension power cord without a protective grounding conductor. Grounding one conductor of a two-conductor outlet is not sufficient protection.

Service instructions are for trained service personnel. To avoid dangerous electric shock, do not perform any service unless qualified to do so. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

If you energize this instrument using an auto-transformer (for voltage reduction), make sure that the common terminal is connected to the earth terminal of the power source.

Whenever it is likely that the ground protection is impaired, you must make the instrument inoperative and secure it against any unintended operation.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

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Capacitors inside the instrument may retain a charge even if the instrument is disconnected from its source of supply.

Safety Symbols



Instruction Manual symbol: The instrument is marked with this symbol when it is necessary for you to refer to the instruction manual in order to protect against damage to the instrument.



Protected conductor symbol.

In the manuals:

WARNING **Warnings call attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury or loss of life. Do not proceed beyond a Warning until the indicated conditions are fully understood and met.**

CAUTION Cautions call attention to a 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 equipment. Do not proceed beyond a Caution until the indicated conditions are fully understood and met.

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1 General Programming Aspects

This chapter provides general information on writing GP-IB/SCPI programs for instruments like the Agilent 81104A and the Agilent 81110A.

Detailed information on programming the Agilent 81104A and Agilent 81110A can be found in *Chapter 2 "Programming Reference" on page 25*.

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The GP-IB Interface Bus

The GP Interface Bus is the interface used for communication between a controller and an external device, such as the Agilent 81110A. The GP-IB conforms to IEEE standard 488-1987, ANSI standard MC 1.1, and IEC recommendation 625-1.

If you are not familiar with the GP-IB, please refer to the following books:

- The Institute of Electrical and Electronic Engineers: IEEE Standard 488.1-1987, *IEEE Standard Digital Interface for Programmable Instrumentation*.
- The Institute of Electrical and Electronic Engineers: IEEE Standard 488.2-1987, *IEEE Standard Codes, Formats, and Common Commands for Use with IEEE Standard 488.1-1987*.

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Agilent 81110A Remote Control

GP-IB Address

You can only set the GP-IB address from the front panel of the instrument (refer to the *Quick Start Guide*).

The default GP-IB address is 10.

Modes of Operation

The Agilent 81110A has two modes of operation:

- Local
  The instrument is operated using the front panel keys.
- Remote
  After receiving the first command or query via the GP-IB, the instrument is put into remote state. The front panel is locked.
  To return to local operating mode, press SHIFT (LOCAL).

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Programming Recommendations

Here are some recommendations for programming the instrument:

- Start programming from the default setting. The common command for setting the default setting is:

  ```
  *RST
  ```

- Switch off the automatic update of the display to increase the programming speed. The device command for switching off the display is:

  ```
  :DISPlay OFF
  ```

- The SCPI standard defines a long and a short form of the commands. For fast programming speed it is recommended to use the short forms. The short forms of the commands are represented by upper case letters. For example the short form of the command to set 100 ns double pulse delay is:

  ```
  :PULS:DOUB:DEL 100NS
  ```

- To improve programming speed it is also allowed to skip optional subsystem command parts. Optional subsystem command parts are depicted in square brackets, e.g.: enable double pulse mode by `[SOURce]:PULSe:DOUBle[1|2][:STATe] ON|OFF`. Sufficient to use:

  ```
  :PULS:DOUB ON      # enables double pulse mode for
                     # output 1
  ```

- The commands to set the timing and level parameters, except of period/frequency, have to be specified for output 1 and output 2. If there is no output specified the command will set the default output 1.

  So, for setting a high level of 3 Volts for output 1 and output 2 the commands are:

  ```
  :VOLT:HIGH 3V      # sets high level of 3 V at out 1
  :VOLT1:HIGH 3V     # sets high level of 3 V at out 1

  :VOLT2:HIGH 3V     # sets high level of 3 V at out 2
  ```


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- It is recommended to test the new setting which will be programmed on the instrument by setting it up manually. Enable the outputs so that the instruments error check system is on and possible parameter conflicts are immediately displayed. When you have found the correct setting, then use this to create the program. In the program it is recommended to send the command for enabling outputs (for example, `:OUTPut1 ON`) as the last command. With this procedure it is possible to switch off the error check system (`:SYSTem:CHECk OFF`) to increase programming speed. The error check is enabled again by sending `*RST`.

```
*RST                # set default settings
:DISP OFF           # switch off display update
:SYST:CHEC OFF      # switch off error check
...                 # other commands to set modes
...                 # and parameters
:OUTP1 ON           # enable the output 1
```

- Selftest of the instrument can be invoked by the common command
  `*TST`
- The Agilent 81110A offers auto calibration for the period (VFO), delay and width circuitry by the device command `:CALibration`. It is recommended to query whether the calibration is passed by sending `:CALibration?`.
- If it is important to know whether the last command is completed then send the common command
  `*OPC?`

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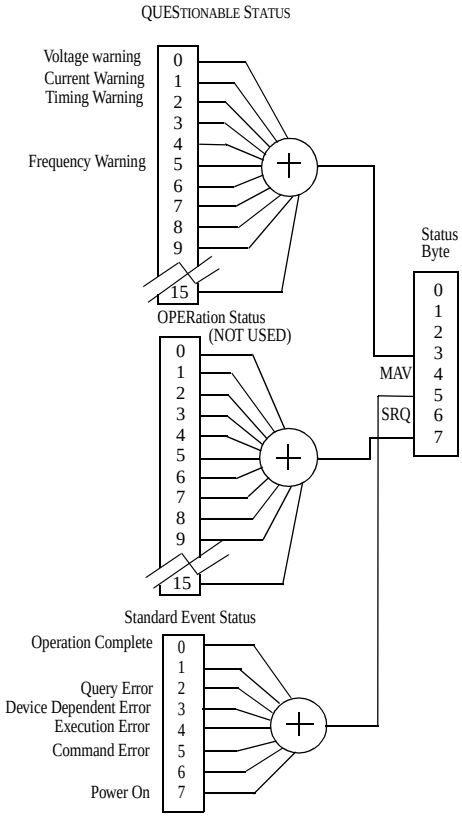
Common Command Summary

This table summarizes the IEEE 488.2 common commands supported by the Agilent 81110A/81104A:

Command	Parameter	Description
*CLS	–	Clear the status structure
*ESE	<0–255>	Set the Standard Event Status register mask
*ESE?	–	Read the state of the Standard Event Status enable register
*ESR?	–	Read the state of the Standard Event Status event register
*IDN?	–	Read the Instrument's Identification string
*LRN?	–	Read the complete Instrument Setting
*OPC	–	Set the Operation Complete bit when all pending actions are complete
*OPC?	–	Read the status of the Operation Complete bit
*OPT?	–	Read the installed options
*RCL	<0–9>	Recall a complete Instrument Setting from memory
*RST	–	Reset the instrument to standard settings
*SAV	<1–9>	Save the complete Instrument Setting to memory
*SRE	<0–255>	Set the Service Request Enable Mask
*SRE?	–	Read the Service Request Enable Mask
*STB?	–	Read the Status Byte
*TRG	–	Trigger
*TST?	–	Execute instrument's self-test
*WAI	–	Wait until all pending actions are complete

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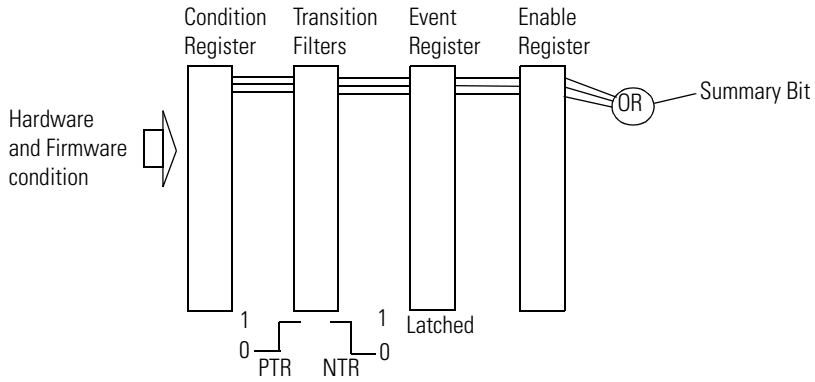
Status Model



The instrument has a status reporting system conforming to IEEE 488.2 and SCPI. The figure above shows the status groups available in the instrument.

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Each status group is made up of component registers, as shown in the figure below.



Condition Register

A condition register contains the current status of the hardware and firmware. It is continuously updated and is not latched or buffered. You can only read condition registers. If there is no command to read the condition register of a particular status group, then it is simply invisible to you.

Transition Filters

Transition filters are used to detect changes of state in the condition register and set the corresponding bit in the event register. You can set transition filter bits to detect positive transitions (PTR), negative transitions (NTR) or both. Transition filters are therefore read-write registers. They are unaffected by *CLS.

Event Register

An event register latches transition events from the condition register as specified by the transition filters or records status events. Querying (reading) the event register clears it, as does the *CLS command. There is no buffering, so while a bit is set, subsequent transition events are not recorded. Event registers are read-only.

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Enable Register

The enable register defines which bits in an event register are included in the logical OR into the summary bit. The enable register is logically ANDed with the event register and the resulting bits ORed into the summary bit. Enable registers are read-write, and are not affected by ***CLS** or querying.

Although all status groups have all of these registers, not all status groups actually use all of the registers. The following table summarizes the registers used in the instrument status groups.

	Registers in Group				
Status Group	**CONDitio n**	**NTR**	**PTR**	**EVENt**	**ENABLe**
QUEStionable	√	√	√	√	√
OPERation[1]	**x**	**x**	**x**	**x**	**x**
Standard Event Status	**x**	**x**	**x**	√**2**	√**3**
Status Byte	**x**	**x**	**x**	√**4**	√**5**

1 Present, but not used. COND and EVEN always 0.
2 Use *ESR? to query.
3 Use *ESE to set, *ESE? to query
4 Use *STB? to query
5 Use *SRE to set, *SRE? to query

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Status Byte

The status byte summarizes the information from all other status groups. The summary bit for the status byte actually appears in bit 6 (RQS) of the status byte. When RQS is set it generates an SRQ interrupt to the controller indicating that at least one instrument on the bus requires attention. You can read the status byte using a serial poll or *STB?

Bit	Description
0	Unused, always 0
1	Unused, always 0
2	Unused, always 0
3	QUESTionable Status Summary Bit
4	MAV—Message AVailable in output buffer
5	Standard Event Status summary bit
6	RQS; ReQuest Service
7	OPERation Status summary Bit, unused

Standard Event Status Group

Bit	Description
0	Operation Complete, set by *OPC
1	Unused, always 0
2	Query Error
3	Device Dependent Error
4	Execution Error
5	Command Error
6	Unused, always 0
7	Power On

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OPERation Status Group

This Status Group is not used in the instrument.

Bit	Description
0	Unused, always 0
1	Unused, always 0
2	Unused, always 0
3	Unused, always 0
4	Unused, always 0
5	Unused, always 0
6	Unused, always 0
7	Unused, always 0
8	Unused, always 0
9	Unused, always 0
10	Unused, always 0
11	Unused, always 0
12	Unused, always 0
13	Unused, always 0
14	Unused, always 0
15	Always 0

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QUEStionable Status Group

Bit	QUEStionable
0	Voltage warning
1	Current warning
2	Time warning
3	Unused, always 0
4	Unused, always 0
5	Frequency warning
6	Unused, always 0
7	Unused, always 0
8	Unused, always 0
9	Unused, always 0
10	Unused, always 0
11	Unused, always 0
12	Unused, always
13	Unused, always 0
14	Unused, always 0
15	Always 0

The QUEStionable Status group is used to report warning conditions amongst the voltage, current, pulse timing and frequency parameters. Warnings occur when a parameter, although not outside its maximum limits, could be causing an invalid signal at the output because of the actual settings and uncertainties of related parameters.

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2 Programming Reference

This chapter provides reference information on the following topics:

- *"Agilent 81110A/81104A SCPI Command Summary" on page 26*
- *"Default Values, Standard Settings" on page 33*
- *"Programming the Instrument Trigger Modes" on page 39*
- *"SCPI Instrument Command List" on page 43*

For general programming information, please refer to *Chapter 1 "General Programming Aspects" on page 13*.

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Agilent 81110A/81104A SCPI Command Summary

Command	Parameter	Description	see page
:ARM		(Trigger mode and source)	
[:SEQuence[1]|:STARt]			
[:LAYer[1]]			
:EWIDth			
[:STATe]	ON|OFF|1|0	Set/read External Width mode	*44*
:FREQuency	<value>	Set/read trigger frequency, when PLL (INT2) used as source	*44*
:IMPedance	<value>	Set/read impedance at EXT INPUT	*45*
:LEVel	<value>	Set/read threshold level at EXT INPUT	*45*
:PERiod	<value>	Set/read trigger period,when PLL (INT2) used as source	*46*
:SENSe	EDGE|LEVel	Set/read trigger on edge or gate on level	*47*
:SLOPe	POS|NEG|EITH	Set/read trigger slope at EXT INPUT	*47*
:SOURce	IMM|INT[1]|INT2|EXT[1]|MAN	Set/read trigger source (VCO | PLL | EXT INPUT | MAN key)	*48*
:CHANnel			
:MATH	OFF|PLUS	Set/read addition of channels 1 and 2 at output 1	*48*
:CALibration[:ALL]		Set/read calibration of period (VFO), delay and width circuitries	*49*

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Command	Parameter	Description	see page
:DIGital			
[:STIMulus]			
:PATTern			
:DATA[1|2|3]	[<start>,]<data>	Set/read pattern data [from Bit<start>]	50
:PRBS[1|2|3]	[<n>,]<length>	Set PRBS 2^n–1 data (n = 7 to 12)	52
:PRESet[1|2|3]	[<n>,]<length>	Set preset pattern with frequency CLOCK÷ n (n = 2 to 16384)	53
[:STATe]	OFF|ON|0|1	Switch Pattern mode on or off	54
:UPDate	OFF|ON|ONCE	Update the hardware with pattern data	54
:SIGNal[1|2]			
:FORMat	RZ|NRZ	Set/read data format of output channel	55
:DISPlay			
[:WINDow]			
[:STATe]	ON|OFF|1|0	Set/read frontpanel display state	55
:MMEMory			
:CATalog?	[A:]	Read directory of memory card	55
:CDIRectory	[<name>]	Change directory on memory card	56
:COPY	<source>[,A:], <dest>[,A:]	Copy a file on memory card	57
:DELete	<name>[,A:]	Delete a file from memory card	57
:INITialize	[A:[DOS]]	Initialize memory card to DOS format	57
:LOAD			
:STATe	<n>,<name>	Load file from memory card to memory n	58
:STORe			
:STATe	<n>,<name>	Store memory n to memory card	58

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Command	Parameter	Description	see page
:OUTPut[1|2]			
[:NORMal]			
[:STATe]	OFF|ON|1|0	Set/read normal output state	59
:COMPlement			
[:STATe]	OFF|ON|1|0	Set/read complement output state	59
:IMPedance			
[:INTernal]	<value>	Set/read internal source impedance of output	59
:EXTernal	<value>	Set/read expected external load impedance at output	60
:POLarity	NORM|INV	Set/read output polarity	60
[:SOURce]			
:CURRent[1|2]			
[:LEVel]			
[:IMMediate]			
[:AMPLitude]	<value>	Set/read channel amplitude current	61
:OFFSet	<value>	Set/read channel offset current	62
:HIGH	<value>	Set/read channel high-level current	63
:LOW	<value>	Set/read channel low-level current	64
:LIMit			
[:HIGH]	<value>	Set/read maximum current limits	65
:LOW	<value>	Set/read minimum current limits	65
:STATe	ON|OFF|1|0	Enable/Disable the current limits	66
:FREQency			
[:CW|:FIXed]	<value>	Set/read frequency of pulses	66
:AUTO	ONCE	Measure frequency at CLK IN	67

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Command	Parameter	Description	see page
[:SOURce]		(continued)	
:HOLD[1|2]	VOLT|CURR	Switch between VOLtage and CURRent command subtrees	68
:PHASe[1|2]			
[:ADJust]	<value>	Set/read channel phase	68
:PULSe			
:DCYCle[1|2]	<value>	Set/read channel dutycycle	69
:DELay[1|2]	<value>	Set/read channel delay (to leading edge)	70
:HOLD	TIME|PRATio	Hold absolute delay or delay as period fixed with varying frequency	71
:UNIT	S|SEC|PCT|DEG|RAD	Set/read delay units	71
:DOUBle[1|2]			
[:STATe]	OFF|ON	Enable/disable double pulses per period	72
:DELay	<value>	Set/read delay between double pulses	72
:HOLD	TIME|PRATio	Hold absolute delay or delay as period fixed with varying frequency	73
:UNIT	S|SEC|PCT	Set/read delay units	74
:HOLD[1|2]	WIDTh|DCYCle|TDELay	Hold Width|Dutycycle|Trailing edge delay fixed with varying frequency	74
:PERiod	<value>	Set/read pulse period	75
:AUTO	ONCE	Measure pulse period at CLK IN	76
:TDELay[1|2]	<value>	Set/read trailing edge delay	76
:TRANsition[1|2]			
:HOLD	TIME|WRATio	Hold absolute transitions|transitions as width ratio fixed with varying width	77
:UNIT	S|SEC|PCT	Set/read transition-time units	77
[:LEADing]	<value>	Set/read leading-edge transition	78
:TRAiling	<value>	Set/read trailing-edge transition	79
:AUTO	OFF|ON|ONCE	Couple trailing edge to leading edge	80

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Command	Parameter	Description	see page
[:SOURce]		(continued)	
:TRIGger[1|2]			
:VOLTage	TTL|ECL	Set/read TRIGGER|STROBE OUTput levels	*80*
:WIDTh[1|2]	<value>	Set/read channel pulse width	*81*
:ROSCillator			
:SOURce	INTernal|EXTernal	Set/read PLL reference source	*82*
:EXTernal			
:FREQuency	<value>	Set/read frequency of external PLL reference	*82*
:VOLTage[1|2]			
[:LEVel]			
[:IMMediate]			
[:AMPlitude]	<value>	Set/read channel amplitude voltage	*83*
:OFFset	<value>	Set/read channel offset voltage	*84*
:HIGH	<value>	Set/read channel high-level voltage	*85*
:LOW	<value>	Set/read channel low-level voltage	*86*
:LIMit			
[:HIGH]	<value>	Set/read maximum voltage limit	*87*
:LOW	<value>	Set/read minimum voltage limit	*87*
:STATe	ON|OFF|1|0	Enable|Disable the voltage limits	*88*

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Command	Parameter	Description	see page
:STATus			
:OPERation			
[:EVENt]?	Numeric	Read Operation event register	*88*
:CONDition	Numeric	Read Operation condition register	*88*
:ENABle	Numeric	Set/Read Operation enable register	*88*
:NTRansition	Numeric	Set/Read Operation negative-transition register	*88*
:PTRansition	Numeric	Set/Read positive-transition register	*88*
:PREset		Clear and preset status groups	*89*
:QUEStionable			
[:EVENt]?	Numeric	Read Questionable event register	*90*
:CONDition?	Numeric	Read Questionable condition register	*90*
:ENABLe	Numeric	Set/Read Questionable enable register	*90*
:NTRansition	Numeric	Set/Read Questionable negative-transition register	*90*
:PTRansition	Numeric	Set/Read Questionable positive-transition register	*90*

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Command	Parameter	Description	see page
:SYSTem			
:CHECk			
[:ALL]			
[:STATe]	OFF	Switch error checking off	*91*
:ERRor?	OFF	Read error queue	*92*
:KEY	Numeric	Simulate key press or read last key pressed	*92*
:PRESet		no function	*94*
:SECurity			
[:STATe]	ON|OFF	Switch security on and off	*95*
:SET	Block data	Set/read complete instrument setting	*96*
:VERSion?		Read SCPI compliance setting	*96*
:WARNing			
[:COUNt]?		Read number of active warnings	*96*
:STRing?		Read active warnings as concatenated string	*97*
:BUFFer?		Read maximum possible length of concatenated string	*97*
:TRIGger		(Pulse mode and period source)	
[:SEQuence [1]|:STARt]			
:COUNt	<value>	Set/read number of triggered periods to be generated per ARM event	*97*
:IMPedance	<value>	Set/read impedance at CLK IN	*99*
:LEVel	<value>	Set/read threshold level at CLK IN	*99*
:SLOPe	POS|NEG	Set/read trigger slope at CLK IN	*100*
:SOURce	IMM|INT[1]|INT2|EXT[2]	Set/read trigger source (IMM | VFO | PLL | CLK IN)	*100*

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Default Values, Standard Settings

Parameter				*RST, Default Values
:ARM	EWIDth	:STATe		OFF
	:FREQuency			100kHz
	:IMPedance			50Ω
	:LEVel			+1.00V
	:PERiod			10.00µs
	:SENSe			EDGE
	:SLOPe			POS
	:SOURce			IMMediate
:CHANnel	:MATH			OFF
:DIG	[:STIMulus:]:PATTern:DATA[1|2|3]			Ch1 Bit1=1, Bit2 to 16384=0 Ch2 Bit1=0, Bit2=1, Bit3 to 16384=0 Strobe Bit1=1, Bit2 to 16384=0
		:PRBS[1|2|3]		not applicable
		:PRESet[1|2|3]		not applicable
		[:STATe]		OFF
		:UPDate		ON
		:SIGNal[1|2]	:FORMat	RZ
:DISPlay	[:WINDow]	[:STATe]		ON
:CALibration[:ALL]				not applicable

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Parameter			*RST, Default Values
:MMEMory	:CATalog?		not applicable
	:CDIRectory		not applicable
	:COPY		not applicable
	:DELete		not applicable
	:INITialize		not applicable
	:LOAD	:STATe	not applicable
	:STORe	:STATe	not applicable
:OUTPut[1|2][:NORMal][:STATe]			OFF
	:COMPlement[:STATe]		OFF
	:IMPedance	[:INTernal]	50Ω
		:EXTernal	50.0Ω
	:POLarity		NORMal

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Parameter	*RST, Default Values
[:SOURce] :CURRent[1|2][:LEVel][:IMM][:AMPL]	20.0mA (from 50Ω into 50Ω)
:OFFset	0.0mA (from 50Ω into 50Ω)
:HIGH	+10.0mA (from 50Ω into 50Ω)
:LOW	–10.0mA (from 50Ω into 50Ω)
:LIMit [:HIGH]	+10.0mA
:LOW	–10.0mA
:STATe	OFF
:FREQ [:CW|:FIXed]	1.00MHz
:AUTO	not applicable
:HOLD[1|2]	VOLT
:PHASe[1|2][:ADJust]	0.0
:PULSe::DCYCle[1|2]	10.0% (derived from Width and Period)
:DELay[1|2]	0.0
:HOLD	TIME
:UNIT	SEC
:DOUBle[1|2]	OFF
:DELay	250 ns
:HOLD	TIME
:UNIT	SEC
:HOLD[1|2]	WIDT

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Parameter			*RST, Default Values
[:SOURce]	:PULSe	:PERiod	1µs
		:AUTO	not applicable
		:TDELay[1|2]	100ns
		:TRANsition[1|2]	
		:HOLD	TIME
		:UNIT	SEC
		[:LEADing]	Agilent 81111A 10V/165 MHz Output: 2.0 ns Agilent 81112A 3.8V/330 MHz Output: 0.8 ns Agilent 81105A 10V/80 MHz Output: 3.0 ns
		:TRAiling	Agilent 81111A 10V/165 MHz Output: 2.0 ns Agilent 81112A 3.8V/330 MHz Output: 0.8 ns Agilent 81105A 10V/80 MHz Output: 3.0 ns
		:AUTO	ON
		:TRIGger[1|2]	
		:VOLTage	TTL
		:WIDTh[1|2]	100ns
	:ROSCillator:SOURce		INTernal
		:EXTernal :FREQ	5MHz

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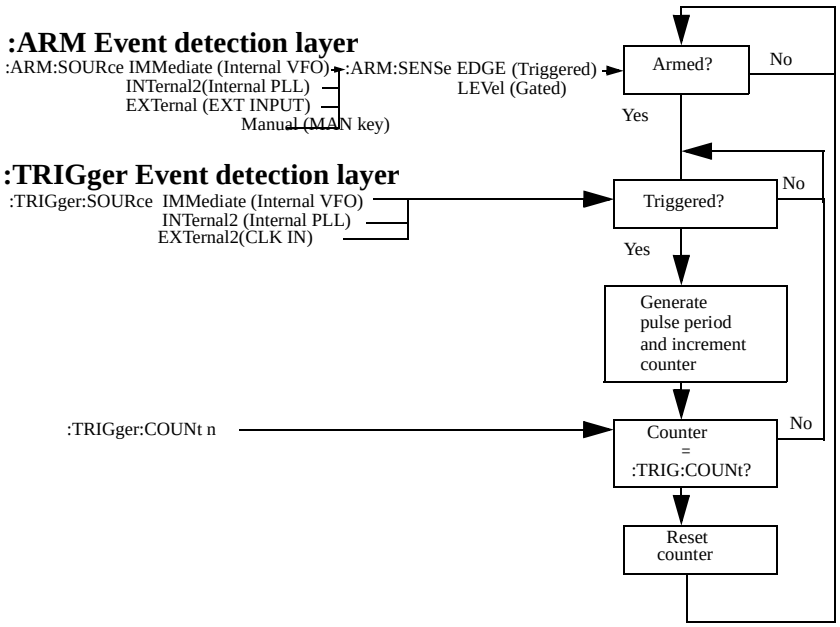
Parameter			*RST, Default Values
[:SOURce]		:VOLTage[1|2]	
		:[LEVel]	
		[IMMediate]	
		[:AMPLitude]	1.0V
		:OFFSet	0.0mV
		:HIGH	500mV
		:LOW	–500mV
		:LIMIt[:High]	+500V
		:LOW	–500V
		:STATe	OFF
:STATus:	:OPERation		not applicable
	:PRESet		not applicable
	:QUEStionable[:EVENt]?		not applicable
:SYSTem	:CHECk	[:ALL] [:STATe]	ON
	:ERRor?		not applicable
	:KEY		+19
	:PRESet		not applicable
	:SECurity	[:STATe]	OFF
	:SET		not applicable
	:VERSion		1992.0
	:WARNing	[:COUNt]?	not applicable
		:STRing?	not applicable
		:BUFFer?	not applicable

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Parameter		*RST, Default Values
:TRIGger	:COUNt	1
	:IMPedance	50Ω
	:LEVel	1.0V
	:SLOPe	POSitive
	:SOURce	IMMediate

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Programming the Instrument Trigger Modes



You program the comprehensive triggering capabilities of the instrument using the SCPI :ARM and :TRIGger subsystems. Using these two command subsystems you can program the operating modes of the instrument which are set up using the MODE/TRG screen on the frontpanel.

Use the `:ARM` subsystem to select the overall triggering mode of the instrument (CONTINUOUS, TRIGGERED, GATED, EXT WIDTH), and the :TRIGger subsystem to select the pulse-period source, triggering and number of pulse periods per `:ARM` event (BURST OR PATTERN length).

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Continuous

Set Continuous mode by arming the instrument from its internal oscillator:

```
:ARM : SOURce IMMediate Arm from internal osc.
```

Triggered

Set Triggered mode by arming the instrument on edges from the EXT INPUT:

```
:ARM:SOURce EXTernal1  Arm from EXT INPUT
:ARM:SENSe EDGE        Arm on edge
:ARM:SLOPe POSitive    Arm on positive edge
:ARM:LEVel 1V          Set EXT INPUT threshold
```

As you have the PLL/External Clock fitted, you can also arm the instrument from the PLL and set the frequency (or period) of the PLL to the required triggering rate:

```
:ARM:SOURce INTernal2  Arm from PLL
:ARM:SENSe  EDGE       Arm on edge
:ARM:SLOPe  POSitive   Arm on positive edge
:ARM:FREQuency <value> Set PLL frequency
```

NOTE The internal PLL (`INTernal2`) *cannot* be used as arming source (triggering rate) if it is already being used as trigger source (pulse-period source).

Gated

Set Gated mode by arming the instrument on levels from the EXT INPUT:

```
:ARM:SOURce EXTernal1  Arm from EXT INPUT
:ARM:SENSe LEVel       Arm on signal level
:ARM:SLOPe POSitive    Arm on positive level
```


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External Width

Set External Width mode by using the `:EWIDth[:STATe]` command:

```
:ARM:EWIDth ON          Switch on EXT WIDTH mode
```

This command disables the arming/triggering system. The arming/triggering system is re-enabled by switching off the External Width mode.

Pulses

Set Pulses mode by setting the trigger count to 1 so that a single triggered pulse period is generated for every arm event. The trigger source sets the pulse period:

```
:TRIGger:COUNt 1          Single pulse period per arm event
:TRIGger:SOURce INTernal 1Pulse period from internal osc.
:DIGital :PATTern OFF     Disable pattern data.
```

Pulse-Period Source	Trigger Source
internal osc.	`INTernal[1]`
internal PLL	`INTernal2`
CLK IN	`EXTernal2`

NOTE The internal PLL (`INTernal2`) *cannot* be used as arming source (triggering rate) if it is already being used as trigger source (pulse-period source).

Note that in Triggered Pulses mode the pulse-period source is not relevant because a single pulse is generated for each arm event.

Burst

Set Burst mode by setting the trigger count to the burst count required. The trigger source sets the pulse period for the pulses within the burst.

```
:TRIGger:COUNt 16         Burst of 16 pulse periods
:TRIGger:SOURce INTernal1 Pulse period from internal osc.
:DIGital:PATTern OFF      Disable pattern data
```


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Pattern

Set Pattern mode by setting the trigger count to the pattern length required, and switching on digital pattern data. The trigger source sets the pulse period for the data pulses:

```
:TRIGger:COUNt 512          Pattern length 512
:TRIGger:SOURce INTernal1   Pulse period from internal osc.
:DIGital:PATTern ON         Enable pattern data
:DIGital:SIGNal1:FORMat NRZ Set OUTPUT 1 data to NRZ
```


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SCPI Instrument Command List

The following reference sections list the instrument commands in alphabetical order. In addition to a command description, the attributes of each command are described under the following headings. Not all of these attributes are applicable to all commands. The commands are conform to the IEEE 488.2 SCPI standard.

Command Shows the short form of the command.

Long Shows the long form of the command.

Form Most commands can be used in different forms:

Set	The command can be used to program the instrument
Query	The command can be used to interrogate the instrument. Add a ? to the command if necessary.
Event	The command performs a one-off action.

Parameter The type of parameter, if any, accepted by the command. The minimum and maximum value of numeric parameters can be accessed by the option MINimum or MAXimum.

Parameter Suffix The suffixes that may follow the parameter.

Functional Coupling Any other commands that are implicitly executed by the command.

Value Coupling Any other parameter that is also changed by the command.

Range Coupling Any other parameters whose valid ranges may be changed by the command.

***RST value** The value/state following a *RST command.

Specified Limits The specified limits of a parameter.

Absolute Limits Some parameters can be programmed beyond their specified limits.

Example Example programming statements.

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Command **:ARM:EWID**

Long `:ARM[:SEQuence[1]|:STARt][:LAYer]:EWIDth[:STATe]`

Form Set & Query

Parameter `ON | OFF | 1 | 0`

***RST value** `OFF`

Description Use this command to enable the EXT WIDTH trigger mode available on the Mode/Trigger screen. When EXT WIDTH mode is switched on, the rest of the `:ARM` and `:TRIG` system is disabled.

In EXT WIDTH mode a signal applied to the EXT INPUT determines the width and period of the output signal(s) from the instrument. You can still control the edge transition times and levels of the output signal(s).

Command **:ARM:FREQ**

Long `:ARM[:SEQuence[1]|:STARt][:LAYer]:FREQuency[:CW][:FIXed]`

Form Set & Query

Parameter Numeric

Parameter Suffix HZ with engineering prefixes, e.g.: MHZ is Megahertz.

***RST value** `100 kHz`

Specified Limits 1 mHz to 150 MHz

Description Use this command to program the frequency of the PLL (INTernal2) when it is used as the `:ARM:SOURce` for internal triggering of pulses, bursts or patterns.

If you are using the PLL as `:TRIGger:SOURce` to set the pulse frequency, use the `[:SOURce]:FREQuency[:CW|:FIXed]` command.

Example To set up bursts of four 100-MHz pulses occurring at a burst rate of 10 MHz:

```
:TRIG:SOUR INT          Select internal osc. as pulse-period source
:FREQ 100MHZ            Set pulse frequency to 100MHz
:ARM:SOUR INT2          Select PLL as triggering source
:ARM:SENS EDGE          Sense edge of PLL signal
:ARM:FREQ 10 MHZ        Set triggering frequency to 10 MHZ
:TRIG:COUNT 4           Set burst length to 4
```


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Command	**:ARM:IMP**
Long	`:ARM[:SEQuence[1]|:STARt][:LAYer]:IMPedance`
Form	Set & Query
Parameter	Numeric
Parameter Suffix	OHM with engineering prefixes, e.g.: `MOHM` is Megaohms.
***RST value**	50 Ω
Specified Limits	50 Ω or 10 kΩ
Description	Use this command to program the input impedance of the EXT INPUT connector. Note that only two settings are available. If you try to program any other value, it will be rounded to one of the specified values.
Example	`:ARM:IMP 50OHM` Set EXT INPUT impedance to 50 W `:ARM:LEV 2.5V` Set EXT INPUT threshold to 2.5 V

Command	**:ARM:LEV**
Long	`:ARM[:SEQuence[1]|:STARt][:LAYer]:LEVel`
Form	Set & Query
Parameter	Numeric
Parameter Suffix	V with engineering prefixes.
***RST value**	+1.0 V
Specified Limits	-10 V to +10 V
Description	Use this command to program the triggering threshold of the EXT INPUT connector.
Example	`:ARM:IMP 50OHM` Set EXT INPUT impedance to 50 Ω `:ARM:LEV 2.5V` Set EXT INPUT threshold to 2.5 V

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Command **:ARM:PER**

Long `:ARM[:SEQuence[1]|:STARt][:LAYer]:PERiod`

Form Set & Query

Parameter Numeric

Parameter Suffix S or SEC with engineering prefixes.

***RST value** 10.00 µs

Specified Limits Consider the following limits for the individual output modules:

Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A	Agilent 8110A
12.5 ns to 999.5 s	6.06 ns to 999.5 s	3.03 ns to 999.5 s	VCO: 6.65 ns to 999 ms PLL: 6.650 ns to 999.0 s

Description Use this command to program the period of the PLL (INTernal2) when it is used as the `:ARM:SOURce` for internal triggering of pulses, bursts or patterns.

If you are using the PLL as `:TRIGger:SOURce`, use the `[:SOURce]:PULSe:PERiod` command to set the pulse period.

Example To set up bursts of four 10-ns pulses occurring every 100 ns:

```
:TRIG:SOUR INT          Select internal osc. as pulse-period source
:PER 10 NS              Set pulse period to 10ns
:ARM:SOUR INT2          Select PLL as triggering source
:ARM:SENS EDGE          Sense edge of PLL signal
:ARM:PER 100ns          Set triggering period to 100ns
:ARM:TRIG:COUNT 4       Set burst length to 4
```


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Command	**:ARM:SENS**
Long	`:ARM[:SEQuence[1]|:STARt][:LAYer]:SENSe`
Form	Set & Query
Parameter	`EDGE	LEVel`
***RST value**	`EDGE`
Description	Use this command to select Triggered or Gated mode by choosing whether the instrument arms on the edge(s) or level of the arming signal. When sensing edges, the instrument triggers when the arming signal crosses the selected threshold level (`:ARM:LEV`) in the selected direction (`:ARM:SLOP`). This corresponds to the Triggered mode selected on the Mode/Trigger screen when using the front panel. When sensing levels, the instrument triggers as long as the arming signal is above (`:ARM:SLOP POS`), or below (`:ARM:SLOP NEG`) the selected threshold level (`:ARM:LEV`). This corresponds to the Gated mode selected on the Mode/Trigger screen when using the front panel.

Command	**:ARM:SLOP**
Long	`:ARM[:SEQuence[1]|:STARt][:LAYer]:SLOPe`
Form	Set & Query
Parameter	`POSitive	NEGative	EITHer`
***RST value**	`POS`
Description	Use this command to select the trigger slope for the arming signal when triggering on edges. Use `EITHer` to trigger on both the positive and negative edges of the arming signal. This allows you to trigger at twice the frequency of the arming signal. If you are arming on levels, use this command to select whether the instrument triggers during the positive or negative cycle of the arming signal.

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Command **:ARM:SOUR**

Long `:ARM[:SEQuence[1]|:STARt][:LAYer]:SOURce`

Form Set & Query

Parameter `IMMediate | INTernal[1] | INTernal2 | EXTernal[1] | MANual`

***RST value** `IMM`

Description Use this command to select the triggering mode of the instrument by selecting the source of the arming signal (Use `:ARM:SENSe EDGE | LEVel` to choose between triggered and gated):

Triggering source	:ARM:SOURce	Mode
internal osc.	`IMMediate|INTernal[1]`	`CONTINUOUS`
PLL	`INTernal2`	`TRIGGERED|GATED by PLL`
EXT INPUT	`EXTernal1`	`TRIGGERED|GATED by:EXT IN`
MAN key	`MANual`	`TRIGGERED|GATED by:MANKey`

Command **:CHAN:MATH**

Long `:CHANnel:MATH`

Form Set & Query

Parameter `OFF | PLUS`

***RST value** `OFF`

Description Use this command to enable or disable channel addition in an instrument with two output channels installed. With `:CHAN:MATH PLUS` the signals from both channels are added at output 1. Output 2 is not used.

This allows you to, for example,

- generate 3 and 4 level waveforms,
- simulate single or repeated glitches,
- generate pulse transitions with a step-change in slew-rate,
- simulate overshoot and undershoot.

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For levels and amplitude values that can be added in the channel addition mode, refer to chapter 3, Specifications, “Levels in Channel Addition” on page 110.

NOTE This functionality is not available for Agilent 81110A with Agilent 81112A 3.8V/330 MHz outputs installed.

Command **:CALibration**

Long `:CALibration[:ALL]`

Form Set & Query

Parameter none

***RST value** none

Description Use this command to perform a timing calibration of the instrument.

The timing circuitries for VCO-period, delay and width are calibrated in reference to the internal PLL reference.

The return values for the query command `:CALibration[:ALL]?` are as follows:

0	calibration passed
>0	calibration failed

When the instrument is switched off and on again, the factory calibration data are activated again.

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Command **:DIG:PATT:DATA[1|2|3]**

Long `:DIGital[:STIMulus]:PATTern:DATA[1|2|3]`

Form Set & Query

Parameter `[<start>,] <data>`

***RST value**

Channel		**Default**		
[1|2|3]	Description	Bit 1	Bit 2	Bits 3 to 16384 (8110A: 4096)
1	CH1 (OUTPUT 1)	1	0	0
2	CH2 (OUTPUT 2)	0	1	0
3	STRB(STROBE OUT)	1	0	0

Description Use this command to set or read the pattern data of one or all channels starting from Bit 1. The <data> is an arbitrary block of program data as defined in IEEE 488.2 7.7.6.2, for example:

NOTE Note that the optional <start> parameter is ignored by the instrument if you use it

```
#1541213
#      Start of block
1      Length of the length of the data
5      Length of the data
41213  5 bytes of data


#21610001000010001000
#           Start of block
2           Length of the length of the data
16         Length of the data
10...00 16 bytes of data
```


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Examples

```
:DIG:PATT:DATA #1541213
```

The instrument uses each byte of data set one Bit in the pattern memory. If you don't specify a particular channel, the lowest three bits of each byte are used to set all three channels, and the top five bits are ignored. Note that you can therefore use the ASCII characters ‘0’,‘1’,‘2’ and ‘3’, to program Outputs 1 and 2 in binary with STROBE=0 (or ‘4’,’5’,’6’, and ‘7’ for STROBE=1):

DATA									**STRB STROBE OUT**	**CH2 OUTPUT2**	**CH1 OUTPUT 1**
ASCII	ignored					used					
	D7	D6	D5	D4	D3	D2	D1	D0			
4	0	1	1	1	0	1	0	0	1	0	0
1	0	1	1	1	0	0	0	1	0	0	1
2	0	1	1	1	0	0	1	0	0	1	0
1	0	1	1	1	0	0	0	1	0	0	1
3	0	1	1	1	0	0	1	1	0	1	1

```
:DIG:PATT:DATA2 #1501011
```

If you specify a particular channel, the least significant bit of each byte is used to set the selected channel, and the top seven bits are ignored. Note that you can therefore use the ASCII characters `1' and `0' to set individual bits to 1 and 0:

DATA									**STRB STROBE OUT**	**CH2 OUTPUT2**	**CH1 OUTPUT**
ASCII	ignored							LSB			
	D7	D6	D5	D4	D3	D2	D1	D0			
0	0	1	1	1	0	0	0	0	X	0	X
1	0	1	1	1	0	0	0	1	X	0	X
0	0	1	1	1	0	1	0	0	X	1	X
1	0	1	1	1	0	0	0	1	X	0	X
1	0	1	1	1	0	0	0	1	X	1	X

X indicates that the bit remains unchanged.

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```
:ARM:SOUR IMM                    Set continuous mode
:DIG:PATT:DATA3 #1501011         Set up pattern data for STROBE channel
:TRIG:COUN 5                     Set pattern length (lastbit) to
:DIG:PATT ON                     Switch on PATTERN mode
```

Command **:DIG:PATT:PRBS[1|2|3]**

Long `:DIGital[:STIMulus]:PATTern:PRBS[1|2|3]`

Form Set

Parameter <n>,<length>

***RST value** Not applicable

Specified Limits

<n>	7 to 14 (integer)	(Agilent 8110A: 7-12)
<length>	2 to 16384 (integer)	(Agilent 8110A: 1- 4096)

Description Use this command to set up PRBS data starting from bit 1. The parameter <n> is used as the basis to generate a 2^n–1 PRBS. The parameter <length> determines how many bits of the PRBS sequence are used. If <length> is longer than the PRBS, the PRBS is repeated as necessary to achieve the required length.

Example To set up a repeating 2^{10}–1 PRBS on output 1:

```
:ARM:SOUR IMM                    Set continuous mode
:TRIG:COUN 1023                  Set pattern length (last bit) to 1023
:DIG:PATT:PRBS1 10,1023          Set up PRBS on OUTPUT 1
:DIG:PATT ON                     Switch on PATTERN mode
```


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Command **:DIG:PATT:PRES[1|2|3]**

Long `:DIGital[:STIMulus]:PATTern:PRESet[1|2|3]`

Form Set

Parameter <n>,<length>

***RST value** Not applicable

Specified Limits

<n>	2 to 16384 (integer)
<length>	2 to 16384 (integer)

Description Use this command to set up clock data starting from bit 1 with value 1.

The parameter <n> is used as the divider to generate a CLOCK÷n sequence (squarewave if NRZ data is selected). The parameter <length> determines the length of the sequence.

n=2 Sequence = 101010101010101....
n=3 Sequence = 100100100100100....
n=4 Sequence = 110011001100110....
n=5 Sequence = 110001100011000....
n=6 Sequence = 111000111000111....
n=7 Sequence = 111000011100001....
n=8 Sequence = 111100001111000....

and so on.

Special Case: <n> = 0, <n> = 1,

If <n> = 0 then the sequence defined by <length> is filled with zeros. If <n> = 1, then the sequence is filled with ones.

Example To set up a CLOCK ÷ 4 squarewave on STROBE OUT:

```
:TRIG:COUN 4096          Set pattern length (last bit) to 4096
:DIG:PATT:PRES3 4,4096   Set up CLOCK÷4 on STRB
:DIG:PATT ON             Switch on PATTERN mode
```

NOTE To produce a continuous squarewave the pattern length must be a multiple of the selected divider, in this case a multiple of 4.

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Command	**:DIG:PATT**
Long	`:DIGital[:STIMulus]:PATTern[:STATe]`
Form	Set & query
Parameter	ON | OFF
***RST**	OFF
Description	Use this command to enable and disable Pattern mode. Use `:TRIG:COUN` to program the length of the pattern.

Command	**:DIG:PATT:UPD**
Long	`:DIGital[:STIMulus]:PATTern:UPDate`
Form	Set & query
Parameter	`ON	OFF	ONCE`
***RST**	`ON`
Description	Use this command to enable and disable the automatic updating of the pattern generating hardware following a `:DIG:PATT:DATA` command. Disable the automatic updating if you want to set up new pattern data in the instrument without affecting the pattern which is currently being generated. You can then update the hardware with the new pattern data by sending a `:DIG:PATT:UPD ONCE` command.

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Command **:DIG:SIGN[1|2]:FORM**

Long `:DIGital[:STIMulus]:SIGNal[1|2]:FORMat`

Format Set & Query

Parameter `RZ | NRZ`

Range Coupling Period, Frequency

***RST value** `RZ`

Description Use this command to set and read the data format of channels 1 and 2 when using Pattern mode. If you don't specify a channel number in the command, channel 1 is assumed.

RZ	Return to Zero. An RZ pulse is generated for each “1” in the data. You can vary the width, edges and levels of the pulse.
NRZ	Non Return to Zero. A pulse of 100% dutycycle is generated for each “1” in the data. You can vary the edges and levels of the pulse.

Example `:DIG:SIGN:FORM NRZ` Set channel 1 data format to NRZ

Command **:DISP**

Long `:DISPlay[:WINDow][:STATe]`

Form Set & Query

Parameter `ON | OFF | 1 | 0`

***RST value** `ON`

Description This command is used to turn the frontpanel display on and off. Switching off the display improves the programming speed of the instrument.

NOTE *RST switches the display back on. Use `:SYSTem:PRESet` to perform an *RST without switching the display back on.

Example `SECDISP OFF` Switch off the frontpanel display

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Command **:MMEM:CAT?**

Long `:MMEMory:CATalog?`

Form Query

Parameter ["A:"]

***RST value** Not applicable

Description Use this command to get a listing of the contents of the currently selected directory on the memory card. As there is only one memory card slot, the parameter A: is optional. The information returned is:

<bytes_used>,<bytes_free>{,<file_entry>}

<bytes_used>	The total number of bytes used on the memory card.
<bytes_free>	The total number of bytes still available on the memory card.
<file_entry>	String containing the name, type and size of one file: "<file_name>,<file_type>,<file_size>"

NOTE The <file_type> is always blank. A directory name has <file_size> = 0

Command **:MMEM:CDIR**

Long `:MMEMory:CDIRectory`

Form Event

Parameter ["directory_name"]

***RST value** Not applicable

Description Use this command to change the current directory on the memory card. If you don't specify a directory name parameter, the root directory is selected.

NOTE Note that you cannot use DOS pathnames as directory names, you can only select a directory name within the current directory.

Use the directory name ".." to move back to the parent directory of the current directory, unless you are already in the root directory "\".

Examples

`:MMEM:CDIR`	Select root directory
`:MMEM:CDIR "PERFORM"`	Select directory "PERFORM"
`:MMEM:CDIR ".."`	Select parent directory

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Command	**:MMEM:COPY**
Long	`:MMEMory:COPY`
Form	Event
Parameter	"filename"[,"A:"],"copyname"[,"A:"]
***RST**	Not applicable
Description	Use this command to copy an existing file *filename* in the current directory to a new file *copyname*. If *copyname* is the name of a sub-directory in the current directory, a copy of the file *filename* is made in the sub-directory. Use ".." as *copyname* to copy a file into the parent directory of the current directory.
Examples	`:MMEM:COPY "test1","test2"` Copy test1 to test2 `:MMEM:COPY "test1",".."` Copy test1 into parent directory

Command	**:MMEM:DEL**
Long	`:MMEMory:DELete`
Form	Event
Parameter	"filename"
***RST**	Not applicable
Description	Use this command to delete file *filename* from the currently selected directory.

Command	**:MMEM:INIT**
Long	`:MMEMory:INITialize`
Form	Event
Parameter	["A:"[,"DOS"]]
***RST**	Not applicable
Description	Use this command to initialize a memory card to DOS format.

CAUTION Initializing a memory card destroys any existing data on the card.

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Command	**:MMEM:LOAD:STAT**
Long	`:MMEMory:LOAD:STATe`
Form	Event
Parameter	<n>,"filename"[,"A:"]
***RST**	Not applicable
Specified Limits	<n> = 0 to 9 (integer)
Description	Use this command to load a complete instrument setting from file *filename* in the current directory into memory <n> in the instrument. Memories 1 to 9 are the internal memories. Use memory 0 to load a default setting as the current instrument setting.
Examples	See next command

Command	**:MMEM:STOR:STAT**
Long	`:MMEMory:STORe:STATe`
Form	Event
Parameter	<n>,"filename"[,"A:"]
***RST**	Not applicable
Specified Limits	<n> = 0 to 9 (integer)
Description	Use this command to store a complete instrument setting from memory <n> to file *filename* in the current directory on the memory card. Memories 1 to 9 are the internal memories. Use memory 0 to store the current instrument setting to a file.

Examples

```
:MMEM:LOAD:STAT 1,"FREQPERF"      Load FREQPERF into memory 1
:MMEM:LOAD:STAT 0,"AMPTEST"       Load AMPTEST as current setting
:*SAV 2                           Save current setting in memory 2
:*RCL 3                           Recall memory 3 as current setting
```


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Command	**:OUTP[1|2]**
Long	`:OUTPut[1|2][:NORMal][:STATe]`
Form	Set & Query
Parameter	ON | OFF | 1 | 0
***RST value**	OFF
Description	Use this command to switch the normal outputs on or off.
Example	`:OUTP1 ON` Switch on output 1 `:OUTP2 OFF` Switch off output 2

Command	**:OUTP[1|2]:COMP**
Long	`:OUTPut[1|2]:COMPlement[:STATe]`
Form	Set & Query
Parameter	ON | OFF | 1 | 0
***RST value**	OFF
Description	Use this command to switch the complement/differential outputs on or off. (Available with Agilent 81112A 3.8 V / 330 MHz output channels)
Example	`:OUTP1:COMP ON` Switch on complement output 1 `:OUTP2:COMP OFF` Switch off complement output 2

Command	**:OUTP[1|2]:IMP**
Long	`:OUTPut[1|2]:IMPedance[:INTernal]`
Form	Set & Query
Parameter	Numeric
Parameter Suffix	`OHM` with engineering prefixes, e.g.: `MOHM` is Megaohms.
***RST value**	50 Ω
Specified Limits	50 Ω or 1 kΩ
Description	Use this command to program the source impedance of the output connectors. Note that only two settings are available. If you try to program any other value, it will be rounded to one of the specified values.

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The Agilent 81112A 3.8V/330 MHz output has a fixed 50 Ω Source impedance.

Example

```
:OUTP1:IMP 50OHM          Set output 1 impedance to 500 Ω
:OUTP2:IMP 1000OHM        Set output 2 impedance to 1 kΩ
```

Command **:OUTP[1|2]:IMP:EXT**

Long `:OUTPut[1|2]:IMPedance:EXTernal`

Form Set & Query

Parameter Numeric

Parameter Suffix `OHM` with engineering prefixes, e.g.: `MOHM` is Megaohms.

***RST value** 50.0 Ω

Specified Limits 0.1 Ω to 1 MΩ

Description Use this command to set the expected load impedance of the device-under-test at the output connectors. If you have a non-50 Ω load, the output levels at the device-under-test will not be the levels you program or set via the frontpanel *unless* you set the expected load using this command. With the Agilent 81112A 3.8V/330MHz output channels it is not possible to set load impedance, it expects 50 Ω loads.

Example

```
:OUTP1:IMP:EXT 47.6OHM    Set load impedance at OUTPUT 1 to 47.6 Ω
:OUTP2:IMP:EXT 1M OHMS    Set load impedance at OUTPUT 2 to 1 MΩ
```

Command **:OUTP[1|2]:POL**

Long `:OUTPut[1|2]:POLarity`

Form Set & Query

Parameter NORMal | INVerted

***RST value** NORM

Description Use this command to invert the signal at the outputs.

Example

```
:OUTP1:POL INV            Inverted signal at output1
:OUTP1:POL NORM           Normal signal at output 1
```


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Command	**:CURR[1|2]**
Long	`[:SOURce]:CURRent[1|2][:LEVel][:IMMediate][:AMPLitude]`
Form	Set & Query
Parameter	Numeric
Parameter suffix	`A` with engineering prefixes.
***RST value**	20 mA (50 Ω into 50 Ω)
Specified Limits	10 V Outputs (from high Z into short): max 400 mA typical 3.8V Outputs (50 Ω into short): max 152 mA typical
Value coupling	$Amplitude = High - Low$ $Offset = \frac{High - Low}{2}$
Range coupling	Offset
Description	This command programs the amplitude current of the output signal. Note that to set the output levels in terms of current, you first have to execute the `[:SOURce]:HOLD CURRent` command to enable the `[:SOURce]:CURRent` subsystem. The available current range is limited by the combination of: • Specified voltage limits • Actual output impedance setting `:OUTPut:IMPedance` • Actual expected load impedance setting: `:OUTPut:IMPedance:EXTernal`

Example

```
:HOLD CURR                Enable CURRENT subsystem
:CURR1 75MA               Set output 1 amplitude to 75 mA
```


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Command	**:CURR[1|2]:OFFSet**
Long	`[:SOURce]:CURRent[1|2][:LEVel][:IMMediate]:OFFSet`
Form	Set & Query
Parameter	Numeric
Parameter suffix	A with engineering prefixes.
***RST value**	0.0 µA (50 Ω into 50 Ω)
Value coupling	$Amplitude = High - Low$ $Offset = \frac{High - Low}{2}$
Range coupling	Amplitude
Description	This command programs the offset current of the output signal. Note that to set the output levels in terms of current, you first have to execute the `[:SOURce]:HOLD CURRent` command to enable the `:SOURce]:CURRent` subsystem. The available current range is limited by the combination of: • Specified voltage limits • Actual output impedance setting `:OUTPut:IMPedance` • Actual expected load impedance setting
Example	`:HOLD CURR` Enable CURRENT subsystem `:CURR1:OFF 50MA` Set output 1 offset to 50 mA

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Command **:CURR[1|2]:HIGH**

Long `[:SOURce]:CURRent[1|2][:LEVel][:IMMediate]:HIGH`

Form Set & Query

Parameter Numeric

Parameter suffix A with engineering prefixes.

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High - Low}{2}$$

Range coupling Low-level

***RST value** +10 mA (50 Ω into 50 Ω)

Specified Limits 10 V Output (from high Z into short): –396 mA to 400 mA typical

3.8 V (from 50 Ω into short): –82 mA to 152 mA typical

Description This command programs the high-level current of the output signal. Note that to set the output levels in terms of current, you first have to execute `[:SOURCE]:HOLD CURRent` command to enable the `[:SOURCE]:CURRent` subsystem.

The available current range is limited by the combination of:

- Specified voltage limits
- Actual output impedance setting `:OUTPut:IMPedance`
- Actual expected load impedance setting: `:OUTPut:IMPedance:EXTernal`

Example

```
:HOLD CURR"                    Enable CURRENT subsystem
:CURR1:HIGH 150MA              Set output 1 high-level to 150 mA
```


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Command	**:CURR[1|2]:LOW**
Long	`[:SOURce]:CURRent[1|2][:LEVel][:IMMediate]:LOW`
Form	Set & Query
Parameter	Numeric
Parameter suffix	A with engineering prefixes.
Value coupling	$Amplitude = High - Low$ $Offset = \frac{High - Low}{2}$
Range coupling	High-level
***RST value**	–10 mA (50 Ω into 50 Ω)
Specified Limits	10 V Outputs (from high Z into short): –400 mA to 396 mA typical 3.8 V Outputs (from 50 Ω into short): –84 mA to 150 mA typical
Description	This command programs the low-level current of the output signal. Note that to set the output levels in terms of current, you first have to execute the `[:SOURce]:HOLD CURRent` command to enable the `[:SOURce]:CURRent` subsystem. The available current range is limited by the combination of: • Specified voltage limits • Actual output Impedance setting `:OUTPut:IMPedance` • Actual expected load impedance setting: `:OUTPUT:IMPedance:EXTernal`
Example	`:HOLD CURR` Enable CURRENT subsystem `:CURR1:LOW 50 MA` Set output 1 low-level to 50 mA

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Command **:CURR[1|2]:LIM**

Long `[:SOURce]:CURRent[1|2]:LIMit[:HIGH]`

Form Set & Query

Parameter Numeric

Parameter suffix A with engineering prefixes.

***RST value** +10.0 mA

Description Use this command to set/read the High-level current limit. If you switch on current limiting, the High-level current cannot be set above the programmed limit.

NOTE The current is *NOT* limited by the OUTPUT hardware, this is a software limit.

Example

`:HOLD CURR`	Enable CURRENT subsystem
`:CURR1:LIM 50 MA`	Set output 1 high-level current limit to 50 mA
`:CURR1:LIM:STAT ON`	Switch on output 1 limits

Command **:CURR[1|2]:LIM:LOW**

Long `[:SOURce]:CURRent[1|2]:LIMit:LOW`

Form Set & Query

Parameter Numeric

Parameter suffix A with engineering prefixes.

***RST value** –10.0 mA

Description Use this command to set/read the Low-level current limit. If you switch on current limiting, the Low-level current cannot be set below the programmed limit.

NOTE The current is *not* limited by the output hardware, this is a software limit.

Example

`:HOLD CURR`	Enable CURRENT subsystem
`:CURR1:LIM:LOW -50MA*`	Set output 1 low-level current limit to –50 mA
`:CURR1:LIM:STAT ON`	Switch on output 1 limits

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Command **:CURR[1|2]:LIM:STAT**

Long `[:SOURce]:CURRent[1|2]:LIMit:STATe`

Form Set & Query

Parameter `ON | OFF | 1 | 0`

***RST value** `OFF`

Description This command switches the output limits on or off. When you switch on the output limits cannot program the output-levels beyond the programmed limits, until you switch off the output limits. The limits apply whether you program high/low levels or amplitude/offset levels.

NOTE You can switch the limits on and off in both the `[:SOURce]:CURRent` and the `[:SOURce]:VOLTage` subsystems *but the current and voltage limits are not enabled/disabled independently.* The voltage and current limits are always enabled/disabled together.

Example

`:HOLD CURR`	Enable CURRENT subsystem
`:CURR1:LIM 50MA`	Set output 1 high-level current limit to 50 mA
`:CURR1:LIM:LOW -50MA`	Set output 1 low-level current limit to –50mA
`:CURR1:LIM:STAT ON`	Switch on output 1 limits

Command **:FREQ**

Long `[:SOURce]:FREQuency[:CW|:FIXed]`

Form Set & Query

Parameter Numeric

Parameter Suffix `HZ` with engineering prefixes, or `MHZ` for Megahertz.

Value coupling

$$Period = \frac{1}{Frequency}$$

***RST value** 1.00 MHz

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Specified limits Consider the following limits for the individual output modules

Agilent 81111A	Agilent 81112A	Agilent 81105A	Agilent 8110A
1 MHz to 165 MHz	1 MHz to 330 MHz	1 MHz to 80 MHz	VCO 1Hz to 150 MHz PLL 1 MHz to 150 MHz

Description Use this command to set/read the pulse frequency. Select the frequency source for the pulse frequency using `:TRIGger:SOURce`. The currently selected source is programmed by this command. Note that the specified limits and available resolution depend on the selected source.

You cannot set the pulse frequency if you have selected the CLK IN connector as the frequency source (`:TRIG:SOUR EXT2`).

Example

```
:TRIG:SOUR INT          Select internal osc. as pulse trigger
:FREQ 75MHz             Set pulse frequency to 75 MHz
```

Command **:FREQ:AUTO**

Long `[:SOURce]:FREQuency[:CW|:FIXed]:AUTO`

Form Event

Parameter `ONCE`

***RST value** Not applicable

Description Use this command to measure the frequency at the CLK IN connector. If the CLK IN connector is the selected pulse frequency source, you can then read the measured value with `:FREQ?`

Example

```
:TRIG:SOUR EXT2         Select ext CLK IN as pulse trigger
:FREQ:AUTO ONCE         Measure frequency at CLK IN
:FREQ?                  Query pulse frequency
```


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Command	**:HOLD**
Long	`[:SOURce]:HOLD`
Form	Set & Query
Parameter	`VOLTage | CURRent`
***RST value**	`VOLT`
Description	Use this command to enable either of the `[:SOURce]:VOLTage` or `[:SOURce]:CURRent` subsystems. You can control the signal levels of the instrument outputs in terms of voltage or current.

Command	**:PHAS[1|2]**
Long	`[:SOURce]:PHASe[1|2][:ADJust]`
Form	Set & Query
Parameter	Numeric
Parameter suffix	DEG or RAD. A parameter without a suffix is interpreted as RAD.
Functional coupling	Programming the pulse phase also executes `[:SOURce]:PULSe:HOLD PHASe` so that the pulse phase is held constant when the signal frequency is changed.
Value coupling	$$Delay = \frac{Phase}{360} \times Period$$
***RST value**	0.0
Specified limits	0 to 360° constrained by delay and period limits.
Description	Use this command to set/read the relative phase delay of the output signal. This is equivalent to setting an absolute or percentage pulse delay with `[:SOURce]:PULSe:DELay`. If you want the phase delay to remain constant when the pulse period is varied (rather than the absolute pulse delay) use `[:SOURce]:PULSe:DELay[1|2]:HOLD PRATio`.

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Example

`:PULS:DEL1 500NS`	Set output 1 delay to 500ns
`:PHAS2 180 DEG`	Set output 2 phase to 180°
`:PULS:DEL1:HOLD TIM`	Hold output 1 delay constant with varying period
`:PULS:DEL2:HOLD PRAT`	Hold output 2 phase constant with varying period

Command **:PULS:DCYC[1|2]**

Long `[:SOURce]:PULSe:DCYCle[1|2]`

Form Set & Query

Parameter Numeric

Value coupling

$$Width = \frac{Dutycycle}{100} \times Period$$

***RST value** 10.0% (derived from Width and Period)

Specified limits 0.001% – 99.9%, depends on width, transition and period.

Description Use this command to program the dutycycle of the pulse signal. If you want to set an absolute pulse width use `[:SOURce]:PULSe:WIDTh[1|2]`.

If you want the pulse dutycycle to remain constant when the pulse period is varied (rather than the absolute pulse width), use `:SOURce]:PULSe:HOLD[1|2] DCYCle`

Example

`:PULS:DCYC1 25PCT`	Set output 1 dutycycle to 25%
`:PULS:HOLD1 DCYC`	Hold dutycycle constant with varying period

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Command **:PULS:DEL[1|2]**

Long `[:SOURce]:PULSe:DELay[1|2]`

Form Set & Query

Parameter Numeric

Parameter suffix S with engineering prefixes. You can change the default unit using `[:SOURce]:PULSe:DELay[1|2]:UNIT.`

Value coupling

$$Phase = \frac{Delay}{Period} \times 360$$

$$Delay\% = \frac{Delay}{Period} \times 100$$

***RST value** 0.0

Specified limits 0.00 ns to 999 s (limited by period and minimum width)

Agilent 81111A	Agilent 81112A	Agilent 81105A	Agilent 8110A
3.03 ns	3.03 ns	12.5 ns	6.65 ns

Description Use this command to set/read the pulse delay. Delay is the time between the start of the pulse period and the start of the leading edge of the pulse.

If you want the pulse delay to remain constant when the pulse period is varied (rather than the phase delay) use `[:SOURce]:PULSe:DELay[1|2]:HOLD TIME.`

Example

`:PULS:DEL1 500NS`	Set output1 delay to500 ns
`:PHAS2 180 DEG`	Set output 2 phase to180°
`:PULS:DEL1:HOLD TIME`	Hold output 1 delay constant with varying period
`:PULS:DEL2:HOLD PRAT`	Hold OUTPUT 2 phase constant with varying period

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Command **:PULS:DEL[1|2]:HOLD**

Long `[:SOURce]:PULSe:DELay[1|2]:HOLD`

Form Set & Query

Parameter `TIME | PRATio`

***RST value** `TIME`

Description Use this command to set/read the coupling between the pulse period and the pulse delay:

TIME	The absolute pulse delay is held fixed when the pulse period is varied (Pulse phase varies).
PRATio	The pulse phase delay (delay as ratio of period) is held fixed when the pulse period is varied (Pulse delay varies.

Example

`:PULS:DEL1 500ns`	Set output 1 delay to 500ns
`:PHAS2 180DEG`	Set output 2 phase to 180°
`:PULS:DEL1:HOLD TIME`	Hold output 1 delay constant with varying period
`:PULS:DEL2:HOLD PRAT`	Hold output 2 phase constant with varying period

Command **:PULS:DEL[1|2]:UNIT**

Long `[:SOURce]:PULSe:DELay[1|2]:UNIT`

Form Set & Query

Parameter `S | SEC | PCT | DEG | RAD`

***RST value** `S`

Description Use this command to set/read the default units for the pulse-delay parameter. The default unit of a parameter is the unit used when the parameter is programmed to a value without a unit suffix.

Example

`:PULS:DEL1:UNIT PCT`	Set output 1 delay unit to %
`:PULS:DEL1 50`	Set output 1 delay to 50% of period

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Command **:PULS:DOUB[1|2]**

Long `[:SOURce]:PULSe:DOUBle[1|2][:STATe]`

Form Set & Query

Parameter `OFF | ON`

***RST value** `OFF`

Description Use this command to switch double-pulse mode on or off. In double-pulse mode two pulses are generated per pulse period and the delay between the leading edges of the first and second pulse can be adjusted.

Command **:PULS:DOUB[1|2]:DEL**

Long `[:SOURce]:PULSe:DOUBle[1|2]:DELay`

Form Set & Query

Parameter Numeric

Parameter suffix `S` with engineering prefixes. You can change the default unit using `[:SOURce]:PULSe:DOUBle:DELay[1|2]:UNIT.`

Value coupling

$$DblDel\% = \frac{DblDel}{Period} \times 100$$

***RST value** 0.0

Specified limits Consider the following limits for the individual output modules:

Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A	Agilent 8110A
12.5 ns to 999.5 s (period – width – 6.25 ns)	6.06 ns to 999.5 s (period – width – 3.03 ns)	3.03 ns to 999.5 s (period – width – 1.5 ns)	6.65 ns to 999 ms (limited by period – width – 6.65 ns)
min period 25 ns	min period 12.2 ns	min period 6.06 ns	min period 13.3 ns

Description Use this command to set/read the delay between the leading edges of the two pulses in double-pulse mode. The first pulse always starts at the start of the pulse period.

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If you want the double-delay to remain constant when the pulse period is varied (rather than the double-delay as percentage of period) use `[:SOURce]:PULSe:DOUBle[1|2]:DELay:HOLD TIME.`

Example

```
:PULS:DOUB1 ON                  Switch on Double pulses on output 1
:PULS:DOUB1:DEL 500NS           Set inter-pulse delay to 500ns
:PULS:DOUB1:DEL:HOLD TIME       Hold inter-pulse delay fixed with varying
                                pulse period
```

Command **:PULS:DOUB[1|2]:DEL:HOLD**

Long Form `[:SOURce]:PULSe:DOUBle[1|2]:DELay:HOLD`

Parameter Set & Query

***RST value** `TIME|PRATio`

Description `TIME`

Use this command to set/read the coupling between the pulse period and the double-pulse delay:

TIME	The absolute double-pulse delay is held fixed when the pulse period is varied.
PRATio	The double-pulse delay as percentage of period is held fixed when the pulse period is varied.

Example

```
:PULS:DOUB1 ON                  Switch on Double pulses on output 1
:PULS:DOUB1:DEL 50 PCT          Set inter-pulse delay to 50% of pulse-
                                period
:PULS:DOUB1:DEL:HOLD PRAT       Hold inter-pulse delay as fixed percentage
                                of pulse period
```


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Command	**:PULS:DOUB[1|2]:DEL:UNIT**
Long	`[:SOURce]:PULSe:DOUBle[1|2]:DELay:UNIT`
Form	Set & Query
Parameter	`S | SEC | PCT`
***RST value**	`S`
Description	Use this command to set/read the default units for the double-delay parameter. The default unit of a parameter is the unit used when the parameter is programmed to a value without a unit suffix.

Example

`:PULS:DOUB1:DEL:UNIT PCT"`	Set output 1 double-delay unit to %
`:PULS:DOUB1:DEL 50`	Set output 1 inter-pulse delay to 50% of period

Command	**:PULS:HOLD[1|2]**
Long	`[:SOURce]:PULSe:HOLD[1|2]`
Form	Set & Query
Parameter	`WIDTh | DCYCle | TDELay`
***RST value**	`WIDTh`
Description	Use this command to set whether the pulse width, the pulse-dutycycle or the pulse-trailing-edge delay is held constant when the pulse period is changed.

Example

`:PULS:DEL:HOLD1 TIME`	Hold output 1 delay fixed when frequency varies
`:PULS:DEL 20NS`	Set output 1 delay to 20ns
`:PULS:HOLD1 DCYC`	Hold output 1 dutycycle fixed when frequency varies
`:PULS:DCYC 25PCT`	Set output 1 dutycycle to 25%

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Command **:PULS:PER**

Long `[:SOURce]:PULSe:PERiod`

Form Set & Query

Parameter Numeric

Parameter Suffix S with engineering prefixes.

Value coupling

$$Frequency = \frac{1}{Period}$$

***RST value** 1 µs

Specified limits Consider the following limits for the individual output modules:

Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A	Agilent 8110A
12.5 ns to 999.5 s	6.06 ns to 999.5 s	3.03 ns to 999.5 s	VCO: 6.65 ns to 999 ms PLL: 6.650 ns to 999.0 s

Description Use this command to set/read the pulse period. Select the pulse-period source using `:TRIGger:SOURce`. The currently selected source is programmed by this command. Note that the specified limits and available resolution depend on the selected source.

You cannot set the pulse period if you have selected the CLK IN connector as the frequency source (`:TRIG:SOUR EXT2`).

Example

```
:TRIG:SOUR INT          Select internal osc. as pulse trigger
:PULS:PER 25NS          Set pulse frequency to 25 ns
```


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Command **:PULS:PER:AUTO**

Long `[:SOURce]:PULSe:PERiod:AUTO`

Form Event

Parameter ONCE

***RST value** Not applicable

Description Use this command to measure the period at the CLK IN connector. If the CLK IN connector is the selected pulse-period source, you can then read the measured value with `:PULS:PER?`

Example

```
:TRIG:SOUR EXT2          Select ext CLK IN as pulse trigger
:PULS:PER:AUTO ONCE      Measure period at CLK IN
:PULS:PER?               Query pulse period
```

Command **:PULS:TDEL[1|2]**

Long `[:SOURce]:PULSe:TDELay[1|2]`

Form Set & Query

Parameter Numeric

Parameter Suffix S with engineering prefixes.

***RST value** 100 ns

Specified Limits Consider the following limits for the individual output modules:

Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A	Agilent 8110A
6.25 ns to 999.5 s (period – 6.25ns)	3.03 ns to 999.5 s (period – 3.03 ns)	1.5 ns to 999.5 s (period – 1.5 ns)	3.30 ns to 999 ms (Maximum = Period – 3.3 ns)

Description Use this command to program the delay of the trailing edge of the pulse relative to the start of the pulse period. This is an alternative method of programming the pulse width.

Example

```
:PULS:DEL1 500NS          Set output 1 delay to 500 ns
:PULS:DEL1:HOLD TIME      Hold output 1 delay constant with varying
                          period
:PULS:TDEL1 750NS         Set output 1 trailing delay to 750 ns
```


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Command **:PULS:TRAN[1|2]:HOLD**

Long `[:SOURce]:PULSe:TRANsition[1|2]:HOLD`

Form Set & Query

Parameter `TIME|WRATio`

***RST value** `TIME`

Description Use this command to set the coupling between transition times and the pulse width:

TIME	The absolute transition times are held when the pulse width is varied.
WRATio	The ratio of transition time to pulse width is held when the pulse width is varied.

Example

`:PULS:TRAN1:HOLD TIME`	Hold output 1 transitions fixed when pulse width varies
`:PULS:TRAN2:HOLD WRAT`	Hold output 2 transition:width ratio when pulse width varies

Command **:PULS:TRAN[1|2]:UNIT**

Long `[:SOURce]:PULSe:TRANsition[1|2]:UNIT`

Form Set & Query

Parameter `S | SEC | PCT`

***RST value** `S`

Description Use this command to set the default units for the pulse transition-times. The default unit is used when the parameter is programmed to a value without a unit suffix.

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Command **:PULS:TRAN[1|2]**

Long `[:SOURce]:PULSe:TRANsition[1|2][:LEADing]`

Form Set & Query

Parameter Numeric

Parameter suffix S with engineering prefixes, or PCT

***RST value** The reset value depends on the output module:

Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A
3 ns	2 ns	0.8 ns

Specified limits Consider the following limits for the individual output modules:

Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A	Agilent 8110A
3 ns to 200 ms	2 ns to 200 ms	0.8 ns/1.6 ns fixed	2 ns to 200 ms

Parameter coupling Trailing edge = Leading edge if `:PULS:TRAN:TRA:AUTO ON`.

This is the default condition.

Use `:PULS:TRAN:TRA:AUTO OFF` to enable independent programming of the trailing edge within a 1:20 ratio for the ranges.

NOTE Agilent 81110A with Agilent 81112A 3.8V/330 MHz Output has coupled transitions.

Description Use this command to set/read the transition time of the pulse-leading-edge. Note that the leading and trailing edges of the pulse have to fit within the defined pulse width

Example

`:PULS:TRAN1 3NS`	Set output 1 leading edge to 3 ns
`:PULS:TRAN1:TRA:AUTO OFF`	Enable independent setting of trailing edge
`:PULS:TRAN1:TRA 15 NS`	Set output 1 trailing edge to 15ns

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Command **:PULS:TRAN[1|2]:TRA**

Long `[:SOURce]:PULSe:TRANsition[1|2]:TRAiling`

Form Set & Query

Parameter Numeric

Parameter suffix S with engineering prefixes, or PCT

***RST value** The reset value depends on the output module:

Agilent 8111A	Agilent 81105A	Agilent 81112
2.00 ns	3 ns	0.8 ns

Specified limits Consider the following limits for the individual output modules:

Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A	Agilent 8110A
3 ns to 200 ms	2 ns to 200 ms	0.8 ns/1.6 ns fixed	2 ns to 200 ms

Parameter coupling Trailing edge = Leading edge if `:PULS:TRAN:TRA:AUTO ON`. This is the default condition.

Use `:PULS:TRAN:TRA:AUTO OFF` to enable independent programming of the trailing edge within a 1:20 ratio for the ranges.

NOTE Agilent 81110A with Agilent 81112A 3.8V/330 MHz Output has coupled transitions.

Description Use this command to set/read the transition time of the pulse-trailing-edge. Note that the leading and trailing edges of the pulse have to fit within the defined pulse width.

Example

`:PULS:TRAN1 3NS`	Set output 1 leading edge to 3ns
`:PULS:TRAN1:TRA:AUTO OFF`	Enable independent setting of trailing edge
`:PULS:TRAN1:TRA: 15NS`	Set output 1 trailing edge to 15 ns

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Command **:PULS:TRAN[1|2]:TRA:AUTO**

Long `:[SOURce]:PULSe:TRANsition[1|2]:TRAiling:AUTO`

Form Set & Query

Parameter ON | OFF | ONCE

***RST value** ON

Description Use this command to set/read the automatic coupling of the pulse-trailing-edge transition time to the leading-edge transition time.

ON	The trailing-edge transition time is automatically set to the same value as the leading edge, and is updated automatically each time the leading-edge transition time changes.
OFF	The trailing-edge transition time is independently programmable.
ONCE	The trailing-edge transition time is set ONCE to the same value as the leading edge.

NOTE Agilent 81110A with Agilent 81112A 3.8V/330 MHz output has coupled transitions.

Example

`:PULS:TRAN1 3NS`	Set output 1 leading edge to 3 n
`:PULS:TRAN1:TRA:AUTO OFF`	Enable independent setting of trailing edge
`:PULS:TRAN1:TRA 15NS`	Set output 1 trailing edge to 15 ns

Command **:PULS:TRIG[1|2]:VOLT**

Long `[:SOURce]:PULSe:TRIGger[1|2]:VOLTage[:LEVel][:IMMediate][:AMPlitude]`

Form Set & Query

Parameter TTL | ECL

***RST value** TTL

Description Use this command to set/read the output levels at the TRIGGER OUT connector.

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Command **:PULS:WIDT[1|2]**

Long `[:SOURce]:PULSe:WIDTh[1|2]`

Form Set & Query

Parameter Numeric

Parameter suffix S with engineering prefixes

***RST value** 100 ns

Specified limits Consider the following limits for the individual output modules:

Agilent 81104A with 81105A	Agilent 81110A with 81110A	Agilent 81110A with 81112A	Agilent 8110A
6.25 ns to 999.5 s (period – 6.25ns)	3.03 ns to 999.0 s (period – 3.03 ns)	1.5 ns to 999.5 s (period – 1.5 ns)	3.30 ns to 999 ms (Maximum = Period – 3.3 ns)

(PLL: 999 s)

Description Use this command to program the width of the pulse signal. If you want to set width as dutycycle use `[:SOURce]:PULSe:DCYCle[1|2]`.

If you want the pulse width to remain constant when the pulse period is varied (rather than the dutycycle) use `[:SOURce]:PULSe:HOLD[1|2] WIDTh`.

Example

```
:PULS:WIDT1 50NS          Set OUTPUT 1 pulse width to 50 ns
:PULS:HOLD1 WIDTH         Hold pulse width constant with varying period
```


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Command **:ROSC:SOUR**

Long `[:SOURce]:ROSCillator:SOURce`

Form Set & Query

Parameter `INTernal | EXTernal`

***RST value** `INT`

Description Use this command to set/read the reference source for the PLL. If you select the external reference (CLK IN connector) you can choose to use a 5 MHz or 10 MHz reference signal using `:ROSC:EXT:FREQ`.

`INTernal`	Lock the PLL to its internal reference
`EXTernal`	Lock the PLL to a reference signal at the CLK IN connector. The external reference signal can be 5 or 10 MHz.

Example

```
:ROSC:SOUR EXT"
:ROSC:EXT:FREQ 10 MHZ
```

Set external PLL reference (CLK IN)
Set expected PLL reference frequency to 10 MHz

Command **:ROSC:EXT:FREQ**

Long `[:SOURce]:ROSCillator:EXTernal:FREQuency`

Form Set & Query

Parameter Numeric

***RST value** 5 MHz

Specified limits 5 MHz or 10 MHz

Description Use this command to set/read the expected reference frequency for the PLL at the CLK IN connector. The external reference can be a 5 or 10 MHz signal. Note that if you program any value other than the two specified values, the value will be set to the nearest of the two specified values.

Example

```
:ROSC:SOUR EXT
:ROSC:EXT:FREQ 10MHZ
```

Set external PLL reference (CLK IN)
Set expected PLL reference frequency to 10 MHz

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Command **:VOLT[1|2]**

Long `[:SOURce]:VOLTage[1|2][:LEVel][:IMMediate][:AMPLitude]`

Form Set & Query

Parameter Numeric

Parameter suffix V with engineering prefixes.

Value coupling

$$High = Offset + \frac{Amplitude}{2}$$

$$Low = Offset - \frac{Amplitude}{2}$$

Range coupling With Offset, see *page 84*

***RST value** 1.00 V

Specified limits Values are valid from 50 Ω into 50 Ω

Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A	Agilent 8110A
100 mVpp to 10.0 Vpp	100 mVpp to 10.0 Vpp	100 mVpp to 3.8 Vpp	100 mVpp to 10.0 Vpp

Description This command programs the amplitude voltage of the output signal. Note that to set the output levels in terms of voltage, you first have to execute the `[:SOURce]:HOLD VOLTage` command to enable the `[:SOURce]:VOLTage` subsystem.

The available voltage range is limited by the combination of:

- Specified current limits
- Actual output Impedance setting `:OUTPut:IMPedance`
- Actual expected load impedance setting: `:OUTput:IMPedance:EXTernal`

Example

```
:HOLD VOLT          Enable VOLTAGE subsystem
:VOLT1 5V           Set output 1 amplitude to 5 V
```


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Command **:VOLT[1|2]:OFFSet**

Long `[:SOURce]:VOLTage[1|2][:LEVel][:IMMediate]:OFFSet`

Form Set & Query

Parameter Numeric

Parameter suffix V with engineering prefixes.

Value coupling

$$High = Offset + \frac{Amplitude}{2}$$

$$Low = Offset - \frac{Amplitude}{2}$$

Range coupling With Amplitude, see *page 83*

***RST value** 0.0 mV

Specified Limits Consider the following limits for the individual output modules:

Agilent 81111A & Agilent 81105A	Agilent 81112A
–10 V to + 10 V	–2 V to +3.8 V

NOTE When using the Level window the amplitude has to be taken into account.

Description This command programs the offset voltage of the output signal. Note that to set the output levels in terms of voltage, you first have to execute the `[:SOURce]:HOLD VOLTage` command to enable the `[:SOURce]:VOLtage` subsystem.

The available voltage range is limited by the combination of:

- Specified current limits
- Actual output impedance setting `:OUTPut:IMPedance`
- Actual expected load impedance setting `:OUTput:IMPedance:EXTernal`

Example

```
:HOLD VOLT                  Enable VOLTAGE subsystem
:VOLT1:OFF -800MV           Set output 1 offset to –800mV
```


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Command **:VOLT[1|2]:HIGH**

Long `[:SOURce]:VOLTage[1|2][:LEVel][:IMMediate]:HIGH`

Form Set & Query

Parameter Numeric

Parameter suffix V with engineering prefixes.

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High - Low}{2}$$

Range coupling With Low-level

***RST value** 500 mV

Specified limits (50 Ω into 50 Ω)

Agilent 81111A & Agilent 81105 A	Agilent 81112A	Agilent 8110A
–9.90 V to 10.0 V	–1.9 V to +3.8 V	–9.90 V to 10.0 V

Description This command programs the High-level voltage of the output signal. Note that to set the output levels in terms of voltage, you first have to execute the `[:SOURce]:HOLD VOLTage` command to enable the `[:SOURce]:VOLTage subsystem`.

The available voltage range is limited by the combination of:

- Specified current limits
- Actual output Impedance setting `:OUTPut:IMPedance`
- Actual expected load impedance setting `:OUTPut:IMPedance:EXTernal`

Example

```
:HOLD VOLT                  Enable VOLTAGE subsystem
:VOLT1:HIGH 4.8V            Set output 1 high level voltage to 4.8V
```


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Command **:VOLT[1|2]:LOW**

Long `[:SOURce]:VOLTage[1|2][:LEVel][:IMMediate]:LOW`

Form Set & Query

Parameter Numeric

Parameter suffix V with engineering prefixes.

Value coupling

$$Amplitude = High - Low$$

$$Offset = \frac{High\text{-}Low}{2}$$

Range coupling With High-level

***RST value** –500 mV

Specified limits (50 Ω into 50 Ω)

Agilent 81111A & Agilent 81105A	Agilent 81112A	Agilent 8110A
–10.0 V to 9.90 V	–2.0 V to 3.7 V	–10.0 V to 9.90 V

Description This command programs the Low-level voltage of the output signal. Note that to set the output levels in terms of voltage, you first have to execute the `[:SOURce]:HOLD VOLTage` command to enable the `[:SOURce]:VOLTage` subsystem.

The available voltage range is limited by the combination of:

- Specified current limits
- Actual output impedance setting `:OUTPut:IMPedance`
- Actual expected load impedance setting `:OUTPut:IMPedance:EXTernal`

Example

```
:HOLD VOLT                    Enable VOLTAGE subsystem
:VOLT1:LOW 500MV              Set output 1 low-level to 500mV
```


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Command	**:VOLT[1|2]:LIM**
Long	`[:SOURce]:VOLTage[1|2]:LIMit[:HIGH]`
Form	Set & Query
Parameter	Numeric
Parameter suffix	V with engineering prefixes.
***RST value**	+500 mV
Description	Use this command to set/read the high-level voltage limit. If you switch on voltage limiting, the high-level voltage cannot be set above the programmed limit. Note that the voltage is *not* limited by the output hardware, this is a software limit.

Example

```
:HOLD VOLT                  Enable VOLTAGE subsystem
:VOLT1:LIM 3V               Set output 1 high-level limit to 3 V
:VOLT1:LIM:STAT ON          Switch on output 1 limits
```

Command	**:VOLT[1|2]:LIM:LOW**
Long	`[:SOURce]:VOLTage[1|2]:LIMit:LOW`
Form	Set & Query
Parameter	Numeric
Parameter suffix	**V** with engineering prefixes.
***RST value**	–500 mV
Description	Use this command to set/read the low-level voltage limit. If you switch on voltage limiting, the low-level voltage cannot be set below the programmed limit. Note that the voltage is *not* limited by the output hardware, this is a software limit.

Example

```
:HOLD VOLT                  Enable VOLTAGE subsystem
:VOLT1:LIM:LOW 0V           Set output 1 Low-level voltage
:VOLT1:LIM:STAT ON          Switch on output 1 limits
```


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Command **:VOLT[1|2]:LIM:STAT**

Long `[:SOURce]:VOLTage[1|2]:LIMit:STATe`

Form Set & Query

Parameter `ON | OFF | 1 | 0`

***RST value** `OFF`

Description This command switches the output limits on or off. When you switch on the output limits cannot program the output levels beyond the programmed limits, until you switch off the voltage limits. The limits apply whether you program high/low levels or amplitude/offset levels.

NOTE You can switch the limits on and off in both the `[:SOURce]:CURRent` and the `[:SOURce]:VOLTage` subsystems *but the current and voltage limits are not enabled/disabled independently.* The voltage and current limits are always enabled/disabled together.

Example

`:HOLD VOLT`	Enable VOLTAGE subsystem
`:VOLT1:LIM 3V`	Set output 1 high level voltage limit to 3 V
`:VOLT1:LIM:LOW 0V`	Set output 1 low-level voltage limit to 0V
`:VOLT1:LIM:STAT ON`	Switch on output 1 limits

Command **:STATus:OPERation**

This command tree accesses the `OPERation` status group. *The* `OPERation` status group is *not* used by the instrument. Therefore, this command tree is redundant.

- `:STATus:OPERation[:EVENt]?`
- `:STATus:OPERation:CONDition?`
- `:STATus:OPERation:ENABle`
- `:STATus:OPERation:NTRansition`
- `:STATus:OPERation:PTRansition`

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Command **:STATus:PRESet**

Long `:STATus:PRESet`

Form Event

***RST value** Not Applicable

Description This command

- Clears all status group event registers
- Clears the error queue
- Presets the status group enable-, PTR-, and NTR-registers as follows:

Status Group	Register	Preset value
OPERation	ENABle	0000000000000000
	PTR	0111111111111111
	NTR	0000000000000000
QUEStionable	ENABle	0000000000000000
	PTR	0111111111111111
	NTR	0000000000000000

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Command **:STATus:QUEStionable**

This command tree accesses the questionable status group. The questionable status group contains warning bits for voltage, current, time and frequency parameters. A warning occurs when the output signal *could* be out of specification due to the combined specification uncertainties of many parameters, although all parameters are set within their individually specified limits. If a parameter is set outside its specified limits an error is generated.

The following commands are used to access the registers within the status group:

1. **:STATus:QUEStionable[:EVENt]?**

`Form`	Query
`*RST value`	Not Applicable
`Description`	This command reads the event register in the questionable status group.

2. **:STATus:QUEStionable:CONDition?**

`Form`	Query
`*RST value`	Not Applicable
`Description`	This command reads the condition register in the questionable status group.

3. **:STATus:QUEStionable:ENABle**

`Form`	Set & Query
`Parameter`	Numeric
`*RST value`	Not affected by *RST
`Specified limits`	0 – 32767
`Description`	This command sets or queries the enable register in the questionable status group.

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4. **:STATus:QUEStionable:NTRansition**

Form	Set & Query
Parameter	Numeric
*RST value	Not applicable'
Specified limits	0 – 32767
Description	This command sets or queries the negative-transition register in the questionable status group.

5. **:STATus:QUEStionable:PTRansition**

Form	Set & Query
Parameter	Numeric
*RST value	Not applicable'
Specified limits	0 – 32767
Description	This command sets or queries the positive-transition register in the questionable status group.

Command **:SYST:CHEC**

Long `:SYSTem:CHECk[:ALL][:STATe]`

Form Set & Query

Parameter OFF

***RST value** ON

Description Use this command to switch the instrument's error checking off. Switch off the error checking if you want to improve the programming speed of the instrument, but remember that no invalid parameter or mode settings will be detected and reported. Error checking is switched on by the *RST command, or when the default setting is invoked.

CAUTION Error checking cannot be switched on from the frontpanel. Error checking is *not* automatically re-enabled if you switch the instrument off and on again. Therefore your test programs should send either *RST or set default setting before ending.

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Command **:SYST:ERR?**

Long `:SYSTem:ERRor?`

Form Query

***RST value** Not Applicable

Description Use this command to read the instrument error queue. The instrument error queue can store up to 30 error codes on a first-in-first-out basis. When you read the error queue, the error number and associated message are put into the instrument's output buffer.

If the queue is empty, the value 0 is returned, meaning “No Error”. If the queue overflows at any time, the last error code is discarded and replaced with –350 meaning “Queue overflow”.

Example

```
:SYS:ERR?                    Query for errors
```

Command **:SYST:KEY**

Long `:SYSTem:KEY`

Form Set & Query

Parameter Numeric

Parameter suffix No suffix allowed

***RST value** +19

Specified limit The following values are supported:

No.	Key Description
–1	No key pressed (Query only)
0	DATA ENTRY 0
1	DATA ENTRY 1
2	DATA ENTRY 2
3	DATA ENTRY 3
4	DATA ENTRY 4
5	DATA ENTRY 5

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No.	Key Description
6	DATA ENTRY 6
7	DATA ENTRY 7
8	DATA ENTRY 8
9	DATA ENTRY 9
10	DATA ENTRY .
11	DATA ENTRY +/-
12	CURSOR UP
13	CURSOR DOWN
14	CURSOR LEFT
15	CURSOR RIGHT
16	MAN
17	STORE
18	HELP
19	SHIFT
20	MORE
21	Softkey 1
22	Softkey 2
23	Softkey 3
24	Softkey 4
25	NANO
26	MICRO/MEGA
27	MILLI/KILO
28	Enter
29	Modify knob left (counter-clockwise)
30	Modify knob right (clockwise)

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Description In query form, this command reads the last key pressed. The buffer is cleared by *RST and returns the value –1 when empty.

In set form, the command simulates pressing a key on the frontpanel. Simulated key strokes are also recorded as the last key pressed.

NOTE `:SYST:KEY 19` sets the instrument to local mode.

- In remote mode *only* the softkeys under the display and the SHIFT (LOCAL) key are active. Since the instrument normally switches to remote mode when any command is received, including `:SYSTem:KEY`, simulating one of the other disabled keys has no effect.
- If you want to simulate full frontpanel operation, you must prevent the instrument from entering remote mode by using the REN line of the GP-IB to maintain local mode.

If you do this, the `:SYSTem:KEY` command is the only command which works. Any other commands will be buffered in the instrument blocking any further `:SYSTem:KEY` commands, until remote mode is enable.

Command **:SYST:PRES**

Long `:SYSTem:PRESet`

Form No function.

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Command	**:SYST:SEC**
Long	`:SYSTem:SECurity[:STATe]`
Form	Set & Query
Parameter	`ON|OFF`
***RST value**	`OFF`
Description	

CAUTION

Do not switch on system security unless you are willing to erase the instrument settings stored in the instrument. All instrument memories, including the current setting, will be overwritten with the default settings if you

- Switch off system security
- Switch the instrument off and on again
- If you accidentally switch on system security, and want to rescue the settings stored in the instrument, store the settings on a memory card. You can then recall them from the memory card later.

Use this command to switch on system security mode. Switch on system security if you need to make sure that all instrument settings stored in the instrument are erased automatically when the instrument is switched off, or when security mode is switched off.

The instrument settings are erased by overwriting them with the default settings.

System security mode is not available via the frontpanel. If you want to erase all settings by hand:

1 SHIFT + RECALL / STORE + 0 to recall the default settings from memory location 0.

2 STORE + 1, STORE + 2, ... STORE + 9, to store the defaults in memory locations 1 to 9.

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Command	**:SYST:SET**
Long	`:SYSTem:SET`
Form	Set & Query
Parameter	Block data
***RST value**	Not applicable
Description	In query form, the command reads a block of data containing the instrument's complete set-up. The set-up information includes all parameter and mode settings, but does not include the contents of the instrument setting memories, the status group registers or the `:DISPlay[:WINDow][:STATe]` The data is in a binary format, not ASCII, and cannot be edited. In set form, the block data must be a complete instrument set-up read using the query form of the command.

Command	**:SYST:VERS?**
Long	`:SYSTem:VERSion?`
Form	Query
***RST value**	1992.0
Description	This command reads the SCPI revision to which the instrument complies.

Command	**:SYST:WARN?**
Long	`:SYSTem:WARNing[:COUNt]?`
Form	Query
***RST value**	Not applicable
Description	Use this command to read the number of warnings which are currently active. Note that the warning status of voltage, current, time and frequency are also summarized by bits in the questionable status register.

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Command **:SYST:WARN:STR?**

Long `:SYSTem:WARNing:STRing?`

Form Query

***RST value** Not applicable

Description Use this command to read all the currently active warning messages. The warning messages are concatenated to form a single string with a ";" as separator between the messages.

Command **:SYST:WARN:BUFF?**

Long `:SYSTem:WARNing:BUFFer?`

Form Query

***RST value** Not applicable

Description Use this command to read the maximum possible number of characters which could be returned by `:SYST:WARN:STR?` if all warnings were active.

Command **:TRIG:COUNt**

Long `:TRIGger[:SEQuence[1]]:COUNt`

Form Set & Query

Parameter Numeric

***RST value** 1

Specified limits `:DIG:PATT OFF:` 1 to 65536
`:DIG:PATT ON:` 2 to 16384 (Agilent 8110 A limit is 2 to 4096)

Description Use this command to set/read the number of trigger events (pulse periods) to be generated for each arming event. This corresponds to selecting the event mode on the Mode/Trigger screen:

`PULSES`	Set a **trigger count of 1** so that a single pulse period is generated for each arming event.- instrument is in pulse (stream) mode

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`BURST of`	Set a **trigger count of 2 to 65536** so that a burst of 2 to 65536 pulse periods is generated for each arming event. Switch off pattern mode so that a pulse (or double-pulse) is generated in each pulse period. (:DIG:PATT OFF)- instrument is in burst mode
`PATTERN of`	Set a **trigger count of 2 to 16384** so that a burst of 2 to 16384 pulse periods is generated for each arming event. Switch on pattern mode so that the pattern memory is used to generate the pulses. (:DIG:PATT ON)- instrument is in pattern mode

Examples

To set up a continuous pattern of NRZ-pulses at output 1 with a 512-bit pattern length:

`:ARM:SOUR IMM`	Set continuous arming
`:TRIG:COUN 512`	Pattern length 512
`:TRIG:SOUR INT1`	Pulse period trigger from internal osc
`:DIG:PATT ON`	Enable pattern operating mode
`:DIG:SIGN1:FORM NRZ`	Set output 1 data to NRZ

To set up a triggered burst of 16 single-pulses at output 1, each burst triggered by a positive edge at the EXT INPUT:

`:ARM:SOUR EXT1`	Set arming from EXT INPUT
`:ARM:SENS EDGE`	Set arming on edges
`:ARM:SLOP POS`	Set arming on positive edges
`:TRIG:COUN 16`	Burst length 16
`:TRIG:SOUR INT1`	Pulse period trigger from internal osc.
`:DIG:PATT OFF`	Disable pattern operating mode
`:PULS:DOUB1 OFF`	Ensure single pulses at OUTPUT 1

To set up a gated pulses single-pulses at output 1, gated by a positive level at the EXT INPUT:

`:ARM:SOUR EXT1`	Set arming from EXT INPUT
`:ARM: SENS LEV`	Set arming on levels
`:ARM:SLOP POS`	Set arming on positive level 1 pulse period
`:TRIG:COUN 1`	Single pulse output mode
`:TRIG:SOUR INT1`	Pulse-period trigger from internal osc.
`:DIG:PATT OFF`	Disable pattern data
`:PULS:DOUB1 OFF`	Ensure single pulses at OUTPUT 1

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Command	**:TRIG:IMP**
Long	`:TRIGger:IMPedance`
Form	Set & Query
Parameter	Numeric
Parameter Suffix	`OHM` with engineering prefixes, e.g.: `MOHM` is Megaohms.
***RST value**	50 Ω
Specified Limits	50 Ω or 10 kΩ
Description	Use this command to program the input impedance of the CLK IN connector. Note that only two settings are available. If you try to program any other value, it will be rounded to one of the specified values.

Example

```
:TRIG:IMP 50OHM          Set CLK IN impedance to 50 Ω
:TRIG:LEV 2.5V           Set CLK IN threshold to 2.5V
:TRIG:SOUR EXT2          Pulse period trigger from CLK IN
```

Command	**:TRIG:LEV**
Long	`:TRIGger:LEVel`
Form	Set & Query
Parameter	Numeric
Parameter Suffix	V with engineering prefixes.
***RST value**	1.0 V
Specified Limits	–10 V to +10 V
Description	Use this command to program the triggering threshold of the CLK IN connector.

Example

```
:TRIG:IMP 50OHM          Set CLK IN impedance to 50 Ω
:TRIG:LEV 2.5V           Set CLK IN threshold to 2.5 V
```


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Command	**:TRIG:SLOP**
Long	**:TRIGger:SLOPe**
Form	**Set & Query**
Parameter	POSitive | NEGative
***RST value**	POS
Description	Use this command to select the trigger slope for the pulse period triggering signal applied to the CLK IN connector.

Command	**:TRIG:SOUR**
Long	:TRIGger:SOURce
Form	Set & Query
Parameter	IMMediate | INTernal[1] | INTernal2 | EXTernal2
***RST value**	IMM
Description	Use this command to select the pulse-period source of the Agilent 81110A by selecting the source of the pulse period trigger signal:

Pulse-period sources set by :TRIG:SOUR

Pulse-period source	**:TRIG:SOURce**
internal osc.	IMMediate | INTernal[1]
internal PLL	INTernal2
CLK IN	EXTernal2

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3 Specifications

In this chapter you will find the specifications of the Agilent 81110A and the Agilent 81104A mainframes and the available output channels.

Mainframe No	Channel No	Description
Agilent 81110A	Agilent 81111A	10V/165 MHz Output
	Agilent 81112A	3.8V/330 MHz Output
Agilent 81104A	Agilent 81105A	10V/80 MHz Output

At the end of this chapter, *"Pulse Parameter Definitions" on page 120* provides detailed information on the definition of the pulse parameters used by the instrument.

NOTE

Warranted Performance

Specifications describe the instrument's warranted performance. Non-warranted values are described as typical. All specifications apply after a 30 minute warm-up phase with 50 Ohm source, a 50 Ohm load resistance and separate channels. They are valid from 0 °C to 55 °C ambient temperature.

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Declaration of Conformity

Manufacturer

Agilent Technologies
Boeblingen Verification Solutions
Herrenberger Str.130

D-71034 Boeblingen/Germany

We declare that the system:

Agilent 81100	**Family of Pulse-/Data Generators**
Agilent 81110 A	**330/165 MHz Pulse/Pattern Generator**
Agilent 81104 A	**80 MHz Pulse Pattern Generator**
Agilent 81101 A	**50 MHz Pulse Pattern Generator**
Agilent 81112 A	**330 MHz , 3.5V Output Module**
Agilent 81130 A *	**400/660 MHz Puls-/Pattern Generator**
Agilent 81131 A *	**400 MHz , 3.5V Output Module**
Agilent 81132 A *	**660 MHz , 2.5V Output Module**
Agilent E 8305 A *	**VXI Plugin 250 MHz Pulse Generator**
Agilent E 8306 A *	**VXI Plugin 100 MHz Clock Generator**

conforms to the following standards:

Safety

IEC 1010-1:1990 +A1:1992 +A2:1995 EN61010-1:1993

EMC

EN 55011:1991 / CISPR 11 Group 1, Class B
* EN 55011:1991 / CISPR 11 Group 1, Class A

EN 61000-4-2:1995	ESD: 4kVcd; 8 kVad;4kV c.p.
EN 61000-4-3:1995	Radiated Immunity: 3V/m 80%AM
ENV 50204: 1995	Radiated Immunity: 3V/m; 50%Dty
EN 61000-4-4:1995	Fast Transients/Bursts: 0.5kV, 1kV
EN 61000-4-5:1995	Surges: 1kVdiff; 2kV com.mode
EN 61000-4-6:1995	Conducted Immunity
EN 61000-4-8:1993	Power freq. magn. field 3A/m; 50Hz
IEC1000-4-11:1994	Voltage Dips and Interruptions

Supplementary Information

The product herewith complies with the requirements of the

- Low Voltage Directive (73/23/EEC) and the
- EMC Directive (89/336/EEC).

During the measurements against EN55011, the I/O ports were terminated with their nominal impedance, the GP-IB connection was terminated with the cable Agilent 10833B. When the product is connected to other devices, the user must ensure that the connecting cables and the other devices are adequately shielded to prevent radiation.

Boeblingen, June 09th 1998 Wolfgang Fenske

Update, Oct. 13th 1998 Regulation Consultant

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Agilent 81110A/81104A Specifications

General

Environmental Conditions

Operating temperature:	**0 °C to +55 °C**
Storage temperature:	-40 °C to +70 °C
Humidity:	95% r.h. up to 40 °C ambient temperature
Altitude:	up to 2000 m
Installation:	Category II
Pollution:	Degree 2
EMC:	conforms to EN50082-1, EN55011, Class A
Battery:	Lithium, type CR2477-N (Agilent part number 1420-0557)

Safety

IEC1010, CSA1010

Power requirements

100–240 Vac, ±10%, 50–60 Hz;

100–120 Vac, ±10%, 400 Hz

Power consumption: 300 VA max.

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Maximum Dimensions (H x W x D)

89 mm x 426 mm x 521 mm

Weight

Net

8.5 kg Single Channel
9.2 kg Dual Channel

Shipping

13.8 kg Dual Channel

Recalibration period

1 year recommended

Warranty

3 years standard

Acoustic Noise Emission

For ambient temperature up to 30°C,
under normal operation and at the typical operator position:

LpA = 52 dB (5.9 bel) typical {47 dB (5.3 bel) at 23°C) typical}

Measured in accordance with ISO 7779/EN 27779.

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Timing Specifications

Common Specifications

The following specifications apply to all timing parameters unless otherwise specified in the following.

Repeatability:	typically 4 times better than accuracy
Resolution:	3.5 digits, best case 5 ps
RMS Jitter:	0.01% + 15 ps

Period

Period can also be entered as frequency.

Period	**Agilent 81110A with 81112A installed**	**Agilent 81110A with 81111A installed**	**Agilent 81104A with 81105A installed**
Range:	3.030 ns to 999.5 s	6.060 ns to 999.5 s	12.50 ns to 999.5 s
Resolution:	3.5 digits, 5 ps best case for VFO 4 digits, 1 ps best case for PLL		
Accuracy:	PLL: 0.01% VFO: 0.5% after selfcal, typical 3% w/o selfcal		PLL: 0.01% VFO: ± 5%
RMS-jitter:	PLL: 0.001% + 15 ps VFO: 0.01% + 15 ps		
Frequency range:	1.00 mHz to 330 MHz	1.00 mHz to 165 MHz	1.00 mHz to 80 MHz

There are 2 period generation sources available:

- startable oscillator (variable frequency oscillator VFO)
- high-accuracy frequency generator (PLL)

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Glitch-free timing changes

With the Agilent 81110A/81104A you can sweep your timing values without danger of spurious pulses or drop-outs that could cause measurement errors. This applies to continuous mode with timing values < 100 ms (frequency: < 10 Hz), and consecutive values between one-half and twice the previous value.

Width

Can be entered as absolute width, duty cycle or trailing-edge delay.

	Agilent 81112A	**Agilent 81111A**	**Agilent 81105A**
Range:	1.515 ns to 999.5 s (max value: period – 1.5 ns)	3.030 ns to 999.5 s (max value: period – 3.03 ns)	6.250 ns to 999.5 s (max value: period – 6.25 ns)
Accuracy:	± 0.5% ± 250 ps after selfcal, typical ± 3.0% ± 250 ps w/o selfcal		±5% ±250 ps
Duty cycle:	0.1% to 95% (depends on period and width; overprogrammable to 99%)		

Duty Cycle values from 0.1% to 95% can be entered directly. For values >95% press shift and use the Modify knob. Note that pulses may be deteriorated or skipped due to the inaccuracy of period and width. Hence for large values, it is better to select complement and enter 100 minus the required duty cycle value.

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Delay

Measured between trigger output and main output. Can be entered as absolute delay, phase ° or % of period.

	Agilent 81112A	Agilent 81111A	Agilent 81105A
Fixed delay from TRIGGER OUT:	14.0 ns typical		15.0 ns typical
Additional variable range:	0.00 ns to 999.5 s (max value: period –3.03 ns)		0.000 ns to 999.5 s (max value: period – 12.5 ns)
Accuracy:	± 0.5% ± 0.5 ns after selfcal, typical ± 3.0% ± 0.5 ns w/o selfcal		± 5% ± 0.5 ns

Double Pulse Delay

Double pulse delay and delay are mutually exclusive. Double Pulse delay is the delay between the two pulses in Double Pulse mode.

	Agilent 81112A	Agilent 81111A	Agilent 81105A
Double Pulse Delay range:	3.030 ns to 999.5 ms (width + 1.5 ns) to (period – width – 1.5 ns)	6.060 ns to 999.5 s (width + 3.03 ns) to (period – width – 3.03 ns)	12.50 ns to 999.5 s (width + 6.25 ns) to (period – width – 6.25 ns)
Accuracy:	± 0.5% ± 150 ps after selfcal, typical ± 3.0% ± 150 ps w/o selfcal		±5% ±250 ps
Min. period:	6.06 ns (165 MHz)	12.2 ns (82 MHz)	25 ns (40 MHz)

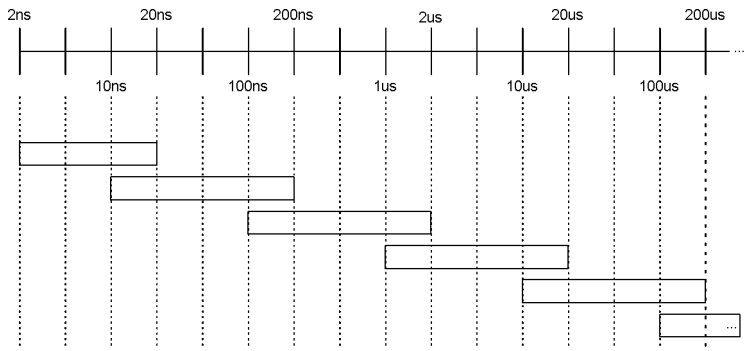
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Transition Times

Measured between 10% and 90% of amplitude. Can be entered as leading/ trailing edge or % of width.

	Agilent 81112A	Agilent 81111A	Agilent 81105A
Range:	800 ps or 1.6 ns, fixed	2.00 ns to 200 ms	3.00 ns to 200 ms
Min. transition:	≤600 ps for Vpp ≤ 1V ≤900 ps for Vpp > 1V	≤2.0 ns	≤3.0 ns
	450 ps typical for Vpp<1v levels (20% to 80% of amplitude)	1.4 ns typical for ECL levels (20% to 80% of amplitude)	n/a
	n/a	5 ns typical for 1 kΩ source impedance	
Accuracy:	n/a	±10% ±200 ps	
Linearity:	n/a	3% typical for transitions >100 ns	

Leading and trailing edges can be programmed independently within the following ranges (Maximum ratio 1:20):



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Level Specifications

	Agilent 81112A	Agilent 81111A	Agilent 81105A
Source impedance:	50 Ω	selectable 50 Ω or 1 kΩ ± 1% typical	
Maximum external voltage:	–2.2 V to + 5.5 V	±24 V	
Short circuit current:	–84 mA to 152 mA	±400 mA (double for channel addition)	
Normal/complement:	selectable		
ON/OFF:	relays connect/disconnect output (HiZ).		
Limits:	high and low levels can be limited to protect the DUT.		

External Load compensation

For loads ≠ to 50Ω, the actual load impedance can be entered to correct the output values into a static load with Agilent 81111A and Agilent 81105A output modules.

Level Parameters

Level parameters can be entered as voltage or current, as high/low-level or offset/amplitude in terms of voltage or current.

	For Agilent 81111A and for Agilent 81105A	
	(50Ω into 50Ω)	(1kΩ into 50Ω)
Amplitude:	100 mVpp to 10.0 Vpp	200 mVpp to 20.0 Vpp
Level Window	–10.0 V to +10.0 V	–20.0 V to + 20.0 V
Level Accuracy:[a] Agilent 81111A Agilent 81105A	 ±(1% Amplitude + 50 mV) ±(3% Amplitude + 75 mV)	 +(1% Amplitude + 100 mV) ±(5% Amplitude + 150 mV)
Resolution:	10 mV	20 mV
Short Circuit Current	±400 mA max, (doubles for channel addition)	

[a] in ± 19 V level window

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	For Agilent 81112A **(50Ω into 50Ω)**
Level Window	–2 V to + 3.80 V
Amplitude	100 mV to 3.8 V
Level Accuracy: Agilent 81112A	±(2% Amplitude + 50 mV)
Resolution:	10 mV
Short Circuit Current	–84 mA to +152 mA

Levels in Channel Addition

If two Agilent 81111A output channels are installed in an Agilent 81110A, or two Agilent 81105A output channels are installed in an Agilent 81104A, then the channel addition feature can be used.

Channel addition is not available with Agilent 81112A output channels.

The following parameters differ from previous specifications if channels are added:

	For Agilent 81111A and for Agilent 81105A	
	(50Ω into 50Ω)	**(1kΩ into 50Ω)**
Amplitude:	100 mVpp to 20.0 Vpp	200 mVpp to 20.0 Vpp
Level window:	–20.0 V to +20.0 V	
Maximum frequency:	60 MHz typical	15 MHz typical
Minimum transitions:	2 ns typical on first channel 5 ns typical on second channel	20 ns typical on both channels
Add fixed delay of second channel	2.5 ns	

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Pulse Performance

	Agilent 81112A	Agilent 81111A	Agilent 81105A
Overshoot, Pre-shoot, Ringing:	±5% of amplitude ±50 mV	±5% of amplitude ±20 mV	
Settling time:	5 ns typical	30 ns typical	
Baseline noise:	4 mV RMS typical	10 mV RMS typical	
Dynamic Crosstalk		< 0.1% typical	

Clock Sources

It is possible to select between two clock sources, either the startable oscillator (VFO), or the PLL/External Clock. In Triggered Mode the PLL can be used as the trigger source for the VFO, without the need of an additional source.

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Clock Input/ PLL Reference Input

Input impedance:	50Ω or 10kΩ selectable
Threshold:	–10 V to +10 V
Maximum input voltage:	±15 V
Input transitions:	<100 ns
Input Frequency:	dc to max 330 MHz, depends on the output module
Minimum pulse width:	1.5 ns
Input sensitivity:	≤ 300 mVpp typical
Delay from Clock Input to TRIGGER OUT:	12 ns typical

Rear panel BNC connector used as:

- External system clock input: pulse frequency = input frequency
- or 5 MHz or 10 MHz frequency reference input for internal PLL.

The input frequency can be measured.

Phase Locked Loop (PLL)

- Locks either to an external frequency reference at the PLL Ref Input Clk In (5 MHz or 10 MHz selectable) or to its internal reference.
- High accuracy period (frequency) source.
  When locked to the internal reference, period accuracy, range, resolution, and jitter are improved.
  When locked to an external frequency reference, the external frequency affects these accuracies.
- Internal triggering of bursts and patterns: the internal PLL can replace an external trigger source, while the output period is determined by the normal internal oscillator.

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External Clock

- The output period is determined by the signal at clock input. Frequency accuracy can be increased by using a precise external clock.
- Trigger synchronously to external clock: the output period is synchronous to the signal at clock input. The signal at the External Input is used for arming.

External Input

Input impedance:	50 Ω or 10 kΩ selectable
Threshold:	-10 V to +10 V
Maximum input voltage:	±15 Vpp
Input transitions:	<100 ns
Input frequency:	dc to max 330 MHz, depends on the output module
Minimum pulse width:	1.5 ns
Input sensitivity:	≤300 mV_{pp} typical

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Output Modes

Pulses Mode

The output signal consists of single or double pulses, controlled by the Trigger mode.

Burst Mode

The output signal consists of bursts of single or double pulses, controlled by the Trigger mode.

Burst count:	2 to 65536
Format:	single or double pulses

Pattern Mode

The output signal consists of patterns of RZ or NRZ pulses, controlled by the Trigger mode.

Pattern Length	16,384 bits/channel and STROBE OUT
Format:	RZ (return-to-zero)
	NRZ (non-return-to-zero)
	DNRZ (delayed non-return-to-zero)
Random pattern:	PRBS 2^n –1, n = 7 to 14

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Trigger Modes

Continuous

Generate continuous pulses, double pulses, bursts or patterns.

External Triggered

Each active input transition (rising, falling or both) triggers a single or double pulse, a burst or a pattern.

The trigger source can be selected from:

- External Input
- MAN Manual Trigger key
- internal PLL.

External Gated

The active input level (high or low) enables pulses, double pulses, bursts or patterns. The last pulse, double pulse, burst or pattern is always completed. The gate source can be selected from:

- External Input
- MAN Manual Trigger key

External Width

To recover a pulse shape of an external signal, applied to the External Input, the period and width are maintained, levels and transitions can be set.

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Trigger and Strobe Specifications

Strobe Output

Level:	TTL or ECL selectable
Output impedance:	50 Ω typical
Maximum external voltage:	–2 V/+7 V
Transition times:	1 ns typical for TTL, 600 ps typical for ECL
Pattern:	16,384 bits NRZ in pattern mode. Marks burst pulses in burst mode

Trigger Output

Level:	TTL or ECL selectable
Output impedance:	50 Ω typical
Trigger pulse width:	typically 50% of period, in EXT WIDTH mode: Agilent 81110A: 1.5 ns typ. Agilent 81104A: 5.9 ns typ.
Maximum external voltage:	–2 V/+7 V
Transition times:	1 ns typical for TTL, 600 ps typical for ECL

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Typical Delays

Delay values are valid for Agilent 81110A with Agilent 81111A 10V/165 MHz outputs.

For Agilent 81112A output subtract 4 ns for times referring to OUT 1/OUT 2.

For Agilent 81104A with Agilent 81105A 10V/80 MHz outputs add 1.0 ns to the OUT 1/OUT 2 values.

Mode	from	to	typ. value
external width	Ext Input	Strobe/Trigger Out OUT 1/OUT 2	8.5 ns 19.5 ns
Trigger Gated	Ext Input	Strobe/Trigger Out OUT 1/OUT 2	12.0 ns 26.0 ns
Continuous	Strobe/ Trigger Out	OUT 1/OUT 2	14.0 ns
Ext. clock signal as pulse period	CLK IN	Strobe/Trigger Out OUT 1/OUT 2	12.0 ns 26.0 ns

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Human Interface

Overprogramming

Parameter values can be entered exceeding the specified range.

Warnings and Errors

Warning messages indicate potentially conflicting parameters due to accuracy tolerances.

Error messages indicate conflicting parameters.

HELP key

Displays a context-sensitive message about the selected parameter. Concept help for getting started is also available. If warnings or errors occur, the HELP key displays the warning/error list accordingly.

Memory

Non-volatile memory

Actual setting is saved on power- down. 9 user and 1 default setting are also stored in instrument.

Memory-card

99 settings can be stored per 1 MB (MS-DOS, PCMCIA) memory card. Also used for convenient firmware updates.

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Remote Control

Operates according to IEEE standard 488.2, 1987 and SCPI 1992.0.

Function Code:

SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1,C0.

Programming times:

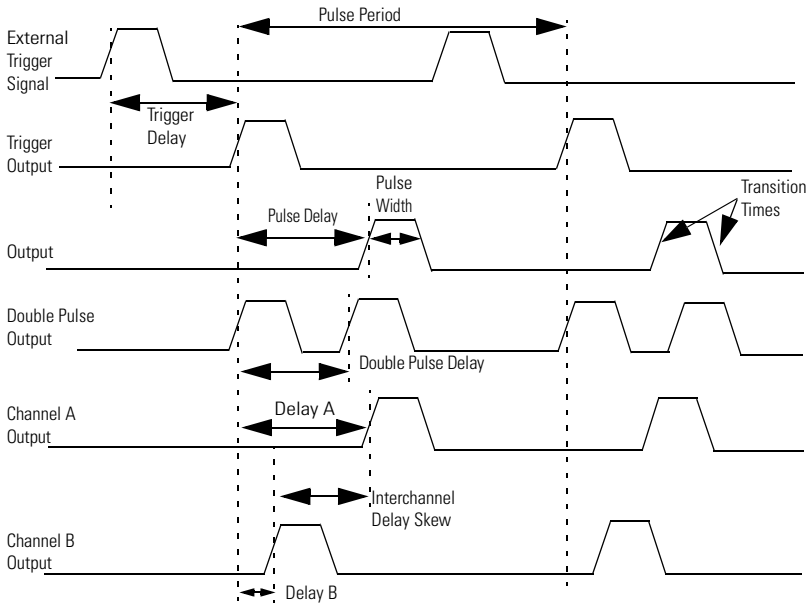
all checks and display off.

Command	Typical execution time
One parameter or mode	30 ms typ.
Recall Setting	250 ms typ
16,384 bit pattern transfer	600 ms typ

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Pulse Parameter Definitions

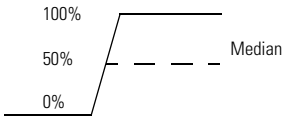
Here you find the pulse parameter definitions of terms used in the instrument specifications. In the following figure a graphical overview of the pulse parameters is provided:



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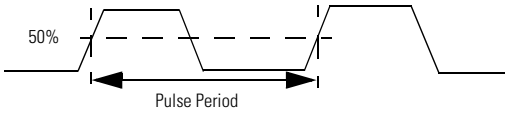
Time Reference Point

The time reference point is at the median of the amplitude (50% amplitude point on pulse edge):



Pulse Period

The time interval between the leading edge medians of consecutive output pulses:

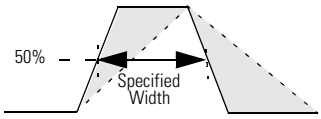


Trigger Delay

Interval between trigger point of the external trigger input signal and the trigger output pulse's leading edge median.

Pulse Width

Interval between leading and trailing edge medians:



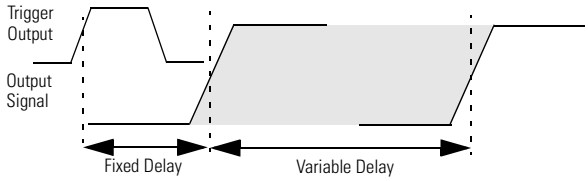
The specified and displayed value is that obtained with fastest edges, essentially equal to the interval from the start of the leading edge to the start of the trailing edge. By designing so that the pulse edges turn about their start points, the interval from leading edge start stays unchanged (in

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practice, start points may shift with changes in transition time) when transition times are varied. This is more convenient for programming and the width display is easy to interpret.

Pulse Delay

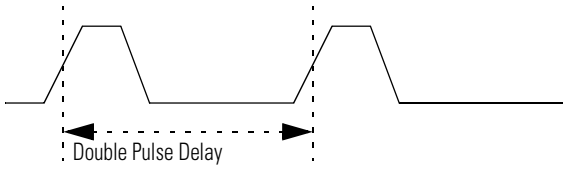
Interval between leading edge medians of trigger output pulse and output pulse:



The specified and displayed value is that obtained with the fastest leading edge. Pulse delay has two components, a fixed delay from trigger output to output signal and a variable delay with respect to the trigger output.

Double Pulse Delay

Interval between leading edge medians of the double pulses.



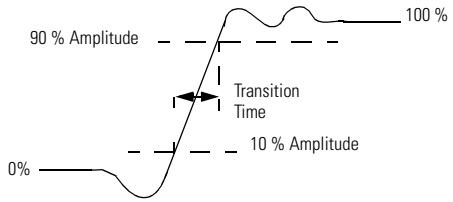
Interchannel Delay (Skew)

Interval between corresponding leading edge medians of the output signals.

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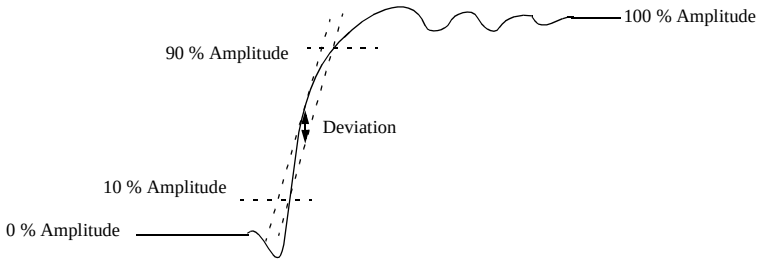
Transition Time

Interval between the 10% and 90% amplitude points on the leading/ trailing edge:



Linearity

Peak deviation of an edge from a straight line through the 10% and 90% amplitude points, expressed as percentage of pulse amplitude:



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Jitter

Short-term instability of one edge relative to a reference edge. Usually specified as rms value, which is one standard deviation or “sigma”. If distribution is assumed Gaussian, six sigma represents 99.74% of the peak-peak jitter.

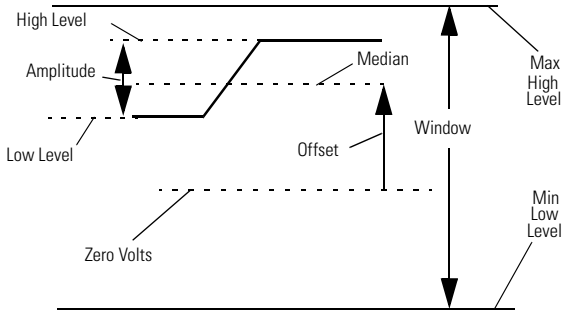
The reference edge for period jitter is the previous leading edge. That for delay jitter is the leading edge of the trigger output. Width jitter is the stability of the trailing edge with regard to the leading edge.

Stability

Long-term average instability over a specific time, for example, hour, year. Jitter is excluded.

Pulse Levels

Pulse output is specified as pulse top and pulse base (usually referred to as high level and low level), or as peak to peak amplitude and median offset. A “window” specification shows the limits within which the pulse can be positioned.

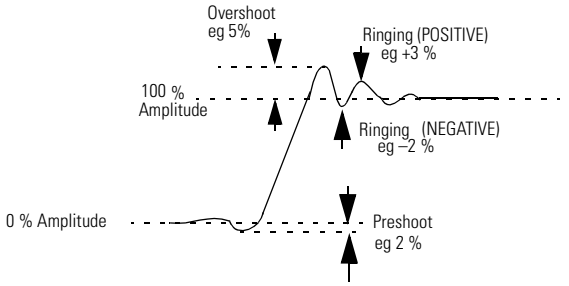


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Preshoot, Overshoot, Ringing

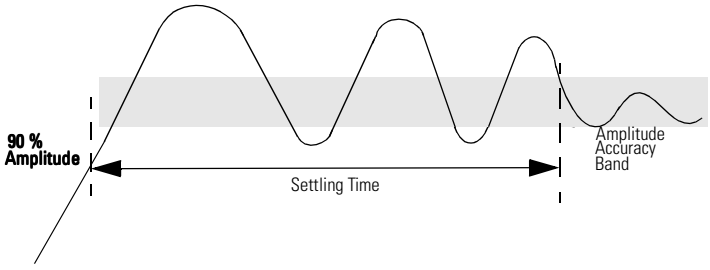
Preshoot and overshoot are peak distortions preceding/following an edge. Ringing is the positive-peak and negative-peak distortion, excluding overshoot, on pulse top or base. For example, a combined preshoot, overshoot, and ringing specification of 5% implies:

- Overshoot/undershoot < 5%
- Largest pulse-top oscillation <± 5%, of pulse amplitude.



Settling Time

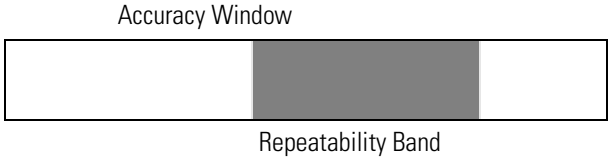
Time taken for pulse levels to settle within level specifications, measured from 90% point on leading edge.



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Repeatability

When an instrument operates under the same environmental conditions and with the same settings, the value of a parameter will lie within a band inside the accuracy window. Repeatability defines the width of this band.



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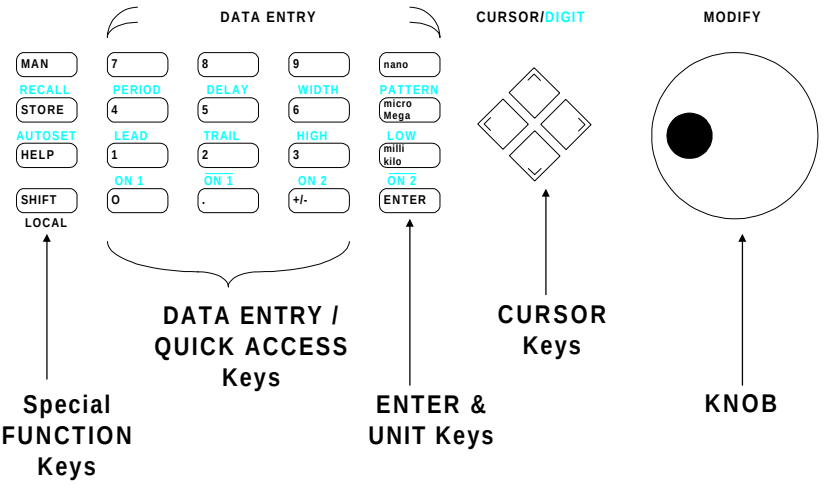
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Front Panel Controls



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