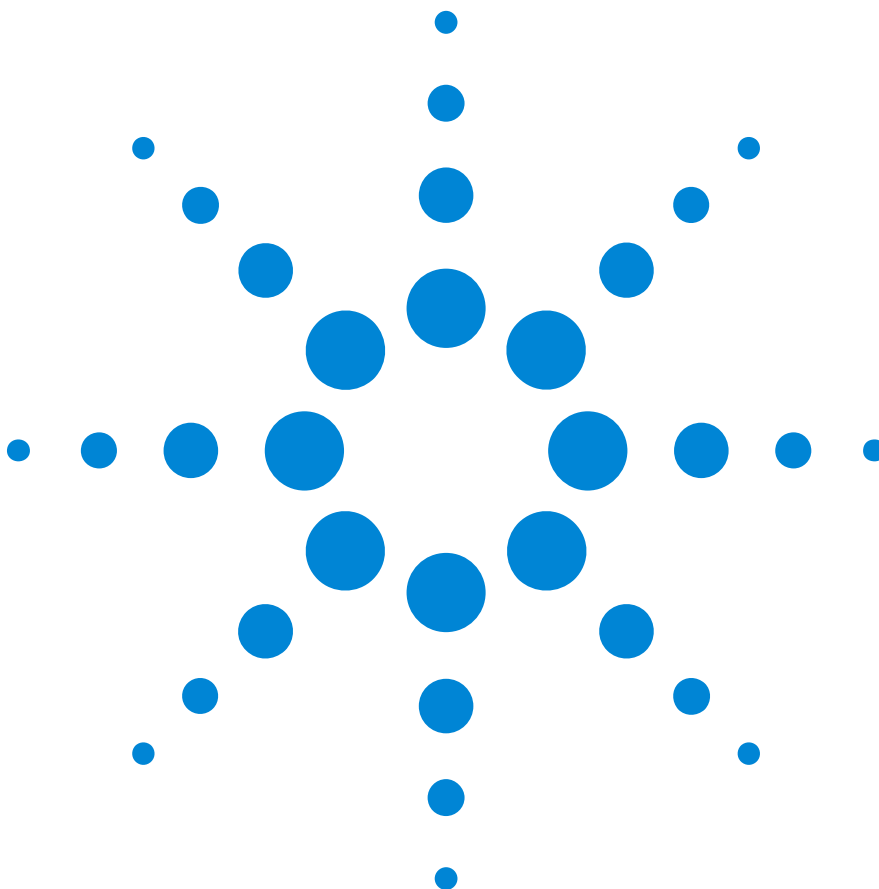


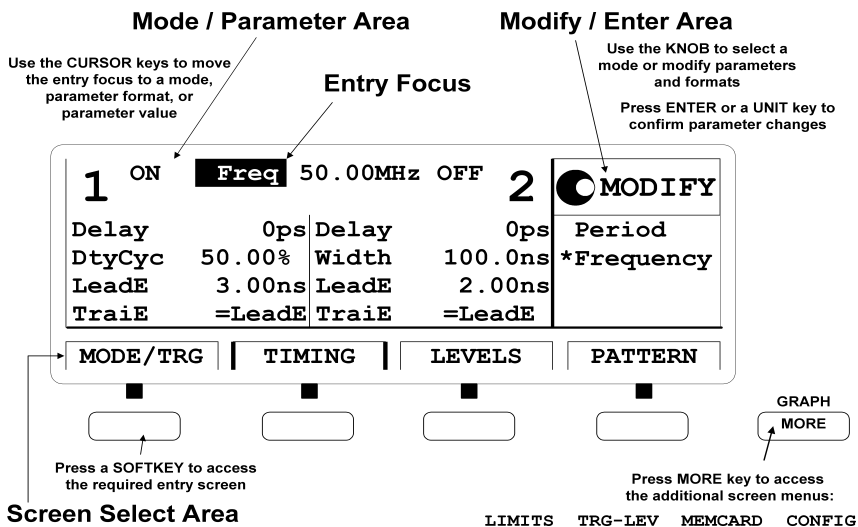


Agilent 81110A 165/330MHz
Agilent 81104A 80 MHz Pulse/Data Generator

Reference Guide



Agilent Technologies



Reference Guide

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

**Part No. 81110-91021
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Notice

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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:

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

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.

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.

Contents

Notice	4
About this book	6
Output Modules	7
Safety Information	8

Chapter 1 **General Programming Aspects**

The GP-IB Interface Bus	14
Agilent 81110A Remote Control	15
Programming Recommendations	16
Common Command Summary	18
Status Model	19

Chapter 2 **Programming Reference**

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

Contents

Chapter 3 Specifications

Declaration of Conformity	102
Agilent 81110A/81104A Specifications	103
General	103
Timing Specifications	105
Level Specifications	109
Clock Sources	111
External Input	113
Output Modes	114
Trigger Modes	115
Trigger and Strobe Specifications	116
Human Interface	118
Memory	118
Remote Control	119
Pulse Parameter Definitions	120

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*.

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*.

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).

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

- 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
```

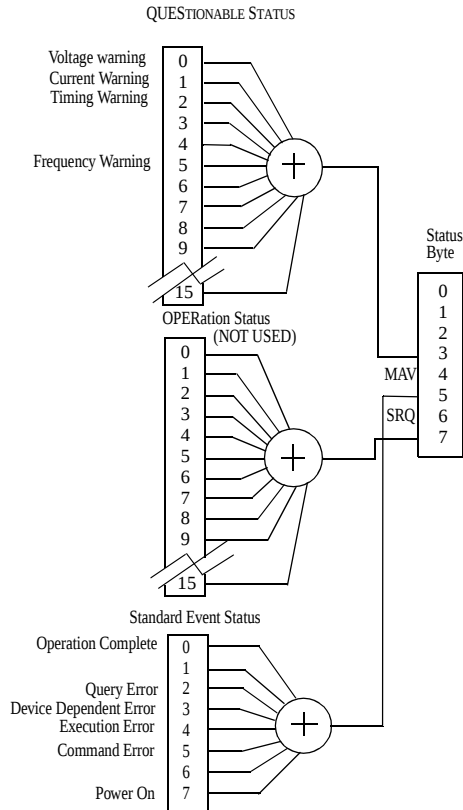
- Selftest of the instrument can be invoked by the common command
*TST
- The Agilent 81110A offers auto calibration for the period (VFO), delay and width circuitry by the device command :CALibration. It is recommended to query whether the calibration is passed by sending :CALibration?.
- If it is important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

Common Command Summary

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

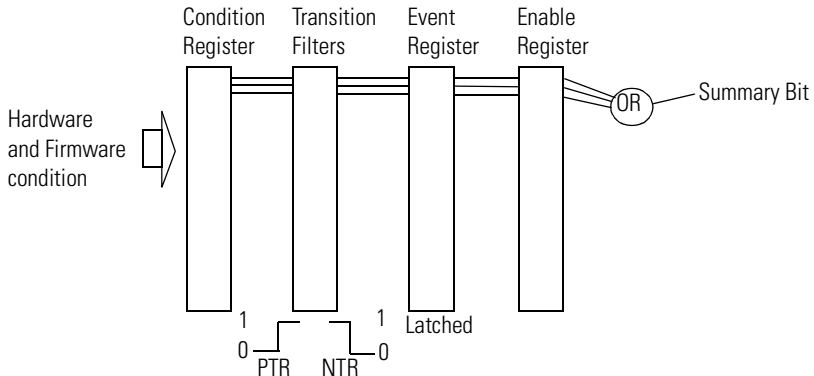
Command	Parameter	Description
*CLS	–	Clear the status structure
*ESE	<0–255>	Set the Standard Event Status register mask
*ESE?	–	Read the state of the Standard Event Status enable register
*ESR?	–	Read the state of the Standard Event Status event register
*IDN?	–	Read the Instrument's Identification 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

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.

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.

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.

Status Group	Registers in Group				
	CONDition	NTR	PTR	EVENTt	ENABLEe
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

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

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

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.

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*.

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
:LEVe1	<value>	Set/read threshold level at EXT INPUT	45
:PERiod	<value>	Set/read trigger period,when PLL (INT2) used as source	46
:SENSe	EDGE LEVe1	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
:CHANne1			
: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

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

Programming Reference
Agilent 81110A/81104A SCPI Command Summary

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
:FREQuency			
[:CW :FIXed]	<value>	Set/read frequency of pulses	66
:AUTO	ONCE	Measure frequency at CLK IN	67

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

Command	Parameter	Description	see page
[:SOURce]		(continued)	
:TRIGger[1 2]			
:VOLTage	TTL ECL	Set/read TRIGGER STROBE OUTput lev- els	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 refer- ence	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

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

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

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

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
:COMPliment[:STATe]	OFF
:IMPedance[:INTernAl]	50Ω
:EXTernAl	50.0Ω
:POLarity	NORMal

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

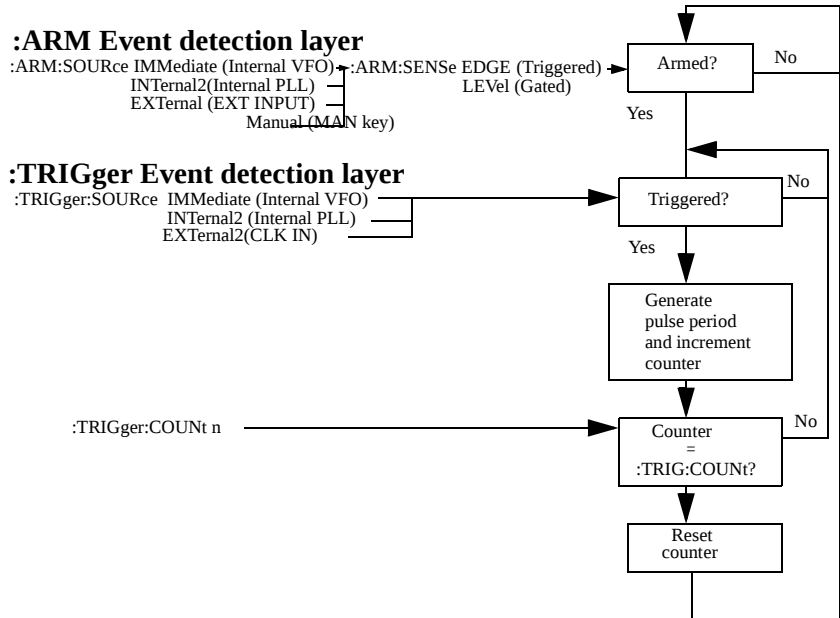
Programming Reference
Default Values, Standard Settings

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

Parameter	*RST, Default Values
[:SOURce]	
:VOLTage[1 2]	
: [LEVe1]	
[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

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

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).

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
```

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 1` Pulse 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

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
```

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: <table><tr><td>Set</td><td>The command can be used to program the instrument</td></tr><tr><td>Query</td><td>The command can be used to interrogate the instrument. Add a ? to the command if necessary.</td></tr><tr><td>Event</td><td>The command performs a one-off action.</td></tr></table>	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.
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.						

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

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 k Ω	
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 500HM :ARM:LEV 2.5V	Set EXT INPUT impedance to 50 Ω 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 500HM :ARM:LEV 2.5V	Set EXT INPUT impedance to 50 Ω Set EXT INPUT threshold to 2.5 V

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 μ s
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

Command	:ARM:SENS
Long	:ARM[:SEquence[1]][:START]][:LAYer]:SENSe
Form	Set & Query
Parameter	EDGE LEVe1
*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.

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.

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: <table><tr><td>0</td><td>calibration passed</td></tr><tr><td>>0</td><td>calibration failed</td></tr></table> When the instrument is switched off and on again, the factory calibration data are activated again.	0	calibration passed	>0	calibration failed
0	calibration passed				
>0	calibration failed				

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

#2161000100010001000
#           Start of block
2           Length of the length of the data
16          Length of the data
10...00    16 bytes of data
```

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.

: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

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: <table style="width: 100%; border: none;"> <tr> <td style="width: 60%;">:TRIG:COUN 4096</td> <td>Set pattern length (last bit) to 4096</td> </tr> <tr> <td>:DIG:PATT:PRES3 4,4096</td> <td>Set up CLOCK÷4 on STRB</td> </tr> <tr> <td>:DIG:PATT ON</td> <td>Switch on PATTERN mode</td> </tr> </table>	: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
: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.						

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.

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

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

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 <i>filename</i> in the current directory to a new file <i>copyname</i> . If <i>copyname</i> is the name of a sub-directory in the current directory, a copy of the file <i>filename</i> is made in the sub-directory. Use ".." as <i>copyname</i> 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 <i>filename</i> 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.
----------------	--

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

Command **:OUTP[1|2]**
Long :OUTPut[1|2][:NORMa1][: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]:COMPliment[: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[:INTerna1]
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 k Ω
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.

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

Example	:OUTP1:IMP 500HM	Set output 1 impedance to 500 Ω
	:OUTP2:IMP 10000HM	Set output 2 impedance to 1 k Ω

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 M Ω

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 47.60HM	Set load impedance at OUTPUT 1 to 47.6 Ω
	:OUTP2:IMP:EXT 1M OHMS	Set load impedance at OUTPUT 2 to 1 M Ω

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

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

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 :CURR1:OFF 50MA	Enable CURRENT subsystem Set output 1 offset to 50 mA

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	$\text{Amplitude} = \text{High} - \text{Low}$ $\text{Offset} = \frac{\text{High} - \text{Low}}{2}$	
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" : CURR1:HIGH 150MA	Enable CURRENT subsystem Set output 1 high-level to 150 mA

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 :CURR1:LOW 50 MA Enable CURRENT subsystem Set output 1 low-level to 50 mA

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

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

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.

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

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

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

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
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Specified limits	Consider the following limits for the individual output modules:
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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	[:SOURce]:PULSe:DOUBle[1 2]:DElay: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 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

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" :PULS:DOUB1:DEL 50	Set output 1 double-delay unit to % 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-duty-cycle or the pulse-trailing-edge delay is held constant when the pulse period is changed.	
Example	:PULS:DEL:HOLD1 TIME :PULS:DEL 20NS :PULS:HOLD1 DCYC :PULS:DCYC 25PCT	Hold output 1 delay fixed when frequency varies Set output 1 delay to 20ns Hold output 1 duty-cycle fixed when frequency varies Set output 1 duty-cycle to 25%

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 μ s
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

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 :PULS:PER:AUTO ONCE :PULS:PER?	Select ext CLK IN as pulse trigger Measure period at CLK IN 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 :PULS:DEL1:HOLD TIME :PULS:TDEL1 750NS	Set output 1 delay to 500 ns Hold output 1 delay constant with varying period Set output 1 trailing delay to 750 ns

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.	

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

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:		
Specified limits	Agilent 8111A	Agilent 81105A	Agilent 81112
	2.00 ns	3 ns	0.8 ns
Specified limits	Agilent 81104A with 81105A	Agilent 81110A with 81111A	Agilent 81110A with 81112A
	3 ns to 200 ms	2 ns to 200 ms	0.8 ns/1.6 ns fixed
			Agilent 8110A 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 :PULS:TRAN1:TRA:AUTO OFF :PULS:TRAN1:TRA: 15NS	Set output 1 leading edge to 3ns Enable independent setting of trailing edge Set output 1 trailing edge to 15 ns	

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[:LEVe1][: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.	

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

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"	Set external PLL reference (CLK IN)
	:ROSC:EXT:FREQ 10 MHZ	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	Set external PLL reference (CLK IN)
	:ROSC:EXT:FREQ 10MHZ	Set expected PLL reference frequency to 10 MHz

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

$$\begin{aligned} \text{High} &= \text{Offset} + \frac{\text{Amplitude}}{2} \\ \text{Low} &= \text{Offset} - \frac{\text{Amplitude}}{2} \end{aligned}$$

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

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

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	

$$\begin{aligned} \textit{Amplitude} &= \textit{High} - \textit{Low} \\ \textit{Offset} &= \frac{\textit{High} - \textit{Low}}{2} \end{aligned}$$

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

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

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 :VOLT1:LOW 500mV Enable VOLTAGE subsystem Set output 1 low-level to 500mV
---------	--

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 <i>not</i> limited by the output hardware, this is a software limit.	
Example	:HOLD VOLT :VOLT1:LIM 3V :VOLT1:LIM:STAT ON	Enable VOLTAGE subsystem Set output 1 high-level limit to 3 V 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 <i>not</i> limited by the output hardware, this is a software limit.	
Example	:HOLD VOLT :VOLT1:LIM:LOW 0V :VOLT1:LIM:STAT ON	Enable VOLTAGE subsystem Set output 1 Low-level voltage Switch on output 1 limits

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 <i>but the current and voltage limits are not enabled/disabled independently</i> . The voltage and current limits are always enabled/disabled together.	
Example	:HOLD VOLT :VOLT1:LIM 3V :VOLT1:LIM:LOW 0V :VOLT1:LIM:STAT ON	Enable VOLTAGE subsystem Set output 1 high level voltage limit to 3 V Set output 1 low-level voltage limit to 0V Switch on output 1 limits

Command	:STATus:OPERation
This command tree accesses the OPERation status group. <i>The OPERation status group is not used by the instrument. Therefore, this command tree is redundant.</i>	
• :STATus:OPERation[:EVENT]? • :STATus:OPERation:CONDition? • :STATus:OPERation:ENABle • :STATus:OPERation:NTRansition • :STATus:OPERation:PTRansition	

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

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.

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 <i>not</i> 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.
----------------	---

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	:SYST: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

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)

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 <i>only</i> 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.

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.

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.

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

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

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 k Ω	
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 500HM :TRIG:LEV 2.5V :TRIG:SOUR EXT2	Set CLK IN impedance to 50 Ω Set CLK IN threshold to 2.5V 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 500HM :TRIG:LEV 2.5V	Set CLK IN impedance to 50 Ω Set CLK IN threshold to 2.5 V

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								
	<table><tr><th>Pulse-period source</th><th>:TRIG:SOURce</th></tr><tr><td>internal osc.</td><td>IMMediate INTErnal[1]</td></tr><tr><td>internal PLL</td><td>INTErnal2</td></tr><tr><td>CLK IN</td><td>EXTErnal2</td></tr></table>	Pulse-period source	:TRIG:SOURce	internal osc.	IMMediate INTErnal[1]	internal PLL	INTErnal2	CLK IN	EXTErnal2
Pulse-period source	:TRIG:SOURce								
internal osc.	IMMediate INTErnal[1]								
internal PLL	INTErnal2								
CLK IN	EXTErnal2								

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.

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

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, $\pm 10\%$, 50–60 Hz;

100–120 Vac, $\pm 10\%$, 400 Hz

Power consumption: 300 VA max.

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.

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: $\pm 5\%$
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)

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:	$\pm 0.5\% \pm 250$ ps after selfcal, typical $\pm 3.0\% \pm 250$ ps w/o selfcal		$\pm 5\% \pm 250$ 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.

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.

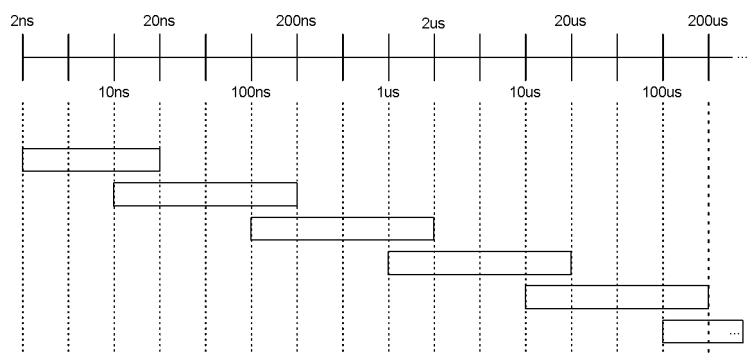
	Agilent 81112A	Agilent 81111A	Agilent 81105A
Double Pulse Delay range:	3.030 ns to 999.5 ms (width + 1.5 ns) to (period – width – 1.5 ns)	6.060 ns to 999.5 s (width + 3.03 ns) to (period – width – 3.03 ns)	12.50 ns to 999.5 s (width + 6.25 ns) to (period – width – 6.25 ns)
Accuracy:	± 0.5% ± 150 ps after 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)

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 $V_{pp} \leq 1V$ ≤ 900 ps for $V_{pp} > 1V$ 450 ps typical for $V_{pp} < 1V$ levels (20% to 80% of amplitude)	≤ 2.0 ns 1.4 ns typical for ECL levels (20% to 80% of amplitude)	≤ 3.0 ns n/a
	n/a	5 ns typical for 1 k Ω source impedance	
Accuracy:	n/a	$\pm 10\% \pm 200$ 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):



Level Specifications

	Agilent 81112A	Agilent 81111A	Agilent 81105A
Source impedance:	50 Ω	selectable 50 Ω or 1 k Ω $\pm$ 1% typical	
Maximum external voltage:	-2.2 V to + 5.5 V		$\pm$ 24 V
Short circuit current:	-84 mA to 152 mA		$\pm$ 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 $\neq$ to 50 Ω , 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	
	(50 Ω into 50 Ω)	(1k Ω into 50 Ω)
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	$\pm$ (1% Amplitude + 50 mV)	+ (1% Amplitude + 100 mV)
Agilent 81105A	$\pm$ (3% Amplitude + 75 mV)	$\pm$ (5% Amplitude + 150 mV)
Resolution:	10 mV	20 mV
Short Circuit Current	$\pm$ 400 mA max, (doubles for channel addition)	

^a in $\pm$ 19 V level window

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 chan- nel	20 ns typical on both chan- nels
Add fixed delay of second channel		2.5 ns

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.

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.

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 k Ω 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

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

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.

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

Typical Delays

Delay values are valid for Agilent 8110A with Agilent 8111A 10V/165 MHz outputs.

For Agilent 8112A 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

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.

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.

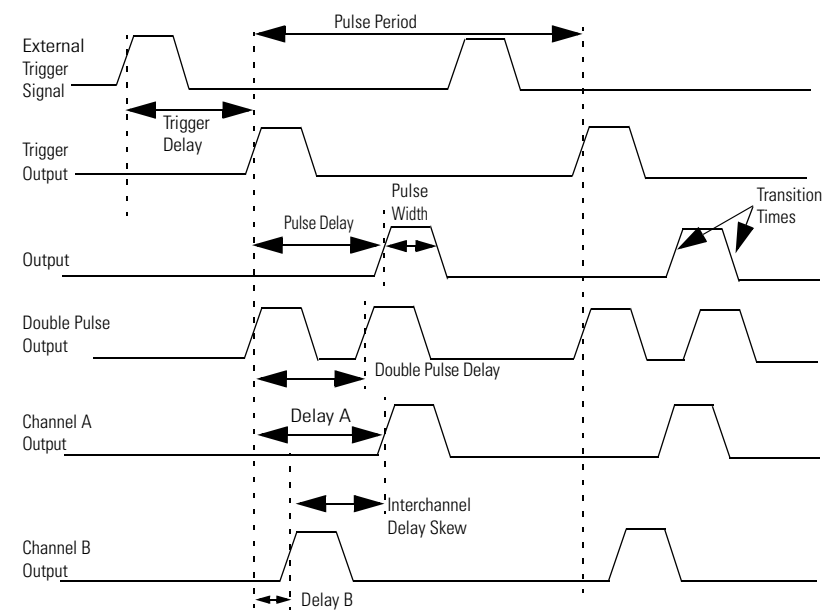
Programming times:

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

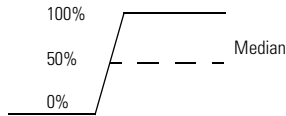
Pulse Parameter Definitions

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:



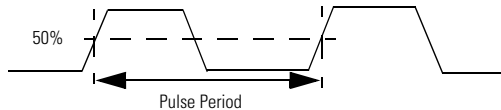
Time Reference Point

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:

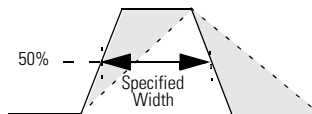


Trigger Delay

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:

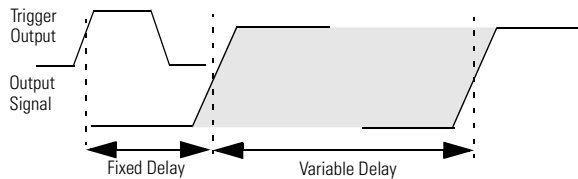


The specified and displayed value is that obtained with fastest edges, essentially equal to the interval from the start of the leading edge to the start of the trailing edge. By designing so that the pulse edges turn about their start points, the interval from leading edge start stays unchanged (in

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

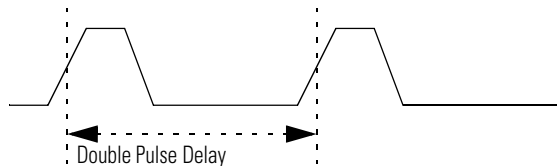
Interval between leading edge medians of trigger output pulse and output pulse:



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.

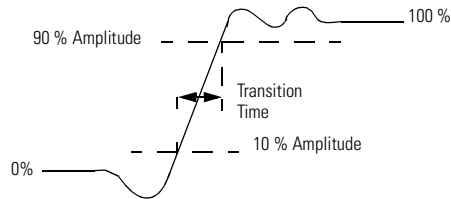


Interchannel Delay (Skew)

Interval between corresponding leading edge medians of the output signals.

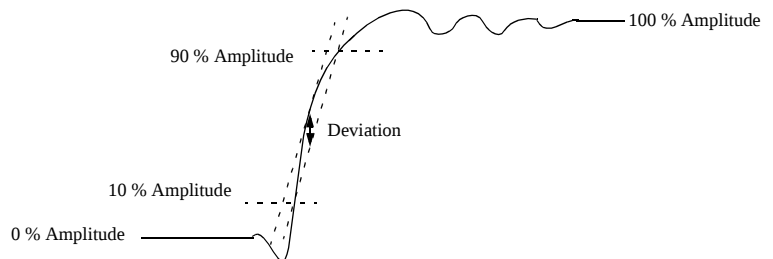
Transition Time

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:



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.

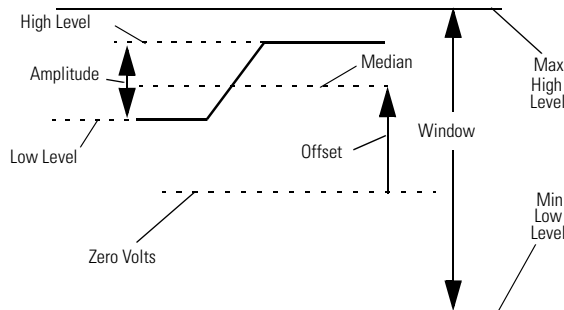
The reference edge for period jitter is the previous leading edge. That for delay jitter is the leading edge of the trigger output. Width jitter is the stability of the trailing edge with regard to the leading edge.

Stability

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

Pulse Levels

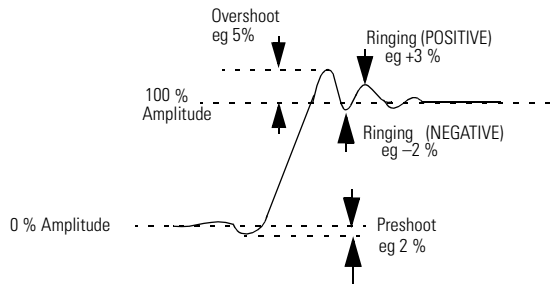
Pulse output is specified as pulse top and pulse base (usually referred to as high level and low level), or as peak to peak amplitude and median offset. A “window” specification shows the limits within which the pulse can be positioned.



Preshoot, Overshoot, Ringing

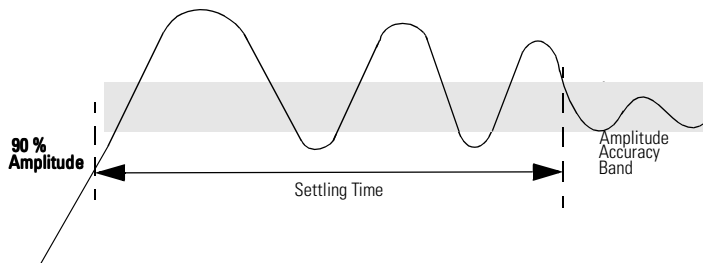
Preshoot and overshoot are peak distortions preceding/following an edge. Ringing is the positive-peak and negative-peak distortion, excluding overshoot, on pulse top or base. For example, a combined preshoot, overshoot, and ringing specification of 5% implies:

- Overshoot/undershoot $< 5\%$
- Largest pulse-top oscillation $< \pm 5\%$, of pulse amplitude.



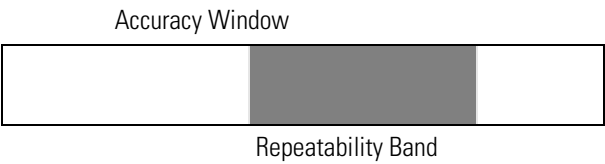
Settling Time

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



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.



Index

Symbols

% of Per 70, 71

A

Acoustic Noise Emission 104

Added at Output 1 48

Amplitude

definition 124

Amplitude current 61

Amplitude voltage 83

B

Burst

Length 97

Mode 97

BURST length 97

BURST mode 97

C

Certification

met specifications 5

Channel addition 48

Clear Error Queue 89

Clear Status 89

CLK IN Impedance 99

CLK IN slope 100

CLK IN Threshold 99

Common Commands 18

Condition Register 20

Configuration

Agilent 81104A 7

Agilent 81110A 7

standard 7

Continuous mode 48

Current Limits 66

D

Db1Del 72

Db1Del 73

Declaration

of Conformity 102

Default units 71, 74

Definition

double pulse 122

interchannel delay 122

jitter 124

Linearity 123

pulse delay 122

pulse levels 124

pulse parameters 120

pulse performance 125

pulse period 121

pulse width 121

repeatability 126

settling time 125

stability 124

time reference point 121

transition time 123

trigger delay 121

Delay 71

Delay% 70, 71

Dimensions 104

DIR 56

DISPLAY

ON/OFF 55

Double Pulse

definition 122

Double-delay 72, 73, 74

Double-pulses 72

Duty-cycle 69

E

Enable Register 21

Error Queue 92

Event Register 20

EXT INPUT Impedance 45

EXT INPUT Threshold 45

EXT WIDTH 44

EXT WIDTH mode 44

External Clock

specifications 113

F

Functional Coupling 43

G

Gated by 47, 48

Gated level 47

Gated mode 47, 48

General

Specifications 103

Index

Glitch-free timing changes
period 106

GP-IB
information 14

H

High Level
definition 124
High-level current 63
High-level current limit 65
High-level voltage 85
High-level voltage limit 87

I

Instrument Setting 96
Interchannel Delay
definition 122

J

Jitter
definition 124

K

Key-code Reference 94

L

Last Key Pressed 92
Leading Edge
definition 123
Leading edge 78
Linearity
definition 123
Load
File into memory 'n' 58
Load Impedance 60
Low Level
definition 124
Low-level current 64
Low-level current limit 65
Low-level voltage 86
Low-level voltage limit 87

M

Measure CLK IN frequency 67
Measure CLK IN period 76

Memory card

Catalog/DIR 56
Change directory 56
Copy file 57
Delete file 57
Initialize 57
Load from Form 57

Memory card Format 57

N

NRZ/RZ 55

O

Offset
definition 124
Offset current 62
Offset voltage 84
Operation Status 23
Options
Agilent 81110A 7
Options Agilent 81104A 7
Output complement 60
Output impedance 59
Output Modules
Agilent 81104A 7
Agilent 81110A 7
OUTPUT ON/OFF 59
Output polarity 60
Overshoot
definition 125

P

Pattern
Clock/n 53
Data 50
Length 97
Mode 54, 97
PRBS 52
Update 54
PATTERN length 97
PATTERN mode 97
Period
specification 105
Phase 68
PLL Frequency 44
PLL Period 46
PLL reference 82
PLL reference frequency 82
Power requirements 103

Index

- Preshoot
 - definition 125
- Programming
 - Burst mode 41
 - Continuous mode 40
 - EXT WIDTH mode 41
 - Gated mode 40
 - Pattern mode 42
 - Pulses mode 41
 - Triggered mode 40
- Pulse Delay
 - definition 122
- Pulse Frequency 66
- Pulse Levels
 - definition 124
- Pulse Parameter
 - definitions 120
- Pulse Performance
 - definition 125
- Pulse Period
 - definition 121
- Pulse Width
 - definition 121
- Pulse-period 75
- Pulse-period source 100
- Pulse-width 81
- Q**
- Questionable Status 24
- Questionable Status Group 90
- R**
- Range Coupling 43
- Reading the Error Queue 92
- Reading the Keyboard 92
- Recalibration period 104
- Repeatability
 - definition 126
- Reset 94
- Ringing
 - definition 125
- RZ/NRZ 55
- S**
- Safety
 - instructions 8
 - symbols 9
- SCPI
 - Command Dictionary 43
 - Version 96
- Seperate Channels 48
- Setting
 - load into memory 'n' 58
- Settling Time
 - definition 125
- Simulating Key-presses 92
- Single-pulses 72
- Skew
 - definition 122
- Specifications 101
 - CLK IN 112
 - delay 107
 - double pulse delay 107
 - external clock 113
 - external input 113
 - general 103
 - memory card 118
 - output modes 114
 - Period 105
 - PLL 112
 - PLL REF 112
 - pulse performance 111
 - pulse width 106
 - remote control 119
 - Strobe output 116
 - Timing 105
 - Timing (PLL) 112
 - transition times 108
 - Trigger modes 115
 - Trigger output 116
- Stability
 - definition 124
- Standard Event Status 22
- Status Byte 22
- Status Group
 - Questionable 90
- Status Groups 19
- Status Model 19
- Status Model Preset 89
- Store
 - from memory 'n' to file 58
- System Preset 94
- System Security 95
- T**
- Time Reference Point
 - definition 121
- Timing
 - specification 105

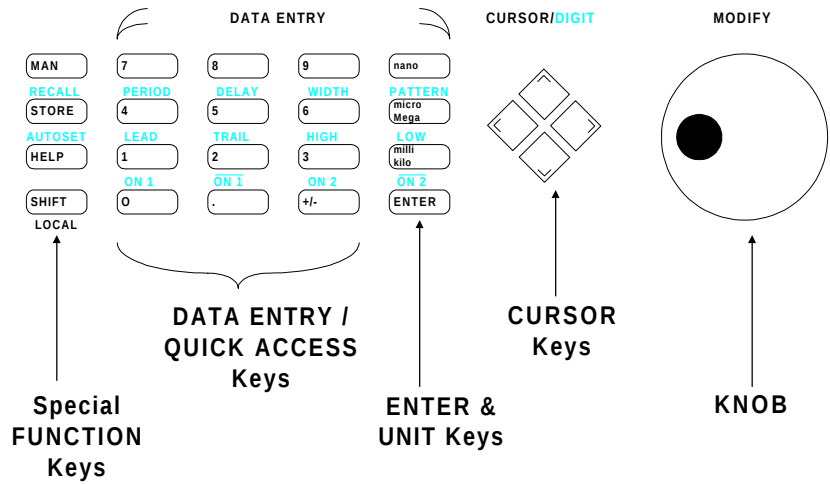
Index

- Trailing Edge
 - definition 123
- Trailing edge 79, 80
- Trailing edge delay 76
- Transition coupling 77
- Transition Filters 20
- Transition Time
 - definition 123
- Transition times 78, 79, 80
- Transition units 77
- Trigger Delay
 - definition 121
- TRIGGER OUT level 80
- Triggered
 - Frequency 44
 - Mode 47, 48
 - Period 46
 - Slope 47
- Triggered by 47, 48

- V**
- Value Coupling 43
- Voltage Limits 88

- W**
- Warnings 96
- Warranted Performance 101
- Warranty 104
- Weight 104

Front Panel Controls



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