# User Manual

# 3171

## WAVEFORM & DUAL OUTPUT PULSE GENERATOR

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### RACAL INSTRUMENTS


**Racal Instruments, Inc**.
4 Goodyear St., Irvine, CA 92618-2002
Tel: (800) RACAL-ATE, (800) 722-2528, (949) 859-8999; FAX: (949) 859-7139

**Racal Instruments, Ltd.**
480 Bath Road, Slough, Berkshire, SL1 6BE, United Kingdom
Tel: +44 (0) 1628 604455; FAX: +44 (0) 1628 662017

**Racal Systems Electronique S.A.**
18 Avenue Dutartre, 78150 LeChesnay, France
Tel: +33 (1) 3923 2222; FAX: +33 (1) 3923 2225

**Racal Systems Elettronica s.r.l.**
Strada 2-Palazzo C4, 20090 Milanofiori Assago, Milan, Italy
Tel: +39 (0)2 5750 1796; FAX +39 (0)2 5750 1828

**Racal Elektronik System GmbH.**
Technologiepark Bergisch Gladbach, Friedrich-Ebert-Strasse, D-51429 Bergisch Gladbach, Germany
Tel.: +49 2204 8442 00; FAX: +49 2204 8442 19

**Racal Australia Pty. Ltd.**
3 Powells Road, Brookvale, NSW 2100, Australia
Tel: +612 9936 7000, FAX: +612 9936 7036

**Racal Electronics Pte. Ltd.**
26 Ayer Rajah Crescent, 04-06/07 Ayer Rajah Industrial Estate, Singapore 0513.
Tel: +65 7792200, FAX: +65 7785400

**Racal Instruments, Ltd.**
Unit 5, 25F., Mega Trade Center, No 1, Mei Wan Road, Tsuen Wan, Hong Kong, PRC
Tel: +852 2405 5500, FAX: +852 2416 4335

**http://www.racalinstruments.com**




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| | | |
|---|---|---|
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| Telephone: | +1 800 722 3262 | (USA) |
| | +44(0) 8706 080134 | (UK) |
| | +852 2405 5500 | (Hong Kong) |
| Fax: | +1 949 859 7309 | (USA) |
| | +44(0) 1628 662017 | (UK) |
| | +852 2416 4335 | (Hong Kong) |

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Authorization is required from Racal Instruments before you send us your product for service or calibration. Call your nearest Racal Instruments support facility. A list is located on the last page of this manual. If you are unsure where to call, contact Racal Instruments, Inc. Customer Support Department in Irvine, California, USA at 1-800-722-3262 or 1-949-859-8999 or via fax at 1-949-859-7139. We can be reached at: helpdesk@racalinstruments.com.

## PROPRIETARY NOTICE

# FOR YOUR SAFETY

Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuit points.

Before operating this instrument:

1. Ensure the instrument is configured to operate on the voltage at the power source. See Installation Section.

2. Ensure the proper fuse is in place for the power source to operate.

3. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

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# TABLE OF CONTENTS

# MODEL 3171

## Getting Started


What's In this Chapter . . . . . 1-1
Introduction . . . . . 1-1
Auto Calibration . . . . . 1-2
(BIT) Built In Test . . . . . 1-2
Understanding The Model 3171 Software . . . . . 1-2
Understanding The Model 3171 Hardware . . . . . 1-5

Arbitrary Waveform Generator Signals . . . . . 1-5
External Modulation Input . . . . . 1-5
Trigger/Gate Input . . . . . 1-5
Main Output . . . . . 1-5
External Clock Input . . . . . 1-5
Sync Output . . . . . 1-7
Cursor Output . . . . . 1-7
Digital Pattern Outputs . . . . . 1-7
Pulse Generator Signals . . . . . 1-8
Pulse Generator 1 Output . . . . . 1-8
Gate Input . . . . . 1-8
Trigger Input . . . . . 1-8
Clkout Output . . . . . 1-8
Pulse Generator 2 Output . . . . . 1-8
Operating Modes: . . . . . 1-8
Continuous Mode Operation . . . . . 1-8
Burst: Mode Operation . . . . . 1-8
Triggered Mode Operation . . . . . 1-9
Gated Mode Operation . . . . . 1-9
Arbitrary Waveform Generator Functional Description . . . . . 1-9
ARB Clocking: . . . . . 1-10
External Clocking: . . . . . 1-10
Pulse Generators Functional Description . . . . . 1-10
VXIbus Interface . . . . . 1-11
Items Shipped With The 3171 . . . . . 1-12


## Configuring The Instrument


Installation Overview . . . . . 2-1
Unpacking and Initial Inspection . . . . . 2-1
Safety Precautions . . . . . 2-1
Long Term Storage or Repackaging For Shipment . . . . . 2-2
Preparation For Use . . . . . 2-2
Logical Address Selection . . . . . 2-3
Installation . . . . . 2-4
Installing The VXI*plug&play* Software . . . . . 2-4
Connecting To The Input/Output Connectors . . . . . 2-5
Arbitrary Waveform Generator Connector Reference . . . . . 2-6
Pulse Generator Connector Reference . . . . . 2-8

Status LED Reference . . . . . 2-9

## Using The Instrument

Overview . . . . . 3-1
Output Termination . . . . . 3-1
Output Protection . . . . . 3-1
Power On/Reset Defaults . . . . . 3-1
Initializing The Instrument . . . . . 3-2
Self Test . . . . . 3-2
Generating A Waveform . . . . . 3-2
Outputting A Waveform . . . . . 3-2
Triggering The Waveform Output . . . . . 3-2
What To Do Now . . . . . 3-3
Model 3171 Standard Commands for Programmable Instruments (SCPI) Commands . . . . . 3-3
SCPI Command Format . . . . . 3-3
Compound Command Separator . . . . . 3-4
Abbreviated Commands . . . . . 3-4
Optional Commands . . . . . 3-4
Numeric Suffixes . . . . . 3-4
Parameters . . . . . 3-5
Queries . . . . . 3-5
[SOURce<n>]:FUNCtion:SHAPe . . . . . 3-9
SOURce3:FUNCtion:POLarity . . . . . 3-9
SOURce3:FUNCtion:COUNt . . . . . 3-10
[SOURce<n>:VOLTage:MODE . . . . . 3-10
[SOURce<n>]:VOLTage[:LEVel][:IMMediate][:AMPLitude . . . . . 3-11
[SOURce<n>]:VOLTage[:LEVel]:TRIGgered[:AMPLitude] . . . . . 3-11
[SOURce<n>]:VOLTage[:LEVel]:TRIGgered:OFFSet . . . . . 3-12
SOURce3:VOLTage:REFerence:STATe . . . . . 3-12
[SOURce<n>]:FREQuency:MODE . . . . . 3-12
SOURce3:FREQuency[:CW] . . . . . 3-13
[SOURce<n>]:PULSe:PERiod . . . . . 3-13
[SOURce<n>]:PULSe:WIDTh . . . . . 3-14
[SOURce<n>]:PULSe:COUNt . . . . . 3-14
[SOURce<n>]:PULSe:POLarity . . . . . 3-14
[SOURce<n>]:PULSe:TRANsition[:LEADing] . . . . . 3-15
[SOURce<n>]:PULSe:TRANsition:TRAiling . . . . . 3-15
[SOURce<n>]:PULSe:TRANsition:STATe . . . . . 3-15
SOURce3:LIST:VOLTage . . . . . 3-16
SOURce3:LIST:REPeat . . . . . 3-16
SOURce3:LIST:COUNt . . . . . 3-16
SOURce3:LIST:GENeration . . . . . 3-17
SOURce3:LIST:SRATe . . . . . 3-17
SOURce3:AM:SOURce . . . . . 3-17
SOURce3:AM:STATe . . . . . 3-18
SOURce3:ROSCillator:SOURce . . . . . 3-18
OUTPut<n>:IMPedance . . . . . 3-18
OUTPut<n>:STATe . . . . . 3-19
OUTPut<n>:TTLTrg<y>:SOURce . . . . . 3-19
OUTPut<n>:TTLTrg<y>: STATe . . . . . 3-20
OUTPut3:FILTer[:LPASs]:FREQuency . . . . . 3-20
OUTPut3:FILTer[:LPASs]:STATe . . . . . 3-20

OUTPUT<n>:EXTernal:STATe . . . . . 3-21
TRIGger<n>[:SEQuence]:SOURce . . . . . 3-21
TRIGger<n>[:SEQuence]:SLOPe . . . . . 3-21
TRIGger<n>[:SEQuence]:DELay . . . . . 3-22
TRIGger<n>:GATE:SOURce . . . . . 3-22
TRIGger<n>:GATE:LEVel . . . . . 3-22
TRIGger<n>:GATE:DELay . . . . . 3-23
TRIGger<n>:GATE:STATe . . . . . 3-23
INITiate<n>:IMMediate . . . . . 3-23
CAlibration:ALL . . . . . 3-23
DIGital3:STIMulus:PATTern[:VALue] . . . . . 3-24
DIGital3:STIMulus:PATTern:REPeat . . . . . 3-24
DIGital3:TIMing:CLOCk . . . . . 3-24
DIGital3:COUNt . . . . . 3-25
SYSTem:ERRor? . . . . . 3-25
SYSTem:VERSion? . . . . . 3-25
SYSTem:PRESet<n> . . . . . 3-26
STATus:OPERation[:EVENt]? . . . . . 3-26
STATus:OPERation:CONDition? . . . . . 3-26
STATus:OPERation:ENABle <nrf> . . . . . 3-26
STATus:OPERation:ENABle? . . . . . 3-27
STATus:QUEStionable[EVENt]? . . . . . 3-27
STATus:QUEStionable:CONDition? . . . . . 3-27
STATus:QUEStionable:ENABle <nrf> . . . . . 3-27
STATus:QUEStionable:ENABle? . . . . . 3-27
STATus:PRESet . . . . . 3-28
SCPI Commands for Signal Types . . . . . 3-28
DC Signal SCPI Commands . . . . . 3-28
AC Signal SCPI Commands . . . . . 3-29
SQUARE WAVE Signal SCPI Commands . . . . . 3-30
TRIANGULAR WAVE Signal SCPI commands . . . . . 3-31
RAMP Signal SCPI Commands . . . . . 3-32
PULSED DC SCPI Commands . . . . . 3-33
ARBITRARY WAVEFORM SCPI Commands . . . . . 3-35
DIGITAL PATTERNS SCPI Commands . . . . . 3-36
IEEE 488.2 Standard Common Commands . . . . . 3-37
*CLS - Clear Status command . . . . . 3-37
*ESE - Standard Event Status Enable Command . . . . . 3-37
*ESE? - Standard Event Status Enable Query . . . . . 3-37
*ESR? - Standard Event Status Register Query . . . . . 3-37
*IDN? - Identification Query . . . . . 3-37
*RST - Reset Command . . . . . 3-37
*SRE - Service Request Enable Command . . . . . 3-37
*SRE? - Service Request Enable Query . . . . . 3-38
*STB - Read Status Byte Query . . . . . 3-38
*TST? - Self Test Query . . . . . 3-38
The SCPI Status Registers . . . . . 3-38
The Status Byte Register (STB) . . . . . 3-40
Reading the Status Byte Register . . . . . 3-40
Clearing the Status Byte Register . . . . . 3-40
Service Request Enable Register (SRE) . . . . . 3-41
Standard Event Status Register (ESR) . . . . . 3-41
Standard Event Status Enable Register (ESE) . . . . . 3-42
Error Messages . . . . . 3-43

## Performance Checks


Performance Checks . . . . . 4-1
Environmental Conditions . . . . . 4-1
Warn-Up Period . . . . . 4-1
Initial Instrument Setting . . . . . 4-1
Recommended Test Equipment . . . . . 4-1
Performance Check Procedures . . . . . 4-2
    Self-Test . . . . . 4-2
    Auto Calibration . . . . . 4-2
(J1-A7) Main Output . . . . . 4-3
    Frequency Accuracy . . . . . 4-3
    Amplitude Accuracy . . . . . 4-4
    DC Offset Characteristics . . . . . 4-5
(J2-A1) PG1OUT . . . . . 4-6
    Frequency & Pulse Width Accuracy . . . . . 4-6
    Amplitude Accuracy . . . . . 4-7
(J2-A5) PG2OUT . . . . . 4-8
    Frequency & Pulse Width Accuracy . . . . . 4-8
    Amplitude Accuracy . . . . . 4-9
    Trigger and Gate Characteristics . . . . . 4-9
        Triggered . . . . . 4-10
        Gated . . . . . 4-12


## Customer Support


Customer Support . . . . . 5-1
Reshipment Instructions . . . . . 5-1


## Support Offices


Support Offices . . . . . 6-1


## Appendix A


Model 3171 Specifications . . . . . A-1

## FIGURES

1-1 Model 3171 Firmware Block diagram . . . . . 1-4
1-2 Model 3171 Hardware Block Diagram . . . . . 1-6
2-1 VXI Logical Address Switch . . . . . 2-3
2-2 Model 3171 Front Panel . . . . . 2-10
3-1 SCPI Status Register . . . . . 3-39

## TABLES

2-1 Arbitrary Waveform Generator Connector Reference . . . . . 2-6
2-2 Pulse Generator Connector Reference . . . . . 2-8
2-3 Status LED Reference . . . . . 2-9
3-1 SCPI Command Quick Reference . . . . . 3-6

# 1

# Getting Started

## What's In This Chapter

This chapter contains a general description of the VXIbus Model 3171 Waveform & Dual Output Pulse Generator and an overall functional description of the instrument. It also describes the front panel connectors and indicators.

## Introduction

The Model 3171 is a single-slot VXI "C" size message based module capable of providing simultaneous Arbitrary Waveform Output and two (2) Pulse Generator outputs. The Model 3171 is a SCPI (Standard Commands for Programmable Instruments) controlled message-based instrument with *VXIplug&play* compatibility. The Model 3171 Arbitrary Waveform Generator Output is an Isolated (Floating) output that can be updated at a rate from 0.15Hz to 80MHz. The two pulse generator outputs can be independently programmed and are simultaneously available from 0.5Hz to 50MHz. The Pulse Generators can output pulses and DC levels as large as $22V_{p-p}$ into 50 Ω. The Arbitrary Waveform Generator can also be used to generate standard waveforms. Standard waveforms are provided for the following waveforms and frequencies:

| **Waveform** | **Frequency** |
|---|---|
| Sine wave | .001 Hz to 10 MHz |
| Triangle wave | .001 Hz to 10 MHz |
| Ramp wave | .001 Hz to 1 MHz |
| Square wave | .001 Hz to 10 MHz |
| Pulse DC | .001 Hz to 40 MHz |

The polarity of these output signals is programmable. Waveforms can be output in bursts from 1 to 65535 waveforms (or run continuously). The arbitrary waveform generator output uses digital techniques to produce user specified custom analog waveforms and DC levels for any voltage level between ± 11V. The shape of the waveform to be generated is defined by a sequence of numeric values loaded into the high speed waveform memory. Each successive memory location contains a value proportional to the amplitude of the waveform point to be generated. In addition, the waveform memory for the ARB is brought out as a 12-bit wide Digital Pattern Generator. The Digital Pattern Generator is output as TTL levels that can source or sink 15mA.

Both Pulse Generators and the Arbitrary Waveform Generator can be gated, triggered, or may generate a counted burst of waveforms or pulses. Both Pulse Generators and the Arbitrary Waveform Generator are triggerable allowing each output to be generated after a precise programmable delay. The delay from a trigger can be from 150ns to 1s with a resolution of 2ns and an ambiguity of less than 5ns. See Appendix A for complete specifications. The clock source for each generator is phase locked to the VXIbus 10MHz system (CLK10).

## Auto Calibration

The Model 3171 does not require manual adjustment in the field. There are no pots or adjustments on the unit that require periodic calibration. Auto Calibration is performed when commanded. Calibration factors are stored in an on-board EEPROM (Electrically Erasable and Programmable Read Only Memory). Amplitude values are measured by a 12-bit A/D with an accuracy of +/- 1-bit. Timing values are referenced to CLK10 on the VXI backplane. Auto Calibration requires less than 3s to perform. BIT should execute successfully prior to running Auto Calibration to prevent bad calibration factors from being generated. To provide the most accurate calibration factors, auto calibration should only be run after the unit has been powered on for a minimum of 30 minutes.

## (BIT) Built In Test

BIT is performed at power on and upon command. The Power on BIT is a subset of the commanded BIT due to the fact that power on BIT must execute in less than 5s for a VXI module. Commanded BIT detects 95% of all faults of the unit and executes in less than 30s. Because of Built in Test (BIT) and Auto Calibration, the Model 3171 is easy to maintain.

# Understanding The Model 3171 Software

The Model 3171 is a fully programmable instrument. There are two ways to program the Model 3171, the first being low level programming of each individual parameter. The second alternative is to use the *VXIplug&play* driver for high level programming. The *VXIplug&play* driver simulates a mechanical front panel with the necessary push buttons, displays and dials to operate the Model 3171 as a bench-top instrument. The Model 3171 will not operate without being programmed. Therefore, it is recommended that the user become familiar with its basic features, functions and programming concepts as described in this and the following paragraphs.

The Model 3171 is a message-based VXIbus instrument. The unit accepts two types of message based commands: Standard Commands for Programmable Instruments (SCPI) commands and IEEE 488.2 Common commands. The IEEE 488.2 Common commands perform functions such as reset, self-test, status byte query, identification, etc. The SCPI commands perform functions such as setting up the instrument, closing relays, triggering, querying instrument states and retrieving data.

**Figure 1** is a block diagram of the Model 3171 firmware. The Model 3171 firmware consists of four blocks of firmware that process the commands sent to the unit. These blocks are: I/O DRIVER, SCPI PARSER, EXECUTION CONTROL and DATA BUFFERS.

The I/O DRIVER firmware provides the interface with the VXIbus. The SCPI PARSER firmware parses the message-based commands received by the IO DRIVER and calls the EXECUTION CONTROL software. The EXECUTION CONTROL firmware processes the commands received and performs the action required. The DATA BUFFERS consist of the INPUT BUFFER, OUTPUT BUFFER, DATA QUEUE and ERROR QUEUE.

At power-up or when commanded to reset, the Model 3171 hardware and software is initialized to the following state:

- Hardware reset issued.
- Hardware output relays opened, disconnecting the ARB, PG1 and PG2 from their respective output pins.
- DC Offset programmed to 0.0V.
- Voltage Amplitudes programmed to 0.0V.
- Phase Lock Loops programmed to quiescent state.
- Calibration factors read from internal memory.
- Software variables initialized to default values.

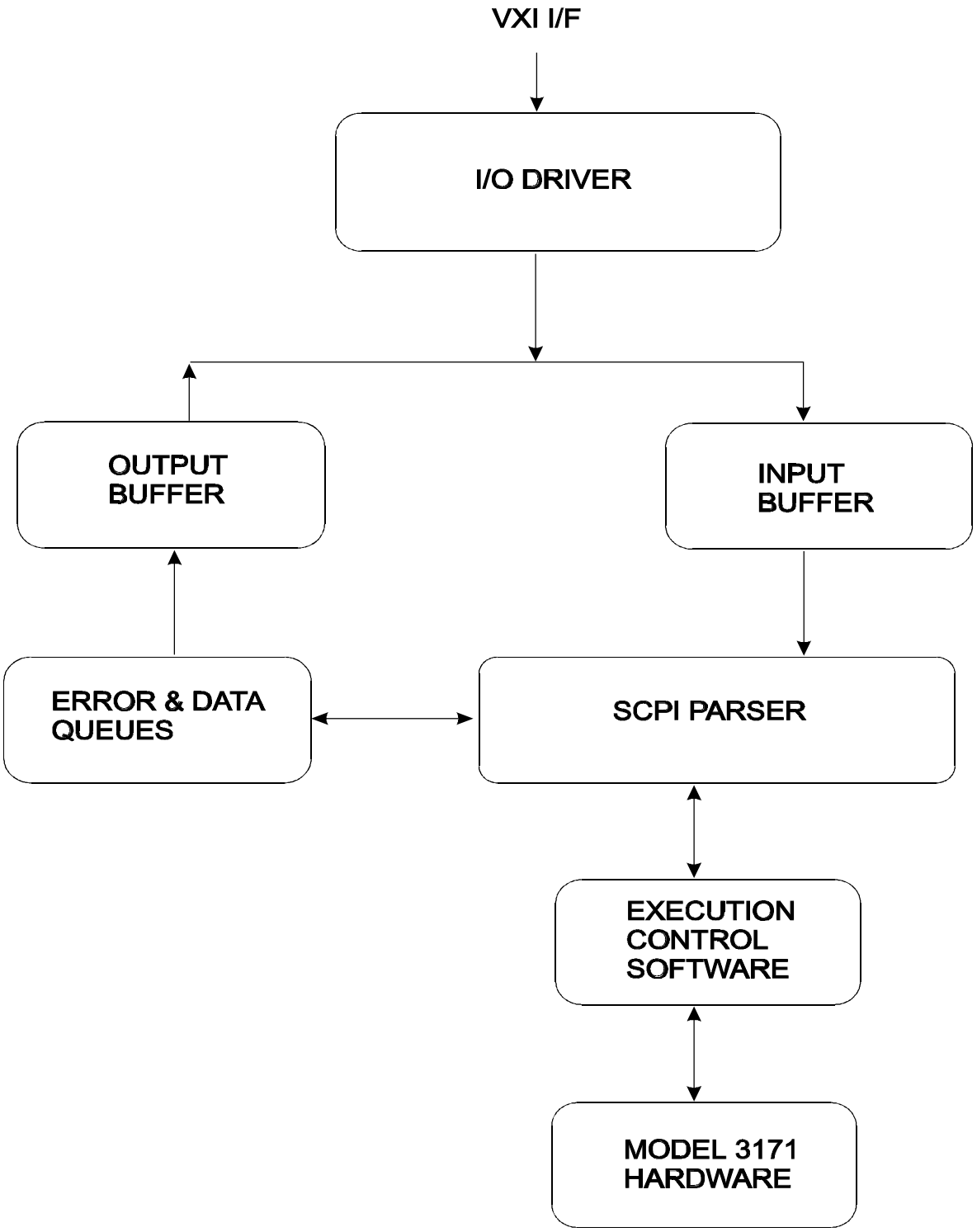


**Figure 1-1 Model 3171 Firmware Block Diagram**

# Understanding The Model 3171 Hardware

## Arbitrary Waveform Generator Signals

The following paragraphs describe each Arbitrary Waveform Generator input/output signals.

### External Modulation Input

The external Modulation coax input (J1-A1) provides the capability to externally amplitude modulate the Main Output signal. Standard Waveforms of sine, triangle, and ramp can be amplitude modulated.

### Trigger/Gate Input

The Trigger or Gate coax input (J1-A3) accepts signals that stimulate the Model 3171 to output waveforms on the Main Output. The trigger input is inactive when the instrument is in the continuous operating mode. When placed in trigger, gated or burst mode, the trigger input is made active and waits for the right condition to trigger the instrument. In trigger and burst modes, the trigger input is edge sensitive, i.e., it senses transitions from high to low or from low to high. The direction of the transition is programmable. The trigger input accepts TTL signals.

In gated mode this input is level sensitive, i.e., the Model 3171 is gated when the level is high and idle when the level is low. The active gating state is programmable.

### Main Output

The Main Output coax pin (J1-A7) provides standard and Arbitrary (coax pin) Waveforms. The output impedance of this output is selectable from <2 Ω, 50 Ω, or 93 Ω. The cable connected to this output should be terminated with a 50 or 93 Ω resistance. The output amplitude is specified when connected to a 50 Ω load. If the output is connected to a different load resistance, determine the actual amplitude from the resistance ratio of the internal output impedance to the load impedance

### External Clock Input

The External Clock input (J1-20) when enabled, accepts fixed level TTL signals in the range of DC to 40MHz. When enabled, the external clock input replaces the internal clock generator and the output waveform will begin generating waveforms with clock rates that are present at the external input. Do not confuse the clock frequency with the frequency of the waveform. The actual frequency of the output waveform depends on the number of points that are allocated for the waveform. For example, if the external clock is 10MHz and the number of points used to generate one cycle of a waveform is 1000, the output frequency is 10KHz (10MHz divided by the number of points).

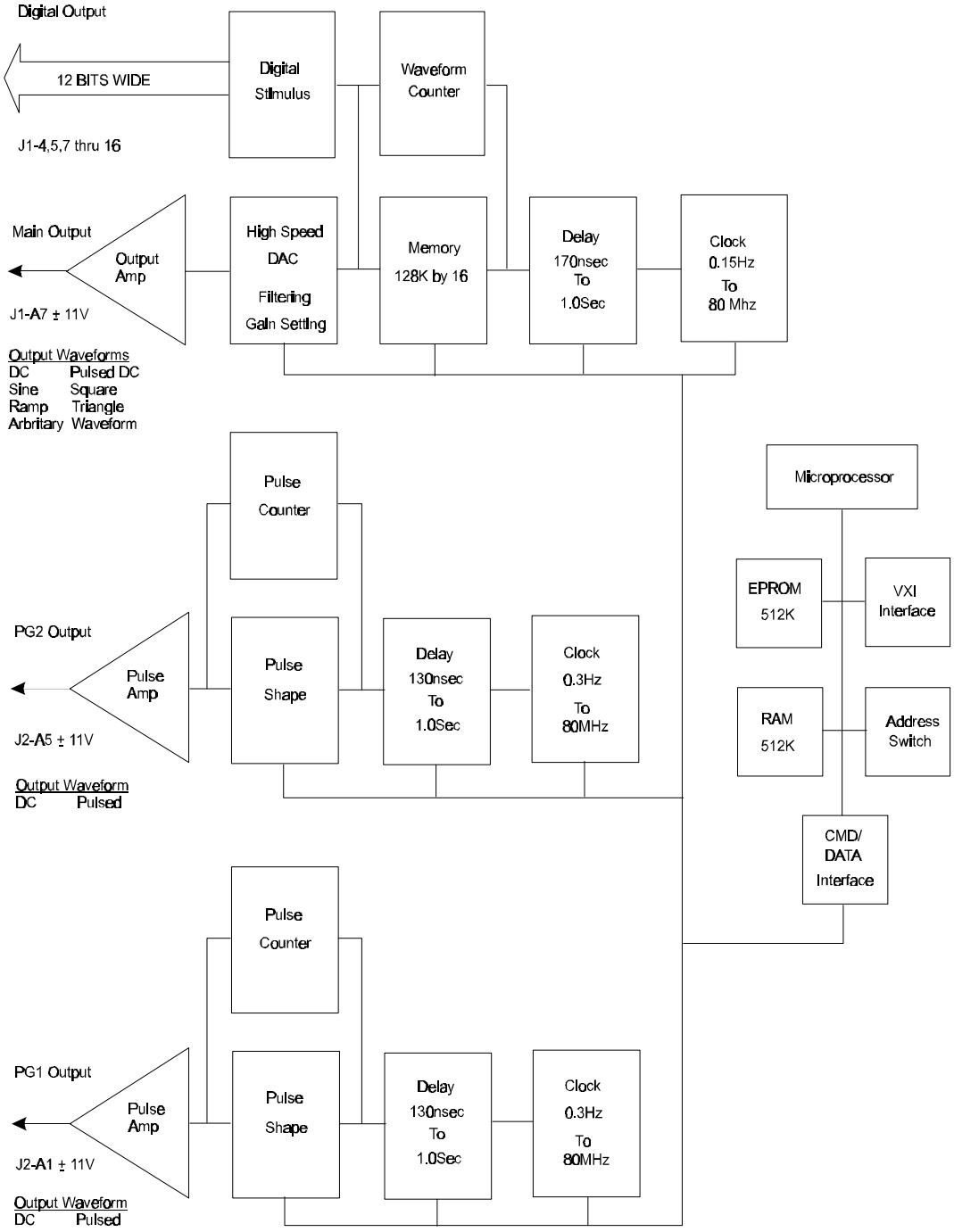


**Figure 1-2 Model 3171 Hardware Block Diagram**

**Sync Output**

The SYNC output (J1-4) generates a single TTL pulse for synchronizing other instruments (i.e., an oscilloscope) to the output waveform. The SYNC signal always appears at a fixed point relative to the waveform. The SYNC output generates a single point pulse for standard and arbitrary waveforms. The location of the SYNC signal is always the last location for standard and arbitrary waveforms. For digital patterns the SYNC output is controlled by bit M12 of the 16-bit digital word.

**Cursor Output**

The Cursor output (J1-5) is a TTL level signal used during digital pattern generation. Cursor out is controlled by bit M13 of the 16-bit digital word.

**Digital Pattern Outputs**

When enabled by the Digital Stimulus Pattern Command, the below listed pins output TTL levels at the programmed sample rate. Up to 4095 different digital patterns can be stored in the waveform memory. Any of the patterns can be loaded multiple times using the repeat list command. The maximum depth of the patterns is 128K patterns. When the Digital Pattern output pins are enabled the main output is disabled.

| Pin | Signal | Description |
|---|---|---|
| J1-7 | Dig0 | Controlled by M0 of the digital word. |
| J1-8 | Dig1 | Controlled by M1 of the digital word. |
| J1-9 | Dig2 | Controlled by M2 of the digital word. |
| J1-10 | Dig3 | Controlled by M3 of the digital word. |
| J1-11 | Dig4 | Controlled by M4 of the digital word. |
| J1-12 | Dig5 | Controlled by M5 of the digital word. |
| J1-13 | Dig6 | Controlled by M6 of the digital word. |
| J1-14 | Dig7 | Controlled by M7 of the digital word. |
| J1-15 | Dig8 | Controlled by M8 of the digital word. |
| J1-16 | Dig9 | Controlled by M9 of the digital word |

## Pulse Generator Signals

The Pulse Generator I/O signals are located on J2 Combination D-sub connector which consists of five coaxial pins. Refer to the description below of the signals and their functions.

### Pulse Generator 1 Output

The Pulse Generator 1 Output coax pin (J2-A1) provides Pulse and DC Waveforms. The output impedance is selectable from <2 Ω, 50 Ω, or 93 Ω. The cable connected to this output should be terminated with a 50 or 93 Ω resistance. The output amplitude is accurate when connected to a 50 Ω load. If the output is connected to a different load resistance, determine the actual amplitude by multiplying the amplitude setting by the resistance ratio of the internal output impedance to the load impedance.

### Gate Input

The Gate Input (J2-A2) accepts signals to gate Pulse Generator 1 or Pulse Generator 2. This input is inactive if either Pulse Gen 1 or Pulse Gen 2 is not in the Gate Mode. The Gate signal can be programmed to be active high or active low. The input gate signal is a TTL level signal. The input is pulled up to +5V through a 4.7K Ω resistor.

### Trigger Input

The Trigger input (J2-A3) accepts signals to trigger Pulse Generator 1 or Pulse Generator 2. This input is inactive if either Pulse Gen 1 or Pulse Gen 2 is not in the Trigger Mode. The Trigger signal can be programmed to be active on the rising or falling edge of the input signal. The input trigger signal is a TTL level signal. The input is pulled up to +5V through a 4.7K Ω resistor.

### Clkout Output

Clkout (J2-A4) is a fixed level TTL signal capable of driving a 50 Ω load. The Clkout signal is derived directly from either the Pulse Gen 1 or Pulse Gen 2 output.

### Pulse Generator 2 Output

The Pulse Generator 2 Output coax pin (J2-A5) provides Pulse and DC Waveforms. The output impedance is selectable from <2 Ω, 50 Ω or 93 Ω. The cable connected to this output should be terminated with a 50 or 93 Ω resistance. The output amplitude is accurate when connected to a 50 Ω load. If the output is connected to a different load resistance, determine the actual amplitude by multiplying the amplitude setting by the resistance ratio of the internal output impedance to the load impedance.

## Operating Modes

Both Pulse Generators and the Arbitrary Waveform Generator can be gated, triggered or may generate a counted burst of waveforms or pulses. Both Pulse Generators and the Arbitrary Waveform Generator are triggerable allowing each output to be generated after a precise programmable delay. See Appendix A for complete specifications. The clock source for each generator is phase locked to the VXI 10MHz system clock.

### Continuous Mode Operation

The Generator runs continuously at the selected frequency.

### Burst Mode Operation

Upon receipt of a trigger, the selected waveform is generated a programmable number of times, from 1 to 65535, following a programmable delay period. See Appendix A for specifications.

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### Triggered Mode Operation

In Triggered mode, each transition of the selected input trigger source stimulates the Model 3171 to generate a burst of a pre-selected number of waveform cycles after a programmable delay period.

### Gated Mode Operation

In the Gated mode, Model 3171 will continuously output a waveform when th gate signal is true at the selected input trigger. The last output cycle will be completed when the gate signal changes to a false state. The time delay between trigger input and waveform output is programmable up to 1 second. See Appendix A for specifications.

## Arbitrary Waveform Generator Functional Description

Refer to **Figure 1-2**. The Model 3171 Arbitrary Waveform Generator Main Output is an Isolated (Floating) output that can be updated at a rate from 0.15Hz to 80MHz. The isolated output allows the output to be floated up to 250V. It also allows low noise signals to be generated without being affected by ground loops from the unit under test. The amplitude of the ARB Output is +/- 11V into 50 Ω with 5.4mV resolution. The ARB uses a 12-bit High Speed DAC to provide 4095 points of vertical amplitude resolution. The output signal can be routed directly from the output amplifier with an impedance less than 2 Ω or can be output through a 50 Ω or 93 Ω resistor. This output impedance is selectable under program control.

Arbitrary waveforms are generated by loading a sequence of digital values into the high speed memory. This memory is 16-bits wide and 128K (131072) locations deep. A waveform can consist of any number of points from a minimum of (1) point to (131072) points. Twelve bits of the waveform memory are used to control the High Speed DAC. The other 4-bits are used as synchronization signals to the VXI trigger bus and as the Sync out and Cursor Out signals on the front panel. The other bit is used to provide a sync signal to an optional expansion card. Each successive memory location contains a digital value proportional to the amplitude of the waveform to be generated. A high resolution programmable time base is used to clock the memory address counter which accesses the next value to be output to the digital to analog converter (DAC). The DAC produces an analog equivalent to the digital value in the waveform memory thereby generating canned or complex arbitrary waveforms.

The output of the High Speed DAC is fed into a high speed analog multiplier to provide amplitude control of the canned waveforms. The Output of the multiplier is then fed into a selectable filter that can be set to no filter or to filters with cutoff frequencies of 22MHz, 2.2MHz, or 2MHz.

The waveform memory can also be output as a 12-bit wide digital pattern generator through TTL level drivers capable of sourcing and sinking 15mA per bit. A waveform counter allows the arbitrary waveform generator to output a burst of waveforms from 1 to 65535 or run continuously.

**Page Changed 4/22/98**

The Arbitrary waveform generator also contains a delay generator to generate a delay after the receipt of a trigger prior to starting the output waveform. This generates delays from 170ns to 1s with a resolution of 2ns or 0.01% of the programmed value. The delay is accurate to +/- 5ns and is independent of the sample rate of the ARB.

### ARB Clocking

The ARB clock is a synthesized clock source that is phase locked to the VXI 10MHz reference. It can be programmed from 40MHz to 80MHz with 4KHz resolution. The output of the clock source may be synchronized to an external trigger, the VXI TTLTRG Bus or a trigger from the onboard microprocessor.

The synchronized output can then be divided by a digital divide by N counter to provide sample rates for the arbitrary waveform generator of 0.15Hz to 80MHz with a resolution of 100ppm worst case.

### External Clocking

Output sample rate may be controlled by an external clock source. When external clocking is selected, the internal clock is bypassed and the waveform is generated using the external clock. Digital pattern outputs are updated on the rising edge of the external clock, analog levels are updated on the falling edge of the external clock.

## Pulse Generators Functional Description

Pulse generators 1 and 2 are two independent 50MHz Pulse Generators that are available simultaneously

Both Pulse Generators are capable of outputting pulses from 0.5Hz to 50MHz with voltage levels up to ± 11V. The pulse generators are identical except for programmable rise and fall time control. Pulse Generator #1 generates pulses with programmable rise and fall times from 5ns to 800µs in five (5) ranges. Pulse generator #2 generates pulses with programmable rise and fall times from 5ns to 40ns in one (1) range. The output pulse can be routed directly from the output amplifier with an impedance less than 2 Ω or can be output through a 50 Ω or 93 Ω resistor. This output impedance is selectable under program control. The output pulse can also be offset within the range of +/- 11V with a resolution of 5.4mV. Both Pulse generators can output DC levels or pulses of either polarity.

**Page Changed 8/3/98**

Each pulse generator consists of a synthesized clock source that is phase locked to the 10MHz VXIbus system clock and a divide by N digital divider that can divide down the clock source from 80MHz to 0.3Hz. Also included are a delay generator, a pulse shaper, a pulse counter to control bursts of pulses and an output amplifier. The delay generator can be positive or negative edge triggered by an external trigger or gate, the VXI TTLTRG bus or the on board microprocessor. The delay generator can generate delays from 120ns to 1s with a resolution of 2ns or 0.01% of the programmed delay, whichever is greater. The pulse shaper sets the pulse width and the rise and fall time for the pulse. Pulse widths can be programmed from 10ns to 1s with 2ns resolution or 0.01% of the programmed value, whichever is greater. The pulse counter allows the pulse generator to operate in a burst mode where N pulses can be generated each time the pulse generator is triggered. The number of pulses generated can be from 1 to 65535. The pulse counter can also be disabled to generate pulses continuously.

Both pulse generators can also be operated in a gate mode. In this mode the pulse generator will output pulses whenever the gate input is brought high and will stop the pulses when the gate input is brought low. If the generator is outputting a pulse while the gate input is brought low, the last complete pulse is outputed before the pulse generator stops. The pulse generator can be made to operate with either an active low or an active high gate signal.

## VXIbus Interface

The VXIbus Interface is provided by a microprocessor based Message-based Interface daughter card.

This card is 3.0 inches by 4.5 inches and is mounted on the Model 3171 Printed Wiring Board. This card contains a 68000 microprocessor, a VXIbus interface chip, 512K of RAM, 512K of EPROM and the associated buffers, decoders, and line drivers for interfacing to the VXIbus and the Model 3171. The control software for the Unit is resident in the EPROM. An address switch located on the Model 3171 PWB is read by the microprocessor to determine the logical address of the unit.

The address switch is located in the upper right side of the module and can be accessed through a cutout in the top cover. The address switch is a DIP switch with 8 individual switches in one package. Each switch corresponds to a bit of an 8-bit word. The switch can be set to any setting from 1 to 255. When a switch is pushed to the right the switch is open, indicating a logic high to the microprocessor. The least significant digit of the address switch is located at the top of the switch and the most significant digit is located at the bottom. When all 8 switches in the package are pushed to the right the switch is set to 255. In this switch configuration the slot zero (0) controller of the VXI chassis will dynamically configure the address for the Model 3171. For any other switch configuration the unit will be assigned the logical address set by the address switch.

## Items Shipped With The 3171

| Qty | Item | Racal Part Number | Vendor Part Number |
|---|---|---|---|
| 1 | User Manual (Disks included) | 980805 | - |
| 1 | VXI*plug&play* Software Driver (included with manual) | 921526 | - |
| 1 | LabVIEW Software Driver (included with manual) | 921398-044 | - |
| 1 | Backshell, Mating Connector for J2 | 602299-025 | ITT Cannon DB121073-51 |
| 1 | Backshell Mating Connector for J1 | 602299-050 | ITT Cannon DD121073-53 |
| 1 | J1 Mating Connector, 7 coax positions, 17 #20 AWG, solder cup signal positions | 602300-005 | ITT Cannon DDM24W7PK87 |
| 1 | J2 Mating Connector, 5 coax positions | 602300-024 | ITT Cannon DBM5W5PK87 |
| 12 | Coaxial Crimp Contacts for J1 & J2 Mating Connections. Use crimp tool ITT Cannon P/N 070051-0000 (not supplied) or equivalent. Mates with RG178B/U or RG196/U coax cable. | 602300-900 | ITT Cannon DM53740 |

# 2

# Configuring The Instrument

## Installation Overview

This chapter contains information and instructions necessary to prepare the Model 3171 for operation. Details are provided for initial inspection, grounding safety requirements, repacking instructions for storage or shipment, logical address selection and installation information.

## Unpacking and Initial Inspection

Unpacking and handling of the unit requires only normal precautions and procedures applicable to handling of sensitive electronic equipment. The contents of all shipping containers should be checked for included accessories and certified against the packing slip to determine that the shipment is complete.

## Safety Precautions

The following safety precautions should be observed before using this product and associated computer. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read the operating information carefully before using the product.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cables, connector jacks, or test fixtures. The American National Standard Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak or 60 VDC are present.

**WARNING**

**For maximum safety, do not touch the product, test cables, or any other instrument parts while power is applied to the circuit under test. ALWAYS remove power from the entire test system before connecting cables or jumpers, installing or removing cards from the computer, or making internal changes such as changing the module address.**

**Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always keep your hands dry while handling the instrument.**

The instrument has been inspected for mechanical and electrical performance before shipment from the factory. It is free of physical defects and in perfect electrical order. Check the instrument for damage in transit and perform the electrical procedures outlined in the section entitled **Unpacking and Initial Inspection**.

## Long Term Storage or Repackaging For Shipment

If the instrument is to be stored for a long period of time or shipped immediately, proceed as directed below. If you have any questions, contact your local Racal Instruments Representative or the Racal Instruments Customer Service Department.

1. Repack the instrument using the wrappings, packing material and accessories originally shipped with the unit. If the original container is not available, purchase replacement materials.
2. Be sure the carton is well-sealed with strong tape or metal straps.
3. Mark the carton with the model and serial number. If it is to be shipped, show sending and return address on two sides of the box.

---

**REMINDER**

**If the instrument is to be shipped to Racal Instruments for repair, attach a tag to the instrument identifying the owner. Note the problem, symptoms, and service or repair desired. Record the model and serial number of the instrument. Show the work authorization order as well as the date and method of shipment. ALWAYS OBTAIN A RETURN AUTHORIZATION NUMBER FROM THE FACTORY BEFORE SHIPPING THE INSTRUMENT TO RACAL INSTRUMENTS**

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## Preparation For Use

Preparation for use includes removing the Model 3171 from the container box, selecting the required logical address and installing the module in a VXIbus chassis.

## Logical Address Selection

The VXIbus Chassis Resource Manager identifies modules in the system by the module's address. VXIbus logical addresses can range from 0 to 255, however, addresses 1 to 254 **only** are reserved for VXIbus modules. Logical address 0 is reserved for the Resource Manager. Logical address 255 permits the Resource Manager to dynamically configure the module logical address.

To change the Model 3171's logical address, use the 8-position DIP switch accessible from the upper right side of the module near the rear end of the case. Refer to **Figure 2-1**. The address switch is a DIP switch with 8 individual switches in one package. Each switch corresponds to a bit of an 8-bit word. The switch can be set to any setting from 1 to 255. When a switch is set to the "1" position the switch is open indicating a logic high to the microprocessor. The least significant digit of the address switch is located at the top of the switch and the most significant digit is located at the bottom. When all 8 switches in the package are set to the "1" position the address is set to 255. In this switch configuration the slot 0 controller of the VXI chassis will dynamically configure the address for the Model 3171. For any other switch configuration the unit will be assigned the logical address set by the address switch.

Racal Instruments ships the Model 3171 with logical address 2.

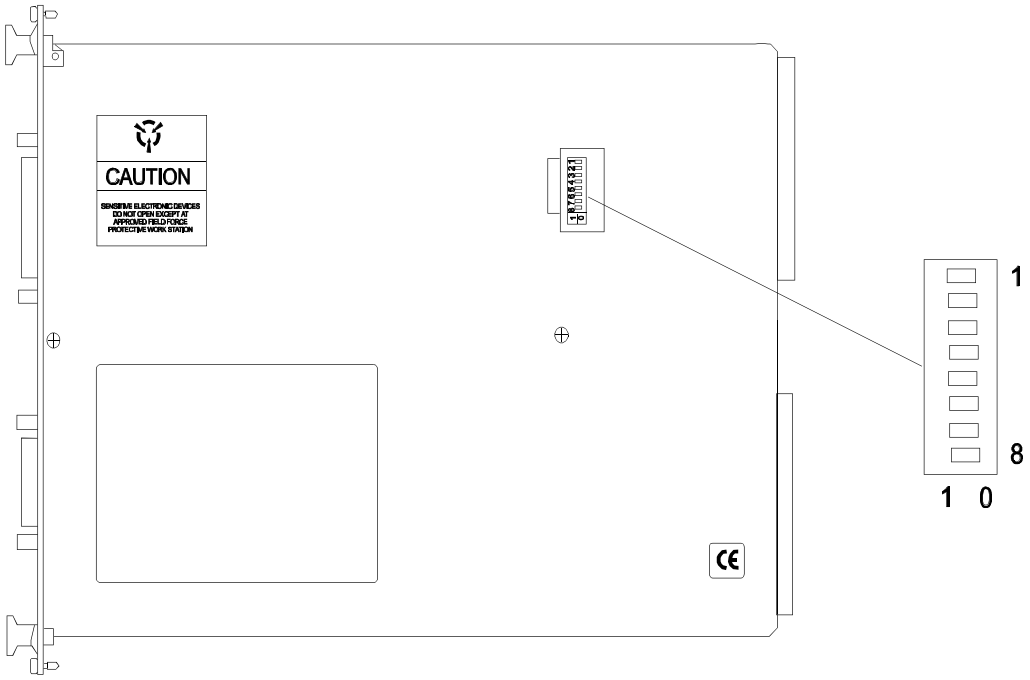



**Figure 2-1 VXI Logical Address Switch**

## Installation

The instrument can be installed in any slot except slot 0 in a VXIbus mainframe. When inserting the instrument into the mainframe, it should be gently rocked back and forth to seat the connectors into the backplane receptacle. The ejectors will be at right angles to the front panel when the instrument is properly seated into the backplane. Use two captive screws above and below the ejectors to secure the instrument into the chassis.

After installation, perform an initial checkout and operational verification.

## Installing The VXI*plug&play* Software

After the 3171 has been installed into the VXI mainframe, the VXI*plug&play* software may be used to communicate with the 3171. To install the software, first power on the mainframe, then perform the following operations:

1. Start Windows (3.1 or later) on your computer if it is not already running.

2. Insert the VXI*plug&play* installation disk #1 into the 3-1/2" floppy disk drive.

3. Run the SETUP program on the installation disk.

4. Follow the instructions presented by the SETUP program.

After the SETUP program has completed, the executable Soft Front Panel program may be run. To run the Soft Front Panel, ensure that the following conditions are met:

1. The host computer is connected to the VXIbus mainframe via a MXI/VXI interface or a GPIB/VXI interface, or the computer is an embedded VXIbus computer.

2. VISA is loaded on your system. VISA is a library of functions which provide communication between a computer and instruments (GPIB and VXI). VISA may be obtained from the manufacturer of the MXI/VXI, GPIB/VXI or embedded computer. The VISA DLL should be installed in the (Windows) system directory for Windows 3.1.

3. The mainframe has power applied and the power switch has been turned ON.

4. For the MXI/VXI and embedded computers, the VXI Init and resource manager program have been run since VXIbus mainframe power was last turned ON.

To run the Soft Front Panel, “double-click” on the “3171 Front Panel” icon in the “VXIPNP” Windows Group.

If the four conditions above are met, the Soft Front Panel program will automatically locate the 3171 in the VXIbus Mainframe. The Soft Front Panel program will display the VXIbus logical address of the 3171, and the “Active” LED on the Soft Front Panel will be green.

## Connecting To The Input/Output Connectors

The mating connectors, contacts, and backshells for the J1 and J2 connectors are supplied in the ship kit received with the Model 3171. Refer to **Tables 2-1, 2-2** and **Figure 2-2** for a description and pinout of the J1 and J2 connectors.

The crimp coax contacts accept RG178B/U or RG196/U coax cable. Use crimp tool ITT Cannon P/N 070051-0000 (not supplied) or equivalent to mate the coax contacts and cable.

The seventeen signal pins on the J1 connector are solder cup type and accept up to 20 AWG wire.

## Arbitrary Waveform Generator Connector Reference

The J1 Combination D connector consists of 7 coaxial pins and 17 signal pins. All inputs and outputs from the J1 connector are isolated from the chassis ground. All return shields for each coaxial pin are connected to isolated floating ground. Pin 1, pin 6, and pin 17 of the signal pins are also connected to the isolated floating ground. The housing of the J1 connector is connected to chassis ground. **Table 2-1** describes each coaxial and signal pin.

**Table 2-1 Arbitrary Waveform Generator Connector Reference**

| Pin | Signal | Description |
|---|---|---|
| J1-A1 | AM IN | External Modulation coax input when enabled provides capability to externally amplitude modulate the Main Output signal. Standard Waveforms of sine, triangle, and ramp can be amplitude modulated. |
| J1-A2,A4,A5,A6 | | Spares for future options |
| J1-A3 | Trig/Gate | Trigger or Gate coax input accepts signals that stimulate the Model 3171 to output waveforms on the Main Output. The trigger input is inactive when the instrument is in the continuous operating mode. When placed in trigger, gated or burst mode, the trigger input is made active and waits for the right condition to trigger the instrument. In trigger and burst modes, the trigger input is edge sensitive, i.e., it senses transitions from high to low or from low to high. The direction of the transition is programmable. The trigger input accepts fixed level TTL signals. In gated mode, this input is level sensitive, i.e., the Model 3171 is gated when the level is high and idle when the level is low. The active gating state is programmable. |
| J1-A7 | Main Output | The Main Output coax pin provides standard and arbitrary waveforms. The output impedance of this output is selectable from <2 Ω, 50 Ω, or 93 Ω. The cable connected to this output should be terminated with a 50 or 93 Ω resistance. The output amplitude is specified when connected to a 50 Ω load. If the output is connected to a different load resistance, determine the actual amplitude from the resistance ratio of the internal output impedance to the load impedance. |
| J1-1,6,17 | | Isolated Ground pins |
| J1-2 | Ext Clk Input | External Clock input when enabled, accepts fixed level TTL signals in the range of DC to 40MHz. When enabled, the external clock input replaces the internal clock generator and the output waveform will begin generating waveforms with clock rates that are present at the external input. Do not confuse the clock frequency with the frequency of the waveform. The actual frequency of the output waveform depends on the number of points that are allocated for the waveform. For example, if the external clock is 10MHz and the number of points used to generate one cycle of a waveform is 1000, the output frequency will be 10KHz (10MHz divided by the number of points). |

**Table 2-1 Arbitrary Waveform Generator Connector Reference**

| Pin | Signal | Description |
|---|---|---|
| J1-3 | | Spare for future option |
| J1-4 | Sync Out | The SYNC output generates a single TTL pulse for synchronizing other instruments (i.e., an oscilloscope) to the output waveform. The SYNC signal always appears at a fixed point relative to the waveform. The SYNC output generates a single point pulse for standard and arbitrary waveforms. The location of the SYNC signal is always the last location for standard and arbitrary waveforms. For digital patterns the SYNC output is controlled by bit M12 of the 16- bit digital word. |
| J1-5 | Cursor Out | The Cursor output is a TTL level signal used during digital pattern generation. Cursor out is controlled by bit M13 of the16-bit digital word. |
| J1-7 thru J1-16 | Digital Pattern Output Signals | When enabled by the Digital Stimulus Pattern Command, the following pins output TTL levels at the programmed sample rate. Up to 4095 different digital patterns can be stored in the waveform memory. Any of the patterns can be loaded multiple times using the repeat list command. The maximum depth of the patterns is 128K patterns. When the Digital Pattern output pins are enabled the main out is disabled. |
| J1-7 | Dig0 | Controlled by M0 of the digital word. |
| J1-8 | Dig1 | Controlled by M1 of the digital word. |
| J1-9 | Dig2 | Controlled by M2 of the digital word. |
| J1-10 | Dig3 | Controlled by M3 of the digital word. |
| J1-11 | Dig4 | Controlled by M4 of the digital word. |
| J1-12 | Dig5 | Controlled by M5 of the digital word. |
| J1-13 | Dig6 | Controlled by M6 of the digital word. |
| J1-14 | Dig7 | Controlled by M7 of the digital word. |
| J1-15 | Dig8 | Controlled by M8 of the digital word. |
| J1-16 | Dig9 | Controlled by M9 of the digital word. |

## Pulse Generator Connector Reference

The J2 Combination D connector consists of five coaxial pins. All coaxial shields in the J2 connector are tied to chassis ground.

Refer to **Table 2-2** for a description of each coax pin.

**Table 2-2 Pulse Generator Connector Reference**

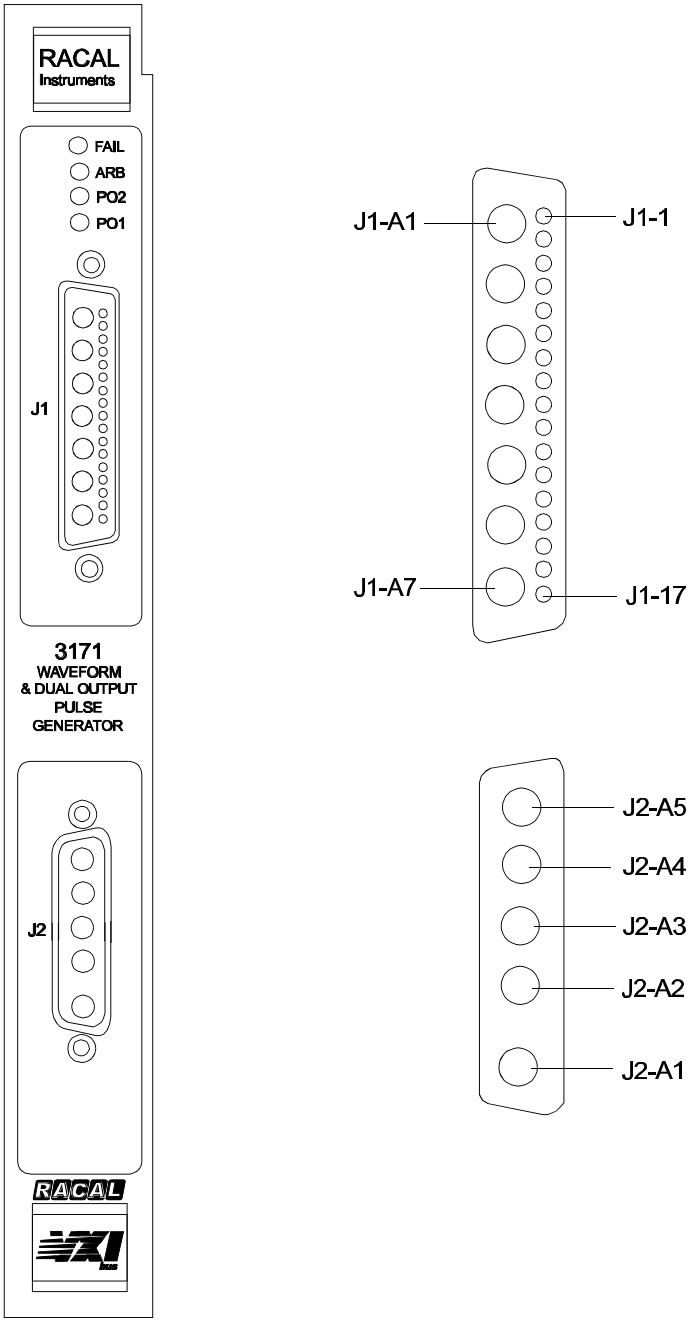
| Pin | Signal | Description |
|---|---|---|
| J2-A1 | PG1OUT | Pulse Generator 1 Output coax pin provides Pulse and DC Waveforms. The output impedance is selectable from <2 Ω, 50 Ω, or 93 Ω. The cable connected to this output should be terminated with a 50 or 93 Ω resistance. The output amplitude is accurate when connected to a 50 Ω load. If the output is connected to a different load resistance, determine the actual amplitude by multiplying the amplitude setting by the resistance ratio of the internal output impedance to the load impedance. |
| J2-A2 | GATE | Gate Input accepts signals to gate Pulse Generator 1 or Pulse Generator 2. This input is inactive if either Pulse Generator 1 or Pulse Generator 2 is not in the Gate Mode. The Gate signal can be programmed to be active high or active low. The input gate signal is a TTL level signal. The input is pulled up to +5V through a 4.7K Ω resistor. |
| J2-A3 | TRIGIN | Trigger input accepts signals to trigger Pulse Generator 1 or Pulse Generator 2. This input is inactive if either Pulse Generator 1 or Pulse Generator 2 is not in the Trigger Mode. The Trigger signal can be programmed to be active on the rising or falling edge of the input signal. The input trigger signal is a TTL level signal. The input is pulled up to +5V through a 4.7K Ω resistor. |
| J2-A4 | CLKOUT | Clkout is a fixed level TTL signal capable of driving a 50 Ω load. The Clkout signal is derived directly from either the Pulse Generator 1 or Pulse Generator 2 output. |
| J2-A5 | PG2OUT | Pulse Generator 2 Output coax pin provides Pulse and DC Waveforms. The output impedance is selectable from <2 Ω, 50 Ω, or 93 Ω. The cable connected to this output should be terminated with a 50 or 93 Ω resistance. The output amplitude is accurate when connected to a 50 Ω load. If the output is connected to a different load resistance, determine the actual amplitude by multiplying the amplitude setting by the resistance ratio of the internal output impedance to the load impedance |

## Status LED Reference

Refer to **Table 2-3** for a description of the front panel status LED's.

**Table 2-3 Status LED Reference**

| Color | LED Indicator | Description |
|---|---|---|
| Red | FAIL | This indicator illuminates red when the VXI backplane signal SYSFAIL* is asserted (low). The 3171 asserts this signal during the power-on-self-test that occurs during the first 5 seconds after power is applied to the system. |
| Green | ARB | ARB LED illuminates when the Arbitrary Waveform Generator output is on. |
| Green | PG2 | PG2 LED illuminates when the Pulse Generator 2 output is on. |
| Green | PG1 | PG1 LED illuminates when the Pulse Generator 1 output is on. |




**Revised May 26, 2000**

**Figure 2-2 Model 3171 Front Panel**

# 3

# Using The Instrument

## Overview

This chapter contains information about how to operate the Model 3171. Unlike bench-type instruments, the Model 3171 must be programmed to turn on functions, change parameters and configure various operating modes. The instrument is programmed using a set of SCPI commands. A list of SCPI commands and their operation is described in this chapter. Also provided are a list of SCPI Commands for each signal type with examples on how to program the Model 3171.

## Output Termination

During use, output connectors must be properly terminated to minimize signal reflection or power loss due to an impedance mismatch. Proper termination is also required for an accurate amplitude level at the each output connector. Use 50 S cables and terminate with terminating resistors at the far end of the cables

## Output Protection

The Model 3171 provides protection for internal circuitry connected to the output connectors. Refer to the specifications in Appendix A to determine the level of protection associated with each output connector.

## Power On/Reset Defaults

At power on, or, as a result of a software reset, the Model 3171 defaults to the conditions shown below:

Hardware reset issued.

Hardware output relays open disconnecting the ARB, PG1 and PG2 from their respective output pins.

DC Offset programmed to 0.0V.

Voltage Amplitudes programmed to 0.0V.

Phase Lock Loops programmed to quiescent state.

Calibration factors read from internal memory.

Software variables initialized to default values.

Refer to section **Model 3171 SCPI Commands** and the **SCPI Commands For Signal types,** below for a software description of the Model 3171 and SCPI command examples.

## Initializing The Instrument

The IEEE-488.2 *RST command resets the instrument hardware and firmware to its power on/reset default state.

Syntax: *RST

The IEEE-488.2 *CLS command may be used to clear the instrument. when the *CLS command is received the instrument clears the SCPI and IEEE-488.2 defined status event registers, and empties all queues except the output queue.

Syntax: *CLS

## Self-Test

The IEEE-488.2 *TST? query causes an internal self-test to be executed and places a response in the output queue. A value of “0” indicates that the self-test passed. A non-zero value indicates that the self-test has failed.

Syntax: *TST?

Consult the Self-test section of the Performance Check Procedures for additional information on self-test.

## Generating a Waveform

The 3171 generates waveforms when it receives the SCPI “SOURce<n>” commands.

Example: To generate a 10 Hz square wave with a 1V amplitude using the Arbitrary Waveform Generator (n=3), send the following commands:

```
*RST
:SOUR3:FUNC:SHAP SQU
:SOUR3:VOLT:TRIG 1
:SOUR3:FREQ 10
```

## Outputting a Waveform

The 3171 connects the instrument (PG1, PG2 or Arbitrary Waveform Generator) to the respective output pin when the OUTPut<n>:STATe ON command is received.

Example: To connect the 10Hz square wave from the above example to the output pin (J1-A7) for use in a 50S system send the following:

```
:OUTP3:IMP 50
:OUTP3:STAT ON
```

## Triggering the Waveform Output

The 3171 is programmed to trigger the output of waveforms using the TRIGger<n> commands:

Example: To software trigger the 10Hz square wave Arbitrary Waveform Generator output from the above example send the following command.

```
:TRIG3:SOUR:IMM
:INIT3:IMM
```

When software triggering is selected the INITiate <n> IMMediate command is the trigger event.

Example: To trigger the Arbitrary Waveform Generator on the negative edge of the VXI TTLTrg7 backplane signal with a 1ms delay, send the following:

```
:TRIG3:SEQ:SLOP:NEG
:TRIG3:SEQ:DEL 1E-3
:TRIG3:SEQ:SOUR:TTLT7
```

## What To Do Now

To write low level code to operate the Model 3171, follow the instructions and examples in this chapter to understand the meaning and response that each command may generate.

Further examples are embedded in the SCPI command definitions below in this chapter.

Refer to the section **SCPI Commands For Signal Types**, later in this chapter for the SCPI commands and recommended sequences for generating specific waveform shapes, (e.g., square waves, sine waves, etc).

## Model 3171 Standard Commands for Programmable Instruments (SCPI) Commands

### SCPI Command Format

The SCPI command structure is a hierarchical structure also know as a tree structure that consists of a top level (or root) command, one or more lower level commands, and their parameters. The following example shows part of a typical subsystem :

```
[SOURce<n>]
    :FUNCtion
        :SHAPe DC | SINusoid | SQUare | TRIangular | RAMP |
        PULSe | USER | DIGital
        :SHAPe?
    :VOLTage
        :MODE FIXed | LIST
        [:LEVel]
            :TRIGgered
                [:AMPLitude] <numeric value>
```

SOURce is the root command, :FUNCtion and :VOLTage are a second level, :SHAPe, :LEVel and MODE are a third level, :TRIGgered is a fourth level and [:AMPLitude] is a fifth level command. Commands :SHAPe,:MODE and [:AMPLitude] have parameters.

## Compound Command Separator

A colon (:) always separates one command from the next level command in a command as shown below:

```
SOURce:VOLTage:MODE FIXed
```

Colons separate the root command from the second level command (SOURce:VOLTage) and the second level from the third level (VOLTage:MODE).

## Abbreviated Commands

The command syntax show most commands as a combination of upper and lower case letters. The upper case letters indicate the abbreviated or short form for the command. Upper case and lower case (the whole keyword) indicate the long form of the command.

For example, if the command syntax shows VOLTage, then VOLT and VOLTAGE are both acceptable forms. Other forms of VOLTage, such as VOLTA will generate an error

## Optional Commands

Square brackets ([]) are used to enclose a keyword that is optional when programming the command; that is, the instrument does the same thing whether the option node is omitted by the programmer or not. Such a node is called a default node.

For example:

```
[SOURce<n>]
   :FUNCtion
        :SHAPe DC | SINusoid | SQUare | TRIangular | RAMP | PULSe
          | USER
```

The root command SOURce is an optional command. SOURce:FUNCtion:SHAPe DC and FUNCtion:SHAPe DC will both result in the function being set to DC Signal.

The braces ({}), or curly brackets, are used to enclose one or more parameters that may be included zero or more times.

The vertical bar (|) can be read as "or" and is used to separate alternative parameter options.

## Numeric Suffixes

Some commands allow numeric suffices, which are used to identify which sub-instrument of the Model 3171 is being programmed. The Model 3171 is one instrument module but contains three separate instruments; Pulse Generator 1 (PG1), Pulse Generator 2 (PG2) and Arbitrary Waveform Generator (ARB). Commands like the [SOURce<n>] allow a numeric suffix. The default numeric suffix is 1.

| Command | Instrument |
|---|---|
| SOURce1 | Pulse Generator 1 |
| SOURce2 | Pulse Generator 2 |
| SOURce3 | Arbitrary Waveform Generator |

## Parameters

<numeric value>: decimal representation of a number including optional signs.

{,<numeric value>} : zero or more decimal numbers.

Discrete value: mnemonic parameters (character strings) used to represent a valid setting. For example DC, SINusoid, SQUare, FIXed, NORMal, etc.

Boolean Program Data: ON (1) or OFF (0)

## Queries

The query form of a command is generated by appending a question mark to the last keyword. All commands, unless otherwise noted, have an additional query form.
For example SOURce1:FUNCtion:SHAPe DC would set the function for Pulse Generator 1 to DC Signal.
The SCPI command SOURce1:FUNCtion:SHAPe? would return the result of what the function was previously set to, or DC for the above shape setting.

**Table 3-1 SCPI Command Quick Reference**

| SCPI Command | Default Parameter Values | Instrument | | |
|---|---|---|---|---|
| | | PG1 | PG2 | ARB |
| | | n=1 | n=2 | n=3 |
| [SOURce<n>] | | | | |
| :FUNCtion | | | | |
| :SHAPe | DC | | | x |
| DC | | x | x | x |
| SINusoid | | | | x |
| SQUare | | | | x |
| TRIangular | | | | x |
| RAMP | | | | x |
| PULSe | | x | x | x |
| USER | | | | x |
| DIGital | | | | x |
| :POLarity NORMal \| INVerted | NORM | | | x |
| :COUNt <numeric value> | 1 | | | x |
| :VOLTage | | | | |
| :MODE | FIX | | | |
| FIXed | | x | x | x |
| LIST | | | | x |
| [:LEVel] | | | | |
| [:IMMediate] | | | | |
| [:AMPLitude] <numeric value> | 0.00 | x | x | x |
| :TRIGgered | | | | |
| [:AMPLitude] <numeric value> | 0.00 | x | x | x |
| :OFFSet <numeric value> | 0.00 | x | x | x |
| :REFerence | | | | |
| :STATe ON \| OFF | OFF | | | x |
| :FREQuency | | | | |
| :MODE CW | CW | x | x | x |
| [:CW] <numeric value> | +1.00000e+03 | | | x |
| :PULSe | | | | |
| :PERiod <numeric value> | +1.25000e-08 | x | x | x |
| :WIDTh <numeric value> | +1.00000e-08 | x | x | x |
| :COUNt <numeric value> | 1 | x | x | x |
| :POLarity NORMal \| INVerted | NORM | x | x | x |
| :TRANsition | | | | |
| [:LEADing] <numeric value> | +5.00000e-09 | x | x | |
| :TRAiling <numeric value> | +5.00000e-09 | x | x | |

**Page Changed 8/3/98**

**Table 3-1 SCPI Command Quick Reference**

| SCPI Command | Default Parameter Values | Instrument | | |
|---|---|---|---|---|
| | | PG1 | PG2 | ARB |
| | | n=1 | n=2 | n=3 |
| :STATe ON \| OFF | Not Implemented | x | x | |
| :LIST | | | | |
| :VOLTage <numeric value> {,<numeric value>} | No Reset Value | | | x |
| :REPeat <numeric value> {,<numeric value>} | No Reset Value | | | x |
| :COUNt <numeric value> | 1 | | | x |
| :GENeration DSEQuence | DSEQ | | | x |
| :SRATe <numeric value> | No Reset Value | | | x |
| :AM | | | | |
| :SOURce EXTernal | INT | | | x |
| :STATe ON*OFF | OFF | | | x |
| :ROSCillator:SOURce INTernal*EXTernal | OFF | | | x |
| | | | | |
| OUTPut <n> | | | | |
| :IMPedance 0 \| 50 \| 93 | 0 | x | x | x |
| [:STATe] ON \| OFF | OFF | x | x | x |
| :TTLTrg<y> | | | | |
| :SOURce INT<z> | INT2 | x | x | x |
| :STATe ON \| OFF | OFF | x | x | x |
| :FILTer | | | | |
| [:LPASs] | | | | |
| :FREQuency <numeric value> | 22.0e6 | | | x |
| :STATe ON \| OFF | OFF | | | x |
| :EXTernal | | | | |
| :STATe ON*OFF | OFF | x | x | |
| | | | | |
| TRIGger<n> | | | | |
| [:SEQuence] | | | | |
| :SOURce EXTernal \| TTLTrg<y> \| IMMediate | IMM | x | x | x |
| :SLOPe POSitive \| NEGative | POS | x | x | x |
| :DELay <numeric value> | +1.00000e-08 | x | x | x |
| :GATE | | | | |
| :SOURce TTLTrg<y> | TTLT8 | x | x | x |
| :LEVel HIGH*LOW | HIGH | x | x | x |
| :DELay <numeric value> | -2.01e+153 | x | x | x |

**Table 3-1 SCPI Command Quick Reference**

| SCPI Command | Default Parameter Values | Instrument | | |
|---|---|---|---|---|
| | | PG1 | PG2 | ARB |
| | | n=1 | n=2 | n=3 |
| :STATe ON*OFF | OFF | x | x | x |
| | | | | |
| INITiate<n> | | | | |
| :IMMediate | No Reset Value | x | x | x |
| | | | | |
| CALibration | | | | |
| :ALL | No Reset Value | x | x | x |
| DIGital3: | | | | |
| :STIMulus | | | | |
| :PATTern | | | | |
| [:VALue] <numeric value> {,<numeric value>} | No Reset Value | | | x |
| :REPeat <numeric value> {,<numeric value>} | No Reset Value | | | x |
| :TIMing | | | | |
| :CLOCk <numeric value> | -6.87983e43 | | | x |
| :COUNt <numeric value> | 1 | | | x |
| | | | | |
| SYSTem | | | | |
| :ERRor? | 0," No Error" | x | x | x |
| :VERSion? | 1992.0 | x | x | x |
| :PRESet<n> | No Reset Value | x | x | x |
| STATus | | | | |
| :OPERation | | | | |
| [:EVENt]? | 0 | x | x | x |
| :CONDition? | Not Implemented | x | x | x |
| :ENABle <nrf> | 0 | x | x | x |
| :ENABle? | 0 | x | x | x |
| :QUEStionable | | | | |
| [:EVENt]? | 0 | x | x | x |
| :CONDition? | Not implemented | x | x | x |
| :ENABle <nrf> | 0 | x | x | x |
| :ENABle? | 0 | x | x | x |
| :PRESet | No Reset Value | x | x | x |

## [SOURce<n>]:FUNCtion: SHAPe

This command controls the shape of the output signal. This commands also denotes the start of a SCPI sequence. If it is not specified the last value programmed will be used.

Syntax: [SOURce<n>]:FUNCtion:SHAPe DC | SINusoid | SQUare | TRIangular | RAMP | PULSe | USER | DIGital

Parameters:
- DC - DC SIGNAL
- SINusoid - AC SIGNAL
- SQUare - SQUARE WAVE
- TRIangular - TRIANGULAR WAVE SIGNAL
- RAMP - RAMP SIGNAL
- PULSe - PULSED DC
- USER - WAVEFORM ( arbitrary waveform )
- DIGital - Digital pattern

Default: DC

For Pulse Generator 1 (n=1), PULSe and DC are allowed.
For Pulse Generator 2 (n=2), PULSe and DC are allowed.

For Arbitrary Waveform Generator (n=3), DC, SINusoid, SQUare, TRIangular, RAMP, PULSe, USER and DIGital are allowed.

Example: SOURce1:FUNCtion:SHAPe PULSe - Sets the output signal for Pulse Generator 1 to Pulsed DC.

## SOURce3:FUNCtion: POLarity

This command controls the polarity of the output signal.

Syntax: SOURce3:FUNCtion:POLarity NORMal | INVerted

Parameters:
- NORMal - A positive going signal is generated.
- INVerted - A negative going signal is generated.

Default: NORM

This command is allowed only with the Arbitrary Waveform Generator (n=3) and is used to control the polarity of the SINusoid, SQUare, TRIangular, and RAMP signals.

Example: SOURce3:FUNCtion:POLarity INVereted - Sets the polarity of the signal to inverted mode.

## SOURce3:FUNCtion: COUNt

This command controls the number of times that the signal is repeated.

Syntax: SOURce3:FUNCtion:COUNt <numeric value>

Parameters: <numeric value> = 0 - Continuous signal
1 to 65535 bursts

Default: 1

This command is allowed only with the Arbitrary Waveform Generator (n=3) and is used to control the polarity of the SINusoid, SQUare, TRIangular, and RAMP signals.

Example: SOURce3:FUNCtion:COUNt 0 - Continuous signal.

## [SOURce<n>]:VOLTage: MODE

This command determines which set of commands control the amplitude setting. If FIXed is selected the amplitude is determined by the LEVel command. If LIST is selected, the amplitude values are determined by an amplitude list specified using the LIST command.

Syntax: [SOURce<n>]:VOLTage:MODE FIXed | LIST

Parameters: FIXed -Voltage amplitude is determined by value in the LEVel command. The FIXed mode is used with all wave shapes except USER.

LIST - Voltage amplitude is determined by the values specified in the LIST3:VOLTage command. This mode is used only with the Arbitrary Waveform Generator (n=3) and a signal type of USER.

Default: FIX

Example: SOURce1:VOLTage:MODE FIXed - selects fixed mode.

### [SOURce<n>]:VOLTage [:LEVel][:IMMediate] [:AMPLitude]

This command controls the voltage amplitude. It is the last statement part of a sequence of SCPI commands that programs the instrument to output a DC SIGNAL. It programs the instrument to the specified voltage level.

Syntax: [SOURce<n>]:VOLTage[:LEVel][:IMMediate][:AMPLitude] <numeric value>

Parameters: <numeric value> = - 11.0V to + 11.0V

Default: 0.00

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: SOURce3:VOLTage:LEVel:IMMediate:AMPLitude 5.0 - Set DC Signal Amplitude for Arbitrary Waveform Generator to 5.0V. The instrument is programmed to output a DC Signal within an amplitude of 5.0V.

### [SOURce<n>]:VOLTage [:LEVel]:TRIGgered [:AMPLitude]

This command controls the peak to peak amplitude of the programmed signal. This command is used with signal types of PULSe, SINusoid, SQUare, TRIangular, and RAMP. The amplitude value is stored in internal memory to be programmed at the end of the signal setup sequence. The output voltage range is -11.0V to +11.0V.

Syntax: [SOURce<n>]:VOLTage[:LEVel]:TRIGgered[:AMPLitude] <numeric value>

Parameter: <numeric value> = 0 to 22.0V for PULSe
0 to 11.0V for SINusoid, SQUare, TRIangular, and RAMP

Default: 0.00

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: SOURce3:VOLTage:LEVel:TRIGgered:AMPLitude 5.0 - Sets the peak to peak amplitude value.

### [SOURce<n>]:VOLTage[:LEVel]:TRIGgered:OFFSet

This command control the DC-OFFSET of the programmed signal. The command is used only with signal types of PULSe, SINusoid, SQUare, TRIangular, and RAMP. The offset value is stored in internal memory to be programmed at the end of the signal setup sequence. The output Voltage range is -11.0V to +11.0V.

Syntax: [SOURce<n>:VOLTage[:LEVel]:TRIGgered:OFFSet <numeric value>

Parameter: <numeric value> = -11.0V to +11.0V

Default: 0.00

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: SOURce1:VOLTage:LEVel:TRIGgered:OFFSet -3.0 - Sets the DC OFFSET for Pulse Generator 1 to -3.0V.

### SOURce3:VOLTage:REFerence:STATe

This command is used to control the connection of the external amplitude modulation signal to the Arbitrary Waveform Generator.

Syntax: SOURce3:VOLTage:REFerence:STATe ON | OFF

Parameter: ON - Connects External Amplitude Modulation to the Arbitrary Waveform Generator.
OFF - Disconnects External Amplitude Modulation.

Default: OFF

This command is used with the Arbitrary Waveform Generator (n=3) only.

Example: SOURce3:VOLTage:REFerence:STATe OFF**.**

### [SOURce<n>]:FREQuency:MODE

This command does not control anything and is included to document the frequency mode. The only mode allowed is CW.

Syntax: [SOURce<n>]:FREQuency:MODE CW

Parameter: CW

Default: CW

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: SOURce1:FREQuency:MODE CW

## SOURce3:FREQuency [:CW]

This command is used to program the frequency value for the programmed signal and is valid with signal types SINusoid, SQUare, TRIangular, and RAMP. This command marks the end of the setup sequence. The instrument will be programmed to the signal type and values specified.

Syntax: SOURce3:FREQuency[:CW] <numeric value>

Parameter: <numeric value> = 0.001 to 10e6 for SINusoid, SQUARE, and TRIangular
0.001 to 1e6 for RAMP

Default: +1.00000e+03

This command is used with the Arbitrary Waveform Generator (n=3) only.

Example: SOURce3:FREQuency:CW 1.E3 - The instrument is programmed to the specified signal with a frequency value of 1000 Hz.

## [SOURce<n>]:PULSe: PERiod

This command is used to program the period value of the pulsed DC signal and is valid only with the PULse signal type. This command marks the end of a signal setup sequence. The instrument will be programmed to the values specified.

Syntax: [SOURce<n>]:PULSe:PERiod <numeric value>

Parameter: <numeric value> = 20.0e-9 to 2 Pulse Generator 1
20.0e-9 to 2 Pulse Generator 2
25.0e-9 to 2 Arbitrary Waveform Generator

Default: +1.25000e-08

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: SOURce1:PULSe:PERiod 1e-6 - Pulse Generator 1 is programmed to a period of 1µS.

## [SOURce<n>]:PULSe :WIDTh

This command is used to program the pulse width value of the pulsed dc signal and is valid with a signal type of PULSe. The pulse width is stored in internal memory and will be used when the setup sequence has been competed with the programming of the period.

Syntax: [SOURce<n>]:PULSe:WIDTh <numeric value>

Parameter: <numeric value> = 10e-9 to1( Pulse Generator 1)10e-9 to1 (Pulse Generator 2)10e-9 to1(Arbitrary Waveform Generator)

Default: +1.00000e-08

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: SOURce1:PULSe:WIDTh 500E-9 - Pulse Generator 1 is programmed to a pulse width of 500ns.

## [SOURce<n>]:PULSe :COUNt

This command is used to program the number of times that the pulse is repeated.

Syntax: [SOURce<n>]:PULSe:COUNt <numeric value>

Parameter: <numeric value> = 0 - Continuous Pulse
1 to 65535 bursts

Default: 1

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: SOURce1:PULSe:COUNt 0 - Pulse Generator 1 is programmed to have a continuous signal.

## [SOURce<n>]:PULSe :POLarity

This command is used to program the polarity of the pulsed DC signal.

Syntax: [SOURce<n>]:PULSe:POLarity NORMal | INVerted

Parameters: NORMal - A positive going signal is generated.
INVerted - A negative going signal is generated.

Default: NORM

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: SOURce1:PULSe:POLarity NORMal - Pulse Generator 1 is programmed to generate a positive going pulse.

### [SOURce<n>]:PULSe :TRANsition[:LEADing]

This command is used to program the rise-time of the pulsed DC signal.

Syntax: [SOURce<n>]:PULSe:TRANsition[:LEADing] <numeric value>

Parameter: <numeric value> = 5e-9 to 8e-4

Default: +5.00000e-09

This command is be used with Pulse Generator 1 (n=1), and Pulse Generator 2 (n=2).

Example: SOURce1:PULSe:TRANsition:LEADing 1E-6 - Pulse Generator 1 is programmed to a rise-time of 1µs.

### [SOURce<n>]:PULSe :TRANsition:TRAiling

This command is used to program the falltime of the pulsed DC signal.

Syntax: [SOURce<n>]:PULSe:TRANsition:TRAiling <numeric value>

Parameter: <numeric value> = 5e-9 to 8e-4

Default: +5.00000e-09

This command is used with Pulse Generator 1 (n=1), and Pulse Generator 2 (n=2).

Example: SOURce1:PULSe:TRANsition:TRAiling 1E-6 - Pulse Generator 1 is programmed to a rise-time of 1µs.

### [SOURce<n>]:PULSe: TRANsition:STATe

This command is used to enable or disable the programming of the rise/fall time for the pulsed DC signal. When the rise/fall-time are disabled (STATe is OFF), the minimum rise/fall times are programmed.

Syntax: [SOURce<n>]:PULSe:TRANsition:STATe ON | OFF

Parameter: <numeric value> = ON - Enable use of the pulse transition times specified by the LEADing and TRAiling values.
OFF - Disable use of pulse transition times and use the default values.

Default: Not implemented

This command is used with Pulse Generator 1 (n=1), and Pulse Generator 2 (n=2).

Example: SOURce1:PULSe:TRANsition:STATe ON - Enable programming of the rise/fall time values.

**Page Changed 8/3/98**

**SOURce3:LIST:VOLTage**

This command is used to program the amplitude values of an arbitrary waveform. The maximum list length is 4095 values.

Syntax: SOURce3:LIST:VOLTage<numeric value>{,<numeric value>}

Parameter: <numeric value> = -11.0 to +11.0

Default: No reset value

This command is used with the Arbitrary Waveform Generator (n=3).

Example: SOURce3:LIST:VOLTage -11.0, 11.0, 5.0, -5.0, 0.0 - An arbitrary waveform with 5 different amplitude values (-11.0V, +11.0V 5.0V, -5.0V, 0.0V). The amplitude values are stored in internal waveform memory.

**SOURce3:LIST:REPeat**

This command is used to program the number of times each amplitude level is repeated. The maximum length is 4095 values. There is no query for this command.

Syntax: SOURce3:LIST:REPeat <numeric value> {,<numeric value>}

Parameter: <numeric value> = 1 to 32767

Default: No reset value

This command is used with the Arbitrary Waveform Generator (n=3).

Example: SOURce3:LIST:REPeat 1,5,10,20,300 - An arbitrary waveform will have 5 different repeat values (1,5,10,20,300). The amplitude values specified for each point will be repeated the specified number of times. The repeat values will be stored in internal memory. The amplitude list length specified by the LIST:VOLTage command and the repeat list length specified by the LIST:REPeat command must have the same list lengths.

**SOURce3:LIST:COUNt**

This command is used to specify the number of times an arbitrary waveform is repeated. There is no query for this command.

Syntax: SOURce3:LIST:COUNt <numeric value>

Parameter: <numeric value> = 0 - Continuous
1 to 65535 bursts

Default: 1

This command is used with the Arbitrary Waveform Generator (n=3).

Example: SOURce3:LIST:COUNt 0 - Arbitrary Waveform Generator will be programmed to generate a continuous arbitrary waveform.

**SOURce3:LIST :GENeration**

This command is used to select how the defined lists are applied to the instrument. Only one option is allowed which is the Default SEQuence (DSEQuence) which causes the instrument to cycle sequentially through the complete list in order.

Syntax: SOURce3:LIST:GENeration DSEQuence

Parameter: DSEQuence - Default SEQuence

Default: DSEQ

This command is used with the Arbitrary Waveform Generator (n=3).

Example: SOURce3:LIST:GENeration DSEQuence

**SOURce3:LIST:SRATe**

This command is used to program the rate at which the arbitrary waveform is output.

Syntax: SOURce3:LIST:SRATe <numeric value>

Parameter: <numeric value> = .15 to 80e6

This command is used with the Arbitrary Waveform Generator (n=3).

Default: No reset value

Example: SOURce3:LIST:SRATe 1.0E6 - The arbitrary waveform is output with a clock rate of 1.0e6 Hz. That is each point will have a period of 1e-6s .

**SOURce3:AM:SOURce**

This command is used to select the external AM Modulation for the Arbitrary Waveform Generator. It is used with SINusoid (AC SIGNAL), TRIangular (TRIANGULAR WAVE SIGNAL) and RAMP (RAMP SIGNAL). This command is used in conjunction with the SOURce3:AM:STATe command.

When AM Modulation is used the output signal is:

Vout = Vprog +2* AM IN
100ns delay from AM IN to Output
If AM IN goes Negative, the output signal reverses phase by 180E.

Syntax: SOURce3:AM:SOURce EXTernal

Parameter: EXTernal

Default: INT

This command is used with Arbitrary Waveform Generator (n=3).

Example: SOURce3:AM:SOURce EXTernal - The arbitrary waveform is setup for external amplitude modulation.

## SOURce3:AM:STATe

This command is used to enable or disable the external AM modulation on Pin J1-A1.

Syntax: SOURce3:AM:STATe ON*OFF.

Parameter: ON - Enable use of the external AM.
OFF - Disable use of external AM.

Default: OFF

This command is with the Arbitrary Waveform Generator (n=3).

Example: SOURce3:AM:STATe ON - Enables external AM signal on J1-A1.

## SOURce3:ROSCillator: SOURce

This command is used to select the source of the clock for the Arbitrary Waveform Generator.

Syntax: SOURce3:ROSCillator:SOURce INTernal*EXTernal

Parameter: INTernal - Selects internal clock source
EXTernal - Selects external clock source on pin J1-2 (Ext Clk Input).

Default: OFF

This command is with the Arbitrary Waveform Generator (n=3).

Example: SOURce3:ROSCillator:SOURce EXTernal - Select clock source as EXT CLK on J1-2.

## DATA3:STARt:ADDRess

This command is used to set the start address for a memory download (or group of multiple memory downloads) using the MEM:DATA3 command.

Syntax: DATA3:STARt:ADDRess <start address>

Parameter: <start address> = 0 to 131071 (0 to #H1FFFF)

For an arbitrary waveform, the start address of the waveform should always be set to 20000H - Number of Data Words in the waveform.

Example: For a 256 (100H) point waveform, the start address should be #H20000 - #H100 = #H1FF00 (130816).

The SCPI syntax is:

```
DATA3:STAR:ADDR #H1FF00
```

## OUTPut<n>:IMPedance

This command is used to select the output impedance that the signal is connected through.

Syntax: OUTPut<n>:IMPedance <numeric value>

Parameter: <numeric value> = 0 - No series impedance
50 - 50 Ohms
93 - 93 Ohms

Default: 0

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: OUTPut1:IMPedance 50 - Pulse Generator 1 is connected through a 50 S resistor to the output connector.

**Revised 4/20/00**

## OUTPut<n>:[STATe]

This command is used to control whether the output terminals are open or closed.

Syntax: OUTPut<n>:STATe ON | OFF

Parameter: <numeric value> = ON - close output relay
OFF - open output relay

Default: OFF

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: OUTPut1:STATe ON - Connects pulse generator 1 to the output.

## OUTPut<n>:TTLTrg<y> :SOURce

This command is used to select which signal drives the VXI back plane TTL trigger lines.

Syntax: OUTPut<n>:TTLTrg<y>:SOURce INT<z>

Parameter: <y> = 1-8 for VXI TTLTrg Bus 0-7
<z> = 1 - Internal CPU Pulse
2 - Pulse generator 1 Output if n=1
Pulse Generator 2 Output if n=2
ARB 16-Bit Output if n=3

Default: INT2

This command is be used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: OUTPut1:TTLTrg1:SOURce INT2 - Output Pulse Generator 1 output on VXI Back plane TTLTrg0.

### OUTPut<n>:TTLTrg<y> :STATe

This command is used to control whether the module drives the VXI backplane trigger bus. When On is selected, the module drives the trigger bus; when OFF is selected, the module does not drive the trigger bus.

Syntax: OUTPut<n>:TTLTrg<y>:STATe ON | OFF

Parameter: ON - module drives VXI back plane trigger bus
OFF - module does not drive the trigger bus.

Default: OFF

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: OUTPut1:TTLTrg1:STATe ON - Signal specified in OUTPut1:TTLTrg<y>:SOURce INT<z> drives the VXI backplane TTLTrg0 line.

### OUTPut3:FILTer[:LPASs] :FREQuency

This command is used to control the selection of the output filters on the Arbitrary Waveform Generator.

Syntax: OUTPut3:FILTer[:LPASs]:FREQuency <numeric value>

Parameter: <numeric value> = 22.0e6
2.2e6
2e6

Default: 22.0e6

This command is used with the Arbitrary Waveform Generator (n=3).

Example: OUTPut3:FILTer:LPASs:FREQuency 22E6 - Selects 22 MHz Filter.

### OUTPut3:FILTer[:LPASs] :STATe

This command is used to turn ON or OFF the filter selected.

Syntax: OUTPut3:FILTer[:LPASs]:STATe ON | OFF

Parameter: ON - Turn filter On
OFF - Turn filter Off

Default: OFF

This command is used with the Arbitrary Waveform Generator (n=3).

Example: OUTPut3:FILTer:LPASs:STATe ON - Turn selected filter on.

### OUTPut<n>:EXTernal :STATe

This command is used to connect or disconnect the PG1 or PG2 output to J2-A4 CLKOUT.

Syntax: OUTPut1:EXTernal:STATe ON*OFF
OUTPut2:EXTernal:STATe ON*OFF

Parameter**:** ON - Connects PG1 or PG2 to J2-A4 (CLKOUT)
OFF - Disconnects signal from J2-A4 (CLKOUT)

Default: OFF

This command is used with Pulse Generator 1 or Pulse Generator 2.

Example: OUTPut1:EXTernal:STATe ON - Connects PG1 to J2-A4 (CLKOUT).
OUTPut2:EXTernal:STATe ON - Connects PG2 to J2-A4 (CLKOUT).

### TRIGger<n>[:SEQuence] :SOURce

This command is used to select the trigger source.

Syntax: TRIGger<n>[:SEQuence]:SOURce EXTernal | TTLTrg<y> | IMMediate

Parameter: EXTernal - External Trigger Input
TTLTrg<y>-<y> = 1-8, VXI back plane TTLTrg0-7
IMMediate - Software Start

Default: IMM

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: TRIGger1:SEQuence:SOURce TTLTrg1 - Select trigger source as TTLTrg0.

### TRIGger<n>[:SEQuence] :SLOPe

This command is used to select the slope of the trigger signal.

Syntax: TRIGger<n>[:SEQuence]:SLOPe POSitive | NEGative

Parameter: POSitive - Positive slope (rising edge)
NEGative - Negative slope (falling edge)

Default: POS

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: TRIGger1:SEQuence:SLOPe POSitive - Selects a positive (rising edge) trigger slope.

### TRIGger<n>[:SEQuence]:DELay

This command is used to specify the time duration from the trigger source to the start of the signal.

Syntax: TRIGger>n>[:SEQuence]:DELay <numeric value>

Parameter: <numeric value> = 10e-9 to 1

Default: +1.00000e-08

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: TRIGger1:SEQuence:DELay 150E-9 - Delay of 150NS from trigger signal until start of pulse generator 1.

### TRIGger<n>:GATE:SOURce

This command is used to select the gate source.

Syntax: TRIGger<n>:GATE:SOURce TTLTrg<y>

Parameter: TTLTrg<y> - <y> = 1-8, VXI backplane TTLTrg Bus 0-7.

Default: TTLT8

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: TRIGger1:GATE:SOURce TTLTrg1 - Select gate source as VXI backplane TTLT Bus 0.

### TRIGger<n>:GATE:LEVel

This command is used to select the slope of the gate signal.

Syntax: TRIGger<n:GATE:LEVel HIGH*LOW

Parameter: HIGH -Gate on when gate signal is high.
LOW - Gate on when gate signal is low.

Default: HIGH

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: TRIGger1:GATE:LEV HIGH - Selects that the signal will be output when the GATE signal is HIGH.

**TRIGger<n>:GATE:DELay**

This command is used to specify the time duration from the gate source to the start of the signal.

Syntax: TRIGger>n:GATE:DELay<numeric value>

Parameter: <numeric value>=10e-9 to 1)

Default: -2.01e+153

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: TRIGger1:GATE:DELay 150E-9 - Delay of 150ns from gate signal until start of pulse generator 1.

**TRIGger<n>:GATE:STATe**

This command is used to enable the gate source.

Parameter: ON - Enables Gate source.
OFF - Disables Gate source.

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Default: OFF

Example: TRIGger1:GATE:STATe ON - Enables the GATE capability.

**INITiate<n>:IMMediate**

This command is used to issue a software start to the specified instrument. There is no query for this command.

Syntax: INITiate<n>:IMMediate

Parameter: None

Default: No reset value

This command is used with Pulse Generator 1 (n=1), Pulse Generator 2 (n=2), and the Arbitrary Waveform Generator (n=3).

Example: INITiate1:IMMediate - will issue a software start to Pulse Generator 1.

**CALibration:ALL**

This command is used to run the internal calibration. There is no query for this command.

Syntax: CALibration:ALL

Parameter: None

Default: No reset value

Example: CALibration:ALL

**DIGital3:STIMulus: PATTern[:VALue]**

This command is used to program digital patterns to be output by the Arbitrary Waveform Generator. The maximum list length is 4095 values.
There is no query for this command.
Syntax: DIGital:STIMulus:PATTern[:VALue] <numeric value> {<numeric value>}

Parameter: <numeric value> = 0 to 65535 decimals

Default: No reset value

This command is used with the Arbitrary Waveform Generator (n=3).

Example:DIGital:STIMulus:PATTern:VALue 0000, 0111, 0222, 0333, 0444 - An digital signal is output with 5 different patterns ( 0000, 0111, 0222, 0333, 0444).

**DIGital3:STIMulus: PATTern:REPeat**

This command is used to program the number of times each digital pattern is to be repeated. The maximum list length is 4095 values. There is no query for this command.

Syntax: DIGital:STIMulus:PATTern:REPeat <numeric value> {,<numeric value>}

Parameter: <numeric value> = 1 to 32767

Default: No reset value

This command is used with the Arbitrary Waveform Generator (n=3).

Example:DIGital:STIMulus:PATTern:REPeat 1, 2, 3, 4, 5 - This will cause the digital pattern output to be repeated the number of cycles specified.

**DIGital3:TIMing:CLOCk**

This command is used to program the rate at which the digital patterns are output.

Syntax: DIGital:TIMing:CLOCk <numeric value>

Parameter: <numeric value> = 0.15 to 80e6

Default: -6.87983e-43

This command is used with the Arbitrary Waveform Generator (n=3).

Example:DIGital:TIMing:CLOCk 10000 - This causes the digital pattern to be output at a pattern rate of 10000 vectors or patterns per second.

## DIGital3:COUNt

This command is used to program the number of times a digital pattern is repeated.

Syntax: DIGital:COUNt <numeric value>

Parameter: <numeric value> = 0 - Continuous
1 to 65535 burst

Default: 1

This command is used with the Arbitrary Waveform Generator (n=3).

Example:DIGital:COUNt 10 - This causes the digital pattern to be repeated 10 times.

## MEMory3:DATA

This command is used to download an arbitrary waveform starting at the address specified using the DATA3:STARt:ADDRess command.

Syntax: MEMory3:DATA <start address>, <depth>, <value> {, <value>}

Parameter: <start address> = 0 to 131071 (0 to #H1FFFF)
<depth> = 1 to 2048
<value> = 0 to 65535

The start address parameter allows the user to download data at an offset (higher address value) from the one specified in the DATA3:STARt:ADDRess command or at the same address (this command can be used more than once, giving the user access to the entire 128k of waveform memory). The address map for the 3171's Arbitrary Waveform Memory is:

| Address | Data |
|---|---|
| #H1FFFF (131071) | See memory data description |
| ▪ | ▪ |
| ▪ | ▪ |
| ▪ | ▪ |
| #H0000 (0) | ▪ |

The depth parameter specifies the number of waveform data words to follow.

The value parameter defines voltage and control bits as shown:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | |

**Revised 4/20/00**

BIT 15 -To VXI Trigger
BIT 14 -Not used
BIT 13 -To Cursor out (J1-5)
BIT 12 -To Sync out (J1-4)
BITS 11-0- Arbitrary Waveform DAC

To calculate Bits 11-0, use the following equation:

DAC Bits 11-0 = 2048 -INT((Expected Voltage/DAC Bit Weight) + 0.5)

where INT is a function returning the integer portion of the number
CF is the conversion factor returned by

READ3:GAIN:HSDAC?

**NOTE €**

**Data must be loaded into memory with the last data word to be output in the highest memory location (#H1FFFF) and the first data word in memory location #H20000 (131072) minus the total number of data words to be output.**

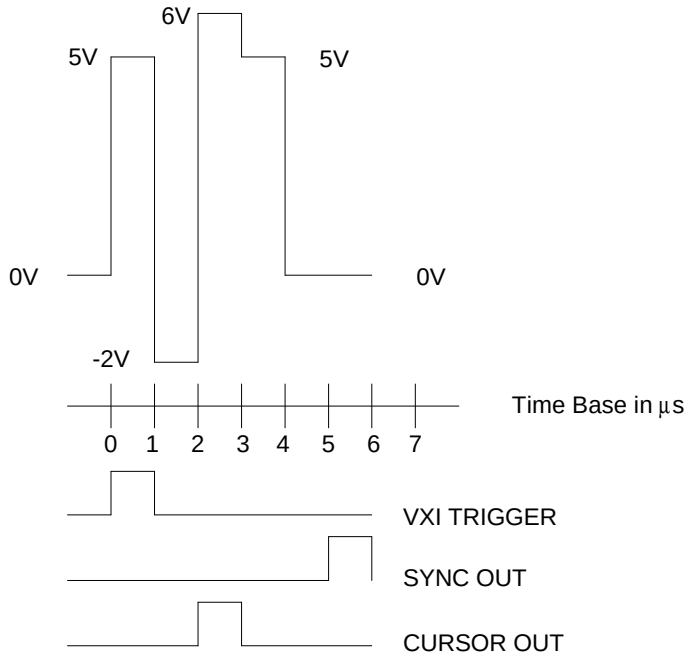
Example: If a burst of 4000 data words was to executed data should be loaded into memory as follows:

| Address | Data |
|---|---|
| #H1FFFF (131071) | Data for last memory location (4000) |
| ▪ | ▪ |
| ▪ | ▪ |
| ▪ | ▪ |
| #H1F060 (127072) | Data for first memory location (1) |

SCPI Syntax required to load the waveform:

```
SOUR3:FUNC:SHAP USER
SOUR3:VOLT:MODE LIST
DATA3:STAR:ADDR #H1FFFA
MEM3:DATA #H1FFFA, 6, #H842E, #H0986, #H236A,
#H042E, #H0800, #H1800
SOUR3:LIST:COUN 0
SOUR3:LIST:SRATE 1.0E6
TRIG3:SEQ:SOUR IMM
OUTP3:IMP 50
OUTP3:STAT ON
INIT3:IMM
```

Sample Waveform:




## DATA3:STARt:ADDRess

This command is used to set the start address for a memory download (or group of multiple memory downloads) using the MEM:DATA3 command.

Syntax: DATA3:STARt:ADDRess <start address>

Parameter: <start address> = 0 to 131071 (0 to #H1FFFF)

For an arbitrary waveform, the start address of the waveform should always be set to 20000H -Number of Data Words in the waveform.

Example: For a 256 (100H) word bit pattern, the start address should be #H20000 -#H100 = #H1FF00 (130816).

The SCPI syntax is:

```
DATA3:STAR:ADDR #H1FF00
```

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## MEMory3:DATA

This command is used to download an arbitrary waveform starting at the address specified using the DATA3:STARt:ADDRess command.

Syntax: MEMory3:DATA <start address>, <depth>, <value> {, <value>}

Parameter: <start address> = 0 to 131071 (0 to #H1FFFF)
<depth> = 1 to 2048
<value> = 0 to 65535

The start address parameter allows the user to download data at an offset (higher address value) from the one specified in the DATA3:STARt:ADDRess command or at the same address (this command can be used more than once, giving the user access to the entire 128k of waveform memory). The address map for the 3171's Digital Pattern Memory is:

| Address | Data |
|---|---|
| #H1FFFF (131071) | See memory data description |
| ▪ | ▪ |
| ▪ | ▪ |
| ▪ | ▪ |
| #H0000 (0) | ▪ |

The depth parameter specifies the number of waveform data words to follow.

The value parameter defines digital word bits as shown:

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | |

BIT 15 - To VXI Trigger
BIT 14 - Not used
BIT 13 - To Cursor out (J1-5)
BIT 12 - To Sync out (J1-4)
BIT 11 - Not used
BIT 10 - Not used
BITS 9-0 - Lower 10 bits of the digital word

**NOTE€**

**Data must be loaded into memory with the last data word to be output in the highest memory location (#H1FFFF) and the first data word in memory location #H20000 (131072) minus the total number of data words to be output.**

Example: If a burst of 8092 digital words was to be executed, data should be loaded into memory as follows:

| Address | Data |
|---|---|
| #H1FFFF (131071) | Data for last digital word (8092) |
| ▪ | ▪ |
| ▪ | ▪ |
| ▪ | ▪ |
| #H1E000 (122880) | Data for first digital word (1) |

The SCPI commands to load the digital data are:

```
DATA3:STAR:ADDR #H1E000
MEM3:DATA   #H1E000,   2048,   <data0001>,   ···
<data2048>
MEM3:DATA   #H1E800,   2048,   <data2049>,   ···
<data4096>
MEM3:DATA   #H1F000,   2048,   <data4097>,   ···
<data6144>
MEM3:DATA   #H1F800,   2048,   <data6145>,   ···
<data8192>
```

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## READ3:GAIN:HSDAC?

This command queries the 3171 for an internal conversion factor that converts the DAC bit setting to an actual voltage at the 3171's present gain setting.

Syntax: READ3:GAIN:HSDAC?

Value Returned: Floating point number representing Volts to DAC bits conversion factor (DAC Bit Weight).

To convert an expected voltage into DAC bits, use the following equation:

DAC Bits 11-0 = 2048 - INT((Expected Voltage/DAC Bit Weight) + 0.5)

where INT is a function returning the integer portion of the number CF is the conversion factor returned by READ3:GAIN:HSDAC?

Example: Calculate the proper DAC output word for the voltage and control bit settings given in the table below when the READ3:GAIN:HSDAC? command returns a value of 0.00511:

| | Output | Memory | Control Bits | Data Bits 11-0 | |
|---|---|---|---|---|---|
| Point | Voltage | Address | 15-12 | 2048 - INT( (Voltage/0.00511)+0.5) | Output Word |
| 1 | 5.0V | #H1FFFA | 1000 (VXI Trigger) | 1070 (#H42E) | #H842E |
| 2 | -2.0V | #H1FFFB | 0000 | 2438 (#H986) | #H0986 |
| 3 | 6.0V | #H1FFFC | 0010 (Cursor Out) | 874 (#H36A) | #H236A |
| 4 | 5.0V | #H1FFFD | 0000 | 1070 (#H42E) | #H042E |
| 5 | 0.0V | #H1FFFE | 0000 | 2048 (#H800) | #H0800 |
| 6 | 0.0V | #H1FFFF | 0001 (Sync Out) | 2048 (#H800) | #H1800 |

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## SYSTem:ERRor?

This command reads the next entry from the error/event queue.

Syntax: SYSTem:ERRor?

Default: 0, “No error”

Result: ASCII character string with format: <Error/event number>, "<Error/event description>"

Example: SYSTem:ERRor?

Return Result Example:

0, "No error"
-100, "Command error"
-101, "Invalid character"
-102, "Syntax error"
-350, "Queue overflow"
etc.

A complete listing of error codes is given later in this chapter in the Error Messages section**.**

## SYSTem:VERSion?

This command reads the system version number.

Syntax: SYSTem:VERSion?

Default: 1992.0

Result : ASCII character string with the version number.

Example: SYSTem:VERSion?

## SYSTem:PRESet<n>

This command is used to reset the specified instrument of the instrument.

Syntax: SYSTem:PRESet<n>

Parameter: <n> = 1 - Pulse Generator 1
<n> = 2 - Pulse Generator 2
<n> = 3 - Arbitrary Waveform Generator

Default: No reset value

Example: SYSTem:PRESet1 - reset Pulse Generator 1

**STATus:OPERation [:EVENt]?**

This command is used to return the contents of the operation event register.

Syntax: STATus:OPERation:[EVENt]?

Default: 0

Example: STATUS:OPERation:EVENt?

Return value: 0 = no error, non-zero = error

**STATus:OPERation :CONDition?**

This command is used to return the contents of the operation condition register.

Syntax: STATus:OPERation:CONDition?

Default: Not implemented

Example: STATUS:OPERation:CONDition?

Return value: 0 = no error, non-zero = error

**STATus:OPERation :ENABle <nrf>**

This command is used to set the enable mask of the operation enable register.

Syntax: STATus:OPERation:ENABle <numeric value>

Parameter: <numeric value> = 0 to 32767

Default: 0

Example: STATUS:OPERation:ENABle 255 - Enables bits 8-15.

**STATus:OPERation :ENABle?**

This command is used to return the contents of the operation enable register.

Syntax: STATus:OPERation:ENABle?

Default: 0

Example: STATUS:OPERation:ENABle? - will return the contents of the operation enable register**.**

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

This command is used to return the contents of the questionable event register.

Syntax: STATus:QUEStionable[:EVENt]?

Default: 0

Example: STATUS:QUEStionable:EVENt? - will return the contents of the questionable event register.

**STATus:QUEStionable :CONDition?**

This command is used to return the contents of the questionable condition register.

Syntax: STATus:QUEStionable:CONDition?

Default: Not implemented

Example: STATUS:QUEStionable:CONDition? - will return the contents of the questionable event register.

**STATus:QUEStionable :ENABle <nrf>**

This command is used to set the enable mask of the questionable enable register.

Syntax: STATus:QUEStionable:ENABle <numeric value>

Default: 0

<numeric value> - 0 to 32767

Example: STATUS:QUEStionable:ENABle 255 - will set the enable mask of the questionable enable register to 255.

**STATus:QUEStionable :ENABle?**

This command is used to return the contents of the questionable enable register.

Syntax: STATus:QUEStionable:ENABle?

Default: 0

Example: STATUS:QUEStionable:ENABle? - will return the contents of the questionable event register.

**STATus:PRESet**

This command configures the SCPI and device-dependent status data structures to 0.

Syntax: STATus:PRESet

Default: No reset value

Example: STATUS:PRESet - configures the SCPI and device-dependent status data structures to 0.

## SCPI Commands For Signal Types

This section lists the SCPI commands required to generate a DC Signal, AC Signal, Square Wave Signal, Triangular Wave Signal, Ramp Signal, Pulsed DC Signal, Arbitrary Waveform or a Digital Pattern.

## DC Signal SCPI Commands

The following table lists the SCPI Commands and the suggested order to Generate a DC Signal for the Pulse Generator 1, Pulse Generator 2 or the Arbitrary Waveform Generator.

| | |
|---|---|
| **SOURce<n>:FUNCtion:SHAPe DC** | **Required** |
| **SOURce<n>:VOLTage:MODE FIXed** | **Optional** |
| **SOURce<n>:VOLTage:LEVel:IMMediate:AMPLitude <numeric value>** | **Required** |
| | |
| **OUTPut<n>:IMPedance 0 \| 50 \| 93** | **Required** |
| **OUTPut<n>:STATe ON*OFF** | **Required** |

| **Instrument** | **<n>** |
|---|---|
| **Pulse Generator 1** | **1** |
| **Pulse Generator 2** | **2** |
| **Arbitrary Waveform Generator** | **3** |

A DC Signal is generated when the SCPI command SOURce<n>:VOLTage:LEVel:IMMediate:AMPLitude <numeric value> is received.

The instrument is connected to the output and the output impedance is programmed when the SCPI command OUTPut<n>:STATe ON is received.

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## AC Signal SCPI Commands

The following table lists the SCPI Commands and the suggested order to generate an AC Signal on the Arbitrary Waveform Generator.

| | |
|---|---|
| **SOURce3:FUNCtion:SHAPe SINusoid** | **Required** |
| **SOURce3:FUNCtion:POLarity NORMal \| INVERTED** | **Optional** |
| **SOURce3:FUNCtion:COUNt 0 to 65535** | **Optional** |
| **SOURce3:VOLTage:MODE FIXed** | **Optional** |
| **SOURce3:VOLTage:LEVel:TRIGgered:AMPLitude <numeric value>** | **Required** |
| **SOURce3:VOLTage:LEVel:TRIGgered:OFFSet <numeric value>** | **Optional** |
| **SOURce3:FREQuency:MODE:CW** | **Optional** |
| **SOURce3:FREQuency:CW <numeric value>** | **Required** |
| | |
| **TRIGger3:SEQuence:SLOPe POSitive \| NEGative** | **Optional** |
| **TRIGger3:SEQuence:DELay <numeric value>** | **Optional** |
| **TRIGger3:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate** | **Optional** |
| **TRIGger3:GATE:LEVel HIGH*LOW** | **Optional** |
| **TRIGger3:GATE:DELay <numeric value>** | **Optional** |
| **TRIGger3:GATE:SOURce TTLTrg<y>** | **Optional** |
| **TRIGger3:GATE:STATe ON*OFF** | **Optional** |
| | |
| **OUTPut3:IMPedance 0 \| 50 \| 93** | **Required** |
| **OUTPut3:STATe ON \| OFF** | **Required** |
| | |
| **INITiate3:IMMediate**<br>*** Required if Trigger SOURce IMMediate** | **Optional*** |

The AC Signal is generated when the SCPI command SOURce3:FREQuency:CW <numeric value> is received.

The Trigger Source, slope and delay are programmed when the SCPI command TRIGger3:SEQuence:SOURce is received.

The Gate Source, level and delay are programmed when the SCPI command TRIGger3:GATE:STATe ON*OFF is received.

The instrument is connected to the output and the output impedance is programmed when the SCPI command OUTPut<n>:STATe ON is received.

The INITiate3:IMMediate command issues a software start and is required if the trigger source is immediate.

To generate an output signal, either a trigger source or a gate source SCPI command must be issued.

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## SQUARE WAVE Signal SCPI Commands

The following table lists the SCPI Commands and the suggested order to generate a Square wave Signal on the Arbitrary Waveform Generator.

| | |
|---|---|
| **SOURce3:FUNCtion:SHAPe SQUare** | **Required** |
| **SOURce3:FUNCtion:POLarity NORMal \| INVERTED** | **Optional** |
| **SOURce3:FUNCtion:COUNt 0 to 65535** | **Optional** |
| **SOURce3:VOLTage:MODE FIXed** | **Optional** |
| **SOURce3:VOLTage:LEVel:TRIGgered:AMPLitude <numeric value>** | **Required** |
| **SOURce3:VOLTage:LEVel:TRIGgered:OFFSet <numeric value>** | **Optional** |
| **SOURce3:FREQuency:MODE:CW** | **Optional** |
| **SOURce3:FREQuency:CW <numeric value>** | **Required** |
| | |
| **TRIGger3:SEQuence:SLOPe POSitive \| NEGative** | **Optional** |
| **TRIGger3:SEQuence:DELay <numeric value>** | **Optional** |
| **TRIGger3:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate** | **Required** |
| **TRIGger3:GATE:LEVel HIGH*LOW** | **Optional** |
| **TRIGger3:GATE:DELay <numeric value>** | **Optional** |
| **TRIGger3:GATE:SOURce TTLTrg<y>** | **Optional** |
| **TRIGger3:GATE:STATe ON*OFF** | **Optional** |
| | |
| **OUTPut3:IMPedance 0 \| 50 \| 93** | **Required** |
| **OUTPut3:STATe ON \| OFF** | **Required** |
| | |
| **INITiate3:IMMediate**<br>*** Required if Trigger SOURce IMMediate** | **Optional*** |

The Square Wave Signal is generated when the SCPI command SOURce3:FREQuency:CW <numeric value> is received.

The Trigger Source, slope and delay are programmed when the SCPI command TRIGger3:SEQuence:SOURce is received.

The Gate Source, level and delay are programmed when the SCPI command TRIGger3:GATE:STATe ON*OFF is received.

The instrument is connected to the output and the output impedance is programmed when the SCPI command OUTPut<n>:STATe ON is received.

The INITiate3:IMMediate command issues a software start and is required if the trigger source is immediate.

To generate an output signal, either a trigger source or a gate source SCPI command must be issued.

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## TRIANGULAR WAVE Signal SCPI Commands

The following table lists the SCPI Commands and the suggested order to generate a Triangular Wave Signal on the Arbitrary Waveform Generator.

| | |
|---|---|
| SOURce3:FUNCtion:SHAPe TRIangular | Required |
| SOURce3:FUNCtion:POLarity NORMal \| INVERTED | Optional |
| SOURce3:FUNCtion:COUNt 0 to 65535 | Optional |
| SOURce3:VOLTage:MODE FIXed | Optional |
| SOURce3:VOLTage:LEVel:TRIGgered:AMPLitude <numeric value> | Required |
| SOURce3:VOLTage:LEVel:TRIGgered:OFFSet <numeric value> | Optional |
| SOURce3:FREQuency:MODE:CW | Optional |
| SOURce3:FREQuency:CW <numeric value> | Required |
| | |
| TRIGger3:SEQuence:SLOPe POSitive \| NEGative | Optional |
| TRIGger3:SEQuence:DELay <numeric value> | Optional |
| TRIGger3:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate | Required |
| TRIGger3:GATE:LEVel HIGH*LOW | Optional |
| TRIGger3:GATE:DELay <numeric value> | Optional |
| TRIGger3:GATE:SOURce TTLTrg<y> | Optional |
| TRIGger3:GATE:STATe ON*OFF | Optional |
| | |
| OUTPut3:IMPedance 0 \| 50 \| 93 | Required |
| OUTPut3:STATe ON \| OFF | Required |
| | |
| INITiate3:IMMediate<br>* Required if Trigger SOURce IMMediate | Optional* |

The Triangular Wave Signal is generated when the SCPI command SOURce3:FREQuency:CW <numeric value> is received.

The Trigger Source, slope and delay are programmed when the SCPI command TRIGger3:SEQuence:SOURce is received.

The Gate Source, level and delay are programmed when the SCPI command TRIGger3:GATE:STATe ON*OFF is received**.**

The instrument is connected to the output and the output impedance is programmed when the SCPI command OUTPut<n>:STATe ON is received.

The INITiate3:IMMediate command issues a software start and is required if the trigger source is immediate.

To generate an output signal, either a trigger source or a gate source SCPI command must be issued.

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## RAMP Signal SCPI Commands

The following table lists the SCPI Commands and the suggested order to generate a Ramp Signal on the Arbitrary Waveform Generator

| | |
|---|---|
| SOURce3:FUNCtion:SHAPe RAMP | Required |
| SOURce3:FUNCtion:POLarity NORMal \| INVERTED | Optional |
| SOURce3:FUNCtion:COUNt 0 to 65535 | Optional |
| SOURce3:VOLTage:MODE FIXed | Optional |
| SOURce3:VOLTage:LEVel:TRIGgered:AMPLitude <numeric value> | Required |
| SOURce3:VOLTage:LEVel:TRIGgered:OFFSet <numeric value> | Optional |
| SOURce3:FREQuency:MODE:CW | Optional |
| SOURce3:FREQuency:CW <numeric value> | Required |
| | |
| TRIGger3:SEQuence:SLOPe POSitive \| NEGative | Optional |
| TRIGger3:SEQuence:DELay <numeric value> | Optional |
| TRIGger3:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate | Required |
| TRIGger3:GATE:LEVel HIGH*LOW | Optional |
| TRIGger3:GATE:DELay <numeric value> | Optional |
| TRIGger3:GATE:SOURce TTLTrg<y> | Optional |
| TRIGger3:GATE:STATe ON*OFF | Optional |
| | |
| OUTPut3:IMPedance 0 \| 50 \| 93 | Required |
| OUTPut3:STATe ON \| OFF | Required |
| | |
| INITiate3:IMMediate<br>* Required if Trigger SOURce IMMediate | Optional* |

The RAMP Signal is generated when the SCPI command SOURce3:FREQuency:CW <numeric value> is received.

The Trigger Source, slope and delay are programmed when the SCPI command TRIGger3:SEQuence:SOURce is received.

The Gate Source, level and delay are programmed when the SCPI command TRIGger3:GATE:STATe ON*OFF is received**.**

The instrument is connected to the output and the output impedance will be programmed when the SCPI command OUTPut<n>:STATe ON is received.

The INITiate3:IMMediate command issues a software start and is required if the trigger source is immediate.

To generate an output signal, either a trigger source or a gate source SCPI command must be issued.

## PULSED DC SCPI Commands

The following table lists the SCPI Commands and the suggested order to generate a Pulsed DC Signal.

| | |
|---|---|
| SOURce<n>:FUNCtion:SHAPe PULSe | Required |
| SOURce<n>:VOLTage:MODE FIXed | Optional |
| SOURce<n>:VOLTage:LEVel:TRIGgered:AMPLitude <numeric value> | Required |
| SOURce<n>:VOLTage:LEVel:TRIGgered:OFFSet <numeric value> | Optional |
| SOURce<n>:PULSe:COUNt 0 to 65535 | Required |
| SOURce<n>:PULSe:POLarity NORMal\|INVERTED | Optional |
| SOURce<n>:PULSe:TRANsition:STATe ON \| OFF | Optional |
| SOURce<n>:PULSe:TRANsition:LEADing <numeric value> | Optional |
| SOURce<n>:PULSe:TRANsition:TRAiling <numeric value> | Optional |
| SOURce<n>:PULSe:WIDTh <numeric value> | Required |
| SOURce<n>:PULSe:PERiod <numeric value> | Required |
| | |
| TRIGger<n>:SEQuence:SLOPe POSitive \| NEGative | Optional |
| TRIGger<n>:SEQuence:DELay <numeric value> | Optional |
| TRIGger<n>:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate | Required |
| TRIGger3:GATE:LEVel HIGH*LOW | Optional |
| TRIGger3:GATE:DELay <numeric value> | Optional |
| TRIGger3:GATE:SOURce TTLTrg<y> | Optional |
| TRIGger3:GATE:STATe ON*OFF | Optional |
| | |
| OUTPut<n>:IMPedance 0 \| 50 \| 93 | Required |
| OUTPut<n>:STATe ON \| OFF | Required |
| | |
| INITiate<n>:IMMediate<br>* Required if Trigger SOURce IMMediate | Optional* |

| Instrument | <n> |
|---|---|
| Pulse Generator 1 | 1 |
| Pulse Generator 2 | 2 |
| Arbitrary Waveform Generator | 3 |

If the instrument is the Arbitrary Waveform Generator, the Rise-Time and Fall-Time are not programmable. The only option allowed is SOURce3:TRANsition:STATe OFF.

The Pulsed DC Signal is generated when the SCPI command SOURce<n>:PULSe:PERiod <numeric value> is received.

**Revised 4/24/00**

The Trigger Source, slope and delay are programmed when the SCPI command TRIGger<n>:SEQuence:SOURce is received.

The Gate Source, level and delay are programmed when the SCPI command TRIGger3:GATE:STATe ON*OFF is received**.**

The instrument is connected to the output and the output impedance is programmed when the SCPI command OUTPut<n>:STATe ON is received.

The INITiate<n>:IMMediate command issues a software start and is required if the trigger source is immediate.

To generate an output signal, either a trigger source or a gate source SCPI command must be issued.

## ARBITRARY WAVEFORM SCPI Commands (4K Buffer Size Limit)

The following table lists the SCPI Commands and the suggested order to generate an Arbitary Waveform.

| | |
|---|---|
| SOURce3:FUNCtion:SHAPe USER | Required |
| SOURce3:VOLTage:MODE LIST | Optional |
| SOURce3:LIST:VOLT <numeric value> {,<numeric value>} | Required |
| SOURce3:LIST:REPeat <numeric value> {,<numeric value>} | Optional |
| SOURce3:LIST:GENeration DSEQuence | Optional |
| SOURce3:LIST:COUNt 0 to 65535 | Required |
| SOURce3:LIST:SRATe <numeric value> | Required |
| | |
| TRIGger3:SEQuence:SLOPe POSitive \| NEGative | Optional |
| TRIGger3:SEQuence:DELay <numeric value> | Optional |
| TRIGger3:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate | Required |
| TRIGger3:GATE:LEVel HIGH \| LOW | Optional |
| TRIGger3:GATE:DELay <numeric value> | Optional |
| TRIGger3:GATE:SOURce TTLTrg<y> | Optional |
| TRIGger3:GATE:STATe ON \| OFF | Optional |
| | Optional |
| OUTPut3:IMPedance 0 \| 50 \| 93 | Required |
| OUTPut3:STATe ON \| OFF | Required |
| | |
| INITiate3:IMMediate<br>* Required if Trigger SOURce IMMediate | Optional* |
| | |

The Arbitrary Waveform is generated when the SCPI command SOURce:LIST:SRATe <numeric value > is received.

The Trigger Source, slope and delay are programmed when the SCPI command TRIGger3:SEQuence:SOURce is received.

The Gate Source, level and delay are programmed when the SCPI command TRIGger3:GATE;STATe ON | OFF is received.

The instrument is connected to the output and the output impedance is programmed when the SCPI command OUTPut<n>:STATe Onis received.

The INITiate3:IMMediate command issues a software start and is required if the trigger source is immediate.

To generate an output signal, either trigger source or a gate source SCPI command must be issued.

**Revised 4/24/00**

## ARBITRARY WAVEFORM SCPI Commands (Up to 128K data words)

SCPI Commands and suggested order to generate an Arbitrary Waveform.

| | |
|---|---|
| SOURce3:FUNCtion:SHAPe USER | Required |
| SOURce3:VOLTage:MODE LIST | Optional |
| DATA3:STARt:ADDRess <start address> | Required |
| MEMory3:DATA <start address>, <depth>, <numeric value> {,<numeric value>} | Required |
| SOURce3:LIST:COUNt 0 to 65535 | Required |
| SOURce3:LIST:SRATe <numeric value> | Required |
| | |
| TRIGger3:SEQuence:SLOPe POSitive \| NEGative | Optional |
| TRIGger3:SEQuence:DELay <numeric value> | Optional |
| TRIGger3:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate | Required |
| | |
| OUTPut3:IMPedance 0 \| 50 \| 93 | Required |
| OUTPut3:STATe ON \| OFF | Required |
| | |
| INITiate3:IMMediate<br>* Required if Trigger Source IMMediate | Optional* |
| READ3:GAIN:HSDAC? | Required |

The SCPI READ3:GAIN:HSDAC? command reads the DAC Bit weight which is used to calculate the DAC setting.

The SCPI DATA3:START:ADDRESS <start address> defines the starting RAM address.

The Arbitrary Waveform is generated when the SCPI command SOURCE3:LIST:SRATE <numeric value> is received**.**

The Trigger Source, slope and delay are programmed when the SCPI command TRIGGER3:SEQUENCE:SOURCE is received.

The instrument is connected/disconnected to the output and the output impedance is programmed when the SCPI command OUTPUT<n>:STATE ON | OFF is received.

The INITIATE3:IMMEDIATE command issues a software start and is required if the trigger source is immediate.

To generate an output signal, either a trigger source or a gate source SCPI command must be issued.

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## DIGITAL PATTERN SCPI Commands (4K Buffer Size Limit)

The following table lists the SCPI Commands and the suggested order to generate a Digital Pattern output.

| | |
|---|---|
| SOURce3:FUNCtion:SHAPe DIGital | Required |
| DIGital:STIMulus:PATTern:VALue <numeric value> {,<numeric value>} | Required |
| DIGital:STIMulus:PATTern:REPeat <numeric value> {, <numeric value>} | Optional |
| DIGital:COUNt 0 to 65535 | Required |
| DIGital:TIMing:CLOCk <numeric value> | Required |
| | |
| TRIGger3:SEQuence:SLOPe POSitive \| NEGative | Optional |
| TRIGger3:SEQuence:DELay <numeric value> | Optional |
| TRIGger3:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate | Required |
| TRIGger3:GATE:LEVel HIGH\|LOW | Optional |
| TRIGger3:GATE:DELay <numeric value> | Optional |
| TRIGger3:GATE:SOURce TTLTrg<y> | Optional |
| TRIGger3:GATE:STATe ON\|OFF | Optional |
| | |
| INITiate3:IMMediate<br>* Required if Trigger Source IMMediate | Optional* |

The Digital pattern is generated when the trigger source is received. The Digital pattern will be programmed when the DIGital:TIMing:CLOCk command is received.

The Trigger Source, slope and delay are programmed when the SCPI command TRIGger3:SEQuence:SOURce is received.

The Gate Source, level and delay are programmed when the SCPI command TRIGger3:GATE:STATe ON|OFF is received.

The instrument is connected to the output and the output impedance is programmed when the SCPI command OUTPut<n>:STATe ON is received.

The INITiate3:IMMediate command issues a software start and is required if the trigger source is immediate.

To generate an output signal, either a trigger source or a gate source SCPI command must be issued.

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## DIGITAL PATTERN SCPI Commands (Up to 128K data words)

SCPI Commands and suggested order to generate a Digital Pattern output.

| | |
|---|---|
| SOURce3:FUNCtion:SHAPe DIGital | Required |
| DATA3:STARt:ADDRess <start address> | Required |
| MEMory3:DATA <start address>, <depth>, <numeric value> {,<numeric value>} | Required |
| DIGital:COUNt 0 to 65535 | Required |
| DIGital:TIMing:CLOCk <numeric value> | Required |
| | |
| TRIGger3:SEQuence:SLOPe POSitive \| NEGative | Optional |
| TRIGger3:SEQuence:DELay <numeric value> | Optional |
| TRIGger3:SEQuence:SOURce EXTernal \| TTLTrg<y> \| IMMediate | Required |
| | |
| INITiate3:IMMediate<br>* Required if Trigger Source IMMediate | Optional* |

The Digital pattern is generated when the trigger source is received. The Digital pattern will be programmed when the DIGital:TIMing:CLOCk command is received.

The Trigger Source, slope and delay will be programmed when the SCPI command TRIGger3:SEQuence:SOURce is received.

The Gate Source, level and delay are programmed when the SCPI command TRIGger3:GATE:STATe ON|OFF is received

The INITiate3:IMMediate command issues a software start and is required if the trigger source is immediate..

To generate an output signal, either a trigger source or a gate source SCPI command must be issued.

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## IEEE 488.2 Standard Common Commands

The IEEE 488.2 standard defines the common commands and queries that perform functions like reset, self test and status byte query. Common commands are four or five characters in length, always begin with the asterisk character (*) and may include one or more parameters.

### *CLS - Clear Status Command

The *CLS command clears the Status Data Structures, empties all queues except the output queue.

Syntax: *CLS

### *ESE - Standard Event Status Enable Command

The *ESE command sets the bits in the Event Status Enable Register.

Syntax: *ESE <decimal number program data>

<decimal number program data> = 0 to 255 and represents the bit value of the Standard Event Status Enable Register.

### *ESE? - Standard Event Status Enable Query

The *ESE? command queries the current contents of the Standard Event Status Enable Register.

Syntax: *ESE?

Value returned: decimal number from 0 to 255.

### *ESR? - Standard Event Status Register Query

The *ESR? command queries and clears the current contents in the Standard Event Status Register.

Syntax: *ESR?

Value returned: decimal number from 0 to 255.

### *IDN? - Identification Query

The *IDN? command queries and returns the identification string of the instrument.

Syntax: *IDN?

Value returned: "Racal Instruments Model 3171"

### *RST - Reset Command

The *RST command resets the instrument hardware and firmware.

Syntax: *RST

### *SRE - Service Request Enable Command

The *SRE command sets the bits in the Service Request Enable Register.

Syntax: *SRE <decimal number program data>

<decimal number program data> = 0 to 255 and represents the bit value of the Service Request Enable Register.

**Revised 4/24/00**

***SRE? - Service Request Enable Query**

The *SRE? command queries and clears the current contents in the Standard Event Status Register.

Syntax: *SRE?

Value returned: decimal number from 0 to 255.

***STB? - Read Status Byte Query**

The *STB? command queries the current contents of the Status Byte Register and Master Summary Status bit.

Syntax: *STB?

Value returned: decimal number from 0 to 255.

***TST? - Self-Test Query**

The *TST? command causes an internal self-test and places a response in the Output Queue indicating whether or not the device completed the self-test without any detected errors. Upon completion of self-test the instrument is returned to its reset state.

Syntax: *TST?

Value returned: 0 if self-test passed, non-zero if self-test failed.

## The SCPI Status Registers

The Model 3171 uses the Status Byte register group and the Standard Event register group to record various instrument conditions. **Figure 3-1** shows the SCPI status system.

An Event Register is a read-only register that reports defined conditions within the generator. Bits in an event register are latched. When an event bit is set, subsequent state changes are ignored. Bits in an event register are automatically cleared by a query of that register or by sending the *CLS command. The *RST command or device clear does not clear bits in an event register. Querying an event register returns a decimal value which corresponds to the binary-weighted sum of all bits set in the register.

An Event Register defines which bits in the corresponding event register are logically ORed together to form a single summary bit. The user can read from and write to an Enable Register. Querying an Enable Register will not clear it. The *CLS command does not clear Enable Registers but it does clear bits in the event registers. To enable bits in an enable register, write a decimal value that corresponds to the binary-weighted sum of the bits required to enable in the register.

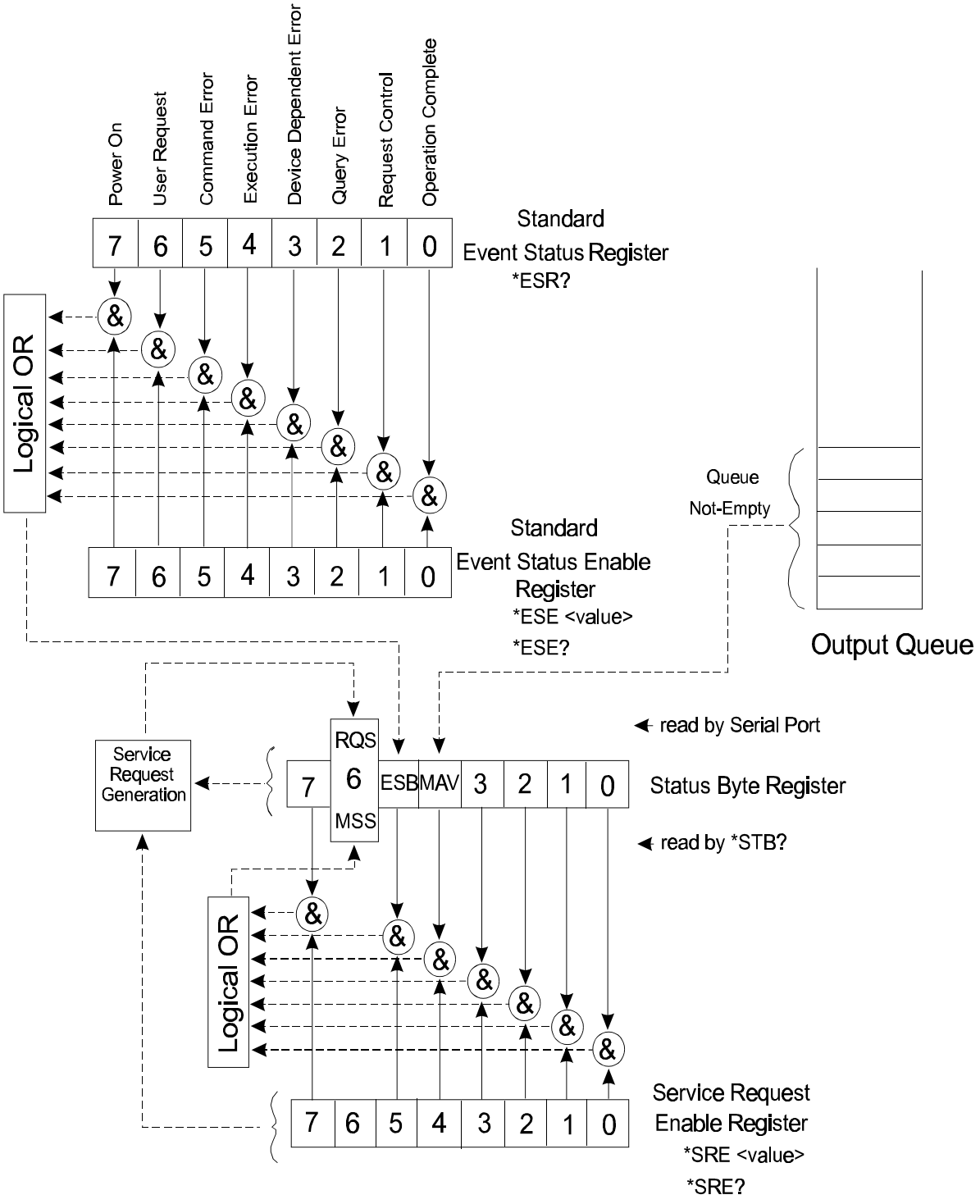


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**Figure 3-1 SCPI Status Register**

## The Status Byte Register (STB)

The Status Byte summary register contains conditions from the other registers. Query data waiting in the generator's output buffer is immediately reported through the Message Available bit (bit 4). Bits in the summary register are not latched. Clearing an event register clears the corresponding bits in the Status Byte summary register. Description of the various bits within the Status Byte summary register is given in the following:

**Bit 0** - Decimal value 1. Not used, always set to 0.
**Bit 1** - Decimal value 2. Not used, always set to 0.
**Bit 2** - Decimal value 4. Not used, always set to 0.
**Bit 3** - Decimal value 8. Not used, always set to 0.

**Bit 4** - Decimal value 16. Message Available Queue Summary Message (MAV). The state of this bit indicates whether or not the output queue is empty. The MAV summary message is true when the output queue is not empty. This message is used to synchronize information exchange with the controller. The controller can, for example, send a query command to the device and then wait for MAV to become true. If an application program begins a read operation of the output queue without first checking for MAV, all system bus activity is held up until the device responds

**Bit 5** - Decimal value 32. Standard Event Status Bit (ESB) Summary Message. This bit indicates whether or not one or more of the enabled ESB events have occurred since the last reading or clearing of the Standard Event Status Register.

**Bit 6** - Decimal value 64. Master Summary Status (MSS)/Request Service (RQS) Bit. This bit indicates if the device has at least one condition to request service. The MSS bit is not part of the IEEE-STD-488.2 status byte and will not be sent in response to a serial poll. However, the RQS bit, if set, will be sent in response to a serial poll.

**Bit 7** - Decimal value 128. Not used, always set to 0.

### Reading the Status Byte Register

The Status Byte summary register can be read with the *STB? common query. The *STB? common query causes the generator to send the contents of the Status Byte register and the MSS (Master Summary Status) summary message as a single <NR1 Numeric Response Message> element. The response represents the sum of the binary-weighted values of the Status Byte Register. The *STB? common query does not alter the status byte.

### Clearing the Status Byte Register

The entire Status Byte register can be cleared by removing the reasons for service from Auxiliary Status registers. Sending the *CLS command to the device after a SCPI command terminator and before a Query clears the Standard Event Status Register and clears the output queue of any unread messages. With the output queue empty, the MAV summary message is set to FALSE. Methods of clearing other auxiliary status registers are discussed in the following paragraphs.

## Service Request Enable Register (SRE)

The Service Request enable register is an 8-bit register that enables corresponding summary messages in the Status Byte Register. Thus, the application programmer can select reasons for the generator to issue a service request by altering the contents of the Service Request Enable Register.

The Service Request Enable Register is read with the *SRE? common query. The response to this query is a number that represents the sum of the binary-weighted value of the Service Request Enable Register. The value of the unused bit 6 is always zero.

The Service Request Enable Register is written using the *SRE command followed by a decimal value representing the bit values of the Register. A bit value of 1 indicates an enabled condition. Consequently, a bit value of zero indicates a disabled condition. The Service Request Enable Register is cleared by sending *SRE0. The generator always ignores the value of bit 6. Summary of *SRE commands is given in the following.

***SRE0** - Clears all bits in the register.
***SRE1** - Not used.
***SRE2** - Not used.
***SRE4** - Not used.
***SRE8** - Not used.
***SRE16** - Service request on MAV.
***SRE32** - Service request on ESB summary bit.
***SRE128** - Not used.

## Standard Event Status Register (ESR)

The Standard Event Status Register reports status for special applications. The 8 bits of the ESR have been defined by the IEEE-STD-488.2 as specific conditions which can be monitored and reported back to the user upon request. The Standard Event Status Register is destructively read with the *ESR? common query. The Standard Event Status Register is cleared with a *CLS common command, with a power-on and when read by *ESR?.

The arrangement of the various bits within the register is firm and is required by all GPIB instruments that implement the IEEE-STD-488.2. Description of the various bits is given in the following:

**Bit 0** - Operation Complete. This bit operation is disabled on the Model 3171.

**Bit 1** - Request Control. This bit operation is disabled on the Model 3171.

**Bit 2** - Query Error. This bit indicates that an attempt is being made to read data from the output queue when no output is either present or pending.

**Bit 3** - Device Dependent Error. This bit is set when an error in a device function occurs.

**Revised 4/24/00**

**Bit 4** - Execution Error. This bit is generated if the parameter following the command is outside of the legal input range of the generator.

**Bit 5** - Command Error. This bit indicates the generator received a command that was a syntax error or a command that the device does not implement.

**Bit 6** - User Request. This bit operation is disabled on the Model 3171.

**Bit 7** - Power On. This bit operation is disabled on the Model 3171.

## Standard Event Status Enable Register (ESE)

The Standard Event Status Enable Register allows one or more events in the Standard Event Status Register to be reflected in the ESB summary message bit. The Standard Event Status Enable Register is an 8-bit register that enables corresponding summary messages in the Standard Event Status Register. Thus, the application programmer can select reasons for the generator to issue an ESB summary message bit by altering the contents of the ESE Register.

The Standard Event Status Enable Register is read with the *ESE? common query. The response to this query is a number that represents the sum of the binary-weighted value of the Standard Event Status Enable Register

The Standard Event Status Enable Register is written using the *ESE command followed by a decimal value representing the bit values of the Register. A bit value one indicates an enabled condition. Consequently, a bit value of zero indicates a disabled condition. The Standard Event Status Enable Register is cleared by setting *ESE0. Summary of *ESE messages is given in the following.

***ESE0** - No mask. Clears all bits in the register.
***ESE1** - ESB on Operation Complete.
***ESE2** - ESB on Request Control.
***ESE4** - ESB on Query Error.
***ESE8** - ESB on Device Dependent Error.
***ESE16** - ESB on Execution Error.
***ESE32** - ESB on Command Error.
***ESE64** - ESB on User Request.
***ESE128** - ESB Power on.

## Error Messages

In general, whenever the Model 3171 receives an invalid SCPI command, it automatically generates an error. Errors are stored in a special error queue and may be retrieved from this buffer one at a time. Errors are retrieved in first-in-first-out (FIFO) order. The first error returned is the first error that was stored. When you have read all errors from the queue, the generator responds with a 0,"No error" message.

If more than 5 errors have occurred, the last error stored in the queue is replaced with -350, “Queue Overflow". No additional errors are stored until you remove errors from the queue. If no errors have occurred when you read the error queue, the generator responds with 0,"No error."

The error queue is cleared when power has been shut off or after a *CLS command has been executed. The *RST command does not clear the error queue. Use the following command to read the error queue:

SYSTem:ERRor?

Errors have the following format (the error string may contain up to 80 characters):

-102,"Syntax error"

A complete listing of the errors that can be detected by the generator is given below.

-102, “Syntax error”
-102, “Syntax error, Comma not expected”
-102, “Syntax error, Unbalanced string”
-102, “Syntax error, unterminated expression”
-104, “Data type error.”
-109, “Missing parameter”
-110, “Command Header Error”
-112, “Program mnemonic too long”
-113, “Undefined header, VOLT:MODE LIST allowed with ARB only”
-113, “Undefined header, DC and PULS only functions allowed”
-114, “Header suffix out of range”
-114, “Header suffix out of range, VOLT:REF:STAT allowed only on ARB”
-114, “Header suffix out of range, FUNC:POL allowed only with ARB”
-114, “Header suffix out of range, FUNC:COUN allowed only with ARB”
-114, “Header suffix out of range, DIGital:STIMulus:PATTern[:VALue] allowed only with ARB”
-114, “Header suffix out of range, DIGital:STIMulus:PATTern:REPeat allowed only with ARB”
-114, “Header suffix out of range, DIGital:TIMing:CLOCk allowed only with ARB”
-114, “Header suffix out of range, DIGital:COUN allowed only with ARB”
-114, “Header suffix out of range, LIST:VOLT allowed only with ARB”
-114, “Header suffix out of range, LIST:VOLT:REP allowed only with ARB”
-114, “Header suffix out of range, LIST:COUN allowed only with ARB”
-114, “Header suffix out of range, LIST:STRATe allowed only with ARB”
-114, “Header suffix out of range, Output filter allowed only with ARB”
-114, “Header suffix out of range, Output filter allowed only with ARB”
-114, “Header suffix out of range, J2-A4 CLKOUT allowed only with PG1 or PG2"
-114, “Header suffix out of range, FREQuency allowed only with ARB”
-114, “Header suffix out of range, FREQ:REF:STAT allowed only with ARB”
-114, “Header suffix out of range, Rise/Fall-Time not allowed with ARB”
-114, “Header suffix out of range, Rise-Time not allowed with ARB”
-114, “Header suffix out of range, Fall-Time not allowed with ARB”
-114, “Header suffix out of range, Double pulse allowed only with PG1"
-114, “Header suffix out of range, Double pulse allowed only with PG1"
-114, “Header suffix out of range, AM Modulation allowed only with ARB”
-114, “Header suffix out of range, AM Modulation allowed only with ARB”
-114, “Header suffix out of range, External Clock Input  allowed only with ARB”
-121, “Invalid character in number”
-131, “Invalid suffix, Unit suffix not defined”
-140, “Character data error”
-144, “Character data too long”
-160, “No defined data”
-161, “Invalid block data”
-200, “Execution error”
-201, “Query only”
-202, “No query allowed”
-204, “Constant not allowed in STATUS subsystem”
-207, “Numeric value not in union”
-208, “Illegal number of parameters, Too many”
-210, “Run out of memory handle”
-211, “Trigger ignored”

-212, “Unit not required”
-213, “Unit ignored”
-221, “Settings conflict, DIGital:TIMing:SOURce must be INTernal”
-222, “Data out of range”
-223, “Too much data, Only 4095 list element allowed”
-226, “List lengths not the same, List lengths don’t match”
-311, “Memory error, parameter list too long”
-330, “Self-test failed”
-350, “Queue overflow, Data queue overflow”
-350, “Queue overflow, Insufficient room in output queue”
-350, “Queue overflow, Output buffer is busy”
-400, “Query error”

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# 4

# Performance Checks

## Performance Checks

This chapter provides performance test information to verify the operation of the Model 3171 to an external voltage and frequency standard. Performance checks verify proper operation of the instrument and should normally be used as part of the incoming inspection of the instrument specifications.

## Environmental Conditions

Test should be performed under laboratory conditions having an ambient temperature of 25°C +/-5°C and at relative humidity of less than 80%. If the instrument has been subject to conditions outside these ranges, allow at least one additional hour for the instrument to stabilize before beginning the adjustment procedure. Always perform a self-test sequence before commencing with the performance checks. The self-test, if executed without failure, ensures proper operation of the generator. If self-test failures have been encountered, the instrument needs to be returned to Racal Instruments for repair. Instructions on how to perform self-test is given later in this chapter in the **Self-Test** section.

## Warm-Up Period

Most equipment is subject to a small amount of drift when it is first turned on. To ensure accuracy, turn on the power to the Model 3171 and allow it to warm-up for at least 30 minutes before beginning the performance test procedure.

## Initial Instrument Setting

To avoid confusion as to which initial setting is used for each test, reset the instrument to factory default values prior to each test. To reset the Model 3171 to factory defaults, send the following command:

```
*RST
```

## Recommended Test Equipment

Recommended test equipment for performance checking is listed below. Test instruments other than those listed may be used only if their specifications equal or exceed the required characteristics.

| **Test Instrument** | **Minimum Specifications** |
|---|---|
| Universal Counter | 100MHz, 10ppm |
| DMM | ACV, 0.2%; DCV, 0.1% accuracy |
| Oscilloscope | 4 channels, 350 MHz analog bandwidth |
| J1 Mating Connector | ITT DDM-24W7P-K87 |
| J2 Mating Connector | ITT DBM5W5P-K87<br>Plug DM53740-1 coax contacts |

Mating connectors connected to BNC cables 1 meter long, 50 Ω impedance.

# Performance Check Procedures

## Self-Test

Built In Test (BIT) is performed at power on and when commanded. The Power on BIT is a subset of the commanded BIT due to the fact that power on BIT must execute in less than 5s for a VXIbus module. Commanded BIT checks about 95% of the Model 3171 hardware and executes in less than 30s. Prior to performing the Performance checks, Commanded BIT is run to verify general operation of the Model 3171. It does not test for accuracy. Therefore, it should be used as an indication that the Model 3171 operates, in general. The SCPI Command *TST? initiates the Commanded BIT procedure. If the instrument fails BIT, it will generate an error. Results of BIT are read back with the SCPI command :SYSTEM:ERROR?. If the instrument executes BIT without errors, 0 is placed in the output queue. A non-zero result indicates BIT failure. If BIT runs successfully the following Performance Checks can be performed. If the BIT procedure fails to respond correctly, the instrument should be returned to Racal Instruments for repair. See **Long Term Storage** or **Repackaging For Shipment.**

Use the following procedures to check the Model 3171 against the specifications. A complete set of specifications is listed in appendix A. The following paragraphs show how to set up the instrument for the test, what the specifications for the tested function are, and what acceptable limits for the test are. If the instrument fails to perform within the specified limits and it passes the Commanded BIT, then perform the Auto Calibration procedure. See **Auto Calibration**. Then rerun the performance checks. If the instrument still fails to perform within the specified limits then the instrument should be returned to Racal Instruments for repair.

## Auto Calibration

Auto Calibration should only be run if self-test (BIT) completes successfully. Auto Calibration is performed when commanded by CALIBRATION:ALL. Calibration factors are stored in an on-board EEPROM (Electrically Erasable and Programmable Read Only Memory). Auto Calibration requires less than 3s to perform.

# (J1-A7) Main Output

## Frequency Accuracy

Accuracy Specifications: +/- .01% of programmed value

Equipment: Counter

1. Configure the Model 3171 as follows:
   Function: SOURCE 3 Square
   Frequency: 10Hz
   Amplitude: 1V
   Remote Commands: *RST
   :SOUR3:FUNC:SHAP SQU
   :SOUR3:VOLT:TRIG 1
   :SOUR3:FREQ 10
   :OUTP3:IMP 50
   :OUTP3:STAT ON
   :TRIG3:SOUR IMM
   :INIT3:IMM

2. Set the counter to frequency measurement.

3. Connect the Model 3171 Main output **J1-A7** to the counter's input. Change the frequency setting as required for the test and verify that the reading on the counter display is as follows:

| **3171 Setting** | **Counter Reading** |
|---|---|
| 10.00 Hz | 9.999 Hz - 10.001 Hz |
| 100.0 Hz | 99.99 Hz - 100.01 Hz |
| 1.000 KHz | 999.9 Hz - 1.0001 KHz |
| 10.00 KHz | 9.999 Khz - 10.001 KHz |
| 100.0 KHz | 99.99 Khz - 100.01 KHz |
| 1.000 MHz | 999.9 Khz - 1.0001 MHz |
| 10.00 MHz | 9.999 Mhz - 10.001 MHz |

If the frequency is out of spec by a small amount, verify the VXIbus CLK10 signal at P2 pin C1. Model 3171 clock generation is derived from the VXIbus CLK10 signal. The CLK10 frequency source from Slot 0 is 10 MHz and its accuracy must be verified to be equal to or better than +/- 100ppm.

## Amplitude Accuracy

Accuracy Specifications: +/- 0.5% of setting or +/-15mV

Equipment: DMM

1. Configure the Model 3171 as follows:
   Function: SOURCE 3 Sine
   Frequency: 1KHz
   Amplitude: 7.07V
   Remote Commands: *RST
   :SOUR3:FUNC:SHAP SIN
   :SOUR3:VOLT:TRIG 7.07
   :SOUR3:FREQ 1000
   :OUTP3:IMP 50
   :OUTP3:STAT ON
   :TRIG3:SOUR IMM
   :INIT3:IMM

2. Set the DMM to ACV measurement (RMS).

3. Connect the Model 3171 Main output **J1-A7** to the DMM's input. Set the amplitude setting as required for the test and verify the reading on the DMM display as follows:

| **3171 Setting** | **DMM Reading** |
|---|---|
| $7.07V_p$ | 4.975V - 5.025V |
| $707V_p$ | .485V - .515V |

## DC Offset Characteristics

Accuracy Specifications: +/- 0.5% of setting or +/-15mV

Equipment: DMM,

1. Configure the Model 3171 as follows:
   Function: SOURCE 3 Sine
   Frequency: 1 MHz
   Amplitude: 1.61V
   DC Offset: 5.0V
   Remote Commands: *RST
   :SOUR3:FUNC:SHAP SIN
   :SOUR3:VOLT:TRIG 1.61
   :SOUR3:VOLT:TRIG:OFFS 5.0
   :SOUR3:FREQ 1000000
   :OUTP3:IMP 50
   :OUTP3:STAT ON
   :TRIG3:SOUR IMM
   :INIT3:IMM

2. Set the DMM to DCV measurement.

3. Connect the Model 3171 Main output **J1-A7** to the DMM input. Set the amplitude setting as required for the test and verify the reading on the DMM display as follows:

| **3171 Vp Setting** | **3171 Offset Setting** | **DMM Reading** |
|---|---|---|
| $1.61V_p$ | +5.00 | 4.975V - 5.025V |
| $1.61V_p$ | -5.00 | -4.975V - -5.025V |
| $0.161V_p$ | 0.500 | 0.485V - 0.515V |
| $0.161V_p$ | -0.500 | -0.485V - -0.515V |

# (J2-A1) PG1OUT

## Frequency & Pulse width Accuracy

Frequency accuracy specifications: +/- .01% of programmed value
Pulse Width accuracy specifications: +/- 0.1% or +/- 5ns

Equipment: Counter

1. Configure the Model 3171 follows:

   Function: SOURCE 1 Pulsed DC
   Period: 0.1s
   Pulse width: 0.05s
   Rise time: 10ns
   Amplitude: 5V
   Output Imp: 50 Ω
   Remote Commands: *RST
   :SOUR1:FUNC:SHAP PULS
   :SOUR1:VOLT:TRIG 5
   :SOUR1:PULS:STAT ON
   :SOUR1:PULS:TRAN:LEAD 10e9
   :SOUR1:WIDT 0.05
   :SOUR1:PER 0.1
   :OUTP1:IMP 50
   :OUTP1:STAT ON
   :TRIG1:SOUR IMM
   :INIT1:IMM

2. Set the counter to frequency measurement then pulse width measurement for each setting.

3. Connect the Model 3171 PG1OUT **J2-A1** to the counters input. Change the period setting as required for the test and adjust the pulse width to 50% of period for each setting then, verify the reading on the counter display as follows:

| **Frequency** | | **Pulse Width** | |
|---|---|---|---|
| **3171 Setting** | **Counter Reading** | **3171 Setting** | **Counter Reading** |
| 10.00 Hz | 9.999 Hz-10.001 Hz | 50.0ms | 49.95-50.05ms |
| 100.0 Hz | 99.99 Hz-100.01 Hz | 5.00ms | 4.995-5.005ms |
| 1.000 Khz | 999.9 Hz-1.0001 Khz | 500µs | 499.5-500.5µs |
| 10.00 Khz | 9.999 Khz-10.001 Khz | 50.0µs | 49.95 - 50.05µs |
| 100.0 Khz | 99.99 Khz -100.01 Khz | 5.00µs | 4.995 - 5.005µs |
| 1.000 Mhz | 999.9 Khz-1.0001 Mhz | 500ns | 495 - 505ns |
| 10.00 Mhz | 9.999 Mhz-10.001 Mhz | 50.0ns | 45.0 - 55.0ns |
| 50.00 MHz | 49.995 Mhz-50.005 MHz | 10ns | 5.0 - 15ns |

If the frequency is out of spec by a small amount, verify the VXIbus CLK10 signal at P2 pin C1. All Model 3171 clock generators are derived from the VXIbus CLK10 signal. The CLK10 frequency source from Slot 0 **MUST** be 10 MHz and its accuracy **MUST** be equal to or better than +/- 100ppm.

## Amplitude Accuracy

Accuracy Specifications: +/- 0.5% of set or +/-15mv

Equipment: DMM

1. Configure the Model 3171 as follows:
   Function: SOURCE 1 DC
   Amplitude: 11V
   Output Imp: 50 Ω
   Remote Commands: *RST
   :SOUR1:FUNC:SHAP DC
   :SOUR1:VOLT 11
   :OUTP1:IMP 50
   :OUTP1:STAT ON

2. Set the DMM to DCV measurement.

3. Connect the Model 3171 PG1OUT **J2-A1** to the DMM input. Set the amplitude setting as required for the test and verify the reading on the DMM display as follows:

| **3171 Setting** | **DMM Reading** |
|---|---|
| ±11.0V | ±10.945V - 11.055V |
| ±5.0V | ±4.975V - 5.025V |
| ±2.0V | ±1.985V - 2.015V |
| ±1.0V | ±0.985V - 1.015V |

# (J2-A5) PG2OUT

## Frequency & Pulse width Accuracy

Frequency accuracy Specifications: +/- .01% of programmed value
Pulse Width accuracy Specifications: +/- 0.1% or +/- 5ns

Equipment: Counter

1. Configure the Model 3171 as follows:
   Function: SOURCE 2 Pulse DC
   Period: 0.1s
   Pulse width: 0.05s
   Rise time: 10ns
   Output Imp: 50 Ω
   Amplitude: 5V
   Remote Commands: *RST
   :SOUR2:FUNC:SHAP PULS
   :SOUR2:VOLT:TRIG 5
   :SOUR2:PULS:TRAN:LEAD 10e-9
   :SOUR2:WIDT 0.05
   :SOUR2:PER 0.1
   :OUTP2:IMP 50
   :OUTPUT2:STAT ON
   :TRIG2:SOUR IMM
   :INIT2:IMM
2. Set the counter to frequency measurement then pulse width measurement for each setting.

3. Connect the Model 3171 PG2OUT **J2-A5** to the counters input. Change the period setting as required for the test and adjust the pulse width to 50% of period for each setting then, verify the reading on the counter display as follows:

| **Frequency 3171 Setting** | **Counter Reading** | **Pulse Width 3171 Setting** | **Counter Reading** |
|---|---|---|---|
| 10.00 Hz | 9.999 Hz - 10.001 Hz | 50.0ms | 49.95-50.05ms |
| 100.0 Hz | 99.99 Hz - 100.01 Hz | 5.00ms | 4.995 - 5.005ms |
| 1.000 Khz | 999.9 Hz - 1.0001 Khz | 500µs | 499.5 - 500.5µs |
| 10.00 Khz | 9.999 Khz - 10.001 Khz | 50.0µs | 49.95- 50.05µs |
| 100.0 Khz | 99.99 Khz - 100.01 Khz | 5.00µse | 4.995 - 5.005µs |
| 1.000 Mhz | 99.9 Khz - 1.0001 Mhz | 500ns | 495 - 505ns |
| 10.00 Mhz | 9.999 Mhz - 10.001 MHz | 50.0ns | 45.0 - 55.0ns |
| 50.00 Mhz | 49.995 Mhz - 50.005 Mhz | 10.0ns | 5.0 - 15ns |

If the frequency is out of spec by a small amount, verify the VXIbus CLK10 signal at P2 pin C1. All Model 3171 clock generators are derived from the VXIbus CLK10 signal. The CLK10 frequency source from Slot 0 **SHALL** be 10 MHz. Its accuracy SHALL be equal to or better than +/- 100ppm.

## Amplitude Accuracy

Accuracy Specifications: +/- 0.5% of set or +/-15mv

Equipment: DMM

1 Configure the Model 3171 as follows:

Function: SOURCE 2 DC
Amplitude: 11V
Output Imp: 50 Ω
Remote Commands: *RST
:SOUR2:FUNC:SHAP DC
:SOUR2:VOLT 11
:OUTP2:IMP 50
:OUTP2:STAT ON

2. Set the DMM to DCV measurement.

3. Connect the Model 3171 PG2OUT **J2-A5** to the DMM input. Set the amplitude setting as required for the test and verify the reading on the DMM display as follows:

| **3171 Setting** | **DMM Reading** |
|---|---|
| ±11.0V | ±10.945V - 11.055V |
| ±5.0V | ±4.975V - 5.025V |
| ±2.0V | ±1.985V - 2.015V |
| ±1.0V | ±0.985V - 1.015V |

## Trigger and Gate Characteristics

In Triggered mode each transition of the selected input trigger source stimulates the Model 3171 to generate a burst of pre-selected number of waveforms after a programmable delay period.

When in Gated mode the signal level at the selected input trigger source enables the Model 3171 to output. The last cycle of the output waveform is always completed.

**For the following tests PG2 will be the source of the trigger or gate signal for PG1 and the Arbitrary Waveform Generator.**

**Equipmen**t: 4 channel oscilloscope

**Triggered**

1. Configure the Model 3171 as follows:

| | |
|---|---|
| Function: | SOURCE 3 Sine Wave |
| Frequency: | 1.000Mhz |
| Amplitude: | 5V |
| Output Imp: | 50 Ω |
| Operating Mode: | Triggered |
| Trigger Source: | TTLTrg Bus 1 |
| Count: | 3 (output 3 waveforms for each trigger) |
| Trigger Delay: | 500ns |
| Trigger Slope: | Positive |

| | |
|---|---|
| Function: | SOURCE 1 Pulse DC |
| Frequency: | 1.000Mhz |
| Pulse Width: | 500ns |
| Rise Time: | 10ns |
| Amplitude: | 5V |
| Output Imp: | 50 Ω |
| Operating Mode: | Triggered |
| Trigger Source: | TTLTrg Bus 1 |
| Count: | 2 (output 2 pulses for each trigger) |
| Trigger Delay: | 500ns |
| Trigger Slope: | Positive |

| | |
|---|---|
| Function: | SOURCE 2 Pulse DC |
| Frequency: | 100.0KHz |
| Pulse Width: | 500ns |
| Rise Time: | 10ns |
| Amplitude: | 5V |
| Output Imp: | 50 Ω |
| Operating Mode: | Continuous |
| Trigger Source: | Immediate |
| Count: | 0 (output continuous pulses) |

Output 2:TTLTrg1:SOURce INT 2 (outputs PG2 signal to TTL Trigger Bus)

Remote Commands:

```
*RST
:OUTP2:TTLT1:SOUR INT2
:OUTP2:TTLT1:STAT ON
:SOUR3:FUNC:SHAP SIN
:SOUR3:FUNC:COUN 3
:SOUR3:VOLT:TRIG 5
:SOUR3:FREQ 1.0E6
:TRIG3:SLOP POS
:TRIG3:DEL 500E-9
:TRIG3:SOUR TTLT1
:OUTP3:IMP 50
:OUTP3:STAT ON
:SOUR1:FUNC:SHAP PULS
:SOUR1:VOLT:TRIG 5
:SOUR1:PULS:COUN 2
:SOUR1:PULS:TRAN:LEAD 10e-9
:SOUR1:WIDT500E-9
:SOUR1:PER 1000E-9
:TRIG1:SLOP POS
:TRIG1:DEL 500E-9
:TRIG1:SOUR TTLT1
:OUTP1:IMP 50
:OUTP1:STAT ON
:SOUR2:FUNC:SHAP PULS
:SOUR2:VOLT:TRIG 5
:SOUR2:PULS:TRAN:LEAD 10e-9
:SOUR2:WIDT. 5E-6
:SOUR2:PER 10E-6
:OUTPUT2:IMP 50
:OUTP2:STAT ON
:TRIG2:SOUR IMM
:INIT2:IMM
```

2. Connect the Main Output (J1-A7) to channel 1 of the scope.
   Connect PG1OUT (J2-A1) to channel 2 of the scope.
   Connect PG2OUT (J2-A5) to channel 3 of the scope.

   Set the scope to trigger on channel 3 the PG2OUT pulse. Verify channel 1 displays 3 sine waves displayed for each rising edge of channel 3 input.

   Verify the first sine wave should start 500ns after the rising edge of the PG2 pulse.

   Verify channel 2 displays (2) 500ns pulses for each pulse on channel 3.

   Verify the first pulse rising edge on channel 2 is delayed 500ns after the rising edge of the PG2 pulse.

**Gated**

1. Configure the model 3171 as follows:

| | |
|---|---|
| Function: | SOURCE 3 Sine Wave |
| Frequency: | 1.000Mhz |
| Amplitude: | 5V |
| Output Imp: | 50 Ω |
| Operating Mode: | Gated |
| Trigger Source: | TTLTrg Bus 1 |
| Count: | 0 (output waveforms continuously until gate is removed) |
| Trigger Delay: | 200ns |
| Gated Level: | Positive |

| | |
|---|---|
| Function: | SOURCE 1 Pulse DC |
| Frequency: | 1.000Mhz |
| Pulse Width: | 500ns |
| Rise Time: | 10ns |
| Amplitude: | 5V |
| Output Imp: | 50 Ω |
| Operating Mode: | Gated |
| Trigger Source: | TTLTrg Bus 1 |
| Count: | 0 (output pulses continuously until gate is removed) |
| Trigger Delay: | 200ns |
| Gated level: | Positive |

| | |
|---|---|
| Function: | SOURCE 2 Pulse DC |
| Frequency: | 100.0KHz |
| Pulse Width: | 7µs |
| Rise Time: | 10ns |
| Amplitude: | 5V |
| Output Imp: | 50 Ω |
| Operating Mode: | Continuous |
| Trigger Source: | Immediate |
| Count: | 0 (output continuous pulses) |

Output 2:TTLTrg1:SOURce INT 2 (outputs PG2 signal to TTL Trigger Bus)

Remote Commands:

```
*RST
:OUTP2:TTLT1:SOUR INT2
:OUTP2:TTLT1:STAT ON
:SOUR3:FUNC:SHAP SIN
:SOUR3:VOLT:TRIG 5
:SOUR3:FREQ 1.0E6
:TRIG3:GATE:LEVEL HIGH
:TRIG3:GATE:SOUR TTLT1
:TRIG3:GATE:DEL 200E-9
:TRIG3:GATE:STAT ON
:OUTP3:IMP 50
:OUTP3:STAT ON
:SOUR1:FUNC:SHAP PULS
:SOUR1:VOLT:TRIG 5
:SOUR1:PULS:COUN 2
:SOUR1:PULS:TRAN:LEAD10e-9
:SOUR1:WIDT500E-9
:SOUR1:PER 1000E-9
:TRIG1:GATE:LEVEL HIGH
:TRIG1:GATE:SOUR TTLT1
:TRIG1:GATE:DEL 200E-9
:TRIG:GATE:STAT ON
:OUTP1:IMP 50
:OUTP1:STAT ON
:SOUR2:FUNC:SHAP PULS
:SOUR2:VOLT:TRIG 5
:SOUR2:PULS:TRAN:LEAD10e-9
:SOUR2:WIDT 7E-6
:SOUR2:PER 10E-6
:OUTP2:IMP 50
:OUTP2:STAT ON
:TRIG2:SOUR IMM
:INIT2:IMM
```

2. Connect the Main Output (J1-A7) to channel 1 of the scope.
   Connect PG1OUT (J2-A1) to channel 2 of the scope.
   Connect PG2OUT (J2-A5) to channel 3 of the scope.

   Set the scope to trigger on the PG2OUT pulse on channel 3. Verify channel 1 displays 8 sine waves displayed while channel 3 input is high.

   Verify the first sine wave should start 200ns after the rising edge of the PG2 pulse.

   Verify channel 2 displays (8) 500ns pulses displayed while channel 3 input is high.

   Verify the first pulse rising edge on channel 2 is delayed 200ns after the rising edge of the PG2 pulse.

# 5

# Customer Support

## Customer Support

Racal Instruments has a complete Service and Parts Department. If you need technical assistance or should it be necessary to return your product for servicing, call 1-800-722-3262 or call 714-859-8999 and ask for Customer Support. You may also contact Customer Support via E-Mail at:

customer_service@rdii.com

If parts are required to repair the product at your facility, call 1-800-722-3262 or 714-859-8999 and ask for the Parts Department.

When sending your instrument in for repair, complete the form in the back of this manual.

## Reshipment Instructions

Use the original packing material when returning the unit to Racal Instruments for servicing. The original shipping carton and the unit's plastic foam will provide the necessary support for safe reshipment.

If the original packing material is unavailable, wrap the unit in ESD shielding material and use foam to surround and protect the unit.

Reship in either the original or a new shipping carton.

# 6

# Support Offices

## Support Offices

Racal Instruments, Inc.
4 Goodyear Street
Irvine, **CA** 92718-2002
Phone: 714-859-8999
800 RACAL-ATE
800-722-2528
FAX: 714-859-7139
E-Mail: customer_service@rdii.com

Racal Instruments Ltd
480 Bath Road
Slough, Berkshire
SL1 6BE, **England**
Phone: +44 (0) 1628 604455
FAX: +44 (0) 1628 662017

Racal Systems Electronique s.a.
18 Avenue Dutartre
78150 LeChesnay, **France**
Phone: +33 (1) 3955 8888
FAX: +33 (1) 3955 6735

Racal Systems Elettronica Srl
Strada 2-Palazzo C4
20090 Milanofiori Assago
Milan, **Italy**
Phone: +39 (02) 5750 1796
FAX: +39 (02) 5750 1828

Racal Elektronik System GmbH
Frankenforster Strasse 21
51427 Bergisch-Gladbach 1, **Germany**
Phone: +49 2204 92220
FAX: +49 2204 21491

Racal Australia Pty Ltd
3 Powells Road
Brookvale, NSW 2100, **Australia**
Phone: +61 (2) 9936 7000
FAX: +61 (2) 9936 7036

Racal Electronics Pte Ltd
26 Ayer Rajah Crescent, 04-06/07
Ayer Rajah Industrial Estate, **Singapore** 0513
Phone: +65 7792200
FAX: +65 7785400

Racal Instruments, Ltd.
Sun House 13th Floor
181 Des Voeux Road, Central, **Hong Kong**
Phone: +852 281 58663
FAX +852 281 58141

# Appendix A

## Model 3171 Specifications

### General Specifications

Basic Functions

| | |
|---|---|
| Waveform Generator | 1 (main Output) |
| Pulse Generators | 2 (Pulse Generator 1 & 2) |

Physical Format: Single Slot, VXI C Size Module

Front Panel I/O

Inputs

Trig/Gate (Arb): TTL,
0-40MHz, 250V isolated
Clock(Arb): TTL, 40MHz max, 250V Isolated
Trig (PG1 & PG2): TTL
Gate (PG1 & PG2): TTL

Outputs

Waveform (Arb): $Z_{out}$ = 2Ω, 50Ω or 93Ω ,250V Isolated
Cursor/Sync (Arb): TTL, ±15mA, 250V Isolated
Digital Word (Arb): TTL, ±15mA, 250V Isolated
Waveform (PG1 & PG2): $Z_{out}$ = 2Ω, 50Ω or 93Ω
Clock (PG1 & PG2): TTL into 50Ω

VXIbus Interface Data
(Single-slot, message based, VXIbus 1.4)

Software

SCPI, IEEE 488.2, LabVIEW, LabWindows/CVI, VXI*plug&play* WIN Framework

Backplane Signal Support

TTLTrg0-7: Trigger Input, Sync Ouput

Cooling

3.96 I/S @ .45mm$H_20$

Built-In Test (BIT)

Power On BIT: <5 seconds
BIT SCPI Command: 95% fault detection, <30 seconds

Auto-Calibration (after 15 minute power-on)

Stored in Non-Volatile Memory, <3 seconds

Status Lights

Red: Power-On Self-Test Failure
Green: Arb Output On/Off
Green: PG2 Output On/Off
Green: PG1 Output On/Off

Peak Current & Power Consumption

| | +24 | +12 | +5 | -2 | -5.2 | -12 | -24 |
|---|---|---|---|---|---|---|---|
| $1_{Pm}$(A) | .45 | .55 | 2.5 | .03 | .4 | .55 | .45 |
| $1_{Dm}$(mA) ,94 | 1.1 | 1.0 | .63 | .81 | 1.6 | .80 | |

Environmental

Temperature
- Operating: 0-50°C
- Storage: -40°C to +70C

Altitude
- Operating: 10,000 ft.
- Storage: 15,000 ft.

Weight
- 3.5lbs (1.6kg)

EMC (Council Directive 89/336/EEC)
- EN55011, Group 1, Class A
- EN50082-1, IEC 801-2,3,4

MTBF
- 19,407 hrs

## Waveform Generator Requirements:

### MAIN OUTPUT (J1-A7)

| | |
|---|---|
| Isolation: 250 volts DC | Isolated from the VXI chassis Ground |
| Waveforms Types: | Frequency Range: |
| ±Sine, | .001Hz to 10MHz |
| ±Square, | .001Hz to 10MHz |
| ±Triangle, | .001Hz to 10MHz |
| ±Ramp, | .001Hz to 1MHz |
| DC, | |
| Pulse DC, | .001Hz to 40MHz |
| Arbitrary. | Sample Rate: 0.15Hz to 80MHz |
| Output Impedance: | 50 Ω/93 Ω/<2 Ω selectable |
| Voltage: | $22V_{p-p}$ into 50Ω; 12 bit resolution |
| Voltage Accuracy: | ± 0.5% or 15 mV |
| Voltage offset: | 0 to ± 11V |
| Resolution: | 12 bits |
| Accuracy: | ±0.5% or 15 mV |
| Frequency: | as shown above |
| Resolution: | .01% of programmed |
| Accuracy: | ± 0.01% of programmed |
| Burst: | 1 to 65535 waveforms or continuous |
| Memory depth: | 128K (131072) |
| Sample rate: | 0.15Hz to 80MHz max |
| Delay from input trigger: | 170s to 1s |
| Resolution: | 2ns or 0.01% of programmed |
| Accuracy: | ±5ns or 0.1% of programmed |
| Trigger source: | External **(J1-A3)**, VXI TTL Trigger bus 0-7 |
| | Positive or negative edge triggered |
| Output Protection: | The Output is current limited to 400mA. |
| Rise Time | <10 nsec for pulse or squarewave non-programmable (5V swing) |

## Pulse Generator #1: (J2-A1)

OUTPUT:

| | |
|---|---|
| Isolation: | NOT isolated from the VXI chassis ground |
| Amplitude: | ± 11V into 50 Ω load |
| Resolution: | 5.4mV |
| Accuracy: | ±0.5% or 15mV (whichever is greater) |
| Offset: | 0 to ± 11V (Amplitude + offset not to exceed ± 11V) |
| Resolution: | 10mV |
| Accuracy: | ±0.5 % or 15mV (whichever is greater) |
| Frequency: | 0.5Hz to 50MHz |
| Resolution: | .01% of programmed |
| Accuracy: | 0.01% of programmed |
| Pulse Width: | 10ns to 1s |
| Resolution: | 2ns or .01% of programmed whichever greater |
| Accuracy: | ±0.1% or ±5ns (whichever is greater) |
| Rise & Fall times: | 5ns to 800µs (5 Ranges)<br>Range 1: 5ns to 150ns (both rise and fall time programmed to the same value controlled by rise time value)<br>Range 2: 150ns to 1.5µs (independent control of both rise and fall time)<br>Range 3: 1.5µs to 13.5µs (independent control of both rise and fall time)<br>Range 4: 13.5µs to 112.5µs (independent control of both rise and fall time)<br>Range 5: 112.5µs to 800µs (independent control of both rise and fall time) |
| Pulse delay: | 130ns to 1s Delay from input trigger (as Relates to fastest Ramps only) |
| Resolution: | 2ns or .01% of programmed whichever is greater |
| Accuracy: | ±0.1% or ±5ns whichever is greater |
| Trigger source: | External **(J2-A3)**, VXI TTL Trigger bus 0-7<br>Positive or negative edge triggered |
| Burst: | 1 to 65535 pulses or continuous<br>Normal or inverted pulse, software selectable |
| Output Protection: | The Output is current limited to 400mA |

## Pulse Generator #2: (J2-A5)

| | |
|---|---|
| Isolation: | NOT isolated from the VXI chassis ground |
| Amplitude: | ± 11V into 50 Ω load |
| Resolution: | 5.4mV |
| Accuracy: | ±0.5% or 15mV whichever greater |
| Offset: | 0 to ± 11V (Amplitude + offset not to exceed ± 11V) |
| Resolution: | 5.4mV |
| Accuracy: | ±0.5% or 15mV (whichever is greater) |
| Frequency: | 0.5Hz to 50MHz |
| Resolution: | .01% of programmed |
| Accuracy: | ± .01% of programmed |
| Pulse Width: | 10ns to 1s |
| Resolution: | 2ns or .01% of programmed whichever greater |
| Accuracy: | ±0.1% or ±5ns whichever greater |
| Rise & Fall times: | 5ns to 40ns (both rise and fall time are programmed to the same value controlled by rise time value) |
| Pulse delay: | 130ns to 1s Delay from input rigger |
| Resolution: | 2ns or .01% of programmed whichever greater |
| Accuracy: | ±0.1% or ±5ns whichever is greater |
| Trigger source: | External **(J2-A3)**, VXI TTL Trigger bus 0-7<br>Positive or negative edge triggered |
| Burst: | 1 to 65535 pulses or continuous, normal or inverted pulse, software selectable |
| Output Protection: | The Output is current limited to 400mA. |

## Gate Input for Pulse Generators #1 & #2 (J2-A2)

| | |
|---|---|
| Input threshold: | TTL Level<br>Input is pulled up through 4.7K resistor to +5V (Input is common for PG1 & PG2) |
| Gate Input: | ±state, software selectable to gate on the Pulse Gen. Pulses appear at output, when Gate is true after programmable delay. When the Gate input goes false, the last complete pulse is output. |

## Trigger Input for Pulse Generators #1 & #2 (J2-A3)

| | |
|---|---|
| Input threshold: | TTL Level<br>Input is pulled up through 4.7K resistor to +5V (Input is common for PG1 & PG2) |
| Trigger Input: | ± edge, software selectable to trigger Pulse Gen. Output appears after programmable delay. |

## CLKOUT (J2-A4)

| | |
|---|---|
| Output: | TTL Level into 50 Ω load<br>PG1 or PG2 can be selected to output on this pin. |

**Page Changed 8/3/98**

## DIGITAL WORD OUTPUT

| Memory Bit: | Output Pin: |
|---|---|
| M15 - to VXI trigger (Most Significant Bit) | |
| M14 - MEMSQW (for expansion card) | |
| M13 - CURSOR OUT | **J1-5** |
| M12 - SYNC OUT | **J1-4** |
| M11 - DAC D1 (MSB) | |
| M10 - DAC D2 | |
| M9 - DIG9 | **J1-16** |
| M8 - DIG8 | **J1-15** |
| M7 - DIG7 | **J1-14** |
| M6 - DIG6 | **J1-13** |
| M5 - DIG5 | **J1-12** |
| M4 - DIG4 | **J1-11** |
| M3 - DIG3 | **J1-10** |
| M2 - DIG2 | **J1-9** |
| M1 - DIG1 | **J1-8** |
| M0 - DIG0 | **J1-7** |

| | |
|---|---|
| Digital Word width: | 12-bit |
| Output Level: | TTL (source & sink 15mA) |
| Availability: | Not available simultaneously with MAIN OUT |
| Frequency: | 0.15Hz to 40 MHz |
| Pulse width: | 12.5ns to 6.6s per memory pattern |
| Memory Depth | 128K |
| Sample rate: | 80MHz max |

## Am In: (J1-A1)

When selected allows input to amplitude modulate **MAIN OUTPUT (J1-A7).**

| | |
|---|---|
| Input voltage: | ±10V |
| Bandwidth: | 400Khz |
| Input Impedance: | 10K Ω |

## TRIG / GATE INPUT: (J1-A3)

Input may be operated as Trigger input or Gate input, Software selectable.
Triggers on + or - edge. Software selectable
Gate on + or - State, Software selectable ; When gate is removed last cycle will be completed.

| | |
|---|---|
| Input threshold: | TTL level (pulled up to +5v through 4.7k Ω resistor) |
| Maximum input frequency: | 40MHz |

## EXTCLK: (J1-2)

External Clock input. When selected can be used as the clock source for the ARB. Digital Values are output on the rising edge. Analog levels are output on the falling edge.

| | |
|---|---|
| Input threshold: | TTL level (pulled up to +5V through 4.7K Ω resistor) |
| Maximum input frequency: | 40MHz |

Racal Instruments

## REPAIR AND CALIBRATION REQUEST FORM

To allow us to better understand your repair requests, we suggest you use the following outline when calling and include a copy with your instrument to be sent to the Racal Repair Facility.

Model_____ Serial No._____ Date_____

Company Name_____ Purchase Order #_____

Billing Address_____
City

State/Province Zip/Postal Code Country

Shipping Address_____
City

State/Province Zip/Postal Code Country

Technical Contact_____ Phone Number ( )_____
Purchasing Contact_____ Phone Number ( )_____

1. Describe, in detail, the problem and symptoms you are having. Please include all set up details, such as input/output levels, frequencies, waveform details, etc.

2. If problem is occurring when unit is in remote, please list the program strings used and the controller type.

3. Please give any additional information you feel would be beneficial in facilitating a faster repair time (i.e., modifications, etc.)

4. Is calibration data required? Yes No (please circle one)

Call before shipping
Note: We do not accept "collect" shipments.

Ship instruments to nearest support office listed on back.

# Support Offices

**Racal Instruments, Inc**.
4 Goodyear St., Irvine, CA  92718-2002
Tel: (800) RACAL-ATE, (949) 859- 8999, FAX:  (949) 859-7309

**Racal Instruments, Ltd.**
480 Bath Road, Slough, Berkshire, SL1 6BE, United Kingdom
Tel: +44 (0) 1628 604455; FAX: +44 (0) 1628 662017

**Racal Systems Electronique**
18 Avenue Dutartre, 78150 LeChesnay, France
Tel: +33 (1) 3923 2222; FAX: +33 (1) 3923 2225

**Racal Systems Elettronica Srl.**
Strada 2-Palazzo C4, 20090 Milanofiori Assago, Milan, Italy
Tel: +39 (02) 5750 1796; FAX +39 (02) 5750 1828

**Racal Elektronik System GmbH.**
Frankenforster Strasse 21, 51427 Bergisch-Gladbach 1, Germany
Tel:+49 2204 92220; FAX: +49 2204 21491

**Racal Australia Pty. Ltd.**
3 Powells Road, Brookvale, NSW 2100, Australia
Tel: +61 (2) 9936 7000, FAX: +61 (2) 9936 7036

**Racal Electronics Pte. Ltd.**
26 Ayer Rajah Crescent, 04-06/07 Ayer Rajah Industrial Estate, Singapore 0513.
Tel: +65 7792200, FAX: +65 7785400

**Racal Instruments, Ltd.**
Room 1213 Nan Fung Centre, Tsuen Wan, New Territories, Hong Kong
Tel: +852 2405 5500, FAX: +852 2416 4335