Power Meter

4421A

Operation Manual

Instruction Book Part Number 920-4421A Rev. E

Safety Precautions

The following are general safety precautions that are not necessarily related to any specific part or procedure, and do not necessarily appear elsewhere in this publication. These precautions must be thoroughly understood and apply to all phases of operation and maintenance.

WARNING

Keep Away From Live Circuits

Operating Personnel must at all times observe general safety precautions. Do not replace components or make adjustments to the inside of the test equipment with the high voltage supply turned on. To avoid casualties, always remove power.

WARNING

Do Not Service Or Adjust Alone

Under no circumstances should any person reach into an enclosure for the purpose of service or adjustment of equipment except in the presence of someone who is capable of rendering aid.

WARNING

Safety Earth Ground

An uninterruptible earth safety ground must be supplied from the main power source to test instruments. Grounding one conductor of a two conductor power cable is not sufficient protection. Serious injury or death can occur if this grounding is not properly supplied.

WARNING

Resuscitation

Personnel working with or near high voltages should be familiar with modern methods of resuscitation.

WARNING

Remove Power

Observe general safety precautions. Do not open the instrument with the power on.

Safety Symbols

WARNING

Warning notes call attention to a procedure, which if not correctly performed, could result in personal injury.

CAUTION

Caution notes call attention to a procedure, which if not correctly performed, could result in damage to the instrument.

Note: *Calls attention to supplemental information.*

Warning Statements

The following safety warnings appear in the text where there is danger to operating and maintenance personnel and are repeated here for emphasis.

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is applied.
Leaking RF energy is a potential health hazard.

See page 26 and 28

WARNING

To avoid personal injury, disconnect the power cord from the AC line before performing any maintenance.

See page 67

WARNING

The Bird 4421A contains no user-serviceable parts.
Do not open the cover.

See page 67

Caution Statements

The following equipment cautions appear in the text and are repeated here for emphasis.

CAUTION

Do not exceed the RF Power or RF frequency specifications of the RF Power Sensor.

See page 26

CAUTION

Do not store the 4421A outside the following temperature ranges

-10° to 50°C, ≤ 1 month

-10° to 35°C, ≤ 6 months

-10° to 25°C, > 6 months

Storage outside these temperature ranges may degrade battery capacity.

See page 77

Safety Statements

USAGE

ANY USE OF THIS INSTRUMENT IN A MANNER NOT SPECIFIED BY THE MANUFACTURER MAY IMPAIR THE INSTRUMENT'S SAFETY PROTECTION.

USO

EL USO DE ESTE INSTRUMENTO DE MANERA NO ESPECIFICADA POR EL FABRICANTE, PUEDE ANULAR LA PROTECCIÓN DE SEGURIDAD DEL INSTRUMENTO.

BENUTZUNG

WIRD DAS GERÄT AUF ANDERE WEISE VERWENDET ALS VOM HERSTELLER BESCHRIEBEN, KANN DIE GERÄTESICHERHEIT BEEINTRÄCHTIGT WERDEN.

UTILISATION

TOUTE UTILISATION DE CET INSTRUMENT QUI N'EST PAS EXPLICITEMENT PRÉVUE PAR LE FABRICANT PEUT ENDOMMAGER LE DISPOSITIF DE PROTECTION DE L'INSTRUMENT.

IMPIEGO

QUALORA QUESTO STRUMENTO VENISSE UTILIZZATO IN MODO DIVERSO DA COME SPECIFICATO DAL PRODUTTORE LA PROZIONE DI SICUREZZA POTREBBE VENIRNE COMPROMESSA.

SERVICE

SERVICING INSTRUCTIONS ARE FOR USE BY SERVICE - TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING UNLESS QUALIFIED TO DO SO.

SERVICIO

LAS INSTRUCCIONES DE SERVICIO SON PARA USO EXCLUSIVO DEL PERSONAL DE SERVICIO CAPACITADO. PARA EVITAR EL PELIGRO DE DESCARGAS ELÉCTRICAS, NO REALICE NINGÚN SERVICIO A MENOS QUE ESTÉ CAPACITADO PARA HACERIO.

WARTUNG

ANWEISUNGEN FÜR DIE WARTUNG DES GERÄTES GELTEN NUR FÜR GESCHULTES FACHPERSONAL.

ZUR VERMEIDUNG GEFÄHRLICHE, ELEKTRISCHE SCHOCKS, SIND WARTUNGSARBEITEN AUSSCHLIEßLICH VON QUALIFIZIERTEM SERVICEPERSONAL DURCHZUFÜHREN.

ENTRENTIEN

L'EMPLOI DES INSTRUCTIONS D'ENTRETIEN DOIT ÊTRE RÉSERVÉ AU PERSONNEL FORMÉ AUX OPÉRATIONS D'ENTRETIEN. POUR PRÉVENIR UN CHOC ÉLECTRIQUE DANGEREUX, NE PAS EFFECTUER D'ENTRETIEN SI L'ON N'A PAS ÉTÉ QUALIFIÉ POUR CE FAIRE.

ASSISTENZA TECNICA

LE ISTRUZIONI RELATIVE ALL'ASSISTENZA SONO PREVISTE ESCLUSIVAMENTE PER IL PERSONALE OPPORTUNAMENTE ADDESTRATO. PER EVITARE PERICOLOSE SCOSSE ELETTRICHE NON EFFETTUARRE ALCUNA RIPARAZIONE A MENO CHE QUALIFICATI A FARLA.

About This Manual

This manual covers the operating & maintenance instructions for the following models:

4421A

Changes to this Manual

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our Solon, Ohio factory. This manual may be periodically updated. When inquiring about updates to this manual refer to the part number and revision on the title page.

Chapter Layout

Introduction — Describes the features of the RF Power Meter.

Setup — Includes unpacking and equipment setup.

Operating Instructions — Identifies steps required to power on, use, and power off the Power Meter.

Troubleshooting — Provides limited troubleshooting instructions for commonly encountered problems.

Maintenance — Lists routine maintenance tasks as well as storage and shipping instructions.

Specifications — Provides the specifications for the Bird RF Power Meter.

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Chapter 1 Introduction

The Bird 4421A Power Meter is used with Bird power sensors to measure RF power.

General Description

The 4421A Power Meter is designed to be used with the Bird Power Sensors as shown in Table 1. The 4421A is equipped with a touchscreen interface. There are several models of the 4421A that feature extended capabilities and enhancements beyond the base model, see "4421A Options" on page 2.

Figure 1 Bird 4421A Power Meter Assembly

Table 1 Compatible Power Sensors

Sensor Type	Bird RF Sensor Model Number	4421A Model
Directional Power Sensors (DPS)	4021, 4022, 4023, 4024, 4025, 4027, 4028	All Models
Pulse Sensors	7023, 7025, 7027, 7037 Series Sensors	4421A-12-11-1

4421A Options

There are several 4421A models, as shown in Table 2. The models are enabled by the installation of a firmware license, thus a base model can be enhanced with additional features by the factory installation of a new license. The following options are available for the 4421A.

One Sensor Operation — One Sensor models, will display the RF power measurements of a single RF Power Sensor connected to one of the Sensor connectors, see "Controls and Indicators" on page 3.

Two Sensor Operation — Two Sensor models, will display the RF power measurements of two RF Power Sensors simultaneously when both sensors are connected to the Sensor connectors.

Remote Operation — Models which include the remote interfaces allow the 4421A's operation to be controlled from a remote computer/controller and, RF Sensor measurements from sensor(s) connected to the 4421A may be received on the remote computer. This option is available as shown in Table 2.

> **Note:** *There are two protocols supported by the 4421A for remote operation, the legacy 4421 protocol and the new SCPI protocol. Either command protocol may be used to remotely access a single sensor. To remotely access two sensors, you must use the SCPI protocol.*

Table 2 4421A Model List

Model Number	Number of Sensors	Remote Interfaces
4421A-10-00-0	One Serial Sensor	None
4421A-20-00-0	Two Serial Sensors	None
4421A-10-11-0	One Serial Sensor	RS-232, Ethernet
4421A-20-11-0	Two Serial Sensors	RS-232, Ethernet
4421A-12-11-1†	One Serial Sensor or Two USB Sensors	RS-232, Ethernet

† Measurement data will only be displayed for the first two sensors connected to the unit.

> **Note:** *Licenses may be purchased to implement increased capabilities of higher level models.*

Optional Rack Mount Kit

A rack mounting kit (Bird Part Number 4421A-RM1) is available for the 4421A, see Appendix 3, Optional Rack Mount on page 91.

Controls and Indicators

Figure 2 Models 4421A-10-00-0, 4421A-20-00-0, 4421A-10-11-0, 4421A-20-11-0

Figure 3 Model 4421A-12-11-1

Item	Indicator	Description
1	Display/Touch Screen	Displays Power Sensor information and acts as the user interface.
2	Power Switch	Used to apply and remove power from the unit. Illuminated ring indicates power is applied to the unit. • Normal Power ON/OFF - Press and release (short press) the power button. • Forced Power Down - Press and hold (long press) the power button for 3 seconds.

3	AC Power Input Connector	Power input connector (C-14, male), 100-240 VAC, 50/60 Hz, with integrated fuse holder, requires 1A, 5x20mm, slow-blow fuses.
4	Ethernet Connector	Ethernet connector provides access to the device's web UI and firmware update capability.
5	RS-232 Serial Port	The serial port allows computer interface capability with the 4421A using either the "4421A SCPI Commands" on page 29 or the "Legacy RS-232 Commands" on page 58 . Either command protocol may be used to remotely access a single sensor. On systems capable of two sensor operation the "4421A SCPI Commands" on page 29 must be used to remotely access two sensors.
6	Sensor Connectors, 402X Model Sensors	**4421A-10-00-0, 4421A-20-00-0, 4421A-10-11-0, 4421A-20-11-0** Two serial sensor cable connectors. Either connector may be used on one sensor models. One or both may be used on two sensor models. **4421A-12-11-1** One serial sensor cable connector. See "4421A Options" on page 2.
7	Sensor Connectors, 70XX Model Sensors	**4421A-12-11-1** Two USB sensor cable connectors.

Chapter 2 User Interface

The 4421A Power Meter supports the 402x series power sensors and the 70xx Pulse Power Sensors.

There are two different display types available to support the functionality of each sensor type.

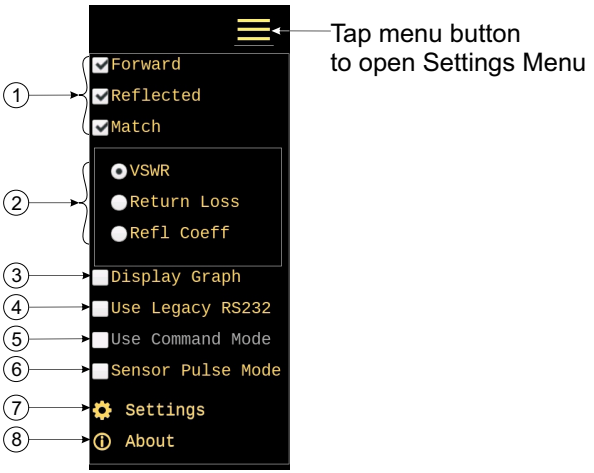
Average Power Display: The average power display is available for all supported sensors. This display is the default view.
See Chapter 3, Average Power Display on page 7 for detailed description of the Average Power Display.

Pulse Power Display: The Pulse Power Display is available for 70xx Pulse Power Sensors. The pulse power display is selected on the Settings Menu.
See Chapter 4, Pulse Power Display on page 13 for detailed description of the Pulse Power Display.

Settings Menu

The settings menu is used to select what information will appear on the 4421A's display as well as configuration of the LAN and Serial Ports. Figure 4 describes the options available via the setting menu.

Figure 4 Settings Menu



Item	Title	Description
1	Measurements	Check boxes used to select which measurements are displayed for the attached sensor(s).

2	Match Format	Radio buttons used to select the format for the match measurement. Match measurement is only displayed on the average power display, see "Average Power Display" on page 7.
3	Display Graph	When check box is selected, a graph is displayed on the screen with the associated measurements. **Note:** *The graph option is not available when the Sensor Pulse Mode is selected*
4	Use Legacy RS232	When check box is selected, the 4421A will accept the RS-232 command set used with legacy 4421 power meters. See Chapter 9, Legacy RS-232 Commands on page 58.
5	Use Command Mode	Command mode emulates the command mode dip switch setting from the legacy 4421 power meters RS-232 command set.
6	Sensor Pulse Mode	This option is used to display pulse power display. When selected, the pulse measurement features are displayed, see "Pulse Power Display" on page 13. When not selected, the standard average power measurements are displayed, see "Average Power Display" on page 7.
7	Settings Icon	When tapped, a menu is displayed for selecting the LAN or Serial configuration menus. • When LAN is tapped, the 4421A's IP address configuration menu is displayed. See "IP Address Settings Display" on page 21. • When Serial is tapped, the 4421A's serial port settings dialog box is displayed. See "Serial Port Setup" on page 22.
8	About	Displays the units Model Number, Serial Number, and Firmware ID. Compliance and software licensing information may also be viewed from the About menu.

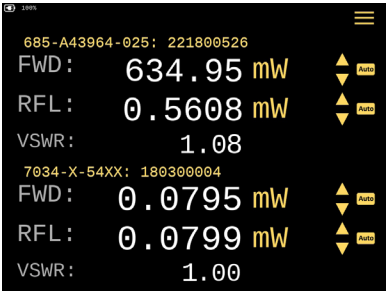
Chapter 3 Average Power Display

The 4421A display is capable of displaying the measurement information from one or two sensors simultaneously (4421A model dependent), see Figure 5. The display may be configured to display the following measurements from a sensor:

- Forward Power
- Reflected Power
- VSWR
- Return Loss
- Reflection Coefficient

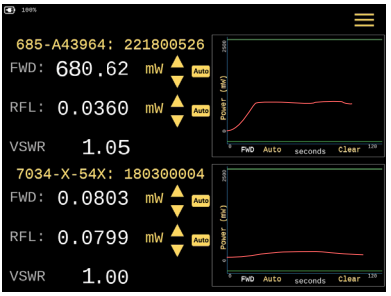
Figure 5 Sensor Measurements Display

One Sensor Connected



Two Sensors Connected

One Sensor with Graph



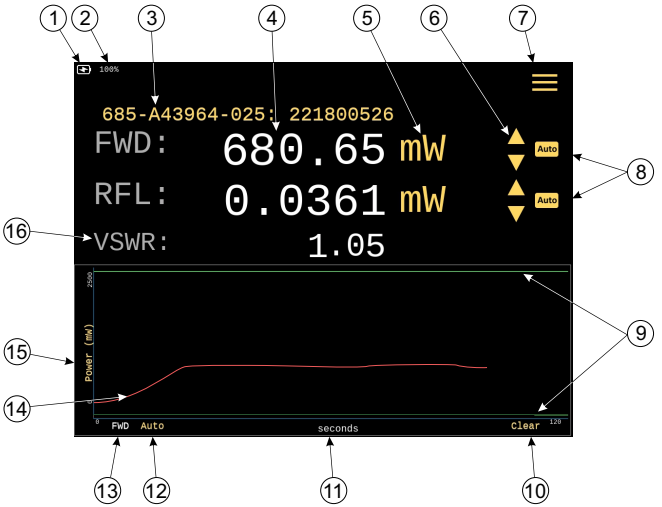
Two Sensors with Graphs

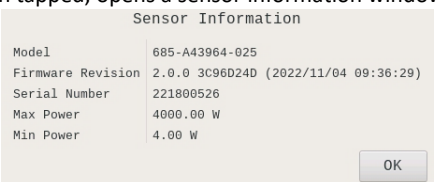
Note: *Dual-sensor display is only available if the dual-sensor license has been purchased and activated. See* "4421A Options" on page 2.

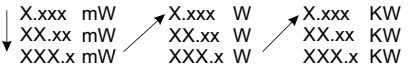
Average Power Display Controls and Indicators

The display is used for presenting information and controlling the behavior of the 4421A. The controls are those items displayed on the screen, that, when tapped cause a change in the 4421A's behavior. Controls can be identified by their color, on screen controls are yellow. The table in Figure 6 describes the on screen controls and indicators.

Figure 6 Display Controls



Item	Indicator	Description
1	Battery/AC Power indicator	When connected to AC power, and battery is below 100%, the charge indicator is displayed.  When connected to AC power and battery is fully charged, a facsimile of an AC Power Plug is displayed.  When on battery power, the charge level of the battery in displayed. 
2	Battery Remaining	Indicates the remaining charge of the internal battery.
3	Sensor model/SN	The sensor model number and serial number are displayed above the sensor's measurement data. When tapped, opens a sensor information window. 

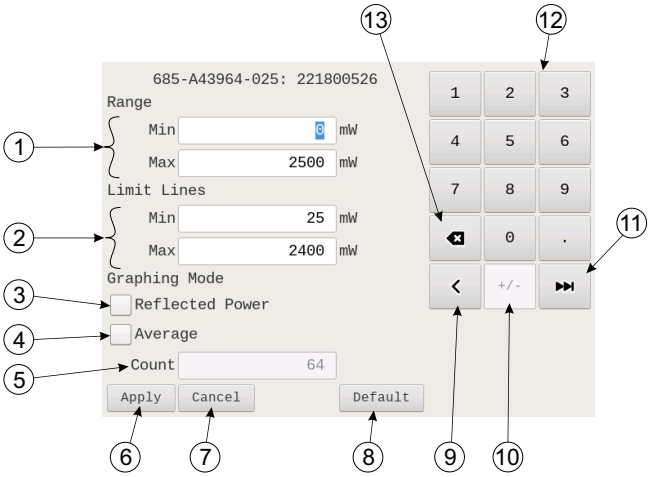
4	Forward and Reflected Power	The sensor readings for Forward and Reflected power may be displayed in milliwatts, Watts, Kilowatts, or dBm. In overrange situations, the 4421A will display the word "RANGE" in place of the actual power reading. When Reflected power measurement is dBm, **-inf** dBm means the reflected power was 0 W (exactly).
5	Measurement Unit	The 4421A will display the signal measurements in **Watts** or **dBm**.
6	Manual Range Controls	Up and Down arrows are used to change the scale of the displayed power readings.  **Note:** *Stops automatic scaling. Auto indicator (item 7) turns off.* **Note:** *Manual Range not available when measurement unit is dBm.*
7	Settings Menu	The settings menu is used to configure what measurement information is displayed, select Pulse Sensor display, and to configure LAN and Serial Port settings. See "Settings Menu" on page 5.
8	Auto Range	Auto - When button is on, indicates range scale is set to auto. Auto - When button is off, indicates range scale is in manual control, see item 6. **Note:** *Auto Range not available when measurement unit is dBm.*
9	Limit Lines	Min and max limit lines (green horizontal lines) may be set to display in the graph's display area. The position of the two lines are set in the "Graph Settings Menu" on page 11.
10	Clear	Tapping Clear discards the graph's accumulated data and resets time scale to 60 seconds.
11	Time Scale	The graph's time scale auto expands as data accumulates with the following scales: • 60, 120, 240, 480 seconds • 15, 30, 60, 120, 240 minutes • 8, 16, 24 hours Data accumulation stops at 24 hours. When graph is turned off then back on the accumulated data is discarded and time scale resets to 60 second span.

12	Auto	Tap Auto to adjust the graph's power scale to fit accumulated data.
13	Plot Source	Indicates the RF Power Measurement, forward or reflected, being used as the source for the power plot. Source is set in the "Graph Settings Menu" on page 11.
14	Measurement Trace	RF Power is plotted on the graph in watts on the vertical axis (y) versus time in the horizontal axis (x). The trace is displayed as a red line. The graph accumulates data at 1 sample/sec as long as a sensor is connected. • If no sensor is connected, accumulation pauses until a sensor is connected. • The graph does not account for any gap while a sensor is disconnected. That is accumulation will resume as if only 1 second has elapsed since the last sample. • The graph does not account for mixing sensors (i.e. switching sensors in the middle of accumulation). • Plotted data is either raw data or averaged data. Mode is set in the "Graph Settings Menu" on page 11.
15	Power	Power scale defaults to the min/max power specification for a connected sensor. The measurement unit will match that selected by the measurement unit selection (see item 4). • Power scale may be adjusted automatically (see item 11, Auto) or via the Graph Settings Menu • Tap to open power dialog.
16	VSWR / Return Loss/ Reflection Coefficient	This line on the display can be set to display one of three measurements: VSWR, Return Loss, or Reflection Coefficient. The Settings Menu is used to select which measurement is displayed. **+inf** will be displayed if Reflected power = Forward power (an uncommon scenario, but could occur with an open circuit).

Graph Settings Menu

The Graph Settings menu is accessed by tapping the power scale on the graph. Figure 7 describes the options in the Graph Settings menu.

Figure 7 Graph Settings Menu



Item	Title	Description
1	Range	Text entry boxes for the entry of Min and Max range for the Power Scale on the Graph. Min and Max values specify the upper and lower limit of the power scale of the graph.
2	Limit Lines	Text entry boxes for the entry of Min and Max value for the limit lines displayed on the Graph. Two horizontal limit lines may be set to user specified levels on the power scale. The Min value sets the location of the lower limit line, while the Max value sets the location of the upper limit line.
3	Reflected Power	When checked, reflected RF Power measurement is plotted on the graph. When unchecked, forward RF Power measurement is plotted on the graph.
4	Average	When Average is checked, each point plotted on the graph is the arithmetic mean of several raw graph samples. number of samples used is specified by the count (5).

5	Count	Numeric entry for specifying the number of samples used for the moving average. Applied when Average On is selected.
6	Apply	When tapped, applies all menu changes and closes the dialog box.
7	Cancel	When tapped, cancels all menu changes and closes the dialog box.
8	Default	When tapped, sets all text entry boxes in the dialog box to Default values.
9	Backspace	When tapped, while entering a new value in a text box, deletes the character at the end of the entry. Deletes entire value when highlighted.
10	Plus/Minus	If power on power graph is in dBm units, it can be used to make power values on the power graph positive or negative. If power units on the graph is W, kW, or mW, this button is disabled.
11	Cursor Advance	When tapped, advances cursor to next text entry box without effecting entered values.
12	Keypad	Numerical keypad used to enter values into the varies text boxes within the dialog box.
13	Clear Text	When tapped, clears all characters in a selected text box.

Chapter 4 Pulse Power Display

The 4421A display is capable of displaying the measurement information from one or two sensors simultaneously (4421A model dependent), see Figure 8.

The Pulse Power Display may be configured to display the following measurements from a sensor:

- Forward Power
- Reflected Power
- Frequency

Pulse Gate Configuration

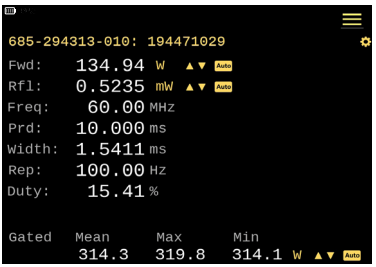
- Pulse Period
- Pulse Width
- Pulse Repetition Frequency
- Duty Cycle
- Pulse Mean Power
- Pulse Maximum Power
- Pulse Minimum Power

Triggered Gate Configuration

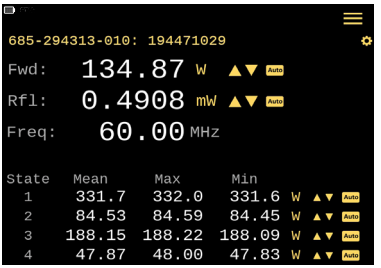
- Gate Mean Power (1 to 4 states)
- Gate Maximum Power (1 to 4 states)
- Gate Minimum Power (1 to 4 states)

When a sensor is first connected, the 4421A reads the sensor configuration from the sensor.

Figure 8 Sensor Measurements Display



Pulse Gate Configuration

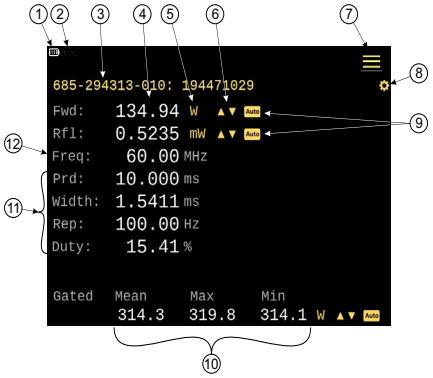


Triggered Gate Configuration

Note: *Dual-sensor display is only available if the dual-sensor license has been purchased and activated. See* "4421A Options" on page 2.

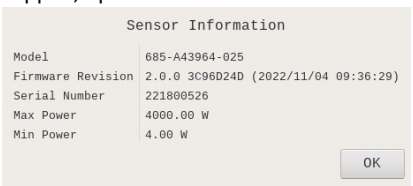
The display is used for presenting information and controlling the behavior of the 4421A. The controls are those items displayed on the screen, that, when tapped cause a change in the 4421A's behavior. Controls can be identified by their color, on screen controls are yellow. The table in Figure 6 describes the on screen controls and indicators.

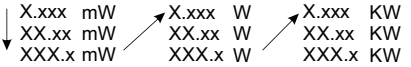
Figure 9 Display Controls



Pulse Gate Configuration

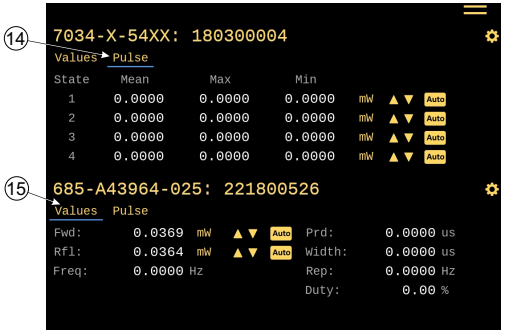
Triggered Gate Configuration

Item	Indicator	Description
1	Battery/AC Power indicator	When connected to AC power, and battery is below 100%, the charge indicator is displayed.  When connected to AC power and battery is fully charged, a facsimile of an AC Power Plug is displayed.  When on battery power, the charge level of the battery in displayed. 
2	Battery Remaining	Indicates the remaining charge of the internal battery.
3	Sensor model/SN	The sensor model number and serial number are displayed above the sensor's measurement data. When tapped, opens a sensor information window. 

4	Forward and Reflected Power	The sensor readings for Forward and Reflected power may be displayed in milliwatts, Watts, Kilowatts, or dBm. In overrange situations, the 4421A will display the word "RANGE" in place of the actual power reading. When Reflected power measurement is dBm, **-inf** dBm means the reflected power was 0 W (exactly).
5	Measurement Unit	The 4421A will display the signal measurements in **Watts** or **dBm**.
6	Manual Range Controls	Up and Down arrows are used to change the scale of the displayed power readings.  **Note:** *Stops automatic scaling. Auto indicator (item 7) turns off.* **Note:** *Manual Range not available when measurement unit is dBm.*
7	Settings Menu	The settings menu is used to configure what measurement information is displayed, and to configure LAN and Serial Port settings. See "Settings Menu" on page 5.
8	Pulse Power Sensor Settings	The Pulse Power Sensor Settings dialog box is used to configure the pulse power sensor display and configure the Pulse Power sensor. See "Pulse Power Sensor Configuration Settings" on page 17.
9	Auto Range	 - When button is on, indicates range scale is set to auto.  - When button is off, indicates range scale is in manual control, see item 6. **Note:** *Auto Range not available when measurement unit is dBm.*
10	Pulse Measurement	The Minimum, Maximum and Mean values for each measured pulse gate.
11	Single Pulse Measurements	The following parameters are display when the pulse gate configuration is selected. These values are not displayed in the triggered gate configuration. • Pulse Period • Pulse Width • Repetition Rate • Duty Cycle
12	Frequency	Frequency of the measured signal.

13	Gated Pulse Measurements	The Minimum, Maximum and Mean values for each configured triggered gate. See "Pulse Power Sensor Configuration Settings" on page 17.

Figure 10 Dual Pulse Sensor Display



Dual Sensor Tabbed Views

Item	Indicator	Description
14	Pulse Tab	The Pulse tab displays the pulse measurements for the associated sensor. Multiple states can be displayed when Gated Pulse measurement is selected. If pulse gate configuration is selected, a single row of pulse measurement results are displayed.
15	Values Tab	The values tab displays the Forward and Reflected power level as well as the frequency. If pulse gate configuration is selected then Pulse Period, Pulse Width, Repetition Rate, and Duty Cycle are also displayed.

Pulse Power Sensor Configuration Settings

The options in the configuration dialog vary with sensor model and mode selection, figures 11, 12, and 13 and associated table illustrate the differences.

Figures 11 and 12 show the configuration options for the majority of Pulse Sensors, figure 13 shows the configuration options for the 7023 and 7025 sensors.

When a sensor is first connected, the 4421A reads the sensor configuration from the sensor. When the configuration dialog is displayed, it shows the configuration settings most recently read from or programmed to the sensor.

Figure 11 Pulse Sensor Triggered Gate Configuration Dialog Box

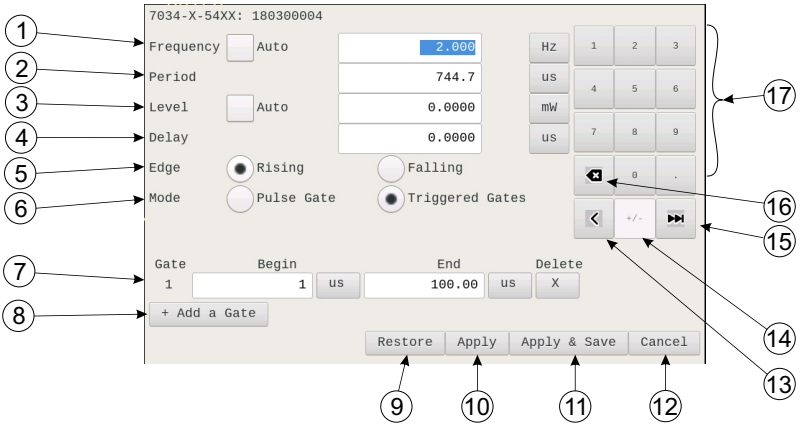


Figure 12 Pulse Sensor Pulse Gate Configuration Dialog Box

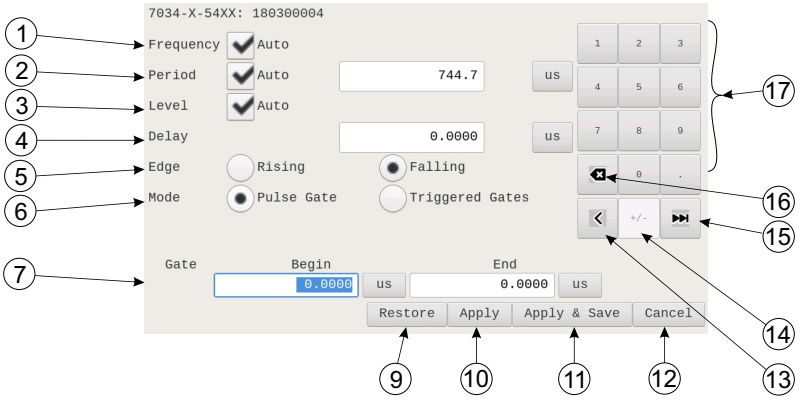
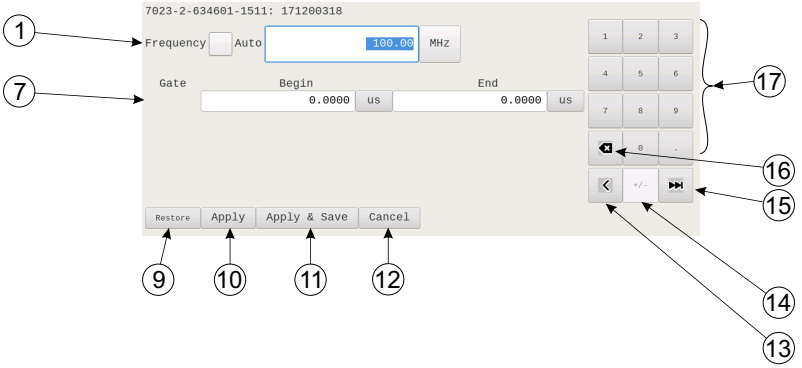


Figure 13 7023/7025 Pulse Sensor Configuration Dialog Box



Item	Indicator	Description
1	Frequency	If auto frequency is on, the sensor attempts to measure the frequency of the signal and uses this measured frequency to look up calibration coefficients. If auto frequency is off, The frequency of the input RF must be entered in the provided text box, the frequency entered must be between min and max frequency for the specific sensor model. The sensor uses this frequency to look up calibration coefficients.
2	Period	Enables/Disables auto pulse period measurement in the sensor. If auto period is on, the sensor attempts to determine the period using an iterative algorithm on a captured sample buffer. All other pulse measurements (repetition rate, width, & duty cycle) depend on this measurement of the period. **Note:** *Period must be manually set when trigger gate mode is selected.*
3	Level	If auto trigger level is on, the sensor will set the trigger level midway between the min and max samples in the buffer. If auto trigger level is off, the desired trigger level in Watts. the sensor looks for the signal to cross this level (either rising or falling depending on the slope setting). The max trigger level should be set below the max power for the sensor (see the sensor specs for this value).
4	Delay	Delay shifts the start of the Power Waveform relative to the trigger event. The limits shown (+/- the period) will work for most sensors.

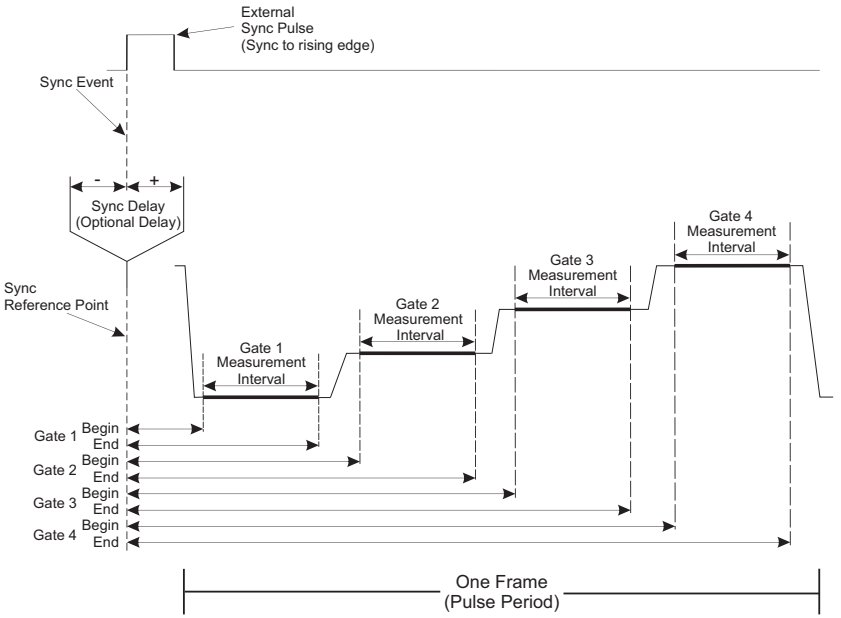
5	Edge	Sets the polarity of the trigger event for both external and internal triggers. Falling means the sensor will look for a falling edge, rising means the sensor will look for a rising edge.
6	Model	Allows for the selection of Pulse gate and triggered gates. **Pulse Gate** - controls the behavior of the automatic gated pulse measurements in the Pulse Sensors. These measurements are designed for use with simple 2 state pulses, and should not be used for pulsed signals with more than 2 states. **Triggered Gate** - controls the behavior of up to four triggered gate states in a multi-state pulse. The Pulse Sensor will calculate the mean, min, and max power for each enabled state. Note that Begin/End times for triggered gates are set relative to the sync point of the sweep. The combined width of all the states should be less than the period specified for the sweep.
7	Gate definition	The begin and end times for up to four pulses. Begin time - Sets the left edge of the state relative to the sync point. End time - Sets the right edge of the state relative to the sync point. See "Triggered Gate Definition" on page 20.
8	Add Gate	The add gate button is used to add begin and end pulse definition times. Up to four gates may be added.
9	Restore	Restore reloads the default file to the dialog (but does not send anything to the sensor).
10	Apply	When tapped, Apply sends the settings from the dialog to the sensor.
11	Apply & Save	When tapped, Apply & Save sends the settings from the dialog to the sensor and saves the settings from the dialog to a default file on the 4421A. **Note:** *The 4421A has only one automatic default file, and is not able to save multiple sensor configurations.*
12	Cancel	When tapped, Cancel closes the dialog without making any changes to the sensor. Any changes made in the dialog will be discarded, and the next time the dialog is opened, it will show the state of the sensor.
13	Backspace	When tapped, while entering a new value in a text box, deletes the character at the end of the entry. Deletes entire value when highlighted.

14	Plus/Minus	If power on power graph is in dBm units, it can be used to make power values on the power graph positive or negative. If power units on the graph is W, kW, or mW, this button is disabled.
15	Cursor Advance	When tapped, advances cursor to next text entry box without effecting entered values.
16	Clear Text	When tapped, clears all characters in a selected text box.
17	Keypad	Numerical keypad used to enter values into the varies text boxes within the dialog box.

Triggered Gate Definition

When triggered gate option is selected for the pulse sensor operation, each gate must be defined. Up to four gates may be defined for a pulse period. Each gate begin and end time should correspond with a region within the pulse period, as shown in "Triggered Gate Definition" on page 20.

Figure 14 Triggered Gate Definition



Chapter 5 Remote Interfaces

Models with the remote interface capabilities have the option for control and measurement reporting over those interfaces.

Ethernet Interface

The Ethernet interface uses a standard RJ-45 connector. The Bird 4421A's Ethernet interface serves two purposes.

Webpage User Interface — the webpage user interface provides for firmware updates and touchscreen calibration reset. Features available for this interface are provided in "Web User Interface" on page 68.

Remote Measurement Control — The Ethernet interface allows a remote computer to control the 4421A. Standard Commands for Programmable Instruments (SCPI) commands are used to control the 4421A, see "4421A SCPI Commands" on page 29 or "Legacy RS-232 Commands" on page 58.

The remote measurement control is only operational on models with the appropriate license installed and activated, see "4421A Options" on page 2.

IP Address Settings Display

The LAN option on the Settings menu is used to access the IP Address configuration menu. This menu displays the current IP Addresses for the 4421A.

The 4421A has a dual IP Address configuration.

- Fixed IP Address: 192.168.44.21 (this address cannot be changed)
- Configurable IP Address: DHCP or Static

Figure 15 IP Address Settings Display

See "Configure Static IP Address" on page 69 or "Configure DHCP" on page 70 for procedures to configure IP Address settings.

RS-232 Serial Interface

The Bird 4421A's RS-232 interface feature is provided to allow remote measurement control. The RS-232 is only operational on models with the appropriate license installed and activated, see "4421A Options" on page 2.

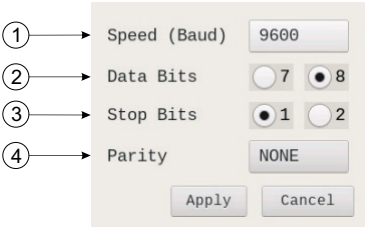
The RS-232 interface uses a standard 9-pin connector. The commands available for this interface are provided in Chapter 8, 4421A SCPI Commands on page 29.

Serial Port Setup

The Serial option on the Settings menu is used to access the serial port settings menu.

The Serial Settings Menu is used to define serial connection settings. See "4421A SCPI Commands" on page 29 for details on serial commands.

Figure 16 Serial Settings Menu



Item	Indicator	Description
1	Baud Rate	The Baud rate may be set to one of the following options: 300 600 1200 2400 4800 9600
2	Data Bits (word length)	Select either 7 or 8 bit data.
3	Stop Bits	Select 1 or 2 stop bits sent at the end of every character,
4	Parity	Options are: **NONE** - no parity bit is sent **EVEN** - parity bit is set so the number of "logical ones" is even. **ODD** - parity bit is set so the number of "logical ones" is odd.

RS-232 Cable Connector

The interface uses a standard 9 pin connector. Pin assignments are listed in Table 3. The 4421A serial port is wired as a “null modem” with all the handshaking signals looped back. The only active pins are 2 and 3, referenced to ground on pin 5.

Table 3 RS-232 Pin Assignments

Pin	Designation	Notes
1	Carrier Detected	Looped back to pins 4 & 6
2	Transmit Data	Transmit data from 4421A
3	Receive Data	Receive data from host
4	Data Terminal Ready	Looped back to pins 1 & 6
5	Ground	Ground
6	Data Set Ready	Looped back to pins 1 & 4
7	Clear to Send	Looped back to pin 8
8	Request to Send	Looped back to pin 7
9	Ring Indicator	Not connected

The 4421A supports legacy RS-232 commands used by Bird’s legacy 4421 Power Meter, and SCPI compliant commands over RS-232 or Ethernet.

- 4421A SCPI Commands - 4421A SCPI commands used RS-232 or Ethernet interfaces. See "4421A SCPI Commands" on page 29.
- Legacy RS-232 Commands - these commands are used by Bird’s legacy 4421 Power Meter, these commands will also work for the 4421A, if the Use Legacy RS232 check box on the settings menu is selected, see "Settings Menu" on page 5.
  See "Legacy RS-232 Commands" on page 58 for available commands.

Chapter 6 Setup

This chapter provides information for unpacking, inspection, and preparing the Bird Power Meter for use.

Unpacking and Inspection

1. Carefully inspect shipping container for signs of damage.
2. Do one of the following:
   - If the shipping container is damaged, do not unpack the unit. Immediately notify the shipping carrier and Bird Electronic Corporation.
   - If the shipping container is not damaged, unpack the unit. Save shipping materials for repackaging.
3. Inspect unit for visual signs of damage.

> **Note:** *If there is damage, immediately notify the shipping carrier and Bird Electronic Corporation.*

Preparation for Use

> **Note:** *The 4421A Power Meter is intended for indoor use only.*

Charge the Battery

> **Note:** *The internal batteries have built-in protection against overcharging.*

It is recommended that the batteries be charged before initial use.

- The AC power source required is 100 - 240 V @ 50/60 Hz, 1ϕ, 30 W

1. Place the 4421A Power Meter on a stable work area.
2. Connect Power Cord to AC power input connector on the 4421A.
3. Plug the cable into the AC power source.
4. Turn on the 4421A and make sure the charge icon is displayed. 
5. Leave the 4421A on and connected to AC until the first full charge has been reached and the plug icon is displayed. 

> **Note:** *This will ensure that the battery remaining % is accurate going forward.*

Setup

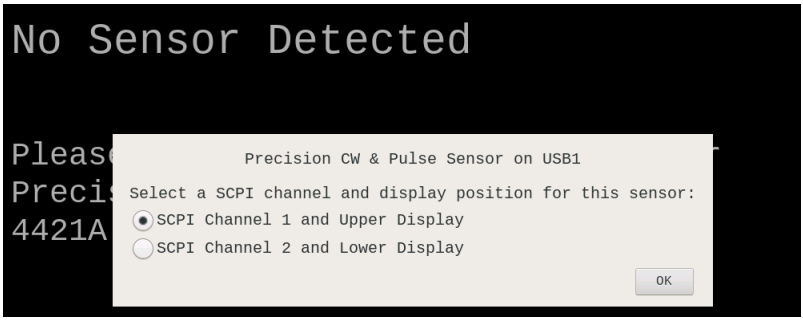
Setup consists of ensuring the 4421A has a power source, internal batteries or AC power source, and attaching a Bird Power Sensor.

- Use the 4421A in a dry, dust-free environment.
- AC power source, if used, is 100 - 240 V @ 50/60 Hz, 1ϕ, 30 W.

1. Press the power button on the left side of the 4421A.
2. Connect the sensor cable to one of the sensor cable connectors on the right side of the 4421A. See Figure 18.
3. Connect the remaining end of the sensor cable to a power sensor.

   Note: *The 4421A will display a SCPI channel/Display Slot selection dialog box when the first sensor is connected to the 4421A. The selected channel is used within SCPI commands for remote operation. The selected display slot determines if the sensor is shown in the upper or lower half of the display when two sensor are connected. Note that the channel and display slot are chosen together.*
4. Select channel in the pop-up dialog box.
5. Click OK.

Figure 17 SCPI Channel Selection



Sensor RF Connections

WARNING

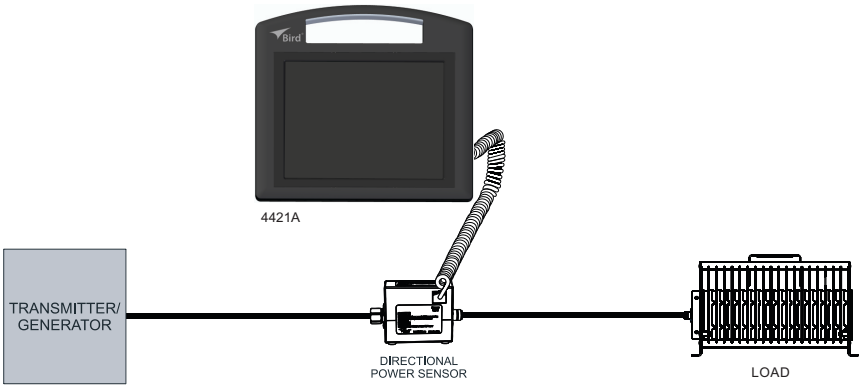
Never attempt to connect or disconnect RF equipment from the transmission line while RF power is applied.
Leaking RF energy is a potential health hazard.

CAUTION

Do not exceed the RF Power or RF frequency specifications of the RF Power Sensor.

1. Connect the RF Power Sensor's output connector to the load.
2. Connect the RF Power Sensor's input connector to the RF source.

Figure 18 4421A Connections



VESA Mount

The 4421A is designed to attach a VESA mount with two 75mm spacing holes. There are two screw locations located on the rear of the 4421A enclosure, see Figure 19.

Mounting Hardware

The following hardware is required (not supplied) to mount the 4421A.

- Two screws, thread-Forming, for thin plastic, M2.5 size, 10 mm long
- Two oversized washers, M2.5 screw size, 2.7 mm ID, 8 mm OD
- VESA Mount with 75mm hole spacing

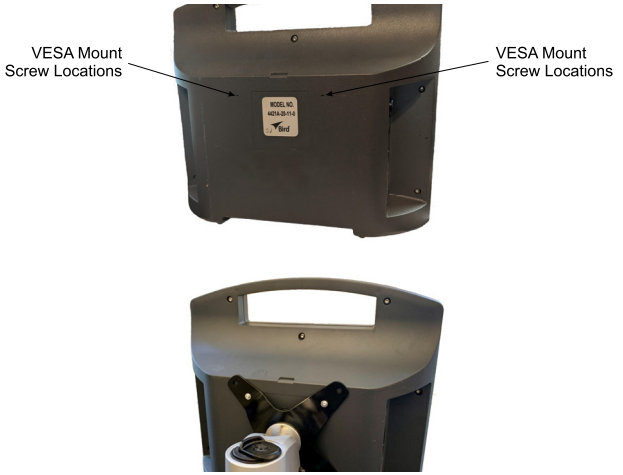
Installation

1. Position the VESA mount on the rear of the 4421A enclosure.
2. Insert the recommended screws into the washers, then drive screws into the indented holes on the rear of the 4421A. The screw will break through a thin plastic barrier.

> **CAUTION**
>
> Do not over tighten the screws. Over tightening will strip the plastic and the screw will not hold the 4421A to the VESA mount.

3. Lightly hand tighten until snug.

Figure 19 VESA Mount



Chapter 7 Operating Instructions

Normal Operation

WARNING

Never attempt to connect or disconnect RF equipment from the transmission line while RF power is applied.
Leaking RF energy is a potential health hazard.

Note: *The 4421A Power Meter is intended for indoor use only.*

Power On

Note: *This procedure assumes the RF Power Sensor is already installed in the RF transmission line. See* "Setup" on page 25 *for additional information regarding setup of the 4421A.*

1. Press Power button on the Bird 4421A power meter side panel.
2. The 4421A takes approximately 30 seconds to complete the boot-up sequence.
3. If required, connect the AC power cable to the 4421A.
4. Connect the sensor cable to one of the sensor cable connectors on the right side of the 4421A.
5. Connect the remaining end of the sensor cable to a power sensor.

   Note: *The 4421A will display a SCPI channel selection dialog box when the first sensor is been connected to the 4421A. The channel selected is used within SCPI commands for remote operation. The selection determines which part of the 4421A display the sensor is displayed if two sensor are connected.*

6. Select channel in the pop-up dialog box.
7. Click OK.
8. Repeat step 4 and step 5 to connect a second RF sensor to the 4421A.

Power Off

1. Press and release the power button for normal power down.
2. If required, disconnect the AC power supply cable.
3. If required, disconnect the sensor cable(s) from the sensor cable connector(s) on the right side of the 4421A.

Chapter 8 4421A SCPI Commands

4421A Standard Commands for Programmable Instruments (SCPI) commands are used to control the 4421A over Ethernet or RS-232 interface.

4421A SCPI Command Syntax

A command is made up of one or more keywords. Consecutive keywords are separated with colons (:). The keywords are followed by 1 or 2 parameters.

Table 4 Optional Keywords and Parameters

Characters	Meaning	Example
[ ]	Square brackets indicate that the enclosed keywords or parameters are optional when composing the command. These implied keywords or parameters will be executed even if they are omitted.	MEASure[:SCALar][:POWer][:FORWard]:AVERage?

Table 5 Command Syntax

Characters, Keywords, and Syntax	Example
Upper- case lettering indicates the minimum set of characters required to execute the command. But, each mode of the command must be in either short form or the complete long form (no in between). Example: Correct: :IDEN :IDENTity Incorrect: :IDENTi	SYSTem:IDENTity:FWRev? SYST:IDEN:FWR? is the minimum requirement.
Lower- case lettering indicates the portion of the command that is optional; it can either be included with the upper- case portion of the command or omitted. This is the flexible format principle called forgiving listening. **Note:** *Commands are not case sensitive. You may use any case or mix the case. Upper and lower case letters shown here are used to indicate the short and long versions of the key words.* See "4421A SCPI Commands" on page 32 for more information.	:IDENTity Either :IDEN, :IDENTity, or :IDENTITY is correct.
A colon must be placed between two command mnemonics.	SYSTem:IDENTity:FWRev?
White space characters, such as <tab> and <space>, are generally ignored as long as they do not occur within or between keywords. However, you must use white space to separate the command from the parameter.	:POW er or MEASure :POWer :AVERage? are not allowed. A <space> between :AVERage? and 1 is mandatory. MEASure :POWer :AVERage? 1
If a command has two parameters, they must be separated by a comma.	CALC:GATE:BEG 1.234 US,1

Table 6 Data Types

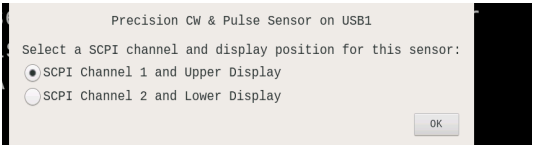
Data Type	Description	Maps to Internal
<NR1>	Signed integer numeric response data. Examples: 123, +456, -789	PARAM_TYPE_SIGNED_INTEGER
<NR2>	Floating point numeric response data without exponent. Examples: 1.23, +4.56, -0.789	PARAM_TYPE_FLOAT
<arbitrary_ascii>	Arbitrary 7-bit ASCII response data. Not enclosed in quotes.	PARAM_TYPE_ARB_ASCII

Sensor Channels

Some SCPI commands require a channel ID to be sent with the command. The 4421A has two SCPI channels, channel 1 and channel 2.

When the first sensor is connected to the 4421A, a dialog box is displayed allowing the user to select the channel the sensor will be assigned, see "Setup" on page 25. If a second sensor is connected to the 4421A it is automatically assigned to the unassigned channel.

Figure 20 SCPI Channel Selection



4421A SCPI Commands

Common

*CLS

Description: Clears the SCPI error queue.

Supported Sensors: N/A

Response Type: N/A Response Values:

Notes:

*IDN?

Description: Gets the 4421A identification

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get device identification in the following format:
BIRD-TECHNOLOGIES,{model},{serial number},{firmware revision}

Calculate

CALCulate:GATE:BEGin[:DELay] <time> [US|MS|S][,1|2]

Description: Set the Pulse Gate Begin delay time

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: N/A Response Values:

Parameter 1 Name: Delay Time Parameter 1 Type: <NR2>
Min: 0 Max: Unit: [US | MS | S]
Default: Parameter Values:

Parameter 2 Name: Sensor Channel Parameter 2 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Set the Gate Begin Delay time for the specified sensor channel. <time> must be >= 0.
The default unit is S.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:GATE:BEGin[:DELay]? [1|2]

Description: Get the Pulse Gate Begin delay time

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the Gate Begin Delay time in seconds from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:GATE:END[:DELay] <time> [US|MS|S][,1|2]

Description: Set the Pulse Gate End delay time

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: N/A Response Values:

Parameter 1 Name: Delay Time Parameter 1 Type: <NR2>
Min: Max: 0 Unit: [US | MS | S]
Default: Parameter Values:

Parameter 2 Name: Sensor Channel Parameter 2 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Set the Gate End Delay time for the specified sensor channel. Time must be <= 0. The default unit is S.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:GATE:END[:DELay]? [1|2]

Description: Get the Pulse Gate End delay time

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the Gate End Delay time in seconds from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:PULSe[:MODel] PULSe|TRIGger[,1|2]

Description: Set the 4421A Pulse Analysis Model

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A

Response Values:

Parameter 1 Name: Analysis Model
Parameter 1 Type: <arbitrary_ascii>
Min: Max: Unit:
Default: Parameter Values: PULSe | TRIGger

Parameter 2 Name: Sensor Channel
Parameter 2 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Set the 4421A Pulse Analysis model for the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:PULSe[:MODel]? [1|2]

Description: Get the 4421A Pulse Analysis Model

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <arbitrary_ascii>

Response Values: PULSe | TRIGger

Parameter 1 Name: Sensor Channel
Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the 4421A Pulse Analysis model from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:STATe<n>:BEGin[:Delay] <time> [US|MS|S][,1|2]

Description: Set a Triggered State Begin offset time

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A

Response Values:

Parameter 1 Name: Delay Time
Parameter 1 Type: <NR2>
Min: 0 Max: Unit: [US | MS | S]
Default: Parameter Values:

Parameter 2 Name: Sensor Channel
Parameter 2 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Set the Pulse State Begin offset time in seconds for the specified sensor channel. The default unit is S.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:STATe<n>:BEGin[:Delay]? [1|2]

Description: Get a Triggered State Begin offset time

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the Pulse State Begin offset time in seconds for the specified sensor channel
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:STATe<n>:ENABle OFF|ON|0|1[,1|2]

Description: Set a Triggered State Enable

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A Response Values:

Parameter 1 Name: Enable Parameter 1 Type: <boolean>
Min: Max: Unit:
Default: 1 Parameter Values: OFF|ON|0|1

Parameter 2 Name: Sensor Channel Parameter 2 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Set the Pulse State Enable state for the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:STATe<n>:ENABle? [1|2]

Description: Get a Triggered State Enable

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <boolean> Response Values: 0|1

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

get the Pulse State Enable state for the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:STATe<n>:END[:Delay] <time> [US|MS|S][,1|2]

Description: Set a Triggered State End offset time

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A — Response Values:

Parameter 1 Name: Delay Time — Parameter 1 Type: <NR2>
Min: 0 — Max: — Unit: [US | MS | S]
Default: — Parameter Values:

Parameter 2 Name: Sensor Channel — Parameter 2 Type: <NR1>
Min: — Max: — Unit:
Default: 1 — Parameter Values: [1 | 2]

Notes:

Set the Pulse State End offset time in seconds for the specified sensor channel. The default unit is S.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

CALCulate:STATe<n>:END[:Delay]? [1|2]

Description: Get a Triggered State End offset time

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> — Response Values:

Parameter 1 Name: Sensor Channel — Parameter 1 Type: <NR1>
Min: — Max: — Unit:
Default: 1 — Parameter Values: [1 | 2]

Notes:

Get the Pulse State End offset time in seconds for the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

Measure

MEASure[:SCALar]:TEMPerature? [1|2]

Description: Get theTemperature from a sensor

Supported Sensors: All

Response Type: <NR2> — Response Values:

Parameter 1 Name: Sensor Channel — Parameter 1 Type: <NR1>
Min: — Max: — Unit:
Default: 1 — Parameter Values: [1 | 2]

Notes:

Get the temperature in degrees C from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:DCYCle? [1|2]

Description: Get the Pulse Duty Cycle from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the Duty Cycle in percent from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:FREQuency? [1|2]

Description: Get the Frequency from a sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the frequency in Hz from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:GATE:MAXimum? [1|2]

Description: Get the Pulse Gate Max Power from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the maximum power in the Pulse Gate from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:GATE:MINimum? [1|2]

Description: Get the Pulse Gate Min Power from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the minimum power in the Pulse Gate from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:GATE[:MEAN]? [1|2]

Description: Get the Pulse Gate Mean Power from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the mean power in the Pulse Gate from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:PERiod? [1|2]

Description: Get the Pulse Period from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the Pulse Period from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:PRF? [1|2]

Description: Get the Pulse Rep Rate from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the pulse repetition rate from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:REFLected:AVERage? [1|2]

Description: Get the Reflected Average Power from a sensor

Supported Sensors: All

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the reflected average power from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:STATe<n>:MAXimum? [1|2]

Description: Get the Max Power in a State from a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the maximum power in the specified Pulse State (Triggered Gate) from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:STATe<n>:MINimum? [1|2]

Description: Get the Min Power in a State from a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the minimum power in the specified Pulse State (Triggered Gate) from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:STATe<n>[:MEAN]? [1|2]

Description: Get the Mean Power in a State from a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the mean power in the specified Pulse State (Triggered Gate) from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer]:WIDTh? [1|2]

Description: Get the Pulse Width from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the Pulse Width from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

MEASure[:SCALar][:POWer][:FORWard]:AVERage? [1|2]

Description: Get the Forward Average Power from a sensor

Supported Sensors: All

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the forward average power from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

Sense

SENSe:FREQuency <freq> [KHZ|HZ|MHZ][,1|2]

Description: Set the manual Signal Frequency on a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: N/A Response Values:

Parameter 1 Name: Frequency Parameter 1 Type: <NR2>

Min: 0 Max: Unit: [HZ | KHZ | MHZ]

Default: Parameter Values:

Parameter 2 Name: Sensor Channel Parameter 2 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Set the manual frequency parameter on the specified sensor channel.The default unit is HZ.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SENSe:FREQuency:AUTO OFF|ON|0|1[,1|2]

Description: Set the Auto Frequency Enable on a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: N/A

Response Values:

Parameter 1 Name: Enable

Parameter 1 Type: <boolean>

Min: Max: Unit:

Default: 1

Parameter Values: OFF|ON|0|1

Parameter 2 Name: Sensor Channel

Parameter 2 Type: <NR1>

Min: Max: Unit:

Default: 1

Parameter Values: [1 | 2]

Notes:

Set the auto frequency enable parameter on the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SENSe:FREQuency:AUTO? [1|2]

Description: Get the Auto Frequency Enable from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <boolean>

Response Values: 0|1

Parameter 1 Name: Sensor Channel

Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1

Parameter Values: [1 | 2]

Notes:

Get the auto frequency enable parameter from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SENSe:FREQuency? [1|2]

Description: Get the manual Signal Frequency from a pulse sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <NR2>

Response Values:

Parameter 1 Name: Sensor Channel

Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1

Parameter Values: [1 | 2]

Notes:

Get the manual frequency parameter in HZ from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SENSe:PERiod <time> [US|MS|S][,1|2]

Description: Set the Manual Signal Period on a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A

Response Values:

Parameter 1 Name: Period Time
Parameter 1 Type: <NR2>
Min: 0
Max:
Unit: [US | MS | S]
Default:

Parameter Values:

Parameter 2 Name: Sensor Channel
Parameter 2 Type: <NR1>
Min:
Max:
Unit:
Default: 1
Parameter Values: [1 | 2]

Notes:

Set the manual period parameter on the specified sensor channel.The default unit is S.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SENSe:PERiod:AUTO OFF|ON|0|1[,1|2]

Description: Set the Auto Period Enable on a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A

Response Values:

Parameter 1 Name: Enable
Parameter 1 Type: <boolean>
Min:
Max:
Unit:
Default: 1
Parameter Values: OFF|ON|0|1

Parameter 2 Name: Sensor Channel
Parameter 2 Type: <NR1>
Min:
Max:
Unit:
Default: 1
Parameter Values: [1 | 2]

Notes:

Set the auto period enable parameter on the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SENSe:PERiod:AUTO? [1|2]

Description: Get the Auto Period Enable from a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <boolean>

Response Values: 0|1

Parameter 1 Name: Sensor Channel
Parameter 1 Type: <NR1>
Min:
Max:
Unit:
Default: 1
Parameter Values: [1 | 2]

Notes:

Get the auto period enable parameter from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SENSe:PERiod? [1|2]

Description: Get the Manual Signal Period from a sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Set the manual period parameter in S from the specified sensor channel.

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

System

SYSTem:COMMunicate:LAN:ADDRess <ip address>

Description: Set the ip address of the 4421A

Supported Sensors: N/A

Response Type: N/A Response Values:

Parameter 1 Name: IP Address Parameter 1 Type: <arbitrary_ascii>

Min: Max: Unit:

Default: Parameter Values:

Notes:

Set the IP address of the 4421A. The parameter is a standard IP string consisting of four decimal values delimited by a period where each value is between 0 and 255. Example: 192.168.1.1.

Note that the client must send the SYSTem:COMM:LAN:REST command before the new parameter values will take affect..

SYSTem:COMMunicate:LAN:ADDRess?

Description: Get the ip address of the 4421A

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get the IP address of the 4421A. The response is a standard IP string consisting of four decimal values delimited by a period where each value is between 0 and 255. Example: 192.168.1.1

SYSTem:COMMunicate:LAN:DHCP[:STATe] OFF|ON|0|1

Description: Set the DHCP state of the 4421A

Supported Sensors: N/A

Response Type: N/A Response Values:

Parameter 1 Name: DHCP Enable Parameter 1 Type: <boolean>

Min: Max: Unit:

Default: 1 Parameter Values: OFF|ON|0|1

Notes:

Set the DHCP enable parameter for the 4421A. When DHCP is enabled (ON or 1) the 4421A will attempt to acquire its network settings from a DCHP server.

Note that the client must send the SYSTem:COMM:LAN:REST command before the new parameter values will take affect.

SYSTem:COMMunicate:LAN:DHCP[:STATe]?

Description: Get the DHCP state of the 4421A

Supported Sensors: N/A

Response Type: <boolean> Response Values: 0|1

Notes:

Get the DHCP enable parameter of the 4421A. When DHCP is enabled (ON or 1) the 4421A will acquire it's network settings from a DCHP server.

SYSTem:COMMunicate:LAN:GATeway <ip address>

Description: Set the Ethernet gateway IP address of the 4421A

Supported Sensors: N/A

Response Type: N/A Response Values:

Parameter 1 Name: Gateway Address Parameter 1 Type: <arbitrary_ascii>

Min: Max: Unit:

Default: Parameter Values:

Notes:

Set the default gateway IP address of the 4421A. The parameter is a standard IP string consisting of four decimal values delimited by a period where each value is between 0 and 255. Example: 192.168.1.1

Note that the client must send the SYSTem:COMM:LAN:REST command before the new parameter values will take affect.

SYSTem:COMMunicate:LAN:GATeway?

Description: Get the Ethernet gateway IP address of the 4421A

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get the default gateway IP address of the 4421A. The response is a standard IP string consisting of four decimal values delimited by a period where each value is between 0 and 255. Example: 192.168.1.1

SYSTem:COMMunicate:LAN:MAC?

Description: Get the Ethernet MAC address of the 4421A.

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get the MAC address. The response is a standard hardware MAC address formatted as a string of 4 colon delimited 2 digit hex values (XX:XX:XX:XX).

SYSTem:COMMunicate:LAN:MASk <ip mask>

Description: Set the subnet mask for the 4421A

Supported Sensors: N/A

Response Type: N/A Response Values:

Parameter 1 Name: Subnet Mask Parameter 1 Type: <arbitrary_ascii>

Min: Max: Unit:

Default: Parameter Values:

Notes:

Set the subnet mask parameter of the 4421A. The parameter is a standard subnet mask string and must conform to subnet mask conventions (see a tutorial on subnet masking for the details on these rules). Example: 255.255.224.0.

Note that the client must send the SYSTem:COMM:LAN:REST command before the new parameter values will take affect.

SYSTem:COMMunicate:LAN:MASk?

Description: Get the subnet mask for the 4421A

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get the subnet mask parameter of the 4421A. The response is a standard subnet mask string. Example: 255.255.224.0

SYSTem:COMMunicate:LAN:RESTart

Description: Resets the LAN connection in the 4421A with the new LAN parameters

Supported Sensors: N/A

Response Type: N/A Response Values:

Notes:

Apply new LAN parameter values and reset the LAN hardware using the new parameters. This command will force the socket to close since the parameters of the socket are being modified. This will force the clinet sending the command to re-establish the socke

SYSTem:COMMunicate:RS232:BAUD [300|600|1200|2400|4800|9600]

Description: Set the RS232 baud rate (bits per second)

Supported Sensors: N/A

Response Type: N/A

Response Values:

Parameter 1 Name: Baud Rate

Parameter 1 Type: <NR1>

Min:

Max:

Unit:

Default: 9600

Parameter Values: 300 | 600 | 1200 | 2400 | 4800 | 9600

Notes:

Set the RS232 bit rate parameter on the 4421A. Parameter set is the list of standard RS232 baud values from 300 to 9600 bits/second.

Note that the client must send the SYST:COMM:RS232:REST command before the new settings will take effect.

SYSTem:COMMunicate:RS232:BAUD?

Description: Get the RS232 baud rate (bits per second)

Supported Sensors: N/A

Response Type: <NR1>

Response Values: 300 | 600 | 1200 | 2400 | 4800 | 9600

Notes:

Get the RS232 bit rate parameter from the 4421A. The response is one of the standard RS232 baud values between 300 and 9600 bits/second

SYSTem:COMMunicate:RS232:FLOWcontrol?

Description: Get the RS232 flow control setting

Supported Sensors: N/A

Response Type: <character data>

Response Values: NONE

Notes:

The 4421A does not support flow control, so this parameter will always return the value "none"

SYSTem:COMMunicate:RS232:LENGTH [7|8]

Description: Set the RS232 length setting (number of data bits transmitted in each frame)

Supported Sensors: N/A

Response Type: N/A

Response Values:

Parameter 1 Name: Bit Length

Parameter 1 Type: <NR1>

Min:

Max:

Unit:

Default: 8

Parameter Values: 7|8

Notes:

Set the RS232 length parameter on the 4421A (number of data bits transmitted in each frame). THe parameter must be 7 or 8. The 4421A defaults to 8 bits.

Note that the client must send the SYST:COMM:RS232:REST command before the new settings will take effect.

SYSTem:COMMunicate:RS232:LENGTH?

Description: Get the RS232 length setting (number of data bits transmitted in each frame)

Supported Sensors: N/A

Response Type: <NR1> Response Values: 7|8

Notes:

Get the RS232 length parameter from the 4421A. The response will be 7 or 8.

SYSTem:COMMunicate:RS232:PARity [N|E|O]

Description: Set the RS232 parity setting

Supported Sensors: N/A

Response Type: N/A Response Values:

Parameter 1 Name: Parity Parameter 1 Type: <character data>

Min: Max: Unit:

Default: 0 Parameter Values: N|E|O

Notes:

Set the RS232 parity parameter on the 4421A. The parameter is one of 'N' (no parity), 'E' (even parity), or 'O' (odd parity).

Note that the client must send the SYST:COMM:RS232:REST command before the new settings will take effect.

SYSTem:COMMunicate:RS232:PARity?

Description: Get the RS232 parity setting

Supported Sensors: N/A

Response Type: <character data> Response Values: N|E|O

Notes:

Get the RS232 parity parameter from the 4421A. The response is one of 'N' (no parity), 'E' (even parity), or 'O' (odd parity).

SYSTem:COMMunicate:RS232:RESTart

Description: Resets the RS232 connection in the 4421A with the new RS232 parameters

Supported Sensors: N/A

Response Type: N/A Response Values:

Notes:

Apply new RS232 parameter values and reset the RS232 hardware using the new parameters. The client sending this commands must also alter it's local RS232 settings to match the new parameters or communications errors will occur.

SYSTem:COMMunicate:RS232:STOPbits [1|2]

Description: Set the number of stop bits used to mark the end of each RS232 frame.

Supported Sensors: N/A

Response Type: N/A Response Values:

Parameter 1 Name: Stop Bits Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: 1|2

Notes:

Set the number of stop bits used to mark the end of each RS232 frame. The parameter must be 1 or 2. THe 4421A defaults to 1 stop bit.

Note that the client must send the SYST:COMM:RS232:REST command before the new settings will take effect.

SYSTem:COMMunicate:RS232:STOPbits?

Description: Get the number of stop bits marking the end of each RS232 frame.

Supported Sensors: N/A

Response Type: <NR1> Response Values: 1|2

Notes:

Get the number of stop bits used to mark the end of each RS232 frame. The response will be 1 or 2.

SYSTem:ERRor:COUNt?

Description: Get the number of errors in the SCPI error queue.

Supported Sensors: N/A

Response Type: <NR1> Response Values:

Notes:

Get the number of errors in the SCPI error queue. The response will be 0 to 17. Errors may be read using the SYST:ERR? Query.

SYSTem:ERRor[:NEXT]?

Description: Get the next entry from the SCPI error queue.

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get the next error in the SCPI error queue. Errors are removed from the queue when read. If the queue is empty, reports, "0, No Error." Use the SYST:ERR:COUN? Query to get the number of erros currently in the queue.

SYSTem:IDENtity:SENSor:FWRev? [1|2]

Description: Get the sensor firmware revision.

Supported Sensors: All

Response Type: <arbitrary_ascii> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the firmware revision string for the sensor connected on the specified channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SYSTem:IDENtity:SENSor:SN? [1|2]

Description: Get the sensor model name.

Supported Sensors: All

Response Type: <arbitrary_ascii> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the serial number string for the sensor connected on the specified channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SYSTem:IDENtity:SENSor[:MODel]? [1|2]

Description: Get the sensor firmware revision string.

Supported Sensors: All

Response Type: <arbitrary_ascii> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Get the model string for the sensor connected on the specified channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SYSTem:IDENtity[:4421A]:FWRev?

Description: Get the 4421A serial number

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get the firmware revision string for the 4421A.

SYSTem:IDENtity[:4421A]:SN?

Description: Get the 4421A model name

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get the serial number string for the 4421A.

SYSTem:IDENtity[:4421A][:MODel]?

Description: Get the 4421A serial number.

Supported Sensors: N/A

Response Type: <arbitrary_ascii> Response Values:

Notes:

Get the model string for the 4421A.

SYSTem:PULSe:CONFig:COMMit [1|2]

Description: Commit the pulse configuration to the sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: N/A Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Commit the SCPI pulse config record to the pulse sensor on the specified sensor channel.

This command should be run last after any commands that alter pulse config parameters to ensure that the sensor is updated with the new parameters before continuing

If the sensor channel is omitted, channel 1 is used.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

Any errors returned from the sensor will be entered into the 4421A error queue and may be read using the SYST:ERR? query.

SYSTem:PULSe:CONFig[:SYNCronize] [1|2]

Description: Synchronize the pulse configuration from the sensor

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: N/A Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>

Min: Max: Unit:

Default: 1 Parameter Values: [1 | 2]

Notes:

Synchronize the SCPI pulse config record from the pulse sensor on the specified sensor channel.

This command should be run first, before any commands that alter pulse config parameters to ensure that the SCPI thread is beginning with an accurate copy of t

If the sensor channel is omitted, channel 1 is returned.

If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

SYSTem:PULSe[:ENABle] OFF|ON|0|1

Description: Set the 4421a Pulse Enable parameter

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: N/A Response Values:

Parameter 1 Name: Enable Parameter 1 Type: <boolean>

Min: Max: Unit:

Default: 1 Parameter Values: OFF|ON|0|1

Notes:

Set the 4421A Pulse Enable parameter to enable pulse emasurements from 7023 and 7024 family sensor. If the Pulse mode is OFF, the 4421A will make CW measurements using connected pulse sensors (similar to those made with a precision CW sensor).

SYSTem:PULSe[:ENABle]?

Description: Get the 4421a Pulse Enable parameter

Supported Sensors: 7023, 7025, 7024, 7027, 7029, 7037, 7039

Response Type: <boolean> Response Values: 0|1

Notes:

Get the 4421A Pulse Enable parameter from the 4421A. The repsonse is 0 (off) or 1 (on). If the Pulse mode is OFF, the 4421A will make CW measurements using connected pulse sensors (similar to those made with a precision CW sensor).

SYSTem:VERSion?

Description: Get the SCPI version.

Supported Sensors: N/A

Response Type: <NR2> Response Values:

Notes:

Get the SCPI version.

Trigger

TRIGger:DELay <time> [US|MS|S][,1|2]

Description: Set the Trigger Delay time on a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A

Response Values:

Parameter 1 Name: Delay Time
Parameter 1 Type: <NR2>
Min:
Max:
Unit:
Default:
Parameter Values:

Parameter 2 Name: Sensor Channel
Parameter 2 Type: <NR1>
Min:
Max:
Unit:
Default: 1
Parameter Values: [1 | 2]

Notes:

Set the trigger delay parameter on the specified sensor channel.The default unit is S.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

TRIGger:DELay? [1|2]

Description: Get the Trigger Delay time from a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <NR2>

Response Values:

Parameter 1 Name: Sensor Channel
Parameter 1 Type: <NR1>
Min:
Max:
Unit:
Default: 1
Parameter Values: [1 | 2]

Notes:

Get the trigger delay parameter in S from the specified sensor channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

TRIGger:LEVel <power> [MW|W|KW][,1|2]

Description: Set the Trigger Level on a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A

Response Values:

Parameter 1 Name: RF Power
Parameter 1 Type: <NR2>
Min:
Max:
Unit:
Default:
Parameter Values:

Parameter 2 Name: Sensor Channel
Parameter 2 Type: <NR1>
Min:
Max:
Unit:
Default: 1
Parameter Values: [1 | 2]

Notes:

Set the trigger level parameter on the specified sensor channel.The default unit is W.
Note that you must disable Auto Trigger level using the TRIGG:LEV:AUTO command for this parameter to take effect.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

TRIGger:LEVel:AUTO OFF|ON|0|1[,1|2]

Description: Set the Auto Trigger Level Enable on a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A

Response Values:

Parameter 1 Name: Enable
Parameter 1 Type: <boolean>
Min:
Max:
Unit:
Default: 1
Parameter Values: OFF|ON|0|1

Parameter 2 Name: Sensor Channel
Parameter 2 Type: <NR1>
Min:
Max:
Unit:
Default: 1
Parameter Values: [1 | 2]

Notes:

Set the auto trigger enable parameter on the pulse sensor on the specified channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

TRIGger:LEVel:AUTO? [1|2]

Description: Get the Auto Trigger Level Enable from a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <boolean>

Response Values: 0|1

Parameter 1 Name: Sensor Channel
Parameter 1 Type: <NR1>
Min:
Max:
Unit:
Default: 1
Parameter Values: [1 | 2]

Notes:

Get the auto trigger enable parameter from the pulse sensor on the specified channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

TRIGger:LEVel? [1|2]

Description: Get the Trigger Level from a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <NR2> Response Values:

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the trigger level parameter in W from the pulse sensor on the specified channel.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

TRIGger:SLOPe POSitive|NEGative[,1|2]

Description: Set the Trigger Slope on a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: N/A Response Values:

Parameter 1 Name: Trigger Slope Parameter 1 Type: <arbitrary_ascii>
Min: Max: Unit:
Default: 0 Parameter Values: NEGative|POSitive
Parameter 2 Name: Sensor Channel Parameter 2 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Set the Trigger Slope for the pulse sensor on the specified sensor channel. Parameter is one of POSitive or NEGative.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

TRIGger:SLOPe? [1|2]

Description: Get the Trigger Slope from a pulse sensor

Supported Sensors: 7024, 7027, 7029, 7037, 7039

Response Type: <arbitrary_ascii> Response Values: NEG|POS

Parameter 1 Name: Sensor Channel Parameter 1 Type: <NR1>
Min: Max: Unit:
Default: 1 Parameter Values: [1 | 2]

Notes:

Get the Trigger Slope from the specified sensor channel. Response is NEG or POS.
If the sensor channel is omitted, channel 1 is returned.
If a supported sensor is not connected on the channel, the command fails and an error is entered in the SCPI error queue.

Error Codes

Mnemonic	Code	Description
Standard SCPI Errors		
SCPI_ERROR_MISSING_PARAMETER	-109	The command or query expects one or more parameters that are missing.
SCPI_ERROR_PARAMETER_ERROR	-220	There is a problem with the format or syntax of a parameter.
SCPI_ERROR_ILLEGAL_PARAMETER_VALUE	-224	The value of the parameter is out of range.
SCPI_ERROR_MEMORY_ERROR	-311	The 4421A encountered a memory error that prevented running the command.
4421A Device Dependent Errors		
SCPI_USER_ERROR_INVALID_CHANNEL	101	The channel parameter is out of range (must be 1 or 2).
SCPI_USER_ERROR_NO_SENSOR	102	There is no sensor connected to the requested channel.
SCPI_USER_ERROR_INVALID_STATE	103	The state number in a state query (e.g. MEAS:STATE1:MEAN? 1) is not valid (must be 1 to 4).
SCPI_USER_ERROR_INVALID_PARAMETER_CW	104	The command or query is not valid when operating the 4421A in the CW mode. Turn on the pulse mode on the main menu to enable this command.
SCPI_USER_ERROR_UNSUPPORTED_FEATURE_7023	105	The command or query is not supported when using a model 7023 or 7025 pulse sensor. The model 7024, 7027 and 7037 sensors offer features not contained in the older sensor models.
SCPI_USER_ERROR_SENSOR_ERROR	106	An error was reported by the connected pulse sensor in response to a configuration command.
SCPI_USER_ERROR_UNSUPPORTED_FEATURE_PULSEGATE	108	The command or query is not valid when operating the 4421A in the Pulse Gate analysis mode. Change the analysis mode to Triggered Gates to enable this command.

Mnemonic	Code	Description
SCPI_USER_ERROR_UNSUPPORTED_FEATURE_TRIGGEREDGATE	109	The command or query is not valid when operating the 4421A in the Triggered Gates analysis mode. Change the analysis mode to Pulse Gate to enable this command.
SCPI_USER_ERROR_UNSUPPORTED_FEATURE_402x_SENSOR	110	The command or query is not supported when using a precision CW sensor in the 402x family of models. These sensors do not offer any of the pulse measurement capabilities available with the model 7027 and 7037 family sensors.

Chapter 9 Legacy RS-232 Commands

The legacy commands are those commands that are original to the predecessor 4421. To use these commands the Use Legacy RS232 check box on the settings menu is selected, see "Settings Menu" on page 5.

> **Note:** *Measurement commands in the legacy protocol only support one sensor. If two sensors are connected to the 4421A, the measurements will come exclusively from channel 1 (Sensor 1).*

Legacy Command Syntax

The Bird 4421A accepts two types of commands. General bus commands are commands, such as Enter (ENT), that apply to any RS-232 interfaced device. Device-dependent commands are specific to the 4421A.

A group of device-dependent commands can be sent as a single string as long as like command categories are not repeated. For example: “FCT1ENT”. This string sets up the 4421A to read forward carrier wave, make one reading on “T1”, and triggers (ENT) a measurement.

> **Note:** *Commands can be entered in either upper or lower case.*

> **Note:** *Only the last command entered of each category will be executed. As a command string is processed by the 4421, each category of command is stored in a separate location. Two commands of the same category will be stored in the same location, so that the second will overwrite and erase the first one.*

General Bus Commands

The general bus commands supported by the RS-232 interface module are listed in Table 7.

Table 7 RS-232 General Bus Commands

Command	Effect on Bird 4421
INT	Returns to default conditions
ENT	Sends a reading to the controller

INi**T**ialize (INT)

Function Resets the Bird 4421 and returns it to the factory defaults.

Remarks If INT is linked with any other command within a string, it must be separated from that command by a space.

ENTer (ENT)

Function Makes the power meter transmit a reading to the controller.

Remarks A measurement must have already been triggered, placing a reading in the output buffer.

To send a reading whenever a measurement is triggered, deselect the **Use Command Mode** check box on the settings menu. The ENT command will not need to be sent.

Device Dependent Commands

The device-dependent commands used by the 4421 Power Meter are listed in Table 8, organized by category.

Table 8 RS-232 Device Dependent Command Summary

Category	Command	Description
Measurement	FC	Forward carrier wave
	RC	Reflected carrier wave
Range	RYY	Auto range on[1]
	RNN	Auto range off, stay at present range
	R00 to R17	Set auto range to one of 18 manual ranges.
Terminators	YT	Two terminators: CR, LF1
Prefixes	PY	Prefix YES1
Triggers	T1	One shot on ENT
	T5	One shot on measurement command
Status	U0	
	U1	
	U2	
Self-Test	J0	
Production	UA	

1 dummy command, the setting they control has only one option.

Forward **C**arrier Wave (FC)
Reflected **C**arrier Wave (RC)

Function Selects forward or reflected RF power measurement mode.

Remarks Measurement results are returned in Watts.

Range (Rxx)

Function Selects a measurement range listed in Table 9.

Remarks If the selected range is outside the range of the connected power sensor, the command is ignored.

Table 9 Measurement Ranges

Command	Power Range
RYY	Turn auto range on
RNN	Turn auto range off. Keep present range
R17	18.0 – 199.9 MW
R16	1.80 – 19.99 MW
R15	0.180 – 1.999 MW
R14	18.0 – 199.9 kW
R13	1.80 – 19.99 kW
R12	0.180 – 1.999 kW
R11	18.0 – 199.9 W
R10	1.80 – 19.99 W
R09	0.180 – 1.999 W
R08	18.0 – 199.9 mW
R07	1.80 – 19.99 mW
R06	0.180 – 1.999 mW
R05	18.0 – 199.9 µW
R04	1.80 – 19.99 µW
R03	0.180 – 1.999 µW
R02	18.0 – 199.9 nW
R01	1.80 – 19.99 nW
R00	0.180 – 1.999 nW

Terminators (YT)

Function Selects the characters that follow the end of a data string. YT indicates for two terminators; a carriage return (CR) and a line feed (LF).

Remarks Many controllers use the terminator sequence to recognize the end of an input string. Using incorrect terminators can lock the bus.

Prefixes (PY)

Function Turns the prefix mode on.

Remarks Prefixes are sent over the bus with the measurement, and indicate the status of the current measurement (see Table 10 for examples):

- "FC","RC" indicates the measurement type.
- "U" indicates underflow; the value sent is ".000".
- "O" indicates overflow; the value sent is "199.9".
- "N" indicates normal; the value sent is a normal on-scale reading.
- "4421" indicates the Bird model number.

Table 10 Prefix Examples

Data String	Description
`NFC.0.123W(CR)(LF)`	Normal (N) forward carrier wave (FC), prefixes on
`OFC 199.9W(CR)(LF)`	Overflowed (O) forward carrier wave (FC), prefixes on
`199.9W(CR)(LF)`	Overflowed forward carrier wave, prefixes off
`URC .000W(CR)(LF)`	Underflowed (U) reflected carrier wave (RC), prefixes on

Triggers (Tx)

Function Selects the condition which will trigger a reading (see Table 11).

Remarks Failure to trigger device before requesting a reading will lock the bus.

Fastest reading rate is 2.4 readings/second; slowest is 1 reading/sec.

Table 11 Trigger Conditions

Command	Trigger Condition
T1	One shot on ENT
T5	One shot on measurement command (FC, FD, RC, RD, SW, RL, MN, MX)

Status (Ux)

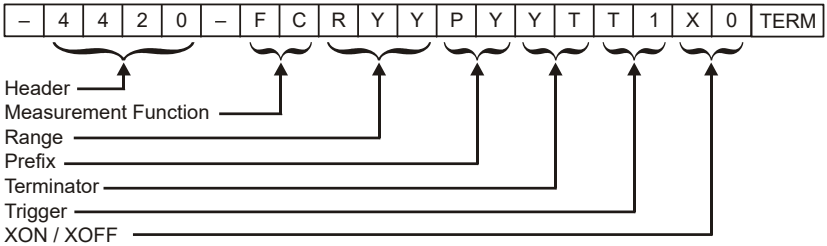
Function Reads a status word and returns the information as a string. Set x to:

- "0" for machine status.
- "1" for error status.
- "2" for revision history.

Remarks After sending the status command, a status word is sent the next time the unit is addressed to talk. To ensure the correct status is transmitted, the status word should be requested as soon as possible after the command is sent.

Machine Status Word (U0) — The format of the machine status word is shown in Figure 21. The default values are also shown.

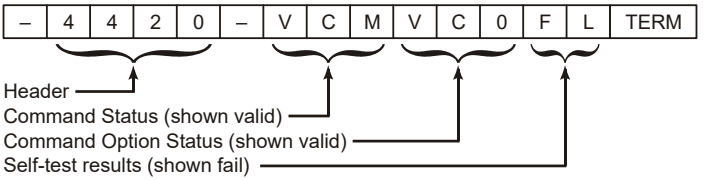
Figure 21 Machine Status Word Format



Note: *This command sets the unit to the settings that were last issued remotely. Therefore, it will over ride any manual changes selected at the front panel of the unit.*

Error Status Word (U1) — The format of the error status word and the possible error messages are shown in Figure 22. All flags will revert to their non-error states after the U1 command is sent.

Figure 22 Error Status Word Format

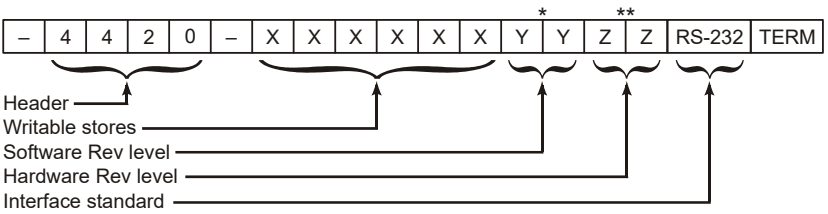


Status	Meaning	Description
ICM	Invalid Command	Set when an illegal device-dependent command (IDDC) such as V2 is received. (V is illegal)
VCM	Valid Command	Set when no IDDC is received.
ICO	Invalid Command Option	Set when an illegal device-dependent command option (IDDCO) such as T6 is received. (6 is illegal)
VCO	Valid Command Option	Set when no IDDCO is received.
PS	Self-test Pass	Set when a self-test has been initiated by the J0 command and the test result is acceptable.
FL	Self-test Fail	Set when the self-test has failed. (This is the default condition.)

Revision History Word (U2) — The format of the revision history word is shown in Figure 23.

Note: *This command is provided for legacy compatibility. The response is fixed.*

Figure 23 Revision History Word Format



* YY is replaced with current software revision level.
** ZZ is replaced with current hardware revision level.

Self Test (J0)

Function Initiates a hardware and software test.

Remarks Results are stored in the U1 status word (see "Status (Ux)" on page 63).

"J0" must be sent each time before reading the result.

> **Note:** *Provided for legacy communications compatibility. The test always passes, results are presented in the U1 status response.*

Production Information (UA)

Function Returns production information string

Remarks UA <mac addr>;<dhcp ip addr>;<misc text><firmware rev date & time in UTC format> <uuid - a unique 36 character hex string><eol>

Ex: "UA f4:e1:1e:8f:46:7d;10.128.1.49;birdeng-VirtualBox 2020-04-29T18:27:04-04:00 b7fe75e4-3aa9-48c2-a163-c4ceacbec8a2<CR><LF>"

PROBLEM	POSSIBLE CAUSE	CORRECTION
Power meter has no power	Are the batteries charged?	Connect the AC power cord to an AC outlet.
	Is the power meter's AC power cord connected to an AC outlet?	Connect the power cord.
Power sensor is not automatically detected by the 4421A.	Is the sensor cable connected to both the power meter and power sensor?	Connect sensor cable.
	Is the sensor cable defective?	Replace sensor cable.
Battery remaining % does not agree with what is expected.	Battery fuel gauge has lost sync with the battery.	Connect the AC power cord while the 4421A is running and wait for the battery indicator to display the plug icon .  This indicates that the charge cycle is complete and the fuel gauge has reestablished sync with the battery.

Chapter 11 Maintenance

This chapter describes routine maintenance. Service beyond this level, or that in Chapter 10, Troubleshooting, page 66, return the unit to a qualified service center.

WARNING

To avoid personal injury, disconnect the power cord from the AC line before performing any maintenance.

WARNING

The Bird 4421A contains no user-serviceable parts.
Do not open the cover.

Routine Maintenance

The Bird 4421A Power Meter requires only simple, routine maintenance.

- Wipe off dust and dirt regularly. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
- Check the connectors and cables for damage.

Storing the 4421A

- If the 4421A is stored, charge the batteries every 6 months. See "Charge the Battery" on page 24.

AC Power Cable

Only replace the A/C input power supply cable with a cable of equivalent rating, and capable of supporting the 4421A power specifications, see "Specifications" on page 78.

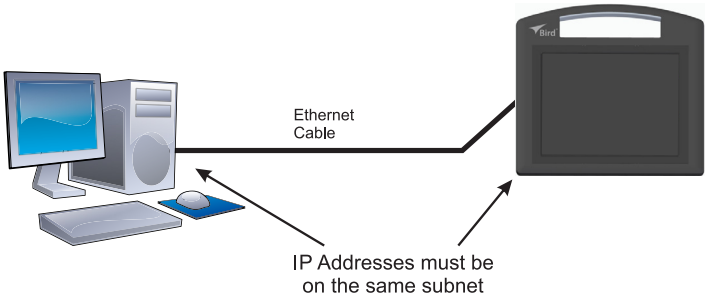
Web User Interface

The Web UI is accessed by entering the 4421A's IP address in the web browser on a PC connected to the 4421A.

4421A's Fixed IP Address: 192.168.44.21

To access the WEB UI, the PC connected to the 4421A must be on the same subnet as the 4421A. See "Configuring PC Network Settings to 4421A Subnet" on page 74.

Figure 24 4421A Ethernet Connection



Static IP Address Configuration — The 4421A has a dual IP Address configuration. A Fixed IP Address (this address cannot be changed) and a configurable IP Address that can be set for DHCP or be set to a static IP Address.

- Static IP Address, see "Configure Static IP Address" on page 69.
- DHCP, see "Configure DHCP" on page 70.

Web UI Description — Provides a description of the screens that make up the Web User Interface, see "Web UI Description" on page 71.

Touchscreen Calibration — The touchscreen may need to be calibrated from time to time, the calibration must be reset using the web UI to initiate the calibration process.
See "Touchscreen Calibration" on page 72.

Firmware Update — The web user interface may be used to install any updates to the 4421A firmware released by Bird. See"Firmware Update" on page 75.

Configure Static IP Address

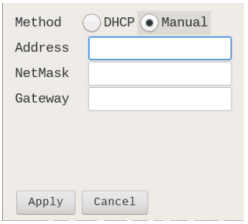
Note: *NetMask and Gateway are optional.*

1. Tap the menu ICON.
2. Tap the Settings menu option, and select **LAN**.
3. Tap the Configure button. See Figure 25.

Figure 25 IP Address Display

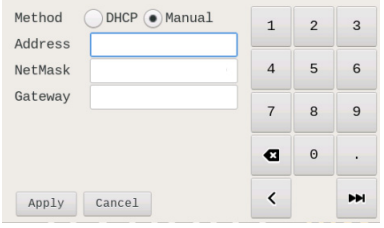
4. Select the manual radio button. See Figure 26.

Figure 26 IP Address Configuration Screens



5. Tap in the Address Text area.
6. Enter the static IP Address using the keypad. See Figure 27.

Figure 27 IP Address Entry



7. Tap ⏭.

Note: *Netmask and Gateway are optional.*

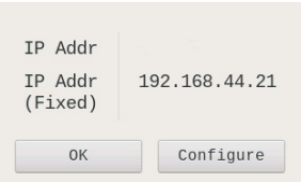
8. Tap the Netmask text area, and enter the netmask.
9. Tap ⏭.

10. Tap the Gateway text area, and enter the Gateway IP Address.
11. Tap Apply to save and exit.
12. Tap the menu ICON.
13. Tap the Settings menu option, and select **LAN**.
14. Verify the IP Address was saved.

Configure DHCP

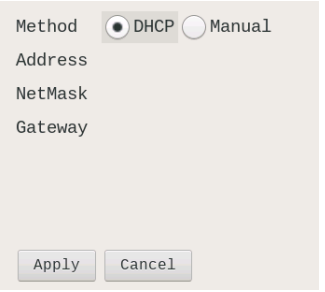
1. Tap the menu ICON.
2. Tap the Settings menu option, and select **LAN**.
3. Tap the Configure button. See Figure 28.

Figure 28 IP Address Display



4. Select the DHCP radio button. See Figure 29.

Figure 29 DHCP Selection



5. Tap Apply to save and exit.

Web UI Description

The Web UI provides the user with several unit status displays and unit maintenance functions.

Status Displays

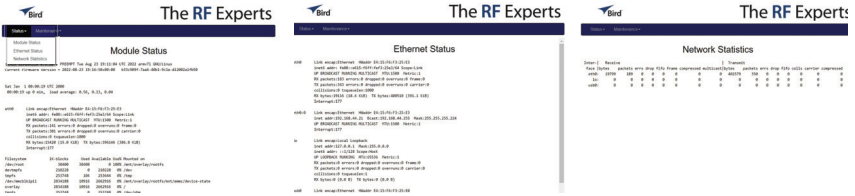
There are three Status displays that provide information about the 4421A.

Module Status — Provides an overview of the 4421As current status including firmware version, time meter, Ethernet status, and file system details.

Ethernet Status — This screen provides detailed Ethernet, LO, and USB status information.

Network Statistics — Provides detail network packet statistics.

Figure 30 Status Displays



Maintenance Displays

There are four maintenance screens which are used while performing procedures in this chapter of the manual.

Upload Firmware — Upload utility for updating 4421As firmware.

Upload Bootloader — Upload utility for updating 4421As bootloader.

Restart — Used for firmware/bootloader updates, to restart 4421A firmware.

Touchscreen Calibration — Used to reset touchscreen calibration and force a re-calibration at the next boot-up.

Figure 31 Maintenance Displays

Touchscreen Calibration

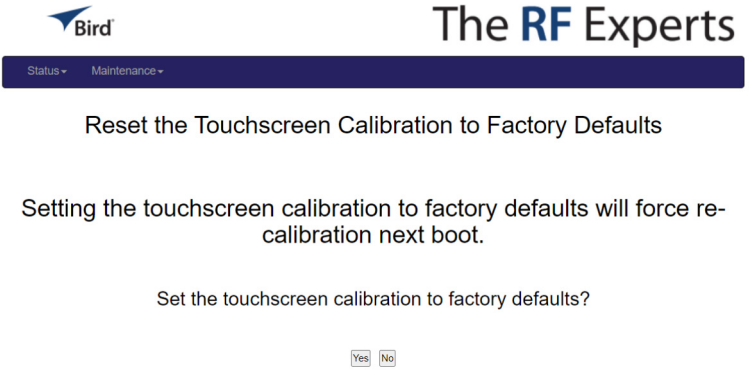
1. Connect Ethernet cable between the PC and the Ethernet Port on the 4421A side panel.
2. Open a web browser on the PC.

   Note: *The PC and 4421A must be on the same network subnet.*
3. Enter the 4421A's IP Address into the browser's address bar.
4. Wait for the WebUI to open.
5. On web UI's Maintenance menu select **Reset Touchscreen Calibration to Factory Defaults**. See Figure 32.

Figure 32 Maintenance Menu

6. Click **Yes** on the Reset the Touchscreen Calibration to Factory Defaults screen. See Figure 33.

Figure 33 Reset Touchscreen Calibration

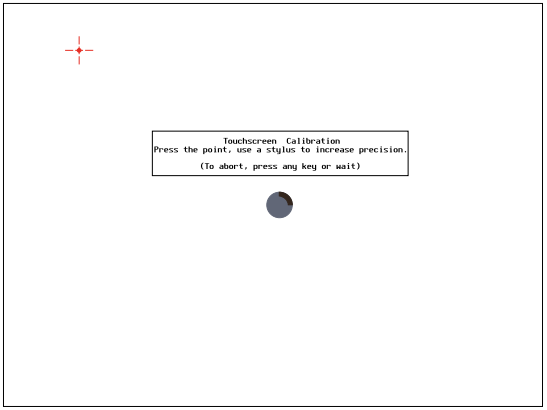


Note: *A popup confirmation message will be displayed.*

7. Click OK on the confirmation message to complete reset.
8. Wait for "Successfully Reset ...." message to be displayed.
9. Press power button on the side of the 4421A to remove power.

10. Power on the 4421A.
11. During the power up routine the calibration dialog will be displayed, see Figure 34.

Figure 34 Calibration Screen



12. Tap each calibration point as they are displayed, beginning in the upper left of the screen.

> **Note:** *After tapping each calibration point in each corner of the display the 4421A will complete power up and display the RF measurement screen.*

Configuring PC Network Settings to 4421A Subnet

Use this procedure to configure a PC to communicate via a point to point Ethernet connection with the 4421A.

Note: *These instructions apply to a Windows 7/10 PC.*

1. Select **Start->Control Panel->Network and Sharing Center** on the PC.
2. Double-click the local area connection and
3. Click the **Properties** button.
4. Scroll to Internet Protocol Version 4 (TCP/IPv4) and double click.
5. Select Use the following IP address.

   Note: *You may use any IP address in the range 192.168.44.[1..31] that is different than the 4421A fixed IP address (192.168.44.21).*

6. Enter the following settings:
   - ✓ IP address: 192.168.44.20
   - ✓ Subnet mask: 255.255.255.224
   - ✓ (Gateway is ignored)

   Note: *These settings will allow the PC to communicate with the 4421A's Fixed IP address via a point to point connection.*

7. Click the **OK** button for the Internet Protocol Version 4 (TCP/IPv4) Properties dialog.
8. Click the **OK** button to apply the connection properties.

Restoring PC Network Connection to DHCP

1. Select **Start->Control Panel->Network and Sharing Center** on the PC.
2. Double-click the local area connection and
3. Click the **Properties** button.
4. Scroll to Internet Protocol Version 4 (TCP/IPv4) and double click.
5. Select “Obtain an IP Address Automatically”.
6. Click the **OK** button for the Internet Protocol (TCP/IP) Properties dialog.
7. Click the **OK** button to apply the connection properties.

Firmware Update

Obtain Firmware

1. Firmware files for the 4421A may be downloaded from the product page on Birdrf.com.
2. Download the firmware file (.zip file).
3. Save the firmware file on the PC you will use to install the firmware on the 4421A.

Install Firmware

> **Note:** *The 4421A has dual IP Address capability, it has a fixed IP address of 192.168.44.21, and may have a second DHCP assigned, or static, IP address. See* "Configuring PC Network Settings to 4421A Subnet" on page 74.

1. Connect Ethernet cable between the PC and the Ethernet Port on the 4421A side panel.
2. Open a web browser on the PC.

> **Note:** *The PC and 4421A must be on the same network subnet.*

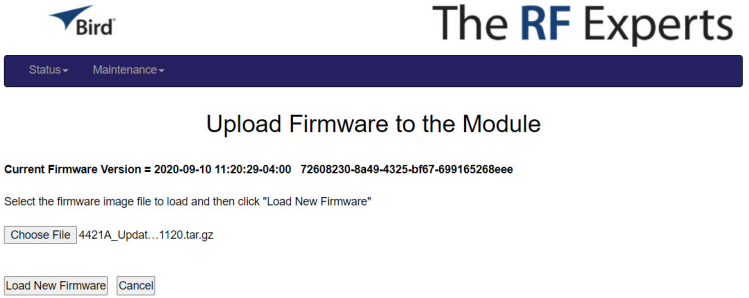
3. Enter the 4421A's IP Address into the browser's address bar.
4. Wait for the WebUI to open.
5. Select **Update Module Firmware** from Maintenance menu. See Figure 35.

Figure 35 Maintenance Menu Selection

> **Note:** *The firmware file will have the following characteristics: XXXXXXX.tar.gz*

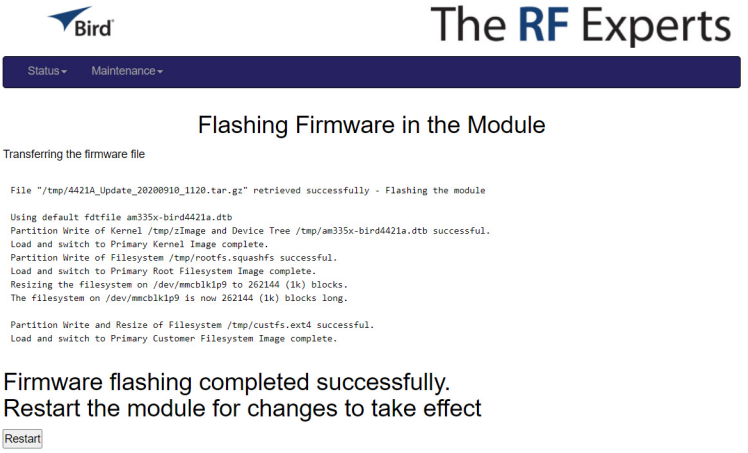
6. Click **Choose File**.
7. Navigate to the location of the firmware file on the PC.

Figure 36 Choose Firmware File



8. Click the **Load New Firmware** button.

Figure 37 Load Firmware



9. Wait for “Firmware flashing completed successfully” message
10. Click **Restart** button.
11. Once restart is complete, verify the firmware update is complete.

Storage and Shipment

Storage

CAUTION

Do not store the 4421A outside the following temperature ranges

-10° to 50°C, ≤ 1 month

-10° to 35°C, ≤ 6 months

-10° to 25°C, > 6 months

Storage outside these temperature ranges may degrade battery capacity.

1. Cover Bird 4421A Power Meter before storing to keep out dust and dirt.
2. Store in a dry, dust-free environment where the ambient temperature will remain between those specified in "Specifications" on page 78 for the intended period of storage.
3. Disconnect Power Meter from the power source to avoid damage by transient over-voltage.
4. If storage will last longer than 6 months, or below 0°C, charge the batteries as specified in "Routine Maintenance" on page 67.

Shipment

Package instrument using the original shipping container. If the original shipping container is not available, use a corrugated box. Place shock absorbing material around all sides of the instrument to prevent movement during handling or shipment. Equipment packaging shall be in accordance with best commercial practices.

Customer Service

Any maintenance or service procedure beyond the scope of those in this chapter should be referred to a qualified service center.

If the unit needs to be returned for any reason, request an Return Material Authorization (RMA) through the Bird Technologies website. All instruments returned must be shipped prepaid and to the attention of the RMA number.

Bird Service Center
30303 Aurora Road
Cleveland (Solon), Ohio 44139-2794
Fax: (440) 248-5426
E-mail: *bsc@birdrf.com*

For the location of the Sales Office nearest you, visit our Web site at:

http://www.birdrf.com

Bird 4421A Power Meter Specifications

Note: *The 4421A Power Meter is intended for indoor use only.*

Compatible Bird Power Sensors All Models: 4421A-12-11-1:	Model Dependent: 4021, 4022, 4023, 4024, 4025, 4027, 4028 7027-series, 7037-series
Sensor Detection	Automatic Sensor detection
Dual sensor support	Two sensors may be connected and measurements displayed simultaneously. **Note:** *Dual-sensor support requires dual-sensor license is purchased and activated.*
Connection to sensor	Wired
Display	
Type	9.7" TFT full color LCD (LED back light), touch screen
Resolution	1024x768
Calibration interval	Not required
I/O Connectors RS-485 (Sensor) Ethernet Serial, RS-232	 2 1 1
Environment	
Operating Temperature	0° to 40° C (32° to 104° F)
Storage Temperature	-10° to 50°C, ≤ 1 month -10° to 35°C, ≤ 6 months -10° to 25°C, > 6 months **Note:** *Storage temperature limited by battery specification. Storage outside this range may degrade battery capacity. For best performance, a full recharge is recommended every 6 months or if stored below 0°C.*
Operating Relative Humidity	95% Max (non condensing)
Max Operating Altitude	6400 m

AC/DC Power Supply	
Input Voltage	100 - 240 V @ 50/60 Hz, 1ϕ, 30 W.
Main Supply Voltage Fluctuations	± 10 %
Over-voltage Category	Category II
Pollution Degree	2
Certifications	MIL28800 CLASS 4; SGS
Physical Characteristics	
Dimensions, nominal:	H x W x D 9 11/16 in. x 10 5/8 in. x 3 37/64 in. (246 mm x 270 mm x 91 mm)
EMC	Directive 2014/30/EU EN 61326-1
UL & CAN/CSA	Directive 2014/35/EU EN 61010-1 EN 61010-2-030

Appendix I SCPI Guidelines

Introduction

The 4421A power meter supports the use of one or two Bird 402x CW sensors or 702x & 703x family sensors and provides user interface and remote SCPI options to configure and acquire measurements from the sensors connected to the 4421A.

This appendix is intended to help you get started using the 4421A via a SCPI client. The guide will cover the configuration and acquisition of measurements for a few general scenarios using SCPI.

The guide is not a SCPI tutorial per se. It is assumed that you understand SCPI in general and know how to establish connections to devices, send commands and queries and read query responses. The focus of this appendix is to guide your interaction with the 4421A specifically, and to guide you through scenarios that require multiple commands and queries to be sent in a particular sequence.

The 4421A will accept SCPI commands and queries via either RS232 or Ethernet. The details in this appendix apply equally to both. See "Remote Interfaces" on page 21 for the details of configuring RS232 or Ethernet.

Commands, Queries, and Handling Errors

SCPI Commands and Queries may generate errors and in SCPI, errors are not reported directly to the sender of a command or query, but are added to a queue for later processing as needed. For this reason, the sender of a command or query must check the queue for errors in order to find out if a command or query failed with an error. See "Error Codes" on page 56 for a list of 4421A SCPI errors.

Use the SYSTem:ERRor:COUNt? query to find out how many errors are in the queue, and use the SYSTem:ERRor? query to read the next error message from the queue. Reading a message removes it from the queue, so the count will decrement by one each time you read a message. If there are no errors in the queue, the SYSTem:ERRor? Query will return “0, No Errors”

Given this arrangement, it is recommended that you always check for errors after each command/query to be sure it completed without errors. The general procedure is:

- Send the command/query
  - If it is a query, read the response
  - Be sure to handle a possible timeout since queries that generate an error will not generally return a response.

- Check the Error Count and if the count is not zero,
  - Read Error Messages until the count is 0 or you get “0, No Errors.”
  - Handle the errors as you wish.

Sensor Configuration

402x precision CW sensors are not configurable, so this section only applies to 702x and 703x Pulse sensors.

Pulse sensors have a large number of configuration options, and the 4421A provides for user customization of a variable ***subset*** of these based on the specific measurement models you select.

The 4421A SCPI parser engine implements a synchronize/modify/commit model to manage the potential complexities of configuring sensors.

The SCPI parser maintains a local copy of the sensor configuration that is initialized when the sensor is first connected and afterwards only synchronized or committed when told to do so by the client. The client should follow this sequence to modify the sensor configuration:

- Send the SYST:PULS:CONF:SYNC command to refresh the synchronization.
- Send other SCPI commands as needed to set various configuration options.
- Send the SYST:PULS:CONF:COMM command to initiate sending the configuration to the sensor and the rest of the 4421A subsystems.
  - The SYST:PULS:CONF:COMM handler gathers all SCPI errors reported from the sensor in response to things like invalid parameter values and passes them onto the 4421A client via the 4421A error queue. For this reason, this query may generate many errors, and it is important to check the error queue as outlined about after sending this command.

There is a table at the end of this Quick Start guide listing all the available sensor configuration options with a descriptions and limits. If there are errors from the SYST:PULS:CONF:COMM command, this table will help you figure out what is wrong.

Principals/Guidelines

These are some general guidelines for working with the Configuration Settings of Pulse Sensors to get useful measurement results.

- If you are making measurements on a signal that varies in frequency over time (for example from a frequency agile generator), turn Auto Frequency off and set the frequency to the center frequency of your signal's range using the SENS:FREQ:AUTO and SENS:FREQ commands. Note that if the actual frequency differs from the one you set, the accuracy of the power measurement is reduced.
  - Bird Pulse Sensors cannot reliably measure frequency when the frequency is shifting, so using a fixed frequency in the center of the expected range will yield the best results from the sensor.
- For simple two state pulsed signals (one "on" and one "off" state):
  - Configure the 4421A to use the Pulsed Gate model. This will provide the most flexible automated measurements possible.
  - In many cases, you can get useful measurements on a simple 2 state pulse signal without any custom configuration using this model (see below for an example SCPI sequence).
  - When using this model, the 4421A will provide the following measurements:
    - Forward and Reflected average power
    - Frequency of the signal
    - Pulse Gate power min, max, and mean. This is the average power inside the "on" state of the pulse. The precise time region is defined by the automatically detected pulse transition edges adjusted by user configurable gate delays relative to the detected edges.
  - If needed, you can configure the trigger and period and gate boundaries.
- For pulsed signals with more than 2 states (multi-state pulses):
  - Configure the 4421A to use the Triggered Gate model. The pulse sensors are not designed to make automated pulse measurements on these more complex pulsed signals, the triggered gate model allows you to provide more detailed configuration parameters to guide how the sensor makes the measurements.
  - To use the Triggered Gate Model you must determine the following information about your signal (this must be done independently of the 4421A):
    - Period
    - Approximate power range of the signal (min to max)

- Shape of the pulsed signal (locations and levels of each state relative to the desired trigger point)
- Given these things, you can determine appropriate trigger conditions and the number and location of states in the pulsed signal

- Set the trigger parameters (slope and level) to unambiguously identify one single edge of the signal. You may use the auto trigger level if there is precisely one edge that crosses the 50% power point in either the rising or falling edge. Otherwise you must set a manual level that is unambiguous.
  - If the trigger settings are ambiguous (meaning more than one edge within one period satisfies the conditions), the measurements will be unreliable.
  - You may set a trigger delay if desired, but if you do you must account for this in the gate begin and end times you select.
- When configuring the triggered gates for measuring power in specific states of a pulse, follow these guidelines for the begin and end delay parameters for the states for best results:
  - The end time of each state must be greater than the begin time.
  - The total span of all the states (begin time of the first state to the end time of the last state) must be less than or equal to the period.
  - Finally note that all gate times are calculated from the gate reference point on the signal
    - The gate reference point is offset from the trigger point by the trigger delay.

Three Scenarios

Here are three hypothetical measurement scenarios to illustrate the general SCPI command sequences needed to configure the 4421A and Sensor and to acquire the measurements from the sensor.

Note: The outlines below omit error checking for simplicity. As noted above, you should use the SYST:ERR:COUN? And SYST:ERR? queries to check for errors after every command or query. This is particularly critical after running the SYST:PULS:CONF:COMM command that sends the configuration to the sensor itself. If there are errors in the configuration commands, ***the sensor will not return reliable measurement results.***

CW Measurements

CW measurements are fully automated in the 4421A. So the only configuration needed from the SCPI client is to configure the 4421A itself for CW measurements (disable the global pulse mode). And since no sensor configuration is involved, the Sync and Commit commands are not needed.

The following SCPI sequence will configure the 4421A for CW measurements and read the forward reflected average power from the sensor on channel 1:

- Configuration Commands (run these once):
  - SYST:PULS OFF 1
- Measurement Queries (run these as often as needed):
  - MEAS:FORW:AVER? 1
  - MEAS:REFL:AVER? 1

Pulse Measurements using the Pulse Gate model

The Pulse Gate model in the 4421A is intended for use with simple 2 state pulsed signals (as defined above). To use this mode, the 4421A must be configured for Pulse measurements and to use the Pulse Gate model.

The following SCPI sequence will configure the 4421A for pulse measurements using the pulse gate model and the default settings for all other parameters and then read all the pulse measurements that are available in the Pulsed Gate model from the sensor on channel 1:

- Configuration Commands (run these once):
  - SYST:PULS ON 1
  - SYST:PULS:CONF:SYNC 1
  - CALC:PULS PULS 1
  - SYST:PULS:CONF:COMM 1

- Measurement Queries (run these as often as needed)
  - MEAS:FORW:AVER? 1
  - MEAS:REFL:AVER? 1
  - MEAS:PER? 1
  - MEAS:WIDT? 1
  - MEAS:DCYC? 1
  - MEAS:PRF? 1
  - MEAS:GATE:MEAN? 1
  - MEAS:GATE:MIN? 1
  - MEAS:GATE:MAX? 1

Pulse Measurements using the Triggered Gate

The Triggered Gate model in the 4421A is intended for use with more complex pulsed signals with more than 2 pulse states (as defined above). To use this mode, the 4421A must be configured for Pulse measurements and to use the Triggered Gate model. The period, power range, trigger requirements, and the state/gate boundaries to be measured must be known.

The following SCPI sequence will configure the 4421A for triggered gate measurements for a signal with the following assumptions:

- Has a 10 ms period.
- Has three pulse states evenly spaced in the period with 10 us transition intervals between them. So the three gates will be defined relative to the trigger with the following being/end times: 0.005 to 3.328 ms, 3.338 to 6.63 ms, and 6.73 to 9.95 ms.
- Has one positive edge that passes through the 50% power level of the signal (i.e. we can use the default sensor trigger parameters - positive/ rising edge, auto level).

The SCPI sequence:

- Configuration Commands (run these once):
  - SYST:PULS ON 1
  - SYST:PULS:CONF:SYNC 1
  - CALC:PULS TRIG 1
  - SENS:PER 10 MS,1
  - CALC:STAT1:ENAB ON,1
  - CALC:STAT1:BEG 0.005 MS,1
  - CALC:STAT1:END 3.328 MS,1
  - CALC:STAT2:ENAB ON,1
  - CALC:STAT2:BEG 3.338 MS,1

- CALC:STAT2:END 6.662 MS,1
- CALC:STAT3:ENAB ON,1
- CALC:STAT3:BEG 6.672 MS,1
- CALC:STAT3:END 9.995 MS,1
- SYST:PULS:CONF:COMM 1

- Measurement Queries (run these as often as needed)
  - MEAS:FORW:AVER? 1
  - MEAS:REFL:AVER? 1
  - MEAS:STAT1:MEAN? 1
  - MEAS:STAT1:MIN? 1
  - MEAS:STAT1:MAX? 1
  - MEAS:STAT2:MEAN? 1
  - MEAS:STAT2:MIN? 1
  - MEAS:STAT2:MAX? 1
  - MEAS:STAT3:MEAN? 1
  - MEAS:STAT3:MIN? 1
  - MEAS:STAT3:MAX? 1

Appendix 2 Sensor Parameter Limits

The limits shown in Table 12 will work for a wide range of pulse sensor models, but some models will accept values beyond the limits listed here. See the specs for your sensor for model specific limits.

Table 12 Sensor Configuration Parameters

Parameter Name	Writable	Min	Max	Description
Frequency Parameters				The Bird Pulse sensors are calibrated over a specified frequency band. The Frequency Parameter configures how the sensor determines what frequency to use when applying the calibration to measurements.
Auto Frequency	Yes	0	1	Enables/Disables auto frequency detection in the sensor. If auto frequency is on, the sensor attempts to measure the frequency of the signal and uses this measured frequency to look up calibration coefficients.
Frequency (MHz)	Yes	min	max	Applies if Auto Frequency is off. If auto frequency is off, the sensor uses this frequency to look up calibration coefficients. Must be between min and max frequency for the specific sensor model. See the sensor specs for this information.
Period Parameters				The Bird Pulse sensors attempt to measure several fundamental pulse parameters in each measurement frame. All of these depend first on determining the period of the pulsed signal. The sensor can be configured to do this automatically, or the user may tell the sensor what period to use.

Parameter Name	Writable	Min	Max	Description
Auto Period	Yes	0	1	Enables/Disables auto pulse period measurement in the sensor. If auto period is on, the sensor attempts to determine the period using an iterative algorithm on a captured sample buffer. All other pulse measurements (repetition rate, width, & duty cycle) depend on this measurement of the period.
Period (ms)	Yes	0.2	10	Applies if Auto Period is off. If auto period is off, the sensor uses this period value and proceeds with the rest of the pulse measurements accordingly. If the period is known, using this option will yield faster measurements in the sensor. Note that the limits are sensor models specific, the limits shown here cover nearly all the production models. A few models will work with limits beyond this range. See the sensor specs for this information.
Trigger Parameters	Yes			Triggered Gate measurements in the sensor depend on a trigger event. The sensor generates an internal trigger based on edge detection in the captured sample buffer.
Slope (POS/NEG)	Yes	NEG	POS	Sets the polarity of the trigger event for both external and internal triggers. NEG means the sensor will look for a falling edge, POS means the sensor will look for a rising edge.
Auto Level	Yes	0	1	Enables/Disables auto trigger level detection for the internal trigger algorithm. If auto trigger level is on, the sensor will set the trigger level midway between the min and max samples in the buffer.

Parameter Name	Writable	Min	Max	Description
Level (W)	Yes	0	Max P	Desired trigger level in Watts. Applies if Auto Trigger Level is off. If auto trigger level is off, the sensor looks for the signal to cross this level (either rising or falling depending on the slope setting). The max trigger level should be set below the max power for the sensor See the sensor specs for this information
Delay (ms)	Yes	-Max Pd	+Max Pd	Trigger delay. Shifts the trigger point to the left or right of the relevant edge. The trigger delay is sensor model specific. The limits shown (+/- the period) will work for most sensors. See the sensor specs for this information.
Pulse Gate Parameters				Pulse Gate Parameters control the behavior of the automatic gated pulse measurements in the Pulse Sensors. These measurements are designed for use with simple 2 state pulses, and should not be used for pulsed signals with more than 2 states.
Begin Delay (ms)	Yes	0	0.9	The left edge of the pulse gate measured from the leading edge (a positive number).
End Delay (ms)	Yes	-0.9	0	The right edge of the measurement gate measured from the trailing edge (a negative number)
Triggered Gate Parameters				Triggered Gate Parameters control the behavior of up to four triggered gate states in a multi-state pulse. The Pulse Sensor will calculate the mean, min, and max power for each enabled state. Note that Begin/End times for triggered gates are set relative to the sync point of the sweep. The combined width of all the states should be less than the period specified for the sweep.

Parameter Name	Writable	Min	Max	Description
Per State (up to 4 states)				
Enabled	Yes	off	on	Enables or disables measurements for this state.
Begin (ms)	Yes	*	*	Sets the left edge of the state relative to the sync point. Limits depend on the number and width of all the enabled states and on the programmed period. See the notes on configuring states for the criteria to follow.
End (ms)	Yes	*	*	Sets the right edge of the state relative to the sync point. Limits depend on the number and width of all the enabled states and on the programmed period. See the notes on configuring states for the criteria to follow.

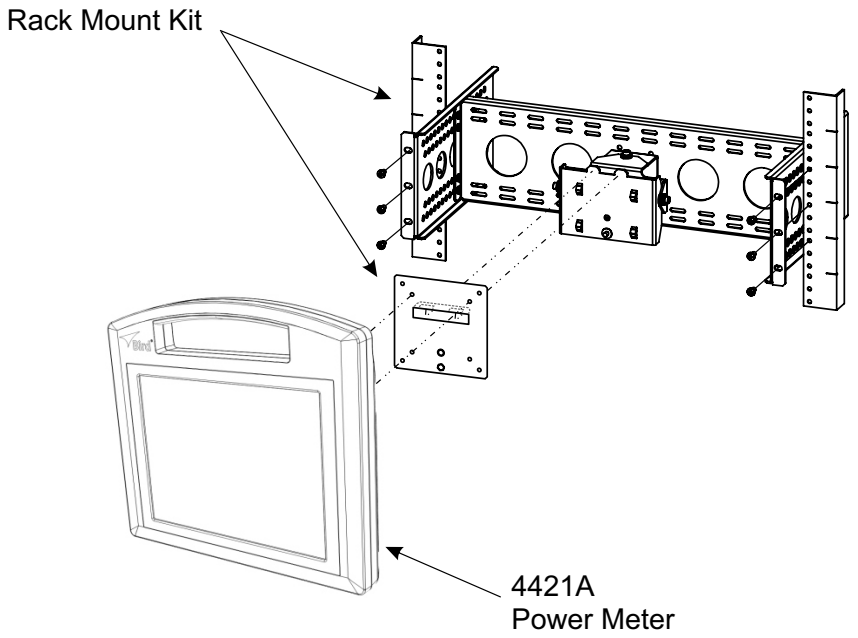
4421A Rack Mounting Kit

The Bird 4421A Rack Mounting Kit (Bird Part Number 4421A-RM1) lets you mount the 4421A into any EIA standard 19" rack. The pan/tilt feature allows four direction movement of the 4421A, making it easy to find the perfect viewing angle.

The 4421A can be mounted anywhere from 1/2'' up to 9-1/2" depth in a rack in increments of 1/4".

All Rack Mount assembly hardware and rack mounting hardware is included.

Figure 38 Rack Mount Kit



After the Rack Mounting kit is installed in a rack, the 4421A can be removed and reinstalled without the use of any tools.

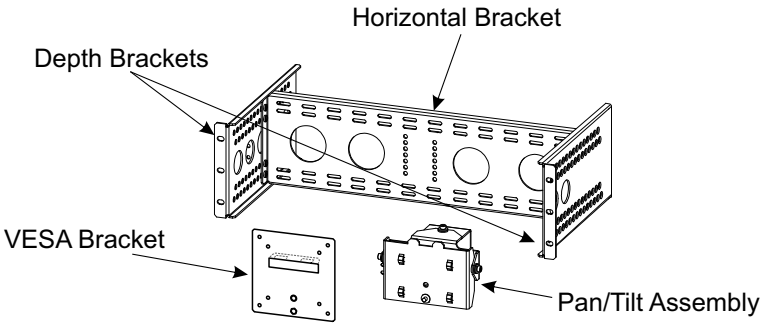
Rack Mount Kit Assembly

This section provides unpacking, inspection, and assembly instructions for the 4421A Rack Mount Kit.

Rack Mount Kit Contents

The Rack mount kit includes the brackets and sub-assembly shown in Figure 39 and attaching hardware listed below.

Figure 39 Rack Kit Contents



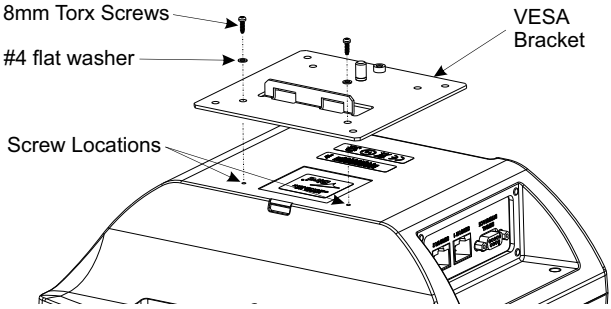
Assembly Instructions

Attaching Hardware	Quantity	Description
VESA Bracket Hardware	3	#4 flat washers
	3	8mm Torx Screws
Assembly Hardware	2	10-32 Pan Head Screws
	4	10-32 Flat Head Screws
Rack Mount Hardware	8	12-24 Square Nuts
	8	12-24 Cage Nuts (Black)
	8	12-24 Pan Head Screws
	8	10-32 Pan Head Screws

Attach VESA Bracket to the 4421A

1. Lay the 4421A face down on a flat work surface.
2. Position the VESA bracket on the rear panel of the 4421A enclosure. See Figure 40.

Figure 40 Attach VESA Bracket



3. Insert the screws into the washers, then drive screws into the indented holes on the rear of the 4421A. The screw will break through a thin plastic barrier.

> **CAUTION**
>
> Do not over tighten the screws. Over tightening will strip the plastic and the screw will not hold the 4421A to the VESA bracket.

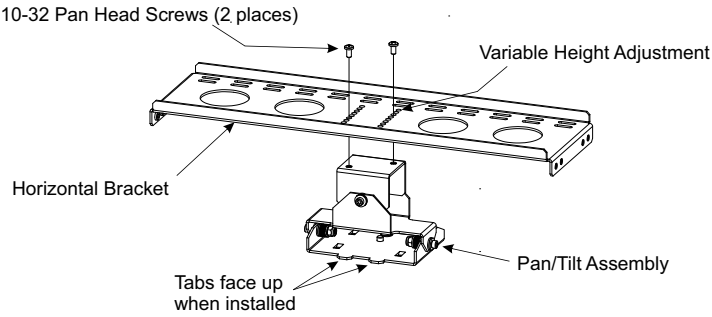
4. Lightly hand tighten until snug.

Rack Kit Assembly

Pan/Tilt Assembly Attachment

1. Lay the Pan/Tilt Assembly face down on a flat work surface, see Figure 41.

Figure 41 Pan/Tilt Assembly Attachment



2. Position the Horizontal Bracket over the Pan/Tilt Assembly.

Note: *Multiple holes in the Horizontal Bracket allow for the vertical adjustment of the 4421A position when installed in the rack.*

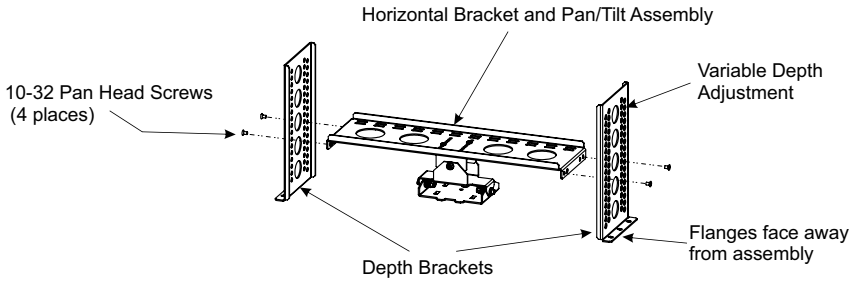
3. Align holes in the Horizontal Bracket, at the desired vertical height, with the threaded holes in the Pan/Tilt Assembly.
4. Install two 10-32 Pan Head Screws.

Depth Bracket Attachment

Note: *The holes in the Depth Brackets determine how far into the rack the 4421A will be when mounted to the Rack Mount Assembly.*

1. Secure one of the Depth Brackets to the Horizontal Bracket using two 10-32 Flat Head Screws.
2. Secure remaining Depth Bracket to the Horizontal Bracket using two 10-32 Flat Head Screws.
   Ensure same depth measurement is used for both Depth Brackets.

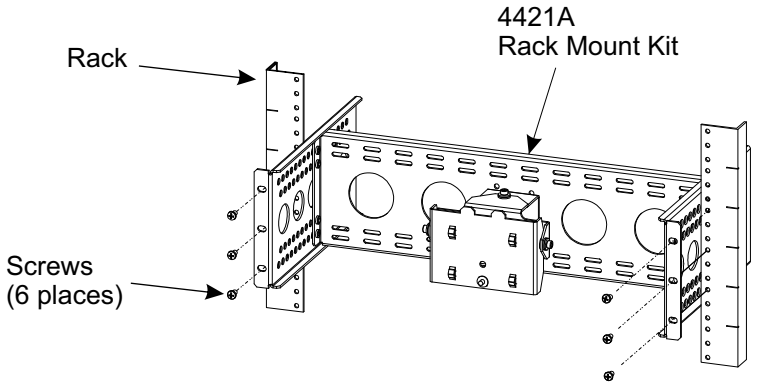
Figure 42 Depth Bracket Attachment



Rack Installation

Attach the Assembly to the Rack using six (6) of the appropriate Rack Mounting Hardware.

Figure 43 Rack Instalation



The Rack Hardware Kit provides various screws and nuts for the four most common types of racks.

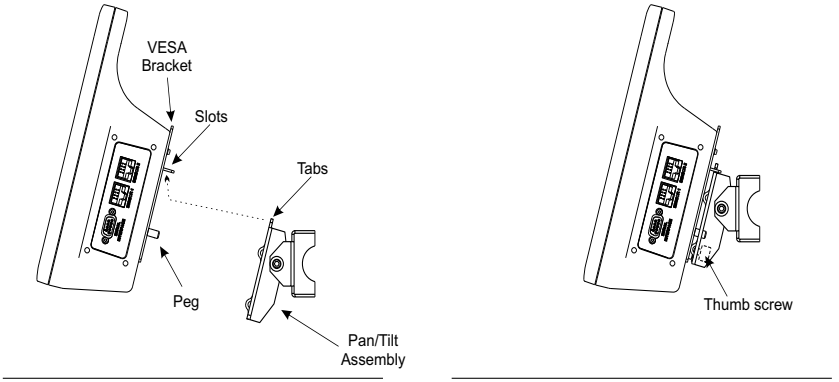
- Square Hole Racks: Install Cage Nuts in appropriate positions. Attach with the larger 12-24 Screws.
- Round Hole Racks (non-threaded): Attach with the larger 12-24 Screws and the square nuts.
- 12-24 Threaded Racks: Attach with the larger 12-24 Screws.
- 10-32 Threaded Racks: Attach with the smaller 10-32 Screws.

Attach 4421A to Rack Mount

The VESA bracket attached to the 4421A allows the unit to easily connect and disconnect with the rack mount.

1. Position the slots on the 4421A VESA Mount over the tabs on the top of the Pan/Tilt Assembly.

Figure 44 Attach 4421A to Rack Mount



2. Insert the peg on the VESA Mount into the hole on the Pan/Tilt Assembly.
3. Tighten the Thumb Screw on the back of the Pan/Tilt Assembly to secure the 4421A to the Rack Mount Assembly.

Limited Warranty

All products manufactured by Seller are warranted to be free from defects in material and workmanship for a period of one (1) year, unless otherwise specified, from date of shipment and to conform to applicable specifications, drawings, blueprints and/or samples. Seller's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by Seller.

If Seller's products are claimed to be defective in material or workmanship or not to conform to specifications, drawings, blueprints and/or samples, Seller shall, upon prompt notice thereof, either examine the products where they are located or issue shipping instructions for return to Seller (transportation-charges prepaid by Buyer). In the event any of our products are proved to be other than as warranted, transportation costs (cheapest way) to and from Seller's plant, will be borne by Seller and reimbursement or credit will be made for amounts so expended by Buyer. Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing within ten (10) days from the date of discovery of the defect.

The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's request and/or to Buyer's specifications. Routine (regularly required) calibration is not covered under this limited warranty. In addition, Seller's warranties do not extend to the failure of tubes, transistors, fuses and batteries, or to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to Seller.

The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR SELLER ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.