M10-14400-3
Issue A May 1993

Instron
Series 4400
IEEE-488 Computer Interface

Installation and Operating Instructions

INSTRON

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Amendment Incorporation Record		
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General Safety Precautions

Materials testing systems are potentially hazardous.

Materials testing involves inherent hazards from high forces, rapid motions and stored energy. You must be aware of all moving and operating components which are potentially hazardous, particularly the actuator in a servohydraulic testing system or the moving crosshead in an electromechanical testing system.

Always be fully aware of the possible hazards involved when operating and maintaining these systems. You must not operate any materials testing equipment unless you are thoroughly familiar with its function and operation. Unfamiliarity with a materials testing system can lead to unexpected actuator or crosshead motion with the consequent risk of injury and damage.

Carefully read all relevant manuals and observe all WARNINGS and CAUTIONS. The term WARNING is used where a hazard may lead to injury or death. The term CAUTION is used where a hazard may lead to damage to equipment or to loss of data.

Ensure that the test set-up to be followed and the actual test to be performed on materials, assemblies or structures constitutes no hazard to operating personnel.

Make full use of all mechanical and electronic limits features. These are supplied for your safety to enable you to prevent movement of the actuator piston beyond desired regions of operation.

The following pages detail various general warnings that you must heed at all times while using materials testing equipment. More specific warnings and cautions willbe found in the text whenever your attention needs to be drawn to a potential hazard.

Your best safety precautions are to gain a thorough understanding of the equipment by reading your instruction manuals and to always use good judgement.

Warning

Disconnect the electrical power supply before removing the covers to electrical equipment.

You must disconnect the equipment from the electrical power supply before removing any electrical safety covers or replacing fuses. Do not reconnect the main power source while the covers are removed unless you are specifically instructed to do so in the manual. Refit covers as soon as possible.

Disconnect power supplies before removing the covers to rotating machinery.

You must disconnect the equipment from all power supplies before removing any cover which gives access to rotating machinery, e.g. belts, screws or shafts. Do not reconnect any power supply while the covers are removed unless you are specifically instructed to do so in the manual. If the equipment needs to be operated to perform maintenance tasks with the covers removed, ensure that all loose clothing, long hair, etc. is tied back. Refit covers as soon as possible.

Warning

Shut down the hydraulic power supply and discharge hydraulic pressure before disconnecting any hydraulic fluid coupling.

Do not disconnect any hydraulic coupling without first shutting down the hydraulic power supply and discharging stored pressure to zero. Tie down or otherwise secure all pressurized hoses to prevent movement during system operation and to prevent the hose from whipping about in the event of a rupture.

Shut off the supply of compressed gas and discharge residual gas pressure before disconnecting any compressed gas coupling

Do not release gas connections without first disconnecting the gas supply and discharging any residual pressure to zero.

Warning

Use protective shields or screens if any possibility exists of a hazard from the failure of a specimen, assembly or structure under test.

Protective shields should be used whenever a risk of injury to operators and observers exists from the failure of a test specimen, assembly or structure, particularly where explosive disintegration may occur. Due to the wide range of specimen materials, assemblies or structures that may be tested using materials testing equipment, any hazard resulting from the failure of a test specimen, assembly or structure is entirely the responsibility of the owner and the user of the equipment.

Protect electrical cables from damage and inadvertent disconnection.

The sudden loss of controlling and feedback signals which can result from a disconnected or damaged cable causes an open loop condition which may drive the actuator or crosshead rapidly to its extremes of motion. All electrical cables, particularly transducer cables, must be protected from damage. Never route cables across the floor without protection, nor suspend cables overhead under excessive strain. Use padding to avoid chafing where cables are routed around corners or through wall openings.

Warning

Wear protective clothing when handling equipment at extremes of temperature.

Materials testing is often carried out at non-ambient temperatures using ovens, furnaces or cryogenic chambers. Extreme temperature means an operating temperature exceeding 60 °C (140 °F) or below 0 °C (32 °F). You must use protective clothing, such as gloves, when handling equipment at these temperatures. A warning notice concerning low or high temperature operation must be displayed whenever temperature control equipment is in use. You should note that the hazard from extreme temperature can extend beyond the immediate area of the test.

Take care when installing or removing a specimen, assembly or structure.

Installation or removal of a specimen, assembly or structure involves working inside the hazard area between the grips or fixtures. Keep clear of the jaws of a grip or fixture at all times. Keep clear of the hazard area between the grips or fixtures during actuator or crosshead movement. Ensure that all actuator or crosshead movements necessary for installation or removal are slow and, where possible, at a low force setting.

Warning

Do not place a testing system offline from computer control without first ensuring that no actuator or crosshead movement will occur upon transfer to manual control.

The actuator or crosshead will immediately respond to manual control settings when the system is placed offline from computer control. Before transferring to manual control, make sure that the control settings are such that unexpected actuator or crosshead movement cannot occur.

Keep clear of the operating envelope of a robotic device unless the device is de-activated.

The robot in an automated testing system presents a hazard because its movements are hard to predict. The robot can go instantly from a waiting state to high speed operation in several axes of motion. During system operation , keep away from the operating envelope of the robot. De-activate the robot before entering the envelope for any purpose, such as reloading the specimen magazine.

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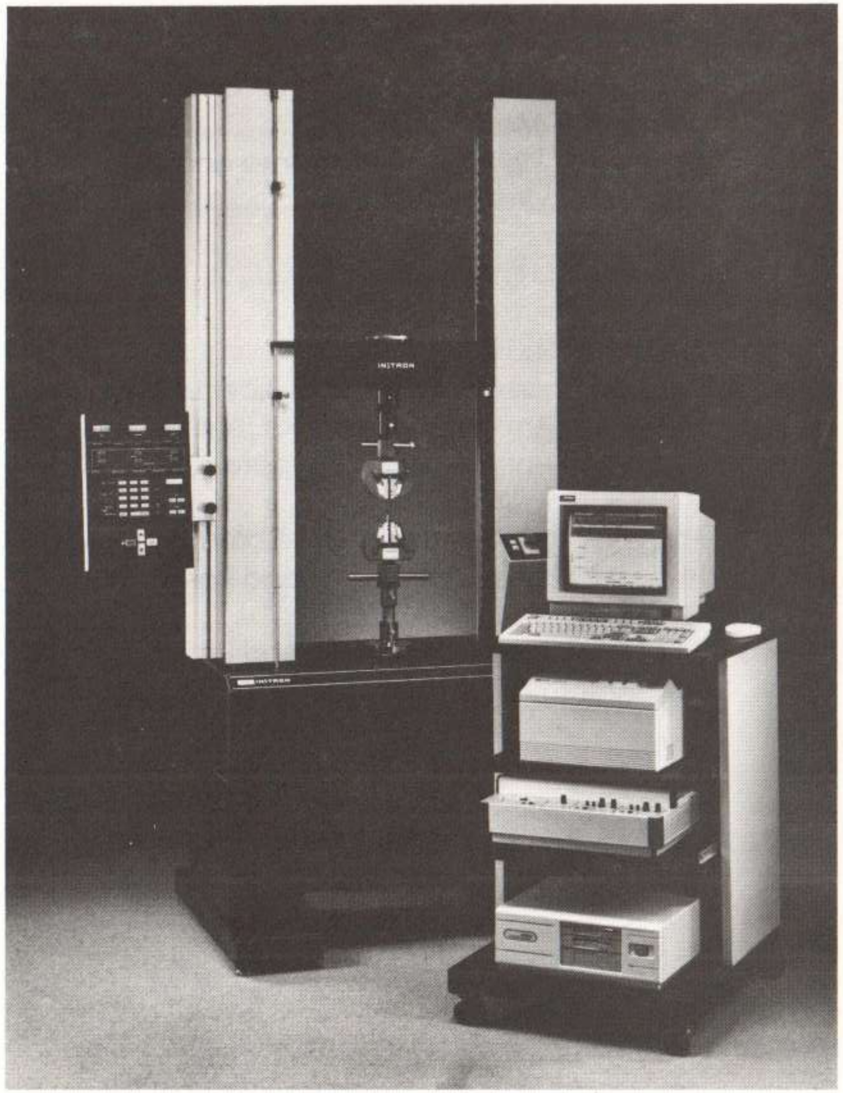


Frontispiece.Series 4400 Universal Testing System

Introduction

Chapter 1
Introduction

This chapter introduces you to the Instron Model 4400 Computer option. The Model 4400 Materials Testing System is an instrument for testing the physical properties of of a wide variety of engineering materials that, in its basic configuration, is a flexible and versatile testing system. With the computer option, machine control and data acquisition are enhanced and automated.

Description

The IEEE-488 Interface option for Instron Model 4400 Test Instruments allows control of the test instrument and the recording of test data by an external computer. The external device is usually an IBM-compatible personal computer, but can be any computer or programmable calculator that has an IEEE-compatible port. The computer must provide the bus control function and be able to transfer program messages to and receive measurement messages from the test instrument.

The computer option uses an industry standard IEEE-448 General Purpose Interface Bus (GPIB) for passing commands and data between the computer and the testing system.

This manual provides specific information that you will need in order to control the test instrument through the IEEE-488 interface. It describes all the valid program messages and other commands that can be sent to the test instrument over the interface. It also describes the resulting measurement messages and other responses that the test instrument can return over the interface. The manual includes descriptions of the sequences, formats, data strings, and programmable signals that are associated with the Model 4400 IEEE-488 interface option.

This manual does not attempt to describe the external device because of the variety of devices that can be used. Thus, the computer and it's interface are referred to only in general terms, and only to the extent necessary to understand the test instrument control via the interface.

Model 4400 IEEE-488 Interface

The Model 4400 IEEE-488 interface option incorporates two standards of the Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE Std-488-1978, Standard Digital Interface for Programmable Instrumentation.
2. IEEE Std-728-1982, Recommended Practice for Code and Format Conventions.

The Model 4400 test instrument supports a subset of the IEEE Std-488-1978 interface functions. Table 1-1 lists these functions and their associated IEEE Standard Identifiers.

This manual briefly describes the functions as implemented in the Model 4400 interface. Refer to the IEEE standards listed previously for additional information.

The interface is primarily designed to transfer digital data messages between devices as strings of 8-bit data bytes (byte-serial) and to transfer polling information such as status in a single bit or byte (bit-parallel). The interface also supports special bus signals such as device clear, device trigger, and service request.

Table 1-1. IEEE-488 Interface Functions Included in the Model Model 4400.

Function Supported	Identifier
Basic Listener	L4
Basic Talker with Serial Poll	T6
Source Handshake	SH1
Acceptor Handshake	AH1
Device Trigger	DT1
Device Clear	DC2
Service Request	SR1
Parallel Poll	PP2
Three-state signal line drivers	E2
Not Supported	
Controller	CO
Secondary Addressing	TEO,LEO
Remote/Local	RLO

How the Interface Operates

The Model 4400 with the IEEE-488 option can be both talker (send messages) and listener (receive messages) on the interface. However, an external device, such as a computer or programmable calculator, must be connected to the interface to provide the controller function. The controller device directs the transfer of information over the interface as instructed by its program. To transfer a message, the controller addresses one device as a talker and the other as a listener. Once a talker/listener link is established, the internal logic in each device controls the actual transfer of data from the talker to listener in a handshaking or asynchronous manner. Figure 1-1 gives a functional overview of the interface.

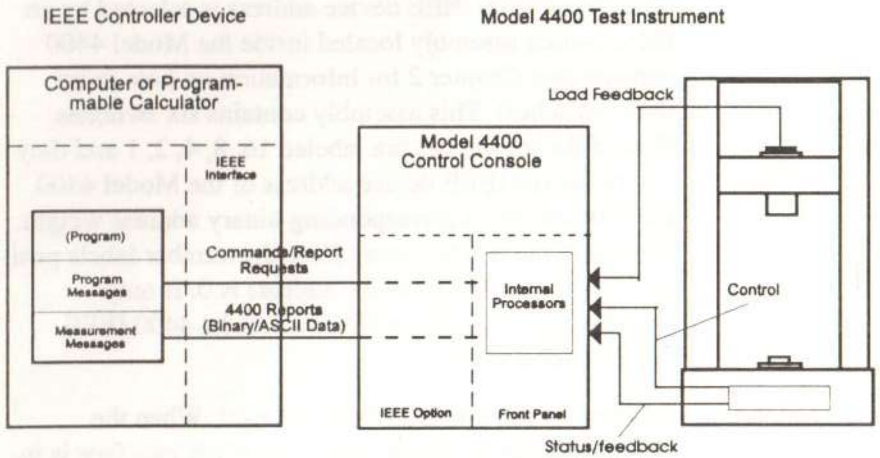


Figure 1-1. System Functional Overview

IEEE Device Address

Addresses are used to differentiate between devices connected to the interface. Each device is assigned a unique IEEE device address and the program of the controller uses these addresses to direct message transfers between the devices. The controller converts the addresses coded in the program into the required talker and listener addresses that control the transfer.

Address switches or jumpers, located on a device, typically select the IEEE address assigned to that device. The IEEE device address used in the program must match the address selected for the corresponding device in order for a message transfer to occur.

The Model 4400 IEEE device address is selected by an IEEE switch assembly located inside the Model 4400 console (see Chapter 2 for information on how to set these switches). This assembly contains six switches. Five of these switches are labeled 16, 8, 4, 2, 1 and they determine the IEEE device address of the Model 4400. Each switch has a corresponding binary address weight. With all five switches away from the number labels position (OFF), the IEEE device address is 0. If only switches 1, 8, and 16 are ON, the Model 4400 IEEE device address is 25.

Address 31 (all switches ON) is illegal. When the switches designate this address, the IEEE interface is inoperable and the IEEE indicator on the Model 4400 front panel flashes to alert the user.

Note *The IEEE device address selected by these switches also affects the parallel poll function. See "Parallel Poll Operation" section on page 1-17.*

Listener/Talker Functions

The listener/talker functions handle the primary message transfers between the external device and the Model 4400 test instrument. The interface controller directs the transfer by addressing the Model 4400 as a listener to send commands to the test instrument, and it addresses the Model 4400 as a talker to receive data from the test instrument.

When a talker/listener link is established, the message is transferred asynchronously as a string of data bytes from the talker to the listener. When the talker sends the last byte, it terminates the talker/listener link and the bus controller can then direct another transfer as required by its program.

Sending Messages to the Model 4400

The program of the external computer (controller) typically uses an output statement, specifying the Model 4400 IEEE device address, to send messages to the test instrument. When the controller addresses the Model 4400 as a listener, the test instrument can accept program messages from the computer (talker).

Program messages are the actual strings of characters as coded in the program of the external device (computer). These messages consist of program commands and/or report request commands directed to the test instrument. Each message can contain one or more test instrument commands. All test instrument commands are described in Chapter 2.

The test instrument reacts to program commands in much the same way as it does to keys on the front panel of the Model 4400, providing the interface is enabled. Report request commands only cause the Model 4400 to assemble a measurement message. The message is sent later when the controller addresses the Model 4400 as a talker. Report requests do not need the interface enabled.

Once the test instrument receives a program message, it begins processing the commands in the sequence received. While processing commands, the Model 4400 becomes "Busy" until the commands are completed. Any attempt to send another message while the Model 4400 is busy, stalls the bus until the test instrument is not busy. The controller can monitor the busy status of the test instrument using the serial polling feature described on page 1-13.

A typical sequence to send messages to the test instrument is as follows. The controller executes an output instruction directed to the Model 4400 test instrument. This causes the test instrument to be addressed as the listener and the computer as the talker. The hardware then transfers the message as coded in the program.

A terminator is sent along with the last character transfer. When the Model 4400 detects the terminator, it starts processing the command(s) in the sequence they were received. The Model 4400 remains busy until it completes the actions required by the message. The program monitors the process using serial polling to determine when the process is complete or if an error occurred.

Receiving Measurement Messages from the Model 4400

It is a two step process to receive a message from the Model 4400. First, the program of the external computer must issue a program message (containing a report request). Then, to receive the measurement message response, the program must issue a separate input statement specifying the Model 4400 IEEE device address. The Model 4400 only transfers the measurement message when the external computer (controller) addresses the test instrument as a talker.

A measurement message is a Model 4400 report consisting of one or more results of measurement or status information. For example, the current load and extension values, or the status of the crosshead. These reports consist of strings of either ASCII or binary data bytes. The format and coding of all the Model 4400 reports are described in Section 2.

Reports are the Model 4400 response to report request commands in a program message. If no report is available when the Model 4400 is addressed to talk, the interface hangs until the report is ready. If no reports were requested, the interface hangs indefinitely. However, most controllers have a timeout feature to escape this condition. The bus can then be cleared using the interface Device Clear function.

A typical sequence to receive a measurement message from the Model 4400 test instrument is as follows. The controller issues a program message to the test instrument containing one or more report request commands. The Model 4400 immediately goes busy until it assembles the requested report(s). When the controller's program wants the report(s), it issues an input instruction specifying the test instrument's device address. In this case, the controller addresses the Model 4400 as the talker and this causes the requested data to be transferred to the computer.

Enabling the Interface Option

The controller's program is allowed to receive reports from the test instrument at any time, but it cannot control the test instrument until the user manually enables the interface. Pressing the IEEE key on the front panel of the test instrument alternately enables and disables the interface control.

The Model 4400 Test Instrument IEEE Interface option becomes functional about two seconds after the test instrument completes its power-up self test. At this time, the controller can send program messages to and receive reports from the test instrument, providing the IEEE device address is properly set. However, if the IEEE lamp is OFF, the test instrument can not execute program commands. Instead, it sets a command error bit in the Model 4400 status byte if a program command is received. Report request commands are executed as received regardless of the state of the IEEE lamp.

Pressing the IEEE key on the front panel will light the IEEE lamp and enables program command execution. If the lamp remains off, then either the interface is not functional, not installed, or the self test is still in progress. Pressing the IEEE key when the lamp is on disables program command execution, aborts processing any program command already in progress, and turns the lamp off.

For safety, the interface is disabled and the IEEE lamp goes out if the STOP button on the crosshead control panel is pressed. This inhibits test instrument control, but allows the computer to obtain report messages from the test instrument.

The interface is completely disabled and the IEEE lamp flashes to alert the user if illegal IEEE device address 31 is currently selected by the Model 4400 device address switches. In this case, the Model 4400 will not respond to any interface messages or interface signals. A new address can be selected by changing the switches in the test instrument and then disabling and reenabling the interface (see Chapter 2).

Note *When the IEEE lamp is turned off and then on, the interface is reinitialized if the address switches have changed. Also, any report activity in progress is aborted.*

Interface Status Functions

To allow direct access to certain status information, the Model 4400 supports the following IEEE-488 interface status functions:

- Serial Poll
- Service Request
- Parallel Poll

These functions use special interface logic so status can be obtained without the use of report request commands.

Serial Poll Function

The serial poll function allows the external program to obtain a status byte from devices on the interface. When the program requests a serial poll from the Model 4400, a status byte is immediately transferred from the test instrument to the computer. The Model 4400 status byte is described in the next section.

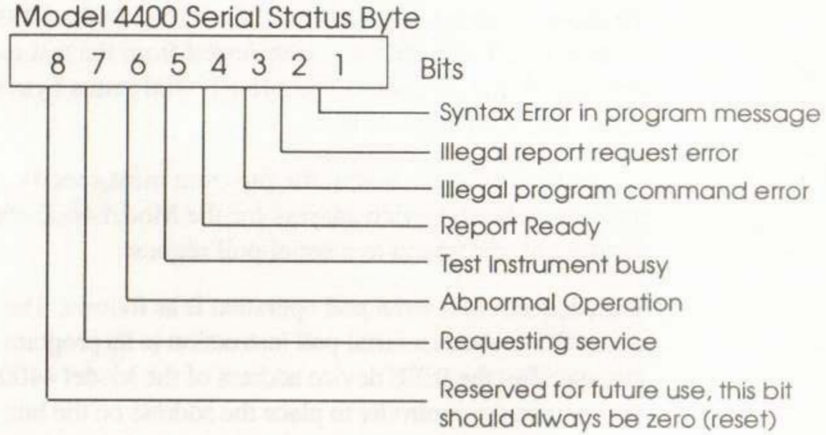
As in any message transfer, the program must specify the correct IEEE device address for the Model 4400 test instrument to respond to a serial poll request.

The sequence of a serial poll operation is as follows. The controller executes a serial poll instruction in its program that specifies the IEEE device address of the Model 4400. This causes the controller to place the address on the bus along with special control signals. The control signals suspend other bus operations. When the test instrument recognizes its address, together with the control signals, it immediately becomes a talker and transfers the current status byte to the controller. Once the transfer occurs, the bus typically returns to whatever activity was occurring before the serial poll transfer.

Model 4400 Status Byte

The Model 4400 status byte provides current test instrument status information to the program of the bus controller (computer). This 8-bit byte is transferred to the controller in response to a serial poll request directed to the Model 4400. The setting of some status byte bits can also generate a service request providing this function is enabled (see "Service Request Operation" in the next section).

Figure 1-2 defines each bit of the Model 4400 status byte. Logic initializes (resets) all status bits to zero after power up, whenever the IEEE interface is enabled, or on



Note: 0 to 1 transition of bits 1,2,3 or 6 generates a service request if enabled.

Figure 1-2. Model 4400 Status Byte Format

a device clear (see "Enabling the Interface" and "Device Clear" sections of this Chapter). When a bit is set to 1, it remains set until a new status is either written or reinitialized. A new status byte is written whenever the test instrument completes processing a program message. However, the Model 4400 busy bit (bit-5) sets immediately when the message is received and then resets to zero when the new status is written (i.e., the Model 4400 completes processing the message). The other bits can change any time during the processing. Therefore, the busy bit must be 0 to consider the rest of the status byte valid.

The following further describes each bit in the Model 4400 (serial poll) status byte:

Bit-1 (Syntax error) This bit sets to 1 if a program message contains a syntax error. For example, if a set speed command was received without a separator (,) between the command code (K13) and desired speed parameter, the syntax error bit sets to 1.

Bit-2 (Illegal report) This bit sets to 1 if a report request is illegal or can not be executed by the Model 4400. For example, if a Strain FS report request (R17) was received and the Strain channel was not installed, this bit would set to 1.

Bit-3 (Illegal Command) This bit sets to 1 if a program command is illegal or can not be executed by the Model 4400. For example, if a keyboard command (Kx) is issued and the interface is disabled (IEEE indicator is off), the Illegal Command sets to 1.

Bit-4 (Report ready) This bit sets to 1 when the test instrument has a report ready to transmit to the computer.

Bit-5 (Busy) This bit, when set, indicates the test instrument is busy and that the error bits are not yet valid. The busy bit sets to 1 when a program message is received and resets to zero when the test instrument completes processing all the commands in the program message.

Note *Crosshead commands keep the busy bit set only for the time it takes to interpret and initiate crosshead movement. A separate report request (RO) can be used to monitor when the crosshead actually stops.*

Bit-6 (Abnormal operation) This bit is a summary of the error condition bits. It sets to 1 when any of the error bits (1,2,3) sets. It resets to 0 when new status is written with no errors or if a device clear is received (see the "Device Clear Function" section later in this chapter).

Bit-7 (Service Request) This bit indicates the Model 4400 is asserting the service request signal. It is set by a 0 to 1 transition of any of the error bits (bits 1,2,3 or 6) providing the Service Request Enable (SRQEN) switch is on. It resets to zero automatically after a serial poll to the test instrument is executed (see the "Service Request Operation" section below).

Bit-8 This bit is reserved for future use and is always 0 (reset).

Service Request Operation

The service request function allows the test instrument to alert the computer when an abnormal condition exists.

This function is controlled by the SRQEN switch located inside the Model 4400 control console (see Chapter 2). When the switch is ON, the service request function is enabled. If the switch is OFF, the service request is disabled.

When the SRQEN switch is ON and any error bit (Bits 1,2,3,6) in the Model 4400 status byte sets (O to 1 transition), the test instrument also asserts the service request signal on the interface. This signal informs the computer that the Model 4400 or some other device on the interface requires service. The device requesting the service is found by performing a serial poll to each device until one is found with bit-7 of its status set (1). When the Model 4400 receives a serial poll, the test instrument automatically resets the service request signal and status bit 7. However, if the computer does not perform a serial poll, the service request signal and bit 7 remain asserted. Error bits in the status byte are not affected by the serial poll operation.

If the SRQEN switch is of f, then the service request bit is always 0 and the interface signal is not generated. The remaining bits in the status byte operate as described in the "Status Byte" section earlier in this chapter.

Parallel Poll Operation

The parallel poll function provides a high speed means for the computer to simultaneously interrogate up to eight devices on the interface. When the controller issues a parallel poll, each device responds by sending a single bit of status information on an assigned data line of the interface.

The meaning of the status bit differs from device to device. For the Model 4400, the assigned status line indicates whether or not the test instrument has a report ready to send. A parallel poll operation takes priority over normal message transfers.

The lower three bits of the Model 4400 IEEE device address specify the data line that the test instrument device activates in response to a parallel poll. The Model 4400 device address is selected by five switches on the IEEE switch assembly (see Figure 2-1). Table 1-2 shows the relationship between the address switch settings and the parallel poll response line.

If more than one device is assigned the same parallel response bit, the response on the associated data line will be the logical "or" of all such devices.

Table 1-2. Relation of Parallel Poll Response and IEEE Device Address

Address Switches MSB LSB	IEEE Bus Data Line	Parallel Poll Response Bit
x x 0 0 0	DIO1	PPR1
x x 0 0 1	DIO2	PPR2
x x 0 1 0	DIO3	PPR3
x x 0 1 1	DIO4	PPR4
x x 1 0 0	DIO5	PPR5
x x 1 0 1	DIO6	PPR6
x x 1 1 0	DIO7	PPR7
x x 1 1 1	DIO8	PPR8

DEVICE CLEAR Function

The IEEE-488 Device Clear function (DCL) or Selective Device Clear (SDC) allows the external computer a means to initialize the Model 4400 interface logic. Most computers activate this function via program command or a manual reset.

When the Model 4400 console detects the IEEE-488 Device Clear signal, the test instrument performs the following:

- Clears any talk or listen activity in progress.
- Cancels any requested reports.
- Resets the serial poll status byte, except the BUSY bit.
- If the test instrument is busy when DCL or SDC is received, the Program command error status bits are allowed to set correctly when the Model 4400 becomes Not Busy.

The Device Clear signal has no effect on enabling the IEEE option.

The IEEE interface retains control if it already is enabled when a Device Clear signal is received. That is, the test instrument can execute K commands.

DEVICE TRIGGER Function

The IEEE trigger feature allows the program a fast means to control the crosshead (i.e. STOP, RETURN, or No Action) by using a trigger signal. The IEEE trigger can be transmitted to the test instrument faster than a complete command string.

To use the trigger, the program first informs the test instrument what crosshead action should occur when a trigger is sensed. The program does this with a previous program command (K39). Once this is done, the program has only to issue an IEEE Group Execute Trigger (GET) statement directed to the test instrument. This generates the interface trigger signal along with the test instrument's device address.

When the test instrument detects its address with the trigger signal, it interrupts what it is doing, and performs the crosshead control action specified in the last K39 command each time the program issues the trigger to the Model 4400. The test instrument defaults to NO ACTION, but once programmed, it retains the same action until reprogrammed or as long as RAM storage is preserved in the test instrument.

Model 4400 Controls Used With the Interface

All Model 4400 controls and indicators are fully active when the IEEE interface is enabled or disabled. A complete description of these controls and indicators is provided in Model 4400 Operating Instructions manual M10-94400-1. The following describes controls and indicators of concern when operating under IEEE interface control (see Figure 1-3).

MAIN POWER SWITCH - (on the load frame) controls test instrument power only. A separate switch controls power to the computer.

IEEE lamp/key - (on main section of the front panel) This key alternately enables or disables the IEEE interface. The lamp lights when the bus is enabled and indicates that the Model 4400 can respond to all interface commands including K (keyboard) commands. The lamp is unlit when the bus is disabled or the IEEE interface is not installed. When the interface is disabled, the Model 4400 accepts all report requests but rejects all K (keyboard) commands, and instead sets the program command execution error bit in the Model 4400 status byte. See "Status Byte" section earlier in this chapter. The lamp flashes if illegal IEEE device address 31 is selected in the Model 4400. It indicates the Model 4400 console can not respond to any IEEE commands.

LOAD CAL lamp/key - (on main section) This key initiates the calibration sequence in the Model 4400 load channel. The lamp lights when the calibration is in progress and flashes when a calibration error is detected.

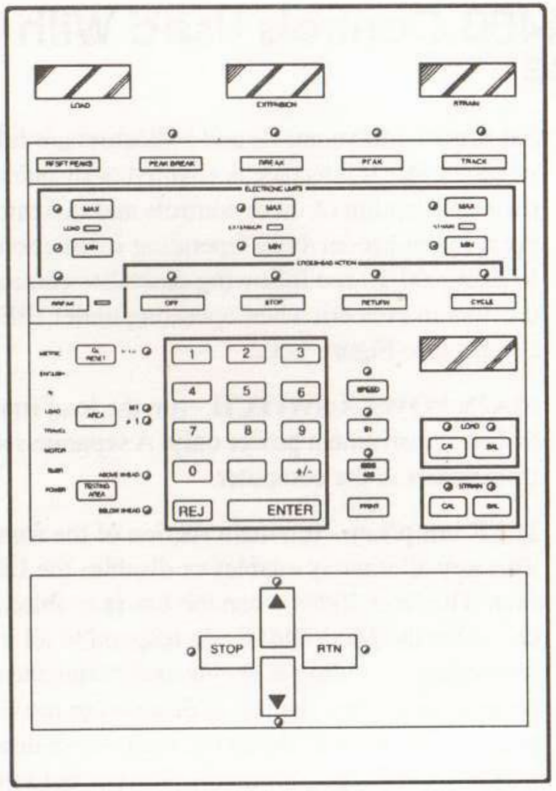


Figure 1-3. Model 4400 Controls and Indicators Used with Computer Operation

A good calibration must be performed before starting tests to ensure valid load data is available for the computer.

STRAIN CAL lamp/key - (on main section) This key initiates the calibration sequence in the Model 4400 Strain channel (if installed). The lamp lights when the calibration is in progress and flashes when a calibration

error is detected. A good calibration must be performed prior to the start of testing to ensure valid strain data is available for the computer.

NOTE *The LOAD CAL, LOAD BAL, STRAIN CAL, STRAIN BAL panel functions cannot be commanded by the computer. Calibration and balance is only initiated at the Model 4400 control panel*

AREA SET, ≠ 1 lamp/key - (on main section) The ≠ 1 lamp lights when load reported to the computer (and displayed) is the result of dividing load by a value of area compensation other than 1.0. Most computer programs perform their own area calculations and therefore expect true load values (≠ l unlit). Pressing the AREA key enables the user to display or enter the area compensator value. The SET lamp lights when the area compensator value is being displayed.

4-DIGIT DISPLAY - (on main section) Displays system variables, such as Area Compensation value when SET is lit, Speed when SPEED is lit, or Results of self test.

The self test must report a 3 in the left digit and either 3 or 9 in the other digits when the IEEE option is installed.

STOP button - (on crosshead control section) The STOP button always stops the crosshead and disables the IEEE bus when pressed. This ensures that the computer cannot command the crosshead after STOP is pressed.

Note *The JOG buttons (on the crosshead control unit, not on the main control panel) allow manual crosshead control without disabling the IEEE bus. However, even if the UP and DOWN buttons are used, the interface is still disabled when the STOP button is pressed.*

Chapter 2
Installation

Outline

This chapter explains how to install and set up the IEEE computer option. Installation of the IEEE Interface board, setting of the IEEE DIP switches, interconnections to the computer, and testing the interface are all covered here.

Installation

IEEE Interface Installation

The IEEE Interface is a separate printed circuit board that must be installed in the Model 4400 Control Console. Installation consists of installing the Interface Board in the Control Console, and installing a cable between the Control Console and the computer. The IEEE Interface option kit contains all of the parts, including the interconnecting cable, that you will need.

Installing the Board

To install the IEEE Interface board in the console, perform the following steps:

Warning

Shut off electrical power to the testing system before beginning this procedure.

(a) Shut off electrical power to the testing system.

(b) Remove the console from the load frame by disconnecting all cables from the rear of the console. Then lift the console and separate the two halves of the mounting bracket. If you are not sure how to do this, additional information can be found in the Model 4400 Operating Instructions manual.

(c) Place the console face down on a work surface covered with a soft cloth or other material to prevent scratching the front panel. It is not necessary to remove the mounting bracket from the console back.

(d) Remove the rear cover of the console by removing all cover retaining screws. Retain the screws for reuse. It is not necessary to remove the main circuit board from the front panel.

(e) Orient the Interface board so that the multi-pin connector on the IEEE Board aligns with the IEEE Board connector on the console main circuit board (not the IEEE cable connector at the bottom of the rear panel), and the four plastic or nylon standoffs align with the four holes in the main circuit board (see Figure 2-1). Press the Interface board into place, ensuring that the four standoffs snap into the holes in the main board, and that the connectors mate with good contact.

(f) Tighten the two connector screws to prevent vibration from separating the connectors.

(g) Replace the rear cover of the Control Console, using the screws removed in Step (d).

(h) Return the console to its mounting bracket on the load frame.

(i) Reconnect all cables removed in Step (b).

Connecting the Computer

Use the following procedure to connect the computer to the Model 4400 System:

(a) Connect the console end of the computer cable to the IEEE connector on the rear panel of the console. Be sure to use the locking devices on the connector.

(b) Connect the computer end of the interconnecting cable to the proper connector on the rear of the computer. For personal computers, this connector will be the IEEE port, usually on an expansion card in the computer. Be sure to use the locking devices on the connector.

(c) Turn on the testing system.

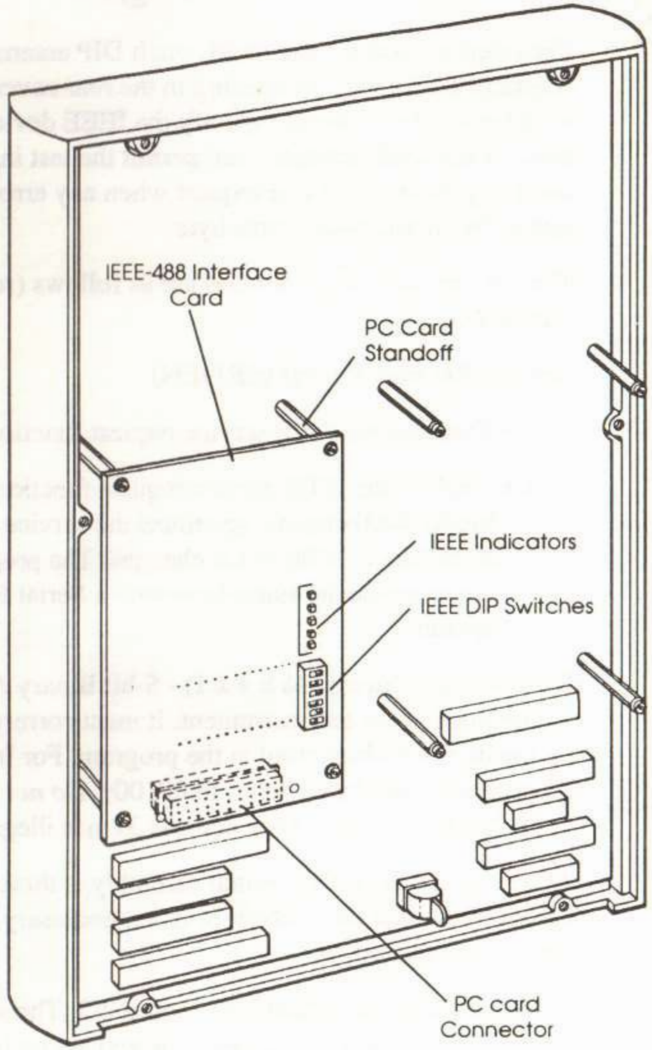


Figure 2-1. Installing the IEEE PC Board

IEEE Interface Switch Settings

The interface board has a multiswitch DIP assembly that is accessible through an opening in the rear cover. The switches on this assembly specify the IEEE device address of the IEEE Interface and permit the test instrument to generate a service request when any error bit sets in the Model 4400 status byte.

The functions of these switches are as follows (refer to Figure 2-2:

Service Request Enable (SRQEN)

0 = Disables the IEEE service request function

1 = Enables the IEEE service request function. The Model 4400 console generates the service request if the Model 4400 status changes. The program can examine the status byte with a Serial Poll operation.

Bus Device Address (16 8 4 2 1) - 5-bit Binary Address assigned to the test instrument. It must correspond to the device address used in the program. For Instron programs, set the switches to 00100_2. *Do not set the switches to* 11111_2. Also, address 31_{10} is illegal.

Access to the IEEE DIP switch assembly is through a cusout in the rear panel cover. It is not necessary to remove the rear cover.

Set the switches as indicated in Figure 2-2. The switches can be a slide, rocker, or toggle type and are on (or set to 1) when the slide is pushed to the left, or the rocker or

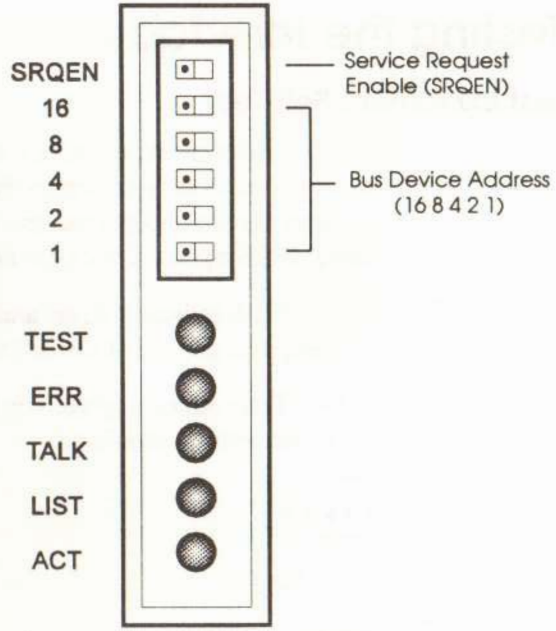


Figure 2-2. IEEE DIP Switches

toggle is depressed on the left. Use a ball point pen or other pointed instrument to set the switches.

The switch settings only become effective upon enabling the IEEE interface. If the switches are changed while the IEEE is enabled, press the IEEE key on the test instrument control console off (to take the IEEE Interface off line), then on again.

Testing the Interface

Test Instrument Self-Test

The test instrument performs a self test whenever power is turned on at the load frame. For computer operation, the user should observe that the self test reports an operational IEEE option. Check for the following:

1. The IEEE indicator lights and goes out during the lamp test portion of the self test.
2. Self Test results displayed on the Model 4400 main panel readout should be:

$\boxed{3\ x\ x\ x}$

(x = 3 or 9)

where:

3 = IEEE and CPU good.
9 = IEEE board not installed, CPU good.
5 = IEEE board bad, CPU good.

If the self test does not report either 3's or 9's, it indicates a failure and a service call is required. Retry the self test by turning power OFF, then ON again. If the self test passes, there is a marginal error and the results should be noted and reported. If the self test fails again, check for the following:

1. Input power matches power selector on the load frame. The console power cable connects to the load frame, not to site power.

2. All cables and components are installed correctly. See installation in the test instrument operation manual.

Note *If the Model 4400 is addressed as a talker while the self-test result is being displayed, a special diagnostic message, with a J# preamble, is transferred to the computer. The contents of this message is for field service use and not described in this manual.*

For more information on the Self-Test, refer to the Model 4400 Operating Instructions manual.

IEEE-488 Interface Test

The IEEE-488 printed circuit board in the test instrument console contains a series of LED indicators that report the condition of its functions. These are visible through the rear panel of the console when the IEEE board is installed, and are labelled TEST, ERROR, TALKing, LISTening, and ACTivity.

During the console self-test routine (initiated either when the system is turned on, or manually by front panel keys), these LEDs are lit in certain combinations to show whether the IEEE interface is functioning properly or not.

You are first alerted to an IEEE interface failure during the self-test routine by the display numbers described in the previous section above. If you wish to find out which section of the interface is at fault, compare the on-off state of the IEEE indicators on the rear panel (see Figure 2-2) to the indications shown in Table 2-1.

Table 2-1. IEEE-488 LED Error Codes

LED Name				Description
ERROR	TALKing	LISTening	ACTivity	
on	on	on	on	LED Test
on	off	off	off	CPU RAM/Timer Error
on	off	off	on	D-P Memory Data Error
on	off	on	off	PROM Error
on	on	off	off	GPIB Driver Error
on	on	on	off	D-P Memory Control Error

In most cases, failure in any part of the IEEE interface will require that you contact Instron Service. When you call Instron Service, the Service Engineer may ask you to describe the on-off state of the LEDs, so you will want to make a list while the error is apparent, before you change the conditions under which the error occurred.

Chapter 3
Message Coding and Format

This chapter describes the coding and format of the messages that the IEEE interface transfers between the controller's program and the Model 4400 test instrument.

Standard Coding

The character code used in the Model 4400 system is the American Standard Code for Information Interchange (ASCII) 7-bit code. The least significant bit is interface data line DI01, the most significant bit is data line DI07. DI08 is ignored when received by the Model 4400 and is always 0 when the systemsends ASCII data. The Model 4400 can also transmit certain reports in 8-bit binary code.

Program Messages

Program messages are commands sent to the Model 4400 to perform front panel operations, request reports, or otherwise program the test instrument. The message is coded in the program of the controller. The code (message) is typically transferred to the test instrument using a controller output instruction specifying the Model 4400's IEEE device address.

The program message is a string of commands, made up of ASCII characters, ending with a terminator. Each message can contain one or more commands, as shown in Figure 3-1.

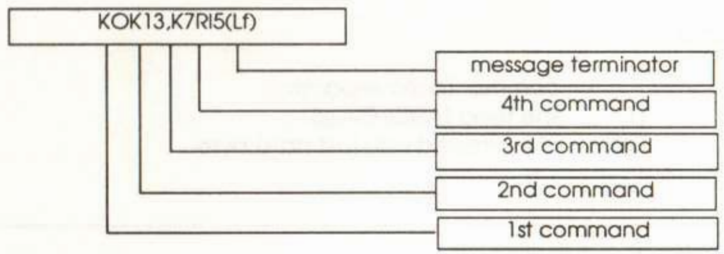


Figure 3-1. Example of Message Structure

Individual program commands consist of a header, followed by a command number that specifies a unique action. Some commands also require numeric parameters that are placed after the command number, separated by a comma (,). The command header is a letter of the alphabet in upper case; one letter for each command type. The comand header serves to separate commands in the program message and indicates the command type.

Table 3-1 shows the valid characters used in program messages.

Table 3-1. Program Message Characters

Command Headers

K R L T

Command Number

0 1 2 3 4 5 6 7 8 9 (digits)

Parameters (numeric values)

0 1 2 3 4 5 6 7 8 9 (digits)

- (minus sign)

. (decimal point)

E (exponent delimiter)

Separators

,	comma (data separator)
Lf	line feed (ASCII OA_{16})
END	EOI asserted with last data byte.

Program Command Format

The format of a program command is:

Hd Cmd# [,Parameter# [Exponent]] (Lf)

Where:

Hd = Command Header – This single alpha upper case character defines the command type. The valid characters are:

K	Keyboard (program) command
L	Loop (report request)
M	Mode (report request)
R	Report (report request)
T	Time (report request)

Cmd# = Command Number – This numeric field defines the specific operation of the command. Table 4-1 lists all the valid program (K) command numbers, and Tables 4-2 and 4-3 list all valid report request command numbers.

Note *The decimal point (.), minus sign (-) and E are illegal characters in the Hd and Cmd# fields and cause the syntax error status bit to set if received. All other characters not listed in Table 4-1 are ignored.*

[ ] = Optional parameter fields. The brackets are not part of the command. Parameters can be expressed as

an integer, decimal number, or as a mantissa and exponent.

, = Required delimiter.

Parameter# = This field specifies a numeric value required by the specific command. See tables 4-1, 4-2 and 4-3. Maximum field length is 10 characters.

E = exponent delimiter – defines following digits as an exponent.

Exponent = this numeric field is an exponent value. Valid characters are digits 0 to 9, minus sign (-) and decimal point (.). Maximum field length is 4 characters.

(Lf) = message terminator, a line feed character (ASCII OA_{16}) or IEEE-488 END message (EOI line asserted along with the last data byte).

Most program messages are in ASCII format; that is, the commands, parameters, and exponents consist of ASCII characters. Certain messages, however, can be coded in binary format where that is more convenient. Binary messages are listed in Table 4-3.

The program message must contain only one terminator and it must follow the last command in the message. Some computers require the terminator to be coded in the program. Others generate it automatically when the last data byte is transferred.

Keyboard Commands

Keyboard commands (identified by K in the command header) cause the test instrument to perform some action that the operator could normally do by pressing keys at the Model 4400 control console (for example, set up a load limit).

The interface must be enabled (IEEE lamp lit) for the test instrument to execute any keyboard command. Table 4-1 lists all the valid keyboard (K) commands.

There are two types of keyboard (K) commands. The simpler type requires no parameter. It consists of a K command header and a command number. This type of command is similar to pressing a single key on the console front panel and produces immediate action. For example:

K11	Resets the peak detector
KO	Stops the crosshead
K21	Resets gauge length

The second type of K command requires a parameter. These commands usually correspond to front panel key operations which need a value entered on the numeric key pad. The format of these commands is a K command header, a command number (O to 9999), a comma, and the parameter. Parameter values must be expressed using the same units currently active in the test instrument. That is, the parameter values are the same as those which would be entered if using the key pad. For example:

K13,20	set speed to 20 in/min (English units active)
K13,20.	same (decimal parameter)
K13,2E1	same (mantissa/exponent)
K40,0	Auto print off
K40,1	Auto print on

The Model 4400 does not execute any K commands in a program message until it receives the message terminator. It then executes the K commands in the order they are received. For example:

KOK13,lK7(Lf)

The above program message is transferred left to right. When the terminator (Lf) is received, the test instrument executes the following sequence.

1. Stops crosshead (KO)
2. Sets speed to 1 in/min.(Kl3,1)
3. Displays peak (K7)

If a format error exists in the program message, the syntax error bit is set. If a command cannot be executed, or if an illegal command number is detected, the illegal program command error bit sets in the Model 4400 status byte (see "Status Byte" on page 1-14).

The Model 4400 rejects all K commands and sets the illegal program command error bit when the interface is disabled (IEEE lamp is off).

Report Request Commands

Report request commands inform the test instrument what information the computer wants in measurement messages. When the test instrument receives a report request, it assembles the requested data in a buffer. The test instrument then sends the report as a measurement message to the computer when it is addressed as a talker. Section 3.6 describes the measurement message response.

Report request commands are sent to the test instrument in program messages, either alone or intermixed with program commands. Up to 10 different report points may be selected for a measurement message response. The commands can also specify that the report be automatically repeated periodically, indefinitely, or a specific number of times. Figure 3-2 shows an example.

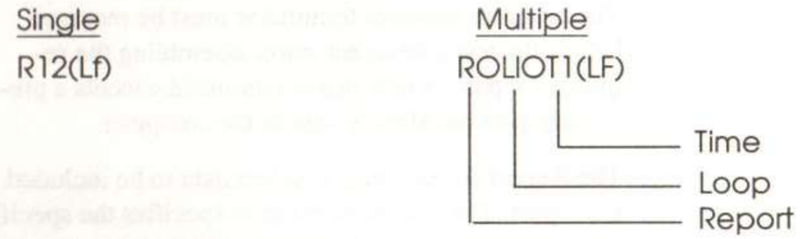


Figure 3-2. Example of Report Request Command Repetition

The format of report request commands is a command header followed by a command number:

Command Header No.

There are four types of report request commands identified by the following letters in the command header, shown in Table 3-2 .

Table 3-2. Report Request command Header Letters

Header	Cmd# Range
R = Report	0 to 253
L = Loop	0 to 65535
T = Time	0 to 65535
M = Mode	0 or 1

The program message terminator must be received before the test instrument starts assembling the requested report. A new report command cancels a previous report not already sent to the computer.

The Report (R) commands select data to be included in the report. The command number specifies the specific test instrument data to be included in the measurement message response. Tables 4-2 and 4-3 list all the possible report points. For example, one report point is current load; another is current units selected in the test instrument. The test instruments accepts up to 10 report commands in a program message and generates the report results in the sequence in which they appear in the message. Any report commands after first 10 in a message are ignored.

The Loop (L) and Time (T) commands are optional and further define the report request message.

The Loop (L) command specifies the number of times the report request will be executed and the Time (T) command specifies time between reports. If no L command or Ll is received in the program message, then only one report request is sent and any T command is ignored. If an L command is received with a number (1 to 65535), the report is repeated the specified number of times. If LO is received, the report is repeated indefinitely.

The Time (T) command determines the time between reports. This period is the T command number times the sample rate (50 milliseconds). For TO or Tl or if T is not included in the program message, the Model 4400 defaults to one report every 50 msec. For T2, the system generates one report every other sample time (100msec) etc. The maximum T value is 65535.

If more than one L or T command is in the program message, only the last received is effective. Sending Ll as the only report request command will stop all reporting.

The Mode (M) command specifies the coding of the report request response. When MO or no M is specified, the test instrument is set to ASCII mode and sends all messages in ASCII code. If Ml is specified, the test instrument is set to binary mode and sends reports in binary code for those requests that allow binary reporting. For requests that do not allow binary reports, results are returned in ASCII code. Table 4-3 indicates the report requests that allow binary reporting.

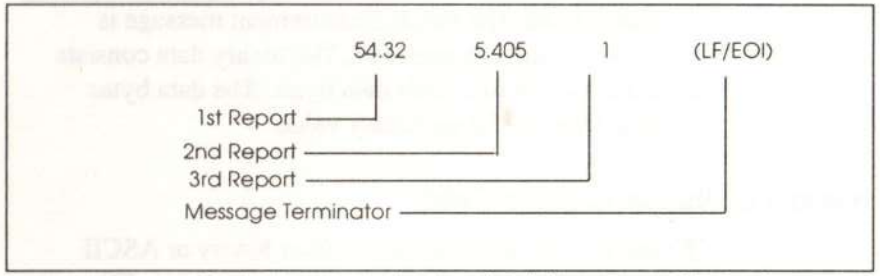
The syntax error bit in the status byte sets if a report request command has a decimal point (.), minus sign (-), or E in the header or command number fields. If the command number is not within range (see above), the illegal report request error bit sets in the status byte (see "Status Byte" section on page 1-14).

Measurement Messages

A measurement message is the test instrument response to report request commands. When the test instrument receives report requests, it assembles the message in a buffer as specified by the commands and sets a flag when the report is ready to transmit. However, the test instrument only transmits the message when the controller addresses it as a talker. This typically occurs when a separate input instruction is executed in the program.

The measurement message is a string of data bytes, which can consist of headers, data fields, data separators, and a terminator. Data fields can contain ASCII decimal numbers, binary numbers, or ASCII text. A measurement message can contain one or more report results (see Table 3-3 for an example).

Table 3-3. Measurement Message Format



Each report result (data field) is separated by a comma (,). The message terminator is a line feed character (Lf) along with interface signal EOI in ASCII mode or the EOI signal with the last data byte in binary mode.

The format of the numeric data fields consist of the characters indicated in Table 3-4.

Table 3-4. Measurement Message Characters

Numeric Data	
1 2 3 4 5 6 7 8 9 0 (digits)	
-	(minus sign in leading character)
.	(decimal point)
E	(exponent delimiter)
Text Data	
A to Z	alpha characters (upper & lower case)
*/%	(asterisk,slash,percent)
Binary Bytes	
8-bit bytes (Data line DI08 is most significant bit)	
Message Preamble	
#I	(precedes binary message)
Separators	
,	comma (data separator)
" "	quotes (before and after text data only)
Lf	Line feed (ASCII OA_{16})
END	EOI asserted with last data byte.

In binary mode, the entire measurement message is preceded by the characters #I. The binary data consists of either two or four 8-bit data bytes. The data bytes carry a 16-bit or 32-bit binary value.

Formats of Numeric Data Field

Numeric data fields can be in either binary or ASCII code. ASCII fields can be in exponent notation. The numeric formats are as follows:

ASCII format

[sg]digits[.digits],

[sg]n.nnnE[sg]ee
(exponent notation)

where:

[] = optional field

sg = sign: if leading character is a minus sign (-), data is a negative number.

digits = numeric value in ASCII code. Data is in the units currently in use and are presented as the value would be displayed on the Model 4400 panel.

. = one or two digits must follow a decimal point. If no decimal point, it is assumed after the last digit.

, = data field separator (only if additional data field follows)

Exponent Notation – Used only to report Load, Strain, and Energy.
n.nnn = mantissa value
E = exponent delimiter
ee = exponent value

Binary Format

#Ibb[bb],

where:

[ ] = optional bytes

#I = Message Preamble – indicates this message was generated with the Model 4400 in binary reporting mode (MI).

Message Coding and Format

b = each b is an 8-bit binary coded byte. bb is a 16-bit binary value result, bbbb is a 32-bit binary value result. First byte sent is most significant byte with bit (DI08) in all bytes the most significant bit.

Note *If result value is negative, 2's compliment coding is used.*

, = data field separator (only if additional data field follows)

Text Data Fields

Text data fields are strings of ASCII coded characters denoted by quotation marks before and after each data field.

Text Data format:

"text",

where:

" " = Data field delimiters, before and after text data.

text = data in ASCII code.

Uncalibrated, Owerflow, and Data Not Available Reports

When data is not available (for example, if a break value was requested before break), or if the channel was not calibrated, the test instrument returns the following value:

0.	ASCII format

or

$80000000_{(16)}$	Binary format

If the related channel is in overflow, the test instrument returns the following value:

99999	ASCII format,
9.999E99	ASCII (exponent notation),

or

$7FFFFFFF_{(16)}$	Binary format

Message Coding and F

Measurement Timing

The Model 4400 test instrument has a basic sampling rate of 50 ms. The LOAD, STRAIN and EXTENSION channels are actually read within 1 ms of each other during each sampling cycle, so the readings can be considered simultaneous values. The readings are converted into digital values and are made available for display or report messages at the sampling rate.

Because of the asynchronous nature of the IEEE interface and of possible data interruptions such as service requests, the program may not receive all the reports it requests. For example, the program can command the test instrument to generate a new report every 50 ms but to receive every report, the program must also cause the computer to address the test instrument as a talker at least every 50 ms. There is no guarantee that the program can do this, particularly if more than one device is connected to the interface. A report is lost if it is not transmitted before the Model 4400 generates a new report.

Several report request commands (RO,R1 and R32,R33) can be used to assess the performance of transmitting reports over the interface. The RO command indicates if one or more reports were missed since the last RO request. The Rl command reports the time (in 50 ms increments) since the last report request was received. This time is reset to zero when the Model 4400 receives a new report request. The Mdoel 4400 also records the time that each A/D conversion cycle occurs. The R32,R33 commands report the time of the A/D conversion cycle associated with a report. The conversion cycle

is the running time (in increments of 1 ms) from system initialization to the occurrence of the related A/D cycle.

A program can determine the number of reports missed by comparing the time of the A/D conversion cycles (R32,R33) associated with the reports transmitted before and after a report missing indication.

Program Command And Report Examples

The following shows examples of program messages and the resulting measurement messages as sent and received by the program of the bus controller.

Examples:

1. Command a report of speed

Send: R27(Lf)
Receive: 10 (LF/EOI)

2. Read, LOAD, EXTENSION, STRAIN

Send: R2R3R4(Lf)
Receive: -5.261EO1, 5.21, 3.61OEOl (LF/EOI)

3. Read LOAD, EXTENSION, & STRAIN, 10 times, each report 500 milliseconds apart.

Send: R2R3R4TlOLlO
Receive: -5.261E01, 5.21, 3.61OE01 (Lf/EOI)
(10 messages are generated, each available 500 milliseconds apart)

4. Stop reading (i.e., send no R code requests).

Send: Ll(Lf)
Receive: (nothing)

5. Read LOAD, EXTENSION, & STRAIN in binary.

Send: R2R3R4Ml(Lf)
Receive: #Ibbbb,bbbb,bbbb(EOI)
Each b = an 8-bit portion of 32-bit result.

6. Read LOAD, with channel overflow in binary format.

Send : R2MI(Lf)
Receive: 7FFFFFFF(EOI) (four bytes in base 16)

Binary values are in the current units selected by the UNITS SELECT switch in the test instrument. One increment of the least significant bit (LSB) of the 32-bit binary indicates the following:

EXTENSION

Metric/SI units - 1 LSB = 10^{-4} mm

Example:
5 mm = 0000C350(16).

English units - 1 LSB = 10^{-5} inch

Example:
2 in. = 00030D40(16)

LOAD or STRAIN

1 LSB = 10-5 of current units Example: 10 lbs = 00OF4240(16)

7. Continuously read LOAD, EXTENSION, & STRAIN every 200 ms.

Send: R2R3R4L0T4(Lf)
Receive: -5.261E01, 5.21, 3.610E0l (LF/EOI)
(a new message is ready every 200 milliseconds)

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Chapter 4

Message Command Tables

This chapter provides a detailed listing of the Program Message Keyboard (K) commands and Report Request commands you will use when programing the Model 4400 test instrument.

Table 4-1 lists all the K commands and any related Report Request commands. Table 4-2 lists all the Report Request Commands and related Results in ASCII format, while Table 4-3 lists the binary format Report Request Commands and Results.

Command Tables

Note <quantity> = parameter as specified Section 2.3. Unless specified, all values are in the current units selected in the test instrument as if entering the value from the Model 4400 numeric keypad.
<n> = denotes a numerical selection and should be replaced by one of the numbers shown.

Program Message Keyboard Commands

Table 4-1. Program Message Keyboard Commands

COMMAND	FUNCTION	RELATED REPORT REQUEST COMMAND
	Crosshead Control Commands	
KO	CROSSHEAD STOP	RO
KI	CROSSHEAD RETURN	RO
K2	CROSSHEAD DOWN	RO
K3	CROSSHEAD UP	RO
K4	SET DIRECTION OF INCREASING LOAD UP	RO
K5	SET DIRECTION OF INCREASING LOAD DOWN	RO
K6	START CROSSHEAD RUNNING IN DIREC-TION OF INCREASING LOAD	RO
K13,<speed>	SET CROSSHEAD SPEED	R27
K21	RESET GAUGE LENGTH	R3
K39,<n>	CROSSHEAD ACTION ON TRIGGER n = 0 NO ACTION 1 STOP	none
	Load Channel Commands	
K12,<area>	SET AREA VALUE	R19
	Display Panel Commands	
K7	DISPLAY PEAK	none
K8	DISPLAY TRACK	none
K9	DISPLAY BREAK	none
K10	DISPLAY PEAK BREAK	none
KII	RESET Model 4400 PEAK DETECTOR	(R6)

Table 4-1. Program Message Keyboard Commands (continued)

COMMAND	FUNCTION	RELATED REPORT REQUEST COMMAND
	Limits Commands	
K24,<max>	LOAD LIMIT MAXIMUM VALUE	R20
K25,<min>	LOAD LIMIT MINIMUM VALUE	R21
K26,<max>	EXTENSION LIMIT MAXIMUM VALUE	R22
K27,<min>	EXTENSION LIMIT MINIMUM VALUE	R23
K28,<max>	STRAIN LIMIT MAXIMUM VALUE	R24
K29,<min>	STRAIN LIMIT MINIMUM VALUE	R25
K30,<n>	LIMIT ACTION ON BREAK n = 1 TO PROGRAM CYCLE 2 TO PROGRAM RETURN 3 TO PROGRAM STOP	R26
K31,<n>	LIMIT ACTION ON MAXIMUM LOAD LIMIT n = same as K30	R26
K32,<n>	LIMIT ACTION ON MINIMUM LOAD LIMIT n = same as K30	R26
K33,<n>	LIMIT ACTION ON MAXIMUM EXTENSION LIMIT n = same as K30	R26
K34,<n>	LIMIT ACTION ON MINIMUM EXTENSION LIMITn = same as K30	R26
K35,<n>	LIMIT ACTION ON MAXIMUM STRAIN LIMIT n = same as K30	R26
K36,<n>	LIMIT ACTION ON MINIMUM STRAIN LIMIT n = same as K30	R26

Table 4-1. Program Message Keyboard Commands (continued)

COMMAND	FUNCTION	RELATED REPORT REQUEST COMMAND
	Miscellaneous Commands	
K37	BEGIN PRINT SEQUENCE	none
K38	NOT USED	none
K40,<n>	AUTOPRINT OPTION n= 0 AUTOPRINT DISABLED 1 AUTOPRINT ENABLED	
K41,<value>	RMOD1(PPT1) EXTENSION INDEPENDENT VARIABLE	R44
K42,<value>	RMOD1(PPT1) STRAIN INDEPENDENT VARI-ABLE	R45
K43,<value>	RMOD2(PPT2) EXTENSION INDEPENDENT VARIABLE	R48
K44,<value>	RMOD2(PPT2) STRAIN INDEPENDENT VARI-ABLE	R49
K47,<n>	CHOICE OF ENERGY INTEGRATION/ RMOD(PPT) INDEPENDENT VARIABLE n = 0 FOR STRAIN 1 FOR EXTENSION	R53
K45,<n>	ENERGY PRINTOUT OPTION n = 0 PRINTOUT SUPPRESSED 1 PRINTOUT ENABLED	R51
K46,<n>	RUBBER MODULUS/PRESET POINT OPTION n = 0 PRINTOUT SUPPRESSED 1 PRINTOUT ENABLED	R52

ASCII Mode Reports

Table 4-2. Report Request Commands and Results in ASCII Format

	ASCII MODE REPORTS		
Report Request Command	Binary Report Available	Function	ASCII REPORT
		Crosshead Control Reports	
RO	yes	Crosshead Status a = 0 stopped 1 RET 2 DOWN 3 UP b = 0 test direction: up is increasing load 1 test direction: down is increasing load c = 0 crosshead is not moving in direction of increasing load. 1 crosshead moving in direction of increasing load. d = 0 no reports missed since last RO report. 1 at least 1 report was missed since last RO report.	a,b,c,d
R3	yes	Current extension	NR2
R27		Current speed	NR2
		Load Channel Reports	
R2	yes	Current load	NR2
R16		Load Full Scale	NR2
R19		Area divisor	NR2

Table 4-2. Report Request Commands and Report Result Formats (continued)

ASCII MODE REPORTS			
Report Request Command	Binary Report Available	Function	ASCII REPORT
Strain Channel Reports			
R4	yes	Current Strain	NR2
R17		Strain Full Scale	NR2
Display Panel Reports			
R6		Peak Load	NR2
R7		Extension at Peak Load	NR2
R8		Strain at Peak Load	NR2
R10		Break Flags n = 0 break has not occurred 1 specimen has broken	n
RII		Load at onset of break	NR2
R12		Extension at break (relative to gauge length)	NR2
R13		Strain at break	NR2
Limits Reports			
R20		Limit Load max.	NR2
R21		Limit Load min	NR2
R22		Limit Extension max	NR2
R23		Limit Extension min	NR2
R24		Limit Strain max	NR2
R25		Limit Strain min	NR2

Table 4-2. Report Request Commands and Results in ASCII Format (continued)

ASCII MODE REPORTS			
Report Request Command	Binary Report Available	Function	ASCII REPORT
Limits Reports (continued)			
R26		Limit Action a= Load maximum limit action b = Load minimum limit action c = Extension maximum limit action d = Extension minimum limit action e = Strain maximum limit action f = Strain minimum limit action g = Action at break 0 = No action 1 = Reverse Crosshead direction (cycle) 2 = Return to gauge length 3 = Stop	a,b,c,d, e,f,g
Timing and Units Reports			
RI	yes	Time since last report Time since last report in 50ms increments (up to 3,276,750ms),	NR2
R15		Current Selected Units n = 0 SI 1 Metric 2 English	n
R32	yes	Model 4400 time of A/D conversion - low order (1 count = lms)	NR2
R33	yes	Model 4400 time of A/D conversion - high order (1 count = 65536ms)	NR2
R34		Load Label	Text
R35		Extension Label	Text

Command Tables

Table 4-2. Report Request Commands and Results in ASCII Format (continued)

ASCII MODE REPORTS			
Report Request Command	Binary Report Available	Function	ASCII REPORT
R36		Strain 1 label	Text
R38		Speed label	Text
R39		Energy units label	Text
		Miscellaneous	
R40		Energy at Peak	NR2
R41		Energy at Break	NR2
R42		Total Energy	NR2
R43		RMODI (PPTI) Load	NR2
R44		RMOD1 (PPT1) Extension	NR2
R45		RMOD1 (PPT1) Strain	NR2
R46		RMODI (PPTI) Energy	NR2
R47		RMOD2 (PPT2) Load	NR2
R48		RMOD2 (PPT2) Extension	NR2
R49		RMOD2 (PPT2) Strain	NR2
R50		RMOD2 (PPT2) Energy	NR2
R51		Energy Printout n = 0 suppressed 1 enabled,	n
R52		RMOD (PPT) Printout n = 0 suppressed 1 enabled	n
R53		Energy/RMOD Ind. Variable n = 0 strain 1 extension	n

Binary Mode Reports

Table 4-3. Report Request Commands and Results in Binary Format

BINARY MODE REPORTS		
Report Request Command	Function	BINARY REPORT FORMAT
RO	Crosshead Status — = not used bits ZZZZ = 0001 Stop 0010 Returning 0100 Moving Down 1000 Moving Up X = 0 Test direction - Up is increasing load. 1 Test direction - Down is increasing load. Y = 0 Crosshead not moving in direction of increasing load. 1 Crosshead moving in direction of increasing load. W = 0 No reports missed since last ROreport. 1 At least one report was missed since last RO report.	(1st byte)— XYZZZZ (2nd byte)———W
R3	Tracking Extension 1 count = 10^{-5} inches (ENGLISH) 1 count = 10^{-4} millimeters (Metric or S.I.)	4 bytes signedbinary
R2	Current Load 1 count = 10^{-5} in current units	
R4	Current Strain 1 count = 10^{-5} in current units	

Command Tables

Table 4-3. Report Request Commands and Results in Binary Format (continued)

BINARY MODE REPORTS		
Report Request Command	Function	BINARY REPORT FORMAT
RI	Time since last report 1 count = 50msec	2 bytes unsigned binary
R32	Model 4400 time of A/D conversion 1 count = l ms	
R33	Model 4400 time of A/D conversion 1 count = 65536msec	

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INSTRON

INSTRON CORPORATION, 100 ROYALL STREET, CANTON, MASS. 02021

Printed in U.S.A.