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Series 110/120 Installation and Terminal Guide

DOC-IWS-232
Revision D
November 1995

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Nematron

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Revision History

Revision	Description
A	Initial release
B	Combined with DOC-IWS-150
C	Minor corrections
D	Minor corrections and added CE mark information

Notice: Nematron Corporation assumes no liability or responsibility for the loss or damage, direct or indirect, arising from the use of this product. Nematron reserves the right to change this product's specifications without notice.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained in this guide does not purport to cover all details or variations in hardware and software. It describes hardware common to all Series 110/120 Workstations.

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Important Information



WARNING

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

CAUTION!

Changes or modifications not expressly approved by Nematron could void the user's authority to operate the equipment.



WARNING

Electric Shock Hazard – Do not operate the Workstation with its back cover removed. There are dangerous high voltages inside.

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WARNING

For Hazardous Locations – If you plan to install your Workstation in a hazardous location, please consult the instructions beginning on page 3-4.

Note: Refer to Appendix B in this manual for EU EMC Directive 89/336/EEC *Declaration of Conformity*.

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Chapter 1

Introduction

This guide contains all the information you need to install and connect your Series 110 or Series 120 Workstation. This guide also describes the operation of the Industrial Terminal version of the firmware.

Guide Organization

Chapter 2 contains an explanation of the Workstation's indicators, keys, and connectors.

Chapters 3 and 4 explain how to install and connect your Workstation.

Chapter 5 describes various service functions, including fuse and battery replacement.

Chapters 6 and 7 describe the use of the Workstation's Terminal capabilities.

Related Documentation

Additional publications you may need include the following, which are included with the IWS-SETUP-120 software package:

Series 110/120 PLC Workstation Guide	DOC-IWS-201
Series 110/120 BASIC Guide	DOC-IWS-187

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Symbols

Certain symbols in this guide help make you aware of critical information, as shown below:



This symbol emphasizes that hazardous voltages, currents, temperatures, or other conditions which cause **personal injury** exist in this equipment or may be associated with its use.



This symbol appears when **equipment damage** may occur if care is not taken.

Note

A note gives information that pertains to a specific firmware release or one form of the hardware only.

Words enclosed in square brackets represent keys on the keyboard. For example, [Enter] refers to the key labeled “Enter” on the Workstation’s keypad. Note that [Shift] refers to any shift key.

Symbol	Refers to
{nnn}	ASCII character of code *nnn*.
[Enter]	
[F( )]	
[Shift Left]	

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[Shift Center] 

[Shift Right] 

[Shift] 

, 

, or 

Displayed Information

This guide indicates text that the Workstation screen shows by enclosing it in a box:

```
Firmware download
mode enabled; ready
to accept download.
(ROM version 2.00)
```

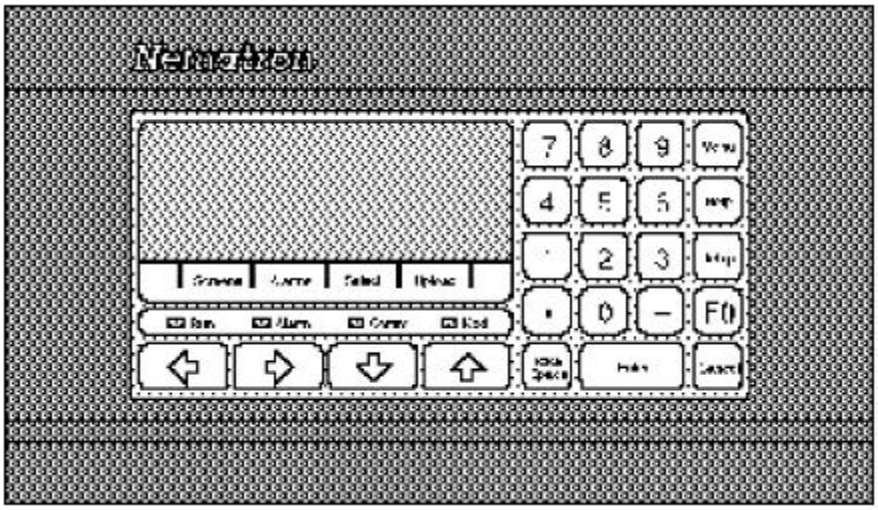
This guide indicates something you are supposed to type by italicizing it: *Type This.*

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Chapter 2

Guided Tour

This chapter describes the displays, indicators, keys, controls on the front of all models of the Series 110 and Series 120 Workstations.



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Display

The Series 110/120 Workstations display four lines with 20 characters on each line. The Series 110 Workstation's display is a liquid crystal display (LCD) with LED backlighting; the Series 120 Workstation's display is a vacuum fluorescent display (VFD).

Character Set

The display's character set includes the entire standard ASCII character set.

The Series 120 Workstation can display the same International characters that are on the IBM PC's Multilingual code page (850), while the Series 110 Workstation is limited to U.S. characters only.

If you're programming in BASIC, you can configure and display programmable characters; the Series 110 Workstation supports eight programmable characters, while the Series 120 supports two.

Brightness/ Viewing Angle Control

You can control the viewing angle (contrast) of the Series 110 display or the brightness of the Series 120 display either by using the on-line configuration menus (see Chapter 6) or by holding down the [F()] key while pressing [↑] or [↓].

Cursor Type

When you are using the BASIC or Terminal firmware, you can select whether the cursor appears as an underscore (Series 110 only) or a solid block, or you can disable the cursor entirely (see Chapter 6).

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End-of-Line and End-of-Screen

Using the configuration capabilities described in Chapter 6, you can select where the Workstation moves the cursor after it prints at the last column or last line of the screen.

Screen Saver

You can configure your Workstation to disable its display after 1 to 255 minutes of inactivity in order to prolong the display's life. When the screen saver is active in the Series 120 Workstation, the unit displays a continuously moving cursor on an otherwise blank screen. When the screen saver is active in the Series 110 Workstation, the LED backlighting is off.

Your operator can cancel the screen saver by pressing any key.

Display Fault Indicator

If the display fails to operate properly, the *Run* light flashes slowly, and the screen remains blank.

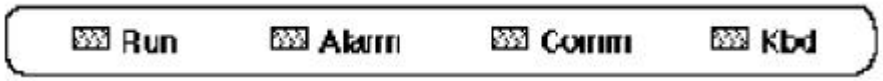
LED Indicators

The four LEDs are labeled *Run*, *Alarm*, *Comm*, and *Kbd*.

For an instant during power-up, all four LED indicators light. This is a lamp test that shows you that the LEDs are working properly.

If there is a problem with your unit, the pattern of LEDs indicates the problem. You should consult the Troubleshooting section for more information.

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The following table describes the function of each LED indicator:

Name	Color	Status	Function
Run	Green	On	System okay
		Fast blink	No firmware loaded; testing memory
		Slow blink	Display faulty
		Off	Fatal hardware error; status of *Alarm* and *Comm* lights indicates specific problem
Alarm	Red	On	If all others off, external memory failure
		On	If *Run* on, unacknowledged alarm
		Slow blink	Battery low
Comm	Green	On	If all others off, internal memory failure
		On	If *Run* on, communications active
Kbd	Green	Blink	Each blink indicates a keypress
		On	Unit detects multiple keys pressed at the same time

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Keyboard

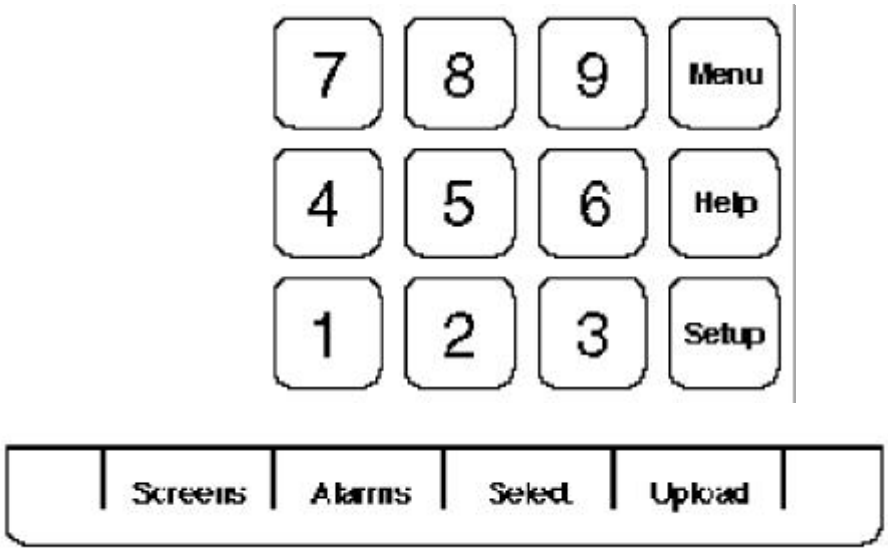
The keyboard on the Series 110/120 Workstations is a sealed-membrane type with stainless steel domes that provide tactile feedback.

Keyboard Inserts

Some of the key legends are changeable by replacing an insert that simply slides in behind the keyboard. To replace the inserts, you may first have to remove the back cover in order to relieve enough pressure on the keyboard so that the insert slides in.

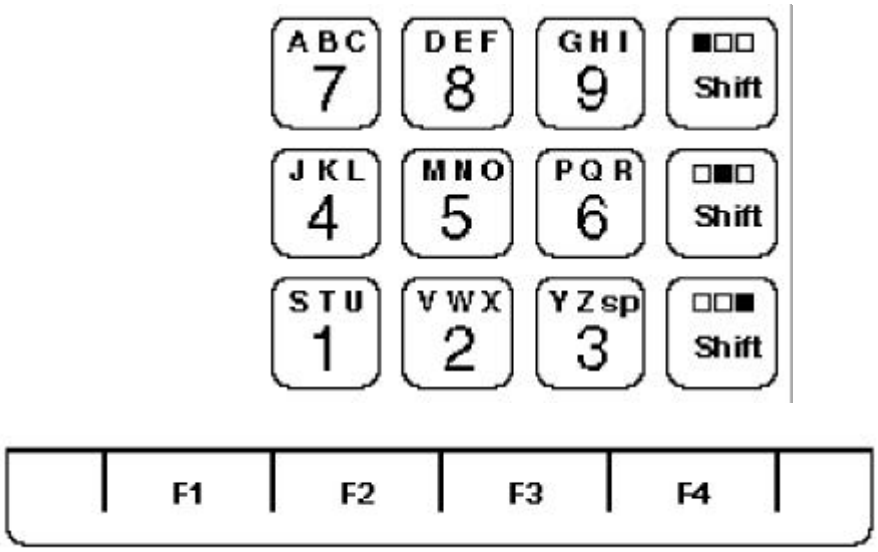
The Workstation comes with two sets of legends. The legends installed in the unit are typically for using the unit as a PLC Workstation, while the extra set is alphanumeric (general-purpose).

PLC Workstation



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Alphanumeric



Key Shifting

To enter a letter or space, you must first press a [Shift] key and then press the appropriate button. For example, to enter a space, you would first press



and then



.

If your application doesn't need letters, you can disable the shift function of the [Shift] keys by following the configuration instructions in Chapter 6, and you can replace the keyboard insert with the PLC Workstation insert shown on the previous page.

Keypress Indicators

When you press a key, the *Kbd* LED lights up and the unit beeps. If you prefer, you can turn off beeping and/or blinking when you configure the unit. See Chapter 6 for configuration instructions.

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Automatic Repeat

You can configure the unit to repeat a key automatically when you hold it down. Chapter 6 describes how to set the amount of time after pressing a key before repeating starts, as well as the amount of time between repeats (i.e., the number of repeats per second).



We strongly recommend against enabling auto-repeat if you have assigned any keys to a machine control function. Please consider whether a stuck key could indirectly harm personnel or equipment.

Special Key Functions

In most cases, the Workstation rejects multiple simultaneous keypresses as invalid. In other words, the Workstation doesn't react when you hold down two keys at the same time.

There are a few exceptions, as listed below:

Hardware Reset

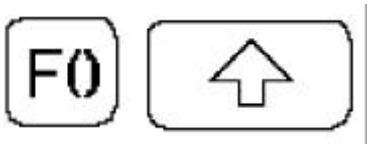
If you install an internal jumper, you can press



simultaneously to generate a "hardware reset," which is usually equivalent to removing and then restoring power. Consult page 5-3 for a description of installing the jumper.

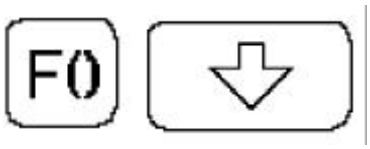
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Increase Brightness or Viewing Angle



increases the viewing angle (contrast) of the Series 110's display or increases the brightness of the Series 120's display. The Series 110's viewing angle adjustment has a range of 100, while the Series 120's brightness adjustment has a range of only 4.

Decrease Brightness or Viewing Angle



decreases the viewing angle (contrast) of the Series 110's display or decreases the brightness of the Series 120's display. The Series 110's viewing angle adjustment has a range of 100, while the Series 120's brightness adjustment has a range of only 4.

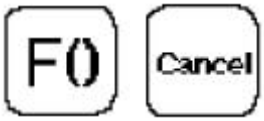
Enable Firmware Download



while powering up enables the Workstation to enter the firmware download mode. See the end of Chapter 4 for instructions.

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Control-C ([Ctrl]-C)



generates a special code whose function depends on the firmware; please consult the appropriate user's manual for more information.

Fault Indicator

If the *Kbd* LED doesn't blink when you press a key, it's likely that the unit is not configured to flash the *Kbd* LED for each keypress. See Chapter 6 for configuration instructions.

If the *Kbd* LED remains on continuously, it indicates that the unit senses an invalid combination of two or more keys. After an invalid key combination, the unit accepts no further keystrokes until it first senses that *no* key is pressed. (This provides some protection against a stuck key.)

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Chapter 3

Installation

This chapter describes how to install your Workstation in a panel.

Environment

Listed below are the various environmental specifications and tolerances of the Series 110/120 Workstations.

Temperature and Humidity

The Series 110 Workstation operates in ambient temperatures between 32° and 122°F (0° to 50°C), while the Series 120 Workstation operates in ambient temperatures between 32° and 131°F (0° to 55°C). The Workstations operate in relative humidity ranging between 5 and 95%. All models tolerate storage temperatures of -40° to 158°F (-40° to 70°C).

Sealing

Your unit is rated for NEMA 4 (water-tight) and NEMA 12 (dust-tight) environments, provided you install it with its gasket intact in a similarly-rated standard gauge metal enclosure.



For installation in plastic enclosures or thin-gauge metal enclosures (less than 14 ga., 0.075”, 1.9mm), please order COS-BKT-120, which contains stiffening brackets that compensate for flexing of the enclosure.

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Hazardous Locations

The end of this chapter contains detailed instructions for installing the Workstation in hazardous locations.

Shock and Vibration

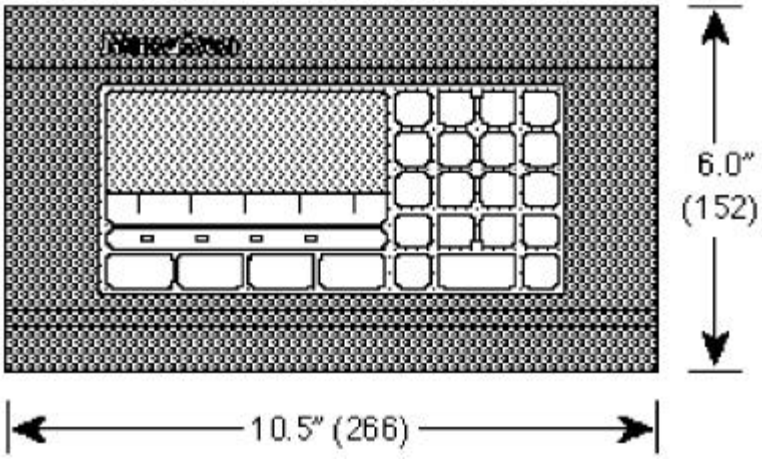
The Workstation can withstand sinusoidal vibration for two hours in each of the three mutually perpendicular axes at frequencies from 5 to 500 Hz. Our test fixture created a 0.25” displacement between 5 and 15.3 Hz, and a 3 G amplitude between 15.3 and 500 Hz.

The Workstation can tolerate a total of eighteen 40 G shocks lasting 9 milliseconds each with a 1/2 sine wave form.

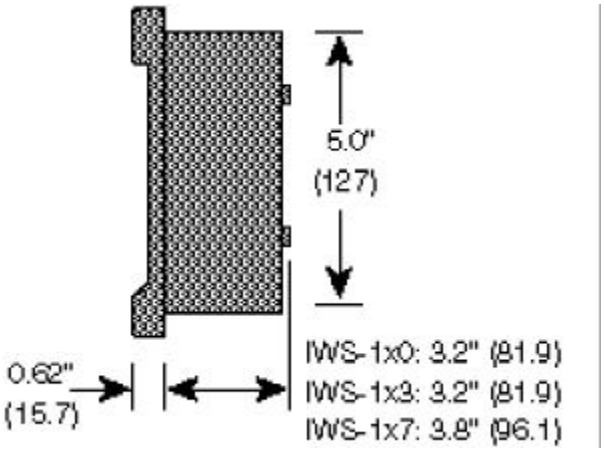
Dimensions

Following are the dimensions of the Workstation itself as well as the cutout dimensions.

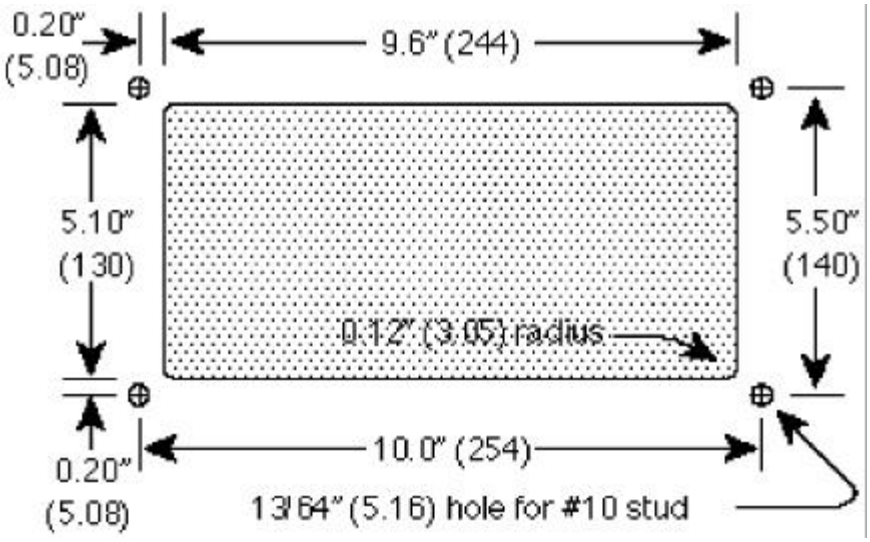
You should allow 4” of clearance behind the Workstation for cable connectors and 2” above and below for airflow.



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Metric dimensions appear in parentheses (mm).



Metric dimensions appear in parentheses (mm).

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Torque Specifications

After placing the Workstation in the cutout, you should tighten each nut to 20 inch/pounds (0.14 newton/ meters) of torque. If you don't have a torque wrench, then try to tighten the nuts to compress the gasket to about 50% of its original thickness.

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Installation in Hazardous Locations

The remainder of this chapter describes the installation of Series 110/120 Industrial Workstations in hazardous locations.

Safety Agency Approvals

Nematron designed the Series 110/120 Industrial Workstations to meet the requirements of Class I, Division 2 Hazardous Locations applications. Class II, Division 2 requirements can also be met when the system is installed in an approved Type 4 enclosure.

The Workstations have been investigated and received UL Listing and CSA Certification as follows:

- Underwriters Laboratories Inc., UL 1604 Standard for Safety, ELECTRICAL EQUIPMENT FOR USE IN CLASS I and CLASS II, DIVISION 2, AND CLASS III HAZARDOUS (CLASSIFIED) LOCATIONS.

  UL File No. E146533

  Approved for installation in hazardous locations, Class I, groups A, B, C, and D, Division 2; and Class II, groups F and G, Division 2. Operating temperature code: T6.

- Canadian Standards Association, Specification C22.2 No. 213-M1987, NON-INCENDIVE ELECTRICAL EQUIPMENT FOR USE IN CLASS I, DIVISION 2 HAZARDOUS LOCATIONS.

  CSA Report No. LR 65779-9

  Certified for installation in hazardous locations, Class I, groups A, B, C, and D, Division 2. Operating temperature code: T6.

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The Workstations have been UL Listed and CSA Certified as non-incendive devices. They are *not* intrinsically safe and must never be operated within a Division 1 hazardous location when installed according to this guide. Nor should any peripheral interface device attached to these Workstations be located within Division 1 locations unless approved and/or certified shunt zener diode barriers are placed in series with each individual signal and DC power line.

Division 1 installations are beyond the bounds of our design intent. Nematron accepts no responsibility for installations of this equipment, or any devices attached to this equipment, in Division 1 locations.

If the intended location does not presently have a Class, Division, and Group rating, then you must consult the appropriate authorities having jurisdiction in order to determine the correct rating.

In accordance with Federal, State/Provincial, and Local regulations, all hazardous locations installations must be inspected by the appropriate authority having jurisdiction prior to use.

These systems are to be installed, serviced, and inspected only by technically qualified personnel.

Note

These systems are both CSA Certified and UL Listed for installation within Class I, Division 2 locations. They are UL Listed for Class II, Division 2 locations only when installed within a UL-recognized Type 4 enclosure as described in the following sections. Canadian Class II installations require investigation of the enclosed

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installation by Canadian Standards Association in order to obtain a Class II Safety approval.

Definitions

We derived the following definitions from Article 500 (sections 5 and 6) of the United States National Fire Protection Agency (Quincy, Massachusetts) National Electric Code (NFPA 70, 1990). They are not complete and are included here only for a general description for those not intimately familiar with Hazardous Locations requirements. You should consult ANSI/NFPA 70 for a complete, detailed description of definitions and installation requirements.

Persons responsible for the installation of this equipment in Hazardous Locations are responsible for ensuring that all relevant codes and regulations related to location rating, enclosure, and wiring are met.

Class I Locations

Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

Class II Locations

Class II locations are those that are, or may become, hazardous because of the presence of combustible dust.

Division 1 Locations

A Division 1 location is one in which flammable or ignitable gasses, vapors, or conductive/combustible dusts and particles can exist under normal operating conditions.



The Series 110/120 Workstations are not suitable for installation within Division 1 locations.

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You must not install electrical equipment in Division 1 locations unless it is intrinsically safe or installed inside of approved explosion-proof enclosures or inside of approved purged and pressurized enclosures.

Division 2 Locations

Division 2 locations are those locations that are normally non-hazardous, but which may become hazardous due to accidents which may expose the area to flammable vapors, gases or combustible dusts.

Series 110/120 Workstations are listed with UL for Class I, Division 2, and Class II, Division 2; and Certified by CSA for Class I, Division 2.

Division 2 locations are those where:

(1) Class I volatile flammable liquids or flammable gasses are handled, processed, or used, but in which the liquids, vapors, or gasses will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such enclosures or systems, or in case of abnormal operation of equipment;

(2) ignitable concentrations of Class I vapors or gasses are normally prevented by positive mechanical ventilation, but which may become hazardous due to mechanical failure of those ventilation systems;

(3) the location is adjacent to a Division 1 location;

(4) Class II conductive/combustible dust is not normally in the air in quantities sufficient to produce explosive or ignitable mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but combustible dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment and where combustible dust accumulations on, in, or in the vicinity of the electrical equipment may be sufficient to interfere with the safe dissipation of heat from electrical

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equipment or may be ignitable by abnormal operation or failure of electrical equipment.

Groups

Flammable and combustible substances are grouped based on the following three factors:

1. Maximum experimental safe gap (MESG)
2. Explosion pressure
3. Ignition temperature

For example, Group A includes vapors and gasses with the lowest ignition temperatures (e.g. acetylene). Group D vapors and gasses have higher ignition temperatures and include acetone, methane, and natural gas among others. You should consult NFPA 497M for more information on group identification and ignition temperature.

Both the component temperatures and potential for spark based upon voltage, current, and circuit characteristics determine the Group rating.

Class I refers only to Groups A, B, C, and D, while Class II refers only to Groups E, F and G. Group E refers to an atmosphere of metal dust, which is *always* Division 1 only.

A device approved for installation within Division 2, Group A locations may be also be used in Groups B, C, or D. Please note that approved Class I equipment may not be suitable for Class II installations.

Series 110/120 Workstations are listed with UL for Class I, groups A, B, C, and D, Division 2; and Class II, groups F and G, Division 2; and Certified by CSA for Class I, groups A, B, C, and D, Division 2.

Temperature Code Rating

The temperature code rating reflects the highest component temperature inside of the equipment when the ambient temperature is 40° C (104° F). These internal component temperatures may not exceed the

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ignition temperature of the substance in question. Temperature Identification numbers are assigned and range from T1 (450° C, 842° F) to T6 (85° C, 185° F).

The Series 110/120 Workstations are assigned a T6 (85° C) temperature code by Underwriters Laboratories and Canadian Standards Association.

Enclosures

You must install your Series 110/120 Workstation within a clean and dry enclosure for both ordinary and hazardous locations. Failure to do so voids the UL Listing and CSA Certification. For the proper panel cutout dimensions, you must refer to the beginning of this chapter.

The front panel meets the requirements of UL and CSA Type 4 and Type 12 enclosures.

For Class I hazardous locations, the enclosure you use must have a minimum rating of Type 12 (NEMA 12, IP 5X). However, we strongly recommend that you use a Type 4 (IP X6) enclosure.
For Class II hazardous locations, you must use a Type 4 enclosure with conduit knockouts. You must install power and communication cables through separate conduit. Failure to do so voids UL Listing. These systems are *not* CSA Certified for installation within Class II hazardous locations.

Panel flatness and rigidity are crucial if a proper panel seal is to be maintained. The Workstations employ an open-cell gasket material that must be compressed 50% or more in order to meet the requirements of Type 4 enclosures.

If you use non-metal type enclosures, such as plastic or fiberglass, then you must install a rigid metal stiffener behind the front panel. Failure to do so may result in an inadequate panel seal due to flexing of the front panel material between the mounting studs.

You must tighten the nuts on the mounting studs to 20 in/lbs, and you must use lock washers.

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The requirements for enclosure fittings, conduit, and wiring vary according to the specific rating of the location and the type of flammable or combustible material involved. Those requirements are beyond the scope of this document and it is your responsibility to ensure that your installation complies with codes and regulations which apply to your specific location. You should consult the appropriate local authority having jurisdiction.

Power Switch

The Workstations do not provide a power switch because the amount of input power they require would classify the power switch as an incendive device. In other words, the voltage and current across the power switch would be capable of creating a spark.

You can install an external power switch rated for ordinary locations only if you locate it in a non-hazardous location, although some codes restrict the distance between the switch and the Workstation. Otherwise, the switch must comply with Class I, Division 1 requirements (explosion proof), which prevents any possible sparking.

Cable Connections

Division 2 hazardous locations regulations require that all cable connections be provided with adequate strain relief and positive interlock. You must never connect or disconnect a power cable while power is applied at either end of the cable.

Division 2 hazardous locations require that all cables be installed in conduit unless the type of cable used is permitted under article 501-4B of the National Electric Code (NFPA 70). Safety agencies have *not* evaluated the communication ports as non-incendive circuits. Therefore, you must install wiring according to article 501-4B of the NEC.

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Power Cable

The Series 110/120 Workstations are provided with a plastic strain relief on the rear of the chassis for the power cable. The power cable must have an external diameter no less than 0.25 inches (6 mm) and must be installed within the strain relief.

The strain relief must be tight enough to tolerate at least 35 lbs (16 kgs) of force. You should leave the wire a little longer between the strain relief and the input power terminal block to avoid excessive tension on the terminal block connections.

The power cable must always include a third wire for Protective Earth ground (green or green/yellow). This includes any DC input voltage applications.



Failure to connect the Protective Earth ground wire may expose the operator to dangerous voltages. In the case of 24 volt applications, failure to connect the PE wire significantly reduces the Workstation's immunity to electromagnetic transients, which can cause unreliable operation or permanent damage.

You must connect the Protective Earth wire (PE) to the terminal labeled PE. The PE wire must be at least 1/4 inch (6 mm) longer than the L1 and L2 wires to ensure that a Protective Earth ground connection is the last connection broken in the event that the wires are accidentally pulled loose from the terminal block.

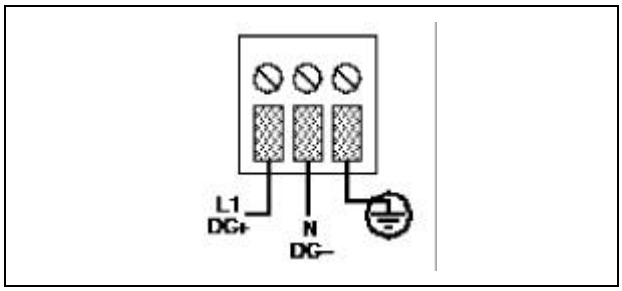
You must strip the three power wires, L1 (DC), L2 (Return or Neutral) and PE, to expose 1/4 inch (6 mm) of wire. If the exposed wire is of the stranded type, then you must apply a small amount of solder to the ends so that the terminal block secures every strand.

To connect the wires to the terminal block, back off each connector screw all the way, insert the wire fully,

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and screw down tightly. Pull on each wire to verify that it is secure.

Terminal	AC	DC
L1	Hot	DC +
N	Neutral	DC –
⏚	earth	earth



Communication Cables

All communication cables should include a chassis ground shield. This shield should include both copper braid and aluminium foil. The D-sub connector housing should be of the conductive type and the ground shield should be well terminated at the connector housing.

The strain relief normally built into the cable connector cover must match the cable itself in order to provide a reliable degree of strain relief. You must *always* secure the D-sub connectors to the Workstation's mating connectors with the screw on each side.



The communication cables must never be connected or disconnected while power is applied at either end of the cable. This may result in an incendive spark. Furthermore, permanent damage to the Workstation may occur.

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Operation and Maintenance

UL and CSA have evaluated the Series 110/120 Workstations with respect to spark ignition and with the understanding that the keyboard keys are the only make/break components that the operator normally exercises. Connections and switch settings located at the rear of the Workstation must not be accessible to the operator and must never be adjusted while power is applied.

With respect to hazardous locations installations, the following rules must always be observed:

1. The Workstation must be installed within an enclosure suitable for the specific application. General purpose enclosures may be acceptable for Class I applications but are never acceptable for Class II applications. Type 4 (IP 66) enclosures are recommended even where not required by regulations.
2. Enclosure doors or openings must remain closed at all times, except when performing service, in order to avoid the accumulation of foreign matter inside of the Workstation.
3. The Workstation must never be subjected to any installation or service procedures unless:

   (a) Power is known to be removed, and
   (b) The area is known to be non-hazardous.

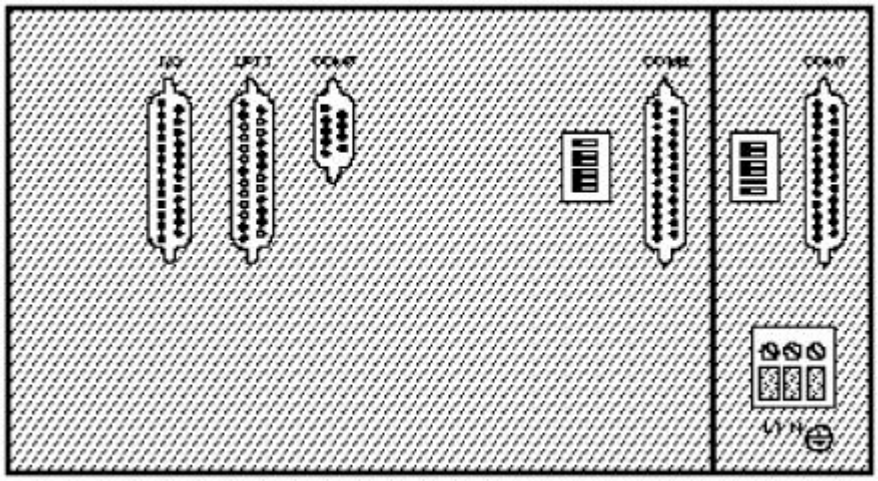
   This includes the installation or removal of power cables, communication cables, power fuse and internal battery as well as setting the DIP switches located at the rear of the unit.
4. All installation and service must be performed only by technically qualified service personnel. These Workstations require no service by an operator in the course of normal operation.

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Chapter 4

Connections

For the rest of this chapter, you should refer to the figure below; note that only the IWS-117 and IWS-127 models have all the communications ports indicated; the IWS-110/120 and IWS-113/123 provide only the COM1 connector.



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Power Connections

The next few pages show how to connect to the line power connector.

You must ground your Workstation at all times. You should also ensure that the Workstation is on the same ground as any other equipment connected to its communications ports (especially if you connect anything to COM3 or LPT1).



If you are installing your Workstation in a hazardous location, then you must follow the instructions at the end of Chapter 3.

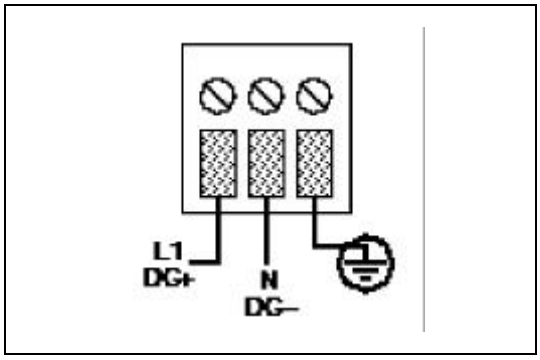
Power Connector

The three-position line power connector accepts 90-250V or optionally 24V ±15% AC/DC, as shown in the drawings below.

The following table shows the specifications of the three-position power input connections; the unit's power consumption is 12 Watts maximum.

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Terminal	AC	DC
L1	Hot	DC +
N	Neutral	DC –
⏚	earth	earth



Be sure to use all three terminals when connecting power; the ground wire should be at least 1/4” (6 mm) longer than the others. To make a connection, strip about 1/4” (6mm) of insulation, turn the screw counter-clockwise until the gap is wide open, insert the wire all the way in, and turn the screw clockwise until it’s tight.

Electrical Grounding

You must make sure that your Workstation is properly connected to earth ground.

If you connect a communications cable to your unit after static electricity has built up or when the Workstation and the other device are on different grounds, the resulting discharge could result in damage to circuit components.

You must properly ground your Workstation to maintain immunity to electrostatic discharge and radio frequency interference.

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Fuse Ratings

For operation at 110/240V, you must use a 1/2 Amp Slo-Blo (type T) fuse. For operation at 24V, you must use a 1 Amp Slo-Blo (type T) fuse. Replacement fuse kits are available under part numbers COS-FUS-120 and COS-FUS-120-V4 respectively.

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Communications Ports

The IWS-117 and IWS-127 have the following communications ports; the IWS-110/120 and IWS-113/123 each has only the COM1 port:

Name	Type
COM1	RS-232/RS-422/RS-485 serial
COM2	RS-232/RS-422/RS-485 serial
COM3	RS-232 serial
LPT1	Centronics printer
I/O	Connects to CBL-D8 I/O racks

The following pages describe the specifications of each port.



Although +5VDC is provided on some communications connectors, there is only 100 mA available; you must take care not to overload the unit's power supply.

Cabling

We recommend using Belden 9830 wire or equivalent (24 ga. stranded copper conductors sheathed in both foil and braided shields). RS-422 connections should use twisted pairs (three twists per inch).

Many communications problems occur with RS-422 connections because of improper cable selection or installation. We urge you to use Belden 9830 or equivalent and to make sure that one twisted pair is the transmit pair while the other twisted pair is the receive pair.

In order to maximize the protection of cable shields, the connectors should be conductive; we recommend using connectors with metal shells.

The maximum length of an RS-232 cable is 50 feet; the maximum length of an RS-422 cable is 4000 feet.

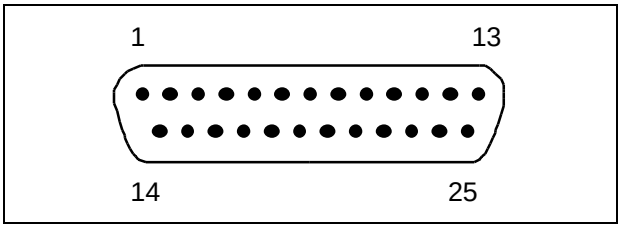
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Note

Never connect the signal and chassis grounds together.

COM1 and COM2

COM1 and COM2 are electrically and physically identical. Each is an optically-isolated serial port capable of RS-232, RS-422, or RS-485 operation.



COM1/COM2 Serial Port; 25-pin Male

Pin	Direction	Type	Function
1			Chassis ground
2	Output	232	TXD - transmit data
3	Input	232	RXD - receive data
4	Output	232	RTS - request to send
5	Input	232	CTS - clear to send
7		232	GND - signal ground
9	Output		+5V (isolated; 100 mA)
14	Output	422	TXD + (if RS-485, RXD +)
15	Output	422	TXD – (if RS-485, RXD –)
16	Input	422	RXD +
17	Input	422	RXD –
19/21		422	120Ω terminating resistor

Note

Never connect the signal and chassis grounds together.

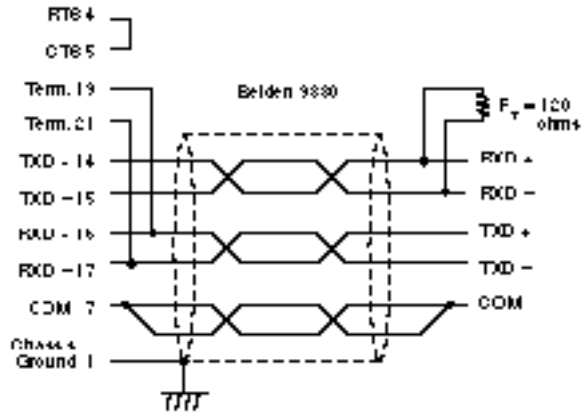
You *must* connect the signal grounds at each end of the cable in order to maintain circuit isolation.

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The resistor available on pins 19 and 21 terminates the receive side of an RS-422 or RS-485 connection. However, when more than two stations are connected together, you should terminate only the stations at each end; intermediate stations are not terminated. The following cable shows the use of terminating resistors:

COM1/COM2 to RS-422

Series 110/120 COM1/COM2 25-pin Female — RS-422

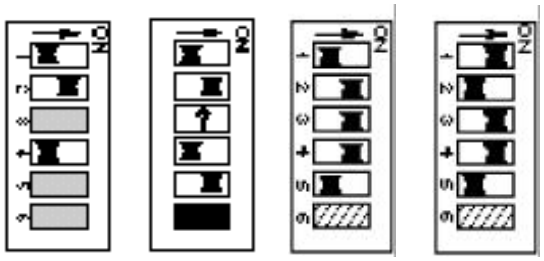


DIP Switch Settings

COM1 and COM2 each has a set of DIP switches that allow you to select operating parameters for RS-232, RS-422 or RS-485 communications; meaningless switch settings are shown in grey:

RS-232	RS-422	RS-485; no echo	RS-485; echo

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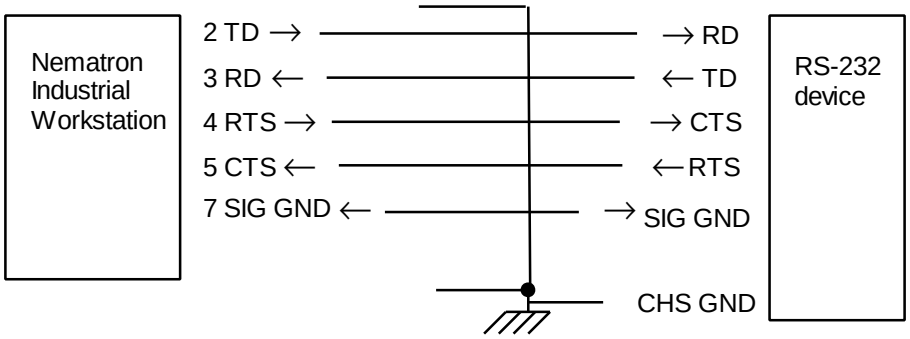
The chart below shows the function of each DIP switch:

#	Description	Off	On
1	RS-485 mode	No echo	Echo
2	RS-485 mode	Echo	No Echo
3	RTS tri-states TXD	Disabled	Enabled
4	Duplex selection	Full (232/422)	Half (485)
5	422/485 selection	485	422

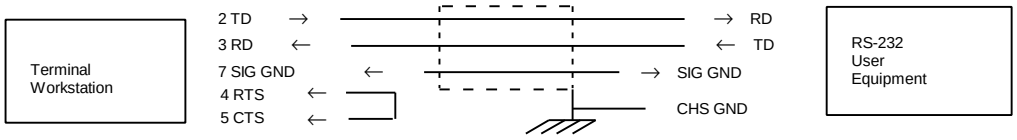
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In an RS-422 application, you should first try turning on switch 3. If you encounter any problems, try turning off this switch.

RS-232 Point-to-Point Communication with Hardware Handshaking



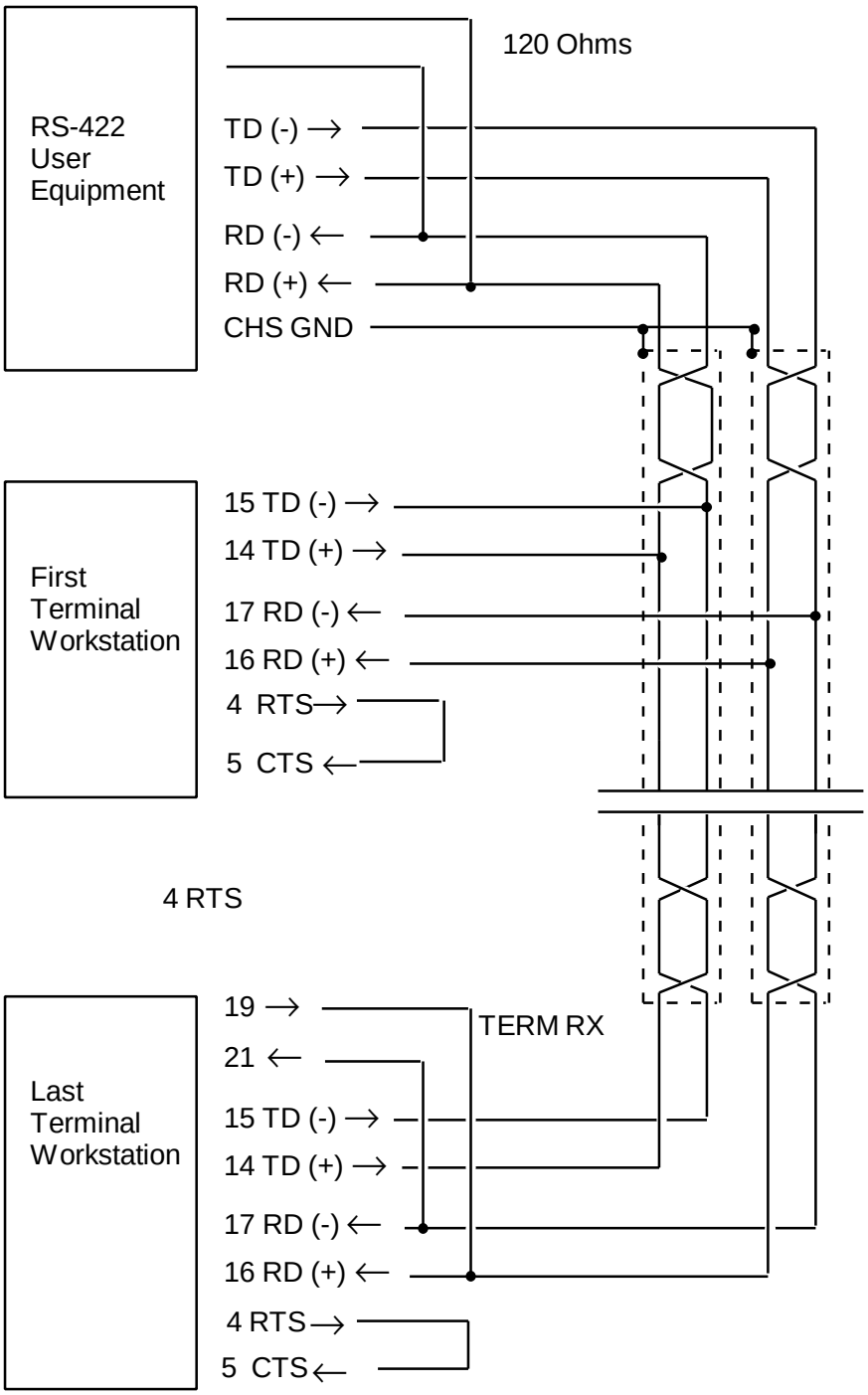
RS-232 Point-to-Point Communication with Software Handshaking



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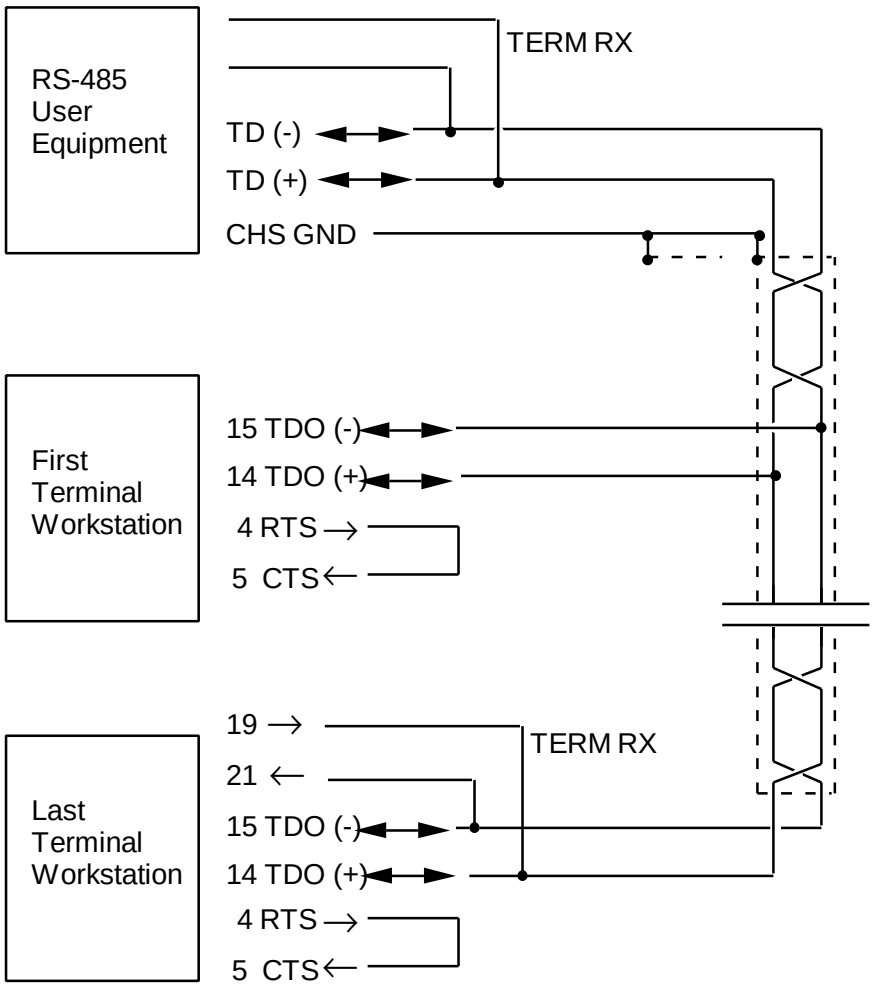
RS-422 Multidrop
Four-wire
Communications

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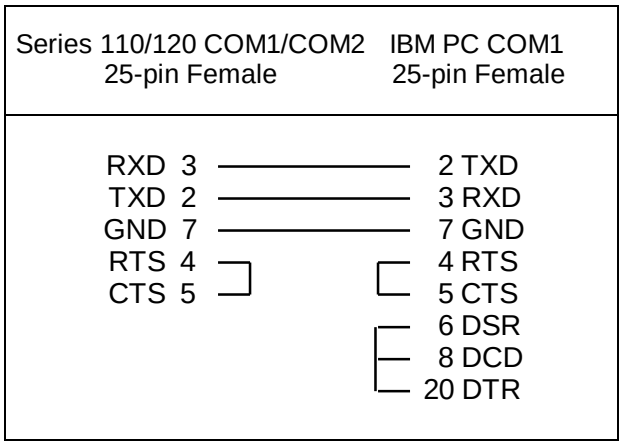
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Wiring for RS-485 Communications



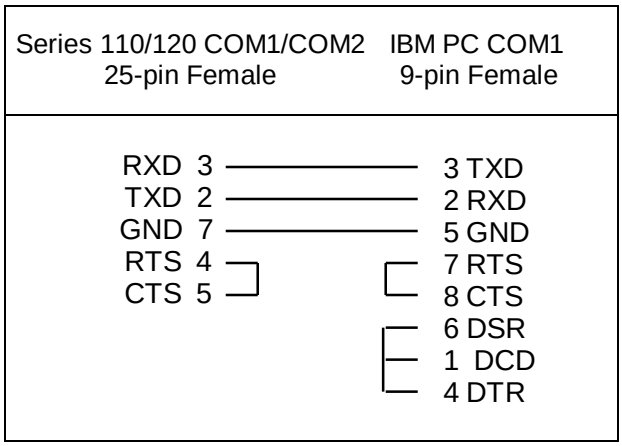
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COM1/COM2 to IBM PC's 25-pin connector



This cable connects your PC's 25-pin COM1 or COM2 serial port to the COM1 or COM2 serial port on the Workstation. You can purchase this cable separately from Nematron under part number CBL-C1.

COM1/COM2 to IBM PC's 9-pin connector

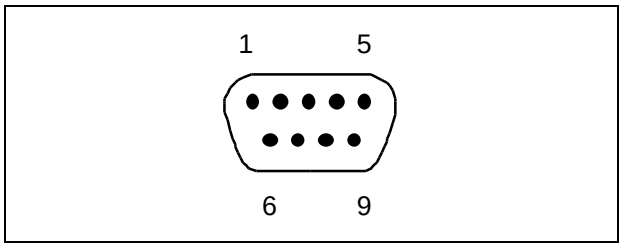


This cable connects your PC's 9-pin COM1 or COM2 serial port to the COM1 or COM2 serial port on the Workstation. We include this cable when you order IWS-SETUP-120, part number CBL-C2.

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COM3

COM3 is a non-isolated serial port capable of RS-232 only. Its pinout is similar to that of an IBM PC's 9-pin serial port.



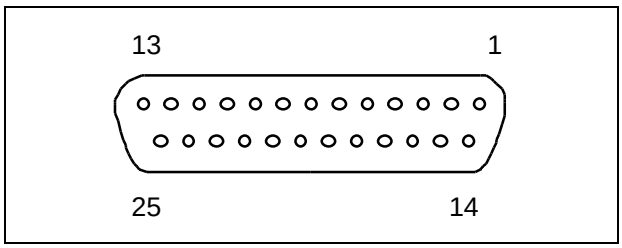
COM3 RS-232 Serial Port; 9-pin Male

Pin	Direction	Function
Shell		Chassis ground
2	Input	RXD - receive data
3	Output	TXD - transmit data
5		GND - signal ground
7	Output	RTS - request to send
8	Input	CTS - clear to send

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LPT1

LPT1 is a parallel printer port that can drive a Centronics-type parallel printer. The connector is compatible with the IBM PC's parallel printer connector.



Parallel (printer) Port; 25-pin Female

Pin	Direction	Function
1	Output	Data strobe
2	Output	D0 - data bit 0
3	Output	D1 - data bit 1
4	Output	D2 - data bit 2
5	Output	D3 - data bit 3
6	Output	D4 - data bit 4
7	Output	D5 - data bit 5
8	Output	D6 - data bit 6
9	Output	D7 - data bit 7
10	Input	Acknowledge Not
11	Input	Busy Not
12	Input	Paper Empty
13	Input	Printer Selected
14	Output	Auto-feed (not implemented)
15	Input	Error Not
16	Output	Reset Not
17	Output	Select Not
18-25		Signal ground

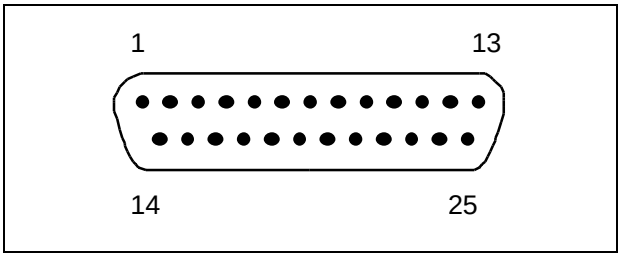
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I/O

The I/O connector supports the optional I/O racks. A simple, straight-through, 25-conductor cable is all you need, although you can make a smaller cable by connecting only those pins indicated below.

Pin 22 provides an independent transistor output that may be useful in certain special applications. The Workstation does not use this pin for I/O racks.

Please contact the factory for information to help you design your own devices to connect to the I/O bus connector.



I/O bus; 25-pin Male

Pin	Direction	Function
2	Output	Output Enable
5		Data; D1
6		Data; D3
7		Data; D5
8		Data; D7
10-12	Output	+5VDC
13	Output	Strobe
14	Output	I/O reset
17		Data; D0
18		Data; D2
19		Data; D4
20		Data; D6
22		Transistor output
23-25		Logic ground

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Firmware Download Instructions

This section describes how to change the firmware in your Series 110/120 Industrial Workstation. You may have to change your firmware either to change its type or to upgrade the current version.

Three types of firmware are available:

- PLC Workstation
- Industrial Computer with BASIC
- Industrial Terminal (all Series 110/120 models leave the factory with this firmware installed)

Because the unit stores its firmware in "flash" memory, each hardware model, which includes the IWS-110/120, IWS-113/123, and IWS-117/127, supports all three types of firmware. To change firmware, you simply plug in an IBM-compatible PC and transmit a firmware file.

When a new Workstation leaves the Nematron factory, it has the Industrial Terminal firmware already downloaded. If you want your unit to operate as a PLC Workstation or as an Industrial Computer, then you can change it by downloading different firmware.

Required Equipment

In order to download firmware, you must have the following equipment and materials available:

- Diskettes included in the IWS-SETUP-120 package.
- IBM-compatible PC with at least 256K RAM, one serial port, one hard disk drive, and one floppy disk drive.
- Cable to connect your PC to the Workstation; this is part number CBL-C1, and is included in the IWS-SETUP-120 package. If your PC has a 9-pin

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serial port, then you need the 9-to-25 adapter that is also included with the package.

- Series 110 or Series 120 Industrial Workstation.

Downloading

The following instructions describe how to download new firmware to your Series 110/120 Industrial Workstation. Before you begin, you should ensure that you have the necessary equipment available.

1. If your new Workstation displays the following screen after completing its power-up self-test, then proceed to step 2:

```
First-time power-up!
Download firmware or
hit any key for on-
line configuration.
```

   If your Workstation does not display this screen, then you must hold down the [→] and [↓] keys simultaneously while powering up the Workstation.

   Note

   You must hold down [→] and [↓] even *before* you apply power. (Unlike other hidden keyboard commands that the Workstation can accept at any time during the power-up self-test, the unit looks for the keyboard command to enter the download mode only at the moment of power-up.)

   This immediately brings up the following message:

```
Firmware download
mode enabled; ready
to accept download.
(ROM version 2.00)
```

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2. If you have already loaded the IWS-SETUP-120 software onto your hard drive, then skip to step 4. Otherwise, insert Disk 1 into your floppy drive, select your floppy drive by typing *A:* or *B:* and then press [Enter]. Then type *INSTALL* and press [Enter]. Follow the instructions the Install program displays on your screen.
3. Connect the download cable between the COM1 or COM2 port on your PC and the COM1 port on your Workstation. If your PC has a 9-pin COM1 port, then you must plug the cable into the 9-to-25 adapter, and plug the adapter into your PC.
4. Type DOWNLOAD followed by the firmware file you want to download to your PC; then press [Enter]. Listed below are your filename choices:

Filename	**Firmware Description**
G0.ROM	PLC Workstation for Allen-Bradley PLC-2 (RS-232) and PLC-5 and GE Fanuc Micro
G1.ROM	PLC Workstation for Allen-Bradley PLC-2 programming port
G2.ROM	PLC Workstation for Allen-Bradley SLC-100/150 and Modbus
G3.ROM	PLC Workstation for Allen-Bradley SLC-500
G4.ROM	PLC Workstation for GE Fanuc SNP (Series 90 Protocol)
G5.ROM	PLC Workstation for GE Fanuc Series 1/3/5/6 and Square D
G6.ROM	PLC Workstation for Omron and Texas Instruments
G7.ROM	PLC Workstation for Siemens and Westinghouse
G8.ROM	PLC Workstation for Mitsubishi
G9.ROM	PLC Workstation for Hitachi
GA.ROM	PLC Workstation for IDEC

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GB.ROM	Industrial Computer with BASIC
GC.ROM	PLC Workstation for Telemecanique
GTM.ROM	Industrial Terminal

For example, to set up your unit as a PLC Workstation for an Allen-Bradley SLC-500, you type *DOWNLOAD G3.ROM*.

To download using COM2, type -2 before the filename; for example, *DOWNLOAD -2 G3.ROM*.

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Chapter 5

Service

This chapter describes how to replace the fuse and offers some suggestions if you encounter problems.

Most problems are related to the Workstation's firmware; this chapter describes only the simple hardware problems that can occur.

Changing the Fuse

Units with a 90-250V power supply require a 1/2 Amp Slo-Blo (type T) fuse; Nematron offers fuses under part number COS-FUS-120, which contains five fuses. For 24V units, you should obtain COS-FUS-120-V4, which contains five 1 Amp Slo-Blo (type T) fuses.

The fuse holder is accessible from the bottom of the Workstation.

If the fuse blows, the Workstation will not run and none of the LED indicators will light. Follow these steps to replace it:

1. Disconnect power to the unit.
2. Correct the condition (usually a power supply overload) that caused the fuse to blow.
3. Using a flat screwdriver, turn the fuse holder counter-clockwise about 30°, until it pops out about 1/4 inch.
4. Remove the old fuse from the holder and replace it with a new one of the same rating.

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5. Push the holder back into the socket, and use the screwdriver to both push in and turn the holder until it locks back into place.

Changing the Battery

The *Alarm* LED continually flashes very slowly when the battery is low, which means that you should replace the battery immediately.

Typically, the battery should last ten years, although we conservatively rate its life at six years. If your battery fails sigificantly sooner than six years, then you should return your Workstation to the factory.

You can order a replacement battery under part number COS-BAT-120, which includes two batteries.



To replace the battery and preserve the memory, you should **not** turn off power to the unit. If you do turn off power, then the Workstation's memory contents will be lost.

The battery is mounted in a holder behind a plate on the side of the Workstation. You should remove the two screws holding this plate to the back cover, remove the old battery, and replace it with a new battery.

Power-Up Sequence

When your Series 110/120 Workstation is properly installed and wired to your power source, the following should occur upon power-up:

1. If the unit has no firmware, it performs an exhaustive test of the firmware memory. During this test, which lasts about one minute, the *Run* LED flashes quickly.

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If the firmware memory test fails, the unit halts, but continues to flash the *Run* light.

If the firmware memory test passes, the unit displays the following message and waits for you to download firmware:

```
Firmware memory is
empty or invalid.
You must download
new firmware. (V2).
```

2. If the unit has firmware, the horn plays the "bugle call" and all four LEDs momentarily flash.
3. Only the *Run* LED remains on; the others go off.
4. The unit performs a self-test including memory, clock, battery, and display. If a test passes, the unit displays "pass" briefly; if a test fails, the unit displays "fail"; if the corresponding hardware is not present, the unit displays "none."

   To speed up the self-test, press [Cancel]; you cannot speed up the first-time self-test.

   If the *Run* light flashes slowly, the display has failed. You must send the unit in for service.

   If the unit stops with just the *Alarm* light on, it indicates that the external memory test has failed. You must send the unit in for service.

   If the unit stops with just the *Comm* light on, it indicates that the internal memory test has failed. You must send the unit in for service.
5. At the end of the self-test, the unit automatically begins normal operation, which varies depending on the firmware.

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Pushbutton Reset Jumper Installation

You can install a jumper in the Workstation that allows you to generate a hardware reset by pressing the [←] and [↑] keys simultaneously. This is usually useful only if you are writing BASIC programs.

To install the jumper, disconnect power and all communications connectors, and remove the screws that hold on the back cover.

Locate the pair of pins labeled “JP1” on the lower left side of the CPU board (the large board located just behind the display) and install a shunt (jumper) across both pins. Please contact Nematron customer support if you need to obtain a shunt.

Replace the back cover, the screws, the communications connector, and finally the power.

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Troubleshooting

Virtually all apparent problems are caused by improper communications connections or inadequate grounding.

Problem noted	Possible cause(s)	Remedy
Run LED flashes very quickly for more than five minutes.	Firmware memory (flash EPROM) is faulty.	Return unit to factory.
Run LED flashes slowly.	Faulty display.	Return unit to factory.
Alarm LED flashes very slowly.	Battery low.	Replace battery.
Alarm LED on; others off.	External RAM memory failure.	Return unit to factory.
Comm LED on; others off.	Internal microprocessor memory failure.	Return unit to factory.
Kbd LED remains on continuously.	Key may be stuck.	Repeatedly press each key until the LED goes out; if the LED doesn't go out, return unit to factory.
No response to some keypresses	Loose keyboard connector; faulty keyboard	Fully seat keyboard connector; return unit to factory for new keyboard.
Firmware download reports that Flash is empty or invalid	Using old version of DOWNLOAD; faulty firmware	Use V1.4 or later of DOWNLOAD; return unit to factory for new firmware.
Communications problems	Invalid DIP switch setting; bad cable; port failure	Verify DIP switch setting and cable; use proper wire for RS-422; check serial port with loopback test described on page 6-11.

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Problem noted	Possible cause(s)	Remedy
Unit resets randomly.	Loose or shorted power cable; short in communications cable.	Check, repair and replace cable(s).
	Workstation not connected to earth ground.	Connect unit to earth ground.
	Voltage potential between earth grounds of Workstation and other devices connected to its communications ports.	Connect all devices to the same earth ground.
	Loose integrated circuits inside.	Open unit, remove boards and press all chips fully into sockets.
	Faulty Workstation power supply.	Return unit to factory.
	Low voltage on incoming power.	Raise voltage.

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Chapter 6

On-Line Configuration

This chapter describes how to access and use the built-in configuration program.

The configuration program allows you to set up the operation of your Workstation. For example, you can set up the communications parameters for your serial ports.

This chapter applies only if you plan to use your Workstation as a Terminal. If you plan to operate your Workstation with the PLC Workstation or BASIC firmware, then you should consult the corresponding user guide.

Accessing the On-Line Configuration Menu

To access the Configuration Menu, press [F()] and [Cancel] simultaneously during the power-up self-test.

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Main Configuration Menu

When you enter the on-line configuration program, you should see the following screen:

```
Configuration Menu
1-Keyboard   2-Clock
3-Display    4-Comm.
5-Utility    6-Term.
```

Note

Any changes you make to the Workstation's operating parameters do not take effect until you exit.

Selecting a Menu Item

To select an item from a menu, simply press the corresponding digit.

Selecting Parameters

To scroll from selection to selection without changing anything, press [↑] or [↓]. If you make a change and then press [↑] or [↓], the unit does not record the change and instead goes to the previous or next selection.

Changing Parameters

To change a parameter, you must press [←] or [→] to choose the desired parameter, and then press [Enter]; the system pauses for one second after displaying the change and then goes to the next selection.

Exiting

Pressing [Cancel] at any time returns to the previous menu (and the unit ignores any change on the current screen). To exit the configuration program entirely, press [F()]-[Cancel].

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Keyboard

Beep on Keypress

Enabled, Disabled

Selects whether the unit beeps when the operator strikes a key. We recommend you leave this *Enabled*.

Blink on Keypress

Enabled, Disabled

Selects whether the unit flashes the *Kbd* LED when the operator strikes a key. We recommend you leave this *Enabled*.

Shift and F() Keys

Enabled, Disabled

Selects whether the unit allows the operator to enter letters or punctuation by pressing a shift key and then a number key.

When disabled, the unit returns a separate key code for every key.

We recommend you leave this *Disabled* unless your application specifically calls for alphabetic entries.

Shift Lock

Enabled, Disabled

Selects whether pressing a shift key twice “locks” the unit into the shift mode. We recommend you leave this *Disabled*.

Auto-Repeat

Enabled, Disabled

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Selects whether holding down a key causes it to repeat continually (after a brief delay). We recommend you leave this *Disabled*.



Leave the auto-repeat option *Disabled* if you have assigned any keys to a machine control function. Please consider whether a stuck key could indirectly harm personnel or equipment.

Repeat Delay

1 to 255

This is the amount of time your operator must hold down a key before it repeats. Note that the resolution of this parameter is 50 milliseconds, which means that a value of 20 equals one second.

If you must enable the auto-repeat option, we recommend a repeat delay of 20.

Repeat Rate

1 to 255

This is the amount of time the unit waits between repeats while a key is held down. The resolution of this parameter is 50 milliseconds, so a value of 2 means the unit repeats every 100 milliseconds, or 10 times each second.

If you must enable the auto-repeat option, we recommend a repeat rate of 2.

Clock

Date Format

U.S. (MM/DD/YY), Int'l (DD.MM.YY)

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Selects the format the Workstation uses to print the date. The U.S. format is *MM/DD/YY*, where the month comes first; for example, June 24, 1991 is 06/24/91.

The Int'l format is *DD.MM.YY*, where the day comes first; for example, June 24, 1991 is 24.06.91.

Date

Selects the current date; note that the Workstation rejects months and days that are invalid.

Time

Selects the current time; note that the Workstation uses a 24-hour clock, so in the afternoon, you must enter the current time plus twelve.

Display

Viewing Angle (LCD)

1 to 100

Selects the viewing angle (contrast) of the LCD display from 1 (lowest) to 100 (highest). We recommend a setting of about 45.

Brightness (VFD)

1 to 4

Selects the brightness level of the VFD display from 1 (dimmest) to 4 (brightest). We recommend a setting of 4 unless your Workstation is in a light-sensitive location (such as a film manufacturing plant).

Screen Saver

Timed, On Continuously, Off Continuously

When you enable the screen saver by selecting *Timed*, the Workstation saves the screen after a specified

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period of inactivity. Pressing any key cancels screen saving.

To save the VFD display (for an IWS-12x), the unit continually moves a flashing solid block across a blanked screen to remind you that the screen is saved.

To save an LCD display (for an IWS-11x), the unit simply turns off the backlighting.

If you select the option *On Continuously*, the screen saver is disabled.

Screen Saver Time

1 to 255

If you have enabled the screen saver by choosing the *Timed* selection under "Screen Saver," this allows you to enter the period of inactivity before the screen turns off. The resolution of this entry is in minutes, so you can enter a time from 1 to 255 minutes.

Line End Action

None, Auto-CR, Auto-CRLF

This selection allows you to choose where the cursor moves after it prints to the last column on a line. Following is how each selection affects the cursor:

None	The cursor remains at the end of the current line.
Auto-CR	The cursor moves to the first column of the current line.
Auto-CRLF	If the cursor is not on the last line, it moves to the first column of the next; if the cursor is on the last line, the cursor movement depends on your choice for the Screen End Action selection.

When the cursor is sent backwards, the same concepts apply. For example, when going backwards from the

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first column, *Auto-CR* moves the cursor to the last column of the current line, while *Auto-CRLF* moves the cursor to the last column of the previous line. Of course, *None* leaves the cursor in the first column.

We recommend you set this to *Auto-CRLF*.

Screen End Action

None, Wrap, Scroll

If you choose *Auto-CRLF* for the Line End Action selection described previously, this selection allows you to choose where the cursor moves after it prints to the last column on the last line. Listed below is how each selection affects the cursor's movement:

None	Cursor remains at the end of the last line.
Wrap	Cursor moves to the first column of the first line.
Scroll	The Workstation moves the bottom three lines to the top and clears the bottom line. Then it moves the cursor to the first column of the last line.

When the cursor is sent backwards, the same concepts apply. For example, when going backwards from the first column of the first line, *Wrap* moves the cursor to the last column of the last line, while *Scroll* moves the top three lines down and places the cursor at the last column of the top line (which is now blank). Of course, *None* leaves the cursor in the first column.

We recommend you set this to *Scroll*.

Cursor

None, Block, Underscore

Selects the cursor type. We recommend you choose the Block cursor. The underscore cursor is available only on the Series 110 models.

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Communications

The sub-menu for configuring the communications ports appears below:

```
Communications Menu

1 - COM1   2 - COM2
3 - COM3
```

After selecting a port, the Workstation allows you to change the following parameters for each port:

Baud Rate

110, 300, 600, 1200, 2400, 4800, 9600, 19200

Selects the speed at which this port transmits and receives. We recommend 9600, but in any event you must ensure that the device connected to this port operates at the same speed.

Parity

None, Odd, Even

Selects whether the Workstation sends and receives an extra bit that helps guard against lost bits. Selecting *None* disables this feature, while *Even* specifies that of the bits received, an even number of them must be high (and conversely for *Odd*).

We recommend you enable parity if the data communicated is critical and if there is no other error-checking scheme (such as a checksum). In any event, this must match the setting of the device connected to this port.

Data Bits

7, 8

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Selects the number of data bits in each byte transmitted. This must match the setting of the device connected to this port.

The combination of 7 data bits, no parity, and 1 stop bits is invalid for COM1. In that instance, we recommend you select 2 stop bits instead.

Stop Bits

1, 2

Selects the number of stop bits transmitted after each byte. This must match or exceed the setting of the device connected to this port. In other words, selecting *2* always works, but selecting *1* usually works.

The combination of 7 data bits, no parity, and 1 stop bits is invalid for COM1. In that instance, we recommend you select 2 stop bits instead.

Transmit Handshake

None, CTS, XON/XOFF

Selects the type of "handshaking" that the Workstation respects when transmitting.

Selecting *None* tells the Workstation to transmit immediately. This works fine if the other device's receiver is *always* ready to receive.

Selecting *CTS* tells the Workstation to transmit only if its CTS input is asserted. Choose this if the other device has an output that it asserts when its receiver is available. This is often called "hardware handshaking."

Selecting *XON/XOFF* tells the Workstation to stop transmitting when it receives an XOFF (ASCII code 19, or [Ctrl]-S) and to resume when it receives an XON (ASCII code 17, or [Ctrl]-Q). This is often called "software handshaking."

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RTS Control

Always On, On During Xmit, On to Receive, On at Xmit

Selects the function of the RTS handshaking line.

In most RS-232 applications, you should select *Always On* and connect it to the CTS input of either the Workstation or the other device.

For virtually all RS-422 and RS-485 applications, you should select *On During Xmit*. The Workstation enables its RS-422/RS-485 transmitter only when RTS is on (but only when DIP switch 3 is set), which is crucial when there are multiple transmitters on the same pair of wires.

Choosing *On to Receive* is the same as choosing *RTS* for the Receive Handshake selection that follows.

Receive Handshake

None, RTS, XON/XOFF

Selects the type of "handshaking" that the Workstation asserts when receiving.

If the Workstation is always ready to receive, you can simply select *None*.

If the other device supports "hardware handshaking" on its transmitter, which usually means that it doesn't transmit unless its CTS input is asserted, you can select *RTS* and connect the Workstation's RTS output to the other device's CTS input. (This is the same as choosing *On to Receive* for the RTS Control selection.)

Finally, if the other device supports "software handshaking," you can select *XON/XOFF* to do the same.

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Convert Parity Error

Enabled, Disabled

This selects whether the Workstation automatically translates characters received with the wrong parity into some other character.

Typically, you would assign a character such as "~" that is normally not displayed. In the Terminal mode, that indicates to the operator that there was a parity error.

We recommend you enable this selection.

Parity Error Char

0 to 255

Selects the ASCII code of the character returned in place of characters received with incorrect parity. You should read the description above under "Convert Parity Error" for more information.

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Utility

Selecting the Utility function from the main configuration menu brings up the following menu:

```
      Utility
1-Keypad test
2-Comm. tests
3-Upload firmware
```

Keypad Test

Pressing 1 from the Utility menu brings up the keypad test:

```
Keyboard Test
Press a key or wait
5 seconds to exit:
[No key pressed]
```

When a key is pressed, it shows up on the bottom line. For example, if the user presses [Enter]:

```
Keyboard Test
Press a key or wait
5 seconds to exit:
[Enter]
```

To exit the keypad test, don't press any keys for five seconds.

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Communi-cations Test

Pressing 2 from the Utility menu brings up the communications test menu:

```
Communications Test

1 - COM1   2 - COM2
3 - COM3   4 - LPT1
```

Every selection from this menu leads to the following:

```
Testing COM1; press
F()-Cancel to exit.
R=
T=
```

If the unit receives any characters on the selected port, it displays them following the "R=." When the user presses a key, the unit transmits it via the selected port.

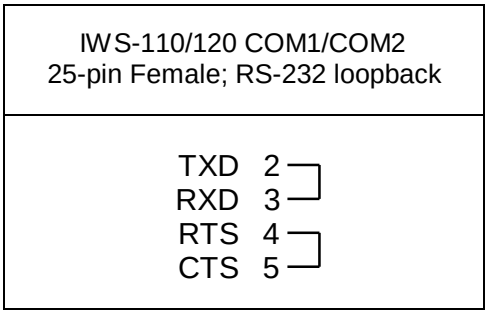
Following the "T=" is the current transmit handshake status: *Port Okay*, *CTS Not Asserted*, or *XOFF Received*.

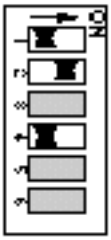
You can set up a "loopback" test by connecting together the transmit and receive pins of the port you want to test. If the port is functioning properly, then the Workstation should display after the "R=" every character you type.

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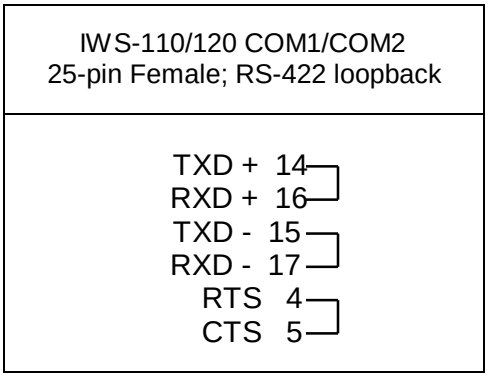
Following are the schematics and DIP switch settings for each kind of loopback:

RS-232





RS-422



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Upload

This allows you to enable uploading of new firmware to the Workstation. After selecting this option, you can follow the instructions on page 4-17 to download firmware.

Terminal

This allows you to set up the following parameters:

Host (Primary) Port

COM1, COM2, COM3

Selects which serial port is connected to the host.

Peripheral Port

COM1, COM2, COM3, LPT1

Selects the default peripheral port; note that the host can send an escape sequence to change the current peripheral port.

Echo to Display

Enabled, Disabled

When you select *Enabled*, which is sometimes called "half-duplex" mode, the Workstation both transmits and displays every key the operator presses.

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When you select *Disabled*, sometimes called "full-duplex," the Workstation simply transmits operator keypresses. In this case, the host typically transmits each keypress back to the Workstation for display.

Although full duplex operation seems more complicated, it has two advantages. First, the operator instantly knows when the host has failed; and second, the host can translate keypresses and return different codes to the Workstation.

Multi-Drop

Enabled, Disabled

When multi-drop is enabled, the Workstation responds only when the host sends a code to "select" the Workstation. This is useful when a single communications port on the host is connected to more than one Workstation.

Multi-Drop Station#

0 to 255

If you have enabled multi-drop, you must enter a station number. We recommend that you not use station number 0 or 255.

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Chapter 7

Terminal Functions

This chapter describes all the functions of the Terminal version of the firmware, including how it sends keypresses to the host, how it displays characters received from the host, and the additional functions it can perform on command from the host.

At the factory, Nematron sets up every Workstation as a Terminal. When you first apply power to your Workstation, it displays the following message:

```
First-time power-up!
Download firmware or
hit any key for on-
line configuration.
```

To use your Workstation as a Terminal, you must enter and exit the on-line Configuration Menu. To do that, you can simply press the [Enter] key, enter any changes to the default Terminal settings, and then press [Cancel].

After you configure your Terminal, or after any subsequent power-up, your Terminal displays the following screen, which indicates that your Workstation is ready to operate:

```
IWS Terminal Mode --
Screen will clear
when any key hit or
character received.
```

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Transmitting

Usually, when the operator presses a key, the Workstation sends the ASCII code of that key to the host. For example, if the operator presses *1*, the Workstation transmits the ASCII code for 1 (the code is 49; see page A-2 for a list of ASCII codes that the Workstation generates).

The rest of this section describes special functions of the keyboard.

Key Echo

There may be applications where you want the Workstation to "echo" characters to the display as well as transmit them to the host.

You can set up the Workstation to echo to the display by making the appropriate selection in the on-line configuration (page 6-13) or by transmitting the escape code *[>14h* to enable echoing or *[>14l* to disable echoing.

"Half duplex" is the term often used to describe a configuration where the Workstation echoes keypresses to its display; "full duplex" describes a configuration where the host echoes keypresses to the terminal.

Keyboard Disable

You can program your host to transmit a code to disable the Workstation's keyboard. The escape string to disable the keyboard is *[2h*; to enable the keyboard, the escape string is *[2l*.

Auto-Repeat

If the operator holds down a key longer than one-half second, the Workstation repeats the key automatically.

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You can disable this feature by programming your host to send the escape command *[24l*.

Keyboard Buffer

Usually, the Workstation transmits a key immediately after the operator presses it. However, if the CTS input to the primary (host) port is not active, the Workstation saves keypresses until CTS becomes active.

The Workstation can save only the first 255 keypresses; if the operator continues to press keys after the buffer is full, the Workstation does not accept them.

Key Shifting

Your operator can send an uppercase letter by pressing one of the [Shift] keys before pressing a number key. For example, to generate the letter A the operator first presses [Shift Left] and then presses *1*. After the operator presses *1*, he must press a shift key again before he can enter another letter.

Shift Lock

The operator can "lock" a shift by pressing the same shift key twice. To cancel a locked shift key, the operator can press the same shift key once again.

Shift Disable

Your host can send the escape code *[21l* to disable the shift and F( ) keys; if the operator presses a shift or F( ) key when shifting is disabled, the Workstation transmits a code for that shift key; see page A-2 for the codes.

To enable the shift and F() keys, your host sends the escape code *[21h*. You can subsequently disable the F() key while leaving the shift keys alone by sending the escape code *[25l*.

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F( ) Key

You can use the [F( )] key to generate characters that do not appear on the keyboard. In fact, you can think of the [F( )] key as a fourth shift key; you can lock it, disable it, and cancel it as described just above. The characters that the [F( )] key generates appear below:

[F()] followed by	ASCII	Character
0	44	,
1	64	@
2	61	=
3	35	#
4	37	%
5	42	*
6	34	"
7	36	$
8	47	/
9	63	?
●	39	’
–	43	+
[←]	60	<
[→]	62	>
[↓]	40	(
[↑]	41	)
[Enter]	58	:
[Cancel]	03	same [Ctrl]-C
[Backspace]	94	^

F( ) Disable

If the F( ) key is disabled as described on the previous page, the Workstation transmits an ASCII code of 027 when the operator presses the F( ) key. This code corresponds to the “Escape” key on most computers.

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Receiving

Usually, when the Workstation receives a character from the host, it displays that character on the display. Page A-1 lists the ASCII code of each character the Workstation displays.

Note

The Workstation cannot receive and process a continuous stream of commands at a high baud rate. You may have to program your host to allow extra time for the Workstation to process your commands.

Control Codes

In addition to transmitting displayable characters to the Workstation, you can program your host to send "control" codes that invoke special functions.

ASCII	Function
06	First byte of "binary" multi-drop select code; indicates that the following byte is a multi-drop station number (must be 0 to 127)
07	Bell
08	Backspace
09	Cursor forward one space
10	Line feed
11	Reverse line feed
12	Form feed (clear screen and home cursor)
13	Carriage return
27	Escape (indicates the start of a special receive function)
127	Performs a destructive backspace

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Special Receive Functions

This section describes the special functions of the Series 110/120 Terminal. Note that the numbers between braces, such as {27} refer to ASCII codes that your host generates with the CHR$(27) function.

Note

The Workstation cannot receive and process a continuous stream of special receive functions at a high baud rate. You may have to program your host to allow extra time for the Workstation to process your commands.

Cursor

The "cursor" indicates where the next displayed character appears. The cursor is normally a flashing block, but it can instead be a flashing underline or completely invisible.

Every time the Workstation displays a character, it advances the cursor to the next character position. To advance the cursor from the last position on a line, the Workstation moves the cursor to the first position of the next line.

To advance the cursor from the last position on the screen, the Workstation "scrolls" the screen up, so that the top line is gone and lines 2 through 4 are moved to lines 1 through 3; then the Workstation places the cursor at the start of the 4th line.

Cursor Type

To display a cursor, your host must issue the "enable cursor" command. If the cursor is disabled, the host can switch from the solid block to the flashing underline, but the Workstation will not display a cursor until the host explicitly enables it.

Function	Code
Enable cursor	{27} [>5l

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Disable cursor	{27} [>5h
Solid block cursor	{27} [>4h
Flashing underline (Series 110 only)	{27} [>4l

Cursor Position Save, Restore and Print

The host can tell the Workstation to save the current cursor position in order to restore it later, but the Workstation does not have the capability to "stack" multiple saves in order to perform multiple restores later. The restore function moves the cursor to the last saved position.

Function	Code
Save cursor position	{27} [s
Restore cursor position	{27} [u
Print cursor position to primary port in the format: *{27} [xx;yyR* where *xx* is the row and *yy* is the column	{27} [6n

Move Cursor

Function	Code
Up 1 line	{27} [A
Up *nn* lines	{27} [*nn*A
Down 1 line	{27} [B
Down *nn* lines	{27} [*nn* B
Right 1 column	{27} [C or {09}
Right *nn* columns	{27} [*nn* C
Left 1 column	{27} [D or {08}
Left *nn* columns	{27} [*nn* D
Down 1, scroll if at bottom	{27} D or {10}
Down 1 to column 1, scroll if at bottom	{27} E

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Up 1, scroll if at top	{27} M or {11}
To home (row 1, column 1)	{27} [H or {27} [f
To home (and clear screen)	{12}
To row *xx*, column *yy*	{27} [*xx*;*yy*H or {27} [*xx*;*yy*f
To row 4, column 10	{27} [4;10H
To column 1	{13}

Automatic Line Feed or Carriage Return

The line feed and carriage return characters (ASCII codes 10 and 13 respectively) are two of many ways to control the cursor's position:

Function	**Code**
Enable line feed after carriage return (and disable carriage return after line feed)	{27} [>8h
Disable line feed after carriage return	{27} [>8l
Enable carriage return after line feed (and disable line feed after carriage return)	{27} [>9h or {27} [20h
Disable carriage return after line feed	{27} [>8l or {27} [20l

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Display

The display commands affect the operation of the display.

Enable/Disable

If your application utilizes the Workstation's capability to transmit through the Workstation to a peripheral port, you may want to disable the display so that characters sent to the peripheral port do not also go to the screen.

Function	Code
Disable display	{27} [?16h
Enable display	{27} [?16l

Clear

There are several commands that can clear the screen partially or entirely.

Function	Code
Entire display	{27} [2J
Clear screen and home cursor	{12}
Cursor to end of screen	{27} [J or {27} [0J
Start of screen to cursor	{27} [1J
Cursor to end of line	{27} [K or {27} [0K
Start of line to cursor	{27} [1K
Current line	{27} [2K

Insert/Delete

The Workstation has a variety of options for inserting and deleting characters and lines.

When the Workstation inserts or deletes a character, it changes only the current line.

Function	Code
Enable character insert mode	{27} [4h
Disable character insert mode	{27} [4l

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Delete character at cursor	{27} [P
Delete *nn* characters at cursor	{27} [*nn* P
Insert 1 line at cursor	{27} [L
Insert *nn* lines at cursor	{27} [*nn* L
Delete 1 line at cursor	{27} [M
Delete *nn* lines at cursor	{27} [*nn* M

Echo

If you set up the Workstation to "echo" characters to the screen (also known as "half duplex" mode), whenever the operator presses a key, the Workstation displays that key on the screen *and* sends it to the host. When you disable echoing, the Workstation only sends keypresses to the host (known as "full duplex" mode).

Function	Code
Enable echo	{27} [>14h
Disable echo	{27) [>14l

Wrap

When the Workstation displays a character at the end of a line, it normally "wraps" automatically to the next line. The host can send a command to turn off this feature.

Function	Code
Enable wrap	{27} [?7h
Disable wrap	{27} [?7l

Flashing Characters

The host can transmit a command to tell the Workstation to display all subsequent characters as flashing characters.

Function	Code
Disable flashing	{27} [0m
Enable flashing	{27} [5m

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Keyboard

There are several functions that control the operation of the keyboard.

To enable the [Shift] keys but leave the [F()] key disabled, your host must first transmit the command to enable both the [Shift] and [F()] keys ({27} [21h) and then transmit the command to disable the [F()] key ({27} [25l).

Function	Code
Disable keyboard entirely	{27} [2h
Disable shift and F( )	{27} [21l
Disable shift lock	{27} [22l
Disable beep	{27} [23l
Disable auto-repeat	{27} [24l
Disable F() as “shift” key	{27} [25l
Enable keyboard	{27} [2l
Enable shift and F( )	{27} [21h
Enable shift lock	{27} [22h
Enable beep	{27} [23h
Enable auto-repeat	{27} [24h
Enable F()	{27} [25h

LEDs

There are some commands that control the status of the *Alarm* and *Comm* LEDs.

Function	Code
Turn on *Comm* LED	{27} [>1h
Turn off *Comm* LED	{27} [>1l
Turn on *Alarm* LED	{27} [>2h
Turn off *Alarm* LED	{27} [>2l

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Message Storage and Retrieval

One of the Workstation's nicest features is its capability to store messages in memory and recall them later with a short command.

The Workstation does not have any on-line message editing capabilities. To store a message in memory, you must program your host to send a message with the proper codes. For example, to program the message "IWS-120 Terminal" as message number 1, your program might contain the statement:

```
PRINT CHR$(27);"[>1uIWS-120 Terminal";CHR$(4);
```

Function	Code
Save *text* as msg *nnn* (1-254)	{27} [>*nnn*u *text* {04}
Append *text* to msg *nnn* (1-254)	{27} [>*nnn*v *text* {04}
Erase all messages	{27} [>255u
Display message *nnn*	{27} [>*nnn*w
Send message *nnn* to primary port	{27} [>*nnn*x
Send message *nnn* to peripheral port	{27} [>*nnn*y
Send number of unused characters of memory storage to primary port in the format *nnnnn* {13}	{27} [>z

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Multi-Drop Functions

With the proper connections, you can connect multiple Workstations to a single intelligent host, all with a single cable. The multi-drop command "selects" a particular Workstation to respond to all subsequent commands (until the host transmits the next select code).

You must follow the instructions on page 6-16 to configure the Workstation for multi-drop operation, and you must properly connect the Workstations to the host using RS-422 or RS-485.

We provide three versions of the select command: two "binary" versions and one "ASCII" version. The following paragraphs explain the differences.

Function	Code
Select station *nnn* (ASCII)	{027} [*nnn*]
Select station *nnn* (binary)	{06} {nnn}
Select station *nnn* (improved binary)	{05} {nnn}

Valid station numbers are 1 to 255 for the ASCII version and 1 to 127 for the binary versions. Station 0 is a "broadcast" address that selects all stations for receive-only operation.

Note

The ASCII command includes the square brackets. For example, to select station 3, your host must send an escape code followed by the string "[3]".

Note

The binary command requires that you send the station number as a single ASCII character. For example, to select station 3, your host would send a character with the ASCII code of 5 or 6 and then a character with the ASCII code of 3. We recommend that you assign station numbers from 33 to

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126, because the others correspond to non-printable ASCII characters.

When the host selects a particular Terminal by sending a select command, the Terminal responds by transmitting everything in its buffer ending with the ASCII code {04}. If the buffer is empty, the Terminal sends only the {04}.

The type of select command determines whether the Terminal sends additional keypresses to the host or holds them until the next select command.

If the Terminal receives an ASCII or binary {06} select command, it first transmits its buffer, then ASCII code {04}, and then any operator keypresses until the Terminal receives a command that selects another terminal. This proves inconvenient in some applications, because the host could receive an operator keypress from a Terminal at the same time that the host sends a new select command, which confuses the host.

If the Terminal receives the improved binary select command, which uses ASCII code {05}, then it responds by transmitting its buffer and ASCII code {04}. The Terminal saves any subsequent operator keypresses until it receives the next select command. This prevents the possibility of confusing the host.

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Ports

Your host can transmit through the Workstation to its other communications ports. To do this, the host first sends a command to select which port is the "peripheral" port.

There are several ways for the Workstation to use the currently selected peripheral port:

1. The Workstation can transmit to the peripheral port every character it receives from the host.
2. The Workstation can transmit to the host every character it receives from the peripheral.
3. The Workstation can transmit the current line, character, or screen to the peripheral port.

Peripheral On/Off

Function	Code
Disable primary to peripheral	{27} [4i
Enable primary to peripheral	{27} [5i
Disable peripheral to primary	{27} [6i
Enable peripheral to primary	{27} [7i

Select Peripheral

Select COM3 as peripheral	{27} [8i
Select COM2 as peripheral	{27} [9i
Select COM1 as peripheral	{27} [10i
Select LPT1 as peripheral	{27} [11i

Transmit from Display

Current screen to primary	{27} [p or {27} [0p
Current line to primary	{27} [1p
Current character to primary	{27} [2p
Current line to peripheral	{27} [3p
Current screen to peripheral	{27} [4p

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Reset to Default Settings

The following command resets the terminal back to its default settings (power-up settings):

Function	Code
Reset to defaults	{27} [z

Time/Date

Several commands read, set, and display the time and/or date; the time is always in the 24-hour format.

Function	Code
Set the time	{27} [hh;mm;ss?s
Set the date (regardless of US/Int'l setting)	{27}[mm;dd;yy?t
Enable date display at cursor	{27} [?14h
Enable time display at cursor	{27} [?15h
Disable date display	{27} [?14l
Disable time display	{27} [?15l
Transmit time to primary (same format as displayed)	{27} [?7n
Transmit date to primary (same format as displayed)	{27} [?8n

Troubleshooting

This section describes possible problems with the operation of your Series 110/120 Industrial Terminal.

When the operator presses a key, it doesn't show up on the display.

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	This might indicate that you haven't set up the host and Workstation to "echo" the operator's entries to the screen. You can either set up the Workstation so that it automatically echoes keypresses to the screen, or you can program your host to transmit back to the Workstation any characters it receives. To set up the Workstation to echo, you can either follow the configuration instructions on page 6-13 or set up your host to send a command as described on page 7-9.
The screen doubles each character it displays.	
	This indicates that you have set up the Workstation to echo characters to the screen and that the host is also echoing characters to the screen. The best solution is to change the Workstation's configuration so that it doesn't echo characters itself, and leave that job to the host.
The host transmits characters, but the Terminal doesn't display anything.	
	The most likely problem is a faulty cable or a mismatch between the communication parameters of the host and the Terminal. You should check your cable and make sure the parameters match. Also, make sure that the host is plugged into the "Primary Port" you have specified in the on-line configuration. Another possibility is that the Workstation is set up in the multi-drop mode and that the host has not sent the proper select command.
The Terminal continually (not occasionally) displays garbled characters.	

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	This indicates a mismatch between the communication parameters of the host and the Terminal. You should check that the baud rate, data bits, stop bits, and parity selections are the same for both the Terminal and the host.
The Terminal occasionally displays garbled characters.	
	This typically indicates that the host is at least occasionally sending too fast for the Workstation, which can overflow the Workstation's receive buffer. You must either add delays in your host program, use a slower baud rate, or implement hardware or software handshaking. RS-485 applications can exhibit the same problem. Make sure you set DIP switch 3 to the "on" position and that you have configured "RTS Control" (under the Comm selection of the On-Line Configuration Menu) to *On During XMIT*.

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Appendix

Receive Character Codes (Terminal Firmware)

The column marked "ASCII" refers to the ASCII code of the character that the host sends to the Workstation. The following two tables show which character the Workstation displays or which function the Workstation performs when it receives the corresponding ASCII code. Unused ASCII codes have no effect.

ASCII	Char	ASCII	Char	ASCII	Char	ASCII	Char
05	Multi-drop (new)	48	0	75	K	102	f
06	Multi-drop	49	1	76	L	103	g
07	Bell	50	2	77	M	104	h
08	Backspace	51	3	78	N	105	i
09	Cursor right	52	4	79	O	106	j
10	Line feed (LF)	53	5	80	P	107	k
11	Reverse LF	54	6	81	Q	108	l
12	Form feed	55	7	82	R	109	m
13	Carriage return	56	8	83	S	110	n
27	Escape	57	9	84	T	111	o
31	§	58	:	85	U	112	p
32	[space]	59	;	86	V	113	q
33	!	60	<	87	W	114	r
34	"	61	=	88	X	115	s
35	#	62	>	89	Y	116	t
36	$	63	?	90	Z	117	u
37	%	64	@	91	[	118	v
38	&	65	A	92	\	119	w
39	'	66	B	93	]	120	x
40	(	67	C	94	^	121	y
41	)	68	D	95	_	122	z
42	*	69	E	96	`	123	{
43	+	70	F	97	a	124	|
44	,	71	G	98	b	125	}
45	–	72	H	99	c	126	~
46	.	73	I	100	d	127	back space
47	/	74	J	101	e		

The following table shows the characters the Series 120 Workstation displays for the ASCII codes indicated. You must set up your host communications for 8 data bits in order for the Workstation to display these characters properly.

These characters correspond roughly to the Multilingual code page (page 850) of PC-compatibles.

Because of display limitations, the Series 110 Workstation displays only the following characters from the Multilingual code page: ñ, Ñ, ü, ä, Ä, and ö.

ASCII	Char	ASCII	Char	ASCII	Char	ASCII	Char
128	Ç	160	á	192	▯	224	α
129	ü	161	í	193	▯	225	β
130	é	162	ó	194	▯	226	Ō
131	â	163	ú	195	▯	227	p
132	ä	164	ñ	196	—	228	S
133	à	165	Ñ	197	▯	229	σ
134	â	166	ª	198	ã	230	µ
135	ç	167	º	199	Ã	231	τ
136	ê	168	¿	200	▯	232	þ
137	ë	169	▯	201	▯	233	θ
138	è	170	¬	202	▯	234	Ω
139	ï	171	½	203	▯	235	δ
140	î	172	¼	204	▯	236	∞
141	ì	173	¡	205	▯	237	φ
142	Ä	174	«	206	▯	238	∈
143	Â	175	»	207	¤	239	´
144	É	176	▯	208	▯	240	≡
145	æ	177	▯	209	Ð	241	±
146	Æ	178	▯	210	E	242	≥
147	ô	179	|	211	Ë	243	≤
148	ö	180	▯	212	È	244	∫
149	ò	181	Á	213	1	245	§
150	û	182	Â	214	Í	246	÷
151	ù	183	À	215	I	247	=
152	ÿ	184	©	216	Ï	248	°
153	Ö	185	▯	217	▯	249	-
154	Ü	186	▯	218	▯	250	˙
155	¢	187	▯	219	▯	251	√
156	£	188	▯	220	▯	252	ɘ
157	¥	189	▯	221	▯	253	2
158	×	190	▯	222	Ì	254	▯
159	*f*	191	▯	223	▯	255	

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Transmit Character Codes (Terminal Firmware)

Key	ASCII Code	Key	ASCII Code
[F()]-[Cancel]	03	7	55
[←]	08	8	56
[→]	09	9	57
[↓]	10	[F()]-[Enter]	58
[↑]	11	[F()]-[←]	60
[Enter]	13	[F()]-2	61
[Shift left] or [Menu]*	14	[F()]-[→]	62
[Shift center] or [Help]*	15	[F()]-9	63
[Cancel]	24	[F()]-1	64
[Shift right] or [Setup]*	25	A	65
[F()]*	27	B	66
[F1] or [Select]	28	C	67
[F2] or [Alarms]	29	D	68
[F3] or [Select]	30	E	69
[F4] or [Upload]	31	F	70
sp (space)	32	G	71
[F()]-6	34	H	72
[F()]-3	35	I	73
[F()]-7	36	J	74
[F()]-4	37	K	75
[F()]-●	39	L	76
[F()]-[↓]	40	M	77
[F()]-[↑]	41	N	78
[F()]-5	42	O	79
+ or [F()-]—	43	P	80
[F()]-0	44	Q	81
–	45	R	82
●	46	S	83
[F()]-8	47	T	84
0	48	U	85
1	49	V	86
2	50	W	87
3	51	X	88
4	52	Y	89
5	53	Z	90
6	54	[F()]-[Backspace]	94
		[Backspace]	127

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* The shift and F( ) keys generate a code only if shifts and F( ) are disabled.

Escape Codes (Terminal Firmware)

To generate one of the functions below, the host device must send an "escape" character followed by the character string in the "Command" column. For example, to move the cursor up one line, your host program might contain the line PRINT CHR$(27);"[A"; where CHR$(27) is the code for an escape character.

Command	Function
[A	Move cursor up 1 line.
[*nn*A	Move cursor up *nn* lines.
[B	Move cursor down 1 line.
[*nn*B	Move cursor down *nn* lines.
[C	Move cursor right 1 character.
[*nn*C	Move cursor right *nn* characters.
[D	Move cursor left 1 character.
[*nn*D	Move cursor left *nn* characters.
D	Index-move cursor down one line, scroll if at bottom.
E	New line: perform index, put cursor at beginning of line.
[H	Move cursor home (row 1, column 1).
[f	Move cursor home (row 1, column 1).
[*xx*;*yy*H	Move cursor to row *nn*, column *yy*.
[*nn*;*yy*f	Move cursor to row *nn*, column *yy*.
[>1h	Turn on *Comm* LED.
[>2h	Turn on *Alarm* LED.
[>4h	Select block cursor.
[>5h	Disable cursor.
[>8h	Automatic line feed on carriage return ON.
[>9h	Automatic carriage return on line feed ON.
[>14h	Echo characters to screen ON.
[?7h	Wrap at end-of-line ON.
[?14h	Enable continuous date display at cursor position.
[?15h	Enable continuous time display at cursor position.
[?16h	Disable display.
[2h	Disable keyboard entry.
[4h	Insert mode ON.
[20h	Automatic carriage return on line feed ON.
[21h	Enable keyboard shift capability.

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[22h	Enable keyboard shift lock capability.
[23h	Enable keyboard beep.
[24h	Enable keyboard auto repeat.
[25h	Enable F() (while leaving the [Shift] keys alone).

Command	**Function**
[4i	Primary to peripheral port OFF.
[5i	Primary to peripheral port ON.
[6i	Peripheral to primary port OFF.
[7i	Peripheral to primary port ON.
[8i	Peripheral port = COM3.
[9i	Peripheral port = COM2.
[10i	Peripheral port = COM1.
[11i	Peripheral port = LPT1 (default).
[J	Clear display from cursor to end of screen.
[0J	Clear display from cursor to end of screen.
[1J	Clear display from cursor to beginning of screen.
[2J	Clear display screen.
[K	Clear display from cursor to end of line.
[0K	Clear display from cursor to end of line.
[1K	Clear display from cursor to beginning of line.
[2K	Clear line on display at current cursor position.
[L	Insert 1 line at cursor.
[*nn*L	Insert *nn* lines at cursor.
[>1l	Turn off *Comm* LED.
[>2l	Turn off *Alarm* LED.
[>4l	Select underline cursor (Series 110 models only).
[>5l	Enable cursor.
[>8l	Automatic line feed on carriage return OFF.
[>9l	Automatic carriage return on line feed OFF.
[>14l	Echo characters to screen OFF.
[?7l	Wrap at end-of-line OFF.
[?14l	Disable date display.
[?15l	Disable time display.
[?16l	Enable display.
[2l	Enable keyboard entry.
[4l	Insert mode OFF.
[20l	Automatic carriage return on line feed OFF.
[21l	Disable keyboard shift capability (shift keys return codes).
[22l	Disable keyboard shift lock capability.
[23l	Disable keyboard beep.

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[24l	Disable keyboard auto repeat.
[25l	Disable the F() key while leaving the [Shift] keys alone.
M	Reverse index.
[M	Delete 1 line at cursor.
[*nn*M	Delete *nn* lines at cursor.
[0m	Disable flashing characters on display.
[5m	Enable flashing characters on display.
[6n	Transmit current cursor position through primary port.
Command	**Function**
[?7n	Transmit time string through primary port.
[?8n	Transmit date string through primary port.
[P	Delete 1 character at cursor.
[*nn*P	Delete *nn* characters at cursor.
[p	Transmit currently displayed screen through primary port.
[0p	Transmit currently displayed screen through primary port.
[1p	Transmit line at cursor through primary port.
[2p	Transmit character at cursor through primary port.
[3p	Transmit line at cursor through peripheral port.
[4p	Transmit currently displayed screen to peripheral port.
[xx;yy;zz?s	Set the time (in 24-hour format: hours, minutes, seconds).
[xx;yy;zz?t	Set the date (month, day, year)
[s	Save cursor position.
[u	Restore cursor to saved position.
[>*nnn*u<text>EOT	Save text as message number *nnn* (EOT is a [Ctrl]-D).
[>255u	Erase all messages in message storage area.
[>*nnn* v<text>EOT	Append text to message *nnn* (EOT is a [Ctrl]-D).
[>*nnn* w	Display message *nnn* .
[>*nnn* x	Send message *nnn* to primary port.
[>*nnn* y	Send message *nnn* to peripheral port.
[z	Reset terminal to default settings.
[>z	Send back number of unused bytes remaining in memory for message storage.
[*nnn*]	Selects station number *nnn* (for multi-drop); *nnn* = 0 to 255, where 0 selects all stations. This is the ASCII version of the select command. The binary forms of the select command do not require a leading escape character: {05} {nnn} and {06} {nnn} are the binary select commands.

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Glossary

ASCII

This is pronounced “askee” and is an abbreviation for American Standard Code for Information Interchange. The IWS-110/120 Terminal uses the ASCII codes to represent characters. Pages A-1 and A-2 contain tables of the characters and their ASCII codes.

Carriage Return

A “carriage return” is a control character of ASCII code 13 that moves the cursor to the first column of the line. On most terminals, the [Enter] or [Return] key generates the ASCII code for a carriage return.

Host

The host is an intelligent device that receives keypresses from the terminal and sends characters to the terminal. Examples of hosts are personal computers and PLC ASCII BASIC modules. The Workstation connects to the host via its COM1 or COM2 port (whichever port is connected to the host is the “primary” port).

Line Feed

A “line feed” is a control character of ASCII code 10 that moves the cursor down one line. On most terminals, the combination of holding down the [Ctrl] key while pressing J generates the ASCII code for a line feed.

Peripheral Port

The host can use the Workstation as a port expander to talk to other devices via the Workstation’s other communications ports. The host can send a command to select any of the ports as the currently active “peripheral” port.

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Primary Port

The serial port connected to the host is the "primary port"; this port is usually COM1.

Terminal

Sometimes described as "dumb," a terminal performs no processing of data; it merely transmits keypresses to the host and displays characters received from the host.

Specifications

Processor

8052 microprocessor running at 11.0592 MHz

Memory

All units have a 64 Kbyte flash EPROM for firmware memory, of which 56 Kbytes are useable. Firmware is also mask-programmed into the ROM of the microprocessor and resides at the lowest 8 Kbytes of code space.

Units have either 32 Kbytes or 64 Kbytes of battery-backed RAM, of which the firmware uses 2.5 Kbytes.

Communications

COM1

RS-232/RS-422/RS-485, DIP-switch selectable; 25-pin male D-shell connector. RTS and CTS handshake lines are available on the RS-232 side only. Optical isolators provide 1500V isolation. Baud rates supported are 300, 600, 1200, 2400, 4800, 9600, and 19200. Data size can be 7 or 8 bits; the number of stop bits can be 1 or 2; and parity can be none, even, or odd.

COM1 does *not* support the combination of 7 data bits, no parity, and 1 stop bit. COM2 and COM3 do support that combination.

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COM2

Optional; same specifications as COM1

COM3

Optional; RS-232 only; not isolated; 9-pin male D-shell connector. Only RTS and CTS handshake lines are supported. Baud rates, data bits, stop bits, and parity options are the same as COM1.

LPT1

Centronics-compatible printer port; 25-pin female D-shell connector

I/O

Proprietary bus to drive I/O racks (part number CBL-D8); 25-pin male D-shell connector

Series 110 Display

Liquid crystal display (LCD) with LED backlighting

Size

4 lines x 20 characters/line; 3.0" wide x 1" high (76.2 mm x 25.4 mm)

Characters

5 x 8 dot matrix;
0.12" wide x 0.19" high (3.18 mm x 4.76 mm)

Dot size

0.022" x 0.022" (0.56 mm x 0.56 mm)

Life

LED backlighting degrades to about one-half brightness after 100,000 hours of use.

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Series 120 Display

Vacuum fluorescent display (VFD)

Size

4 lines x 20 characters/line; 3.6” wide x 1” high (90.4 mm x 25.4 mm)

Characters

5 x 7 dot matrix;
0.12” wide x 0.2” high (3.0 mm x 5.0 mm)

Dot size

0.016” x 0.020” (0.4 mm x 0.5 mm)

Life

Degrades to about one-half brightness after 40,000 hours of use; dots that remain on continuously for more than five hours a day degrade faster.

Keyboard

28 membrane keys; 16 keys have replaceable legends; stainless steel domes provide tactile feel with an actuation pressure of 15 oz. ±3 oz. and a key life of 2 million cycles; horn and LED provide audible and visible feedback.

LED Indicators

Run, *Alarm*, *Comm*, *Kbd*; Alarm is red, others are green

Service Power

90-250V, AC 50/60 Hz or DC; 12 watts;
optionally 24V ±15%, AC 50/60 Hz or DC

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Exposed Materials

Bezel: Fiberglass-filled LEXAN® covered with POLANE® T paint

Gasket: PORON® high-density cellular urethane

Keyboard: textured polyester with UV hardcoat

Dimensions

10.5” x 6.0” x 3.6” (26.6 cm x 15.2 cm x 9.1 cm); 7 pounds (3 kg).

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Ratings

Environment

	Rating	Specification
Operating Temperature	Series 110: 32°-122°F (0°-50°C) Series 120: 32°-131°F (0°-55°C)	IEC 68-2-1, Test Ad IEC 68-2-2, Test Bd
Storage Temperature	-40°F (-40°C) to 158°F (70°C)	IEC 68-2-1, Test Ab IEC 68-2-2, Test Bb
Operating Humidity	5 to 95% relative humidity, non-condensing	IEC 68-2-3, test Ca
Front Panel Seal	Water tight Dust-tight	NEMA 4/12 (IP 66)

Mechanical

	Rating	Specification
Operational Vibration	5–8 Hz, 0.8 inch 8–500 Hz, 3 G	IEC 68-2-6, Test Fc
Operational Shock	40 G, 9 msec	IEC 68-2-27, Test Ea
Packaged Drop	29.5” (75 cm)	NSTC Project 1A

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EMC

	Rating	Specification
Electrostatic Discharge	15 kV (I/O port pins excluded)	IEC 801-2, Level 4
High Frequency Transients	4 kV (power), 2 kV (I/O) 5x50 nsec, 2.5 kHz repetition rate, 15 msec burst duration, 300 msec burst period	IEC 801-4, Level 4
RF Susceptibility	10 V/M, 27–1000 MHz	IEC 801-3, Level 3
Conducted/Radiated Emissions		FCC Part 15, Class A; EN 55022, Class B
EU	EU EMC Directive 89/336/EEC	CE Mark

Safety Compliance

	Specification	Description
Underwriter's Laboratories	UL 1604	Class I, Division 2, hazardous locations, Groups A, B, C, D, T6
Canadian Standards Association	CSA 22.2, #142 CSA 22.2, #213	Process Control Equipment Class I, Division 2, hazardous locations
EU	EU LVD Directive 73/23/EEC	CE Mark

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Appendix B

EU EMC Directive 89/336/EEC Declaration of Conformity

Nematron Corporation hereby acknowledges that compliance testing for the Series 100 Workstations in accordance with all applicable standards of the EU's EMC Directive 89/336/EEC was successfully completed, as specified in the *Declaration of Conformity* on the following page.

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