

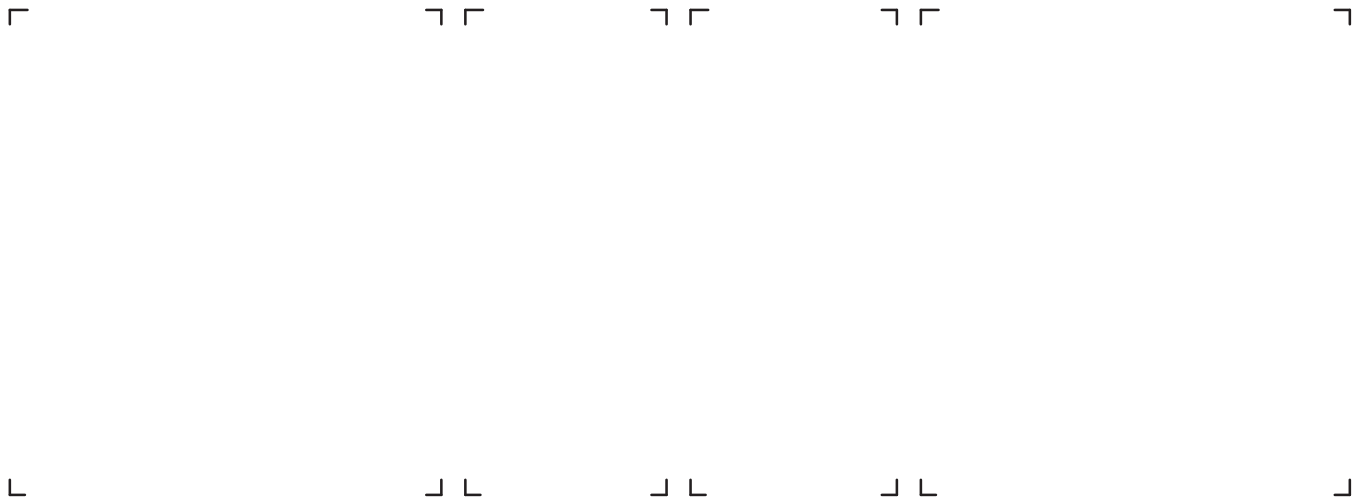


Allen-Bradley

IMC 121 Servo Control System

(Cat. No. 1771-HS1)

System Overview



The Allen-Bradley IMC 121 Servo Control System is high-performance “Servo control in a module” with a programmable analog output. The IMC 121 also uses a high-level motion management language(MML) and features single slot addressing on the PLC.

Single-Axis closed loop Programming with an additional Analog Output.

You can arrange an IMC 121 motion control module to control analog machines. The IMC 121 can be used in a variety of applications, including:

- automated assembly
- PC board drilling
- material handling
- grinding

Offline Development System. The IMC 121 works with an offline development system (ODS) that uses IBM XT/AT compatible personal computers. The longline option lets ODS communicate with the motion controller module up to 1200 cable feet (393 m) away.

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Benefits

Uses a powerful high level motion management language (MML). With MML, a utility of ODS, you can:

- perform arithmetic and logical operations on variables
- program your own routines and functions

As a part of ODS, MML:

- uses pull down windows and dialogue boxes that ease programming .
- features online help that assists you through all the operations

Has single slot addressing. Your response times are greatly increased at all levels, allowing you to send commands and receive feedback faster than was possible on earlier controls.

Features a programmable analog output. The IMC 121 allows you to keep any analog devices you have to stay in operation.

Capable of direct handheld software interface. The handheld pendant lets you operate, test, and troubleshoot your system on the plant floor. It lets you perform the following menu-driven functions:

- debug MML programs
- jog the axis
- teach motion paths
- modify certain adjustable machine parameters (AMP)

The longline option gives your handheld pendant or ODS terminal communication with the IMC 121 motion controller from up to 1200 feet (393 m) away.

Resides in compatible Series B 1771 I/O chassis. The IMC 121 is compatible with a variety of Allen-Bradley programmable controllers, I/O adapters, drives, and various feedback devices.

Compatible with resolver and encoder feedback systems. The IMC 121 provides feedback channels for either resolver or encoder feedback systems. In resolver systems the IMC 121 allows for dual resolvers (master/vernier). It also offers separate termination panels for encoders, resolvers and Temposonic linear transducers.

Contents

The table below illustrates the order in which the features and functions of the IMC 121 are presented in this publication.

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System Configurations

There are several ways you can configure your IMC 121 System. This section discusses communication and feedback configurations.

Communication Overview

Depending on your application, you can choose from several communication configurations for use with the IMC 121.

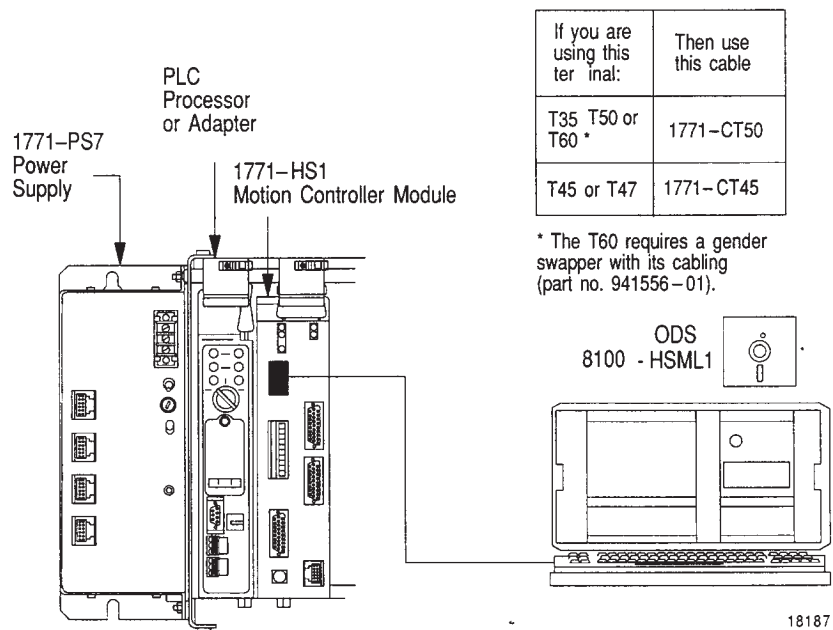
Using ODS with the Motion Controller Module

Your ODS terminal can be any of the following:

- Allen-Bradley T35, T45, T47, T50, or T60 industrial terminals
- IBM XT/AT compatible personal computers

The ODS terminal is connected to the RS-232 connector on the motion controller module as shown in Figure 1.

Figure 1
Using ODS with the Motion Controller Module

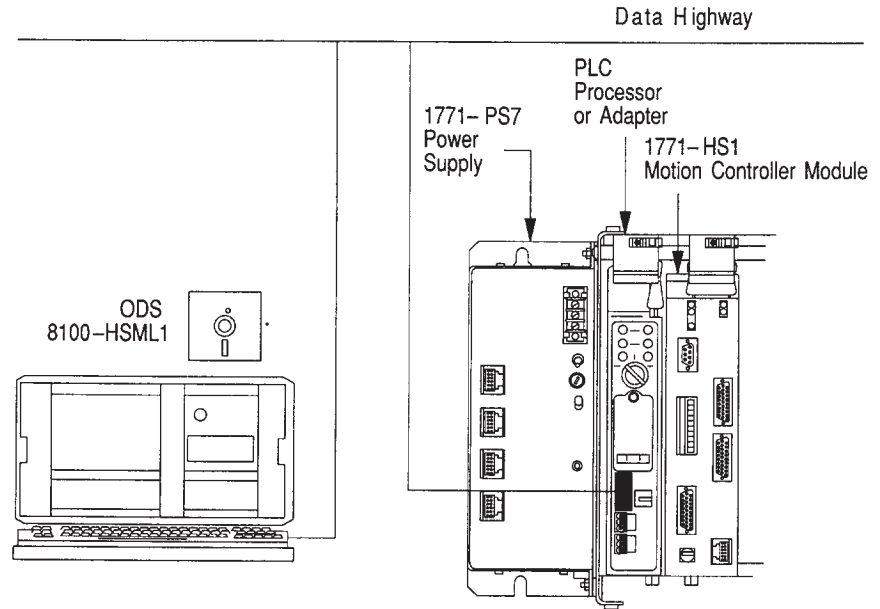


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Using ODS on Data Highway Plus

You can use this configuration to upload and download your MML parameters and AMP files. Do this through any ODS terminal that is linked to your Data Highway Plus communication line as shown in Figure 2.

Figure 2
ODS Using Data Highway Plus

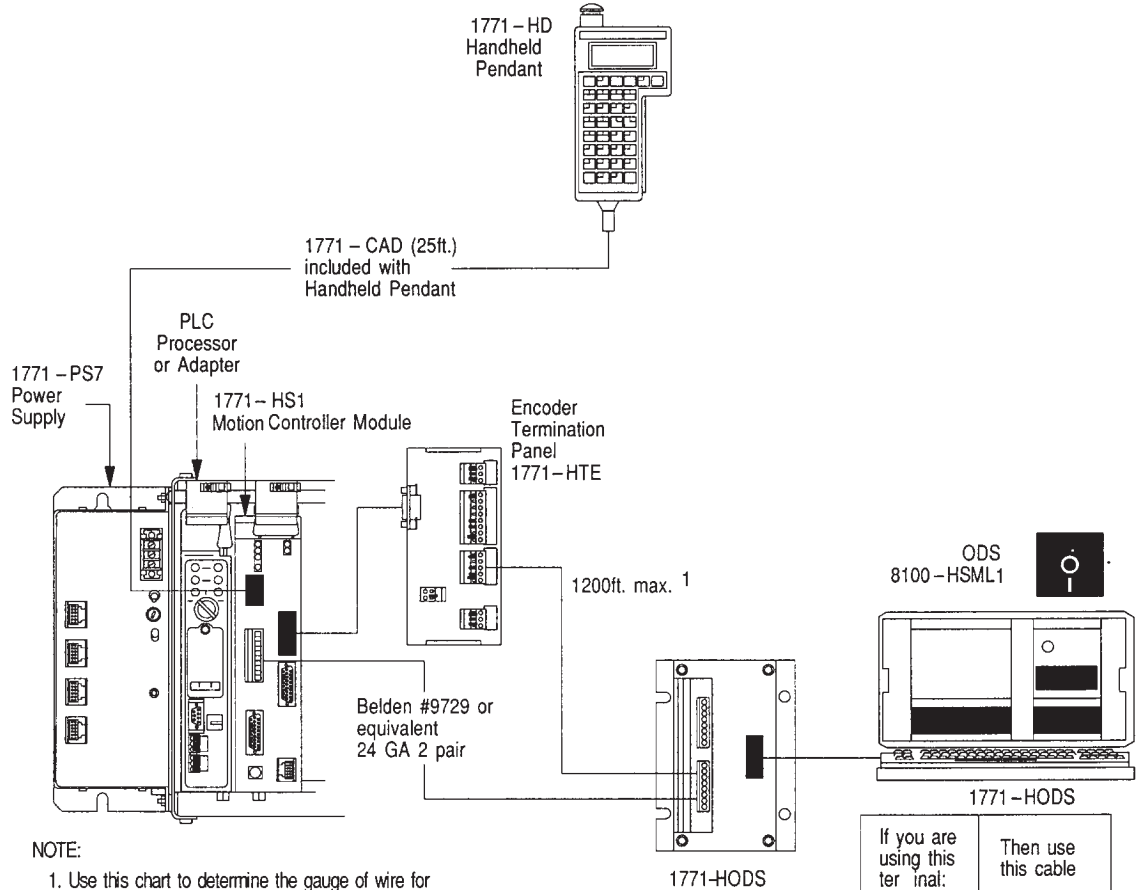


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Using ODS with the 1771-HODS Panel

This configuration lets you connect both the handheld pendant and your ODS terminal to the motion controller module. You can extend the handheld pendant up to 25 cable feet (8 m) from the RS-232 port on the servo controller module. The ODS terminal can be placed up to 1200 cable feet (393 m) from the RS-422 (comm) connector on the motion controller module as shown in Figure 3.

Figure 3
Using ODS with the Longline Option



NOTE:

1. Use this chart to determine the gauge of wire for your required distance. Loop resistance between the termination panel and the 1771-HODS cannot exceed 4.9 ohms.

Belden #	Max Distance	Wire gauge
8719	1200 ft.	12 AWG
	800 ft.	14 AWG
	500 ft.	16 AWG
	300 ft.	18 AWG
	200 ft.	20 AWG
	75 ft.	24 AWG

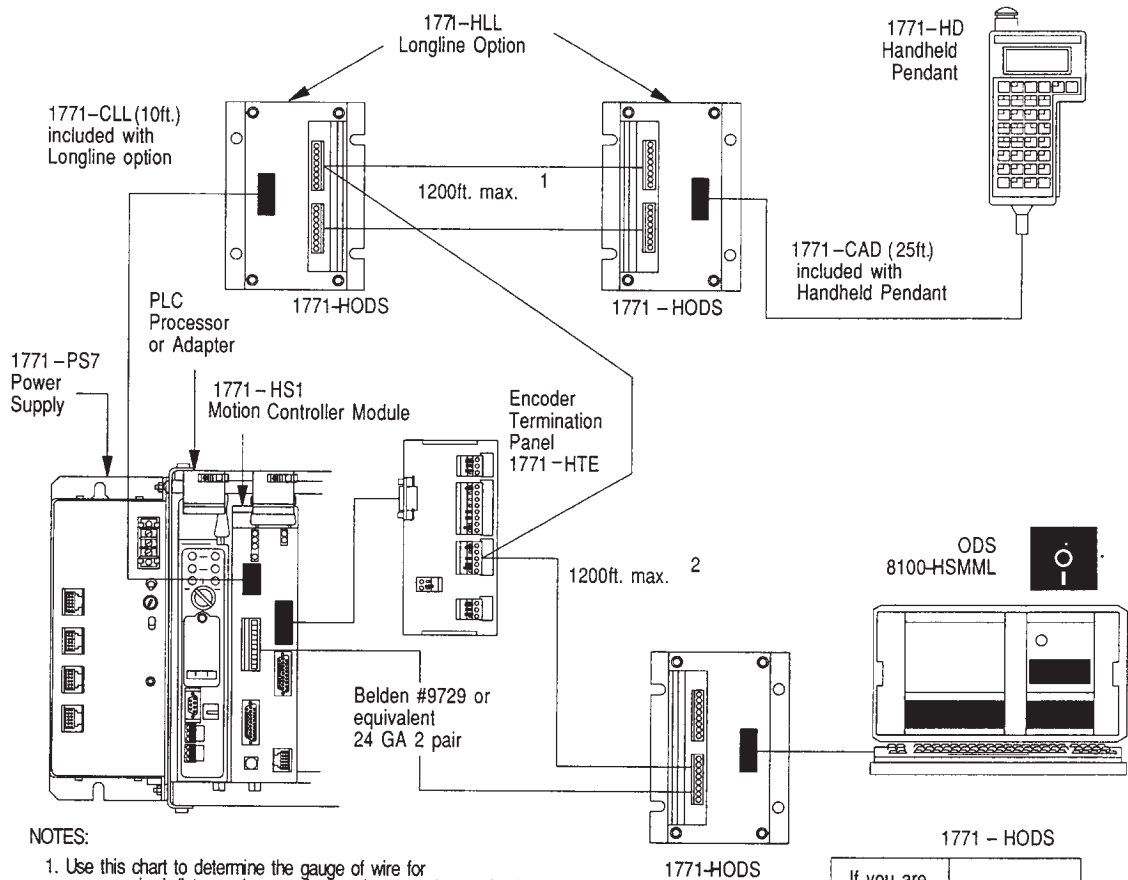
If you are using this terminal:	Then use this cable
T35 T50 or T60 *	1771-CT50
T45 or T47	1771-CT45

* The T60 requires a gender swapper with its cabling (part no. 941556-01).

Using the Handheld Pendant with the Longline Option and ODS with the 1771-HODS Panel

The longline option lets you connect either the handheld pendant and ODS up to 1200 cable feet (393 m) away from the motion controller module. In the configuration shown in Figure 4, the 1771-HODS panel is used to extend the ODS terminal up to 1200 feet from the RS422 (comm) connector. The longline option (1771-HLL) is used to extend the handheld pendant up to 1200 feet from the R5232 port as shown in Figure 4.

**Figure 4
Using the 1771-HODS Panel with the Longline Option**



NOTES:

1. Use this chart to determine the gauge of wire for your required distance. Loop resistance between the termination panel and the second 1771-HODS cannot exceed 4.9 ohms.

Belden #	Max Distance	Wire gauge
8719	1200 f	12 AWG
	800 f	14 AWG
	500 f	16 AWG
	300 f	18 AWG
	200 f	20 AWG
	75 f	24 AWG

2. Loop resistance between the termination panel and the 1771-HODS cannot exceed 4.9 ohms.

1771-HODS	
If you are using this terminal:	Then use this cable
T35 T50 or T60 *	1771-CT50
T45 or T47	1771-CT45

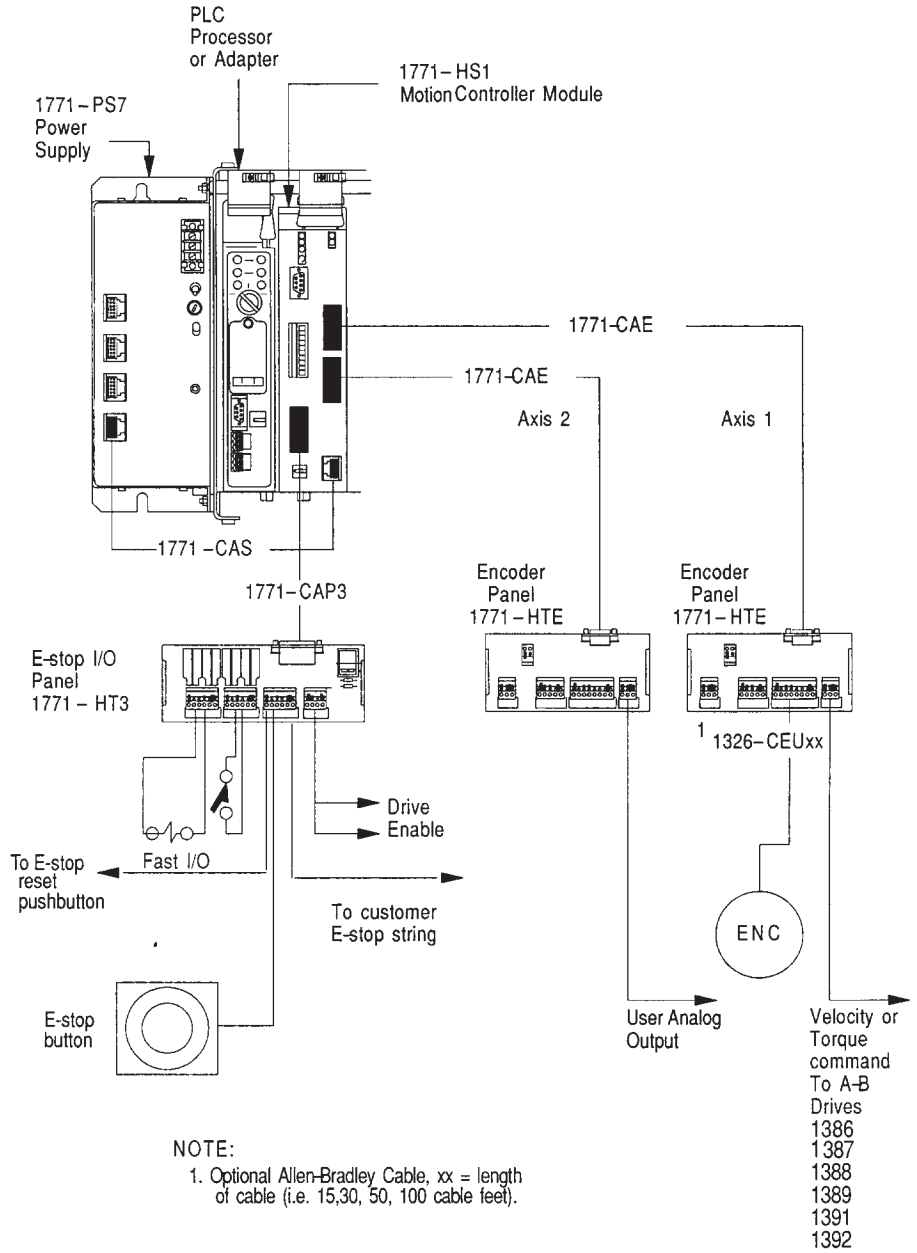
The T60 requires a gender swapper with its cabling (part no. 941556-01).

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Using Encoders

Figure 5 shows an IMC 121 motion controller module monitoring encoder feedback from an axis.

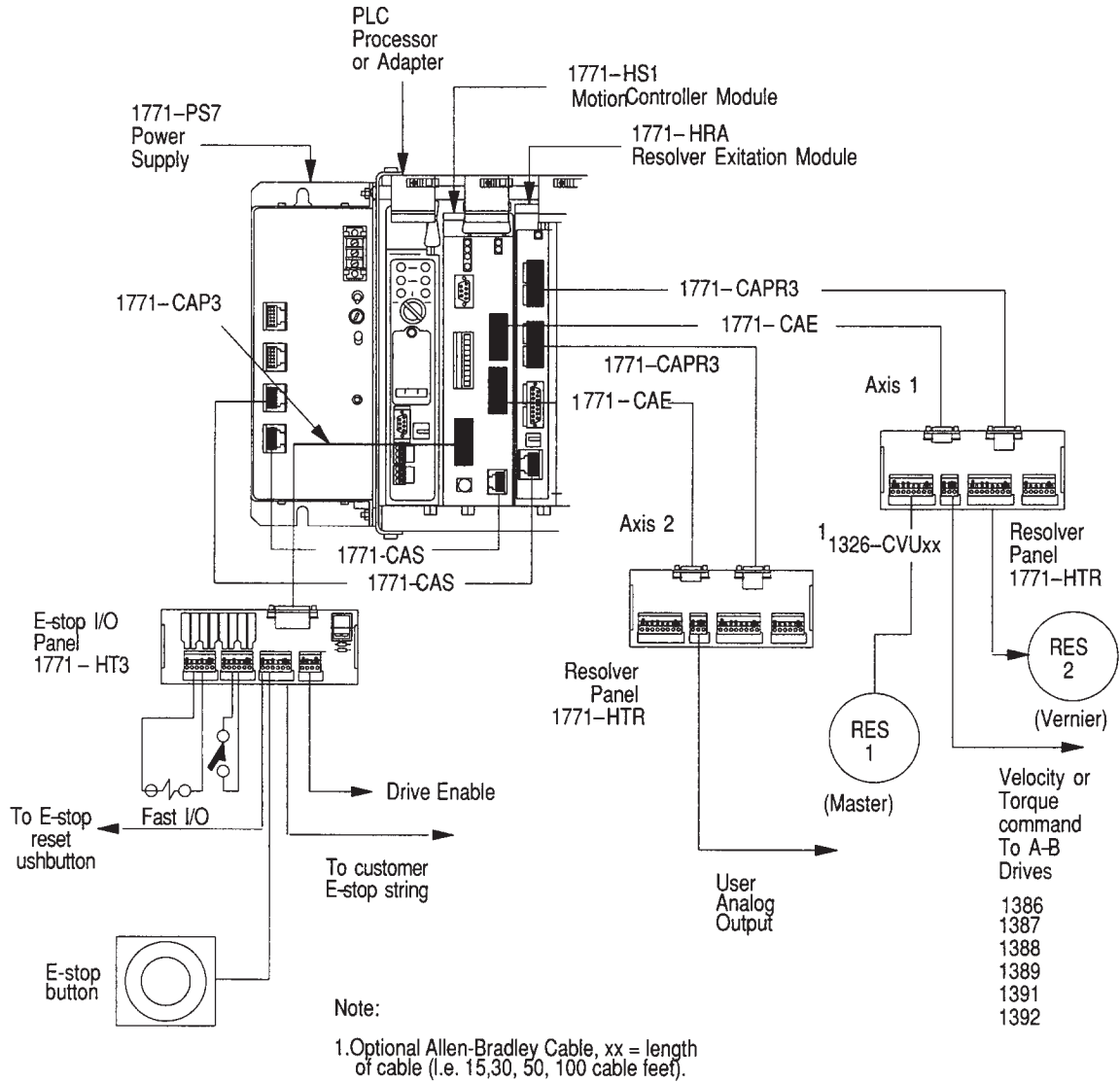
Figure 5
An Encoder Feedback System Configuration



Using Resolvers

Figure 6 shows an IMC 121 module monitoring single and dual resolver (master/vernier) feedback, and a resolver excitation module providing stator excitation.

Figure 6
A Resolver Feedback System configuration



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IMC 121 Motion Control System Components

This section discusses the software and hardware components of the IMC 121 System.

Offline Development System Software (cat. no. 8100-HSML1)

Offline Development System (ODS) software uses an IBM PC XT/AT compatible personal computer to create, edit and document:

- Adjustable Machine Parameters (AMP)
- Motion Management Language (MML) programs

By connecting your personal computer to the RS232 port or the RS422 (comm) connector of the IMC 121 motion controller module, you can download AMP and MML files to the module. You can also upload AMP and MML from the module to your personal computer and edit global variables in MML.

The main features of ODS software include:

- pull down menus for easy access to options
- help system with complete information about the operation you are performing at every step
- access to DOS partition during use of ODS
- file management feature lets you copy, rename and delete one or all MML files stored in memory
- available on 5 1/4 and 3 1/2 inch diskettes

Motion Management Language

With MML you can:

- program axis motion (linear and rotary)
- choose from two methods of accel/decel: rectangular and trapezoidal
- program acceleration and “jerk” (the rate of change of acceleration) with AMP defined parameters for the trapezoidal method of accel/decel. The same profile is used for both acceleration and deceleration.

Syntax Directed Editor

The syntax directed editor (S DE) helps you create and edit MML programs. The SDE is well-suited for beginning programmers or those who program infrequently.

IMC 121 Motion Controller Module (cat. no. 1771-HS1)

- This module, shown in Figure 8, is the focal point of the IMC 121 Motion Control System. Each motion controller module:
 - monitors feedback on an axis
 - monitors absolute position at any time after initial power-up and homing
 - provides 4 fast outputs and monitors 4 fast inputs directly on the module
 - stores application programs and configuration data on a removable memory cartridge
 - uses discrete and block transfer to communicate with:
 - compatible Allen-Bradley PLCs and remote I/O adapters through the 1771 backplane
 - handheld pendant
 - IBM-compatible personal computers

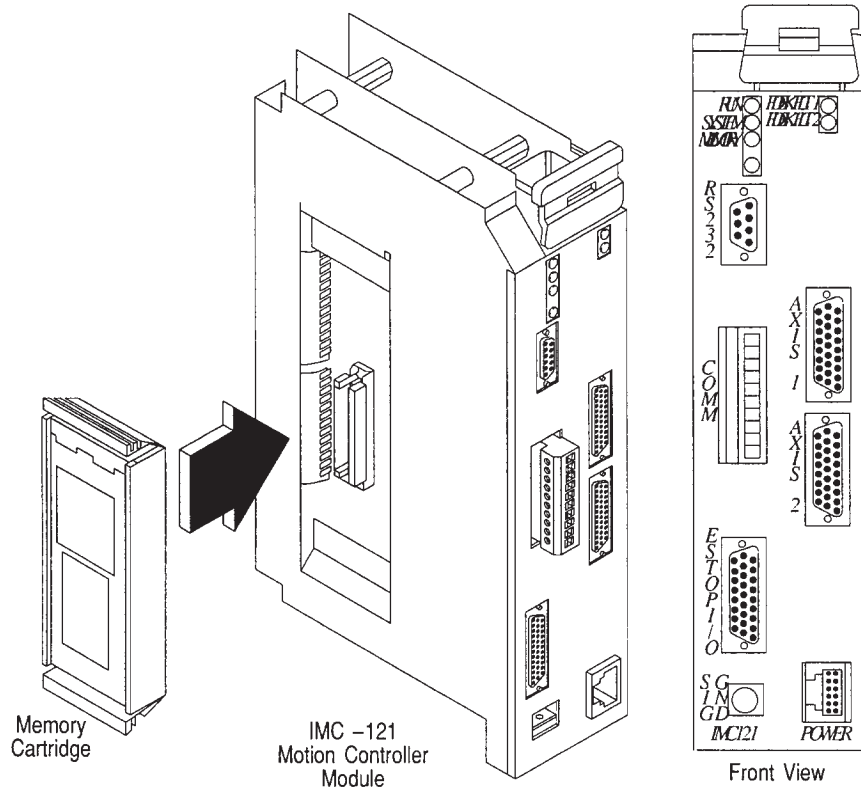
IMC 121 Memory Cartridge (cat. no. 1771 -HM3A)

The IMC 121 motion controller module includes a CMOS memory cartridge that provides user memory for the system. The memory cartridge, shown in Figure 8:

- stores system configurations, MML programs, and AMP parameters
- lets you transport programs and configuration information to a replacement motion control module if one should happen to malfunction
- is available in 128Kb (64 Kword)
- includes a removable lithium battery for back-up purposes

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Figure 8
IMC 121 Motion Controller Module (cat. no.1771-HS1) with Portable
Memory Cartridge (cat. no. 1771-HM3A)



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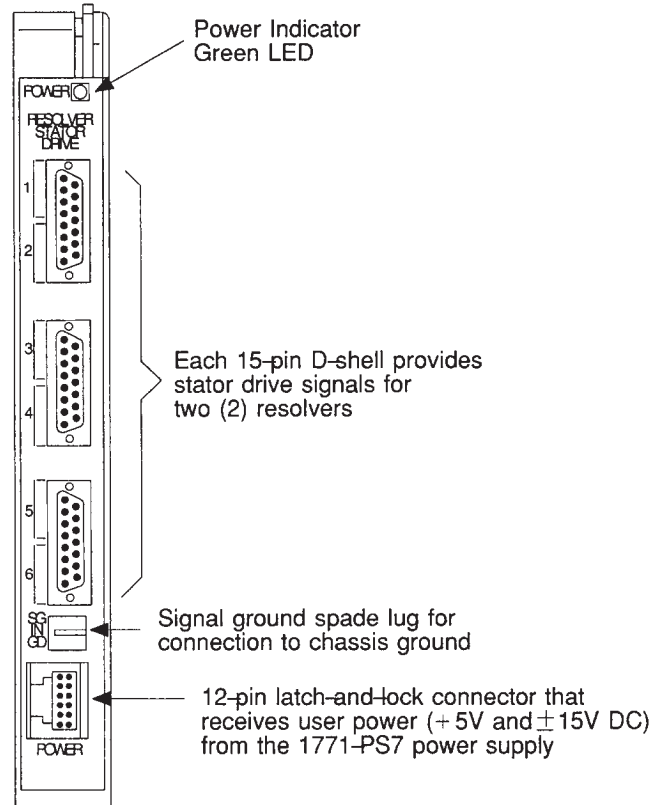
Resolved Excitation Module (cat. no. 1771-HRA)

The resolver excitation module shown in Figure 9 generates sinusoidal signals that excite the stators of resolver feedback devices in your application. These sinusoids are in quadrature (sin/cos) and are precisely controlled in phase, amplitude (7V RMS) and frequency (2.5KHz).

The resolver excitation module uses power output amplifiers to drive stator windings of 1 to 6 receiver type (stator primary) resolvers. The rotor feedback from these resolvers must go to the motion controller module residing in the same chassis with the resolver excitation module.

The resolver excitation module (cat. no. 1771 -HRA) is also compatible with IMC 120 motion controller modules as well as IMC 123 motion controller modules.

Figure 9
IMC 123 Resolver Excitation Module (cat. no 1771-HRA)



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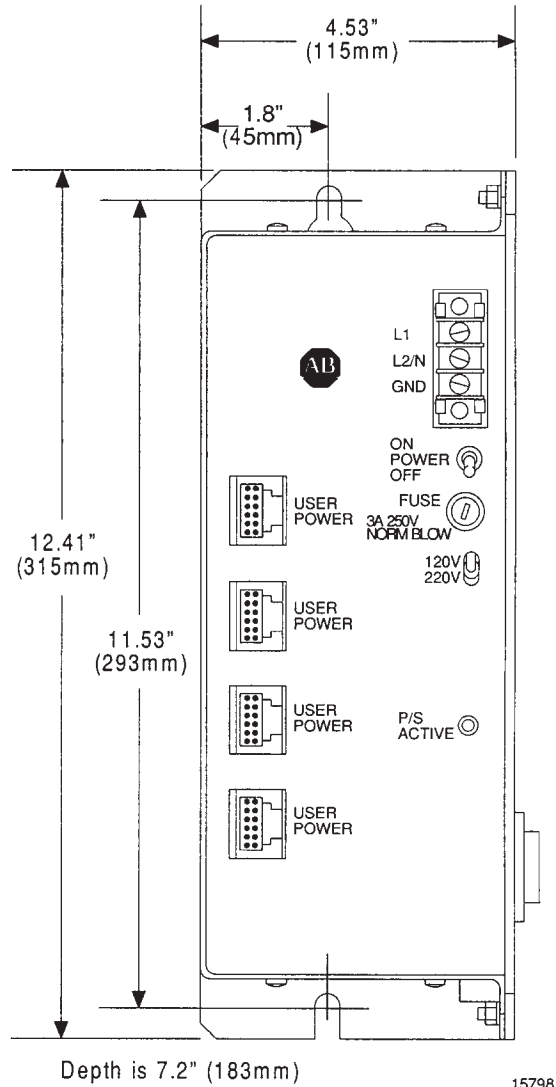
1771-PS7 Power Supply

The 1771-PS7 power supply, shown in Figure 10, can supply 65W of power to the user side and 80W to the backplane. However, the total power drawn by your system cannot exceed 100W. The 1771-PS7 power supply mounts to these chassis through a mating connector:

- 1771-A1B – 4 slot chassis
- 1771-A2B – 8 slot chassis
- 1771-A4B – 16 slot chassis

You can use the 1771-A3B (12 slot) chassis if a 1771-PSCC power cable is used to connect the chassis. The only way to connect a 1771-PS7 to a 1771-A3B is with a cable. The connector is on the top of the A3B rack.

Figure 10
1771-PS7 Power Supply



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Handheld Pendant (cat. no. 1771-HD)

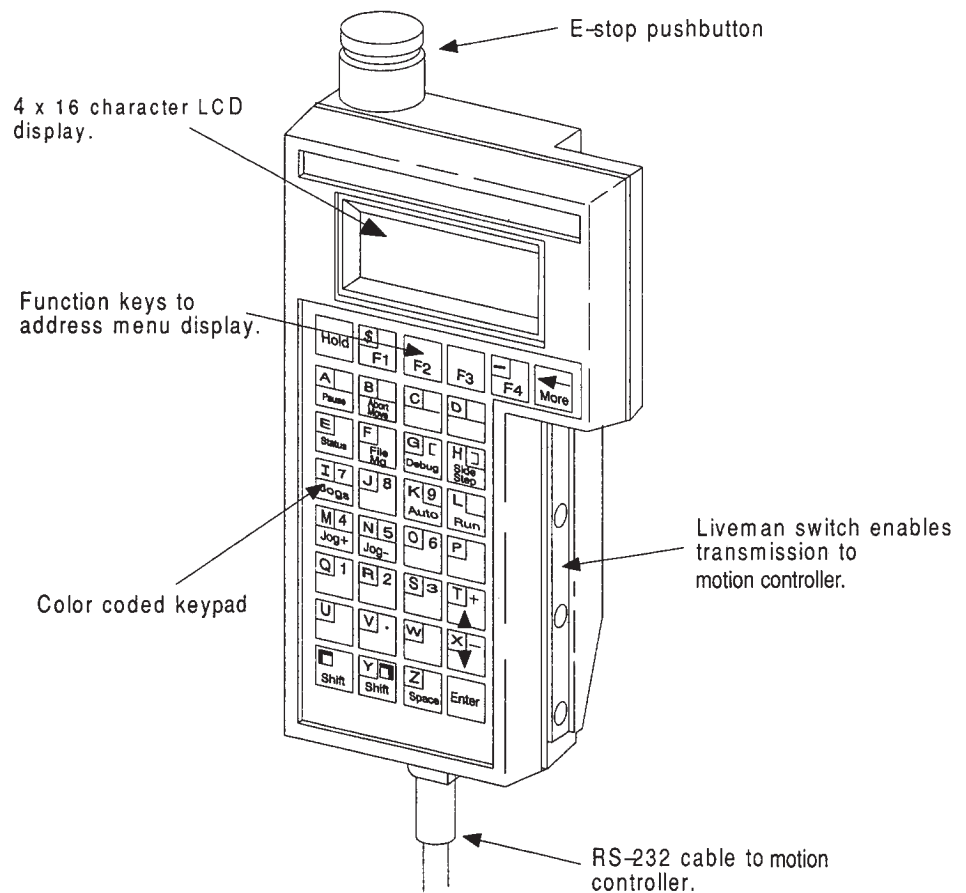
The handheld pendant, shown in Figure 11, is a portable, menu-driven, operator interface for IMC 121 motion control modules. It is compatible with IMC 120 and IMC 123 systems. The handheld pendant connects directly to the RS 232 port of the IMC 121.

When connected through the longline option (cat. no. 1771 -HLL) the handheld pendant can communicate up to 1200 cable feet (393 m) from the motion controller module.

The pendant lets you perform the following menu driven functions:

- invert velocity command and position feedback during integration .
- debug an MML program with dry run, single step, and feedrate override functions. You can also teach, display and modify variables and paths .
- jog the axis by incremental distances or continuously in any direction .
- use the file manager functions to display the size, number and name of stored MML programs, and select, copy, delete or rename programs
- modify and initialize system variables and parameters . use the E-Stop button on the handheld pendant to cause an emergency stop.

Figure 11
IMC 121 Handheld Pendant (cat. no 1771-HD)



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Termination Panels (cat. no. 1771-HT3, -HTE, -HTT, HTR)

To give you more flexibility in installing your motion control system, the IMC 121 features four termination panels shown in Figures 12-15. Each panel can be wall-mounted or mounted on DIN-type railing. The system offers these panels:

- E-Stop and I/O – consists of connections for 4 fast inputs and 4 fast outputs, customer E-Stop string, and E-stop reset pushbutton. LEDs show status of each I/O point
- Encoder – supports one axis and additional external power for encoders
- Temposonic – supports Temposonic linear displacement transducer
- Resolver – supports one axis in both single and dual resolver configurations and 5 power for 1771-HODS long line option and $\pm 15V$ for linear scales

All panels feature pluggable connections.

- 1771-OF (4 single-ended analog inputs) when combined with expander output module, 1771-E4
- 1771-IX (6 floating differential thermocouple inputs)
- 1771-IY (6 floating differential input expander)

The resolver excitation module (cat. no. 1771-HRA) is compatible with the IMC 120 Servo Control System and the IMC 123 Motion Control System. However, the IMC 120 resolver excitation module (cat. no. 1771-HR) is not compatible with the IMC 121 Motion Control System nor the IMC 123 Motion Control System.

Product Features

The product features given in this data sheet were current as of the date of this publication. Allen-Bradley reserves the right to revise these features without prior notice. Contact your Allen-Bradley sales representative for the most current information.

Axis Control

Feature:	Description:
Axis Type	Programmable analog I/O Linear, or rotary Rotary axis with rollover programmed in degrees or revolutions Dual resolver (master/vernier) absolute feedback supported Incremental encoder or resolver feedback supported (no mix on same module) Temposonics feedback devices supported
Accerlation and Deceleration	Rectangular and trapezoidal (selectable) Programmable acceleration Programmable jerk (rate of change of acceleration) for positioning moves
Probing	Use of trigger probe

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121 Offline Development Software (cat. no. 8100-HSML1)

Compatible Computers:

- Allen-Bradley T35, T45, T47 or T50 Industrial Terminals
- Allen-Bradley Series 6120, 6121, and 6122 Industrial Computers
- IBM PC XT/AT or 100% compatible

Requirements:

- 640K bytes RAM
- 10 or 20M byte hard disk
- 1 serial port for connection to motion controller, and one parallel port for printer
- Monochrome or color monitor
- MS-DOS or PC-DOS version 2.1 to 4.01

Use:

- Create, edit, document, compile, MML programs
- Download/upload AMP and MML files to/from motion controller
- Context sensitive help provides instructions and information at each step of use
- Backup/restore project files with floppy diskette
- Access DOS partition without exiting ODS

Adjustable Machine Parameters (AMP):

Selectable Features:	Programmable Features:
units for display and entry of parameter values – feet, inches, meters, cm, mm, degrees or revolutions, seconds or minutes	linear or rotary axis
standard or velocity feed forward motion loop closure	rollover position
source of home limit switch – fast I/O, PLC, or not required	software overtravel limits
	reversal error compensation
	coarse and fine in-position tolerances
	maximum loop gain
	axis following error loop limit
	home position value
	home calibration position

Feature:	Description:
Maximum motion velocity	<p>Maximum servo vel. (ipm) = $\frac{1.5 \times 10^8}{P}$ x (servo resolution)</p> <p>Example: A 2 pole resolver is connected to a 5 revs/inch ball screw What is the maximum motion velocity?</p> <p>$\frac{1.5 \times 10^8}{P} \times (50 \times 10^{-6}) = 3,750 \text{ rpm}$</p>
What is the motion resolution? 2 pole = 1 electrical cycle/rev	

Emergency Stop Characteristics:

Feature:	Description:
Detection and Control of E-Stop Conditions Provided on-Board	
Each module provides separate and independent E-Stop circuit	
Hardware E-Stop activated by:	<p>customer defined E-Stop circuit (Refer to the IMC 121 Installation Manual, publication 1771-6.2.4)</p> <p>pushbutton on 1771-HD handheld pendant</p> <p>broken wire in the user power supply cable (1771-CAS)</p> <p>powerfail signal (from 1771 backplane)</p>
Software E-Stop activated by:	<p>watchdog timeout</p> <p>quadrature error detection</p> <p>broken feedback wire detection</p> <p>excess motion following error</p> <p>Software E-Stop can only be released if no hardware faults are present</p>
E-Stop Relay Contacts Specifications	<p>Switching volts – 40V dc (max)</p> <p>Operate Time – 500us (typ)</p> <p>Contact Bounce –t 200us (typ)</p> <p>Contact Resistance – 150 milliohms (typ)</p> <p>Resistive Contact Rating – 4VA at 0.25A (max)</p>

General Local Fast Output (Source Drivers):

Feature:	Description:
4 fast outputs	+24V dc designed for compatibility with 1771 -PS7
Output short circuit protection	detection of overcurrent of +24V (4 outputs × 100mA steady state) If short detected (600mA, min) then shutdown after short circuit trip delay (110 usec, typ). Recovery by removing short and cycling power
High level on state voltage	19V (min) 23V (typical) 27V (max)
High level on state current	100mA (max)
Offstate leakage current (output shorted to GND)	200us (max)
Short circuit trip current (each output)	600mA (min) 760mA (typical) 964mA (max)
Short circuit trip delay	65us (min) 110us (typical) 200us (max)
Surge current (each output)	150mA for 0.5s max

General Purpose Local Fast Inputs:

Feature:	Description:
Number of Fast Inputs	4 (24Vdc)
User Programmable Inputs for Touch Probe	1 possible
Low-High Trip Threshold	16.1V dc (max) 11.5V dc (typical) 7.2V dc (min)
High-Low Trip Threshold	11.4V Ddc(max) 7.4V dc (typical) 4.0V dc (min)
V _{HYST}	6.5V (max) 4.1V (typical) 1.9V (min)
Low-High Debounce Filter	178us (max) 100us (typical) 63us (min)
High-Low Debounce Filter	178us (max) 100us (typical) 57us (min)
Input Voltage	± 75V (absolute max)
Input Current (at 27V)	0.5mA (max)

Environmental Specifications:

Feature:	Description:
Operating Temperature	0 to 605C (32 to 1405F) inlet air temperature
Storage Temperature	-40 to 855C (-40 to 1855F)
Operating Altitude	up to 6562 ft (2000 m)
Operating Humidity	5 to 95%, non-condensing

PLC Communications:

- Block and Single Transfer In Double Density Environment – single slot addressing
- IMC 121 sends status info to PLC once each I/O scan
- PLC can:
 - incrementally or continuously jog axes
 - home axes
 - cause quick retract and E-Stop
 - select auto or manual operation
 - request single step execution
 - override feedrate – provide offset information
 - pass integer and real data

RS-232 Port:

- 9 pin D-shell
- Interfaces with handheld pendant and offline development terminal

Communication Connector:

- 10 screw connectors
- Interfaces with ODS terminal up to 1200 ft (393 m)
- Baud rate – 2400 baud . Maximum cable length – 50ft (16m), or 1200ft (393 m) with the longline option

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