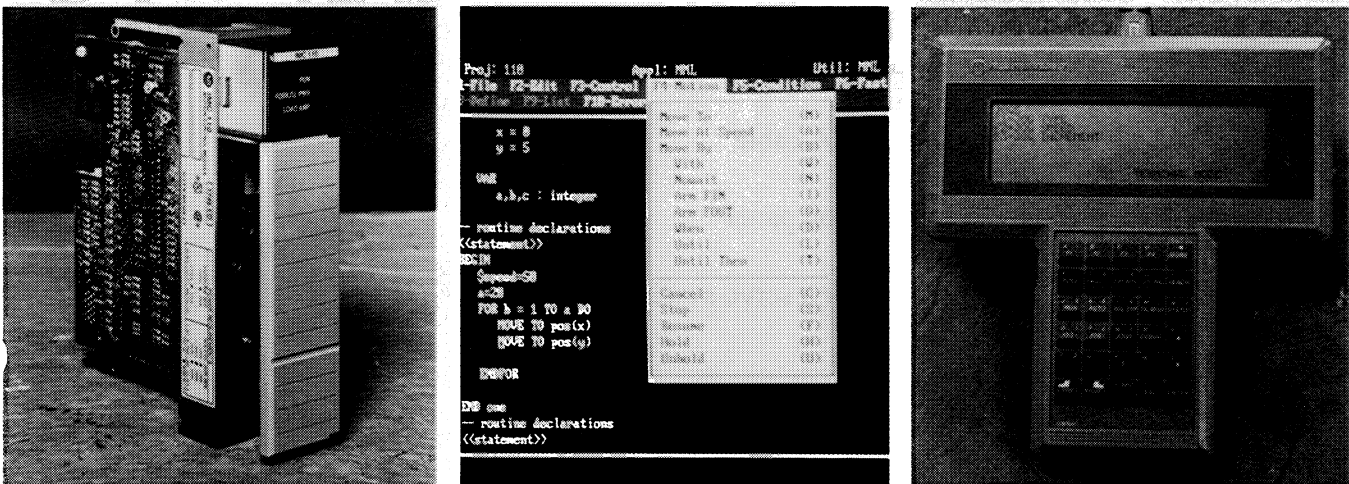




IMC 110 Motion Control System (Cat. No. 1746-HS)

System Overview



Provides a motion control system that works with SLC products.

The IMC 110 motion control system is compatible with all SLC 500 racks, modular or fixed. Also, you can convert the SLC 500 handheld terminal to work with motion programs. You enter a command sequence that puts the terminal into IMC 110 mode. Once in IMC 110 mode, the terminal becomes a handheld pendant and can be used (with a special keyboard overlay) to monitor and debug IMC 110 motion programs.

Uses a powerful high-level motion management language (MML). MML is the program language of the IMC 110 system. When you use MML, the Syntax-Directed Editor (SDE) uses pull-down menus and dialogue boxes that simplify programming. SDE also provides online help to assist you through the programming operations.

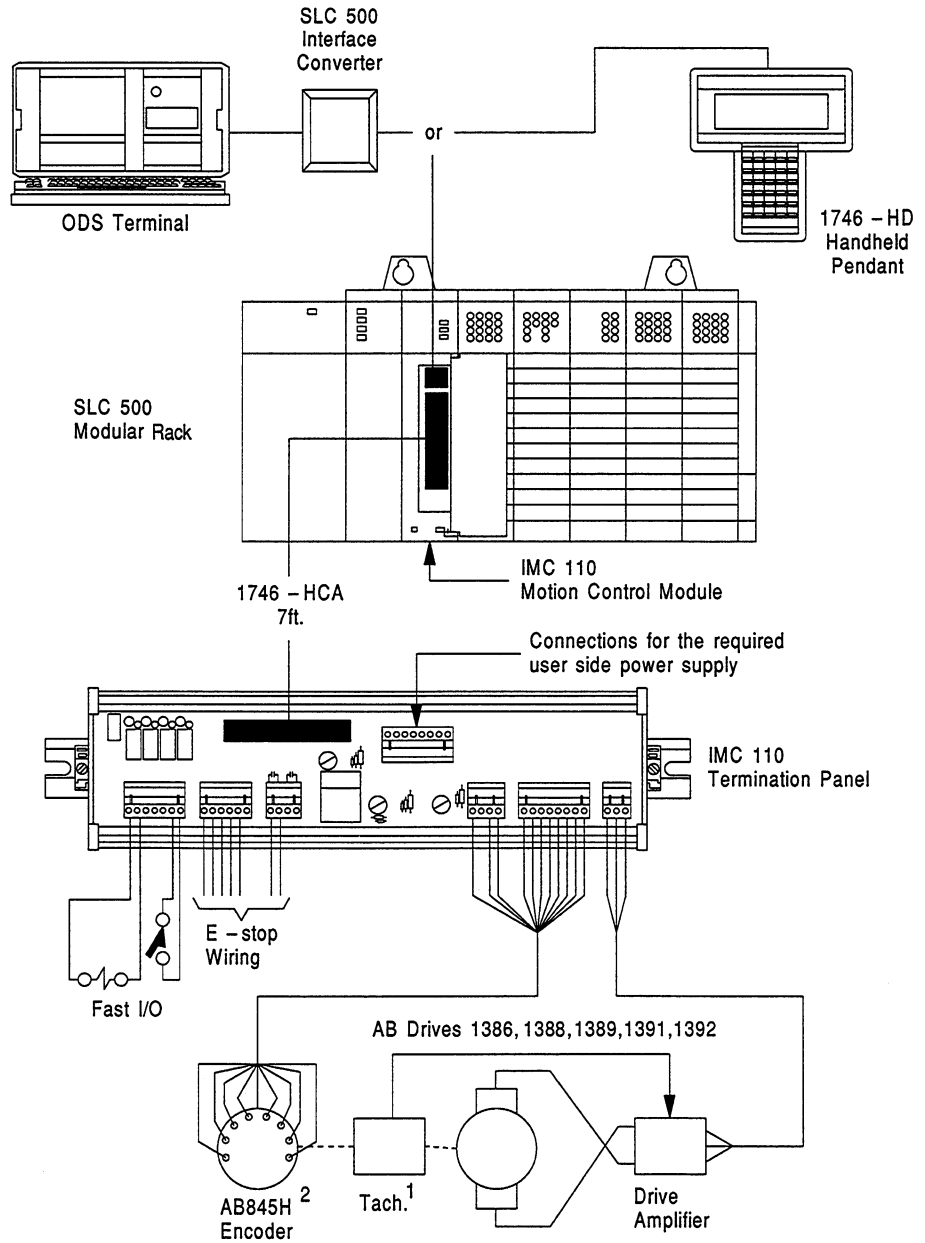
Uses one system to specify parameters and develop programs. The Offline Development System (ODS) creates, edits and documents MML programs and Adjustable Machine Parameters (AMP). AMP includes variables that let you customize a program for a particular application.

Typical IMC 110 Configuration

Figure 1 shows a typical IMC 110 configuration. This configuration includes:

- T50 terminal with ODS installed
- SLC 500 interface converter
- SLC 500 handheld terminal configured for IMC 110 operation (handheld pendant)
- SLC 500 modular rack
- IMC 110 motion control module
- 1746-HCA cable
- termination panel
- wiring for a servo system

Figure 1
Typical IMC 110 Configuration



NOTES:

- 1 AC drives do not require tachometer.
- 2 When supplying the +5V encoder with an external power supply, connect the return line from the power supply to the encoder power on the termination panel.

Components of the IMC 110 System

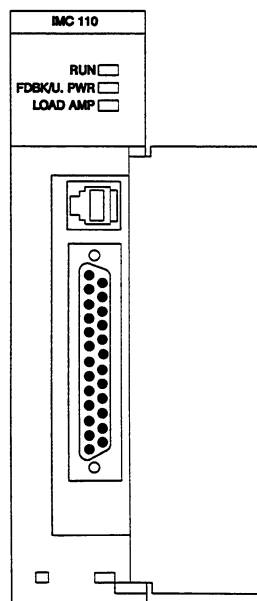
This section describes the components of the IMC 110 system.

IMC 110 Motion Control Module

The motion control module, shown in Figure 2, is the focal point of the IMC 110 system. The motion control module:

- monitors encoder feedback on one channel up to 300 kHz at 0° quadrature
- monitors position and following error at any time after initial power-up and homing
- provides one fast output
- monitors three fast inputs
- uses discrete transfer to communicate with compatible Allen-Bradley SLC 500 system components through the backplane of the SLC 500
- uses the RS-485 connector to communicate with:
 - handheld pendant
 - ODS terminal

Figure 2
IMC 110 Motion Control Module with Door Open



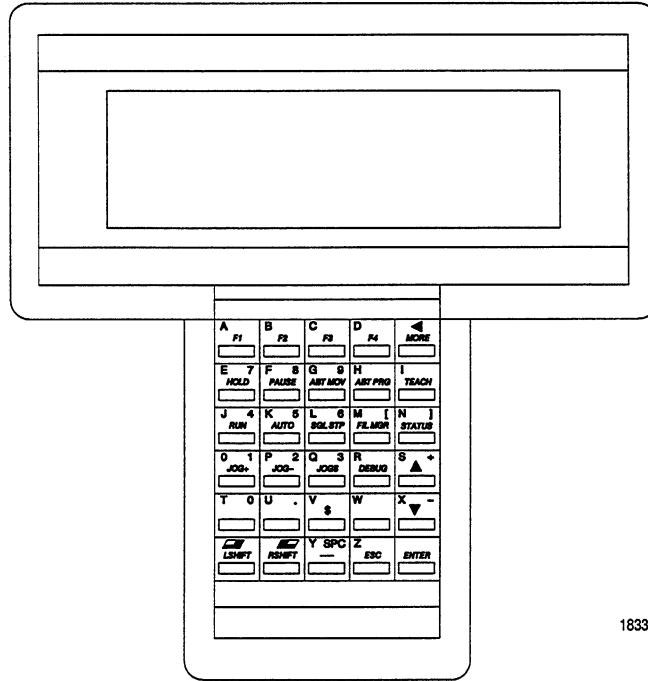
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IMC 110 Handheld Pendant

The handheld pendant, shown in Figure 3, is the same handheld terminal as used with the SLC 500 programmable controller. The handheld terminal includes a 2 m (6 ft.) cable that connects to the RS-485 port of the control module or the SLC 500 CPU. You enter a command sequence to convert the terminal to IMC 110 mode. Then you place an IMC 110 overlay over the keyboard. Once the terminal is in IMC 110 mode, it is referred to as the handheld pendant. The pendant:

- debugs a MML program with the following functions: dry run, set a breakpoint, and modify a variable
- initializes and modifies system variables
- jogs the axis by incremental distances or continuous movement in both directions (positive or negative)
- uses the file manager to display the size, number, and name of stored MML programs, and select, copy, delete or rename programs
- monitors status, motion, machine position, mode, and jog type
- displays errors in the hardware and software
- teaches positions

Figure 3
 IMC 110 Handheld Pendant



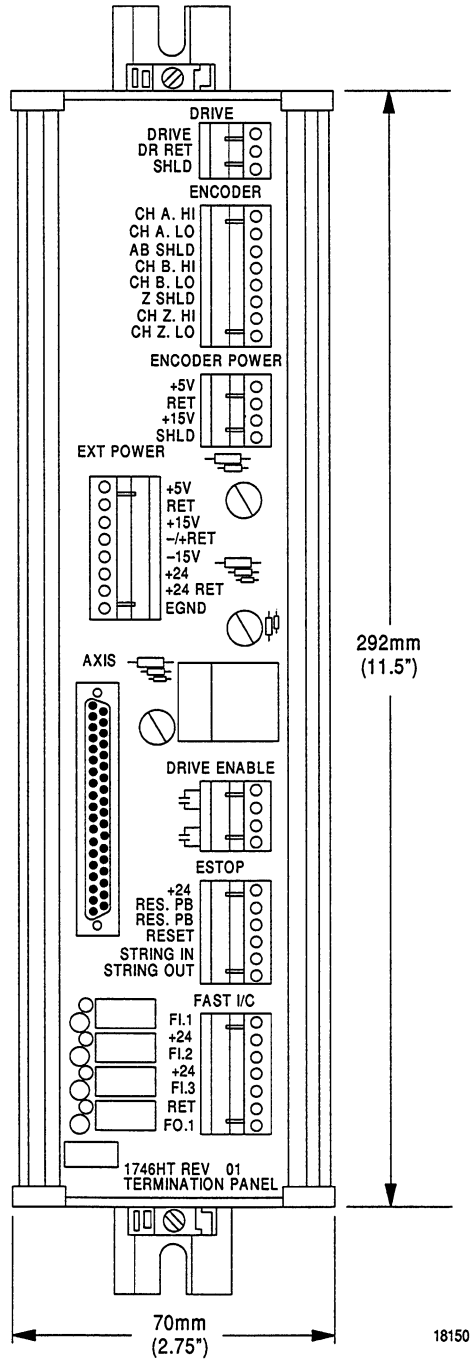
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IMC 110 Termination Panel

To provide you with more flexibility, the IMC 110 motion control system features a termination panel shown in Figure 4. You can mount the panel on a DIN-type rail. The features of the termination panel include:

- E-Stop — connections for customer E-stop string
- Fast I/O — connections for three fast inputs and one fast output. LEDs show status of each I/O point
- Encoder – supports encoder feedback for one axis
- Drive — connections to analog drive
- External Power — connections for +5V, ±15V and +24V power from customer power supply

Figure 4
IMC 110 Termination Panel



System Power Supply

The user supplies a power source for the IMC 110. The power supply must be:

- +5V, ±15V, and +24V
- able to meet the minimum voltage requirements of the encoders and other circuitry.

ODS Software

The software for the Offline Development System (ODS) creates, edits, and documents:

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

ODS is available on 5-1/4 and 3-1/2 inch disks. You can access the ODS software through:

- Allen-Bradley T35, T45, T47, T50, T60 industrial terminals
- Allen-Bradley 6120/6121 personal computers
- IBM XT/AT personal computers or 100% compatibles

By connecting an Allen-Bradley industrial terminal, 6120/6121 computer, or an IBM XT/AT or IBM-compatible computer to the RS-485 port of the IMC 110, you can:

- download AMP and MML files to the module
- upload AMP and MML files to the Allen-Bradley industrial terminal or personal computer

With ODS, you can:

- pull down menus for easy access to options
- call up a help screen at every step
- access DOS partitions
- copy, rename, and delete one or all MML files stored in the memory of the ODS or IMC 110

Motion Management Language (MML).

With MML, you can:

- monitor and act upon external events
- do arithmetic and logical operations on variables
- program your own routines and functions
- program axis motion
- utilize the capabilities of high-level language, such as initialize variables

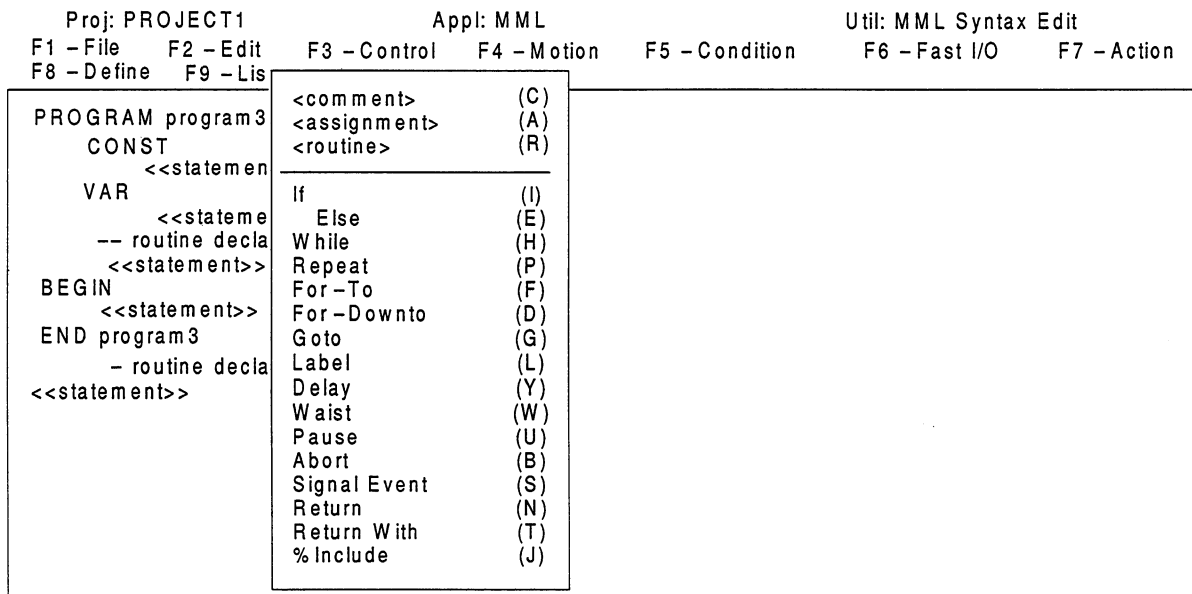
Syntax-Directed Editor (SDE).

The Syntax-Directed Editor (SDE) helps you create and edit MML programs. The beginning or infrequent programmer can use the SDE with no difficulty.

Select the statement that you want to program from one of the pull-down menus, then type in identifiers or other data needed to complete the statement. Figure 5 shows a SDE screen displaying the F3-Control menu that can program:

- comments
- control statements
- assignment statements
- routine calls

Figure 5
Pull Down Menu in SDE



Specifications for the IMC 110 Motion Control System

These specifications are current as of the publication date. Allen-Bradley reserves the right to revise these specifications without prior notice. Contact your Allen-Bradley sales representative for the most current information.

Specifications for Axis Control

Number of Controlled Axes

- One axis per motion control module

Axis type

- Linear
- Rotary (with rollover programmed in degrees or revolutions)

Acceleration and Deceleration

- Programmable rectangular acceleration

IMC 110 Motion Control Module

User-Power Connections

- +5V dc, ± 15 V dc (supplied by the user's power supply)

Memory

- 128K bytes of EPROM with 32K bytes of static RAM
- 12K bytes available to customer for RAM storage of AMP and MML programs
- RAM backup time after 8 hour charge;
 - @ 25°C — 30 days typical; 11 days worst case
 - @ 40°C — 21 days typical; 5 days worst case

Velocity Command (Analog Output)

- Output voltage swing: $\pm 10\text{Vdc}$
- Resolution: 12 bits DAC (including sign bit) at 4.88mV per bit
- Load range: 2K – 20K ohm
- Conversion time: 100 μs
- Differential linearity: ± 1 LSB maximum (monotonic over entire temperature range)
- Output offset voltage: 500 μs maximum
- Gain error drift: ± 7 LSB maximum

Feedback Circuitry

- One feedback channel per module
- Differential incremental encoder with gated markers supported
- Minimum channel frequency: 300 kHz at 0° quadrature error
- Formula for determining channel frequency:
 - $F_{\text{chan}} = 3334(90^\circ - E_Q^\circ)$
 - Where F_{chan} = channel's frequency in Hz
 - Where E_Q = quadrature error in degrees (from 90°)
- Input Signal
 - encoder feedback on channels A, B, and Z must be differential with 5V compatible output signals (8830 line driver or equivalent)
 - input sink current (DC): 6.8 mA (typical), 7.5mA maximum)
 - input sink current (AC): 42mA (maximum)
(The value of 42 mA represents the peak current that occurs as the differential switches state due to the AC termination, with a 4.V differential swing. The current will decay per the RC time constant resulting from the 0.01 μF capacitor and the 221 ohm resistor)
- Voltage for the common mode input: $\pm 7\text{V}$

Operating Conditions

- Temperature (inlet air): 0° to 60° C
(32° to 150°F)
- Altitude: up to 2000 m (6562 ft)
- Humidity: 5 to 95%, non-condensing atmosphere

Storage Temperature

- -40° to 85° C
- (-40° to 185°F)

Emergency Stop (E-Stop) Characteristics

- Detection and control of E-Stop conditions provided on the board
- Each module provides a separate and independent E-Stop circuit
- Hardware E-Stop activated by:
 - customer-defined E-Stop circuit (refer to the IMC 110 Installation Manual, publication 1746-ND001)
 - broken wire in the user power-supply cable
 - powerfail signal from the SLC 500 backplane
- Software E-Stop activated by:
 - initiated watchdog timeout
 - detected quadrature error
 - detected broken feedback wire
 - detected excess following error
 - lost communication with SLC
 - lost user power supply
 - filled fast-input queue
- Software E-Stop can only be released if no hardware faults are present
- Specifications for the E-Stop relay contacts
 - switching volts: 80Vdc (maximum)
 - operational time: 500µs (typical)
 - contact bounce: <200µs (typical)
 - contact resistance: 150 milliohm (typical)
 - resistive contact rating: 4VA at 0.25A (maximum)

General Local Fast Outputs (Source Drivers)

- One fast output (compatible with a customer-equipped +24V dc power supply)
- High-level, on-state output voltage: refer to the specifications for the user-side power supply
- High-level, on-state output current
 - without termination panel: +5V (maximum) and 0V (minimum) at 24mA
 - with termination panel: +24V (maximum) at 400mA

RS-485 Port

- uses a telephone-type connector
- interfaces directly with the handheld pendant
- interfaces indirectly with the ODS terminal via the RS-232 to RS-485 converter
- 4800 baud

General Purpose Local Fast Inputs

- Number of fast inputs: 3 (compatible with a customer-equipped +24V dc power supply)
- Low-high trip threshold: 14.61V dc (maximum), 12.5V dc (typical), 10.51V dc (minimum)
- High-low trip threshold: 10.3V dc (maximum), 8.3V dc (typical), 6.4V dc (minimum)
- V_{HYST} : 6.5V dc (maximum), 4.1V dc (typical), 1.9V dc (minimum)
- Low-high trip debounce filter: 0.2 ms (typical)
- High-low debounce filter: 0.2 ms (typical)
- Input voltage: $\pm 75V$ (maximum)
- Input current (at 27V): 50mA (maximum)

SLC 500 Backplane Communications

- IMC 110 sends status information to the SLC 500 once each I/O scan, including:
 - actual position or following error
- SLC 500 sends the following control information to the IMC 110 once each I/O scan:
 - jog the axis either incrementally or continuously
 - home the axis
 - cause E-Stop
 - select auto or manual operation
 - request single-step execution
 - speed override
 - provide offset information
 - return to position
 - quick retract (alternate home)

Current Requirements

- +5V — .300 A
- +24V — .104 A (when using handheld pendant)

Compatibility

- Version 2.0 memory pack required to support SLC 500 and IMC 110 capabilities

Connections and Mounting

- 2 m (6 ft.) cable (included with pendant) connects directly to the RS-485 port of the control module

Dimensions

- Height: 201 mm (7.9in.)
- Width (across the LCD screen): 193 mm (7.6 in.)
- Depth: 50.8 mm (2 in.)

Display

- 8 lines by 40 characters LCD

Keys

- Overlay for SLC 500 handheld terminal provided for IMC 110 operation
- Color-coded, hard and soft keys

Uses

- Menu-driven operator interface
- Manual operations:
 - home the axis
 - return to position
 - jog the axis by incremental or continuous movement
- Program debug and execution:
 - select a program
 - run by open loop or normal operation
 - disconnect and connect SLC 500 programmable controller
 - set and clear breakpoints
 - modify variables
- Status display:
 - program
 - position and following error
 - programmed motion
 - operation mode
 - error status
- File management:
 - list programs
 - select programs
 - copy, delete, rename programs
 - display program information: number, name, size, debug
 - remove debug information from program
- Teach variables:
 - initialized or uninitialized
 - modify positions and variables

Termination Panel

Mounting

- Mount up to 2.1m (7 ft) from the motion control module
- Easy installation requiring only a screwdriver and a wirestripper

E-Stop Relay (Cat. No. 700-HC14Z24)

- Contacts rated at 120V ac at 3A continuous; 15 μ s operating time
- Coil: +24V at .05A

System Power Supply

Input Requirements

- The IMC 110 has no input requirements for the system power supply

Output Capability

Supply	Tolerance	Current	Maximum Ripple Allowed Peak-to-Peak (P-P)
User +5V	±5%	at 0.150A not including encoder	100mV at 5A
User +15V	±5%	at 0.030A not including encoder	100mV at 1A
User -15V	±5%	at 0.030A not including encoder	100mV at 1A
User +24V	±5%	at 0.060A not including FOUT current	400mV at 2A

Offline Development Software

Compatible Computers

- Allen-Bradley T35, T45, T47, T50, T60 industrial terminals
- Allen-Bradley 6120/6121 personal computers
- IBM XT/AT or 100% compatible personal computers

Requirements

- 640Kbytes RAM
- hard disk drive with a minimum storage of 10 Mbytes
- 5-1/4 inch or 3-1/2 inch diskette drive
- Serial port for motion control module
- Parallel port for printer
- Monochrome or color monitor
- MS-DOS or PC-DOS version 2.1 to 3.3

Functions of ODS

- Creates, edits, documents, and compiles MML programs
- Downloads/uploads AMP and MML files to/from motion control module
- Restores project files with a floppy diskette
- Creates backup copies of project files with a floppy diskette
- Provides instructions and information at each step of use
- Accesses DOS partition without exiting ODS

Adjustable Machine Parameters

- Programmable linear or rotary axis
- Programmable rollover position
- Programmable reversal error value
- Selectable power turns on units: inches/millimeters, degrees/revolutions
- Programmable coarse and fine in-position tolerances
- Selectable standard or velocity feed forward motion loop closure
- Programmable maximum axis gain
- Programmable excess following error loop limit
- Programmable home position value
- Programmable direction moving off the home limit switch
- Programmable home calibration position
- Selectable source of home limit switch: fast I/O or SLC
- Selectable position for homing the axis: limit switch or encoder marker
- Programmable increment and speed for jogging the axis

Motion Management Language (MML)

- Syntax-Directed Editor (SDE) or text editor for program development
- Develop programs on ODS, download to the controller, debug with the handheld pendant
- MML programs reside on control
- Parallel asynchronous execution of condition handlers, motion and other program statements
- Arithmetic, relational, and boolean operations
- Built-in and user-defined routines
- Global and local condition handlers to monitor for and react to specified conditions
- Integer, real or boolean constants
- Integer, real, boolean, position, and array variables
- Integer values: ± 2147483547
- Boolean operations: $>$, $> =$, $=$, $<$, $< >$, $<$, $< =$, AND, OR, NOT
- Real data operations: $+$, $-$, $*$, $/$, $>$, $> =$, $=$, $<$, $< >$, $<$, $< =$ AND, OR, NOT, DIV, MOD

- Programmable control of I/O through MML
 - three fast inputs and one fast output
 - discrete transfer with the SLC

- Condition handlers
 - event or state monitoring
 - local condition handlers monitor conditions for a single move statement
 - global condition handlers monitor conditions throughout a program
 - reaction to a condition can be a predefined action or a routine

- Motion control
 - asynchronous motion in relation to the program

**Ordering the IMC 110
Motion Control System**

Table 1.B lists the catalog numbers you use to order the components of the IMC 110 motion control system.

**Table 1.B
Ordering the IMC 110 System**

Component	Catalog Number	What You Receive
control module	1746-HS	control module Installation Manual
termination panel	1746-HT	termination panel mounting brackets Termination Panel Installation Data Sheet
cable that connects the control module to the termination panel	1746-HCA	cable
handheld pendant	1746-HHDOC	keyboard overlay Handheld Pendant Operator's Manual
ODS	8100-HS110	Software on 5-1/4 in. and 3-1/2 in. disks Programming Manual AMP Reference Manual ODS User's Manual
documentation set	1746-HCDOC	Installation Manual Handheld Pendant Operator's Manual Programming Manual AMP Reference Manual

Where to Find More Information Table 1.C lists the content and publication numbers of the documents that discuss the IMC 110 system.

Table 1.C
Finding More Information About the IMC 110 System

If you want to know about:	Refer to this document:	Publication Number
<ul style="list-style-type: none"> • selecting encoders, power supplies, and drives • installing the control module, termination panel, and handheld pendant • wiring fast I/O, E-stop, power supplies, encoders, and drives • integrating the axis • recovering from an error message 	Installation Manual	1746-ND001
<ul style="list-style-type: none"> • the handheld pendant • entering IMC 110 mode • monitoring and debugging programs • jogging the axis • teaching program positions 	Handheld Pendant Operator's Manual	1746-ND002
<ul style="list-style-type: none"> • AMP • creating, editing, documenting, uploading and downloading AMP files • a specific AMP parameter (description, range and default) 	AMP Reference Manual	1746-ND003
<ul style="list-style-type: none"> • MML • using SDE • uploading and downloading MML programs • declaring constants and variables • programming with MML • IMC 110/SLC communications • SLC programming examples • recovering from an error message 	MML Programming Manual	1746-ND004



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