



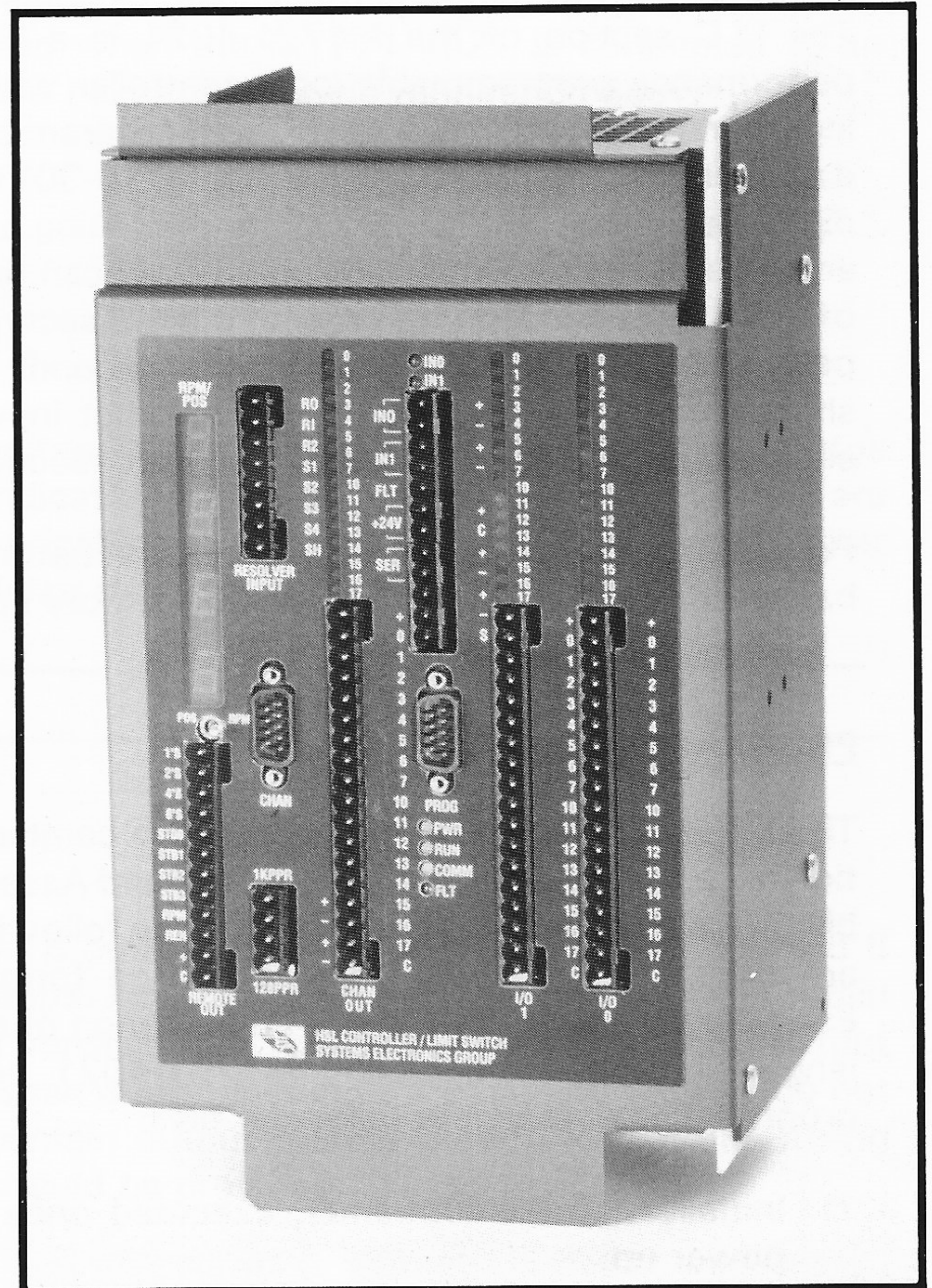
SYSTEMS M4000

INDUSTRIAL CONTROLLER

M1771-4021 **INTELLIGENT PLS MODULE** **(A-B 1771 I/O CHASSIS)**

FEATURES:

- o INTELLIGENT PROGRAMMABLE LIMIT SWITCH MODULE WITH 16 TIMING CHANNELS, BUILT-IN PROCESSOR, 10-30VDC DIGITAL INPUTS, AND 10-30VDC DIGITAL OUTPUTS
- o INTERFACES WITH MACHINE MOUNTED RESOLVERS
- o 24K BYTES BATTERY-BACKED CMOS RAM USER PROGRAM MEMORY AND 2K BYTES DATA MEMORY
- o HIGH PERFORMANCE: 0.6 MSEC PER K SCAN TIME WITH THROUGH-PUTS AS LOW AS 80 MICROSECONDS. RESOLVER TRACKING RATES UP TO 6,000 RPM WITH CHANNEL UPDATE UNCERTAINTY OF LESS THAN ONE MICROSECOND
- o PROGRAMMABLE SCALE FACTOR (2 TO 512) AND OFFSET (0 TO ONE MINUS THE SCALE FACTOR)
- o MOTION OUTPUT WITH PROGRAMMABLE LOW AND HIGH SPEED THRESHOLDS
- o BRAKE WEAR COMPENSATION ALGORITHM FOR CONSISTENT STOPPING OF PRESSES
- o BUILT IN 4-DIGIT RPM/POSITION DISPLAY ALONG WITH RPM/POSITION DISPLAY OUTPUT CONNECTOR FOR REMOTE DISPLAYS OR INTERFACING TO PLCs
- o PROGRAMMED WITH SYSdev AND PLSdev: DOS BASED SOFTWARE PACKAGES ALLOW PROGRAM-



MING IN LADDER, HIGH-LEVEL(C), AND ASSEMBLY AS WELL AS ON AND OFF-LINE PROGRAMMING OF TIMING CHANNELS

- o REMOVABLE FIELD WIRING CONNECTORS
- o FITS IN ALLEN-BRADLEY 1771 I/O CHASSIS FOR A-B 1771 COMPATIBILITY

GENERAL DESCRIPTION

The M1771-4021 is a combination of a 16-channel programmable limit switch (PLS) and 16 in/16 out digital I/O of a high performance programmable logic controller (PLC). This combination forms a powerful intelligent PLS module

which contains 16 timing channels and yet can implement user logic (written in Ladder and High-level(C)) which activates the 16 digital outputs based on the timing channels and 16 digital inputs.

GENERAL DESCRIPTION (cont'd)

The M1771-4021 resides in the Allen-Bradley 1771 I/O chassis, providing a high performance PLS/PLC front end for the Allen-Bradley PLC.

The M1771-4021 is based on the proven M4000 series product line.

PLC SECTION

The PLC section of the M1771-4021 is a high performance programmable logic controller which incorporates a built-in processor, user program and data memory, 10-30VDC digital inputs, 10-30VDC digital outputs (1 AMP), RS-232 programming port and a serial network interface port. The scan time of the PLC section is on the order of 0.6 milliseconds per K with scan times as low as 80 microseconds for short programs. Two additional interrupt inputs allow throughputs even less than 80 microseconds.

Program memory consists of 24K bytes of battery-backed CMOS RAM memory. Data memory con-

sists of 200 bytes of directly addressed non-battery backed RAM and 2K bytes of indirectly addressed battery-backed RAM.

Programming of the PLC section is implemented with SYSdev, an IBM PC or compatible software package that allows the user to create, document, and compile the user logic program as well as directly interface to the M1771-4021 for program download and on-line monitoring. Complete program printouts including the user program listing, cross reference, and memory map can also be generated.

PROGRAM STRUCTURE

The SYSdev programming language is a combination of Ladder, High-level (subset of C) and Assembly (MCS-51). All the files shown in the following are programmed in the same language format. Each file can be written in any combination of the language types. The typical M1771-4021 user program consists of the following files:

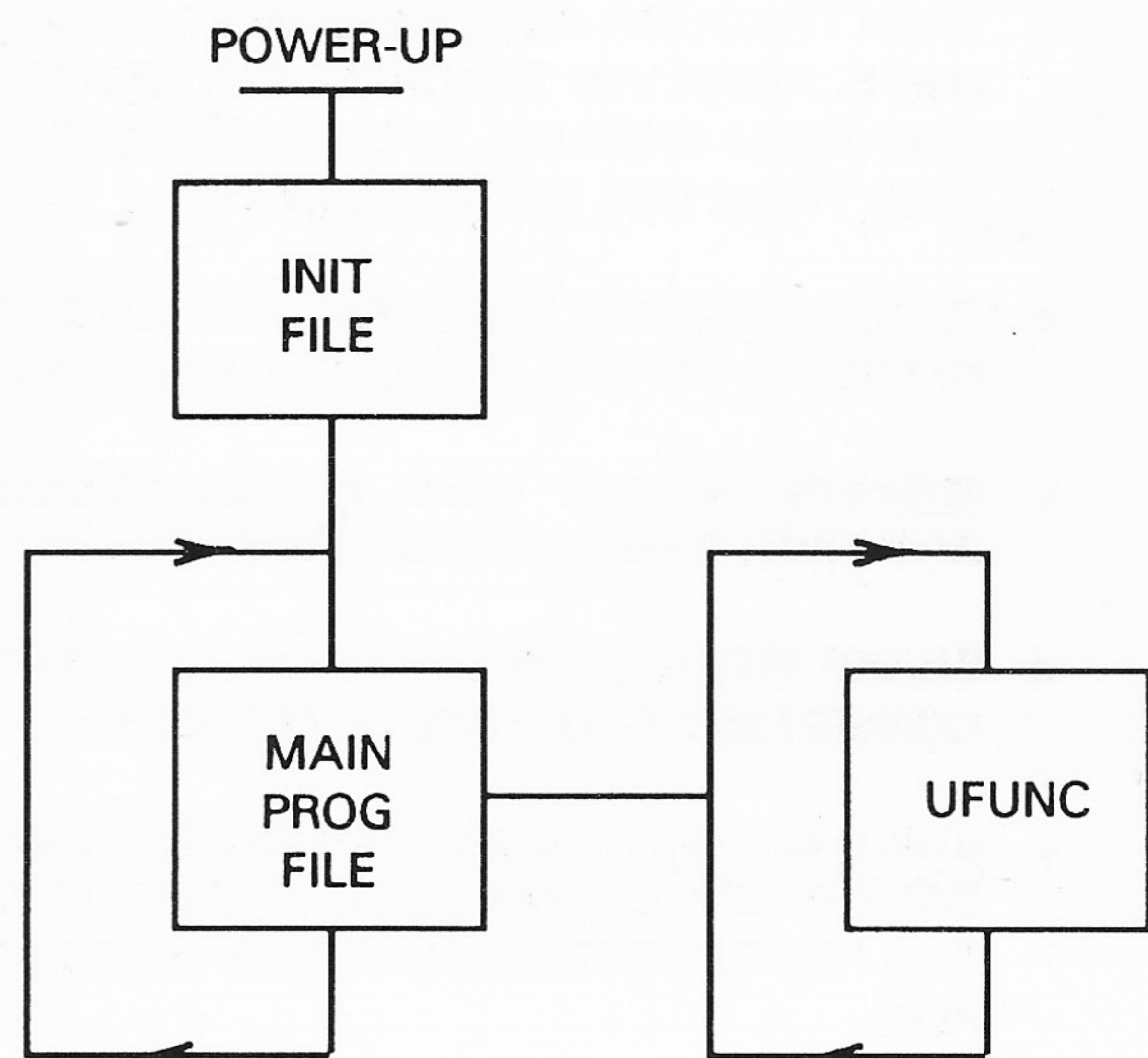
- 1) Initialization file (optional): executed once at power up.
- 2) Main Program file (required): scanned continuously.
- 3) User Function file (optional): up to 100 user defined subroutines which can be called from any of the above files.

Each file is executed sequentially from beginning to end. The main program is executed (scanned) continuously unless a user function is called from the main program. When this occurs, main program execution is suspended while the user function file is executed. At the completion of the user function, program execution resumes at the point in the main program where the user function was called.

Each file is implemented as a series of consecutive blocks. Each block is defined as one of the three

programming languages: Ladder, High-level or Assembly. Blocks of the different languages can be intermixed as necessary within the file.

Under normal program execution, the scan time of the main program will vary as a function of the true/false conditions of the logic. When the optional "fixed scan time" feature is enabled in the M1771-4021 configuration, the scan time can be set to either 0.5, 1.0, or 10.0 milliseconds. This allows fixed rate sampling or high speed time bases to be implemented with the M1771-4021 module.



INTERFACE PORTS

The M1771-4021 module contains two interface ports: the serial network comm port and the PROGramming port.

SERIAL NETWORK: The serial network port conforms to the S3000-N1 network. This network is a high speed (up to 344KBPS), twisted pair, serial network configured in a master/slave topology. Up to 32 M1771-4021 modules and/or S3000 processors (nodes) can be connected on one network.

Communications between the nodes on the network is controlled via commands (sfunc13) in the user application program resident in the node acting as the master.

PROG PORT: The PROG port is an RS-232 port dedicated for on-line monitoring and program download when the M1771-4021 is connected to an IBM PC or compatible running SYSdev.

DIGITAL INPUTS

The digital inputs are 10-30VDC sourcing (true high) which are used to interface to the application inputs such as proximity sensors, pushbuttons, etc. The input is "on" ("1") when the input voltage exceeds 10VDC and is "off" ("0") when the input

voltage is below 5VDC. Individual LED status indication is provided for each input. All inputs are optically isolated and provided with an input filter delay (nominally 1.0 milliseconds).

DIGITAL OUTPUTS

The digital outputs are 10-30VDC sourcing (true high) which are used to interface to the application outputs such as solenoids, lamps, PLC inputs, etc. Each output is rated at 1 amp DC (continuous) with an inrush (pulsed) current drive capability of 5 amps for 100msec. The sum of the current within

an 8 output group must not, however, exceed 6 amps. All outputs are optically isolated and contain a transient suppression circuit to protect the output when driving inductive loads. The outputs do not contain output fusing, therefore, external fusing should be provided.

DIAGNOSTICS/FAULT DETECTION

The M1771-4021 contains comprehensive fault detection routines which verify the proper operation of the module at all times. In addition, the M1771-4021 contains a fault interlock (24VDC, 100mAMP, sinking) output which can be interlocked to the control system for system shut down or annunciation when a fault is detected. Some of the faults detected include:

- Loss of scan (watchdog timer time-out)
- Invalid User program (no program loaded)
- Network communications fault
- Etc.

When a fault is detected, program execution is suspended, the RUN LED on the M1771-4021 is extinguished, the FAULT LED is illuminated and the fault interlock output is turned "off". Using SYSdev, the fault can be displayed in the SYSdev fault menu. This menu shows the fault code, a description of the fault, and a suggested corrective action to quickly pin-point the fault and correct it.

In addition to the fault code detection, a hardware confidence test is resident in the module to provide a complete test of the module hardware. This test is initiated through SYSdev and can be used to verify the M1771-4021 for proper operation.

PLS SECTION

The PLS section is a high speed programmable limit or cam switch which accepts angular position information in the form of resolver format signals and converts these to digital. The module contains 16 timing channels which can be programmed "on" and "off" at user defined position set-points. Two additional outputs with a fixed number of pulses per revolution (one at 128, the other at 1024) are available to drive digital tachometers, etc.

The scale factor of the PLS is programmable from 2 to 512 divisions per revolution, while the offset is programmable from 0 to one minus the scale factor. Other programmable features include a

brake wear compensation algorithm for use with presses and a motion (speed) output which is activated "on" and "off" at user defined low and high speeds. Programming of the PLS section is implemented with PLSdev, a DOS-based software package which allows the user to program the timing channels both on and off-line, set the PLS configuration, upload and download programs to and from the PLS, etc.

High speed operation of the PLS section is obtained with a resolver tracking rate greater than 6,000 RPM and a timing channel output update uncertainty of less than one microsecond to a change in angular position.

RESOLVER INTERFACE

The M1771-4021 can be used with virtually any type of resolver which incorporates a rotor reference signal and two stator feedback signals. These include resolvers manufactured by C&A, Autotech, Gemco, etc. A dip switch accessible through an access hole on the left side of the module selects the

desired resolver reference voltage, either 1.45VRMS or 3.70VRMS. For Autotech and Gemco resolvers, the reference should be set at 1.45VRMS, for C&A at 3.70VRMS. For other resolvers, refer to the manufacturer's specifications to determine which reference should be selected.

TIMING CHANNELS

The M1771-4021 contains 16 timing channels. Each timing channel can be programmed with up to 50 arbitrary "on-off" set-points or with a pulse train of fixed "on" and "off" divisions throughout the entire channel. All timing channels are mapped to 10-30VDC sourcing (100milliamp) outputs which can be wired to PLC inputs for machine control timing. The status of each timing channel

output is indicated with an individual LED. The timing channel outputs contain short circuit protection such that the detection of a short circuit disables the outputs, with a fault code displayed on the RPM/POSITION display. Once the short circuit condition is removed, the fault code can be reset and the outputs will resume normal operation.

RPM/POSITION DISPLAY/OUTPUT CONNECTOR

A 4-digit RPM/POSITION display is built into the M1771-4021. In addition, an RPM/POSITION output connector is also built-in for remote displays or for interfacing to PLCs. Eight 24VDC sinking (true low) outputs and two 10-30VDC sourcing (true high) inputs are available on the connector. The eight outputs multiplex the data for the four digits using four wires for the digit data and four wires as the individual digit strobes. This configuration reduces the wire count required for remote displays. The two inputs are REMOTE ENABLE and

RPM SELECT. If REMOTE ENABLE is "low", RPM or POSITION is selected locally via the RPM/POSITION toggle switch on the M1771-4021. If REMOTE ENABLE is "high", POSITION is displayed when RPM SELECT is a "high". When REMOTE ENABLE is high, the strobe time of the output connector digit strobes can be user programmed from 2.5msec to 640msec. This allows the user to guarantee the digit strobe time is longer than the display strobe time or PLC scan time to which the M1771-4021 is interfaced.

BRAKE WEAR COMPENSATION

The brake wear compensation algorithm can be used in conjunction with presses which incorporate a top dead center (TDC) or back dead center (BDC) stop feature. With these presses, a timing signal is used to declutch the press for TDC or BDC stops. However, as the brake wears, the press will no longer stop at TDC, but will instead overshoot. When enabled, the brake wear algorithm of the M1771-4021 will automatically adjust the TDC timing signal such that the press always stops at the desired stopping location regardless of brake wear.

The brake wear algorithm is implemented in CH00 and can be enabled or disabled by the user. When disabled, CH00 functions as a standard timing

channel. When enabled, the following parameters, set by the user, are used to implement the algorithm: Desired Stop Location, Allowed Error, CH00 Timing Width, and Compensation Window.

In addition to the above parameters, the REMOTE ENABLE input is used to enable the brake wear compensation. The adjustment of CH00 is performed when the press is stopped (RPM = 0) and the REMOTE ENABLE input is high. If the REMOTE ENABLE input is low when the press is stopped, CH00 is not altered regardless of the stopping location. This allows the algorithm to be bypassed for inch and single modes as well as emergency stops.

MOTION (SPEED) OUTPUT

The motion output is a user enabled feature which uses the CH17 output. Two user programmable parameters are used in conjunction with the motion output: low speed threshold and high speed threshold. When enabled as a motion output, CH17 is

"on" when the speed (RPM) is between the low and high speed thresholds. When the speed is below the low speed threshold or above the high speed threshold, CH17 is "off". When disabled, CH17 functions as a standard timing channel.

PROGRAMMING

Configuration and timing channel programming of the M1771-4021 is performed with PLSdev, a DOS-based programming software package which runs on any IBM PC or compatible. Connection of the PC to the M1771-4021 is implemented with an RS-232 cable, no other hardware is required. PLSdev allows the user to perform the following:

- o Configuration of the M1771-4021 including:
 - Scale factor
 - Offset
 - Brake wear compensation enable/parameter programming
 - Motion output enable/parameter programming

- o On and Off-line timing channel programming including:
 - arbitrary set-point programming
 - pulse train channel programming
 - timing channel fine tune
- o Channel set-points download to M1771-4021
- o Channel set-points upload from M1771-4021
- o Configuration and channel set-points print-outs

SPECIFICATIONS

Module Size:

Length:	Standard 1771 I/O length
Height:	Standard 1771 I/O height
Width:	5 slots

Power Requirements:

Supply Voltage:	24VDC +/-10%
Supply Current:	1.0 Amp (max)

Temperature Ranges:

Storage:	0 to 60 degrees C
Operating:	0 to 60 degrees C

Relative Humidity:

5 to 95% non-condensing

PLC SPECIFICATIONS

Memory:

Program:	24K bytes battery backed CMOS RAM
Data:	
indirectly addressed:	2K bytes battery backed CMOS RAM
directly addressed:	(non-battery backed)
Flags (F):	112 bits
Bytes (B):	200 bytes
Words (W):	100 words

Execution Times:

Scan Time:	0.60msec per 1K bytes
Main Program overhead:	80 microseconds
Fixed Scan Time bases:	0.5, 1.0, and 10.0 milliseconds

Interface Ports:

PROG PORT:	
Type:	RS-232
Comm Rate:	9600 BAUD

Serial Network:

Type:	RS-485
Comm Rate (max):	344KBPS
# of nodes (max):	32
Isolation:	2000 VRMS
Protocol:	Proprietary

Digital Input Voltage:

Vin(on-min):	10.0 volts
Vin(on-max):	30.0 volts
Vin(off-min):	5.0 volts

Digital Input Current (max):

10 milliamps at Vin = 30volts

Digital Input Filter Delay:

min delay:	0.5 milliseconds
max delay:	2.0 milliseconds

Digital Input Optical Isolation:

1500 Vrms

Digital Output Voltage:

Voltage Range:	10-30VDC
Vout (on-min):	VCC - 2.00 volts
Vout (on-max):	VCC - 0.25 volts
Vout (off-max):	1.5 volts

Digital Output Current:

Iout (on max - continuous):	1.00 amp DC
Iout (on max - pulsed):	5.00 amp DC (for 100msec)
Iout (off max - leakage):	100 microamps

Digital Output Response Time:

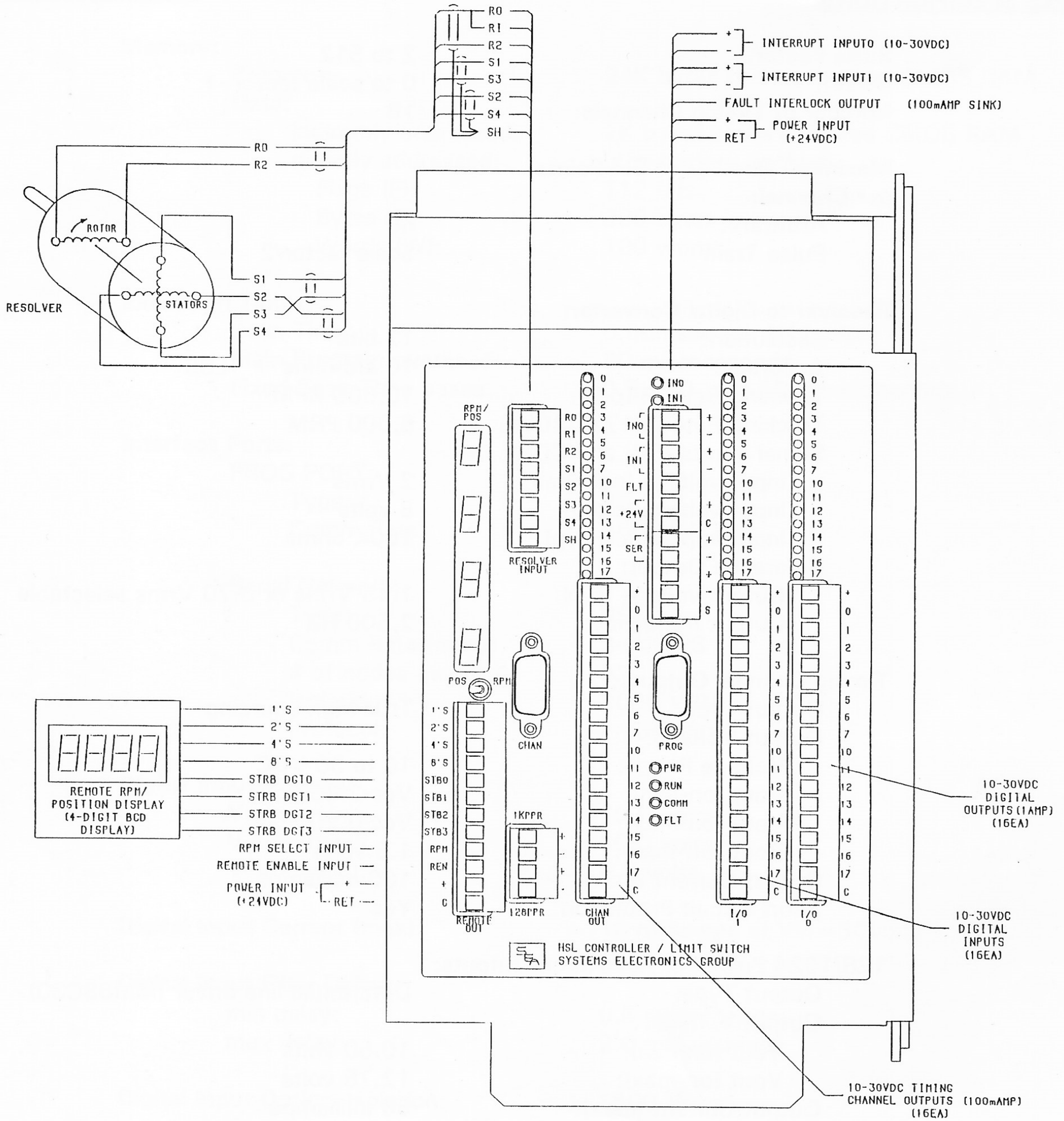
max on time:	50 microseconds
max off time:	75 microseconds

Digital Output Optical Isolation:

1500 Vrms

PLS SPECIFICATIONS

Scale Factor:	2 to 512
Offset:	0 to scale factor -1
Number of Timing Channels:	16
Maximum Number of Set-Points per Channel:	
Arbitrary:	50
Pulse Train	Scale factor/2
Resolver-to-Digital Converter:	
Resolution:	12 bits
Accuracy:	10 arc mins + 1LSB
Tracking Rate (R-to-D):	10,000 RPM
Tracking Rate (M1771-4021)	6,000 PRM
Signal Inputs (SIN and COS):	
Input voltage (nominal):	2 Vrms
Input voltage (max):	8 volts
Input impedance (typ):	100K ohms
Reference Output:	
Output voltage level:	1.45 Vrms or 3.70 Vrms selectable
Output frequency:	2,500 HZ
Timing Channel Outputs:	
Output Type:	True high sourcing
Output Voltage:	
Voltage Range:	10 to 30 VDC
Vout (on-min):	Vcc-2.00 volts
Vout (on-max):	Vcc-0.20 volts
Vout (off-max):	1.5 volts
Output Current (max):	100 milliamps
Short Circuit Protection:	Yes
128/1024 Pulse Per Revolution Outputs:	
Output Type:	Differential line driver (MM88C30)
Output Voltage:	
Vout (on-min):	10.50 volts
Vout (on-max):	12.75 volts
Output Current (max):	50 milliamps
Short Circuit Protection:	No
RPM/POSITION Outputs:	
Output Type:	True Low Sinking (24VDC)
Output Voltage:	
Vout (on-max):	1.50 volts
Vout (off-min):	20 volts
Output Current (max):	50 milliamps
REMOTE ENABLE and RPM SELECT Inputs:	
Input Type:	True high sourcing
Input Voltage:	
Vin (on-min):	12 volts
Vin (on-max):	30 volts
Vin (off-max):	5 volts
Input Current (max):	10 milliamps at Vin = 30 volts



M1771-4021

16 IN - 16 OUT PLC / 16 CHANNEL PLS
(A-B 1771 I/O CHASSIS)



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