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INTELLIGENT COMMUNICATION PROCESSING SYSTEM

MODEL 59660

OPERATION AND MAINTENANCE MANUAL

INCLUDING:

ICP/Host Interface (P/N 990-60049-0101)

ICP Multiplexer (P/N 990-59670-0101)

Digital to Analog Converter (P/N 990-59856-0101)

Document Number 990-59660-9800

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OPERATION AND MAINTENANCE MANUAL
MODEL 59660
INTELLIGENT COMMUNICATION PROCESSING SYSTEM (ICP)

1. GENERAL INFORMATION

1.1 PURPOSE OF THE SYSTEM

The Intelligent Communications Processor System (ICP) is designed to provide an efficient interface between many remote seismic digitizer systems and a personal computer (PC) based recording and analysis system.

1.2 DESCRIPTION OF SYSTEM

The ICP consists of the ICP/Host Interface, Multiport Serial Controller, and interconnecting cables. The Host Interface module is installed in an AT card slot of a 386 or higher class PC providing a **MicroSoft WindowsNT™** environment. The Multiport Controller, a separate rack mountable or desktop enclosure connects via cable to the Host Interface Module and provides serial link multiplexers for RS-232 serial data inputs and up to thirty two (32) digital to analog output ports. Provision is made for the connection of a precision time source for accurately time tagging incoming data not time tagged at the source.

The Multiport Controller can accommodate from one to four multiplexer module, with each module providing four full duplex, user configurable RS-232 ports, and one, thirty two channel digital to analog converter (DAC) module. One or two Multiport Controllers can be daisy chained to a single Host Interface Module for a maximum aggregate of twenty four serial ports or seventy two seismic data components. A typical ICP system configuration is shown in Figure 1-1.

ICP system operation requires serial digital time code and 1 pulse second (1PPS) inputs synchronized with Universal Time Coordinated (UTC). The serial time stream must be compatible with Trimble Navigation Limited's ASCII Interface Protocol (TAIP). The 1PPS can be either a positive or negative going pulse of at least 10 microsend duration with the leading edge being "on time". The Geotech Instruments GPS-1 or GTS-ONE units meet these requirements and are compatible with the ICP System.

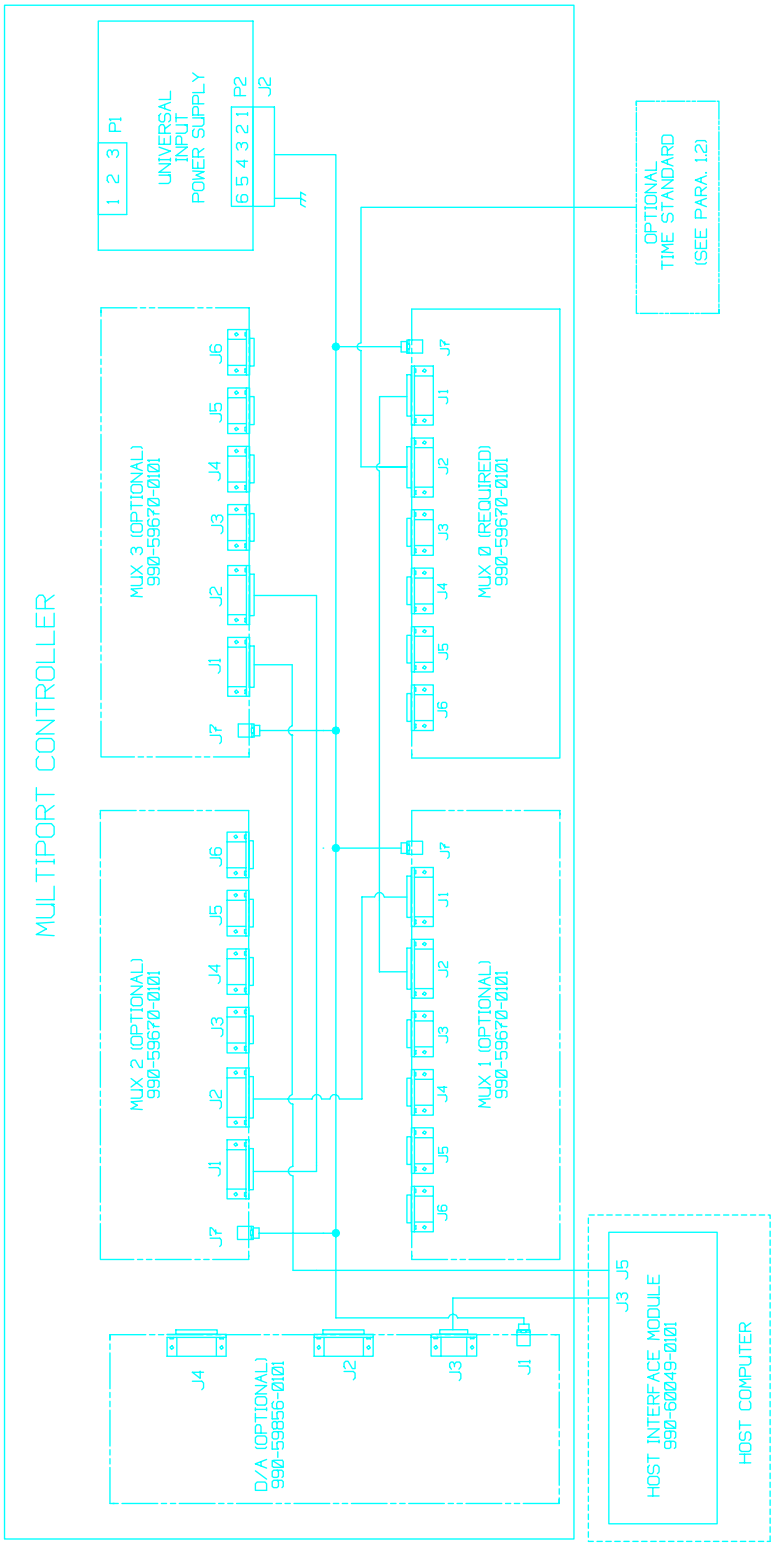

Figure 1-1. Typical ICP system configuration.

1.3 DESCRIPTION OF SYSTEM OPERATION

Digitized and formatted remote site seismic data is telemetered to the central data collection location as a serial RS-232 bit stream. At the central location, each serial data stream, consisting of up to three components of seismic data, is input via one of up to 24 serial ports of the configured Multiport Controller(s), to the Host Interface for ultimate display and archive.

The multiplexer ports are configured from the host computer, and in return port and multiplexer status is provided to the host. The standard multiplexer is programmed to recieve data from any combination of up to four remote stations compatible with any of the following acquisition systems:

12 bit Geotech Instruments Model 49.60 Digitizers;
16 bit Geotech Instruments Compact Remote Stations (CRS);
24 bit Geotech Instruments Digital Telemetry Sysytems (DTS-24);
24 bit Geotech Instruments DR Series Systems.

Data from the remote station(s) is time aligned and formatted into one second demultiplexed blocks which is conditioned to be output to the Host Interface. Each port can accommodate up to three components of seismic data.

The Host Interface converts the 24 bit data from the multiplexers to 32 bit data for the host computer, converts the data to floating point for digital filtering and event detection, and performs digital filtering and event detection as prescribed by the user via the system configuration software. Twenty seconds of seismic data, including raw data, short period filtered data and very long period filtered data (greater than 20 second period) is maintained in a RAM spool for the host.

The Host Interface also configures and controls the 32 output channels of the DAC module allowing the user to define the DAC channel output (any of the up to 72 input seismic data channels), data type to be output (raw, SP filtered, LP filtered or event detector input), and the DAC channel output scale factor.

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2. DESCRIPTION OF FUNCTIONAL MODULES

2.1 GENERAL

Schematic diagrams for all functional modules are provided in Section 6 of this document and may be referred to during the review of this section for a more comprehensive understanding of module functionality.

2.2 MULTIPORT CONTROLLER

2.2.1 General Description - Multiport Controller

The Multiport Controller provides the interfaces to the external components of a digital seismic data acquisition system. Three functional module types make up the Multiport Controller. These are:

Multiplexer Module, P/N 990-59670-0101
Digital to Analog Converter Module, P/N 997-59856-0101
Power Supply Module, P/N IPS PU30-12SL.

The functional modules of the Multiport Controller are housed in a rack mountable enclosure. Basic Multiport Controller configuration consists of a power supply module and a single multiplexer module providing capability for interfacing from one to four RS-232 serial data links and an external Geotech Instruments GPS-1 or GTS-ONE time standard to the ICP Host Interface. Optionally the Multiport Controller can be configured for an additional one to three multiplexer modules providing up to 12 additional remote serial data links, and a digital to analog converter module for providing the capability to output up to 32 channels of data to external analog recorders.

The Multiport Controller front panel contains a tinted translucent window permitting viewing of the various status indicators of configured internal modules.

External cable access is provided for direct connection to all installed functional modules.

The Multiport Controller is shown pictorially in Figure 2-1.

2.2.2 Controls and Indicators - Multiport Controller

Multiport Controller controls and indicators are limited to those required for connection, application and monitoring primary electrical power. Rear panel connector J3 provides the input of primary electrical power via a Belden 17250 power cable. Rear panel switch S1 controls the application of primary power and LED DS1 glows red when the switch is on and the power cable is connected to a live AC power main. The Multiport Controller power supply is a wide range input device, operational on any line voltage between 100 and 240 VAC and line frequency from 47 to 63 Hz.

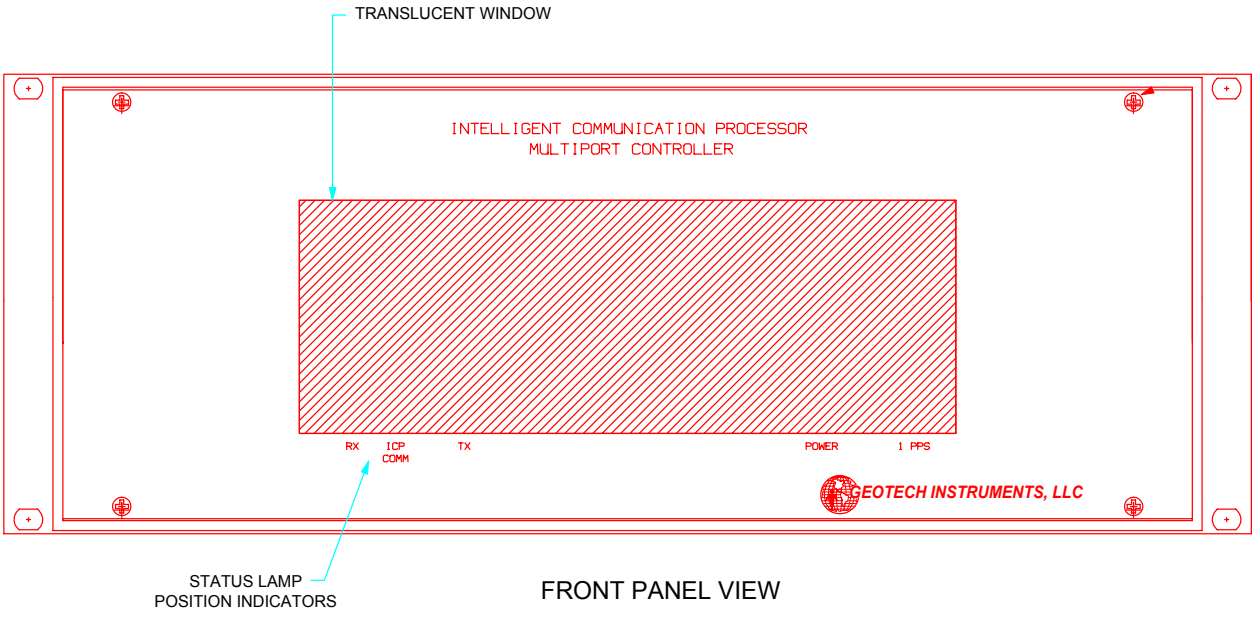
The locations of internal Multiplexer Module indicator LED's (RX, ICP COMM, TX, POWER and 1PPS) are labeled on the front panel of the Multiport Controller. The use and meaning of these indicators is described in a following paragraph.

2.2.3 Specifications - Multiport Controller

MECHANICAL CHARACTERISTICS	
Size (Front Panel)	19 inches wide X 6.969 inches high (48.3 cm X 17.7 cm)
Size (Enclosure)	17.3 inches wide X 10 inches deep X 6.969 inches high (44 cm X 25.4 cm X 17.7 cm)
Weight	15 lbs. (6.8 kg)
ENVIRONMENTAL CHARACTERISTICS	
Operating Temperature	32^0 to 122^0 F (0^0 to 50^0 C)
Storage Temperature	-22^0 to 144^0 F (-30^0 to $+65^0$ C)
Relative Humidity	5% to 95% non condensing
POWER REQUIREMENTS	
Voltage	100 to 240 VAC
Frequency	47 to 63 Hertz
Power	Less than 20 Watts

2.2.4 Multiplexer Module, P/N 990-59670-0101

The ICP Multiplexer accepts input data from up to four RS232 ports, pre-formats the data if necessary and re transmits the data to the ICP controller module over a high speed data link. The high speed data link is a half duplex two wire link combined with interrupt lines. A maximum of five Multiplexer modules can be configured in a single Multiport Controller unit and one ICP Host Controller module manages up to 24 Multiplexer ports.



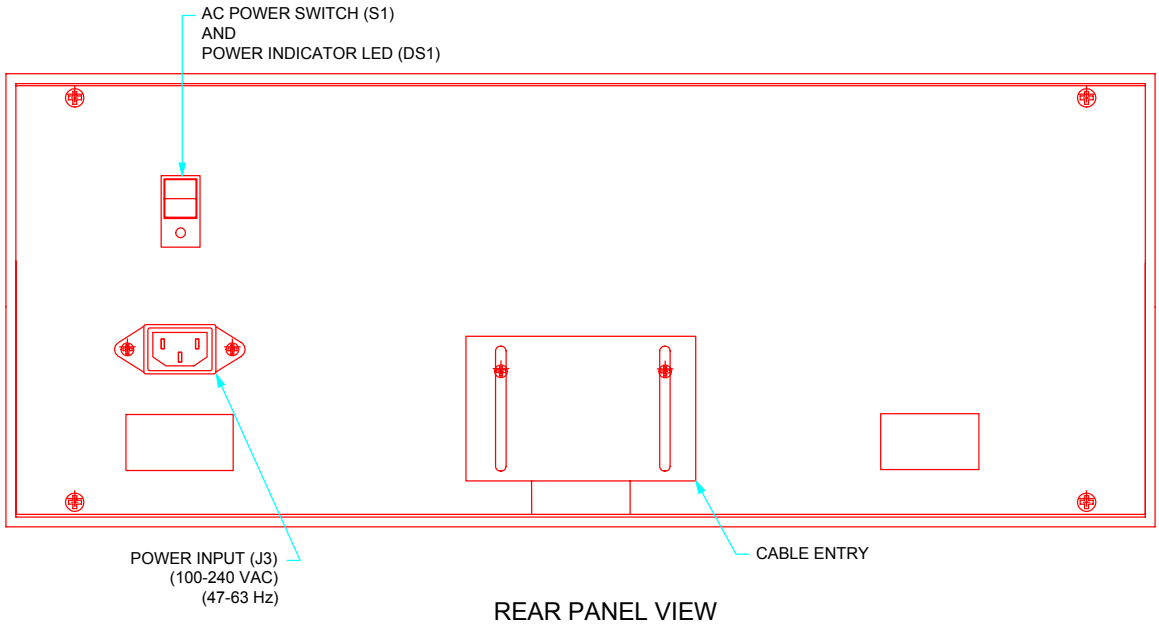


Figure 2-1. Multiport Controller front and rear panel views.

Each multiplexer port is configured through the ICP Controller. Each port can be configured to operate in a Geotech Instruments Digital Telemetry System (DTS) mode. In the DTS mode the multiplexer will time align the data to a 1pps input and reformat the data. The multiplexer compares each port data input to configuration information and will provide status to the controller. When active in this mode diagnostic data is provided to inform the controller of the following faults:

no 1 pps interrupt;
no data received;
check sum error received.

Standard PC compatible connectors are used for each RS232 port. Two of the board connectors are designed to daisy-chain two or more multiplexer modules to the ICP and an external time source. A simple two wire removable terminal block connector is provided for 12 volt power. Jumpers are used to select the multiplexer's ID number, the polarity of the 1pps signal, and the value of the modem control pull-up resistance, and an optional null modem interface connection. Indicators are provided for RS232 RX and TX, ICP data transmission, 1PPS, and applied power

2.2.4.1 Controls and Indicators - Multiplexer Module

A momentary reset switch is provided to refresh the on board firmware of the Multiplexer Module. Several status LED's provide visual confirmation regarding ICP to Multiplexer handshaking, an active 1pps signal, and applied power. Jumpers provide the user versatility in configuring RS232 I/O port assignments, multiplexer ID selection, 1pps polarity requirements and GPS-1 receiver power. The jumpers, switches and indicator LED descriptions are detailed in the following paragraphs. Figure 2-2 illustrates the location of all controls, indicators and connectors of the Multiplexer Module.

2.2.4.1.1 Multiplexer I.D. Jumpers.

Each Multiplexer Module connected to the same ICP Controller must have a unique I.D. number and data ready flag (DRDYx) in order to communicate with the controller. W1 - W4, W31, W32, W35 and W36 select the data ready interrupt line (DRDY0 through DRDY7). W15, W16 and W17 provide the binary values 0 - 7 for I.D. Each installed Multiplexer Module must have a unique I.D. number and corresponding data ready (DRDYx) jumper installed. The data ready jumpers may be considered mutually exclusive in that each Multiplexer Module may have one and only one data ready jumper installed. Table 2-1 defines the Multiplexer I.D. and data ready jumper installations. Current ICP software does not support multiplexer ID 6 or 7 or their corresponding data ready flags.

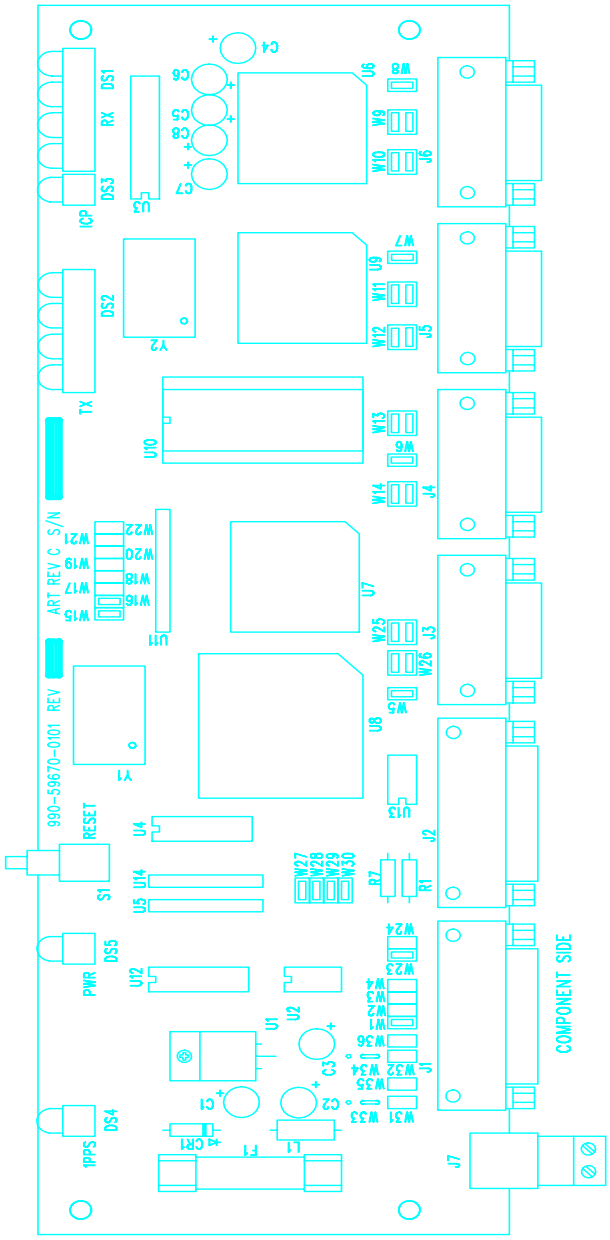


Figure 2-2. Multiplexer Module controls, indicators and connectors.

2.2.4.1.2 1 PPS Polarity Jumper.

As described in paragraph 1.2, ICP System requires a 1 PPS input from a UTC synchronized timing source. The 1 PPS input is required for time synchronization whenever a DTS remote station is connected to any port. Any precise 1 Hertz clock meeting the specifications defined in paragraph 1.2 synchronized to UTC time may be used. The multiplexer will interrupt on the negative going edge of the clock when jumper W23 is installed and W24 is open. The multiplexer will interrupt on the positive going edge when W23 is open and W24 is installed.

Table 2-1. Multiplexer Module I.D. and data ready jumpers.

Mux ID	0	1	2	3	4	5	6	7
W1	Jumper	open	open	open	open	open	open	open
W2	Open	jumper	open	open	open	open	open	open
W3	Open	open	jumper	open	open	open	open	open
W4	Open	open	open	jumper	open	open	open	open
W31	Open	open	open	open	jumper	open	open	open
W32	Open	open	open	open	open	jumper	open	open
W35	Open	open	open	open	open	open	jumper	open
W36	Open	open	open	open	open	open	open	jumper
W15	Open	jumper	open	jumper	open	jumper	open	jumper
W16	Open	open	jumper	jumper	open	open	jumper	jumper
W17	Open	open	open	open	jumper	jumper	jumper	jumper

CAUTION

W23 and W24 jumpers should never be installed simultaneously.

Note: The 1 PPS pulse is normally input from a GPS-1 or GTS-ONE timing source via the multiplexer J1 and output to the ICP Host Interface via Multiplexer Module connector J2. This 1 PPS signal is then buffered and returned to the Multiplexer Module as a negative going pulse with a 100 mSecond pulse duration.

2.2.4.1.3 RS-232 Port Configuration Jumpers.

To configure each of the multiplexer's RS-232 ports, four unique jumpers are provided. The multiplexer's 9-pin male connectors are configured for standard I/O asynchronous output. To reserve RX, TX, RTS and CTS, turn the jumpers 90 degrees relative to card connector edge and configure them in accordance with Table 2-2. The pull-up jumpers are used for the CTS and DCD inputs, however, these inputs are ignored when operating in the DTS mode.

Table 2-2. Multiplexer Module RS-232 port configuration jumpers.

Connector	Port	Reverse RX/TX	Reverse RTS/CTS	Pull up CTS	Pull up DCD
J3	A	W26 *	W25 *	W5	W27
J4	B	W14 *	W13 *	W6	W28
J5	C	W12 *	W11 *	W7	W29
J6	D	W10 *	W9 *	W8	W30

* jumper pair

2.2.4.1.4 GPS Receiver Power Jumpers.

W33 and W34 are two position solder jumpers typically configured at the factory. If a GPS-1 receiver or GTS-ONE is used for the precision time source, it should be connected only to J2 of Multiplexer Module 1. W33 and W34 on the Multiplexer Module connected so that DRDY6 and DRDY7 are available at both J1 or J2 (jumpers installed between positions 1 and 2 of W33 and W34). This configuration is used when +12 VDC is not required to power any external timing source. It prevents any accidental connection on the J1 or J2 connectors that may be directed back to the Host Interface Module or an additional daisy-chained Multiplexer Module. If the ICP system uses a GPS-1 receiver jumpers W33 and W34 must be installed in position 2-3. By doing this, +12 VDC becomes available to the receiver at J2 pin 1 and DC common to J2 pin 2. Move jumpers W33 and W34 from position 1 and 2 to 2 and 3 if you need power for a receiver. The 12 VDC power on the Multiplexer Module is fuse protected and labeled F1.

2.2.4.1.5 Reserved Jumpers - Multiplexer Module.

Multiplexer Module jumpers W18 through W22 are reserved for future applications.

2.2.4.1.6 Reset Button - Multiplexer Module.

A reset button is provided on the Multiplexer Module. This switch (S1) performs a hardware reset.

2.2.4.1.7 Status Indicators - Multiplexer Module.

Table 2-3 lists and functionally describes each status indicator of the Multiplexer Module.

Table 2-3. Multiplexer Module status indicators.

CIRCUIT DESIG.	LABEL	DESCRIPTION	FUNCTION
DS1	RX	Four Position Red LED	Serial port data input (receive) activity. LED illuminated indicates a mark condition (+ input level). Indicators are Port A, B, C, D from left to right as viewed from face of LED package
DS2	TX	Four Position Amber LED	Serial port data output (transmit) activity. LED illuminated indicates a mark condition (+ output level). Indicators are Port A, B, C, D from left to right as viewed from face of LED package
DS3	ICP	Green LED	Indicates data communication active between Multiplexer Module and Host Interface Module.
DS4	1 PPS	Red LED	LED illuminated indicates 1 PPS input. Normal activity noted by LED flashing at 1 PPS rate.
DS5	PWR	Red LED	LED illuminated indicates +5 VDC logic power is applied to the module.

2.2.4.2 Connectors - Multiplexer Module

2.2.4.2.1 CSMA Protocol Connectors - Multiplexer Module.

High speed communications between the ICP Module and multiple Multiplexer Modules is via CSMA protocol communications, described in Appendix A of this manual. Multiplexer Module connector J1 is provided to accommodate this protocol. Connector J2 can be configured as an additional CSMA protocol port or as an interface port for GPS-1 or GTS-ONE time reference, depending upon jumper W33 and W34 configuration.

Connectors J1 and J2 are 15 pin 'D' male receptacles. Table 2-4 describes the J1 and J2 pin assignments.

If an external time reference (GPS-1 or GTS-ONE) if used should be connected to J2 of the first module (I.D. = 0) installed. Configure W33 and W34 jumpers as required for the time reference unit. If multiple Multiplexer Modules are configured (currently limited to a maximum of 5), the modules are daisy chained via cable P/N 990-60156-0101, from Module 0 connector J1 to module 1 connector J2, etc.. Connector J1 of the last configured Multiplexer Module shall be cabled to the ICP Host Interface Module via cable P/N 990-60156-0102.

Table 2-4. Multiplexer Module Connector J1 and J2 pin assignments.

Connector Pin	Applicable Jumper	Signal/Function
J1-1		Multiplexer Module 6 data ready (DRDY6) (not supported by current software)
J2-1	W33-1,2	Multiplexer Module 6 data ready (DRDY6) (not supported by current software)
	W33-2,3	+12 VDC (GPS-1 +V)
J1-2		Multiplexer Module 7data ready (DRDY7) (not supported by current software)
J2-2	W34-1,2	Multiplexer Module 7 data ready (DRDY7) (not supported by current software)
J2-2	W34-2,3	+12 VDC Common (GPS-1 -V)
J1-3, J2-3		SD + to/from ICP Host Interface Module
J1-4, J2-4		SD - to/from ICP Host Interface Module
J1-5, J2-5		Multiplexer Module 0 data ready (DRDY0)
J1-6, J2-6		Multiplexer Module 1 (if configured) data ready (DRDY1)
J1-7, J2-7		Multiplexer Module 2 (if configured) data ready (DRDY2)
J1-8, J2-8		Multiplexer Module 3 (if configured) data ready (DRDY3)
J1-9, J2-9		1PPS input from ICP Host Interface Module
J1-10, J2-10		Multiplexer Module 4 (if configured) data ready (DRDY4)
J1-11, J2-11		Multiplexer Module 5 (if configured) data ready (DRDY5)
J1-12, J2-12		TXT serial input to Radio Time Receiver
J1-13, J2-13		RXT serial output from Radio Time Receiver
J1-14, J2-14		Signal Common
J1-15, J2-15		1 PPS output from Time Reference to ICP

		Controller

2.2.4.2.2 RS232 Connections Connectors - Multiplexer Module.

Each Multiplexer Module has four ports for accepting RS-232 serial data from remote data acquisition systems. These ports are accommodated via connectors J3 through J6 (Ports A through D, respectively). Each connector is electrically configured identically to a standard PC RS-232, 9 Pin D connector. Jumpers are provided to configure each port as Data Terminal Equipment (DTE) or Data Communications Equipment (DCE). Port connector pin assignments are as shown in Table 2-5 (DTE configuration) unless modified by jumper configuration per paragraph 2.2.4.1.3.

2.2.4.2.3 Power Connector - Multiplexer Module.

+12 VDC power is applied to the Multiplexer Module via connector J7. This connector is a 2 pin header that mates with a 2 position right angle plug block (Precision Connector Designs Part No. ELFP02210). Pin 1 of J7 is on the left looking into the pins (toward the end of the board). The connections are:

Pin 1 + 12 VDC
Pin 2 Power Return

Table 2-5. Multiplexer Module RS-232 port connector pin assignments.

J3 - J6 Pin	Function
1	DCD (Data Carrier Detect), Input
2	RX (Receive Data), Input
3	TX (Transmit Data), Output
4	DTR (Data Terminal Ready), Output
5	Ground
6	Not Used
7	RTS (Request to Send), Output
8	CTS (Clear To Send), Input
9	Not Used

2.2.4.3 Specifications - Multiplexer Module

GENERAL	
CPU	80C152 Communications Controller
Data Buffer	32K x 8 CMOS Static RAM
EPROM Space	24K Bytes Maximum
CPU Clock	16 MHz
Input Baud Rate	38.4 K Baud maximum per port
Output Rate	2.0 M bps maximum
INPUT SPECIFICATIONS	
Type	RS232C Asynchronous
Number of Ports	4
Baud Rate	2400, 4800, 9600, 19200, 38400 baud(see Appendix B)
Data Format	DTS100, 49.70 or 49.60 in DTS Mode (see Appendix B)
Time Alignment	In the DTS Mode incoming data is synchronized to the 1 PPS input so that each 1 sec. block output will be synchronized data.
Fractional Delay	Selectable from 0 to 995 milliseconds in 5 ms increments.(see Appendix A)
OUTPUT SPECIFICATIONS	
Type	RS-485 CSMA Half Duplex
Bit Rate	400,000 bits per second
Control Lines	Positive Going Data Ready
Data Format	See Appendix A
MECHANICAL CHARACTERISTICS	
Size	3 5/8 in. x 10.0 in. x 5/8 in. (92.1 mm x 254 mm x 15.9 mm)
Weight	0.46 pounds (0.21 kg)
ENVIRONMENTAL CHARACTERISTICS	
Operating Temperature	0 to + 60 deg C
Storage Temperature	- 30 to + 85 deg C
Relative Humidity	5% to 95% non condensing
POWER REQUIREMENTS	
Voltage	10 to 13 Volts
Current	120 mA

2.2.5 32 CHANNEL DIGITAL TO ANALOG CONVERTER

The ICP 32 Channel D/A Module utilizes an Analog Devices AD766, 16-Bit DSP Dacport chip to provide a simple interface to TI's TMS320C31 DSP which is used on the Host Interface Module. The D/A chip accepts data from the serial port of the DSP and converts the data at 3200 conversions each second. The DSP controls the strobes for demultiplexing the data to 32 outputs at a 100 sample per second rate. Four CMOS deMultiplexer chips provide switching and eight Quad Op-Amps provide track and hold for the outputs. Power supply isolation is provided by four 12 volt to ± 12 volt DC/DC Converters. Each output is protected with a 100 ohm series resistor. The ± 3 volt output of the D/A is rescaled to give a ± 5 volt output for an input of +32767/-32768 counts.

2.2.5.1 Controls and Indicators - 32 Channel D/A Module

The 32 Channel D/A Module does not have nor require any operator configurable controls nor indicators.

2.2.5.2 Connectors - 32 Channel D/A Module

The 32 Channel D/A Module has a power connector, digital data and control input connector, and two 16 channel analog output connectors. These connectors are described physically and functionally in the following paragraphs. Figure 2-3 illustrates the location of connectors of the 32 Channel D/A Module.

2.2.5.2.1 Power Connector - J1 - 32 Channel D/A Module.

The 32 Channel D/A Module power connector, J1 is a 2 pin header that mates with a 2 pin right angle plug block (Precision Connector Designs P/N ELFP02210). Pin 1 of J1 is on the left looking into the pins. The J1 pin assignments are:

Pin 1	12 volts
Pin 2	Power Common

2.2.5.2.2 Digital Data Input and Control Connector - J3 - 32 Channel D/A Module.

D/A module control and data input is via connector J3, a 15 pin "D" type female receptacle. The mating connector is a 15 pin "D" type male plug, and is a part of Cable Assembly DA/ICP, Geotech Instruments P/N 990-60157-0101. The pin out description is shown in Table 2-6.

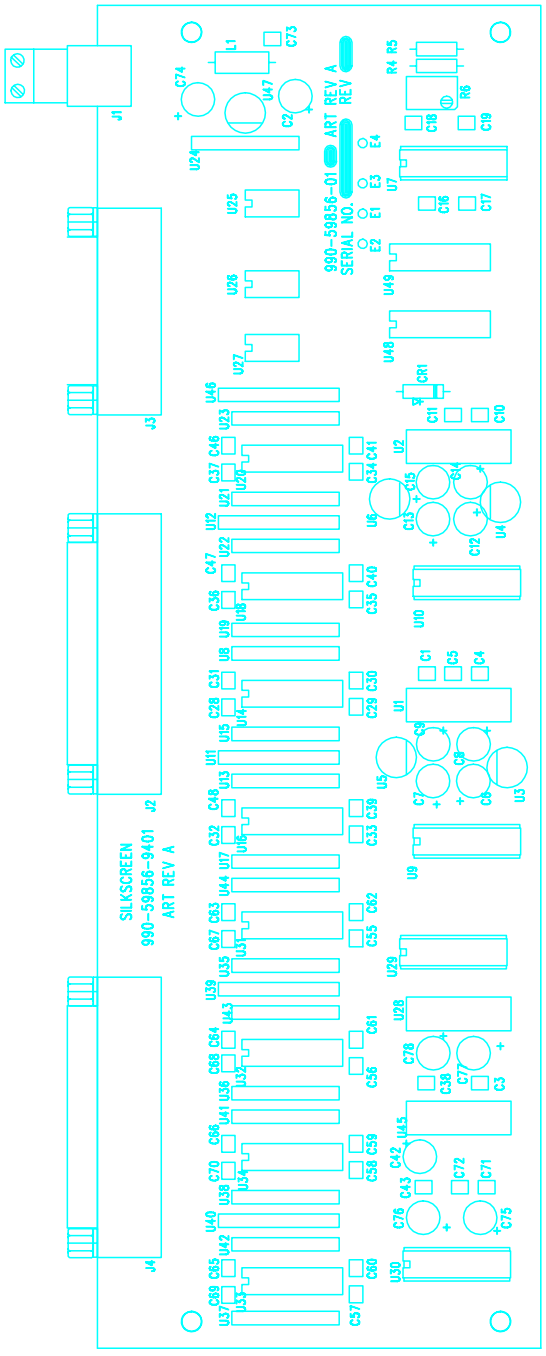


Figure 2-3 32 Channel D/A Module connector locations.

Table 2-6. 32 Channel D/A Module input connector J3 pin assignments.

Pin	Signal/Function
J3-1	D/AA0 - Address 0 to D/A 1 to 8 Demultiplexers
J3-2	D/AA1 - Address 1 to D/A 1 to 8 Demultiplexers
J3-3	D/AA2 - Address 2 to D/A 1 to 8 Demultiplexers
J3-4	DMUXE0 - Enable to Demultiplexer 0
J3-5	DMUXE1 - Enable to Demultiplexer 1
J3-6	DMUXE0 - Enable to Demultiplexer 2
J3-7	DMUXE0 - Enable to Demultiplexer 3
J3-8	DMUXE0 - Enable to Demultiplexer 4 (not used)
J3-9	CLKA - Clock to Serial Input 16 bit D/A (Normal Phase)
J3-10	CLKB - Clock to Serial Input 16 bit D/A (Reverse Phase)
J3-11	LEA - Latch Enable to Serial 16 bit D/A (Normal Phase)
J3-12	LEB - Latch Enable to Serial 16 bit D/A (Reverse Phase)
J3-13	DATA - Serial Data (Normal Phase)
J3-14	DATB - Serial Data (Reverse Phase)
J3-15	COMMON

2.2.5.2.3 Analog Output Connectors - J2 and J4 - 32 Channel D/A Module.

Analog output from the 32 Channel D/A Module is through two 25 pin “D” type female receptacles, J2 and J4. D/A module control and data input is via connectors J2 and J4. These connectors are both 25 pin “D” type female receptacles. Mating connectors are 25 pin “D” type male plugs. Pinouts for connectors J2 and J4 are shown in Table 2-7.

Table 2-7. 32 Channel D/A Module output connector (J2, J4) pin assignments.

Pin	Signal	Pin	Signal
J2-1	Channel 1 Output	J4-1	Channel 17 Output
J2-2	Channel 2 Output	J4-2	Channel 18 Output
J2-3	Channel 3 Output	J4-3	Channel 19 Output
J2-4	Channel 4 Output	J4-4	Channel 20 Output
J2-5	Channel 5 Output	J4-5	Channel 21 Output
J2-6	Channel 6 Output	J4-6	Channel 22 Output
J2-7	Channel 7 Output	J4-7	Channel 23 Output
J2-8	Channel 8 Output	J4-8	Channel 24 Output
J2-9	Channel 9 Output	J4-9	Channel 25 Output
J2-10	Channel 10 Output	J4-10	Channel 26 Output
J2-11	Channel 11 Output	J4-11	Channel 27 Output
J2-12	Channel 12 Output	J4-12	Channel 28 Output
J2-13	Channel 13 Output	J4-13	Channel 29 Output
J2-14	Channel 14 Output	J4-14	Channel 30 Output
J2-15	Channel 15 Output	J4-15	Channel 31 Output
J2-16	Channel 16 Output	J4-16	Channel 32 Output
J2-17	Analog Common	J4-17	Analog Common
J2-18	Analog Common	J4-18	Analog Common
J2-19	Analog Common	J4-19	Analog Common
J2-20	Analog Common	J4-20	Analog Common
J2-21	Analog Common	J4-21	Analog Common
J2-22	Analog Common	J4-22	Analog Common
J2-23	Analog Common	J4-23	Analog Common
J2-24	Analog Common	J4-24	Analog Common
J2-25	Power Ground	J4-25	Power Ground

2.2.5.3 Specifications - 32 Channel D/A Module

GENERAL	
Number of analog outputs	32
Sensitivity	152.6 microvolts per count
Accuracy	4% of FSR
Full Scale Output	10 volts peak-peak
Output sample rate	100 samples per second
Output Impedance	100 ohm
Dynamic Range	66dB
Resolution	16 Bits
MECHANICAL CHARACTERISTICS	
Size	3 5/8 in. x 10.0 in. x 5/8 in. (92.1 mm x 254 mm x 15.9 mm)
Weight	TBD
ENVIRONMENTAL CHARACTERISTICS	
Operating Temperature	0 to + 60 deg C
Storage Temperature	- 40 to + 85 deg C
Relative Humidity	10% to 85% non condensing
POWER REQUIREMENTS	
Voltage	+12.0 (+/- 2) VDC
Current	TBD

2.3 ICP Host Interface Module

The ICP/HOST Interface Module uses the Texas Instruments TMS320C31 digital signal processor (DSP) chip running at 25 Mhz., with two 32 bit x 256K RAM modules for application software and data buffers. The DSP also has an 8K x 32 bit EPROM array.

The interface to the ICP Multiplexer Module(s) is an Intel 80C152 communications controller. This chip interfaces to the DSP through four 8 bit x 1024 high speed FIFOs. Both the ICP/HOST and the ICP Multiplexer uses a PSD301 programmable system device. This chip pair provides the interface for connecting a GPS-1 Radio Time Receiver, providing BCD time of year every second.

The interface to the host computer is through dual-port RAM. The size of the dual-port RAM is 32K x 16 bits. An I/O port provides memory address selection and hardware control of the module from host software. The I/O port address is jumper selected from 0 hex to 3FF hex. The default setting is 150 hex. The module provides outputs to the 32 Channel Digital to Analog converter via the serial output of the DSP and demultiplexer port control outputs.

The I/O port base address provides access to an 8 bit control port. The bit assignments are:

Bit 0	least significant bit of memory page
Bit 1	most significant bit of memory page
Bit 2	address 14 of memory base address
Bit 3	address 15 of memory base address
Bit 4	reset DSP and Communications Controller
Bit 5	interrupt DSP
Bit 6	enable bit for memory read and DSP interrupt to host
Bit 7	enable bit clock

A read from the I/O port base address gives the contents of the control port. The I/O port base address plus one, provides an 8 bit latch for the most significant bits of the dual port base address:

Bit 0	address 16 of memory base address
Bit 1	address 17 of memory base address
Bit 2	address 18 of memory base address
Bit 3	address 19 of memory base address
Bit 4	address 20 of memory base address
Bit 5	address 21 of memory base address
Bit 6	address 22 of memory base address
Bit 7	address 23 of memory base address

A read from the I/O port base address plus one yields the latched contents. The interrupt to the host is jumper selected for IRQ3-7, IRQ9-12 or IRQ14-15. The dual-port memory has an area reserved for handshaking and configuration data. Most of this memory is for data requested by the host. The application software for the DSP is loaded from this memory into the DSP working memory during initialization.

2.3.1 Controls and Indicators - Host Interface Module

The Host Interface Module utilizes on board jumpers to configure interrupt levels (IRQ) to the host computer, output port address, and 1 pulse per second (1PPS) input polarity. The jumpers and their use are described in the following paragraphs. Figure 2-3 illustrates the location of all controls, indicators and connectors of the Host Interface Module.

2.3.1.1 Interrupt Level Selection - Host Interface Module.

Host Interface Module interrupt request levels are defined in Table 2-8.

Table 2-8. Host Interface Module interrupt select jumpers.

Jumper	IRQ	Description
W1	IRQ2/9	Interrupt Request 9, redirected to IRQ2
W2	IRQ7	Interrupt Request 7, normally used for LPT
W3	IRQ6	Interrupt Request 6, normally used for floppy disk
W4	IRQ5	Interrupt Request 5, normal IRQ for floppy disk
W5	IRQ4	Interrupt Request 4, normal IRQ for COM port
W6	IRQ3	Interrupt Request 3, normal IRQ for COM port
W7	IRQ10	Interrupt Request 10, Unassigned
W8	IRQ11	Interrupt Request 11, Unassigned
W9	IRQ12	Interrupt Request 12, Unassigned
W10	RQ15	Interrupt Request 15, Unassigned
W11	RQ14	Interrupt Request 14, normal IRQ for hard disk

2.3.1.2 Output Port Address Selection - Host Interface Module.

Eight jumpers are provided to allow the ICP Port Address to be selected from 0 hex to 3FF hex, in steps of 4. Each jumper has a binary weight as indicated in Table 2-9. The Host Interface Module uses the jumper configured port address and this address plus 1.

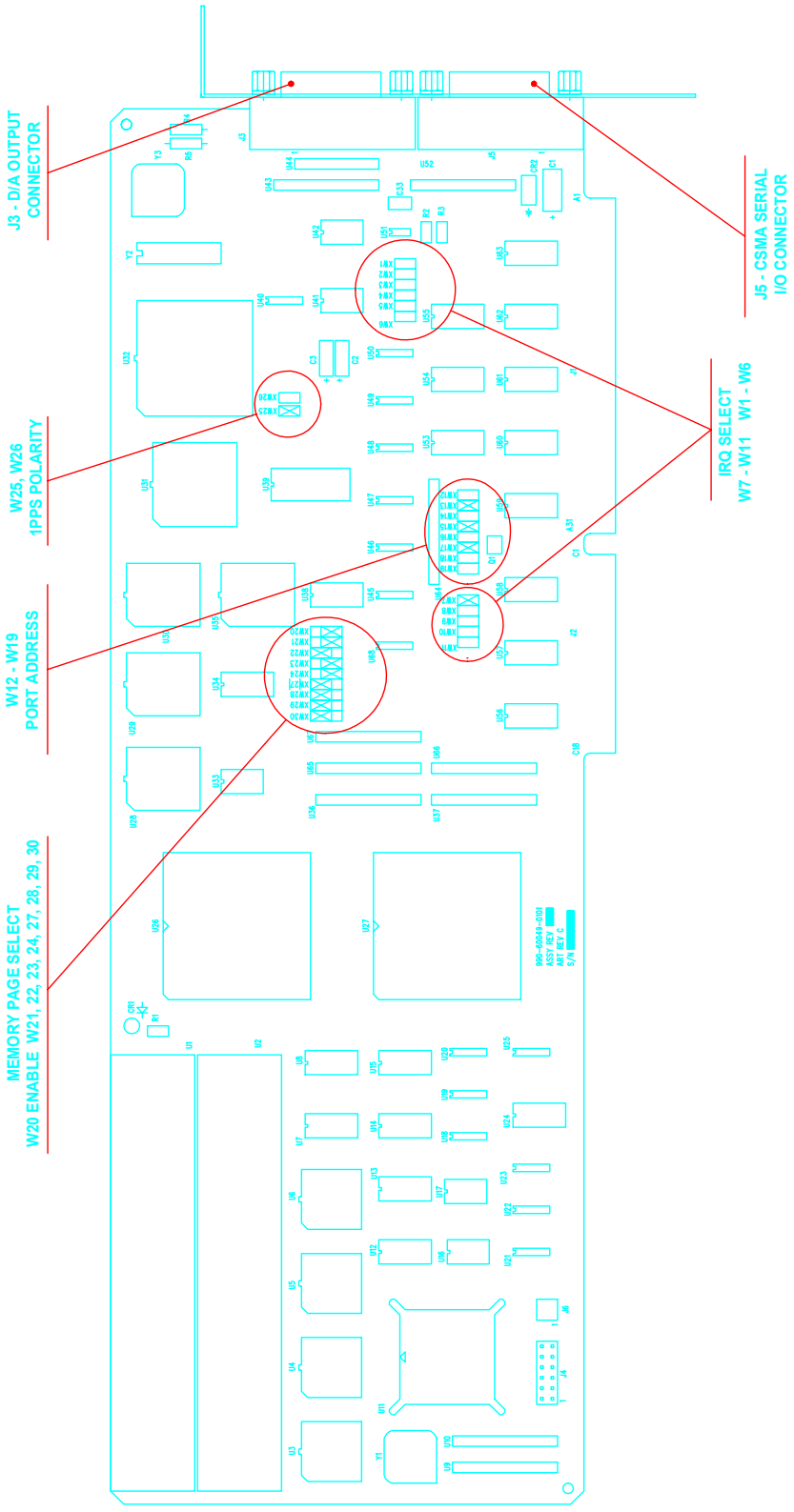


Figure 2-4 Controls, indicators and connectors of the Host Interface Module.

Table 2-9. Host Interface Module output port address selection.

W12	W13	W14	W15	W16	W17	W18	W19	I/O Port Base Address
						open	open	0 hex
						open	jumper	4 hex
						jumper	open	8 hex
open	open	open	open	open	open			000 hex
open	open	open	open	open	jump			010 hex
open	open	open	open	jump	open			020 hex
open	open	open	jump	open	open			040 hex
open	open	jump	open	open	open			080 hex
open	jump	open	open	open	open			100 hex
jump	open	open	open	open	open			200 hex

The weights of all installed jumpers are added to determine the ICP Port Address.

Example: Jumpers installed at W12, W16, W17 and W19 = port address 234 hex. Module thus uses port addresses 234 hex and 235 hex.

2.3.1.3 One PPS Input Polarity Select - Host Interface Module.

The normal one second pulse input is negative going on the second. W25 is jumpered, at factory, for a negative going input. If a positive input is used the jumper on W25 should be removed and replaced on W26.

CAUTION

Installing jumpers on both W25 and W26 can cause hardware damage and/or cause erratic ICP operation.

2.3.1.4 Dual Port Memory Base Address

The Dual Port memory base address can be set by software through the I/O port as described in section 2.3 or by hardware jumpers on the board. However, the hardware jumper method is normally used as it is the most compatible method with the widest range of PC computer hardware.

Jumper W20 is used to enable or disable the I/O port software register. When installed on pins 2 to 3, the I/O port software register is enabled and software can select the Dual Port memory base address. When in this mode no jumpers should be installed on jumpers W21 – 24 and W27 – 30. When jumper W2 is installed on pins 1 to 2, the I/O port software register is disabled and jumpers W21 – 24 and W27 – 30 are used to select the Dual Port memory base address. This is the normal mode of operation.

Jumpers W21 – 24 and W27 – 30 are used to compare with the upper 8 bits of the address to select the 64K byte memory page to use. Table 2-10 shows how jumpers W21 – 24 and W27 – 30 are used to select the Dual Port memory base address. When a jumper is installed between pins 1 to 2, a logic high (1) signal is selected. When a jumper is installed between pins 2 to 3, a logic low (0) signal is selected. Each must have a jumper installed in one or the other positions for proper operation. Note that the 0D0000h base page address is standard for the ICP system and should not be change except under the direction by Geotech engineers.

Table 2-10. Dual Port Memory Base Address Jumpers

Address	W30 (A23)	W29 (A22)	W28 (A21)	W27 (A20)	W24 (A19)	W23 (A18)	W22 (A17)	W21 (A16)
0B0000h	2-3	2-3	2-3	2-3	1-2	2-3	1-2	1-2
0C0000h	2-3	2-3	2-3	2-3	1-2	1-2	2-3	2-3
0D0000h	2-3	2-3	2-3	2-3	1-2	1-2	2-3	1-2
0E0000h	2-3	2-3	2-3	2-3	1-2	1-2	1-2	2-3
0F0000h	2-3	2-3	2-3	2-3	1-2	1-2	1-2	1-2

2.3.2 Connectors - Host Interface Module

Host Interface Module is configured with four connectors. J1 and J2 are IBM PC bus compatible card edge connectors having pinout assignments compatible with the IBM standard AT pinout. Connector J3 provides outputs for the 32 channel digital to analog converter board and J5 provides the high speed CSMA I/O connection for up to 6 four port Multiplexer Modules. Connector pinouts are described in the following paragraphs.

2.3.2.1 J3 - 32 Channel D/A Output Connections - Host Interface Module.

J3 is a 15 pin “D” female receptacle. The mating cable is Geotech P/N 990-60157-0101. The J3 pin out description is in Table 2-11.

Table 2-11. Host Interface Module digital to analog port connector (J3).

J3 Pin	Function
Pin 1	D/AA0 - Address 0 to D/A 1 to 8 Demultiplexers
Pin 2	D/AA1 - Address 1 to D/A 1 to 8 Demultiplexers
Pin 3	D/AA2 - Address 2 to D/A 1 to 8 Demultiplexers
Pin 4	DMUXE0 - Enable to Demultiplexer 0
Pin 5	DMUXE1 - Enable to Demultiplexer 1
Pin 6	DMUXE0 - Enable to Demultiplexer 2
Pin 7	DMUXE0 - Enable to Demultiplexer 3
Pin 8	DMUXE0 - Enable to Demultiplexer 4 (not used)
Pin 9	CLKA - Clock to Serial Input 16 bit D/A (Normal Phase)
Pin 10	CLKB - Clock to Serial Input 16 bit D/A (Reverse Phase)
Pin 11	LEA - Latch Enable to Serial 16 bit D/A (Normal Phase)
Pin 12	LEB - Latch Enable to Serial 16 bit D/A (Reverse Phase)
Pin 13	DATA - Serial Data (Normal Phase)
Pin 14	DATB - Serial Data (Reverse Phase)
Pin 15	Common

2.3.2.2 J5 - CSMA Protocol Connectors - Host Interface Module.

Connector J5 provides the connection between the Host Interface Module and the remote Multiplexer Modules. J5 connector pinout descriptions are shown in Table 2-12.

Table 2-12. Host Interface Module connector J5 pin assignments.

Connector Pin	Signal/Function
J5-1	DRDY6 - Multiplexer Module 6 (if configured) data ready
J5-2	DRDY7 - Multiplexer Module 7 (if configured) data ready
J5-3	SD + to/from ICP Multiplexer Module
J5-4	SD - to/from ICP Multiplexer Module
J5-5	DRDY0 - Multiplexer Module 0 data ready
J5-6	DRDY1 - Multiplexer Module 1 (if configured) data ready
J5-7	DRDY2 - Multiplexer Module 2 (if configured) data ready
J5-8	DRDY3 - Multiplexer Module 3 (if configured) data ready
J5-9	1PPS input from ICP communications controller
J5-10	DRDY4 - Multiplexer Module 4 (if configured) data ready
J5-11	DRDY5 - Multiplexer Module 5 (if configured) data ready
J5-12	TXT serial output to Time Receiver
J5-13	RXT serial input from Time Receiver
J5-14	Signal Common
J5-15	1 PPS input to communications controller

2.3.3 Specifications - Host Interface Module

HOST PERSONAL COMPUTER	
Slot Requirement	1 Full size AT slot (16 bit ISA bus)
Host Memory requirement	16k byte memory window
SERIAL INTERFACE	
Protocol	CSMA
Coding Scheme	Manchester Encoding
Speed	400,000 clocks per second (1 bit transfer per clock)
Overhead	ICP data - 0.7% to 2% Format and hand shake - 2.3% to 7%
MECHANICAL CHARACTERISTICS	
Size	4.80 in. High x 13.85 in. Long x 0.75 in. Thick
Weight	TBD
ENVIRONMENTAL CHARACTERISTICS	
Operating Temperature	0 to + 50 deg C
Storage Temperature	- 30 to + 85 deg C
Relative Humidity	10% to 85% non condensing
POWER REQUIREMENTS	
Voltage	+5.0 Volts +/- 0.25 volts
Current	TBD

3. INSTALLATION

3.1 GENERAL

Installation of the ICP System consists of:

- Configuration and installation of the Multiport Controller unit;
- Configuration and installation of the Host Interface Module;
- Installation of interconnecting cables;
- Installation and connection of optional timing system;
- Installation and configuration of operating software.

Each of these installation topics is discussed in detail in a paragraph to follow.

3.2 UNPACKING AND INSPECTION

Upon receipt of shipment, carefully inspect the shipping documentation to insure all crate or other containers are accounted for. Additionally, examine all shipping containers and their contents for damage. Immediately notify the shipping agent and Geotech Instruments, LLC of any damage noted.

A packing list showing specific package contents will be provided with each shipment. A typical shipment will include the following contents:

- ICP System including
  - Multiport Controller;
  - Host Interface Module, P/N 990-60049-0101;
  - Cable Assembly, Mux. to Mux./ICP, P/N 990-60156-0102;
  - Operation and Maintenance Manual, P/N 990-59660-9800;
  - Power Cable, Belden P/N 17250.
-
- Optional Items, possibly including:
  - GPS-1 Interface Cable, P/N 990-59878-0106;
  - Cable Assembly, Mux. to GTS-ONE, P/N 990-60172-0101;
  - Cable Assembly, DA to ICP, P/N 990-60157-0101.

Compare package contents to the enclosed packing list to verify all items are accounted for. Notify Geotech Instruments, LLC of any missing or damaged items.

3.3 INSTALLATION PLANNING

Prior to placement or installation of any component of the ICP System, careful consideration should be given to the overall installation plan. In particular, attention should be given to such aspects as serviceability, environment, and simplicity of installation.

Typically, the installation environment requirement is driven by the host computer. The host computer should be installed in an area meeting minimum environmental requirements as specified by the manufacturer of the device. Other considerations include availability of equipment rack space for installation of the Multiport Controller enclosure, and cable length requirements between the various system components.

3.3.1 Host Computer Recommended Performance

The ICP Host Interface installs in a host computer having the following recommended minimum specifications:

Hardware Architecture/Speed	Pentium - 200
Operating System	**MicroSoft Windows NT™** V4.0 with service pack 4
Random Access Memory	64 Mbytes
Hard Disk	1 Gbyte
Available RAM Window	16 kBytes
CPU Slot requirement	Full size AT slot, 16 bit ISA bus

Host computer specifications not meeting the above recommendations may result in a corresponding reduction of system performance.

3.3.2 Equipment Location

Standard or special order cable lengths must be considered when selecting locations of the various equipment items. Standard cable lengths are indicated in the following table. Consult the factory if other cable lengths are desired. mating connectors for the Multiplexer data I/O and D/A port are provided, but it is the responsibility of the user to assemble the required cables.

Table 3-1. Standard ICP System Cable Lengths

Cable Assembly, Mux. to ICP, P/N 990-60156-0102 (Multiport Controller to Host Computer)	25 Feet (7.6 M)
Cable Assembly, DA to ICP, P/N 990-60157-0101 (Multiport Controller to Host Computer)	25 Feet (7.6 M)
GPS-1 Interface Cable, P/N 990-59878-0106 (Multiport Controller to Host Computer)	100 Feet (30.48 M)
Cable Assembly, Mux. to GTS-ONE (Multiport Controller to GTS-ONE)	10 Feet (3.05 M)

3.4 INSTALLATION OF MULTIPORT CONTROLLER

As described in previous sections of this document, the Host Interface Module is designed for installation in an **IBM™** standard personal computer (AT) running the ***MicroSoft WindowsNT™*** operating environment. The Host Interface Module requires one 16 bit ISA bus slot. Prior to installation of the Host Interface Module in the host computer system, the user must determine the starting address of an available 16kByte memory block that can be dedicated to the ICP software task, as well as an available hardware interrupt level. It is also necessary to configure Host Interface Module for the selected memory address and interrupt level through the on board configuration jumpers.

3.4.1 Determination of Available Host Resources.

To determine available host computer resources, the PC should first be booted in the ***MicroSoft WindowsNT™*** environment. From the ***MicroSoft WindowsNT™*** program manager, select **FILE**, **RUN**, and enter ***WINMSD.EXE***. From the ***WINMSD*** screen, select **IRQ/Port Status**. Under the screen area labeled **INTERRUPTS**, examine the list of interrupts currently in use, and select an unused interrupt level for use with the ICP System (typically IRQ 10 is available). Similarly, from the **PORT** area, examine the ports (port addresses) currently in use. Select an unused port address (typically 150h) for the ICP System. Make a note of the selections made for later system configuration.

Upon completion of the above steps select **OK** to return to the main ***WINMSD*** menu, then select the **DMA/MEMORY** button. As above, examine the tables to determine the start address (physical address) of an available 16 kByte (length = 4000h) contiguous memory block. Typically B0000H is available. As above, make note of

the selected start address for system configuration as described in the following paragraph. Exit the ***WINMSD*** program upon completion of these steps.

Consult the ***MicroSoft WindowsNT™*** documentation for additional information on the use of the ***WINMSD*** program.

3.4.2 Registry of Selected System Parameters

To be added

3.4.3 ICP Host Interface Module Configuration

Adjust the Host Interface Module configuration jumpers to reflect the I/O Port Address and IRQ levels as selected in preceding paragraphs. Refer to paragraph 2.2.5.1 of the manual for jumper configuration details.

3.4.4 Physical Installation of the Host Interface Module

The Host Interface Module requires a full length AT card slot (16 bit ISA bus) of the host computer. Refer to the computer system vendor's manual for installation instructions for system expansion and/or third party devices.

3.5 INSTALLATION OF MULTIPORT CONTROLLER

The Multiport Controller, described in previous section of this document, provides the necessary hardware interface between the Host Interface Module and external communications equipment, analog waveform recording devices and external timing system hardware.

The Multiport Controller enclosure is designed for installation in a 19" E.I.A. standard equipment rack. The enclosure front panel requires a vertical panel space of 4 rack units (7 inches) and 9.5 inches (24 cm) of rack depth, not including cable entry. The device should be mounted in a user supplied equipment rack using rack mount screws supplied by rhe rack vendor.

3.6 ICP SYSTEM CABLING

ICP System cabling involves the interconnection of Multiplexer modules within the Multiport Controller (typically accomplished prior to shipment from the factory), interconnection of Multiplexer Modules with the Host Interface Module, interconnection of the Host Interface Module D/A output to the D/A Module in the Multiport Controller, interconnection of the D/A Module outputs to the analog recording devices, and interconnection of external serial data streams to the Multiplexer Module and serial ports.

Typical ICP System interconnections are shown in Figure 3-1 of this document. Figure 3-2 indicates the Multiplexer and D/A Module positions within the Multiport Controller. Table 3-2 tabularizes required and optional interconnections. Specific connector/function pinouts are described in Chapter 2 of this document.

CAUTION

INSTALLATION OF CABLING BETWEEN ICP SYSTEM DEVICES AND BETWEEN ICP SYSTEM AND EXTERNAL DEVICES REQUIRE THE MULTIPORT CONTROLLER COVER TO BE REMOVED. THIS EXPOSES THE INSTALLATION TECHNICIAN TO POSSIBLE DANGEROUS ELECTRICAL CIRCUITS. INSTALLATION TECHNICIANS ARE ADVISED TO TAKE PROPER PRECAUTIONS WHILE INSTALLING/SERVICING

3.7 HOST COMPUTER SOFTWARE INSTALLATION

To be added

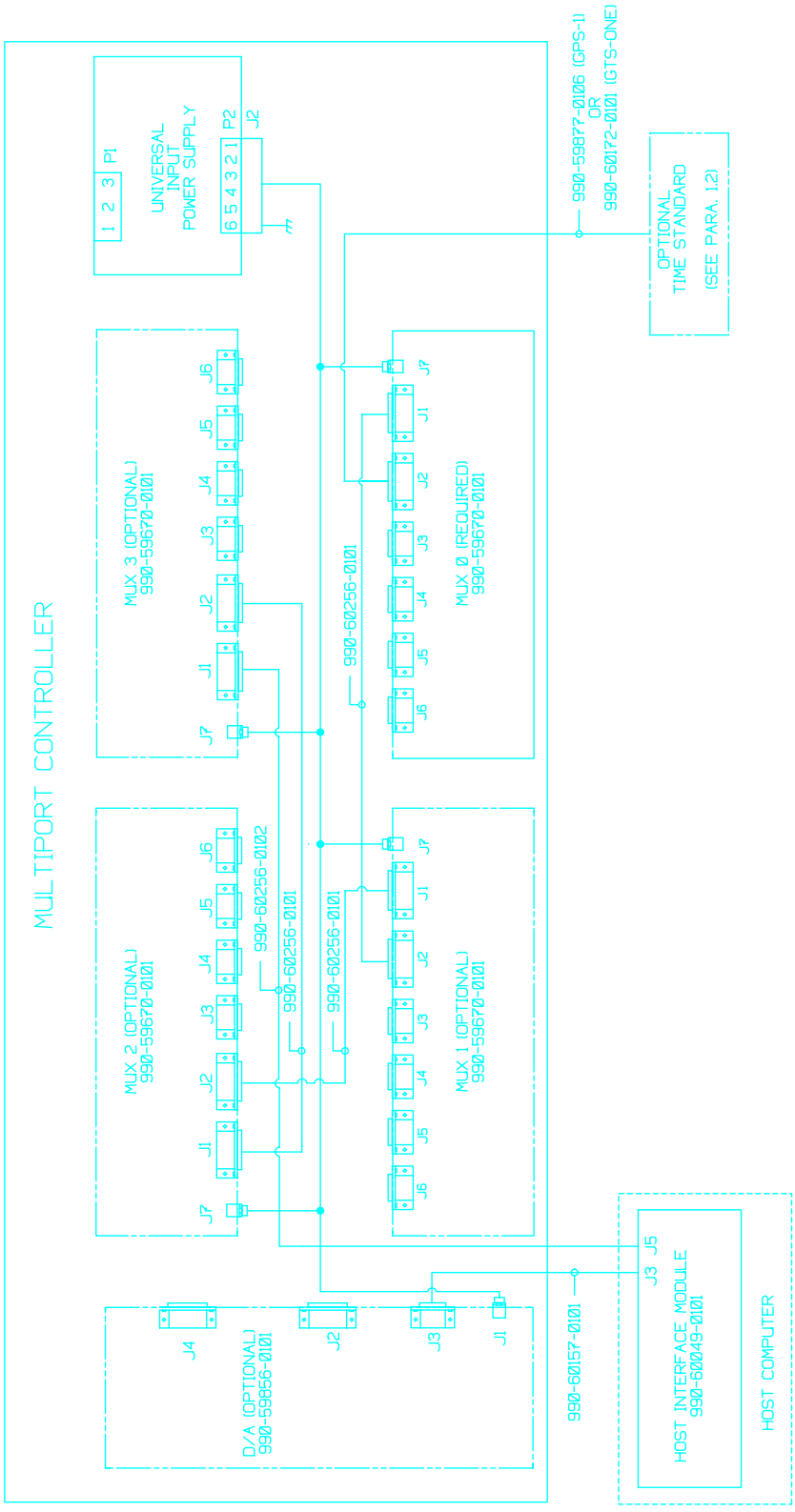


Figure 3-1 Typical ICP interconnection diagram.

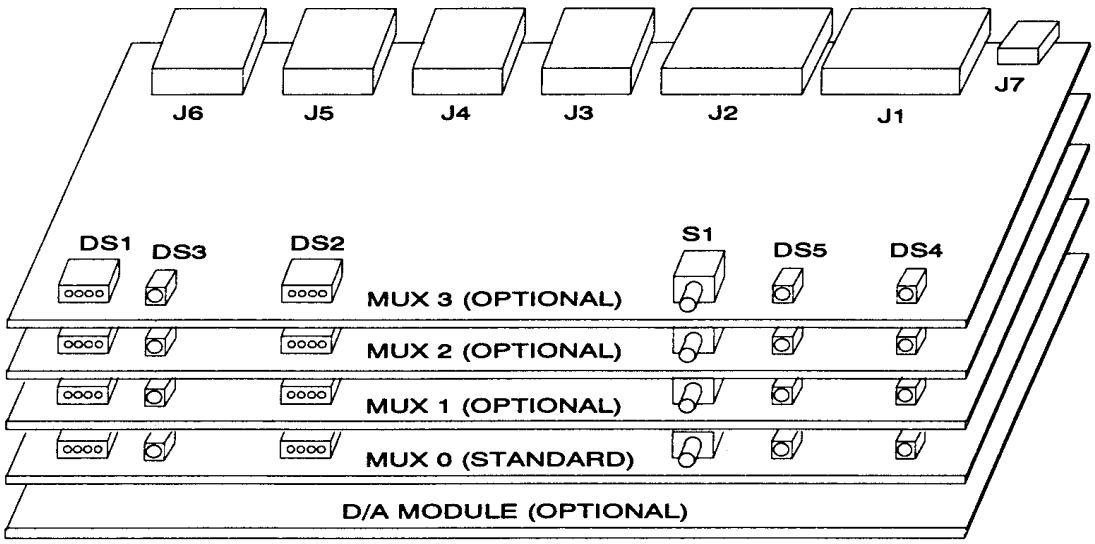


Figure 3-2 Multiport Controller internal module positions.

Table 3-2 ICP System cabling

FROM		TO		
MODULE	CONNECTOR	MODULE	CONNECTOR	CABLE
EXTERNAL RS-232 SERIAL DATA SOURCES 1-4		MUX 0 (CONTROLLER #1)	J3, J4, J5, J6	USER SUPPLIED AS REQUIRED (NOTE 2)
EXTERNAL RS-232 SERIAL DATA SOURCES 5-8		MUX 1 (CONTROLLER #1)	J3, J4, J5, J6	USER SUPPLIED AS REQUIRED (NOTE 2)
EXTERNAL RS-232 SERIAL DATA SOURCES 9-12		MUX 2 (CONTROLLER #1)	J3, J4, J5, J6	USER SUPPLIED AS REQUIRED (NOTE 2)
EXTERNAL RS-232 SERIAL DATA SOURCES 13-16		MUX 3 (CONTROLLER #1)	J3, J4, J5, J6	USER SUPPLIED AS REQUIRED (NOTE 2)
EXTERNAL RS-232 SERIAL DATA SOURCES 17-20		MUX 0 (CONTROLLER #2)	J3, J4, J5, J6	USER SUPPLIED AS REQUIRED (NOTE 2)
EXTERNAL RS-232 SERIAL DATA SOURCES 21-24		MUX 1 (CONTROLLER #2)	J3, J4, J5, J6	USER SUPPLIED AS REQUIRED (NOTE 2)
EXTERNAL TIME STANDARD (GPS-1)		MUX 0 (CONTROLLER #1)	J2	990-59877-0106 (NOTE 3)
OR				
EXTERNAL TIME STANDARD (GTS-ONE)		MUX 0 (CONTROLLER #1)	J2	990-60172-0101 (NOTE 3)
MUX 0 (CONTROLLER #1)	J1	MUX 1 (CONTROLLER #1)	J2	990-60156-0101
MUX 1 (CONTROLLER #1)	J1	MUX 2 (CONTROLLER #1)	J2	990-60156-0101
MUX 2 (CONTROLLER #1)	J1	MUX 3 (CONTROLLER #1)	J2	990-60156-0101
MUX 3 (CONTROLLER #1)	J1	MUX 0 (CONTROLLER #2)	J2	990-60156-0102
MUX 0 (CONTROLLER #2)	J1	MUX 1 (CONTROLLER #2)	J2	990-60156-0101
MUX 1 (CONTROLLER #2)	J1	HOST INTERFACE MODULE	J5	990-60156-0102 (NOTE 4)
HOST INTERFACE MODULE	J3	D/A MODULE	J3	990-60157-0101
D/A MODULE	J2	EXTERNAL ANALOG RECORDER		USER SUPPLIED AS REQUIRED (NOTE 1)
D/A MODULE	J4	EXTERNAL ANALOG RECORDER		USER SUPPLIED AS REQUIRED (NOTE 1)

NOTES:
1. TABLE ASSUMES A FULL COMPLEMENT OF MULTIPLEXER MODULES (6) WHICH REQUIRES TWO MULTIPORT CONTROLLERS.
2. MATING CONNECTORS FOR CONNECTIONS TO EXTERNAL DEVICES ARE PROVIDED WITH THE UNITS. SEE SECTION 2 OF THIS DOCUMENT FOR CONNECTOR PIN ASSIGNMENTS.
3. OPTIONAL TIME STANDARD MUST BE CONNECTED TO J2 OF MUX 0. CONFIGURE MUX 0 W33, W34 JUMPERS AS REQUIRED FOR TIMING SYSTEM USED.
4. CONNECTION TO HOST INTERFACE MODULE MUST BE FROM J1 OF LAST CONFIGURED MULTIPLEXER MODULE.

4. OPERATION

4.1 GENERAL

This section of the **Intelligent Communications Processor System Installation and Operation Manual** describes the procedures for controlling the functionality and configuration of the system. In this section, the various host computer display screens will be pictured with necessary supporting text to describe the purpose of the particular screen display and define the parameters associated with the particular screen. The ICP system is designed to operate in the **MicroSoft WindowsNT™** environment. It is thus necessary that the user become familiar with this operating system prior to attempting to install, configure or use ICP.

4.2 ICP SOFTWARE OPERATION

With the host computer booted in the **MicroSoft WindowsNT ™** environment, the **NT** Desktop screen will display several ICP related icons in addition to many of the standard ones, similar to that shown in Figure 4-1. The ICP specific programs, *Icpacq, Icprtd, Locate, Cmdicp*, and *Drsetup* can also be executed by selecting the **START** button on **NT**'s Task Bar. This selection displays the ICP Utilities option which provides access to the five ICP specific programs.

To configure the ICP system, select the *Cmdicp* icon. This selection displays the ICP configuration window, as show in Figure 4-2. Initially, all system parameters must be defined. Subsequent changes to the system's configuration or the initial setup can be accessed through the **Configure** selection on the **Cmdicp** tool bar. Section 4.2.1 explains each parameter in detail and defines the acceptable values for each field.

Select the *Icpacq* icon to initialize the ICP hardware and begin acquisition. This selection uses the information provided in the configuration file for task management and system control. After selecting this option, the ICP may display several messages in the pop-up window. Initially, the last message displayed in the window is GPS time. Before the ICP system will start, GPS time must be valid. This window also displays event detection information if the system is configured for that mode and a trigger condition exists. Other miscellaneous error condition message can also be viewed in the window.

The real time display program which is used to display stored data or real time channel information can be activated by selecting the *Icprtd* icon. After selecting this option, the initial window shown in Figure 4-17 is displayed. Many of the available options that are used to manipulate the collected data is described in Section 4.5.

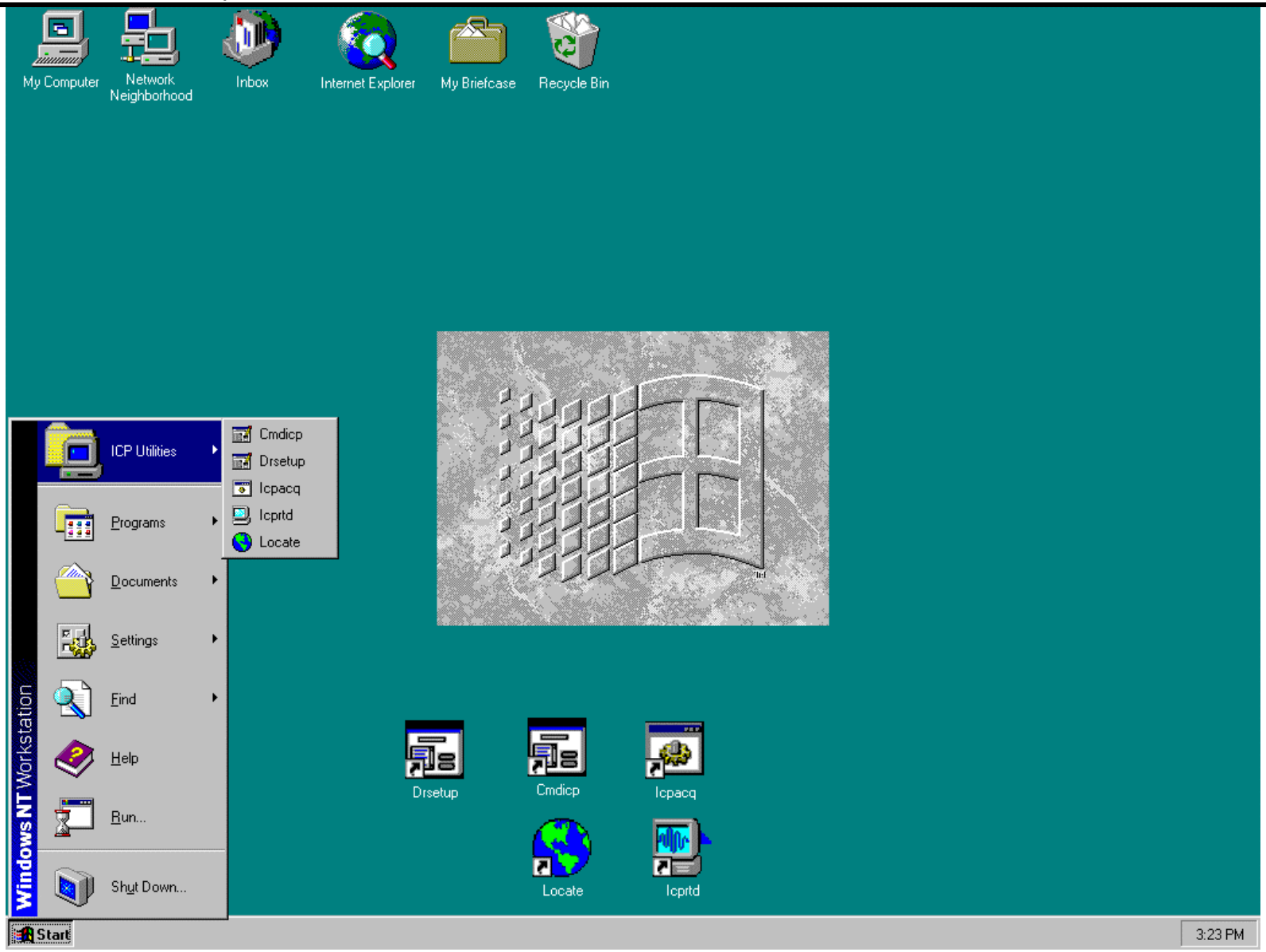


Figure 4-1. ICP Startup Screen

To initiate the ICP location program, select the *Locate* icon. This program can also be launched within the **Cmdicp** setup screen. Using this program to locate an event can only be accomplished if proper configuration settings are met. Refer to section 4.2.3 for configuration information.

The *Drsetup* icon conveniently activates the DR-24 configuration program. This routine is used to remotely configure the DR-24 acquisition system. Appendix E contains figures detailing each setup screen and additional information related to the setup of a DR-24 acquisition system.

The initial ICP screen is shown in figure 4-2. As indicated by this figure, the ICP software window title, menu, tool and status bars have the same look and functionality as other ***MicroSoft Windows™*** or ***WindowsNT™*** applications. Only the menu bar **Configure** and **Record** functions will be treated in detail in this document. While using ICP software, the status bar displays messages that are helpful to the user in the selection of various options. Menu item scroll bars and arrows are provided with many of the menu entries to show current configurations and/or acceptable menu item parameters.

Several system menus contain **Current Value** and **Entry Select** windows. With the selection of valid **Port**, **Mux Port**, or **Station Name Component**, as described in subsequent paragraphs, the **Current Value** field will reflect the existing configuration of the associated parameters listed in the **Entry Select** portion of the window. To add or modify an **Entry Select** field content, place the mouse cursor within the desired entry field then type an acceptable parameter value. Alternatively, point and click (left mouse button) on the pull down button (down arrow) associated with the desired **Entry Select** item. The resulting pull down will list all acceptable Input parameters.

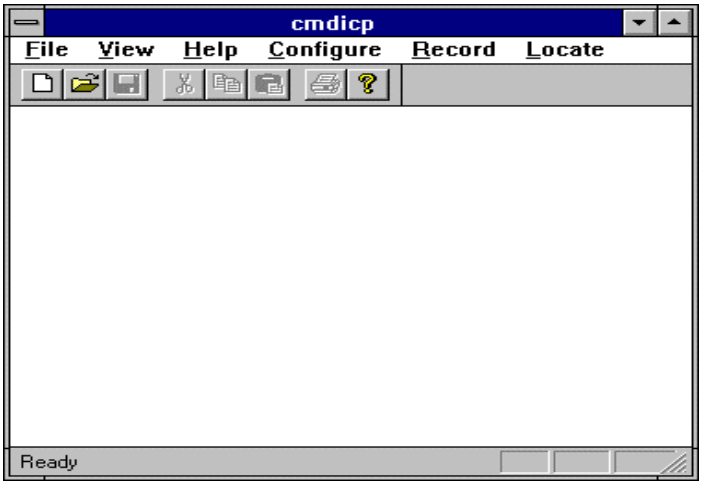


Figure 4-2. Initial ICP screen display.

Scroll to the desired value and left mouse click on the value. With each **Entry Select** entry or modification, the system will prompt for confirmation or cancellation of the entry or change. An operator response is required before continuing.

Most menus will contain an **OK** button which must be selected to return to the previous menu and activate any configuration additions or modifications.

4.2.1 ICP Configuration

ICP configuration is initially selected and/or modified through the ICP menu bar **Configure** button. Selection of this button pulls down an additional menu window as shown in figure 4-3. Each of the **Station Parameters** options are discussed in the following paragraphs.

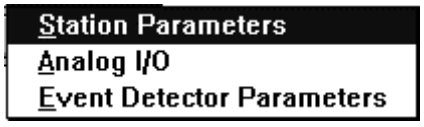


Figure 4-3. ICP **Configure** pull down menu.

4.2.1.1 ICP Configuration - Station Parameters

Selection of the **Station Parameters** button of the **Configure** pull down menu pulls down an additional menu as shown in figure 4-4. Through this menu, the user defines station particular information about remote data sites, ICP Multiplexer configuration and Multiplexer port specific information and configuration. Each item of the **Station Parameters** pull down men is discussed in the following paragraphs.

4.2.1.1.1 Station Parameters - Names

Selection of the **Names** button of the **Station Parameters** pull down displays an additional window (**Station Name Component Description**) as shown in figure 4-5. ICP will accommodate up to 60 seismic data channels at 100 samples per second per channel. These data channels can be input in any combination of one to three channels per incoming serial data link (Multiplexer port) for a maximum of twenty four ports. Through this menu, users must provide a unique name for each seismic data channel to be configured. **Station Name Component Descriptions** are limited to six characters and typically include characters to define a unique remote station as well as sensor and/or bandpass characteristics. Typical name styles may be such as ABCSPV or ABCBBN, where the station name is ABC and SPV represents

a short period vertical component and BBN represents a broadband North-South component.

The **Current List** pull down lists all currently configured **Station Name Component Descriptions**. The **Entry** field allows adding or delete specific station/component names via the **Add** and **Delete** buttons. Upon completion of configured **Station Name Component Descriptions** modifications, the **OK** button must be selected to return to the **Station Parameters** pull down menu.

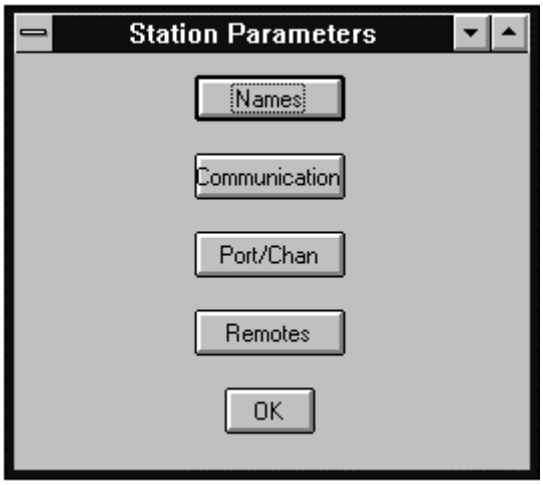


Figure 4-4. ICP **Station Parameters** menu.

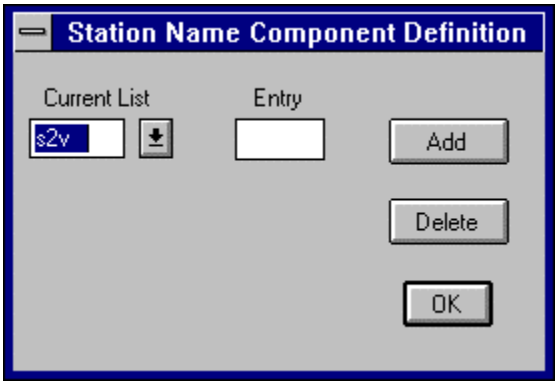


Figure 4-5. Station Name Component Definition pull down window.

4.2.1.1.2 Station Parameters - Communications

ICP Multiplexer ports are configured through the **Communication** pull down screen from **the Station Parameters** menu. This screen is illustrated in Figure 4-6 and each entry is described in Table 4-1.

Upon completion of **ICP Multiplexer Port Definition** configuration, modification or review, select **OK** to return to the **Station Parameters** screen.

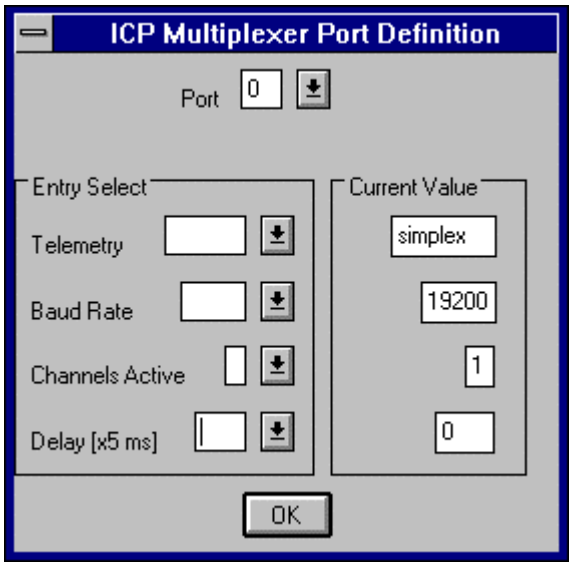


Figure 4-6. ICP **Multiplexer Port Definition** screen.

4.2.1.1.3 Station Parameters - Port/Chan

Each ICP port data stream can accommodate from 1 to 3 seismic data channels as defined in paragraph 4.2.1.1.1. Each of these channels must be configured as to the type and characteristics of digital data filters that are to be applied prior to data file display or archive. This is accomplished through the **Port/Chan**. button selection from the **Station Parameters** pull down. The resulting **ICP Port-Channel Definition** screen is shown in Figure 4-7. Specific filter characteristics are presented in Appendix C of this document. Screen data fields are described in the following:

Station Name Component This parameter must match one of the Station Name Component entries configured under Station Parameters - Name of paragraph 4.2.1.1.1. A blank or no entry associated with a

Table 4-1. **ICP Multiplexer Port Definition** menu entries.

Field or Entry Select	Description of Entry
Port	An ICP **Port** is defined as one of four RS-232 I/O ports of each Multiplexer Module. An ICP system is capable of supporting up to 5 Multiplexer Modules, thus a total of 20 ports are possible. Each configured port is assigned a unique number from 0 to 19, sequentially, starting with Multiplexer Module 0 (MUX0) port A.
Telemetry	Acceptable values for the **Telemetry** parameter are limited to **simplex**, if only one way communication (data receive) is utilized, or **duplex** if the network utilizes two way communication.
Baud Rate	The **Baud Rate** parameter specifies the configured baud rate for the serial data I/O port. Acceptable **Baud Rate** values expressed as bits per second are: 1,200 9,600 2,400 19,200 4,800 38,400
Channels Active	Specifies the number of channels in the selected port to be recognized by the system. Acceptable values are: 0, 1, 3. To turn off all channels, select 0. To make 1 or 3 channel(s) active select 1 or 3 respectively.
Delay (x5 ms)	This parameter allows for compensation for known transmission delays. The use of this parameter is non essential for systems whose data are time tagged at the remote sensor site. If, however, data is time tagged at the receiving location, the delay can become significant and require compensation for accurately time tagged data. Acceptable parameters are integer values from 1 to 200, with the selected value representing a multiple of 5 milliseconds.

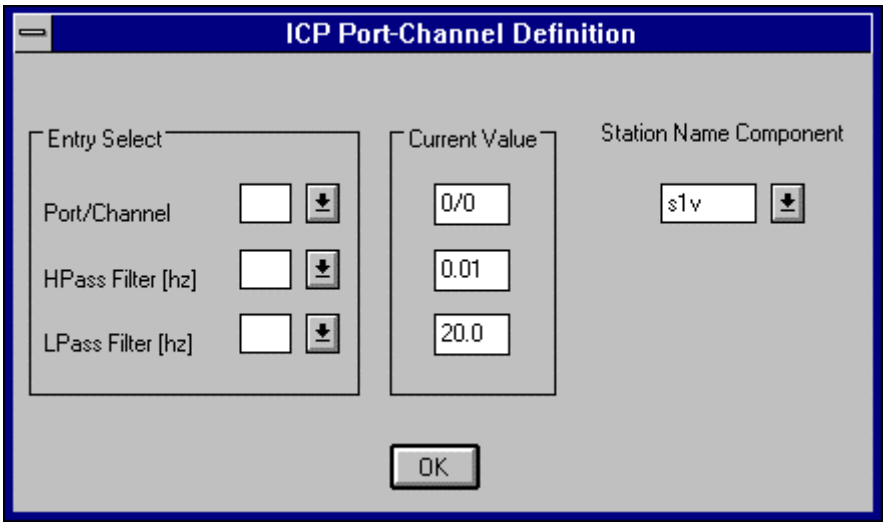


Figure 4-7. **ICP Port-Channel Definition** screen.

Current Value field indicates the selected **Station Name Component** has not been previously configured.

Entry Select

Port/Channel This parameter bridges the association of a **Station Name Component** with a communications **Port**. **Port/Channel** entries are in the form A/B, where A is a valid Multiplexer port in the range 0 through 23 (see paragraph 4.2.1.1.2), and B is a valid seismic data channel associated with that serial data stream. Acceptable B values are 0 through 2, representing 1 to 3 data channels.

HP Filter (Hz) This parameter specifies the digital high pass (low cut) filter (or none) to be applied to the selected **Port/Channel** data. Acceptable channel high pass filter corner frequencies (in Hz) are

NONE	
0.01	0.10
0.03	0.33
0.05	0.50

LP Filter (Hz) This parameter specifies the digital low pass (high cut) filter (or none) to be applied to the selected **Port/Channel** data. Acceptable channel low pass filter corner frequencies (in Hz.) are

NONE	
2.00	12.00
4.00	16.00
6.00	18.00
8.00	20.00

Upon completion of **ICP Port-Channel Definition** configuration, modification or review, select **OK** to return to the **Station Parameters** screen.

4.2.1.1.4 Station Parameters - Remotes

Selection of the Remotes button from the Station Parameters screen brings up a Remote Station Definition window through which the user may specify certain mandatory and other optional parameters related to each remote sensor site. Figure 4-8 illustrates this screen. These parameters are described in the following:

Mux Port This parameter relates the data in the **Current Value** and **Entry Select** fields to a specific Multiplexer port. This field must contain a valid channel prior to the display or modification of data. A mouse click on the scroll button adjacent to this field causes a pull down window display of currently configured ports. Acceptable values are 0 through 23.

Entry Select

Data Format This parameter specifies the bit resolution of the digitizing scheme for the connected remote data site. Acceptable values are 12, 16, or 24 bit.

Time Base This parameter specifies the source of the data time tag. Acceptable values are **Remote**, indicating incoming data frames have been time tagged at the remote digitizer site, or **Central** if the data frames are to be time tagged and time aligned by the ICP system.

Sample Rate This parameter specifies the data sample rate of the remote digitizer connected to the specified Multiplexer port. Acceptable values are 50, 100 or 200 samples per second per data channel. (Note: Currently, 200 sps mode is not supported.)

Select the **OK** button to return to the **Station Parameters** menu.

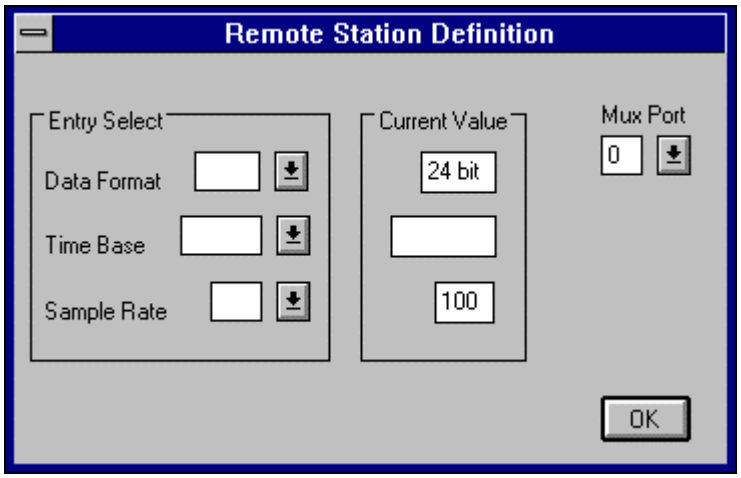


Figure 4-8. **Remote Station Definition** screen.

4.2.1.2 ICP Configuration - Analog I/O

Selection of the **Analog I/O** button from the ICP main screen pulls down a menu screen as shown in Figure 4-9. This menu allows the operator to configure each of up to 32 analog output ports if the ICP system includes an optional D/A Module. Menu appearance and functionality is identical to that described in paragraph 4.2.1.1 for the **Station Parameters** menu. Specific menu entries and data fields are defined in the following paragraphs.

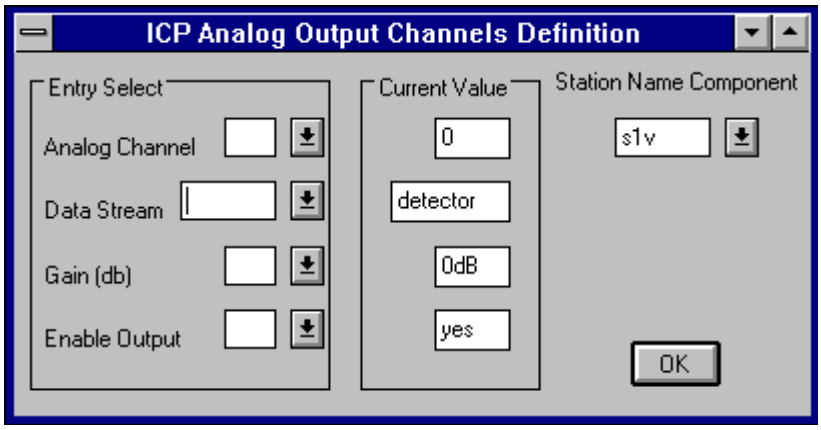


Figure 4-9. **ICP Analog Output Channels Definition** screen.

Station Name Component The **Station Name Component** field defines a specific remote station as defined in paragraph 4.2.1.1.1. and must match one of the **Station Name Component** entries configured under **Station Parameters - Name**. This parameter specifies the channel data to be output on the selected **Analog Channel**. A blank or no entry associated with a **Current Value** field indicates the selected **Station Name Component** has not been previously configured.

Entry Select

Analog Channel This **parameter** defines one of 32 unique D/A Module output ports. Acceptable values are 0 through 31.

Data Stream The **Data Stream** parameter specifies what type of filtering, if any, is to be applied to the selected **Station Name Component** data. Acceptable entries are:

None	No data is output;
Raw	Channel raw or unfiltered data is output;
Filtered	Data filters defined in the **ICP Port Definition** menu are applied;
Detector	Data filters defined in the **ICP STA/LTA Detector Definition**

	or **ICP Level Detector Definition** menus (paragraph 4.2.1.3.1 and 4.2.1.3.2) are applied;
Gain (dB)	The **Gain** parameter specifies the channel gain (attenuation) relative to the raw ICP data. Acceptable parameters are 0, -24, -48, and -72 dB. D/A output is a 16 bit word with each attenuation step being applied as a 4 bit shift of an ICP 32 bit data word. 0 dB thus outputs the least significant 16 bits plus sign, and -72 dB outputs the 16 most significant bits plus sign.
Enable Output	This parameter enables (value = Yes) or disables (value = No) the specified D/A output.

Select **OK** upon completion of D/A channel configuration to return to the **Station Parameters** menu.

4.2.1.3 ICP Configuration - Event Detector Parameters

Selection of the **Event Detector Parameters** button from the ICP main screen pulls down a menu screen as shown in Figure 4-10. This menu allows the operator to define an **STA/LTA** (Short Term Average/Long Term Average ratio) and/or **Level** type event detector. Selection of the detector type causes another menu screen display, for parameter configuration of the detector type selected. Figures 4-11 and 4-12 illustrate the configuration screen menus.

ICP System allows a combined total of 60 event detectors to be defined. ICP further allows the user to specify which detector (or none) and what detector parameters are to be applied to each seismic data channel component individually.

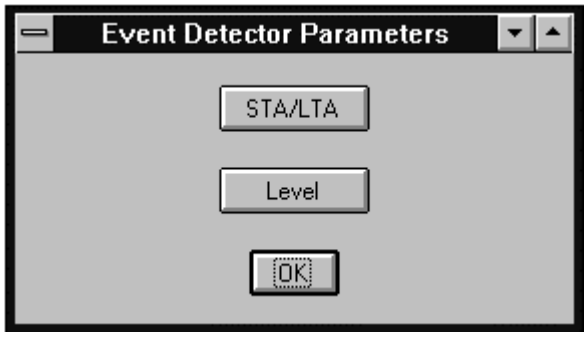


Figure 4-10. Event Detector Parameters

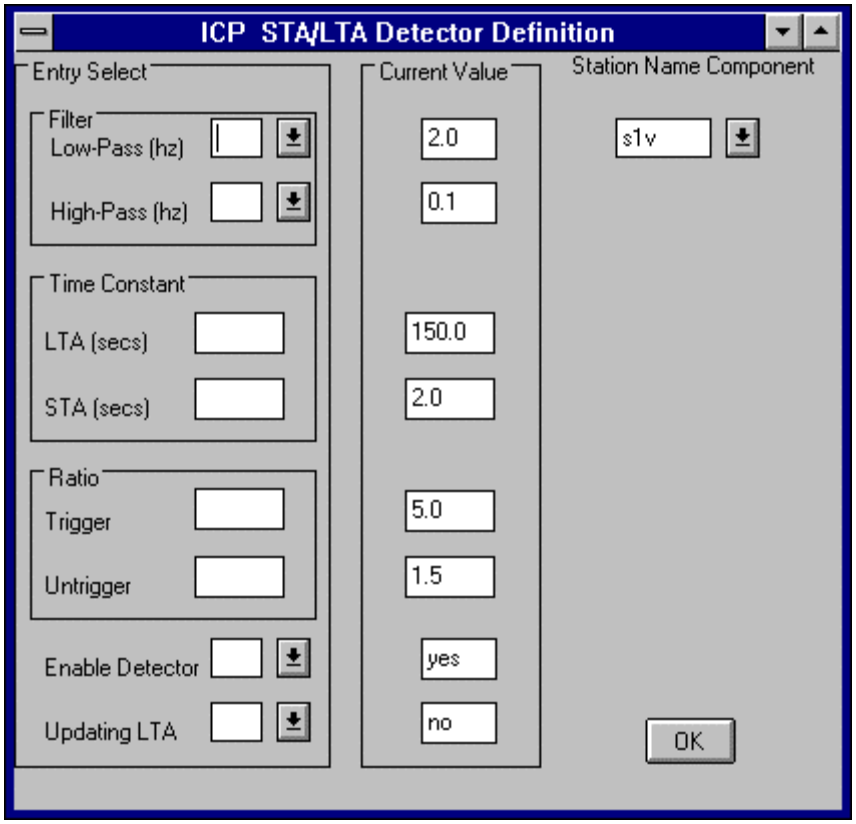


Figure 4-11. **ICP STA/LTA Detector Definition** screen

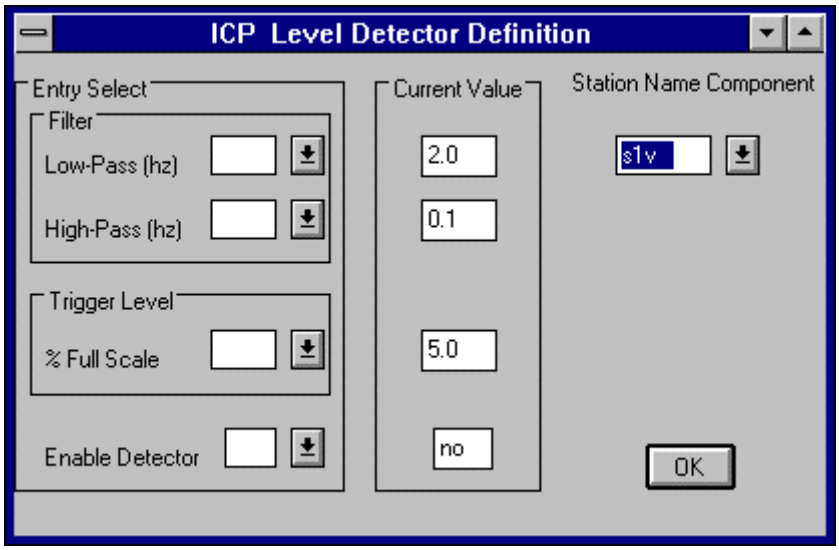


Figure 4-12. **ICP Level Detector Definition** menu.

4.2.1.3.1 STA/LTA Event Detector Definition

The **ICP STA/LTA Detector Definition** menu is shown in Figure 4-11. Menu items are described in the following summary.

Station Name Component — The **Station Name Component** field defines a specific remote station as defined in paragraph 4.2.1.1.1. and must match one of the **Station Name Component** entries configured under **Station Parameters - Name**. This parameter specifies the channel data to be affected by the corresponding **Current Value** and **Entry Select** fields.

Entry Select

Filter — These table entries determine the digital filter characteristics applied to the selected **Station Name Component** data channel prior to event detection.

Low-Pass (Hz) — This parameter specifies the low pass filter characteristics. Acceptable low pass filter frequencies (in Hz) are

1.00	5.00	20.00
2.00	10.00	40.00

High-Pass (Hz) This parameter specifies the high pass filter characteristics. Acceptable high pass filter frequencies (in Hz.) are

0.10	0.50	2.00
0.20	1.00	4.00

Time Constant These parameters specify a window length in seconds over which a short term average and/or long term average signal amplitude is to be determined for the purpose of declaring an event on the **Station Name Component** under test.

LTA (secs) This parameter specifies the length in seconds required for the long term average (LTA) to be determined. The shorter the window, the more responsive the system is to changes LTA. The LTA can be any integer value greater than 0 and less than or equal to 255 seconds however the LTA value must be greater than the STA value.

STA (secs.) This parameter specifies the length in seconds required for the short term average (STA) to be determined. The shorter the window, the more responsive the system is to changes STA. The STA can be any integer value greater than 0 and less than or equal to 255 seconds, however the STA value must be less than the LTA value.

Ratio **Ratio** refers to the STA/LTA ratio, and determines the trigger point for the declaration of an event on the **Station Name Component** under scrutiny.

Trigger **Trigger** ratio determines the point at which the STA/LTA ratio causes an event trigger and can be any value greater than 0 and less than or equal to 255. The smaller the **Trigger** ratio, the greater the detector sensitivity.

Untrigger **Untrigger** ratio determines the point at which the STA/LTA ratio causes an untrigger condition and

can be any value greater than 0 and less than or equal to 255. The **Untrigger** ratio must be less than the trigger ratio.

Enable Detector Value = Yes implies the detector algorithm is applied to the specified data stream; Value = No implies the detector is disabled.

Updating LTA This parameter allows the user to specify the LTA window remain active through a declared event, or to disable the LTA window during the **Trigger/Untrigger** time frame. Value = Yes allows LTA averaging to continue. Value = No terminates LTA update until after **Untrigger**.

Select **OK** to return to the previous menu.

4.2.1.3.2 ICP Level Detector Definition

The ICP Level Detector Definition menu is shown in Figure 4-12. Menu items are described in the following summary.

Station Name Component The **Station Name Component** field defines a specific remote station as defined in paragraph 4.2.1.1.1. and must match one of the **Station Name Component** entries configured under **Station Parameters - Name**. This parameter specifies the channel data to be affected by the corresponding **Current Value** and **Entry Select** fields.

Entry Select

Filter These table entries determine the digital filter characteristics applied to the selected **Station Name Component** data channel prior to event detection.

Low-Pass (Hz) This parameter specifies the low pass filter characteristics. Acceptable low pass filter frequencies (in Hz.) are

1.00	5.00	20.00
2.00	10.00	40.00

High-Pass (Hz) This parameter specifies the high pass filter characteristics. Acceptable high pass filter frequencies (in Hz.) are

0.10	0.50	2.00
0.20	1.00	4.00

Trigger Level This parameter defines the rms. signal level required to declare an event on the channel under test.

% Full Scale The rms. trigger level is specified as an integer value between 5 and 100 (in increments of 5). The number represents the % of full scale required to declare an event.

Enable Detector This parameter specifies whether the defined detector is active or inactive on the selected channel. Value = Yes, detector active. Value = No, detector disabled.

Select **OK** to return to the previous menu.

4.2.2 Record

ICP record functions are initiated and controlled via selection of the **Record** button of the ICP main menu. Selection of this button pulls down the menu of Figure 4-13 which allows the selection of **Event** or **Continuous** record modes. ICP System is capable of recording (archiving) data in either mode, or both modes simultaneously. Selection of the desired mode button from the main menu accesses an additional configuration menu for the selected mode. Mode configuration is described in the following paragraphs.

Figure 4-13. ICP **Record** control pull down.

4.2.2.1 ICP Event Record Control

Selection of The **Event** option from the ICP **Record** control pull down displays the **Event Record Control** menu. Through this menu, the operator establishes the parameters necessary to write event record files upon event trigger based on trigger parameters defined in previous paragraphs. The Event Record Control menu is shown in Figure 4-14. Parametric descriptions are contained in the discourse following.

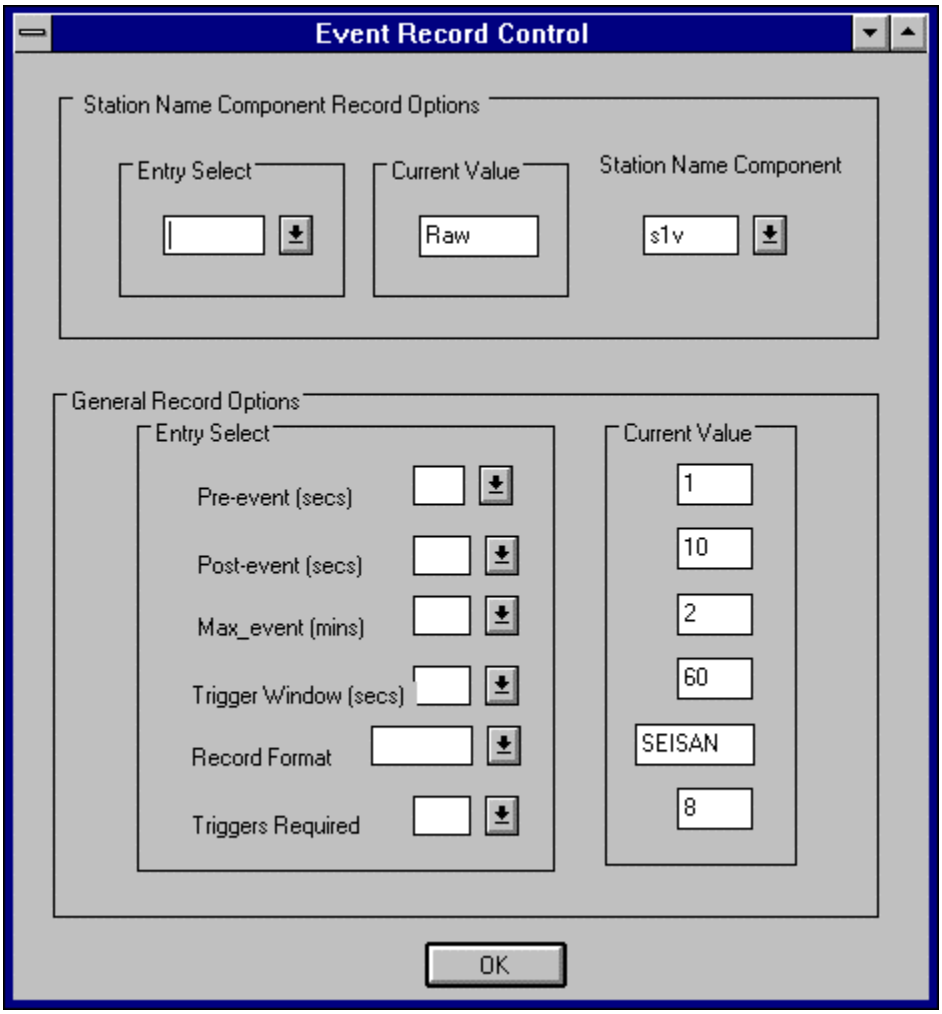


Figure 4-14. ICP Event Record Control menu.

Station Name Component The **Station Name Component** field defines a specific remote station as defined in paragraph 4.2.1.1.1. and must match one of the **Station Name Component** entries configured under **Station Parameters - Name**. This parameter specifies the channel data to be affected by the corresponding **Current Value** and **Entry Select** fields.

Entry Select

None	No data is recorded;
Raw	Channel raw or unfiltered data is recorded;
Filtered	Data filters defined in the **ICP Port Definition** menu are applied
Both	Raw and filtered data are recorded

Pre-event (secs) This parameter allows the inclusion of a specified amount of pre event waveform data to be included in an event record file. Pre event data is defined as a fixed length (in seconds) of data immediately preceding an event trigger declaration. Pre event data is specified in integer seconds in the range 1 to 10 in 1 second increments, 15 to 50 in 5 second increments or 60 to 90 in 10 second increments.

Post-event (secs) This parameter allows the inclusion of specified post-event waveform data to be included in an event record file. Post event data is defined as a fixed length (in seconds) of data immediately following an event period. The post event data period begins at the untrigger or detrigger point for all declared events. Post event data is specified in integer seconds in the range 1 to 10 in 1 second increments, 15 to 50 in 5 second increments or 60 to 90 in 10 second increments.

Max_event (mins) **Max_event** length is a parameter that will limit the maximum length of a record file. The max event time frame begins at event trigger declaration and extends for the duration of **Max_event**, thus the longest file length (in time) will be **Max_event** plus **Pre-event**. **Max_event** is specified in integer minutes in the range 1 to 10 in 1 minute increments, and 20 to 60 minutes in 10 minute increments.

Trigger Window (secs) **Trigger Window** specifies a time window for association of multiple station event triggers as a

single event. This parameter is determined by the seismic network geometry and allows for the wave path travel time across the network. **Trigger Window** is specified as integer seconds in the range 0 to 5 in 1 second increments, 10 to 60 in 10 second increments, 120 to 300 in 60 second increments, and 600 or 1200 seconds.

Record Format — ICP system users can specify event data record files to be written as ***PC-SUDS*** or ***SEISAN*** formatted files (multiplexed data file - one file for all defined **Station Name Components**) or ***DADiSP™*** formatted files (one file for each defined **Station Name Component**) (see paragraph 4.3 for additional information).

Triggers Required — ICP System allows users to establish a voting scenario requiring multiple seismic data channel (**Station Name Component**) triggers be declared before declaring a seismic event and creating an event data file. Acceptable values are integers from 1 to the maximum number of defined **Station Name Components,** not to exceed 60.

Select **OK** upon completion of **Event Record Control** setup to return to the previous menu and begin event record recording.

4.2.2.2 ICP Continuous Record Control

Selection of **Continuous** from the **Record** pull down displays the **Continuous Record Control** menu shown in Figure 4-15. This menu provides the means to define parameters associated with the continuous data record function. Continuous Record Control parameters are described in the following list.

Station Name Component — The **Station Name Component** field defines a specific remote station as defined in paragraph 4.2.1.1.1. and must match one of the **Station Name Component** entries configured under **Station Parameters - Name**. This parameter specifies the channel data to be affected by the corresponding **Current Value** and **Entry Select** fields.

Entry Select

None	No data is recorded;
Raw	Channel raw or unfiltered data is recorded;

	Filtered — Data filters defined in the **ICP Port Definition** menu are applied Both — Raw and filtered data is recorded
File Size (mins)	Acceptable file size parameters are 15, 30 and 60 minutes. This parameter limits the maximum length of each file written (one file for <u>all</u> defined **Station Name Components** in ***PC-SUDS,*** or ***SEISAN*** format or one file for <u>each</u> defined **Station Name Component** in ***DADiSP™*** format).
Record Format	ICP system users can specify event data record files to be written as either ***PC-SUDS,*** or ***SEISAN*** formatted files (multiplexed data file - one file for <u>all</u> defined **Station Name Components**) or ***DADiSP™*** formatted files (one file for <u>each</u> defined **Station Name Component**) (see paragraph 4.3 for additional information).
Spool Size (Mb)	**Spool Size** limits the maximum amount of disk space utilized to archive event or continuous data files. In continuous recording mode, the oldest data files are over-written by new files whenever **Spool Size** is exceeded by an attempt to write a new data file. Event records on the other hand are never over-written thus when event recording is enabled, only continuous data files, if existent can be overwritten. Data recording will thus cease if **Spool Size** is exceeded and only event files exist. **Spool Size** is specified in 100 Mbyte blocks from 100 to 1,000.

Selecting **OK** upon completion of **Continuous Record Control** configuration will return to the previous menu and begin continuous data recording.

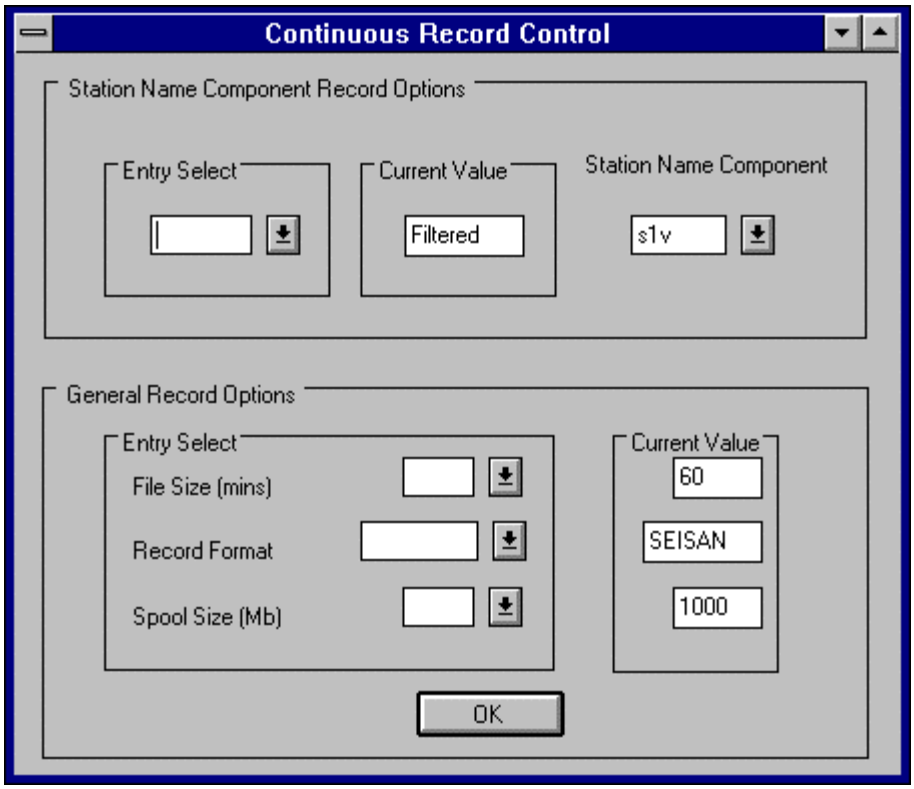


Figure 4-15. Continuous Record Control screen.

4.2.3 Location

ICP location function is initiated and controlled via selection of the **Locate** button of the ICP main menu. Selection of this button displays the **Parameter** menu. Through this menu, the operator establishes the parameters necessary for determining the location of an event. The Real Time Location Control Parameters menu is shown in Figure 4-16. Parametric descriptions are contained in the following discourse.

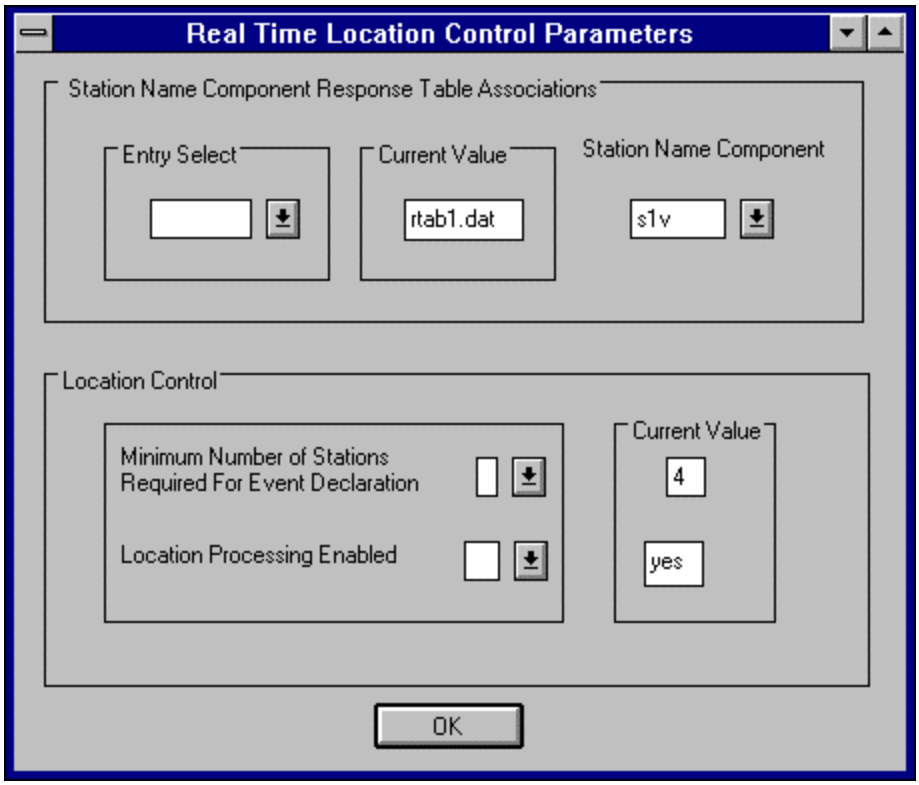


Figure 4-16 ICP Real Time Location Control Parameters menu

Station Name Component The **Station Name Component** field defines a specific remote station as defined in paragraph 4.2.1.1.1. and must match one of the **Station Name Component** entries configured under **Station Parameters - Name**. This parameter specifies the channel data to be affected by the corresponding **Current Value** and **Entry Select** fields.

Entry Select This table entry determines the parametric data required for determining the location of an event. These entries are identified as rtab**x** where **x** is 1 through 10. While each table name uniquely defines specific sensor/system characteristics it can be used by more than one station. To generate these table configuration files refer to Appendix D.

Minimum Number of Stations Required for Event Detection

This field defines the minimum number of stations required before the system declares an event. A valid station is one that triggered because it satisfied the detector conditions defined in the **ICP Event Detector Parameters** menu. A minimum of three and no more than 20 stations can be selected.

Location Processing Enabled

This parameter activates (value=Yes) or deactivates (value=No) the location processing function.

4.3 DATA FILE STRUCTURES

ICP System creates waveform data files, either continuous or event files, as described in the previous paragraphs. Archived data file names are descriptive such that the operator can determine from the name the file and data type as well as the data time. PC-SUDS data is recorded in 16 bit integer format (Geotech Instruments 16 bit Compact Remote Station) or 32 bit format (Geotech Instruments 24 bit DR-24 System). DADiSP and SEISAN data are recorded in 32 bit long format. File name descriptors are assigned as follows:

PC-SUDS Continuous Data RAWhhmm.ddd or FILhhmm.ddd,

where

RAW= raw (unfiltered) data
FIL= filtered data
hh= hour (first sample of record)
mm= minute (first sample of record)
ddd= Julian date.

PC-SUDS Event Data EVRnnnn.ddd or EVFnnn.ddd,

where

EVR= raw (unfiltered) event data
EVF= filtered event data
nnnn= event number (sequential daily number - 0001-9999)
ddd= Julian date.

SEISAN Continuous Data SNRhhmm.ddd or SNFhhmm.ddd,

where

SNR= raw (unfiltered) data
SNF= filtered data
hh= hour (first sample of record)
mm= minute (first sample of record)
ddd= Julian date.

SEISAN Event Data ESRnnnn.ddd or ESFnnn.ddd,

where

ESR= raw (unfiltered) event data
ESF= filtered event data
nnnn= event number (sequential daily number - 0001-9999)
ddd= Julian date.

DADiSP™ Continuous Data DRnnhhmm.ddd or DFnnhhmm.ddd,

where

DR= raw (unfiltered) data
DF= filtered data
nn= **Station Name Component** number (0 - 71)
hh= hour (first sample of record)
mm= minute (first sample of record)
ddd= Julian date.

DADiSP™ Event Data ERnnxxxx.ddd or EFnnxxxx.ddd,

where

ER= raw (unfiltered) event data
EF= filtered event data
nn= **Station Name Component** number (0 - 71)
xxxx= event number (sequential daily number - 0001-9999)
ddd= Julian date.

4.4 WAVEFORM DATA DISPLAY

ICP data files are archived, as described in previous paragraphs, as either ***PC-SUDS***, ***SEISAN*** or ***DADiSP™*** formatted data files. Data display thus requires the user acquire a compatible software package.

For informational use only, ***PC-SUDS*** is a data format developed and supported by

International Association of Seismology and Physics
of the Earth's Interior (IASPEI)
P.O. Box "1", Menlo Park, CA 94026.

IASPEI software includes several volumes of acquisition, display, and analysis routines for the acquisition and processing of seismic data. Information and software are available through

Seismological Society of America
201 Plaza Professional Building
El Cerrito, CA 94530
(Tel.: 510-525-5474).

SEISAN is a product of

Institute of Solid Earth Physics
University of Bergen
Allegaten 41, 5007 Bergen
Norway

SEISAN offers software capabilities for determining event location and detailed analysis of seismic data.

DADiSP™ is a product of

DSP Development Corporation
One Kendall Square
Cambridge, Massachusetts 02139.

DADiSP™ also includes software modules for the display and analysis of seismic and other waveform data.

4.5 ICP REAL TIME DISPLAY

The ICP real time display feature is a user friendly application program that allows the operator to view waveform data either from a file or in near real time. As described in previous paragraphs, PC-SUDS, DADISP, and SEISAN formatted data files are supported.

To initiate the program double click on the Real Time Display icon. The real time window, shown in Figure 4-17 will be displayed. As indicated by this figure, the ICP software tool bar and status have the same look and functionality as other ***Microsoft Windows*** or ***WindowsNT*** applications. Two windows should be present, the primary **Real Time Display** window and the secondary **Channel Selection** one.

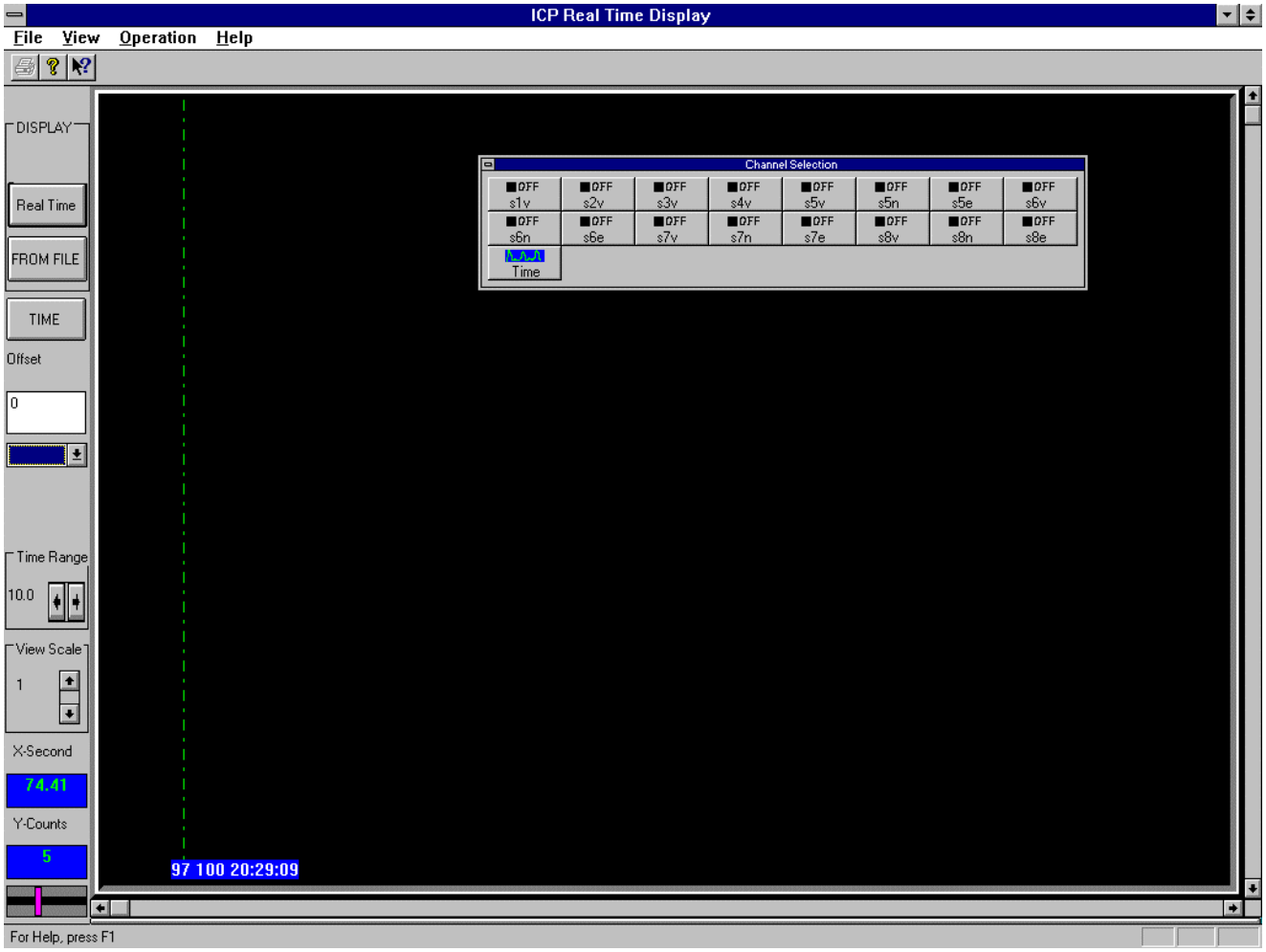


Figure 4-17 ICP REAL TIME DISPLAY screen

4.5.1 Channel Selection

As previous mentioned, starting the main program pops up this window. This window can also be initialized by clicking on the tool bar entry labeled **View** as shown in Figure 4-18. Selection of this button pulls down another menu that contains the **Channel Selection Bar** field and if activated will display the Channel Selection window.

The Channel Selection window contains all the station name components that were previously defined in the **ICP Station Parameters-Name Definition** in paragraph 4.2.1.1. Each station component can be configured to be on or off. By clicking the individual ON/OFF windows, the operator controls whether or not that station component has a window for displaying waveform data. Any number of channels can be selected to be active, however, as the number increases the resolution of each waveform window decreases.

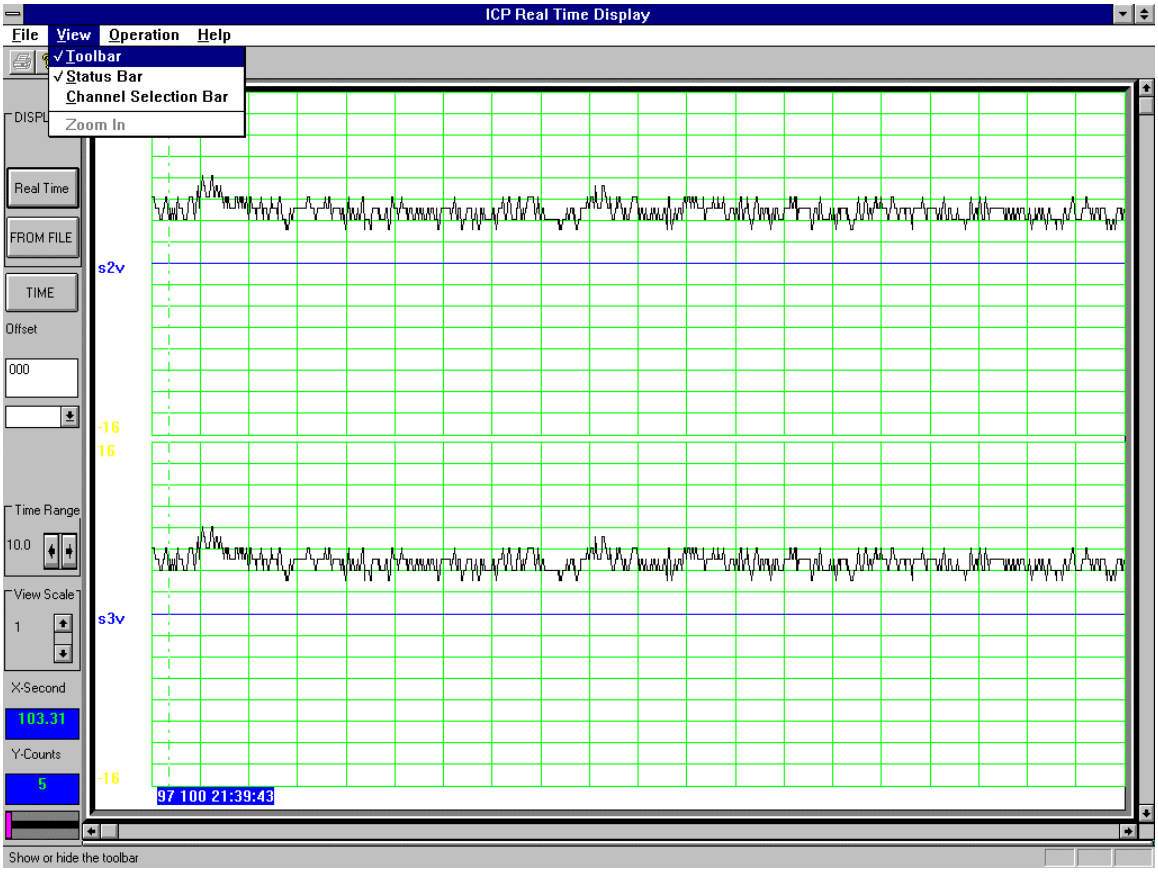


Figure 4-18 Channel Selection Bar pull-down screen

4.5.2 Offset Adjustment

Two methods are used to compensate for an offset inherent to the signal. Initially, the display offset value is set to zero. To incorporate an offset into a particular display window the operator can manually enter the desired offset value in the **Offset** field. A pull-down menu below this field determines which waveform the offset is being applied to. When invoked, the pull down window will display the station component names that are active. After associating the correct offset value to the appropriate station component, the operator must use the **SpaceBar** to enable the change.

To activate an offset capability via mouse, select the **Operation** button on the ICP Real Time Display menu bar as shown in Figure 4-19. This operation provides the operator with the choice of activating the **Offset Adjustment** selection. Once selected, the mouse functions like an offset pointer when positioned inside the waveform window. The waveform will offset by the amount indicated by the position of the cursor in the direction of the horizontal axis. Click the left button on the mouse to implement the offset.

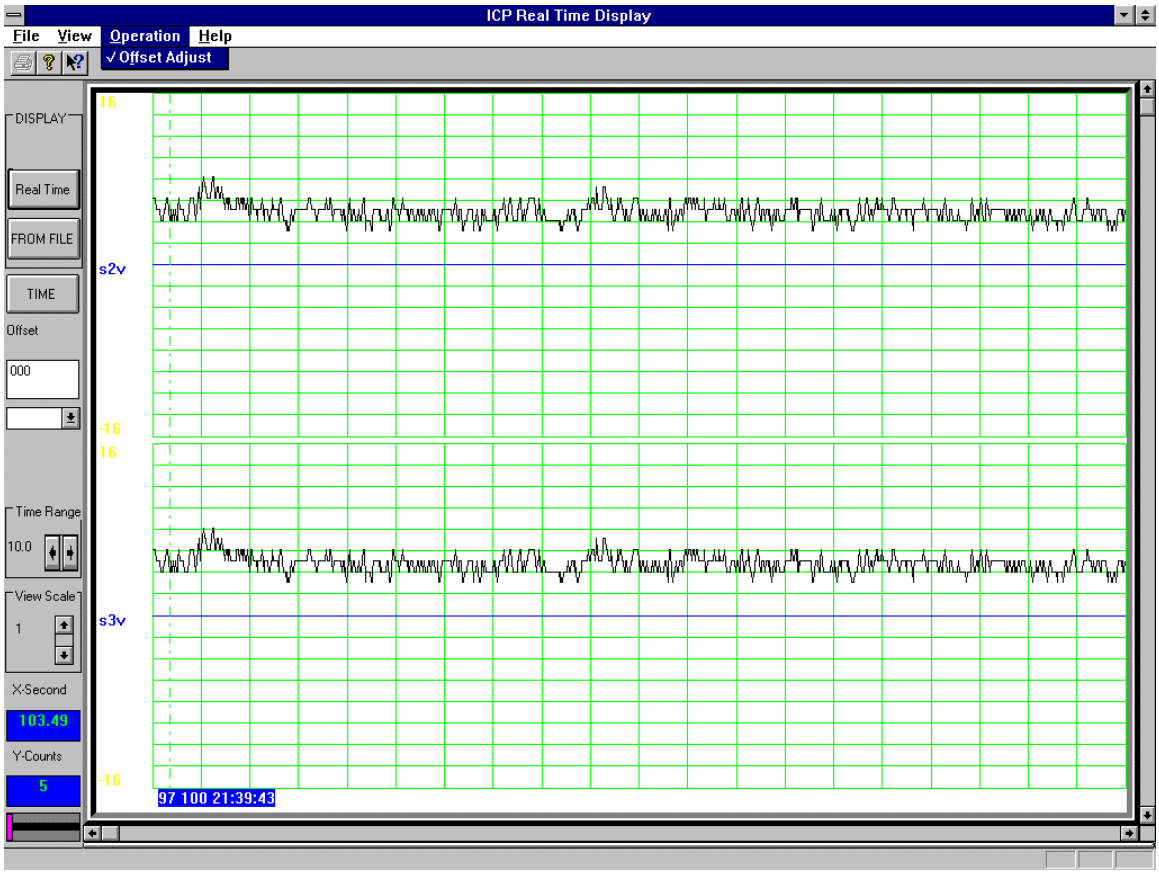


Figure 4-19 Offset Adjustment pull down bar

4.5.3 Display

Three embossed buttons labeled **Real Time/Stop, From File/Close,** and **Time/FTT** are inputs required for displaying the data. This selection applies to the entire ICP Real Time Display window. Thus, one window cannot display real time data while another one displays a waveform from a file.

Real Time/Stop This selection displays near real time data received from the ICP system. When the Real Time function is active, the button is renamed to **Stop** which serves as the switch to stop acquiring real time data. The present mode of operation is displayed in the region above the three primary buttons.

From File/Close Selecting the From File button allows the operator to display continuous or event waveform data from an archived file. The operator selects the properly formatted file (DADISP, SEISAN, PC-SUDS) to display. As shown in Figure 4-20, a **Channel Selection** dialog box appears which allows the operator to either open an archived data file from disk or remove an already open one from memory. After selecting a file to open, the **Channel Selection** window updates it format and includes a channel ON/OFF button for each station component found in the file structure. Like previously defined in paragraph 4.6.1, this button toggles the display window on and off. To end this display session click on the **Close** button.

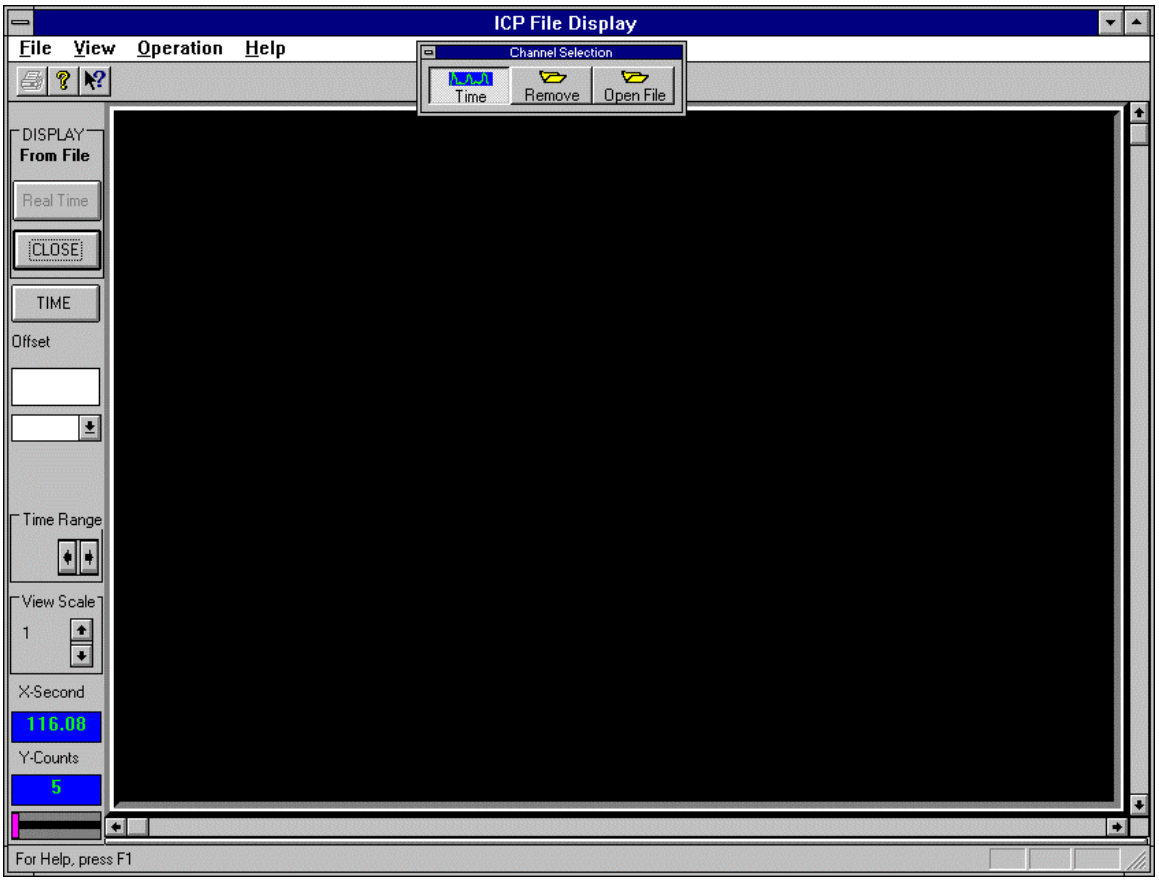


Figure 4-20 From File Selection pop up menu

Time/FFT The **Time** button is used to define the horizontal axis in time units. This mode is active when Time is displayed on the button. The frequency domain is active when the button displays FFT, however, this function is not fully implemented at this time.

4.5.4 Time Range

The resolution of the horizontal scale can be changed and is controlled by the value that has been selected in the **Time Range** window. A small value will increase the resolution whereas a large number decreases it but provides a means for viewing more data. The minimum value allowed is .1 and the maximum is 120. The unit of measure is seconds. A selection of 120 allows the operator to view 120 seconds of data in the display window.

4.5.5 View Scale

The resolution of the vertical scale is controlled by the value that has been selected in the **View Scale** window. Similar to the Time Range function, this selection allows the operator to view the waveform data in different degrees of resolution. The values range from 1 to 21. A large value expands the vertical grid which provides for greater resolution.

4.5.6 Pointer Position

4.5.6.1 X Second

This window contains the value of the horizontal axis parameter where the cursor is pointing to.

4.5.6.2 Y Counts

This window contains the value of the waveform in terms of the vertical axis parameter. It is defined by the position of the cursor. The Y Count window is active only when the waveform is displayed **From File** or if the **Real Time** display has been stopped.

4.5.7 Time Marker

A click, hold, and drag Time Mark vertical bar is provided to identify the exact time of a particular point on the waveform. Initially, this bar is positioned to the far left of the display. Below the bar is a window displaying year, day, and time information as shown in Figure 4-21. The time in the display window is slightly different from true GPS time because of system delays.

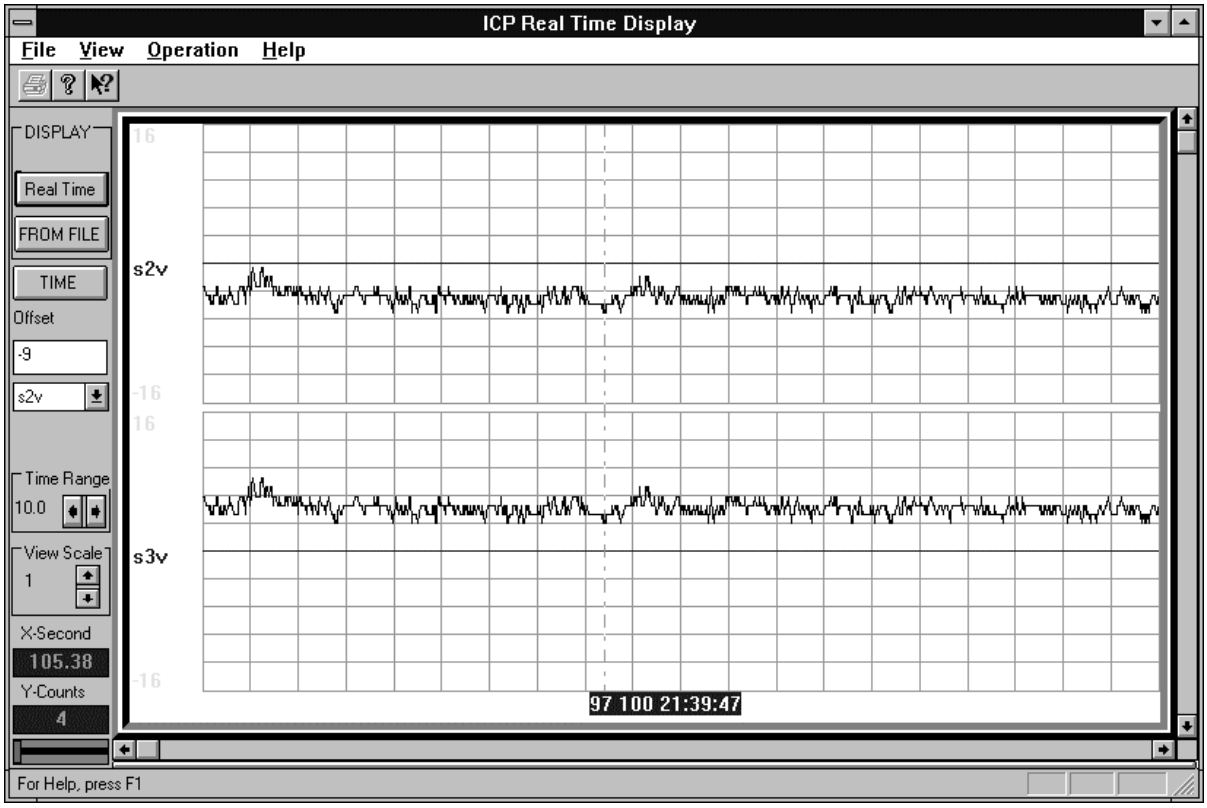


Figure 4-21 Scrolling Time Marker

4.5.8 Window Parameters

4.5.8.1 Range

Changing the vertical scale for each individual waveform window is accomplished by clicking the right mouse button on any region within the grid. A pop up menu as shown in Figure 4-22 contains the parameters that can be modified. Click on the **Range** button to activate the list. Expressed in counts, the vertical range is from 16 to 2147M.

4.5.8.2 Curve Color

To display the waveform in different colors click the right mouse button and select the **Curve Color** option. Another window pops up which allows the operator to choose from several different curve color options.

4.5.8.3 Background Color

To display the background in different colors click the right mouse button and select the **Background Color** option. A second window pops up which allows for the selection of several different color options.

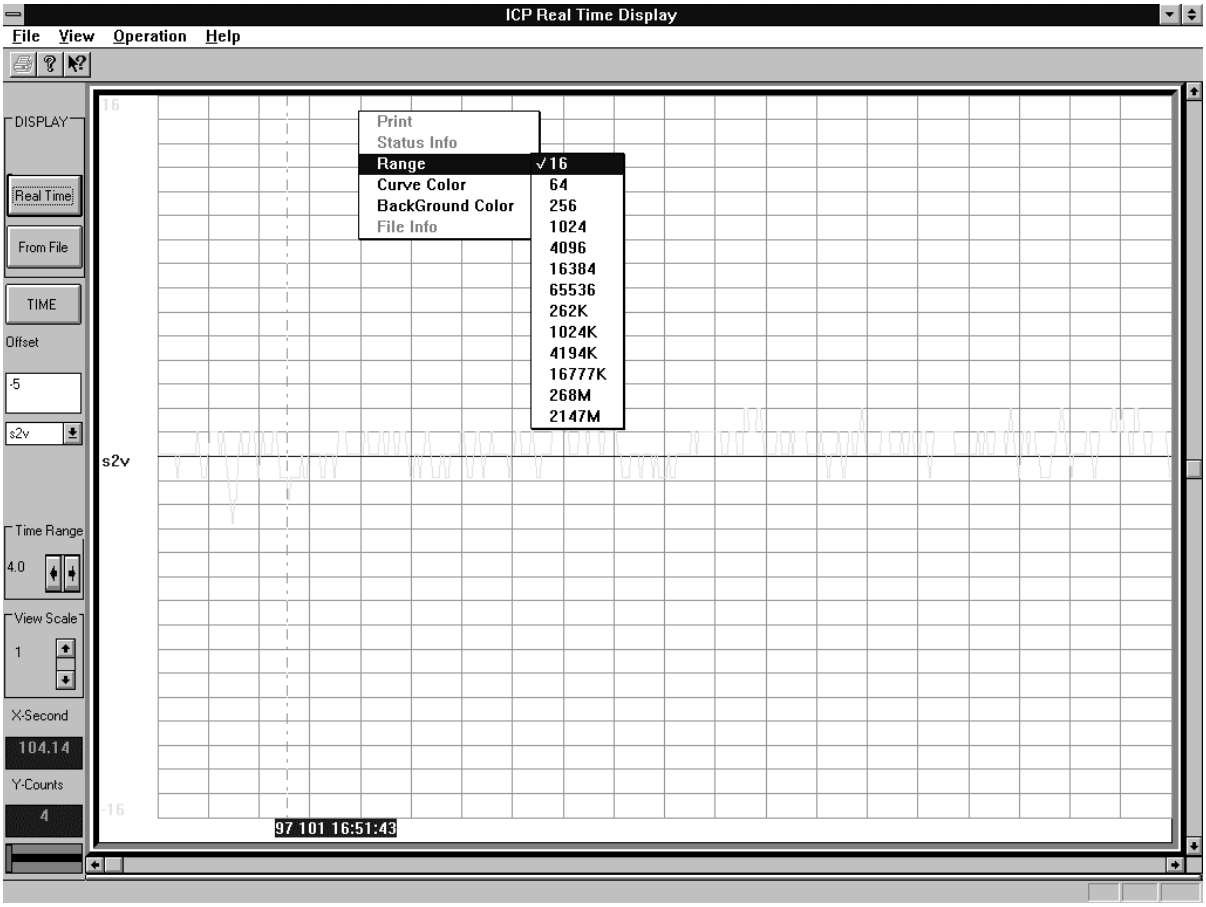


Figure 4-22 Range and Color Selection screen

5. MAINTENANCE

The ICP System is designed with the finest components available. After initial installation and configuration it should require minimal maintenance unless subject to abuse. Under normal operating conditions the system will require ocassional sofdtware maintenance due to loss of power or operator error. Should the system cease to operate, or operate in a less than optimum mode, two levels of maintenance actions are recommended. The first level requires the operator to halt then restart ICP operation. This action causes a reinitialization of ICP software and download of stored configuration information to the Multiport Controller devices. If this fails to correct the problem it is recommended system power be cycled to both the host computer and Multiport Controller, then system startup be initialized. Refer to the previous section of this document for operational procedures.

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6. SCHEMATIC DIAGRAMS

Schematic diagrams for the ICP System, modules and cables are included in this section. The following diagrams are included:

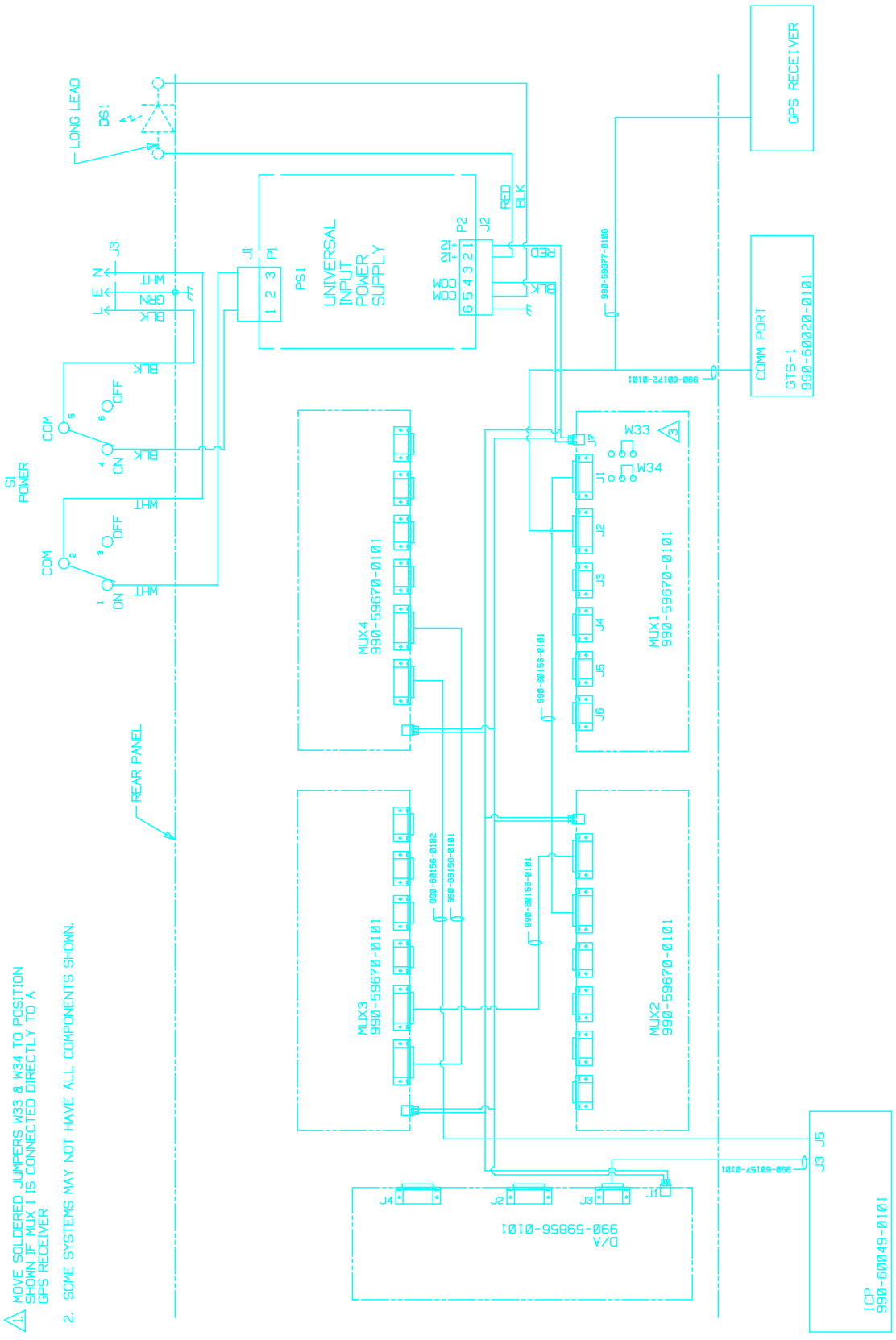

Figure 6-1 ICP System, Model Number 990-59660-0101

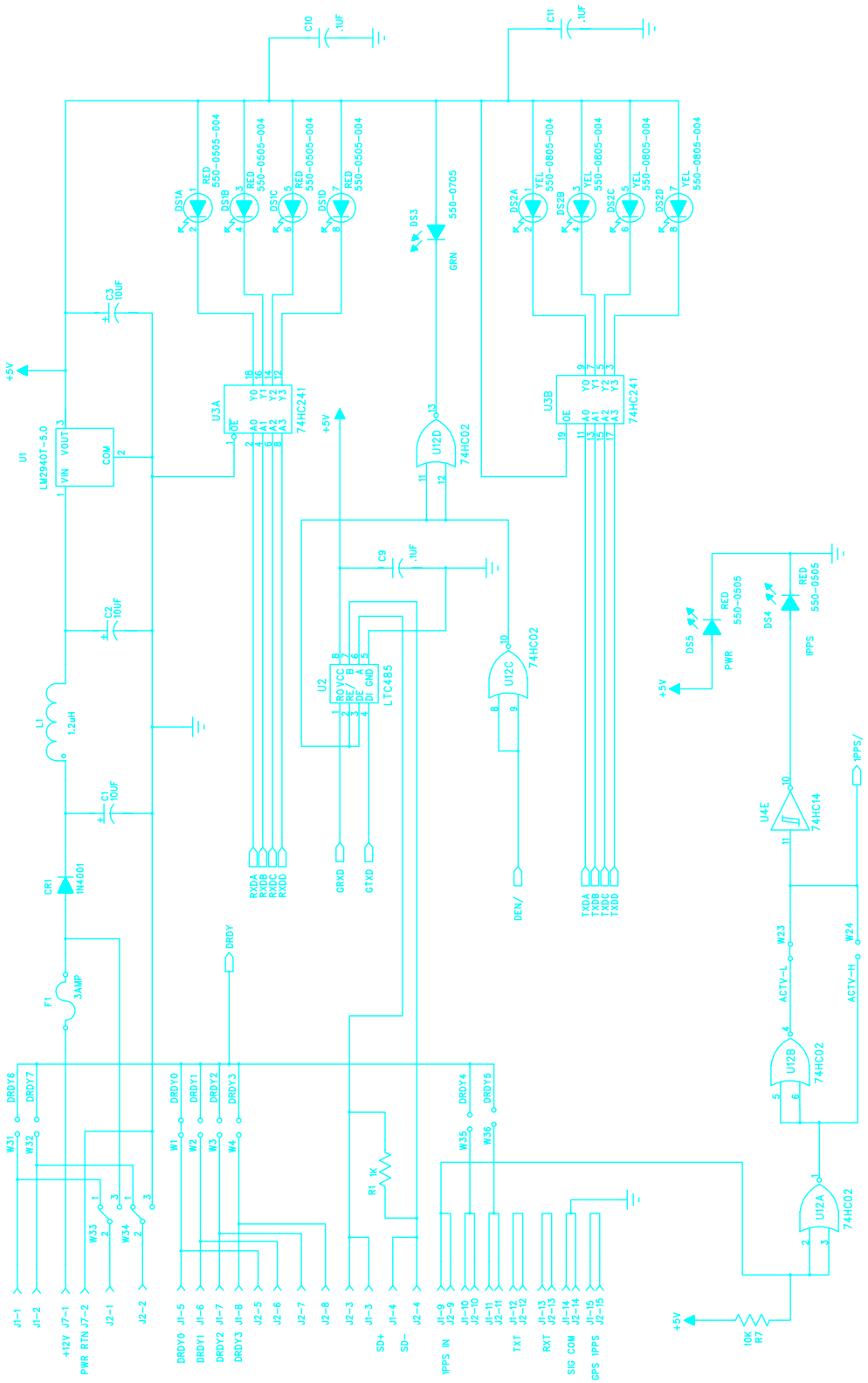

Figure 6-2 ICP Multiplexer Module, Model Number 990-59670-0101 (Page 1 0f 3)

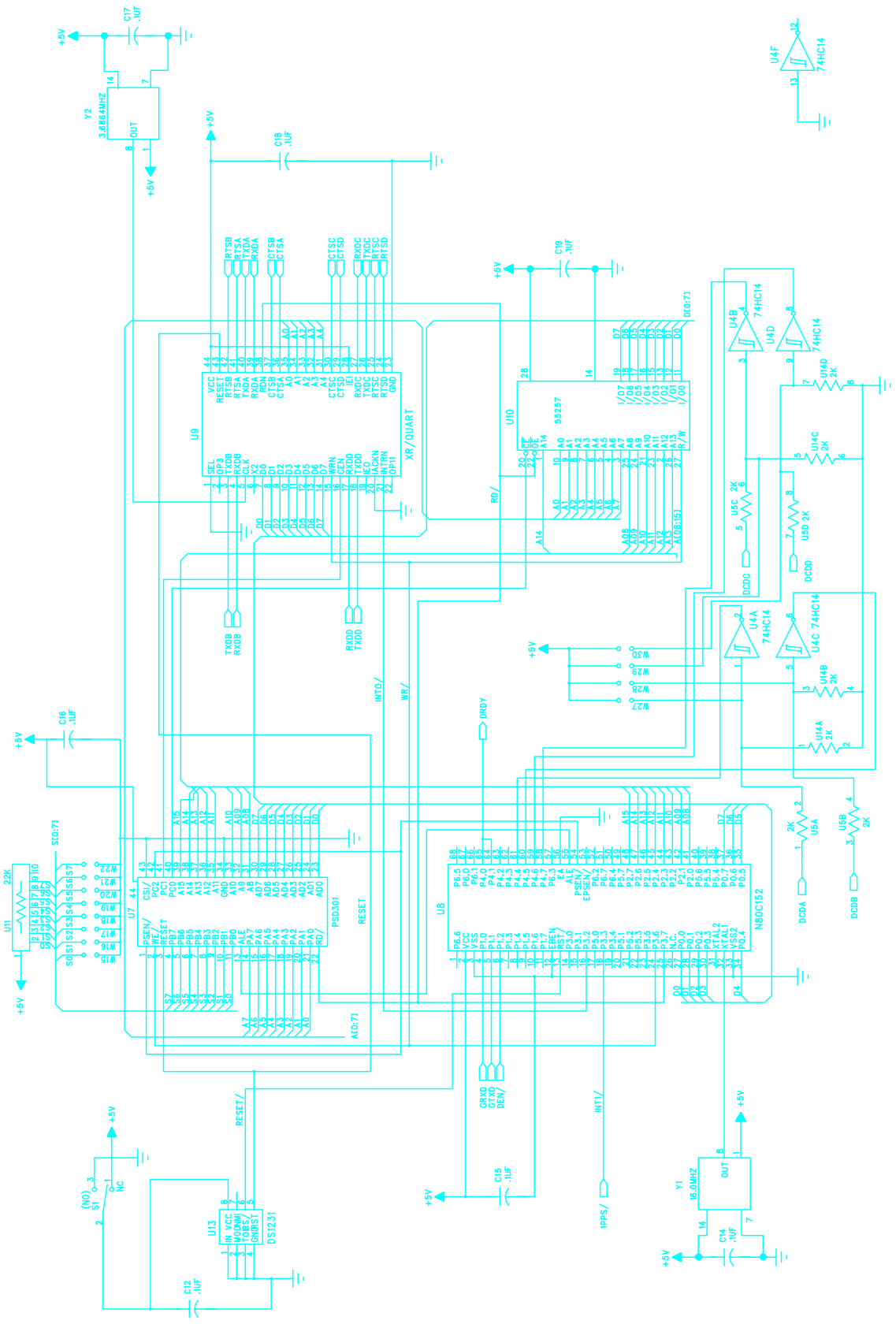

Figure 6-2 ICP Multiplexer Module, Model Number 990-59670-0101 (Page 2 0f 3)

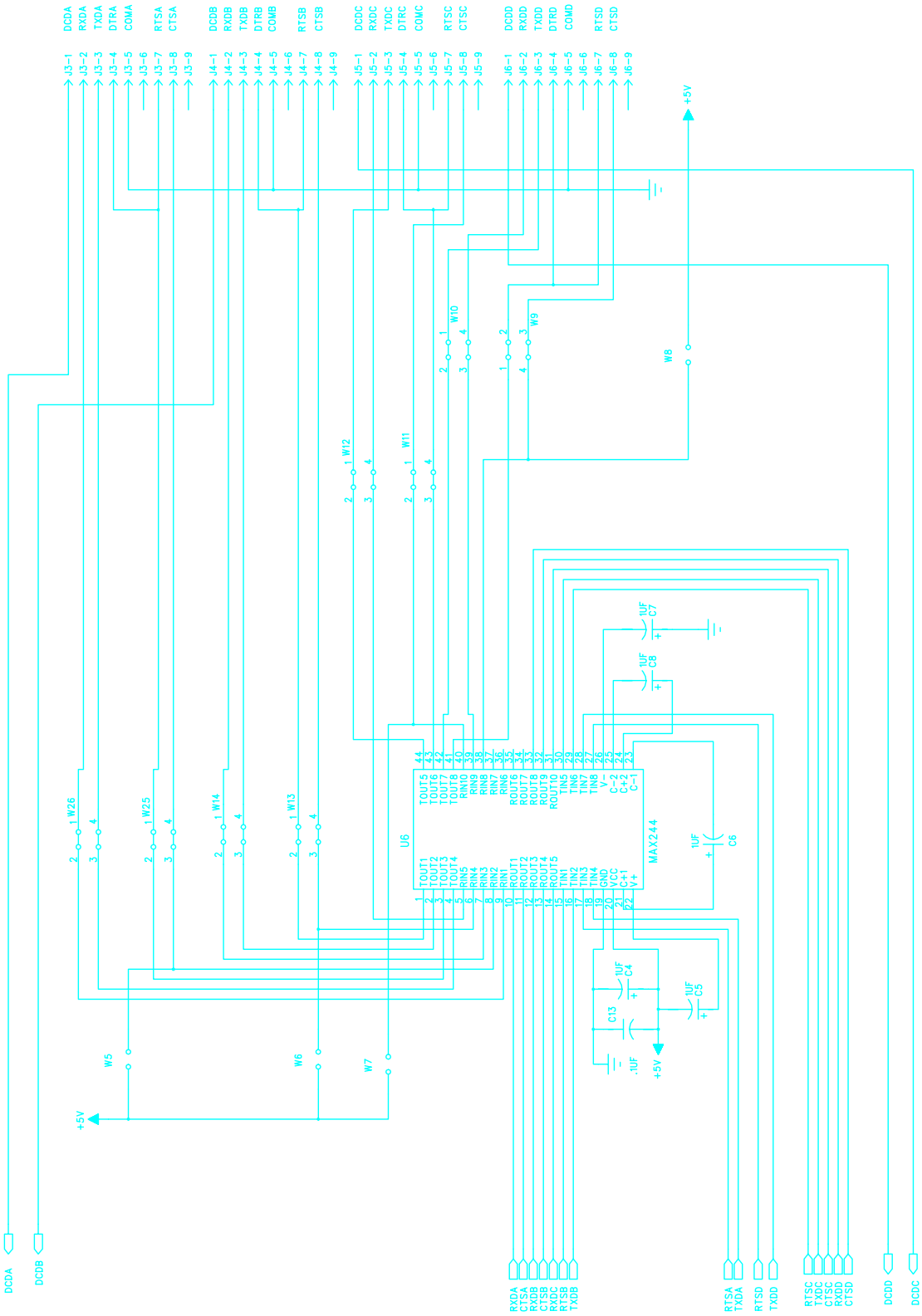

Figure 6-2 ICP Multiplexer Module, Model Number 990-59670-0101 (Page 3 0f 3)

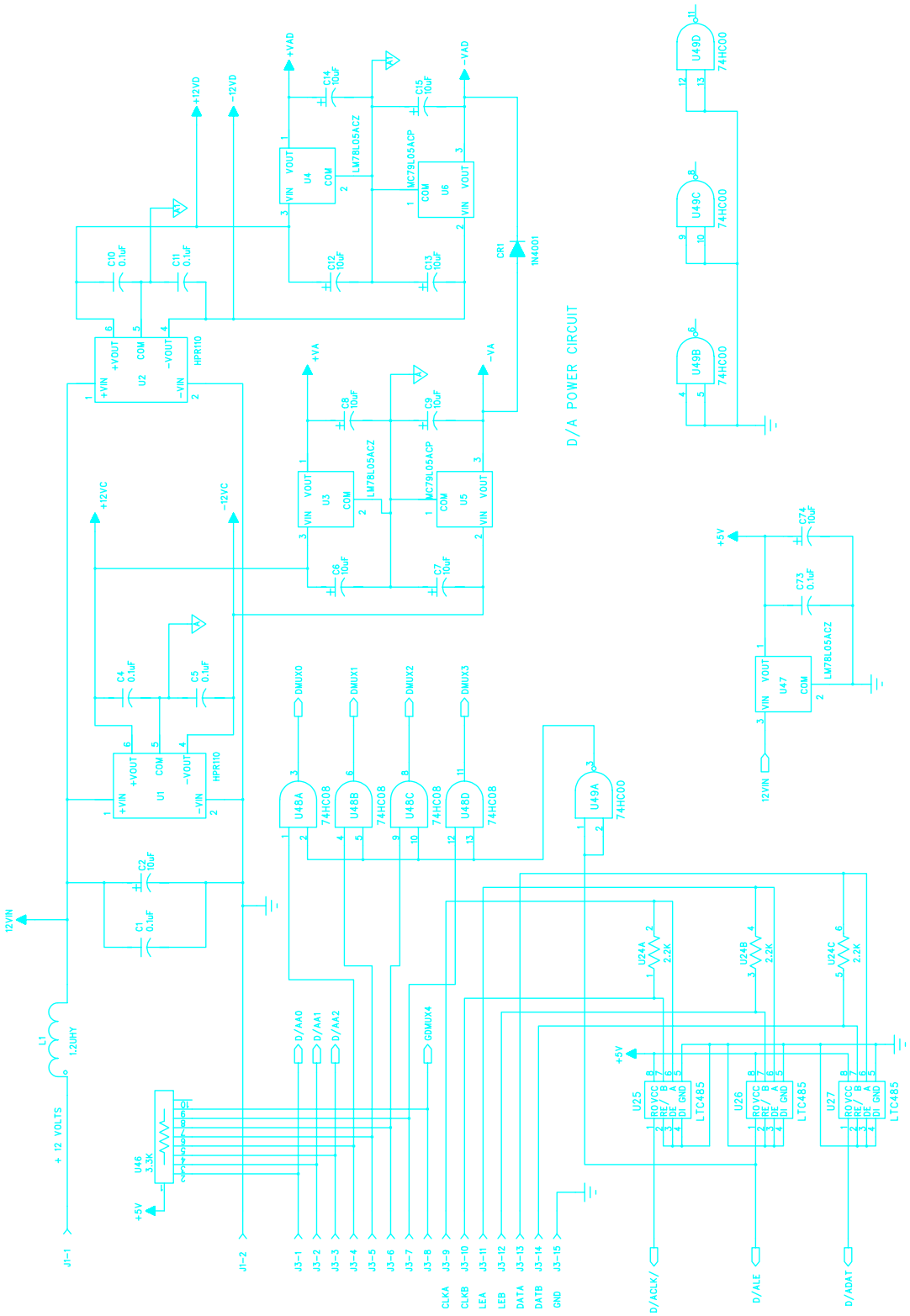

Figure 6-3 32 Channel D/A Module, Part Number 990-59856-0101 (Page 1 of 3)

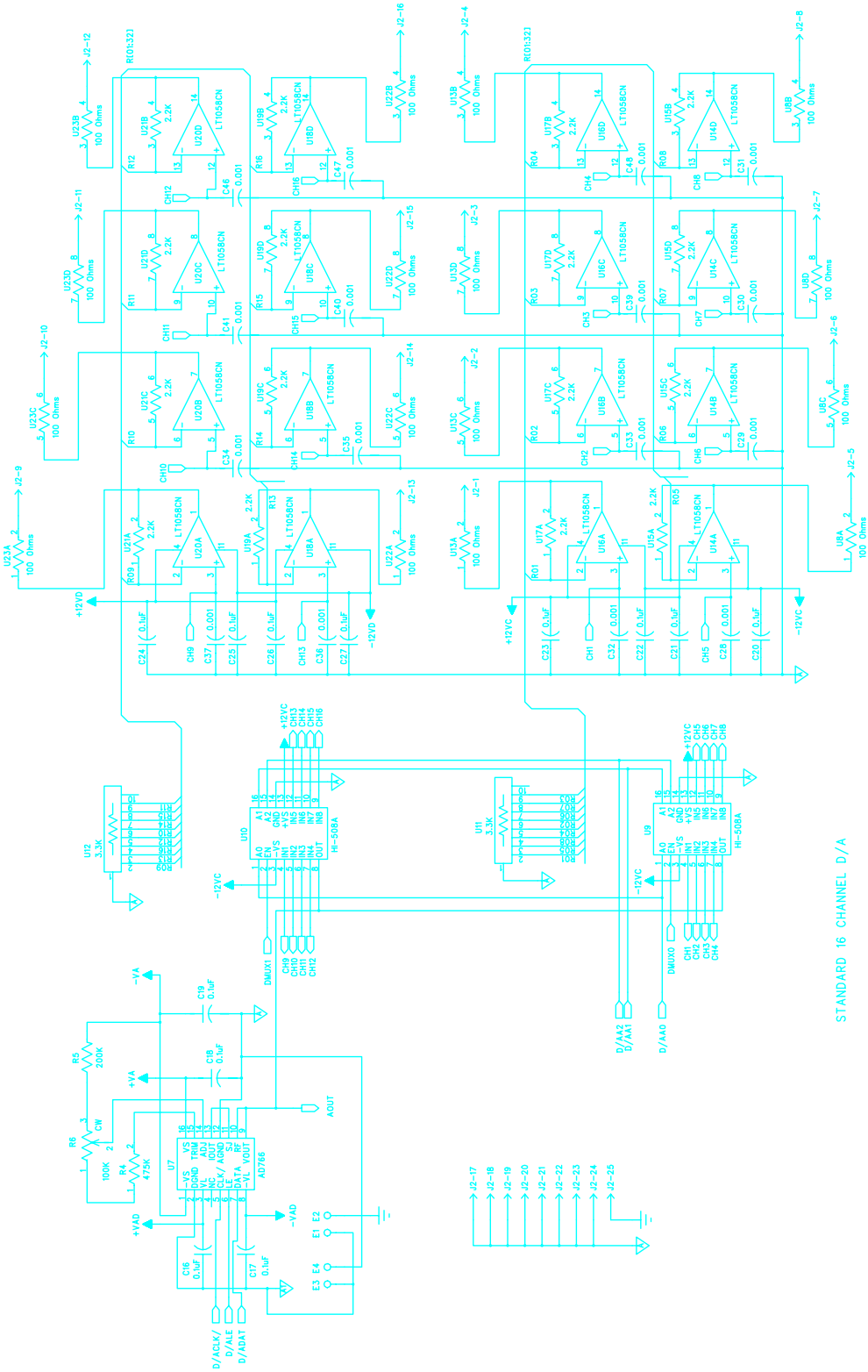

Figure 6-3 32 Channel D/A Module, Part Number 990-59856-0101 (Page 2 of 3)

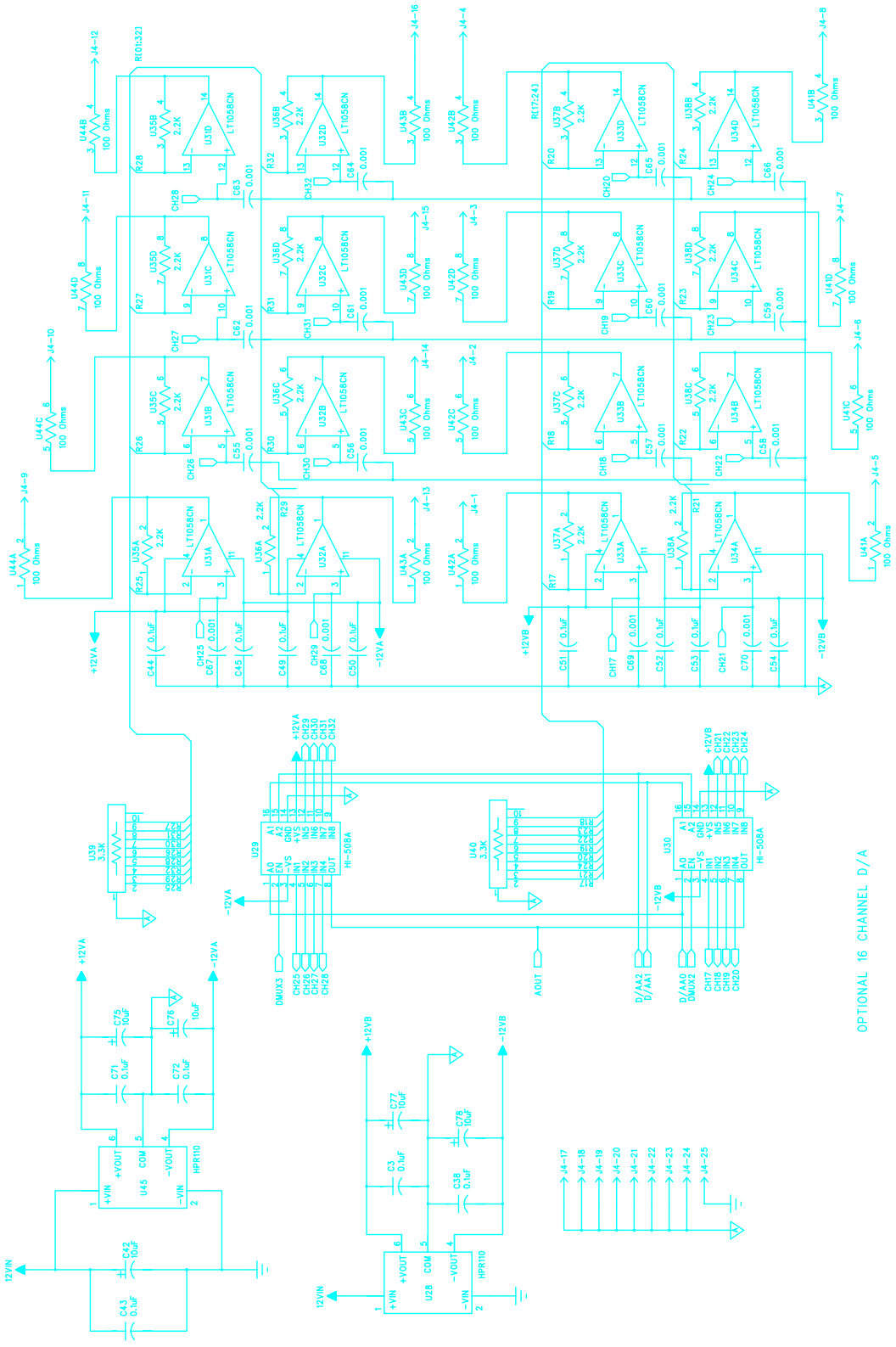

Figure 6-3 32 Channel D/A Module, Part Number 990-59856-0101 (Page 3 of 3)

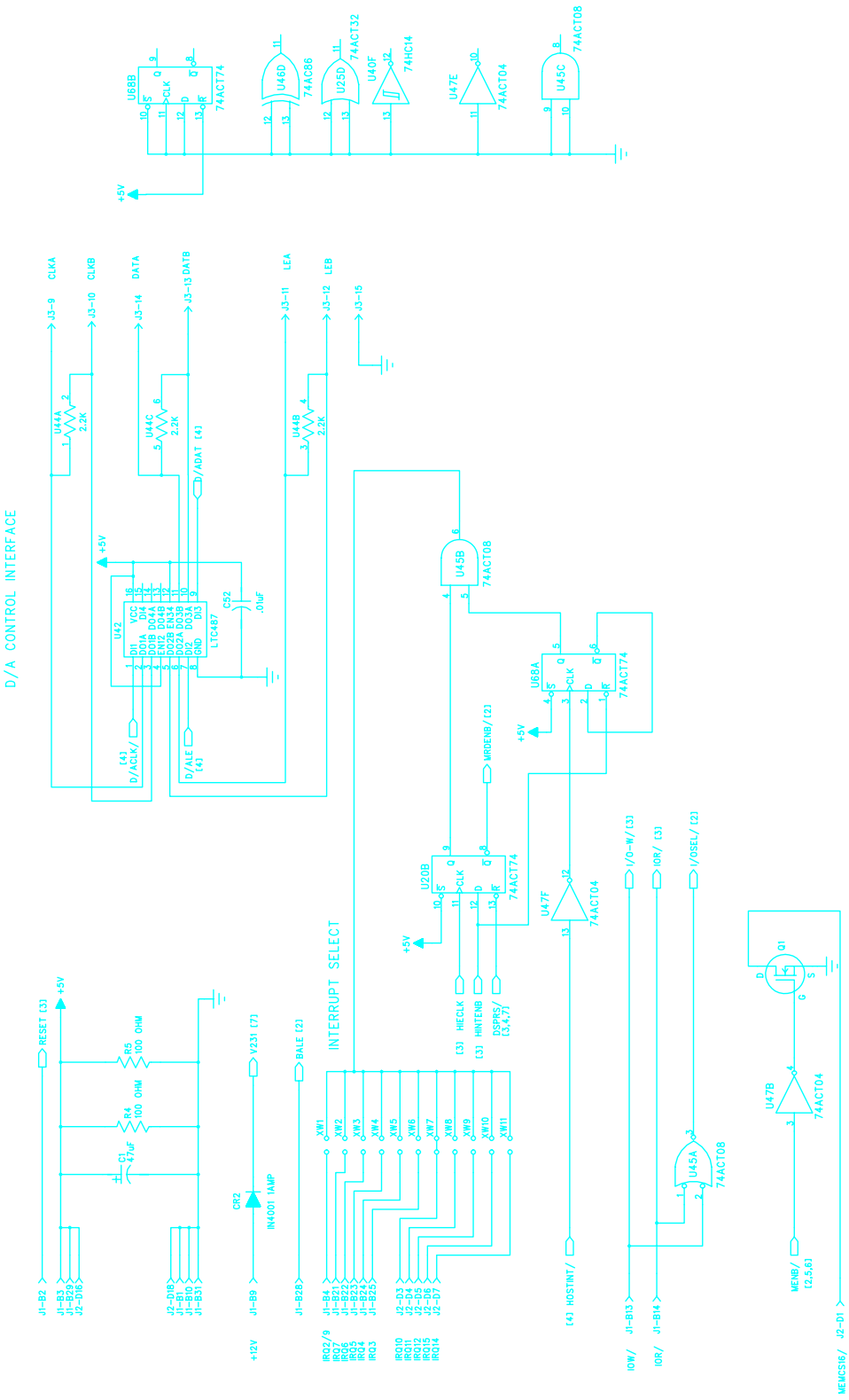

Figure 6-4 ICP Host Interface, Part Number 990-60049-0101 (page 1 of 8)

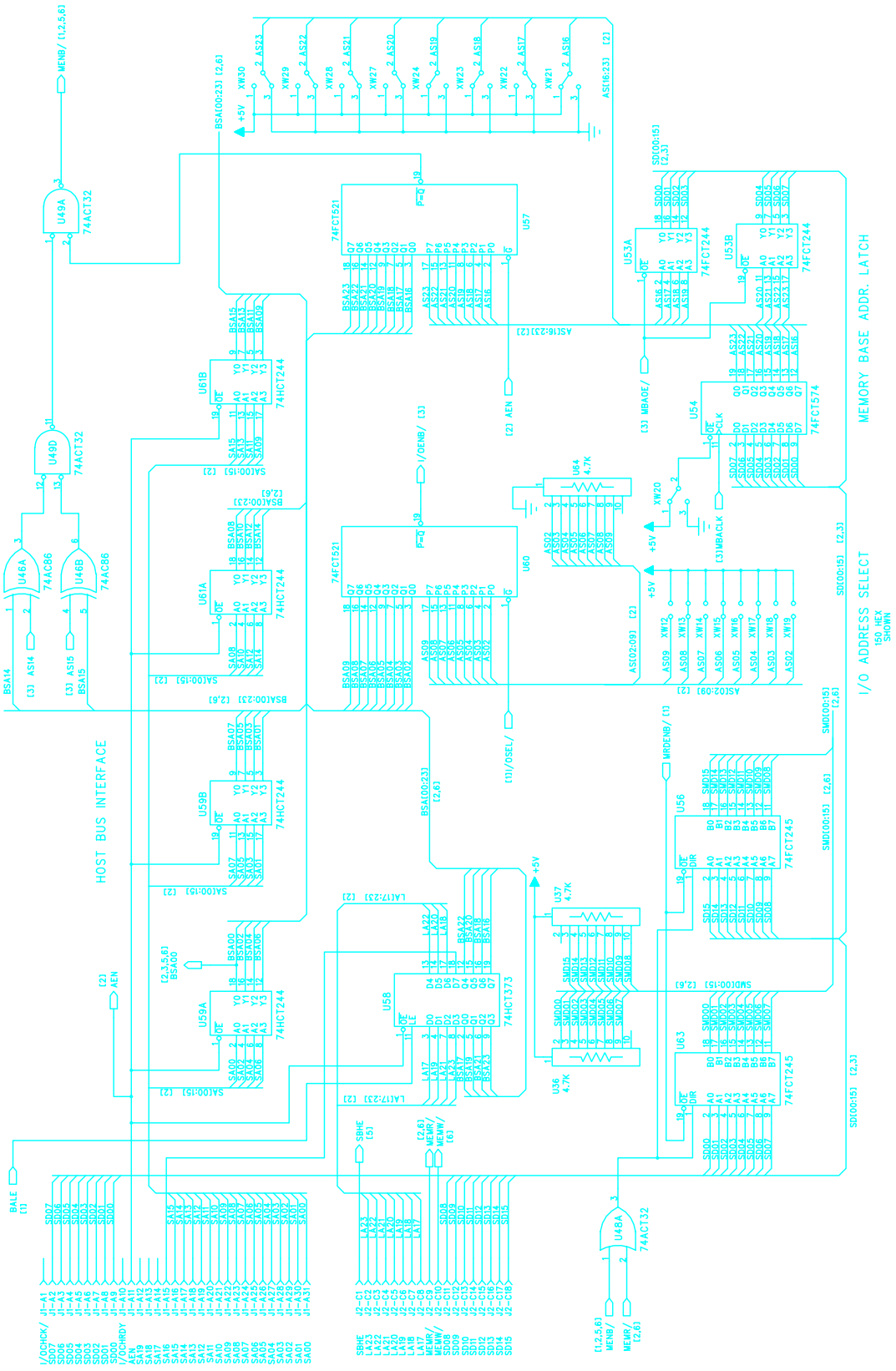

Figure 6-4 ICP Host Interface, Part Number 990-60049-0101 (page 2 of 8)

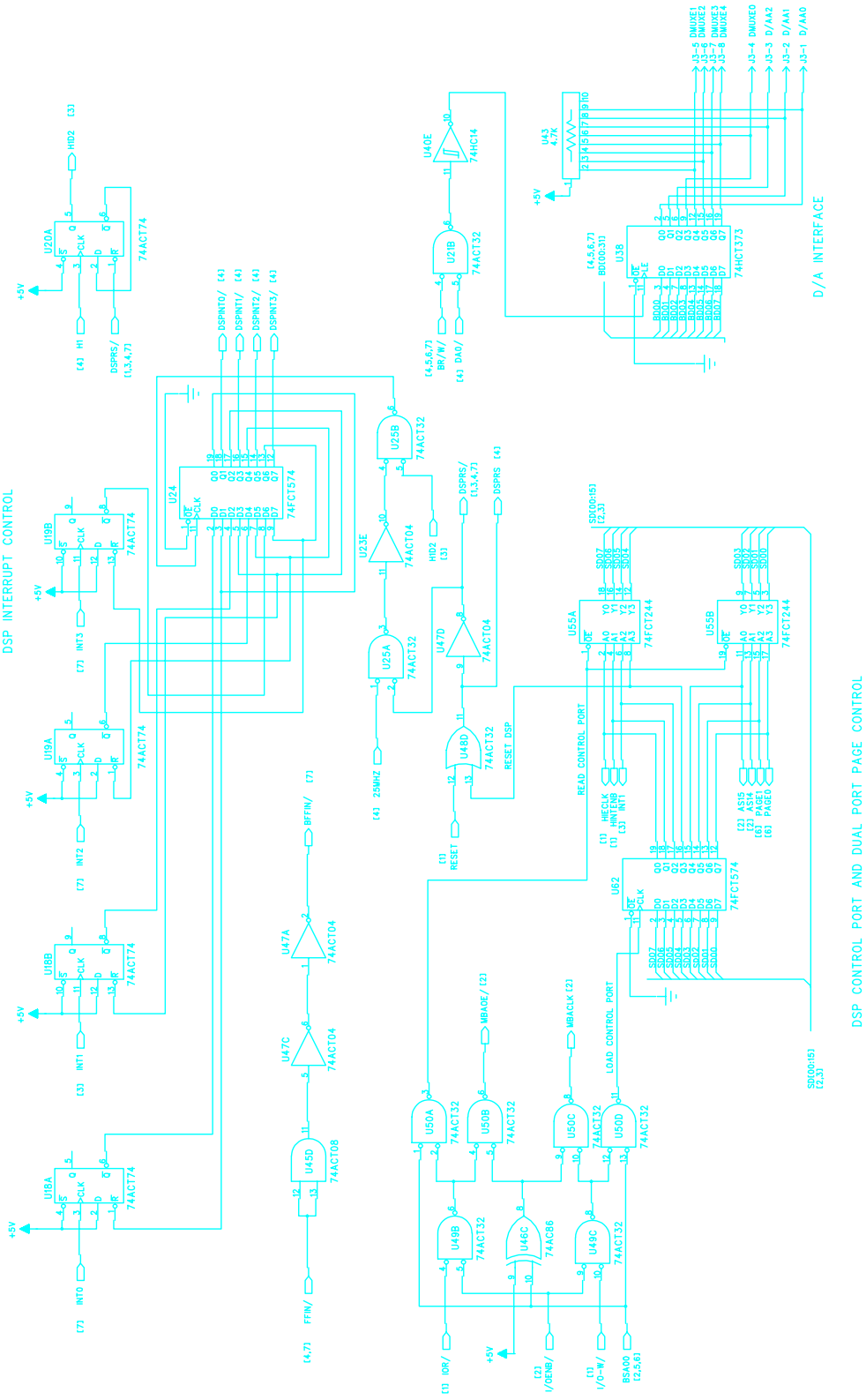

Figure 6-4 ICP Host Interface, Part Number 990-60049-0101 (page 3 of 8)

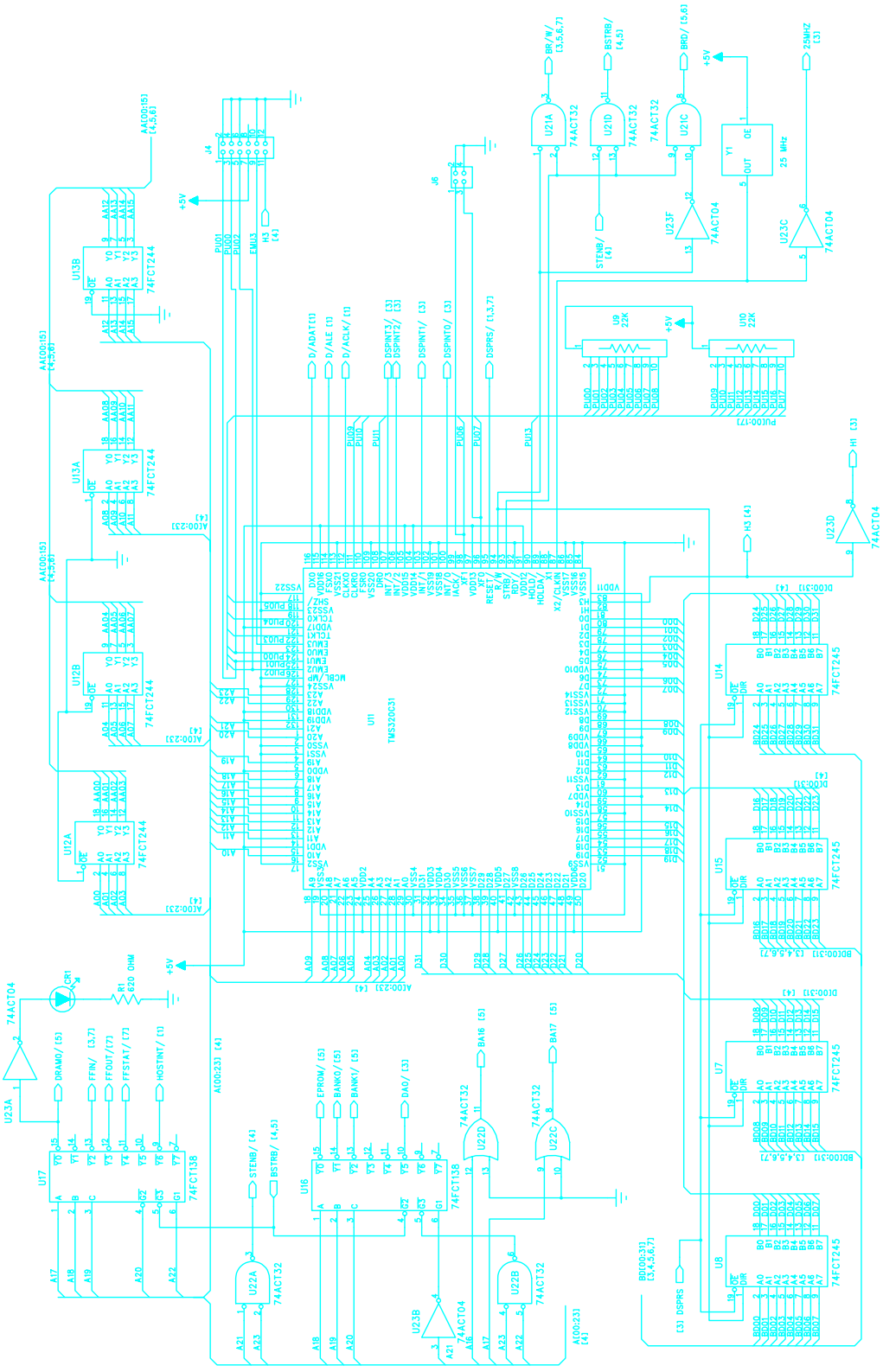

Figure 6-4 ICP Host Interface, Part Number 990-60049-0101 (page 4 of 8)

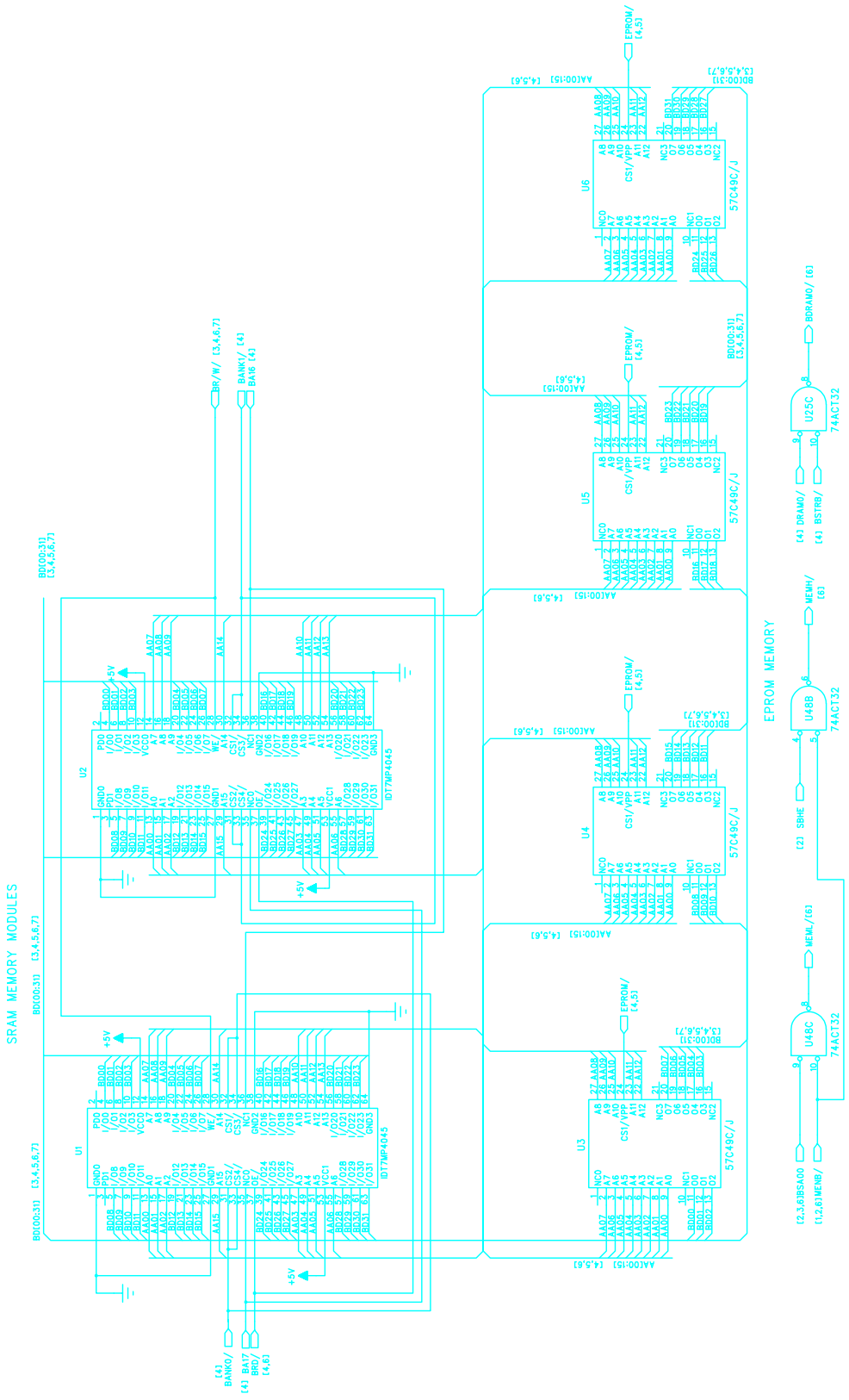

Figure 6-4 ICP Host Interface, Part Number 990-60049-0101 (page 5 of 8)

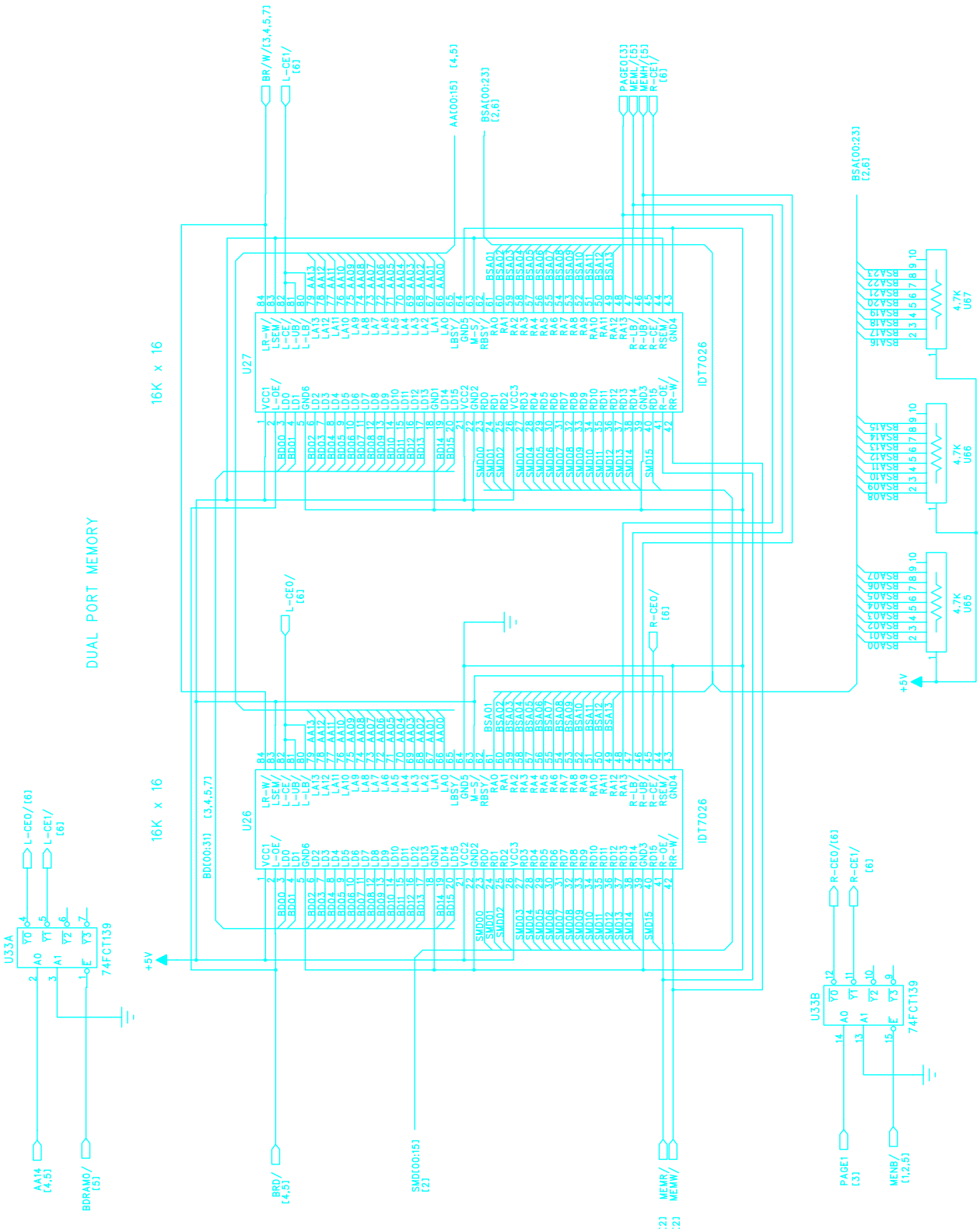

Figure 6-4 ICP Host Interface, Part Number 990-60049-0101 (page 6 of 8)

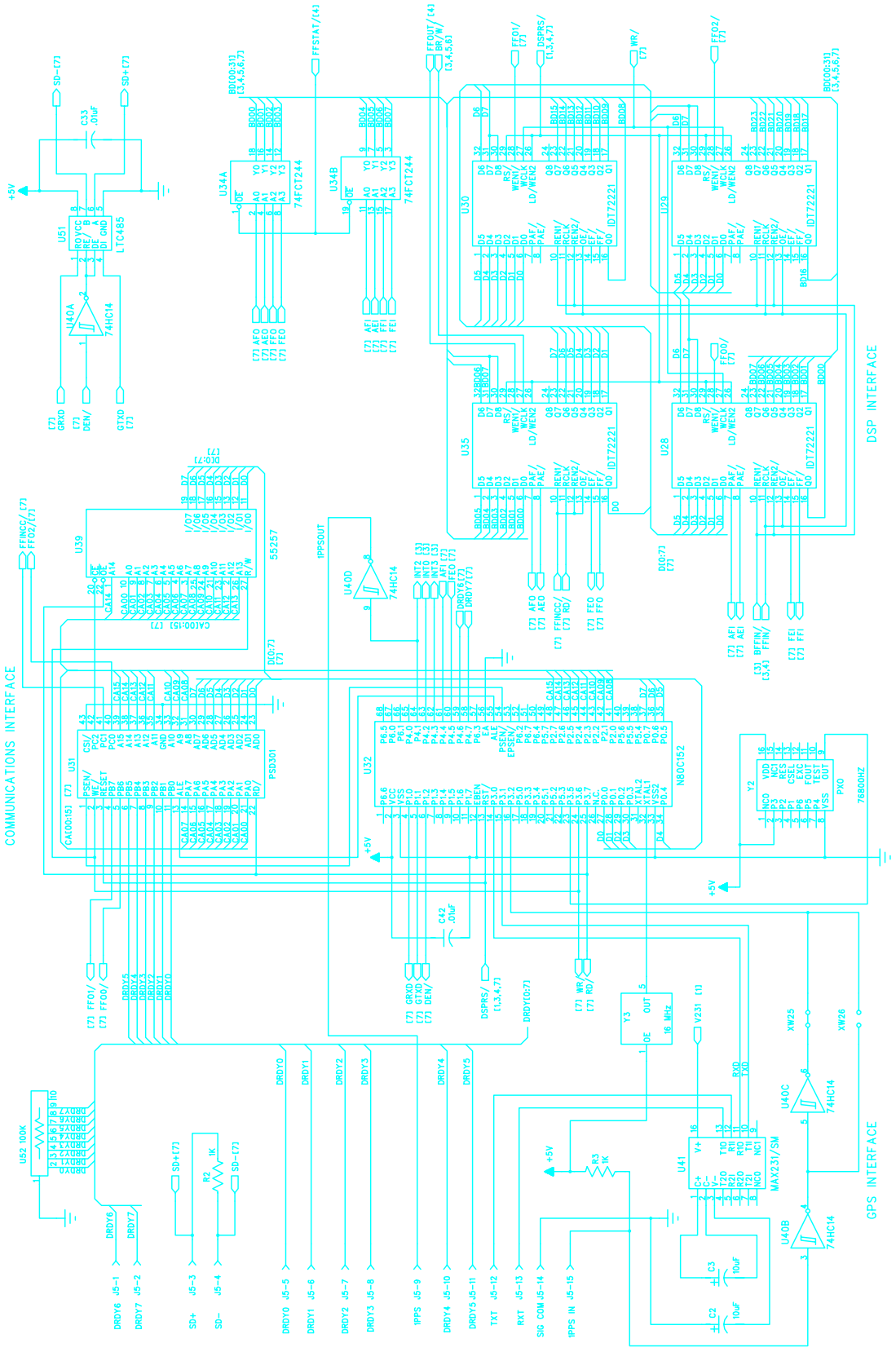

Figure 6-4 ICP Host Interface, Part Number 990-60049-0101 (page 7 of 8)

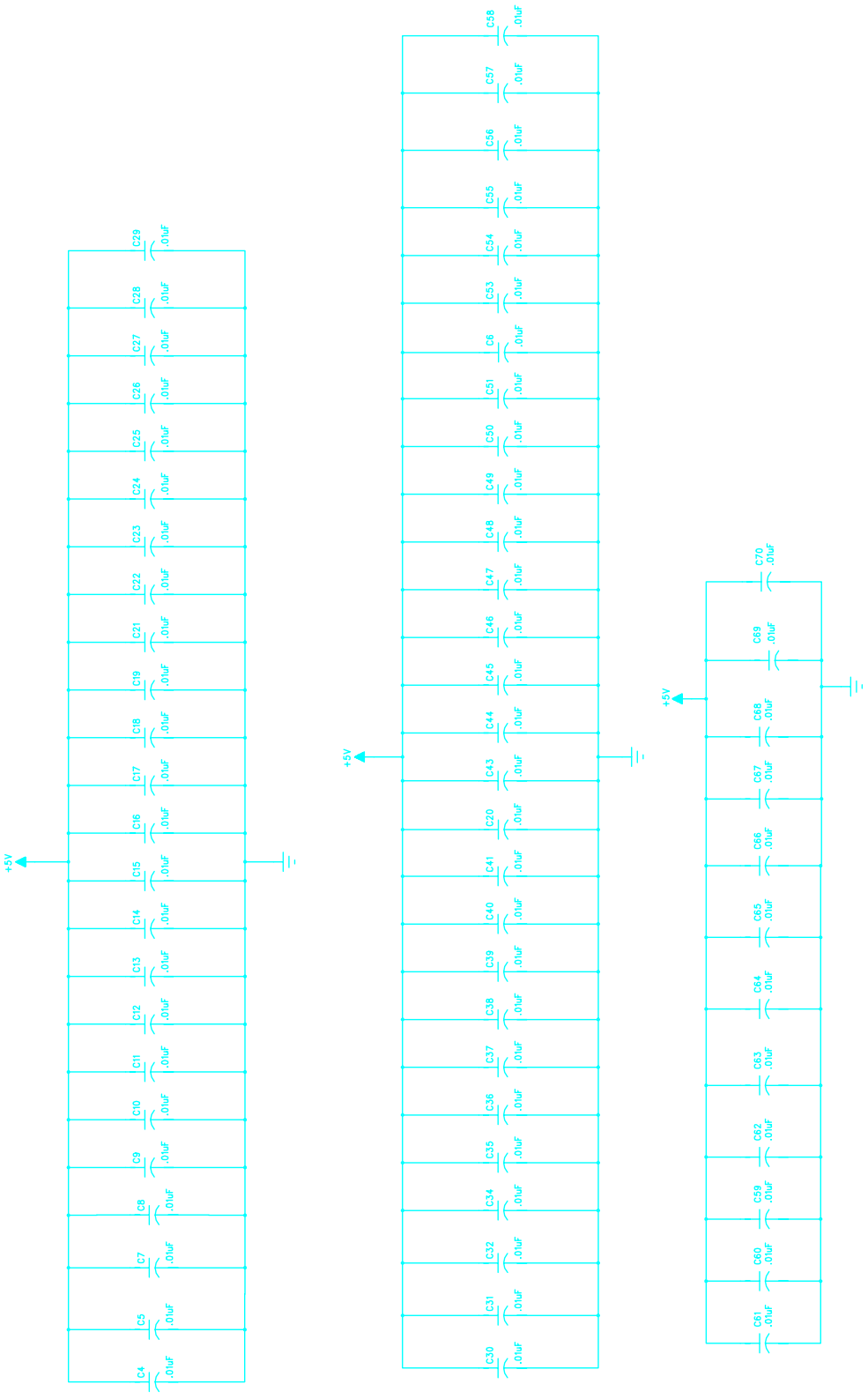

Figure 6-4 ICP Host Interface, Part Number 990-60049-0101 (page 8 of 8)

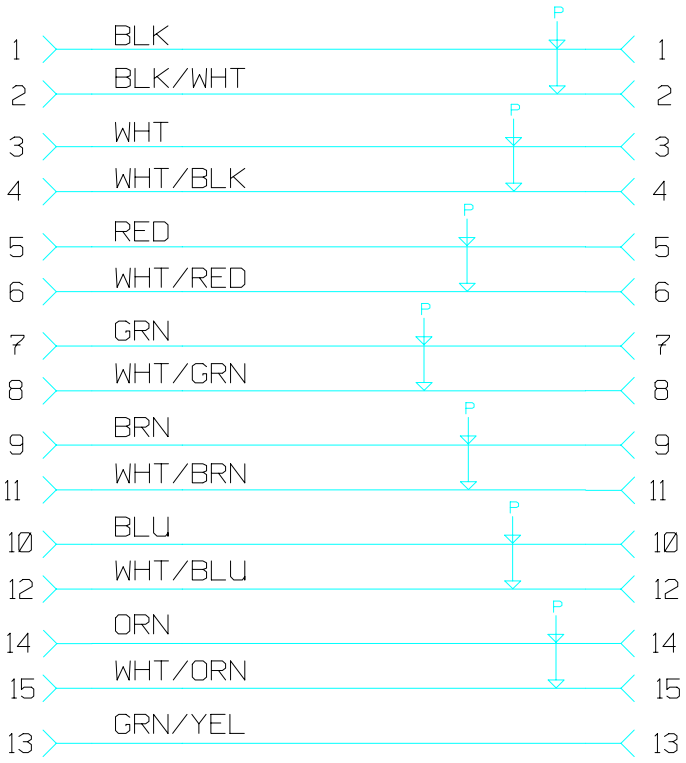

Figure 6-5 ICP Multiplexer to Multiplexer Module daisy chain cable, P/N 990-60156-0101.

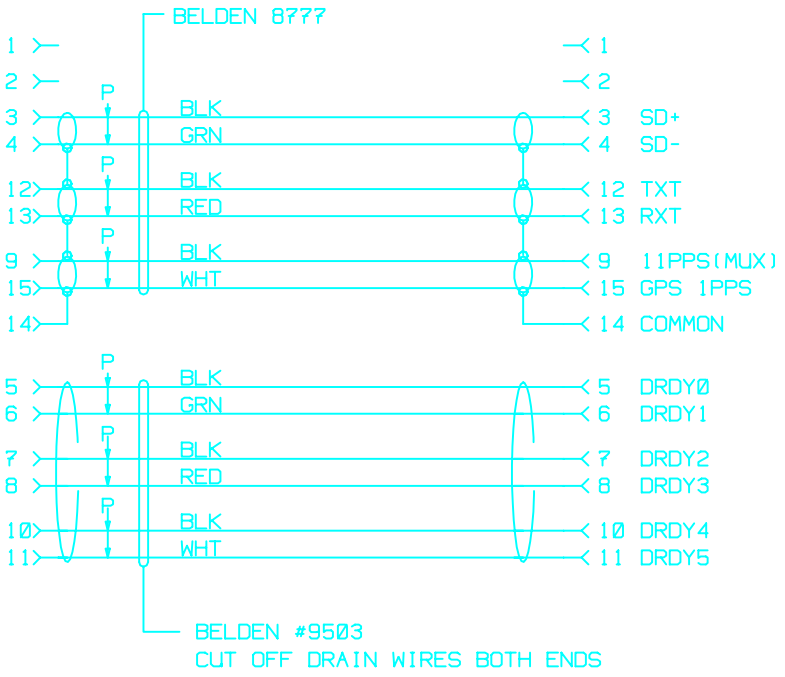

Figure 6-6 ICP Multiplexer to Host Interface Module cable, P/N 990-60156-0102

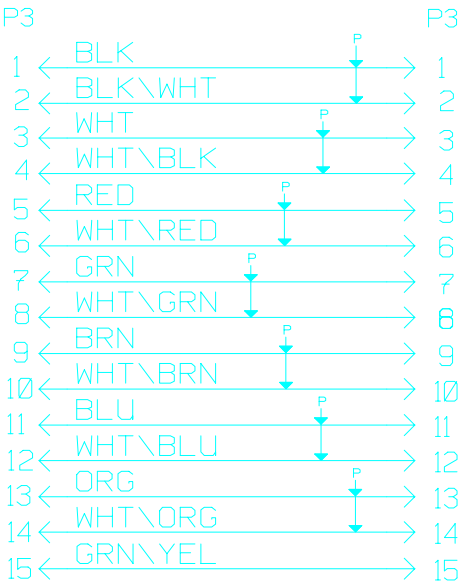

Figure 6-7 ICP Host Interface Module to D/A Module Interface Cable, P/N 990-60157-0101

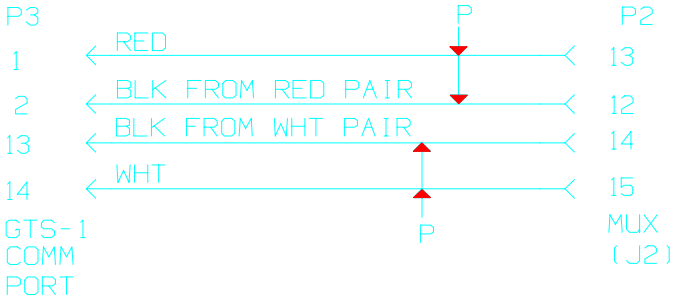

Figure 6-8 GTS-ONE to Multiplexer Module Interface Cable, P/N 990-60172-0101

PARTS LISTS AND ASSEMBLY DRAWINGS

Parts lists and assembly drawings for the ICP System are included in this section. The following Assemblies and Parts Lists are included:

Figure 7-1 Assembly and Parts List, ICP System, 990-59660-0101

Figure 7-2 Assembly and Parts List, ICP Multiplexer Module, 990-59670-0101

Figure 7-3 Assembly and Parts List, 32 Channel D/A Module, 990-59856-0101

Figure 7-4 Assembly and Parts List, ICP Host Interface, 990-60049-0101

Figure 7-5 Assembly and Parts List, ICP Multiplexer to Multiplexer daisy chain cable, P/N 990-60156-0101

Figure 7-6 Assembly and Parts List, ICP Multiplexer to Host Interface Module cable, P/N 990-60156-0102

Figure 7-7 Assembly and Parts List, ICP Host Interface Module to D/A Module Interface Cable, P/N 990-60157-0101

Figure 7-8 Assembly and Parts List, GTS-ONE to Multiplexer Module Interface Cable, P/N 990-60172-0101

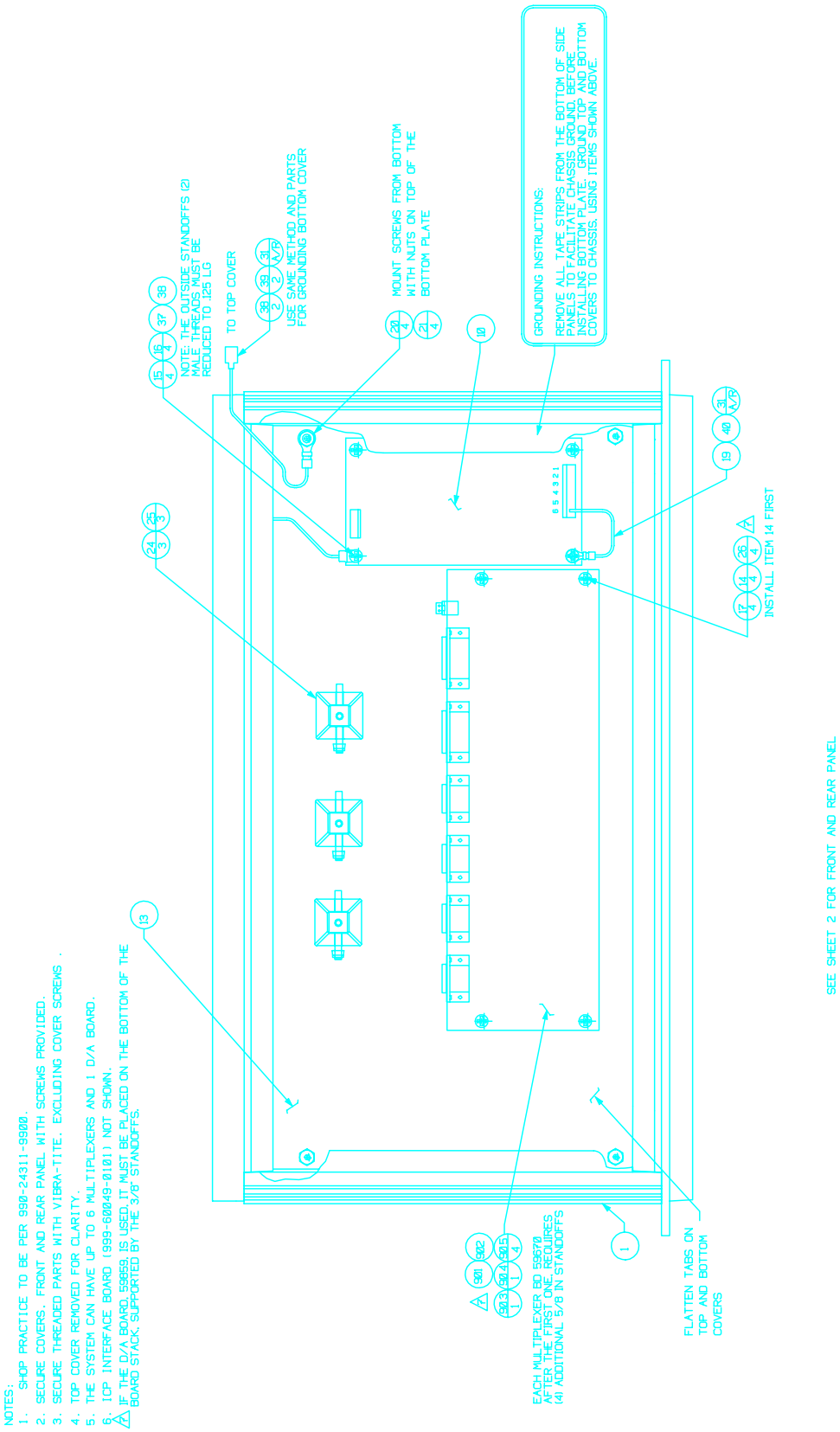

Figure 7-1 ICP System, 990-59660-0101 (Page 1 of 2)

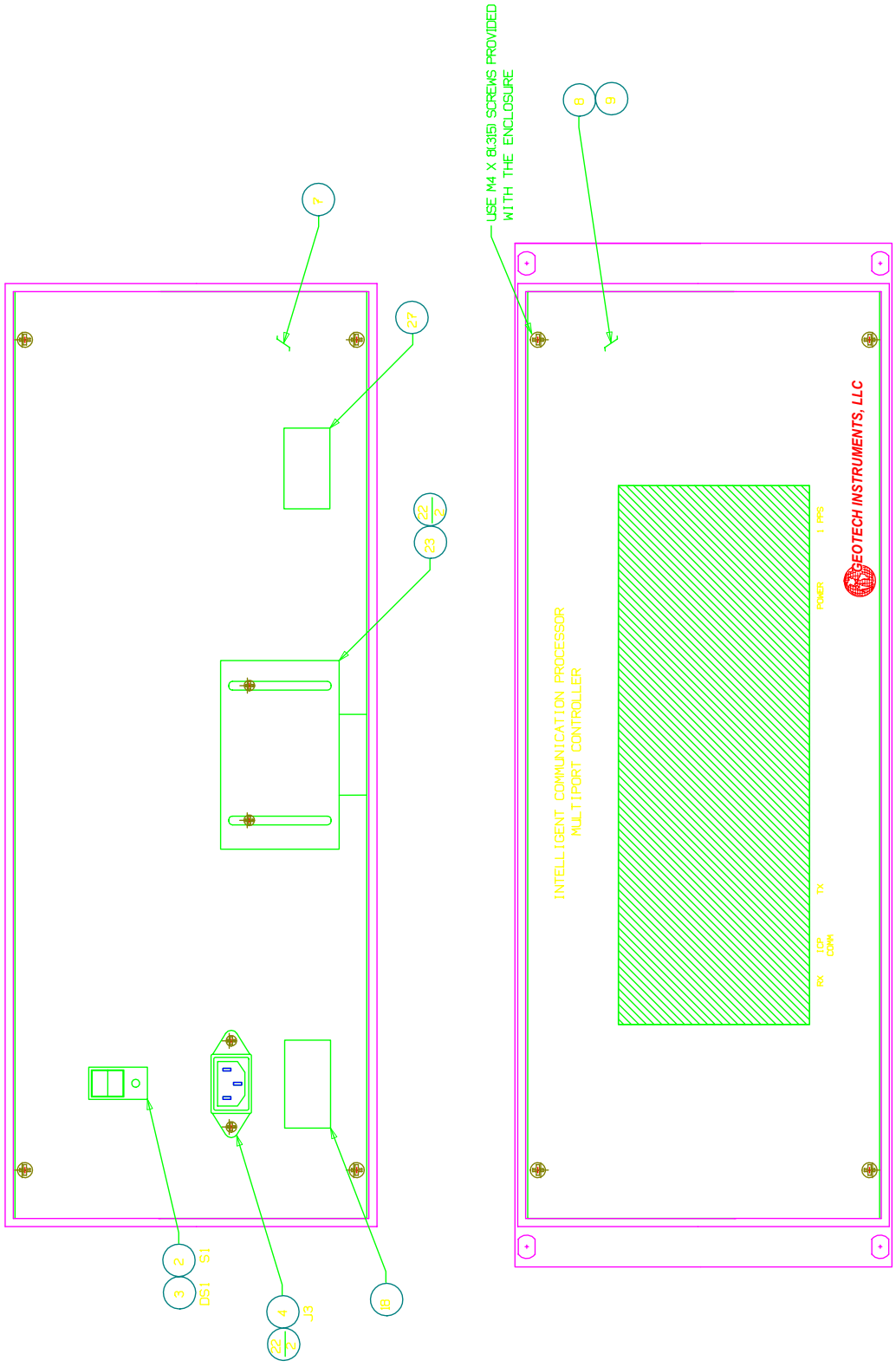

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Figure 7-1 ICP System, 990-59660-0101 (Page 2 of 2)

GEOTECH INSTRUMENTS, LLC

SINGLE LEVEL BILL OF MATERIAL
Date: Feb 16, 2000

ASSEMBLY: **990596600101 ICP SYSTEM** Engnr Relse E48676 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
015151082856	1	1.000	EA	ENCLOSURE,RACK MANUFACTURER SCHROFF	R59660 MFG. PART NO. 10828-056	-5
006407201522	2	1.000	EA	SWITCH,ROCKER,DP Ref: S1 MANUFACTURER C&K COMPONENTS	R59660 MFG. PART NO. 7201J52ZQE22	-5
062143028112	3	1.000	EA	DIODE,LIGHT EMITTING Ref: DS1 MANUFACTURER INDUSTERIAL DEVICES INC	R59660 MFG. PART NO. 4302H1-12V	-5
007425133010	4	1.000	EA	PLUG,POWER,AC,25OV,6 Ref: J3 MANUFACTURER SWITCHCRAFT INC	C44681 MFG. PART NO. EAC-309	B5
019011725000	5	1.000	EA	CORD,BUSINESS MACHINE,3 CONDUC TOR,7.5 FT Ref: PACKING LIST ITEM MANUFACTURER BELDEN MFG. CO.	R59660 MFG. PART NO. 17250	-5
990601530101	7	1.000	EA	BACK PANEL,MUX-D/A	R59660	-5
990601480101	8	1.000	EA	PANEL,FRONT,MUX-D/A	E48592	A5
990601490101	9	1.000	EA	WINDOW,FRONT PANEL	R59660	-5
065301623012	10	1.000	EA	POWER SUPPLY,30W Ref: PS1 MANUFACTURER INTERNATIONAL PWR SOURCES	R60020 MFG. PART NO. PU30-12SL	-5
007769503061	11	1.000	EA	HOUSING,6 POS,.156 CC Ref: J2 MANUFACTURER MOLEX PRODUCTS	R60020 MFG. PART NO. 09-50-3061	-5
007769503031	12	1.000	EA	HOUSING,3 POS,.156 CC Ref: J1 MANUFACTURER MOLEX PRODUCTS	R60020 MFG. PART NO. 09-50-3031	-5
990601550101	13	1.000	EA	PLATE,BOTTOM	E48391	A5

ASSEMBLY: **990596600101 ICP SYSTEM** Engnr Relse E48676 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
315800020085	14	4.000	EA	1/4 HX,MALE-FEMALE,STDOFF3/8 L ONG,6-32 THD	E43966	A5
				MANUFACTURER	MFG. PART NO	
				AMATOM ELECT HDW (MITE CORP)	9738-SS-0632-7	
				LYN-TRON INC	SS-6981-0.375-01	
				GLOBE ELECTRONIC HARDWARE INC	SS-7302-632-12	
				RAF ELECT HWD INC	4532-632-SS-20	
035260130400	15	4.000	EA	SCREW,MACH,PAN HD,CROSS RECESS ED,300 SER,SST,4-40 X 1/4 LG	E47758 A5	
				MANUFACTURER	MFG PART NO	
				ANY AUTHORIZED SUPPLIER		
315800020046	16	4.000	EA	STDOFF,M/F,1/2"LG,4-40 THD,SST	R59660	-5
				MANUFACTURER	MFG. PART NO	
				RAF ELECTRONIC HARDWARE	4530-440-SS-20	
				AMATOM ELECTRONIC HARDWARE	9739-SS-440-7	
035260180400	17	4.000	EA	SCREW,MACH,PAN HD,CROSS RECESS ED,300 SER,SST,6-32 X 1/4 LG	C47758	A5
				MANUFACTURER	MFG. PART NO	
				ANY AUTHORIZED SUPPLIER		
990364300112	18	1.000	EA	TAG,PWR WARNING,115/	R60020	-1
007768500134	19	7.000	EA	TERMINAL,CRIMP	R60020	-5
				MANUFACTURER	MFG. PART NO.	
				MOLEX PRODUCTS	08-50-0134	
035260180700	20	4.000	EA	SCREW,MACH,PAN HD,CROSS RECES SED,18-8 SST,6-32 X 7/16 LG		
				MANUFACTURER	MFG. PART NO.	
				ANY AUTHORIZED SUPPLIER		
038020180000	21	4.000	EA	NUT,HEX,CHAMFERED CORNER 18-8 SST,6-32 (5/16 AF X 7/64 THK)	RELSD	-5
				MANUFACTURER	MFG. PART NO.	
				ANY AUTHORISED SUPPLIER	MS35649-264	
035260130500	22	4.000	EA	SCREW,MACH,PAN HD,CROSS RECESS ED,300 SER,SST,4-40 X 5/16 LG	R59660	-5
				MANUFACTURER	MFG. PART NO.	
				ANY AUTHORIZED SUPPLIER		
990601540101	23	1.000	EA	COVER,CABLE,MUX-D/A	E48601	B5
				REFERENCE DRAWINGS		
				A 990-60154-1101 SLBOM		
015161500041	24	3.000	EA	MOUNT,CABLE TIE	C48080	A5
				MANUFACTURER	MFG. PART NO.	
				DEC INC.	0J0-0004A	
				PANDUIT CORP.	ABM2S-A-C	
				DENNISON MFG. CO	08462	

ASSEMBLY: **990596600101 ICP SYSTEM** Engnr Relse E48676 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
015060153300	25	3.000	EA	TIE,CABLE,0-1 1/4 BUNDLE DIA MANUFACTURER PANDUIT CORP	RELSD MFG. PART NO. SST1.5M	-5
015803512310	26	4.000	EA	STDOFF,CONV,HX,.250,.138-32 THD,.625 LG,SST/PASSIVATED MANUFACTURER AMATOM ELECT HDW (MITE CORP) RAF LYN-TRON GLOBE ELECTRONIC HDW.	C48594 MFG PART NO 9740-SS-0632-7 4536-632-SS-20 SS-6981-0.625-01 SS-7306-632-12	A5
990049500103	27	1.000	EA	NAMEPLATE REFERENCE DRAWINGS A 990-04950-1003 INSTALLATION INSTRUCTIONS	E47884	E5
064062200120	29	36.000	IN	WIRE,ELECTRICAL,STRANDED,INSULATED,VINYL(TYPE B),22 AWG,WHT MANUFACTURER ANY AUTHORIZED SUPPLIER	RELSD MFG. PART NO. M16878/1-B-F-B-9	-5
064062200420	30	22.000	IN	WIRE,ELECTRICAL,STRANDED,INSULATED,VINYL(TP B),22 AWG,GRN MANUFACTURER ANY	RELSD MFG. PART NO.	-5
064062200220	31	52.000	IN	WIRE,ELECTRICAL,STRANDED,INSULATED,VINYL(TP B),22 AWG,BLK MANUFACTURER ANY	RELSD MFG. PART NO.	-5
064062200320	32	36.000	IN	WIRE,ELECTRICAL,STRANDED,INSULATED,VINYL(TP B),22 AWG,RED MANUFACTURER ANY	RELSD MFG. PART NO.	-5
990601560102	33	1.000	EA	CABLE ASSY,MUX TO ICP Ref: PACKING LIST ITEM REFERENCE DRAWINGS A 990-60156-1102 SLBOM	E48682	B5
990596609801	34	1.000	EA	O&M MANUAL Ref: PACKING LIST ITEM	R9660	-5
990602160101	36	1.000	EA	SOFTWARE,ICP Ref: PACKING LIST ITEM REFERENCE DRAWINGS A 990-60216-1101 SLBOM	R59660	-5
008685014466	37	1.000	EA	TAB,QUICK DISC,.032 x .250 MANUFACTURER PC TECHNOLOGY/NEWARK	R59660 MFG. PART NO. MTL-2503-A-MT/50N466	-5
008012599200	38	3.000	EA	RECEPTACLE,TAB(.032 X.250),22-18 AWG,RED SLEEVE MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	C43170 MFG PART NO 640903-1	A5

ASSEMBLY: **990596600101 ICP SYSTEM** Engnr Relse E48676 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
008013615200	39	2.000	EA	LUG,CRIMP,RING,22-16 AWG RED, NO. 6		
				MANUFACTURER	MFG PART NO	
				AMP SPECIAL INDUSTRIES (AMF)	36152	
374011002202	40	1.000	EA	LUG,CRIMP,RING,22-16 AWG,NO.4 STUD,RED SLEEVE *	NONE	A5
				MANUFACTURER	MFG PART NO	
				AMP SPECIAL INDUSTRIES (AMF)	320882	
990598560101	901	0.000	EA	ASSEMBY,32 CHANNEL D/A	E48478	F5
				REFERENCE DRAWINGS		
				A 990-59856-1101 SLBOM		
				D 990-59856-2101 SCHEMATIC		
990601570101	902	0.000	EA	CABLE ASSY,D/A TO ICP	E48683	A5
				REFERENCE DRAWINGS		
				A 990-60157-1101 SLBOM		
990596700101	903	0.000	EA	ICP MULTIPLEXER ASSEMBLY	E48480	E5
				Ref: MINIMUM OF ONE BOARD REQUIRED/SYSTEM		
				REFERENCE DRAWINGS		
				A 990-59670-1101 SLBOM		
				D 990-59670-2101 SCHEMATIC		
990601560101	904	0.000	EA	CABLE ASSY,MUX TO MUX	E48681	B5
				Ref: 1 REQ'D FOR EACH ITEM 903 USED		
				REFERENCE DRAWINGS		
				A-990-60156-1101 SLBOM		
015803512310	905	0.000	EA	STDOFF,CONV,HX,.250,.138-32 THD,.625 LG,SST/PASSIVATED	C48594	A5
				MANUFACTURER	MFG PART NO	
				AMATOM ELECT HDW (MITE CORP)	9740-SS-0632-7	
				RAF	4536-632-SS-20	
				LYN-TRON	SS-6981-0.625-01	
				GLOBE ELECTRONIC HDW.	SS-7306-632-12	
990600490101	906	0.000	EA	ICP/HOST INTERFACE	E48643	C5
				Ref: PACKING LIST ITEM,ONE REQUIRED/SYSTEM. BOARD IS INSTALLED IN THE COMPUTER		
				REFERENCE DRAWINGS		
				A 990-60049-1101 SLBOM		
				D 990-60049-2101 SCHEMATIC		
990598770106	913	0.000	EA	RECEIVER & CABLE ASSY MUX-GPS	E48613	H5
990601720101	914	0.000	EA	CABLE ASSY,MUX TO GTS-1	E48684	B5
				REFERENCE DRAWINGS		
				A 990-60172-1101 SLBOM		

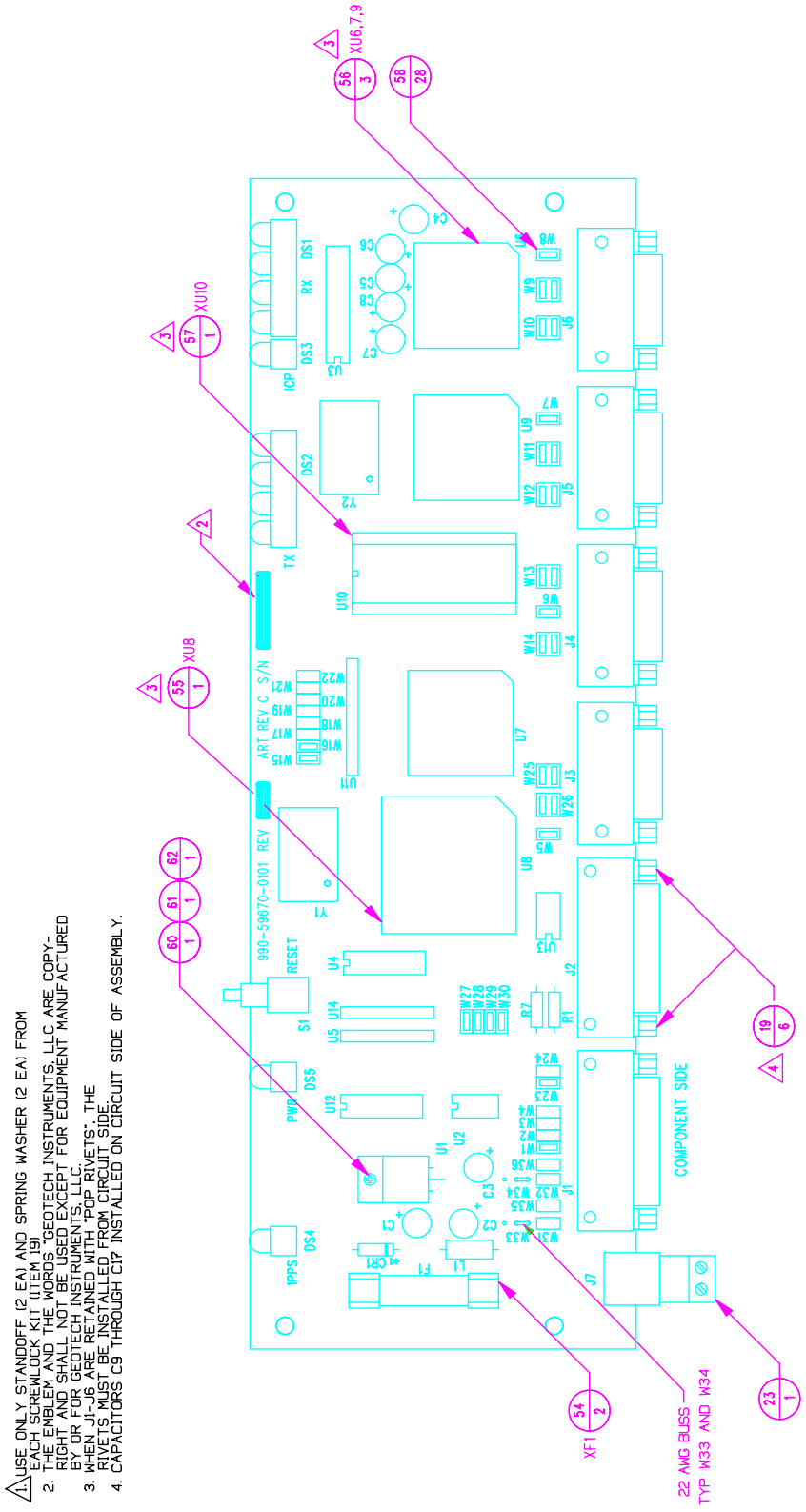

Figure 7-2 ICP Multiplexer Module, 990-59670-0101

Geotech Instruments, LLC

S I N G L E L E V E L B I L L O F M A T E R I A L
Date: Feb 16, 2000

ASSEMBLY: **990596700101 ICP MULTIPLEXER ASSEMBLY** Engnr Relse E48480 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
990596700201	1	1.000	EA	FAB-4 CH MULTIPLEXER	E48589	E5
002710250712	4	3.000	EA	CAPACITOR,10MF,25V,10% Ref: C1,2,3 MANUFACTURER SPRAGUE ELECTRIC CO SPRAGUE ELECTRIC CO	C42644 MFG PART NO 196D106X9025KA1 199D106X9025CA2	A5
002610350712	5	5.000	EA	CAPACITOR,1.0 MF,35V,10 Ref: C4-8 MANUFACTURER SPRAGUE ELECTRIC CO SPRAGUE ELECTRIC CO	C42736 MFG PART NO 199D105X9035AA2 196D105X9035HA1	A5
502510500855	6	11.000	EA	CAPACITOR,0.1uF,50V,10%,SMT ON REEL TAPE,EIA PKG 1206 Ref: C9-19 MANUFACTURER JOHANSON DIELECTRIC PHILIPS COMPONENTS AVX CORP KEMET ELECTRONICS CORP	R59660 MFG. PART NO 500R18W104KV4E 12062R104K9BB0 12065C104KAT1A C1206C104K5RAC	-5
012010400100	11	1.000	EA	DIODE Ref: CR1 MANUFACTURER ANY AUTHORIZED SUPPLIER	RELSD MFG PART NO 1N4001	-5
062155005054	14	1.000	EA	LED,4 ELEMENT,5mm,RT ANGLE, Ref: DS1 MANUFACTURER DIALIGHT & DIALCO (DIGITRONICS)	R59660 MFG. PART NO 50-0505-004	-5
062155008054	15	1.000	EA	LED,4 ELEMENT,5mm,YEL,RT ANGLE Ref: DS2 MANUFACTURER DIALIGHT & DIALCO (DIGITRONICS)	R59660 MFG. PART NO 550-0805-004	-5
062115500705	16	1.000	EA	LED,5mm,GRN,RT ANGLE Ref: DS3 MANUFACTURER DIALIGHT & DIALCO (DIGITRONICS)	R59660 MFG. PART NO. 550-0705	-5
062115500505	17	2.000	EA	LED,5mm,RED,RT ANGLE Ref: DS4,5 MANUFACTURER DIALIGHT & DIALCO (DIGITRONICS	R59660 MFG. PART NO. 550-0505	-5

ASSEMBLY: **990596700101 ICP MULTIPLEXER ASSEMBLY** Engnr Relse E48480 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
004101030005	18	1.000	EA	FUSE,3AG,3 AMP,250V		
				Ref: F1		
				MANUFACTURER	MFG PART NO	
				LITTELFUSE	312003	
				BUSSMAN MFG(MCGRAY EDISON CO	AGC 3	
007782058171	19	6.000	EA	SCREWLOCK,FEMALE		
				MANUFACTURER	MFG PART NO	
				AMP SPECIAL INDUSTRIES (AMF)	205817-1	
007787478414	20	2.000	EA	CONN,D,15 POS(PIN),RT ANGLE	R60020	-5
				Ref: J1,2		
				SEE ITEM 905 FOR ALTERNATE		
				MANUFACTURER	MFG PART NO	
				AMP SPECIAL INDUSTRIES (AMF)	747841-4	
007787478404	21	4.000	EA	CONN,D,9 POS(PIN),RT ANGLE	R60020	-5
				Ref: J3-6		
				SEE ITEM 906 FOR ALTERNATE		
				MANUFACTURER	MFG PART NO	
				AMP SPECIAL INDUSTRIES (AMF)	747840-4	
007005122210	22	1.000	EA	HEADER,RT ANGLE,2 PIN		
				Ref: J7		
				MANUFACTURER	MFG PART NO	
				PRECISION CONNECTOR DESIGNSELFH02210		
007005082210	23	1.000	EA	PLUG BLOCK,RT ANGLE,2 POS	R59660	-5
				Ref: P7		
				MANUFACTURER	MFG. PART NO	
				PRECISION CONNECTOR DESIGNSELFP02210		
001051001035	24	1.000	EA	RSTR,FXD,1K,1/4W,5%	5/3/82	-5
				Ref: R1		
				MANUFACTURER	MFG PART NO	
				ALLEN BRADLEY	CB1025	
010017508802	25	1.000	EA	INDUCTOR,FIXED,SHIELDED 1.2Uh	C48660	A5
				MS TYPE 75088-2		
				Ref: L1		
				MANUFACTURER	MFG PART NO	
				ANY AUTHORIZED SUPPLIER	MS75088-2	
				J. W. MILLER	9250-122	
				DELEVAN	1641-122	
001061001035	26	1.000	EA	RSTR,FXD,10K,1/4W,5%	RELSD	-5
				Ref: R7		
				MANUFACTURER	MFG. PART NO	
				ALLEN BRADLEY	CB1035	
006402016120	28	1.000	EA	SWITCH,PUSHBUTTON,SPDT	C47901	A5
				Ref: S1		
				MANUFACTURER	MFG PART NO	
				C & K COMPONENTS INC	TP12-SH9-ABE	

ASSEMBLY: **990596700101 ICP MULTIPLEXER ASSEMBLY** Engnr Relse E48480 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
012622904205	29	1.000	EA	REGULATOR,5V Ref: U1		
				MANUFACTURER	MFG PART NO	
				NATIONAL SEMICONDUCTOR	LM2940T-5.0	
012154853198	30	1.000	EA	LOW POWER RS485 INTERFACE Ref: U2		
				MANUFACTURER	MFG PART NO	
				LINEAR TECHNOLOGY INC	LTC485CN8	
012107483241	31	1.000	EA	IC,OCTAL BUFFER AND LINE DRIVE R,3 STATE OUTPUTS Ref: U3		
				MANUFACTURER	MFG PART NO	
				TEXAS INSTRUMENTS	SN74HC241N	
012107483014	32	1.000	EA	IC,HEX INVERTING Ref: U4	C47539	A5
				MANUFACTURER	MFG PART NO	
				MOTOROLA	MC74HC14N	
				NATIONAL SEMICONDUCTOR	MM74HC14AN	
				RCA CORP	CD74HC14E	
				TEXAS INSTRUMENTS	SN74HC14N	
301712020804	33	2.000	EA	RSTR,NETWORK,2K,2%,SIP,4 RSTR 8 PIN, Ref: U5,14		
				MANUFACTURER	MFG PART NO	
				TRW	608-3-202G	
				BOURNS INSTRUMENT INC	4308R-102-202	
				CTS CORP	750-83-2K	
012102443000	34	1.000	EA	RS-232 DRIVERS/RECEIVERS Ref: U6		
				MANUFACTURER	MFG PART NO	
				MAXIM INTERGRATED PRODUCTS	MAX244CQH	
990597610101	35	1.000	EA	PROGRAMMABLE SYS DEVICE Ref: U7	R59670	-1
012438031522	36	1.000	EA	IC,COMMUNICATION CONTROLLER, 16.5 MHz Ref: U8	C48663	B5
				MANUFACTURER	MFG PART NO	
				INTEL CORP	N80C152JB-1 (OBSOLETE)	
				KAWASAKI	KS152JB3 (INTEL N80C152JB-1 REPLACEMENT PART)	
012638236843	37	1.000	EA	QUAD CHANNEL UART,CMOS Ref: U9		
				MANUFACTURER	MFG PART NO	
				EXAR INTEGRATED SYS	XR-82C684CJ/44	
012635525712	38	1.000	EA	IC,32K X 8 CMOS STATIC RAM Ref: U10	C48376	C5
				MANUFACTURER	MFG PART NO	
				TOSHIBA AMERICA INC	TC55257DPL-70L	

ASSEMBLY: **990596700101 ICP MULTIPLEXER ASSEMBLY** Engnr Relse E48480 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
301712231009	39	1.000	EA	RSTR,NETWORK,22K,2%,SIP, PIN,9 RSTR Ref: U11 MANUFACTURER CTS CORP BOURNS INSTRUMENT INC	R00000 MFG PART NO 750-101-R22K 4310R-101-223	-5
012107483002	40	1.000	EA	IC,QUAD 2-INPUT NOR GATE Ref: U12 MANUFACTURER ANY AUTHORIZED SUPPLIER	R60020 MFG PART NO 74HC02 PLSTC	-5
012991231200	41	1.000	EA	I.C.,POWER MONITOR Ref: U13 MANUFACTURER DALLAS SEMICONDUCTOR CORP	 MFG PART NO DS1231-20	
007787499122	42	4.000	EA	BACKSHELL KIT,9 PIN Ref: PACKING LIST (990-59660-8601) ITEM MANUFACTURER AMP SPECIAL INDUSTRIES (AMF	C48290 MFG. PART NO 749914-2	A5
007787479052	44	4.000	EA	CONNECTOR,9 PIN D,FEMALE Ref: PACKING LIST (990-59660-8601) ITEM MANUFACTURER CINCH-JONES (TRW) AMP SPECIAL INDUSTRIES (AMF)	R59660 MFG. PART NO DE9S 747905-2	-5
007936550102	45	8.000	EA	CONNECTOR,2 POSITION Ref: XW5-8,31,32,35,36 MANUFACTURER BERG ELECT DIV OF DU PONT	 MFG. PART NO 65500-102	
007936510104	46	9.000	EA	CONNECTOR,4 POS Ref: XW9-14,23-26 MANUFACTURER BERG ELECT DIV OF DU PONT	C47759 MFG PART NO 67996-104	A5
007936510108	47	2.000	EA	CONNECTOR,8 POS Ref: XW1-4,27-30 MANUFACTURER BERG ELECT DIV OF DU PONT	E47759 MFG PART NO 67996-108	A5
007936510116	48	1.000	EA	CONNECTOR,16 POS Ref: XW15-22 MANUFACTURER BERG ELECT DIV OF DU PONT	E47759 MFG PART NO 67996-116	A5
011195116160	51	1.000	EA	CRYSTAL OSC,16.0MHZ Ref: Y1 SEE ITEM 900 AND 901 FOR ALTERNATES MANUFACTURER EPSON AMERICA INC	R59660 MFG PART NO SG-51P-16.000MHZ-.01	-5

ASSEMBLY: **990596700101 ICP MULTIPLEXER ASSEMBLY** Engnr Relse E48480 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
011195116368	52	1.000	EA	CRYSTAL OSC,3.6864MHZ R59660 Ref: Y2 SEE ITEM 902 AND 903 FOR ALTERNATES MANUFACTURER EPSON AMERICA INC	-5 MFG PART NO SG-51P-3.6864MHZ-.01	
004200102069	54	2.000	EA	CLIP,FUSE,3AG,NICKEL PLATE Ref: XF1 MANUFACTURER LITTELFUSE	RELSD MFG PART NO 102074	-5
007376816410	55	1.000	EA	SOCKET,68 PIN,PLCC Ref: XU8 MANUFACTURER BURNDY CORP	 MFG PART NO QILE68P-410T	
007374416410	56	3.000	EA	SOCKET,44 PIN,PLCC Ref: XU6,7,9 MANUFACTURER BURNDY CORP	 MFG PART NO QILE44P-410T	
007370281100	57	1.000	EA	SOCKET,I.C.,28 PIN Ref: XU10 MANUFACTURER BURNDY CORP	C48144 MFG PART NO DILB28P223T	A5
007936547404	58	28.000	EA	JUMPER,.100 CC Ref: W1,5-16,23,25-30 MANUFACTURER BERG ELECT DIV OF DU PONT	 MFG PART NO 65474-010	
035260130400	60	0.000	EA	SCREW,MACH,PAN HD,CROSS RECESS ED,300 SER,SST,4-40 X 1/4 LG MANUFACTURER ANY AUTHORIZED SUPPLIER	E47758 MFG PART NO	A5
038561080000	61	0.000	EA	WASHER,LOCK,INTERNAL TOOTH,400 SER SST,NO. 4 MANUFACTURER ANY AUTHORIZED SUPPLIER	RELSD MFG PART NO MS35333-70	-5
038050130000	62	1.000	EA	NUT,SML PAT,HEXAGON,4-40 300 S ER SST,UNC-2B MANUFACTURER ANY AUTHORIZED SUPPLIER	RELSD MFG PART NO NAS671-C4	-A
011091345160	900	0.000	EA	CRYSTAL OSC,16.0MHZ Ref: ALTERNATE FOR ITEM 51 MANUFACTURER CTS KNIGHTS	R59660 MFG PART NO MX045-16.000MHZ-.01%	-5
011135426016	901	0.000	EA	OSCILLATOR,CMOS,16.0MHZ Ref: ALTERNATE FOR ITEM 51 MANUFACTURER DALE ELECTRONICS INC	 MFG PART NO XO-54B-60-16.0MHz	

ASSEMBLY: **990596700101 ICP MULTIPLEXER ASSEMBLY** Engnr Relse E48480 Engnr Rev E5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
011091345368	902	0.000	EA	CRYSTAL OSC,3.68MHZ Ref: ALTERNATE FOR ITEM 52 MANUFACTURER CTS KNIGHTS	R59660 MFG PART NO MX045-3.6864MHZ-.01%	-5
011135426036	903	0.000	EA	OSCILLATOR,CMOS,3.6864MHZ Ref: ALTERNATE FOR ITEM 52 MANUFACTURER DALE ELECTRONICS INC	 MFG PART NO XO-54B-60-3.3864MHz	
040119030800	904	0.000	EA	RIVET,BLIND(POP),3/32 DIAX .126 - .250 GRIP,BODY-5 Ref: 2 EA REQUIRED FOR EACH 905 OR 906 USED MANUFACTURER POP FASTNER(DIV OF EMHART FAST	 MFG PART NO AD34ABS	
007787472364	905	0.000	EA	CONNECTOR,15 POS,RT ANGLE Ref: ALTERNATE FOR ITEM 20 MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	 MFG PART NO 747236-4	
007787472504	906	0.000	EA	CONNECTOR,9 POS RT ANGLE MALE Ref: ALTERNATE FOR ITEM 21 MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	 MFG PART NO 747250-4	

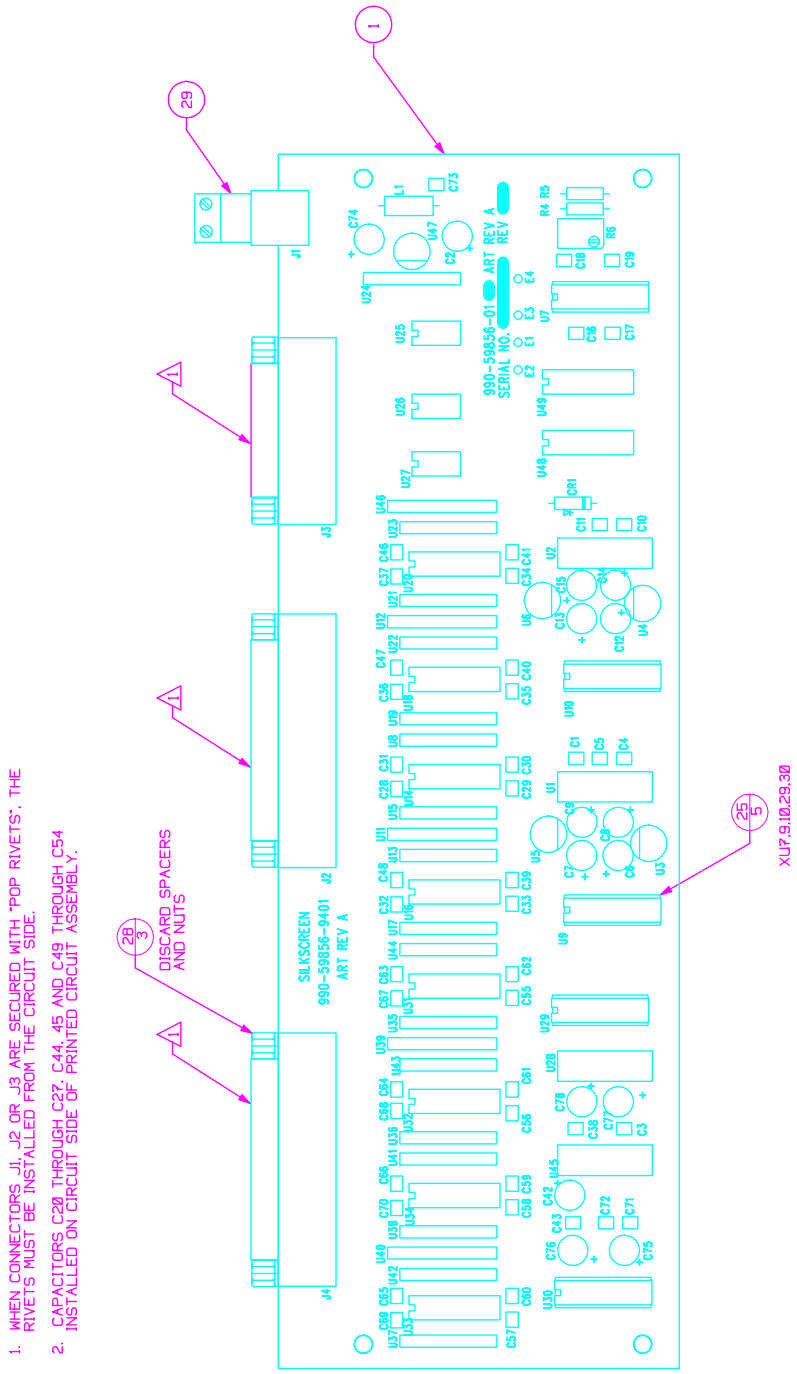

Figure 7-3 32 Channel D/A Module, 990-59856-0101

Geotech Instruments, LLC

SINGLE LEVEL BILL OF MATERIAL
Date: Feb 16, 2000

ASSEMBLY **990598560101** **ASSEMBY,32 CHANNEL D/A** Engnr Relse E48478 Engnr Rev F5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
990598560201	1	1.000	EA	FAB-32 CHANNEL D/A	E48432	E5
502310500855	2	32.000	EA	CAPACITOR,1000pF,50V,10%,SMT, ON REEL TAPE,EIA PKG 1206 Ref: C28-37,C39-41,C46-48,C55-70 MANUFACTURER JOHANSON DIELECTRIC KEMET ELECTRONICS CORP PHILIPS COMPONENTS AVX CORP	R59660 MFG. PART NO 500R18N102KV4E C1206C102KGAC 1206CG102K9BB0 12065A102KAT1A	-5
502510500855	3	31.000	EA	CAPACITOR,0.1uF,50V,10%,SMT, ON REEL TAPE,EIA PKG 1206 Ref: C1,C3-5,C10,C11,C16-27,C38,C43-45,C49-54,C71-73 MANUFACTURER JOHANSON DIELECTRIC PHILIPS COMPONENTS AVX CORP KEMET ELECTRONICS CORP	R59660 MFG. PART NO 500R18W104KV4E 12062R104K9BB0 12065C104KAT1A C1206C104K5RAC	-5
002710258684	4	15.000	EA	CAPACITOR,10MF,25V,20% Ref: C2,6-9,12-15,42,74-78 MANUFACTURER SPRAGUE ELECTRIC CO	 MFG PART NO 199D106X0025CE2	
064252210250	5	2.000	EA	WIRE,JUMPER,INSULATED,TEF,0.25 0 LG X 0.250 HIGH,22 AWG Ref: JUMPER, E1-E2, E3-E4 MANUFACTURER SQUIRES ELECTRONICS	C30682 MFG. PART NO J0.250X0.250T22	A1
012010400100	6	1.000	EA	DIODE Ref: CR1 MANUFACTURER ANY AUTHORIZED SUPPLIER	RELSD MFG PART NO 1N4001	-5
007787478464	7	2.000	EA	CONN,D,25 POS(SKT),RIGHT ANGLE Ref: J2.J4 MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R59660 MFG PART NO 747846-4	-5
007787478454	8	1.000	EA	CONN,D,15 POS(SKT),RT ANGLE Ref: J3 MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG PART NO 747845-4	-5
007005122210	9	1.000	EA	HEADER,RT ANGLE,2 PIN Ref: J1 MANUFACTURER PRECISION CONNECTOR DESIGNSELFH02210	 MFG PART NO	

ASSEMBLY **990598560101** **ASSEMBY,32 CHANNEL D/A** Engnr Relse E48478 Engnr Rev F5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
010017508802	10	1.000	EA	INDUCTOR,FIXED,SHIELDED 1.2uH MS TYPE 75088-2 Ref: L1 MANUFACTURER ANY AUTHORIZED SUPPLIER J. W. MILLER DELEVAN	C48660 MFG PART NO MS75088-2 9250-122 1641-122	A5
065627500110	11	4.000	EA	CONVERTER,12V TO +/-12V Ref: U1,2,28,45 MANUFACTURER BURR BROWN RESEARCH CORP	 MFG PART NO HPR110	
012627805130	12	3.000	EA	VOLTAGE REGULATOR,5V POS Ref: U3,4,47 MANUFACTURER TEXAS INSTRUMENTS NATIONAL SEMICONDUCTOR	C47719 MFG PART NO uA78L05ACLP LM78L05ACZ	A5
012627905130	13	2.000	EA	VOLTAGE REG,-5V,100MA Ref: U5,U6 MANUFACTURER MOTOROLA NATIONAL SEMICONDUCTOR	C44677 MFG PART NO MC79L05ACP LM79L05ACZ	A5
012154853198	14	3.000	EA	LOW POWER RS485 INTERFACE Ref: U25,U26,U27 MANUFACTURER LINEAR TECHNOLOGY INC	 MFG PART NO LTC485CN8	
012100766000	15	1.000	EA	I.C. Ref: U7 MANUFACTURER ANALOG DEVICES INC	 MFG PART NO AD766JN	
012621058314	16	8.000	EA	OP AMP,QUAD Ref: U14,16,18,20,31-34 MANUFACTURER LINEAR TECHNOLOGY INC	 MFG PART NO LT1058CN	
012101310508	17	4.000	EA	8 CHANNEL ANALOG MUX Ref: U9,10,29,30 MANUFACTURER BURR BROWN RESEARCH CORP	C47899 MFG PART NO MPC-508AP	A5
001171009074	18	1.000	EA	RSTR,VAR,100K Ref: R6 MANUFACTURER BECKMAN INSTRUMENTS INC	 MFG PART NO 68WR100K	
001072000901	19	1.000	EA	RSTR,FXD,200K,1/10 W,1% Ref: R5 MANUFACTURER ANY AUTHORIZED SUPPLIER	 MFG PART NO RN55C2003F	

ASSEMBLY **990598560101** **ASSEMBY,32 CHANNEL D/A** Engnr Relse E48478 Engnr Rev F5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
001074750901	20	1.000	EA	RSTR,FXD,475 K,1/10W,1% Ref: R4 MANUFACTURER ANY AUTHORIZED SUPPLIER	 MFG PART NO RN55C4753F	
001753309067	21	5.000	EA	RSTR,3.3K,9 RSTR 10 PIN SIP,2% Ref: U11,12,39,40,46 MANUFACTURER DALE ELECTRONICS ING	 MFG PART NO CSC09A-01-332G	
007783312727	22	4.000	EA	SOCKET,SPRING,COMP LEAD,22 AWG Ref: E1-E4 MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	RELSD MFG. PART NO 2-331272-7	-5
001752209067	23	9.000	EA	RSTR,2.2K,4 RSTR 8 PIN SIP Ref: U15,17,19,21,24,35-38 MANUFACTURER DALE ELECTRONICS INC	 MFG PART NO CSC8A-03-222G	
001751009067	24	8.000	EA	RSTR,100 OHM,4 RSTR 8 PIN SIP Ref: U8,13,22,23,41-44 MANUFACTURER DALE ELECTRONICS INC	 MFG PART NO CSC8A-03-101G	
007370161100	25	5.000	EA	SOCKET,I.C.,16 PIN Ref: XU7,XU9,XU10,XU29,XU30 MANUFACTURER BURNDY CORP	C48140 MFG PART NO DILB16P223T	A5
012107483000	26	1.000	EA	I.C.,QUAD 2-INPUT NAND GATE, HIGH SPEED Ref: U49 MANUFACTURER ANY AUTHORIZED SUPPLIER	R59660 MFG PART NO 74HC00 PLSTC	-5
012107483008	27	1.000	EA	I.C.,QUAD 2-INPUT AND GATE, HIGH SPEED Ref: U48 MANUFACTURER ANY AUTHORIZED SUPPLIER	R59660 MFG PART NO 74HC08 PLSTC	-5
007782058171	28	3.000	EA	SCREWLOCK,FEMALE MANUFACTURER AMP SPECIAL INDUSTRIES (AMF	 MFG PART NO 205817-1	
007005082210	29	1.000	EA	PLUG BLOCK,RT ANGLE,2 POS Ref: PACKING LIST (990-59660-8601) ITEM MANUFACTURER PRECISION CONNECTOR DESIGNSELFP02210	R59660 MFG. PART NO	-5
007787479122	30	2.000	EA	PLUG,25 PIN,DB Ref: PACKING LIST (990-59660-8601) ITEM MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R59660 MFG. PART NO 747912-2	-5

ASSEMBLY	**990598560101**		**ASSEMBY,32 CHANNEL D/A**		Engnr Relse E48478	Engnr Rev F5
Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
007787496262	31	2.000	EA	BACKSHELL KIT,25 PIN Ref: PACKING LIST (990-59660-8601) ITEM MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R59970 MFG. PART NO 749626-2	-5
007787457834	900	0.000	EA	RECEPTACLE,25 PIN MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	 MFG PART NO 745783-4	
007787457824	901	0.000	EA	CONNECTOR,15 POS RT ANGLE MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	 MFG PART NO 745782-4	
040119030800	902	0.000	EA	RIVET,BLIND(POP),3/32 DIAX .12 6 - .250 GRIP,BODY-5 MANUFACTURER POP FASTNER(DIV OF EMHART FAST	 MFG PART NO AD34ABS	

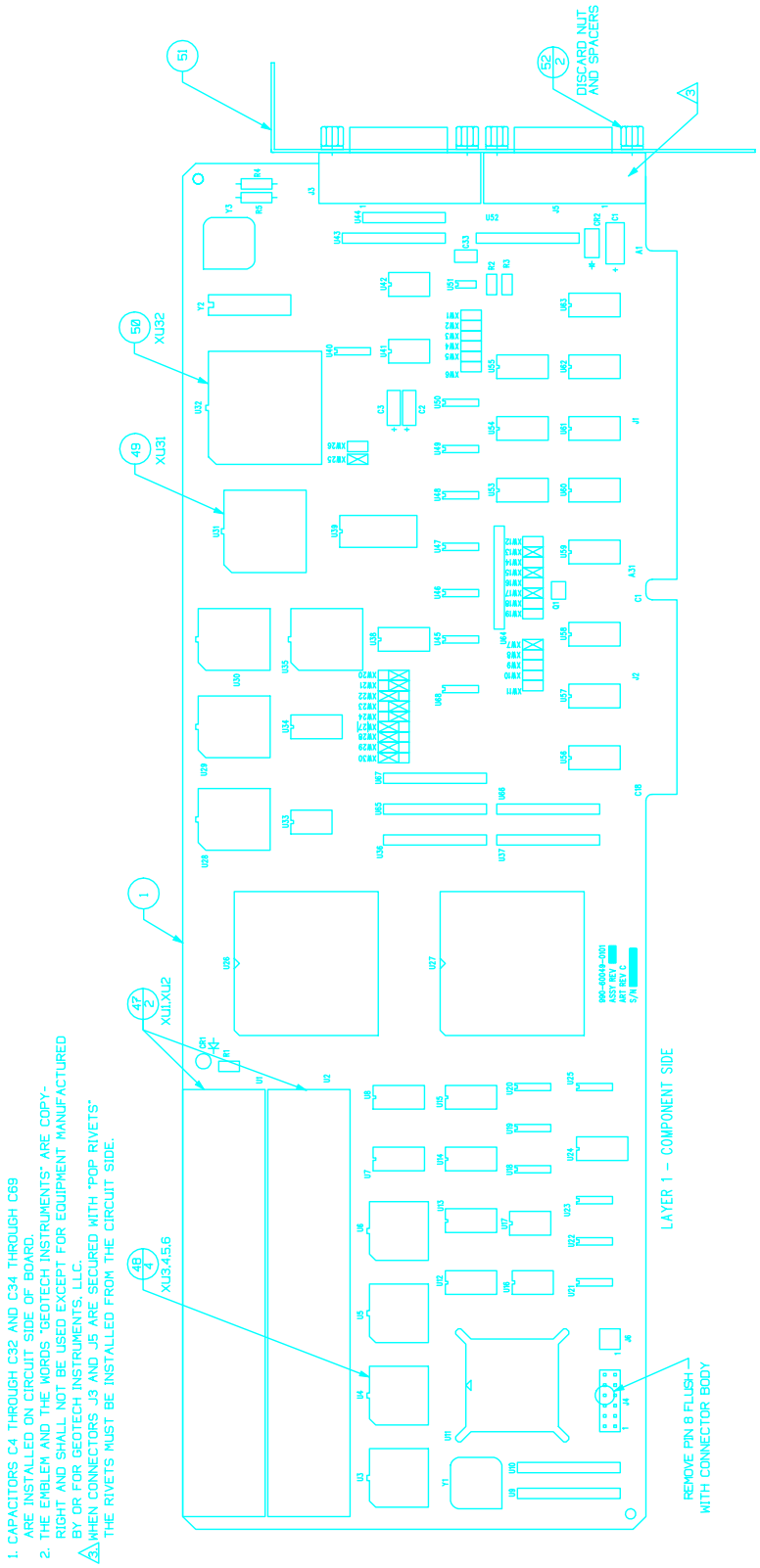

Figure 7-4 ICP Host Interface, 990-60049-0101

Geotech Instruments, LLC

S I N G L E L E V E L B I L L O F M A T E R I A L
Date: Feb 16, 2000

ASSEMBLY **990600490101 ICP/HOST INTERFACE** Engnr Relse E48643 Engnr Rev C5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
990600490201	1	1.000	EA	FAB,ICP/HOST INTERFACE	E48643	C5
001752209067	2	1.000	EA	RSTR,2.2K,4 RSTR 8 PIN P Ref: U44 MANUFACTURER DALE ELECTRONICS INC	 MFG PART NO CSC8A-03-222G	
007787478454	3	1.000	EA	CONN,D,15 POS(SKT),RT ANGLE Ref: J3 MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG PART NO 747845-4	-5
007787478414	4	1.000	E	CONN,D,15 POS(PIN),RT ANGLE Ref: J5 MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG PART NO 747841-4	-5
007936510104	5	1.000	EA	CONNECTOR,4 POS Ref: J6 MANUFACTURER BERG ELECT DIV OF DU PONT	C47759 MFG PART NO 67996-104	A5
007936510112	6	2.000	EA	CONNECTOR,12 POS,.100 CC (2X6) Ref: J4,XW1-XW6 MANUFACTURER BERG ELECT DIV OF DU PONT	E47759 MFG PART NO 67996-112	A5
007936550102	7	2.000	EA	CONNECTOR,2 POSITION Ref: XW25,XW26 MANUFACTURER BERG ELECT DIV OF DU PONT	 MFG. PART NO 65500-102	
011011624768	8	1.000	EA	CRYSTAL OSC,.0064HZ TO 768KHz Ref: Y2 MANUFACTURER EPSON CRYSTAL	C48659 MFG PART NO SPG-8640CN	A5
011191972500	9	1.000	EA	CRYSTAL OSC,25.0 MHz Ref: Y1 MANUFACTURER EPSON AMERICA INC	 MFG PART NO SG-531P25.000MHZ	
012438031522	10	1.000	EA	IC,COMMUNICATION CONTROLLER 16.5 MHz Ref: U32 MANUFACTURER INTEL CORP KAWASAKI	C48663 MFG PART NO N80C152JB-1 (OBSOLETE) KS152JB3 (INTEL N80C152JB-1 REPLACEMENT PART)	B5

ASSEMBLY **990600490101 ICP/HOST INTERFACE** Engnr Relse E48643 Engnr Rev C5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
012543201310	11	1.000	EA	I.C.DIGITAL SIGNAL PROCESSOR Ref: U11 MANUFACTURER TEXAS INSTRUMENTS	C48385 MFG PART NO TMS320C31PQL40	A5
990601470101	12	1.000	EA	PROGRAMMED DEVICE Ref: U31	R59660	-1
012637144045	13	2.000		EASTATIC RAM MODULE 256K X 32 BIT Ref: U1,U2 MANUFACTURER INTEGRATED DEVICES TECHNOLOGY	C48393 MFG PART NO IDT7MP4045-S-20M	B5
062100821700	14	1.000	EA	LED,RED Ref: CR1 MANUFACTURER HEWLETT-PACKARD CO	 MFG PART NO HLMP-1700	
301712231009	15	2.000	EA	RSTR,NETWORK,22K,2%,SIP,L-P,10 PIN,9 RSTR Ref: U9,U10 MANUFACTURER CTS CORP BOURNS INSTRUMENT INC	R00000 MFG PART NO 750-101-R22K 4310R-101-223	-5
301714721009	16	7.000	EA	RSTR,NETWORK,SIP,4.7K,2%, 10 PIN,9 RSTR Ref: U36,37,43,U64-67 MANUFACTURER BOURNS INSTRUMENT INC TRW CTS CORP	 MFG PART NO 4310R-101-472 610-1-472G 750-101-R4.7K	
512635525726	17	1.000	EA	IC,CMOS RAM,32K x 8,SMT Ref: U39 MANUFACTURER TOSHIBA AMERICA INC	C48392 MFG PART NO TC55257DFL-70L	A5
512635734933	18	4.000	EA	PROM/RPROM,8K X 8 CMOS,SMT Ref: U3,4,5,6 MANUFACTURER WAFERSCALE INTERGRATION INC	R60050 MFG PART NO WS57C49C-35J	-5
512107413086	19	1.000	EA	IC,QUAD XOR GATE,SMT Ref: U46 MANUFACTURER NATIONAL SEMICONDUCTOR	R59660 MFG. PART NO 74AC86SC	-5
512107413104	20	2.000		EA IC,HEX INV BUFFER,SMT Ref: U23,U47 MANUFACTURER NATIONAL SEMICONDUCTOR	R59660 MFG PART NO 74ACT04SC	-5
512107413108	21	1.000	EA	IC,QUAD AND GATE,SMT Ref: U45 MANUFACTURER NATIONAL SEMICONDUCTOR	R59660 MFG PART NO 74ACT08SC	-5

ASSEMBLY **990600490101 ICP/HOST INTERFACE** Engnr Relse E48643 Engnr Rev C5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
512107413132	22	6.000	EA	IC,QUAD OR GATE,SMT Ref: U21,22,25,48,49,50 MANUFACTURER NATIONAL SEMICONDUCTOR	R59660 MFG PART NO 74ACT32SC	
512107413174	23	4.000	EA	IC,DUAL D FLIP-PLOP,SMT Ref: U18,19,20,68 MANUFACTURER NATIONAL SEMICONDUCTOR	R59660 MFG PART NO 74ACT74SC	
512637463138	24	2.000	EA	IC,GATED 3 TO 8 DECODER,SMT Ref: U16,17 MANUFACTURER INTEGRATED DEVICE TECHNOLOGY	R59660 MFG. PART NO IDT74FCT138SO	-5
512637463139	25	1.000	EA	IC,DUAL 2 TO 4 DECODER,SMT Ref: U33 MANUFACTURER INTEGRATED DEVICE TECHNOLOGY	R59660 MFG PART NO IDT74FCT139SO	-5
512637463244	26	5.000	EA	IC,DUAL 4 BIT BUFFER,SMT Ref: U12,13,34,53,55 MANUFACTURER EPSON AMERICA INC	R59660 MFG PART NO IDT74FCT244SO	-5
512637463245	27	6.000	EA	IC,BIDIRECT 8 BIT BUFFER,SMT Ref: U7,8,14,15,56,63 MANUFACTURER INTEGRATED DEVICE TECHNOLOGY	R59660 MFG PART NO IDT74FCT245SO	-5
512637463521	28	2.000	EA	IC,8 BIT COMPARATOR,SMT Ref: U57,60 MANUFACTURER INTEGRATED DEVICE TECHNOLOGY	R59660 MFG PART NO IDT74FCT521SO	-5
512637463574	29	3.000	EA	IC,8 BIT LATCH,SMT Ref: U24,54,62 MANUFACTURER INTEGRATED DEVICE TECHNOLOGY	R59660 MFG PART NO IDT74FCT574SO	-5
512107481014	30	1.000	EA	I.C.,HEX INVERTING,SMT Ref: U40 MANUFACTURER SGS-THOMSON TOSHIBA AMERICA INC NATIONAL SEMICONDUCTOR HARRIS SEMICOND(HARRIS-INTERTY MOTOROLA PHILIPS COMPONENTS TEXAS INSTRUMENTS	C47767 MFG PART NO M74HC14M1 TC74HC14AFN MM74HC14M CD74HC14M MC74HC14AD 74HC14D SN74HC14D	A5
512107482244	31	2.000	EA	IC,DUAL 4 BIT BUFFER, Ref: U59,61 MANUFACTURER TEXAS INSTRUMENTS	R59660 MFG PART NO SN74HCT244DW	-5

ASSEMBLY **990600490101 ICP/HOST INTERFACE** Engnr Relse E48643 Engnr Rev C5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
512107482373	32	2.000	EA	IC,8 BIT LATCH,SMT Ref: U38,58 MANUFACTURER TEXAS INSTRUMENTS	R59660 MFG. PART NO SN74HCT373DW	-5
502410508855	33	67.000	EA	CAPACITOR,.01uF,50V,20%,SMT, ON REEL TAPE,EIA PKG 1206 Ref: C4-70 MANUFACTURER JOHANSON DIELECTRIC PHILIPS COMPONENTS AVX CORP KEMET ELECTRONICS CORP	R59660 MFG. PART NO 500R18W103MV4E 12062R103M9BB0 12065C103MAT1A C1206C103M5RAC	-5
502710160416	34	2.000	EA	CAPACITOR,10 MF,16V,10%,SMT ON REEL TAPE Ref: C2,C3 MANUFACTURER KEMET ELECTRONICS CORP. AVX CORP	C48499 MFG. PART NO T491C106K016AS TAJC106K016R	A5
502747100416	35	1.000	EA	CAPACITOR,47uF,10V,10%,SMT Ref: C1 MANUFACTURER KEMET ELECTRONICS CORP.	R59660 MFG. PART NO T491D476K010AS	-5
512010400100	36	1.000	EA	DIODE,1 AMP,SMT Ref: CR2 MANUFACTURER GENERAL INST(MICROELECT DIV)	R59660 MFG. PART NO GL41AT/R	-5
512637026155	37	2.000	EA	IC,DUAL PORT RAM,16K x 16,SMT Ref: U26,U27 MANUFACTURER INTEGRATED DEVICE TECHNOLOGY	R59660 MFG. PART NO IDT7026S-55J	-5
512637222135	38	4.000	EA	IC,CLOCKED FIFO,1K x 9 Ref: U28,29,30,35 MANUFACTURER INTEGRATED DEVICE TECHNOLOGY	C48658 MFG. PART NO IDT72221L25J	A5
512154853198	39	1.000	EA	IC,RS485 TRANCEIVER,SMT Ref: U51 MANUFACTURER LINEAR TECHNOLOGY INC	R59660 MFG. PART NO LTC485CS8	-5
512154873140	40	1.000	EA	IC,QUAD RS485 DRIVER,SMT Ref: U42 MANUFACTURER LINEAR TECHNOLOGY INC	R59660 MFG. PART NO LCT487CS	-5
512102313235	41	1.000	EA	IC,DUAL RS232 TRANCEIVER,SMT Ref: U41 MANUFACTURER MAXIM INTERGRATED PRODUCTS	R59660 MFG. PART NO MAX231CWE	-5

ASSEMBLY **990600490101 ICP/HOST INTERFACE** Engnr Relse E48643 Engnr Rev C5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
512200138000	42	1.000	EA	IC,H-MOS SURFACE MOUNT,SMT Ref: Q1 MANUFACTURER ZETEX	R59660 MFG. PART NO BSS138ZXCT	-5
501051000876	43	2.000	EA	RSTR,FXD,1K,1/8W,5%,SMT ON TAPE REEL,EIA PKG 1206 Ref: R2,R3 MANUFACTURER DALE ELECTRONICS INC KOA SPEER ELECTRONICS AVX CORP	C48217 MFG. PART NO CRCW1206102JRT1 RM73B2BT102J CR32-102J-T	B5
007968000103	44	9.000	EA	CONNECTOR,3 POSITION Ref: XW20-XW24,XW27-XW30 MANUFACTURER BERG ELECT DIV OF DU PONT	 MFG. PART NO 68000-103	
501046200876	45	1.000	EA	RSTR,FXD,620 OHM,1/8W,5%,SMT ON REEL TAPE,EIA PKG 1206 Ref: R1 MANUFACTURER DALE ELECTRONICS INC	R59660 MFG. PART NO CRCW1206621JL	-5
011191971600	46	1.000	EA	CRYSTAL,16.000 MHZ Ref: Y3 MANUFACTURER EPSON AMERICA INC	R59660 MFG. PART NO SG-531P16.0000	-5
007366411911	47	2.000	EA	CONNECTOR,64 PIN SIM 22.5 DEG (TIN) Ref: XU1,XU2 MANUFACTURER MOLEX PRODUCTS CO	C48292 MFG. PART NO 15-82-0664	A5
507912820140	48	4.000	EA	SOCKET,SMT,28 PIN PLCC, W/O ALIGNMENT PINS Ref: XU3,4,5,6 MANUFACTURER SAMTEC	R59660 MFG. PART NO PLCC-028-T-N	-5
507914420140	49	1.000	EA	SOCKET,SMT,44 PIN PLCC, W/O ALIGNMENT PINS Ref: XU31 MANUFACTURER SAMTEC	R59660 MFG. PART NO PLCC-044-T-N	-5
507916820140	50	1.000	EA	SOCKET,SMT,68 PIN PLCC, W/O ALIGNMENT PINS Ref: XU32 MANUFACTURER SAMTEC	R60070 MFG. PART NO PLCC-068-T-N	-5
020310100000	51	1.000	EA	BRACKET MANUFACTURER GLOBE MANUFACTURING SALES	 MFG. PART NO G100	

ASSEMBLY **990600490101 ICP/HOST INTERFACE** Engnr Relse E48643 Engnr Rev C5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
007782058171	52	2.000	EA	SCREWLOCK,FEMALE		
				MANUFACTURER	MFG. PART NO	
				AMP SPECIAL INDUSTRIES (AMF)	205817-1	
007936510110	53	1.000	EA	CONNECTOR,10 POS	E47759	A5
				Ref: XW7-XW11		
				MANUFACTURER	MFG. PART NO	
				BERG ELECT DIV OF DU PONT	67996-110	
007936510116	54	1.000	EA	CONNECTOR,16 POS	E47759	A5
				Ref: XW12-XW19		
				MANUFACTURER	MFG. PART NO	
				BERG ELECT DIV OF DU PONT	67996-116	
301711041009	55	1.000	EA	RSTR,NETWORK,100 K,2%,10 PIN,	R00000	-5
				9 RSTR (SCD 301-71000-0000)		
				Ref: U52		
				MANUFACTURER	MFG. PART NO	
				BOURNS INSTRUMENT INC	4310R-101-104	
				CTS CORP	750-101-R100K	
001041003077	56	2.000	EA	RSTR,FXD,100 OHM,1W,2%		
				Ref: R4,5		
				MANUFACTURER	MFG. PART NO	
				DALE ELECTRONICS ING	G-1-80-100 OHM-2%	
007936547404	57	14.000	EA	JUMPER,.100 CC		
				Ref: W7,13,15,17,20-24,27-30		
				MANUFACTURER	MFG. PART NO	
				BERG ELECT DIV OF DU PONT	65474-010	
007787457824	900	0.000	EA	CONNECTOR,15 POS RT ANGLE		
				MANUFACTURER	MFG. PART NO	
				AMP SPECIAL INDUSTRIES (AMF)	745782-4	
007787472364	901	0.000	EA	CONNECTOR,15 POS,RT ANGLE		
				MANUFACTURER	MFG. PART NO	
				AMP SPECIAL INDUSTRIES (AMF)	747236-4	
040119030800	902	0.000	EA	RIVET,BLIND(POP),3/32 DIAX .126		
				- .250 GRIP,BODY-5		
				MANUFACTURER	MFG. PART NO	
				POP FASTNER(DIV OF EMHART FAST	AD34ABS	

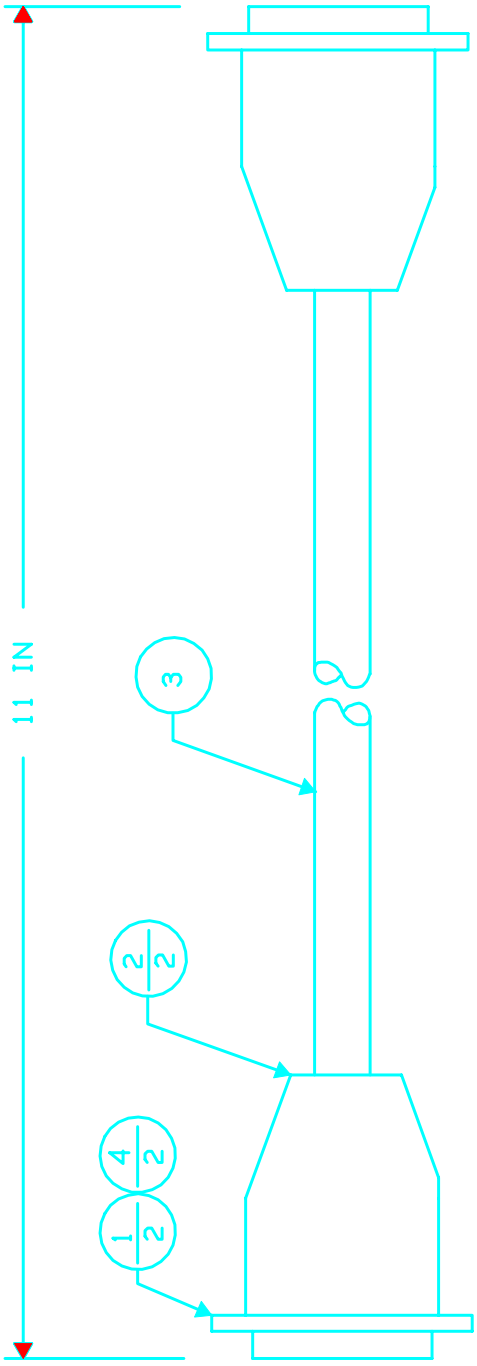

Figure 7-5 ICP Multiplexer to Multiplexer Interface Module daisy chain cable, P/N 990-60156-0101

Geotech Instruments, LLC

SINGLE LEVEL BILL OF MATERIAL
Date: Feb 16, 2000

ASSEMBLY **990601560101 CABLE ASSY,MUX TO MUX** Engnr Relse E48681 Engnr Rev B5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
007787479092	1	2.000	EA	PLUG,15 PIN,FEMALE,D MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG. PART NO 747909-2	-5
007787499152	2	2.000	EA	BACKSHELL KIT,15 PIN,PLASTIC MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG. PART NO 749915-2	-5
064122408515	3	12.000	IN	CABLE,7 1/2 PR,24AWG MANUFACTURER QUABBIN	R59660 MFG. PART NO. 8515	-5
007782059801	4	2.000	EA	RETAINER KIT,MALE SCREW MANUFACTURER AMP SPECIAL INDUSTRIES (AMF	R59660 MFG. PART NO. 205980-1	-5

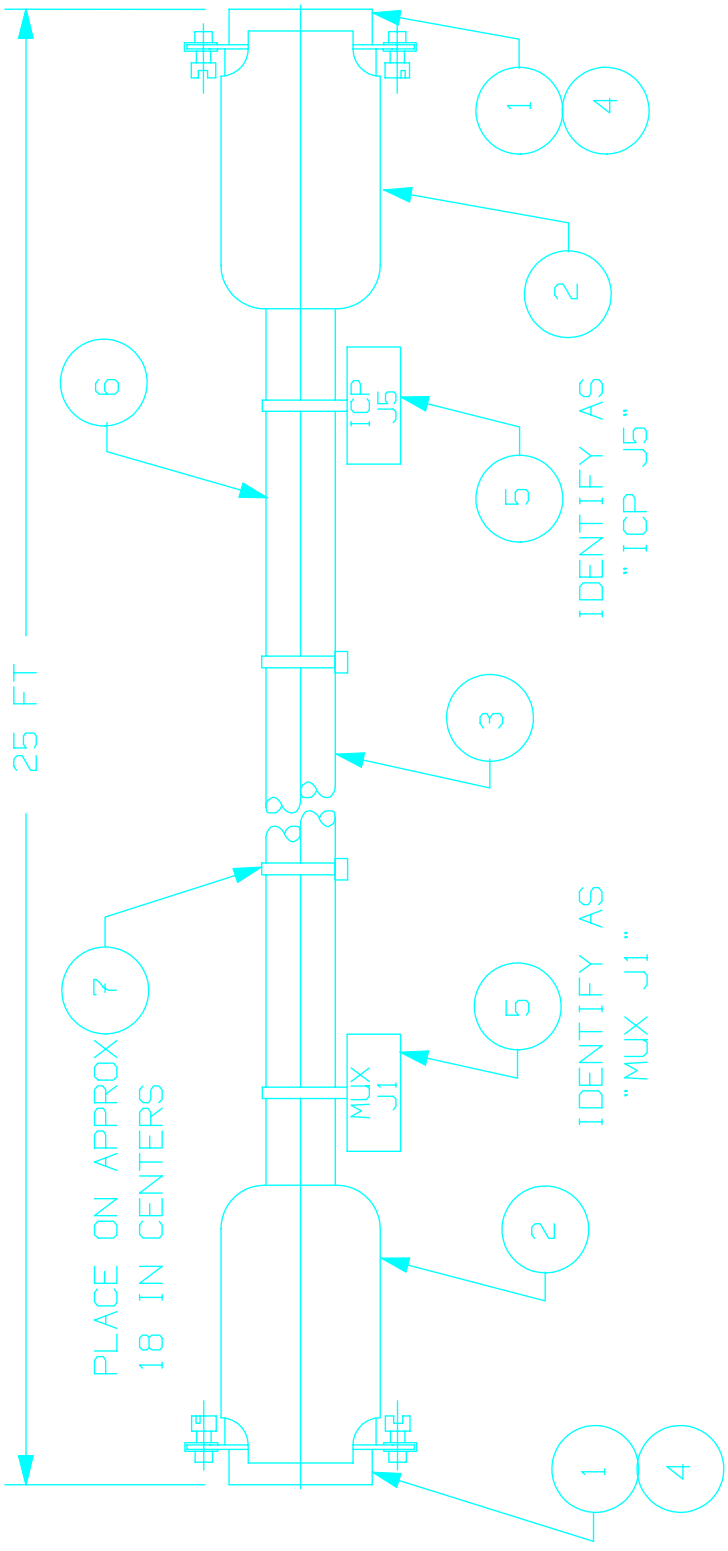

Figure 7-6 ICP Multiplexer to Host Interface Module cable, P/N 990-60156-0102

Geotech Instruments, LLC

SINGLE LEVEL BILL OF MATERIAL
Date: Feb 16, 2000

ASSEMBLY **990601560102 CABLE ASSY,MUX TO ICP** Engnr Relse E48682 Engnr Rev B5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
007787479092	1	2.000	EA	PLUG,15 PIN,FEMALE,D MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG. PART NO. 747909-2	-5
007787499152	2	2.000	EA	BACKSHELL KIT,15 PIN,PLASTIC MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG. PART NO. 749915-2	-5
064120877700	3	300.000	IN	CABLE,3 SHLD PR,22 AWG MANUFACTURER CAROL CABLE BELDEN MFG CO	C41206 MFG PART NO C6040 8777	A5
007782059801	4	2.000	EA	RETAINER KIT,MALE SCREW MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R59660 MFG. PART NO. 205980-1	-5
015060061000	5	2.000	EA	MARKER,CABLE,TIE MANUFACTURER PANDUIT CORP.	R59660 MFG. PART NO. PLF1M	-5
064120950300	6	300.000	IN	CABLE,3 PR TWISTED,SHLD,24 AWG MANUFACTURER QUABBIN BELDEN ALPHA CAROL CABLE	C48277 MFG. PART NO. 8115 9503 5473 C0602	A5
015060153300	7	16.000	EA	TIE,CABLE,0-1 1/4 BUNDLE DIA (NO SUBSTITUTION) MANUFACTURER PANDUIT CORP	RELSD MFG. PART NO. SST1.5M	-5

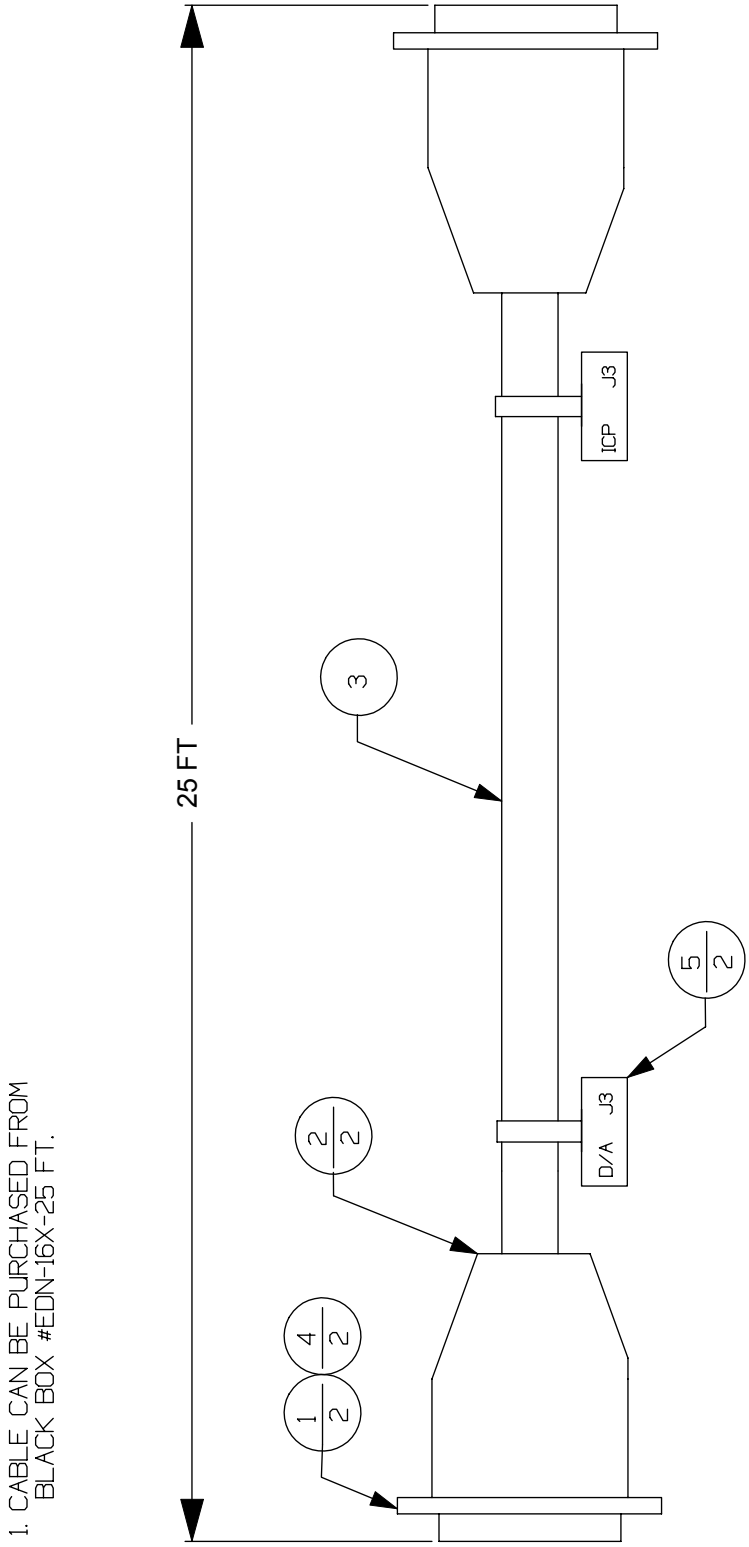

Figure 7-7 ICP Host Interface Module to D/A Module Interface Cable, P/N 990-60157-0101

Geotech Instruments, LLC

SINGLE LEVEL BILL OF MATERIAL

Date: Feb 16, 2000

ASSEMBLY **990601570101 CABLE ASSY,D/A TO ICP** Engnr Relse E48683 Engnr Rev A5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
007787479082	1	2.000	EA	PLUG,15 PIN,MALE,D MANUFACTURER AMP SPECIAL INDUSTRIES	R60020 MFG. PART NO. 747908-2	-5
007787499152	2	2.000	EA	BACKSHELL KIT,15 PIN,PLASTIC MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG. PART NO. 749915-2	-5
064122408515	3	300.000	IN	CABLE,7 1/2 PR,24AWG MANUFACTURER QUABBIN	R59660 MFG PART NO. 8515	-5
007782059801	4	2.000	EA	RETAINER KIT,MALE SCREW MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R59660 MFG. PART NO. 205980-1	-5
015060061000	5	2.000	EA	MARKER,CABLE,TIE MANUFACTURER PANDUIT CORP.	R59660 MFG. PART NO. PLF1M	-5

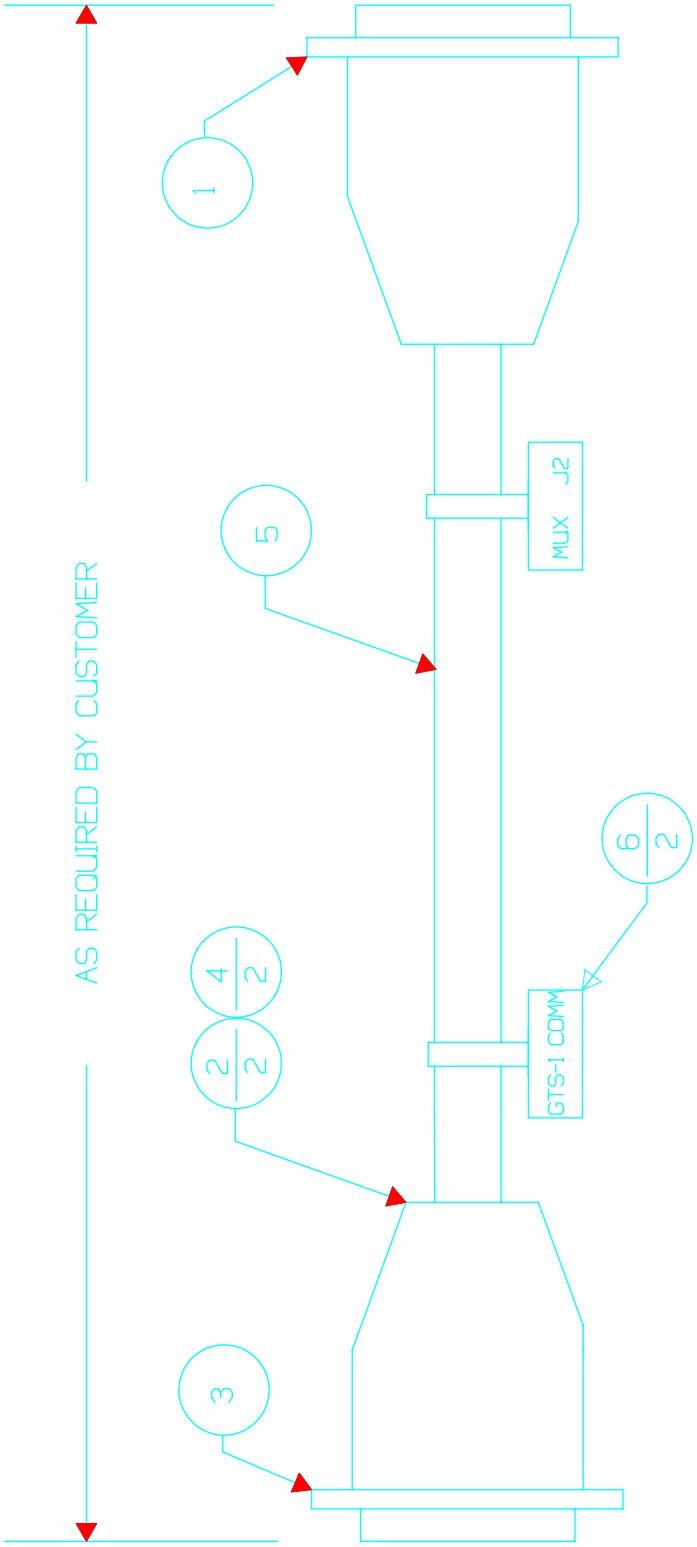

Figure 7-8 GTS-ONE to Multiplexer Module Interface Cable, P/N 990-60172-0101

Geotech Instruments, LLC

SINGLE LEVEL BILL OF MATERIAL
Date: Feb 16, 2000

ASSEMBLY **990601720101 CABLE ASSY,MUX TO GTS-1** Engnr Relse E48684 Engnr Rev B5

Component	Item	Qty Per	Um	Component Description	Engnr Relese	Engnr Rev
007787479092	1	1.000	EA	PLUG,15 PIN,FEMALE,D MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG. PART NO. 747909-2	-5
007787499152	2	2.000	EA	BACKSHELL KIT,15 PIN,PLASTIC MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R60020 MFG. PART NO. 749915-2	-5
007787479082	3	1.000	EA	PLUG,15 PIN,MALE,D MANUFACTURER AMP SPECIAL INDUSTRIES	R60020 MFG. PART NO. 747908-2	-5
007782059801	4	2.000	EA	RETAINER KIT,MALE SCREW MANUFACTURER AMP SPECIAL INDUSTRIES (AMF)	R59660 MFG. PART NO. 205980-1	-5
064122408110	5	0.000	IN	CABLE,2 PR,24AWG MANUFACTURER BELDEN MFG. CO. QUABBIN BELDEN MFG CO	R59660 MFG. PART NO. 9502 8110 9502	-5
015060061000	6	2.000	EA	MARKER,CABLE,TIE MANUFACTURER PANDUIT CORP.	R59660 MFG. PART NO. PLF1M	-5

APPENDIX A

CSMA COMMUNICATIONS FORMAT
FOR
TWO WIRE CONNECTION BETWEEN
ICP HOST INTERFACE AND THE ICP MULTIPLEXER

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CSMA PROTOCOL

The connection between the ICP Control Interface Module and the Multiplexer Module(s) of the Multiport Controller utilizes Carrier Sense Multi-Access (CSMA) protocol. The link is controlled by the ICP Control Interface Module through commands from the host and a simple data ready acknowledge from the Multiplexer Module(s). When the ICP Control Interface Module sends an acknowledge to the Multiplexer the line is clear, and the ICP Control Interface Module is ready to accept information. The collision detect feature of the CSMA protocol is not implemented in this system in order to increase the bandwidth for high volume real-time data.

1.1 CSMA FRAME

The CSMA frame is generated and received through programmable hardware in the 80C152 communications controllers. The data is Manchester encoded by hardware. The general format for the Multiplexer Module to ICP Host Interface frame is as shown in the following:

|PREAMBLE||BOF||ADDRESS||INFORMATION||CRC||EOF|

where

preamble 8 bits of alternating 1s and 0s

BOF (beginning of frame) two successive 1s (part of the preamble)

Address 8 bits. Each Multiplexer Module has a unique address. Received addresses are decoded by programmable hardware. Transmitted addresses must be included in the information field. The following addresses are reserved for this system:

ICP Module	16
1st ICP Multiplexer	0
2nd ICP Multiplexer	1
3rd ICP Multiplexer	2
4th ICP Multiplexer	3
5th ICP Multiplexer	4
6th ICP Multiplexer	5
7th ICP Multiplexer	6 (Not implemented)
8th ICP Multiplexer	7 (Not implemented)

Information Can be of any length of 8 bit bytes to a maximum of 65,535 bytes. The information field format is described in section 2.

CRC 16 bits, hardware generated and hardware tested.

EOF (End of frame) idle condition.

2. INFORMATION FIELDS

2.1 GENERAL

The information field is user defined. The general format is:

|SIZE||TYPE||PORT*||DATA|

* or Multiplexer (for status block)

Where

Size Defines the size of the information block. The **Size** field is 2 bytes in length with least significant byte first.

Type Two bytes defining the data type included in the **Information** field. Data type codes are

01h	ICP to Multiplexer configuration block
02h	Not used
03h	ICP to Multiplexer data ready acknowledge
04h	Not Used
05h	ICP to Multiplexer transparent data to transmit
06h	Multiplexer to ICP status block
07h	ICP to Multiplexer port activate command
08h	Multiplexer to ICP data received (followed by **Data**)
09h	ICP to Multiplexer request for status
0Ah	Multiplexer to ICP transparent data received (followed by data)
0Bh	ICP to Multiplexer port reset command
0Ch	Multiplexer to ICP transparent acknowledge received
0Dh	ICP to Multiplexer reset all command
0Eh	ICP to Multiplexer reset port second command

Port One byte identifying which Multiplexer RS-232 port (A, B, C, or D) the data is associated with. Port ID's are

Port A	0
Port B	1
Port C	2
Port D	3

Data Data field associated with previous **Size**, **Type** and **Port** fields.

2.2 DATA BLOCKS

2.2.1 Configuration Block (from ICP)

Byte 1 Operating Mode

0 = DTS Data
1 = Transparent Data

Byte 2 Baud Rate Code

1200 Baud = 66 Hex
2400 Baud = 88 Hex
4800 Baud = 99 Hex
9600 Baud = BB Hex
19.2KBaud = C0 Hex
38.4KBaud = CC Hex

Byte 3 Block Size To Receive, least significant byte (Block size is total number of bytes in a one second data frame, less the two byte check sum)

Byte 4 Block Size To Receive, most significant byte (see above)

Examples: 12 Bit Data, at 50 samples per second and 3 components = (50 x 3 x 3)/2 + 6 = 231 bytes

12 Bit Data, at 100 samples per second and 1 component = (100 x 3)/2 + 6 = 156 bytes

16 Bit Data, at 100 samples per second and 3 components = 100 x 3 x 2 + 6 = 606 bytes

16 Bit Data, at 100 samples per second and 1 component = 100 x 2 + 6 = 206 bytes

24 Bit Data, at 50 samples per second and 3 components = 50 x 3 x 3 + 6 + 3 x 2 = 462 bytes

24 Bit Data, at 100 samples per second and 3 components = 100 x 3 x 3 + 6 + 3 x 2 = 912 bytes

Byte 5 Data Type Code (presently defined)

6C Hex = 12 Bit Data
16 Hex = 16 Bit Data
49 Hex = 24 Bit Data

Byte 6 Station Code (0 to 255)
Byte 7 Number of Components (1, 2 or 3)
Byte 8 Sample Rate (50 or 100 samples per second)
Byte 9 Fractional Transmission Delay (DTS Mode Only)

0 to 199 times 5 milliseconds (0 to 1 second).

Byte 10 Present Second (0 - 59)

Additional bytes will be added to accommodate the Transparent Mode.

2.2.2 Status Block (from Multiplexer)

The Multiplexer sets status bits as required. The status bits are cleared after status has been requested and sent. Byte-wise information field is as follows:

| Block Size ||Type || ID || Status Bytes |

Where

Block Size 2 byte field indicating total status block length, least significant byte first (value always = 9 bytes).

Type Data type code, one byte, value = 06h (See paragraph 2.1)

ID One byte denoting Multiplexer ID (0 to 7)

Status Bytes Five bytes denoting Multiplexer, port A, port B, port C and port D status respectively.

2.2.2.1 Multiplexer Status

Multiplexer status bits are true high and carry the following definitions:

Bit 0 Multiplexer idle
Bit 1 No 1 PPS

Bits 2 - 7 Reserved

2.2.2.2 Port Status

Multiplexer port status bits are true high and defined as follows:

Bit 0	Port configured
Bit 1	Port active
Bit 2	No Data Received
Bit 3	Check Sum Error
Bit 4	Wrong Data Type Received - valid only when receiving data
Bit 5	Wrong Sample Rate Received - valid only when receiving data
Bit 6	Wrong Number of Channels Received - valid only when receiving data
Bit 7	Wrong Station Code Received - valid only when receiving data

2.2.3 DTS Data Block

The DTS data block will have a three byte header followed by Channel 1 data. Channel 2 data then Channel 3 data will follow if this data is available. The data is in a 24 bit format at 100 samples per second. If the data is received in a 50 sample per second format each sample received is stored twice.

The received data is time aligned to the local 1 PPS input. The data ready flag to the host computer is seen about 10 to 100 milliseconds after the end of a transmission. Because of variables in time of transmission and transmission block length the block may be received by the ICP Host Interface in less than 2 seconds, or some time greater than 2 seconds after the first sample in the block was sampled. The header will consist of Station Code, Number of Components and Captured Second.

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APPENDIX B

DTS DATA FORMAT FROM ICP MULTIPLEXER TO ICP HOST INTERFACE MODULE

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DTS DATA FORMAT

FROM ICP MULTIPLEXERTO ICP COMMUNICATIONS CONTROLLER

The data is received in one second blocks and re transmitted in one second time aligned blocks. Each block will represent data from one port. The data is formatted for 100 sps and 24 bits including sign extension if necessary. Two different size blocks will be received by the controller, single component blocks and three component blocks. See Appendix A for overall protocol.

DATA HEADER

Byte 1	(32h for single component or 8Ah for 3 component data)
Byte 2	Most significant byte of block length (01h for single component or 03h for 3 component data)
Byte 3	Type block (08h)
Byte 4	Port ID (xxh for Port ID 0,1,2, or 3)
Byte 5	Station Address (xxh, where address = 0 to 255)
Byte 6	Number of Components (01h or 03h)
Byte 7	Second of block (xxh where second = 0 to 59)
Byte 8	00H

SINGLE COMPONENT DATA FORMAT

Each single component data channel block contains one second of data. This data is presented in the following order:

First Sample in Second	Least Significant Byte Next Most Significant Byte Most Significant Byte	
⋮	⋮	Channel 1
Last Sample in Second	Least Significant Byte Next Most Significant Byte Most Significant Byte	

THREE COMPONENT DATA FORMAT

Each three component data channel block contains a one second block of data for each component. This data is presented in the following order:

First Sample in Second	Least Significant Byte Next Most Significant Byte Most Significant Byte	
⋮	⋮	Channel 1
Last Sample in Second	Least Significant Byte Next Most Significant Byte Most Significant Byte	
First Sample in Second	Least Significant Byte Next Most Significant Byte Most Significant Byte	
⋮	⋮	Channel 2
Last Sample in Second	Least Significant Byte Next Most Significant Byte Most Significant Byte	
First Sample in Second	Least Significant Byte Next Most Significant Byte Most Significant Byte	
⋮	⋮	Channel 3
Last Sample in Second	Least Significant Byte Next Most Significant Byte Most Significant Byte	

APPENDIX C

ICP SYSTEM DIGITAL FILTER DESCRIPTIONS

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ICP SYSTEM DIGITAL FILTER DESCRIPTIONS

The ICP System provides three sets of filter types for incoming raw data. These are: 1) Short Period band pass; 2) Long Period band pass; and 3) Band pass filters for the data sent to the event detector. All of the filters are implemented using 32 bit floating point.

The short period band pass is provided to the host for recording at the sample rate of the raw data (default is 100 samples per second). The high pass is an infinite impulse response (IIR) design using bilinear transformation to achieve a 2nd order Butterworth. The low pass filter is an equiripple finite impulse response (FIR) design with coefficients selected for minimum pass band ripple. The one second delay in this filter is corrected by the ICP.

At the present time the Long Period band pass is implemented as a very long period low pass FIR design with a cutoff frequency of 0.05 Hz. The filter is a two stage design. The first stage provides a cutoff at 2.0 Hz. with the stop band down 120dB at 4.0 Hz. The second stage is 3dB down at 0.06 Hz. and 120dB down at 0.1 Hz. The delay through the filter is 29 seconds.

The detector filter has a 1st order high pass Butterworth IIR design section and a 6th order low pass Butterworth IIR design section. The delay through this filter is approximately 1/Fo where Fo is the low pass corner frequency.

Filter coefficients for all ICP filter selections designed to date are shown in the following sections.

Coefficients for Detector Low-Pass Filters

Defines for low pass detector filters.

The low pass filter coefficients are for 6 pole Butterworth. The 1 Hertz filter is typical:

Filter Type	Low Pass
Analog Filter Type	Butterworth
Passband Ripple in dB	-3.0000 (maximum attenuation)
Stopband Ripple in dB	-120.0000 (minimum attenuation)
Passband Cutoff Freq.	0.100000E+01 Hz
Stopband Cutoff Freq.	0.100000E+02 Hz
Sampling Frequency	0.100000E+03 HZ
Filter Design Method	Bilinear Transformation
Filter Order	6 (0006h)
Number Of Sections	3 (0003h)
No. Of Quantized Bits	32 (0020h)
Quantization Type	Floating Point

Filter Type - 1 Hz LP - 6 Pole Butterworth
Overall gain = 0.85514664E-09

Section	Coefficient ID	Coefficient
1	B1	2.0000000
	B2	1.0000000
	A1	1.8818681
	A2	-.88559182
2	B1	2.0000000
	B2	1.0000000
	A1	1.9111620
	A2	-.91494368
3	B1	2.0000000
	B2	1.0000000
	A1	1.9641181
	A2	-.96800457

Filter Type - 2 Hz LP - 6 Pole Butterworth
Overall gain = 0.48750822E-07

Section	Coefficient ID	Coefficient
1	B1	2.0000000
	B2	1.0000000
	A1	1.7698680
	A2	-.78394603
2	B1	2.0000000
	B2	1.0000000
	A1	1.8226252
	A2	-.83712292
3	B1	2.0000000
	B2	1.0000000
	A1	1.9218503
	A2	-.93713725

Filter Type - 5 Hz LP - 6 Pole Butterworth
Overall gain = 0.85948826E-05

Section	Coefficient ID	Coefficient
1	B1	2.0000000
	B2	1.0000000
	A1	1.4646832
	A2	-.54012030
2	B1	2.0000000
	B2	1.0000000
	A1	1.5608507
	A2	-.64124075
3	B1	2.0000000
	B2	1.0000000
	A1	1.7611301
	A2	-.85183541

Filter Type - 10 Hz LP - 6 Pole Butterworth
Overall gain = 0.34118372E-03

Section	Coefficient ID	Coefficient
1	B1	2.0000000
	B2	1.0000000
	A1	1.0317753
	A2	-.27556004
2	B1	2.0000000
	B2	1.0000000
	A1	1.1426799
	A2	-.41266880
3	B1	2.0000000
	B2	1.0000000
	A1	1.4040881
	A2	-.73584180

Filter Type - 20 Hz LP - 6 Pole Butterworth
Overall gain = 0.10327551E-01

Section	Coefficient ID	Coefficient
1	B1	2.0000000
	B2	1.0000000
	A1	.32172718
	A2	-.42338575E-01
2	B1	2.0000000
	B2	1.0000000
	A1	.36908114
	A2	-.19575694
3	B1	2.0000000
	B2	1.0000000
	A1	.49536759
	A2	-.60490249

Filter Type - 40 Hz LP - 6 Pole Butterworth
Overall gain = 0.28954554

Section	Coefficient ID	Coefficient
1	B1	2.0000000
	B2	1.0000000
	A1	-1.0323635
	A2	-.27585586
2	B1	2.0000000
	B2	1.0000000
	A1	-1.1432811
	A2	-.41293440
3	B1	2.0000000
	B2	1.0000000
	A1	-1.4046815
	A2	-.73598857

Coefficients for Detector High-Pass Filters

Defines for detector high pass filters.

The high pass filter coefficients are for 2 pole Butterworth. The 0.1 Hertz filter is typical:

Filter Type	High Pass
Analog Filter Type	Butterworth
Passband Ripple in dB	-3.0000 (maximum attenuation)
Stopband Ripple in dB	-20.0000 (minimum attenuation)
Passband Cutoff Frequency	0.100000E+00 Hertz
Stopband Cutoff Frequency	0.100000E-01 Hertz
Sampling Frequency	0.100000E+03 Hertz
Filter Design Method	Bilinear Transformation
Filter Order	1 (0001h)
Number Of Sections	1 (0001h)
No. Of Quantized Bits	32 (0020h)
Quantization Type	Floating Point

Filter Type - 0.1 Hz HP - 2 Pole Butterworth
Overall gain = 0 .99687564

Section	Coefficient ID	Coefficient
1	B1	-1.0000000
	B2	.00000000
	A1	.99375128
	A2	.00000000

Filter Type - 0.2 Hz HP - 2 Pole Butterworth
Overall gain = 0.99377068

Section	Coefficient ID	Coefficient
1	B1	-1.0000000
	B2	.00000000
	A1	.98754136
	A2	.00000000

Filter Type - 0.5 Hz HP - 2 Pole Butterworth
Overall gain = 0.98456982

Section	Coefficient ID	Coefficient
1	B1	-1.0000000
	B2	.00000000
	A1	.96913965
	A2	.00000000

Filter Type - 1.0 Hz HP - 2 Pole Butterworth
Overall gain = 0.96960132

Section	Coefficient ID	Coefficient
1	B1	-1.0000000
	B2	.00000000
	A1	.93920263
	A2	.00000000

Filter Type - 2.0 Hz HP - 2 Pole Butterworth
Overall gain = 0.94094138

Section	Coefficient ID	Coefficient
1	B1	-1.0000000
	B2	.00000000
	A1	.88188277
	A2	.00000000

Filter Type - 4.0 Hz HP - 2 Pole Butterworth
Overall gain = 0.88807599

Section	Coefficient ID	Coefficient
1	B1	-1.0000000
	B2	.00000000
	A1	.77615197
	A2	.00000000

Coefficients for Short Period High-Pass Filters

Filter Type - 0.01 Hz 2nd Order High Pass
Overall gain = 0.99955634

Section	Coefficient ID	Coefficient
1	B1	-2.0000000
	B2	1.00000000
	A1	1.9991125
	A2	-.99911287

Filter Type - 0.03 Hz 2nd Order High Pass
Overall gain = 0.99853666

Section	Coefficient ID	Coefficient
1	B1	-2.0000000
	B2	1.00000000
	A1	1.9970712
	A2	-.99707546

Filter Type - 0.05 Hz 2nd Order High Pass
Overall gain = 0.99778365

Section	Coefficient ID	Coefficient
1	B1	-2.0000000
	B2	1.00000000
	A1	1.9955624
	A2	-.99557222

Filter Type - 0.1 Hz 2nd Order High Pass
Overall gain = 0.99557222

Section	Coefficient ID	Coefficient
1	B1	-2.0000000
	B2	1.00000000
	A1	1.9911248
	A2	-.99116405

Filter Type - 0.33 Hz 2nd Order High Pass
Overall gain = 0.98533139

Section	Coefficient ID	Coefficient
1	B1	-2.0000000
	B2	1.00000000
	A1	1.9704476
	A2	-.97087797

Filter Type - 0.5 Hz 2nd Order High Pass
Overall gain = 0.97805625

Section	Coefficient ID	Coefficient
1	B1	-2.0000000
	B2	1.00000000
	A1	1.9556309
	A2	-.95659409

Coefficients for Short Period Low-Pass Filters

Filter Type - 2.0 Hz Low Pass, 49 Tap

Tap	Coefficient	Tap	Coefficient
0	.1847790554165840E-04	25	.5526728648692369E-01
1	.6602099165320396E-04	26	.5376566387712955E-01
2	.1553162001073360E-03	27	.5134600773453712E-01
3	.3287140280008316E-03	28	.4812619043514132E-01
4	.6151492707431316E-03	29	.4425870627164841E-01
5	.1070894300937653E-02	30	.3991939406841993E-01
6	.1747058238834143E-02	31	.3529527876526117E-01
7	.2709977794438601E-02	32	.3057175269350410E-01
8	.4020278342068195E-02	33	.2592153614386916E-01
9	.5740075837820768E-02	34	.2149442397058010E-01
10	.7917591836303473E-02	35	.1741105038672686E-01
11	.1058717863634229E-01	36	.1375780487433076E-01
12	.1375780487433076E-01	37	.1058717863634229E-01
13	.1741105038672686E-01	38	.7917591836303473E-02
14	.2149442397058010E-01	39	.5740075837820768E-02
15	.2592153614386916E-01	40	.4020278342068195E-02
16	.3057175269350410E-01	41	.2709977794438601E-02
17	.3529527876526117E-01	42	.1747058238834143E-02
18	.3991939406841993E-01	43	.1070894300937653E-02
19	.4425870627164841E-01	44	.6151492707431316E-03
20	.4812619043514132E-01	45	.3287140280008316E-03
21	.5134600773453712E-01	46	.1553162001073360E-03
22	.5376566387712955E-01	47	.6602099165320396E-04
23	.5526728648692369E-01	48	.1847790554165840E-04
24	.5577631527557969E-01		

Filter Type - 4.0 Hz Low Pass, 25 Tap

Tap	Coefficient	Tap	Coefficient
0	.4290370270609856E-04	13	.1074210507795215E+00
1	.3287829458713531E-03	14	.9617159143090248E-01
2	.1257671974599361E-02	15	.7979846047237515E-01
3	.3535681869834661E-02	16	.6114466581493616E-01
4	.8094430435448885E-02	17	.4302348755300045E-01
5	.1589526422321796E-01	18	.2757020341232419E-01
6	.2757020341232419E-01	19	.1589526422321796E-01
7	.4302348755300045E-01	20	.8094430435448885E-02
8	.6114466581493616E-01	21	.3535681869834661E-02
9	.7979846047237515E-01	22	.1257671974599361E-02
10	.9617159143090248E-01	23	.3287829458713531E-03
11	.1074210507795215E+00	24	.4290370270609856E-04
12	.1114315604791045E+00		

Filter Type - 6.0 Hz Low Pass, 17 Tap

Tap	Coefficient	Tap	Coefficient
0	-.3161747008562088E-04	9	.1601552157662809E+00
1	.3960728645324707E-03	10	.1215184866450727E+00
2	.3477729391306639E-02	11	.7551832869648933E-01
3	.1393289258703589E-01	12	.3736245818436146E-01
4	.3736245818436146E-01	13	.1393289258703589E-01
5	.7551832869648933E-01	14	.3477729391306639E-02
6	.1215184866450727E+00	15	.3960728645324707E-03
7	.1601552157662809E+00	16	-.3161747008562088E-04
8	.1753408308140934E+00		

Filter Type - 8.0 Hz Low Pass, 17 Tap

Tap	Coefficient	Tap	Coefficient
0	-.4241876304149628E-03	9	.1908182715997100E+00
1	-.2151188440620899E-02	10	.1293795686215162E+00
2	-.4567528609186411E-02	11	.6319340923801064E-01
3	-.1857914496213198E-02	12	.1757202530279756E-01
4	.1757202530279756E-01	13	-.1857914496213198E-02
5	.6319340923801064E-01	14	-.4567528609186411E-02
6	.1293795686215162E+00	15	-.2151188440620899E-02
7	.1908182715997100E+00	16	-.4241876304149628E-03
8	.2160750874318182E+00		

Filter Type - 12.0 Hz Low Pass, 11 Tap

Tap	Coefficient	Tap	Coefficient
0	-.2385237254202366E-02	6	.2334622116759419E+00
1	-.5129145924001932E-02	7	.1068860120140016E+00
2	.1891528023406863E-01	8	.1891528023406863E-01
3	.1068860120140016E+00	9	-.5129145924001932E-02
4	.2334622116759419E+00	10	-.2385237254202366E-02
5	.2965017217211425E+00		

Filter Type - 16.0 Hz Low Pass, 11 Tap

Tap	Coefficient	Tap	Coefficient
0	-.5763957742601633E-02	6	.2678682846017182E+00
1	-.2192187542095780E-01	7	.9180865343660116E-01
2	-.1211254531517625E-01	8	-.1211254531517625E-01
3	.9180865343660116E-01	9	-.2192187542095780E-01
4	.2678682846017182E+00	10	-.5763957742601633E-02
5	.3602429009042680E+00		

Filter Type - 18.0 Hz Low Pass, 7 Tap

Tap	Coefficient
0	-.2312555490061641E-01
1	.1762509671971202E-01
2	.2731195287778974E+00
3	.4647618806920946E+00
4	.2731195287778974E+00
5	.1762509671971202E-01
6	-.2312555490061641E-01

Filter Type - 20.0 Hz Low Pass, 5 Tap

Tap	Coefficient
0	-.3399344859644771E-01
1	.2500019017606974E+00
2	.5679830652661622E+00
3	.2500019017606974E+00
4	-.3399344859644771E-01

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APPENDIX D

ICP SYSTEM location response table

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HOW TO GENERATE AN ICP LOCATION RESPONSE TABLE

Introduction

A response table is a collection of amplitude vs. frequency values within a given passband for a specific system. The system response function characterizes the entire system which includes sensor and data acquisition components. These unique characteristics are required for accurate location analysis and must be defined by the operator.

Creating a unique table can be accomplished several different ways, either by editing an existing properly formatted response file or simply executing Seisan's RESP.EXE file. Geotech supports this format and modifies it for further table manipulation and data conversion. To initiate the program, the operator must execute the RESP.EXE file which is located in the ICP directory. For more information about the response program, reference The Seisan Earthquake Analysis Software manual.

Creating Response Table files

At the DOS command prompt, toggle to full screen mode by holding down the ALT key and press ENTER).

From the *ICP* directory:

1) Type ***RESP*** to run the response program.

2) Answer the relevant questions.

3) Rename the output file (RESPONSE.OUT) to RTAB**X.**DAT where **X** is an identifier for each unique sensor/system. It is possible to have ten separate files. ie. RTAB1.DAT, RTAB2.DAT, RTAB3.DAT, etc. Note: Every time you run the RESP program a new RESPONSE.OUT file is created which erases the earlier output file.

4) After you have created the desired number of RTABX.DAT files then:
   Type ***CRETABLE***
   This program generates a file named RESPONSE.DAT which is used by the ICP system.

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APPENDIX E

CONFIGURATION REQUIREMENTS FOR THE DR-24 REMOTE ACQUISITION SYSTEM

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CONFIGURATION REQUIREMENTS FOR THE DR-24

REMOTE ACQUISITION SYSTEM

INTRODUCTION

Configuring the remote acquisition system (DR-24) is made simple using the DRSETUP software. To view the main setup window as shown in Figure E-1, click on the DRSETUP icon. Several of the tool and status bar selections have the same look and functionality as other ***MicroSoft Windows*** or ***WindowsNT*** applications. Only the **Functions** selection will be discussed since this option is unique to the DR-24 acquisition system.

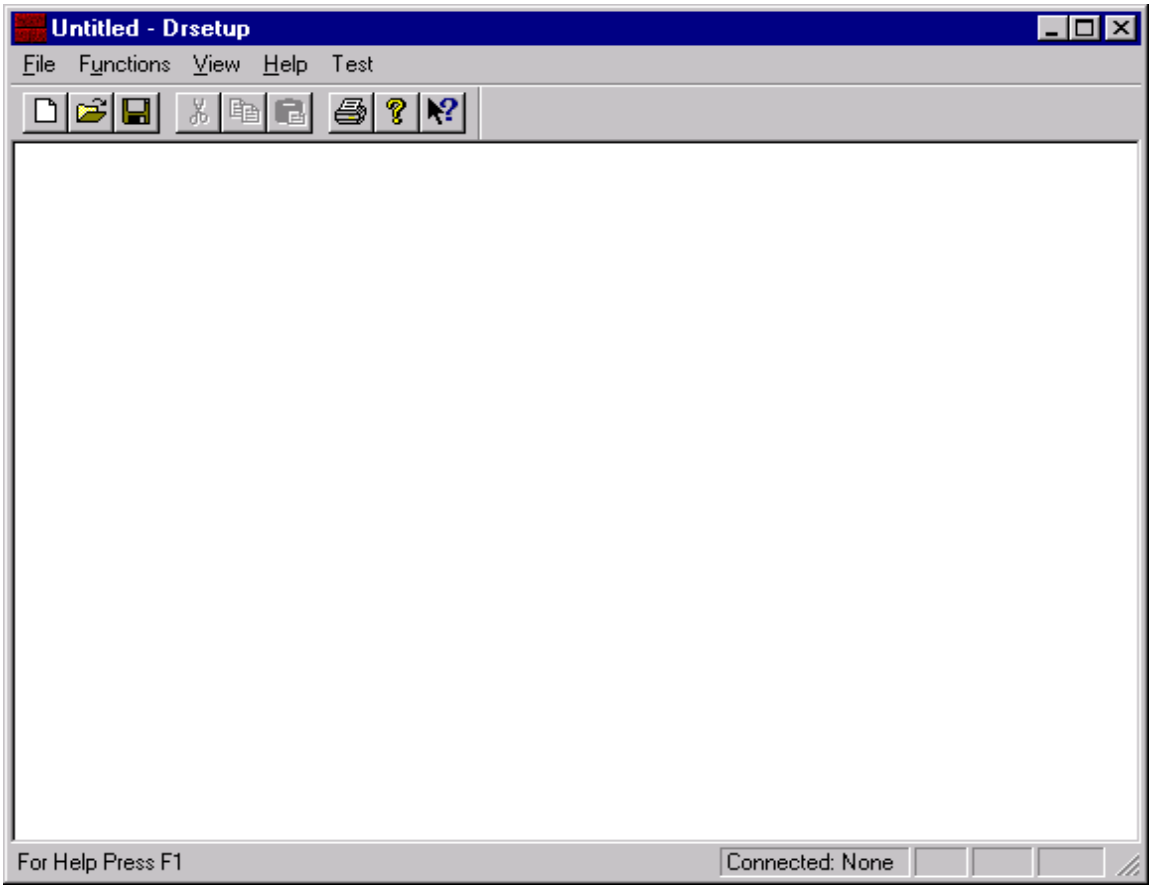

Figure E-1 Initial DR-24 Setup Screen

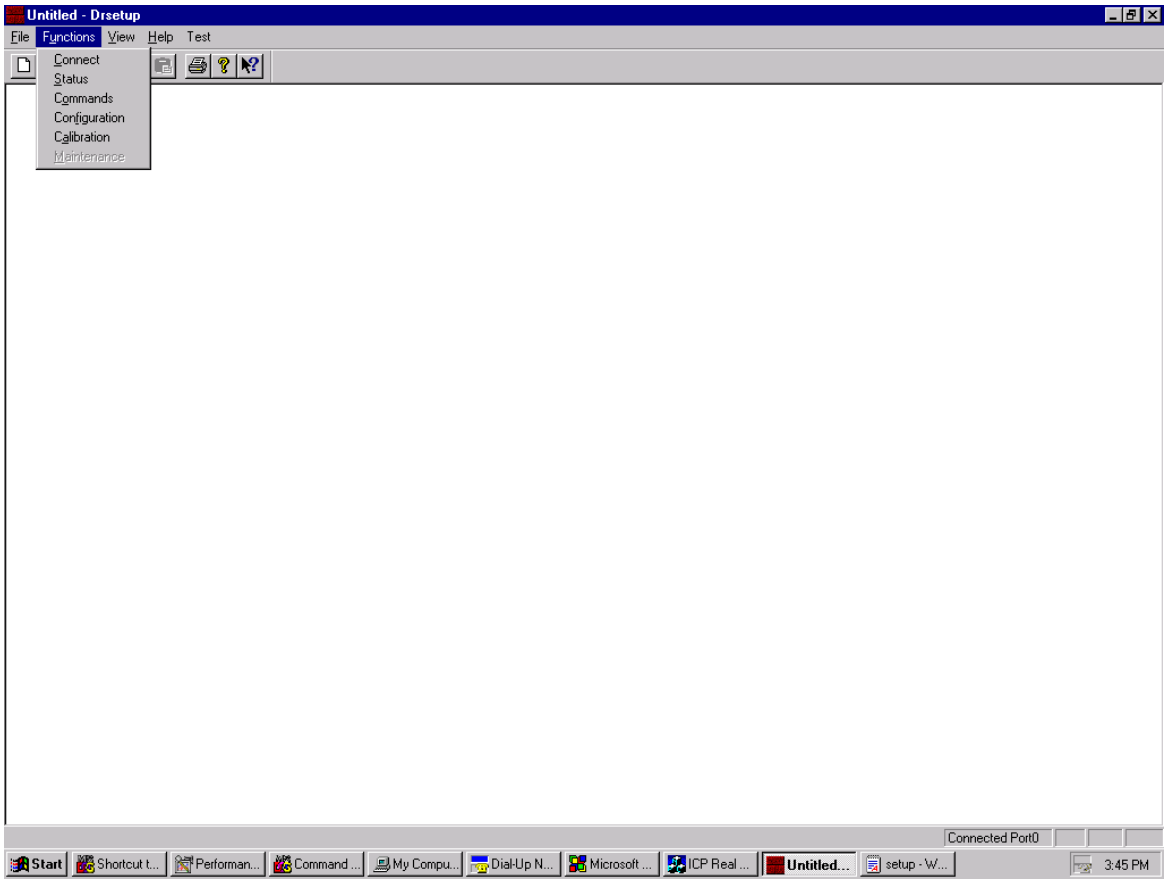

Figure E-2 Functions pull down menu screen

The **Functions** selection on the status bar has five applicable options, **Connect, Status , Commands, Configuration, and Calibration** as indicated in Figure E-2.

CONNECT

Initially, the **Connect** option is the only selection that is available. The other options depend on the successful connection to the DR-24 for system feedback. After selecting Connect, the menu shown in Figure E-3 pops up. This menu allows the operator to connect to a particular predefined station (defined in the ICP setup) by selecting the station from a list and activating the ONLINE option. Selecting the OK button forces the connection to that station. If communication to that station is successful then the other options in the Functions group become active, otherwise a No Response flag will be displayed. The bottom status bar displays which station is connected.

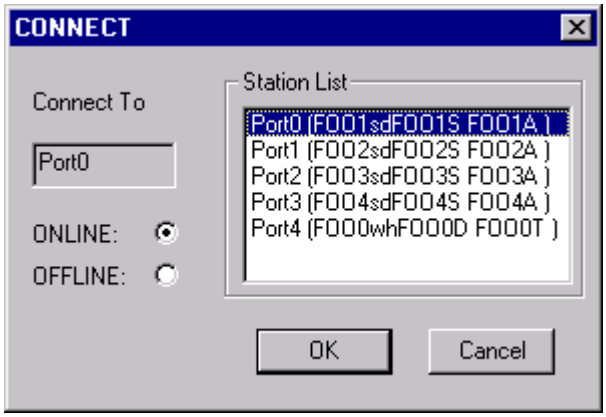

Figure E-3 Connect menu

STATUS

Selecting **Status** from the **Functions** group displays three configuration options for the attached station. Information regarding system hardware configuration is presented in the **Hardware** window. Figure E-4 details the hardware specific information that is retrieved from the station. As indicated in the figure, a user can determine system configuration of a specific station.

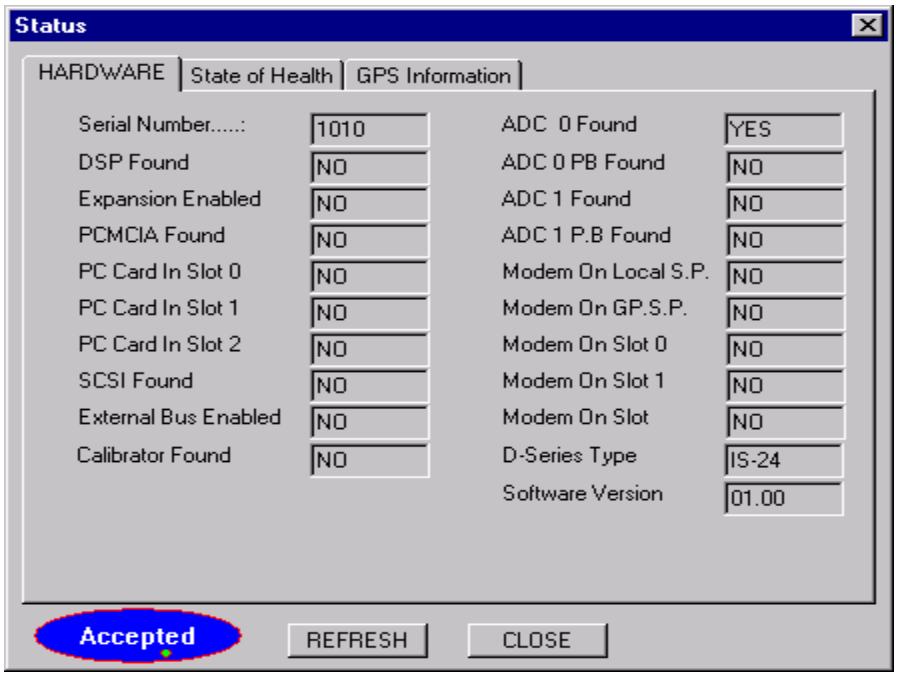

Figure E-4 Hardware Status pop up screen

State of Health

Selecting the **State of Health** option in the **Status** window displays another set of system parameters as shown in Figure E-5. The information displayed serves as a monitoring function for the acquisition system. The window displays several voltage values, temperature measurements, and other system specific information. There are several reserved SOH fields for future implementation.

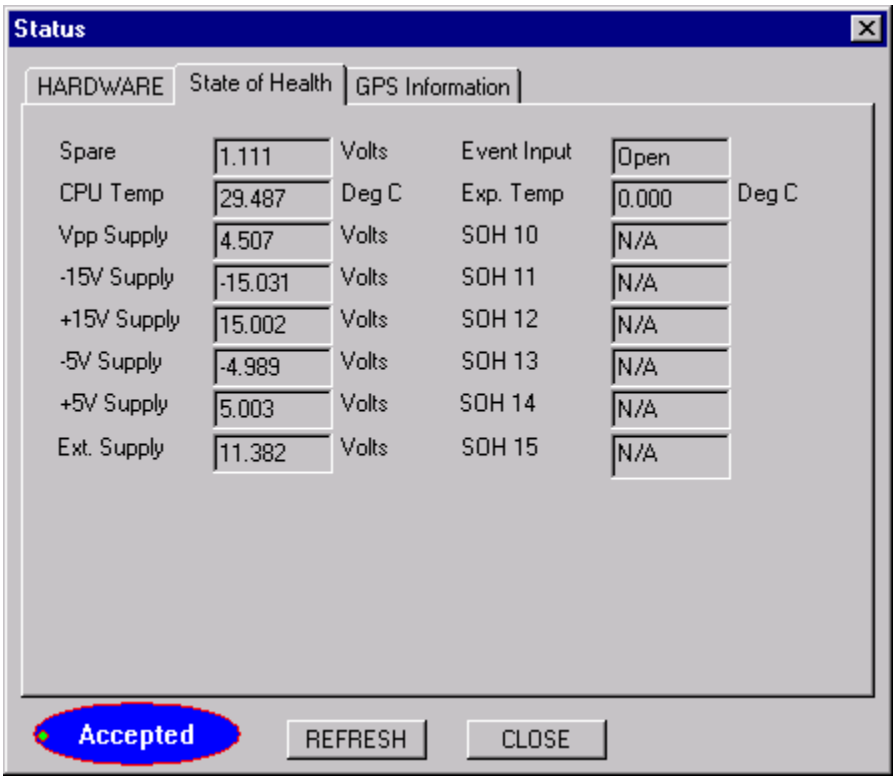

Figure E-5 State of Health status window

To obtain timing information, select the **GPS Information** option in the **Status** window. GPS status information, synchronization selection criteria, and system positioning data are displayed in this window as shown in Figure E-6 This screen allows the operator to monitor GPS functions and determine if their timing source is operational. GPS specific fields become inactive if an external timing source is used other than GPS.

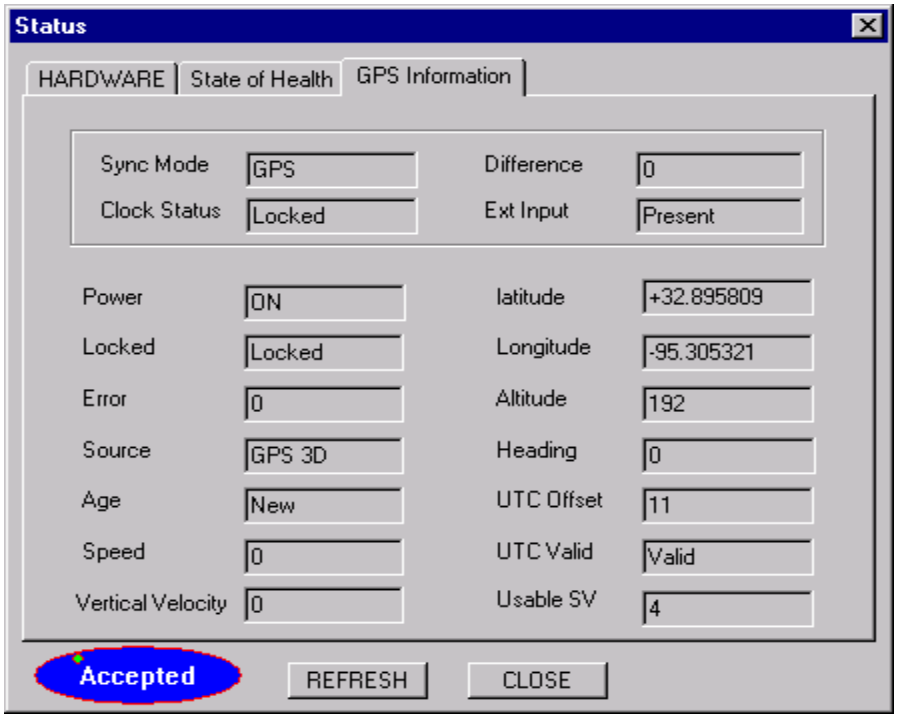

Figure E-6 GPS status Information

Command

Click on **Command** in the **Functions** group to display eight command operations. The window shown in Figure E-7 displays the options in the Command field that can control selected operations of the acquisition system. This figure also shows the selected command, **Acquisition,** that is used to control whether or not the DR-24 is in acquisition mode.

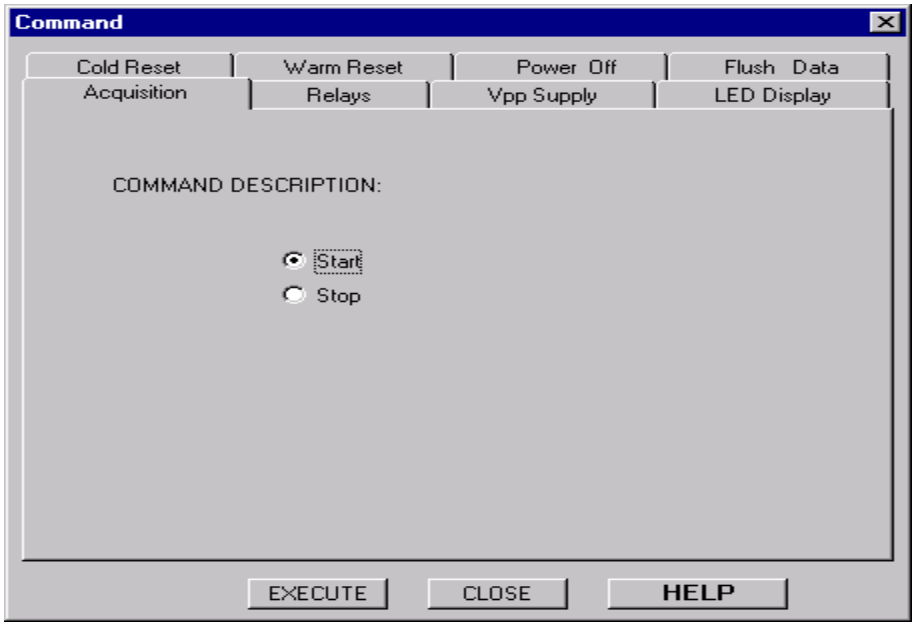

Figure E-7 Acquisition command menu

Selecting an input for the DR-24 can be accomplished through the **Relays** command selection as shown in Figure E-8. Three input options are available, a shorted input, a loop back, and a signal source The loop back (L.B.) circuit is only functional when an optional calibrator board is installed. Issuing the L.B. command without a calibrator board trips the input relays which causes an open circuit to the analog front end. With a calibration board, the predefined calibration schedule is executed and feed back to the analog circuitry in the DR-24 instead of being applied to a sensor. Data acquired from this configuration is recorded as a data file not a calibration file.

The operator can control three of the four LED's (Time, Memory, and Status) in the DR-24 by selecting the **LED Display** option. To conserve power and reduce noise, execute the OFF button in this window to turn the LED's off.

The **Vpp Supply** selection in the **Command** window allows the operator to control and monitor the Vpp FLASH programming voltage level. This voltage will change from 5 volts to 12 volts for approximately two minutes and is used for test or maintenance.

Re-initializing the system can be accomplished by either a **Warm Reset** or a **Cold Reset**. Executing a warm reset causes the DR-24 to terminate data acquisition and allow the firmware to re-initialize its software parameters without loss of time synchronization. A cold reset command re-initializes the software and the hardware as it restarts the system.

The **Power Off** option terminates all data acquisition functions and turns the DR-24 completely off. An instrument can only be turned back on manually once this command has been issued.

Figure E-8 Relays Command setup screen

The **Configuration** option in the **Function** group consists of three additional system configuration requirement windows. The selections are **Communications, Channels**, and **Time**. The Communications window, shown in Figure E-9 is used to display the present configuration for the data transmission link, its protocol and identifies which port it applies to. The configuration of these ports can only be changed using the DRlaptop software. The Local port baud rate is the rate at which the DR-24 communicates with its attached terminal (serial port interface) and the Main baud rate is the connection rate that the DR-24 uses to connect to the ICP system.

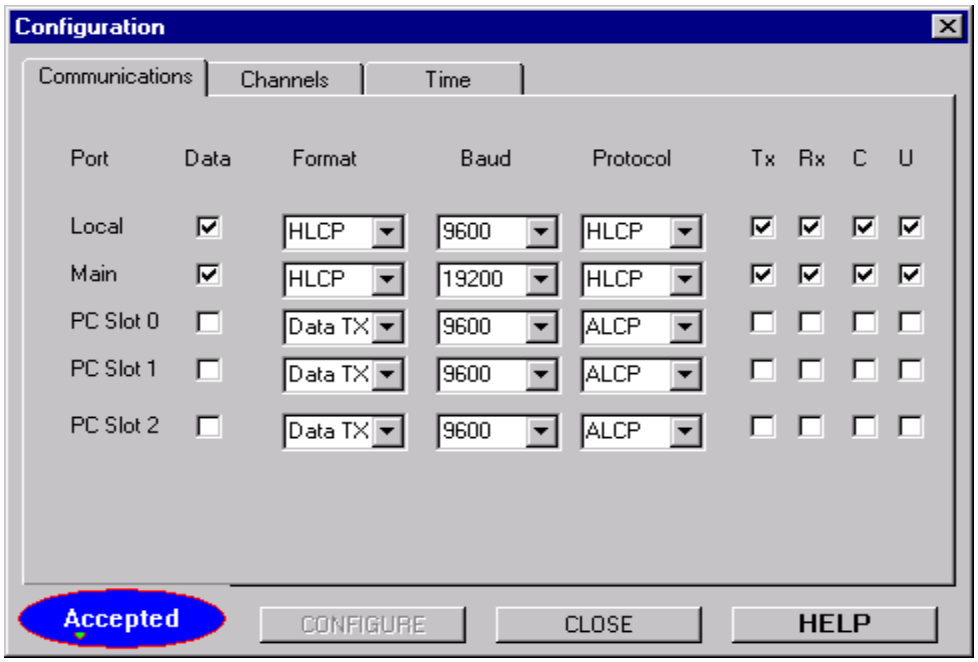

Figure E-9 Communications Configuration menu

Selecting sample rate parameters and configuring them to specific channels can be accomplished by enabling the **Channels** option from the **Configuration** group. As shown in Figure E-10, sample rates are selected (50 or 100 sps) and individually configured to each predefined channel. All channels in a DR-24 must have the same sample rate or be disabled.

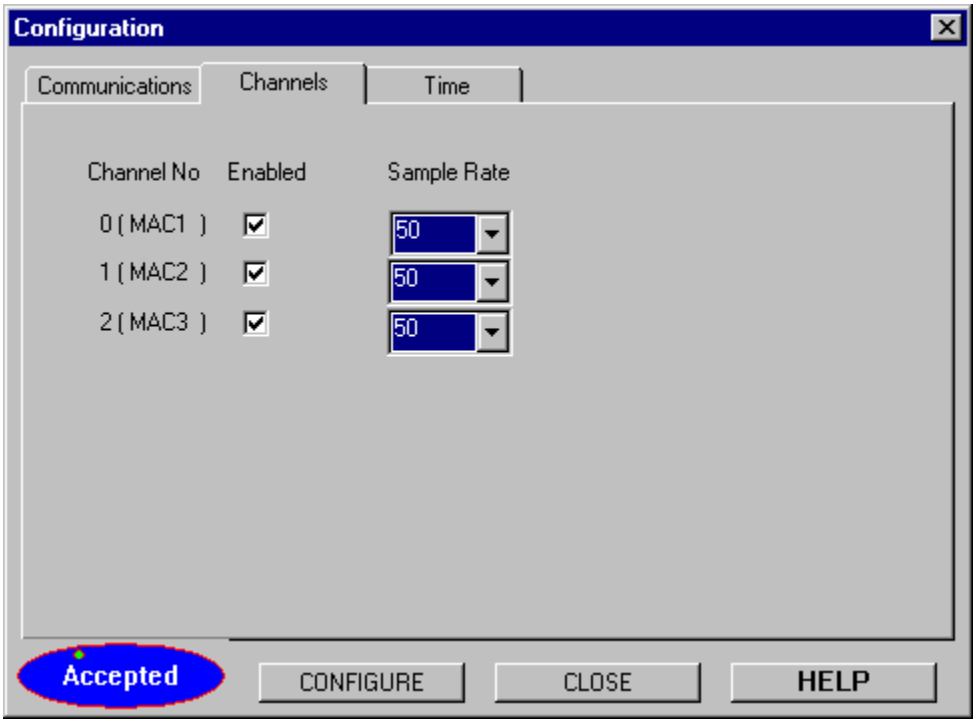

Figure E-10 Channel Configuration setup screen

Several time synchronization options are available in the **Time** selection of the **Configuration** group. As shown in Figure E-11, *GPS Cycle Time* and *Jam Set Threshold* are fields requiring input information if the GPS sync mode is selected. The GPS cycle time field allows the operator to specify the amount of time that must elapse before turning on the GPS receiver again after its last successful GPS lock.

The Jam Set parameter defines a condition in which the difference between the GPS reference and the DR-24's internal clock must exceed before a jam set occurs. When this condition is meet, the DR-24 will correct the time difference to less than the jam set threshold in one step and continue to adjust its internal time until the time difference is minimal. The operator can also set time manually by entering the required information in the **Time** fields and execute it by using the **Send** command.

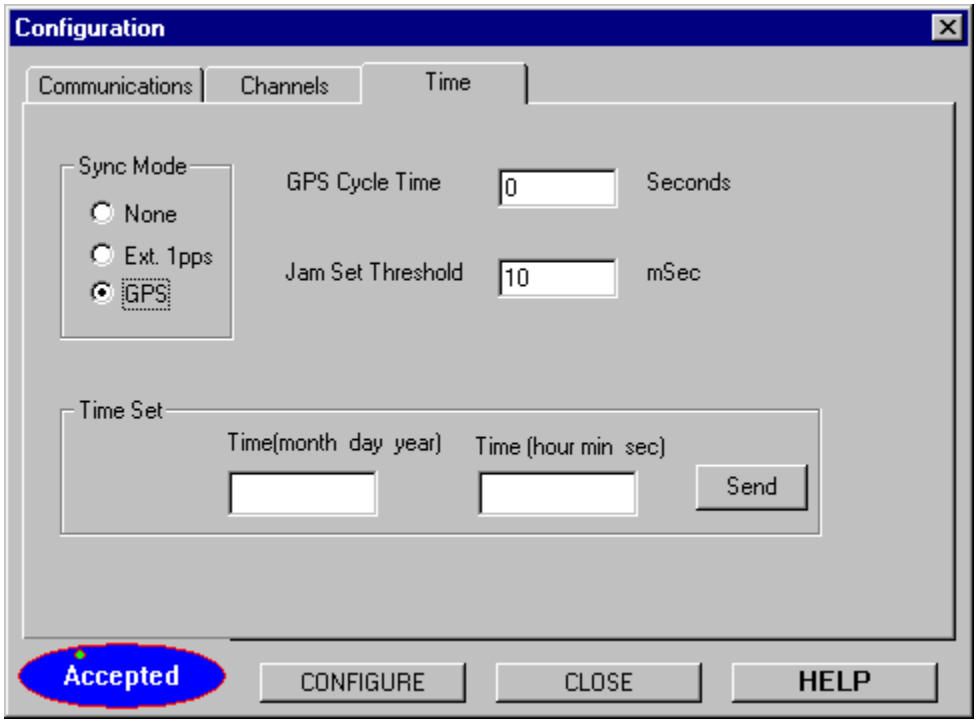

Figure E-11 Time Configuration setup screen

Select **Calibration** in the **Function** group to define the type and duration of a calibration signal for a specific channel. As shown in Figure E-12, select **Immediate** to generate a calibration signal instantly. After selecting *Start*, the operator can define the desired calibration signal and determine whether or not it should be applied to a particular channel. A *Send* command will execute the calibration request even if a channel is not selected. After generating the calibration signal the acquisition mode reverts back to the *Sensor* mode. If an immediate calibration command is received while another calibration is already in progress it will be rejected. The selection of calibration signals are 1)Sinewave, 2) Noise, 3) Pulse, 4) Random Pulse, and 5) Shorted Input. However, without a calibration board many of these calibration types are not available.

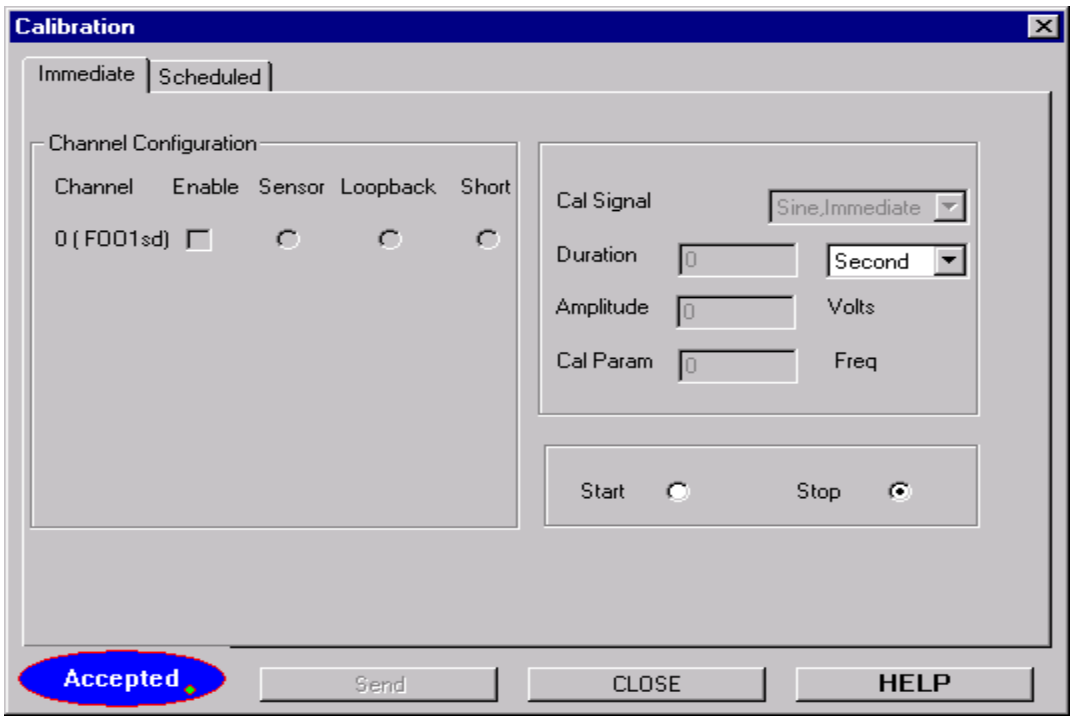

Figure E-12 Immediate calibration setup screen

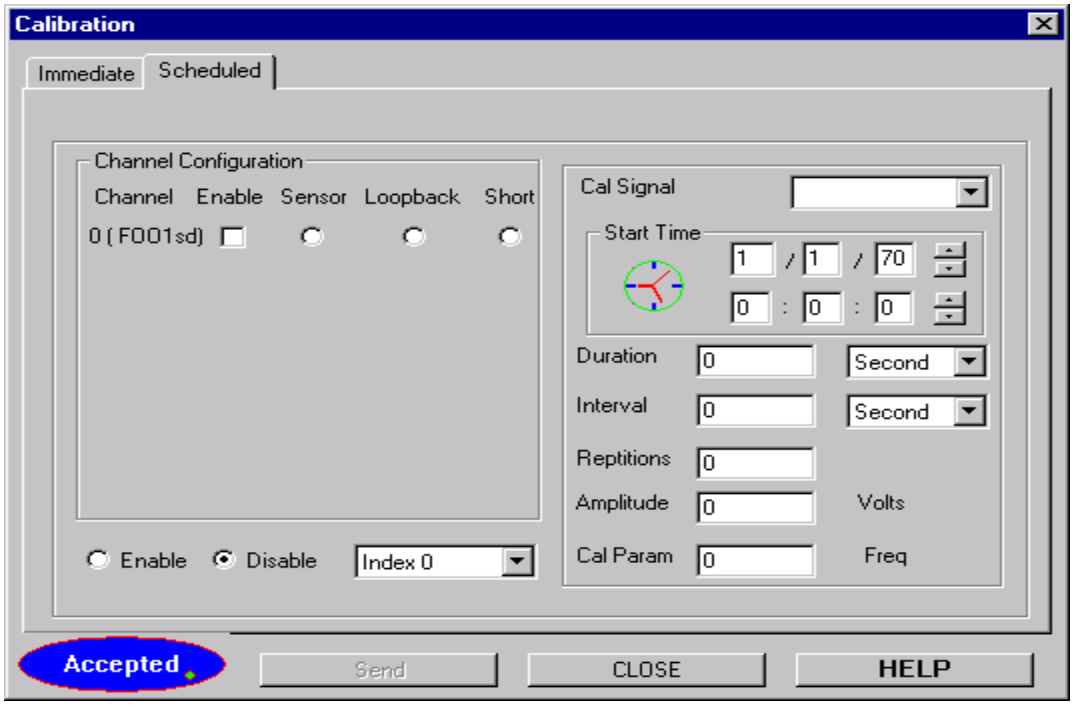

Figure E-13 Schedule calibration setup screen

The **Scheduled** option, shown in Figure E-13, allows the operator to plan and execute calibration episodes. Several parameters are required to be entered for the various types of calibration options.

Start Time defines the beginning time of the first calibration of the schedule.
Duration defines how long the calibration will run.
Interval is a parameter defining a period of time from the start of one calibration event to the next one.
Repetition defines the number of times a scheduled calibration will occur. The maximum value for this field is 65,535.
Amplitude, expressed in volts, sets the output magnitude of the selected calibration source.
Cal Parameter is a parameter defining the frequency of the sinusoidal calibration signal.

After entering the details about a calibration requirement, it can be stored into one of the possible 32 index options by enabling the **Index** window. This allows the operator to retain multiple calibration configurations without having to create them more than once.