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LEADER IN SIGNAL CONDITIONING

Series ECS9120/21
High Level Expander Board

USER'S MANUAL

20-002.3
8500-191-A08627

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HIGH LEVEL EXPANDER MANUAL
Contents

		PAGE
1.	General Information	1.1
1.1	Introduction	1.1
1.2	Description	1.1
2.	Principles of Operation	2.1
2.1	Analog Input Multiplexer	2.1
2.2	Auto Zero Circuit	2.1
2.3	Input Transient Protection	2.1
2.4	Card Decode and Mode Control Circuits	2.3
2.5	Conversion Control Circuit	2.3
2.6	Reading Data	2.3
3.	Preparation for Use	3.1
3.1	Unpacking and Inspection	3.1
3.2	Card Cage Considerations	3.1
3.3	Channel Assignment	3.1
3.4	Analog Input Connections and Jumpers	3.2
3.5	Analog Input Connector	3.4
3.6	Input Ranges	3.5
3.7	Acromags Expander Bus	3.6
3.8	P1 Connector	3.7
3.9	I.D. Prom	3.7
3.10	Installation	3.7
4.	Service Information	4.1
4.1	Preliminary Service Procedure	4.1
4.2	Calibration	4.1
4.3	Replaceable Parts	4.1
4.4	Service And Repair Assistance	4.4
4.5	Replaceable Parts	4.2
5.	Specifications	5.1

LIST OF FIGURES

		PAGE
2.1	High Level Expander Block Diagram	2.2
3.1	Analog Input Configuration	3.3

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LIST OF TABLES

2.1 Personality Codes 2.3

3.1 Channels Used 3.2
3.2 Channel Blocks 3.2
3.3 Analog Input Connector (single ended inputs) 3.4
3.4 Analog Input Connector (differential inputs) 3.5
3.4 Termination Resistors 3.5
3.5 Input Ranges 3.6
3.6 P1 Connector 3.7
3.7 Backplane Connector 3.7

LIST OF DRAWINGS

4.1 Parts Location Drawing 4.5
4.2 Schematic 4.6
4.3 Schematic 4.7

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1.1 INTRODUCTION

The Series ECS9120 and ECS9121 High Level Expander Cards provide a means for expanding the number of high level inputs in the Data Aquisition System beyond those available on the Intelligent Base Card.

This manual covers the model types listed below:

MODEL TYPES:

ECS9120 Configurable for 16 Differential channels or 32 single ended channels of high level input. (Input protection circuitry not included).

ECS9121 Configured for 16 differential channels, (32 single ended channels are not available). Input protection circuitry for each channel is included.

1.2 DESCRIPTION

The Series ECS9120/21 High Level Expander Cards conform to the standard eurocard physical and mechanical dimensions as described in VME specification (Rev. C). Power (+5V) and ground are connected via the P1 connector. These expander cards do not connect with any of the VMEbus signal lines. Analog inputs as well as communication with the Intelligent Base Card are made via the P2 connector. Because of this, the expander should only be used with the Acromag 9910, P2, Backplane.

The Series ECS9120 High Level Expander Cards feature:

* Up to 16 Differential or 32 Single-Ended Inputs
* Auto Zero Circuitry
* Socket for I.D. PROM
* Compatable with standard Eurocard Card Cage

The Series ECS9121 High Level Expander Cards feature:

* Up to 16 Differential Inputs
* Input Transient Protection Circuitry
* Auto Zero Circuitry

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* Socket for I.D. PROM

* Compatable with Standard Eurocard Card Cage.

* 10 Hz Single Pole Filters

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This section provides a functional description of the High Level Expander Card which consists of the following functional blocks:

- Analog Input Multiplexer
- Auto Zero Circuit
- Input Transient Protection
- Card Decode Circuit
- Mode Control Circuit

Figure 2.1 is a block diagram of the High Level Expander Card. Refer to the Schematic and Parts Location Drawings for items referenced in the following information.

2.1 ANALOG INPUT MULTIPLEXER

The Analog Input Multiplexer consists of four CMOS (8-input) analog multiplexers and accepts 16 differential or 32 single-ended inputs. The three least significant bits of the Channel Select Lines are appled to each of the four analog input multiplexers to determine which inputs will be activated. When configured for single-ended operation, only one of the analog multiplexers is enabled at a time. For differential operation, two analog multiplexers are enabled simultaneously.

J2, J3 and J4 are used to connect the outputs of the analog multiplexers to the output switch (U9) via half of the analog switch, U10.

2.2 AUTO ZERO CIRCUIT

Half of the analog switch, U10, is used to short the inputs of the buffer amplifiers to analog common when U4 decodes the auto zero mode or when the channel select register points to a channel location not on the card. This is equivalent to a zero input signal. The data obtained in this mode is used to correct for offset drifts due to temperature and aging.

2.3 INPUT TRANSIENT PROTECTION

The Model ECS9121 is designed with transient protection circuitry. This circuitry protects high level, non-isolated inputs from damage due to high voltage static discharge.

The 10 Hz filter consists of a single pole RC network where the R is divided into two resistors to maintain a balanced differential input. Resistors in both legs of the circuit provide additional protection against static discharge. A diode bridge is connected to each input circuit. Normally these diodes are reverse biased. When a voltage is applied to an

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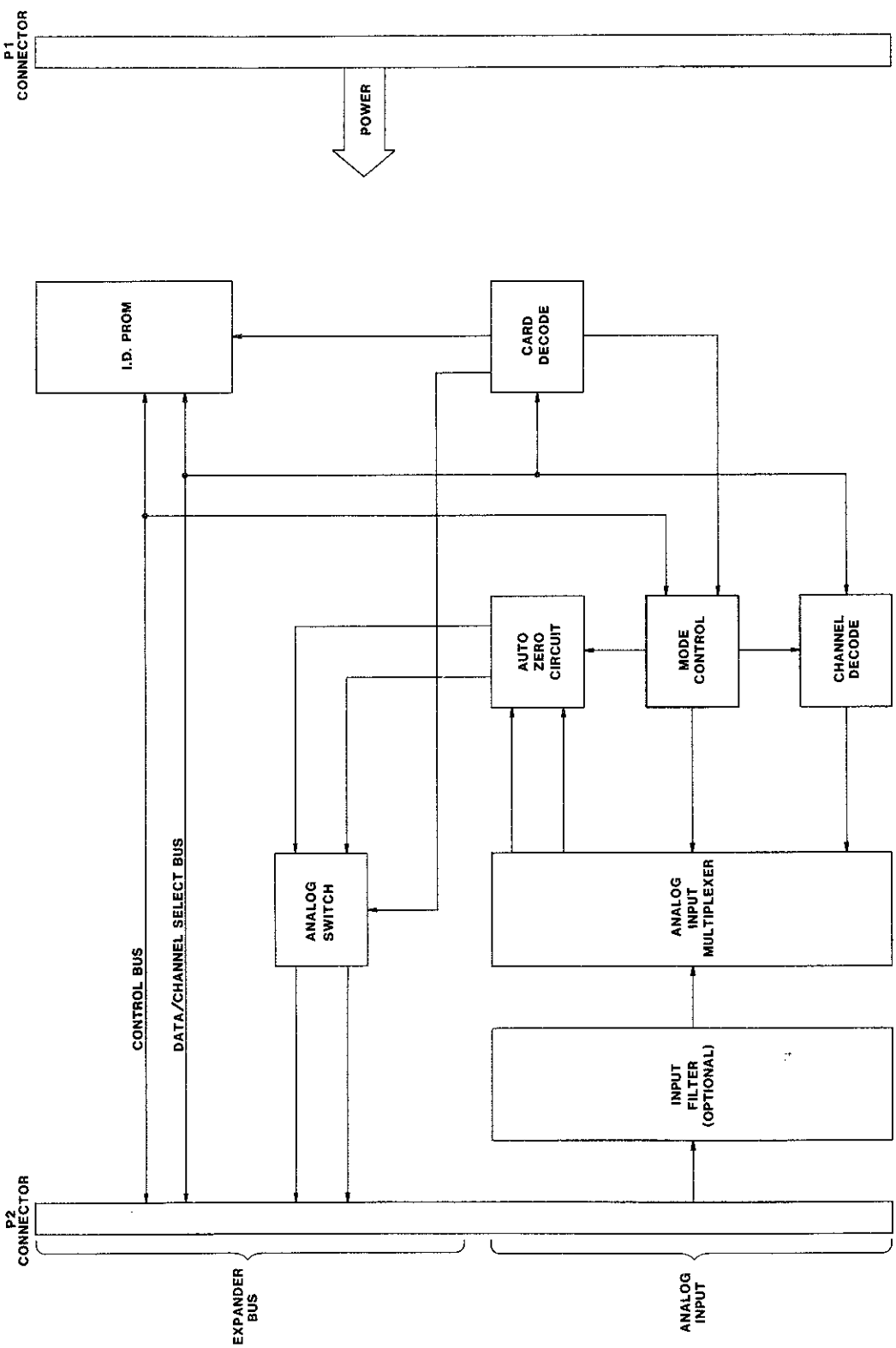


FIGURE 2.1: HIGH LEVEL EXPANDER BLOCK DIAGRAM

Acromag
WIXOM, MICH.
TITLE
HIGH LEVEL EXPANDER BLOCK DIAGRAM
SIZE
D
DRAWING
4500-776
SHEET
1 OF 1
REV

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input terminal which is in excess of the zener clipping voltage established by D1 and D2. A diode in the bridge conducts and thus limits the voltage to the multiplexers. Bias supplies maintain a minimum reverse voltage across the bridge diodes during normal operation.

There are locations for user installed voltage divider resistors (R12) for each of the differential inputs. The accuracy of the input resistors should be considered when using the voltage divider for precision. If a high degree of accuracy is required, the use of 0.1% tolerance input resistors is suggested.

2.4 CARD DECODE AND MODE CONTROL CIRCUITS

The card decode determines if the Intelligent Base Card has addressed the expander. Jumper J5 determines if the card is configured to decode 16 differential channels or 32 single ended channels. If J5 selects 16 differential channels, then CD0 thru CD3 are compared to switch S1 to produce a Valid Card Signal. If J5 selects 32 single ended channels, then CD1 thru CD3 are compared to the 3 most significant bits of S1 to produce a Valid Card Signal.

The mode decode is done in Programmable Logic Device U4. When the valid card signal is enabled, RG0 thru R63 lines select whether an auto zero or a channel will be enabled. If a channel is enabled, Programmable logic Device U3 enables the appropriate multiplexers corresponding to the channel selected.

2.5 CONVERSION CONTROL CIRCUIT

When a conversion request (CREQ/STROBE) is received from the Intelligent Base Card, monostable multivibrator U18 causes a 20 uS pulse. At the end of this pulse, Flip Flop U19 clocks causing an active low on its output. This signal is gated with valid card (VCD) to cause a conversion trigger (CTRIG) to be sent to the Intelligent Base Card. The 20 uS delay is required to allow the analog input signal to settle after being selected.

2.6 READING DATA

The high level expander channels can be read by communicating with the Intelligent Base Card, either through the serial port or the VMEbus. Data may be read in engineering units or DATA BITS. Before reading the output data for a channel, the user must first assign a "Personality Code" to the channels he wishes to read. A Personality Code is a 2 byte word that lets the Intelligent Base Card know what type of input is present for each channel.

TABLE 2.1 PERSONALITY CODES

Personality Code	Input Description	
0000H 0021H	No Personality -10V to +10V	High Level

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For Example:

We wish to read the data for high level channel 137 from the serial port. The output should be in volts. We must first set the personality code.

```
TYPE:   SPC   137   21   V
         |     |     |    |__ Carriage Return
         |     |     |
         |     |     |_______ Personality Code (HEX)
         |     |
         |     |_____________ Channel (Decimal)
         |
         |___________________ Command "Set Personality Code"

TYPE:    V___________________ Carriage Return

Reply:  Ready
```

Now we will read the channel

```
TYPE:   CRI   137   V
         |     |    |_______ Carriage Return
         |     |
         |     |_____________ Channel Number (decimal)
         |
         |___________________ "Continuously Read Input Command"

Reply:  137   4.8V  21
        137   4.8V  21
         .     .    .
         .     .    .
         .     .    ._______ Personality code (HEX)
         |     |
         |     |_____________ Data in volts
         |
         |___________________ Channel Number
```

(See the IBC manual for detail programing information)

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This section provides instructions for unpacking, inspection, card cage installation, jumpers, cabling, and options.

3.1 UNPACKING AND INSPECTION

Inspect the shipping carton immediately upon receipt for evidence of mishandling during transit. If the shipping carton is severly damaged or waterstained, request that the carrier's agent be present when the carton is opened. If the carrier's agent is not present when the carton is opened and the contents of the carton are damaged, keep the carton and packing material for the agent's inspection.

For repairs to a product damaged in shipment, refer to the Acromag Service Policy to obtain return instructions. It is suggested that salvageable shipping cartons and packing material be saved for future use in the event the product must be shipped.

The card is adequately protected with foam during shipment. It is advisable to visually inspect the card for evidence of severe handling prior to applying power.

3.2 CARD CAGE CONSIDERATIONS

Refer to the specifications for bus loading and power requirements. Be sure that the system power supplies are able to accommodate the additional requirements within voltage tolerances specified.

Adequate circulation of air must be provided to prevent a temperature rise above the maximum operating temperature. Large and continuing fluctuations in ambient air temperature should be avoided. If the installation is in an industrial environment, and the card is exposed to environmental air, careful consideration should be given to air filtering.

3.3 CHANNEL ASSIGNMENT

The channel select register data from the Intelligent Base Card is brought through the Acromag expander backplane P2 and is decoded by the Expander Card. The analog input signal on the expander is connected via the expander backplane P2 to the Intelligent Base Card for conversion to digital data.

The Channel Assignment Switches must be set so that the expander is addressed by the Channel Select Register at a 16 channel block not occupied by the Intelligent Base Card or another Expander Card.

If the Intelligent Base Card has the analog input option (Model AVME9110), the first 16 or 32 channels are used by that card; otherwise it is possible to locate inputs on the Expander Card beginning at channel 0. See Table 3.2 and the Parts Location Drawing.

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TABLE 3.1: CHANNELS USED

MODEL NO.	CHANNELS USED
ECS9120	16 or 32
ECS9121	16

TABLE 3.2: CHANNEL BLOCKS

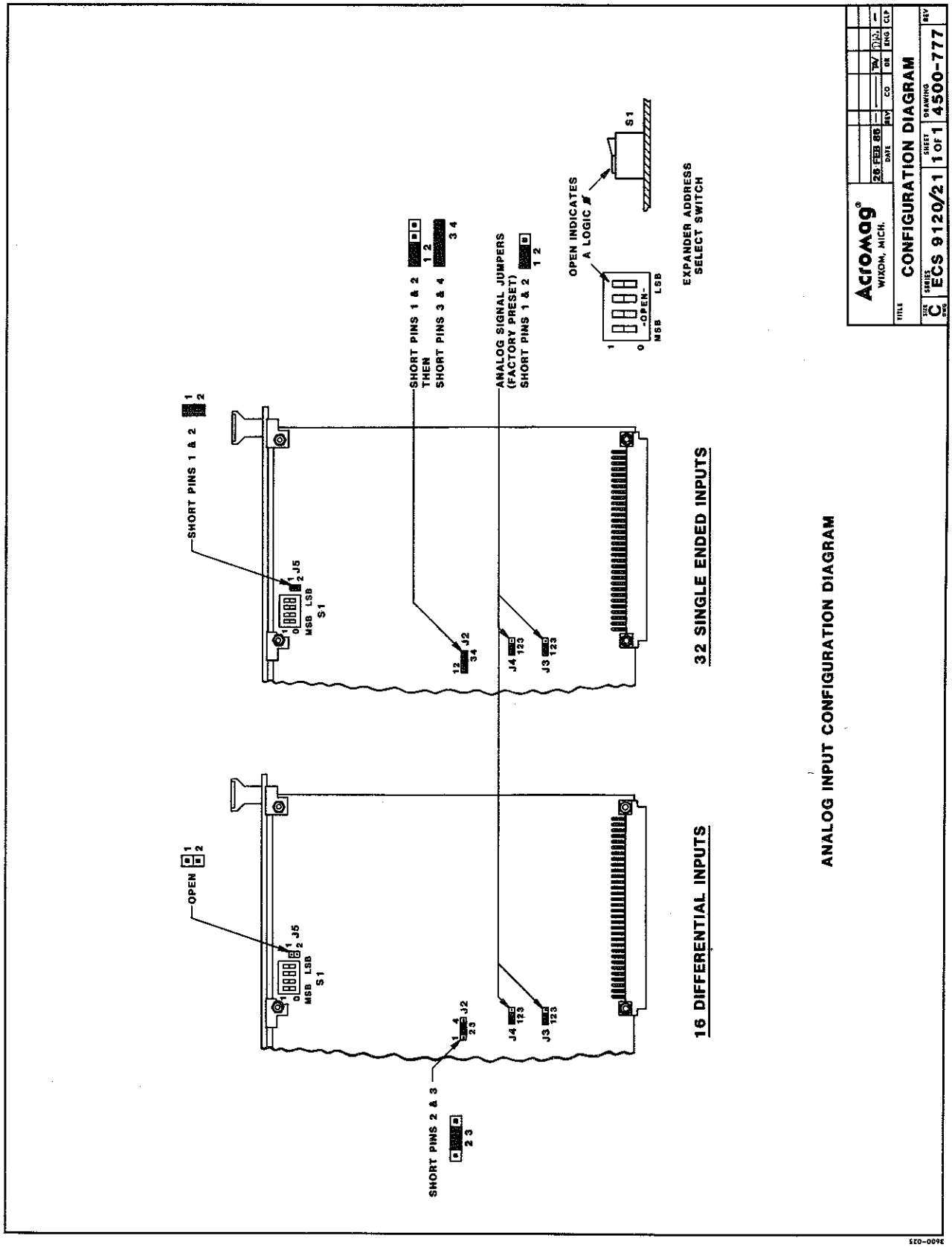
DIFFERENTIAL CHANNELS	SINGLE-ENDED CHANNELS	BIT-SWITCH S1 7	6	5	4
0 thru 15	0 thru 31	0	0	0	0
16 -- 31	0 -- 31	0	0	0	1
32 -- 47	32 -- 63	0	0	1	0
48 -- 63	32 -- 63	0	0	1	1
64 -- 79	64 -- 95	0	1	0	0
80 -- 95	64 -- 95	0	1	0	1
96 -- 111	96 -- 127	0	1	1	0
112 -- 127	96 -- 127	0	1	1	1
128 -- 143	128 -- 159	1	0	0	0
144 -- 159	128 -- 159	1	0	0	1
160 -- 175	160 -- 191	1	0	1	0
176 -- 191	160 -- 191	1	0	1	1
192 -- 207	192 -- 223	1	1	0	0
208 -- 223	192 -- 223	1	1	0	1
224 -- 239	224 -- 255	1	1	1	0
240 thru 255	224 thru 255	1	1	1	1

3.4 ANALOG INPUT CONNECTIONS AND JUMPERS

Refer to Figure 3.1 and the High Level Expander Card Schematic and Parts Location Drawings for details concerning the correct analog input jumper connections for each input configuration. Connect the sense input to signal common for the single-ended configuration. For pseudo-differential operation, a voltage up to the common mode range can be applied between the sense input and analog common.

Model ECS9120 configured for differential inputs may be reconfigured for single-ended operation. The opposite is also true with the exception of Model ECS9121 which must always be configured for differential operation.

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3.5 ANALOG INPUT CONNECTOR

Analog inputs are connected to the High Level Expander Card via connector P2. Tables 3.3 and 3.4 shows the connection for either single-ended or differential inputs.

TABLE 3.3: ANALOG INPUT CONNECTOR (Single Ended Inputs)

	Row	A	B	C
Expander Bus	1	ER/$\overline{W}$	$\overline{CREQ/STROBE}$	$\overline{CTRIG}$
	2	C3	C2	C1
	3	C0	CH3/D3	CH2/D2
	4	CH1/D1	CH0/D0	RG3
	5	RG2	RG1	RG0
	6	GUARD	A+	A-
Analog Inputs	7			
	8			
	9	ANA. COM.		ANA. COM.
	10	CHAN 30		CHAN 31
	11	CHAN 22		CHAN 23
	12	ANA REF		ANA REF
	13	CHAN 28		CHAN 29
	14	CHAN 20		CHAN 21
	15			
	16	CHAN 26		CHAN 27
	17	CHAN 18		CHAN 19
	18			
	19	CHAN 24		CHAN 25
	20	CHAN 16		CHAN 17
	21			
	22	CHAN 14		CHAN 15
	23	CHAN 6		CHAN 7
	24			
	25	CHAN 12		CHAN 13
	26	CHAN 4		CHAN 5
	27			
	28	CHAN 10		CHAN 11
	29	CHAN 2		CHAN 3
	30			
	31	CHAN 8		CHAN 9
	32	CHAN 0		CHAN 1

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TABLE 3.4: ANALOG INPUT CONNECTOR (Differential Inputs)

	Row	A	B	C
Expander Bus	1	ER/$\overline{W}$	$\overline{CREQ/STROBE}$	$\overline{CTRIG}$
	2	C3	C2	C1
	3	C0	CH3/D3	CH2/D2
	4	CH1/D1	CH0/D0	RG3
	5	RG2	RG1	RG0
	6	GUARD	A+	A-
Analog Inputs	7			
	8			
	9	ANA. COM.		ANA. COM.
	10	-CHAN 14		-CHAN 15
	11	+CHAN 14		+CHAN 15
	12	ANA. REF.		ANA. REF.
	13	-CHAN 12		-CHAN 13
	14	+CHAN 12		+CHAN 13
	15			
	16	-CHAN 10		-CHAN 11
	17	+CHAN 10		+CHAN 11
	18			
	19	-CHAN 8		-CHAN 9
	20	+CHAN 8		+CHAN 9
	21			
	22	-CHAN 6		-CHAN 7
	23	+CHAN 6		+CHAN 7
	24			
	25	-CHAN 4		-CHAN 5
	26	+CHAN 4		+CHAN 5
	27			
	28	-CHAN 2		-CHAN 3
	29	+CHAN 2		+CHAN 3
	30			
	31	-CHAN 0		-CHAN 1
	32	+CHAN 0		+CHAN 1

3.6 INPUT RANGES

The transfer equation which describes the relationship between the analog input signal on the High Level Expander Card and the Digital Output Code on the Intelligent Base Card is derived from the following equations. The Intelligent Base Card equation is:

$$D = 819.2\ e_{in}$$

D = Data in Bits
e_{in} = IBC input voltage

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The equation covering the models ECS9120 and ECS9121 is:

$$e_{out} = e_{in}$$

where e_{out} = Expander Card Output
e_{in} = Expander Card Input

Combining these equations produces the overall transfer equation.

$$D = 819.2\ e_{in}$$

where D = Data in Bits
e_{in} = Expander Card Input

For Example:

IF $e_{in} = -10V$ D = -8192 bits
$e_{in} = 0V$ D = 0000 bits
$e_{in} = 9V$ D = 7373 bits

TABLE 3.5 INPUT RANGE

Nominal Input Range		Input Span	Resolution	Accuracy
min	max	Full Scale	mV/bit	25°C
-10V to +10V		20V	1.22 mV	±1.22 mV

3.7 ACROMAG'S EXPANDER BUS

A portion of analog input connector P2 is used to interconnect digital signals from the expander to the Intelligent Base Card. Note: This Expander Card should only be plugged into an Acromag, P2, Expander Backplane. Refer to Table 3.3 for pin functions.

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3.8 P1 CONNECTOR

Table 3.6 shows the pins used by the Millivolt/Thermocouple Expander Card on the P1 Connector.

TABLE 3.6 P1 CONNECTOR

Signal	Pins
+5V	A32,B32,C32
Ground	A9,A11,A15 A17,A19,B20 B23,C9
No Connection	All Others

3.9 I.D. PROM

The I.D. PROM provides a means by which information concerning the model number can be stored. The user can read the I.D. information and quickly generate the system configuration. Programs can be written for all types of inputs independent of address location.

The device consists of a 32 byte fuse link Programable Read Only Memory or PROM. The least significant 4 bits of each byte are used to store the information. The most significant 4 bits of each byte are not used. Standard codes have been established for the convenience of developing software. Refer to the Intelligent Base Card Manual for methods of reading these codes.

3.10 INSTALLATION

CAUTION

Always turn OFF power to the card cage before installing or removing a data acquisition system card or cables. Failure to do so can result in damage to the card.

Install the card in a card cage slot as far from the CPU and memory cards as possible to reduce the possibility of interference from the digital circuitry. Install cables carrying analog signals away from power and digital computer cables and other sources of high electrical noise.

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This section provides calibration procedures, service diagrams and instructions on how to obtain service and repair assistance.

4.1 PRELIMINARY SERVICE PROCEDURE

Before beginning repair verify that the supply voltages at the computer bus connector are within tolerance as shown in the specifications section. Next verify that the Intelligent Base Card and the digital circuitry on the High Level Expander Card are functioning correctly.

4.2 CALIBRATION

The High Level Expander Card does not require calibration. If the data does not appear to be calibrated, check the calibration on the IBC.

4.3 REPLACEABLE PARTS

The Replaceable Parts List is provided as an aid to the user in troubleshooting the card. Replacement parts and repair services are available from Acromag. If repair is deemed necessary in this circuitry, it is highly recommended that the card be returned to Acromag for repair and recalibration.

Changes are sometimes made to improve the product, to facilitate delivery, or to control cost. It is therefore important to include the reference Number, the Acromag Part Number, the card Model Number, and the card Serial Number when providing information to order parts.

ECS9120 PART LIST

REFERENCE NUMBER	ACROMAG PART NO.	DESCRIPTION
C1,3	1002-321	10 UF
C2,4,8-12,16-23 ,25-29,31	1002-530	.1 UF
C5-7		Not Used
C24	1002-442	0.01 UF
C32-48		Not Used
C49,57	1002-314	150 UF
C51,52	1002-444	.22 UF
C53,55	1002-319	3.3 UF
C54,56	1002-320	1 UF
C50	1002-321	10 UF
D1,2	1001-092	4746
D3,4		Not Used
D9,10,11,12	1001-167	Rec. Fast Recovery

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REFERENCE NUMBER	ACROMAG PART NO.	DESCRIPTION
J1		Not Used
J2	1004-365	4 Pos
J3,4	1004-333	3 Pos
J5	1004-410	2 Pos
L1-6		Not Used
P1,2	1004-505	96 PIN
Q1,2	1023-112	MJE800T
R1-4,8,11-14		Not Used
R6	1006-765	5.62K
R9,10	1100-334	Zero Ohm
R15	1100-266	4.7K
R16-34		Not Used
R35	1000-823	220
R36,37,38	1000-827	470
R39,40	1000-831	1K
T1	1014-090	XFMR
S1	1037-015	4 PST
U1,2	1201-244	74HCT244N
U3,4	1033-560	82S153N
U5-8	1033-292	508A-7
U9,10	1033-288	0201
U11	1033-298	TBP18S030N3
U12,13,14,15		Not Used
U16	1033-222	78M15
U17	1033-234	UA79M15
U18	1033-276	74LS423
U19	1033-266	74LS74
X1	1004-366	16 PIN SOCKET

ECS9121 PARTS LIST

REFERENCE NUMBER	ACROMAG PART NO.	DESCRIPTION
C1,3	1002-321	10 UF
C2,4,8-12,16-23 ,25-29,31	1002-530	.1 UF
C15	1002-108	1 UF

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REFERENCE NUMBER	ACROMAG PART NO.	DESCRIPTION
C24	1002-442	0.01 UF
C5-7		Not Used
C32-48		Not Used
C49,57	1002-314	150 UF
C51,52	1002-444	.22 UF
C53,55	1002-319	3.3 UF
C54,56	1002-320	1 UF
C50	1002-321	10 UF
D1,2	1001-092	4746
D3,4		Not Used
D5-8	5006-648	IN914B
D9,10,11,12	1001-167	Rec. Fast Recovery
J2	1004-365	4 Pos
J3,4	1004-333	3 Pos
J5	1004-410	2 Pos
L1-6		Not Used
P1,2	1004-505	96 PIN
Q1,2	1023-112	MJE800T
R1-4,8,11,16-32		Not Used
R6	1006-765	5.62K
R9,10	1000-842	8.2K
R15	1100-266	4.7K
R16-34		Not Used
R35	1000-823	220
R36,37,38	1000-827	470
R39,40	1000-831	1K
T1	1014-090	XFMR
S1	1037-015	4 PST
U1,2	1201-244	74CHT244N
U3,4	1033-560	82S153N
U5-8	1033-292	508A-7
U9,10	1033-288	0201
U11	1023-298	TBP18S030N3
U12,13,14,15		Not Used
U16	1033-222	78M15
U17	1033-234	UA79M15
U18	1033-276	74LS423
U19	1033-266	74LS74
X1	1004-366	16 PIN SOCKET

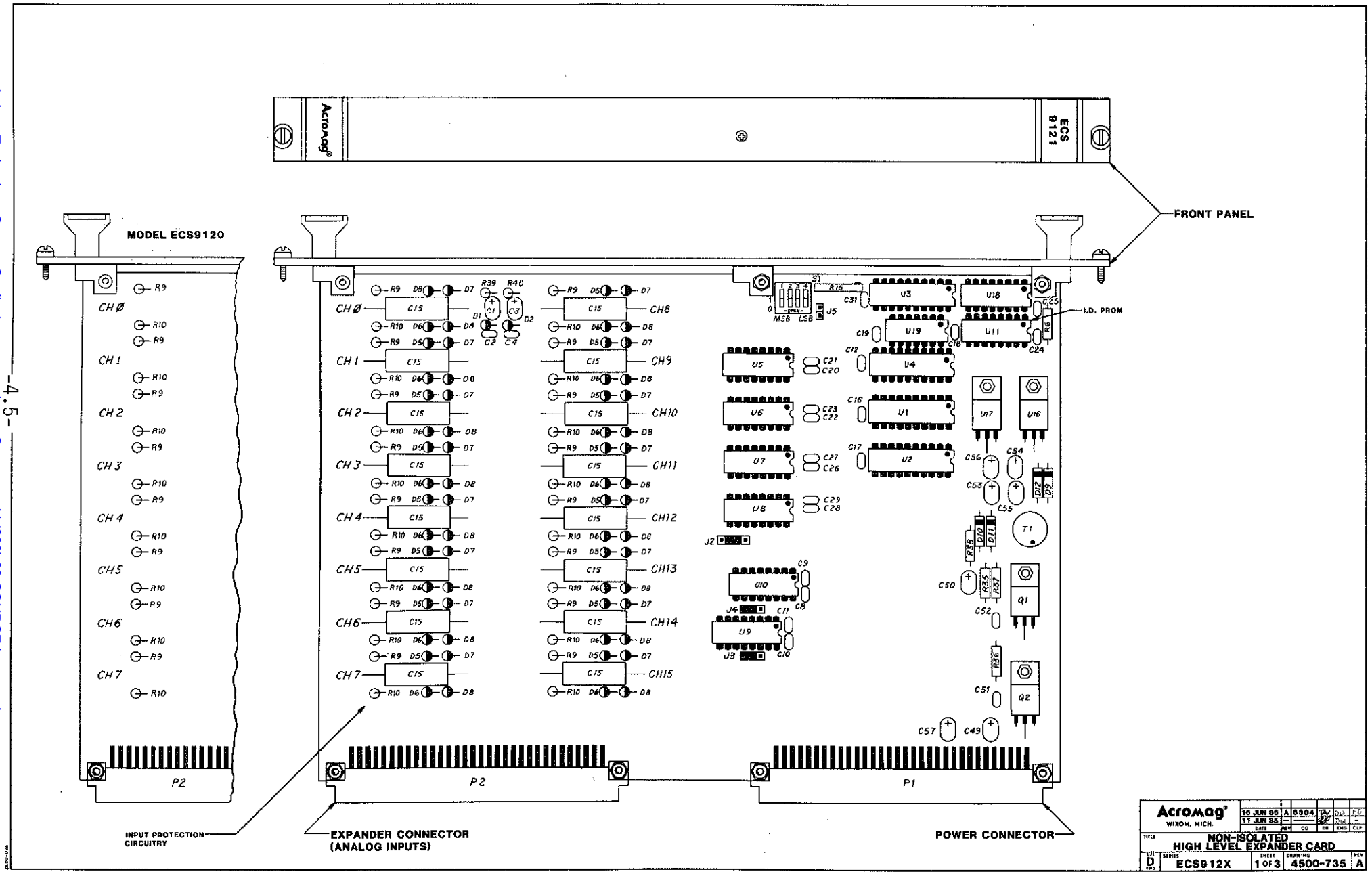
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4.4 SERVICE AND REPAIR ASSISTANCE

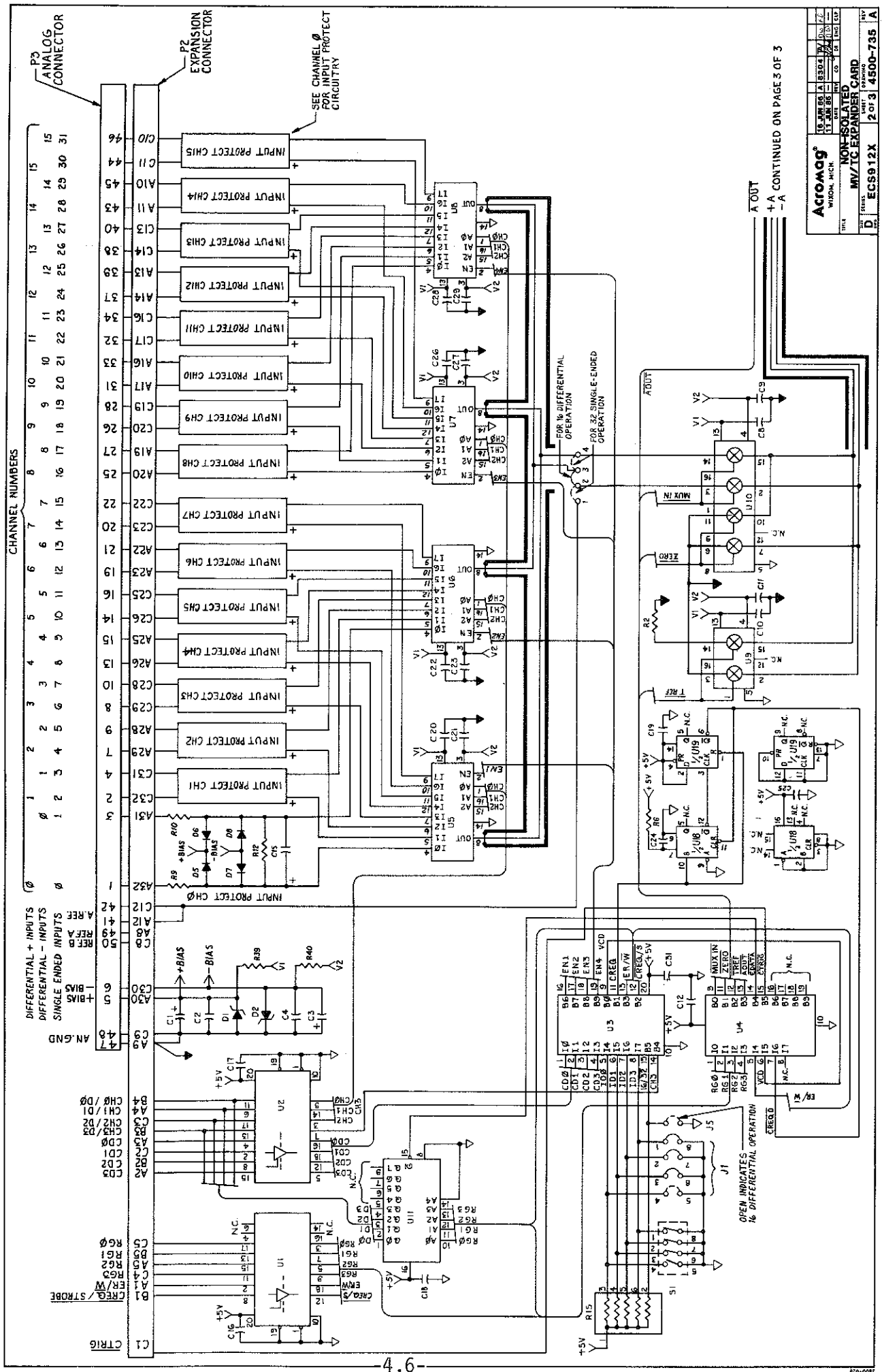
If it is determined that parts need to be replaced, it is highly recommended that the card be returned to Acromag for repair. Acromag uses tested and burned in parts, and in some cases, parts that have been selected for characteristics beyond that specified by the manufacturer. Acromag has automated test equipment that thoroughly checks the performance of each card. When a card is first produced and when any repair is made, it is tested, placed in a burn in room at elevated temperatures, and retested before shipment.

Please refer to Acromag's Service Policy Bulletin or contact the factory for complete details on how to obtain parts and service.

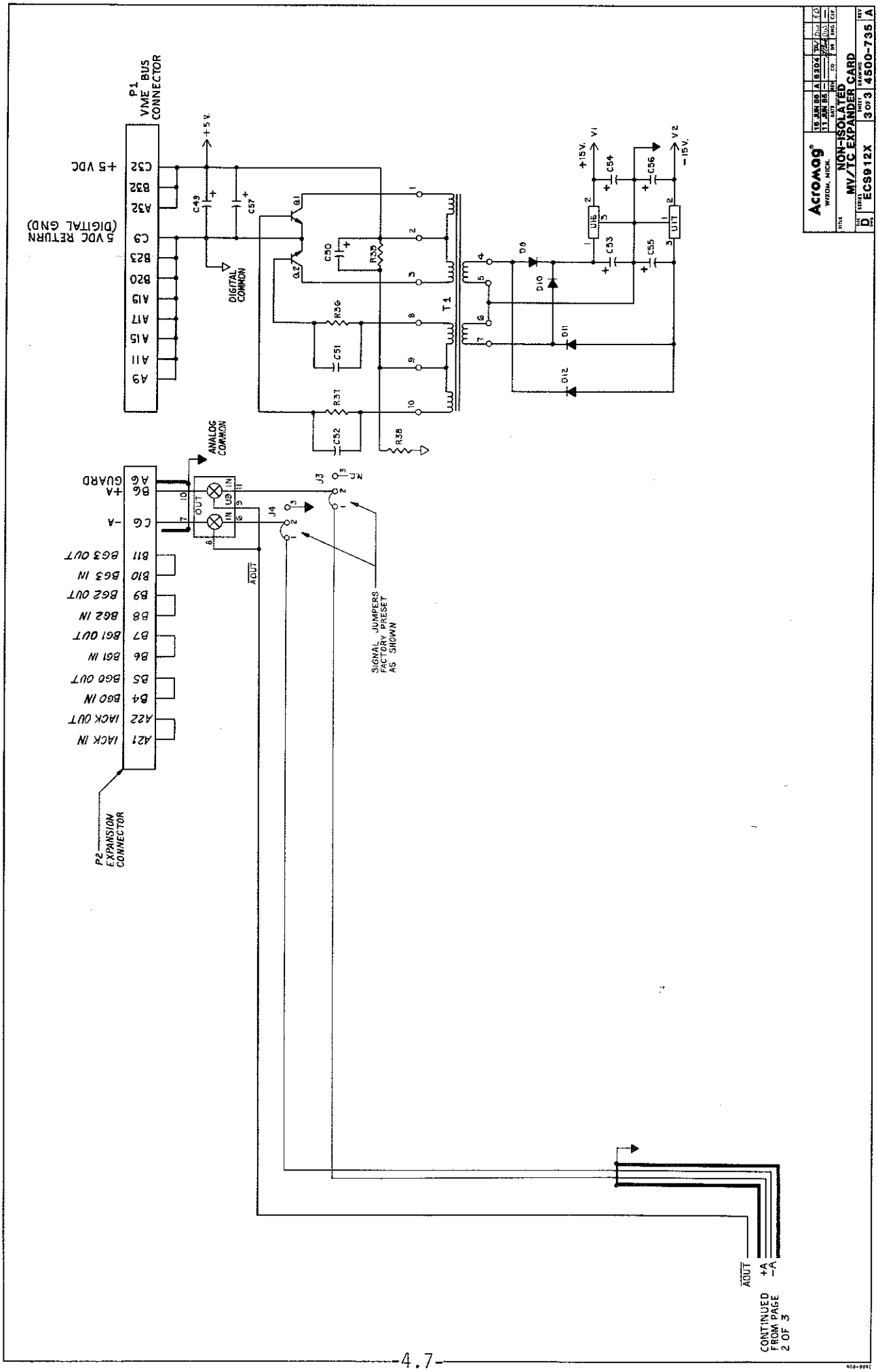
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The following specifications are given for 25°C ambient temperature and nominal power supply values unless otherwise noted.

GENERAL INFORMATION	
Operating Temperature	0° to 70°C
Storage Temperature	-25°C to +85°C
Physical Characteristics	
Length	9.187 in. (233.3 mm)
Width	6.299 in. (180 mm)
Board Thickness	0.062 in. (1.59 mm)
Component Height	0.55 in. max. (13.97 mm max.)
Recommended Card Spacing	0.8 in. min. (20.32 mm min.)
Mating Connectors	
P1,P2	IEC type 603-2-C096MX-xxx or equivalent.
ANALOG SECTION	
Input Configurations	
ECS9120	16 Differential or 32 single-ended inputs
ECS9121	16 Differential inputs
Input Range	-10V to +10V (Signal plus common mode voltage)
Input Resistance	10^9 ohms
Input Bias Current	1 nA (Typical)
Input Filtering (-3 dB)	
ECS9120	200 kHz (on the IBC)
ECS9121	10 Hz (single pole)
Input Noise	2.4 mV p-p
Input Overvoltage Protection	
ECS9120	±32 Volts Continuous
ECS9121	±60 Volts Continuous
Input Surge Rejection	
ECS9121	meets ANSI/IEEE standard C37.90-1978

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Input Electrostatic Discharge Protection ECS9121	meets DOD-STD-1686
Input Offset Error	Auto zero corrects for offset errors due to temperature and aging.
Common Mode Rejection Ratio (60 Hz)	76 dB
Power Supply Rejection Ratio (60 Hz)	84 dB
Channel to Channel Rejection Ratio (60 Hz)	78 dB
Conversion Sequence Time*	20 uS
Throughput Rate*	50,000 Samples/Sec same channel continuous reading, auto zero continuous reading alternating channels continuous reading
DIGITAL SECTION	
VMEbus Loding	No-Load
Expander Bus Loading	1 ua (high or low) max
POWER REQUIREMENTS ECS9120/21	+5V 0.43 Amps

* This applies only to the High Level Expander Card. Total system conversion sequence time would be the IBC Scan Time plus the Expander Conversion Sequence Time.

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