Installation and Operation Manual

MODEL X120

INPUT MULTIPLEXER & CONTROLLER MODULE

MANUAL X120-3000
REVISION 3.6
FEBRUARY 1997

RONAN

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SPECIFICATIONS - MODEL X120 MULTIPLEXER/TERMINATION UNIT

Features

- Monitors up to 48 switching devices
- Reliable high-speed event transmission
- Interfaces with most plant computers and the Ronan Model X110 Serial Input Visual Annunciator
- Internal relay for self-test and power supply status
- Digital filtering to assure accurate monitoring of status changes
- Up to 32 units may be series connected to monitor up to 1,536 total inputs
- Considerable savings in cable costs by the use of serial transmission

General Description

The Ronan Model X120 Multiplexer/Termination Unit is designed to continuously monitor up to 48 field contacts and/or solid state switching devices. Any input status change is converted to serial data which can be transferred to a plant computer or serial input display device, like Ronan's Model X110 visual annunciator. The input signals are monitored using opto-isolated input circuits to provide isolation between input signal voltages and the Model X120 logic circuits. The 48 inputs are sequentially scanned on a continuous basis.

Input status changes are digitally filtered for a 16 millisecond period before being transmitted over the high speed serial line. Self-test and watchdog timer circuits, in addition to power supply monitor circuits, are displayed by means of LED indicators. Loss of a power supply voltage will de-energize the self-test relay.

Up to 32 Model X120 units can be daisy-chained to form a single serial output which monitors the status of up to 1,536 field contacts or solid state switching devices.

Each Model X120 unit receives 5 VDC power to operate its internal logic. An isolated 125 VDC or 24 VDC voltage source can be used to power the field contacts. The isolated power source, along with digital filtering, assures maximum noise immunity for system operation.

Specifications

Input Voltage: *X120 Logic:* 5 VDC, 24 VDC, 48 VDC, 115 VAC, 125 VDC or 230 VAC ± 10%
Isolated Field Contact: 24 or 125 VDC ± 20%

Power Requirements: *Isolated:* 0.5 A @ 24 VDC plus 0.25 A @ 24 or 125 VDC
Non-isolated: 0.75 A @ 24 VDC

Capacity: 48 inputs

Protocol: Ronan Proprietary

Data Transmission:

Type	Distance (Feet)	Rate (Baud)
RS422/485	4000	2400
	4000	4800
	4000	9600
	2000	19200

Universal Data Format: per point status change
 # Symbol: Start of data string
2 Digits: Termination assembly ID
2 Digits: Point ID
1 Character: O=Open, C=Closed, F=False Alarm (ignore message)
ODH Character: End of data string

Ronan Proprietary Data Format: Contact Factory

Output Relay:

- Normally energized, SPST 2 A @ 24 VDC
- Monitors internal logic, all power supplies and optional ground detection

Indicators (LED):

- Power supplies available
- Input test error
- Transmit error
- Run/status indication
- Ground fault condition

Operating Temperature: 0-60°C (32-140°F)

Storage Temperature: -40-85°C (-40-185°F)

Minimum Sustained Data Transfer Rate: 190 events per second (at 19.2 K baud using Ronan proprietary protocol)

Specifications subject to change without notice.

1.0 MULTIPLEXER CONTROLLER MODULE X120-1000

The primary function of the controller board is to gather "event" data from 48 input channels and relay the collected information to the Model X110 via RS422/485. This is done by continuous scanning of each of the eight inputs with U7 (1-OF-8 DECODER/DEMULTIPLEXER). There are 8 outputs from U7 (CS0, CS1, CS2, CS3, CS4, CS5, CS6, CS7) which are used to scan all the channels and to read the status of SW2 and SW3. The function and the logical address of each output is shown in Figure 1.

IDENT.	LOGIC ADDRESS	FUNCTION
CS0	8000H	READING DATA FROM CH. 1-8
CS1	8001H	READING DATA FROM CH. 9-16
CS2	8002H	READING DATA FROM CH. 17-24
CS3	8003H	READING DATA FROM CH. 25-32
CS4	8004H	READING DATA FROM CH. 32-40
CS5	8005H	READING DATA FROM CH. 41-48
CS6	8006H	READING DATA FROM SW2 → 1-8
CS7	8007H	READING DATA FROM SW3 → 1-8

Figure 1

Each time the controller board scans all the input channels, it stores all the data in the internal memory and makes filter calculations (refer to filtering section for more information). After filter processing, all the status changes of inputs are transferred to the transmit buffer and ready to be transmitted. If the old status change of any input has not been transmitted from the transmit buffer before the status of the same input changes, the controller board would not register the new status change of that input channel. Therefore the old status of input channels would not be lost before being transmitted to the X110 system.

2.0 DATA FORMAT AND PROTOCOL

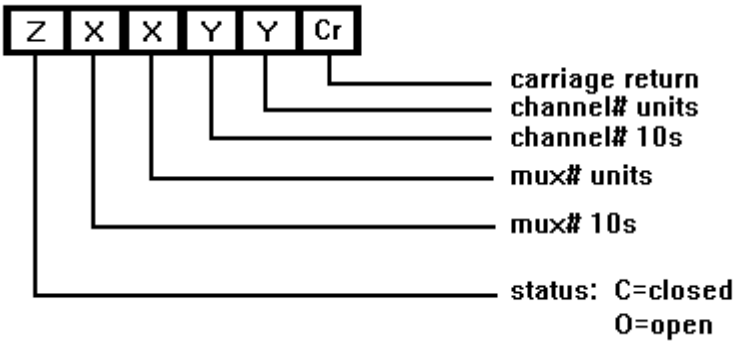
All the data from the X120 is transmitted serially via RS232 (P1) to a terminal/printer and RS422/485 (P2) to X110.

2.1 Data Transmission Format

Baudrate	=	1200 / 9600
Number of data bits	=	7
Number of stop bits	=	1
Parity	=	Even

2.2 Status Format

Six bytes of data would be transmitted each time the status of any input channel changes. The formats of these data bytes are shown below:



2.3 Protocol

The protocol between X120 and X110 is RONAN proprietary and is done to make sure that any status data transmitted from the X120 would be received by the X110 properly. Each time the X120 transmits a status change of an input, it will wait for approximately 250ms to receive an ACK (Ctr F) from the X110 which means that the X110 received the data without any error. If after 250ms the ACK is not received, the same status would be transmitted again up to three times. After the third time, the transmit error LED would be illuminated and the horn relay would be activated before sending the next status change.

Note: When an ACK is received by the X120, the transmit error LED would be turned off (if it was on) and the horn relay would be deactivated.

3.0 SPECIAL FUNCTIONS

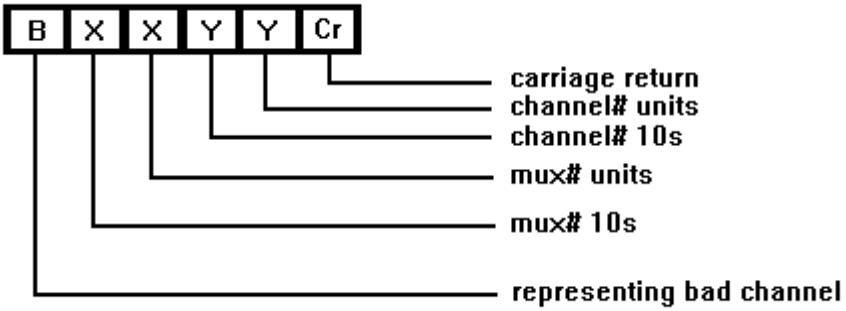
Along with its event collecting/transmitting tasks, the controller board performs a number of secondary tasks that are explained in different sections.

3.1 Filtering

Before reporting the occurrence of an "event", the controller board's program makes "software filter" calculation. Recall, that a change in the status of a contact must be seen for a specified duration of time equal to the "time constant value") before an event is actually declared. The filter calculations are made to determine when the proper duration of time has expired. The "time constant value" is set to 16ms for all the input channels.

3.2 Input Channel Test

The controller board tests all the 48 input channels of the multiplexer for alarm and return to normal conditions (only if SW2-7 is set to the ON position) each time it is reset. The test error LED would be illuminated and the horn relay would be made active if any of the 48 input channels failed to test. This test is done by using two relays K1 and K2. The K1 relay is used to disconnect the field contact power to all the inputs. The K2 relay is used to test all the input channels by connecting and disconnecting the field contact voltage to all the channels and checking all the outputs for proper function. The test error flag would be set on each channel that was bad and they will be reported before the alarm summary (refer to ALARM SUMMARY section for more information) with the following format:

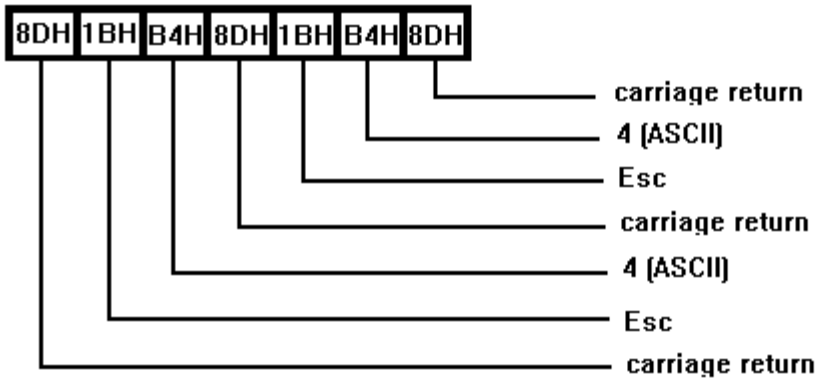


The BAD channel report is very useful for troubleshooting input boards. By connecting a terminal to RS232 (P1) port, all the bad channels (if there is any) would be displayed before the alarm summary each time the X120 is reset.

Note: The input channel test is valid only if all 48 inputs are set for dry contact (B&C jumpers installed).

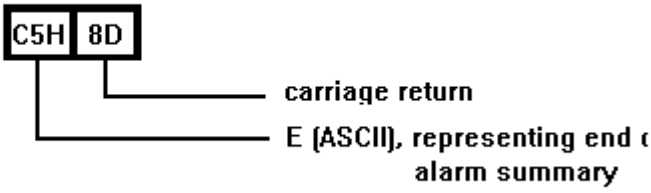
3.3 Alarm Summary

To update all the annunciator windows with the current status of inputs, Alarm Summary of all the input channels (open or closed) would be reported if the X120 is reset. To clear all the annunciator windows before alarm summary, the following data would be sent:



Note: All the data is sent with even parity.

After clearing all the windows, all the bad input channels would be reported (if there is any) only if SW2-7 was set to the ON position. The alarm summary would be reported next, followed by this data:



4.0 CONFIGURATIONS

The X120 multiplexers can be connected to the X110 system in two different ways (parallel & serial) and J2, J3, J4, J5 burg jumpers have to be set differently for each X120 in different configurations.

4.1 Parallel Configuration

Only one X120 is connected to the X110(s) in this configuration and J2, J3, J4 and J5 burg jumpers are used (installed).

4.2 Serial Configuration

Two to thirty-two X120s can be connected together serially in this configuration. Only J2 & J3 on the first X120 and J4 & J5 on the last X120 are installed. J2, J3, J4 and J5 should not be installed on any X120 between first and last.

Figure 2 shows how the X120s are connected serially.

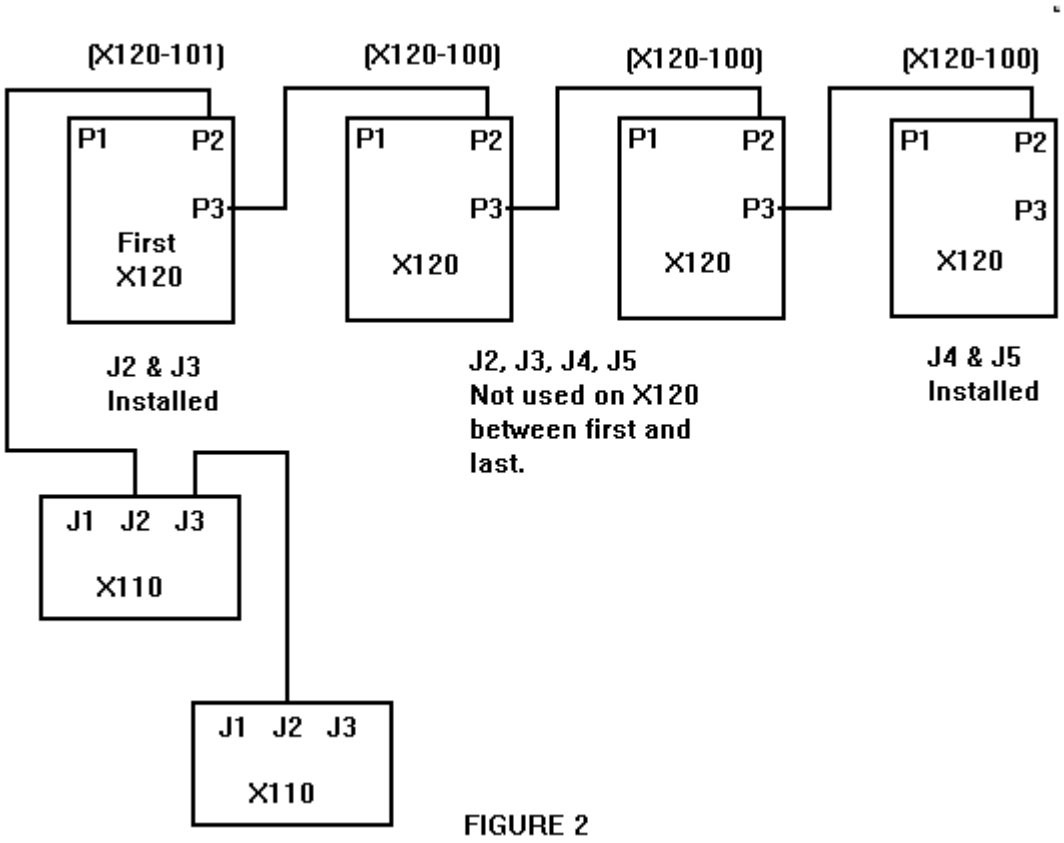


FIGURE 2

5.0 LED INDICATIONS

There are three LEDs on the controller board that indicate the status of the X120s and communication between X120s and X110s. The operations of these LEDs are explained in the following sections.

5.1 Test Error LED (Red)

Refer to section 3.2.

5.2 Transmit Error LED (Red)

Refer to section 2.3.

5.3 Status/Run LED (Green)

The run/status LED indicates the connection between all the X120 multiplexers. All the run/status LEDs should be flashing synchronously if connections between all the X120s are okay. The flashing rate depends on the number of X120 multiplexers connected together and decreases by connecting more X120(s) in the chain.

Note 1: If any of the X120 multiplexers is transmitting events, the run/status LEDs stop flashing during the transmission time and stay on or off depending on its state which transmission started.

Note 2: Make sure that all the burg jumpers (J2, J3, J4, J5) are installed properly.

6.0 JUMPER SETTINGS

6.1 J2, J3, J4, J5

Refer to section 4.0.

6.2 J6 Jumper

The DS1232 (U9) provides a watchdog timer function by forcing RST and $\overline{RST}$ signals to the active state when the ST input is not simulated for a predetermined time. The time period is set by the TD input to be 150 ms with TD connected to ground (J6-2&3 installed), 600 ms with TD left unconnected (J6 not installed), and 1.2 seconds with TD connected to Vcc (J6-1&2 installed).

The factory setting is (J6-1&2 installed)

6.3 J7 Jumper

This jumper is for setting the horn relay contact to normally open or normally closed. The horn relay is normally energized. To set the horn relay output contact, install (J7-1&2) for normally open and (J7-2&3) for normally closed.

The factory setting is normally open (J7-1&2 installed)

6.4 J8, J9 Jumpers

These jumpers are to enable/disable the data transmission to test port (P1). P1 port is used for testing the X120 boards and can be connected to any terminal with the RS232 port to display the ASCII data transmitted by the X120 to the X110.

Install J8 & J9 to enable and remove J8 & J9 to disable the data transmission from the X120 to RS232 test port P1.

The factory setting (J8&J9 installed)

Note: The J8 & J9 are installed only on the master controller board to test the system.

6.5 J10, J11 Jumpers

These jumpers are to enable/disable the data reception from RS232 test port (P1) and they are used only for testing the system.

The factory setting is (J10&J11 installed)

Note: If you install J10 & J11 for testing the system, disconnect the cable between the X120 and X110.

6.6 J12, J13 Jumpers

Installing a burg jumper on J12 will place in service a 112 ohm line-to-line terminator across the receiver line (RXD, RXD RTN). If the system is subject to extremely noisy environments, it would be better to terminate only the receiver side of the communication line by line-to-ground termination on each side of the receiver line (RXC, RXD RTN). Installing burg jumpers on both J12 and J13 will terminate each side of the receiver line through 56 ohm to ground.

6.7 J14, J15 Jumpers

Installing a burg jumper on J14 will place in service a 112 ohm line-to-line terminator across the receiver line (TXC, TXC RTN). Installing burg jumpers on both J14 and J15 will terminate each side of the transmitter line through 56 ohm to ground.

7.0 SWITCH SETTINGS

Position 1 to 5 of SW2 are for setting the MUX numbers and they are set as follows:

MUX NUMBER	SW2-5	SW2-4	SW2-3	SW2-2	SW2-1
MUX 01	OFF	OFF	OFF	OFF	OFF
MUX 02	OFF	OFF	OFF	OFF	ON
MUX 03	OFF	OFF	OFF	ON	OFF
MUX 04	OFF	OFF	OFF	ON	ON
MUX 05	OFF	OFF	ON	OFF	OFF
MUX 06	OFF	OFF	ON	OFF	ON
MUX 07	OFF	OFF	ON	ON	OFF
MUX 08	OFF	OFF	ON	ON	ON
MUX 09	OFF	ON	OFF	OFF	OFF
MUX 10	OFF	ON	OFF	OFF	ON
MUX 11	OFF	ON	OFF	ON	OFF
MUX 12	OFF	ON	OFF	ON	ON
MUX 13	OFF	ON	ON	OFF	OFF
MUX 14	OFF	ON	ON	OFF	ON
MUX 15	OFF	ON	ON	ON	OFF
MUX 16	OFF	ON	ON	ON	ON
MUX 17	ON	OFF	OFF	OFF	OFF
MUX 18	ON	OFF	OFF	OFF	ON
MUX 19	ON	OFF	OFF	ON	OFF
MUX 20	ON	OFF	OFF	ON	ON
MUX 21	ON	OFF	ON	OFF	OFF
MUX 22	ON	OFF	ON	OFF	ON
MUX 23	ON	OFF	ON	ON	OFF
MUX 24	ON	OFF	ON	ON	ON
MUX 25	ON	ON	OFF	OFF	OFF
MUX 26	ON	ON	OFF	OFF	ON
MUX 27	ON	ON	OFF	ON	OFF
MUX 28	ON	ON	OFF	ON	ON
MUX 29	ON	ON	ON	OFF	OFF
MUX 30	ON	ON	ON	OFF	ON
MUX 31	ON	ON	ON	ON	OFF
MUX 32	ON	ON	ON	ON	ON

7.1 SW2-6

SW2-6 = ON 9600 Baudrate
SW2-6 = OFF 1200 Baudrate

7.2 SW2-7

Position 7 of SW2 is to enable (SW2-7 ON) or disable (SW2-7 OFF) the input channels tests. Refer to section 3.2 for more information.

7.3 SW2-8

Position 8 of SW2 is for setting the multiplexer as the master or slave. If there are more than one multiplexers connected together, set only one of them as the master (SW2-8 ON) and the others as the slave (SW2-8 OFF).

7.4 SW3-1 to SW3-8

These switches are for spares.

8.0 INPUT LOGIC MODULES

There are 48 filed contact inputs on each input module and each of them is connected to a full wave bridge rectifier circuit. Two input resistors (R2 & R3) have been added to each circuit for limiting the current and the outputs. Bridge rectifiers are connected to the opto-isolators which provide both noise immunity and voltage protection for the internal circuitry. The oto-isolators are then connected to analog delay circuits, which reduce the effects of line voltage transients. Every 8 outputs from the delay circuits are then connected to an associated line of the octal buffer which can be read by the controller board.

Each field contact input can be set for dry or live voltage input. Install a burg jumper on position (A) to set the field contact input to live voltage or install two burg jumpers on positions B & C to set it to dry contact input. Refer to sheet two of the X120D21 drawing to see how it works.

There are two types of input logic modules, X120-1001 which is equipped with standard input terminals and the X120-1005 which is equipped with quick-disconnect input terminals. All the other terminals and input circuitry are the same on both the X120-1001 and X120-1005.

9.0 REFERENCED DRAWINGS

X120-1001	Field Assembly
X120-1000	Multiplexer X120
X120D21	X120-DT Multiplexer Outline & Wiring Information
X120D37	X120-ST Field Multiplexer Assembly
X120C15	X120 to X120 Daisy Chain Cable Assembly
X120C16	X110 to X120 Cable Assembly
X120C36	X120 Extension Cable

These drawings can be found at the end of this manual.

10.0 PARTS LISTS

X120-1000 Controller Module

Item	Qty	Part Number	Description	I.D.
1	1	X120-1000C	PCB	
2	2	4310R-101-103	RESISTOR, NETWORK SIP COM 10K	RP1,2
3	1	ICL232CPE	IC, RECEIVER\TRANS\RS232	U1
4	1	DILB40P-11	IC, SOCKET\40	U6
5	1	DILB28P-11	IC, SOCKET\28	U11
6	1	80C31	IC, MICROPROCESSOR, CMOS\4KX8	U6
7	1	27C256-2	IC, ROM\PROGRAMMABLE\256K NOTE: THIS PART IS PROGRAMMED BY RONAN TO: MPBR002 U11 FOR SINGLE AND X120 010892 MULTIPLE MUX'S	U11
8	1	74HC373	IC, CMOS\LATCH\8\DATA	U12
9	1	7437	IC, DRVR\NAND\QUAD\48MA	U4
10	1	DS1232	IC, MONITOR\POWER\WATCHDOG TIMER	U9
11	2	74HC240N	IC, CMOS\INVERTER\TRI-STATE\8	U13,14
12	1	74HC138	IC, CMOS\DECODER\3-8\LINE	U7
13	1	SN75174	IC, DRIVER\LINE	U3
14	1	SN75175	IC, RECEIVER\LINE	U2
15	1	UDN2595A	DRIVER, 8 CHANNEL CURRENT SINK	U8
16	1	11.059MHZHC-49	XTAL, 11.059M	CY1
17	7	104A101C20	CAPACITOR, AXIAL/CER/.1M/100	C8-10,13,16-18
18	1	EP11D1CBE	SWITCH, PB\PCB\SPST	SW1
19	2	1N4148	DIODE, SIG\75V\400M	CR1,2
20	3	T83S11D112-5VDC	RELAY, GP\PCB\5DC\DPDT	K1-3
21	1	1N270	DIODE, SIGNAL NOTE: INSTALL CR3 BACKWARDS	CR3
22	3	RC07GF103J	RESISTOR, CF\10K\.25\5	R1-3
23	3	RC07GF511J	RESISTOR, CF\510\.25\5	R4-6
24	1	292-0003	CONNECTOR, PCB\EDGE\6 NOTE: INSTALL ON BACK OF THE PCB	J1
25	28	CA36SP100230430	PLUG, STRIP\LINE\36 PINS NOTE: STRIP 2 OF EACH	J2-5,8-15
26	2	CA36SP100230430	PLUG, STRIP\LINE\36 PINS	J6,7
27	2	330R501M05	CAPACITOR, RADIAL\MIC\33P\500	C11,12
28	4	226A100T10	CAPACITOR, AXIAL\TAN\22M\10	C1-4
29	1	745068-7	CONNECTOR, 25 PIN D-TYPE FEMALE	P1
30	1	745062-5	CONNECTOR, 15 PIN D-TYPE MALE	P3
31	1	745067-5	CONNECTOR, 15 PIN D-TYPE FEMALE	P2
32	2	435626-5	SWITCH, DIP\PCB\85W	SW2,3
33	2	HLMP-3300	LED, RED\HI\.198 NOTE: LEADS SHOULD BE 4"	D1,2
34	1	HLMP-3502	LED, GREEN\HI\.198 NOTE: LEADS SHOULD BE 4"	D3
35	1	4308R-102-560	RESISTOR, NETWORK SIP IND 56K	RP3
36	1	4308R-102-121	RESISTOR, NETWORK SIP IND	RP4
37	6	4-40 X 5/16 PPH	SCREW, PHIL\PAN\HD	P1-3

X120-1001-230 Input Logic Module

Item	Qty	Part Number	Description	I.D.
1	1	X120-1001C	PCB	
2	288	1N4005	DIODE, REC\600\1	CR1-6
3	48	6N139	IC, ISOLATOR\OPTICAL	U1-48
4	48	RC07GF105J	RESISTOR, CF\1M\.25\5	R1
5	96	RC20GF153J	RESISTOR, CF\15K\.5\5	R2,3
6	54	104A101C20	CAPACITOR, AXIAL\CER\.1M\100	C1-54
7	6	4310R-101-103	RESISTOR, NETWORK SIP COM 10K	RP1,4,5,8,9,12
8	6	898-3-R100K	RESISTOR, NETWORK\DIP\IND\100K	RP2,3,6,7,10,11
9	6	74HC240N	IC, CMOS\INVERTER\TRI-STATE\8	U49-54
10	2	T83S11D112-5VDC	RELAY, GP\PCB\5DC\DPDT	K1,2
11	2	1N4148	DIODE, SIG\74V\400M	CR7,8
12	192	CA36SP100230430	PLUG, STRIP\LINE\36 PINS NOTE: STRIP OF 2	B,C
13	1	291-0003	CONNECTOR, PCB\EDGE\18	J1
14	4	1731035	TERMINAL BLOCK, PCB 3 POINT	TB1-4
15	192	531220-2	SHUNT 2 PIN	B,C
16	1	1731022	TERMINAL BLOCK, PCB, 2 POINT	TB5
17	48	DILB08P-11T	SOCKET, IC	U1-48
18	1	V275LA20A	VARISTOR, 369\OPR\VOLT	V1
19	4	7002922	CONNECTOR	TBA,TBB, TBC,TBD
20	4	7002922	CONNECTOR	TBA, TBB, TBC, TBD
21	2	03JUMPERS	JUMPER, .3\.125\22AWG\PVC	J1,2

X120-1001-125 Input Logic Module

Item	Qty	Part Number	Description	I.D.
1			NOTE: IDENTIFY BOARD PER X120-1001-125VDC/115VAC	
2	1	X120-1001C	PCB	
3	288	1N4005	DIODE, REC\600\1	CR1-6
4	48	6N139	IC, ISOLATOR\OPTICAL	U1-48
5	48	RC07GF105J	RESISTOR, CF\1M\.25\5	R1
6	96	RC20GF623J	RESISTOR, CF\62K\.5\5	R2,3
7	54	104A101C20	CAPACITOR, AXIAL\CER\.1M\100	C1-54
8	6	4310R-101-103	RESISTOR, NETWORK SIP COM 10K	RP1,4,5,8,9,12
9	6	898-3-R100K	RESISTOR, NETWORK\DIP\IND\100K	RP2,3,6,7,10,11
10	6	74HC240N	IC, CMOS\INVERTER\TRI-STATE\8	U49-54
11	2	T83S11D112-5VDC	RELAY, GP\PCB\5DC\DPDT	K1,2
12	2	1N4148	DIODE, SIG\74V\400M	CR7,8
13	192	CA36SP100230430	PLUG, STRIP\LINE\36 PINS NOTE: STRIP OF 2	B,C
14	1	291-0003	CONNECTOR, PCB\EDGE\18	J1
15	4	1731035	TERMINAL BLOCK, PCB 3 POINT	TB1-4
16	192	531220-2	SHUNT 2 PIN	B,C
17	1	1731022	TERMINAL BLOCK, PCB, 2 POINT	TB5
18	48	DILB08P-11T	SOCKET, IC	U1-48
19	1	V275LA20A	VARISTOR, 369\OPR\VOLT	V1
20	4	7002922	CONNECTOR	TBA,TBB, TBC,TBD
20	4	7002922	CONNECTOR	TBA, TBB, TBC, TBD
21	2	03JUMPERS	JUMPER, .3\.125\22AWG\PVC	J1,2

X120-1001-48 Input Logic Module

Item	Qty	Part Number	Description	I.D.
1	1	X120-1001C	PCB	
2	288	1N4005	DIODE, REC\600\1	CR1-6
3	48	6N139	IC, ISOLATOR\OPTICAL	U1-48
4	48	RC07GF105J	RESISTOR, CF\1M\.25\5	R1
5	96	RC20GF223J	RESISTOR, CF\22K\.5\5	R2,3
6	54	104A101C20	CAPACITOR, AXIAL\CER\.1M\100	C1-54
7	6	4310R-101-103	RESISTOR, NETWORK SIP COM 10K	RP1,4,5,8,9,12
8	6	898-3-R100K	RESISTOR, NETWORK\DIP\IND\100K	RP2,3,6,7,10,11
9	6	74HC240N	IC, CMOS\INVERTER\TRI-STATE\8	U49-54
10	2	T83S11D112-5VDC	RELAY, GP\PCB\5DC\DPDT	K1,2
11	2	1N4148	DIODE, SIG\74V\400M	CR7,8
12	192	CA36SP100230430	PLUG, STRIP\LINE\36 PINS NOTE: STRIP OF 2	B,C
13	1	291-0003	CONNECTOR, PCB\EDGE\18	J1
14	4	1731035	TERMINAL BLOCK, PCB 3 POINT	TB1-4
15	192	531220-2	SHUNT 2 PIN	B,C
16	1	1731022	TERMINAL BLOCK, PCB, 2 POINT	TB5
17	48	DILB08P-11T	SOCKET, IC	U1-48
18	1	V275LA20A	VARISTOR, 369\OPR\VOLT	V1
19	4	7002922	CONNECTOR	TBA,TBB, TBC,TBD
20	4	7002922	CONNECTOR	TBA, TBB, TBC, TBD
20	2	03JUMPERS	JUMPER, .3\.125\22AWG\PVC	J1,2

X120-1001-24 Input Logic Module

Item	Qty	Part Number	Description	I.D.
1	1	X120-1001C	PCB	
2	288	1N4005	DIODE, REC\600\1	CR1-6
3	48	6N139	IC, ISOLATOR\OPTICAL	U1-48
4	48	RC07GF105J	RESISTOR, CF\1M\.25\5	R1
5	96	RC20GF623J	RESISTOR, CF\62K\.5\5	R2,3
6	54	104A101C20	CAPACITOR, AXIAL\CER\.1M\100	C1-54
7	6	4310R-101-103	RESISTOR, NETWORK SIP COM 10K	RP1,4,5,8,9,12
8	6	898-3-R100K	RESISTOR, NETWORK\DIP\IND\100K	RP2,3,6,7,10,11
9	6	74HC240N	IC, CMOS\INVERTER\TRI-STATE\8	U49-54
10	2	T83S11D112-5VDC	RELAY, GP\PCB\5DC\DPDT	K1,2
11	2	1N4148	DIODE, SIG\74V\400M	CR7,8
12	192	CA36SP100230430	PLUG, STRIP\LINE\36 PINS NOTE: STRIP OF 2	B,C
13	1	291-0003	CONNECTOR, PCB\EDGE\18	J1
14	4	1731035	TERMINAL BLOCK, PCB 3 POINT	TB1-4
15	192	531220-2	SHUNT 2 PIN	B,C
16	1	1731022	TERMINAL BLOCK, PCB, 2 POINT	TB5
17	48	DILB08P-11T	SOCKET, IC	U1-48
18	1	V275LA20A	VARISTOR, 369\OPR\VOLT	V1
19	4	7002922	CONNECTOR	TBA,TBB, TBC,TBD
20	4	7002922	CONNECTOR	TBA, TBB, TBC, TBD
21	2	03JUMPERS	JUMPER, .3\.125\22AWG\PVC	J1,2

X120-GD-24 Ground Detector Module

Item	Qty	Part Number	Description	I.D.
1	1	X120-1003A	PCB	KEY 3-4
2	1	LM393N	IC, COMP, LP, LO, DUAL	U1
3	1	68WR1MEG	POTENTIOMETER, CERAMIC 1M/20	R15
4	3	RC07GF103J	RESISTOR, CF, 10K, .25, 5	R16,17,21
5	5	RC07GF105J	RESISTOR, CF, 1M, .25, 5	R6,11,13,14,20
6	2	RC07GF115J	RESISTOR, CF, 1.1M, .25, 5	R9,12
7	2	RC07GF156J	RESISTOR, CF, 15M, .25, 5	R7,8
8	1	RC20GF472J	RESISTOR, CF, 4.7K, .5, 5	R3
9	2	RC20GF512J	RESISTOR, CF, 5.1K, .5, 5	R1,2
10	2	RC20GF513J	RESISTOR, CF, 51K, .5, 5	R4,5
11	2	103A101C10	CAPACITOR, AXIAL, CERAMIC, 0.1M	C1,2
12	3	1N4148	DIODE, SIGNAL, 75V, 400M	CR1,2,R12
13	1	1N4005	DIODE, REC, 600, 1	CR4
14	2	RC07GF1RJ	RESISTOR, CF, 1, .25, 5	CR5,R10
15	1	HLMP3001	LED, RED, STANDARD, .19	POWER
16	2	HLMP1300	LED, RED, STANDARD	LED1,2
17	1	2N4249	TRANSISTOR, PNP, 60, 92	Q1
18	1	2N3568		Q2
19	1	T82S11D11424VDC	RELAY, GP, PCB, 24DC, DPDT	K1
20	1	CP-66	CARD EJECTOR	PCB
21	2	22 AWG	WIRE, 22 GA BUSS	R18,19

X120-GD-125 Ground Detector Module

Item	Qty	Part Number	Description	I.D.
1	1	X120-1003A	PCB	KEY 3-4
2	1	LM393N	IC, COMP, LP, LO, DUAL	U1
3	1	RC07GF472J	RESISTOR, CF, 4.7K, .25, 5 NOTE: STAND A 4.7K OHM RESISTOR ON END & CONNECT FROMSILKSCREEN SIDE R13 TO SILKSCREEN SIDE R14.	
4	3	RC07GF273J	RESISTOR, CF, 27K, .25, 5 NOTE: ON SOLDER SIDE OF PCB, CONNECT A 27KOHM RESISTOR AT THE FOLLOWING LOCATIONS: A) SILKSCREEN SIDE R18 TO SILKSCREEN SIDE R14 B) SILKSCREEN SIDE R19 TO SILKSCREEN SIDE R13	
5	4	RC07GF103J	RESISTOR, CF, 10K, .25, 5 NOTE: ON COMPONENT SIDE OF PCB, CONNECT A 10KOHM RESISTOR FROM SILKSCREEN SIDE R11 TO OPPOSITE SILKSCREEN SIDE R13.	R16,17,21
6	1	RC07GF563J	RESISTOR, CF, 56K, .25, 5	R20
7	1	RC07GF105J	RESISTOR, CF, 1M, .25, 5 NOTE: ON COMPONENT SIDE ADD A 1 MEGA-OHM RESISTOR FROM SILKSCREEN SIDE R8 TO OPPOSITE SILKSCREEN SIDE C2.	
8	1	RC07GF106J	RESISTOR, CF, 10M, .25, 5	R7
9	1	RC20GF472J	RESISTOR, CF, 4.7K, .5, 5	R3
10	2	RC20GF512J	RESISTOR, CF, 5.1K, .5, 5	R1,2
11	2	RC20GF393J	RESISTOR, CF, 39K, .5, 5 NOTE: ON COMPONENT SIDE OF PCB, ADD A 39KOHM RESISTOR AT THE FOLLOWING LOCATIONS: A) SILKSCREEN SIDE R4 TO SILKSCREEN SIDE R18 B) SILKSCREEN SIDE R5 TO SILKSCREEN SIDE R19	

12	2	1.5KOHM5W	RESISTOR, POWER WW NOTE: CONNECT RESISTORS AT R18,19 SO THAT TOP OF RESISTORS ARE LEVEL WITH TOP OF RELAY AT K1	R18,19
13	2	103A101C10	CAPACITOR, AXIAL, CERAMIC, .01M	C1,2
14	2	1N4148	DIODE, SIGNAL, 75V, 400M	CR1,2
15	1	1N4005	DIODE, REC, 600, 1	CR4
16	1	1N5359B	DIODE, ZENER, 5, 24, 50M	CR3
17	2	RC07GF1RJ	RESISTOR, CF, 1, .25, 5 NOTE: ON COMPONENT SIDE OF PCB, ADD A ONE OHM RESISTOR FROM SILKSCREEN SIDE R12 TO OPPOSITE SILKSCREEN SIDE OF R14.	CR5
18	1	HLMP-3001	LED, RED, STANDARD, .19	POWER
19	2	HLMP-1300	LED, RED, STANDARD	LED1,2
20	1	2N4249	TRANSISTOR, PNP, 60, 92	Q1
21	1	2N3568-5	TRANSISTOR, NPN, 60 , 92	Q2
22	1	T82S11D11424VDC	RELAY, GP, PCB, 24DC, DPDT	K1
23	1	CP66	CARD EJECTOR	PCB
24	1	1N270	DIODE, SIGNAL NOTE: ON COMPONENT SIDE ADD A 1N270 DIODE FROM PIN 4 U1 (ANODE) TO OPPOSITE SILKSCREEN R8 (CATHODE)	
25	1	106A350E28	CAPACITOR, AXIAL, ELE, 10M, 35 NOTE: CONNECT CAPACITOR FROM R1,2 SOLDER PAD (POSITIVE) TO POSITION OPPOSITE OF SILKSCREEN R3 (NEGATIVE). COVER EXPOSED LEADS WITH 22 AWG TEFLON TUBING. FOR ALL COMPONENT ADDITIONS, COVER EXPOSED LEADS WITH 22 AWG TEFLON TUBING.	C3

X120-FCPS2424 Power Supply

Item	Qty	Part Number	Description	I.D.
1	1	X120-1002B	PCB	
2	1	CP66	CARD EJECTOR	
3	1	7101P4D9AQE	SWITCH, TOGGLE, PCB, SPDT	S1
4	1	312.500	FUSE	F1
5	2	3529	FUSE HOLDER	
6	3	NOT USED	COMPONENTS NOT USED	C6,J1,R6
7	2	RC07GF100J	RESISTOR, CF, 10, .25, 5	R4,5
8	1	RC07GF152J	RESISTOR, CF, 1.5K, .25, 5	R1
9	1	RC20GF180J	RESISTOR, CF, 18, .5, 5	R2
10	1	02JUMPER	JUMPER	R7
11	1	RN55C5112F	RESISTOR, MF, 51.1K, .125, 1	R3
12	1	101R501M05	CAPACITOR, RAD, MIC, 100P, 500	C3
13	1	104A101C20	CAPACITOR, AXIAL, CER, .1M, 100	C2
14	3	503R501C20	CAPACITOR, RADIAL, CER, .05M, 500	C1,5,7
15	1	156A400E28	CAPACITOR, AXIAL, ELE, 15M, 40	C4
16	2	1N457A	DIODE, SIG, 60, 150M	D2,3
17	2	1N4937	DIODE, REC, 600, 1	D4,5
18	2	1N4005	DIODE, REC, 600, 1	D7,8
19	1	1N963B	DIODE, ZENER, .4, 12, 10M	D1
20	2	VN0109N2	FET, N, MOS, 90 TO 39	Q1,2
21	2	2260R	HEATSINK	ON Q1,2
22	1	CD4047BE	IC, BUF, MULTIVIB, LOW, PWR	U1
23	1	CD4041UBE	IC, BUF, TRUE, COMP, GT, QUAD	U2
24	1	HLMP-3300	LED, RED, HI, .198	LED1

25	1	T82P11D11424VDC	RELAY, GP,PCB,24DC,DPDT	K1
26	1	X120B25-6	TRANSFORMER, DC/DC	T1
27	2	05JUMPERS	JUMPER, .5,.125,22AWG,PVC	J2,3

X120-FCPS12524 Power Supply

Item	Qty	Part Number	Description	I.D.
1	1	X120-1002B	PCB	
2	1	CP66	CARD EJECTOR	
3	1	7101P4D9AQE	SWITCH, TOGGLE, PCB, SPDT	S1
4	1	312.150	FUSE, .15A	F1
5	2	3529	FUSE HOLDER	
6	3	NOT USED	COMPONENTS NOT USED	C6,J1,R6
7	2	RC07GF100J	RESISTOR, CF, 10, .25, 5	R4,5
8	1	UT-2A 50 OHM 5%	RESISTOR, PWR/WW/2.5	R2
9	1		NOTE: USE BUSS WIRE FOR R7.	
10	1	RC42GF273J	RESISTOR, CF,27K,2,5	R1
11	1	RN55C5112F	RESISTOR, MF, 51.1K, .125, 1	R3
12	1	101R501M05	CAPACITOR, RAD, MIC, 100P, 500	C3
13	1	104A101C20	CAPACITOR, AXIAL, CER, .1M, 100	C2
14	3	503R501C20	CAPACITOR, RADIAL, CER, .05M, 500	C1,5,7
15	1	156A400E28	CAPACITOR, AXIAL, ELE, 15M, 40	C4
16	2	1N457A	DIODE, SIG, 60, 150M	D2,3
17	2	1N4937	DIODE, REC, 600, 1	D4,5
18	2	1N4005	DIODE, REC, 600, 1	D7,8
19	1	1N963B	DIODE, ZENER, .4, 12, 10M	D1
20	2	VN0350N2	TRANSISTOR	Q1,2
21	2	2260R	HEATSINK	ON Q1,2
22	1	CD4047BE	IC, BUF, MULTIVIB, LOW, PWR	U1
23	1	CD4041UBE	IC, BUF, TRUE, COMP, GT, QUAD	U2
24	1	HLMP-3300	LED, RED, HI, .198	LED1
25	1	T82N11D114-24V	RELAY	K1
26	1	X120B25-3	TRANSFORMER, DC/DC	T1
27	2	05JUMPERS	JUMPER, .5,.125,22AWG,PVC	J2,3

X120-FCPS125125 Power Supply

Item	Qty	Part Number	Description	I.D.
1	1	X120-1002B	PCB	
2	1	CP66	CARD EJECTOR	
3	1	7101P4D9AQE	SWITCH, TOGGLE, PCB, SPDT	S1
4	1	312.150	FUSE .15A	F1
5	2	3529	FUSE HOLDER	
6	6	NOT USED	COMPONENTS NOT USED	C6, D6, D9, J1, R6, VR1
7	2	RC07GF100J	RESISTOR, CF, 10, .25, 5	R4,5
8	1	UT-2A 50 OHM 5%	RESISTOR, PWR,WW,2.5	R2
9	1	UT-2A 7KOHM 5%	RESISTOR, PWR,WW,2.5	R7
10	1	RC42GF273J	RESISTOR, CF,27K,2,5	R1
11	1	RN55C5112F	RESISTOR, MF, 51.1K, .125, 1	R3
12	1	101R501M05	CAPACITOR, RAD, MIC, 100P, 500	C3
13	1	104A101C20	CAPACITOR, AXIAL, CER, .1M, 100	C2
14	3	503R501C20	CAPACITOR, RADIAL, CER, .05M, 500	C1,5,7
15	1	475A251E28	CAPACITOR, AXIAL, ELE, 4.7M,250	C4
16	2	1N457A	DIODE, SIG, 60, 150M	D2,3

17	2	1N4937	DIODE, REC, 600, 1	D4,5
18	2	1N4005	DIODE, REC, 600, 1	D7,8
19	1	1N963B	DIODE, ZENER, .4, 12, 10M	D1
20	2	VN0350N2	TRANSISTOR	Q1,2
21	2	0771786N	PAD, TRANSISTOR	Q1,2
22	2	2260R	HEATSINK	USE ON Q1,2
23	1	CD4047BE	IC, BUF/MULTIVIB/LOW/PWR	U1
24	1	CD4041UBE	IC, BUF/COMP/GT/QUAD	U2
25	1	HLMP-3300	LED, RED/HI/.198	LED1
26	1	T82N11D114-48	RELAY	K1
27	1	X120B25-2	TRANSFORMER, DC/DC	T1
28	2	05JUMPERS	JUMPER, .5/.125/22AWG/PVC	J2,3

X120-FCPS24125 Power Supply

Item	Qty	Part Number	Description	I.D.
1	1	X120-1002B	PCB	
2	1	CP66	CARD EJECTOR	
3	1	7101P4D9AQE	SWITCH, TOGGLE, PCB, SPDT	S1
4	1	312.001	FUSE 1A	F1
5	2	3529	FUSE HOLDER	
6	3	NOT USED	COMPONENTS NOT USED	C6,J1,R6
7	2	RC07GF100J	RESISTOR, CF, 10, .25, 5	R4,5
8	1	RC07GF152J	RESISTOR, 1/4W, 5%, 1.5K	R1
9	1		JUMPER	R2
10	1	UT2A-7K	RESISTOR, 2W, 5%, 7K	R7
11	1	RN55C5112F	RESISTOR, MF, 51.1K, .125, 1	R3
12	1	101R501M05	CAPACITOR, RAD, MIC, 100P, 500	C3
13	1	104A101C20	CAPACITOR, AXIAL, CER, .1M, 100	C2
14	3	503R501C20	CAPACITOR, RADIAL, CER, .05M, 500	C1,5,7
15	1	475A251E28	CAPACITOR, AXIAL, ELE, 4.7M,250	C4
16	2	1N457A	DIODE, SIG, 60, 150M	D2,3
17	2	1N4937	DIODE, REC, 600, 1	D4,5
18	2	1N4005	DIODE, REC, 600, 1	D7,8
19	1	1N963B	DIODE, ZENER, .4, 12, 10M	D1
20	2	RFL4N12	V-MOS FET	Q1,2
21	2	2260R	HEATSINK	USE ON Q1,2
22	1	CD4047BE	IC, BUF/MULTIVIB/LOW/PWR	U1
23	1	CD4041UBE	IC, BUF/COMP/GT/QUAD	U2
24	1	HLMP-3300	LED, RED/HI/.198	LED1
25	1	T85N11D114-48 or G5V-2-DC48	RELAY	K1
26	1	X120B25-5	TRANSFORMER, DC/DC	T1
27	2	05JUMPERS	JUMPER, .5/.125/22AWG/PVC	J2,3

X120-LPS-24 Power Supply

Item	Qty	Part Number	Description	I.D.
1	1	X120-1002B	PCB	
2	1	CP66	CARD EJECTOR	
3	1	7101P4D9AQE	SWITCH, TOGGLE, PCB, SPDT	S1
4	1	312.500	FUSE	F1
5	2	3529	FUSE HOLDER	
6	1	RC07GF471J	RESISTOR, CF,470,.25,5	R6

7	2	RC07GF102J	RESISTOR, CF,1K,.25,5	R4,5
8	1	RC07GF152J	RESISTOR, 1/4W, 5%, 1.5K	R1
9	1	7200-25	INDUCTOR	R2
10	1	RC42GF820J	RESISTOR, CF,82,2,5	R7
11	1	RN55C5112F	RESISTOR, MF, 51.1K, .125, 1	R3
12	1	101R501M05	CAPACITOR, RAD, MIC, 100P, 500	C3
13	2	105R500C20	CAPACITOR, RAD,CERAMIC,1M	C1,5
14	1	104A101C20	CAPACITOR, AXIAL,CERAMIC,.1M,100	C2
15	1	503R501C20	CAPACITOR, RAD,CER,0.5M,500	C7
16	1	685R350T10	CAPACITOR, RAD,TAN,6.8M,35	C6
17	1	157A250E28	CAPACITOR, AXIAL,ELE,150M,25	C4
18	2	1N457A	DIODE, SIG,60,150M	D2,3
19	2	1N4937	DIODE, REC,600,1	D4,5
20	2	1N4005	DIODE, REC,600,1	D6,7
21	1	1N963B	DIODE, ZENER,.4,12,10M	D1
22	1	MBR160	DIODE, SCHOTTKY	D9
23	2	RFL4N12	TRANSISTOR	Q1,2
24	2	2260R	HEATSINK	ON Q1,2
25	1	CD4047B	IC, BUF,MULTIVIB,LOW,PWR	U1
26	1	CD4041UBE	IC, BUF,TRUE,COMP,GT,QUAD	U2
27	1	LM7805CT	VOLTAGE REGULATOR 5V TO –220	REG1
28	1	HLMP-3300	LED, RED,HI,.198	LED1
29	1	RY-6WZ-K or T82S11D114-05 or G5V-2-DC6	RELAY	K1
30	1	X120B25-4	TRANSFORMER, DC/DC	T1
31	2	05JUMPERS	JUMPER, .5,.125,22AWG,PVC	J1,3
32	1	6072B	HEATSINK	
33	1	0440X0086PHPHMS	SCREW, 4-40X1/4 PHIL,PAN,MS	FOR REG1
34	1	4-40 SM PATTERN	NUT, SMALL PATTERN	FOR REG1
35	1	4-INT-L/W	WASHER, INTERNAL LOCK	FOR REG1

X120-LPS-48 Power Supply

Item	Qty	Part Number	Description	I.D.
1	1	X120-1002B	PCB	
2	1	CP66	CARD EJECTOR	
3	1	7101P4D9AQE	SWITCH, TOGGLE, PCB, SPDT	S1
4	1	312.500	FUSE	F1
5	2	3529	FUSE HOLDER	
6	1	RC07GF471J	RESISTOR, CF,470,.25,5	R6
7	2	RC07GF100J	RESISTOR, CF,10,.25,5	R4,5
8	1	UT-2A 20 OHM 5%	RESISTOR, PWR,WW,2.5	R2
9	1	RC42GF820J	RESISTOR, CF,82,2,5	R7
10	1	RC32GF392J	RESISTOR, CF,3.9K,1,5	R1
11	1	RN55C5112F	RESISTOR, MF,51.1K,.125,1	R3
12	1	101R501M05	CAPACITOR, RAD,MIC,100P,500	C3
13	1	105R500C20	CAPACITOR, RAD,CERAMIC,1M	C5
14	1	104A101C20	CAPACITOR, AXIAL,CER,.1M,100	C2
15	1	503R501C20	CAPACITOR, RAD,CER,0.5M,500	C7
16	1	685R350T10	CAPACITOR, RAD,TAN,6.8M,35	C6
17	1	157A250E28	CAPACITOR, AXIAL,ELE,150M,25	C4
18	1	503R501C20	CAPACITOR, RADIAL,CER,.05M,500	C1
19	2	1N457A	DIODE, SIG,60,150M	D2,3

20	2	1N4937	DIODE, REC,600,1	D4,5
21	2	1N4005	DIODE, REC,600,1	D6,7
22	1	1N963B	DIODE, ZNR,.4,12,10M	D1
23	1	MBR160	DIODE, SCHOTTKY	D9
24	2	VN0340N2	FET, N,MOS,400 TO 39	Q1,2
25	2	2260R	HEATSINK	ON Q1,2
26	1	CD4047B	IC, BUF,MULTIVIB,LOW,PWR	U1
27	1	CD4041UBE	IC, BUF,TRUE,COMP,GT,QUAD	U2
28	1	LM340AT-5.0	TRANSISTOR, REG TO –220	REG1
29	1	HLMP-3300	LED, RED,HI,.198	LED1
30	1	RY-6WZ-K	RELAY	K1
31	1	X120B25-7	TRANSFORMER, DC/DC	T1
32	2	05JUMPERS	JUMPER, .5,.125,22AWG,PVC	J1,3
33	1	6072B	HEATSINK	
34	1	0440X0086PHPHMS	SCREW, 4-40X1/4 PHIL/PAN/MS	FOR REG1
35	1	4-40 SM PATTERN	NUT, SMALL PATTERN	FOR REG1
36	1	4-INT-L/W	WASHER, INTERNAL LOCK	FOR REG1

X120-LPS-115 Power Supply

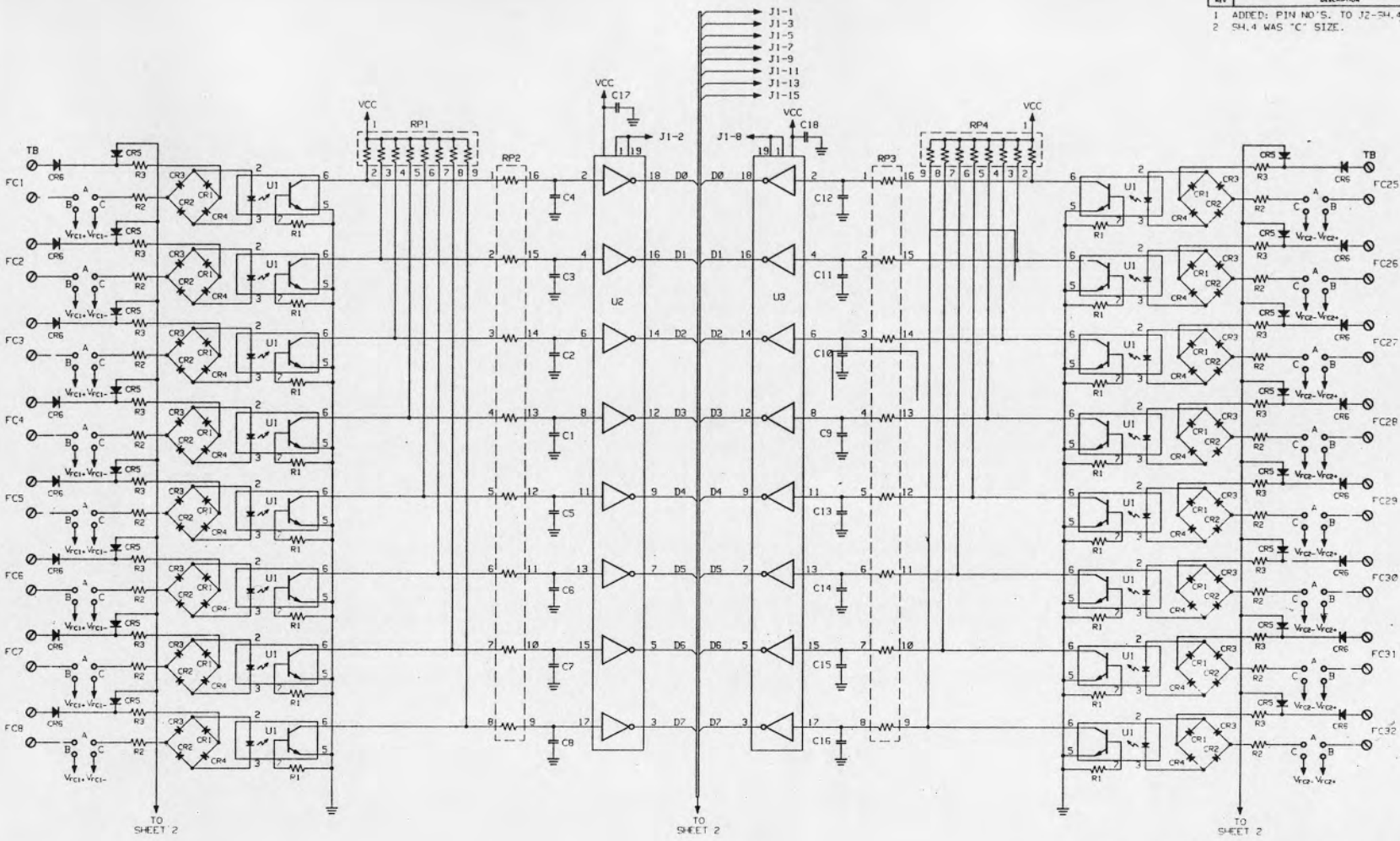
Item	Qty	Part Number	Description	I.D.
1	1	X120-1006B	PCB	
2	1	05JUMPERS	JUMPER, .5/.125/22AWG/PVC	J7
3	2	NOT USED	COMPONENTS NOT USED	J4,8
4	1	RC07GF220J	RESISTOR, CF/22/.25/5	R4
5	1	RC07GF271J	RESISTOR, CF/270/.25/5	R3
6	1	RC07GF471J	RESISTOR, CF,470,.25,5	R1
7	1	RN55C9530F	RESISTOR, MF/953/.125/1	R2
8	6	1N4005	DIODE, REC/600/1	D1-6
9	2	1N5817	DIODE, REC/20/1 NOTE: SEE DRAWING X120B148 FOR D5 INSTALLATION.	D5
10	1	HLMP-3001	LED, RED/STD/.19	LED
11	1	104A500C20	CAPACITOR, AXIAL/CERAMIC/.1M	C3
12	1	105A350T20	CAPACITOR, AXIAL/TAN/1M/35	C4
13	2	338A400E28	CAPACITOR, AXIAL/ELE/3300M/40	C1,2
14	1	LM317T	IC, VOLTAGE/REG/ADJ	VR1
15	1	6106B14	HEATSINK	VR1
16	1	0440X0086PHPHMS	SCREW, 4-40X1/4 PHIL/PAN/MS	
17	1	4-40 SM PATTERN	NUT, SMALL PATTERN	VR1
18	1	4-INT L/W	WASHER, INTERNAL LOCK	VR1
19	1	T82S11D114-5VDC	RELAY, GP/PCB/5DC/DPDT	K1
20	2	3529	FUSE HOLDER	F1
21	1	312.500	FUSE	F1
22	1	7101P4D9AQE	SWITCH, TOGGLE/PCB/SPDT	SW1
23	1	LP10-600	TRANSFORMER, STEP DOWN/PCB/50/60	T1
24	1	X120B44	TRANSFORMER, SPACER	T1
25	4	4.40 X 1	SCREW, PHIL/PAN/HD	T1
26	4	W2812	SPACER NOTE: MOUNT NYLON SPACERS 2671 ON SOLDER SIDE OF PCB.	T1
27	4	4-INT-L/W	WASHER, INTERNAL LOCK	T1
28	4	4-40 HEX	HEX NUT	T1
29	1	CP-66	CARD EJECTOR	PCB

30	1	NOTE	J1 [ ] 115VAC INPUT (NOT USED) [ ] 230VAC INPUT (USED, 05 JUMPER)	
31	1	NOTE	J2,3 [ ] 115VAC INPUT (USED 05 JUMPER) [ ] 230VAC INPUT (NOT USED)	

X120-LPS-125 Power Supply

Item	Qty	Part Number	Description	I.D.
1	1	X120-1002B	PCB	
2	1	CP-66	CARD EJECTOR	
3	1	7101P4D9AQE	SWITCH, TOGGLE/PCB/SPDT	S1
4	1	312.100	FUSE, 0.1 AMP	F1
5	2	3529	FUSE HOLDER	
6	1	RC07GF471J	RESISTOR, CF/470/.25/5	R6
7	2	RC07GF100J	RESISTOR, CF/10/.25/5	R4,5
8	1	7200-25	INDUCTOR	R2
9	1	RC42GF820J	RESISTOR, CF/82/2/5	R7
10	1	RC42GF273J	RESISTOR, CF/27K/2/5	R1
11	1	RN55C5112F	RESISTOR, MF/51.1K/.125/1	R3
12	1	101R501M05	CAPACITOR, RAD/MIC/100P/500	C3
13	1	105R500C20	CAPACITOR, RADIAL/CERAMIC/1M	C5
14	1	104A101C20	CAPACITOR, AXIAL/CERAMIC/.1M/100	C2
15	2	503R501C20	CAPACITOR, RADIAL/CER/0.5M/500	C1,7
16	1	685R350T10	CAPACITOR, RADIAL/TAN/6.8M/35	C6
17	1	157A250E28	CAPACITOR, AXIAL/ELE/150M/25	C4
18	2	NOT USED	COMPONENTS NOT USED	D2,3
19	2	1N4937	DIODE, REC/600/1	D4,5
20	2	1N4005	DIODE, REC/600/1	D6,7
21	1	1N963B	DIODE, ZENER/.4/12/10M	D1
22	1	MBR160	DIODE, SCHOTTKY	D9
23	2	IRFF420	FET, N/CHANNEL/500	Q1,2
24	2	0771786N	PAD, TRANSISTOR	Q1,2
25	2	22260R	HEATSINK	ON Q1,2
26	1	CD4047B	IC, BUF/MULTIVIB/LOW/PWR	U1
27	1	CD4041UBE	IC, BUF/TRUE/COMP/GT/QUAD	U2
28	1	LM7805CT	VOLTAGE REGULATOR 5V TO –220	REG1
29	1	HLMP-3300	LED, RED/HI/.198	LED1
30	1	RY-6WZ-K	RELAY	K1
31	1	X120B25-1	TRANSFORMER, DC/DC	T1
32	2	05JUMPERS	JUMPER, .5/.125/22AWG/PVC	J1,3
33	2	NOT USED	COMPONENTS NOT USED	J2,D8
34	1	6072B	HEATSINK	REG1
35	1	4-40 X 3/8	SCREW, PHIL/PAN/HD	REG1
36	1	#4	WASHER, SPRING LOCK SST	REG1
37	1	4-40 HEX	HEX NUT	REG1

REV	DESCRIPTION	DATE	BY	ENGR	APPR	QAR
1	ADDED: PIN NO'S. TO J2-SH.4	22.AUG.88	DH			
2	SH.4 WAS "C" SIZE.	22.AUG.88	DH			



SHEET 1 OF 4

ITEM NO.	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
			LIST OF MATERIALS	

TOLERANCE UNLESS OTHERWISE SPECIFIED — DECIMALS: XX ± .03, XXX ± .010 — ANGLES ± 1°

CUSTOMER

MATERIAL

FINISH

NEXT ASSY | USED ON: X120021

APPLICATION: DO NOT SCALE DRAWING

TITLE: FIELD ASSEMBLY X120-1001

F.S. NUMBER

SCALE

DRAWN BY: KWANG 27-OCT-87

ENGINEERED BY: N.SAFAIYEH 2-24-88

APPROVED BY: P.PONS 2-23-88

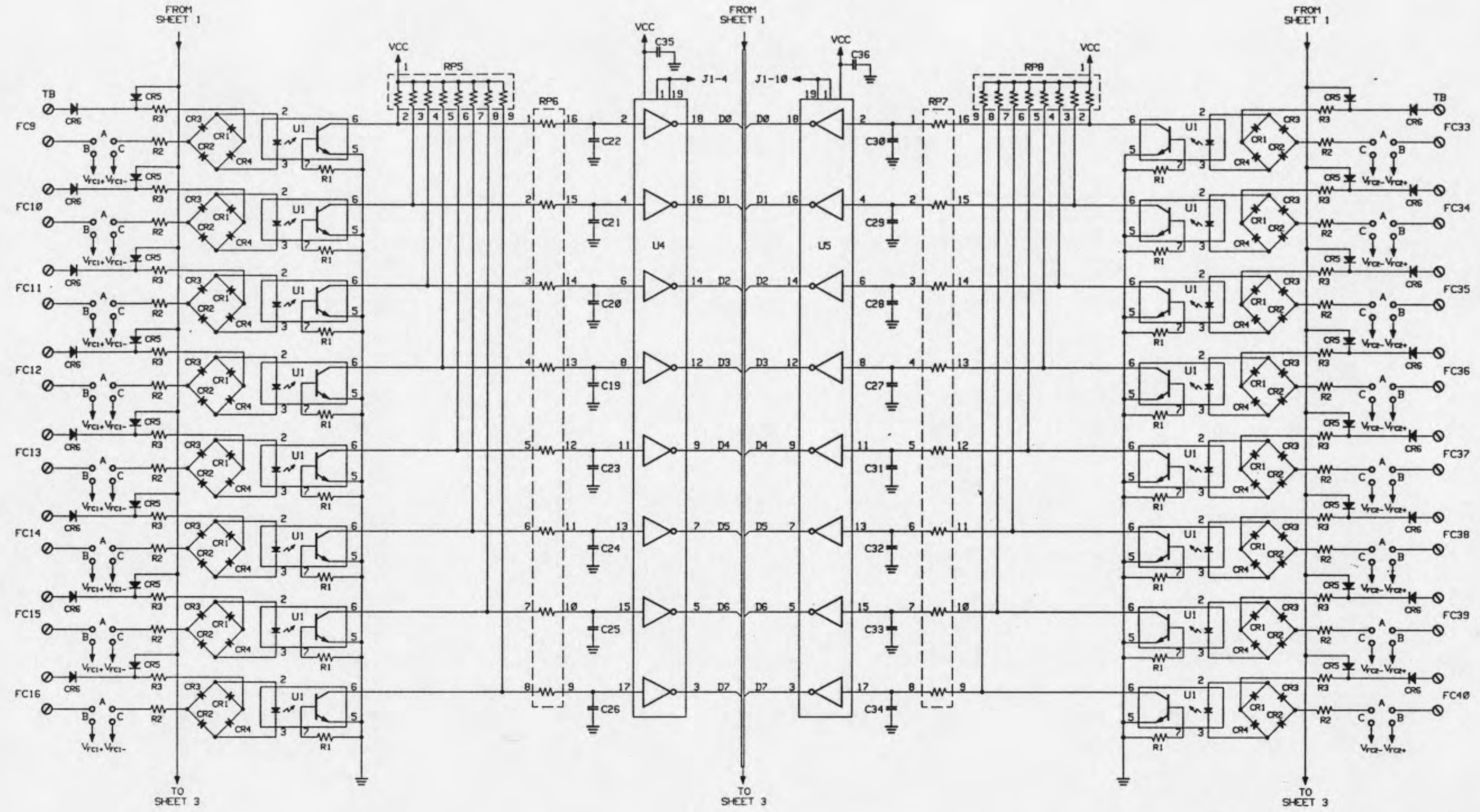
QUALITY ASSURANCE REVIEWED: A.GASCA 2-23-88

RONAN, WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X120-1001 REV: 2

DISK#:X120Ea FOLDER#: 01
IG.#120A1001 R2 22-AUG-88

REV	DESCRIPTION	DATE	BY	ENGR	APPR	QAR
	SEE SHEET 1					



SHEET 2 OF 4

ITEM NO.	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
LIST OF MATERIALS				

TOLERANCE UNLESS OTHERWISE SPECIFIED: DECIMALS XX ± .03, XXX ± .010; ANGLES ± ½°

CUSTOMER

MATERIAL

FINISH

NEXT ASSY	USED ON
	X120021

APPLICATION

DO NOT SCALE DRAWING

TITLE: FIELD ASSEMBLY X120-1001

DRAWN BY: KHANG 27-OCT-87

ENGINEERED BY: Kevin Schaich 2/24/88

APPROVED BY: TW 2/23/88

QUALITY ASSURANCE REVIEWED: [signature]

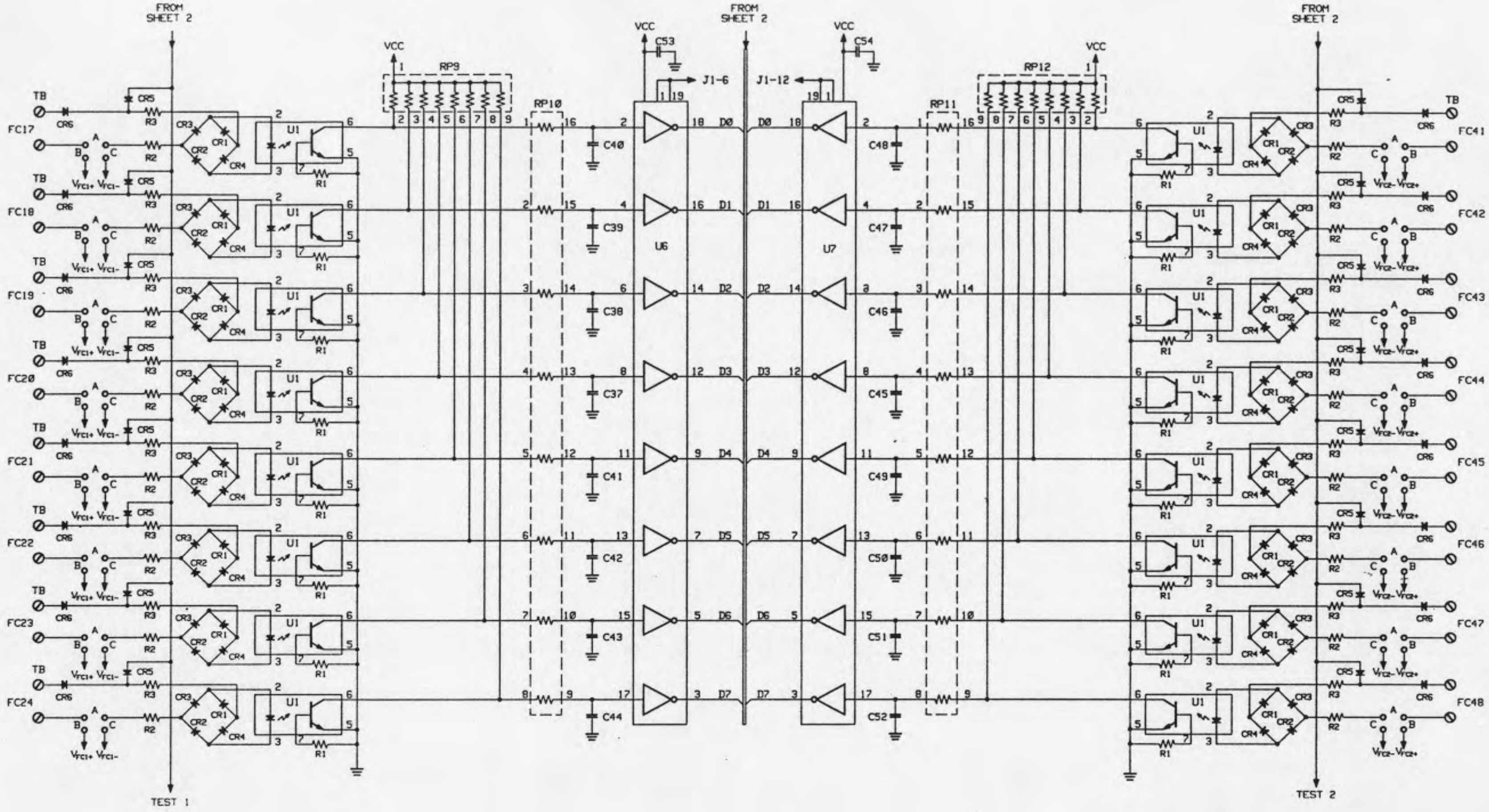
P.O. NUMBER

SCALE

RONAN
WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X120-1001 REV 2

REV	DESCRIPTION	DATE	BY	ENGR	APPD	QAR
	SEE SHEET 1					



SHEET 3 OF 4

ITEM NO.	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
LIST OF MATERIALS				

	X120021
NEXT ASSY	USED ON
APPLICATION	

TOLERANCE UNLESS OTHERWISE SPECIFIED: DECIMALS XX ± .03, XXX ± .010; ANGLES ± ½°

CUSTOMER:

MATERIAL:

FINISH:

DO NOT SCALE DRAWING

TITLE: FIELD ASSEMBLY X120-1001

DRAWN BY: KWANG 27-OCT-87

ENGINEERED BY: Kevin S[illegible] 2/[illegible]

APPROVED BY: [illegible] 2/[illegible]/88

QUALITY ASSURANCE REVIEWED: [illegible] 2/[illegible]/88

P.O. NUMBER:

SCALE:

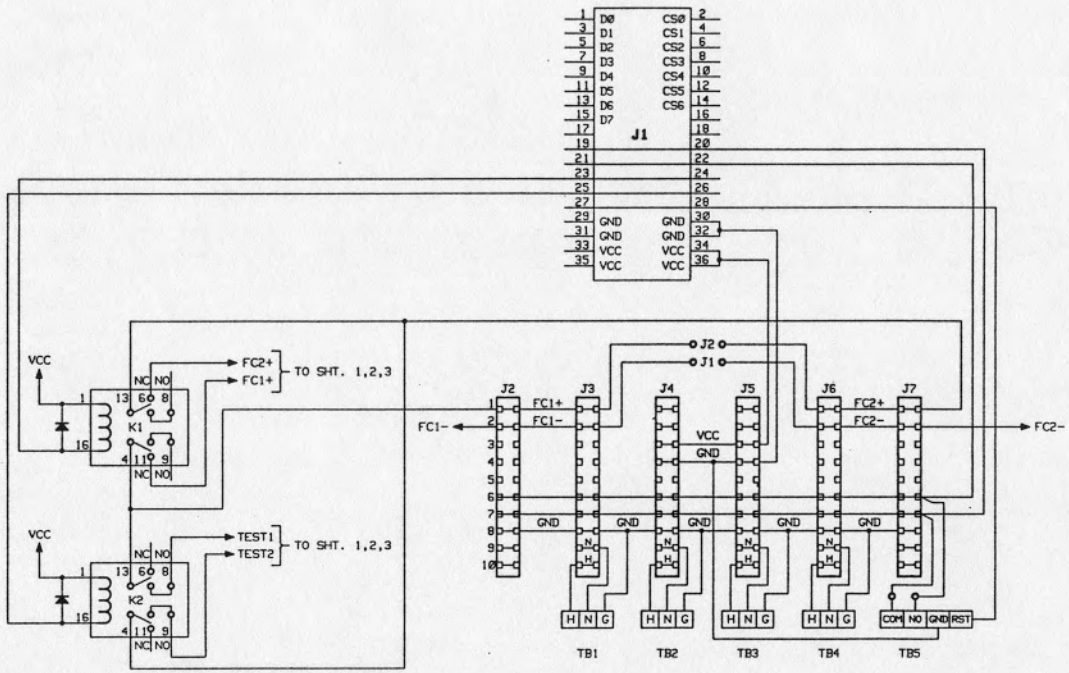
RONAN
WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X120-1001 REV 2

DISK0:X120Cx FOLDER0:1
IG.0120C1001 AW 11-FEB-88

REV	DESCRIPTION	DATE	BY	ENGR	APPR	QAR

SEE SHEET 1.



SHEET 4 OF 4

ITEM NO.	QTY	CODE /	PART NUMBER	DESCRIPTION	SPEC

LIST OF MATERIALS

TOLERANCE UNLESS OTHERWISE SPECIFIED: DECIMALS: XX ± .03, XXX ± .010, ANGLES ± 1°

CUSTOMER

MATERIAL:

FINISH:

X12ØØ21

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

TITLE: MULTIPLEXER INPUT MODULE X12Ø-1ØØ1

P.O. NUMBER | SCALE

DRAWN BY: KWANG 02-NOV-87

ENGINEERED BY: K.S 24-FEB-88

APPROVED BY: R.P 23-FEB-88

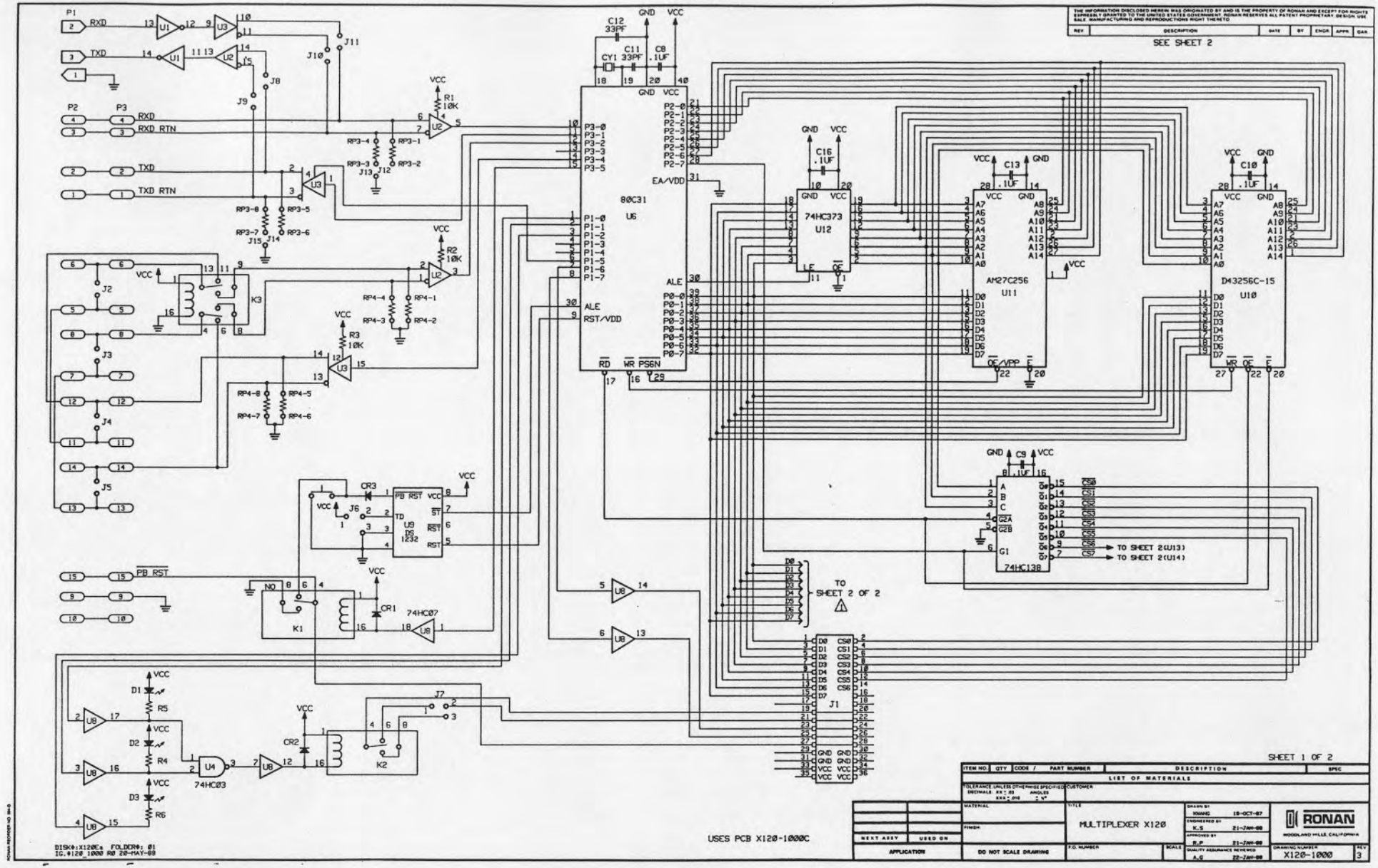
QUALITY ASSURANCE REVIEWED: A.G 23-FEB-88

RONAN, WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X12Ø-1ØØ1 REV: 2

DISK#: X12XX FOL:1

IG.012RD1001 R1 11-APR-88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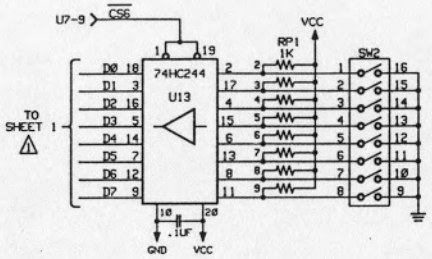
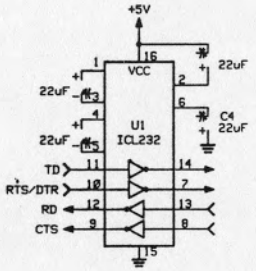
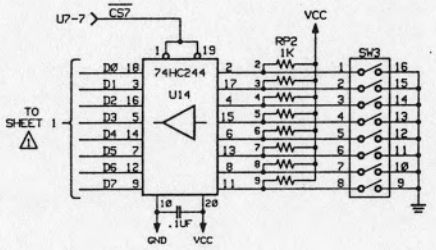
SEE SHEET 2
TO SHEET 2 OF 2
TO SHEET 2(U13)
TO SHEET 2(U14)
SHEET 1 OF 2
USES PCB X120-1000C
MULTIPLEXER X120
RONAN
WOODLAND HILLS, CALIFORNIA
X120-1000
LIST OF MATERIALS
80C31
74HC373
AM27C256
D43256C-15
74HC138
74HC07
74HC03
MAX232
DO NOT SCALE DRAWING

NOTE: THIS DRAWING IS NOT TO BE REVISED WITHOUT ISSUING A COPY OF REVISIONS MADE TO THE INTERACTIVE GRAPHICS DEPT.

REV	DESCRIPTION	DATE	BY	ENGR	APPR	DAR
1	ADDED RP3-1 TO RP3-8, RP4-1 TO RP4-8, J12 TO J15, CR3 & SM.2, DELETED R4,R5,R6,&R7.	28MAY88	KP	KS	BH	AC
2	SHEET 2 WAS C SIZE	26OCT88	HF	CH	BH	AC
3	CHGD U8 P/N & DELETED R11 ON PIN 11,12,13.	26MAY92	MA	KS	BH	AC







SHEET 2 OF 2

USES PCB X120-1000C

ITEM NO.	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
			LIST OF MATERIALS	

TOLERANCE UNLESS OTHERWISE SPECIFIED: DECIMALS .XX ± .03, .XXX ± .010; ANGLES ± 1°. CUSTOMER

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

TITLE: MULTIPLEXER X120

F.D. NUMBER | SCALE

DRAWN BY: DWANG 19-MAY-92

ENGINEERED BY: KS 19-MAY-92

APPROVED BY: D.M. 19-MAY-92

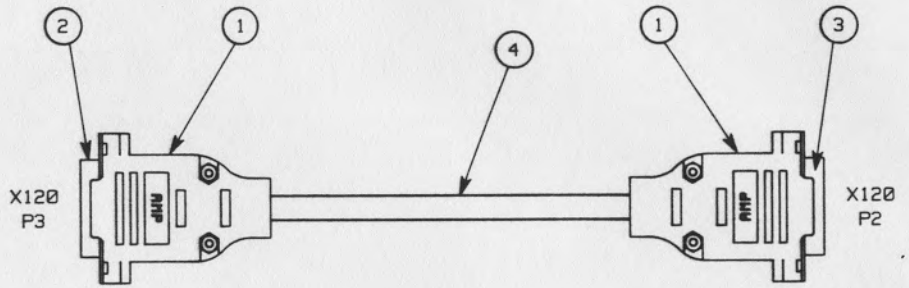
QUALITY ASSURANCE REVIEWED: K.C. 19-MAY-92

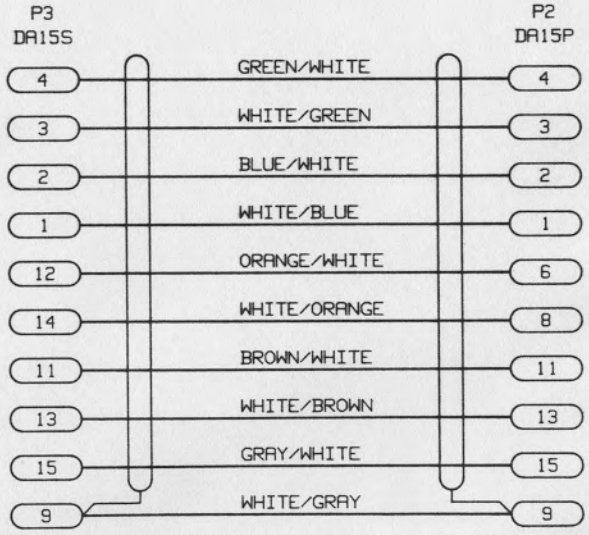
RONAN, WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X120-1000 | REV: 3

DISK0:X120Cx FOLDER0: 01
IG.4120d1000 R3 26-MAY-92

REV	DESCRIPTION	DATE	BY	ENGR	APPR.	QAR.
1	REV. PART NO.S	15-FEB-89	NF	RP.		





ITEM NO.	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
5				
4	1	8135	CABLE	BELDEN
3	1	745494-1	15 PIN CONNECTOR (MALE)	AMP
2	1	745493-1	15 PIN CONNECTOR (FEMALE)	AMP
1	2	747099-1	COVER	AMP

LIST OF MATERIALS

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMALS XX ± .03 ANGLES
XXX ± .010 ± ½°

CUSTOMER

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

TITLE: X120 TO X120 DAISY CHAIN CABLE ASSY (X120-100)

P.O. NUMBER

SCALE

DRAWN BY 01-29-88

ENGINEERED BY R.P. 01-29-88

APPROVED BY D.H 01-29-88

QUALITY ASSURANCE REVIEWED A.G. 01-29-88

RONAN
WOODLAND HILLS, CALIFORNIA

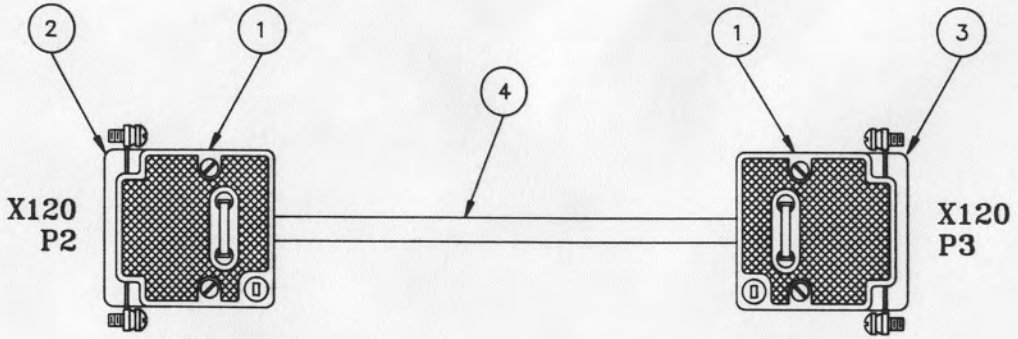
DRAWING NUMBER X120C15

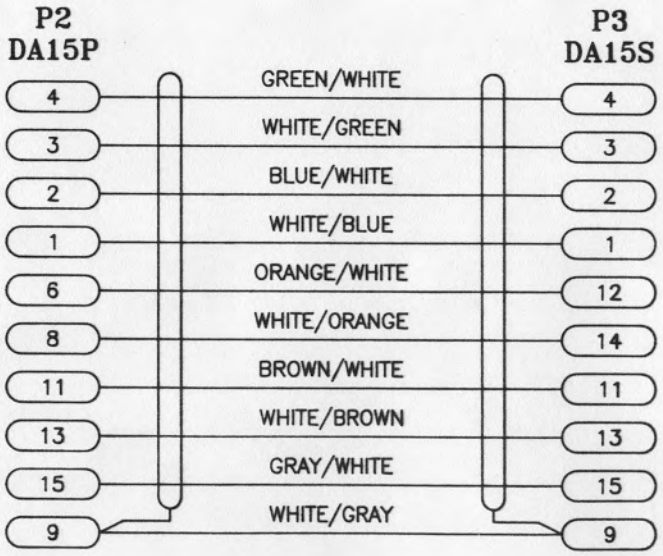
REV 1

VOL: IGB 120 & X120Mb FOLDER#:XXX
IG.#X120C015 R0 01-29-88

RONAN REORDER NO 003-C

REV	DESCRIPTION	DATE	BY	ENGR	APPR	QAR
1	REVISED ITEM #2 & 3	4/16/92	KP	RP.	R.H	A.G.





ITEM NO.	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
5				
4	1	8135	CABLE	BELDEN
3	1	DA15S	15 PIN CONNECTOR (FEMALE)	CANNON
2	1	DA15P	15 PIN CONNECTOR (MALE)	CANNON
1	2	DB110963-2	COVER	CANNON

LIST OF MATERIALS

TOLERANCE UNLESS OTHERWISE SPECIFIED
DECIMALS: XX ± .03 ANGLES ± ½°
XXX ± .010

CUSTOMER

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

TITLE
X120
EXTENSION CABLE
(X120-102)

P.O. NUMBER

SCALE

DRAWN BY KSP 31-MAY-88
ENGINEERED BY KS 31-MAY-88
APPROVED BY D.H 31-MAY-88
QUALITY ASSURANCE REVIEWED AG 31-MAY-88

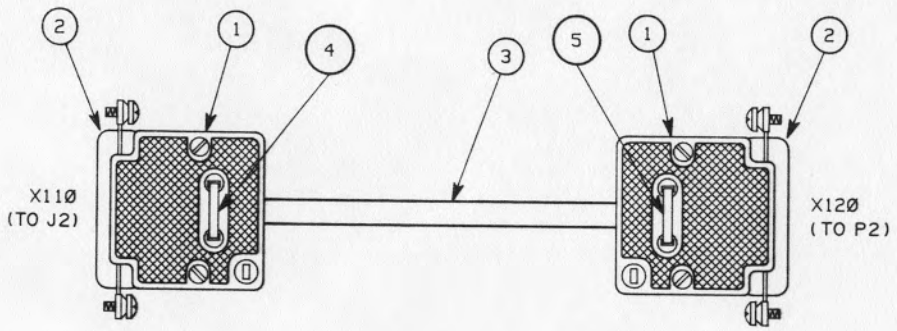
RONAN
WOODLAND HILLS, CALIFORNIA

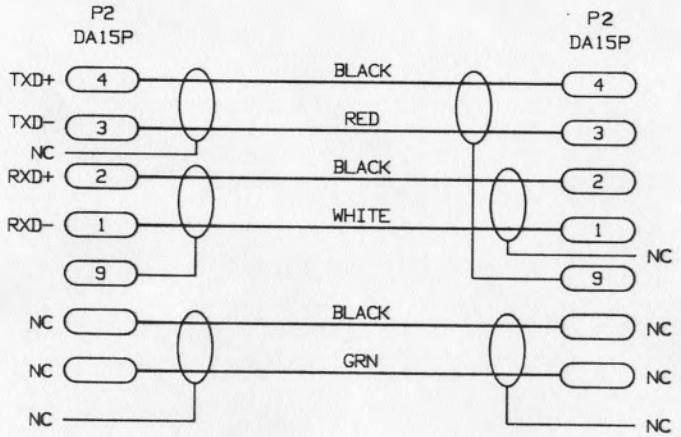
DRAWING NUMBER X120C36
REV 1

DISK: ~~X#A5~~
#X120C36
X120rli3 #9

RONAN REORDER NO. 003-C

REV.	DESCRIPTION	DATE	BY	ENGR	APPR	QAR
1	ADDED ITEM NO.4 & 5	5.26.88	KSP			
2	ADDED (TO J2), (TO P2)	2/20/89				
3	REVISED PER ECO: 9356	03/07/00				





ITEM NO.	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
5	1	LABEL	X120 P3	
4	1	LABEL	X110 P2	
3	1	9730	CABLE (3 PAIRS)	BELDON
2	2	DA15P	15 PIN CONNECTOR (MALE)	CANNON
1	2	DB110963-2	COVER	CANNON

LIST OF MATERIALS

TOLERANCE: UNLESS OTHERWISE SPECIFIED
DECIMALS: XX ± .03 ANGLES: ± ½°
XXX ± .010

CUSTOMER

MATERIAL:

FINISH:

TITLE: X110 TO X120 CABLE ASSY (X120-101)

DRAWN BY: TAN 29-JAN-88
ENGINEERED BY: KS 02-FEB-88
APPROVED BY: DH 02-FEB-88
QUALITY ASSURANCE REVIEWED: AG 02-FEB-88

RONAN
WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X120C16
REV: 3

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

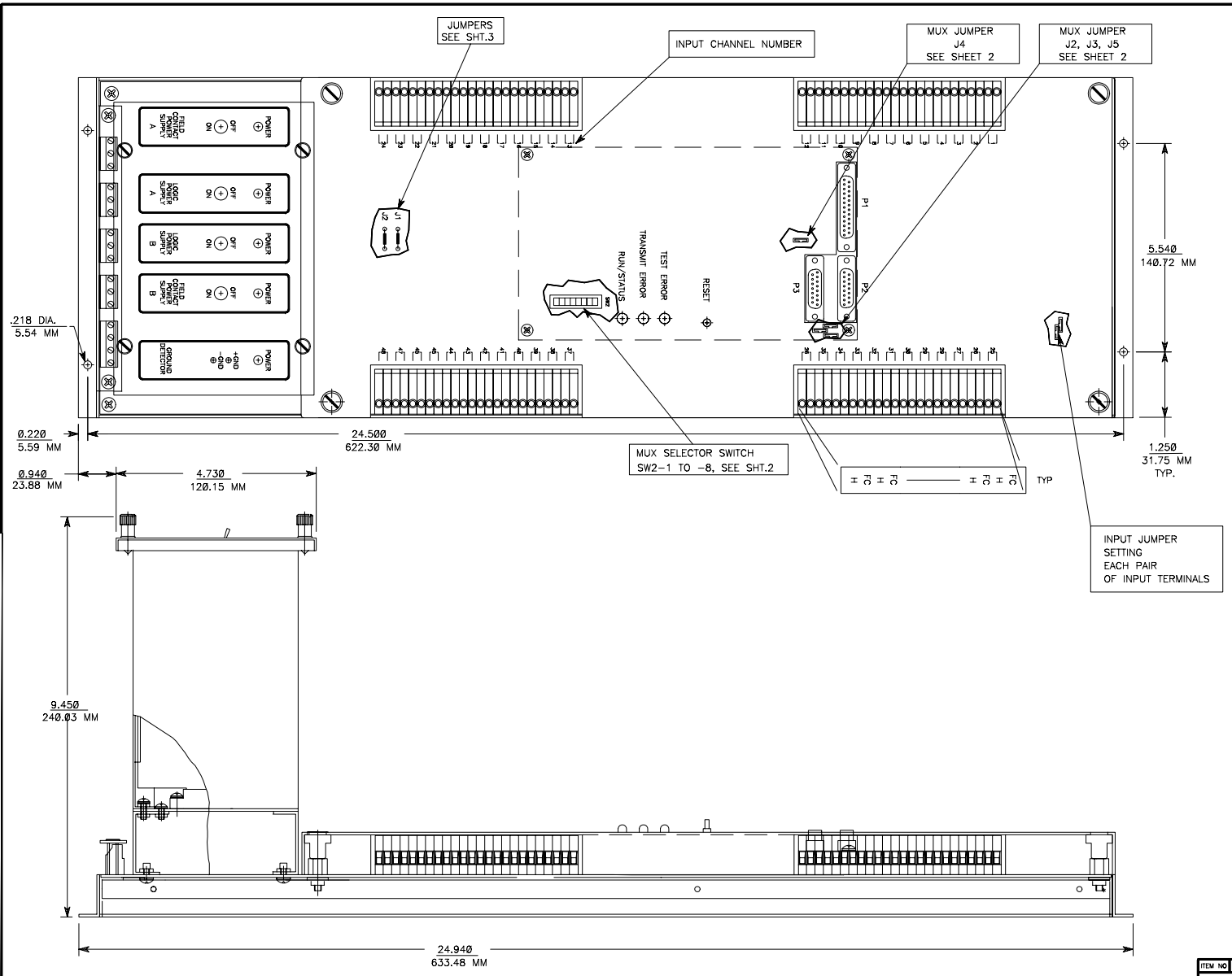
P.O. NUMBER

SCALE

RONAN REORDER NO. 003-C

DISK#: X120#b FOLDER#: #1
IG.#X120C816 R3 26-MAY-88

REV.	DESCRIPTION	DATE	BY	ENGR.	APPR.	QAR.
1	CHANGED: POWER SUPPLY COVER ON SH.1, CORRECTED TEXT ON SH.1-2	01.AUG.88	DH	CM	RH	AG
2	INPUT TERMINAL ID. WAS H,FC,H...ETC	29.MAR.89	DH	CM	RH	AG
3	PER E.C.O. #2536	01.APR.94	NF	TC	RH	AG
4	PER E.C.O. #3364	23.AUG.94	NF	KS	RH	AG
5	REVISED PER E.C.O. #6624	4-28-97	KP	KS	RH	AG



SHEET 1 ØF 3

ITEM NO	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC

LIST OF MATERIALS

TOLERANCE: UNLESS OTHERWISE SPECIFIED
DECIMAL: XX ± .03 ANGLES: ±1°
XXX ± .010 ± .5'

CUSTOMER

	X120-1001
	X120D45
NEXT ASSY	USED ON
APPLICATION	

MATERIAL:

FINISH:

DO NOT SCALE DRAWING

TITLE: X120-DT MULTIPLEXER OUTLINE AND WIRING INFO.

P.O. NUMBER

SCALE

	BY	DATE
DRAWN BY	T. D. ZUNIGA	04-MAR-88
ENGINEERED BY	T. D. ZUNIGA	04-MAR-88
APPROVED BY	D.HEWITSON	14-MAR-88
QUALITY ASSURANCE REVIEWED	B.GARINO	15-MAR-88

RONAN
WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X120D21 REV: 5

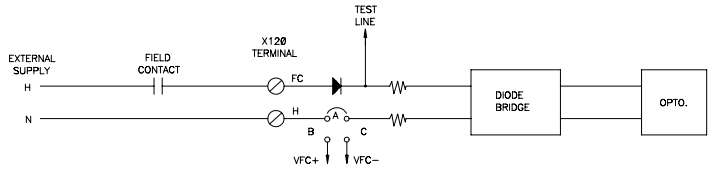
DWG FILE: X120D21A.DWG
DATE: 4/28/1997
TIME: 11:49 A.M.
SCALE: 1.000=1.00
#X120D21A

REV.	DESCRIPTION	DATE	BY	ENGR.	APPR.	CHR.

SEE SHEET 1

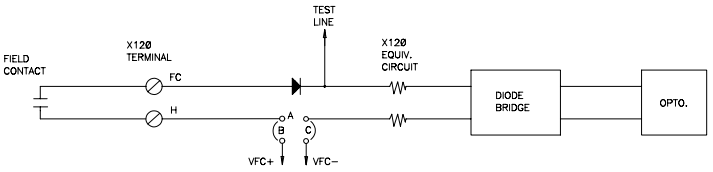
INPUT WIRING (FOR CHANNEL 1 – 48)

LIVE AC INPUT (115AC) (INSTALL INPUT JUMPER A)

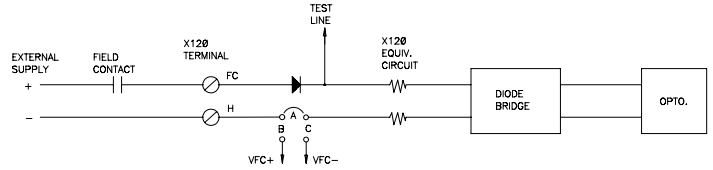


NOTE:
1.) SWITCH SW2–7 MUST BE OFF WITH LIVE INPUTS OR DAMAGE TO UNIT WILL OCCUR.

DRY INPUT (INSTALL INPUT JUMPERS B & C)



LIVE DC INPUT (24–125VDC) (INSTALL INPUT JUMPER A)



NOTE:
1.) SWITCH SW2–7 MUST BE OFF WITH LIVE INPUTS OR DAMAGE TO UNIT WILL OCCUR.

MUX JUMPER SETTING

J2	INSTALLED FIRST MUX IN STRING
J3	INSTALLED FIRST MUX IN STRING
J4	INSTALLED LAST MUX IN STRING
J5	INSTALLED LAST MUX IN STRING

MUX SWITCH SETTING

POSITIONS 1 TO 5 OF SW2 ARE FOR SETTING THE MUX NUMBERS AND ARE SET AS FOLLOWS:

MUX NUMBERS	SW2–5	SW2–4	SW2–3	SW2–2	SW2–1
MUX Ø1	OFF	OFF	OFF	OFF	OFF
MUX Ø2	OFF	OFF	OFF	OFF	ON
MUX Ø3	OFF	OFF	OFF	ON	OFF
MUX Ø4	OFF	OFF	OFF	ON	ON
MUX Ø5	OFF	OFF	ON	OFF	OFF
MUX Ø6	OFF	OFF	ON	OFF	ON
MUX Ø7	OFF	OFF	ON	ON	OFF
MUX Ø8	OFF	OFF	ON	ON	ON
MUX Ø9	OFF	ON	OFF	OFF	OFF
MUX 1Ø	OFF	ON	OFF	OFF	ON
MUX 11	OFF	ON	OFF	ON	OFF
MUX 12	OFF	ON	OFF	ON	ON
MUX 13	OFF	ON	ON	OFF	OFF
MUX 14	OFF	ON	ON	OFF	ON
MUX 15	OFF	ON	ON	ON	OFF
MUX 16	OFF	ON	ON	ON	ON
MUX 17	ON	OFF	OFF	OFF	OFF
MUX 18	ON	OFF	OFF	OFF	ON
MUX 19	ON	OFF	OFF	ON	OFF
MUX 2Ø	ON	OFF	OFF	ON	ON
MUX 21	ON	OFF	ON	OFF	OFF
MUX 22	ON	OFF	ON	OFF	ON
MUX 23	ON	OFF	ON	ON	OFF
MUX 24	ON	OFF	ON	ON	ON
MUX 25	ON	ON	OFF	OFF	OFF
MUX 26	ON	ON	OFF	OFF	ON
MUX 27	ON	ON	OFF	ON	OFF
MUX 28	ON	ON	OFF	ON	ON
MUX 29	ON	ON	ON	OFF	OFF
MUX 3Ø	ON	ON	ON	OFF	ON
MUX 31	ON	ON	ON	ON	OFF
MUX 32	ON	ON	ON	ON	ON

SW2–6	SPARE
SW2–7	ON = AUTO TEST ENABLED OFF = AUTO TEST DISABLED
SW2–8	ON = MASTER (LAST IN STRING) OFF = SLAVE

ITEM NO	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC

LIST OF MATERIALS

TOLERANCE: UNLESS OTHERWISE SPECIFIED
DECIMAL: XX ± .03 ANGLES: ± .5°
XXX ± .010

CUSTOMER

MATERIAL:

FINISH:

TITLE: X12Ø–DT MULTIPLEXER OUTLINE AND WIRING INFO.

DRAWN BY / DATE

ENGINEERED BY

APPROVED BY

QUALITY ASSURANCE REVIEWED

X12Ø–DT

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

P.O. NUMBER | SCALE

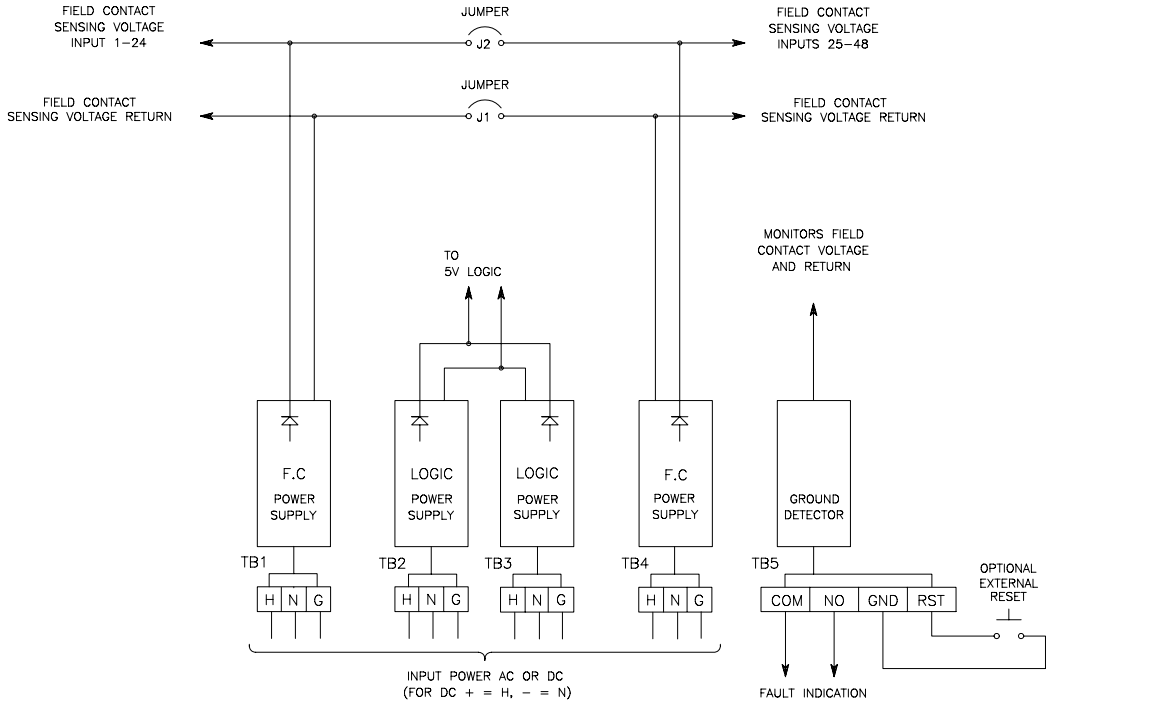
RONAN
WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X12ØD21 | REV: 5

DWG FILE: X12ØD21B.DWG
DATE: 4/28/1997
TIME: 11:35 A.M.
SCALE: 1.00=1.00
E:\ENGDWG\XSTD\X12Ø
DISK:X12Ø_2 FLDR:2

REV.	DESCRIPTION	DATE	BY	ENGR.	APPR.	QAR.

SEE SHEET 1.



NORMALLY ENERGIZED, NORMALLY CLOSED CONTACT OUTPUT FOR GROUND FAULT, POWER SUPPLY FAILURE, INPUT TEST ERROR OR COMMUNICATIONS ERROR

NOTES:

1.) JUMPERS J1 & J2 ARE INSTALLED WHEN ONLY ONE FCPS IS USED OR REDUNDANT SUPPLIES ARE DESIRED.

ITEM NO	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
LIST OF MATERIALS				

TOLERANCE: UNLESS OTHERWISE SPECIFIED
DECIMAL: XX ± .03 ANGLES: ± .5°
XXX ± .010

CUSTOMER

MATERIAL:

FINISH:

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

TITLE: X120–DT MULTIPLEXER OUTLINE AND WIRING INFO.

P.O. NUMBER | SCALE

DRAWN BY | DATE

ENGINEERED BY

APPROVED BY

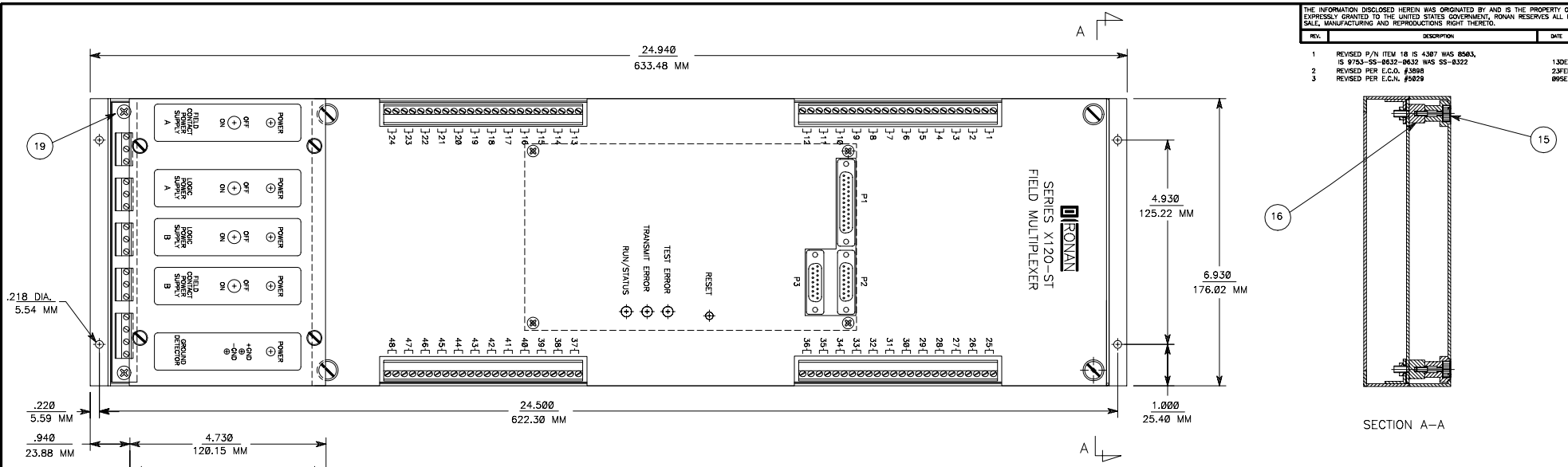
QUALITY ASSURANCE REVIEWED

RONAN
WOODLAND HILLS, CALIFORNIA

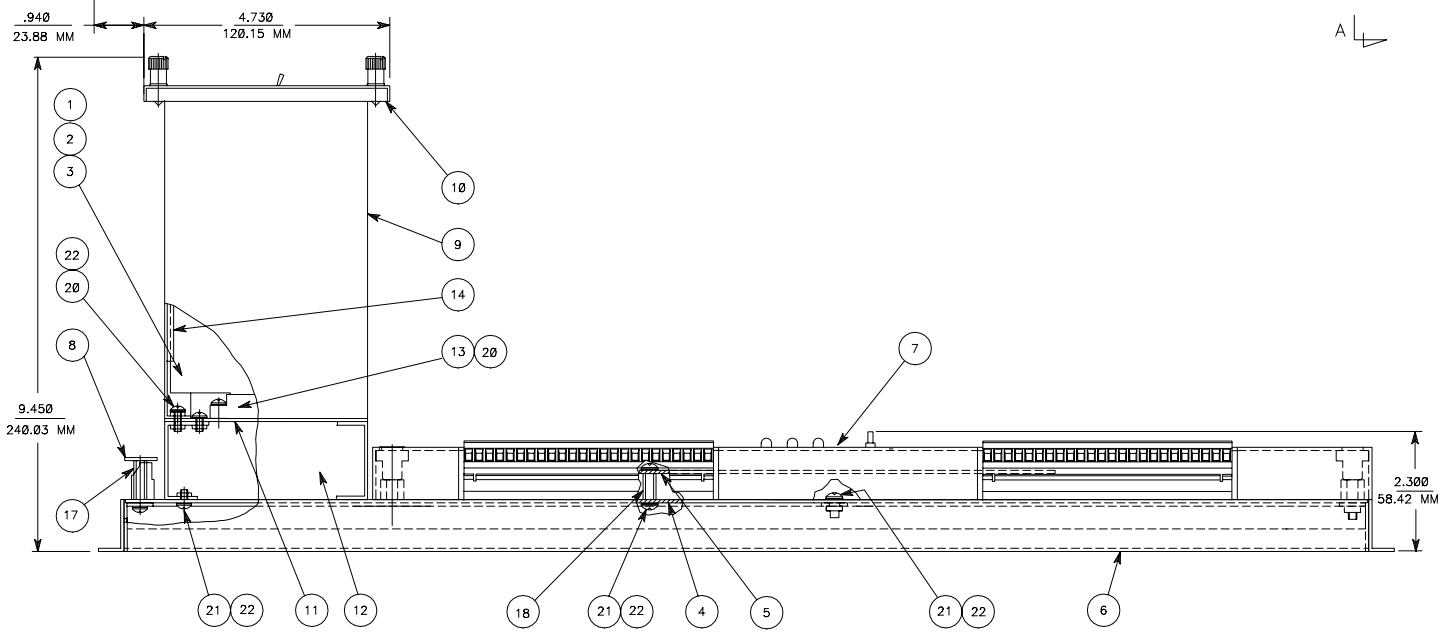
DRAWING NUMBER: X120D21 | REV: 5

DWG FILE: X120D21C.DWG
DATE: 4/28/1997
TIME: 11:10 A.M.
SCALE: 1.00=1.00
E:\ENGDWG\XSTD\X120
DISK:X120_2 FLDR:2

REV.	DESCRIPTION	DATE	BY	ENGR.	APPR.	QAR.
1	REVISED P/N ITEM 18 IS 4307 WAS 8503, IS 9753-SS-0632-0632 WAS SS-0322	13DEC88	MA	RS	KS	AG
2	REVISED PER E.C.O. #3898	23FEB95	NF	TC	KS	AG
3	REVISED PER E.C.N. #5029	09SEP97	SSW	KS	TC	AG



SECTION A–A



NOTE: FOR WIRING SEE DWG. NO. X120C47

ITEM NO	QTY	CODE / PART NUMBER	DESCRIPTION	SPEC
22	24		#6 INTERNAL TOOTH LOCK WASHER	
21	20		#6-32 X 1/4 PH PAN HD MS	
20	14		#6-32 X 7/16 PH PAN HD MS	
19	2		#6-32 X 3/8" PH FLAT HD MS	
18	4	4307	#6 HEX SPACER 1/2	
17	2	8425	#6 HEX SPACER 3/4	
16	4	9753-SS-0632-0632	STANDOFF	AMATOM
15	4	58-28-406-24	SCREW FASTENER	SOUTHCO
14	10	E-500	CARD GUIDE	BIVAR
13	5	EB81-A10SGFV	CONNECTOR	DALE
12	1	X120C42	ADAPTER CHASSIS	RONAN
11	1	X120C41	CONNECTOR PLATE	RONAN
10	1	X120C39	COVER	RONAN
9	1	X120D38	CARD RACK	RONAN
8	1	X120B17-1	TERMINAL COVER	RONAN
7	1	X120D12	COVER,P.C.B	RONAN
6	1	X120D11	FRAME P.C.B.	RONAN
5	1	X120-1000B	P.C.B.	RONAN
4	1	X120-1001C	P.C.B.	RONAN
3	AS REQD	X120D18	LOGIC POWER SUPPLY MODULE	RONAN
2	AS REQD	X120D7	FIELD CONTACT POWER SUPPLY MODULE	RONAN
1	AS REQD	X120D5	GROUND DETECTOR MODULE	RONAN

LIST OF MATERIALS

TOLERANCE: UNLESS OTHERWISE SPECIFIED
DECIMAL: XX ± .03 ANGLES: ± .5°
XXX ± .010

CUSTOMER

MATERIAL:

FINISH:

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

TITLE: X120-ST FIELD MULTIPLEXER ASSEMBLY

P.O. NUMBER | SCALE

DRAWN BY: P.S. 22-JUN-88
ENGINEERED BY: K.S. 22-JUN-88
APPROVED BY: T.P. 22-JUN-88
QUALITY ASSURANCE REVIEWED: A.G. 22-JUN-88

RONAN
WOODLAND HILLS, CALIFORNIA

DRAWING NUMBER: X120D37 | REV: 3

DWG FILE: X120D37.DWG
DATE: 2/23/1995
TIME: 3:02 P.M.
SCALE: 1.00=1.00
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