Z E T R O N

MODELS 18 AND 18+ CONTROL LINK
INSTALLATION AND OPERATIONS MANUAL

#025-9214C

Table of Contents

Table of Contents
(Continued)

Table of Contents
(Continued)

WARRANTY STATEMENT

Zetron, Inc. warrants that all equipment sold pursuant to any resultant agreement shall be free from defects in material or workmanship at the time of delivery. Such warranty shall extend from the time of delivery for one year. Buyer must provide written notice to Zetron within this prescribed warranty period of any defect; if the defect is not the result of improper usage, service, maintenance, or installation and equipment has not been otherwise damaged or modified after delivery, Zetron shall either replace or repair the defective part or parts of equipment or replace the equipment or refund the purchase price at Zetron's option after return of such equipment by buyer to Zetron. Shipment to Zetron's facility shall be borne on account of buyer.

1. Consequential Damages: Zetron shall not be liable for any incidental or consequential damages incurred as a result of any defect in any equipment sold hereunder, and Zetron's liability is specifically limited to the obligation described herein to repair or replace a defective part or parts covered by this warranty.

2. Exclusive Warranty: The warranty set forth herein is the only warranty, oral or written, made by Zetron and is in lieu of and replaces all other warranties, expressed or implied, including the warranty of merchantability and the warranty of fitness for particular purpose.

COPYRIGHT NOTICE

The software in the Models 18 and 18+ Control Link is copyrighted by and remains the property of Zetron, Inc. Reproduction, duplication, or disclosure is not permitted without prior written consent of Zetron, Inc. No part of this document may be copied or reproduced in any form without the prior written consent of Zetron, Inc.

FEDERAL COMMUNICATIONS COMMISSION (FCC) REGULATIONS

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.

2. This device must accept any interference received, including interference that may cause undesired operation.

1. INTRODUCTION

1. INTRODUCTION
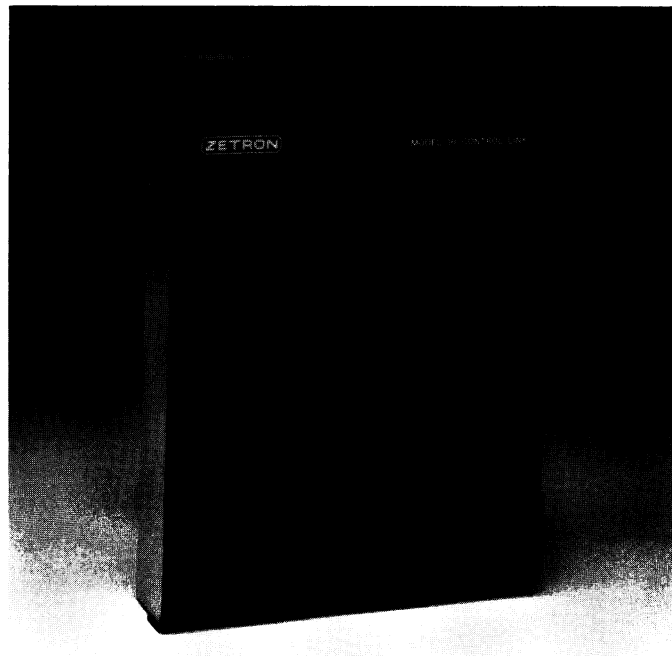
GENERAL

The Control Link is a microprocessor-based telemetry unit and, along with the user's radio link, make up the communications network necessary for monitoring and controlling equipment at remote sites. One Control Link is typically located at a control point where equipment, such as pumps, valves, generators, lights and other equipment, is turned on and off. The other Control Link is typically located at a monitoring point where events and equipment conditions, such as power fail, water level, battery voltage, flow rate, fire, and intruder, are monitored. Changes in these events will cause one Control Link to report to another Control Link that will provide a control function in response.

The Control Link is either a Model 18 or Model 18+. The Model 18 handles digital I/O only. The Model 18+ has analog I/O and twice the digital inputs and outputs of the Model 18.

The Models 18 and 18+ provide the following I/O capabilities:

I/O	Model 18	Model 18+
Digital inputs (senses on/off conditions)	8	16
Open collector outputs	8	16
Analog inputs (4-20 mA, 0-5 VDC)	0	4
Analog outputs (0-5 VDC)	0	4

With these differences in mind, the common features will be referred to as the features of the Control Link.

Each I/O point on a Control Link is configurable as to which I/O point it is to control or by which I/O point it is to be controlled. The Control Link may be in a system of several units as their I/O may individually be linked to different Control Links. Each Control Link has its own specific ID called an address.

The I/O limitations are that:

1. Digital I/O cannot be linked with Analog I/O.
2. A single input can only control a single output, and a single output can only be controlled by a single input.
3. An input on a Control Link may not control an output on that same Control Link.

The Control Link reports by transmitting a Minimum Shift Keyed (MSK) data burst that contains the sender's address, the destination address, and data about the inputs and outputs. MSK is a special modem signaling format optimized for reliable radio communications.

The Control Link interfaces directly to a wide variety of two-way radios, either conventional or trunking. The Control Link I/O connects to sensing devices that can provide dry contact closure to ground, TTL level voltage changes for digital inputs, or 0-5 volts or 4-20 mA for analog measurement. The outputs of the Control Link connect to devices that accept open collector outputs as digital control or 0-5 VDC analog control.

Some sensing devices output a series of pulses where each pulse represents a multiple of a measured quantity. For example, a water flow meter might output a single pulse for every 1000 gallons. The digital inputs on a Control Link can be configured to count these pulses, then transmit them to another Control Link where they are reproduced.

The Control Link is configured by RS-232 port to allow the user to change parameters such as radio key up delay and whether the outputs are normal or inverted logic.

SYSTEM DESCRIPTION
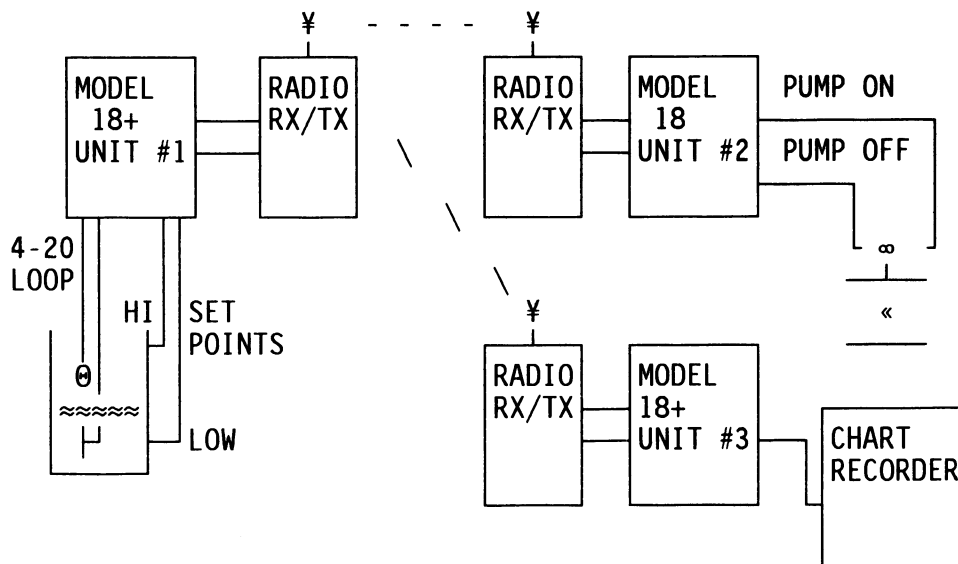
A Typical Control Link System

Unit #1 is monitoring with an analog input a 4-20 mA loop connected to a float sensor as well as to dry contacts set to trip when the tank reaches a high level or a low level. The analog input requires this unit be a Model 18+.

Unit #2 is configured to respond to the changes of the set points being monitored by unit #1. When the tank level rises, the pump gets turned off; when the tank level lowers, the pump gets turned on. Unit #2 has no analog and its function could be accomplished with the Model 18.

Unit #3 is configured to respond to the changes of the 4-20 mA loop being monitored by Unit #1. The level of the tank would be recorded on the strip chart. This application would require the Model 18+.

The analog inputs are 0 to 5 VDC and the levels being monitored should be scaled to meet this. Many devices already output 0 to 5 VDC. However, 4-20 mA loops and 12-volt power supplies do not. The diagram below shows how to convert these two power sources into 0 to 5 VDC levels for the Control Link. There is a 249-ohm resistor in the Control Link that may be used to convert 4-20 mA to volts.

```
                       ┌─ +12 VDC
                       │              MODEL 18+
MODEL 18+             ⊟470 kΩ        ANALOG INPUT ──┬── 4 - 20 mA Loop
ANALOG INPUT ──┤                                    │
                     ⊟330 kΩ                       ⊟249 Ω
                       │                            │
                       ▼ Ground                     ▼ Ground
```
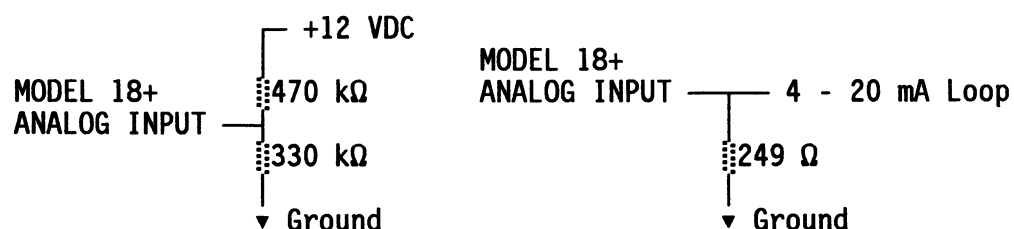
Common Conversion Circuits for 0-5 VDC Scaling

2. SPECIFICATIONS

2. SPECIFICATIONS

PHYSICAL

Power Supply	13.8 VDC nominal, 10.5-16 VDC
Current	75 mA typical, 200 mA max
Temperature	0 to +60 degrees Celsius
Size	7.25"W x 10.5"D x 2.25"H
Weight	2 pounds

RADIO INTERFACE

Audio Output	20 mV to 2 V p-p (mic level audio), 1 kΩ
Audio Input	100 mV to 4 V p-p, 50 kΩ
Channel Busy Input	Low: 0 to 0.7 VDC, <100 Ω to ground
	High: 3.5 to 12 VDC, >10 kΩ to ground
PTT Output	Relay to VCC or ground, 150 mA max, can be jumpered

Radio Modem Specifications

Data Rate	1200 baud
Signaling	Minimum Shift Keying (MSK)

Signal Integrity

Required Signal Strength	95% success at 12 dB SINAD
Probability of False Data	1 in 10^9 (0.0000001%)

RS-232 INTERFACE

Baud Rate	4800
Parity	None
Bits	8
Stop Bits	1

I/O SPECIFICATIONS

External Inputs

Contact Closure Inputs	Model 18: 8 inputs
	Model 18+: 16 inputs
	Contact closure to ground or
	0-5 V or 5-0 V voltage change
	Logic low: 0 to 0.7 VDC, <10 Ω to ground
	or <0.8 VDC
	Logic high: pulled up through external resistor
	Driver output: >10 kΩ to ground
	Protected to +50 VDC
Analog Inputs	Model 18+: 4 inputs
	0 to 5 VDC analog sensor with
	8-bit A/D input (20 mV/bit)

External Outputs

Open Collector Outputs

Model 18:   8 outputs
Model 18+: 16 outputs
50 VDC max, 100 mA sink typical

Analog Outputs

Model 18+: 4 outputs
0 to 5 VDC 8-bit D/A (20 mV/bit)

3. OPERATION AND CONFIGURATION

3. OPERATION AND CONFIGURATION
(Continued)

3. OPERATION AND CONFIGURATION

GENERAL OPERATION

The Control Link has an RS-232 port for configuration, an I/O port for connection to external equipment, and a radio interface. Each Control Link is given a unique address that only it recognizes.

The Control Link continuously monitors for an MSK message to be received or for a change in any one of its active inputs. If it receives a message that contains the Control Links address, it will transpond back. If the message is a command to open or close relays, the Control Link will perform the command. For closed loop control, an input on the Control Link can be connected to a sensor which verifies the command was executed (e.g., a flow sensor on a pump, a voltage output on a generator.)

When the Control Link detects a change in any of its active analog or digital inputs, it will first check to see if the radio channel is busy. If the channel is busy, the Control Link will wait until the channel is free. If the channel is not busy, the Control Link will transmit its data and then wait for a reply, indicating that the receiving Control Link has decoded the message properly. If within 15 seconds, the Control Link has not received a reply, it will resend the data, and again wait. If the Control Link fails to receive a response after a number of tries configured by the user, it will latch an alarm. When communications are restored, the Control Link will release the alarm.

If a power failure occurs, the outputs will go to the "off" state. When power is restored, the Control Link will automatically report the status of its inputs to the other Control Links and resume normal operation.

CONFIGURATION

To configure a Control Link, you will need:

1. A "Dumb Terminal" or a PC running in the Dumb Terminal mode. Software programs such as CrossTalk, Kermit, ZCU, Procom and others will provide terminal emulation on a PC.

2. A cable with a male 9-pin "D" style connector on one end to interface with the Control Link and a connector on the other end to interface with the serial port of your PC or Dumb Terminal. See cable pin out in Section 4.

Configuration Instructions

1. Connect the cable described above between J2, the 9-pin "D" style connector on the Control Link, and the serial port of the PC or dumb terminal.

2. Connect a 12-volt power supply with power off to the Control Link's pin 1 of P3 and ground to pin 2 of P3.

3. Make sure your dumb terminal or PC is set at 4800 baud, 8 bit, no parity, 1 stop bit.

4. Turn the 12-volt power supply on. You should see "Model 18 Control Link" and the software version displayed on the CRT.

5. Press the space bar three times, and the Control Link will display the Main Menu.

MAIN MENU

1) Factory defaults
2) System setup
3) Disable all I/Os
4) Digital inputs
5) Digital outputs
6) Analog inputs
7) Analog outputs

Items 2 and 4 through 7 on the Main Menu cause other menus to be displayed. Item 1 resets all parameters to the factory defaults. Item 3 disables all the inputs and outputs at once.

FACTORY DEFAULTS

This menu selection will allow the user to reset all configurable parameters to the defaults set at the factory including input/output definitions. The user is prompted again to make sure he/she really wants to reset all definitions.

DISABLE ALL I/Os

The factory default for the Control Link is to have all inputs and outputs enabled. If you use only a few I/O points, it is sometimes more convenient to start configuration with all inputs and outputs disabled and then just enable those that will be used.

Selecting this menu item disables all inputs and outputs at once.

SYSTEM SETUP MENU

Menu Selections	Factory Settings	Range
1) Prekey time	0.5 seconds	0-4.0 seconds
2) Channel busy detect	Low = Busy	Low or High
3) Channel busy Timeout	0.5 seconds	0-4.0 seconds
4) Transceiver type	Conventional	Conv. or Trunking
5) Number of retries	5	1-99
6) Beginning retry timeout	5 seconds	5-99 seconds
7) Communications failure alarm	none	momentary, latched, none
8) Failure alarm momentary time	5 seconds	1-99 seconds
9) Enable/Disable Polling	Enabled	Enabled, Disabled
A) Polling interval	30 minutes	1-250 minutes
B) Poll failure mode		

Prekey Time
This menu selection allows the user to change the delay between the time PTT (Push To Talk) is activated and the time the MSK signaling begins. The default is 500 milliseconds and is configurable from 0 to 4 seconds in 100 millisecond increments.

For trunked operation, this is the delay from the time a channel acquired signal is received on the COR input until the data is sent. If there is no delay required (as should be with trunked radio), set this to 0.

IMPORTANT: THE CONTROL LINK CONTAINS A COLLISION HANDLING ROUTINE THAT IS MOST EFFICIENT WHEN ALL CONTROL LINKS ON THE SYSTEM ARE CONFIGURED WITH THE SAME PREKEY TIME.

Channel Busy Detect
This is the configuration for the Carrier Detect, Pin 6 on P3. To identify when the channel is in use, the carrier must be configured to inhibit transmission on either high (+5 or open) or ground (0 V). The option chosen here will PREVENT transmission.

For trunked operation, this is used the same way to inhibit transmission. The proper name for this parameter should be "channel acquired indication" when a trunked system is being used.

Channel Busy Timeout
Enter the amount of time in tenths of seconds that the channel has to be available before the Control Link can seize the channel. This can prevent the Control Link from interrupting a conversation.

For trunked operation, this is used to determine that the TX indicator has stopped flashing (requesting a channel) and is on solid verifying that the channel has been acquired. (This is only if you are using the TX indicator to provide the channel acquired signal.)

Transceiver Type
This lets the user select whether the Control Link is to be used on a conventional or trunking radio system. The difference being in trunking you request a channel by giving PTT and in conventional you first look to see if the channel is available before giving PTT.

For trunked operation timing, PTT is pressed for 15 seconds while looking for a channel. If a channel is acquired prior to the 15 seconds (this is based on the logic indication on the COR input) the Control Link will wait the Prekey delay, send the data and release PTT. After 15 seconds, if no channel is available, the Control Link will release PTT, wait 30 seconds and retry.

Number of Retries
Each transmission requires a correct response from the receiving unit. Enter the number of attempts required before the transmission is to be considered a failure.

Beginning Retry Timeout
Enter the time allowed for the receiving unit to answer. After the retry time has expired, this unit will resend the data.

Communication Failure Alarm
A communication failure alarm is initiated when a unit fails to respond to a sending device. The sending device tries from 1 to 99 times before initiating a communications failure.

Disable the communication failure alarm or set the alarm output to latch for as long as the communication failure exists or to close momentarily. To set the timing for the momentary closure option, see the next menu item.

Note:MODEL 18 USES OUTPUT #8 AS THE COMMUNICATIONS FAILURE OUTPUT.
MODEL 18+ USES OUTPUT #16 AS THE COMMUNICATIONS FAILURE OUTPUT

Failure Alarm Momentary Time
Enter the time duration in seconds to close the communication failure alarm output when it has been configured as a momentary closure. (See previous menu item.)

Enable/Disable Polling
Enable or disable the unit from polling the other unit(s) in the system to verify operation. When enabled, set the interval at which the unit polls using the next menu item.

Polling Interval
Set the interval at which the unit will periodically poll the other unit(s) that are controlling this unit. This is done to verify that all the units are operating. (See previous menu item.)

Poll Failure Mode
Select whether you want the outputs to be turned off (open collector for digital outputs, 0 volts for analog outputs) or to retain their current state when the response to a poll is not received.

DIGITAL INPUT MENU

Menu Selections	Factory Settings	Range
1) Next input		
2) Enable/disable input	Enabled	
3) Unit to notify		0-255
4) Input mode	Status	Status or pulse
5) Status debounce time	0.0 seconds	0.0-25.0 seconds
6) Pulse width	0.5 seconds	0.1 to 60 seconds
7) Pulse gap	0.5 seconds	0.1 to 60 seconds
8) Pulse level	High	High or low
9) Pulse reporting count	0	0 to 65 000 pulses
A) Pulse reporting period	0	0 to 1440 minutes

Next Input
This menu selection will increment to the next input for modification. If the current input number is 8 (16 for the Model 18+), it will wrap back to 1. The bottom line of the main menu displays the current input number.

Enable/Disable Input
Enable this input to report changes to another Control Link (see Unit to Notify menu item below). Disable this input when it will not be used or is under repair.

Unit to Notify
Enter the address of the unit to which this input will report.

The factory defaults for the unit and input numbers to notify and to follow are the unit address +1 for even addresses and the unit address -1 for odd addresses. Inputs and outputs default to their own number.

Examples:

    Unit 0 Input 1 reports to Unit 1 Output 1
    Unit 1 Input 1 reports to Unit 0 Output 1
    Unit 5 Input 3 reports to Unit 4 Output 3
    Unit 4 Input 3 reports to Unit 5 Output 3

These are factory-set defaults and can be changed by the user at any time.

* * * * * * * * * * * * * * N O T E * * * * * * * * * * * * * * * *

If the address is changed on a Control Link, you must reset the factory defaults or the I/O reporting will be based on the previous address.

* *

Input Mode
Select whether the input is to operate in status or pulse counting mode.

In status mode, the Control Link reports each change in the level of the input. In pulse mode, the Control Link counts pulses and reports when a specific count is reached or at periodic intervals. The counter is reset to 0 after each report.

The mode for the corresponding digital output should match this setting.

Status Debounce Time
In status mode, each input may have a 'debounce' time. In other words, the amount of time the input must reside in one state (high or low, on or off) in order to trigger a transmission of data.

Pulse Width
The pulse width is the minimum duration of the pulse. In other words, the input must remain active during this interval for the pulse to be counted.

Pulse Gap
The pulse gap is the minimum spacing between pulses. The input must remain inactive during this interval after a pulse in order for the pulse to be counted.
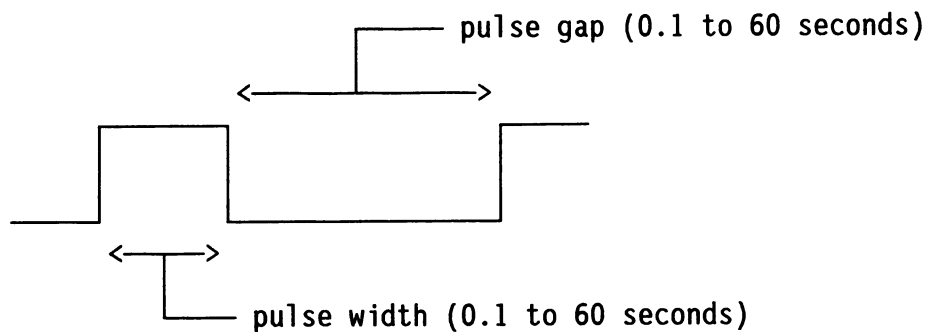
Pulse Diagram

Pulse Level
Indicate whether the pulses being sensed by this input are active high (or open circuit) or low (ground).

Pulse Reporting Count
Set the number of pulses that will cause the Control Link to send a pulse count report for this input. Enter 0 to disable this feature.

Pulse Reporting Period
Set the reporting period for this input when in pulse mode. This will cause the Control Link to transmit the pulse count (unless no pulses were counted) at regular intervals. Enter 0 to disable this feature.

DIGITAL OUTPUT MENU

Menu Selections	Factory Settings	Range
1) Next output		
2) Enable/disable output	Enabled	
3) Unit and input to follow		
4) Output mode	Status	Status or pulse
5) Status inversion	Disabled	Disabled or enabled
6) Pulse width	0.5 seconds	0.1 to 25.0 seconds
7) Pulse gap	0.5 seconds	0.1 to 25.0 seconds
8) Pulse level	High	High or low
9) Turn output on		
A) Turn output off		

Next Output
This menu selection allows the user to increment to the next output number.
Once incremented, the parameters for this output will be displayed along
with the menu. Once the user reaches output number 8 (16 for the Model
18+), this item will change the current output back to number 1. The bottom
line of the main menu displays the current output number.

Enable/Disable Output
Enable this Output to follow a particular input on another Control Link
(see menu item below). Disable this output when it will not be used or is
under repair.

Unit and Input to Follow
Enter the Unit address and input number that controls this output.

The factory defaults for the unit and input numbers to notify and to follow
are the unit address +1 for even addresses and the unit address -1 for odd
addresses. Inputs and outputs default to their own number.

Examples:

        Unit 0 Input 1 reports to Unit 1 Output 1
        Unit 1 Input 1 reports to Unit 0 Output 1
        Unit 5 Input 3 reports to Unit 4 Output 3
        Unit 4 Input 3 reports to Unit 5 Output 3

These are the factory defaults and can be changed by the user at any time.
If the address is changed on a Control Link, you must reset the factory
defaults or the I/O reporting will be based on the previous address.

Output Mode
Set the mode for this output to either status or pulse.

In status mode, the output will follow level changes in the specified
digital input. In pulse mode, pulses detected at the digital input will be
re-created at this output.

The mode for the corresponding digital input should match this setting.

Status Inversion
When in status mode, this output will reproduce the inverse of the input that it has been configured to follow.

Pulse Width
Set the width of the active part of the output pulse. See the pulse diagram on page 3-6.

Pulse Gap
Set the length of the gap between output pulses. See the pulse diagram on page 3-6.

Neither the output pulse width nor pulse gap need be identical to the settings for the corresponding digital input. However, in order to keep the output pulses from lagging too far behind the input, the settings should be similar.

Pulse Level
Indicate whether the pulses created at this output are to be active high (open collector) or low (ground).

Turn Output On/Turn Output Off
These menu selections allow the user to locally control the outputs. This is used to verify operation of the Control Link and any connected equipment. Once power is removed, all outputs return to the off state.

ANALOG INPUT MENU (MODEL 18+ ONLY)

Note: THE FOLLOWING MENUS ON THE ANALOG I/O REFER TO THE MODEL 18+ ONLY!

Menu Selections	Factory Settings	Range
1) Next Input		
2) Enable/Disable Input	Enabled	
3) Delta Value	5%	0.4-99.6%
4) Debounce time	3 seconds	0.0-25.0
5) Unit to notify	4-5	0-255

Note:DISABLE ANY UNUSED ANALOG INPUTS OR NOISE MAY CAUSE UNWANTED DATA TRANSMISSIONS

Next Input
This will increment to the next input number for modification. If the current input number is 4, it will wrap back to 1. The bottom line of the main menu displays the current input number.

Enable/Disable Input
Enable this input to report changes in status to another Control Link (see Unit to Notify menu item below). Disable this input when it will not be used or is under repair.

Delta Value
The delta value is the minimum percent change, referenced to full scale, required to cause the Control Link to send a data transmission update. The minimum delta value allowed is 0.4%. This change would be either in the positive or negative direction. The change would have to remain in effect or increase in magnitude for the duration of the debounce time. (See the next menu item.)

Debounce Time
Enter the amount of time the input must remain outside the delta value from the last known value to have new data sent. This will prevent noise spikes and interference from causing false data readings.

Unit to Notify
Enter the unit address to which this input will report a change in state.

The factory defaults for the unit and input numbers to notify and to follow are the unit address +1 for even addresses and the unit address -1 for odd addresses. Inputs and outputs default to their own number.

Examples:

    Unit 0 Input 1 reports to Unit 1 Output 1
    Unit 1 Input 1 reports to Unit 0 Output 1
    Unit 5 Input 3 reports to Unit 4 Output 3
    Unit 4 Input 3 reports to Unit 5 Output 3

These are the factory defaults and can be changed by the user at any time.

* * * * * * * * * * * * * *   N O T E   * * * * * * * * * * * * * * * *

If the address is changed on a Control Link, you must reset the factory defaults or the I/O reporting will be based on the previous address.

* *

ANALOG OUTPUT MENU (MODEL 18+ ONLY)

Menu Selections	Factory Settings	Range
1) Next output		
2) Enable/Disable output	Enabled	
3) Unit & Input to follow	4-5	
4) Set output level	0.00 volts	0.00-5.00 volts

Next Output
This will increment to the next output number for modification. If the current output number is 4, it will wrap back to 1. The bottom line of the main menu displays the current input number.

Enable/Disable Output
Enable this Output to follow a particular input on another Control Link (see menu item below). Disable this output when it will not be used or is under repair.

Unit and Input to Follow
Enter the Unit address and input number that controls this output.

The factory defaults for the unit and input numbers to notify and to follow are the unit address +1 for even addresses and the unit address -1 for odd addresses. Inputs and outputs default to their own number.

Examples:

    Unit 0 Input 1 reports to Unit 1 Output 1
    Unit 1 Input 1 reports to Unit 0 Output 1
    Unit 5 Input 3 reports to Unit 4 Output 3
    Unit 4 Input 3 reports to Unit 5 Output 3

These are the factory defaults and can be changed by the user at any time. If the address is changed on a Control Link, you must reset the factory defaults or the I/O reporting will be based on the previous address.

Set Output Level
The user can test the Control Link and any attached equipment by entering a value of 0-5 volts here. That value will be produced on the analog output.

ADDRESSING THE CONTROL LINK

The Control Link address can be set to any value from 0 to 255. This is done by using the 8-position dip switch labeled SW1. Position #1 is the LSB and #8 is the MSB. All off corresponds to 0, all on is 255. The count is binary:

    #1 1
    #2 2
    #3 4
    #4 8
    #5 16
    #6 32
    #7 64
    #8 128

Each unit on a system must have a different ID in order to respond.

Examples:

```
         1   2   3   4   5   6   7   8
    ON  ┌──────────────────────────────┐
        │ ▪   ▪                        │
        │                              │
        │        ▪   ▪   ▪   ▪   ▪   ▪ │
    OFF └──────────────────────────────┘
```
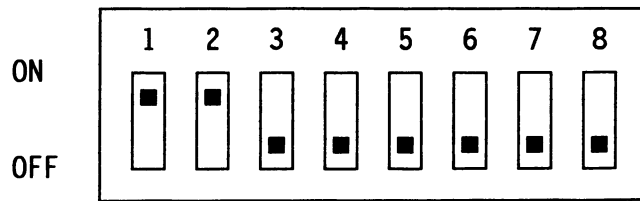
This configuration would define this unit as #3:   1 + 2 = 3

```
         1   2   3   4   5   6   7   8
    ON  ┌──────────────────────────────┐
        │     ▪       ▪   ▪            │
        │                              │
        │ ▪       ▪           ▪   ▪   ▪ │
    OFF └──────────────────────────────┘
```
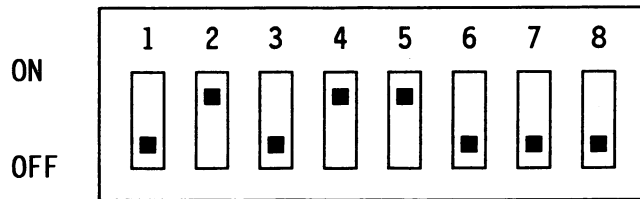
This configuration would define this unit as #26:   2 + 8 + 16 = 26

SYSTEM OPERATIONAL LIMITS

Inputs

Chatter

Chattering occurs when a status being monitored changes rapidly (more than once every few seconds). Chattering can cause the Control Link to send multiple reports using excessive air time. The debounce time in the Control Link should be used to prevent excessive transmissions. Also in a pulse counting application the pulse count feature should be used rather than trying to transmit each pulse as it happens.

Broken Connection

Analog Input — The voltage read by the analog input will float, following the voltage of the previous analog input. More than 5 kohm source impedance will increase susceptibility to noise.

Digital Input

The Digital inputs have a +12 VDC pull up and read a logic high with nothing connected.

Outputs

Power Up State

The analog outputs power up in a 0 volt state. The digital outputs power up in a high impedance, open collector state.

Power Off State

The analog outputs power off in a 0 volt state. The digital outputs power off in a high impedance, 0 volt state.

Unit Over Voltage   Over voltage damage to any of the I/O, power supply, or RF inputs caused by lightning, improper connection, etc. can cause unpredictable behavior in any of the electronic components. The Control Link provides safeguards against this type of damage, but damage is still possible. Full testing of suspect hardware should be performed.

RS-232   Currently the Control Link only uses the serial port for programming. If the Control Link is left in programming mode, the unit will time out after 30 seconds and normal operation will resume. While in programming mode, transmission and reception of data via FFSK is suspended.

Power

Brown Power   There is a low power reset circuit in the Control Link which disconnects power when supply voltage drops below 9.35 volts ±5%.

Power Up Conditions   The Control Link performs a self-test on power up. If there are errors detected during the self-test, operation is suspended. The digital and analog output states are designed to be in a high impedance and 0 VDC state respectively. If the self-test fails, these default values may not be valid.

Radio Connections and Associated Problems
Loss of transmit or receive audio anywhere along the communications path (repeater, radio, connector or Control Link) will cause a communications failure at both ends of the link. This will result in communications failure status for the I/O associated with this link.

Carrier Detect   Failed Connection — If the Carrier Detect fails, the Control Link will transmit at will or be inhibited from transmitting. The former will increase the risk of collisions, the latter will cause a communications fail alarm at both ends of the link.

Push to Talk   If Push to Talk fails, the radio will either transmit no data or be locked in transmit and block all other transmissions on the channel. There are jumper settings to provide proper default open or closed conditions for power off and standby for most radios.

Transmit Request   Failed Connection — If the transmit request line is disconnected, collisions with the Control Links sharing the same radio may increase. If the transmit request line is shorted, this will cause a communications fail alarm at both ends of the link.

Addressing   Dip-Switch Failure — If an Control Link has a dip-
                        switch failure causing a change in address, data sent
                        by the new address has the potential to false another
                        Control Link's data at the same address. Also the mate
                        of the Control Link will see no data from the expected
                        address and will consider this a communications
                        failure.

Radio System   A radio stuck in transmit for any reason (PTT held in,
                        electronic failure, chattering PTT, etc.) will prevent
                        or interfere with other transmissions. Radios should
                        provide a PTT timer that prevents continuous
                        transmission for extended periods of time, usually 3
                        minutes. This will only help if the radios are
                        functioning properly and will not prevent all cases of
                        transmit lock-out.

Critical System Failures Summary
Critical system failures can be caused by any of the following conditions:

* Chattering input causing repeated transmissions
* Radio stuck in transmit due to:
    - PTT held on by Control Link, user, or radio failure with no timeout
    - Radio locked in transmit due to radio failure
    - Carrier from another radio system causing interference
    - Hardware/firmware failure causing chattering PTT
* Repeater down

4. SETUP AND INSTALLATION

4. SETUP AND INSTALLATION

INSTALLATION

Power Connection
The power connection is made on the same connector as the radio connections. The Control Link operates from 10.5-16 VDC. Since it requires less than 100 mA, the radio power supply (if it provides 10.5-16 VDC) is often used to power the Control Link. A 12-volt sealed lead acid battery (Gel Cell) can be used with a 12-volt power supply to power the radio and Control Link and to provide back-up operating power in case of a main power failure.

Radio Connection
The Radio Connector P3 on the Control Link requires six connections to interface with the radio.

1. Push To Talk   Pin 3 (PTT OUT)
2. Transmit Audio   Pin 9 (TX AUD)
3. Receive Audio   Pin 10 (RX AUD)
4. Carrier Detect   Pin 6 (COR)
5. +12 VDC   Pin 1
6. Ground   Pin 2

Step 1. Cable Connection
The Control Link is shipped with a small plastic bag containing a plastic 10-pin connector and 10 metal crimp pins. This connector mates with the Radio Connector P3 on the Control Link. Construct a cable using this connector to provide an interface to the radio that provides the six connections listed above.

Step 2. Carrier Detect and Push to Talk Settings
Verify correct jumper settings for Carrier Detect and Push To Talk (PTT) based on the radio you are using.

Carrier Detect
JP1
A   10K Ohm pull down to ground on Carrier Detect input
B   10K Ohm pull up to +12 VDC on Carrier Detect input

If your radio provides a logic change of 0-5 VDC when the channel is busy, install JP1 in the A position and configure the Carrier detect level as high in the Control Link software parameters.

If your radio provides a logic change of 5-0 VDC when the channel is busy, install JP1 in the A position and leave the Control Link Carrier detect in the factory default software configuration setting of low.

If your radio provides a form C dry contact closure to ground or open collector output, install JP1 in the B position and leave the Control Link Carrier detect in the factory default software configuration setting of low.

You may wish to refer to the Channel Busy Detect subsection (in Section 3) which discusses the carrier detect setting. There is a software controlled LED that will be lit when carrier is detected (based on what was set during configuration).

Push To Talk Common (PTT Com)
JP3
A   PTT completes the connection between P3 Pin 3 and Pin 4.
B   PTT provides a ground on P3 Pin 3. (Pin 4 not used)

Push To Talk Out (PTT Out)
JP4
IN   PTT provides a +5 VDC pull up on P3 Pin 3 when not engaged.
OUT   PTT goes to an open circuit on P3 Pin 3 when not engaged.

Step 3. Transmit and Receive Audio Adjustment
Connect two Control Links to their radios and power supply, and turn power on.

There are two jumpers located next to the large square IC. These jumpers are labeled Test A and Test B. With power on, putting a jumper on Test A and/or Test B will cause the unit to enable Push to Talk and send the following tones:

Test A	Test B	Tone
out	out	None
out	in	1200 Hz
in	out	1800 Hz
in	in	Alternating 1200 and 1800 Hz

In Control Link #1, put test A and Test B jumpers in place. This will cause the radio to key up and transmit an alternating 1200 Hz and 1800 Hz tone.

On Control Link #1, adjust the square R24 pot labeled **TX AUD** to provide an audio output level that meets the radio manufacturer's specification.

Look at TP1 on Control Link #2 with an oscilloscope or volt meter with an AC setting. Adjust the square R23 pot labeled **RX AUD** and JP7 on Control Link #2 until TP1 measures between 0.5 and 2.0 volts peak to peak (0.35 to 1.4 VRMS).

JP7
A   Low 1x gain on Receive Audio
B   High 10x gain on Receive Audio

Repeat Step 3 but for transmit audio on Control Link #2 and receive audio on Control Link #1.

* * * * * * * * * * * * *   C A U T I O N   * * * * * * * * * * * * * * *

Remove the jumpers when finished testing. Do not to leave the radios transmitting continuously as this can harm some radios.

* *

Step 4. Configuration of Control Links

Refer to the configuration section and set your desired I/O and system parameters.

Step 5. Simple Tests to Verify Settings

Digital Inputs and Outputs - If you are using the digital inputs of the Control Link, try the following.

1. Choose a linked input and output. Unit #1, input #1 and Unit #0, output #1 would be a linked input and output if the factory defaults are used.

2. Connect the output you have chosen to +5VDC, found on pin 16 of J1, using a 1 KΩ resistor as a temporary load.

3. You should measure 5 VDC ±0.5 VDC at the output.

4. Ground the input you have chosen and keep it grounded. You should now measure between 0.6 and 0.7 VDC at the output.

Analog Inputs and Outputs (Model 18+ only) - If you are using the analog inputs of the Model 18+, try the following.

1. Choose a linked input and output. Unit #1, analog input #1 and Unit #0, analog output #1 would be a linked input and output if the factory defaults are used.

2. With the Control Links connected to the radios and power on, apply a ground to the analog input. You should be able to measure 0 Volts DC at the analog output.

3. Apply 5 Volts DC to the analog input and measure the analog output. You should measure 5 Volts DC.

4. If you do not see a change at the output when you change the voltage at the input, check the connector pin out to verify that you are looking at the correct I/O points. If the radio is transmitting when you change the voltage at the input, check the configuration of both Model 18+s.

5. If the radio does not transmit when you change the voltage at the input, check the carrier detect jumper settings and configuration, and check the configuration of the input to make sure it is enabled.

MODEL 18 EXTERNAL CONNECTIONS

RADIO CONNECTOR (P3)

Pin #	Connection	Schematic Label
1	Power	+12VDC
2	Ground	GND
3	Push to Talk	PTT OUT
4	Push to Talk Common	PTT COM
5	n/a	
6	Carrier Detect	COR
7	Ground	GND
8	Transmit Request ** Special Function	TXREQ
9	Transmit Audio	TXAUD
10	Receive Audio	RXAUD

** Special Function - This line will allow up to 15 Control Links to connect to a single Radio Transceiver. Transmit Request prevents multiple units from transmitting simultaneously. To use, just connect a single wire to this pin between all the Control Links on the same Radio Transceiver. The Control Link with the lowest ID will have priority in using the Radio.

Model 18 Jumper Settings

JP1   Carrier Detect
A   47K pull down to ground
B   47k pull up to +12 VDC

JP2   +12 VDC (fused) to J2 Pin 6 of RS-232 Connector (DB9)

JP3   Push To Talk
A   Push to Talk completes the connection between P3 Pin 3 and Pin 4.
B   Push to Talk provides a ground indication on P3 Pin 3.

JP4   Push To Talk
IN   Push to Talk provides a +5 VDC pull up on release.
OUT   Push to Talk goes to open upon release.

JP5   Test A
JP6   Test B
       See Installation, Step 3 subsection on previous pages.

JP7   Receive Audio Gain
A   Low 1x gain on Receive Audio
B   High 10x gain on Receive Audio

JP8   External Audio
A   External Audio Source Input
B   No External Audio

JP9   Transmit Audio
IN   50 Ω impedance
OUT   600 Ω impedance

JP10 Carrier Detect Threshold Adjust
A   Adjustable Carrier Detect Threshold level, 0 to 10 VDC
B   0-1.4 VDC Logic low, 3.0-5.0 VDC Logic high

JP11-14
249-ohm load resistors

JP15-18
Not Used

JP19 +5 V Output (For units with Part No. 702-9439 Rev. B and higher)
IN   +5 VDC enabled on Pin 16 J1
OUT   +5 VDC disconnected on Pin 16 J1

* * * * * * * * * * * * *   C A U T I O N   * * * * * * * * * * * * * *

This output is not fused. **DO NOT** connect to another voltage source.

* *

Model 18 I/O Connections

J2 DB9-S(9-pin RS-232 Port)

Pin #	Description	Schematic Label
1	n/c	
2	n/c	
3	Transmit from Control Link	TXD
4	Receive from external device	RXD
5	Ground	GND
6	+12V DC (fused) - JP2 enable jumper	+12V
7	n/c	
8	n/c	
9	Data Terminal Ready	DTR

J1

Pin #	Connection
1	Ground
2	Digital Input #1
3	Digital Input #2
4	Digital Input #3
5	Digital Input #4
6	Digital Input #5
7	Digital Input #6
8	Digital Input #7
9	Digital Input #8
10	Ground
11	Not Used
12	Not Used
13	Not Used
14	Not Used
15	External Audio In
16	+5V DC (regulated)
17	Ground
18	+12V DC (fused)

J4

Pin #	Connection
1	Ground
2	Digital Output #1
3	Digital Output #2
4	Digital Output #3
5	Digital Output #4
6	Digital Output #5
7	Digital Output #6
8	Digital Output #7
9	Digital Output #8

MODEL 18+ EXTERNAL CONNECTIONS

IF YOU HAVE PURCHASED THE MODEL 18+ (PART No. 901-9287), THE FOLLOWING CONNECTIONS HAVE BEEN SUPPLIED.

IF YOU HAVE PURCHASED THE MODEL 18, THESE PAGES DO NOT APPLY!

Radio Connector (P3)

Pin #	Connection	Schematic Label
1	Power	+12VDC
2	Ground	GND
3	Push to Talk	PTT OUT
4	Push to Talk Common	PTT COM
5	n/a	
6	Carrier Detect	COR
7	Ground	GND
8	Transmit Request ** Special Function	TXREQ
9	Transmit Audio	TXAUD
10	Receive Audio	RXAUD

** Special Function - This line will allow up to 15 Control Links to connect to a single Radio Transceiver. Transmit Request prevents multiple units from transmitting simultaneously. To use, just connect a single wire to this pin between all the Control Links on the same Radio Transceiver. The Control Link with the lowest ID will have priority in using the Radio.

Model 18+ Jumper Settings

JP1 Carrier Detect
A   47K pull down to ground
B   47K pull up to +12 VDC

JP2   +12 VDC (fused) to J2 Pin 6 of RS-232 Connector (DB9)

JP3 Push To Talk
A   Push to Talk completes the connection between P3 Pin 3 and Pin 4.
B   Push to Talk provides a ground indication on P3 Pin 3.

JP4 Push To Talk
IN   Push to Talk provides a +5 VDC pull up on release.
OUT   Push to Talk goes to open upon release.

JP5   Test A
JP6   Test B   See Installation, Step 3 subsection on previous pages.

JP7 Receive Audio Gain
A   Low 1x gain on Receive Audio
B   High 10x gain on Receive Audio

JP8 External Audio
A   External Audio Source Input
B   No External Audio

JP9 Transmit Audio
IN   50 Ω impedance
OUT   600 Ω impedance

JP10 Carrier Detect Threshold Adjust
A   Adjustable Carrier Detect threshold level, 0 to 10 VDC
B   0-1.4 VDC Logic low, 3.0-5.0 VDC Logic high

JP11   Analog Input #1 249 Ω series resistor
JP12   Analog Input #2 249 Ω series resistor
JP13   Analog Input #3 249 Ω series resistor
JP14   Analog Input #4 249 Ω series resistor

JP15-JP18   Not Used

JP19 +5 V Output (For units with Part No. 702-9440 Rev. B and higher)
IN   +5 VDC enabled on Pin 16 J1
OUT   +5 VDC disconnected on Pin 16 J1

* * * * * * * * * * * * * C A U T I O N * * * * * * * * * * * * * * *

This output is not fused. **DO NOT** connect to another voltage source.

* *

JP20   +5VDC supply for I/O option board

JP21-JP37   I/O Option board configuration jumpers (see pages 4-10 and 4-11)

Model 18+ I/O Connections

J2 DB9-S(9-pin RS-232 Port)

Pin #	Connection	Schematic Label
1	n/c	
2	n/c	
3	Transmit from Control Link	TXD
4	Receive from external device	RXD
5	Ground	GND
6	+12V DC (fused) - JP2 enable jumper	+12V
7	n/c	
8	n/c	
9	Data Terminal Ready	DTR

J1

Pin #	Connection
1	Ground
2	Analog Input #1
3	Analog Input #2
4	Analog Input #3
5	Analog Input #4
6	Not Used
7	Not Used
8	Not Used
9	Not Used
10	Ground
11	Analog Output #1
12	Analog Output #2
13	Analog Output #3
14	Analog Output #4
15	External Audio In
16	+5V DC (regulated)
17	Ground
18	+12V DC (fused)

J4

Pin #	Connection
1	Ground
2	Digital Input #1
3	Digital Input #2
4	Digital Input #3
5	Digital Input #4
6	Digital Input #5
7	Digital Input #6
8	Digital Input #7
9	Digital Input #8
10	Ground
11	Digital Input #9
12	Digital Input #10
13	Digital Input #11
14	Digital Input #12
15	Digital Input #13
16	Digital Input #14
17	Digital Input #15
18	Digital Input #16

J5

Pin #	Connection
1	Ground
2	Digital Output #1
3	Digital Output #2
4	Digital Output #3
5	Digital Output #4
6	Digital Output #5
7	Digital Output #6
8	Digital Output #7
9	Digital Output #8
10	Ground
11	Digital Output #9
12	Digital Output #10
13	Digital Output #11
14	Digital Output #12
15	Digital Output #13
16	Digital Output #14
17	Digital Output #15
18	Digital Output #16

MODEL 18+ 50-PIN I/O BOARD CONNECTOR

The 50-pin I/O Board Connector P6 is designed for connection to many of the Signal Conditioning Boards available from a variety of manufacturers. This allows connection to these boards using a standard 50-conductor ribbon cable. There are jumpers, JP21 to JP36, that allow the I/O channels to be configured as inputs or outputs.

```
Digital Input #1 ──────┤ •│1
I/O Board connection ──┤ •│2
Digital Output #1 ─────┤ •│3
```
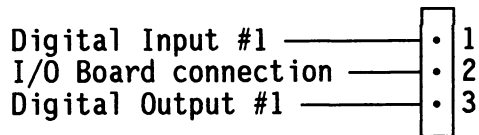
A jumper connecting Pin #1 and Pin #2 will connect digital input #1 to channel 1 of the I/O board.

A jumper connecting Pin #2 and Pin #3 will connect digital output #1 to channel 1 of the I/O board.

This connector, P6, supports 4,8 and 16 channel optically isolated I/O boards. The 50-pin connectors provide common ground on the even pins, +5 VDC on pin 49 and channels 1 to 24 on the odd pins starting with pin 47 and counting backwards from there.

A 24 I/O board is also supported but channels 17-24 are not equipped with the jumper in the diagram above. For channels 17-24 a single stake pin is exposed for each channel on the Control Link and must be connected to the appropriate input or output.

P6   50 Pin I/O board connector

Pin #	Connection
1	Module 24
2	Ground
3	Module 23
4	Ground
5	Module 22
6	Ground
7	Module 21
8	Ground
9	Module 20
10	Ground
11	Module 19
12	Ground
13	Module 18
14	Ground
15	Module 17
16	Ground
17	Digital I/O 16
18	Ground
19	Digital I/O 15
20	Ground
21	Digital I/O 14
22	Ground
23	Digital I/O 13
24	Ground
25	Digital I/O 12
26	Ground
27	Digital I/O 11
28	Ground
29	Digital I/O 10
30	Ground
31	Digital I/O 9
32	Ground
33	Digital I/O 8
34	Ground
35	Digital I/O 7
36	Ground
37	Digital I/O 6
38	Ground
39	Digital I/O 5
40	Ground
41	Digital I/O 4
42	Ground
43	Digital I/O 3
44	Ground
45	Digital I/O 2
46	Ground
47	Digital I/O 1
48	Ground
49	+ 5 Volts DC (jumpered)
50	Ground

5. THEORY OF OPERATION

5. THEORY OF OPERATION

## BASIC FUNCTIONAL DESCRIPTION

The Control Link is a microprocessor-based system with a software intensive architecture that greatly enhances the versatility of the Control Link and allows it to be quickly adapted to varied tasks.

The microprocessor controls all internal, tone generation, audio path control and external interface operations.

FUNCTIONAL BLOCK DIAGRAM
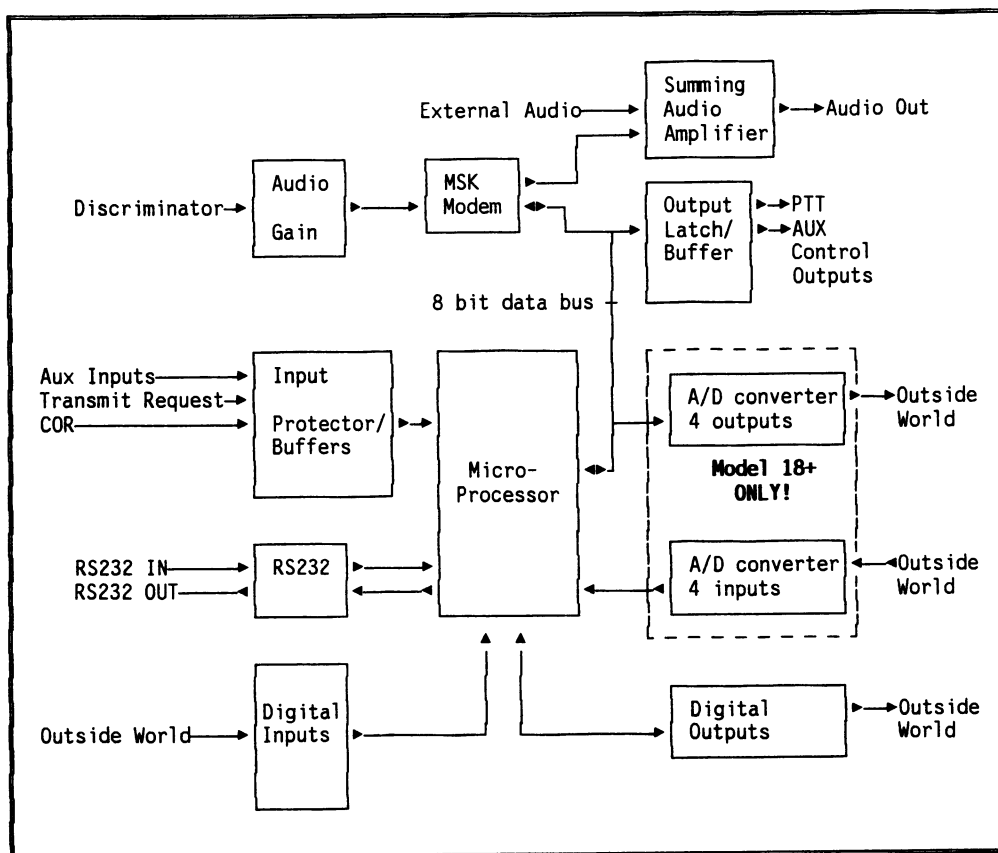
6. TROUBLESHOOTING GUIDE

6. TROUBLESHOOTING GUIDE

In case of installation or operational difficulty, call the Zetron
Industrial Systems Division at (206) 820-6363. Please have the serial
number of the unit and/or the Zetron order number. If the call is made from
the installation site by the installer or radio technician, the problem can
usually be solved over the phone.

Some commonly encountered problems can be solved by following the
recommendations below.

Problem: Unit will not communicate with PC or dumb terminal.

Recommendations: Make sure you are using some communications software
such as Cross-Talk, Pro-Comm, Kermit or ZCU or you are
using a dumb terminal. You cannot access the
programming mode directly from DOS.

Verify the baud rate at 4800, 8 bit, no parity, 1 stop
bit with echo off.

Verify that you have specified the correct
communications port.

You should see between -6 and -12 VDC on pins 2 and 3
of J1, the black 9-pin connector, when the RTU
is connected to the PC and both the PC and RTU have
power. If you do not see these voltages, check the
connections; most often they are reversed.

There should be a common ground reference for the
Control Link and the PC or terminal.

Press the space bar three times to access the menu.

Problem: Unit will not key the radio.

Recommendations: Check jumpers JP3 and JP4.

Make sure Channel Busy Detect is set correctly.

Problem: Units will not communicate.

Recommendation: Check addresses on all Control Links.

Problem:　　　　　　　　Unit is transmitting at unpredictable times.

Recommendation:　　　　Excess transmissions are usually due to one of the following: 1. an unused output is enabled causing the Control Link to send poll commands to another unit, or 2. an unused analog input is enabled causing the Control Link to detect and transmit input changes to another unit.

　　　　　　　　　　　　　Make sure all unused inputs and outputs are disabled.

　　　　　　　　　　　　　When creating a system using more than two Control Links, it is usually better to disable all I/O points first, and then re-enable only those that are to be used.

7. REPAIR

M1700 SERIES ENCLOSURE OUTLINE

COVER CENTERING PIN

7.25

1.125   5.00

2.75

2.25

1.00

6.00

10.50

10.625

BASE
PLATE

COVER

WIRING
ACCESS
AREA

COVER LATCH

7.375

2.75

2.25

1.25

1.25   3.25

.50

RADIO CABLE CLAMP

I/O WIRING CLAMP AREA

024-0057A

M1700 SERIES ENCLOSURE INSTRUCTIONS

TO REMOVE COVER

PULL LATCHES
TO RELEASE COVER

COVER
CENTERING
PIN

ROTATE COVER UP TO REMOVE
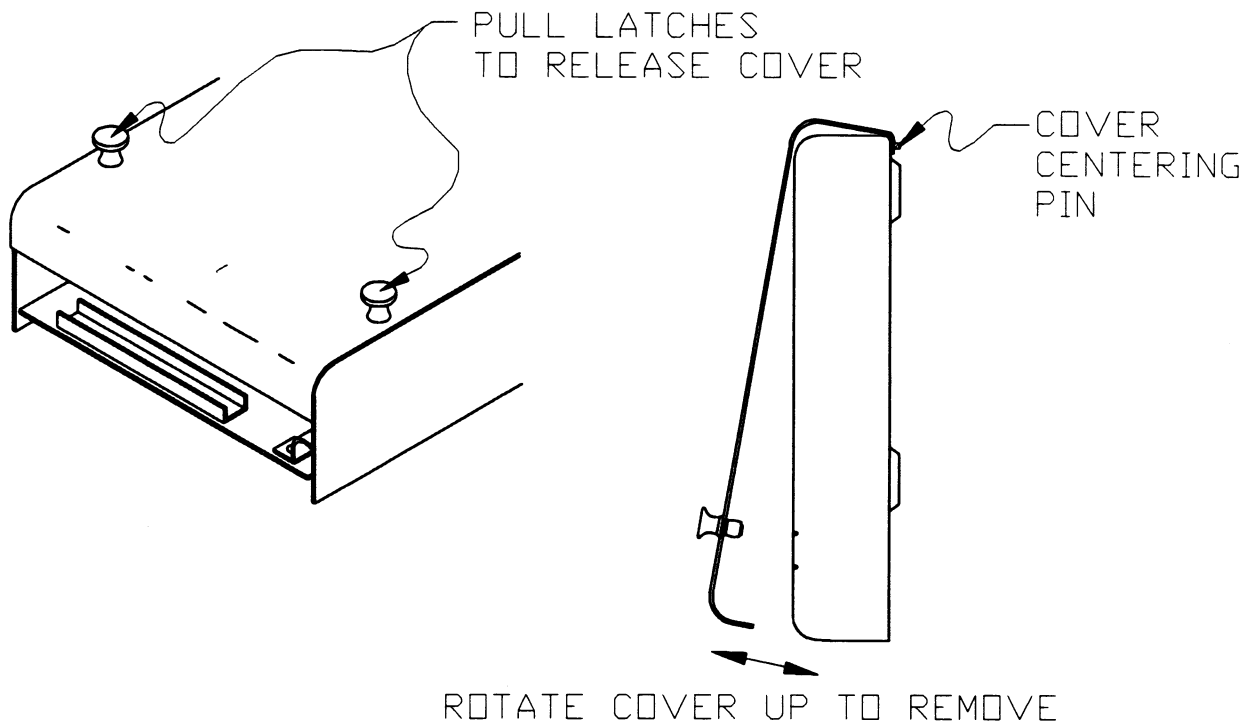
TO REPLACE COVER: POSITION COVER OVER THE CENTERING
PIN AND ROTATE CLOSED. LATCHES MUST BE IN THE "OUT" –
RELEASED POSITION TO ALLOW THE COVER TO FULLY CLOSE.
PUSH LATCHES "IN" TO SECURE COVER.

440 X 5/8 THREADED STANDOFF
2 PLCS

STRAIN RELIEF

632 X 1/4 SCREW
2 PLCS

CHASSIS GROUND

#6 STAR WASHER
2 PLCS

I/O CABLING
ACCESS AREA

HALF CLAMP

RADIO CABLE

024-0056C

UP

1.00 in.
(25.4 mm)

REMOVE PCB TO
ACCESS MOUNTING
HOLES (4 PLCS)

6.00 in.
(152 mm)

RECOMMEND #8 PAN HEAD
MOUNTING HARDWARE

1.125 in.
(28.5 mm)

5.00 in.
(127 mm)

NOT TO SCALE

GND

STRAIN RELIEF

DOWN

HALF
CLAMP

024-0056C PG. 2

7-3
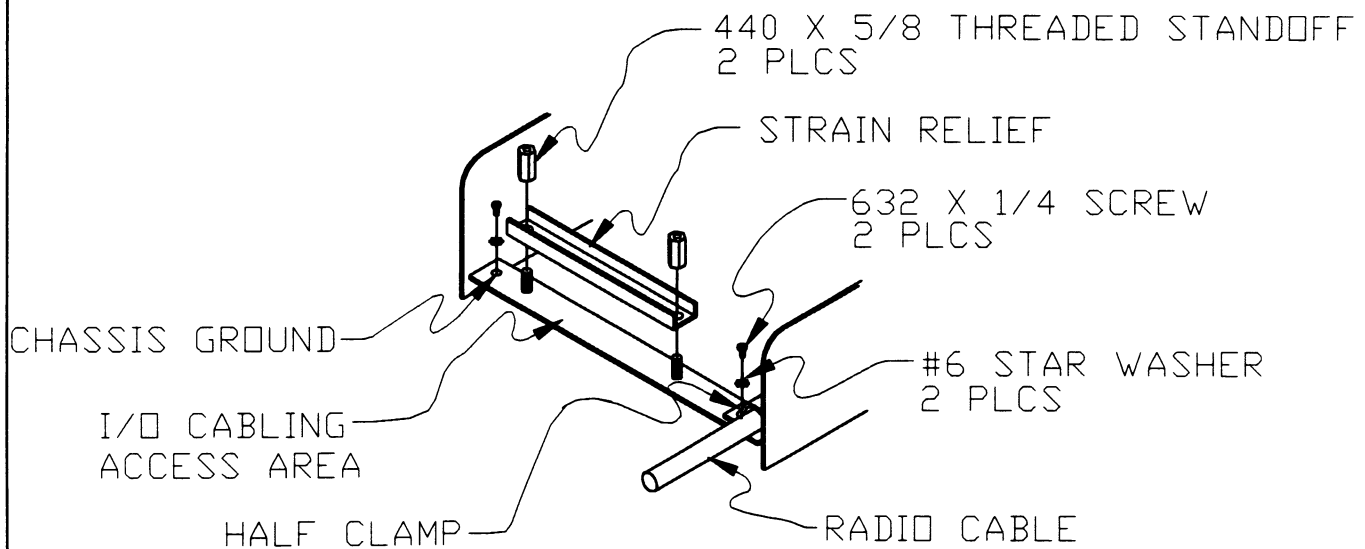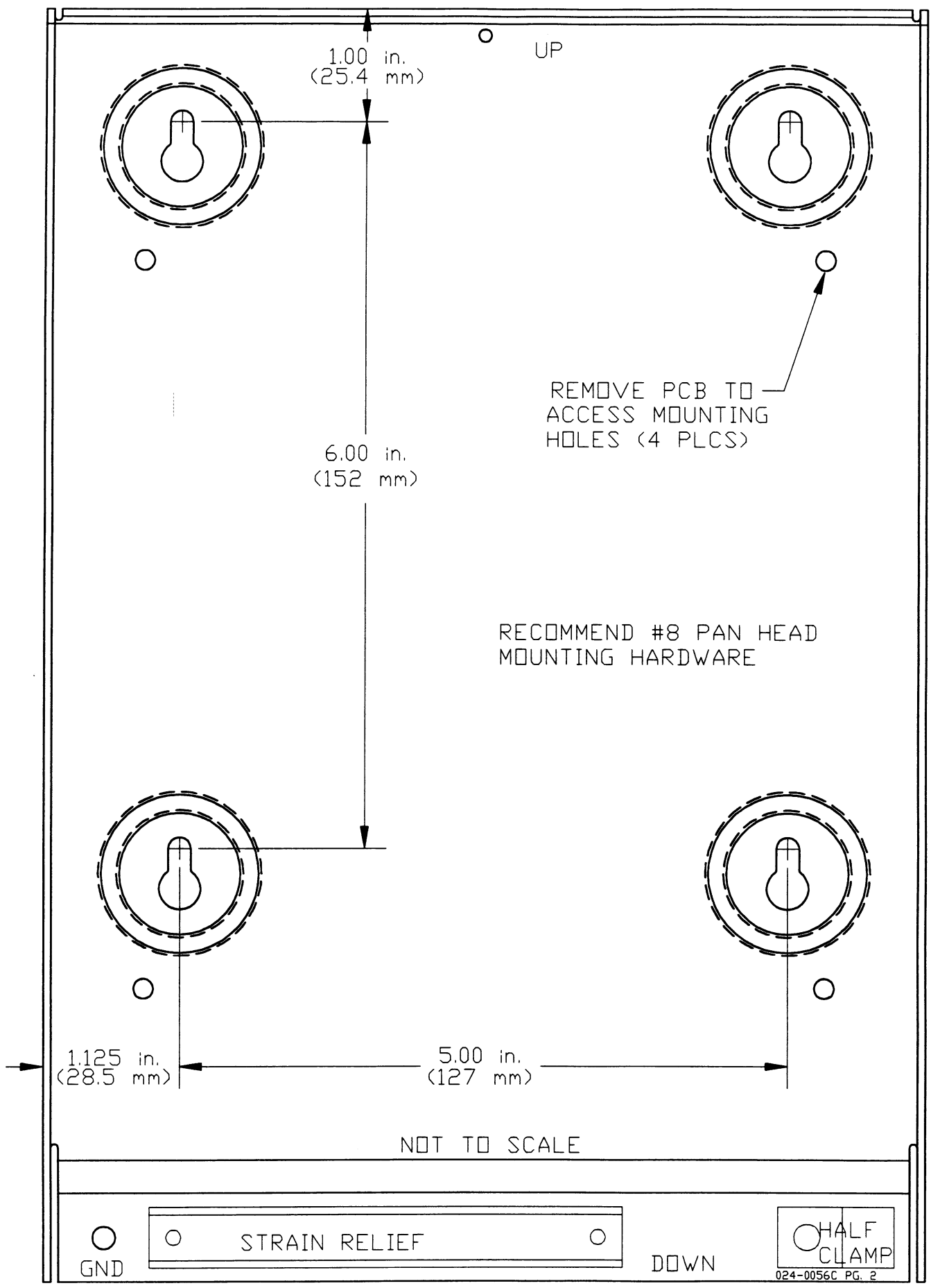
MODEL 18 CONTROL LINK PARTS LIST (702-9439B)

LEGEND:
+ = OPTION
/ = NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY

Item	Quantity	Reference	Part	Description		Mfg.Part No.
1	1	R6	101-0025	10 OHM 1/4W 5%	CARBON FILM	
2	1	R27	101-0047	47 OHM 1/4W 5%	CARBON FILM	
3	1	R13	101-0049	100 OHM 1/4W 5%	CARBON FILM	
4	1	R9	101-0057	220 OHM 1/4W 5%	CARBON FILM	
5	3	R46,R50,R51	101-0065	470 OHM 1/4W 5%	CARBON FILM	
6	2	R26,R36	101-0066	510 OHM 1/4W 5%	CARBON FILM	
7	5	R31,R32,R33,R34,R49	101-0081	2.2K 1/4W 5%	CARBON FILM	
8	1	R17	101-0089	4.7K 1/4W 5%	CARBON FILM	
9	16	R4,R7,R8,R11,R12,R14,R21, R23,R29,R35,R39,R37,R38, R40,R41,R47	101-0097	10K 1/4W 5% CARBON FILM		
10	1	R20	101-0099	12K 1/4W 5%	CARBON FILM	
11	1	R15	101-0105	22K 1/4W 5%	CARBON FILM	
12	1	R24	101-0106	24K 1/4W 5%	CARBON FILM	
13	1	R19	101-0109	33K 1/4W 5%	CARBON FILM	
14	3	R5,R18,R30	101-0113	47K 1/4W 5%	CARBON FILM	
15	1	R25	101-0115	56K 1/4W 5%	CARBON FILM	
16	1	R100	101-0121	100K 1/4W 5%	CARBON FILM	
17	1	R16	101-0131	270K 1/4W 5%	CARBON FILM	
18	1	R1	101-0138	510K 1/4W 5%	CARBON FILM	
19	3	R2,R3,R10	101-0145	1M 1/4W 5%	CARBON FILM	
20	4	R42,R43,R44,R45	104-0047	249 OHM 1/4W 1%		5043ED249ROF
21	1	R28	107-0501	5K POT 1 TURN		3386P-1-502
22	2	R48,R22	107-0502	50K POT 1 TURN		3386P-1-503
23	1	RP5	119-0006	10K x 9 R-SIP		4610X-101-103
24	1	RP4	119-0014	47K x 8 R-DIP		4116R-001-473
25	1	RP3	119-0018	47K X 8 R-SIP		RSL9X473J
26	2	RP1,RP2	119-0025	10K X 4 R-SIP		4608X-102-103
27	8	C25,C35,C36,C37,C39,C40, C41,C42	150-0096	1000 PF 1KV +-20%	CERAMIC DISC	GE-102G
28	4	C2,C3,C30,C31	151-0022	22PF 50V +-10%		CN15C220K
29	1	C15	151-0047	470 PF 50V +-10%	CERAMIC, TEMPERATURE STABLE	CW15C471K
30	22	C5,C8,C10,C12,C14,C17, C18,C20,C21,C22,C26,C27, C28,C29,C32,C33,C34,C43, C44,C45,C46,C51	151-0180	.1 UF 50V +-10%	CERAMIC, UNSTABLE	AVXSR205E104MAA
31	4	C6,C9,C16,C23	152-0012	.1 UF 50V +-5%	POLYESTER	ECQ-V1H104JZ
32	1	C24	152-0040	4.7 UF 50V	NON-POLAR ELECTROLYTIC	EHN-4.7M50BA
33	2	C1,C4	154-0025	1 UF 35V TANTALUM		ECS-F-35E1

MODEL 18 CONTROL LINK PARTS LIST (702-9439B) CONTINUED

Item	Quantity	Reference	Part	Description	Mfg.Part No.
34	6	C13,C19,C47,C48,C49,C50	154-0100	10 UF 16V TANTALUM	ECS-FICE106K
35	1	C11	155-0083	470 UF 10 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECEA-1AU471
36	1	C7	155-0141	3300 UF 16V +30%-10% RADIAL ALUMINUM ELECTROLYTIC	ECET16R332SW
37	7	E1,E2,E3,E4,E5,E6,E7	305-0001	FERRITE BEADS W/ LEADS	11413-3B
38	1	DS1	311-0010	LED RED LAMP	HLMP3300
39	1	DS2	311-0022	LED RED, T-1	LTL-4221
40	1	U19	316-0232	RS232 DRIVER	AD232JN
41	2	U5,U6	316-3072	DUAL HF OP-AMP	MC33072P
42	1	VR1	316-7805	REGULATOR, +5V 1.5A	LM340T-5
43	1	U2	321-0429	FFSK MODEM 24 DIP	
44	1	U13 NOTE 2	321-0751	ASIC 001	
45	1	U1	321-6264	8K X 8 RAM 150NS (5NS write hold)	MB-8461A-10L
46	1	U4	321-6812	MICRO P W/EEPROM	MC68HC11A1FN
47	1	U3 NOTE 2	322-7256	32Kx8 CMOS EPROM	AM27C256-200DC
48	1	U10	324-4138	DECODER 1 OF 8	MCH74HC138
49	1	U8	324-4373	OCTAL LATCH	MC74HC373
50	2	U9,U12	324-4374	OCTAL DFF REG	MC74HC374N
51	1	U11	324-7400	QUAD NAND	MC74HC00
52	1	U7	324-7414	HEX SCHMIDT	74HC14
53	1	U16	324-4259	LATCH, 8 BIT ADRESSABLE	74HC259
54	2	U17,U15	325-4244	OCTAL BUFFER	KS74HCT244
55	2	U18,U14	340-2003	RELAY DRIVER 50V/.5A	ULN2003
56	2	Q2,Q1	340-3904	NPN 40V/200MA	2N3904
57	1	CR1	342-3009	SILICON .50 SP	1N4148
58	1	CR3	342-3011	SILICON 1A 1000V .50 SP	1N4007
59	1	CR2	343-3100	1W 8.2V +-5% .50 SP	1N4738A
60	1	SW1	371-0010	DIP SW, 8 POS	CTS-206-008
61	2	Y1,Y2 NOTE 1	376-4032	4.032 MHz HC-18 CASE	CTS MP043
62	1	K1	380-0030	DPDT 12V COIL MINI RELAY	FBR244ND012/02CP
63	1	J2	401-0021	DB9 S	DEP-9S-CA
64	2	JA1,JB1	401-0222	9 PIN 90 DEGREE HEADER	1119.6
65	1	J4	401-0227	9 PIN 180 DEGREE HEADER	1106.6
66	1	P3	401-0223	10 PIN VERTICAL LOCKING HEADER	26-60-4100
67	4	TP1,TP2,TP3,TP4	403-0001	1 OF 401-0052	
68	9	JP2,JP4,JP5,JP6,JP11, JP12,JP13,JP14,JP19	403-0002	2 OF 401-0052	

MODEL 18 CONTROL LINK PARTS LIST (702-9439B) CONTINUED

Item	Quantity	Reference	Part	Description	Mfg.Part No.
69	6	JP1,JP3,JP7,JP8,JP9,JP10	403-0003	3 OF 401-0052	
70	1	F1	416-1576	FUSE AGC 1 A	AGC 1
71	2	XJ2	401-0042	DB LOCK SCREW	
72	10	XJP1,XJP3,XJP7,XJP8,	402-3040	MINI JUMPER	
		XJP9,XJP10 (POS B)			
		XJP4,XJP5,XJP6,XJP19 (INSTALL ON ONE PIN ONLY)			
73	2	XU5,XU6	407-0008	SKT, 08 PIN DIP	
74	2	XU7,XU11	407-0014	SKT, 14 PIN DIP	
75	5	XU10,XU14,XU16,XU18,XU19	407-0016	SKT, 16 PIN DIP	
76	5	XU8,XU9,XU12,XU15,XU17	407-0020	SKT, 20 PIN DIP	
77	1	XU13	407-0023	SKT, 24 PIN SKINNY DIP	
78	1	XU2	407-0024	SKT, 24 PIN DIP	
79	2	XU1,XU3	407-0028	SKT, 28 PIN DIP DBL	
80	1	XU4	407-0052	SKT, 52 PIN LCC	
81	2	XF1	416-3040	FUSE CLIP	
82	1	PCB	410-9439B	M1708 RTU BOARD	

NOTES:
1. SECURE COMPONENT TO BOARD USING 22GA. WIRE OR EQUIV.
2. TO BE PROGRAMMED AND INSTALLED BY PRODUCTION TECHNICIAN.

SHT 2 OF 3

ANALOG1
ANALOG2
ANALOG3
ANALOG4
FAIN
SOUT
TXREQ

D [0..7]
FAOUT
CORIND
R
SIN
$2400*
$2800*
R*

00894392.SCH

SHT 3 OF 3

D [0..7]
FAOUT
CORIND
R
SIN
$2400*
$2800*
R*

ANALOG1
ANALOG2
ANALOG3
ANALOG4
FAIN
SOUT
TXREQ

00894393.SCH

NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL CAPACITORS ARE IN MICROFARADS.

2. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.

3. ALL POTENTIOMETERS ARE 1 TURN.

UNUSED PARTS:

+12V   RP5I
        10
        10K

+5V   RP2D
        7   8
        10K

6   11
U14F
2003

7   10
U14G
2003

12   11
13
U11D
74HC00
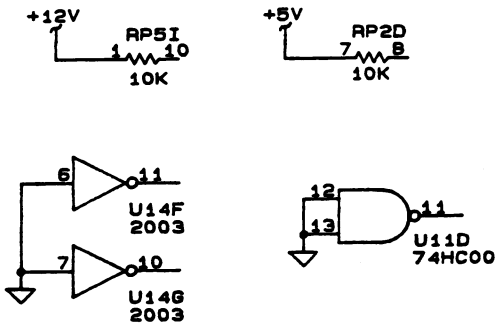
LEGEND:

+   OPTION, INSTALL PER
     CUSTOMER ORDER.

·   INSTALLED ON
     HIGHER ASSEMBLY.

♦   NOT INSTALLED.

—X— CUT TRACE.

---- JUMPER WIRE.

ZETRON, INC.

12335 134TH COURT N.E.
REDMOND, WASHINGTON, 98052-2433

Title
M1708 RTU

Size	Document Number	REV
B	008-9439	B

Date: September 4, 1992 Sheet 1 of 3

ZETRON, INC.

Title
MODEL 1708 RTU

Size	Document Number	REV
B	008-9439	B
Date:	November 11, 1992	Sheet 3 of 3

MODEL 18 CONTROL LINK SILKSCREEN (702-9439B)
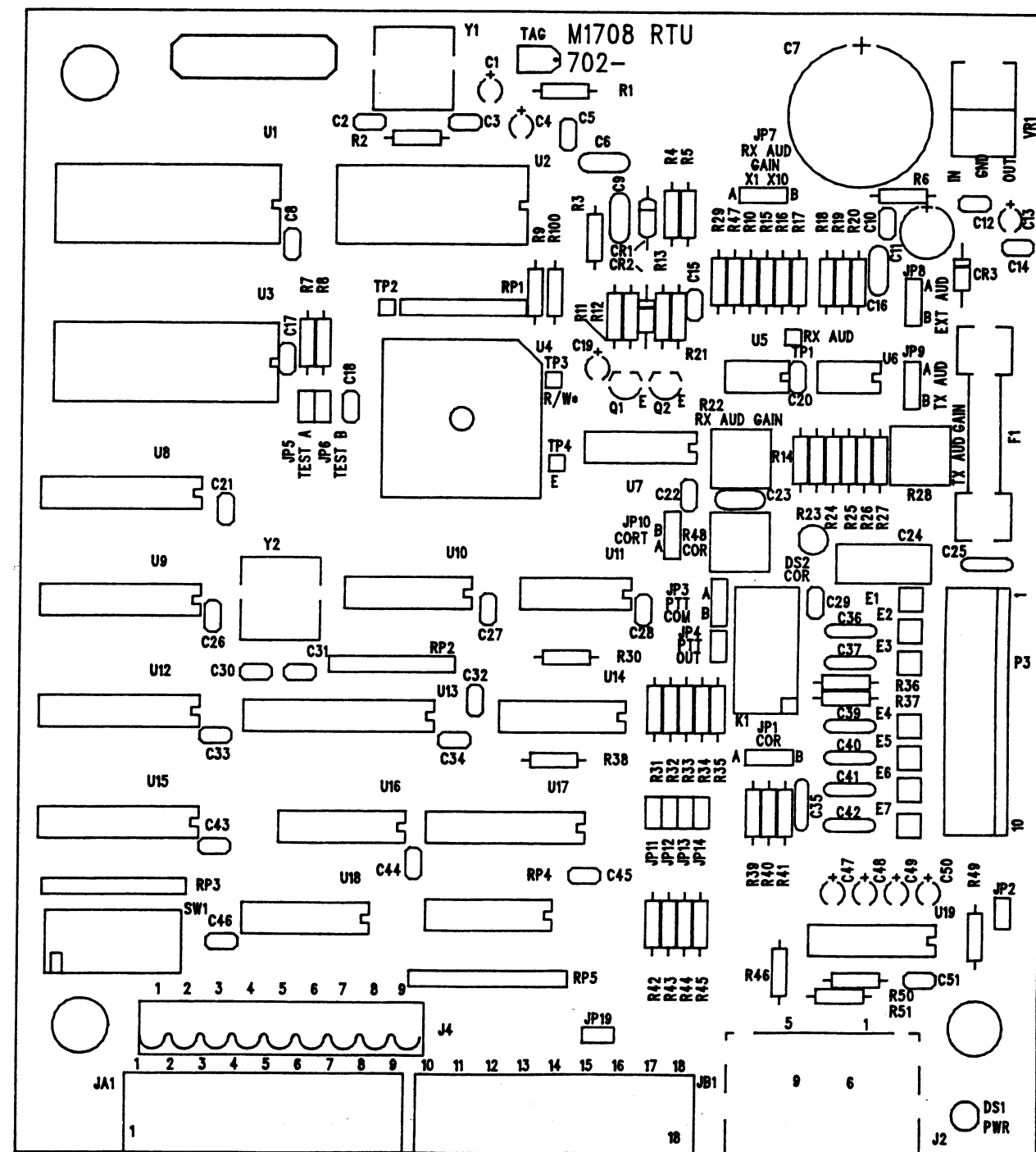
MODEL 18+ CONTROL LINK PARTS LIST (702-9440B)

LEGEND:
+ = OPTION
/ = NOT INSTALLED
^ = INSTALLED ON HIGHER ASSY

Item	Quantity	Reference	Part	Description	Mfg.Part No.
1	1	R25	101-0025	10 OHM 1/4W 5% CARBON FILM	
2	1	R18	101-0047	47 OHM 1/4W 5% CARBON FILM	
3	1	R13	101-0049	100 OHM 1/4W 5% CARBON FILM	
4	1	R6	101-0057	220 OHM 1/4W 5% CARBON FILM	
5	3	R48,R49,R57	101-0065	470 OHM 1/4W 5% CARBON FILM	
6	2	R22,R35	101-0066	510 OHM 1/4W 5% CARBON FILM	
7	1	R50	101-0081	2.2K 1/4W 5% CARBON FILM	
8	1	R19	101-0089	4.7K 1/4W 5% CARBON FILM	
9	17	R2,R11,R12,R14,R15,R30, R32,R33,R34,R36,R37,R38, R39,R51,R52,R53,R54	101-0097	10K 1/4W 5% CARBON FILM	
10	1	R3	101-0099	12K 1/4W 5% CARBON FILM	
11	1	R16	101-0105	22K 1/4W 5% CARBON FILM	
12	1	R20	101-0106	24K 1/4W 5% CARBON FILM	
13	1	R4	101-0109	33K 1/4W 5% CARBON FILM	
14	3	R1,R10,R31	101-0113	47K 1/4W 5% CARBON FILM	
15	1	R21	101-0115	56K 1/4W 5% CARBON FILM	
16	5	R8,R26,R27,R28,R29	101-0121	100K 1/4W 5% CARBON FILM	
17	1	R17	101-0131	270K 1/4W 5% CARBON FILM	
18	1	R7	101-0138	510K 1/4W 5% CARBON FILM	
19	3	R5,R9,R56	101-0145	1M 1/4W 5% CARBON FILM	
20	8	R40,R41,R42,R43,R44,R45, R46,R47	104-0047	249 OHM 1/4W 1%	5043ED249ROF
21	1	R24	107-0501	5K POT 1 TURN	3386P-1-502
22	2	R55,R23	107-0502	50K POT 1 TURN	3386P-1-503
23	2	RP8,RP5	119-0014	47K x 8 R-DIP	4116R-001-473
24	1	RP2	119-0018	47K X 8 R-SIP	RSL9X473J
25	1	RP1	119-0021	R/2R 100K/200K 10 PIN	RSC10L104G
26	2	RP6,RP9	119-0024	10K X 8 R-DIP	4116R-001-103
27	2	RP3,RP4	119-0025	10K X 4 R-SIP	4608X-102-103
28	1	RP7	119-0029	2.2K X 8 R-DIP	4116R-011-222
29	8	C44,C47,C50,C51,C53,C54, C55,C56	150-0096	1000 PF 1KV +-20% CERAMIC DISC	GE-102G
30	4	C3,C4,C30,C31	151-0022	22PF 50V +-10%	CN15C220K
31	1	C7	151-0047	470 PF 50V +-10% CERAMIC, TEMPERATURE STABLE	CW15C471K
32	29	C1,C6,C8,C9,C10,C15,C16, C17,C18,C19,C20,C24,C25, C27,C28,C29,C32,C38,C39, C40,C41,C42,C43,C45,C46, C48,C49,C52,C57	151-0180	.1 UF 50V +-10% CERAMIC, UNSTABLE	AVXSR205E104MAA
33	8	C2,C12,C13,C21,C34,C35, C36,C37	152-0012	.1 UF 50V +-5% POLYESTER	ECQ-V1H104JZ

MODEL 18+ CONTROL LINK PARTS LIST (702-9440B) Continued

Item	Quantity	Reference	Part	Description	Mfg.Part No.
34	1	C22	152-0040	4.7 UF 50V NON-POLAR ELECTROLYTIC	EHN-4.7M50BA
35	2	C5,C11	154-0025	1 UF 35V TANTALUM	ECS-F-35E1
36	6	C14,C26,C58,C59,C60,C61	154-0100	10 UF 16V TANTALUM	ECS-FICE106K
37	1	C23	155-0083	470 UF 10 VOLT RADIAL ALUMINUM ELECTROLYTIC	ECEA-1AU471
38	1	C33	155-0141	3300 UF 16V +30%-10% RADIAL ALUMINUM ELECTROLYTIC	ECET16R332SW
39	7	E1,E2,E3,E4,E5,E6,E7	305-0001	FERRITE BEADS W/ LEADS	11413-3B
40	1	DS1	311-0010	LED RED LAMP	HLMP3300
41	1	DS2	311-0022	LED RED, T-1	LTL-4221
42	1	U25	316-0232	RS232 DRIVER	AD232JN
43	1	U24	316-0324	OP-AMP, QUAD	LM324
44	1	U5	316-0358	OP-AMP, DUAL	LM358N
45	2	U6,U26	316-3072	DUAL HF OP-AMP	MC33072P
46	1	VR1	316-7805	REGULATOR, +5V 1.5A	LM340T-5
47	1	U3	321-0429	FFSK MODEM 24 DIP	
48	1	U15 NOTE 2	321-0751	ASIC 001	
49	1	U1	321-6264	8K X 8 RAM 150NS (5NS write hold)	MB-8461A-10L
50	1	U10	321-6812	MICRO P W/EEPROM	MC68HC11A1FN
51	1	U2 NOTE 2	322-7256	32Kx8 CMOS EPROM	AM27C256-200DC
52	1	U18	323-4066	QUAD ANALOG SWITCH	MC14066B
53	1	U13	324-4138	DECODER 1 OF 8	MCH74HC138
54	2	U16,U20	324-4259	LATCH, 8 BIT ADDRESSABLE	74HC259
55	1	U7	324-4373	OCTAL LATCH	MC74HC373
56	2	U12,U9	324-4374	OCTAL DFF REG	MC74HC374N
57	1	U11	324-7400	QUAD NAND	MC74HC00
58	1	U8	324-7414	HEX SCHMIDT	74HC14
59	3	U14,U17,U19	325-4244	OCTAL BUFFER	KS74HCT244
60	1	U4	325-4374	OCTAL DFF REG TS	74HCT374
61	3	U21,U22,U23	340-2003	RELAY DRIVER 50V/.5A	ULN2003
62	2	Q1,Q2	340-3904	NPN 40V/200MA	2N3904
63	10	CR1,CR2,CR5,CR6,CR7,CR8, CR9,CR10,CR11,CR12	342-3009	SILICON .50 SP	1N4148
64	1	CR4	342-3011	SILICON 1A 1000V .50 SP	1N4007
65	1	CR3	343-3100	1W 8.2V +-5% .50 SP	1N4738A
66	1	SW1	371-0010	DIP SW, 8 POS	CTS-206-008
67	2	Y1,Y2 NOTE 1	376-4032	4.032 MHz HC-18 CASE	CTS MP043
68	1	K1	380-0030	DPDT 12V COIL MINI RELAY	FBR244ND012/02CP
69	1	J2	401-0021	DB9 S	DEP-9S-CA
70	2	J1A,J1B	401-0222	9 PIN 90 DEGREE HEADER	1119.6
71	1	P3	401-0223	10 PIN VERTICAL LOCKING HEADER	26-60-4100
72	4	J4B,J4A,J5B,J5A	401-0227	9 PIN 180 DEGREE HEADER	1106.6
73	1	P6	401-1153	50 PIN RIBBON CONNECTOR HEADER	050-050-153A
74	4	TP1,TP2,TP3,TP4	403-0001	1 OF 401-0052	
75	14	JP2,JP4,JP5,JP6,JP11, JP12,JP13,JP14,JP15,JP16, JP17,JP18,JP19,JP20	403-0002	2 OF 401-0052	

MODEL 18+ CONTROL LINK PARTS LIST (702-9440B) Continued

Item	Quantity	Reference	Part	Description	Mfg.Part No.
76	22	JP1,JP3,JP7,JP8,JP9,JP10, JP21,JP22,JP23,JP24,JP25, JP26,JP27,JP28,JP29,JP30, JP31,JP32,JP33,JP34,JP35, JP36	403-0003	3 OF 401-0052	
77	1	JP37	403-0008	8 OF 401-0052	
78	1	F1	416-1576	FUSE AGC 1 A	AGC 1
79	2	XJ1	401-0042	DB LOCK SCREW	
80	10	XJP1,XJP3,XJP7,XJP8, XJP9,XJP10 (POS B) XJP4,XJP5,XJP6,XJP19 (INSTALL ON ONE PIN ONLY)	402-3040	MINI JUMPER	
81	3	XU5,XU6,XU26	407-0008	SKT, 08 PIN DIP	
82	4	XU8,XU11,XU18,XU24	407-0014	SKT, 14 PIN DIP	
83	7	XU13,XU16,XU20,XU21,XU22, XU23,XU25	407-0016	SKT, 16 PIN DIP	
84	7	XU4,XU7,XU9,XU12,XU14, XU17,XU19	407-0020	SKT, 20 PIN DIP	
85	1	XU15	407-0023	SKT, 24 PIN SKINNY DIP	
86	1	XU3	407-0024	SKT, 24 PIN DIP	
87	2	XU1,XU2	407-0028	SKT, 28 PIN DIP	
88	1	XU10	407-0052	SKT, 52 PIN LCC	
89	2	XF1	416-3040	FUSE CLIP	
90	1	PCB	410-9440B	M1716 RTU BOARD	

NOTES:
1. SECURE COMPONENT TO BOARD USING 22GA. WIRE OR EQUIV.
2. TO BE PROGRAMMED AND INSTALLED BY PRODUCTION TECH.

REV	DESCRIPTION	DRN	APD	DATE
A	RELEASE	KM		
B	HCN 1942A	KN	D.H.	11-12-42

SHT 2 OF 3

> ALOG1   D[0..7] >
> ALOG2   D/A >
> ALOG3
> ALOG4   DAC1 >
> ALOG5   DAC2 >
> ALOG6   DAC3 >
> ALOG7   DAC4 >
> ALOG8
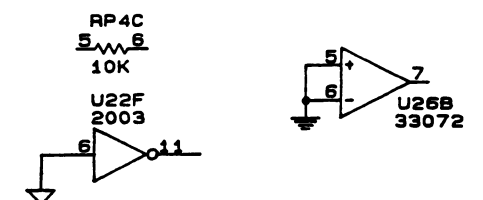>   FAOUT >
> FAIN   CORIND >

> IN1   OUT1 >
> IN2   OUT2 >
> IN3   OUT3 >
> IN4   OUT4 >
> IN5   OUT5 >
> IN6   OUT6 >
> IN7   OUT7 >
> IN8   OUT8 >
> IN9   OUT9 >
> IN10   OUT10 >
> IN11   OUT11 >
> IN12   OUT12 >
> IN13   OUT13 >
> IN14   OUT14 >
> IN15   OUT15 >
> IN16   OUT16 >

>   R
>   R*
>   SIN
> SOUT
> TXREQ $2400*
> $2800*

00894402.SCH

SHT 3 OF 3

> D[0..7]
> D/A
> DAC1
> DAC2
> DAC3
> DAC4
> CORT

> IN1   OUT1 >
> IN2   OUT2 >
> IN3   OUT3 >
> IN4   OUT4 >
> IN5   OUT5 >
> IN6   OUT6 >
> IN7   OUT7 >
> IN8   OUT8 >
> IN9   OUT9 >
> IN10   OUT10 >
> IN11   OUT11 >
> IN12   OUT12 >
> IN13   OUT13 >
> IN14   OUT14 >
> IN15   OUT15 >
> IN16   OUT16 >

> R   PTT >
> R*
> SIN
> $2400*   SOUT >
> $2800*

00894403.SCH

SHT 4 OF 4

> D/A   ALOG1 >
>   ALOG2 >
> DAC1   ALOG3 >
> DAC2   ALOG4 >
> DAC3   ALOG5 >
> DAC4   ALOG6 >
>   ALOG7 >
>   ALOG8 >
> FAOUT   CORT >
> CORIND   FAIN >

> OUT1   IN1 >
> OUT2   IN2 >
> OUT3   IN3 >
> OUT4   IN4 >
> OUT5   IN5 >
> OUT6   IN6 >
> OUT7   IN7 >
> OUT8   IN8 >
> OUT9   IN9 >
> OUT10   IN10 >
> OUT11   IN11 >
> OUT12   IN12 >
> OUT13   IN13 >
> OUT14   IN14 >
> OUT15   IN15 >
> OUT16   IN16 >

> PTT

>   TXREQ

00894404.SCH

NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL CAPACITORS ARE IN MICROFARADS.

2. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
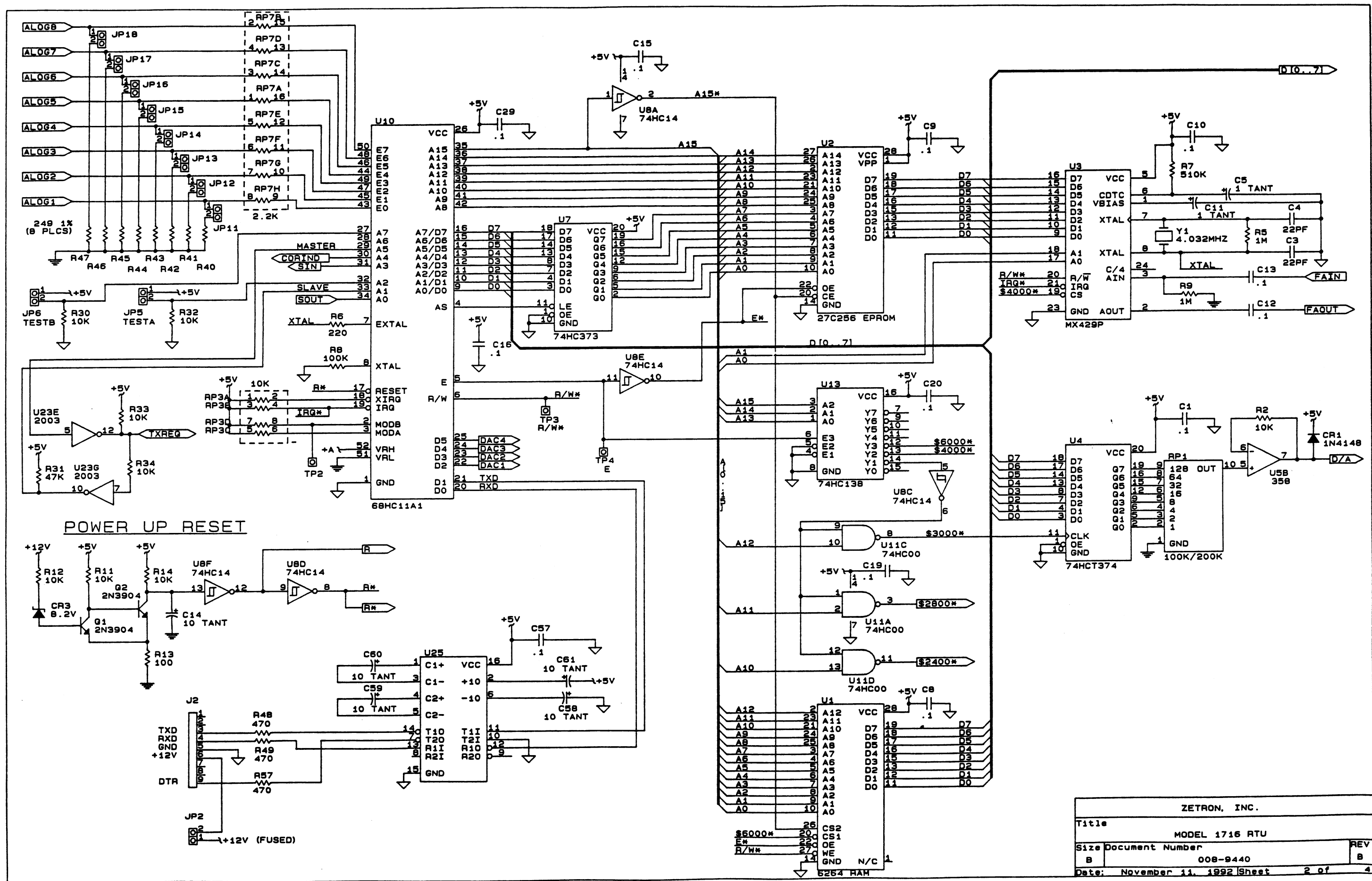
3. ALL POTENTIOMETERS ARE 1 TURN.

UNUSED PARTS:

RP4C
5 —/\/\/— 6
10K

U22F
2003
6 — o11

5
6
7
U26B
33072

LEGEND:

+	OPTION. INSTALL PER CUSTOMER ORDER.
-	INSTALLED ON HIGHER ASSEMBLY.
*	NOT INSTALLED.
——X——	CUT TRACE.
- - - - - -	JUMPER WIRE.

ZETRON, INC.

12335 134TH COURT N.E.
REDMOND, WASHINGTON, 98052-2433

Title
M1716 RTU

Size: B
Document Number: 008-9440
REV: B

Date: September 4, 1992   Sheet   1 of   4

ZETRON, INC.

Title: MODEL 1716 RTU

Size: B
Document Number: 008-9440
REV: B
Date: November 11, 1992
Sheet 2 of 4

7-15
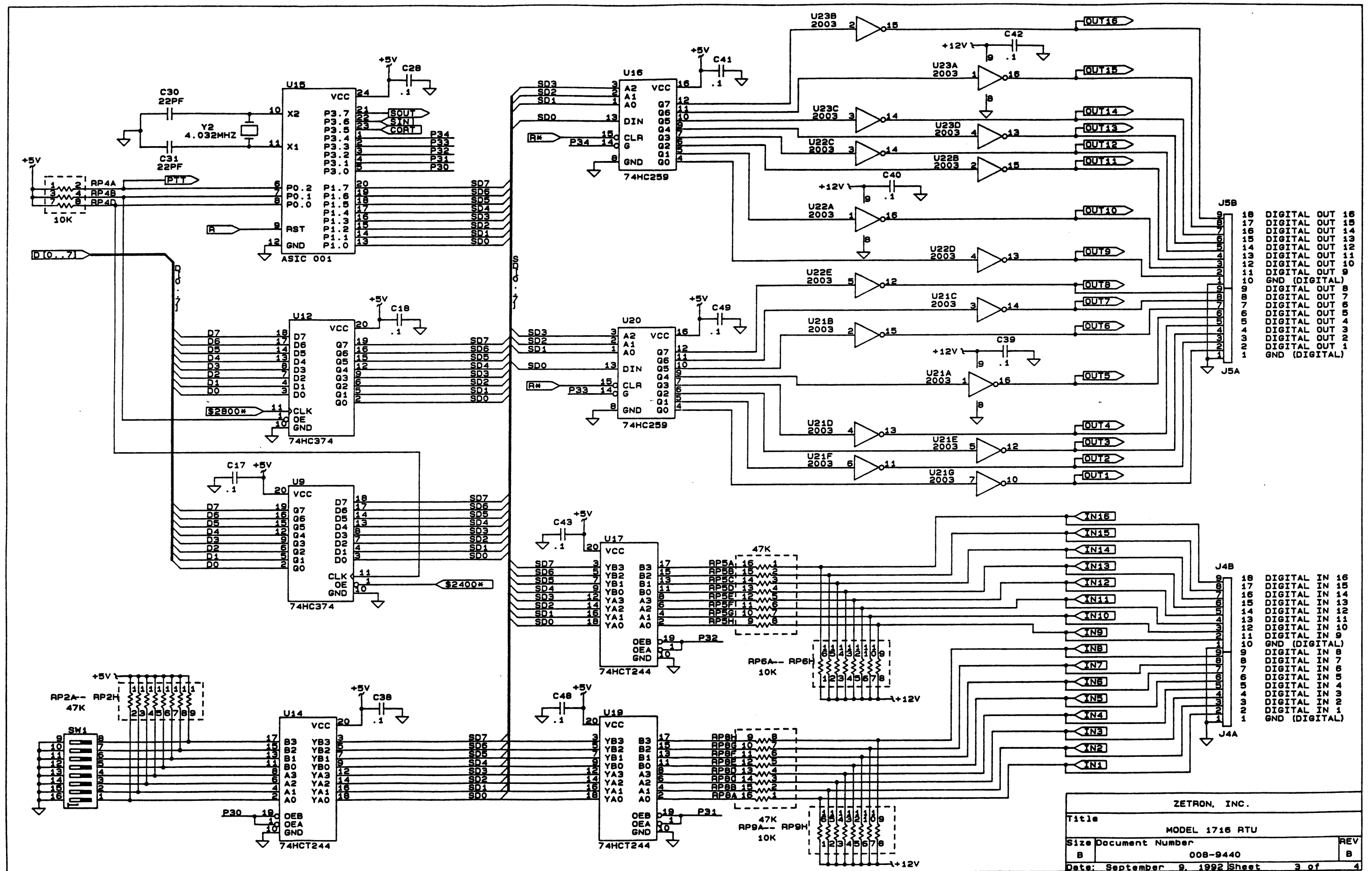
MODEL 1716 RTU

ZETRON, INC.

Size: B Document Number: 008-9440 REV: B

Date: September 9, 1992 Sheet 3 of 4

ZETRON, INC.

Title
MODEL 1716 RTU

Size: B
Document Number
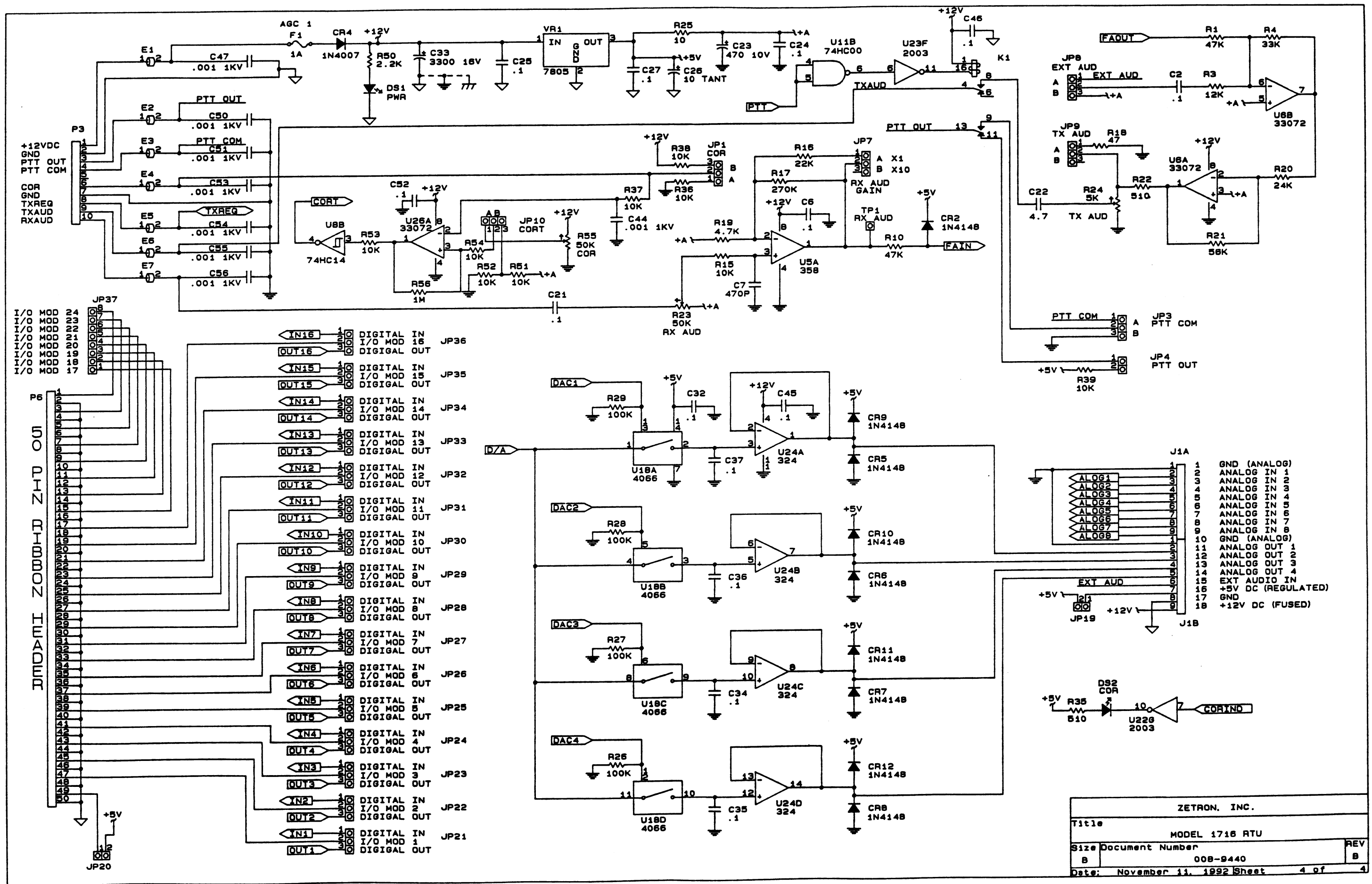008-9440
REV: B

Date: November 11, 1992
Sheet 4 of 4

MODEL 18+ CONTROL LINK SILKSCREEN (702-9440B)