MOSELEY ASSOCIATES, INC.

INSTRUCTION MANUAL

MODEL TCS-2A
MICROPROCESSOR-BASED
TELEMETRY CONTROL SYSTEM

MOSELEY ASSOCIATES, INC.
Santa Barbara Research Park
111 Castilian Drive
Goleta, California 93017

9 June 1980

(805) 968-9621

TABLE OF CONTENTS

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense will be required to take whatever measures may be required to correct the interference.

1 January 1981

At the Command Terminal, the status conditions are displayed on eight LEDs. The commands are selected via eight switches. The telemetry value displayed is selected by the CHANNEL SELECT push button. Both terminals are equipped with CARRIER DETECT indicators and LAMP/STATUS TEST push buttons.

The Remote Terminal performs these four basic functions:

1. Outputs and displays commands received from the Command Terminal
2. Inputs and displays status conditions
3. Inputs and displays telemetry (analog) values
4. Sends command echo, status, and telemetry information to the Commmand Terminal

The Command Terminal performs these four basic functions:

1. Inputs commands
2. Displays status conditions
3. Displays telemetry (analog) values
4. Requests display information from and sends command information to the Remote Terminal

2.0 SYSTEM SPECIFICATIONS

2.1 INTRODUCTION

In addition to the system specifications, the specifications of each operational section is presented.

2.2 SYSTEM

Type	Microprocessor-based Remote and Command Terminals
Number of Command Terminals	One active in a system at one time
Number of Remote Terminals	One typical, 16 maximum
Control Fail-safe	Complies with current FCC requirements for AM and FM service. Responds 45 seconds after failure of interconnect circuit. Output relay contacts: SPDT (Form C) rated at 50 W, non-inductive. (30 Vdc or 120 Vac, maximum)
Alarm Indications	Command Terminal: visual Remote Terminal: visual and/or external aural user capabilities.
Maintenance Override	LED at the Command Terminal indicates Remote Terminal is being calibrated.

2.3 INTERCONNECT

Classes	2-wire or 4-wire, FM subcarrier, or combination
2-Wire or 4-Wire	600 ohm balanced line, nominal. Series 3002 (basic conditioning) data channel per Bell System Technical Reference PUB-41004. Send level: 0 dBm, nominal. Receive level: -30 dBm, minimum.

Radio	2,200 ohm unbalanced line, nominal. Send level: 1.5 V p-p, nominal. Receive level: 0.25 V p-p, minimum
Modulation	Two-tone FSK. Mark frequency: 2,200 Hz Space frequency: 1,200 Hz
Data Rate	1,200 bits/second 2-way non-simultaneous
Data Format	7-bit ASCII plus parity in a 10 bit frame

2.4 COMMAND FUNCTIONS

Number of Command Lines	Eight per Remote Terminal
Inputs	Front-panel switches or external TTL-compatible closures at the Command Terminal. (3,300 ohm internal pull-up resistors)
Switch Modes	User programmable for either momentary or latching operation. Exclusive interlocks available upon request.
Tally-back	Front-panel LEDs at Remote Terminal. Command Terminal internal check.
Outputs	SPDT (Form C) relay contacts rated at 50 W, non-inductive. (30 Vdc or 120 Vac, maximum)
Response Time	125 ms, typical

2.5 STATUS FUNCTIONS

Number of Inputs	Eight per Remote Terminal

Inputs	TTL-compatible closures at the Remote Terminal. (3,300 ohm internal pull-up resistors)
Input Filtering	L-C low-pass filter per input
Input States	User programmable for N.O. or N.C. closures.
Indication	Front-panel LEDs at Remote and Command Terminals.
Outputs	TTL open collectors at the Command Terminal. 24 Vdc, 100 mA, maximum
Response Time	125 ms, typical

2.6 TELEMETRY (ANALOG) FUNCTIONS

Number of Channels	Eight per Remote Terminal
Inputs	Analog, ±10 Vdc, maximum
Input Impedance	1 Megohm, nominal
Input Filtering	L-C low-pass filter per channel
Calibration	Via potentiometers accessible through the front panel of the Remote Terminal. Calibration tool supplied.
A/D Resolution	One part in 1024
Measurement Accuracy	Better than 0.5%
Sample Interval	Greater than five times/second. (Less than 200 ms)
Display	3-3/4 digits (4096 counts, maximum) and polarity for value, one digit for channel.
Response Time	250 ms, typical

2.7 PHYSICAL

Power (Command and Remote)	120/240 Vac, 50/60 Hz 30 W, typical
Operating Temperature	0-50 C
Size (Command and Remote)	4.5 cm H x 48.4 cm W x 35.5 cm D (1.75" H x 19.0" W x 14.0" D) Depth less external connectors
Shipping Weight	
System	9 Kg (20 lbs), approximate
Command Terminal	4 Kg (9 lbs), approximate
Remote Terminal	5 Kg (11 lbs), approximate

3.0 UNPACKING AND PRE-INSTALLATION CHECKOUT

3.1 UNPACKING

The TCS-2A Command and Remote Terminals should be carefully unpacked and inspected for evident shipping damage. Keep all packing material in case a claim is to be made against the carrier for damages. Should this inspection reveal any damage, immediately file a claim with the carrier.

Remove the top covers from the units. Confirm that the various plug-in components are securely seated in their sockets.

3.2 PRE-INSTALLATION CHECKOUT

The purpose of this checkout is for the user to gain familiarity with system operation while both Command and Remote Terminals are together in one location. It is recommended that the user read the entire manual to understand the TCS-2A operation BEFORE attempting to connect the system to the user's equipment.

3.2.1 Command Terminal

Verify that the power-line voltage selector and fuse are set for the line voltage to be applied to the unit. The voltage selector is located at the left rear of the chassis. The units are shipped for 120 VAC operation unless otherwise specified. The voltage selected can be observed on the PC card visible through the window in the AC power connector. To change the voltage, remove the power cord, slide the access window to the left, and, with a small needle-nose pliers, grasp and remove the PC card. Orient the card for proper operation--either 120 Vac or 240 Vac only--and firmly re-place the PC card. Install the proper fuse for the applied voltage

as indicated by the placard on the AC power connector. Slide the window to the right and install the AC power cord.

Connect the AC power cord to the AC mains.

With the cover still removed, observe the left LED (CR10) on the (L-shaped) modem board. It should turn ON and OFF at a periodic rate indicating that the terminal is attempting to communicate with the Remote Terminal.

Depress the LAMP/STATUS TEST key. All LEDs and displays on the front panel, except for the STATUS LEDs, should illuminate. Releasing the key should extinguish the LEDs and displays.

This concludes the Command Terminal initial chekcout. Note that if the terminal is left in this conditon for an extended period of time (approximately 45 seconds), a fail-safe message on the display will result.

Remove the AC power cord from the AC mains.

3.2.2 Remote Terminal

Verify that the power-line voltage selector and fuse are set for the proper line voltage as explained above in the Command Terminal section.

Connect the AC power cord to the AC mains.

Depress the LAMP/STATUS TEST key. All LEDs and displays on the front panel should illuminate. Releasing the key should extinguish the LEDs and displays.

This concludes the Remote Terminal initial checkout. Note that, if the terminal is left in this condition for extended period of time (approximately 45 seconds), a fail-safe message on the display will result.

Remove the AC power cord from the AC mains.

3.2.3 System

The Command and Remote Terminals are normally shipped for 2-wire operation. For 4-wire operation, the following parts are to be installed on each modem board, and may be ordered from Moseley Associates, Inc. (Customer Service).

ITEM	DESCRIPTION	MANUFACTURER'S #	MOSELEY #	QUANTITY
T2	Transformer	Microtran MT1-PC	4090106	1
R3	Resistor	RC07GF391K (390Ω 1/4 W)	4410197	1

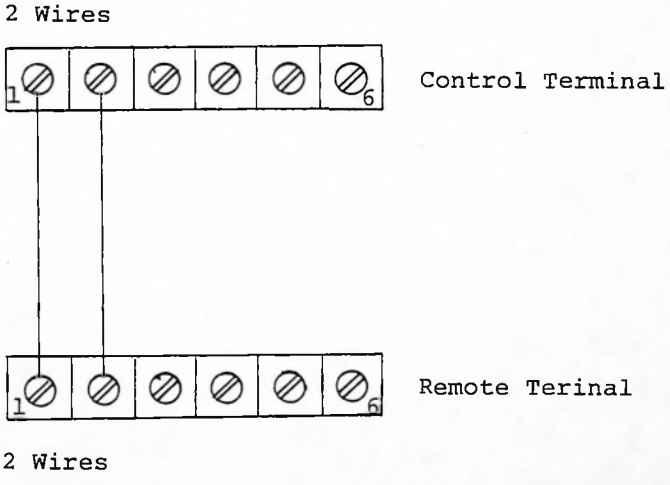
The instructions for installation may be found on drawing #20D2752 (Modem Component Assembly).

For radio operation, in addition to the components above, the following parts are to be installed on each rear panel. These may also be ordered from Moseley Associates, Inc. (Customer Service).

DESCRIPTION	MANUFACTURER'S #	MOSELEY #	QUANTITY
BNC Connector	Amphenol UG-1094/U	3030244	2
Ground Lug	Zierick 334	1190073	2

The instructions for installation may be found on drawing #20D2750 (Remote Component Assembly) or on drawing #20D2753 (Command Component Assembly).

Place the Command and Remote Terminals next to each other on a large flat surface. Connect the units together with short lengths of wire. Figure 3-1 shows the 2-wire interconnect, and Figure 3-2 shows the 4-wire interconnect. If the optional BNC connectors have been ordered, the connections may be made as in Figure 3-3.



2-Wire Interconnect
Figure 3-1

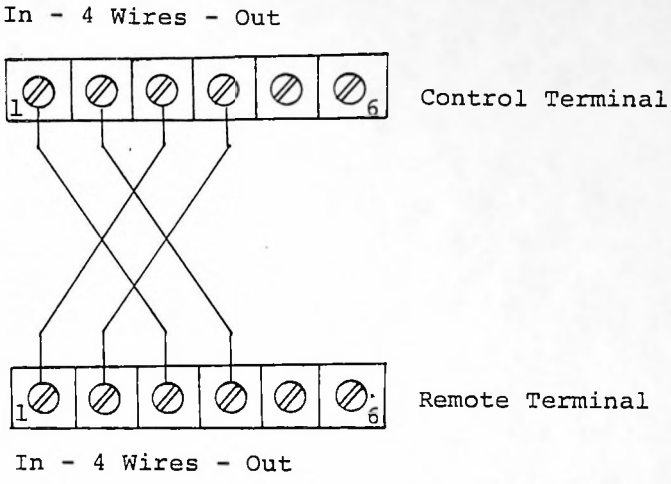


Figure 3-2
4-Wire Interconnect

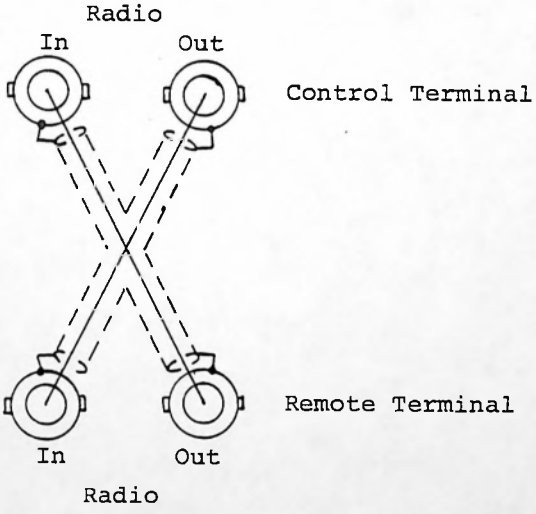


Figure 3-3
Radio Interconnect

With the covers still removed, verify that S3 (on the right-hand side) of the main electronics boards (the largest) in both terminals is set for the same position.

Verify that a jumper exists between the two terminals on the rear panel of the Remote Terminal marked "Control Enable".

Connect both AC power cords to the AC mains.

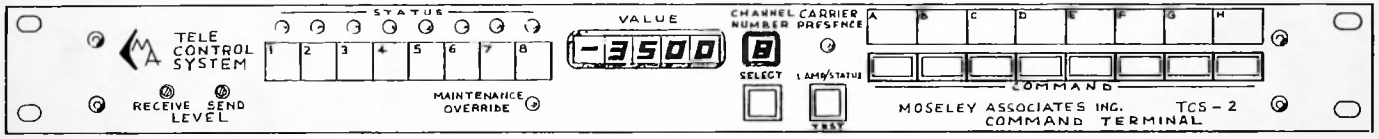
Note the LEDs on both modem boards. They should be flashing periodically together. If necessary, measure and adjust the input and output levels of the modems, as described in Section 7.3.2.

Depress the LAMP/STATUS TEST key on the Command Terminal front panel. All LEDs and displays, except for CARRIER PRESENCE, on BOTH front panels should illuminate. Releasing the key will return the LEDs and displays to normal operation.

Referring to Sections 4 and 5, the effects of commands may be observed, status inputs may be programmed for the user's requirements, and telemetry channels that have inputs may be calibrated.

In the event that any difficulty is encountered, review thoroughly Sections 4 and 7 to determine the cause of the difficulty.

This concludes the system pre-installation check. The user at this time may wish to set the status input switches on the Remote Terminal for logic levels that will be encountered in actual operation. (See Section 5.3.4) Remove the AC power cords from the AC mains and replace the top covers on the terminals.



REAR VIEW

SKC 6416

4-0

MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA

COMMAND TERMINAL
TCS-2

SKC 6416

4.0 COMMAND TERMINAL OPERATION

4.1 INTRODUCTION

This section defines the operation of the Command Terminal from the operator's viewpoint. A detailed description of each function is presented.

4.2 FRONT PANEL CONTROLS AND INDICATORS

When reading this section, please refer to an actual Command Terminal or drawing SKC6416.

4.2.1 Receive and Send Level

The RECEIVE LEVEL control adjusts the squelch level of the incoming signal for the demodulator. The SEND LEVEL potentiometer adjusts the output level of the modulator between -15 dBm and +6 dBm (minimum). Normally these levels are adjusted once at the time of system installation as described in Section 7.3.2. Once adjusted, it is usually not necessary to change the settings.

4.2.2 Status Indicators

The eight red LEDs display the condition or state of each status input at the Remote Terminal. Note the status inputs are following and not latching. Each input is user programmable at the Remote Terminal for a N.O. or N.C. closure (or alternately, active-high or active-low TTL levels).

4.2.3 Maintenance Override

The single yellow LED indicates, when illuminated, that the Remote Terminal has been placed in the local mode. When in this condition,

the Command Terminal can receive status and telemetry information, but cannot issue commands.

4.2.4 Value Display

This 3-3/4 digit display (4096 counts) gives the digitized value of the analog voltage of the selected telemetry channel. When the value is positive, no sign is indicated; when negative, a minus sign is shown. In an overrange condition, "OUCH" appears. Leading zeros are suppressed for readings below 1000. The value is blanked when Channel 0 is selected. When the Command Terminal is not receiving data from a Remote Terminal, "FAIL" and "SAFE" are displayed alternately instead of the telemetry value.

4.2.5 Channel Number Display

This 1-digit display gives the channel number of the telemetry value displayed. The channel is selected via the CHANNEL SELECT push button.

4.2.6 Channel Select

The desired telemetry channel is selected by this push button. Each time the push button is depressed and released, the channel number display is advanced by one. Channels 1-8 are analog channels. Channel 0 blanks the value display.

4.2.7 Carrier Presence

This green LED is illuminated whenever the level of the received carrier is higher than the squelch level selected via the RECEIVE LEVEL potentiometer. Otherwise, the indicator will remain off. Under normal line conditions, the LED should be illuminated or flashing.

4.2.8 Lamp/Status Test

This push button activates the lamp test and sytem status test functions. When depressed, all the LEDs and displays, except for CARRIER PRESENCE, should be illuminated. The displays will show "8"s in this condition. There will be a slight delay in the illumination of the STATUS indicators. The STATUS indicators are tested via the Remote Terminal to insure system integrity. Releasing the push button returns the LEDs and displays to normal operation.

4.2.9 Command Switches

These switches allow the operator to issue up to eight independent command to the Remote Terminal. Each can be user-programmed, via a small tab on top of each switch, to be either latching or momentary. Interlocking action can be provided on special order. For positive indication of state, the command switch faces become yellow when active and black when released.

4.3 REAR-PANEL CONNECTIONS

When reading this section, please refer to an actual Command Terminal or drawing SKC6416.

4.3.1 Site Select

This 9-pin "D" connector allows the user access to the four site-select lines together with +5 Vdc and logic ground. This is provided to allow a single Command Terminal to communicate with multiple Remote Terminals. Ths user could wire a BCD-encoded thumbwheel or rotary switch to select different sites. It should be noted that, when multiple Remote Terminals are controlled using this feature, only momentary type commands are practical. The LED indicators and displays would be time-multiplexed and only indicate the conditions that exist at the site selected.

4.3.2 Status Output

This 25-pin "D" connector provides status indication to the user's external equipment. Each status output corresponds to a LED on the front panel. Each output, when used with its ground return, is capable of sinking up to 100 mA at voltages up to 24 Vdc.

4.3.3 Command Input

This 25-pin "D" connector allows the user to issue commands from external circuitry. Eight active input lines and eight logic ground lines are provided. The command inputs accept TTL-compatible closures to ground. Each input has a 3300 ohm internal pull-up. Note that the front-panel switches must be OFF in order to use external switching and vice-versa since each of the two corresponding inputs is paralleled (ORed together).

4.3.4 Terminal Barrier Strip

These connections are used to interconnect the TCS-2A system. Two of the six connections are not used. In the 2-wire mode, the modems are operated over a single AC interconnect pair. Such service can be provided by a leased telephone company private channel or user-provided equipment. A simple conductor pair will also suffice provided the specifications of the telephone interconnect are met. The modem board (91C7174) should be jumpered for 2-wire operation. Figure 3-1 shows the 2-wire interconnect.

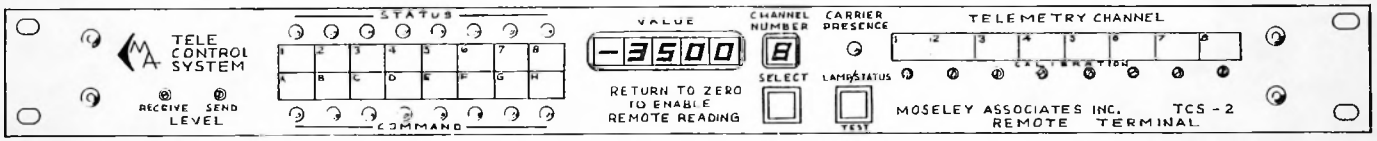
In the 4-wire mode, two communication pairs are required for proper operation. The modem board should be strapped for 4-wire operation. Figure 3-2 shows the 4-wire interconnect.

4.3.5 Optional BNC Connectors

At the user's request, two BNC connectors can be installed at the factory to provide unbalanced input and output interconnect signals for radio circuits. The nominal impedance of each circuit is 2200 ohms. Figure 3-3 shows the radio interconnect.

4.3.6 AC Power

The standard TCS-2A power supply accepts either 120 Vac or 240 Vac at 50 or 60 Hz. The power supply module has a receptacle for the line cord that also contains the AC line fuse and a voltage-programming PC card (See Section 3.2.1).



REAR VIEW

SKC 6415

5-0

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA

REMOTE TERMINAL
TCS - 2

SIZE PART NO. NONE
SKC 6415

5.0 REMOTE TERMINAL OPERATION

5.1 INTRODUCTION

This section defines the operation of the Remote Terminal from the operator's viewpoint. A detailed description of each function is presented.

5.2 FRONT-PANEL CONTROLS AND INDICATORS

When reading this section, please refer to an actual Remote Terminal or drawing SKC6415.

5.2.1 Receive and Send Level

The RECEIVE LEVEL control adjusts the squelch level of the incoming signal for the demodulator. The send level potentiometer adjusts the output level of the modulator between -15 dBm and +6 dBm. (minimum). Normally these levels are adjusted once at the time of system installation, as described in Section 7.3.2. Once adjusted, it is usually not necessary to change the settings.

5.2.2 Status Indicators

The eight red LEDs display the condition or state of each status input at the Remote Terminal. Note the status inputs are following and not latching. Each input is user programmable at the Remote Terminal for a N.O. or N.C. closure (or alternately, active-high or active-low TTL levels). An ON position of S2 denotes N.O. and an OFF position denotes N.C.

5.2.3 Command Indicators

The eight yellow LEDs indicate which commands have been issued by the Command Terminal. In order for the LEDs to indicate the state of the command output relays, the control enable terminals on the

rear panel must be connected together either by a strap or a defeat switch. Alternatively, the terminals may be connected via the fail-safe relay. In this configuration, the command output relays normally will operate simultaneously with the LEDs. If the interconnect ceases to function, the fail-safe relay will relax, thus disabling the command output relays. The LEDs will still reflect the last issued commands prior to the loss of interconnect. These configurations are shown in drawing SKC6415.

5.2.4 Value Display

This 3-3/4 digit display (4096 counts) gives the digitized value of the analog voltage of the telemetry channel being calibrated. When the value is positive, no sign is indicated; when negative, a minus sign is shown. In an overrange condition, "OUCH" appears. Leading zeros are suppressed for readings below 1000. The value is blanked when Channel 0 is selected. When the Remote Terminal is in a fail-safe condition, "FAIL" and "SAFE" are displayed alternately instead of the telemetry value.

5.2.5 Channel Number Display

This 1-digit display gives the channel number of the telemetry value being calibrated. The channel is selected via the CHANNEL SELECT push button.

5.2.6 Channel Select

The telemetry channel to be calibrated is selected by this push button. Each time the push button is depressed and released, the channel number display is advanced by one. Channels 1-8 are analog channels. Channel 0 blanks the value display and returns the Remote Terminal to the control mode enabling commands to be received from the Control Terminal. Once again, COMMANDS WILL BE IGNORED UNLESS CHANNEL 0 IS SELECTED AT THE REMOTE TERMINAL!

5.2.7 Carrier Presence

This green LED is illuminated whenever the level of the received carrier is higher than the squelch level selected via the RECEIVE LEVEL potentiometer. Otherwise, the indicator will remain off. Under normal line conditions, the LED should be flashing.

5.2.8 Lamp/Status Test

This push button activates the lamp test and remote status test functions. When depressed, all the LEDs and displays, except for CARRIER PRESENCE, should be illuminated. The displays will show "8"s in this condition. In addition to the LEDs and displays at the Remote Terminal, the STATUS LED's at the Command Terminal will be illuminated. This is another system integrity test. Releasing the push button returns the LEDs and displays to normal operation.

5.2.9 Telemetry (Analog) Channel Calibration

These eight potentiometers allow individual calibration of the eight analog inputs. The CHANNEL SELECT push button activates the calibration mode. The CHANNEL NUMBER display indicates which channel is being calibrated. Adjust the corresponding trim pot to obtain the desired reading at the VALUE display. Return the terminal to Channel 0 to enable commands to be received from the Command Terminal. The MAINTENANCE OVERRIDE LED at the Command Terminal indicates when the Remote Terminal is being calibrated.

A note is in order here to explain the correspondence between the analog input and the value displayed. When a calibrate potentiometer is at its highest position (fully clockwise), then the display value is equal to the analog voltage at the input of the corresponding channel. This correspondence holds up the full-scale value which is +4.096 Vdc. An input exceeding this voltage will produce

an overrange error ("OUCH"). When the potentiometer is a position less than fully clockwise, the value will read a value LESS than the voltage on the corresponding input. By utilizing the potentiometer, values up to +10 Vdc on the inputs may be measured. For further information on calibration, see Section 10, Applications.

5.3 REAR-PANEL CONNECTIONS

5.3.1 Analog Input

This 25-pin "D" connector provides eight analog inputs and their associated returns to permit twisted pairs to connect the user's equipment to the TCS-2A. Each of the 16 lines has a L-C low-pass filter to improve RF rejection. Each of the eight inputs also has a R-C low-pass filter to smooth low-frequency noise that may be present on these DC lines. The input impedance is approximately 1 Megohm.

5.3.2 Relay Output

This 37-pin "D" connector provides access to all three contacts (ARM, N.O., and N.C.) of each of the nine TCS-2A output relays (eight command relays and one fail-safe relay). The contacts are rated for 50 W, up to 30 Vdc or 120 Vac, non-inductive.

5.3.3 Status Input

This 25-pin "D" connector provides eight status inputs and their associated logic grounds to permit twisted pairs to connect the user's equipment to the TCS-2A. Each of the 16 lines has a L-C low-pass filter to improve RF rejection. The inputs are TTL-compatible with 3300 ohm internal pull-ups. Each input is user programmable (via S2 on the main electronics board) to accept either N.O. or N.C. closures (active-high or active low TTL levels). An ON position of S2 denotes N.O. and an OFF position denotes N.C.

5.3.4 Terminal Barrier Strip

Two of these six connections are used to enable the output relays and the remainder are used to interconnect the TCS-2A system. To enable the relays, the CONTROL ENABLE terminals must be connected together either by a strap or by a user-supplied external defeat switch. See Figure 5-2 for a typical connection.

In the 2-wire interconnect mode, the modems are operated over a single AC interconnect pair. Such service can be provided by a leased telephone company private channel or user-provided equipment. A simple conductor pair will also suffice if the conditions of the Series 3002 data channel are met. The modem board (91C7174) should be strapped for 2-wire operation. Figure 3-1 shows the 2-wire interconnect.

In the 4-wire mode, two communication pairs are required for proper operation. The modem board should be strapped for 4-wire operation. Figure 3-2 shows the 4-wire interconnect.

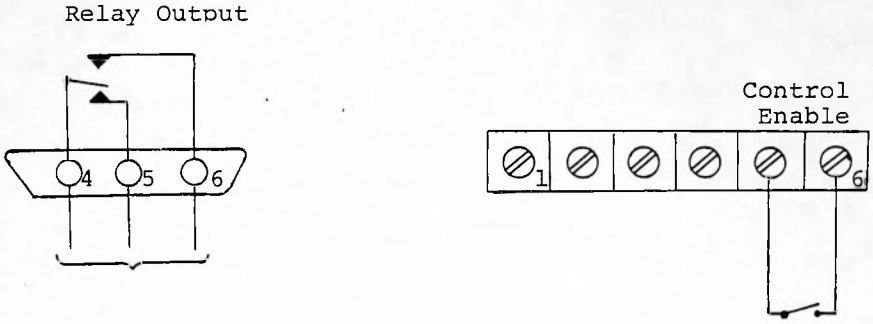
5.3.5 Optional BNC Connectors

At the user's request, two BNC connectors can be installed at the factory to provide unbalanced input and output interconnect signals for radio circuits. The nominal impedance of each circuit is 2200 ohms. Figure 3-3 shows the radio interconnect.

5.3.6 AC Power

The standard TCS-2A power supply accepts either 120 Vac or 240 Vac at 50 or 60 Hz. The power supply module has a receptacle for the line cord that also contains the AC line fuse and a voltage-programming PC card (see Section 3.2.1).

TCS-2A Remote Terminal



N.O. or N.C. interfaced to fail-safe input of transmitter.

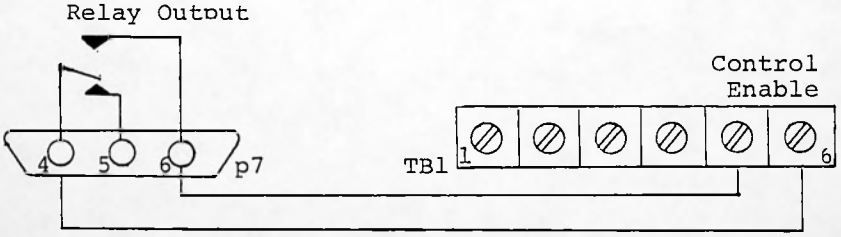
Pins 4 and 6 used with transmitters requiring N.C. contacts.

Pins 4 and 5 used with transmitters requiring N.O. contacts.

To use external defeat switch, the strap provided with the Remote Terminal must be removed.

FIGURE 5-2a
SUGGESTED FAIL-SAFE AND CONTROL ENABLE FUNCTIONS

TCS-2A Remote Terminal



NOTE: This configuration complies with FCC requirements only for those installations where a latching function is used for plate-on control.

FIGURE 5-2b
ALTERNATE FAIL-SAFE CONFIGURATION

6.0 INSTALLATION

6.1 INTRODUCTION

The purpose of this section is to provide installation details for the TCS-2A terminals.

6.2 LOCATION

The TCS-2A is designed for industry standard RTNA rack mounting. The terminal should be mounted in the rack at approximately eye-level for easiest operation. Insert the terminal in the rack or cabinet and install appropriate screws with washers through the oval hole in the chassis flanges.

6.3 INTERCONNECT

The TCS-2A has been designed to accept 2-wire or 4-wire telephone interconnects, radio circuits, or a combination of both telephone and radio. Figure 3-1 shows the 2-wire interconnect; Figure 3-2 shows the 4-wire interconnect, and Figure 3-3 shows the radio interconnect. For mixed operations, refer to Figures 3-2 and 3-3.

6.4 USER EQUIPMENT

The TCS-2A interfaces are as follows:

Control Terminal:

Site Select--female 9-pin "D" connector

Function	J6 pin
Site 1	5
Common	6
Site 2	4
Common	6
Site 4	3
Common	6
Site 8	2
Common	6
+5 Vdc	1

Status Output--female 25-pin "D" connector

Function	J7 pin
External Status 1	13
Common	25
External Status 2	6
Common	19
External Status 3	5
Common	18
External Status 4	12
Common	24
External Status 5	9
Common	22
External Status 6	2
Common	15
External Status 7	1
Common	14
External Status 8	8
Common	21

Command Input--male 25-pin "D" connector

Function	P8 pin
External Command A	13
Common	25
External Command B	12
Common	24
External Command C	11
Common	23
External Command D	10
Common	22
External Command E	9
Common	21
External Command F	8
Common	20
External Command G	7
Common	19
External Command H	6
Common	18

Remote Terminal:

Analog Input--male 25-pin "D" connector

Function	P6 pin
Channel 1	11
Common 1	12
Channel 2	23
Common 2	24
Channel 3	1
Common 3	14
Channel 4	2
Common 4	3
Channel 5	4
Common 5	17
Channel 6	5
Common 6	6
Channel 7	7
Common 7	8
Channel 8	9
Common 8	22

Relay Output--male 37-pin "D" connector

Function		P7 pin
Command A	Arm	2
	N.C.	1
	N.O.	3
Command B	Arm	25
	N.C.	26
	N.O.	27
Command C	Arm	21
	N.C.	22
	N.O.	20
Command D	Arm	7
	N.C.	8
	N.O.	9
Command E	Arm	11
	N.C.	10
	N.O.	12
Command F	Arm	17
	N.C.	18
	N.O.	19
Command G	Arm	36
	N.C.	37
	N.O.	35

	Command H	Arm 14
		N.C. 15
		N.O. 16
	Fail-safe	Arm 4
		N.C. 5
		N.O. 6

Status Input--male 25-pin "D" connector

Function	P8 pin
Status 1	3
Common 1	2
Status 2	13
Common 2	25
Status 3	12
Common 3	24
Status 4	11
Common 4	10
Status 5	9
Common 5	8
Status 6	7
Common 6	19
Status 7	6
Common 7	5
Status 8	4
Common 8	16

It is strongly recommended that the user use SHIELDED TWISTED PAIRS whenever possible to connect his equipment to the TCS-2A. This is especially important for the Remote Terminal. It is also recommended that the user connect the TCS-2A to system ground via the "GND" terminal on the rear panel.

6.5 COMPLETION

This completes installation of the terminal. Power may now be connected to the TCS-2A. It does not matter which terminal, Remote or Command, is powered up first. The system will operate properly once both terminals are connected together. The modem has been adjusted at the factory for a 0.0 dBm output and a -16 dBm input. The output should be checked at this time and adjusted, if necessary. The input should be set for proper squelch level.

7.0 HARDWARE OVERVIEW

7.1 INTRODUCTION

Each terminal of the TCS-2A is composed of four modules: Power supply, modem board, display board, and main electronics board. The operation of each will be presented.

7.2 POWER SUPPLY

The standard TCS-2A AC power supply is shown in schematic 91B7176. The AC input connector contains the filter for RFI protection of the TCS-2A. Transformer T1 supplies two center tapped voltages which are full-wave rectified by CR1 and CR2 and filtered by C1, C4, C7, and C10 to provide +15, -15, +8.5, and -8.5 Vdc. These four voltages are regulated down by VR1, VR2, VR3, VR4, and their associated capacitors (C2 and C3, C5 and C6, C8 and C9, and C11 and C12) to provide +12, -12, +5, and -5 Vdc. These four voltages, together with common, are fed to the main electronics board via J5.

7.3 MODEM

7.3.1 Description

The TCS-2A modem is shown in schematic 91C7174. The modem board interfaces with the main electronics board via P3. The data to be transmitted is buffered by U3-C and fed into the XR2206 modulator (U4-9). CR10 and its driver (U3-D) provide a visual indication that data is being received from the main electronics board. The modulator converts the data into FSK tones. A high input causes a low frequency (mark) of 1200 Hz to be generated; a low input causes a high frequency (space) of 2200 Hz to be generated. Switches S2 and S3 allow testing of the two resulting frequencies. Q2, combined with the *MODCON input, provides ON/OFF control of the

modulator. Potentiometers R46 and R47 adjust the high and low frequencies, respectively. The output of the modulator (U4-2) is capacitively coupled to the SEND LEVEL potentiometer (R48) and buffered by an op-amp (U5) before being outputted to T2 (or T1 for 2-wire operation). CR11 and CR12 protect the op-amp from voltage spikes from the output transformer.

The incoming FSK signal is fed through an impedance-matching network (R1-R5) and transformer T1. CR1 and CR2 are clamping diodes used to limit the input voltage range. The signal is then fed through a band-pass filter (U1-A, U1-B, and associated components) to remove signals in the unwanted frequency bands. The signal is then capacitively coupled to RECEIVE LEVEL potentiometer R14 and amplifier U1-C. This amplified signal is then clamped and capacitively coupled to the XR2211 phase-locked-loop demodulator (U2-2). Switch SW1 allows VCO center-frequency adjustment via potentiometer R33. The demodulator received data output (U2-7) is buffered by U3-B. A temperature-compensating network is composed of R32, R34, R35, C19, and C20. Op-amp U1-D and its associated circuitry provide a squelch output (TP7) which is buffered by U3-A and fed to transistor Q1 to drive CR9 (CARRIER DETECT) and the *DCD output.

7.3.2 Adjustments

The component layout for the modem is shown on drawing 20D2752. The modems have been adjusted at the factory according to the following procedures:

Step 1: Make sure the modems are properly jumpered, according to Notes 2 and 3 on the drawing, for your requirements.

Step 2: MODULATOR ADJUSTMENT: Set S2 to the "TEST" position (to the right). Connect a frequency counter to TP10 (black). TP2 (red) or TP8 (grey) may be used for ground. A 10 Kohm resistor in series with the frequency counter may be necessary to stabilize the reading.

Step 3: HIGH FREQUENCY ADJUSTMENT: Set S3 to the "HI" position (to the right). Adjust R46 to obtain a frequency of 2200 ± 20 Hz.

Step 4: LOW FREQUENCY ADJUSTMENT: Set S3 to the "LO" position (to the left). Adjust R47 to obtain a frequency of 1200 ± 20 Hz.

Step 5: OUTPUT LEVEL ADJUSTMENT: Connect a dB meter and a 600Ω load to the rear-panel output terminals. Adjust the SEND LEVEL potentiometer (R48) for an output signal strength of -1.0 ± 1.0 dBm (1.5 ± 0.1 V p-p for radio). Return S2 to the "OPER" position (to the left).

Step 6: DEMODULATOR ADJUSTMENT: Set S1 to the "CAL" position (to the left). Connect a frequency counter to TP5 (green). TP2 (red) or TP8 (grey) may be used for ground. A 10 Kohm resistor in series with the frequency counter may be used to stabilize the reading. Adjust the frequency to 1700 ± 20 Hz using R33. Return S1 to the "OPER" position.

Step 7: INPUT LEVEL ADJUSTMENT: Connect a 1200 Hz sine-wave set for -16 dBm to the rear-panel input terminals. (When adjusting the level for actual operating conditions, the output of the opposite terminal may be used for the input.) Adjust the RECEIVE LEVEL potentiometer (R14) clockwise until CR9 (the red LED on the right) illuminates. Note that, under normal operating conditions, the LED will be flashing.

7.4 DISPLAY

The TCS-2A remote display board is shown in schematic 91C7170. The display board interfaces with the main electronics board via J2. The command display board operation is identical to the remote. The interface to the main electronics board is via P1. Incoming data is fed into a 54-bit shift register (U1-U6) that is clocked by a single clock line (*DISCLCK). The last 52 bits of the shift register each drives one LED or display segment

(CR2-CR17 and U11-U16). Transistor Q1, combined with the *+5DISP input, provides ON/OFF control of the display. The LAMP/STATUS TEST key illuminates all LEDs and displays except for the STATUS LEDs.

7.5 REMOTE MAIN ELECTRONICS

The remote main electronics board is shown in schematic 91D7173.

7.5.1 Microprocessor and buses

The microprocessor (U2) data, address, and control buses are connected to U4 and U5 (ROM = read-only memory), U6 and U7 (RAM = random-access memory), U8, U13, and U14 (PIA = programmable interface adapter), and U12 (ACIA = asynchronous communications interface adapter). The TCS-2A does not use U5, U6, or U7. U3 is a decoder used to select addresses for all devices connected to the microprocessor.

U1 and its associated circuitry form a power-up and external reset switch. Upon power-up *RST is initially low, disabling the microprocessor and it peripherals. C47 slowly charges through R1. When the voltage on C47 reaches the voltage formed by the R4/R5 voltage divider, the comparator (U1) output releases *RST, allowing it to go high. This starts the microprocessor on its merry way. S4 provides an alternate method for bringing *RST low to reset the microprocessor.

7.5.2 Status Inputs

L10 - L25 and C14 - C36 form low-pass filters which provide RF rejection for each status input and its common. Input buffers U19 and U20 also combine with S2 and R15 - R36 to allow programming

of each input for either N.O. or N.C. closures (active-high or active-low TTL levels). CR2 - CR9 are used as a part of the LAMP/STATUS TEST function. When the LAMP/STATUS TEST key is depressed, these diodes pull each input low, independent of external conditions.

7.5.3 Relay Outputs

The outputs of the PIAs are buffered by U21 and U22. L26 - L34 and C38 - C46 are low-pass filters to provide RF rejection from the RLY 12V line (accessible by external equipment). Each of the nine output relays (K1 - K9) is wired with a suppressor diode to clamp voltage spikes. Each of the three contacts (ARM, N.O. and N.C.) of each relay is available to external equipment.

7.5.4 A/D Converter

The A/D converter (U15) is controlled through PIA3 (U14). R58, C75, and C76 form a temperature-compensating network. U16 and its associated components form a stable voltage reference for the A/D. An analog multiplexer (U18) is used to select the desired channel to be converted. R60 - R67 and C79 - C86 form low-pass filters to smooth each analog input voltage. R68 - R75 are calibration potentiometers accessible through the front panel. L35 - L50 and C87 - C102 form low-pass filters on each input and its common for RF rejection.

7.5.5 Modem Interface

A divide-by-52 clock divider (U9 and U11) provides 19200 Hz from the 1 MHz system clock for use by the ACIA (U12). The ACIA provides data formatting and control to interface serial asynchronous communications information to the data bus. The functional configuration of the ACIA is programmed via software.

7.5.6 Miscellaneous

An AUTO RESET function is formed by U17 and its associated components. The software strobes the input of this circuit periodically. In the event that the input is not strobed for approximately 500 ms., the circuit will pull low the *RST line and also shut down the modem via the *MODCON line.

SITE SELECT switch S3 allows multiple remote sites to be added to the TCS-2A system. The remainder of the outputs of PIA2 are used to interface to the display board and to select the analog channel to be converted.

RF filters are formed by L1 - L9 and C1 - C13 for the interconnect. RV1 and RV2 replace fuses for transient voltage protection of the modem.

7.5.7 Adjustment

Only one adjustment is needed for the operation of this board. The voltage at TP4 (yellow) is adjusted at the factory via R56 for 2.048 ± 0.001 Vdc.

7.6 COMMAND MAIN ELECTRONICS

The command main electronics board is shown in schematic 91D7183.

7.6.1 Microprocessor and buses

The microprocessor (U2) data, address, and control buses are connected to U4 and U5 (ROM = read-only memory), U6 and U7 (RAM = random-access memory), U8 and U13 (PIA = programmable interface adapter, and U12 (ACIA = asynchronous communications interface adapter). The TCS-2A does not use U5, U6, or U7. U3 is a decoder used to select addresses for all devices connected to the microprocessor.

U1 and its associated circuitry form a power-up and external reset switch. Upon power-up, *RST is initially low, disabling the microprocessor and its peripherals. C47 slowly charges through R1. When the voltage on C47 reaches the voltage formed by the R4/R5 voltage divider, the comparator (U1) output releases *RST, allowing it to go high. This starts the microprocessor on its merry way. S4 provides an alternate method for bringing *RST low to reset the microprocessor.

7.6.2 Command Inputs

The front-panel switch (S1) is ANDed together with the external command inputs via P8. Because of this, all external commands must be OFF (TTL high) in order for the front-panel switches to be operative, and vice-versa. U19 and U20 double as buffers for the PIA.

7.6.3 Status Outputs

Output buffers U16, U18, U21, and U22 are capable of sinking 30 mA at 30 Vdc, maximum. Note that these open-collector outputs do not have pull-ups.

7.6.4 Modem Interface

A divide-by-52 clock divider (U9 and U11) provides 19200 Hz from the 1 MHz system clock for use by the ACIA (U12). The ACIA provides data formatting and control to interface serial asynchronous communications information to the data bus. The functional configuration of the ACIA is programmed via software.

7.6.5 Miscellaneous

An AUTO RESET function is formed by U17 and its associated components. The software strobes the input of this circuit

periodically. In the event that the input is not strobbed for approximately 500 ms., the circuit will pull low the *RST line and also shut down the modem via the *MODCON line.

SITE SELECT switch S3 allows multiple remote sites to be added to the TCS-2A system. Note that since the external inputs are wired in parallel with the switch, the switches must be OFF for external selection, and vice-versa. The remainder of the outputs of PIA2 are used to interface with the display board.

RF filters are formed by L1 - L7 and C34 - C44 for the interconnect. RV1 and RV2 replace fuses for transient voltage protection of the modem.

8.0 SOFTWARE OVERVIEW

8.1 INTRODUCTION

Refer to Figure 8-1 while reading this section. The CPU generates the addresses from which data will be stored or retrieved. The address bus consists of 16 bits. The TCS-2A uses 13 of these bits, allowing 8192 (2^{13}) addresses. These lines are used by the CPU to select RAM (random-access memory), ROM1 or ROM2 (read-only memory), PIA1, PIA2, or PIA3 (peripheral interface adapter), or ACIA (asynchronous communications interface adapter). The RAM is used to store data such as commands, status conditions, and data which the software needs to keep operating. The ROM used by the TCS-2A is an EPROM (electrically-programmable read-only memory). The ROM stores the program which tells the CPU how to use the data stored in RAM. The PIAs are used to interface to other hardware, such as an analog-to-digital converter (A/D) or input or output buffers. The ACIA is used to communicate with the modem.

The data bus is used to carry the data between the CPU and other parts in the system. This bus is bi-directional. When the CPU writes (stores) data, the CPU outputs data and the peripherals input data. Conversely, when the CPU reads (recalls) data, the CPU inputs data and the peripherals output data. The direction of data flow is controlled by the R/*W (read or write) line. Data is read into the CPU when this line is high. The VMA (valid memory address) line of the CPU signals to the address decoder that the address bus has a valid address. No data transfers occur unless this line is high. Output line E (enable) is the 1 MHz system clock used for bus timing. Data transfers occur when this line is high.

8.2 OVERVIEW

When power is applied to the TCS-2A, the microprocessor (containing the CPU) and its peripherals are reset. The software then initializes the PIAs (data direction, interrupts, and initial conditions), the ACIA (word length, modem speed, transmit control, receive control, and interrupts), and RAM (initial conditions).

Once the Remote Terminal is active, it is always listening to the communications circuit for a message from the Command Terminal. Upon receipt of the message, which contains channel number and command information, the Remote Terminal outputs the commands and forms a message of its own for return to the Command Terminal. This message contains channel, value, status, and command information. When not communicating with the Command Terminal, the Remote Terminal periodically checks itself for proper operations, monitors the front panel for inputs, monitors the status inputs, checks A/D operation, and updates the display.

During communications, each terminal performs extensive error checking to ensure receipt of valid data. The Remote Terminal must receive one valid message within 45 seconds of the previous valid message in order to maintain the fail-safe output active.

Once the Command Terminal is active, it attempts to periodically communicate with the Remote Terminal. The message format has been explained above. If the Command Terminal is unsuccessful, it will display a message on the front panel. When not communicating with the Remote Terminal, the Command Terminal periodically checks itself for proper operation, monitors the front panel for inputs, monitors the command inputs, and updates the display.

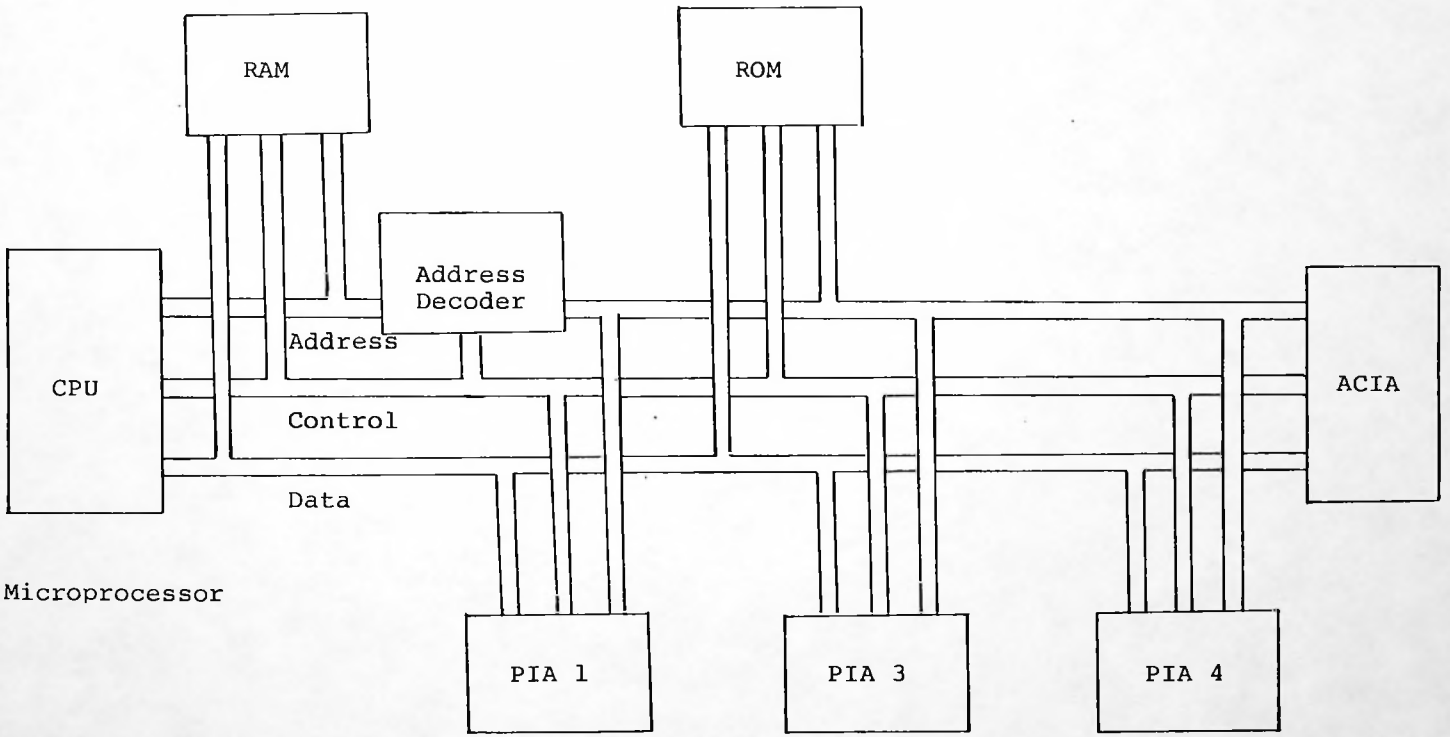


FIGURE 8-1

TCS-2A MICROPROCESSOR SYSTEM

9.0 MAINTENANCE

9.1 INTRODUCTION

The purpose of this section is to provide a guide to the maintenance of the TCS-2A at the module level. Schematics and card layouts can be found at the end of this manual.

CAUTION

ALWAYS REMOVE POWER FROM A TERMINAL WHENEVER PRINTED CIRCUIT MODULES ARE REMOVED OR REPLACED IN THE UNIT. FAILURE TO OBSERVE THIS PRECAUTION MAY CAUSE DAMAGE TO ONE OR MORE MODULES.

9.2 HANDLING CMOS DEVICES

The TCS-2A contains several CMOS devices such as the 6802 MPU, 6821 PIAs, 6850 ACIA, 2716 EPROM, and 4040 RIPPLE COUNTER. Unfortunately, these devices can be damaged by severe electrical transient voltages (static electricity). A person walking over a waxed floor can generate voltage potentials in excess of 15 kV., depending upon floor conditions and humidity. The following precautions are recommended to reduce damage to the CMOS devices:

1. All CMOS devices should be stored in materials that are anti-static. CMOS devices must never be inserted into Styrofoam.
2. All CMOS devices should be placed on a grounded bench surface and the user should be grounded before touching the device.
3. Nylon or other static generating materials should not come into contact with the device.
4. Do not remove CMOS devices from sockets with power applied, or remove boards with power applied.

5. Treat boards that contain CMOS devices just like the device itself.

6. When wrapping a module for shipment, never use any plastic material that is not marked as being anti-static. Mose anti-static plastic material is a pale, pink color and identified as anti-static.

7. Always use grounded test equipment to diagnose problems and ground the test equipment to the unit before placing probes on the circuits.

9.3 FAULT ISOLATION - LEVEL 1

This section outlines the steps necessary to isolate the fault down to board level. Always go through these steps before attempting to service the equipment.

1. Insure all switches are in their proper positons:
   Remote main electronics: S1 = "AUTO"
   Command main electronics: S2 = "AUTO"
   Both main electronics: S3 should be set the same.
   Both modems: S1 = "OPER"
   Both modems: S2 = "OPER"

2. Check the power supply voltages; ±5 and ±12 Vdc should be present. If not, the power supply probably is at fault.

3. Depress the RESET switch (S4) on the main electronics board. This forces the CPU to begin the program from the beginning. Check CR19 (the red LED). If it remains on, the main electronics board probably is at fault.

4. Depress the LAMP/STATUS TEST key on the front panel of the Command Terminal. All LEDs and displays at both terminals should be illuminated. If the Remote Terminal LEDs and displays are

not lit, or if the Command Terminal STATUS LEDs are not lit, then one of the modems probably is at fault. If a few of the LED's are not lit, then the display probably is at fault.

5. If all commands or all status channels do not work, and CHANNEL SELECT works, the modem probably is at fault. If only one command or one status channel does not work, then telemetry channel does not work, then the main electronics board probably is at fault.

9.4 FAULT ISOLATION - LEVEL 2

The following is a guide to aid in the isolation of problems once it has been decided which board is at fault.

9.4.1 Power Supply

The following checks should be performed:

1. Check the fuse in the AC receptacle (See Section 3.2.1).
2. If all the voltages are not present, then the AC filter or transformer probably is at fault.
3. If two of the voltages are not present (±12 or ±5), then the corresponding rectifier bridge probably is at fault.
4. If one of the voltages is not present or has the wrong value, then the corresponding voltage regulator probably is at fault.

9.4.2 Display

The following is a guide to troubleshooting the display board:

1. If one LED or display segment is not illuminated when LAMP/STATUS TEST is depressed, then suspect that LED or display.
2. If several LEDs or display segments near each other are not lit when the LAMP/STATUS TEST is depressed, then suspect one of the display drivers.

3. The switches may be tested by monitoring the voltage across the switch when depressed. Alternately, power may be removed and the contacts checked with an ohmmeter while the switch is being depressed.

9.4.3 Modem

The following procedure can be used to troubleshoot the modem:

1. Check the input and output levels (See Section 7.3.2).
2. Check CR10 (the RED LED on the left) to make sure data is being received from the main electronics board. If it is not lit, and U3 is operational, then the main electronics board probably is at fault.
3. If CR10 indicates data is getting to the modem, then check the other terminal to see if the data is being received. CR9 (the RED LED on the right) indicates data is being received. Note that Switch S2 may be used to send a constant tone. Note also that, if in the 2-wire mode, each modem hears itself.
4. The transmitted signal may be examined at TP9 and at TP11. These two signals should be in sync with each other and TP10.
5. The received signal may be examined at TP1, TP3, TP4, and TP6. These signals should be in sync with each other. If two succeeding signals are not in sync, suspect the circuitry between the two test points.

9.4.4 Main Electronics

The following may be used to troubleshoot the main electronics board:

1. Depress and hold the RESET switch (S4). After about 1/2 second, CR19 (the RED LED) should come ON. After releasing the switch, the LED should go OFF.

In Auto Reset CR19 stays on after S1 is depressed. S1 in Normal is OK

If the LED does not illuminate, or remains ON, then check the reset circuit. The output of U1 should follow the RESET switch action. When depressed, the output should go low; when released, the output should go high. If not, suspect U1.

If the reset circuit is operational, then check U17 pin 1. A periodic pulse should appear. If not, then suspect the microprocessor (U2) or memory (U4). If so, then suspect the one-shot (U17) or the buffer (U23).

2. Check the modem transmit LED. If it is not flashing periodically, then check for the ACIA clock. Check for a 1 MHz signal at TP2 (red). If the signal is not there, suspect the crystal (Y1) or the microprocessor (U2). If the 1 MHz signal is there, check U9 pin 15 for a 76.92 kHz signal. If this signal is not there, suspect U9. If the 76.92 kHz signal is there, check U11 pin 7 for a 19.2 kHz clock. If the clock is not there, suspect U11.

   If the clock is present, check U12 pin 5 for a periodic bursts of signal. If not there, suspect the ACIA (U12). If so, suspect U10.

3. If all the STATUS and COMMAND channels do not work, then PIA1 is probably at fault. If a single STATUS or COMMAND channel is not working, perform the following:

   Check all external wiring carefully for proper connections.

   Check the input and output levels of the corresponding buffer to determine if the correct signal is present. (This applies to external equipment as well.)

4. If any of the TELEMETRY (ANALOG) channels do not work, perform the following checks:

   Check all external wiring carefully for proper connections.

Check the input of U18 that corresponds to the analog channel in question for the correct voltage.

Check TP3 (orange) for the correct voltage. The voltage should be very close to the voltage of the channel selected. If not, suspect the ANALOG MULTIPLEXER (U18).

Check TP4 (yellow) for 2.048 ± 0.001 Vdc. If the voltage cannot be adjusted to this voltage via R56, suspect the VOLTAGE REFERENCE (U16).

If none of the above is the culprit, then either the A/D CONVERTER (U15) or PIA3 (U14) should be suspected as being at fault.

10.0 APPLICATIONS

10.1 INTRODUCTION

The purpose of this section is to provide some typical applications of the TCS-2A that may be applicable to the broadcast industry. The TCS-2A Telecontrol System is designed for flexibility of service. The TCS-2A can be used in a multitude of sophisticated applications. The following is a short discussion of possible extensions to the basic TCS-2A.

10.2 COMPLETELY WIRELESS OPERATION

The TCS-2A may be combined with a subcarrier system, such as the Moseley Associates SCM-1, a subcarrier mainframe (generators and/or demodulators), to provide completely wireless operation over radio links, such as the Moseley Associates aural STLs. A typical connection to a SCM-1 is shown in Figure 10-1.

10.3 ANALOG INPUTS (REMOTE TERMINAL)

MAKE NO CONNECTIONS TO THE ANALOG INPUTS ON THE TCS-2A UNTIL THE REQUIREMENTS OUTLINED IN THE FOLLOWING PARAGRAPHS ARE UNDERSTOOD.

The metering signals applied to the TCS-2A inputs are not the same voltages or currents that are indicated on the broadcast transmitter panel meters. Instead, they are derived independently in a manner such that they do not interfere with the regular meters but are representative of the readings of those meters. Because the actual voltage or current to be measured is not brought out from the broadcast transmitter, but rather only a sample of it is, this voltage is also known as the metering sample. Figure 10-2 will help to illustrate this point.

In "A" of Figure 10-2, resistors R1, R2, and R3 have been added to develop an output voltage representative of plate voltage. Resistors R1 and R2 are typically in the several megohm range, with

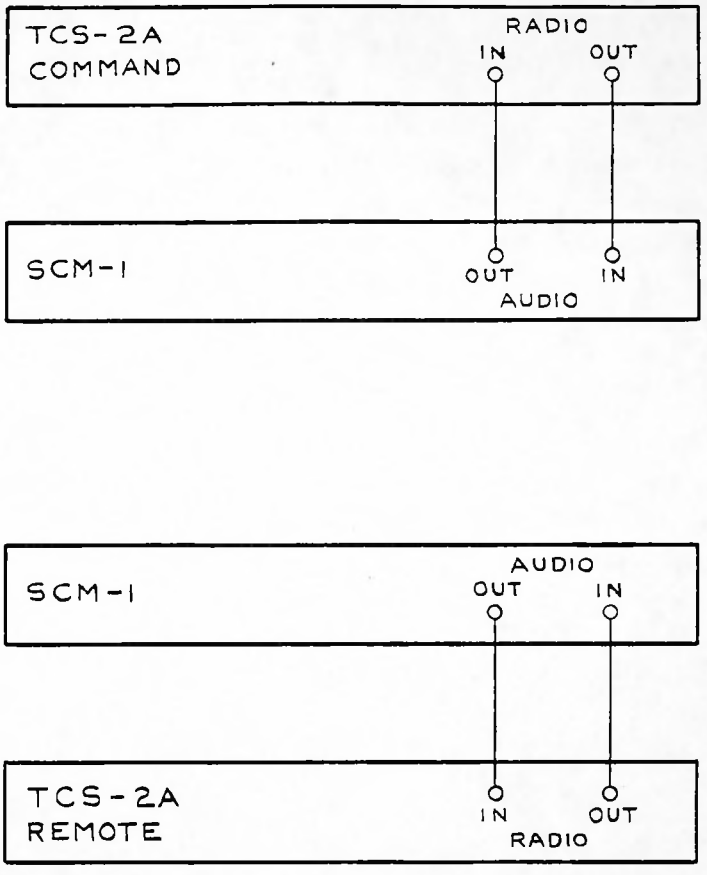


FIGURE 10-1

TCS-2A/SUBCARRIER INTERCONNECT

NOTE: SCM-1 units are shown above with full complement of subcarrier generators and detectors. SCM-1 units may be used for subcarrier transmission in only one direction if desired.

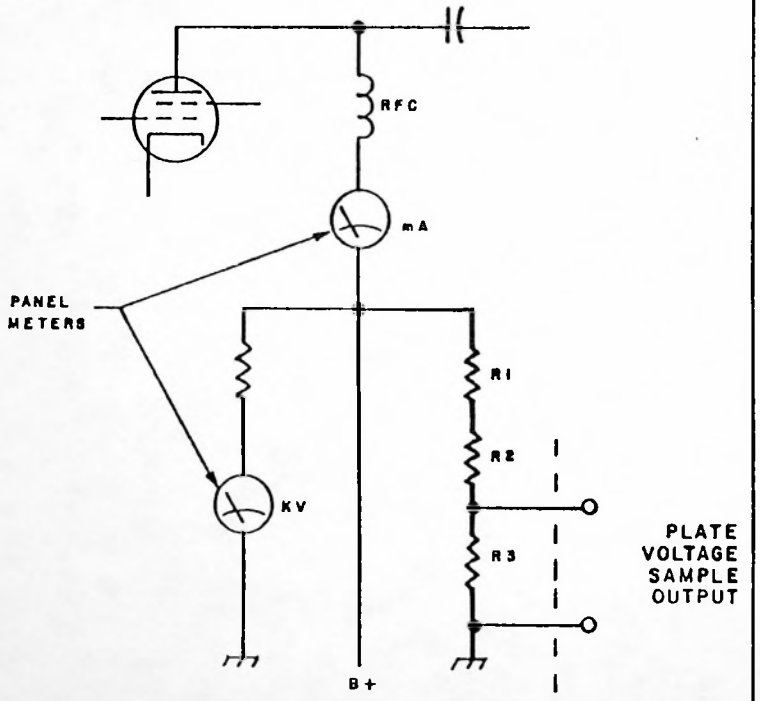
wattage ratings in the vicinity of 10 watts to 20 watts. Stable metal-oxide resistors are preferred. Resistor R3 is in the vicinity of 10KΩ to 100KΩ and serves to keep the output sample terminals at a reasonable voltage should the external load (the remote control metering input) be removed. The target output voltage is 2 volts DC, with 1-volt minimum and a 10-volt maximum. Less than 2 volts may not allow a full-scale reading. More than 4 volts may make it difficult for the setting of calibration controls to obtain a specific reading. This assembly is available from Moseley Associates as Type PVK-1A or PVK-1B, or PVK-2 Plate Voltage Sampling Kits.

In Figure 10-2, a shunt resistor in the vicinity of 1Ω is shown added as R4. This resistor develops a sample of plate current but at a safe location. The value of this resistor should be calculated to develop 2 volts target with normal plate current flowing.

> MAKE CONNECTIONS TO THIS RESISTOR SECURELY: IF IT OPENS OR IF ITS CONNECTIONS BECOME CORRODED, THE OUTPUT SAMPLE TERMINALS WILL HAVE EXCESSIVE VOLTAGE ON THEM. PARALELED RESISTORS ARE PREFERRED FOR THIS REASON.

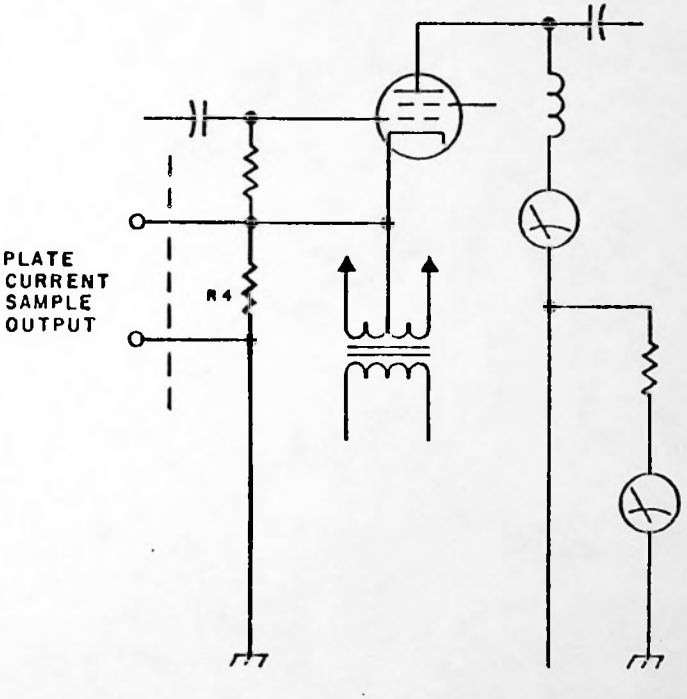
Bear in mind that the TCS-2A Analog inputs must be in the form of DC. Hence, if it is desired to include a sample of filament voltage in the metering line-up, the AC voltage must be rectified. A simple method of accomplishing this is shown in Figure 10-3 at "A". This same technique may be used for monitoring line voltage. The filament voltage may be rectified directly if it has a center tap or one side is at ground potential. This device is available as an accessory from Moseley Associates, Type LVK-3 Line Voltage Sampling Kit.

AM antenna base current may be measured by noting that the tower is a linear device, and then measuring voltage instead. The two are directly related. The circuitry in Figure 10-3 "B" has been proven



A

DERIVING PLATE VOLTAGE SAMPLE



B

DERIVING PLATE CURRENT SAMPLE

FIGURE 10-2

to be satisfactory. The 10 pf capacitor may be a short piece of coaxial cable or a small-value, transmitting-type mica capacitor. The two capacitors in series form an RF voltage divider, down to approximately 20 volts to 50 volts peak. This RF is rectified by the diode (preferably germanium, but use a 150 volt or 200 volt high-speed device in any event) and smoothed by the 0.01µf capacitor. For high base-voltage installations, reduce the value of the 10 pf capacitor so that the RF voltage at the junction of the two capacitors is of the order of 30 volts peak. This same system may be used to measure transmission-line or common-point current. This unit is available from Moseley Associates as Type RFK-1 AM-RF Transmission Line Voltage Sampling Kit. Alternatively, the analog (DC) output of a type-approved antenna monitor may be used to measure the base current.

In FM installations, RF voltage is also typically sampled to represent forward power. A diode assembly used for this application is depicted in Figure 10-3 "C". This device is available from Moseley Associates as Type RFK-2 or RFK-3 FM-RF Transmission Line Voltage Sampling Kits.

The outputs from reflectometers and frequency monitors are generally at a low level requiring special interfacing. Both of these are solved through the use of a DC Amplifier. For nonlinear applications, such as reflectometers, the Moseley Associates DCA-2 DC Amplifier provides power-to-linear conversion. For linear applications, such as frequency monitors, the Moseley Associates DCA-2 is also recommended.

Bear in mind that whatever the source of the metering voltage sample, it should measure in the vicinity of ±2 volts DC when a 1 megohm resistor is connected across it, and it should measure

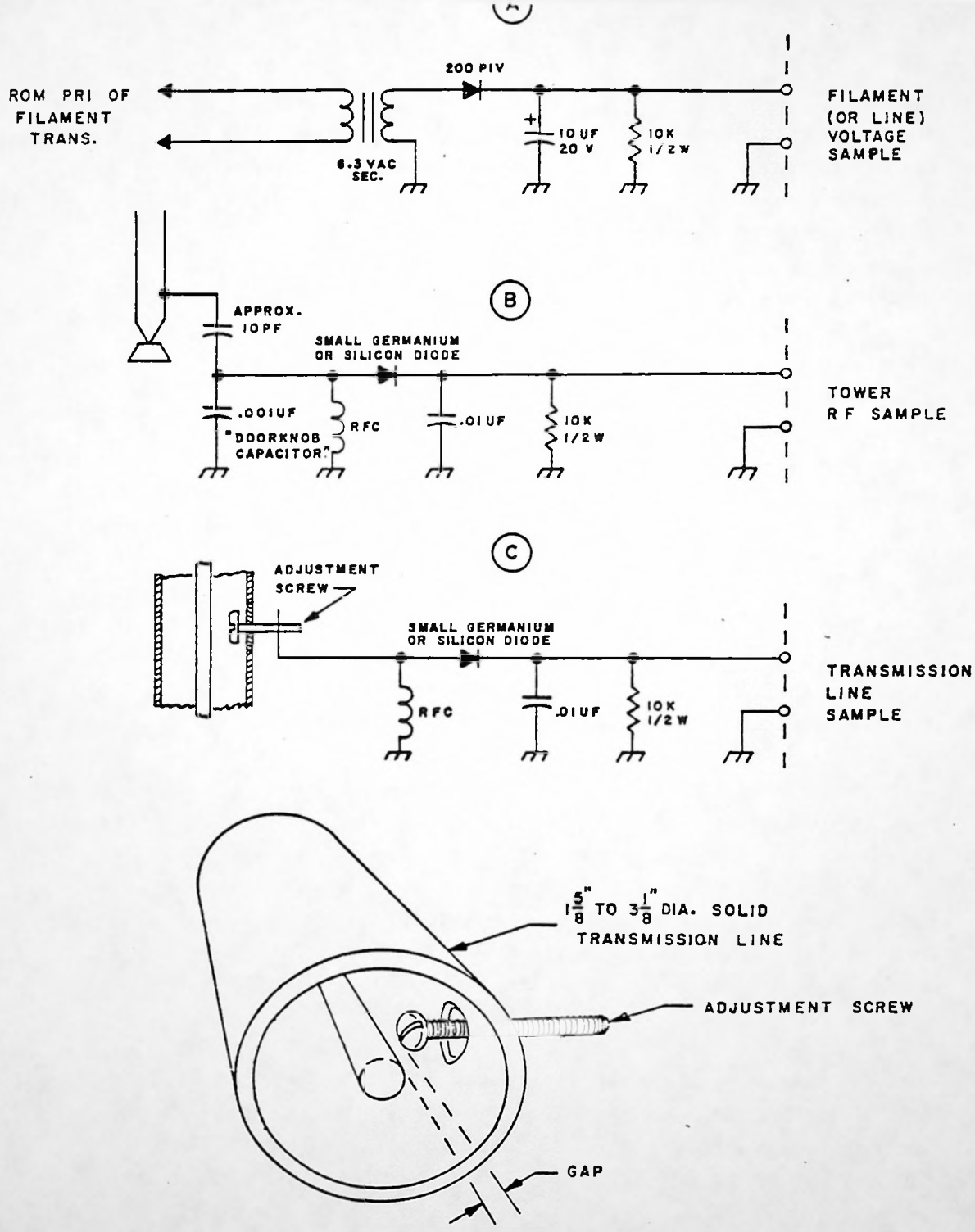

A
ROM PRI OF FILAMENT TRANS.
200 PIV
10 UF 20 V
10K 1/2W
6.3 VAC SEC.
FILAMENT (OR LINE) VOLTAGE SAMPLE
B
APPROX. 10PF
SMALL GERMANIUM OR SILICON DIODE
.001UF "DOORKNOB CAPACITOR"
RFC
.01UF
10K 1/2W
TOWER R F SAMPLE
C
ADJUSTMENT SCREW
SMALL GERMANIUM OR SILICON DIODE
RFC
.01UF
10K 1/2W
TRANSMISSION LINE SAMPLE
1 5/8" TO 3 1/8" DIA. SOLID TRANSMISSION LINE
ADJUSTMENT SCREW
GAP

FIGURE 10-3

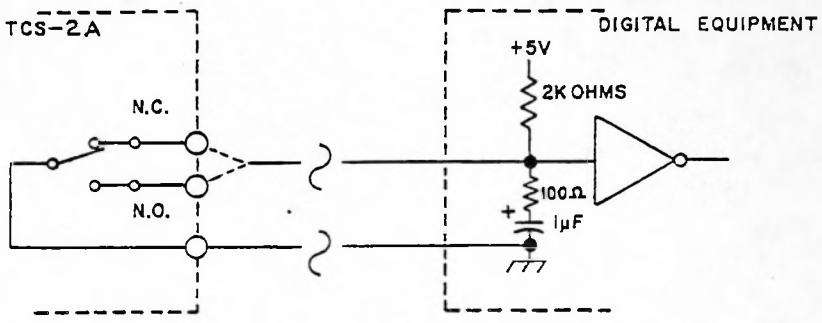
not more than 10 volts when this resistor is disconnected. If the sample is above or below ground, all terminals and points where it is exposed should be covered, and an isolation amplifier must be used, or damage may result to the TCS-2A. It should not be more than 10 volts above or below ground unless wiring is protected. The use of shielded wire, conduit, and other techniques to keep RF out of the metering samples should be encouraged.

When calibrating a digital telemetry system, such as the TCS-2A, the user should take advantage of the most possible digits. For example, if the plate current is 1.5 amps, calibrate the sample as "1500". Least significant digit "jitter" from the AID and the sample may have a devastating effect if improperly calibrated. If the sample has been calibrated as "15", normal jitter may vary the readings from 14 to 16. But, calibrated at "1500", jitter may vary the readings from 1499 to 1501. Obviously, there is an appreciable difference between these two methods of calibration. Just remember the analog counterpart and use "Full-scale".

10.4 RELAY OUTPUTS (REMOTE TERMINAL)

The command output relays of the TCS-2A are capable of switching a 50-watt non-inductive load of up to 120 Vac or 30 Vdc. Inductive loads (relay coils, etc.) should have a "clamping" diode wired across them to inhibit negative voltage spikes. External relays should be used when it is desired to switch loads greater than 50 watts. Local safety regulations may require protected external relays when high voltages are being switched. The TCS-2A outputs can also be interfaced with transistor-transistor logic (TTL) digital circuits. The relay contacts should be wired so that one side is referenced to the digital common (ground), and the other relay contact to the digital input. A pull-up resistor may be necessary, and it is advisable to wire a 1μf capacitor and a 100 ohm resistor (in series) across the relay output to suppress contact bounce.

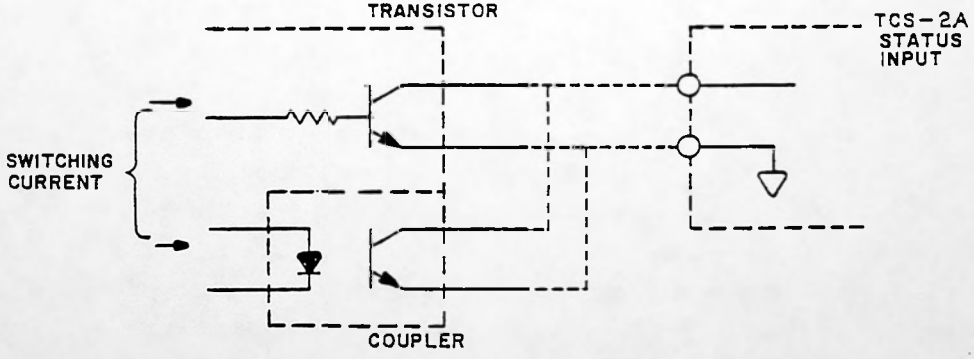
All relay contacts are available, normally-open (N.O.) or normally-closed (N.C.), as required for proper logic level polarity.
See figure below:



10.5 STATUS INPUTS (REMOTE TERMINAL)

The TCS-2A status inputs are referenced to the system common. These inputs require a closure between a status pin and the common pin for actuation (change-of-state). This closure may be accomplished by hard contacts (Relay, Switch, etc.), or by a semiconductor junction.

The status inputs can be operated with a NPN-type (example - 2N2924) transistor or an optical coupler (example - TIL-112) as shown below. The optical coupler provides for a floating Status Input.

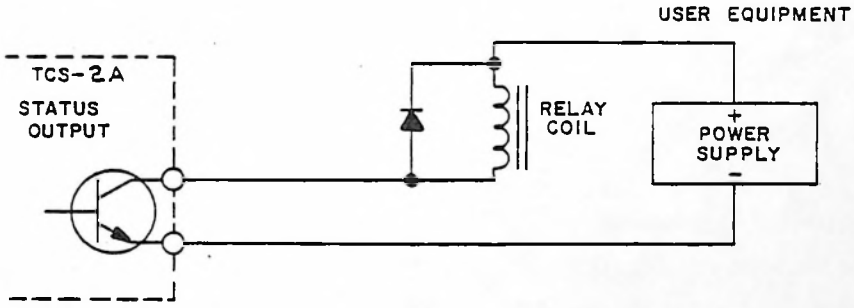


Make sure the digital ground is connected to the status common.

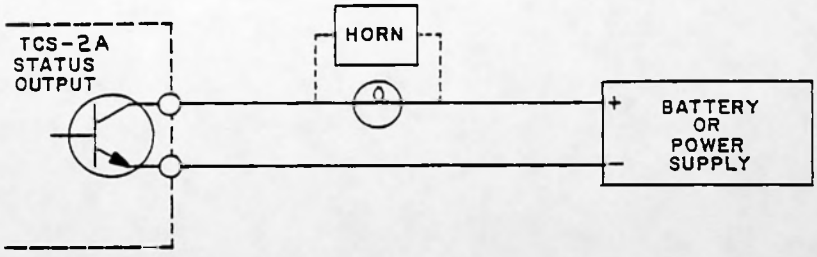
10.7 STATUS OUTPUTS (COMMAND TERMINAL)

The TCS-2A Command Terminal provides for individual external status outputs capable of sinking a maximum 24 Vdc at 100 mA load.

These outputs are NPN-transistor junctions (open-collector) where the emitters are joined to the system common. These junctions can drive external relays in order to switch AC or larger DC loads. The DC excitation voltage for the external relays must be supplied by the user, and the negative pole of the supply should be connected to the status output common. A "clamping" diode should be wired across the relay coils in order to deter negative voltage spikes from damaging the output drivers.



The TCS-2A status outputs may also be used for signalling other DC aural and visual alarms.



More than one status output may be interconnected in parallel in order to sum the outputs to a single alarm device. In this way, an aural alarm may be initiated by any single status alarm. (See also Section 10.11)

10.8 COMMAND INPUTS (COMMAND TERMINAL)

The TCS-2A provides for external switch (or transistor) closures to interface with the Command Terminal. These inputs are wired in parallel with the front-panel controls so that either facility can override the other. The control inputs are actuated by closures (less than 100Ω) between the control pins and the system common. If independent command capability is not required, the command inputs can be operated by an external binary encoded thumbwheel switch. The control inputs can alternately be driven by TTL digital logic or discrete transistor circuits.

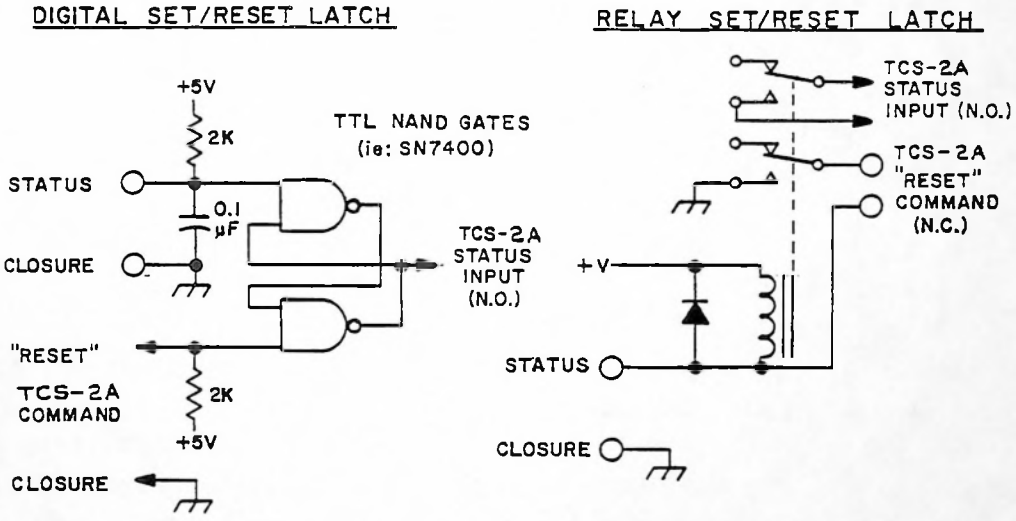
10.9 ANALOG TOLERANCE ALARM

It is possible, with the TCS-2A, to use a companion TAU-3 (or similar) Tolerance Alarm Unit for monitoring analog voltages. The TAU-3 offers both upper and lower preset limits. A single TAU-3 unit is capable of processing eight independent analog comparisons. The alarm output (N.O.) from the comparator can be used to drive the TCS-2A Remote Terminal status inputs. For further information concerning the TAU-3, contact the Moseley Associates, Inc. Marketing Department.

10.10 LATCHING STATUS INPUTS

The TCS-2A status inputs are non-latching. The status indications follow the corresponding changes in the status inputs. Some applications (example - security alarms) require latching status functions.

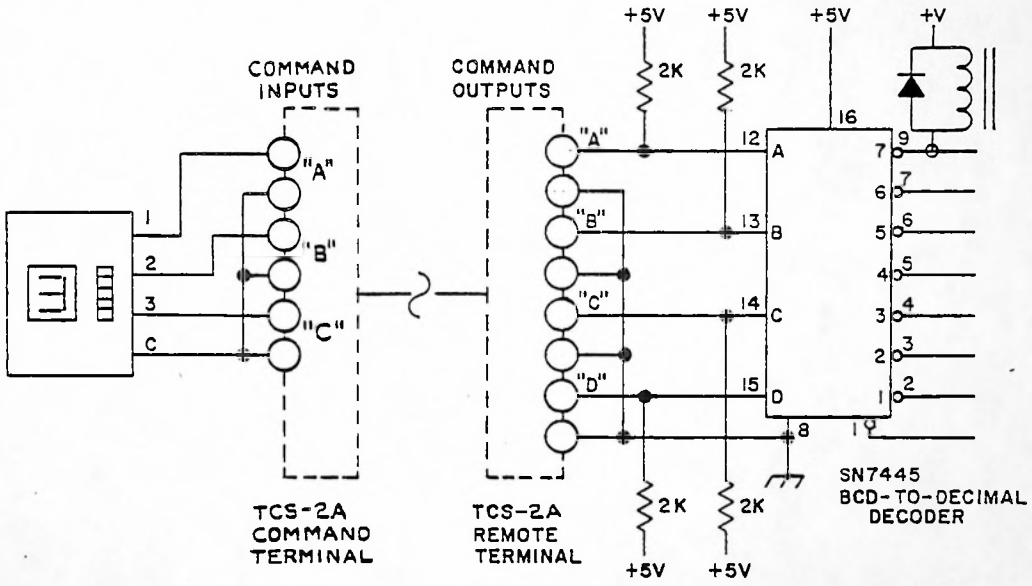
This mode of operation can be added externally to the TCS-2A Remote Terminal. Either relay-relay logic or TTL digital devices may be used in the implementation. One command channel must be used for operation of a Status Clear (Reset) function.

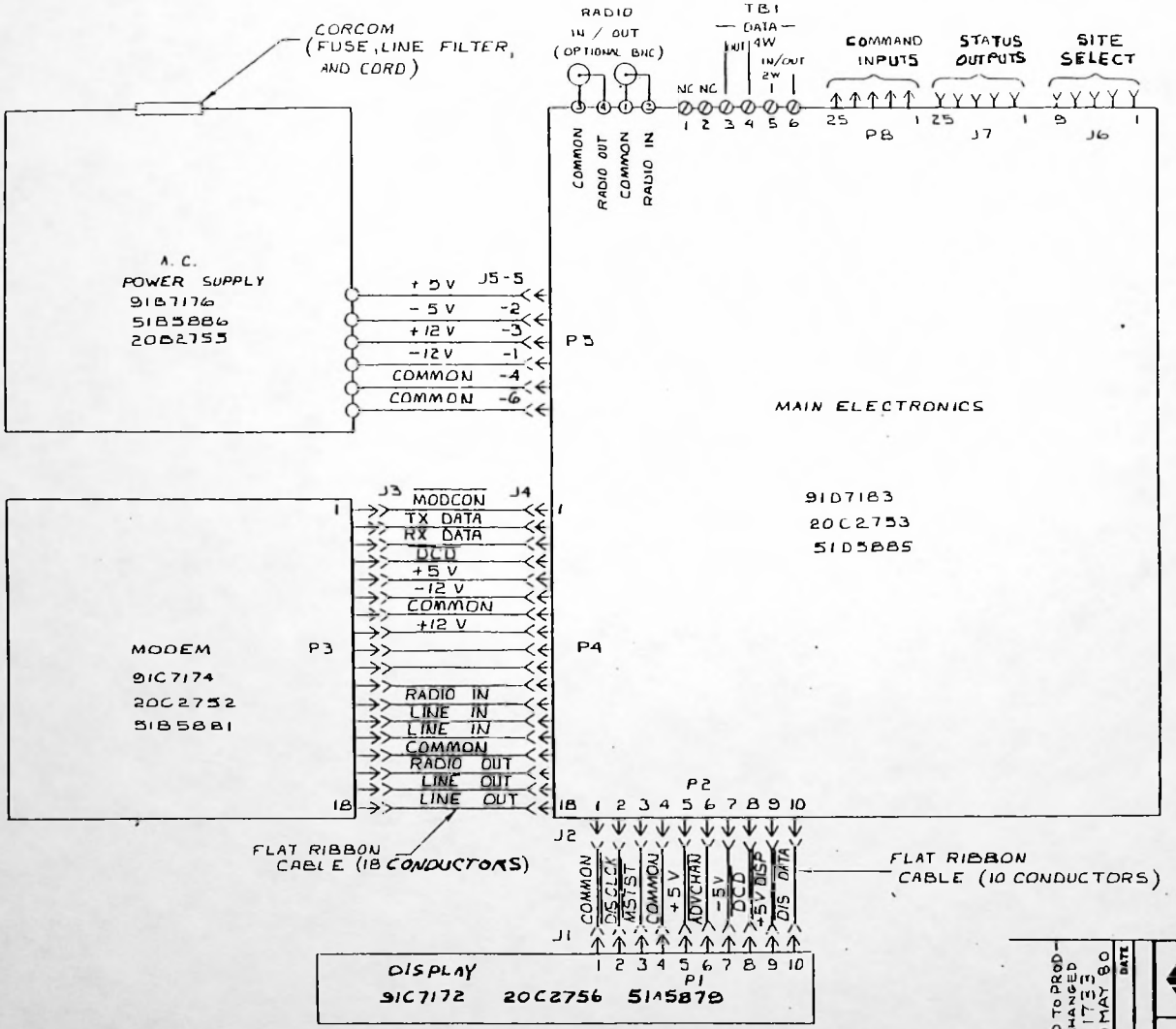


10.11 MOMENTARY COMMAND APPLICATION

The TCS-2A basic command capability is eight independent control channels. Each channels is independent of the others. If independence is not necessary, then the system can be configured for a maximum of 128 momentary commands by adding the appropriate decoding logic. One command channel is used as a strobe command, and the other channels are encoded to describe the function number desired. By using one strobe, the remaining seven channels can be used for binary representation to 128 discrete channels. A simple channel momentary control system is shown on the following page using only four of the TCS-2A Command functions.

The decoder at the Remote Terminal is capable of driving a small DC relay coil directly. The strobe (Command "D") output should be wired normally-open so that manual initiation will cause the decoder to recognize the inputs A through C. This idea can be expanded by adding more decoders, and thumbwheel switches. A latching function could be implemented by adding Set-Reset (S-R) latches on each decoder output. Wired appropriately, one channel might set the latch, and another reset it. Similar set-ups may also be used to multiplex status channels.


COMMAND INPUTS
COMMAND OUTPUTS
+5V
+5V
+5V
+V
2K
2K
"A"
"B"
"C"
"D"
1
2
3
C
12
13
14
15
A
B
C
D
16
8
7
6
5
4
3
2
1
9
SN7445
BCD-TO-DECIMAL
DECODER
TCS-2A
COMMAND
TERMINAL
TCS-2A
REMOTE
TERMINAL



RELEASED TO PRODUCTION & CHANGED PER ECO 1733 L.D.H. 30 MAY 80

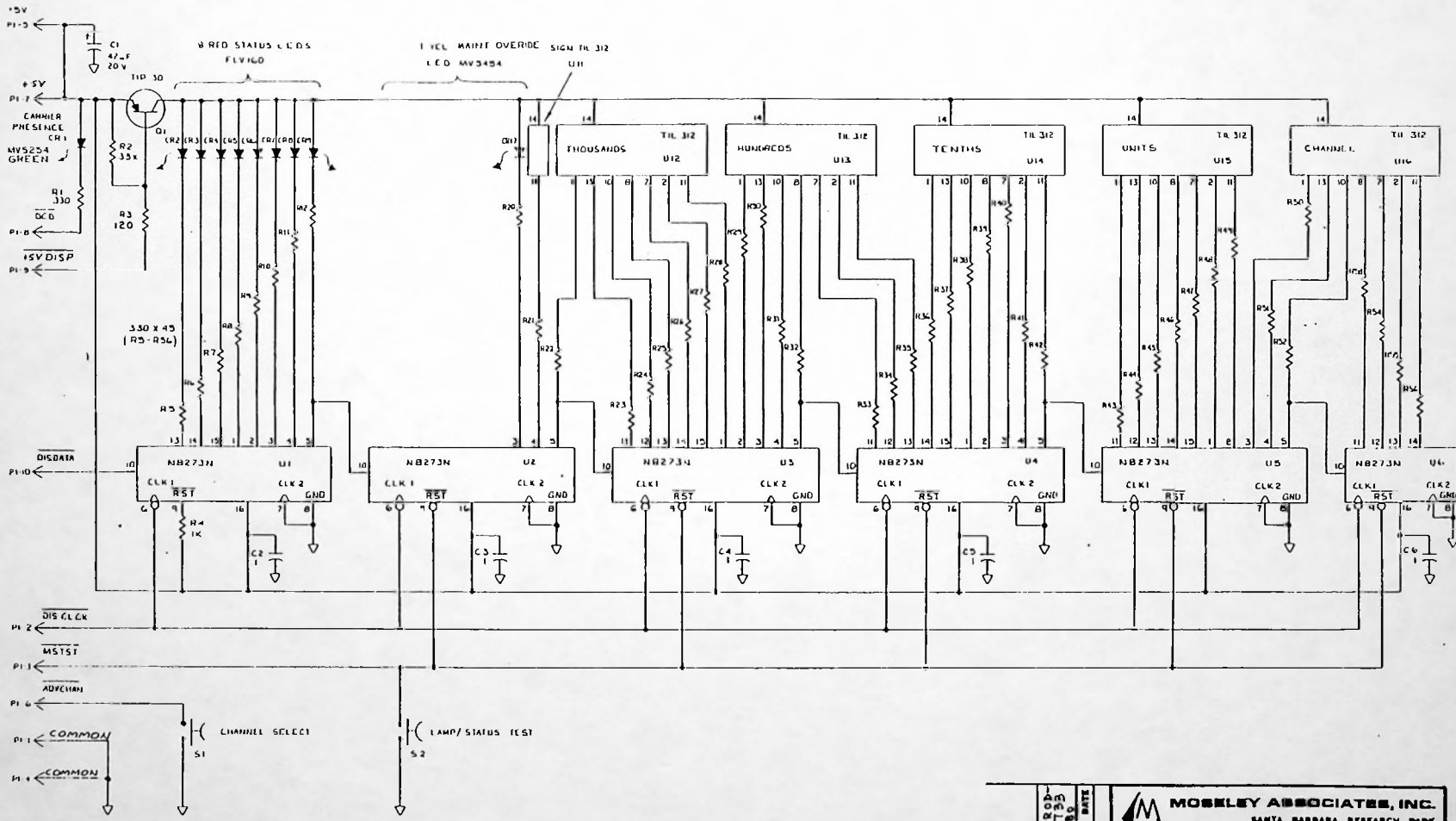
REVISIONS	MGMT. APPR.	DATE
A		

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

WIRING DIAGRAM
TCS-2 COMMAND TERMINAL

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	A.B.	11 JUN 80	SCALE:
CHK		29 OCT 79	
ENG		19 JUL 79	81C2677 A0



NOTES

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%
   CAPACITOR VALUES ARE IN MICROFARADS
2. PC BOARD 51A3679
3. COMPONENT LAYOUT 20C2748
4. U7 CONTAINS R24,25,26,28,31,32,48
   U8 " R33,34,35,36,40,41,42
   U9 " R23,27,30,43,45,46,47
   U10 " R49,50,51,53,54,55,56

RELEASED TO PROD. PER ECO 1733 5.P.H. 25 MAY 79

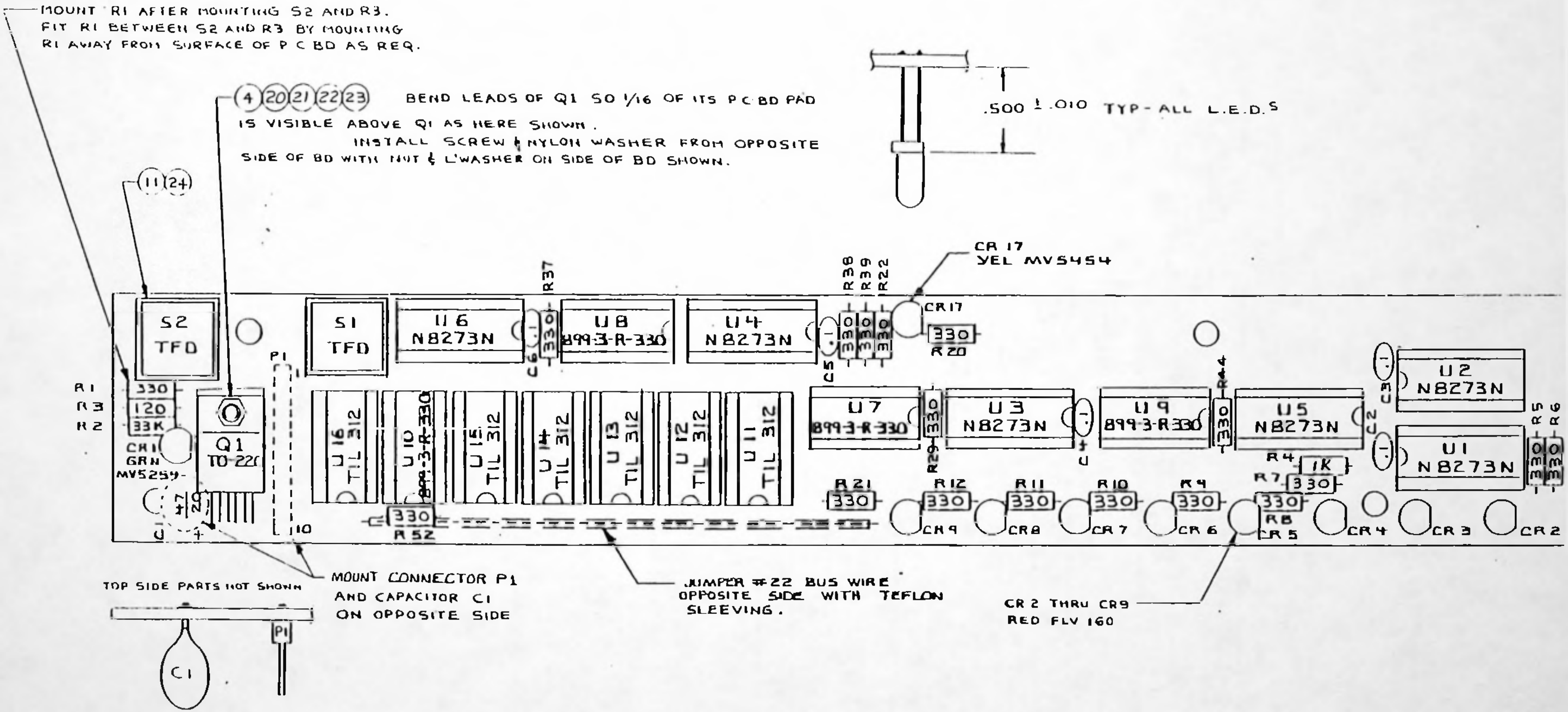
REVISIONS	DATE	APPR.
A		

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

SCHEMATIC
TCS-2 COMMAND DISPLAY PANEL

TOL: FRACT. ± 1/32, .XX ± .03, .XXX = .010, ∠ ± 1/2°

DWN	A J B	5 JUN 79	SCALE:
CHK	JCR	13 Jun 79	9 1 C 7 1 7 2 A Ø
ENG	RWB	29 Jun 79	



NOTES

1. UNLESS OTHERWISE SPECIFIED RESISTORS ARE IN OHMS 1/4W 10 %. CAPACITORS ARE IN MICROFARADS.
2. P.C. BD. 51A5874
3. SCHEMATIC 91C 7172
4. CR 10-16 & R 13-19 ARE NOT USED.
5. U11 - U16 ORIENTATION:

REV	REVISIONS	DATE
B1	ADD NOTE #5 TO DWG FOR R72 11-24-80	
B0	DELETED ITEM 19 AND ADD TO Q1 ECO 1896	
A	RELEASED TO PRODUCTION AND CHANGED PER ECO 1733 L.D.H. 21 MAY 80	

MOSELEY ASSOCIATES, INC
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA

COMPONENT LAYOUT
TCS-2 CMND DISPLAY

TOL: FRACT. ± 1/32, .XX ± .03, .XXX ± .010

DWN		30 OCT 79	SCALE:
CHK		11-6-79	20C 2751 B
ENG		6 Nov 79	

ITEM NO.	DESCRIPTION	REF. DES.	STOCK NO.	QTY.
24	SWITCH COVER/PUSH BUTTON, LT GRAY	S1, S2	3190568	2
23	WASHER-LOCK, #4 SPLIT RING SS		1050632	1
22	WASHER-FLAT, #4 NYLON		1050657	1
21	NUT-#4-40, SMALL PATTERN, SS		1050590	1
20	SCREW-#4-40x3/8, PAN HD, SS		1050152	1
19				
18	CONNECTOR MOLEX 22-03-2201	P1	3250545	1
17	RESISTOR BECKMAN 899-3-R330	U7-U10	4540084	4
16	RESISTOR 1KΩ 1/4W 10%	R4	4410207	1
15	DIODE L.E.D. YEL	CR17	3390143	1
14	RESISTOR 33KΩ 1/4W 10%	R2	4410437	1
13	RESISTOR 120Ω 1/4W 10%	R3	4410103	1
12	RESISTOR 330Ω 1/4W 10%	R1, 5-12, 20-22, 29, 37-39, 44, 52	4410189	18
11	SWITCH SCHADOW TFD	S1, S2	3170164	2
10	CAPACITOR .1µF/50V	C2-6	4310207	5
9	CAPACITOR 47µF/20V	C1	4280137	1
8	I.C. SOCKET 16 PIN	U1-U6	3250032	6
7	I.C. SOCKET 14 PIN	U7-U16	3250024	10
6	DIODE, L.E.D. GRN	CR1	3390150	1
5	DIODE, L.E.D. RED	CR2-9	3390127	8
4	TRANSISTOR TEX. INST. TIP30	Q1	3640216	1
3	I.C. SIGN. N8273N	U1-U6	3730736	6
2	I.C. TEX. INST. TIL312	U11-16	3690039	6
1	P.C. BOARD	51A5279	3472073	1

REVISIONS	DATE
B1	ADD NOTE # 5 TO DWG ECO 1972 11-24-80
B0	DELETED ITEM 19 AND INFO TO Q1. ECO 1814 9-12-80
A0	RELEASED TO PRODUCTION AND CHANGED PER ECO 1733 L.D.H. 21 MAY 80

MGMT. APPR.

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA

COMPONENT LAYOUT
TCS-2 CMND DISPLAY

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°
DWN BWF 30 OCT 79 SCALE:
CHK CK 11-6-79
ENG 1K 16 Nov 79

20C 2751 B1

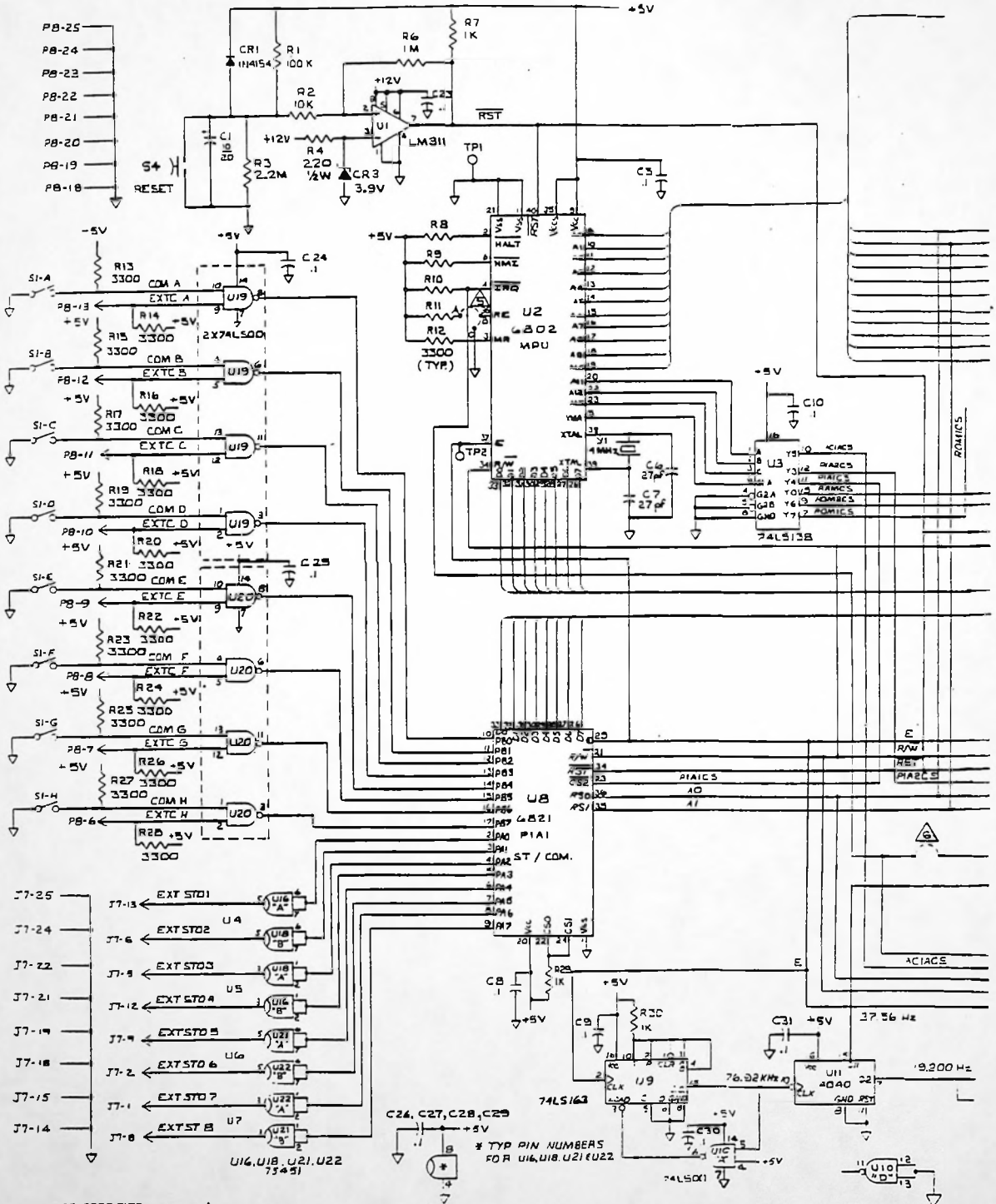
BY	REVISIONS	DATE
	CHANGES: ECO 3105 28 AUG 81 CH	
	RELEASED AND CHANGED PER ECO 1733, 16 NOV 80 DWF	

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

SCHEMATIC TCS-2
MAIN ELECTRONICS COMMAND

TOL: FRACT. ± 1/32.	.XX ± .03.	.XXX = .010.	∠ ± 1/2°
DWN		9 JUL 79	SCALE:
CHK		29 OCT 79	91D7183 B0
ENG		29 OCT 79	

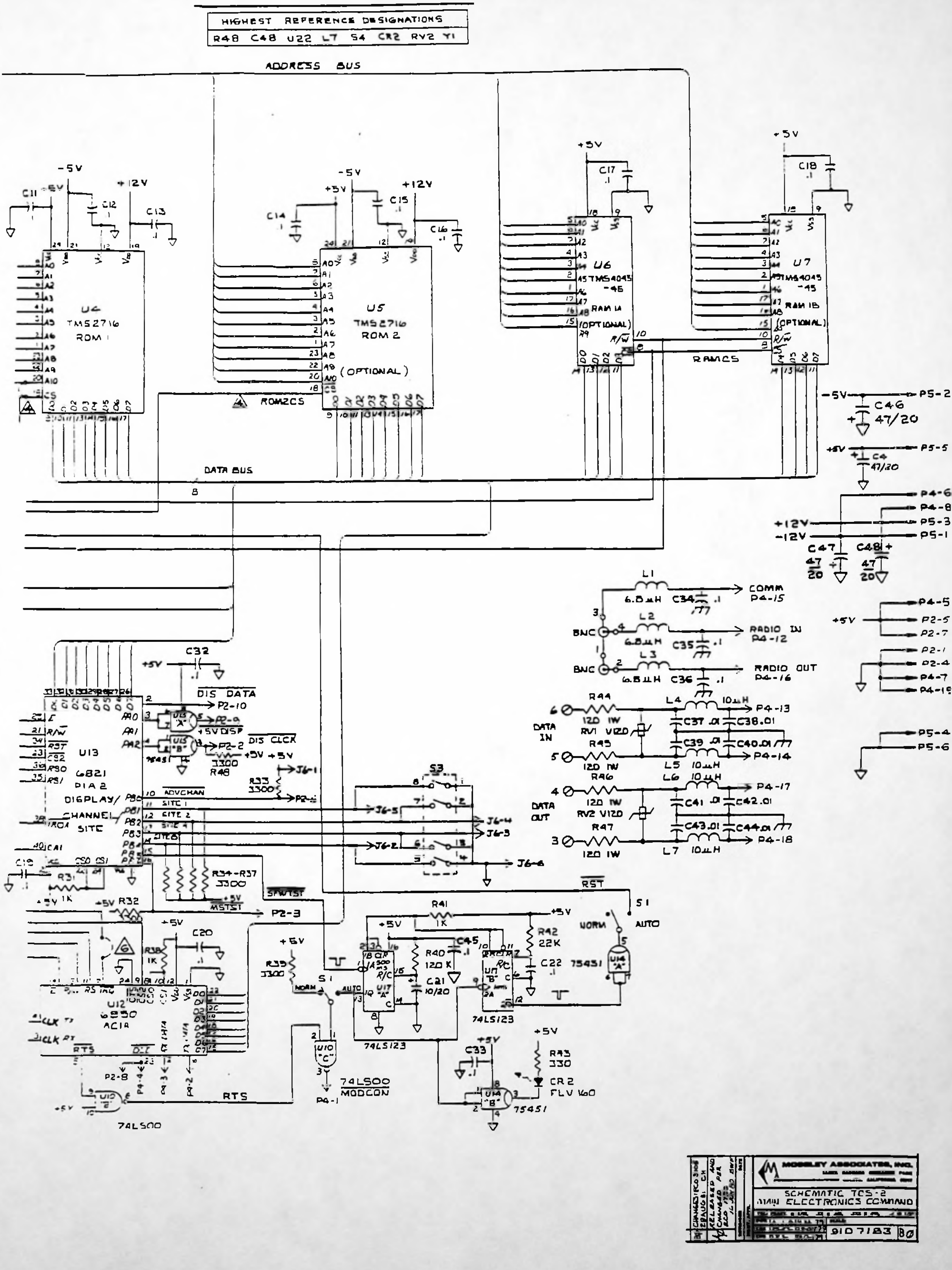
MGMT. APPR.

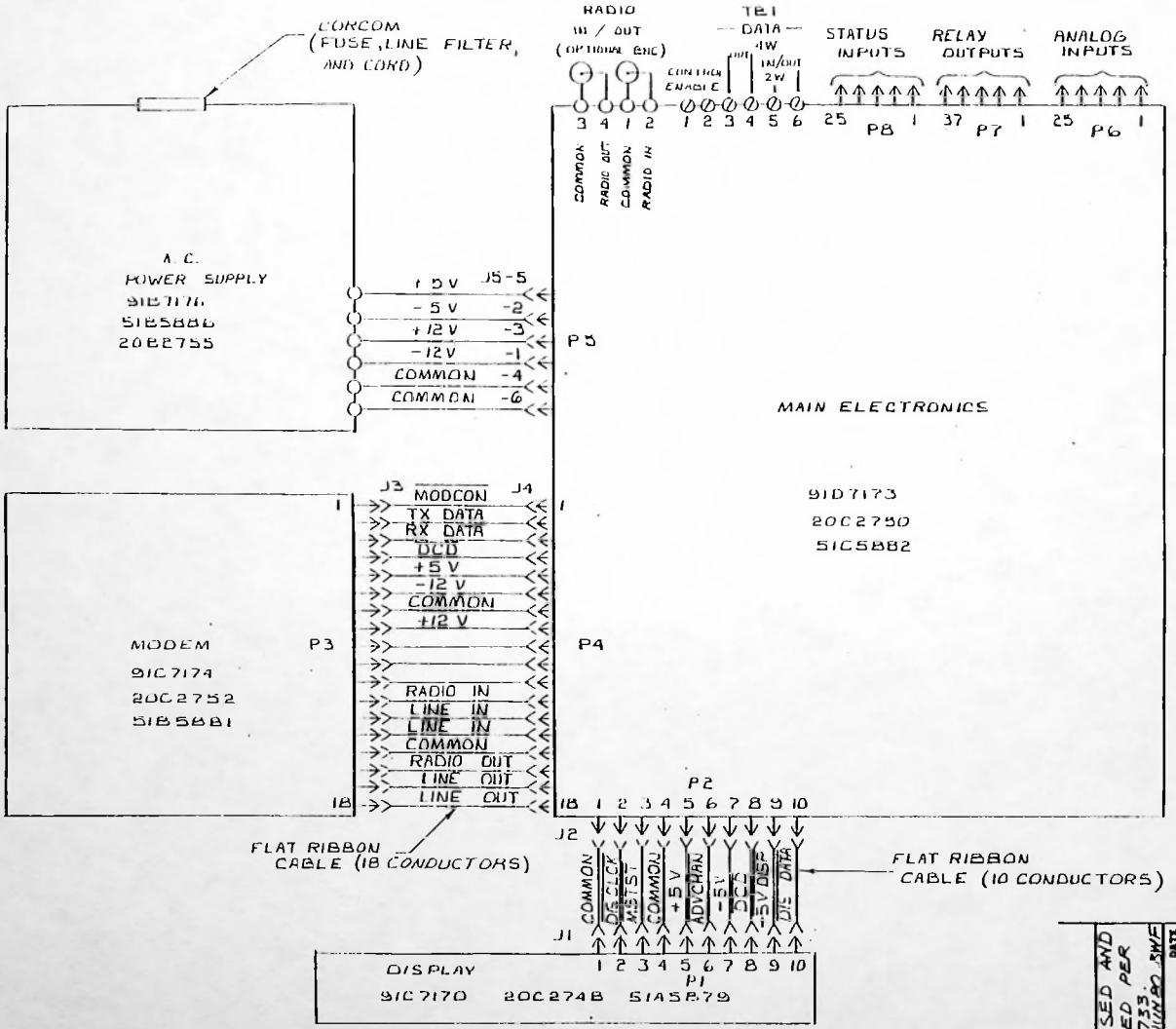


NOTES:
1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4W, 10% CAPACITOR VALUES ARE IN MICROFARADS.
2. P.C. BOARD 510588S
3. COMPONENT LAYOUT 200 2753

4. INSTALL JUMPER WHEN 1K ROM (TMS 2708) IS USED.
5. JUMPER B TO A FOR -1 OPTION (INTERNAL RAM) JUMPER B TO C FOR -2 OPTION (EXTERNAL 1K RAM) JUMPER IN TEST ACCORDING TO SOFTWARE OPTION.

NOTES CONTINUED:
7. = CHASSIS GND
= LOGIC COMMON


HIGHEST REFERENCE DESIGNATIONS
R48 C48 U22 L7 S4 CR2 RV2 Y1
ADDRESS BUS
DATA BUS
U4
TMS2716
ROM 1
U5
TMS2716
ROM 2
(OPTIONAL)
ROM2CS
U6
TMS4045-45
RAM 1A
(OPTIONAL)
U7
TMS4045-45
RAM 1B
(OPTIONAL)
RAMCS
-5V
+5V
+12V
-12V
C46 47/20
C47 47/20
C48 47/20
P5-2
P5-5
P4-6
P4-8
P5-3
P5-1
COMM P4-15
RADIO IN P4-12
RADIO OUT P4-16
BNC
L1 6.8µH
L2 6.8µH
L3 6.8µH
DATA IN
DATA OUT
RV1 V120
RV2 V120
R44 120 1W
R45 120 1W
R46 120 1W
R47 120 1W
P4-13
P4-14
P4-17
P4-18
P4-5
P2-5
P2-7
P2-1
P2-4
P4-7
P4-19
P5-4
P5-6
U13
6821
PIA 2
DISPLAY/CHANNEL SITE
DIS DATA
DIS CLCK
P2-10
P2-9
P2-2
+5V DISP
R48 3300
R33 3300
J6-1
ADVCHAN
SITE 1
SITE 2
SITE 4
SITE 8
J6-5
J6-4
J6-3
J6-2
J6-6
S3
R34-R37 3300
SFWTST
MSTST
P2-3
RST
S1
NORM
AUTO
R41 1K
R42 22K
R40 120K
C21 10/20
C22 .1
75451
U14 "A"
U17 "A"
U17 "B"
74LS123
U12
6850
ACIA
RTS
DCD
P2-8
P4-4
P4-3
P2-2
U10 "C"
74LS00
MODCON
P4-1
U10 "E"
74LS00
R43 330
CR2
FLV 160
U14 "B"
75451
MOSELEY ASSOCIATES, INC.
SCHEMATIC TCS-2
MAIN ELECTRONICS COMMAND
910 7183
B0



RELEASED AND CHANGED PER ECO 1733. SWF

REVISIONS	DESCRIPTION	DATE	APPL.
A			

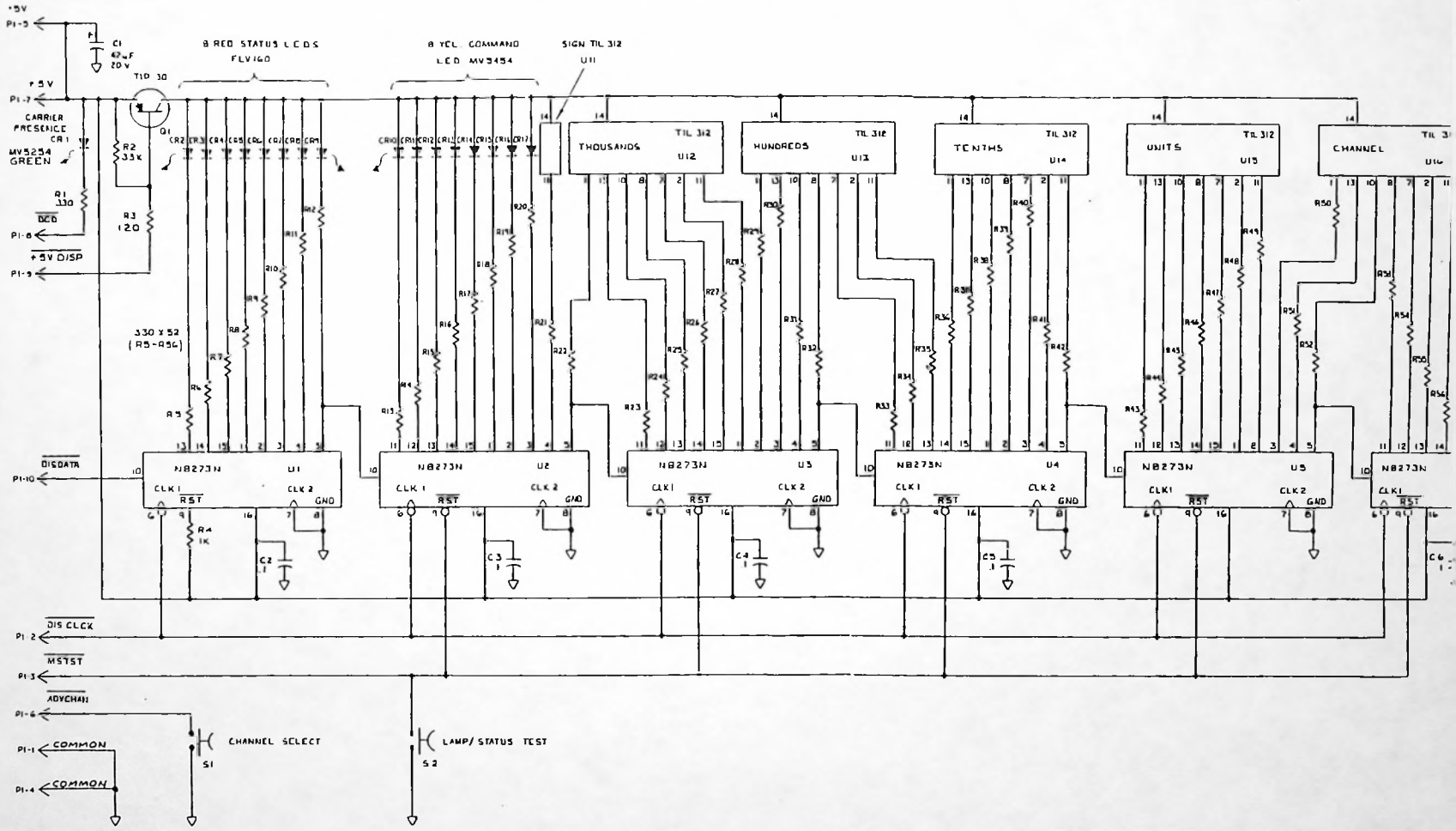
MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93117

WIRING DIAGRAM
TCS-2 REMOTE (REF)

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN AJB 11 JUN 79 SCALE:
CHK [illegible] 29 OCT 79
ENG [illegible] 29 OCT 79

21C2676 AØ



NOTES

1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4 W, 10%
   CAPACITOR VALUES ARE IN MICROFARADS
2. PC BOARD 51A3678
3. COMPONENT LAYOUT 20C2748
4. U7 CONTAINS R24,25,26,28,31,32,48
   U8 " R33,34,35,36,40,41,42
   U9 " R23,27,30,43,45,46,47
   U10 " R49,50,51,53,54,55,56

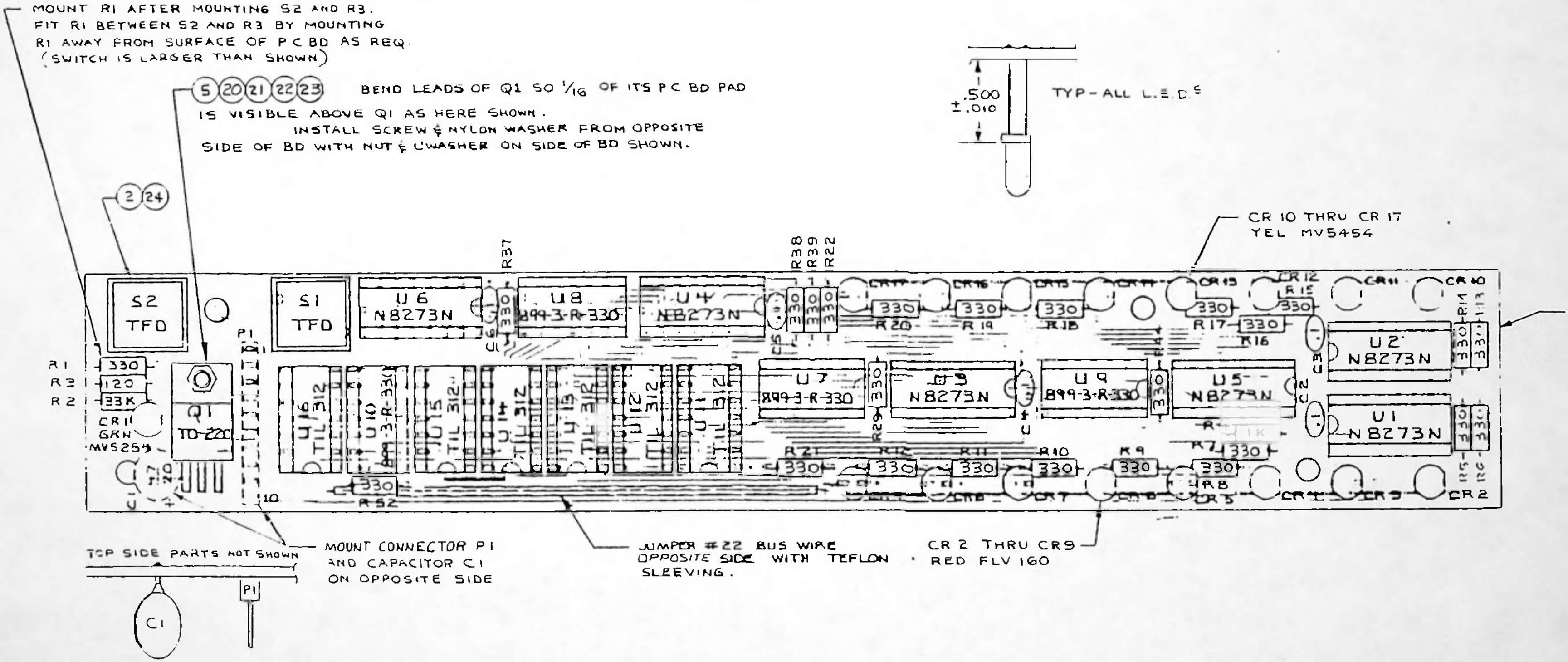
RELEASED TO PRODUCTION PER ECO 1733
REVISIONS | DATE | MGMT. APPR.

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93117

SCHEMATIC
TCS-2 REMOTE DISPLAY PANEL

TOL: FRACT. ± 1/32, .XX ± .03, .XXX ± .010, ∠ ± 1/2°

DWN	A. J. B.	5 JUN 79	SCALE:
CHK		7-3-79	91C7170 A
ENG			



NOTES

1. UNLESS OTHERWISE SPECIFIED RESISTORS ARE IN OHMS 1/4W 10 %. CAPACITORS ARE IN MICROFARADS.
2. P.C. BD. 51A5879
3. SCHEMATIC 91C 7170
4. U11 - U16 ORIENTATION:

REV	DESCRIPTION
B1	ADD NOTE #4 TO DWG RO RTZ 11-24-80
B0	DELETED ITEM R. AND INFO. TO Q1. ECO 1896
A0	RELEASED TO PRODUCTION AND CHANGED PER ECO 1733 L.D.K. 21 MAY 80

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA

COMPONENT LAYOUT
TCS-2 REMOTE DISPLAY

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°
DWN BWF 24 OCT 79 SCALE: 2X
20C 2748 B1

24	SWITCH COVER/PUSH BUTTON, LT GRY MAT. 5A2619-27	S1, S2	3190568	2
23	WASHER-LOCK, #4 SPLIT RING SS		1050632	1
22	WASHER-FLAT, #4 NYLON		1050657	1
21	NUT-#4-40, SMALL PATTERN SS		1050582	1
20	SCREW-#4-40 x 3/8, B.H., SS		1050152	1
19				
18	CONNECTOR MOLEX 22-03-2201	P1	3250545	1
17	RESISTOR BECKMAN 899-3-R330	U7-U10	4540084	4
16	RESISTOR 1KΩ 1/4W 10%	R4	4410247	1
15	I.C. SOCKET 16 PIN	U1-U6	3250032	6
14	I.C. SOCKET 14 PIN	U7-U16	3250024	10
13	RESISTOR 33KΩ 1/4W 10%	R2	4410437	1
12	RESISTOR 120Ω 1/4W 10%	R3	4410130	1
11	RESISTOR 330Ω 1/4W 10%	R1, 5-22, 29, 37-39, 44, 52	4410189	25
10	CAPACITOR .1µF/50V	C2-C6	4310207	5
9	CAPACITOR 47µF/20V	C1	4280137	1
8	DIODE L.E.D GRN	CR1	3390150	1
7	DIODE L.E.D. YEL	CR10-17	3390143	8
6	DIODE L.E.D. RED	CR2-9	3390127	8
5	TRANSISTOR TIP 30	Q1	3640216	1
4	I.C. TEX. INST. TIL 312	U11-16	3690039	6
3	I.C. SIGN. N8273N	U1-6	3730736	6
2	SWITCH, SHADOW TFD	S1, S2	3170164	2
1	P.C. BOARD MAI 51C5879	REV. 00	3472073	1
ITEM NO.	DESCRIPTION	REF. DES.	STOCK NO.	QTY

20C2748 B1

REVISIONS	
ADD NOTE #4 TO DWG RD, 972 11-24-80	B1
DELETED ITEM 19. AND INSD TO 21. ECO1896 9-10-80	B0
RELEASED TO PRODUCTION AND CHANGED PER ECO 1733 L.D.H. 21 MAY 80	A0

DATE — MGMT. APPR.

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

COMPONENT LAYOUT
TCS-2 REMOTE DISPLAY

TOL: FRACT. = 1/32, .XX = .030, .XXX = .015, ∠ = 1/2°

DWN	RWF 24 OCT 79	SCALE:	2X
CHK	NUK 11-79	20C 2748	B1
ENG	YKT 16 Nov 79		

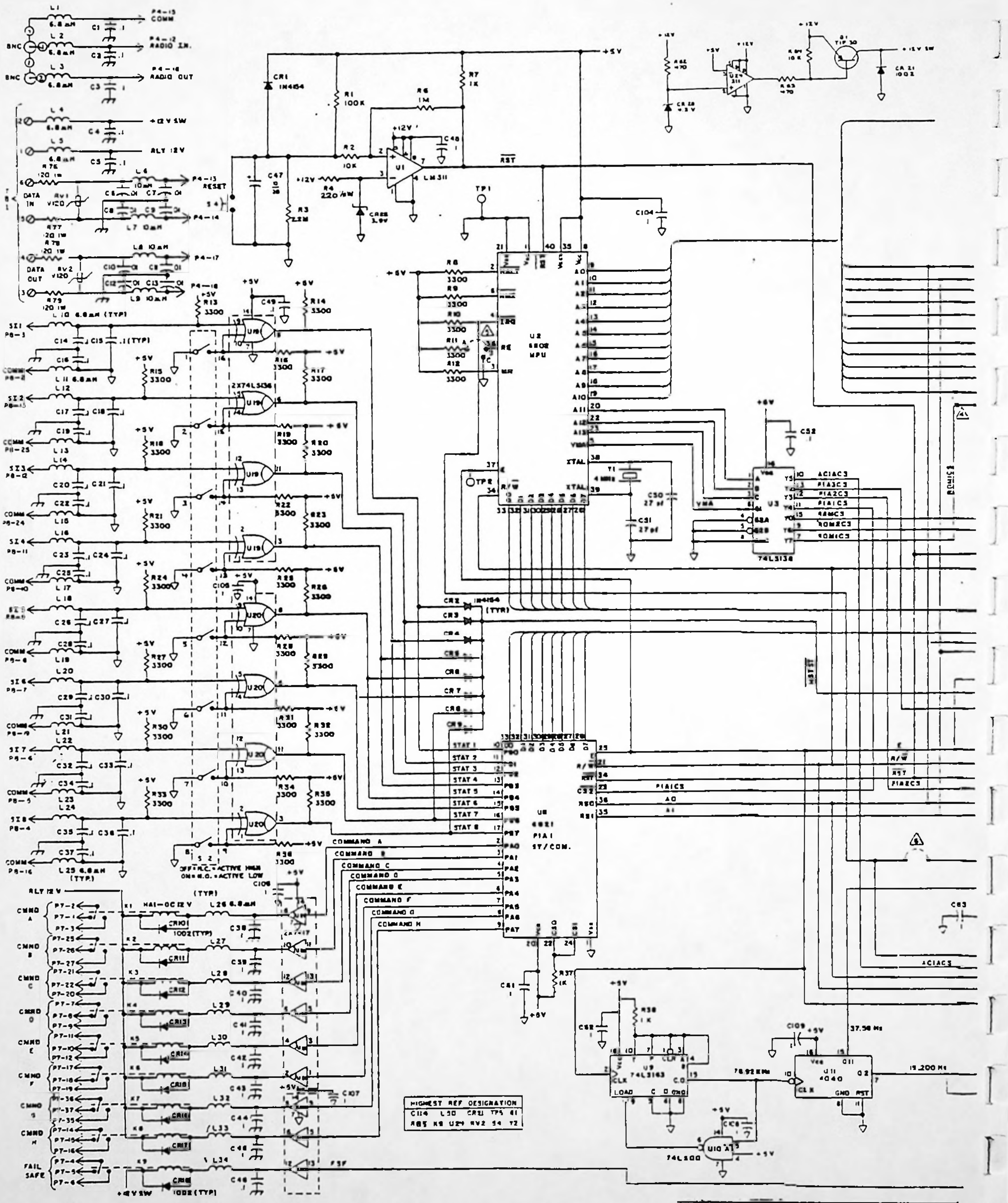
REVISIONS			DATE	APPR.
C	CHANGES: ECO 3104			
B	RELEASED AND CHANGED PER ECO 1733.	11 JUN 80	DWP	

MOBELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

SCHEMATIC
TCS-2 REMOTE MAIN ELECTRONICS

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°

DWN	A. J. [illegible] 5 MAY 71	SCALE:
CHK	[illegible] 5-3-71	
ENG	[illegible]	91D7173 C



NOTES:

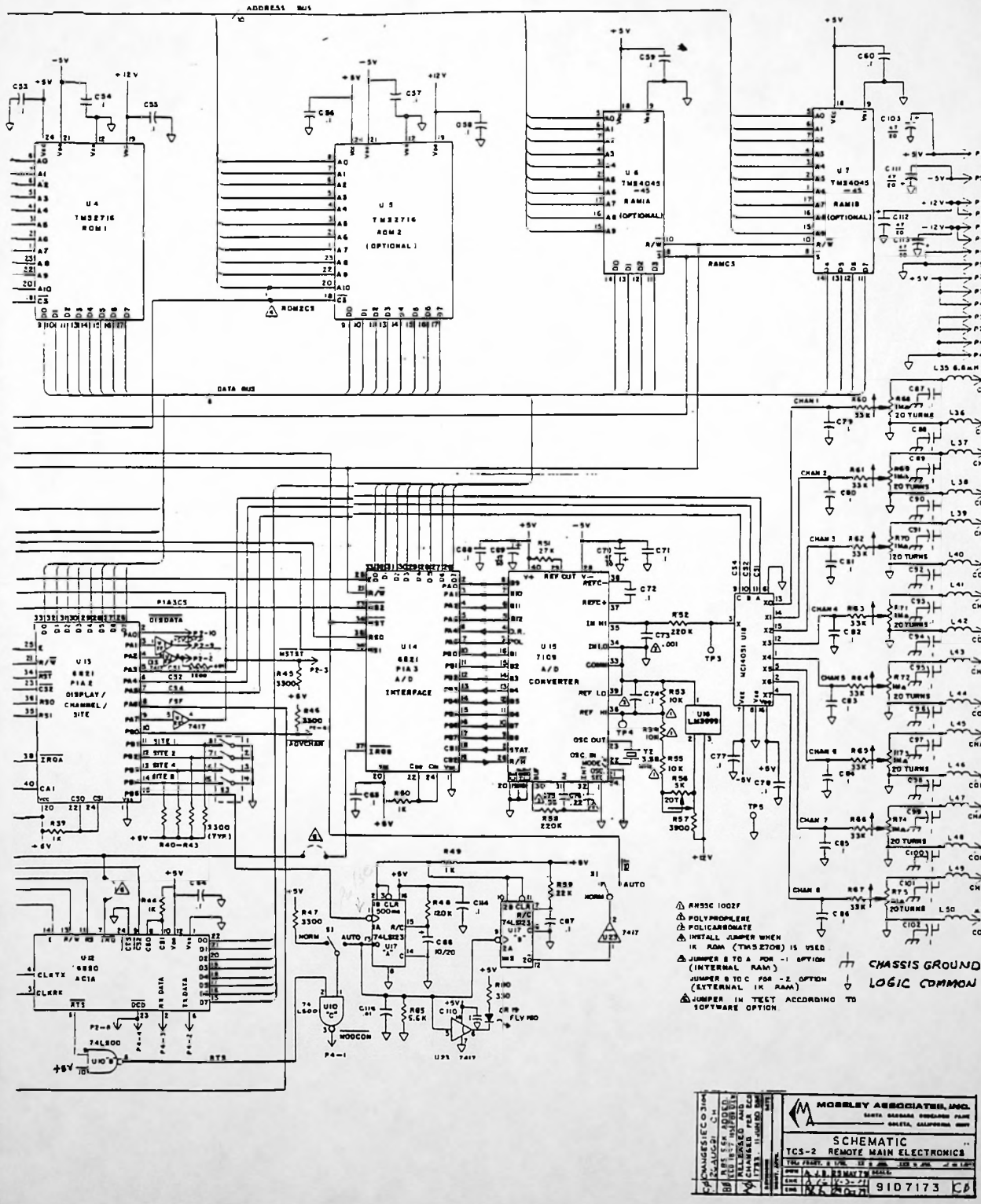
1. UNLESS OTHERWISE SPECIFIED
   RESISTOR VALUES ARE IN OHMS, 1/4W, 10 %
   CAPACITOR VALUES ARE IN MICROFARDS.
2. P.C. BOARD 51D5882 - 11, -21.
3. COMPONENT LAYOUT 2002750

MOSELEY ASSOCIATES, INC.

SCHEMATIC

TCS-2 REMOTE MAIN ELECTRONICS

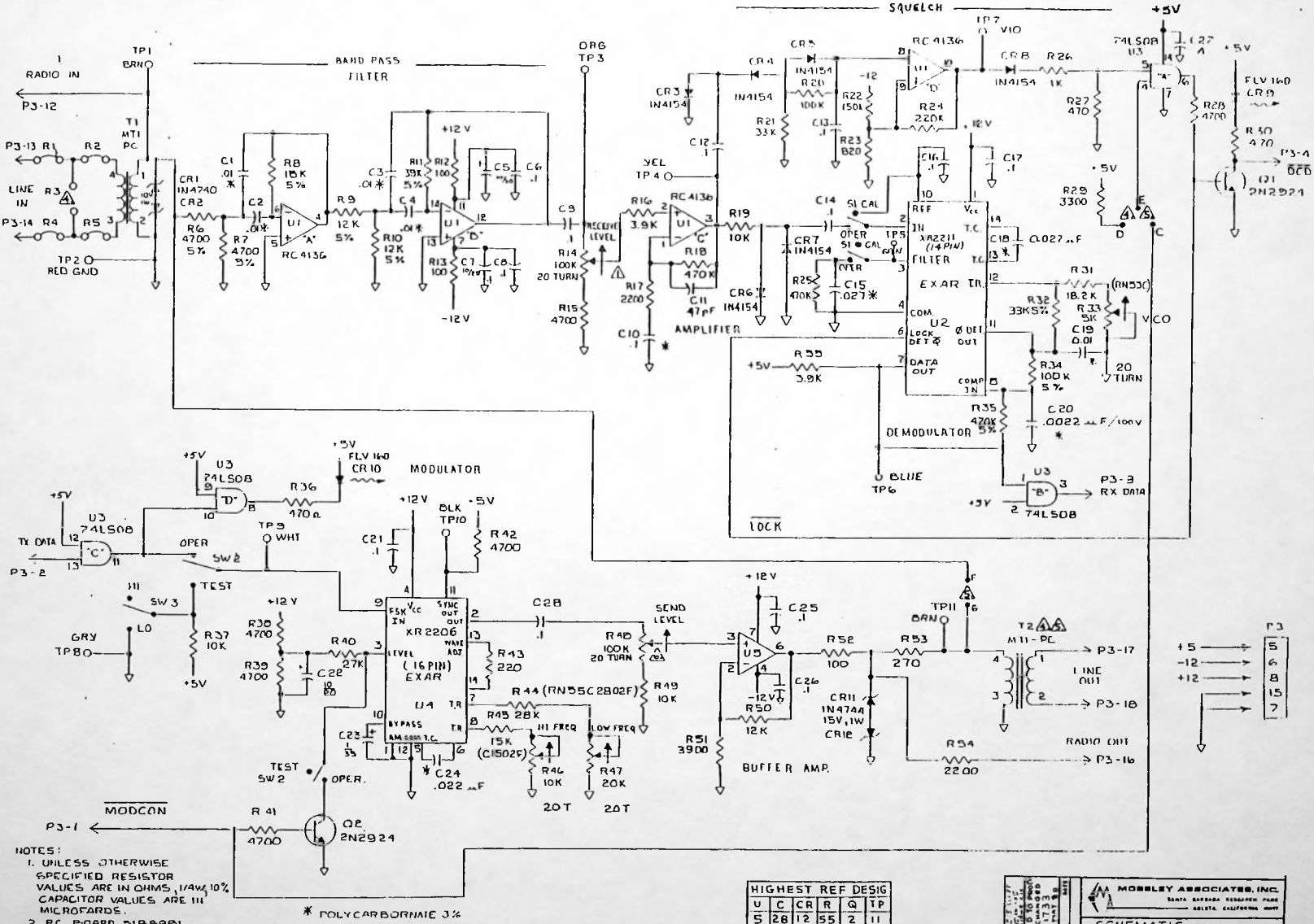
91D7173



MOSELEY ASSOCIATES, INC.
SANTA BARBARA, CALIFORNIA, U.S.A.

SCHEMATIC
TCS-2 REMOTE MAIN ELECTRONICS

9107173 C0



NOTES:
1. UNLESS OTHERWISE SPECIFIED RESISTOR VALUES ARE IN OHMS, 1/4W, 10%. CAPACITOR VALUES ARE IN MICROFARDS.
2. PC. BOARD 51B5881
3. COMPONENT LAYOUT 20C2752
4. FOR RADIO OR 4-WIRE OPERATION, USE X-FORMER T2 AND JUMPER BETWEEN D AND E, AND INSTALL R3-390Ω (-2 OPTION)
5. FOR 2-WIRE OPERATION, DELETE X-FORMER T2 AND JUMPER BETWEEN C & E AND BETWEEN F & G (-1 OPTION)
6. R48 ACCESSIBLE THRU FRONT PANEL

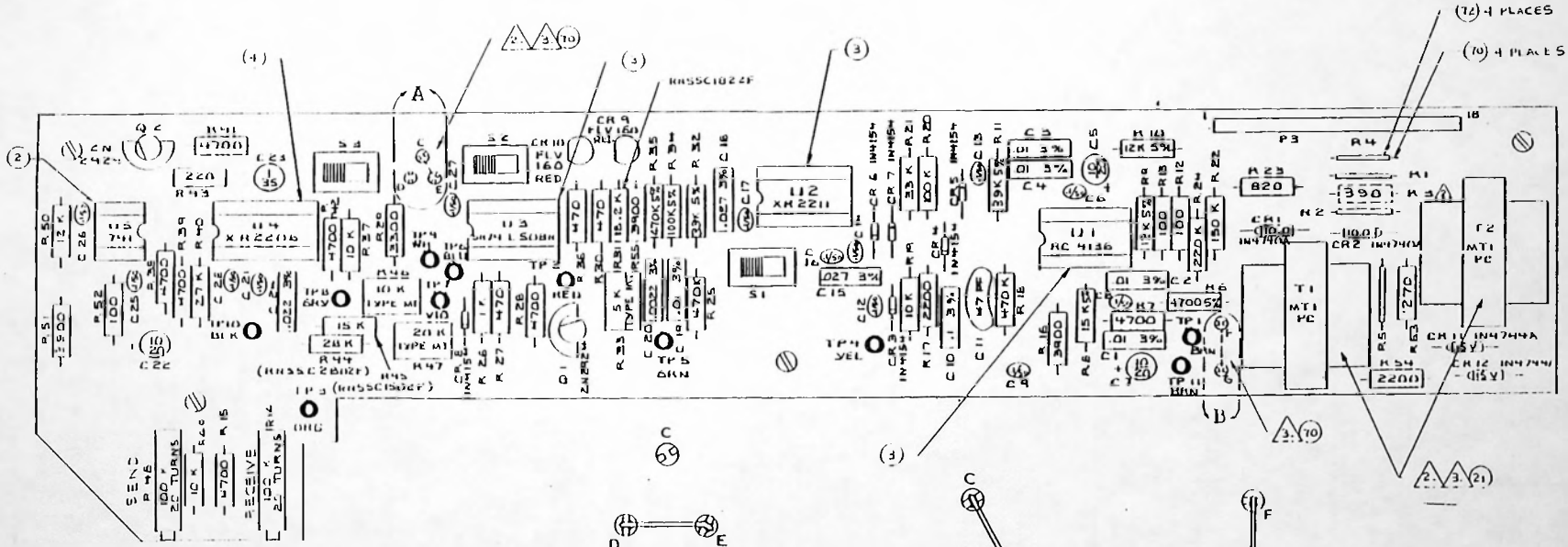
* POLYCARBORNATE 3%

HIGHEST REF DESIG					
U	C	CR	R	Q	TP
5	28	12	55	2	11

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA

SCHEMATIC
TCS-2 MODEM

91C7174 B



DETAIL A

20D2752-2 OPTION

SEE NOTE 2

DETAIL A DETAIL B

20D2752-1 OPTION

SEE NOTE 3

NOTES

1. UNLESS OTHERWISE SPECIFIED RESISTORS ARE IN OHMS, 1/4 W, 10 %. CAPACITORS ARE IN MICROFARADS.
2. FOR 20D2752-2 OPTION (RADIO OR 4-WIRE OPERATION): INSTALL ITEM 21 AT BOTH LOCATIONS, T1 AND T2; INSTALL JUMPER BETWEEN D AND E AT LOCATION A. (NO OTHER JUMPERS AT A OR B); INSTALL R3: 390Ω
3. FOR 20D2752-1 OPTION (2-WIRE OPERATION): INSTALL ITEM 21 AT LOCATION T1 ONLY; INSTALL JUMPER BETWEEN C AND E AT LOCATION A; INSTALL JUMPER BETWEEN F AND G AT LOCATION B (NO OTHER JUMPER AT A)
4. P.C. BOARD 5185881-50
5. SCHEMATIC 91C7174

REVISIONS	DESCRIPTION	DATE	APPR.
	RELEASED TO PRODUCTION & CHANGED FROM E.C.O. 17333	29 MAY 80	

MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

COMPONENT ASSEMBLY
TCS-2 MODEM

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1/2°
SCALE:
CHK
ENG
20D 2752 SH

Rev.	ITEM NO.	DESCRIPTION	REF. DES.	STOCK NO.	QTY
	[illegible]	SLEEVING-TEFLON [illegible]	L1,2,4,5	1560234	A/R
	71	RESISTOR 3300Ω [illegible]	R51	4410320	1
	70	WIRE, BUS, [illegible]	[illegible]	1641927	A/R
	69	CAPACITOR .0033µF [illegible]	[illegible]	4250049	1
	68	CONNECTOR [illegible]	P3	3250545	1
	67	RESISTOR 470KΩ ¼W 5%	R35	4460549	1
	66	" 100KΩ " "	R34	4460491	1
	65	" 470KΩ " 10%	R18,23	4410577	2
	64	" 220KΩ " "	R24	4410536	1
	63	" 150KΩ " "	R22	4410510	1
	62	" 100KΩ " "	R20	4410494	1
	61	" 27KΩ " "	R40	4410429	1
	60	" 33KΩ " "	R21	4410437	1
	59	" 12KΩ " "	R50	4410387	1
	58	" 10KΩ " "	R19,37,49	4410379	3
	57	" 3.9KΩ " "	R16,55	4410320	2
	56	" 1KΩ " "	R25	4410247	1
	55	" 4.7K ¼W 10%	R15,28,38,39,41,42	4410332	6
	54	" 3.3KΩ ¼W 10%	R29	4410304	1
	53	" 2.2KΩ " "	R17,R54	4410289	2
	52	" 820Ω " "	R23	4410239	1
	51	" 270Ω " "	R53	4410171	1
	50	" 470Ω " "	R27,30,36	4410205	3
	49	" 220Ω " "	R43	4410163	1
2	48	" 390Ω " "	R3	4410197	1
	47	" 100Ω " "	R12,13,52	4410122	3
	46	" 39KΩ " 5%	R11	4460416	1
	45	" 15KΩ " "	R8	4460341	1
	44	" 12KΩ " "	R10,R9	4460325	2
	43	" 33KΩ " "	R32	4460390	1
	42	" 4.7KΩ " "	R6,7	4460002	2
	41	" 15KΩ ⅛W 1%	R45	4510152	1
	40	" 28KΩ " "	R44	4510194	1
	39	RESISTOR 18.2KΩ " "	R31	4510179	1
	38	POTENTIOMETER 5KΩ	R33	4630166	1
	37	" 20KΩ	R47	4630331	1
	36	" 10KΩ	R46	4630273	1
	35	POTENTIOMETER 100KΩ	R14,48	4630505	2
	34	CAPACITOR 1µf 35V	C23	4280038	1
	33	" 47pf	C11	4210183	1
	32	" .1µf 50V	C6,8,9,12-14,16,17,21,25-29	4310207	13
	31	" 10µf 20V	C22,5,7	4290079	3
	30	" .022µf 100V 3%	C24	4250298	1
	29	" .027µf " "	C18,C15	4250312	2
	28	" .1µf " "	C10	4250486	1
	27	CAPACITOR .01µf " "	C1-4,19	4250171	5
	26	TRANSISTOR 2N2924	Q1,Q2	3630027	2
	25	DIODE L.E.D. FLV 160	CR9,10	3390127	2
	24	DIODE 1N4744A	CR11,12	3600228	2
	23	DIODE 1N4154	CR3-9	3600145	6
	22	DIODE 10V 1W	CR1,2	3600202	2
2, 3	21	TRANSFORMER MTI-PC	T1,2	4090106	
	20	SWITCH 23-021-114	SW1-3	3190253	3
	19	I.C. TEX. INST. 741	U5	3660008	1
	18	" EXAR XR2206	U4	3730819	1
	17	" TEX. INST. SN74LS08N	U3	366093	1
	16	" EXAR XR2211	U2	3730827	1
	15	I.C. TEX. INST. RC4136N	U1	3730462	1
	14	TEST POINT BLK	TP10	3290020	1
	13	" " WHT	TP9	3290111	1
	12	" " GRY	TP8	3290103	1
	11	" " VIO	TP7	3290095	1
	10	" " BLU	TP6	3290087	1
	9	" " GRN	TP5	3290079	1
	8	" " YEL	TP4	3290061	1
	7	" " ORG	TP3	3290053	1
	6	" " RED	TP2	3290046	1
	5	TEST POINT BRN	TP1,11	3290038	2
	4	I.C. SOCKET 16 PIN	U4	3250032	1
	3	I.C. SOCKET 14 PIN	U1,U2,U3	3250024	3
	2	I.C. SOCKET 8 PIN	U5	3250016	1
	1	PC BOARD MAI 5185881	REV. 3-23	3472081	1

REVISIONS: [illegible] DESIGN; RELEASED TO PROD.; [illegible] CHANGED [illegible] 1733 [illegible] MAY 80

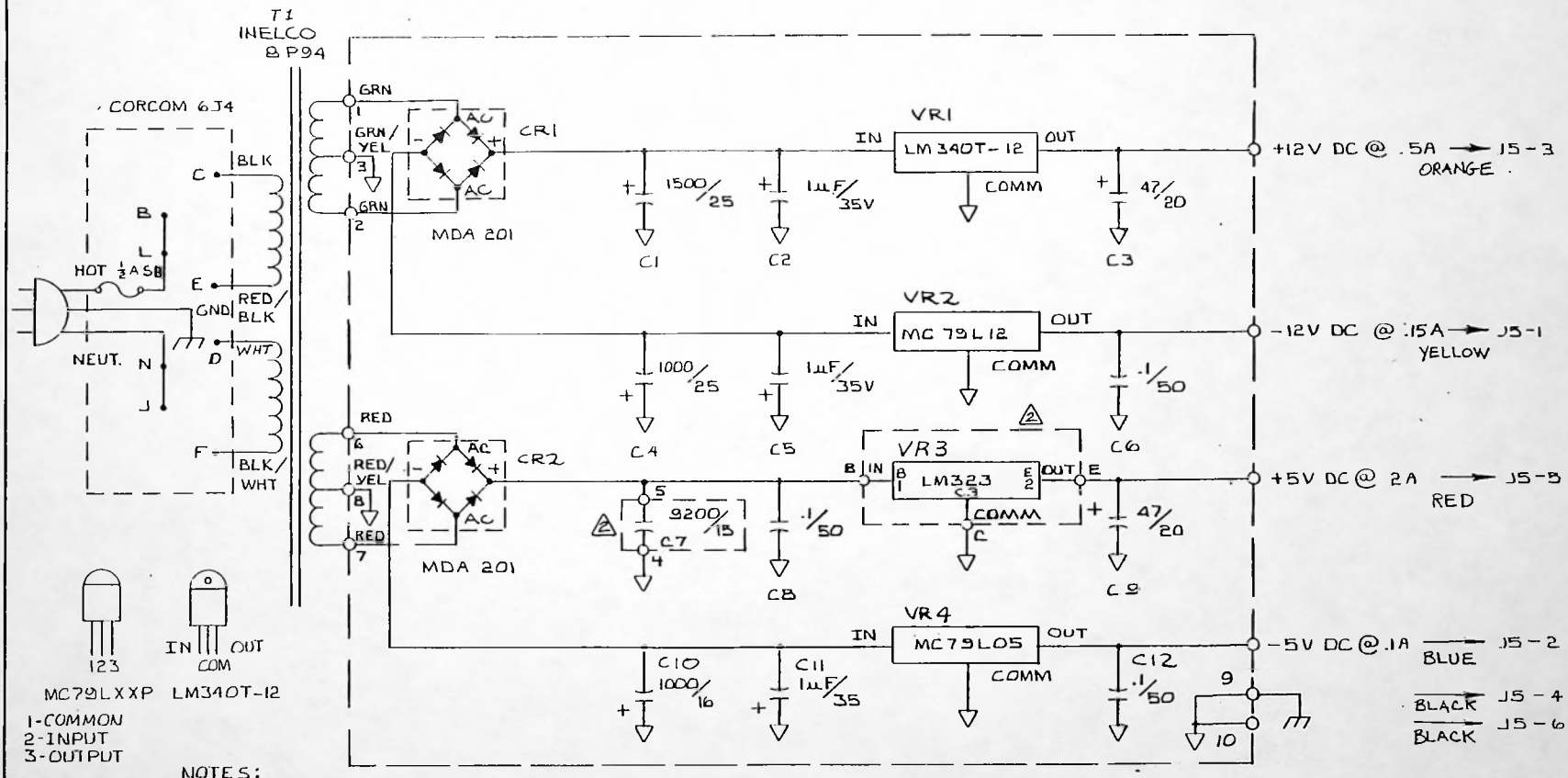
MOSELEY ASSOCIATES, INC.
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93017

COMPONENT ASSEMBLY
TCS-2 MODEM

TOL: FRACT. ± 1/32 .XX ± .03 .XXX ± .010 ∠ ± 1/2°

DWN: BWE [illegible] OCT 79 | SCALE
CHK: [illegible]
ENG: [illegible]

20D 2752 B



NOTES:

1. UNLESS OTHERWISE SPECIFIED
   ALL CAPACITOR VALUES ARE IN MICROFARADS
2. NOT MOUNTED ON P.C. BOARD
3. P.C. BOARD 51B5891-10
4. COMPONENT LAYOUT 20C2764-AΦ

REVISIONS	DATE	MGMT. APPR.
A ADDED J4 TO FUSE CHANGED PER ECO 1942		
B RELEASED AND CHANGES PER ECO 1733, 2% MYLAR ADDED		
C RELEASED 6-8-79		

MOSELEY ASSOCIATES, INC
SANTA BARBARA RESEARCH PARK
GOLETA, CALIFORNIA 93

SCHEMATIC
A.C. POWER SUPPLY

TOL: FRACT. ± 1/32, .XX ± .030, .XXX ± .010, ∠ ± 1°			
DWN	A. J.D	10 JUL 79	SCALE: 1:1
CHK	[illegible]	6-3-79	91B7176 C
ENG	[illegible]	[illegible]	

PARENT ITEM NO 9050501

SPARE PTS KIT-TCS-2A SP-50 DATE 4/22/81 PAGE 1

MOSELEY ASSOCIATES INC
111 CASTILIAN DRIVE
GOLETA CA 93117
805 968-9621

COMPONENT ITEM NO.	STOCK LOCA	MANUFACTURER PART NUMBER	COMPONENT DESCRIPTION	QUANTITY PER	UM	UNIT SALES PRICE	TOTAL SALES PRICE
3390127	2812	FLV160	LED RED	3	EA	.58	1.74
3390143	2715	MV-5354	LED AMBER	2	EA	1.37	2.74
3390150	2722	MV-5254	LED GREEN	1	EA	1.37	1.37
3600145	2721	1N4154	DIO 1N4154 25V 4NS SI DO35	3	EA	.16	.48
3600202	2744	1N4740A	DIO Z1N4740A 10V 1W 5% AIAY	1	EA	1.09	1.09
3600228	2744	1N4744A	DIO Z1N4744A 15V 1W 5% AIAY	1	EA	1.26	1.26
3610003	2721	10D2	DIO 10D2 200V 1A SI D039	2	EA	.39	.78
3610078	2744	MDA-201	DIO MDA-201 100V BRIDGE 2A	1	EA	3.29	3.29
3630027	2721	2N2924LFS	XT NS2N2924LFS.2W160M025V.1A7P	1	EA	.54	.54
3640216	2743	TIP-30	XT PPTIP-30 02W003M040V01A	1	EA	1.47	1.47
3650058	2713	LM-323K	RGLTR PLM323K 05V 3.0A TO3	1	EA	10.70	10.70
3650074	2743	LM-340T-12	RGLTR PLM340T12 12V 1.5A TO220	1	EA	2.56	2.56
3650132	2712	MC79L05 ACP	RGLTR NMC79L05 05V 0.1A TO92	1	EA	2.80	2.80
3650140	2743	MC79L12	RGLTR NMC79L12 12V 0.1A TO92	1	EA	2.80	2.80
3650249	2715	LM-3999Z	RGLTR LM3999Z 6.9V TO92	1	EA	6.65	6.65
3660008	2812	SN72741P	IC UA741P OPAMP GEN COMP	1	EA	.83	.83
3660149	2743	SN7417N	IC SN7417N HXBUF/DRIV15VOC	1	EA	1.65	1.65
3660669	2743	SN74LS00N	IC SN74LS00N QU 2IN NAND	1	EA	.84	.84
3660693	2743	SN74LS08N	IC SN74LS08N QU 2IN AND	1	EA	.84	.84
3660768	2743	SN74LS123N	IC SN74LS123N DURETRMONOMULTI	1	EA	2.08	2.08
3660784	2743	SN74LS136N	IC SN74LS136N QU 2IN EXCLOR OC	1	EA	1.06	1.06
3660792	2743	SN74LS138N	IC SN74LS138N 3-8LINEDECDEMUX	1	EA	1.96	1.96

PARENT ITEM NO 9050501

SPARE PTS KIT-TCS-2A SP-50 DATE 4/22/81 PAGE 2

MOSELEY ASSOCIATES INC
111 CASTILIAN DRIVE
GOLETA CA 93117
805 968-9621

COMPONENT ITEM NO.	STOCK LOCA	MANUFACTURER PART NUMBER	COMPONENT DESCRIPTION	QUANTITY PER	UM	UNIT SALES PRICE	TOTAL SALES PRICE
3660826	2743	SN74LS163AN	IC SN74LS163AN BINCOUNT PRESET	1	EA	2.21	2.21
3660917	2742	SN75451P	IC SN75451P DU AND HIGHV OC	2	EA	1.02	2.04
3680063	2324	CD4040BE	IC CD4040BE 12 STAGE BIN CT	1	EA	4.66	4.66
3680139	2743	MC14051P	IC MC14051P 8CH MUX R280 7V	1	EA	4.41	4.41
3690039	2742	TIL-312	IC TIL-312 DISP 7 SEG 2DP	2	EA	3.54	7.08
3710019	2713	MC6802P	IC MC6802P MICROPROCESSOR	1	EA	23.90	23.90
3710027	2713	MC6821P	IC MC6821P PIA INTERFACE	1	EA	14.70	14.70
3710043	2743	MC6850P	IC MC6850P ACIA INTERFACE	1	EA	13.83	13.83
3730165	2743	LM-311N	IC LM311N COMPARITOR SNGL	1	EA	1.79	1.79
3730462	2743	RC4136N	IC RC4136N OPAMP QUAD 741	1	EA	2.98	2.98
3730629	2742	ICL7109CPL	IC ICL7109CPL A-D CONV 12BITS	1	EA	52.50	52.50
3730736	2742	N8273N	IC N8273N 10BIT SHIFT PAR	2	EA	8.72	17.44
3730819	2742	XR-2206CP	IC XR-2206CP VCO WAVE GEN	1	EA	11.13	11.13
3730827	2742	XR-2211CP	IC XR-2211CP FSK MODEM	1	EA	13.30	13.30

TOTAL PRICE 221.50

PARENT ITEM NO 9051392

OPT S/P KIT TCS-2A SP-50 DATE 4/22/81 PAGE 1

[redacted]
111 CASTILIAN DRIVE
GOLETA CA 93117
805 968-9621

COMPONENT ITEM NO.	STOCK LOCA	MANUFACTURER PART NUMBER	COMPONENT DESCRIPTION	QUANTITY PER	UM	UNIT SALES PRICE	TOTAL SALES PRICE
3270162	2721	HAL DC12V	RELAY	1	EA	5.43	5.43
3340163	2734	30A0066	XTAL 4.0 MHZ MRC-1/TCS-2A	1	EA	37.50	37.50
3340189	2734	30A0072	XTAL 3.579545 MHZ TCS-2A	1	EA	37.50	37.50
3370236	2735	MDL 1/2	FUSE	5	EA	1.53	7.65
4090106	2713	MT1-PC	XFMR	1	EA	14.00	14.00
4090395	2023	3-1101	XFMR 8-P-94	1	EA	63.67	63.67
4270096	2723	36D922G015AB2A	CAP PWR LYTIC 9200/15V	1	EA	7.32	7.32
4590170	2744	V-120-MA1A	VARISTOR	1	EA	2.28	2.28

TOTAL PRICE 175.35