ARC-16

REMOTE CONTROL SYSTEM
INSTRUCTION MANUAL

BURK TECHNOLOGY

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REV. A

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Section One
INTRODUCTION

Description

The ARC-16 Remote Control System provides a flexible means of controlling and monitoring one or more broadcast transmitter plants from one or more studios or other remote locations.

Physical Description

The standard system consists of two physically identical units, each requiring two units of rack space (3-1/2 inches) in a standard EIA nineteen inch rack. The unit designated as the transmitter unit includes the input and output connectors to connect to the equipment to be monitored and controlled. The unit designated as the studio unit is installed at the remote control point.

Inputs and Outputs

Telemetry channels allow monitoring of up to sixteen DC samples which are typically scaled down from important voltage, current, or power values at the transmitter plant. These values are displayed in a four digit format on a 32-character LCD display at both the studio and transmitter. The displayed value may be one of four selected types: millivolt, linear, power, or indirect.

Sixteen status inputs provide a tally for various on/off conditions at the transmitter plant. The polarity of each status channel is selectable, allowing an on or off indication as desired regardless of input polarity. Typical applications for these channels include monitoring of antenna switches, overload indicators, generator status, security alarms, and smoke detectors.

Thirty-two outputs designated as "raise" and "lower" for each of the sixteen channels allow control of transmitters, generators, antenna switches and other plant equipment.

Fail-safe

Two fail-safe outputs are available, with each input/output board monitoring the presence of a specific chassis.

Communications Link

The link between studio and transmitter may be either wire or radio. Wire links are typically voice grade telephone lines but may be any circuit that will pass standard Bell 103 modem tones. The 300 baud data does not require conditioned lines in most cases.

Radio links are typically an STL subcarrier for the studio to transmitter path and an FM subcarrier for the return link. A 450 MHz telemetry return link (TRL) may also be used to provide the return path.

Modems appropriate for the type of service are provided with the ARC-16. A change in link type may be accomplished at any time by plugging in the appropriate modem board. Burk Technology, Inc. will exchange modems for a nominal charge.

Alarms

For each metering channel, an upper and lower limit may be specified. If the actual reading exceeds these limits, an alarm is set. Additionally, any of the status inputs may be assigned to set an alarm. Up to ten alarms are stacked in chronological order. Alarms are masked for 10 seconds at power-up to allow monitored signals to stabilize. Inputs that continue to show an alarm condition cause the front panel indicator to illuminate and the external alarm output to be turned on. The alarms must be cleared by the operator by pressing the ‹**CLEAR**› switch. This turns off the external alarm, then presents each of the alarms on the display, most recent first.

Controls and Displays

Seven push-button switches on the front panel control the operation of the ARC-16. Channel selection and raise and lower outputs may be controlled from either the transmitter or studio unit. From the transmitter, a maintenance mode may be selected which disables studio control and overrides the fail-safe output. A mode switch allows the user to browse through a menu of setup options, including site selection, calibration, limits, decimal point position and status polarity. Modes are also available to allow the user to edit labels assigned to each site and each channel.

In the normal mode, the 32-character alpha-numeric LCD displays, in clear-text form, the selected site, channel, channel label, and associated analog value. In each of the remaining modes, a prompt line offers the user the appropriate choices and indicates which switches to press to effect any changes.

Sixteen red LED's display the status of the various on/off conditions being monitored at the selected site. Should a complete link failure occur, the LED's flash rapidly to signal the user that data is not being received from the remote site.

LED indicators on the maintenance, mode, and clear switches provide information on the present mode and status of the remote control system.

Calibration

Front panel calibration allows each channel to be calibrated from the transmitter without the assistance of the studio operator. The indicated value is increased or decreased using the ‹**RAISE**›and ‹**LOWER**› push-buttons in the calibrate mode. The rate of change increases as the switch is held, allowing precise calibration or rapid gross changes.

Memory Retention

All setup and calibration data as well as user defined labels are preserved in non-volatile memory. Either unit (or both units) may be powered down for up to ten years without having to repeat setup or calibration. Any circuit board may be removed and serviced without loss of data. Additionally, the unit powers up with the maintenance mode in the position last selected. This allows normal return to remote operation after power failure, yet safety is not compromised should a power outage occur during maintenance.

Accuracy

12-bit plus sign analog to digital conversion and a highly stable reference voltage assures accurate readings over a wide temperature range. Vertical and longitudinal redundancy checks are performed on both data links to assure accuracy many orders of magnitude better than the error rate of the communications channel. Additional redundancy on the studio to transmitter link data prevents execution of erroneous commands.

Options

Interface Panel

The raise, lower, and fail-safe outputs are open collector with sufficient drive (250 ma) for direct interface in some installations, however a relay interface panel is available and recommended for most applications.

The interface panel, model IP-8, provides 10-amp form C contacts for all outputs and also provides barrier strip connections for the status and metering inputs. This panel may be conveniently located at the rear of a rack and plugged into the unit, permitting the ARC-16 to be easily removed for maintenance. A front mount adapter kit is available for installation in racks with no rear rails.

Computer Interface

The ARC-16 studio unit or transmitter unit may be connected to a personal computer via the CI Computer Interface option. This option greatly expands the versatility of the ARC-16, allowing automatic mode changes, limits monitoring, full screen display, and automatic logging. This option may be field installed at any time.

Enhanced Speech Interface Option

The model ESI Enhanced Speech Interface Option may be used to access the remote control system from any Touchtone® telephone. A synthesized voice announces readings and status. Commands may be executed by pressing digits on the telephone keypad.

The ARC-16 may be set to call a series of telephone numbers whenever an alarm condition occurs. The ESI option incorporates safeguards such as password security and fail-safe timeout to help comply with FCC rules for dial-up remote control operation.

The ESI may be installed at the studio or at the transmitter. When installed at the transmitter, a redundant control path is available, should the primary link fail.

Antenna Monitor Interface

The optional antenna monitor interface, model AMI-2, provides for direct interface with a Potomac Instruments model AM-19 or similar antenna monitor. Up to eight towers may be scanned with phase and ratio presented directly for each tower.

Bi-directional Control

Up to sixteen channels of control, metering, and status may be added to the studio unit to provide control and monitoring of studio equipment from the transmitter or from the ESI or computer interface. Typical applications include program automation, EBS monitoring and activation, selection of audio processors and building security. Each SIO option provides eight channels of input/output.

External Status Indications

The model SSI Studio Status Indicator provides open-collector outputs for each of the individual status lights on the ARC-16 studio unit. These may be used to drive external indicators such as annunciator panels or audible alarms.

Multi-site Operation

Two sites may be controlled by the ARC-16 by adding an ARC-16T transmitter unit. Two studio sites may be used to control one transmitter site with the addition of an ARC-16S studio unit. In either case, an additional modem and TPA-Two Port Adapter must be installed in the unit that connects to both remote sites. All three sites have access each other.

Additional information on the above options is provided in separate instruction manuals for each option.

Warranty

Burk Technology, Inc. warrants the ARC-16 remote control system to be free of defects in materials and workmanship for a period of 24 months from the date of purchase. Equipment will be repaired or replaced at the option of Burk Technology and returned freight prepaid to the customer. Damage due to abuse or improper operation or installation of the equipment or caused by fire or flood or harsh environment is not to be covered by this warranty. Damage in shipping is not the responsibility of Burk Technology. A return authorization must be obtained before returning any equipment. Materials returned under this warranty must be shipped freight prepaid and insured in the original shipping carton or suitable substitute to Burk Technology, 7 Beaver Brook Road, Littleton, MA 01460. Repairs not covered under this warranty will be made at prevailing shop rates established by Burk Technology, Inc..

THE WARRANTY SET FORTH ABOVE IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BURK TECHNOLOGY, INC. SHALL NOT BE LIABLE TO ANY PARTY FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF THIS EQUIPMENT.

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. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 16 of the FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. 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.

Section Two
OPERATION

Switches and Indicators

In normal operation, all LED indicators are extinguished and the alpha-numeric LCD displays the currently selected site and channel. In the following discussion, references to the local site mean the site where the operator is currently located, not necessarily the transmitter. Indications in the normal mode will be described first.

LCD Display

The LCD displays current data on the top line and prompts for additional data on the second line. The following descriptions apply to both studio and transmitter units, except where noted.

The upper left character of the LCD indicates the site designator for the currently selected site. In an installation with only one controlled site, this will normally be A.

The following two digits are the channel number of the currently selected channel. A user-defined channel label is centered on the first line. If no label has been entered, dashes will appear.

The right end of the first line contains a four-digit number, representing the value being read on the selected channel. If no data has been received, the display will read all dashes.

The name of the selected site will appear at the lower left of the display. If no name has been assigned, or if the unit has not received a site label from the monitored site, dashes will appear in this field.

Status LED's

Sixteen status LED's display the current state of any status lines connected to the monitored unit. A legend area is

provided on the front panel to record the function of each LED. If all sixteen LED's are blinking rapidly, communications from the monitored site has been lost.

Maintenance Switch

The ‹MAINT› switch allows the operator to shut out control from any other site and override the fail-safe at the local site. In this mode, no control can be effected by a remote unit, although the local operator may continue to control from the front panel. The maintenance override switch and indicator apply only to the local site, regardless of which site is selected for display.

Mode Switch

The ‹MODE› switch allows the user to select from a number of options. Pressing the switch advances through a menu of choices, with a prompt displayed on the second line of the LCD indicating the appropriate keys to press. A left or right arrow refers to the ‹CHANNEL› keys. Solid triangles refer to the similarly marked ‹RAISE› and ‹LOWER› keys.

The LED above the ‹MODE› switch alerts the operator to the fact that this unit is in a mode other than normal. Holding this switch for one second will return the unit from any mode to the normal mode and extinguish the light.

Clear Switch

The LED above the ‹CLEAR› switch alerts the operator to an alarm condition as described in more detail below. Pressing the switch will immediately terminate the external alarm signal and display the most recent alarm condition.

Each press of the switch will clear one alarm, until all alarms up to a maximum of ten have been cleared. After all alarms have been cleared, the display will revert to the normal mode and display the channel and site that had been selected prior to pressing clear.

The clear switch may be used to quickly return to normal mode if no alarms are active.

Channel Switches

In the normal mode, the ‹CHANNEL› switches are used to select the channel to be monitored. Depending on the number of channels in use, pressing a switch will cause the channel to roll over from the highest to channel 1 or from channel 1 to the highest.

In other modes, if the function of these switches is different, left and right arrows will appear as prompts on the second line of the display. The edit modes, for instance, use the ‹CHANNEL› switches to control the cursor.

Raise/Lower Switches

In the normal mode, the ‹RAISE› and ‹LOWER› switches cause the associated output to turn on for the length of time the switch is held. The triangle pointing up may refer to ON, RAISE, ADVANCE, or some similar function, depending on the exact application. Similarly, the triangle pointing down may mean OFF or LOWER.

Other modes use these switches to take action of some sort. In every case, the second line of the display will use the triangles to indicate the function of the switches.

Operating Modes

As the ‹MODE› switch is pressed, the ARC-16 will advance to the next mode that is appropriate for the system configuration. Not all modes are available at all sites. The calibrate function, for example, is only available at sites with Input/Output boards installed, and then only when the local site is selected.

Select Site

The select site option appears when the ‹MODE› switch is first depressed from the normal mode. The user is prompted to select the letter of the site desired by pressing the ‹RAISE› or ‹LOWER› switches. Only sites with at least one channel assigned are offered for selection. If only one site is available, this menu item is skipped entirely. Note that this would be the case with a studio unit linked to just one transmitter, unless SIO is installed at the studio as well.

Limits Monitoring

Pressing ‹RAISE› or ‹LOWER› will toggle the limits monitoring function on and off. When limits monitoring is on, any status channel tagged for alarm reporting and any analog channel with a non-zero upper or lower limit will set the alarm. The external alarm will be turned on and the ‹CLEAR› LED will illuminate.

Once an alarm is on, it will not reappear in the alarm stack until the alarm condition has been removed and applied again. This prevents a chattering alarm signal from filling the alarm stack.

After the alarms have been cleared, it is possible to see what alarms are still set by turning limits monitoring off and back on again.

The limits monitoring option is available at any site. Alarms are set according to the originating site setup, but are stacked individually at each site. Clearing alarms at the studio does not clear them on the transmitter unit.

Calibrate

This mode is available only at sites where at least one channel is active. The calibration is accomplished by adjusting the displayed value using the ‹RAISE› and ‹LOWER› keys. Short presses will advance the number one digit at a time. Holding the switch down will cause the change to speed up.

A channel that is set to read millivolts cannot be calibrated. As a reminder, (MV) appears in the lower right portion of the display.

Values below about 250mV may also not calibrate, as there is insufficient level to assure specified accuracy.

A reading of 9999 that cannot be lowered means the input signal is excessive. This can be confirmed by reading the channel in the millivolts position.

Set Decimal Point

The decimal point may be rotated into any of four positions, again using the ‹RAISE› and ‹LOWER› keys. The decimal position will display the same at all sites when this channel is accessed. Although the decimal point may be moved on a channel set to read millivolts, the decimal is not significant.

Set Upper Limit

The upper limit may be set for any analog channel by using the same procedure as calibration. To disable alarm reporting on any one channel, set the limit to zero.

Set Lower Limit

The lower limit may also be set for any channel using the same procedure. Again, disable alarm reporting by setting the limit to zero.

Select Type

Any of four types of conversion may be selected for any analog channel:

Millivolt (MV) reads the approximate absolute voltage of the input sample.

Linear (LIN) scales the input sample linearly. This is the most common conversion type.

Power (PWR) squares the input sample so that a voltage representation of power may be used accurately. Use this type for RF power samples.

Indirect (IND) offers a calculated indirect output power by multiplying the selected channel by the previous channel. To use this feature, connect plate current to this channel and plate voltage to one channel lower. (You may wish to connect one of the samples to two inputs so that you can still read the direct value.)

This channel is calibrated as any other channel, and uses the raw input from the two samples so is unaffected by the previous channel calibration.

Set Polarity

Every status channel may be set for normal or inverted reading. This is useful for normally on signals where the status LED should light during absence of signal.

Select Alarm

Each status channel may be set to activate an alarm when the LED illuminates. Toggle this function on or off with the ‹**RAISE**› and ‹**LOWER**› keys.

Edit Channel Labels

Use this mode to assign labels and/or units of measurement to each channel. Up to seven characters may be used for each label.

The ‹**RAISE**› and ‹**LOWER**› keys will change the character at the cursor position, and the ‹**CHANNEL**› keys will control the cursor movement. When the end of the label is reached, you will be prompted to reverse direction to re-edit or continue on to the next or previous label.

Note that labels are sent from one site to the other in the background, and may take a minute or more to appear at another site. Also note that the label will not change at another site until the channel has been re-selected.

Version and Serial Number

This mode will display the internal chassis serial number and version of the installed firmware.

One more press of the mode switch will return the system to normal mode.

Section Three
INSTALLATION

Before installation, it is recommended that the operation of the ARC-16 is thoroughly understood and that a brief checkout be performed with both units at the same location. Read Section Two thoroughly before proceeding. It is also desirable to have the plant interconnections fully documented and all wiring in place before beginning the installation.

Initial Inspection

The studio and transmitter units are packed separately in cartons designed specifically for the ARC-16. The location and orientation of the cushioning material should be noted and the material saved in case it is necessary to reship the unit.

Visual Inspection

Check both cartons to see that you have one studio unit and one transmitter unit (standard system) with the proper options indicated on the side panel. If the interface panel option has been ordered, it will be packed in a separate carton.

Carefully unpack both units and inspect for shipping damage. If damage is detected, immediately file a claim with the freight carrier. They will usually send an inspector to fill out a report and will want to see the packing materials as well.

Each carton should contain the following items:

- Studio or transmitter unit
- Power cord
- Instruction manual
- Mating I/O connectors (transmitter unit only, may be packaged with optional IP-8 Interface Panel)

Internal Inspection

There are no internal adjustments normally required before installing the system but it may be desirable to remove the top cover from each unit to be certain that there is no concealed shipping damage. In particular, the power transformer should be tightly secured to the chassis and all socketed IC's and inter connect cables should be firmly seated in the sockets. The plug- on jumper on the modem boards should be in the opposite position in the two units.

Unless otherwise requested and so marked, the ARC-16 is shipped for operation at 115V nominal. This may be confirmed by observing the transformer primary connections on the output terminals of the power entry module. Connections for both 115V and 230V operation are as follows:For 115v operation, Blue and Violet connect to one terminal; Gray and Brown to the other. Proper fuse is a one-half amp slow-blow.

For 230v operation, Blue connects to one terminal; Brown connects to the other terminal; Violet and Gray are linked together. Reduce the fuse to 1/4 amp for operation on 230v.

Functional System Checkout

Place both units in a convenient location near each other and connect the communications links as appropriate for the type of modems installed. If wire modems are installed, connect the barrier strip terminals marked "Line" from one unit to the other. If radio modems are installed, use BNC cables to connect "Radio In" to "Radio Out" and vice versa. This will not be possible if a subcarrier receiver is being used. In this case, only the studio to transmitter link can be confirmed prior to installation.

Apply Power

Apply power to both units. If the status lights are flashing, recheck the modem connections or refer to the troubleshooting section if necessary.

Advance Channels

Press the channel select switch on either unit and verify that the channel advances to the next digit. When the maximum channel is reached, the display will advance to channel one. The display on the opposite unit will not change.

Check Analog Inputs

Refer to figure 3-1 and table 3-2 and connect a 1.5 volt battery or other voltage source to one of the analog inputs. Select the appropriate channel on the transmitter unit. Make certain that the channel is in the millivolt (MV) setting. the display should read the battery voltage in millivolts. Change the conversion type for this channel to linear (LIN). Move to the calibrate mode and adjust the displayed value to some convenient number. Exit the calibrate mode by pressing the ‹CLEAR› switch. If transmitter to studio communications are correct, the studio unit should no longer be flashing and should indicate the same value when that channel is selected.

Check Status Inputs

Refer to figure 3-1 and table 3-1a and short one of the status inputs to ground. Both units should display the change in status.

Check Outputs

Refer to figure 3-2 and table 3-1b and connect a lamp, LED, or relay to one of the raise outputs. Figure 3-4 shows several ways to connect various devices to the open collector outputs. The external device should be off until the appropriate channel is selected and the raise switch is pressed. Verify that the output is asserted from the studio only when the system is not in the maintenance mode.

If the outputs do not function properly when the command is given from the transmitter, recheck the connections and refer to the troubleshooting section if necessary. If the outputs function from the transmitter unit but not the studio unit, the link from the studio may not be valid. Recheck the modem connections and refer to the troubleshooting section if necessary.

Check Alarms

Connect an indicator to the alarm output, referring to figures 3- 2 and 3-3 and table 3-1b. The alarm output should be off. Now set one of the status channels to alarm and turn limits monitoring on. Ground the status input and observe that the external alarm activates. Pressing the ‹CLEAR› switch will turn off the alarm.

Check Fail-Safe

The fail-safe output may be tested by removing the studio to transmitter link. Observe that each active fail-safe output turns off after about 90 seconds. A fail-safe is active only when another ARC-16 chassis is detected. The fail-safe remains inactive on stand alone chassis. Press the maintenance switch and observe that the fail-safe output turns on. Turn maintenance off, restore the link and observe that fail-safe is again enabled.

This completes the basic system check out.

Rear Panel Connections

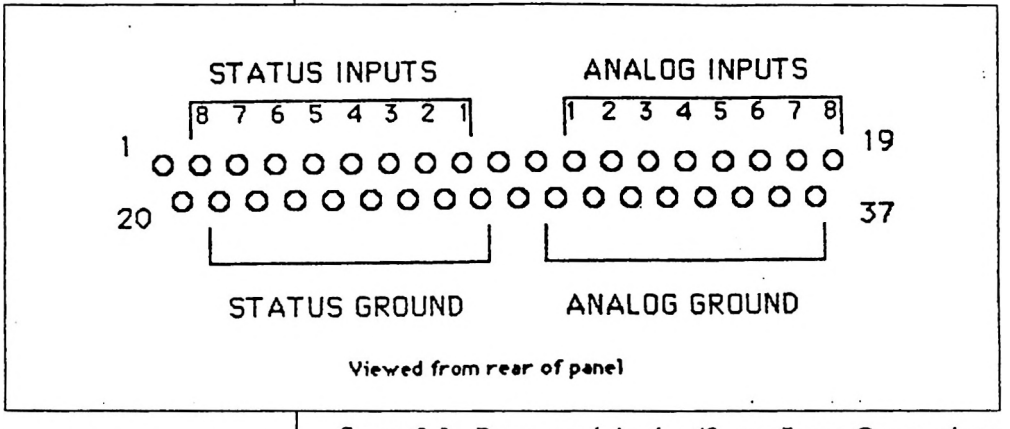


figure 3-1. Rear panel Analog/Status Input Connections

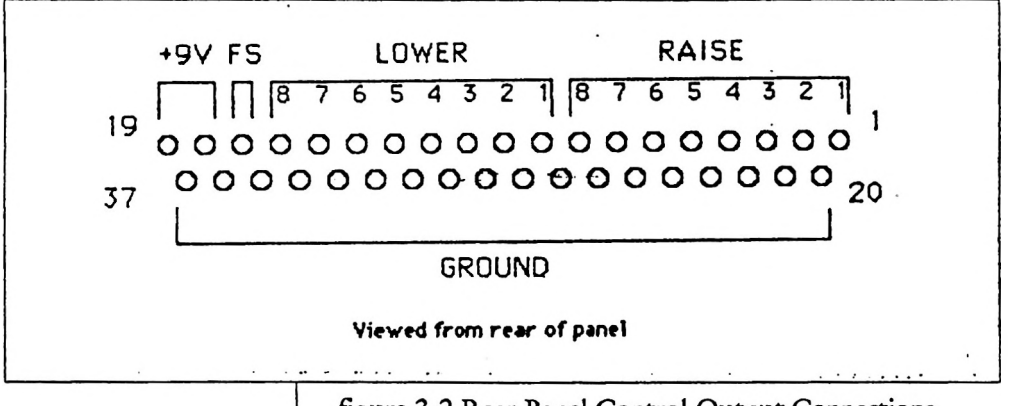


figure 3-2 Rear Panel Control Output Connections

Pin 1	ALARM +
Pin 2	GROUND
Pin 3	LINE1 +
Pin 4	LINE1–
Pin 5	LINE2 +
Pin 6	LINE2–

figure 3-3. Rear Panel Barrier Strip Connections

1	3.3k pull-up to +5	Ground	37
2	Status #8 +	Ground	36
3	Status #7 +	Ground	35
4	Status #6 +	Ground	34
5	Status #5 +	Ground	33
6	Status #4 +	Ground	32
7	Status #3 +	Ground	31
8	Status #2 +	Ground	30
9	Status #1 +	Ground	29
10	Status Ground	Ground	28
11	Analog Ground	Ground	27
12	Analog Channel 1	Ground	26
13	Analog Channel 2	Ground	25
14	Analog Channel 3	Ground	24
15	Analog Channel 4	Ground	23
16	Analog Channel 5	Ground	22
17	Analog Channel 6	Ground	21
18	Analog Channel 7	Ground	20
19	Analog Channel 8		

table 3-1a. Analog/Status Input Connector Pin-outs. (Channels 1-8)

1	Channel 1 Raise	Ground	37
2	Channel 2 Raise	Ground	36
3	Channel 3 Raise	Ground	35
4	Channel 4 Raise	Ground	34
5	Channel 5 Raise	Ground	33
6	Channel 6 Raise	Ground	32
7	Channel 7 Raise	Ground	31
8	Channel 8 Raise	Ground	30
9	Channel 1 Lower	Ground	29
10	Channel 2 Lower	Ground	28
11	Channel 3 Lower	Ground	27
12	Channel 4 Lower	Ground	26
13	Channel 5 Lower	Ground	25
14	Channel 6 Lower	Ground	24
15	Channel 7 Lower	Ground	23
16	Channel 8 Lower	Ground	22
17	Fail-safe	Ground	21
18	9vdc unregulated	Ground	20
19	9vdc unregulated		

table 3-1b. Control Output Connector Pin-outs. (Channels 1-8)

1	3.3k pull-up to +5	Ground	37
2	Status #16 +	Ground	36
3	Status #15 +	Ground	35
4	Status #14 +	Ground	34
5	Status #13 +	Ground	33
6	Status #12 +	Ground	32
7	Status #11 +	Ground	31
8	Status #10 +	Ground	30
9	Status #9 +	Ground	29
10	Status Ground	Ground	28
11	Analog Ground	Ground	27
12	Analog Channel 9	Ground	26
13	Analog Channel 10	Ground	25
14	Analog Channel 11	Ground	24
15	Analog Channel 12	Ground	23
16	Analog Channel 13	Ground	22
17	Analog Channel 14	Ground	21
18	Analog Channel 15	Ground	20
19	Analog Channel 16		

table 3-1c. Analog/Status Input Connector Pin-outs. (Channels 9-16)

1	Channel 9 Raise	Ground	37
2	Channel 10 Raise	Ground	36
3	Channel 11 Raise	Ground	35
4	Channel 12 Raise	Ground	34
5	Channel 13 Raise	Ground	33
6	Channel 14 Raise	Ground	32
7	Channel 15 Raise	Ground	31
8	Channel 16 Raise	Ground	30
9	Channel 9 Lower	Ground	29
10	Channel 10 Lower	Ground	28
11	Channel 11 Lower	Ground	27
12	Channel 12 Lower	Ground	26
13	Channel 13 Lower	Ground	25
14	Channel 14 Lower	Ground	24
15	Channel 15 Lower	Ground	23
16	Channel 16 Lower	Ground	22
17	Fail-safe	Ground	21
18	+9vdc unregulated	Ground	20
19	+9vdc unregulated		

table 3-1d. Control Output Connector Pin-outs. (Channels 9-16)

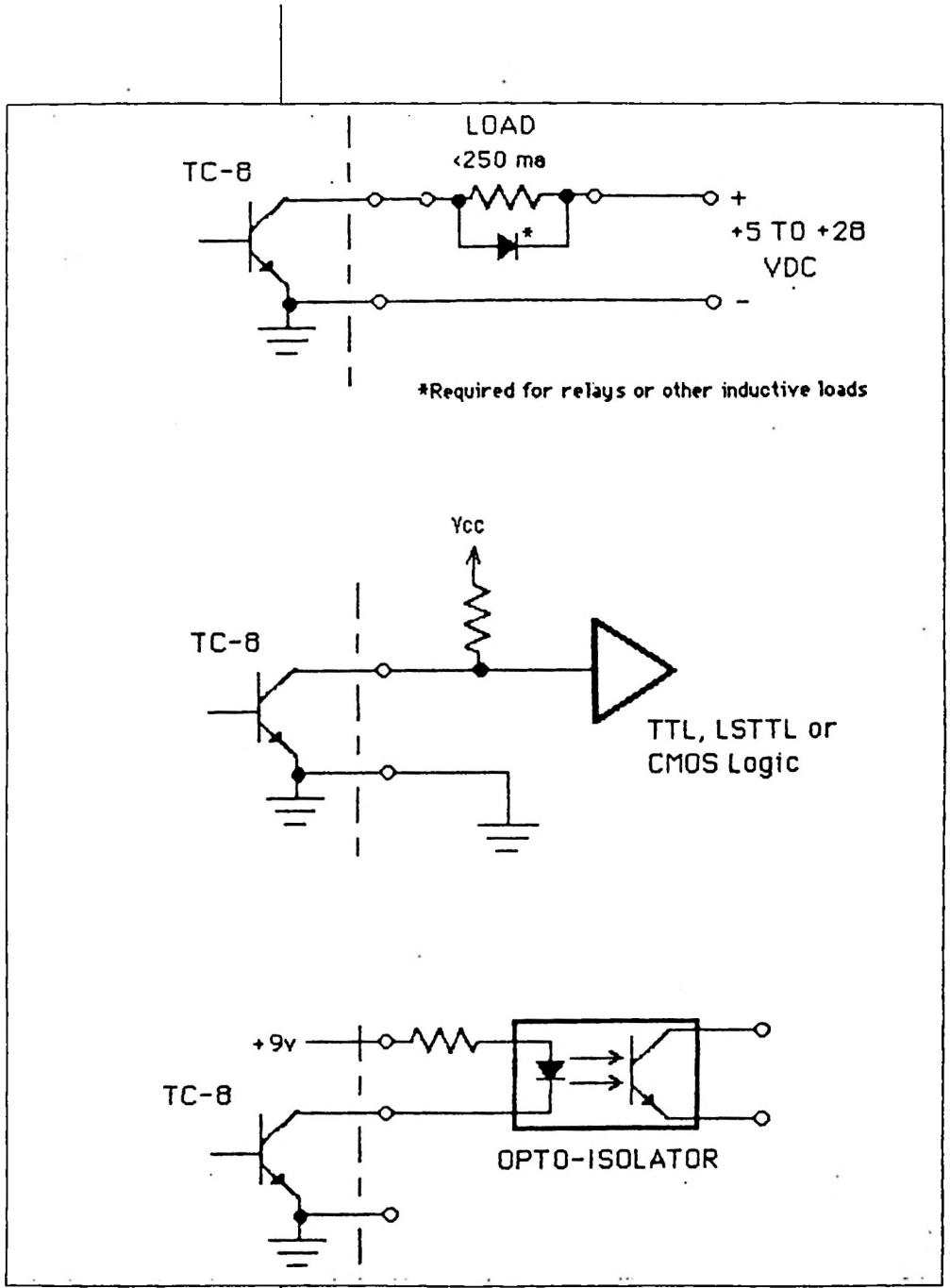


figure 3-4. Output Connections to External Devices.

Control Outputs

The outputs from the ARC-16 are rugged and nearly bullet-proof but care should still be used to make certain that the outputs are operated within a safe current area. Reasonable overcurrent will not damage the outputs but will prevent them from properly driving the load until the load is reduced to a proper level.

Suitable Loads

Transmitters and associated equipment use various voltages for remote control operation. Some modern transmitters use 12 or 24 volts DC and may be directly interfaced to the ARC-16. If the control circuits operate on more than 28 volts or require AC, it will be necessary to interface the ARC-16 with external relays. The optional interface panel is suitable for this and allows direct connection of AC or DC switching contacts. Note that high-current switching loads (greater than about .5 amps) should still use slave relays of adequate rating.

If 110 volt control circuits are used, do not leave the contacts exposed where someone (maybe you!) might accidentally discover their full potential. For this reason we find it highly desirable to use low voltage DC for control with slave relays mounted within the equipment cabinets where necessary.

For the remainder of this discussion we will assume that all outputs will drive DC loads of 28 volts or less and that the required slave relays are installed within the equipment as necessary. DC power supplies used to provide the operate voltage should be limited to some reasonable size for safety and reliability. A 2-amp regulated supply of 12 or 24 volts is plenty of power for almost any plant and will not turn into an arc welder if a cable is shorted.

Using Open Collector Outputs

To use the open collector outputs it is necessary to provide a proper source of voltage to the controlled device and bring the ground side of the device to the ARC-16 output. This is commonly referred to as "ground operate" as the open collector output provides the required ground when the command is executed. Of course you must also provide a ground return to the power supply. Please observe the polarity on all outputs. The output voltage must be above ground for the output to work. Figure 3-4 shows several possible configurations. The ground for all outputs is common but at least one ground return should be provided to each external unit. Do not depend on station

ground for this as ground loops will surely result. It is not necessary to run control circuits in shielded cable.

Latched Outputs

All outputs with the exception of the fail-safe are momentary and are normally off. In some cases it may be necessary to provide a latched output or a normally on output. This can either be accomplished by using external relays or external logic. Latching relays are available as mechanical latches or as magnetic latches that hold with remanent magnetism. They are typically operated by connecting the "raise" output to one coil (on) and the "lower" output to the other coil (off).

External Logic

If it is decided to use external logic, TTL, LS-TTL or CMOS devices may be operated directly from the ARC-16 outputs (with pull-ups where required). This will allow flip-flops, gates and external status signals to be integrated into the control system as dictated by the unique plant requirements. Relays may then be driven where necessary using transistor drivers or opto- isolators. Up to 200 ma of unregulated DC voltage may be taken from the control output connector as indicated. This may be used to provide Vcc for the external logic using a five volt three- terminal regulator on the external logic board.

Analog Inputs

Most transmitters provide remote metering outputs which provide a sample voltage within the acceptable range. In some cases it will be necessary to convert the signal to a DC sample or perhaps install a voltage divider to bring the sample within range. Some equipment produces extremely low output samples and it may be desirable to install an instrumentation amplifier to improve the accuracy of the sample. The ARC-16 will meet specs with an input as low as 250 mv which is adequate for most equipment including several popular reflectometers which produce notoriously low sample voltages. As a general rule, the sample should be pre- scaled to provide four volts for the highest expected value. This will provide maximum resolution and accuracy.

Sample Voltage Connections

Connect the desired sample voltages to the analog inputs as indicated in figure 3-1 and table 3-1b. Each sample should be brought to the ARC-16 in a shielded cable to reduce noise on the sample. All analog inputs have a com-

mon ground but again it is important to provide the best possible ground return for each sample. In extremely noisy environments it may be necessary to carry the signal ground as a separate conductor in a shielded cable with the shield tied to chassis ground at only one end.

Multiple Power Levels

Where the station operates at more than one power level with the same transmitter it is often difficult to achieve accurate samples over the entire range. This is due to poor tracking of the sample voltage as opposed to any limitation in the ARC-16. The simplest solution is to connect the same sample to two ARC-16 inputs and calibrate one for each mode. This limits the tracking requirements to about ten percent of the range instead of the entire difference from high to low power. Where the additional channels are not available it may be necessary to use external correction amplifiers which have adjustable slope and intercept.

Additional Connections

Status Inputs

The status inputs are provided with internal pull-up resistors so that they may be used with switch closures or active outputs. The minimum acceptable signal is an LS TTL output. The input has a fan-in of one unit load. The highest acceptable signal is 28 VDC. Hysteresis is provided on all status inputs to improve noise immunity. Care should still be exercised to assure a good, direct ground return for each input and to make certain that the source comes as close to ground as possible for an off indication. An input voltage between -28 volts and +0.8 volts will result in an off indication.

Where switch closures are used, the inputs are relatively immune to bounce but the switch contacts must provide a good low resistance path to assure reliable operation. Switch closures are connected directly from ground to the status input. Again, use a separate, dedicated ground return for each piece of equipment.

Fail-safe Output

The fail-safe output remains on as long as there is valid data arriving from the studio. This output is frequently used to control the filament circuit of the transmitter al-

though it may be integrated into the control system in a different manner. It is an open collector output with exactly the same characteristics and over-current protection as the raise and lower outputs.

Alarm Outputs

The alarm outputs are identical on the studio and transmitter units. They provide the means to connect an external alarm to the ARC-16. Each time an alarm is detected, the output will activate, and when the alarm is acknowledged, the output will deactivate. These are low-current open collector outputs and must not be connected to loads greater than 50 ma. The alarms may consist of lights, buzzers or other appropriate signals. Use interface techniques similar to those shown in figure 3-4. An external source of voltage is required to drive the alarm.

Connection to AM Antenna Monitors

To provide remote monitoring of phase and current in a directional array, it is necessary to provide some means of switching from the reference tower to the other towers. The optional Antenna Monitor Interface, model AMI-2 is recommended for this purpose.

Communications

The selection of suitable STL and TSL circuits will be controlled by cost and availability of voice-grade phone lines, availability of 450 MHz or 950 MHz spectrum, cost of RF equipment and the existence of a line of sight path to the transmitter. Redundancy and reliability should be considered when choosing the type of links to use.

The ARC-16 may be used with virtually any type of link, however, the appropriate modems must be specified for each type of link. Modems may be exchanged for a nominal charge.

Wire Circuits

By far the simplest type of link is a common voice-grade phone line. The wire modems supplied in the ARC-16 utilize standard Bell 103 tones and will work well over almost any 2-wire telephone circuit that will pass voice frequencies.

The wire modems provide transformer isolation for dedicated (dry) telephone loops. A coupler must be installed to connect the modem to a dial circuit.

Lightning Protection

Lightning protection is provided on board, however, external transient suppression is strongly recommended. The model TE-2 Transient Eliminator is available and has proven effective.

Four-Wire Circuits

If for any reason it is necessary to use 4-wire telephone circuits, modems must be specified for 4-wire. External transformers and lightning protection will also be required.

Wire Line Connections

The telephone line is connected to the barrier strip terminals marked "Line 1" on the rear panel of both units. A second site may be connected to Line 2 only if the optional second modem and TPA Two Port Adapter has been ordered and installed.

Signal Levels

The loss on the wire line should ideally be less than 20dB. It is a good idea to make a record of the actual level for later comparison. Confirm with headphones that the line is free of hum and noise.

Radio Circuits

Where telephone circuits are not available or desirable, radio modems may be used which provide a subcarrier for use with 950 MHz STL transmitters for control and an FM subcarrier for metering. A 450 MHz TRL transmitter may also be used for the metering if modems are specified for audio.

Subcarriers

Radio modems may be specified on any frequency form 39kHz to 185kHz. For the control path, the choice depends on the STL equipment being used. For metering, 67kHz or 92kHz may be used.

STL Transmitter Connection

The ARC-16 studio unit must be connected to the subcarrier input of the STL transmitter using a cable with BNC connectors on each end. Make certain that the studio and transmitter units are equipped with modems on the desired frequency before connecting the output to the STL transmitter.

STL Subcarrier Levels

The injection level of the subcarrier must be adjusted prior to operating the remote control system. Normally, the STL transmitter will provide a metering position for the subcarrier. The meter is typically calibrated so that a 100 percent reading corresponds to the recommended subcarrier level. Adjust the injection control located on the output module until the STL meter reads 100 percent.

STL Receiver Connection

Connect the STL receiver subcarrier output to the "Radio In" BNC connector on the ARC-16. No adjustments to the ARC-16 are required at this end of the link.

FM Exciter Connection

Connect "Radio Out" on the ARC-16 to the subcarrier input of the FM exciter. Usually, the exciter has a subcarrier level adjustment. If not, adjust the injection level on the ARC-16 Output module. In either case, set the injection to 5 percent.

If a subcarrier modulation monitor is not available, the adjustment may be made by removing the stereo pilot and all other sources of modulation and adjusting for 5 percent total modulation. After the system has been tested, injection level can often be reduced to as little as one or two percent.

SCA Receiver

Where SCA is used for metering, it is necessary to receive the FM signal at the studio and feed the subcarrier audio into the ARC-16. Use of a modulation monitor as a source for the data has not proven successful in many cases. Frequently, the level is insufficient, requiring that subcarrier injection be increased. A dedicated subcarrier receiver is an inexpensive solution that has worked well.

Connect the SCA receiver to a good antenna and confirm that data is heard at the receiver output. The output of the receiver should then be connected to the "Radio In" connector on the ARC-16. No further adjustment should be necessary, however, you may wish to confirm that approximately one volt peak-to-peak is available at the output of the SCA receiver.

TRL Connections

A TRL transmitter and receiver may be directly connected to an ARC-16 provided that the Universal Modems have been specified and installed. Note that the connections are

made to the BNC connectors on the ARC-16 and not to the Line terminals.

Customizing the System

To fully realize the convenience of the ARC-16 Remote Control System, several variable are made field adjustable through the use of a configuration menu. Installation of additional options will also require the use of this menu. Variables that may be set in the field include:

- Site Labels
- Access codes
- Number of active channels
- Number of I/O boards
- Port communications
- Additional options

Accessing the Configuration Menu

To reach the configuration menu it is necessary to remove power from the ARC-16. With the power off, press and hold both the ‹MODE› and ‹CLEAR› switches at the same time and re-apply power. Continue holding the switches for at least one second after power has been restored. Each successive menu topic is accessed by pressing the ‹MODE› switch.

Data Reception

Receive Data assignments tell each unit from which port to accept valid data. This becomes important when more than one path exists. One path should be selected as the source for each reporting device.

Port 1 for a WIRE modem (WMS or WMT) appears on the rear panel LINE 1 terminals. Universal Modems use the lower set of BNC connectors as Port 1. In both cases, Port 1 implies the modem installed on the chassis floor of the ARC-16.

Port 2 is available in a chassis when the TPA - Two Port Adapter Option is installed, in which case Port 2 refers to the upper modem board.

Data Transmission

Send Port assignments allow you to control the flow of data from unit to unit in multi-site systems. The default setting is to send LOCAL data out all available ports (PORTS 1+2) whether 2 ports exist or not. Data from

other remote sites is not sent out unless the local chassis has the TPA Two Port Adapter or AMI-2 Option installed. Inform each chassis about the location of other sites in your system by using the 'CHANNEL' and 'RAISE' or 'LOWER' switches. If no extra modem is installed in this unit, then all external devices will be accessed via 'PORT 1'.

Site Name

The chassis Site Name may be customized with 7 characters or less. This feature makes using a multi-site system more understandable when you select each location. Select a character position to be edited using the 'Channel' switches, and edit the displayed character using 'RAISE' and 'LOWER'.

Access Codes

The MASTER/USER menu allows customizing the passwords used in the ESI Enhanced Speech Interface and CI Computer Interface Options.

Highest Channels

The Highest Channel available for each site may be assigned to eliminate unused channels from being displayed, or to restrict certain commands from being accessed by particular locations. Limiting each chassis to the highest channel used also makes more efficient use of the communications links at each site. Select each available site using 'Channel' switches and set the numerical value using 'RAISE' and 'LOWER'.

Options

Each of the installed options requires a YES/NO response. **Make certain that the desired options are physically installed before attempting to select them within the menu.** Scan the available options using the 'Channel' switches and change the desired selection using 'RAISE' and 'LOWER' to toggle the YES/NO display.

The available options are:

- CH. 1-8 First Input/Output board

Answer YES if this unit contains an I/O card in the lowest slot. (I/O cards connect status and metering inputs and control outputs to the ARC-16. An I/O card has two DB-37 connectors on the rear.)

- CH.9-16 Input/Output board

Answer YES if this unit contains an I/O card in the middle slot.

- LCL ESI ESI Enhanced Speech Interface

Answer YES only if a ESI (Enhanced Speech Interface) is installed in this unit. The presence of two RJ-11 and a DB-9 connector confirms that a ESI is installed.

- DTMF Tone Dial/Pulse Dial

If you have LCL ESI selected you may choose pulse dial by selecting NO, or tone dial by selecting YES.

- P 1 DSU Remote Digital Speech Unit

Answer YES only if you have a speech interface installed at the site designated as the next alphabetic letter. Alphabetic designations follow the pattern A,B,C,D,A,B, etc. (From site 'A' perspective, 1 site away is site 'B', 2 sites to 'C', 3 sites to 'D')

- P 2 DSU Remote Digital Speech Unit

Answer YES only if you have a speech interface installed at the site designated as 2 sites away from the current site. (From site 'B' perspective, site 'D' is 2 site pointers away.)

- P 3 DSU Remote Digital Speech Unit

Answer YES only if you have a speech interface installed at the site designated as 3 sites away from the current site. (From site 'C' perspective, site 'B' is 3 site pointers away.)

- AMI-2 Antenna Monitor Interface Option.

Answer YES to enable the antenna monitor interface. The IC at U4 on the CPU board must be labeled AMI 4.1 or greater for this option to function.

- P 1 SSI Studio Status Interface

Answer YES to enable the Studio Status Indicator for the unit designated as the NEXT alphabetical site, following the sequence A,B,C,D,A,B, etc. For this option to take effect, an SSI card must be installed and connected to the middle header on the AUX board. (The AUX board plugs directly into the CPU board and has three 24-pin headers.) An SSI card appears as an I/O card with only one DB-37 connector.

- P 2 SSI Studio Status Interface #2

Answer YES to enable the Studio Status Indicator for the unit designated as 2 site letters from the current site, following the sequence A,B,C,D,A,B, etc. For this option to take effect, an SSI card must be installed and connected to the rear-most header on the AUX board.

- 2 PORTS Two Port Adapter

Answer YES if the Two Port Adapter is installed on the CPU board. This is a small plug-in card that mounts near the middle of the CPU board and connects to two modems, allowing connection of multiple sites.

Section Four
TECHNICAL DESCRIPTION

The ARC-16 remote control system consists of four basic modules in the transmitter unit and three similar modules in the studio unit. A description of each module will follow a brief overview of the system.

Overview

Both studio and transmitter units are microprocessor based. All displays and outputs are derived from the microprocessor (MPU). Analog input voltages are converted to a 12 bit binary value by the analog to digital converter, then multiplied by a calibration constant and converted to a decimal number by the MPU. Status inputs are conditioned and read by the MPU and converted to the proper polarity. All raise, lower and alarm outputs and the fail-safe output are driven under the control of the MPU. All switches and displays are also connected to the MPU.

A watchdog timer gets periodically retriggered by the program and forces a master reset if the program fails for any reason.

Communications

Communications with the studio is via an appropriate modem which converts FSK signals to digital levels. The modem connects to an asynchronous communications interface adapter (ACIA) which converts the incoming serial data into parallel so it can be read by the MPU and similarly converts MPU data into serial form for transmission by the modem.

Sub-system Locations

The MPU, memory, ACIA and power supply are all located on the CPU board located near the front of the chas-

sis. The A/D converter, input conditioning and output drivers are located on the I/O board which is at the rear of the chassis on the transmitter unit. This board connects to the CPU board via a 24 pin header. All displays and switches are located on the display board immediately behind the front panel. The modem board, located in the rear near the center contains the modem, protective circuitry for the line connection and the alarm output.

I/O Board

Two I/O boards are located in the transmitter unit and optionally in the studio unit (SIO Option). Each board contains analog input, status input and control and fail-safe outputs.

Input Multiplexer

Each analog input channel is filtered and sent to a CD4051 eight input analog multiplexer. The multiplexer receives channel select commands from the MPU via a 74HC175 latch and puts the proper channel into the input of the ICL7109 A/D converter (ADC). Negative voltage for the multiplexer and the ADC is obtained from an ICL7660 DC to DC converter.

Analog to Digital Conversion

The ADC is a dual-slope integrator which compares the input voltage with a very stable reference voltage from an AD680J. The 12 bits plus sign and overrange are read by the MPU whenever the ADC signals via an interrupt that a conversion has been completed.

The next channel to be read is latched into the multiplexer and another conversion starts immediately. The program controls the sequence of channels to be read and updates active channels more rapidly than stabile ones but still reads all channels periodically.

The crystal frequency and clock divider ratio for the ADC are chosen to provide rejection to 60 Hz components on the incoming samples. This coupled with effective input RF filtering provides a very quiet signal for the ADC.

Status Inputs

Status inputs are connected to two MC74HCT14 hex Schmitt trigger circuits. These inputs have a pull-up to five volts. The MC74HCT14 provides hysteresis to provide noise immunity. The MC74HCT14 outputs are put on the bus at the proper time by a 74HCT244 buffer. The program scans these inputs once every few milliseconds,

exclusive ORs the status with a mask to selectively invert polarity, and displays the result.

Control Outputs

Seventeen outputs are provided on the I/O board, eight raise, eight lower, and fail-safe. These outputs are latched by the program into two TPIC6A259 addressable latches (raise and lower) and bit 3 of the 74HCT175 (fail-safe). When the current exceeds the maximum allowed, the device turns off. The output will attempt to cycle on repeatedly and will return to the on condition as soon as the overload is removed.

Modem Board

The modem boards consist of an MC145443 Bell 103 modem with switched capacitor filters.

Wire Modems

On wire modem boards, the input and output are combined in a duplexer implemented within the MC145443 and connected to a 600 to 600 ohm transformer for connection with the line. The line connections are protected from transients by a network of capacitors, zener diodes and a metal-oxide varistor and brought to the barrier strip on the rear panel.

Universal Modems

Universal modems provide for a variety of communication links, combining FSK audio with FM or STL subcarriers and even RS-232. The AFSK signal from the modem is connected to the FM input of an XR2206 function generator to produce a modulated subcarrier. An XR2211 decoder is used to demodulate the incoming subcarrier and supply the modem with an AFSK signal. The subcarrier input and output appear on BNC connectors on the rear panel. For use with a TRL transmitter the baseband AFSK appears on the output BNC as well as the Line 1 connection on the barrier strip.

Each modem board contains a three pin header with a plug-on jumper which is used to select answer or originate modes for each modem. The studio modem is operated in the answer mode (2025 Hz and 2225 Hz transmit) and the transmitter modem is operated in the originate mode (1070 Hz and 1270 Hz transmit). The jumper is clearly labeled S and T for these settings.

Alarm Output

The modem board also contains a 74LS123 retriggerable one-shot which is triggered by the MPU when no alarm is present. The output drives a 2N3903 NPN transistor which provides an open collector output to the barrier strip to drive a alarm output. To indicate reception of a programmed alarm, the retrigger pulse is inhibited which allows the one-shot to time out. Since the one-shot requires continuous support from the program, the alarm will also be asserted if the unit experiences a catastrophic failure.

Display Board

A 16x2 alpha-numeric LCD on the display board latches, stores, and displays data from the MPU. Three 74LS259's latch data from the bus to the nineteen LED indicators and control the electo-luminescent backlighting. The seven switches are taken directly to the CPU board.

CPU Board

An MC6802 8-bit microprocessor on the CPU board executes the program stored in a 27128A 128k bit EPROM. Temporary storage is provided by random access memory internal to the MC6802. Non- volatile storage of calibration constants and setup data is provided by a 2817A EEPROM. A 74LS244 buffers the front panel switch inputs. Two 74LS138's provide partial address decoding for all sub systems.

Serial Communications

An MC6850 Asynchronous Communications Interface Adapter handles the data conversion for the modem. The baud rate clock for the MC6850 is obtained by dividing down the 1 MHz E signal from the MPU with a 74LS161 and a CD4024 to 16 times the baud rate. A jumper is permanently installed on the CD4024 output to select 300 baud.

Watchdog Timer

A DS1232 watchdog timer drives the master reset. The timer is retriggered but the interrupt output pin of the MC6850. If the program ceases to reload data into the MC6850, no further triggers are received and it times out in about 500 mS resetting the CPU.

Power Supply

Incoming AC is fused in the power entry module and fed to an EMI filter to reduce susceptibility to RF noise on

the power line and also to reduce the radiation of signals generated by the internal clocks. The power is then fed to a toroidal power transformer which produces 9 volts RMS. The secondary is connected to the power supply rectifier, filter, and regulators on the CPU board. One UGH7805 regulator provides 5 volts to the display board while a second provides 5 volts to the remaining subsystems. Unregulated DC is also provided to the I/O board to provide a source for the precision reference. This voltage is also made available on the rear panel to power external logic or the optional relay interface panel.

Section Five
TROUBLESHOOTING

The ARC-16 is built using highly reliable components and conservative circuit design. Many years of trouble-free operation can be expected without any routine maintenance other than occasional cleaning of the front panel with a mild detergent.

How to get Help

In the event of a problem, the following suggestions will serve as a starting point for troubleshooting. If you get stuck on a problem, don't hesitate to call the factory for assistance. An engineer is available during normal office hours (9AM to 5PM Eastern Time) at (978) 486-0086. Spare parts are stocked at the factory and will be shipped overnight when requested.

The procedures that follow may require skills or test equipment not available at the station. Proceed only as far as you can without risking possible further damage, then call the factory.

Power Supply Problems

If nothing lights on the front panel the most likely cause is a power supply failure. The fuse may be checked by unplugging the unit and removing the rectangular insert on the rear of the power entry module. Check the fuse visually or with an ohm meter and replace if necessary with a fuse of the proper rating (AGC .5 amp for 115 volt units). Never defeat the fuse protection.

If the fuse continues to blow, the most likely cause is a short in one of the power supply components or across the unregulated buss. Remove the I/O connectors. If the unit lights up with the connectors removed, look for a short or a high current load on the unregulated output pin of the

Control Out connector. It is also possible that the mating connector has been miswired.

Visually inspect the rectifier diodes and check with an ohm meter if they look like they have been excessively hot. Before replacing a shorted diode, try to determine the cause of the high current condition. Unplug the ribbon cables going to the modem and I/O boards to isolate the board containing the short. If the problem is isolated to the modem or I/O board, look for a solder bridge or loose piece of wire causing a short. A short in the ICL7660 or associated components on the I/O board could also be the cause.

If the fuse continues to blow with only the CPU and display boards connected, there is probably a short in one of the power supply components. Check the rectifier diodes, filter capacitors and regulators in that order.

Isolating a Defective Regulator

If the fuse is OK but the display is still blank, check that 5 volts +/- .25 volts is present at the output of both 7805 regulators. Exercise caution near the regulator heat sink as it normally runs hot to the touch.

If no voltage is present at this point, check for approximately 9 volts across one of the large electrolytic capacitors and approximately 9 volts RMS between the anodes of the rectifier diodes. If DC is present on the input of the regulators but not on the output, replace the regulator.

Power Transformer, Rectifier and Filter

If AC is present but DC is not, suspect the diodes. If there is no AC on the diode anodes, check the power connector on the CPU board for an unseated wire. Unplug the power connector and check for AC from the transformer. If AC is present, remove the CPU board from the chassis and check for an open trace or defective solder connection. If no AC is present on the connector, the problem is isolated to the connector, power transformer, power entry module, or line cord.

I/O Problems

Control Outputs

If an output does not function properly, first check the external connections. If other outputs work, move the load

to another output to confirm that the external load and connections are proper.

If no output functions, the problem may be on the I/O board or CPU board.

Status Inputs

Status input problems are most likely related to the connector or one of the MC74HCT14's. If all inputs 1-6 or both 7-8 are bad, replace the associated MC74HCT14. A single bad input is possibly the result of a bent pin on the connector.

Analog Inputs

Analog input problems may be due to destruction of the input multiplexer by excessive voltage at the input, connector problems, or a failure on the CPU or I/O board. Once the connector and other obvious possibilities have been eliminated, it will be necessary to check operation of the multiplexer.

With at least one input connected, check for a periodic voltage on the output of the CD4051. The channels are scanned fast enough that an oscilloscope will be necessary to obtain useful information.

It is also possible to remove the MC4051 IC and insert a voltage directly into the ICL7109 ADC. Note that you will still obtain different readings on each channel as the calibration constant is most like different on each one.

Both the CD4051 and the ICL7109 require -5 volts for proper operation. Check the output of the ICL7660 for -5 volts +/- .25v.

Pin 2 of the ICL7109 should change state periodically, indicating the completion of a conversion. If it does not, suspect the chip, crystal or capacitors.

CPU Problems

Improper or erratic operation may be due to improper configuration or a problem on the CPU board. **Verify your system configuration first.** Refer to Customizing the System on page 31. This should be considered if one unit works properly but the other operates abnormally. Lightning damage will often affect the 6802 MPU, the 27128 EPROM, the 2817 EEPROM and the 8264 RAM. Factory service is recommended where feasible and repair/exchange circuit boards are normally kept in stock for overnight delivery.

Display Problems

The display boards are identical in both units and may be swapped to confirm a problem. Be certain to orient both ribbon connectors exactly as they were. Improper switch operation may be confirmed by observing the closures to ground on the 15 pin connector.

Since the display board does not connect to outside sources of excessive voltage, problems are rare.

Modem Problems

Before suspecting a modem problem, check the link. If the link appears satisfactory, put both units at the same location and connect the line terminals together. (Wire modems only.)

If the units function back to back but fail on the actual link, it is possible that there is either too much or too little loss on the link. If the loss is greater than about 30 dB, the modems may not function reliably.

A cursory check of then modem can be made by monitoring the line output with headphones. You should hear a continuous stream of data from both units.

The transmitter unit must transmit on one frequency pair while the studio unit transmits on the other. Note that this is only a rough measurement. It is still possible to receive bad data even when you can hear the tones clearly. Make certain that the plug-on jumper is installed on different pins in both units.

Lightning

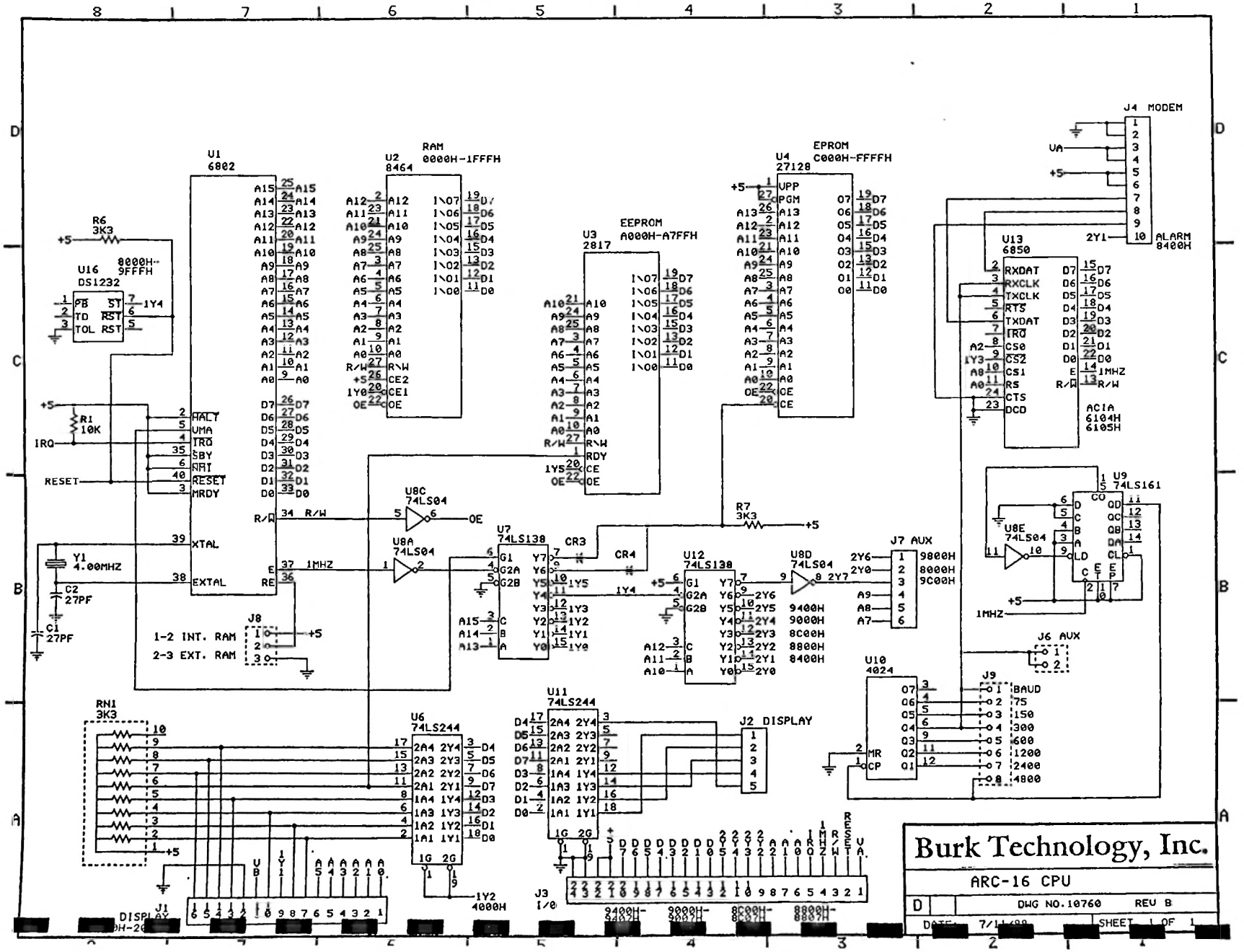
If you suspect that the line has been hit by lightning, it is possible that the protective components have been destroyed. The MOV, zener diodes and .01 capacitors can be removed and the 5 ohm resistors jumpered to determine if this is the problem. If this restores normal operation, replace the damaged components promptly to avoid more serious damage.

Universal Modems

Universal modems can be tested by connecting the units back to back. The only adjustment normally required is injection level, which may be set to produce the proper level for the associated exciter or STL transmitter. If no metering is provided on the associated equipment, observe the output on an oscilloscope and set the injection for the specified level. The injection control is the only adjustment available on the output module. Deviation should only be adjusted if proper equipment is available.

Section Six

SCHEMATICS AND DRAWINGS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ARC-16 CPU
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U3 2817 EEPROM A000H-A7FFH
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U7 74LS138
U8 74LS04
U9 74LS161
U10 4024
U11 74LS244
U12 74LS138
U13 6850 ACIA 6104H 6105H
U16 DS1232 8000H-9FFFH
J1 DISPLAY
J2 DISPLAY
J3 I/O
J4 MODEM
J6 AUX
J7 AUX
J8
J9
R1 10K
R6 3K3
R7 3K3
RN1 3K3
Y1 4.00MHZ
C1 27PF
C2 27PF
CR3
CR4
1-2 INT. RAM
2-3 EXT. RAM
1MHZ
ALARM 8400H
9800H
8000H
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8C00H
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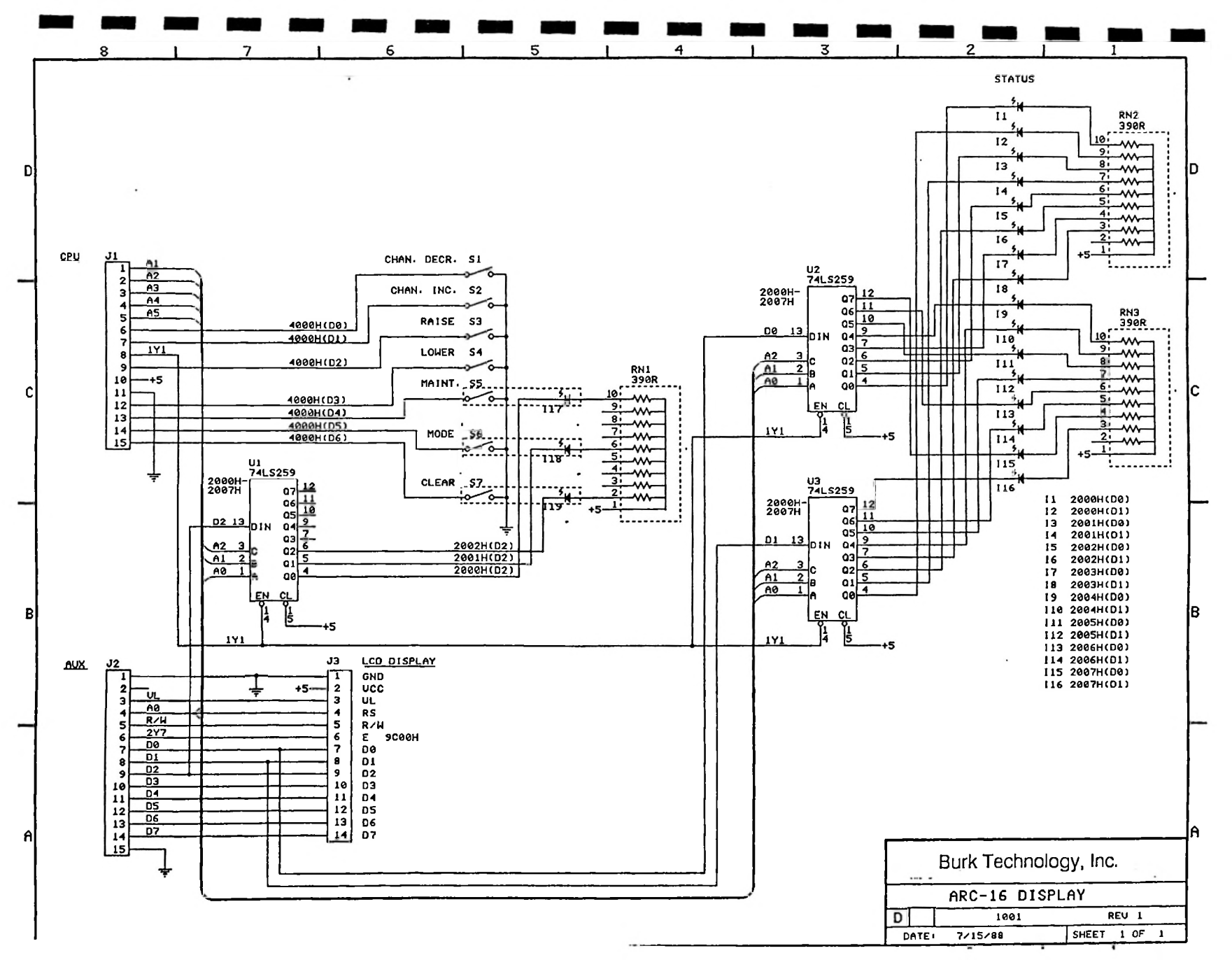
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LOWER S4
MAINT. S5
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4000H(D2)
4000H(D3)
4000H(D4)
4000H(D5)
4000H(D6)
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RN2 390R
RN3 390R
U1 74LS259
U2 74LS259
U3 74LS259
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2002H(D2)
2001H(D2)
2000H(D2)
AUX
J2
J3
LCD DISPLAY
GND
VCC
UL
RS
R/W
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D0
D1
D2
D3
D4
D5
D6
D7
I1 2000H(D0)
I2 2000H(D1)
I3 2001H(D0)
I4 2001H(D1)
I5 2002H(D0)
I6 2002H(D1)
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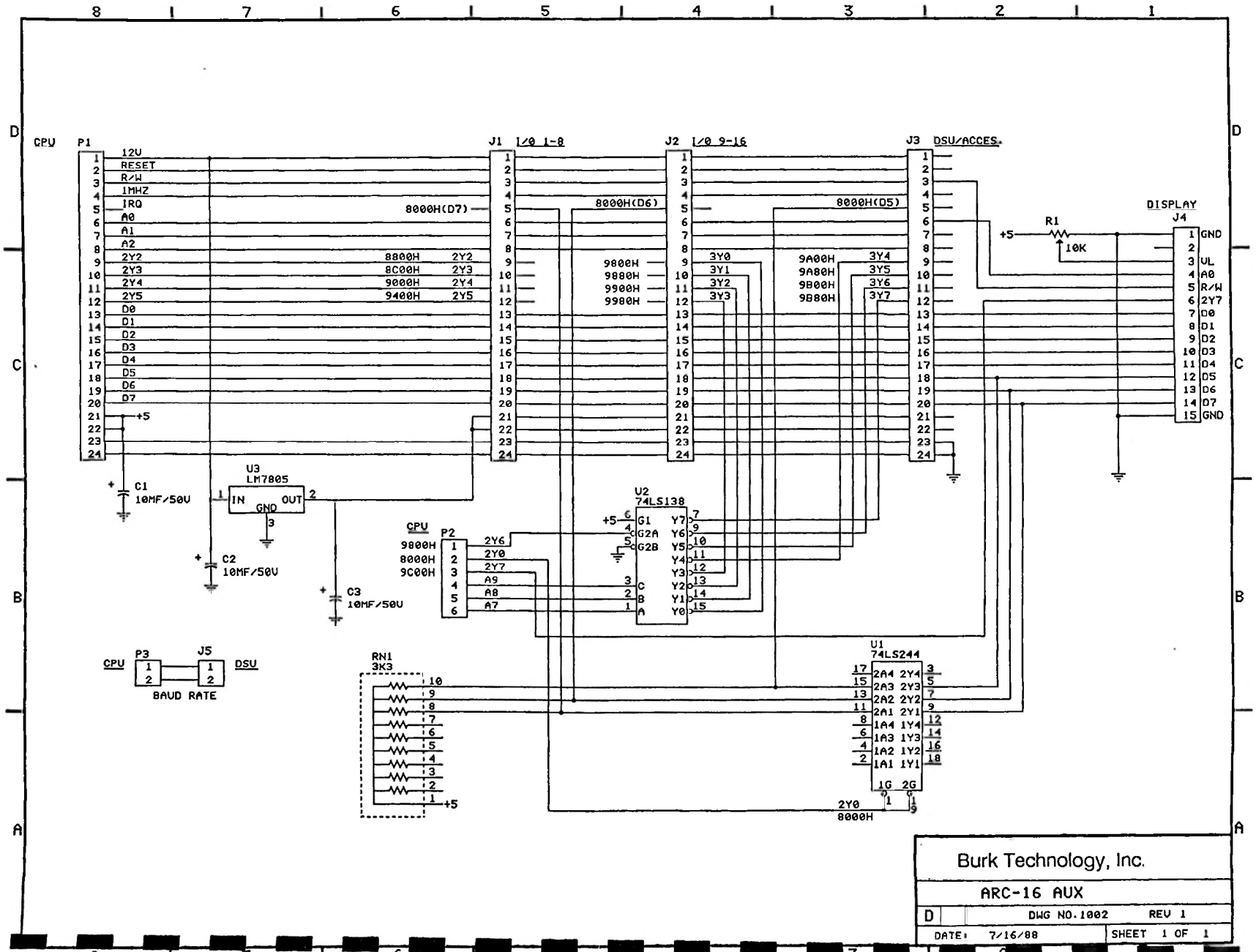

Burk Technology, Inc.	
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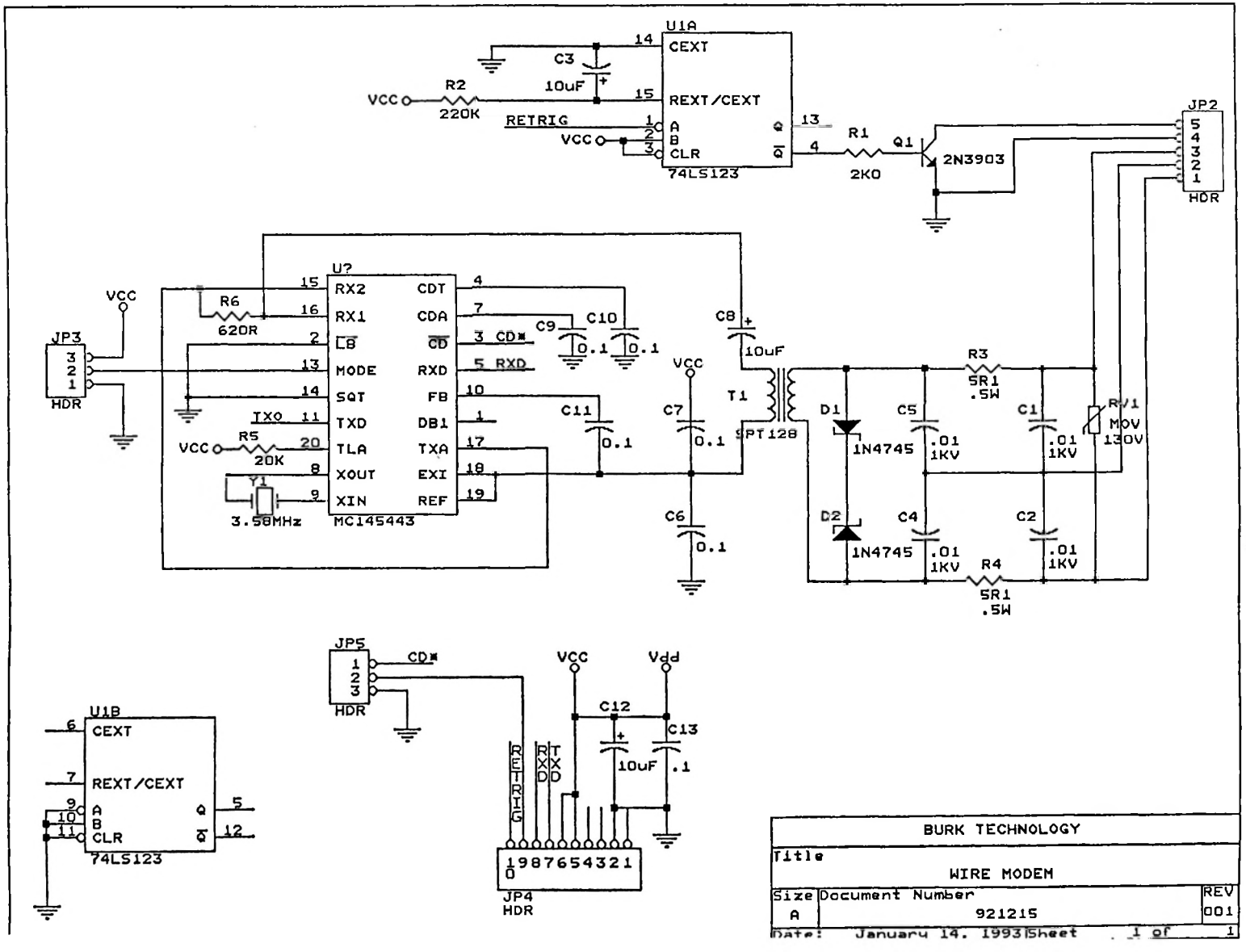
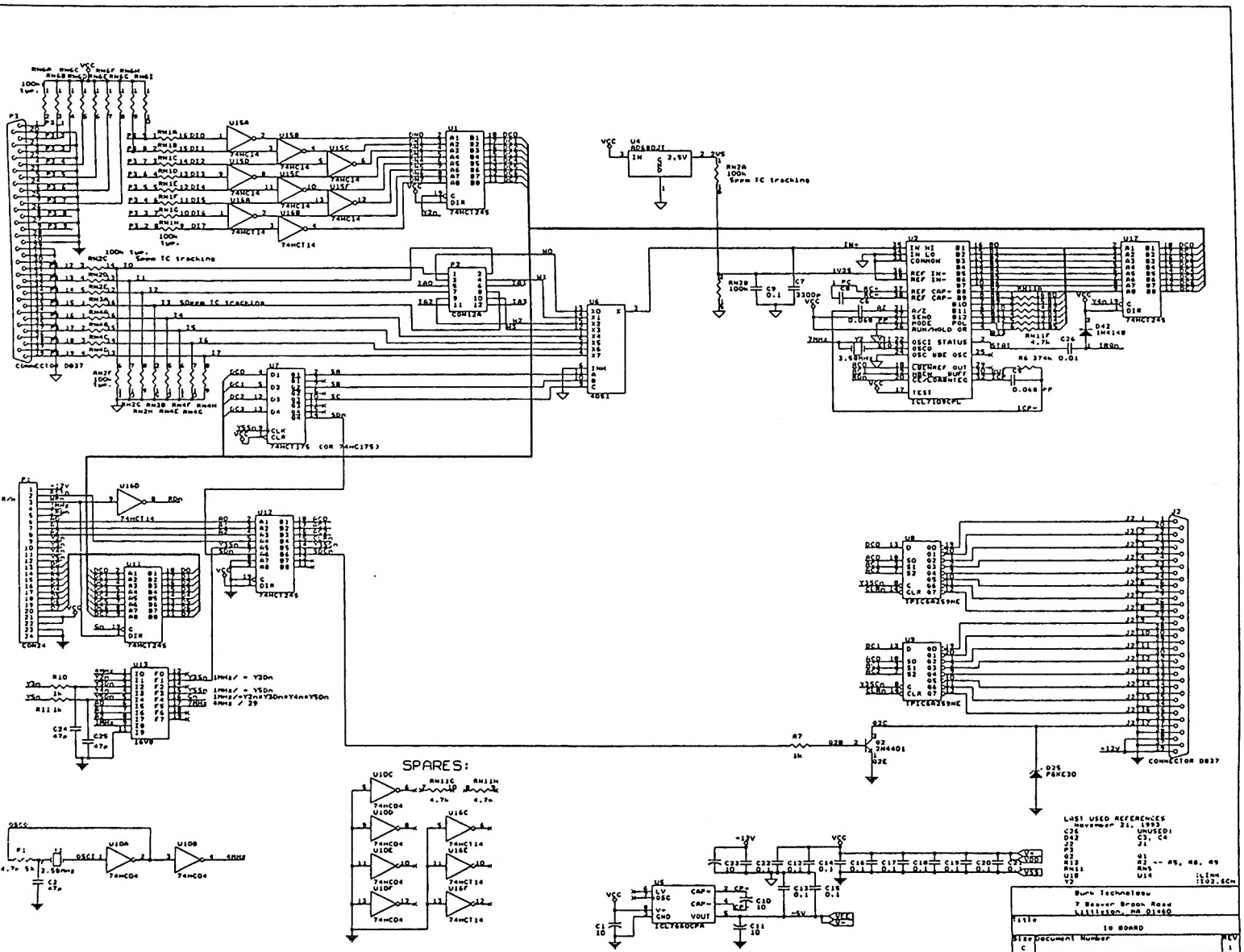
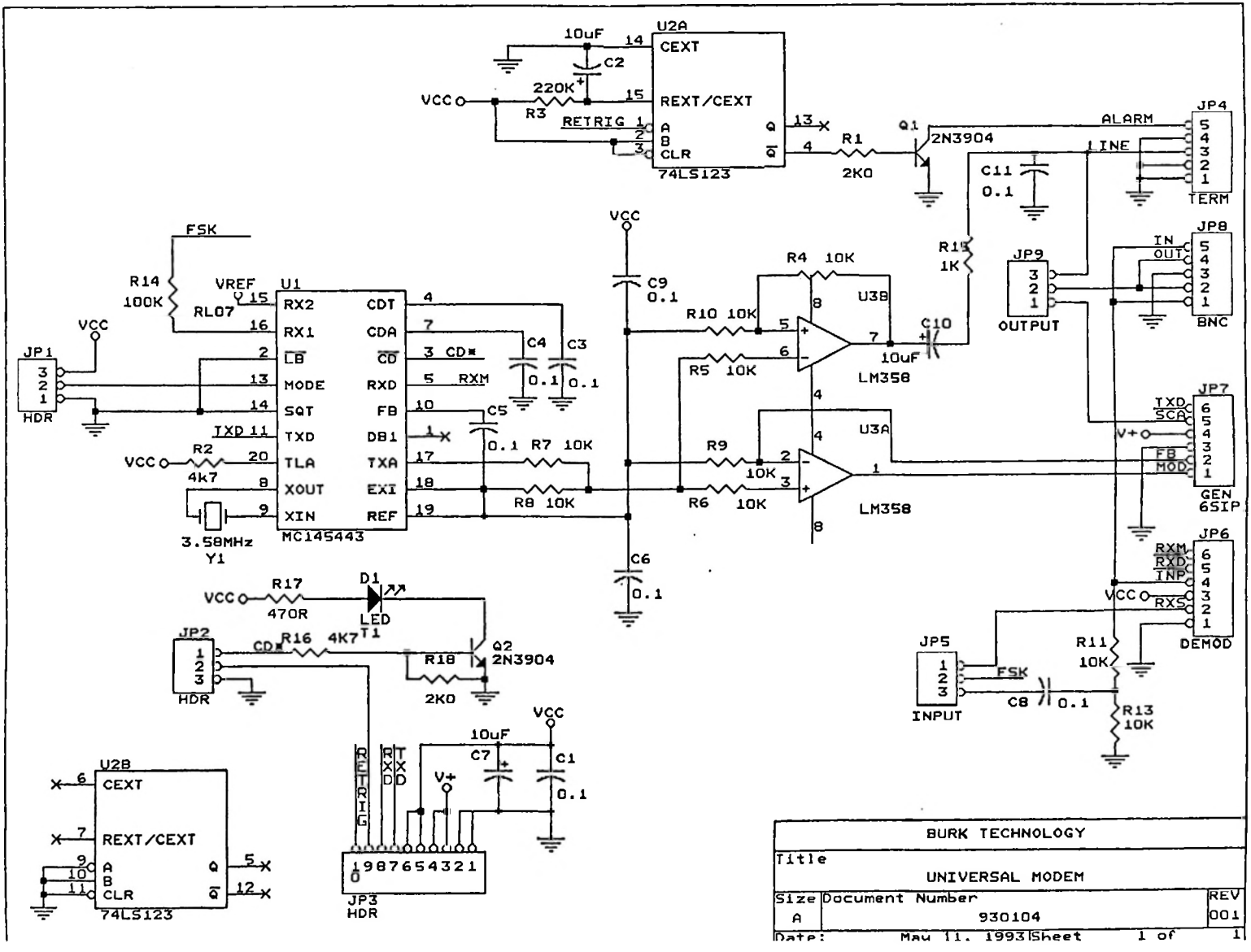
D	DWG NO.1002 REV 1
DATE: 7/16/88	SHEET 1 OF 1



BURK TECHNOLOGY		
Title: WIRE MODEM		
Size: A	Document Number: 921215	REV: 001
Date: January 14, 1993	Sheet 1 of 1	


SPARES:
LAST USED REFERENCES
November 21, 1993
Burk Technology
7 Beaver Brook Road
Littleton, MA 01460
I/O BOARD
Size Document Number REV
Date: January 11, 1994 Sheet of



BURK TECHNOLOGY		
Title: UNIVERSAL MODEM		
Size: A	Document Number: 930104	REV: 001
Date: May 11, 1993	Sheet 1 of 1	

Configuring Universal Modems

The Universal Modem provides for a variety of communication options required for linking Burk Technology remote control systems.

Standard on the Universal Modem is FSK Audio communication, but it may be easily converted for use with STL or FM Broadcast subcarriers, and even RS-232 data links with simple plug-in modules.

AUDIO INPUT - For use with an audio input (TRL, SCA receivers,..) no INPUT MODULE should be installed. Instead, a single 2-pin shunt is connected at JP6, pins 5 and 6 (marked with '*' on board). The 3-pin INPUT selector JP5 should have its 2-pin shunt installed to the AUDIO (Right) pair of pins.

AUDIO OUTPUT - For audio output, no OUTPUT MODULE is required. Audio is always present at the LINE 1 terminal on the back panel. Audio will also appear on the BNC OUTPUT connector if OUTPUT selector JP9 has a 2-pin shunt on the AUDIO (Right) set of pins.

SUBCARRIER INPUT - INPUT MODULES are used to recover subcarrier data for use by the remote control. Any shunts should be removed from JP6, and the desired INPUT MODULE installed. The INPUT selector JP5 should have a shunt installed on the MODULE (Left) position.

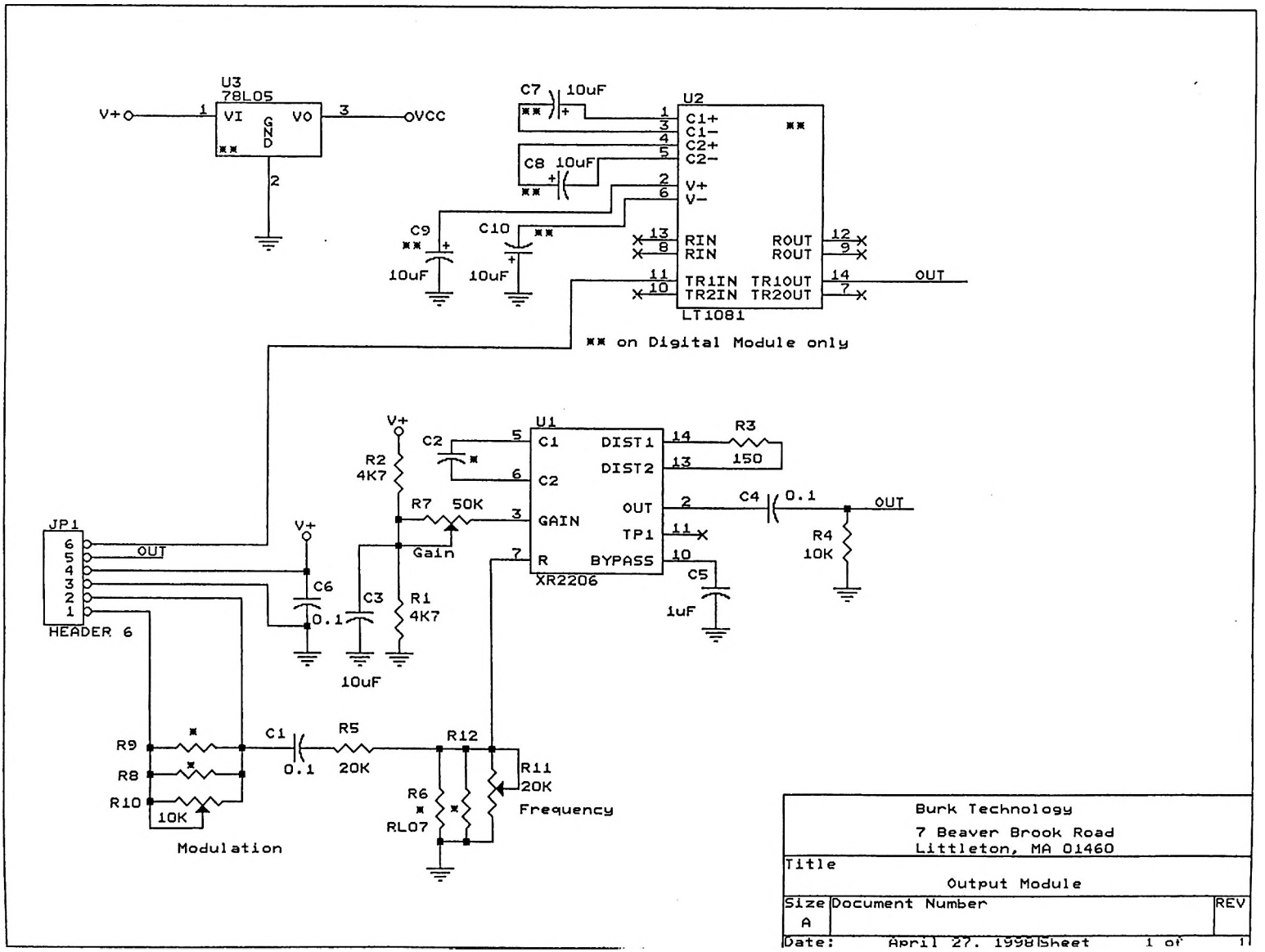
SUBCARRIER OUTPUT - Various OUTPUT MODULES are available which can generate FM subcarriers for use on STLs and on FM broadcast channels. An OUTPUT MODULE should be installed at JP7, and the OUTPUT selector JP9 should have a shunt installed on the MODULE (Left) position. A single control is provided for adjustment of injection level.

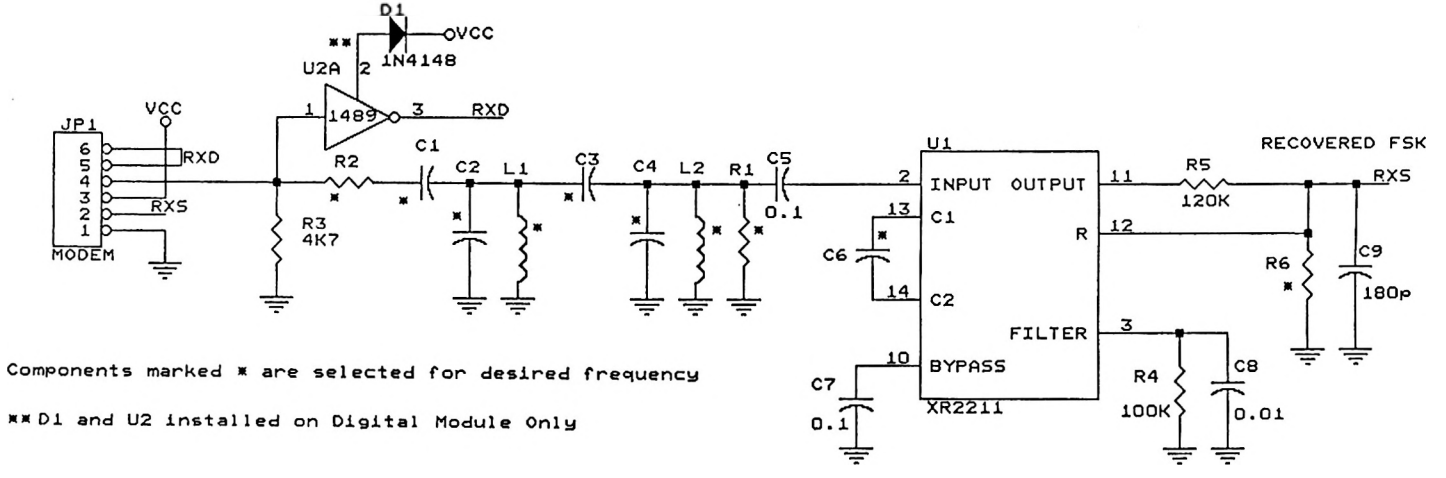
DIGITAL INPUT - For recovery of RS-232 data, install an INPUT DIGITAL MODULE in place of a shunt at JP6. Move the INPUT selector JP5 to MODULE (Left).

DIGITAL OUTPUT - RS-232 communication is treated in the same manner as a subcarrier. Install an OUTPUT DIGITAL MODULE at location JP7, and select MODULE (Left) on OUTPUT selector JP9.

Available modules include:

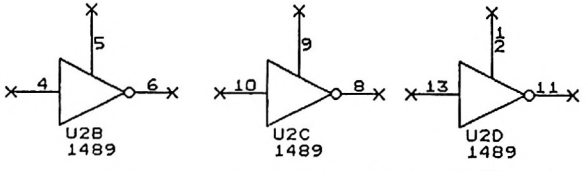
OUTPUT DIGITAL MODULE	INPUT DIGITAL MODULE
OUTPUT 39 KHZ MODULE	INPUT 39 KHZ MODULE
OUTPUT 67 KHZ MODULE	INPUT 67 KHZ MODULE
OUTPUT 92 KHZ MODULE	INPUT 92 KHZ MODULE
OUTPUT 110 KHZ MODULE	INPUT 110 KHZ MODULE
OUTPUT 152 KHZ MODULE	INPUT 152 KHZ MODULE
OUTPUT 185 KHZ MODULE	INPUT 185 KHZ MODULE


U3
78L05
V+
VI
GND
VO
VCC
C7 10uF
U2
C1+
C1-
C2+
C2-
C8 10uF
V+
V-
C9
10uF
C10
10uF
RIN
RIN
ROUT
ROUT
TR1IN
TR2IN
TR1OUT
TR2OUT
OUT
LT1081
** on Digital Module only
U1
C1
C2
DIST1
DIST2
OUT
GAIN
TP1
R
BYPASS
XR2206
R2
4K7
C2
R7 50K
Gain
R3
150
C4 0.1
OUT
R4
10K
C5
1uF
JP1
HEADER 6
OUT
C6
0.1
C3
10uF
R1
4K7
R9
R8
R10
10K
Modulation
C1
0.1
R5
20K
R12
R11
20K
Frequency
R6
RL07
Burk Technology
7 Beaver Brook Road
Littleton, MA 01460
Title
Output Module
Size
A
Document Number
REV
Date: April 27, 1998 Sheet 1 of 1



Components marked * are selected for desired frequency

** D1 and U2 installed on Digital Module Only



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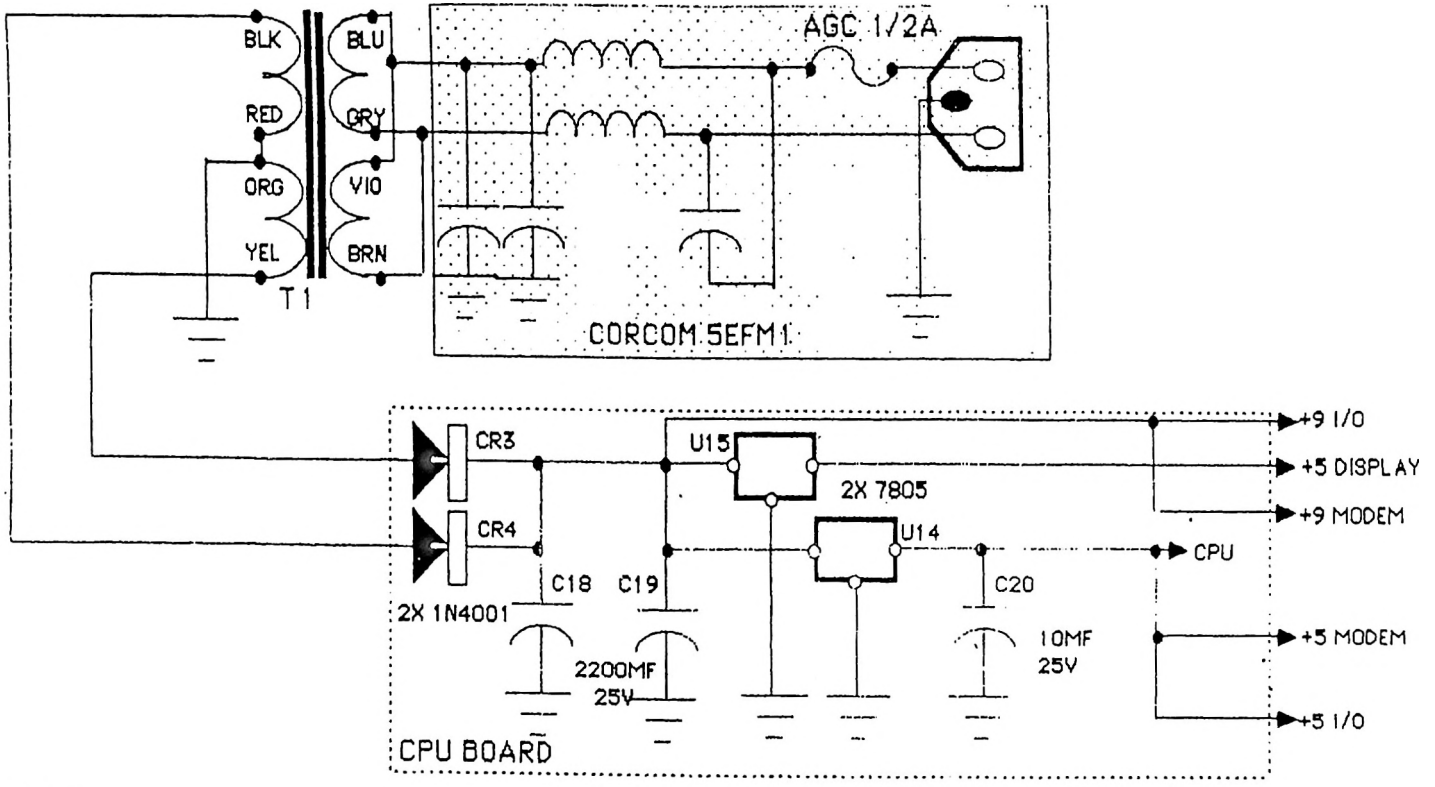
7 Beaver Brook Road
Littleton, MA 01460

Title
INPUT MODULE

Size	Document Number	REV
A	921231	

Date: Apr 28, Sh



POWER SUPPLY SCHEMATIC

POWER SUPPLY SCHEMATIC

ARC-16 Specifications

BURK TECHNOLOGY

Description:
Multi-site transmitter remote control system.

Analog Inputs:
16 inputs ± 4.5VDC maximum referenced to ground.

Status Inputs:
16 inputs; switch closure, +28VDC max.

Control Outputs:
32 open collector outputs (16 raise, 16 lower) maximum 250mA, 28V; 10 amp maximum with optional interface.

Fail-safe and link alarm outputs:
Open collector fail-safe output activated 90 seconds after detection of studio to transmitter link failure.

Controls:
Front panel selection of mode, maintenance override, channel increment, channel decrement, on/raise, off/lower, alarm clear.

Modes:
Normal operating mode
Site selection
Audible alarm enable
Auto-answer enable
Call-out enable
Calibrate
Set decimal point
Set lower limits
Set upper limits
Select power or linear
Select indirect power
Invert status polarity
Status alarm enable
Edit labels
Edit site names
Edit password

Calibration:
Each channel is calibrated using the raise and lower keys to adjust the reading to the proper value. The speed of the change in value is proportional permitting ± 1 digit adjustment or rapid gross changes.

Communication link:
One Bell 3002 or equivalent 2-wire circuit or STL subcarrier (telemetry) or suitable audio path such as 450mhz TRL. Note that multiple sites may be connected in a daisy chain configuration.
Modem boards are installed for the class of service requested. Boards will be exchanged at customer request for a nominal handling charge.

Modem Characteristics:
Wire modems: 600Ω balanced, -9dBm out, -30dBm min. in.
Universal modems: 2200Ω unbalanced (balancing option available), 1.5Vp-p out, 0.25Vp-p min. in; FM on selected subcarrier between 39kHz and 185kHz.

Modulation:
FSK 1070Hz and 1270Hz transmitter to studio, 2025Hz and 2225Hz studio to transmitter.

Data rate:
300 bps 8 bit word, odd parity, 1 start bit, 1 stop bit, full duplex with error detection.

Display:
32 character (16 X 2) LCD alphanumeric display, 16 LED status indicators, 3 mode indicators.

A/D converter:
12-bit dual slope integration with auto-zero.

Measurement accuracy:
Better than 0.1% for 4V input. Better than 0.5% at min. 0.25V input.

Temperature stability:
5 ppm/°C from 0°C to +50°C.

Memory retention:
Non-volatile storage of calibration constants, setup information and user defined labels for ten years without power.

External connections:

Analog and status inputs:	DB-37P
Control outputs:	DB-37S
Link (radio):	BNC
Link (audio):	Barrier strip
AC Power:	IEC power cord

Power requirements:
117VAC nominal; 50/60Hz 30 watts.
May be ordered 220V.

Physical:
3 1/2" H X 19" W X 11" D
EIA standard .

CDL

AutoPilot™

BURK TECHNOLOGY

CDL

AutoPilot™

Instruction manual for

CDL Control, Display, Logging Software

for use with the ARC-16 Remote Control System.

Includes instructions for

optional AutoPilot Software.

Version 4.5D

November 1994

Burk Technology, Inc.
7 Beaver Brook Road
Littleton, MA 01460

(508) 486-0086

Table of Contents

Section One
INTRODUCTION

The CDL (Control/Display/Logging) system when used with a Burk Technology ARC-16 Remote Control System and your PC provides the finest transmitter control system available. We hope you'll be pleased with your decision, and we stand ready to help you get up and running as quickly as possible.

To get the most out of your system, we recommend that you read the entire manual before beginning installation. CDL offers many choices for personalizing the system. By understanding what is possible before you begin, you will save time and be assured of a perfect fit for your station.

Quick Start

If you choose to "jump in" without reading all the way through, here are a few pointers for a quick start:

The ARC-16 Demo disk contains both a demonstration and a simulator for the computer interface. You can get a good feel for the system by running first the demonstration, then trying the simulator. (References to the CI-16 on the demo disk also apply to the newer CDL program.)

Make sure that the ARC-16 system is already set up and operating correctly before installing the CDL software. Copy the form in Appendix D, and assign names to all control, metering and status functions that you intend to use, so that you can easily edit the labels in the CDL program.

Refer to Section Two for instructions on running the installation program. Do NOT copy the files directly from the disk, but instead run INSTALL as instructed.

Refer to Appendix B for cable requirements before connecting the computer to the ARC-16. This is especially important if you are doing an upgrade from an earlier system, since there are some changes in the cabling and connector requirements.

Complete installation and setup instructions are included in Sections Two and Three. Following this procedure will assure a smooth installation. If you encounter difficulties, refer first to the manual, then call tech support if necessary.

Description

The CDL Control/Display/Logging system consists of a set of programs which permit control of a connected ARC-16 Remote Control System.

The programs are designed to be run on an IBM PC-XT, AT or compatible. The PC may be directly connected or may be connected via modem for remote operation.

If you have AutoPilot, the extensions for automatic control are described the AutoPilot section of this manual. This manual refers to the program as ARC16, as that is the program name which is used for either CDL or CDL with AutoPilot.

Display functions

Current meter readings and status from any site may be displayed, with user programmed control, metering and status labels for each channel. Values outside of the limits programmed in the ARC-16 are displayed in red or yellow for high and low alarms, respectively.

Status inputs that are currently active cause a user-programmed status "on" message to be displayed in a user-selected color. Status inputs that are off are displayed dimly, using a user-programmed "off" message.

The currently selected control channel is also prominently displayed.

Automatic logging

An operating log may be printed for selected channels from any connected site. Logging may be turned on and off and the logging interval adjusted from the keyboard. Dial-up users may select a logging interval which will automatical-

ly dial, connect, log and disconnect. The times will be reported on the log for all alarms that have occurred since the last call (up to four hours in the past), and a set of current readings will be recorded.

Control functions

Cursor control keys on the keyboard are used to select sites, change channels and raise or lower outputs. Single character alphabetic commands are used for system control functions.

On-screen editing

Labels for control and metering channels may be edited directly on the screen. Status on and status off messages may also be edited, as can the color of the status on messages.

What's New

CDL replaces the software previously shipped with the CI-16 computer interface. While CDL retains the same look and feel, users of Burk Technology CI-16 software will appreciate several enhancements.

A new install program, along with an improved setup program saves time and assures the user of a correct installation. Each field has context-sensitive help available, and all required data can be entered directly without the use of an editor.

Log-to-Disk, previously available only to AutoPilot users, is now standard in CDL.

The ability to automatically change from daylight to standard time and vice versa is now standard with CDL.

CDL, when used with the Model ESI Enhanced Speech Interface will now connect at 1200 baud without the use of reverse tones. Support is provided for a broad range of modems.

Computer requirements

Processor

For maximum performance, an 80286 based computer is recommended, although in most cases it is possible to run the CDL on an 8086 or 8088. AutoPilot requires a '286.

Operating system

PC-DOS or MS-DOS 3.0 or later

Memory

512K RAM is normally sufficient for the program and the operating system.

Disks

The program requires at least one 5-1/4" or 3-1/2" floppy disk. It is preferable to install on a hard disk if available. 300K of disk space is required as a minimum. Additional space may be required if logging is directed to the hard disk.

Monitor

Although the program will work with a Hercules compatible monochrome adapter and monitor, or with most CGA and EGA monitors, a VGA monitor is recommended.

Ports

A serial port (COM1 or COM2) is required for the link to the ARC- 16. An additional port (serial or parallel) is required only if direct logging is desired. Please note that COM3 or COM4 may not be used for either the ARC-16 connection or for printing.

Computer connections

The type of connection used between the computer and the ARC-16 will depend on the interface used. Please refer to Appendix B.

ARC-16 Requirements

ARC Firmware

CDL and AutoPilot version 4.5 or above will operate only with an ARC-16 which contains firmware version 4.5 or above. This can be confirmed by pressing ‹MODE› on the ARC-16 until the serial number and version is displayed.

Only the ARC-16 unit which contains the interface for the computer must have version 4.5 or above.

ARC version 4.5 in one ARC-16 unit will work properly with ARC version 4.4 in another unit, but not with any version 2 or 3 firmware.

Computer Interface Option

CDL and AutoPilot version 4.5 or above must be used with either a Model CI or a Model ESI interface. See Appendix B for more information.

Users upgrading from CI-16 must reset the baud rate jumper on the CI card. See Appendix B.

Warranty

Burk Technology, Inc. warrants the CI-16 Computer Interface to be free of defects in materials and workmanship for a period of 24 months from the date of purchase. Equipment will be repaired or replaced at the option of Burk Technology and returned freight prepaid to the customer. Damage due to abuse or improper operation or installation of the equipment or caused by fire or flood or harsh environment is not to be covered by this warranty. Damage in shipping is not the responsibility of Burk Technology. A return authorization must be obtained before returning any equipment. Materials returned under this warranty must be shipped freight prepaid and insured in the original shipping carton or suitable substitute to Burk Technology, Inc., 7 Lomar Drive, Pepperell, MA 01463. Repairs not covered under this warranty will be made at prevailing shop rates established by Burk Technology.

THE WARRANTY SET FORTH ABOVE IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BURK TECHNOLOGY SHALL NOT BE LIABLE TO ANY PARTY FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF THIS EQUIPMENT.

Section Two
INSTALLATION

This section covers the installation of CDL software on your PC. Installation should not be attempted until the ARC-16 system is fully functional and all channels are assigned to the specific functions you have chosen for your plant.

A form to help you assign labels and functions for each channel is included in Appendix D, along with an explanation of each entry. Make a photocopy of the form for each channel that you are planning to use.

For best results, read this manual completely, fill out the forms for each channel, then return to this section to complete the installation.

Hardware Installation

Since CDL software can be used in several different configurations, your specific hardware requirements are determined by the exact choice of computer and remote control equipment. Please refer to Appendix B for information pertaining to your installation.

Software Installation

CDL software may be installed on as many computers as you would like, but is licensed for use with only one ARC-

16 unit (although control and monitoring will be available for all sites directly linked to that unit).

To connect one computer to more than one ARC-16 unit requires a separate installation on the computer, plus a separate registration for each unit.

You might install CDL on a PC at the studio which is directly connected via RS-232, and, if you are using an ESI, on another computer with a modem. Both computers would use the same registration. The installation on one PC should be completed before beginning installation on additional computers to avoid the need to make duplicate entries. See page 17 for instructions on transferring data to a second PC.

New Installations

The procedure that follows will create a new directory on the drive of your choice, and will build a complete set of files. You will need at least 300K of free space on the drive.

Skip to the Running INSTALL section.

Upgrades from Previous Versions

If you are upgrading an earlier version of CDL or CI-16, the correct procedure depends on which version is currently installed. To determine the current version , press ‹ALT› V while running the ARC-16 program.

If the current version is earlier than version 4, you should do a complete new installation in another directory.

> **INSTALL will build files in a directory containing an earlier version, but will not produce the correct results. Since several data files were extended in version 4, the original files are too short, and will produce an error when CDL attempts to load the files.**

Versions 4 or later may be upgraded simply by running INSTALL as described below. Any data files you have created will be retained, provided that the dates on these files are 1-01-90 or later.

> **If you are upgrading a previously installed AutoPilot, run INSTALL for CDL first, then run INSTALL for AutoPilot. In both instances, be sure to specify the directory where AutoPilot was originally installed.**

Since the upgraded files will be installed directly in your existing directory, you should make a complete backup of

this directory before proceeding. If there is sufficient space on your hard disk, you can copy all files in this directory to a backup directory. Alternatively, you can use a backup utility (or simply copy) to make a floppy disk backup. Refer to your DOS manual for help in making a backup.

Proper operation of INSTALL depends on the DOS date being correct, since files are retained or replaced depending on the date they were created. Some files are written during editing and normal program execution, therefore always make certain that the date is correct before running any CDL program, including INSTALL. To check or change the DOS date, type *DATE* from the DOS prompt.

Running INSTALL

The installation of all required files on your computer is completed easily by following these steps:

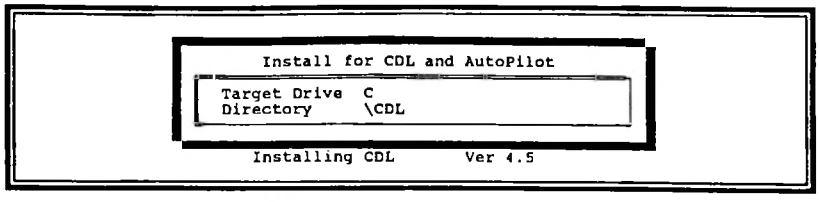
1. Insert the CDL master diskette in any available drive on your computer.

The CDL master must not be write protected, since temporary files are created on this disk during installation.

2. Change to the selected drive by typing the drive letter followed by a colon and a return. E.g. *A:* ‹ENTER›

3. Type *INSTALL* ‹ENTER›

On some monitors, such as a laptop with a monochrome VGA screen, forcing the display to monochrome will improve the appearance. Do this by using the -b option (*INSTALL -b*).



4. If the default drive and directory are acceptable, you may proceed without making any changes. If you wish to select a different drive or directory, make the desired changes before proceeding. Upgrades from version 4 or above must be installed in the same directory as before to avoid reentering labels and setup information. Type in the existing drive and directory, including the initial backslash.

INSTALL will create a new directory if you specify one that does not exist. It will, however only create directories one level below an exist directory. Specifying \FOO\CDL as the desired directory will only work if \FOO already exists.

5. Press [F2] to proceed with the installation. The screen will briefly show "Ready for Install", then files will be unpacked directly to the specified drive. If, instead, you wish to return to DOS and terminate the installation, press [F3].

If you are doing an upgrade installation, it is normal for the installation process to report that files are being skipped, since user data that has been entered previously will not be copied over.

6. Following a successful installation, The README.DOC file will be displayed. If you would like a printed copy of this file, and a printer is connected, return to DOS and type

COPY README.DOC PRN

When INSTALL is complete, your directory should contain the following files:

README.DOC
An ASCII text file which may be typed or printed. Contains supplemental information and a list of commands to run CDL programs. Is displayed automatically following INSTALL.

PRODUCT.DAT
An ASCII text file which may be typed or printed. Contains program name, version, and date of manufacture. Used by INSTALL and ARC16 programs. Should not be altered.

ARCSETUP.EXE
An executable program used to set or change system configuration, labels, dates, etc. Must be run from the directory where CDL is installed. May be removed after configuration to prevent unauthorized changes. Requires the following additional files:

ARCSETUP.QSL
DST.FRM
DISPLAY.FRM
COMSET.FRM
LOGGING.FRM
GRAPH.FRM
ACCESS.FRM
COLUMNS.FRM
TIMEZONE.FRM
HEADER.FRM
ST.FRM

EDLABEL.BAT
A batch file which sets the environment variable SETUP=1, then executes ARC16, which enables on-screen editing of screen labels. Clears SETUP variable after exit from ARC16. Must be run from directory where CDL is installed. May be removed to prevent unauthorized changes.

ARC16.EXE
An executable file which contains the main CDL program. Includes the AutoPilot extensions if AutoPilot has been installed. Must be run from the directory where CDL is installed.

TIMEZONE
A data file which contains the name of the current time zone and the date of the next time zone change. Used by ARC16 and ARCSETUP.

LOGGING
A data file which contains the name of the logging device or file. Used by ARC16 and ARCSETUP.

ARC16.CFG
A data file which contains various system configuration data such as com port, baud rate, monitor type, site names, etc. Used by ARC16 and ARCSETUP.

PRTINT.CFG
A data file which retains the last set logging interval. Used by ARC16.

MODEM.DAT
A data file which contains the initialization string for the modem connected to the computer. Used by ARC16 and ARCSETUP.

STCOLOR.DAT
A data file which contains the user defined colors for status messages. Used by ARC16.

NOMINAL.DAT
A data file which contains the nominal values for the bar graph display. Used by ARC16.

STPRINT.DAT
A data file which contains the user selections for printing or not printing status messages each time status changes. Used by ARC16.

UPW.DAT
A data file which contains registration data. Used by ARC16 and ARCSETUP.

LOGCOL.LBL
A data file which contains site, channel and label information for each log column. Used by ARC16 and ARCSETUP.

CONTROL.LBL
METERING.LBL
UNITS.LBL
STATUSME.LBL
Data files which contain screen labels for control, metering, units and status messages. Used by ARC16.

HEADER.LBL
An ASCII text file which contains the log header. Used by ARC16 and ARCSETUP.

COLORC.ODE
MONOC.ODE
BLKWHTC.ODE
Data files which contain color sets for different monitor types. Used by ARC16 and ARCSETUP.

OFFLINE.TXT
TIMEHELP.TXT
HELP.TXT
ASCII text files for pop-up windows. May be edited by user. Used by ARC16.

If this is an upgrade from a version earlier than 4.5, your directory will contain a SETUP.EXE file. This program is no longer used, and may be deleted from your directory.

After CDL has been successfully installed, proceed to Section Three to complete the configuration and setup of your system.

Re-running INSTALL

Any time you would like to restore a file to the original release version, you may delete the file, then run INSTALL again from the master disk. INSTALL will only replace missing files, and will not change the files you have edited since the last installation.

Installing CDL on another computer

Although INSTALL may be run again from the master disk to install the system on another computer, much effort will be saved by first completing the setup described in Section Three, then copying the entire directory to a floppy disk, which can be transferred to the second computer. Configuration information unique to the second computer may then be edited using ARCSETUP.

If channel labels or other data are changed in the future, it is possible to copy only the affected files. The file list above should assist in determining which files need to be copied.

Installation Errors

Normally, INSTALL will run to conclusion, building all required files, then displaying README.DOC before returning to DOS. Any error encountered during the process will be reported on the bottom line of the install screen. Possible errors encountered during installation are:

Unable to switch to specified drive and path

This error indicates that an attempt to change to the directory that was specified has failed, or that the newly named directory could not be created. Make sure that the directory is only one level below an existing directory. Also verify that the drive letter is valid.

Insufficient space on drive X

The most likely cause of this error is an attempt to write to a drive which is write-protected.

Unable to create file on master disk
Unable to open temporary file on master disk

An attempt to create or open a temporary file on the source disk has failed. Check to make sure that the master CDL disk is not write protected.

Skipped. Disk Full

During the unpacking of files, it is possible for the program to report a Disk Full condition, and skip the transfer of some files. Although the installation will appear to complete normally, the missing files will likely cause one or more of the operating programs to fail. Remove unneeded files from the drive and run INSTALL again.

Installation Terminated

This message indicates that INSTALL was aborted by the operator pressing [F3] or by an error.

Section Three
SETUP

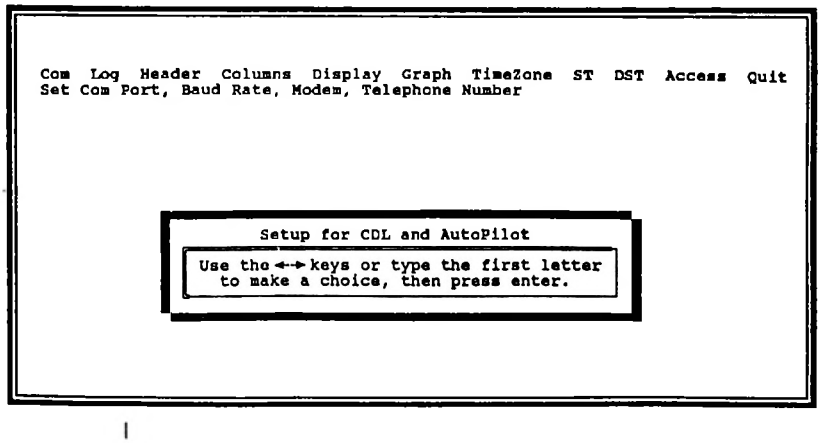
Before CDL can be used to control and monitor an ARC-16, the ARCSETUP program must be run to enter configuration data.

Running Setup

Change to the directory where CDL is installed and type *ARCSETUP* from the DOS prompt.

> **On some monitors, such as a laptop with a monochrome VGA screen, forcing the display to monochrome will improve the appearance. Do this by using the -b option (*ARCSETUP -b*).**

The screen will display a menu bar across the top with instructions as follows:



The main menu appears on the first line of the menu bar. The currently selected topic will be highlighted. The second line of the menu bar will change as you scroll through the various topics, detailing the fields which are included under the currently selected topic.

Selecting a Topic

Choose a topic as directed, then press enter. The appropriate data entry screen will appear, with the default or last entered values displayed. Use ‹TAB›, ‹SHIFT-TAB›, and the cursor keys to navigate on the screen.

Help

Press [F1] on any field for specific help on that field.

Saving Changes

Press [F2] to return to the main menu. If you have made any changes, you will be asked if you wish to save the changes. Type *Y* to save or *N* if you would like to retain the original values.

Alternatively, you may press [F3] to automatically save the changes to this screen and return to the main menu.

> **The [F3] prompt only appears on the status bar at the bottom of the screen after changes have been made to at least one field. If you have typed changes into a text field, press ‹ENTER› to display the [F3] prompt.**

Changes may be verified by re-selecting the topic from the main menu.

Returning to DOS

To leave ARCSETUP and return to DOS, select QUIT from the main menu.

Quick Setup

If you are anxious to try CDL without performing a complete setup, skip to the following steps to do a minimum setup.

After completing these steps, verify that the hardware setup is correct, then proceed to Section Four, Operation. Logging will be disabled, the bar graph will be meaning-

less, and the channels will lack custom labels, but the screen will display proper readings and control of the ARC-16 will be possible.

If you encounter difficulties, read the balance of this section to understand the effect of other setup choices. You may also need to review the hardware requirements in Appendix B.

After verifying proper operation, return to this section to complete the full setup.

Topic: COM

Set the following items according to your requirements:

Com Port

Baud Rate

Modem

If a modem is being used, complete these items:

Tone or Pulse Dial

Telephone Number

Topic: LOG

Set Number of Lines per page to 0 (disables logging).

Topic: DISPLAY

Choose an appropriate color set

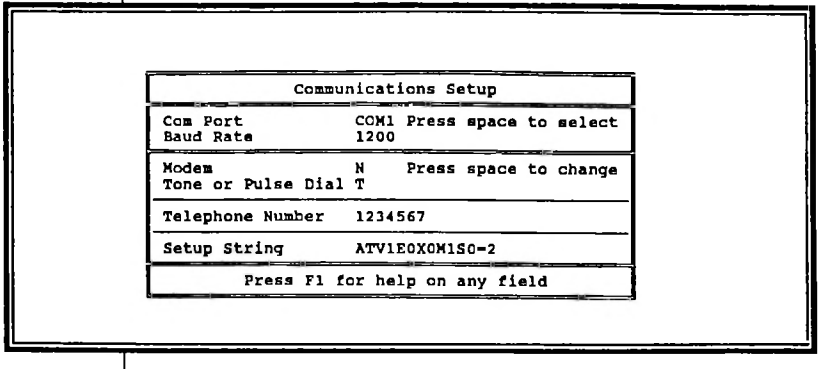
Topic: ACCESS

Set User Password to match the ARC-16. Leave the other fields blank.

Full Setup

Complete instructions are provided here for each field in each topic. Proceed through all topics to complete the setup.

Topic: COM



Com Port

Select the com port on your computer that will be used to connect to the ARC-16. Pressing ‹**SPACE**› will open a selection window. Use the up and down arrow keys to select the correct port, then press ‹**ENTER**›.

Baud Rate

Press ‹**SPACE**› to open a selection window. This setting must match the baud rate used by your ARC-16 interface. For ESI users, the choice must be 1200 baud. CI users may require 300 or 1200 baud. Refer to Appendix B for more information.

Modem

If you are using a direct connection from your COM port to the ARC-16 RS-232 connector, answer no (*N*). If you are using a Hayes compatible modem to connect to an ARC-16 with ESI, answer yes (*Y*). Press ‹**SPACE**› to toggle yes or no, then press ‹**ENTER**›.

Tone or Pulse Dial

This answer is required only if you answered yes to the modem field above. Select *T* if the computer modem will be used on a line that supports tone dialing. Select *P* if the computer must dial out using pulse dialing.

Telephone Number

This field is required only if you answered yes to the modem field above. Enter the telephone number for the line that is connected to the ARC-16. Dashes or spaces may be included for clarity but are not required. Pauses may be added at any point in the number by entering a slash (/). Do NOT enter a comma for a pause, as this will cause unpredictable results.

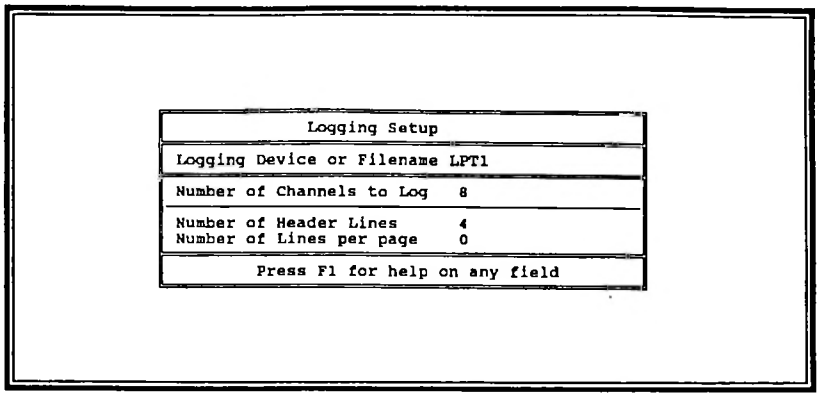
Users who are upgrading from an older CI-16 or AutoPilot will need to delete the 'A' or 'R' character at the end of the telephone number. This was used to reverse the modem tones. Starting with CDL version 4.5, it is not necessary to use reverse tones.

Setup String

This field is required only if you answered yes to the modem field above. This string is sent to reset the modem during normal execution of the ARC16 program (CDL or AutoPilot). Since the default string will work in almost all cases, you should have a specific reason to change this field.

If the setup string has been altered and you would like to restore the default value, return to the DOS prompt and delete the MODEM.DAT file, then re-run the INSTALL program, specifying the same directory. INSTALL will replace only this file, assuming no other files were deleted.

Topic: Log



Logging Device or Filename

The default for this field is *LPT1*. This will direct the logging output to a printer connected to LPT1. You may specify another device or a filename, including drive and path.

If a serial port is specified (COM1 or COM2) a mode statement should be added to the AUTOEXEC.BAT file to specify the correct baud rate and other RS-232 specifications for the printer. Refer to the DOS manual for further instructions on using MODE and AUTOEXEC.BAT.

If a file name is specified, logging output will not be sent to the printer, but will instead be sent to a file. If the file does not exist, one will be created. If it does exist, output will be appended to this file.

Logging may be directed to a floppy disk, in which case the user would be expected to change the disk periodically.

It is up to the user to make certain that the specified drive has sufficient space to hold the logging file. The space required depends on the number of header lines, the number of channels logged, the logging interval and the number of status events generated. Approximately 5K of disk space will be required for each full page of an 80-column log.

Number of Channels to Log

Enter the total number of channels that you would like to appear on the printed log. Each channel will appear in a separate column on the log. Each line on the log will re-

quire 14 spaces, plus 9 spaces for each channel. The maximum number of channels that may be logged is determined by the carriage width of the printer and the pitch of the type. Using compressed print and a wide carriage, a maximum of 24 channels may be logged.

Number of Header Lines

The top of each log page contains a user-defined header, which may contain station information, FCC required data such as efficiency factor, EBS notations, etc. The text to be printed in the header will be entered in the next topic. This field tells the ARC16 program how many lines of the header are to be printed. Up to nine lines may be specified.

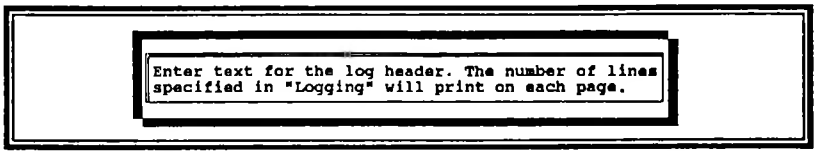
Number of Lines per page

Enter the total number of lines to be printed on each page, including the header, log column labels and all lines of actual log data. For an eleven inch log form, up to 66 lines may be entered.

If no printer is connected, you can prevent the computer from waiting for the printer by specifying zero lines per page.

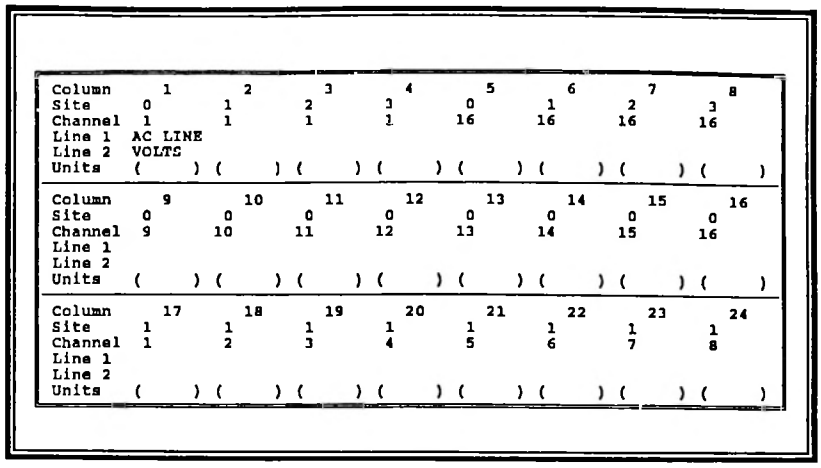
For log-to-disk, a larger value may be desired. This field will allow up to 99 lines to be specified.

Topic: Header



Enter each line as you wish it to appear at the top of each page. Only the number of header lines specified in the previous topic will actually print, although the file may contain up to nine lines of text. Each line is 79 characters long.

Topic: Columns



Column	1	2	3	4	5	6	7	8
Site	0	1	2	3	0	1	2	3
Channel	1	1	1	1	16	16	16	16
Line 1	AC LINE							
Line 2	VOLTS							
Units	( )	( )	( )	( )	( )	( )	( )	( )

Column	9	10	11	12	13	14	15	16
Site	0	0	0	0	0	0	0	0
Channel	9	10	11	12	13	14	15	16
Line 1								
Line 2								
Units	( )	( )	( )	( )	( )	( )	( )	( )

Column	17	18	19	20	21	22	23	24
Site	1	1	1	1	1	1	1	1
Channel	1	2	3	4	5	6	7	8
Line 1								
Line 2								
Units	( )	( )	( )	( )	( )	( )	( )	( )

This screen, although daunting at first glance, is actually quite simple, since each set of five fields is the same for every log column. It is only necessary to complete entries for as many channels as you wish to log. Reference to a completed set of forms from Appendix D will greatly simplify your work on this screen.

The first eight columns will also be the eight bars of the bar graph which is displayed by the ARC16 program. This dictates that the column assignments should be chosen carefully to include the most important functions in the first eight columns.

Site

Logging channels may be selected from any connected site. Enter a number from 0 to 3 to indicate the site from which this channel will be logged.

> **Site numbers are relative to the site where the computer is connected to the ARC-16. Refer to Specifying Site Numbers on page 32 to make certain you are selecting the proper site.**

Channel

Indicate the channel number to be logged in this field.

Line 1

Enter the first line of the label for this column.

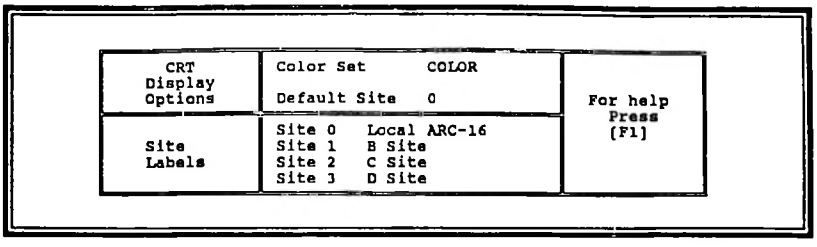
Line 2

Enter the second line of the label for this column.

Units

Enter the unit of measurement for this column (watts, volts, etc.).

Topic: Display



Color Set

Press ‹SPACE› to open the selection window. For CGA, EGA, VGA or Super VGA monitors, select COLOR. For monochrome monitors, select MONO. Better results may be obtained on some LCD displays by selecting BLKWHT. Feel free to experiment to obtain the best display for your monitor.

> **Although the colors for each type of display have been carefully chosen to be suitable on a wide range of monitors, you may have specific requirements which require additional customizing. Appendix C includes instructions for altering the colors on a detailed basis.**

Default Site

Enter a number from 0 to 3 to control which site is automatically displayed when the ARC16 program is started.

> **Site numbers are relative to the site where the computer is connected to the ARC-16. Refer to Specifying Site Numbers on page 32 to make certain you are selecting the proper site.**

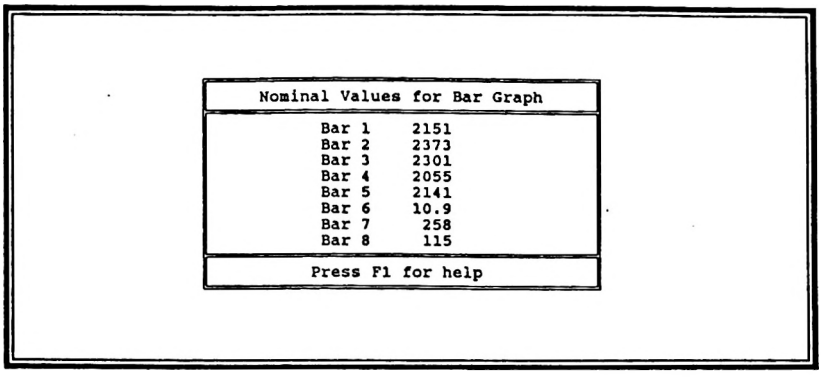
Site Labels

Site labels are displayed on each page of the display and on the printed log. Typically, the call letters or a description such as "XMTR or STUDIO" might be used. This entry

only affects the text printed or displayed. It does not actually assign the site to a site number.

To prevent a site page from being available (e.g. for an unused site), enter a dash (-) as the first character of the site label and delete all remaining characters in the field.

Topic: Graph



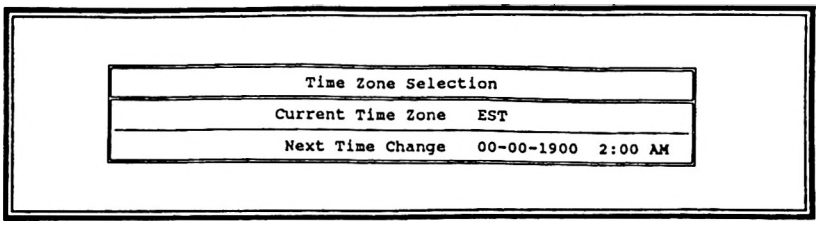
Recall that the first eight log channels as specified in the Columns topic will also appear on a bar graph which may be displayed on the screen. Each bar will be scaled so that when the associated metering channel is at the nominal value specified here, the bar will meet the "barber pole" near the right side of the screen.

For each bar, enter the nominal value for the associated channel. Refer to your completed forms and to the Columns topic to determine the correct values. These values may be entered as floating point numbers; the decimal point is significant, but does not have to appear in the same position as on the ARC-16.

Topic: TimeZone

Current Time Zone

Press ‹SPACE› to open the selection window. Choose the time zone you are currently using. The selected time zone will appear on the screen and on the logs.



If your time zone does not appear in the selection window, you may still alter the time zone by manually editing the file TIMEZONE to display the proper letters. (Use EDLIN or, in DOS 5 or above, EDIT.) Exercise care to leave all the characters in exactly the same position. The time zone must be exactly three characters, and the middle character must be 'S' or 'D'.

Next Time Change

Enter the date (MM-DD-19YY) for the next change to or from daylight savings time. If a standard time is selected in the previous field (e.g. EST), the time will advance one hour when the date entered is reached. If a daylight time is selected (e.g. EDT), the time will be set back one hour.

The change is made by directly setting the DOS clock at 2:00AM on the date specified.

If 00-00-1900 is entered in this field, no time change will take place. To enter this value, ignore the range error warning and press F3 to save the change.

It is up to the user to set the date for the next time change after a change occurs. This may be done at any time, from the first day after the change up until the day before the next change.

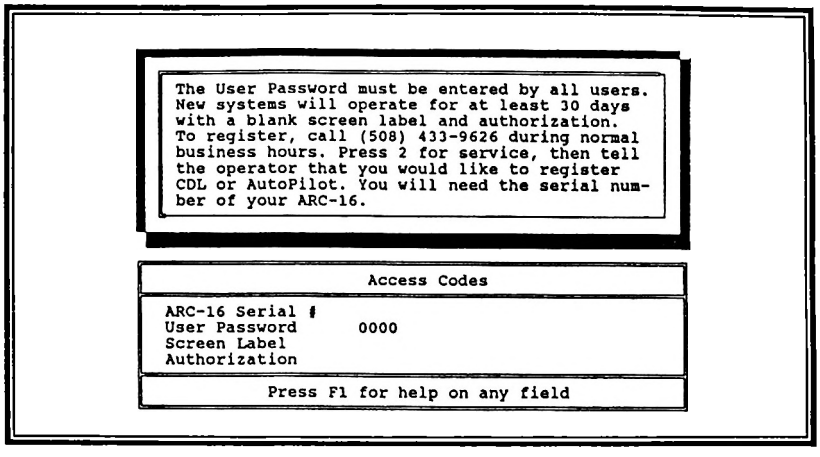
Certain add-on computer clock boards also reset the time on the proper date. To avoid a double correction, you must use only one method. We recommend using CDL to change the time, since that will permit the proper data to be displayed and logged.

Topic: ST
Topic: DST

These screens are for AutoPilot only, and may be ignored in CDL.

Topic: Access

The access screen is used to enter the user password and registration information.



ARC-16 Serial #

The serial number as displayed on the ARC-16 should be entered in this field. This number will be required for registration.

To determine the serial number on the ARC-16, press MODE repeatedly until the display shows the version and serial number.

> **This number will generally be the same as the number on the rear of the ARC-16 chassis. In some cases, especially where the ARC-16 firmware has been updated, the number may be different. It is the number on the display that should be entered here.**

User Password

All users must enter the user password exactly as shown on the ARC-16. If the user password is changed on the ARC-16, run ARCSETUP again, and change the password to match.

To determine the user password on the ARC-16, access the configuration menu and press ‹**MODE**› repeatedly until the display shows MASTER-USER. The user password is the second four digits (the digits directly under the word USER). See the ARC-16 manual for details.

Screen Label

This field should be left blank until your CDL system is registered. When you are ready to register the system, enter a label that will be displayed on the screen and all logs. This label becomes part of the registration code and can not be changed without getting a new registration.

Authorization

When you are ready to register your CDL system, follow the instructions on the screen to obtain an authorization code. Enter the code exactly as received in this field.

> **Your CDL system will operate for at least thirty days from the date received with a blank screen label and authorization. Until an authorization is received, it is important that these fields be left blank. Any characters in these fields will cause the system to stop.**

If you are uncertain of the age of your CDL disk, enter

TYPE PRODUCT.DAT ‹ENTER› at the DOS prompt. The date manufactured will provide an indication of the age of the disk. Disks are always shipped with a grace period beyond thirty days. If your disk is well beyond that date, you should call to immediately register CDL.

Topic: Quit

Choose Quit to return to the operating system.

Specifying Site Numbers

It is important to understand the difference between site numbers and site letters.

Site letters are used as the absolute site identifier within an ARC-16 system. They are assigned during the initial ARC-16 setup, and normally do not need to be changed.

Sites are identified by numbers in CDL program and are relative to the unit which is connected to the computer. For this reason, site numbers will relate to different site letters, depending on where the computer is connected. (This seemingly indirect approach is made necessary by the need to send and store data from several sites over many possible links in a multi-site system.)

Site 0 is always the local site (i.e. the site which contains the computer interface being used). Site 1 is the next higher letter, with letter 'D' "rolling over" to 'A'. Site 2 is the next higher letter, then site 3.

The following table helps to illustrate this relationship. Remember, Site 0 is always the site where the computer interface is located.

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

For example, if the computer is connected to the studio which happens to be site D, and the transmitter is site A, then, from the table, all data pertaining to the transmitter site should be entered as site 1. If instead the transmitter were designated C, CDL would expect to find the transmitter data as site 3.

If access to an ARC-16 system is available through more than one computer interface (e.g. a CI at the studio and an ESI at the transmitter), a separate directory will be necessary for each. The site numbers will be different in each directory, and it will be necessary to rebuild the label files.

Editing Screen Labels

Before entering the screen labels as described here, it may be useful to refer to the screen description on page 38 to gain an understanding of the purpose for each label. The site selection section on page 41 will also apply.

Screen labels may be edited during normal program operation whenever the SETUP environment variable is set to 1. After editing the labels it is advisable to reset this variable to prevent unauthorized changes. The setup environment variable is automatically turned on and off by running the EDLABEL batch file.

During normal program execution you can determine if label editing is permitted by pressing the right arrow cursor key. If a label becomes highlighted, editing is enabled. Pressing the right arrow will do nothing if editing is not enabled.

Starting EDLABEL

To run the EDLABEL batch file, make certain that you are in the directory where CDL is installed and type

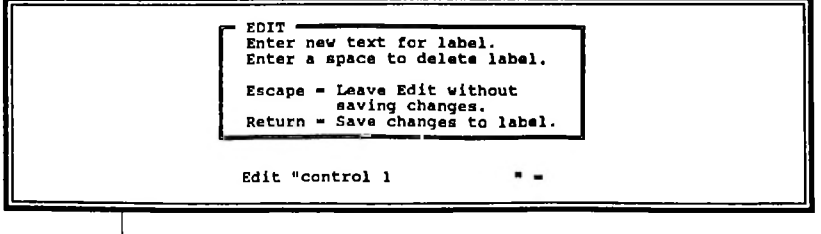
EDLABEL ‹ENTER›

at the DOS prompt. The program will start as normal, but editing is now enabled.

Selecting a Label

To select a label to edit, use the cursor keys to highlight the desired label. The up and down cursor keys will move through the channels, and the left and right cursor keys will select control, metering, units or status.

With the desired label highlighted, press *E* to edit. The lower portion of the screen is used for editing. A help window will appear with the available editing commands.



Type in a new label, following the instructions in the EDIT help window.

> **If *E* doesn't appear to do anything, it is possible that you have the channel number highlighted instead of a user defined label.**

Editing Status Messages

The status messages are a little more complicated, since there are several ways CDL can handle status conditions.

After using the left and right arrow keys to select a status message to edit, press *E* to see the following on the lower screen:

```
Enter new label for status OFF.  To edit status ON condition, press Right arrow.
                                                          ALT-P to toggle printing
                    Edit "OFF                        " -
```

The first statement indicates that the message to be displayed for the OFF condition has been selected for editing. The message can be set to blank so that the status field only displays something when the status is ON.

In addition to entering the text for the OFF message, you may select whether changes to this status channel should be used to generate a message on the log. ALT P will toggle printing. The current selection is displayed at the bottom of the status column.

Editing Status ON

If you want to edit the message for the ON condition, press the right arrow cursor key. The lower screen will now display this editing area:

```
Enter new label for status ON.  To edit status OFF condition, press Left arrow.
To change status ON color, use Up and Down arrows.     ALT-P to toggle printing
                    Edit "ON                         " -
```

This is almost like the Status OFF editing, except that you now have the addition of a color choice for the Status ON message. Use the Up and Down arrow cursor keys as

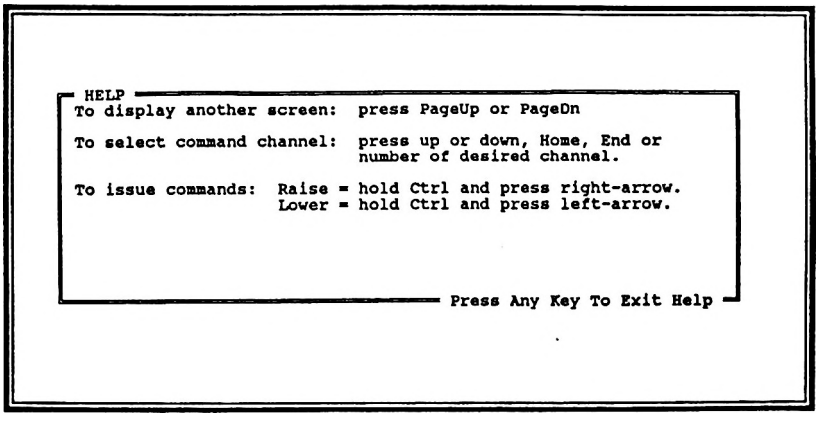
prompted on the screen and observe the actual affect on the text displayed. Each color is available as blinking or non-blinking. Press the cursor keys repeatedly to see all possible combinations.

Disabling Label Editing

When finished editing, use ‹ESC› to exit the program. The EDLABEL batch will automatically clear the SETUP environment variable and return to the DOS prompt.

Customizing Help Text

When the [F1] key is pressed, a help window appears.



The text for this window is in the HELP.TXT file and may be customized by the user using EDLIN, EDIT or any editor or word processor in non-document (ASCII text) mode. The size of the window is fixed.

To restore this window to the original text, delete HELP.TXT and run INSTALL again from the master disk.

Proceed to Section Four, Operation after completing this section.

Section Four

CDL OPERATION

Before running the ARC16 program, you must run INSTALL as described in Section Two, and perform at least the minimum setup described in Section Three. The ARC-16 should be connected, either directly to the computer or to a phone line.

Quick Start

For maximum benefit from the CDL program, you should read through this section carefully. If you'd like to jump ahead to try the program, the following Quick Start will get you going. You may refer back to this section if you have questions.

1. Change to the directory where CDL is installed.

2. Type *ARC16* ‹**ENTER**›

The default site will be displayed.

3. Use the up and down cursor keys to highlight a channel.

A command may be sent to the ARC-16 by pressing ‹**CTRL**› plus the left or right arrow key.

> **Caution: The command will actually be sent to the ARC-16. Do not send a command unless you are certain that the channel will not affect normal station operation.**

4. Press ‹**PAGE UP**› or ‹**PAGE DOWN**› to browse through the available sites. One of the pages will be a bar graph, which will display data only if the first eight logging channels have been assigned.

5. To exit the program to complete the setup or make changes, press ‹ESC›

Starting the Program

The main CDL program is contained in the ARC16.EXE file.

From the operating system, change to the disk or directory containing the program and files and type

ARC16 ‹ENTER›

The default site will be displayed as shown here.

```
11-02-1993                        FM Transmitter                    13:06:10 EST

   CONTROL              METERING                          STATUS
 1 Fil ON/OFF           FM Filament      00.00 Volts      FM Filaments Off
 2 Plate ON/OFF         FM Plate E       0.001 K Volts    FM Plates Off
 3 Power Trim           FM Plate I       0.001 Amps
 4 Power Trim           FM Power FWD     00.00 K Watts    *** CARRIER OFF ***
 5 Pwr Transfer         FM AC Line V     240.4 Volts      Power from Mains
 6 Generator            Gen Line V       000.0 Volts      Generator Idle
 7 Stereo/Mono          Stereo Mon       100.0 Percent    Stereo
 8 Audio Proc           Audio Input      100.0 Percent    Optimod
 9 Aux Fil              Aux Fil          00.00 Volts      Aux Filament Off
10 Aux Plate            Aux Plate E      0.001 K Volts    Aux Plate Off
11 Aux Pwr Trim         Aux Plate I      0.001 Amps
12 Aux Pwr Trim         Power FWD        00.00 K Watts    Tower Lights Off
13 De-Icers             Temperature      010.8 Deg. F     De-Ice Off
14 Ant MAIN/AUX         FM Pwr FWD       00.00 K Watts    Antenna on Main
15 O'Load RESET         Ant Pwr REFL     00.00 K Watts
16 Dummy Air            Dummy Load       00.00 K Watts    Dummy Air Off

     LOGGING          | AutoPilot is OFF |      COMMANDS          |      STATUS
(C)=Change Logging    | (A) = Turn Auto ON | (F1) = HELP          | Logging:  DISABLED
(H)=Print Log Title   |                    | (ESC)ape = Exit      |   Not Connected
(L)=Print Log line    | (M) = Edit Modes   | (D)= Dial Remote     |
```

Screen Description

Each site is displayed on a separate page similar to this one. The screen is divided into several areas:

Title Bar

The top line of the screen includes the current date, time, time zone and the site label for the selected site.

Channel Column

The first column at the far left of the screen indicates the channel numbers from 1 to 16.

Control Column

The second column contains the user defined control functions for each channel. The currently selected channel will be highlighted.

> **All user defined screen labels are edited using EDLABEL, described in Section Three, Setup.**

Metering Columns

The center columns contain metering information for the selected site. Column three is the user defined label for the metering function.

The actual reading for this channel is displayed and constantly updated in the fourth column. A number in this column will be highlighted if the channel is above or below the limits set on the ARC-16 (if limits monitoring is on).

The next column displays the user defined units for each channel.

Status Column

User defined status messages are displayed in the last column. OFF messages are displayed dimly on a color monitor. ON messages are displayed in a user-defined color and may be programmed to blink.

The bottom of the screen contains system information which is updated according to the current state of the CDL and ARC-16 system.

Logging Block

Logging commands and the required keypress are displayed in the Logging block in the lower left corner of the screen.

AutoPilot Block

This section indicates the presence of the AutoPilot extensions and whether AutoPilot is turned on or off. See the AutoPilot manual for more information.

Commands Block

This section of the screen contains command information to help the user remember commonly needed command keys. If the system is ready to accept commands, the command key combinations are displayed in this block.

The commands are blanked when they are not available. Commands will not be displayed when the selected site is

in the maintenance mode. "MAINTENANCE MODE" will instead be displayed in the command block.

If a modem is being used to connect to the ARC-16, this block will display the available dialing command prompts, switching to the raise/lower commands only when the system is connected and ready to accept these commands.

Status Block

Logging and Modem status are displayed in this block. The currently selected logging interval is displayed, as well as the type and status of the ARC-16 connection. During a modem connect, this block will echo the messages from the modem so that the progress of the connection can be monitored.

Normal Operation

Help

A help window is available during normal operation by pressing [F1]. The command block contains a reminder that this key is available should help be required.

This text may be customized. Refer to Section Three, Setup for more information.

Establishing a connection

The status block indicates whether and how the system is connected. If there is no current connection, the block will display "NOT CONNECTED". If the system is directly connected and running, the display will indicate "LOCAL CONNECTION".

A connection by modem may be completed from the computer to the ARC-16 in one of three ways:

1) by pressing (D)ial, which will call the ARC-16 and remain connected until ‹ESC› is pressed,

2) by pressing (L)ine, which will call, collect the current data, print one line, then hang up, or

3) by defining a log interval greater than 1 minute, which will automatically call, log, and hang up at the defined interval.

Calls from ARC-16 to Computer

If a modem is installed, the CDL program may be set to answer calls. Pressing *T* toggles ANSWER ENABLED and ANSWER DISABLED, as displayed in the STATUS block.

When ANSWER is enabled, if the ARC-16 detects an alarm condition and is programmed to call the computer, CDL will answer the call and perform the following steps:

1) Direct the modem to send an answer carrier.

2) Acknowledge the originate carrier from the ARC-16.

3) Send password and authorization information to verify that this is a valid call.

4) Request alarm reports from the ARC-16.

5) Print the alarm reports to the log output, including the actual time each alarm occurred up to four hours ago.

6) Receive a complete set of current values from all connected sites.

7) Print a log line with the current time and data.

8) Disconnect and reset the modem.

Site Selection

Select the desired site by pressing **‹PAGE UP›** or **‹PAGE DOWN›**. Each site is displayed on a separate page with the name of the site in the title bar.

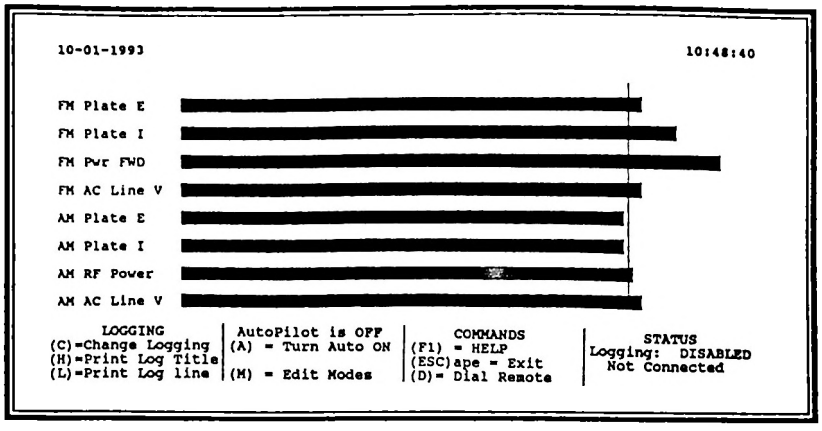
Since data from all sites is constantly being updated in memory, changing to a new site will display all current readings instantly.

If a dial-up modem connection is used to connect to the ARC-16, the data displayed will be current as of the last connection.

Bar Graph Display

One page contains a bar graph with a bar for each of eight channels selected from any site. The vertical line at the right of the page (referred to as a "barber pole" because of its appearance on a color monitor) represents the nominal value for that channel. Each bar is scaled to that value, so that all bars should be at the line if all values are exactly equal to the specified nominal value.

A bar extending to the right of the barber pole indicates a value that is higher than normal.



On a color monitor, the bars are normally green. If a channel exceeds the high limit specified in the ARC-16, the bar will turn red. Values below the low limit will be yellow.

If the channels for display are chosen carefully and the nominal values entered accurately, the bar graph provides a very useful display for an operator, especially where more than one site is being monitored.

To make adjustments in response to an out of tolerance condition, the operator should use ‹**PAGE UP**› or ‹**PAGE DOWN**› to return to the appropriate site page and enter commands as necessary.

Keyboard Control

Channel selection

Metering and status values are displayed constantly for all channels at the selected site, so no channel selection is necessary to obtain readings.

For control, it is necessary to highlight the desired channel.

This can be accomplished in several ways. The up and down arrow keys allow you to browse through the channels. ‹HOME› jumps to channel 1 and ‹END› jumps to channel 16. You may also type the number of the desired channel or, if ‹NUM LOCK› is on, you may directly enter the channel number using the numeric keypad.

Raise/Lower Commands

To issue a command, first select the desired channel as described above. The selected channel will be highlighted on the display. Now hold down the control key and press the left or right arrow keys for lower or raise, respectively. On a color monitor, the channel activated last will display in yellow (lower) or red (raise) until another channel selection is made.

Raise/lower commands are sent for approximately 1.5 seconds. It is not necessary to hold the key down for the command to be sent. If a longer closure is desired, as may be the case when adjusting power, you may hold the key down as long as desired.

Logging

Control of the automatic logger is by a set of single-character commands that may be entered at any time.

Logging Interval

The log may be updated at intervals from 1 minute to 3 hours. Pressing *C* will change the interval or turn the print output off completely. Note that the logging will occur on the cardinal times. That is, if three hours is the selected interval, the log will print at midnight, 3AM, 6AM, etc., regardless of when the program was started or the selection was made. The last logging time is displayed on the screen below the current time.

In addition to the timed outputs, the log will print whenever a status condition changes or an alarm occurs on a logged channel.

> **Individual status channels may be inhibited from generating a logging output. This is useful for frequently activated status signals that would generated unnecessary log entries. See Section Three, Setup for more information.**

Header

Pressing *H* will cause a page to eject and a new header will be printed. This is not necessary during normal operation, since headers are automatically printed at the top of each log, but does allow you to clear the log and start a new page at any time.

Line

Type *L* to print an immediate line on the log. The most recent values will be printed.

> **Brackets around an analog reading on the printed log signify that the reading is outside the limits as defined in the ARC-16.**

That's all there is to running CDL. To help you remember the commands, a quick reference command summary is included in Appendix A.

Section Five
AUTOPILOT

Description

AutoPilot is an optional software package which may be installed on any computer on which CDL is already installed.

AutoPilot provides an extensive set of automatic control features which are designed to help you maintain tight control of your plant with a minimum of effort.

Each user-defined function is described as a mode. There are sixty possible modes, each of which may contain up to nineteen steps.

Modes may be defined to control power, change pattern, switch to an auxiliary transmitter, or just about anything else that can be described in a flow chart.

Modes may be activated by a change in status or value, or may be activated by time or keypress. Time may be expressed as a fixed time or as a specially defined time such as sunrise and sunset. A table stores these times for the whole year, with four defined times for each month. A second table stores the times for daylight savings time as well.

The modes are defined using a "point and shoot" mode editor, making entry a snap, even for computer novices.

A tutorial is provided, with step-by-step instructions for completing a functioning mode. In addition, several typical modes are presented as templates for your own modes.

Installing AutoPilot

Whether you are doing a brand new installation or an upgrade, CDL must be installed and set up before installing AutoPilot. If you do not have CDL running at this point, return to Sections Two and Three.

An INSTALL program is included on the AutoPilot master diskette. Run INSTALL, following the directions in Section Two. Be sure to install AutoPilot in the same directory where CDL is installed.

Your directory will now contain the following additional files:

AE.EXE
The mode editor for AutoPilot. Normally invoked by pressing *M* in the ARC16 program, but may be started from DOS by typing *AE* ‹ENTER›.

ATS.DAT
A data file containing all of the modes created by AE. Used by ARC16.

ATS.MSG
A text file containing all of the user-defined messages for display and logging. Edited in AE and used by ARC16.

ATS.NAM
A text file containing all of the mode names. Created by AE. Used by ARC16.

SCHEDULE.ST
SCHEDULE.DST
Text files which contain the pre-sunrise, sunrise, sunset and post-sunset times for standard time and daylight savings time, respectively. Edited with ARCSETUP. Used by ARC16.

ARCSETUP for AutoPilot

All of the setup required for AutoPilot should already have been done using ARCSETUP for CDL (Section Three),

with the exception of the sunrise/sunset files and AutoPilot registration.

AutoPilot Registration

As with CDL, AutoPilot must be registered within 30 days. The authorization code for AutoPilot will be different from the CDL authorization code. If you have not yet registered CDL and intend to run AutoPilot, you may register AutoPilot without registering CDL. If you intend to run both, you will need both registrations.

Setting Sunrise/Sunset Times

Change to the directory where AutoPilot is installed and type *ARCSETUP* from the DOS prompt. Select the ST topic and enter the monthly times for the four events.

It is only necessary to enter times for the events you will be using. Normally, refer to the station license for the correct times.

Now return to the menu and select the DST topic. Note that the times for this file must be entered in daylight savings time, so add an hour to the times listed on your license.

Running AutoPilot

AutoPilot is started in exactly the same way as CDL. In fact, the AutoPilot INSTALL program replaced the ARC16.EXE program. All of the original CDL functions are present, but now the program includes the AutoPilot extensions for automatic control.

To start AutoPilot, change to the directory where AutoPilot was installed and type *ARC16* ‹**ENTER**›.

The screen will look exactly the same, except for the AutoPilot block at the bottom of the page.

AutoPilot Status

The AutoPilot block at the bottom of the screen indicates whether AutoPilot is on or off. Pressing ***A*** will toggle the status. When AutoPilot is on, automatic functions will run according to the instructions in the user-defined modes. When AutoPilot is off, ARC16 runs just like CDL.

Starting the Mode Editor

The AutoPilot status block also displays a reminder that the mode editor may be entered by pressing *M*.

> **The mode editor makes extensive use of the labels defined by the user in the ARC16 program, and uses the site labels defined in ARCSETUP. It is important to complete these assignments before attempting to use the mode editor.**

The mode editor is used to enter instructions for automatic execution. During mode editing, the normal ARC16 program is suspended. It may be re-started automatically when mode editing is completed.

Main Menu

```
File Run Mode Name Type Init Copy Edit Quit
Load, Save or Print modes
```

When the mode editor is first started, a menu appears at the top of the screen. The first line indicates the available topics. The second line provides the choices available or the functions performed when the highlighted topic is chosen. Change to the desired topic by pressing the first letter of the topic, or browse the topics using the cursor keys.

Choose the highlighted topic by pressing ‹**ENTER**›

From any topic, you may return to this menu by pressing ‹**ESC**›.

Topic: File

The **File** choice allows you to load, save or print the complete set of modes. When you start the editor the mode file is opened automatically, so **Load** is only necessary if you wish to abandon changes and resume editing on the original set of modes.

Save allows you to save your work without exiting the editor.

Print will print all modes that contain at least one step.

Topic: Run

Run starts the ARC16 program to return to normal operation. If you have made changes to the mode file, you will be prompted to save before exiting the mode editor. Answer (N)o only if you wish to revert to the previous set of modes and abandon all changes made during this edit session.

Topic: Mode

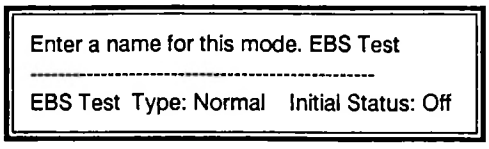
Select desired mode .....

[F2] 1	16 Transfer	31	46
[F3] 2 F3-AM On	17 Sample	32	47
[F4] 3 F4-AMoff	18 CycleGEN	33	48
[F5] 4 F5-FM On	19 Shut Dwn	34	49
[F6] 5 F6- FMoff	20	35	50
[F7] 6 EBS Enbl	21	36	51
[F8] 7 EBSdisbl	22	37	52
[F9] 8 F9-TwrLt	23	38	53
[F10] 9 LitesOff	24	39	54
10 AM Trim	25	40	55
11 FM Trim	26	41	56
12	27	42	57
13 EBSTest	28	43	58
14	29	44	59
15	30	45	60

Use the cursor keys to select a mode to edit. Press ‹**ENTER**› to complete the selection. Generally, the mode numbers are not significant. You may pick any unused mode to enter instructions for a new mode. The first nine modes are the only modes accessible from the keyboard, so these modes should be reserved for functions which you will want to start manually.

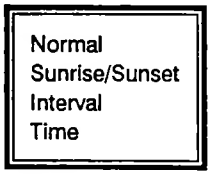
Topic: Name

Each mode that contains instructions should be named with a short, descriptive name. To give the mode a new name, select this topic and type the desired name.



Topic: Type

The mode type is set or changed with this topic. A pop-up window will appear with four choices.



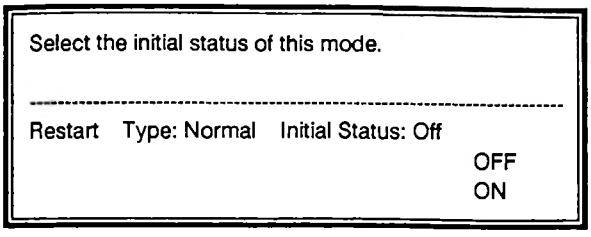
Normal is selected for modes that are to be enabled by function key (modes 1-9) or by other modes. **Interval** indicates that the mode will be executed as often as indicated *when enabled*. **Time** is used for modes that are to be executed at a certain time of day *when enabled*.

Use the cursor keys to select the desired type, then press ‹**ENTER**›.

If you have selected **Interval** or **Time**, you will be asked to enter an interval or time in hours and minutes. Be sure to enter time in 24-hour format (13:00 = 1:00PM).

If you have selected **Sunrise/Sunset** you will be prompted to choose one of four times of day: **Pre-Sunrise, Sunrise, Sunset** or **Post-Sunset**. Again, make a selection using the cursor keys, then press ‹**ENTER**›. The actual times for modes of this type are stored in the SCHEDULE.ST and SCHEDULE.DST files which are edited using ARCSETUP.

Topic: Init



A mode may be enabled when the program is first loaded by specifying an initial condition of **ON**.

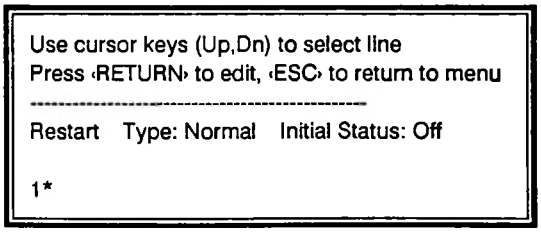
All modes that are expected to be on all the time should be set to an initial condition of **ON**. A **Time** mode, for instance, will not execute unless the initial condition is **ON**. Normally, function key modes are set to an initial condition of **OFF**.

Topic: Copy

The Copy command allows a mode to be duplicated easily. By copying one mode to another, you can rename the second mode, then make any required edits. This is particularly useful for copying functions such as power adjust for a second transmitter.

Topic: Edit

The required steps for editing a mode are explained in this section. In order to fully understand this section, it will be necessary to study the How Modes Work section on page 55. Return to this section when you are ready to implement the modes you have planned.



Each mode may have up to 19 lines of instructions. Although the lines may initially look complicated, they are

actually very simple to edit, since each step of the entry for each line presents a selection window.

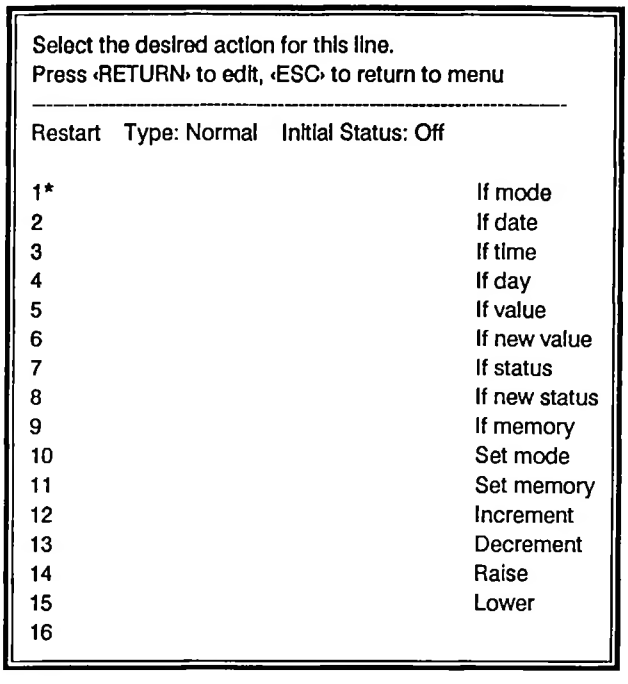
The * after the line number indicates the line to be edited. Use the cursor keys to select the desired line.

A line may be inserted by pressing ‹**INSERT**›. All subsequent lines will be moved down. Press ‹**DELETE**› to remove a line.

Be sure to edit line numbers in GO TO statements after you insert or delete lines.

Execution of the mode begins on the first line and ends on the first blank line. Therefore, it is essential to begin on line 1 or the mode will never execute.

When the desired line has been selected, press ‹**ENTER**›. A window will pop up showing the possible actions for this line.



Select the desired command from the selection window. The commands are described in the Commands section which follows.

Topic: Quit

The quit command is provided as a means to exit to DOS. Normally, you will use **Run** instead, which will return directly to the ARC16 program.

Quit provides a chance to save changes before exiting to DOS.

Mode Commands

IF MODE	Tests the current status of the indicated mode.
IF DATE	Tests the current date.
IF TIME	Tests the current time.
IF DAY	Tests the current day of the week.
IF VALUE	Tests a metering value from the specified site. Uses the last value obtained without waiting for a refresh. If telemetry from the site is un-available the value reverts to -1.
IF NEW VALUE	As above, but waits for a refresh before performing the test.
IF STATUS	Tests a status condition from the specified site. Uses the last condition obtained without waiting for a refresh.
IF NEW STATUS	As above, but waits for a refresh before performing the test.
IF MEMORY	Tests one of fifty user memories.
SET MODE	Allows another mode to be turned on or off.
SET MEMORY	Sets the contents of the specified memory to an initial value.
INCREMENT	Increases the value in the specified memory by one.
DECREMENT	Decreases the value in the specified memory by one.
RAISE	Activates the specified RAISE relay for the length of time indicated.
LOWER	Activates the specified LOWER relay for the length of time indicated.

WAIT	Suspends execution of this mode for the length of time specified.
GOTO LINE	Causes an unconditional branch to the indicated line.
MESSAGE	Displays and prints the selected message.
PRINT VALUE	Prints the selected metering value.
PRINT STATUS	Prints the selected status message.

How Modes Work

Each enabled mode runs concurrently with all other enabled modes. Think of AutoPilot as sixty separate computers, all running independent programs.

The mode execution is tightly controlled so that it is almost impossible to make a mistake in one mode which would prevent execution of other modes (Unless the mode is inadvertently commanded to turn off another mode).

Even if a mode contains the instruction 1 GOTO LINE 1, which would be an endless loop in other programming environments, AutoPilot will continue to function properly (although the mode with this instruction will serve no useful purpose).

Mode Instructions

Each mode contains up to nineteen instructions. Each instruction contains a test, a command, a message, or a branch to another instruction.

Tests

All of the actions beginning with "IF" specify a test to be performed to determine the next line to be executed. Each test includes two objects to be compared, a comparison operator and a "go to" line. If the test is true, execution branches to the line indicated, else execution resumes at the next line. If the next line is blank, execution ends and the mode is turned off.

```
1* If mode EBS Test = Off goto line 19
```

Here execution branches if the EBS Test mode is OFF, else continues on the next line.

It is usually better to test a mode for OFF rather than ENABLED, since an enabled mode that is executing at the same time may actually be in a wait status which would not pass the test for ENABLED even though it actually is enabled.

Note that a branch to an empty line terminates the mode activity and disables the mode.

```
2 If value [D 4] WZZZ-FM FM RF Power ‹ 17.5 goto line5
```

In this case, execution branches to line 5 if the power is less than 17.5 kW. If the power is greater than or equal to 17.5, execution continues on line 3.

An important distinction must be made between IF VALUE and IF NEW VALUE. Since IF NEW VALUE waits for a refresh from the ARC-16, you can be assured that the value reflects the result of any changes that were made by this or another mode. Subsequent comparisons may be made using IF VALUE to speed execution. The following mode segment illustrates this usage:

```
FM Trim   Type: Normal   Initial Status: Enabled
1  If new status [D 2] WZZZ-FM FM Main is O = OFF goto line19
2  If new value [D 4] WZZZ-FM FM RF Power ‹ 19 goto line  8
3  If value [D 4] WZZZ-FM FM RF Power › 25.5 goto line  12
4  Goto Line  1
5
6
7
8  Raise [D 3] WZZZ-FM Power Adjust for 1.5 seconds
9  Message | FM Power Adjusted UP                    |
10  Goto Line  1
11
12* Lower [D 3] WZZZ-FM Power Adjust for 1.5 seconds
13  Message | FM Power Adjusted DOWN                  |
14  Goto Line 1
15
```

Commands

A command is an instruction to turn another mode on or off, or a raise or lower command to one of the ARC-16's. Line 8 above is a command to raise the power adjust channel. Whenever a raise or lower command is chosen, the appropriate selection windows will appear to allow the proper site, channel and duration to be chosen.

If consecutive instructions contain commands, there will be a 1 second delay between each command and each command will be asserted for the duration specified. That means that several channels may actually be asserted simultaneously if the pulse width is long enough for them to overlap. The exception to this is when consecutive commands are issued to the same channel. In this case, the most recent command will terminate the previous command for that channel. This prevents raise and lower from being simultaneously asserted on the same channel.

Messages

Frequently, it is useful to log and display a message when a particular point in a mode is reached. In the mode sample above, every time AutoPilot makes a power adjustment, it reports that fact on the display and on the log.

Use the **MESSAGE** command to print and display a 40-character message. This is useful for logging the execution of a command as in the above examples. There are fifty messages available and each message may be used in any mode. Editing a message will change the text wherever it is used, so take care not to alter a message required by another mode. To edit a new message, select a blank line in the window and press return.

Use the **PRINT VALUE or PRINT STATUS** command to print the current value or status of any channel without printing a complete log line. You may use PRINT VALUE to print values that are normally not logged, but are of interest only at certain times or if they exceed specified limits.

Use **PRINT LOGLINE** to force printing of the normal log line at any time.

Branches

Each instruction is executed sequentially until a blank line is encountered. The sequence may be altered by conditional branches or by a GOTO instruction. All branching is done within the mode.

A mode that needs to be run continuously requires a **GOTO LINE 1** statement. The power adjust example above illustrates this use. Note that the GOTO could have been to another line if initialization steps that are not to be repeated are necessary.

Mode Interaction

It is important to understand the interaction of the modes, since it is useful to have modes turn other modes on and off.

Each mode may be in an enabled or disabled state at any time. This state may be altered by the SET MODE command or, in the case of the first nine modes, by pressing the appropriate function key.

A very practical use of this feature is to have the function key modes turn on and off complete sets of modes depending on the time of day, transmitter in use, etc. This means that the operator can depend on the same function key performing an appropriate action regardless of which transmitter is in use or which pattern is correct for this time of day.

Be careful not to construct modes which counteract each other. The best way to avoid this problem is to have a set

of master modes which turn one set off before turning another set on.

Interval and Time modes may be created for events which should occur at specific times or intervals, but they are not normally required for periodic testing, since in most cases there is no reason not to test continuously.

User Memories

User memories are intended primarily for counters. It is sometimes desirable to try a procedure several times, then quit or do something else. A transmitter restart procedure, for instance, might be tried three times before reporting failure.

The explanation which follows this example is also useful to gain an understanding of branching instructions.

```
Restart  Type: Normal  Initial Status: Off

1 Set memory 1 to 3
2 If mode F3-AM On = Off goto line 1
3 If new status [B 2] WXXX-AM Main Plate O = ON goto line 1
4 Raise [B 2] WXXX-AM Plate ON/OFF for 2 seconds
5 Decrement Memory 1
6 If memory 1 › 0 goto line 2
7 Set mode F3-AM On Off
8 Set mode Aux On  Enabled
9 Message | Main AM Xmtr Failed - Starting Aux     |
10*
```

In the above example, memory 1 is used as a "three- strike" counter. The counter is initialized to a value of 3 in line 1. The test in line 2 basically tells this mode to do nothing if the Sign-On key (F3) has not been pressed.

Line 3 will only be executed if the F3-AM On mode is active. This line tests for the status of the plate circuit in the main transmitter. If the plate circuit is on, this mode has nothing further to do, so it branches back to line 1 to continue testing. As long as the mode tested in line 2 remains on, this mode will wait in line 3 until the status of the plate circuit is reported by the ARC-16 again, and will loop until this status indicates that the plates have gone off.

When the test in line 3 fails, line 4 executes, pulsing the plate on for 2 seconds.

Since we want to try this three times before giving up, the counter is decremented in line 5.

Line 6 checks to see if we've already done this 3 times. If we have, execution continues on line 7, otherwise the branch goes back to line 2.

If the plates are back on, the counter is reset by going back to line 1. If not, we try again until the test in line 6 fails.

Line 7 uses the SET MODE command to disable the normal transmitter on mode. We've tried to restart three times without success, and we don't want to keep banging on this rig.

Line 8 starts a different mode which is a set of instructions for turning on the Auxiliary transmitter.

Line 9 tells the operator what has happened.

Since line 10 is blank, this mode is now finished and will not execute any more instructions (even if there were instructions on line 11).

Using AutoPilot

AutoPilot runs silently in the background during normal ARC16 operation. About the only thing the operator has to be aware of is the possibility that AutoPilot will override his commands from the keyboard. If, for instance, a mode is running which is designed to reset the plates if they get knocked off, every time the operator hits the plates off, AutoPilot will put them right back on.

This is easily avoided by turning AutoPilot off (Press A) before doing any manual controlling.

With a properly constructed set of modes, the operator should have little reason to issue commands directly.

AutoPilot Operations

While running ARC16, Press ‹PAGE UP› or ‹PAGE DOWN› to display an additional page titled AutoPilot Operations.

```
06-20-1991                    AutoPilot Operations                    03:06
Mode ID  S Time PC  Mode ID  S Time PC  Mode ID  S Time PC  Mode ID  S Time PC

F2          00:00 1            00:00 1            00:00 1            00:00 1
F3-AM On    00:00 1  CycleGEN E 18:50 1            00:00 1            00:00 1
F4-AMoff    00:00 1  Shut Dwn E 22:59 1            00:00 1            00:00 1
F5-FM On    00:00 1            00:00 1            00:00 1            00:00 1
F6-FMoff    00:00 1            00:00 1            00:00 1            00:00 1
F7          00:00 1            00:00 1            00:00 1            00:00 1
F8          00:00 1            00:00 1            00:00 1            00:00 1
F9-TwrLt W  00:00 2            00:00 1            00:00 1            00:00 1
F10         00:00 1            00:00 1            00:00 1            00:00 1
AM Trim     00:00 1            00:00 1            00:00 1            00:00 1
FM Trim  W  00:00 1            00:00 1            00:00 1            03:05 1
            00:00 1            00:00 1            00:00 1            03:15 1
EBS Test E  09:15 1            00:00 1            00:00 1
            00:00 1            00:00 1            00:00 1
Transfer E  02:59 1            00:00 1            00:00 1
            00:00 1            00:00 2            00:00 1

    LOGGING                 AutoPilot              COMMANDS            STATUS

(C)=Change Logging     (A) = Turn Auto OFF    (F1) = HELP        Logging:  2 HOURS
(H)=Print Log Title                                              LOCAL CONNECTION
(L)=Print Log line     (M) = Edit Modes
```

Each mode is displayed with current information about the mode. The first nine modes are reserved for function keys [F2] through [F10]. A mode assigned to one of these keys will be enabled by pressing the appropriate function key. The modes are enabled by execution of other modes. An E in the status column signifies that the modes is enabled and ready to run.

If the mode is a TIME or INTERVAL type, the time scheduled for the next execution of the mode is shown in the Time column.

An enabled mode may be waiting at some step before execution continues. This is indicated by a W in the Status column if the wait is a time delay. If the mode is waiting for new data before proceeding, a D will appear. An active mode will display E. The PC (program counter) column shows the next step to be executed by the mode. A mode that is not enabled will always be at step 1.

Using this screen and referring to a listing of the user-defined modes, it is possible to determine the state of any mode.

The entire staff at Burk Technology hopes you find using CDL and AutoPilot to be an enjoyable experience. We're all proud of our products and of the high standards of service and support that we have been able to provide.

We hope you will share your comments with us, favorable or otherwise, in order that we might continue to provide the best possible remote control solutions to the broadcast industry.

Appendix A
COMMAND SUMMARY

ARC16

To start the normal program (CDL or CDL w/Auto-Pilot), first change to the drive and directory where ARC16 is installed. If ARC16 is on drive C in directory \CDL, type

C: ‹ENTER›
CD \CDL‹ENTER›

Then type

ARC16 ‹ENTER›

to start the program.

Use the following commands while running ARC16:

Modem

D	Dial remote site.
L	Dial remote site, print Log Line, Disconnect.
T	Telephone answer enable/disable.
[ESC]	Disconnect from remote site.

Display

[PageUp]	Next screen
[PageDown]	Previous screen
[F1]	HELP window
[ALT]-V	Program name and version
[ALT]-T	Time zone window

Control

0-9	Select command channel.
[UpArrow]	Select previous channel
[DnArrow]	Select next channel
[Home]	Select channel 1
[End]	Select channel 16
[Ctrl-Left Arrow]	Send LOWER command on selected channel
[Ctrl-Right Arrow]	Send RAISE command on selected channel

Logging

C	Change logging interval.
H	Print Log Header.
L	Print Log Line.

Quit

[ESC]	Exit program and return to DOS

AutoPilot

In addition to the above, the following commands are available if AutoPilot is installed:

A	Toggle AutoPilot on and off.
M	Enter Mode Editor.
[F2]-[F9]	Start a function key activated mode.

EDLABEL

To start the ARC16 program with on-screen label editing enabled, first change to the drive and directory where ARC16 is installed. If ARC16 is on drive C in directory \CDL, type

C: ‹**ENTER**›
CD \CDL ‹**ENTER**›

Then type

ARC16 ‹**ENTER**›

All of the ARC16 commands listed above are available, plus the following commands which are used to edit labels on-screen.

Select label to edit

[Left Arrow]	Move Left to highlight screen label
[Right Arrow]	Move Right to highlight screen label

Enter Edit mode

E	Edit highlighted screen label

Editing

[ENTER]	Save changes to label
[ESC]	Abandon changes to label

Status messages

[Left Arrow]	Change from ON message to OFF
[Right Arrow]	Change from OFF message to ON
[ALT]-P	Toggle message printing on change
[Up Arrow]	Next color (ON message only)
[Down Arrow]	Previous color (ON message only)

ARCSETUP

To start ARCSETUP, first change to the drive and directory where ARC16 is installed. If ARC16 is on drive C in directory \CDL, type

C: ‹**ENTER**›
CD \CDL ‹**ENTER**›

Then type

ARCSETUP ‹**ENTER**›

to start the program. Use the following commands while running ARCSETUP:

Select topic

[Left Arrow]	Select previous topic.
[Right Arrow]	Select next topic.
A-Z	Select topic with initial letter.
[ENTER]	Open window for highlighted topic.

Cursor		
	[Arrow keys]	Move cursor by character
	[TAB]	Move to next field
	[SHIFT]-[TAB]	Move to previous field
Data entry		
	[ENTER]	Accept entry and advance to next field
Multiple choice fields		
	[SPACE]	Open choice window
	[Up Arrow]	Move up one choice
	[Down Arrow]	Move down one choice
	[ENTER]	Accept entry and advance to next field
Return to main menu		
	[F2]	Return to main menu. Prompts for save if any changes have been made.
	[F3]	Return to main menu. Automatically saves if any changes have been made.
Help		
	[F1]	Displays help for the currently selected field.

Appendix B
HARDWARE INSTALLATION

The ARC-16 Remote Control System may be controlled by CDL or AutoPilot software only if a computer interface has been installed in one of the ARC-16 units. This may be a Model CI Computer Interface or a Model ESI Enhanced Speech Interface.

> **The Model CI is equivalent to the interface included with the older CI-16.**

To verify that an interface is installed in your ARC-16, check the rear apron for the presence of a DB-25 or DB-9 connector. Also note whether there are RJ-11 telephone jacks next to the connector.

A DB-25 connector with no RJ-11's indicates the presence of a Model CI computer interface. Follow the instructions in this appendix for using this interface.

A DB-9 connector with two RJ-11's and a phono jack indicates an ESI is installed. Follow the ESI instructions in this appendix.

A DB-25 with one or two RJ-11 jacks indicates a DSU/CI-16 is installed. CDL and AutoPilot version 4.5 or above will not function with this option. You must either use an older version of software or upgrade to ESI to add computer control to this unit.

Checking the Baud Rate

The Model ESI is preset at 1200 baud. You may proceed to the ESI connections section if you are using this interface.

The Model CI may be strapped for 300 or 1200 baud. To determine the current setting, locate the baud rate jumper on the board and refer to the CI schematic for the proper

setting. Change the strap if necessary to set the desired baud rate.

A different jumper is necessary when changing from ARC4.4 or below to ARC4.5 or above. If you are upgrading an older CI-16 interface, a change in this strap is mandatory. Be sure to cut the etched link on the board if no strap is currently installed.

Installing the Interface

If you have determined that an interface is already installed in the ARC-16 unit and that the baud rate is correct, you may skip this section and continue with the CI or ESI Connections section as appropriate.

Installing the Model ESI

If you have purchased an ESI as an option or upgrade, refer to the ESI manual for hardware installation instructions. After completing the installation and setup of the ESI, refer to the ESI Connections section in this appendix to complete the installation.

Installing the Model CI

If you have purchased the Model CI Computer Interface, you will need to install the board in the ARC-16. For field installation, the CI circuit board is shipped with the following accessory items:

3 - #6-32 x 1 M/F standoffs

3 - #6-32 x 1/4 machine screws

1 - 24-pin ribbon jumper

Installation in Units with I/O Boards

The CI must be installed as the top board in the right rear of the ARC-16. Remove the front center, rear center, and rear right hand #6 mounting screws from the uppermost I/O board and replace them with the standoffs provided.

Next, connect one end of the 24-pin ribbon jumper to the header on the CI so that it extends away from the board.

Install the CI on the standoffs so that the DB-25 connector extends through the slot in the rear of the ARC-16. Secure with the #6 scress provided.

Connect the 24-pin jumper to the AUX board which is at the right end of the CPU board. The jumper must be connected to the header closest to the display board. Exercise caution when mating the connectors, as they are easily misregistered.

Installation In Units Without I/O Boards

Standoffs are not necessary when installing a CI in a studio unit with no other accessory cards. Proceed as above but mount the CI directly to the PEM fasteners in the chassis. It is still necessary to connect to the front header on the AUX board.

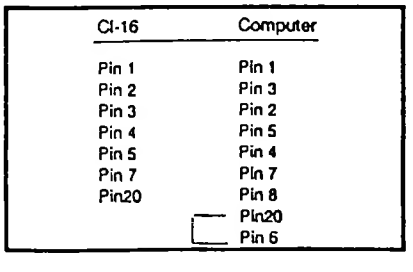
CI Connections

This section applies only if you are using the Model CI interface. If you are using the Model ESI, refer to the ESI Connections section.

The Model CI is normally connected to the computer using a direct link and the RS-232 protocol. The DB-25 connector on the rear of the CI is connected to COM1 or COM2 on the computer. The computer may be located up to fifty feet from the ARC-16.

Connect the computer using a standard 25 conducter cable and a null modem adapter. 25-pin to 9-pin adapters are readily available if the computer has a 9-pin connector. The null modem adapter, a small unit with a male and female 25-pin connector, is readily available at any computer outlet.

If it is necessary to construct a cable, the required connections are shown here.



ESI Connections

Direct Connection

The RS-232 connector on the ESI is a DB-9M. To connect to the computer, you will need a cable which is wired according to the appropriate diagram below. If your computer has a 25-pin COM port, a 9-pin female to 25 pin female cable is required. If you are using a computer with a 9-pin COM port, a cable with DB-9 female connectors on each end may be used.

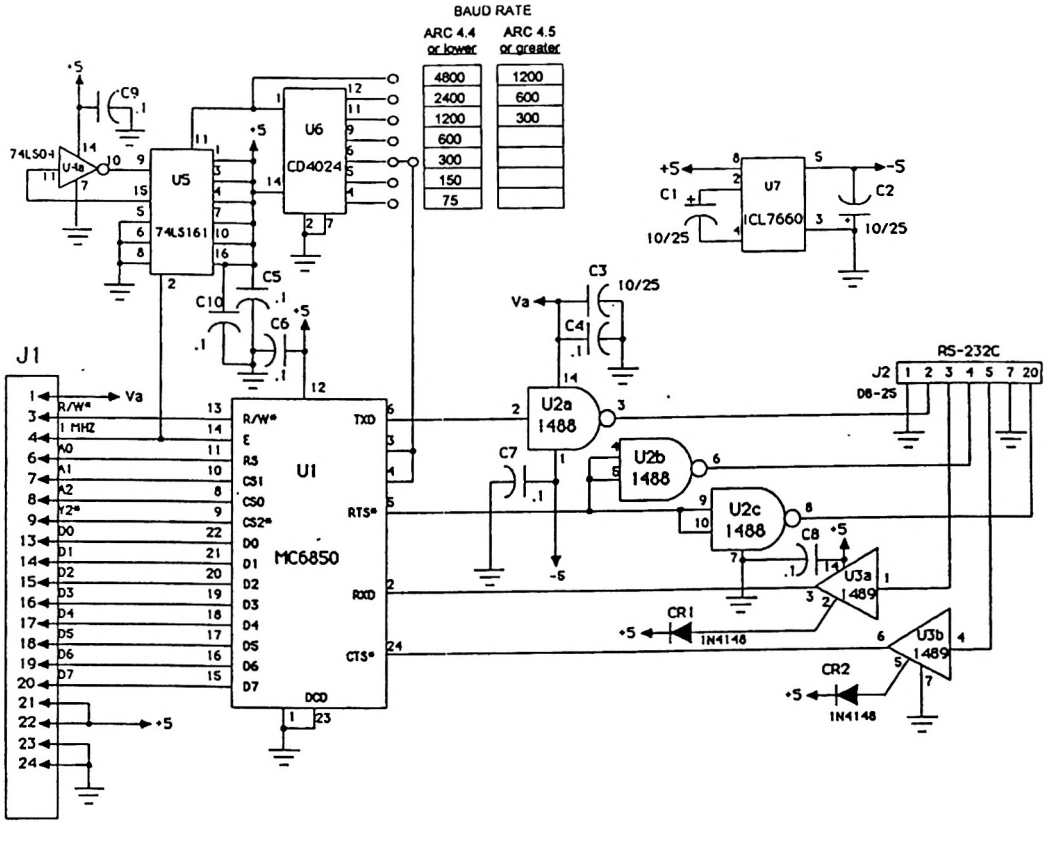
If necessary, a cable may be constructed using these pinouts.

> **A ten foot DB-9F to DB-25F cable is available from Burk Technology.**

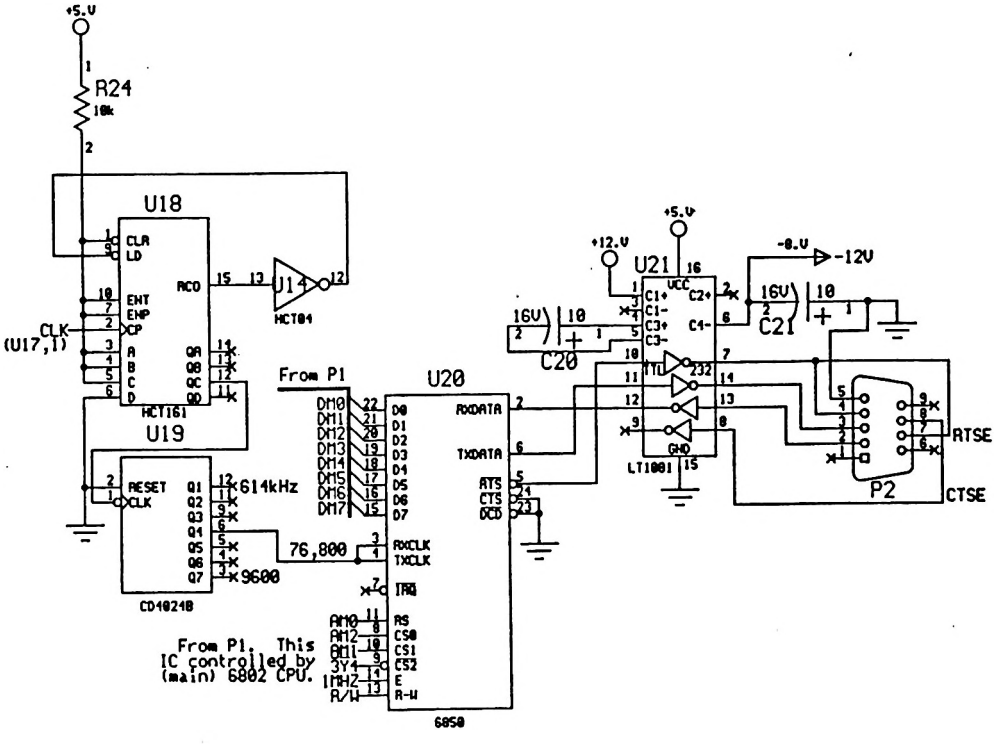
DB-25F (to computer)		DB9-F (to ESI)
2 TxD	. . . . .	2 RxD
3 RxD	. . . . .	3 TxD
5 CTS	. . . . .	7 RTS
7 GND	. . . . .	5 GND

DB-9F (to computer)		DB9F (to ESI)
2 RxD	. . . . .	3 TxD
3 TxD	. . . . .	2 RxD
5 GND	. . . . .	5 GND
8 CTS	. . . . .	7 RTS

Model CI Schematic



ESI Computer Interface Schematic



Appendix C
CUSTOMIZING COLORS

The colors used for various types of information on the ARC16 screens are controlled by data in the color code file. There are three default color code files in the CDL directory. They are named COLORC.ODE, MONOC.ODE and BLKWHTC.ODE. One of these three files is selected for use in ARCSETUP (DISPLAY topic).

In most cases, one of these three files will produce good results on your monitor. However, you may edit any of these three files with an ASCII editor if you wish to use a custom set of colors.

For each type of displayed information, there are two values that must be specified. The first is the foreground color. The second is the background.

Some experimentation may be necessary to produce a set of colors that works for your application.

Be aware that not every possible message or display has a unique color pair. A change in any of these values may have an effect on another part of the display. Check in particular that the bar graph display is satisfactory after making any changes to the color code file.

In the event that you wish to return to the default set, delete any modified color code files and re-run install to replace the files with the original. Alternatively, you may wish to keep a backup of the original before you begin editing. Simply copy the file to be edited to a file with another name, such as COLORC.OLD.

Default Color Codes

COLORC.ODE File	MONOC.ODE File	BLKWHTC.ODE File	
7	2	5	Normal text
1	15	0	
14	0	8	Low alarm limits
1	15	5	
12	0	8	High alarm limits
1	15	5	
12	8	24	Status ON condition
1	15	5	
9	2	0	Status OFF condition
1	15	0	
15	10	0	Control channel highlight
1	15	5	
12	10	10	Raise command issued
1	15	5	
14	10	10	Lower command issued
1	15	5	
1	0	0	Frame across top of screen
7	15	10	

0	BLACK	17	BLINKING BLUE
1	BLUE	18	BLINKING GREEN
2	GREEN	19	BLINKING CYAN
3	CYAN	20	BLINKING RED
4	RED	21	BLINKING MAGENTA
5	MAGENTA	22	BLINKING BROWN
6	BROWN	23	BLINKING WHITE
7	WHITE	24	BLINKING GREY
8	GREY	25	BLINKING LIGHT BLUE
9	LIGHT BLUE	26	BLINKING LIGHT GREEN
10	LIGHT GREEN	27	BLINKING LIGHT CYAN
11	LIGHT CYAN	28	BLINKING LIGHT RED
12	LIGHT RED	29	BLINKING LIGHT MAGENTA
13	LIGHT MAGENTA	30	BLINKING YELLOW
14	YELLOW	31	BLINKING BRIGHT WHITE
15	BRIGHT WHITE		
16	BLINKING BLACK		

Appendix D
FORMS

The form on page 83 provides a convenient means of collecting all of the information for each channel in the system. Photocopy the form so that you have one page for each channel.

The completed forms should be bound and kept with the manual for future reference. It is suggested that the forms be completed before running ARCSETUP, as this will reduce the time required to set up the system.

The form is divided into ARC-16, CDL/AutoPilot and ESI sections. Complete only the sections needed, depending on the options installed in your system. Blanks that are noted "for reference" are not actually entered into the system, but are useful during the editing of other values.

A sample form is included for reference.

ARC-16

All of the data in this section refers to the ARC-16 unit. CDL and ESI labels will be edited based on the information in this section. See the ARC-16 manual for details about any of these values.

SITE Enter the name of the site for this channel.

SITE LETTER Enter the letter for this site, as displayed on the ARC-16 to the left of the channel number.

CHANNEL# Enter the channel number.

LABEL	Enter up to seven characters for the label for this channel that appears on the ARC-16 LCD display. This label should reflect the control and/or metering function of the channel.
CONTROL FUNCTION	For reference, enter the raise/lower function.
METERING FUNCTION	For reference, enter the metering function.
UNITS	For reference, enter the unit of measurement (kV, mA, etc.).
NOMINAL VALUE	For reference, enter the expected normal reading of this channel. This information will be useful for setting the CDL bar graph scaling in ARCSETUP.
SAMPLE VOLTAGE	For reference, enter the measured sample voltage for this channel. Recording this value will aid in troubleshooting.
DECIMAL POINT	Circle the desired position of the decimal point.
TYPE	Circle the type of metering.
LOW LIMIT	Record the low limit for this channel. This is an alarm point.
HIGH LIMIT	Record the high limit for this channel. This is an alarm point.
STATUS FUNCTION	For reference, enter the status function for the status input numbered the same as this channel.
STATUS POLARITY	Circle whether this status input is normal or inverted.
STATUS ALARM	Circle whether this status channel is set to trigger an alarm.

CDL

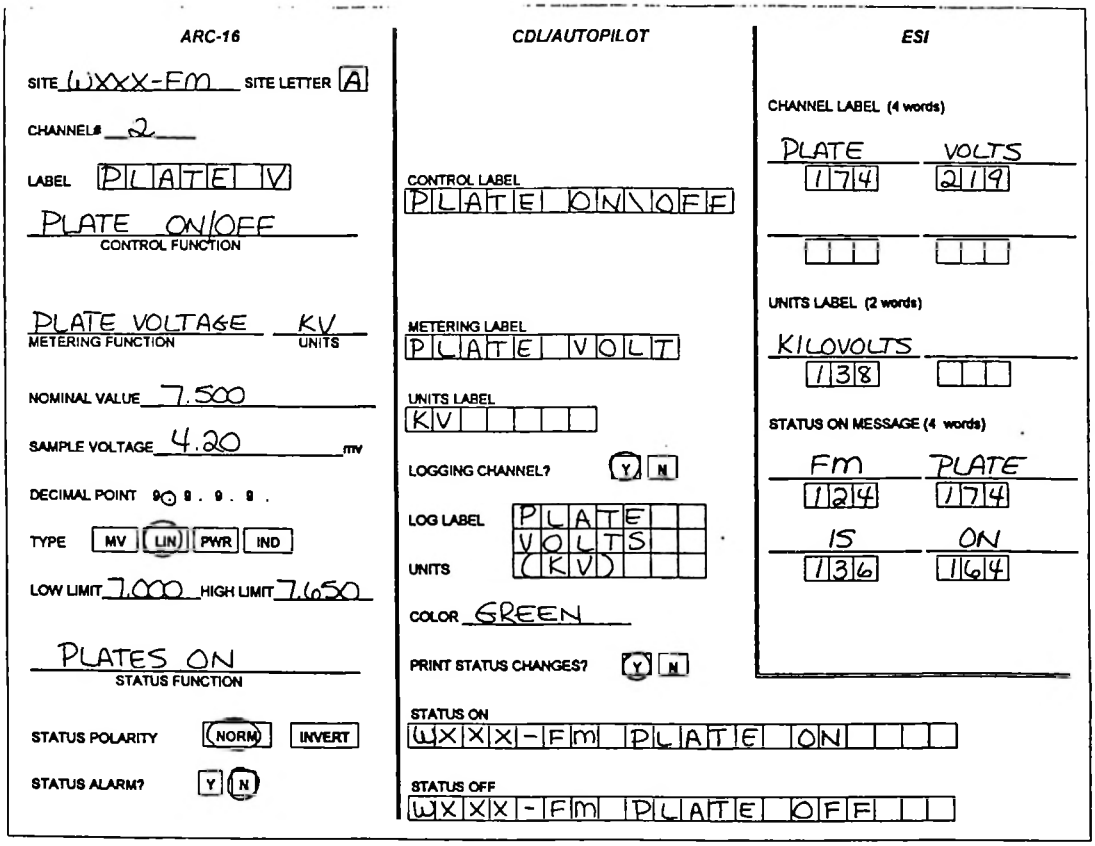
CONTROL LABEL	Enter a screen label of up to 12 characters. This label should describe the raise/lower functions for this channel.
METERING LABEL	Enter a screen label of up to 10 characters. This label should describe the metering function for this channel.
UNITS LABEL	Enter a screen label of up to 7 characters to describe the unit of measurement for this channel.

LOGGING CHANNEL?	If this is a channel that will appear on the log, circle Y.
LOG LABEL	If this is a logging channel, express the metering label in two lines of up to seven characters each. This label will appear above the appropriate column on the operating log.
UNITS	This label may be any seven characters, but is intended for the unit of measurement for this channel which will appear on the operating log.
COLOR	Enter the color desired for display of the status ON message.
PRINT STATUS CHANGES?	Circle Y if a line should be printed on the log each time this status channel changes.
STATUS ON	Enter a message of up to 20 characters to be displayed when this status channel is ON.
STATUS OFF	Enter a message of up to 20 characters to be displayed when this status channel is OFF.

ESI

CHANNEL LABEL	Enter up to four words from the ESI vocabulary to describe this channel. Enter the three-digit numbers for each word directly under the word.
UNITS LABEL	Enter up to two words from the ESI vocabulary for the unit of measurement for this channel.
STATUS ON MESSAGE	Enter up to four words from the ESI vocabulary to describe the Status ON condition.

Sample Form



ARC-16

SITE WXXX-FM SITE LETTER A

CHANNEL# 2

LABEL PLATE V

PLATE ON/OFF
CONTROL FUNCTION

PLATE VOLTAGE — KV
METERING FUNCTION — UNITS

NOMINAL VALUE 7.500

SAMPLE VOLTAGE 4.20 mv

DECIMAL POINT 9 (9.9.9.)

TYPE [MV] (LIN) [PWR] [IND]

LOW LIMIT 7.000 HIGH LIMIT 7.650

PLATES ON
STATUS FUNCTION

STATUS POLARITY (NORM) [INVERT]

STATUS ALARM? [Y] (N)

CDL/AUTOPILOT

CONTROL LABEL
PLATE ON\OFF

METERING LABEL
PLATE VOLT

UNITS LABEL
KV

LOGGING CHANNEL? (Y) [N]

LOG LABEL
PLATE
VOLTS

UNITS
(KV)

COLOR GREEN

PRINT STATUS CHANGES? (Y) [N]

STATUS ON
WXXX-FM PLATE ON

STATUS OFF
WXXX-FM PLATE OFF

ESI

CHANNEL LABEL (4 words)

PLATE	VOLTS
1174	2119

UNITS LABEL (2 words)

KILOVOLTS	
1138	

STATUS ON MESSAGE (4 words)

FM	PLATE
1124	1174
IS	ON
1136	1164

ARC-16

SITE_____ SITE LETTER [ ]

CHANNEL# _____

LABEL [ ][ ][ ][ ][ ][ ][ ]

_____
CONTROL FUNCTION

_____ _____
METERING FUNCTION UNITS

NOMINAL VALUE_____

SAMPLE VOLTAGE_____mv

DECIMAL POINT 9 . 9 . 9 . 9 .

TYPE [MV] [LIN] [PWR] [IND]

LOW LIMIT_____HIGH LIMIT_____

_____
STATUS FUNCTION

STATUS POLARITY [NORM] [INVERT]

STATUS ALARM? [Y] [N]

CDL/AUTOPILOT

CONTROL LABEL
[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

METERING LABEL
[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

UNITS LABEL
[ ][ ][ ][ ][ ][ ][ ]

LOGGING CHANNEL? [Y] [N]

LOG LABEL [ ][ ][ ][ ][ ][ ][ ]

UNITS [ ][ ][ ][ ][ ][ ][ ]

COLOR _____

PRINT STATUS CHANGES? [Y] [N]

STATUS ON
[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

STATUS OFF
[ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

ESI

CHANNEL LABEL (4 words)

_____ _____
[ ][ ][ ] [ ][ ][ ]

_____ _____
[ ][ ][ ] [ ][ ][ ]

UNITS LABEL (2 words)

_____ _____
[ ][ ][ ] [ ][ ][ ]

STATUS ON MESSAGE (4 words)

_____ _____
[ ][ ][ ] [ ][ ][ ]

_____ _____
[ ][ ][ ] [ ][ ][ ]

ESI

ENHANCED SPEECH INTERFACE FOR ARC-16 REMOTE CONTROL

INSTRUCTION MANUAL

BURK TECHNOLOGY

ESI

ENHANCED SPEECH INTERFACE FOR ARC-16 REMOTE CONTROL

INSTRUCTION MANUAL

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FAX (978) 486-0081

REV A

Contents

Section One
INTRODUCTION

Description

The Model ESI Enhanced Speech Interface adds dial-up control and metering capability to any Burk Technology ARC-16 Remote Control System. A standard Touch-Tone® phone is all that is required to access the remote control. A digitally recorded voice announces all status and meter readings. Pressing digits on a telephone keypad selects the desired functions and sends commands to the system. The ESI is accessed by calling in or may be set to dial out whenever an alarm condition is detected.

In addition, the ESI provides two connections for computer control and monitoring, using the optional Burk Technology CDL software for PCs.

An LED on the rear of the ESI provides diagnostic information to aid in determining proper operation of the unit.

Physical Description

The ESI consists of a printed circuit board which is easily field installed in existing ARC-16 systems. The ESI may be installed at any site within the ARC-16 system, and will have access to all connected sites within the system. The ARC-16SA Stand Alone Remote Control System includes the ESI as standard equipment. See page 19 for installation instructions.

Connections

An RJ-11 jack marked LINE on the rear of the ESI provides connection to a standard dial telephone line. A second jack marked SET may optionally be connected to a telephone set. The line may be used for other purposes using the telephone set when the ESI is not in use. The telephone set may also be used for direct operation of the ESI.

A DB-9 connector provides connection to a PC COM port for local computer operation. The second computer connection is via the LINE jack (RJ-11) using the built-in 1200 baud modem. Refer to the CDL Instruction Manual for computer connection information.

An RCA phono jack on the rear of the ESI permits connection of an audio signal to be monitored by telephone. See page 19.

Security

The ESI is protected from unauthorized access by two levels of password protection. A four-digit user password must be entered before any functions may be performed. See page 11. A separate master password must be entered to alter any of the user programmed information. An incorrect password causes the ESI to hang up immediately.

Passwords are assigned from the front panel of the ARC-16 through the configuration menu. See page 20.

Additionally, the ESI operating mode may be set from the front panel of any connected ARC-16. Separate selection of call-out and answer modes is available. A call in progress may be terminated from any connected ARC-16 unit. See page 10.

Metering and Control Functions

All channels of all connected sites may be metered by telephone by entering the number of the channel on the telephone keypad. The ESI responds with the channel number, a user programmed channel label, the current value, and a user programmed unit of measurement. A repeat function allows the user to easily monitor the effect of any adjustments.

Raise and lower commands may be sent to the selected channel and are asserted for the duration of the key press. See page 13.

Status Reporting

A status report may be requested which announces all status signals which are currently active. For each status signal, the status channel number is announced, followed by a user programmed status message. See page 14.

Alarm Reporting

The ten most recent alarms in the system are reported on request. Alarms for all connected sites are presented with the most recent first. While the call is in progress, the caller

is alerted to any new alarms. The caller may clear the alarms or ask for them to be repeated at any time. See page 14.

Limits monitoring may be turned on or off by the caller or from the front panel. See page 15.

Site Selection

Any connected site in the system may be selected for control and monitoring. The caller may switch between sites at will during the call. See page 14.

Call-Out Feature

If the call-out feature has been enabled, up to nine telephone numbers will be dialed in sequence until a valid response has been received. The ESI waits between calls to allow for incoming calls during an alarm condition.

The numbers may be programmed from the telephone if the caller has entered the master password. See page 17.

User Defined Labels

Voice labels are provided for all metering and status channels. Units of measure (kilovolts, milliamps, etc.), may also be assigned to each metering channel. See page 16.

Help Functions

An exclusive VOICE HELP feature provides context sensitive help during the operation of the ESI. Reminders of available commands are provided if a command is not entered correctly or after a delay of a few seconds. A help menu can be accessed at any time by dialing a two-digit code. See page 12.

Audio Monitoring

An audio signal may be monitored by pressing a two-digit code. This may be used to monitor an off-air signal, a security system, an EBS receiver, or any other available audio signal. See page 15.

Broadcast Specific Vocabulary

Users of the Burk Technology DSU Digital Speech Unit will be pleased to note an expanded vocabulary with many words chosen specifically for broadcast applications. This vocabulary was developed by seeking the recommendations of our many broadcast customers.

Warranty

Burk Technology, Inc. warrants the ESI Enhanced Speech Interface to be free of defects in materials and workmanship for a period of 24 months from the date of purchase. Equipment will be repaired or replaced at the option of Burk Technology and returned freight prepaid to the customer. Damage due to abuse or improper operation or installation of the equipment or caused by fire or flood or harsh environment is not to be covered by this warranty. Damage in shipping is not the responsibility of Burk Technology. A return authorization must be obtained before returning any equipment. Materials returned under this warranty must be shipped freight prepaid and insured in the original shipping carton or suitable substitute to Burk Technology, Inc.,7 Beaver Brook Road, Littleton, MA 01460. Repairs not covered under this warranty will be made at prevailing shop rates established by Burk Technology.

THE WARRANTY SET FORTH ABOVE IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BURK TECHNOLOGY SHALL NOT BE LIABLE TO ANY PARTY FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF THIS EQUIPMENT.

Section Two
OPERATION

These instructions assume that the ARC-16 has been installed and tested for local operation. If these steps have not been completed, please refer to the ARC-16 Instruction Manual.

Before attempting to operate the ESI, it is necessary to complete the installation and configuration of the unit as outlined in the INSTALLATION section of this manual. If your system is a Stand Alone unit (ARC-16SA) or was purchased with the ESI installed, you may proceed with the following operating instructions after fully familiarizing yourself with the local operation of the ARC-16.

Front Panel Controls

Before attempting a call with the ESI, the following settings must be made on the front of the ARC-16. If the appropriate menus do not appear, it is possible that the setup has not been done using the configuration menu. Refer to the INSTALLATION section for help in performing the setup.

Mode Selection

The ESI may be operated in the answer or call-out mode, or both. Modes are selected by first accessing the appropriate menu using the ‹**MODE**› switch on the front panel.

The mode selections may be made from any connected ARC-16. ESIs at other sites, if installed, are accessed by stepping through the options with the ‹**CHANNEL**› keys.

Call-Out Mode

Press ‹MODE› until the display shows

CALL? YES|NO

then press the ‹RAISE› key to select the call-out mode.

The display will now read

CALL? YES

Note that if you are selecting this mode from a remote site, the display will not change unless and until the site containing the ESI responds to the request.

In the call-out mode, the ESI will begin dialing as soon as an alarm condition is detected. The unit then repeatedly speaks the sign-on message and waits for a valid password entry. If none is received, the next number in the list is dialed. A delay between numbers allows for a possible incoming call during an alarm condition.

When a blank number is encountered, the ESI discontinues the outward dialing. Dialing also ceases if the Call-Out mode is disabled or the alarm stack is cleared from the front panel of the unit where the ESI is installed.

Answer Mode

When the CALL mode is displayed, use the ‹CHANNEL› keys if necessary to obtain the

ANSWER YES|NO

display, then press the ‹RAISE› key to select the answer mode. The display will now read

ANSWER YES

In the answer mode, the ESI will answer after a selected number of rings. A brief answer tone is heard, followed by the sign-on message, which is repeated until a DTMF tone is received from the user. This continues until the unit times out or the password is received.

The answer mode may be disabled by pressing the ‹LOWER› key.

Local Mode

It is not necessary to have CALL or ANSWER set to access the ESI through the local telephone set. Press and hold the <MAINT> key for several seconds. The ESI will respond with a normal sign-on message and expect a password to be entered. Since pressing the <MAINT> key will also cause the unit to toggle into or out of the maintenance mode, it is good practice to first press the <MAINT> key briefly before accessing the ESI. This will cause it to toggle back when the switch is held, leaving the maintenance mode set as it was before.

System Changes

Changing Password

To change either the master or user password, enter the configuration menu as described on page 20, then follow the instructions for password entry.

Tone Selection

To select tone or pulse dialing, enter the configuration menu as described on page 20, then follow the instructions for Tone or Pulse Dialing.

Number of Rings

The number of rings for answering is set during a call. See page 15.

Dial-Up Controls

The following instructions apply once a call has been completed. To complete a call, either call in from a remote telephone (ANSWER=YES) or use the Local Mode described above. You will need to know the master or user password entered during configuration (page 20). At least one telephone number must be entered before the unit will call out on a alarm condition. The master password is required to enter the telephone number.

Password Entry

A valid password response is necessary to proceed with control and metering functions. If editing functions are desired, the master password must be entered. An incorrect password causes the unit to hang up immediately.

The password entered at the beginning of the call determines the mode of operation (master or user) for the duration of the call.

You may enter the password at any time during the sign-on message. When calling into the system, experienced users will begin the password entry before or even during the carrier tone. The sign-on stops at the completion of the first word following receipt of a valid DTMF tone.

If you make a mistake during password entry, continue to enter the remaining digits to force an immediate hangup. This will allow you to redial without waiting for the time-out.

Once a valid password is entered, the unit responds with the alarm status and waits for a command. The unit will remain connected until one of the following events occurs:

–A hang-up command is issued.

–A key is not pressed for a pre-determined period of time.

–The current access mode is disabled from the front panel.

Voice Help

When a key has not been pressed for several seconds, a helpful prompt will be heard. This "voice help" feature is context sensitive, suggesting raise and lower commands after a channel has been reported, etc. A full help menu can be requested at any time by dialing 98.

As timeout approaches, another prompt will ask for a command. A grace period of fifteen seconds permits additional entry, resetting the timeout. The timeout period is also context sensitive, permitting longer delays in modes that typically require a little more time to consider a response. Pressing ‹00› or any other command will reset the timer and allow the call to continue.

Alarm Message

If, during the course of a call, a new alarm occurs, the ESI will announce "Alarm". No action is required for the caller to continue, but it is an indication that he may wish to check the alarm stack.

Error Message

Any attempt to select an invalid site, channel or function will be followed by the word "error". Only sites installed in the system may be accessed, and only channels available at the selected site may be accessed. Channels must be

selected before raise and lower commands may be given and before label editing can be performed.

An error message may also be heard when reading a metering channel if the channel has experienced an over range condition.

Command Entry

All primary commands are two digits in length. The commands are discussed in detail below. (See page 23 for a complete listing of the commands.)

If only one digit of a command is entered, the ESI waits for a few seconds for a second digit, then assumes a two-digit command beginning with zero. E.g. if ‹**5**› is pressed and not followed by another digit promptly, 05 is assumed. This feature conveniently handles the two-digit commands without having to press an "enter" key, and also allows for single-digit entry of the first nine channels.

Channel Selection

Channels for the currently selected site are accessed by entering ‹**01**› through ‹**16**›. When the channel is selected, an announcement is made in the following format:

- [Channel Number] [Site Designation] [Channel Label]
- "equals" [Meter Reading] [Channel Units]

Raise/Lower

To assert the raise output for the selected channel, press ‹**#**›. At the end of the tone, the ESI will respond with "raise".

To assert the lower output for the selected channel, press ‹*****›. The ESI will respond with "lower".

The output will assert at the end of the key press. If you are using a phone which produces a fixed-length tone, the output will be occur for approximately one half second at the end of the tone. If no channel is selected, or if the ARC-16 is in the maintenance mode, an error will be reported.

Repeat

To repeat the current reading, enter ‹**00**›. The ESI will respond with an updated reading, followed by the unit of measurement, e.g. "Seven point two seven five kilovolts".

Status Reporting

A current status report is requested by entering ‹20›. The ESI will respond with a list of all status channels that are currently on, including the user programmed status message for each.

The status report can be abandoned at any time by entering a new command.

Alarm Reporting

Entering ‹30› will cause a current alarm report and allow the user to clear the alarms. Alarms are read from the alarm stack of the unit in which the ESI is installed, and in reverse chronological order, i.e. most recent first.

The alarm stack contains alarms from all connected sites, therefore the alarm report is a comprehensive summary of the last ten alarm events system wide.

The alarm report format varies with the type of alarm. For a status alarm, the report is as follows:

- [Site Designation] "Status Channel"
- [Status Channel Number]
- [User Defined Status Message]

For a high or low limit alarm, the report is as follows:

- "Channel" [Site Designation] [Channel Number]
- [User Defined Channel Label]
- "Is above upper limit | Is below lower limit"

At the conclusion of the alarm report, the ESI responds with "To clear alarms, press pound." You may clear the alarm stack by pressing ‹#›. The ESI will announce that "Alarms are clear." This will also extinguish the alarm light on the front of the ARC-16 where the ESI is installed.

Pressing ‹*› will leave the alarm stack as it was.

The alarm report can also be abandoned and the stack left intact by entering any new command.

Site Selection

The currently selected site can be determined by pressing ‹40›. The ESI responds with the site designation (A, B, C or D) followed by the user defined site label.

A different site may be selected by pressing ‹41›, ‹42›, ‹43› or ‹44› for sites A, B, C, or D, respectively. If the selection is not a valid site, the ESI responds with "error".

Otherwise, the ESI announces the site designation followed by the user defined site label.

All subsequent commands will be addressed to the selected site until another site selection is made.

Limits Monitoring

Entering ‹**50**› will report the state of the limits monitoring function for the site at which the ESI is installed. Entering ‹**51**› turns the limits monitoring on, while ‹**52**› turns the limits monitoring off. These functions are all followed by the report "Limits Monitor is on|off".

Hang-up Command

You may command the ESI to hang up at any time by entering ‹**99**›.

Extend Timeout Command

For certain operations, it may be desirable to have the ESI remain on line, but silent for an extended period of time. Pressing ‹**54**› will extend the timeout to one minute. Entering a new command or just pressing any key will restore the timeout to the normal time.

Audio Monitoring

Audio connected to the phono jack on the rear of the unit may be heard at any time by pressing ‹**55**›. Audio will be heard for thirty seconds. Commands may be entered during audio playback, but the voice is suspended. Audio monitoring may be cancelled by pressing ‹**56**› (effective with ARC 4.5B or above).

Number of Rings

The user may determine the number of rings for which the ESI has been programmed by pressing ‹**60**›. Only the master operator may change the number of rings. If the master password has been entered at the beginning of the call, the number of rings may be set from one to nine by entering ‹**61**› to ‹**69**› respectively. The ESI will respond with the selected number.

Label Editing

The following functions allow the master operator to enter and edit various messages and labels and are only accessible if the master password has been entered.

Sign-On Message

A 16-word sign-on message may be auditioned and/or entered by pressing ‹70›. The existing message, if any, will be spoken.

Select the entry mode by pressing ‹#›. The ESI will respond with "enter".

Now enter a three-digit number corresponding to the word in the vocabulary (page 25). The ESI will recite the selected word.

Continue entering three-digit sequences until the entire phrase is complete. Pressing ‹*› will terminate the entry and the phrase will be spoken again. You may start over at any time by pressing ‹#›.

Channel Labels

For any of the channel label editing functions, you must first select a channel using ‹01› through ‹16›.

Press ‹71› to hear the current label for the currently selected channel. Press ‹#› to edit the label.

A four-word channel label may be entered using the three-digit sequences for each word as described above. After terminating the phrase with the ‹*› key, you may select a new channel to edit. If all four words are entered, the label editing is terminated automatically.

Unit Labels

Unit labels are normally used to assign units of measurement such as " kilovolts" or "milliamps" following the value reported for the channel. A two-word unit label is assigned to each channel and may be heard by first selecting the desired channel, then entering ‹72›. Press ‹#› to edit the label. After terminating the label with the ‹*› key, you may select a new channel to edit. If both words are entered, the label editing is terminated automatically.

Status Labels

Each status channel has a four-word label which is added to the status report any time the status signal is on. The status label should include the appropriate message for the on state. E.g. if status channel one is on whenever transmitter one is on, the label should read "Transmitter one on air" or something similar.

Status labels are accessed by entering ‹73› after selecting the desired channel number. Press ‹#› to edit the label. After terminating the label with the ‹*› key, you may

select a new channel to edit. If all four words are entered, the label editing is terminated automatically.

Site Label

Each selected site may be given an eight-word label by first selecting the site, then entering ‹74›. The label is used to identify the site whenever the site selection commands are used. A typical label might be "WXXX FM Transmitter Site" or "WYYY Studio." Press ‹#› to edit the label. Terminate editing with the ‹*› key.

Number Entry

Up to nine telephone numbers may be entered and retained in memory for use by the call-out feature. Each number may be up to fifteen digits long. The following functions are only available if the master password has been entered.

Number Selection

Each of the nine number locations is accessed by pressing ‹81› through ‹89› respectively. If a number has been previously entered in that location, the ESI will respond by announcing the number. Select another number location if desired, or proceed to enter a new number in that location.

Entering a New Number

Once a location has been selected, press ‹#› to enter a new number in that location. The ESI will respond with "enter". Now enter up to fifteen digits, followed by ‹*›. The ESI will read the new number back to you.

Entering a Pause

(not available if chassis contains AMI-2 option)

A leading O in a location is interpreted as five seconds of delay before dialing the remaining digits. The ESI will see this entry as a contiuation of the previous phone number. Multiple zeros are possible for greater delays and sucessive locations may be cascaded for elaborate dialing sequences. As an example, the following entries will cause the ESI to dial a prefix, wait 5 seconds, dial a paging service, wait 10 more seconds, then enter the digits to be displayed.

81# 9 *

82# 0 1 800 555 5555 *

83# 0 0 123 4567 *

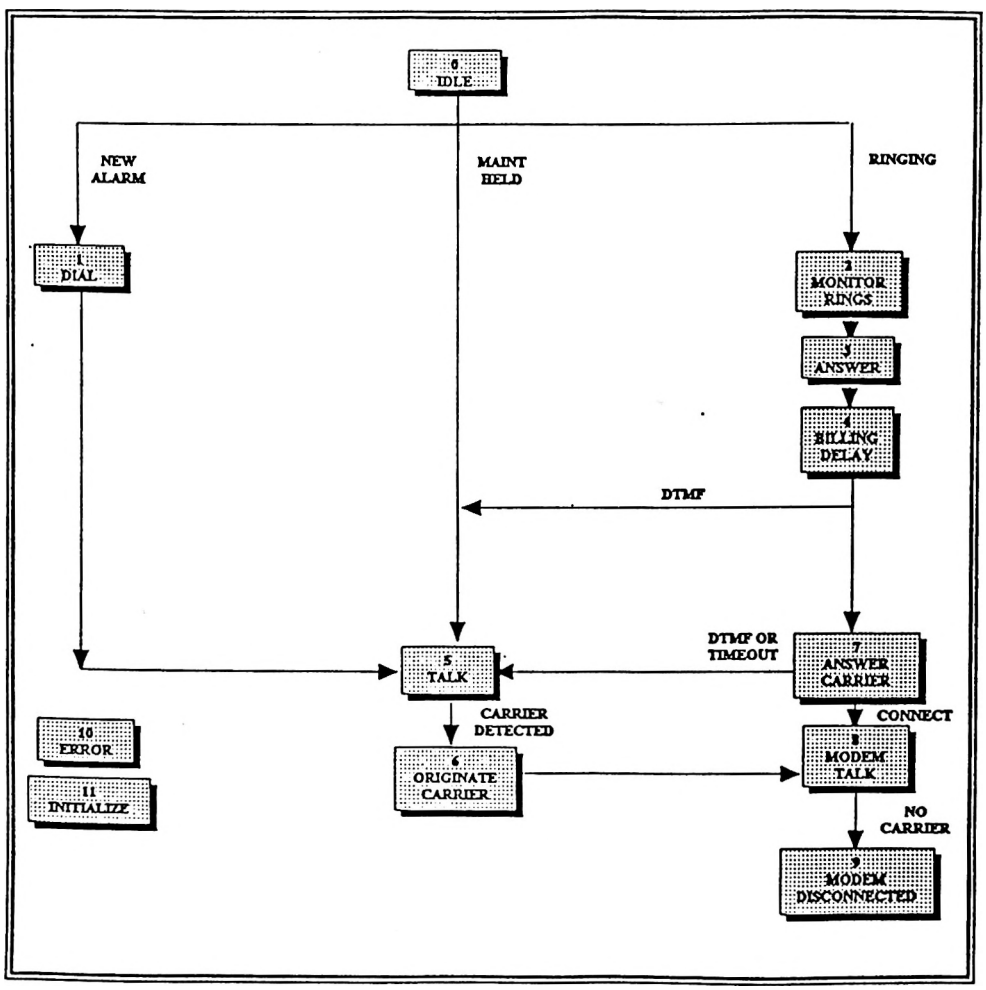
Clearing a Number

An existing number may be removed by entering ‹#*›. This will remove the old number and leave a blank location. Note: The ESI will stop calling when a blank number is encountered. If it is desired to have the ESI call repeatedly until a answer is received, fill all nine numbers.

Diagnostics

The state of the ESI operation can be determined at any time by observing the LED on the rear of the unit. The LED will blink a number of times depending on the current operational state of the board. This provides useful information if the unit does not operate as expected.

The state map shown here will help to visualize the operation of the ESI.



Section Three
INSTALLATION

Installation

An ARC-16 ordered with the ESI or an ARC-16SA (stand-alone), includes a factory installed ESI. Configuration will also be completed, although access to the configuration menu will still be necessary to change the passwords.

Mounting the ESI

If the ESI is provided separately, it will be necessary to install the ESI module in the ARC-16 chassis.

Use the mounting hardware provided to secure the unit above the I/O boards (if present) at the right rear of the chassis. The ESI connects to the header on the AUX board closest to the front of the ARC-16, using the 24-conductor jumper cable provided.

Telephone Connection

An RJ-11 jack marked LINE is provided for the telephone line connection. Use a standard modular cord to connect the ESI. A second RJ-11 marked SET may be connected to a local telephone set.

Although the ESI has transient protection on the board, it is nearly impossible to protect the unit if lightning is allowed to enter the chassis. For this reason, a model TE-RJ transient suppressor installed outside of the rack is strongly recommended. Lightning induced through an unprotected telephone line is the most frequent cause of system failure.

Audio Connection

If desired, connect a source of unbalanced audio to the phono jack on the rear of the ESI. The signal should be one volt rms or less.

Configuration

To reach the configuration menu, it is necessary to remove power from the ARC-16. With the power off, press and hold both the ‹MODE› and ‹CLEAR› switches at the same time and re-apply power. Continue holding the switches for at least one second after power has been restored.

Local ESI Option

Press ‹MODE› until the display shows

CH. 1-8 YES|NO.

Use the ‹CHANNEL› keys to advance the display to

LCL ESI YES|NO.

If the ESI is being installed in this unit, press ‹RAISE› to turn the option on.

If the local ESI option had not previously been set, it will be necessary to power down and re-enter the configuration menus to proceed.

Tone or Pulse Dial

To select tone or pulse dial, enter the configuration menu at the site from which control is desired and press ‹MODE› until the display reaches the option menu.

Use the ‹CHANNEL› keys to advance the display to

DTMF YES|NO.

If the phone circuit recognizes tones, press the ‹RAISE› to turn the option on. If DTMF is set to NO, pulse dialing will be used.

Password Entry

It is recommended that the MASTER Password be kept secure and only used by management and engineering personnel. The USER password should be issued to all duty operators and should be changed regularly.

To enter the master and user passwords, enter the configuration menus as above and press the ‹MODE› switch until the display shows

0000--0000
MASTER USER.

The first four digits are the master password that is required for label and telephone number editing. The second four digits set the user password.

After editing the passwords, press ‹MODE› until the ‹MODE› LED is extinguished.

Configuration for remote sites

To control a remotely installed ESI or DSU, enter the configuration menu at the site from which control is desired and press ‹MODE› until the display reaches the option menu. For the following steps, it will be necessary to determine which site letters refer to ESI or DSU equipped sites. The pointers refer to sites identified as one or two letters above or below the local site. E.g. if this is site A and the ESI is installed at site B, this is referenced as P1. C would be P2.

Press ‹CHANNEL› until the display shows

P 1 DSU YES|NO.

If there is an ESI or DSU installed at the site designated one letter above the local site, press ‹RAISE›. Use the ‹CHANNEL› keys to display

P 2 DSU YES|NO.

Press ‹RAISE› if there is an ESI or DSU at the site designated two letters above the local site.

P 3 DSU YES|NO.

Press ‹RAISE› if there is an ESI or DSU at the site designated one letter below the local site.

Press ‹MODE› until the ‹MODE› LED extinguishes.

This completes the system configuration. Proceed to the operation section.

Section Four

TABLES

Commands

00	Repeat last reading
01-16	Select Channel
#	Raise
*	Lower

20	**Status Report**
30	**Alarm Report**
#	Clear alarms
*	Exit without clearing

40	**Site Selection**
41	Site A
42	Site B
43	Site C
44	Site D

50	**Limits Monitor**
51	Limits On
52	Limits Off
54	Extend Timeout
55	Audio Monitor On
56	Audio Monitor Off (ARC 4.5B or above)

60	Number of Rings

98	**Help**
99	**Hang up**

Master Password Only

61-69	Set Number of Rings 1-9

70	**Sign-on Message**
71	**Channel Label**
72	**Channel Units**
73	**Status Message**
74	**Site Label**
#	Enter new message
*	End entry and play message

81- 89	**Telephone numbers**
#	Enter new number
*	End entry and play number

Vocabulary

00	000	COAX	265	FLOW	284
01	001	COMBINER	266	FM	**124**
02	002	COMMAND	104	FORWARD	285
03	003	COMPOSITE	267	FREEZING	286
04	004	COMPUTER	268	FREQUENCY	287
05	005	CONTACT	105	FRONT	125
06	006	CONTROL	106	FUEL	126
07	007	CONVERTER	269	FURNACE	288
08	008	CURRENT	107	**G**	**071**
09	009	**D**	**068**	GAS	289
10	010	DAY	108	GENERATOR	290
11	011	DECREASE	109	GOODBYE	127
12	012	DEGREE	110	GROUND	291
13	013	DEICER	270	**H**	**072**
14	014	DELAY	271	HEATER	292
15	015	DETECTOR	272	HELLO	128
16	016	DIAL	111	HELP	129
A	**065**	DOOR	273	HERTZ	130
ABOVE	091	DOWN	112	HIGH	131
AIR	092	DRIVE	274	HOT	132
ALARM	093	DUMMY	275	**I**	**073**
AM	094	**E**	**069**	IN	133
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BEAM	262	FAHRENHEIT	121	LIGHT	142
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BUILDING	263	FAN	280	LINE	144
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U	**085**
UNDER	215
UP	216
UTILITY	217
V	**086**
VIDEO	325
VISUAL	326
VOICE	218
VOLTS	219
VSWR	327
W	**087**
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WATER	328
WATTS	222
X	**088**
Y	**089**
Z	**090**
ZONE	329
(PAUSE) 20 ms	059
(PAUSE) 40 ms	060
(PAUSE) 80 ms	061
(PAUSE) 160 ms	062
(PAUSE) 320 ms	063
(PAUSE) 640 ms	064

BDT-115

Wireless Data Transceiver

Instruction Manual

BURK TECHNOLOGY

BDT-115

Wireless Data Transceiver

Instruction Manual

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March 2001

This manual is for use by purchasers and other authorized users of the Burk Technology BDT-115 Wireless Data Transceiver only. No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, or for any purpose without the express written permission of Burk Technology.

Warranty

Your Burk Technology BDT-115 Wireless Data Transceiver is warranted against defects in materials and manufacturing for a period of two years from the date of purchase. In the event of a product failure due to materials or workmanship, Burk Technology will, at its discretion, repair or replace the defective product.

Burk Technology, its suppliers, and its licensors shall in no event be liable for any damages arising from the use of or inability to use this product. This includes business interruption, loss of business information, or other loss which may arise from the use of this product.

Information in this document is subject to change without notice.

The Burk Technology Wireless Data Transceiver is made in the United States of America.

Printed in the United States of America.

FCC Notification

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 and 2) this device must accept any interference received, including interference that may cause undesired operation.

This device must be operated as supplied by Burk Technology. Any changes or modifications made to the device without the express written approval of Burk Technology may void the user's authority to operate the device.

CAUTION: The model numbers DGR09 and DGR-115 have maximum transmitted output power of 955mW and 1 Watt, respectively. It is recommended that the transmit antenna be kept at least 23 cm away from nearby persons to satisfy FCC RF exposure requirements.

Note: *This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Note: Whenever any Burk Technology module is placed inside an enclosure a label ***must*** be placed on the outside of that enclosure which includes the module's FCC ID.

This product is licensed by The United States. Diversion contrary to U.S. law is prohibited.

Shipment or re-export of this product outside of The United States may require authorization by the U.S. Bureau of Export Administration. Please contact Burk Technology for assistance and further information.

Model# DGRO9RFS is suitable for use in Class 1, Division 2, Groups A, B, C, and D or non-hazardous locations only.

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Quick Start

This manual covers the operation of the 900 MHz spread spectrum transceiver from Burk Technology.

When purchased as a pair the Burk Technology Wireless Data Transceivers are shipped from the factory pre-configured to operate together in point-to-point applications. The transceivers are preset for high-speed data communications and to communicate only with each other.

The Transceivers will potentially operate in virtually any environment where RS232 data communications occur. The transceivers function as a 9-pin null modem cable. If the transceiver is to be used in an application where a null modem cable is used (such as communication between two computers), then it can be connected directly. If the transceiver is to be used to replace a straight-through RS232 cable, then a null modem cable must be placed between the transceiver and the DCE instrument to which it is connected.

To establish communications between a pair of Burk Wireless Data Transceivers just received from the factory:

1. Set the baud rate on each transceiver to match the baud rate of the instrument to which it is attached. Please note that when you are setting the transceiver's baud rate you are setting its RS232 data rate, which must match the rate for the instrument to which it is attached. This in turn means that the baud rate does not have to be on the same setting for the two transceivers.
2. Verify that the RS232 connector on the cable supplied will fit the RS232 interface on the instrument to which it is being connected. The cable supplied will fit a 9 pin male RS232 connector; any other format will need an adapter or different cable.
3. Screw the included whip antennas in the modem (DGR-115 model only), ensuring they are snug and properly seated. Any transceiver may be operated without an antenna for bench top testing without concern for damaging the product.
4. Connect the Transceiver to the instrument with the RS232 cable and attach the power adapter to the Transceiver. Shortly after both modems are plugged in they should establish a communications link with each other and your connection is complete!

Note: *The terms Modem and Transceiver are used interchangeably in this manual and in the text of the setup menu. While the words have different meanings, the two terms should be treated as one and the same for the purposes of use of the Burk Technology product.*

Tuning Transceiver Performance

Our transceiver allows you to tune several parameters to optimize its performance for your particular application. All adjustments are done through the setup program, a user interface that eliminates the need for setup diskettes, DIP switch settings, or custom software.

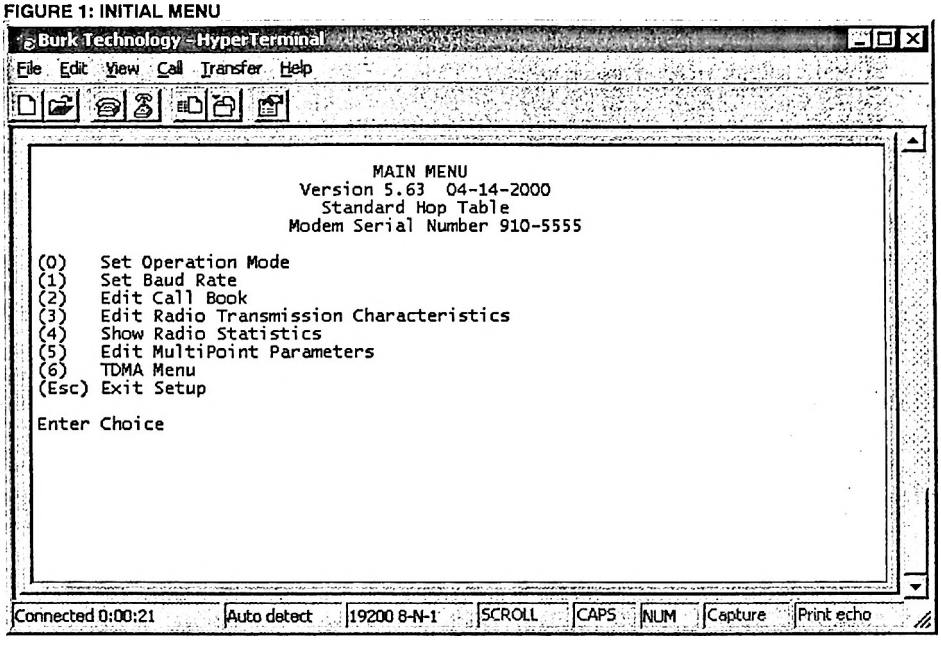
The setup program is invoked by connecting the transceiver to any terminal program, setting the baud rate for that terminal to 19200 baud, and putting the transceiver into setup mode (on most models this is done by pressing the Setup button). While any terminal that can be set to 19200 baud will work, examples for this manual were generated using HyperTerminal for Microsoft Windows.

TABLE 1: SETUP MENU TERMINAL SETTINGS

Parameter	Setting
Baud Rate	19200
Data Bits	8
Parity	None
Stop Bits	1
Parity Check	None / Off
Carrier Detect	None / Off

When the setup program is invoked, all three LEDs on the front panel will turn green and will remain green for the entire time the transceiver is in setup mode. The main menu screen for the setup program is shown in Figure 1:

FIGURE 1: INITIAL MENU

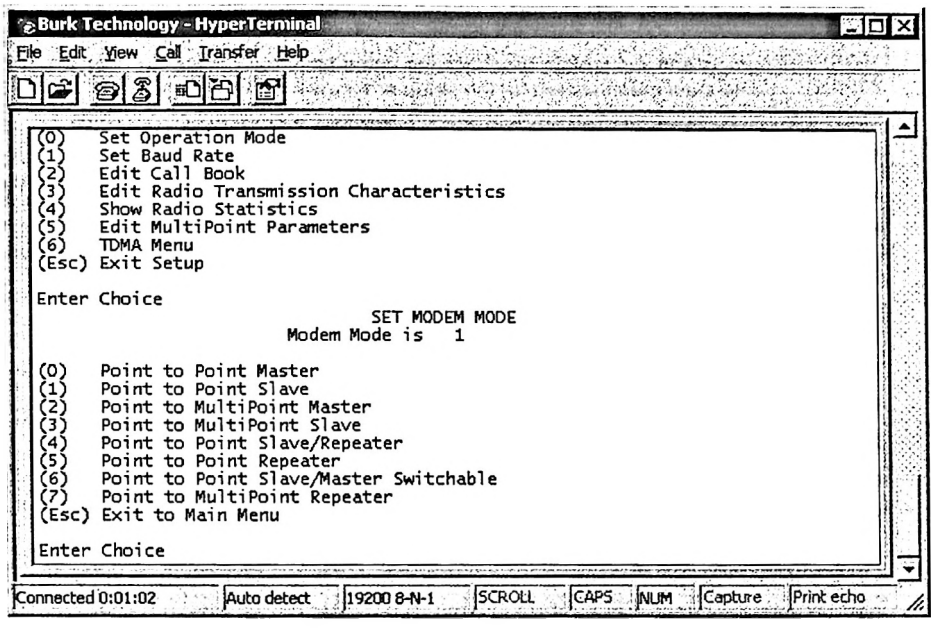


The initial menu provides the transceiver's unique serial number, firmware version, and the set of choices for editing the operational parameters and viewing the performance data.

(0) Set Operation Mode

When item (0) is selected the Operation Mode Menu appears as shown in figure 2. The Operation Mode option is used to designate the method in which the particular transceiver will be used. Our transceivers operate in a Master to Slave configuration; therefore, any transceivers that are intended to operate together must be set up as such. In a point-to-point setup, either the master or slave may be used on either end of the communications link without any performance degradation. One consideration when setting up the transceivers is that a number of parameters are controlled by the settings in the master; therefore, you may wish to deploy the master on the communications end where you will have easier access to the transceiver.

FIGURE 2: OPERATION MODE MENU


Burk Technology - HyperTerminal
File Edit View Call Transfer Help
(0) Set Operation Mode
(1) Set Baud Rate
(2) Edit Call Book
(3) Edit Radio Transmission Characteristics
(4) Show Radio Statistics
(5) Edit MultiPoint Parameters
(6) TDMA Menu
(Esc) Exit Setup
Enter Choice
SET MODEM MODE
Modem Mode is 1
(0) Point to Point Master
(1) Point to Point Slave
(2) Point to MultiPoint Master
(3) Point to MultiPoint Slave
(4) Point to Point Slave/Repeater
(5) Point to Point Repeater
(6) Point to Point Slave/Master Switchable
(7) Point to MultiPoint Repeater
(Esc) Exit to Main Menu
Enter Choice
Connected 0:01:02
Auto detect
19200 8-N-1
SCROLL
CAPS
NUM
Capture
Print echo

Operation Mode Selections

(0) Point-to-Point Master

As mentioned previously, the transceivers operate in a Master/Slave configuration. When designated as a master in point-to-point mode the transceiver will call any or all slaves it is instructed to call in the Call Book. In Point to Point mode the master determines the settings used for most of the Radio Transmission Characteristics, regardless of the settings in the slaves and/or repeaters. The settings for the slave and repeater(s) not determined by the master are RF Xmit Power, Slave Security, and Retry Time Out.

A quick method of identifying a master is to power up the transceiver. Prior to establishing a communication link with a slave or repeater all three of the master's LEDs will be solid red.

(1) Point-to-Point Slave

When set up as a slave, a Burk Wireless Transceiver will communicate with any master in its call book, either directly or through one or two repeaters. When functioning as a slave, the Entry to Call feature in the transceiver's call book is not operational. The slave will communicate with any master on the list that calls.

(2) Point-to-Multipoint Master

The transceiver may be set to run in Multipoint mode, which allows one master to simultaneously be in communication with numerous slaves. A Point-to-Multipoint Master will communicate only with other transceivers designated as Point-to-Multipoint Slaves or Point-to-Multipoint Repeaters.

Please refer to the next chapter 'Multipoint Operation', for more information on running a Multipoint network.

(3) Point-to-Multipoint Slave

Setting (3) allows the transceiver to operate as a slave in a Multipoint network.

Please refer to the next chapter - 'Multipoint Operation' for more information on running a Multipoint network.

(4) Point-to-Point Slave/Repeater

Option 4 allows you to designate the transceiver to act as either a slave or a repeater, depending upon the instructions received from the master for the specific communications session. When a transceiver is placed in an ideal location, this setting offers the flexibility of using that transceiver as an end point in the communication link (slave) or to extend the link to a point further (repeater). These functions are not, however, available simultaneously (the transceiver cannot act as both a slave and a repeater at the same time). This option is available in multipoint operation.

A word of caution: A transceiver designated, as a repeater has no security features, as explained below. When a transceiver is designated as a Point-to-Point Slave/Repeater, it will allow any master to use it as a repeater.

(5) Point-to-Point Repeater

You are allowed the use of up to two repeaters in a communications link, significantly extending the operating range. When designated as a repeater a transceiver behaves as a pass-through link. All settings for the call book, baud rate, and radio transmission characteristics are disabled. A repeater will connect with any master that calls it (repeater must be set up in the master's call book).

The use of one repeater in a communications link will reduce the top data throughput available when compared to a direct master to slave link (generally on the order of 50%). This impact is generally noticed only when using the Transceivers at 115.2 KBaud. The throughput does not decrease further if two repeaters are used.

(6) Point-to-Point Slave/Master Switchable

Mode 6 is a versatile option that allows the transceiver to be controlled entirely through software commands. When in mode 6, a number of key parameters in the transceiver's user interface may be changed either directly (as if using the Windows Terminal program) or through the use of script files. In addition, when the transceiver is in mode 6 and not calling a slave it will be a slave itself and accept any appropriate calls from other transceivers.

In mode 6:

- The transceiver remains in slave mode until called by another transceiver in its Call Book or instructed to call another transceiver through an ATDT command. The master will disconnect when DTR goes low.
- The user may change settings in the user interface without using the setup button (this may be of particular value if the transceiver is not in an easily accessible location).
- Predetermined script files may be used which allow any of the transceiver's settings to be changed upon execution of that file. This, in turn, allows the user to establish push button command sets that will instruct the transceiver to call a predetermined slave.

Note: *All AT commands issued to the transceiver in Mode 6 must be entered in ALL CAPS.*

TABLE 2: AT SCRIPT FILE COMMANDS

Script File Command	Function Controlled
ATXF	Frequency Key
ATXT	Max Packet Size
ATXD	Min Packet Size
ATXX	Transmit Rate
ATXR	RF Data Rate
ATXP	RF Transmit Power
ATDT	Position in Call Book to Call
ATD	Allows specific BDT-115 Serial Number to be entered to call
ATXC_	Used in conjunction with the ATD command, instructs transceivers which repeater path to follow
ATXS	Instructs Transceiver to go into Setup Mode

Using Mode 6 to call a transceiver not listed in the Call Book

Mode 6 will accept the command ATD####### where ####### is any arbitrary modem serial number such as 5551234. Upon receipt of this command the modem will call that modem even though the number is not in the sending modem's Call Book. The modem will use the repeater(s) specified in the Call Book. This means it is now possible to call an unlimited number of slaves through script files in mode 6 and have up to 10 different repeater combinations.

To use the new features the following steps should be followed:

1. If one or two repeaters are to be used they must first be set up in the Call Book. This would be done by setting up a number to call (this may be a dummy number) through the repeater(s) which you wish to use.

2. Issue the command ATXC# where # corresponds to the position in the Call Book where the repeater(s) is/are located.

3. Issue the command ATD####### where ####### is the serial number of the transceiver with which you are attempting a link. The transceiver will link first to the repeater(s) specified and then to the slave transceiver.

4. If you wish to link to a different slave, this time without using a repeater, it is imperative that you reissue the ATXC# command, with # being either a position in the Call Book that contains no repeaters or the letter A. When the command ATXCA is issued the modem is instructed to Call All and no repeaters are used.

The Slave security may be disabled so that a modem operating as a slave (Modes 1,4, and 6) will connect to any modem calling it regardless of whether the calling modem is in the slave's Call Book. This feature is necessary when there are more than 10 transceivers that may call into a slave and will allow any of the units in the system to call in. An entry exists in the Edit Radio Characteristics Menu so that this feature can be enabled or disabled.

(7) Point-to-Multipoint Repeater

Setting (7) allows the transceiver to operate as a repeater in a Multipoint network.

Please refer to the next chapter, 'Multipoint Operation', for more information on running a Multipoint network.

Multipoint Operation

Theory of Operation

In a Multipoint system, a transceiver designated as a master is able to simultaneously be in communication with numerous slaves. In its simplest form, a Multipoint network functions with the master broadcasting its messages to all slaves and slaves responding to the master when given data by the device connected to the RS232 port.

It is important to note the differences between point-to-point and multipoint systems. In a point-to-point system all packets are acknowledged, whether sent from the master to the slave or from the slave to the master. In a multipoint system outbound packets (those sent from the master or repeater out to slaves or other repeaters) are sent a fixed number of times (see Master Packet Repeat). The receiving transceiver (slave or repeater) will accept the first packet received that passes the 32 bit CRC, however the packet is not acknowledged. On the return trip (data going back to the master) all packets sent are acknowledged or retransmitted until they are acknowledged. Therefore, the return link in a multipoint system is generally very robust.

Traditionally, a Multipoint network is used in applications where data is collected from many instruments and reported back to one central site. As such, the architecture of such a system is completely different from point-to-point applications. The theoretical maximum number of slaves that can be configured into a Multipoint network is a function of the data throughput needed from each of the slaves. For example, if the network will be polling slaves once a day to retrieve sparse data, several hundred slaves could be configured to a single master. If, on the other hand, each slave will be transmitting data at greater levels then fewer slaves may be connected to the master (the overall system will be closer to capacity with fewer slaves). The theoretical limit of a Multipoint system is influenced by the following parameters:

1. The size of the blocks of data. The longer the data blocks, the smaller the system capacity.
2. RS232 baud rate.
3. The amount of contention between slaves. Use of repeaters. A single repeater in a Multipoint network will decrease overall system capacity by 50%; more than one repeater does not further decrease network capacity.

Installing Multipoint Systems

When installing multipoint systems it is important that some planning is done up front. Unlike point-to-point systems (where the master will set certain system parameters), a multipoint system requires that many parameters are set consistently on all transceivers in the system. This includes RF data rate, min and max packet size, number of repeaters, and frequency key.

Furthermore, if several independent multipoint systems are to be located in close proximity the planning becomes much more critical. In this scenario it becomes very important to include as much frequency and time diversity as possible through use of different frequency keys, min and max packet sizes, and frequency banks. Please contact Burk Technology if you have any questions about the installation of multipoint systems.

Setting Multipoint Parameters

(0) Number Repeaters

In a Multipoint network it is critical for timing purposes to know whether or not there are repeaters in the network. Any transceiver that is used as a repeater essentially becomes a master to the slaves and other repeaters to which it is communicating. Therefore, the user must identify whether or not the network contains repeaters. This is done by assigning a value in parameter (0), Number Repeaters. The value should be 0 if there are no repeaters in the network and 1 if repeaters are present. This parameter must be set to the same value in all units in a Multipoint network (master, slaves, and repeater(s)).

(1) Master Packet Repeat

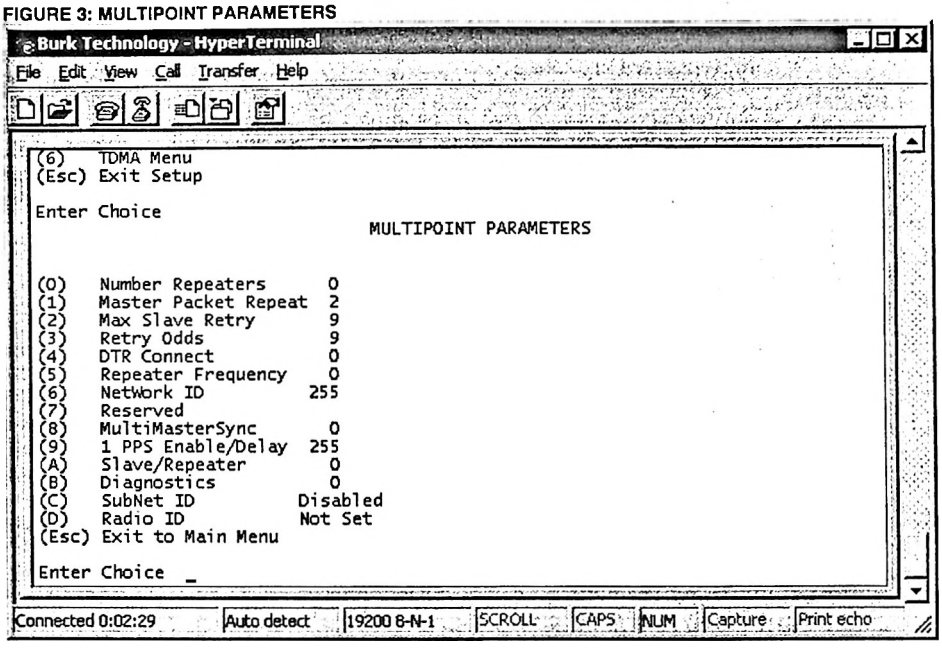
In point-to-point operation the transceivers acknowledge every data packet transmitted. In a Multipoint network, the slaves do not acknowledge transmissions from a master to the slaves. This is to prevent system overload. If the slaves acknowledged all data transmissions from the master in a large Multipoint system, then all system capacity would be spent having the master listen for acknowledgments from the slaves. Because the transmission is not acknowledged by the slaves 100% confidence does not exist that every slave has received every message from the master. To address this issue the user may modify option (1) Master Packet Repeat, assigning a value between 0 (the packet is transmitted once) to 9 (the packet is transmitted 10 times). For networks with solid RF links, this parameter would be set at the lower end of the scale (0-1). If the network has some weak or marginal links it would be set toward the higher values. If a slave receives a good packet from a master more than once it will discard the repeated packets received. In addition, once a multipoint repeater receives a good packet from the master it will discard any of the repeated packets. In turn, the repeater will send the packet out (to the next repeater or to the slaves) the number of times corresponding to *its* Master Packet Repeat setting. For more information on this, see the next section, Master Packet Repeat in Multipoint Systems with Repeaters.

It is important to keep in mind that increasing the master packet repeat will not only increase the probability of a packet getting through, but will also increase latency in the system because each packet from the master or repeater is being sent more often. Therefore it is important to find the optimal mix between system robustness, throughput, and latency. In general a setting of 3 will work well for most systems.

Master Packet Repeat in Multipoint Systems with Repeaters

The Master Packet Repeat parameter must also be set in multipoint repeaters when they are used in a multipoint system. In a multipoint system, a repeater looks like a master to a slave. Therefore, the repeater will send the packet out the number of times corresponding to its Master Packet Repeat parameter. If this parameter is set improperly the reliability of the overall system may be compromised. For example, assume the master's Master Packet Repeat parameter is set to 3 and the link between the master and repeater is robust. Now, assume that the repeater's Master Packet Repeat is set to 0 resulting in marginal communications between the repeater and the slaves it's communicating with. The data between the master and slaves communicating through the repeater will be marginal because it is only as strong as the weakest link, which in this case is the link between the repeater and slaves.

FIGURE 3: MULTIPOINT PARAMETERS



(2) Max Slave Retry

(3) Retry Odds

While packets transmitted from the master to the slaves in a Multipoint network are not acknowledged, packets transmitted from slaves to the master are. However, it is possible that more than one slave will attempt to transmit to the master at the same time, and it is therefore important that a protocol exists to resolve contention for the master between slaves. This is addressed through parameters (2) Max Slave Retry and (3) Retry Odds. The Max Slave Retry setting defines how many times (0 to 9) the slave will attempt to retransmit a packet to the master before beginning to use a back-off algorithm. Once the slave has unsuccessfully attempted to transmit the packet the number of times specified in Max Slave Retry it will attempt to transmit to the master on a random basis. The Retry Odds parameter determines the probability that the slave will attempt to retransmit the packet to the master; a low setting will assign low odds to the slave attempting to transmit and conversely a high setting will assign high odds. An example of how this parameter might be used would be when considering two different slaves in a Multipoint network, one close in with a strong RF link and the other far from the master with a weak link. It may be desirable to assign a higher Retry Odd to the slave with the weaker link to give it a better chance of competing with the closer slave for the master's attention.

(4) DTR Connect

Another parameter in a Multipoint network is (4) DTR Connect. When set at 1 the slave will connect to the master if it is free when the DTR line goes high on the 9 pin RS232 connector. In setting 2, the transceiver will accumulate data in its buffer and transmit in a burst when the buffer is full. This mode is valuable when a

network has many low data rate devices and it is desirable to increase overall network capacity. In setting 0, the transceiver will transmit when the RS232 data is received.

(5) Repeater Frequency

The repeater's hopping pattern must also be set in a Multipoint network; this is accomplished with parameter (5) Repeater Frequency. Setting this parameter is in contrast with point-to-point mode where the repeater automatically uses the master's hopping pattern. The repeater may be programmed to either use the master's hopping pattern (selection 0) or its own (selection 1).

(6) Network ID

Option (6) Network ID allows multipoint networks to be established without the use of the Call Book. If the Network ID is set to any value lower than the default (255) the slaves in the multipoint network will communicate with the first multipoint master or repeater heard with the same Network ID. When the Network ID is used multipoint masters and repeaters may be replaced without reprogramming all of the slaves in the network. In addition, this allows a slave to establish communications with different Masters (though not at the same time) without having the serial numbers in the Call Book. This is very useful in mobile multipoint applications.

(7) MultiMaster Synch

MultiMaster Synch is reserved for applications (either point to point or multipoint) with concentrations of Master units where it is necessary to reduce interference between the Masters. Please contact Burk Technology for more information.

(8) 1 PPS Enable/Delay

The 1 PPS Enable/Delay option allows the radio network to propagate a GPS 1PPS signal from the master transceiver to all slaves in a multipoint network. When this parameter is properly enabled a 1 PPS pulse on the DTR pin of the master will provide a 1 PPS pulse on the CD line of any slave in the network.

To use the 1 PPS Enable/Delay feature, you must follow the the steps below.

1. The 1 PPS Enable/Delay parameter in the master must be set to 0.
2. The master must have a 1 PPS pulse on the DTR pin.
3. The 1 PPS Enable/Delay parameter on the slaves must be enabled. The calibration on the slave is typically factory set. However, the slaves may also be calibrated with the following procedures:
    1. Trigger an oscilloscope on the 1 PPS pulse (from a GPS receiver) on the DTR pin of the master.
    2. Monitor the CD line of the slave.
    3. If the timing on the slave differs from the master it may be adjusted via the value in the slave's 1 PPS Enable/Delay parameter. The difference in time between each incremental integer value is 542.534nS. Changing the parameter to higher values decreases the

slave time delay and changing the parameter to lower values increases the time delay.

When properly calibrated the CD line of a slave radio will output a pulse that goes high for about 2 mS in synch with the 1 PPS pulse on the master radio. The output on the slave will occur within 20 microseconds of the input to the master.

Note: *When 1 PPS is enabled the master* ***must*** *have a 1 PPS pulse on its DTR pin, otherwise the network will not function.*

(9) Slave/Repeater

The Slave/Repeater mode allows a transceiver in a multipoint system to simultaneously act as a slave and a repeater. When in this mode a transceiver will repeat any packets sent from a master as well as send them out the RS232 port. Thus where 2 transceivers would be necessary previously (one to repeat and one to be a slave) only one is now needed.

To operate a transceiver as a multipoint slave/repeater you must set the operation mode to (7) Multipoint Repeater and then enable the slave/repeater option (setting of 1).

(A) Diagnostics

This option, when enabled, provides diagnostics data over a multipoint network simultaneously with the application data. Proper use of diagnostics requires the following:

1. Version 5.62 / 1.62 or later firmware in every transceiver in the network
2. Diagnostics must be enabled on the Master (set to 1)
3. Number of Repeaters must be set to 1 on every transceiver in the network, even if there are no repeaters in the network.
4. A second computer to run the diagnostics software
5. A diagnostics cable (available from Burk Technology)
6. Diagnostics software (available from Burk Technology)

Please contact Burk Technology if you are interested in using the diagnostics feature in your network.

(B) Subnet ID

In a Multipoint Network where the Network ID is used (instead of the Call Book) when a slave is initially powered it will connect with the first Repeater or Master that it hears with the same Network ID. Likewise, a repeater in the network, when initially powered up, will connect to the first master or repeater that it hears with the same Network ID.

In typical applications this approach works very well, however there are scenarios where you want to force communications to follow a specific path. For example, you may want to ensure that two repeaters in the system are communicating in series instead of in parallel, or it may be desirable to force slaves to communicate to specific repeaters for load balancing purposes.

There are two components to the Subnet ID:

1. Rcv Subnet ID. This setting identifies who a repeater or slave will listen to.

2. Xmit Subnet ID. This setting identifies the sub network this device transmits on, and in turn which devices will listen to it. *The Xmit Subnet ID parameter is relevant for Multipoint Repeaters only.*

To disable the Subnet ID, both the Rcv Subnet ID and the Xmit Subnet ID should be set to F.

***Note**: The Subnet ID settings are irrelevant for the Master.*

***Note**: The Master always transmits on Subnet ID=0, regardless of the setting. To force communications directly through the Master the Slave or Repeater's Rcv SubnetID must be set to 0.*

***Note**: The Subnet ID works only in Multipoint Networks using NetworkID.*

***Note**: In typical Multipoint Networks the Freq Key must be at the same setting for all transceivers. If the SubnetID is used the sub network may be set to a different Freq Key.*

***Note**: If both Rcv SubnetID and Xmit SubnetID are set to 0 the SubnetID will show **Roaming** in the menu. This feature has not been enabled at the time of the printing of this manual.*

The drawing below depicts a Multipoint Network in which the Subnet ID is used to force communications along specific paths. In this example Repeater1 *must* talk directly to the Master, and Repeater2 *must* talk directly to Repeater1. Communications for Slaves 1, 2, and 3 are forced along the direction of the solid lines, and Slave4 may link to the first Master or Repeater it hears.

The respective Subnet ID settings are shown in table 3 on the following page.

FIGURE 4: MULTIPOINT SUBNET DIAGRAM

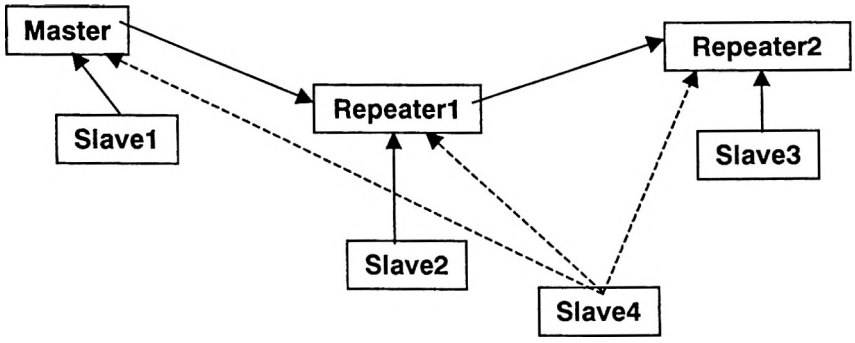


TABLE 3: SUBNET ID SETTINGS

Transceiver	Rcv SubnetID	Xmit SubnetID	Notes
Master	NA	NA	May be set to anything
Repeater1	0	1	0 forces it to link only to the Master
Repeater2	1	2	Rcv SubnetID=1 forces communication through Repeater1 (Repeater1 transmits on SubnetID 1)
Slave1	0	NA	Rcv SubnetID=0 forces

			communication through the Master
Slave2	1	NA	Rcv SubnetID=1 forces communication through Repeater1
Slave3	2	NA	Rcv SubnetID=2 forces communication through Repeater2
Slave4	F	F	Setting of FF allows the Slave to link with the first Master or Repeater it hears with the correct NetworkID

Note: *The specific SubnetID settings in the previous example are arbitrary. Other than using Rcv SubnetID = 0 to listen only to the Master, and Rcv SubnetID and Xmit SubnetID set to FF to listen to the first Master or Repeater, any settings may be used to set the sub networks up.*

(C) Radio ID

Option (D) allows the transceiver to be designated with a user selectable 4-digit number that identifies the transceiver in the diagnostics mode.

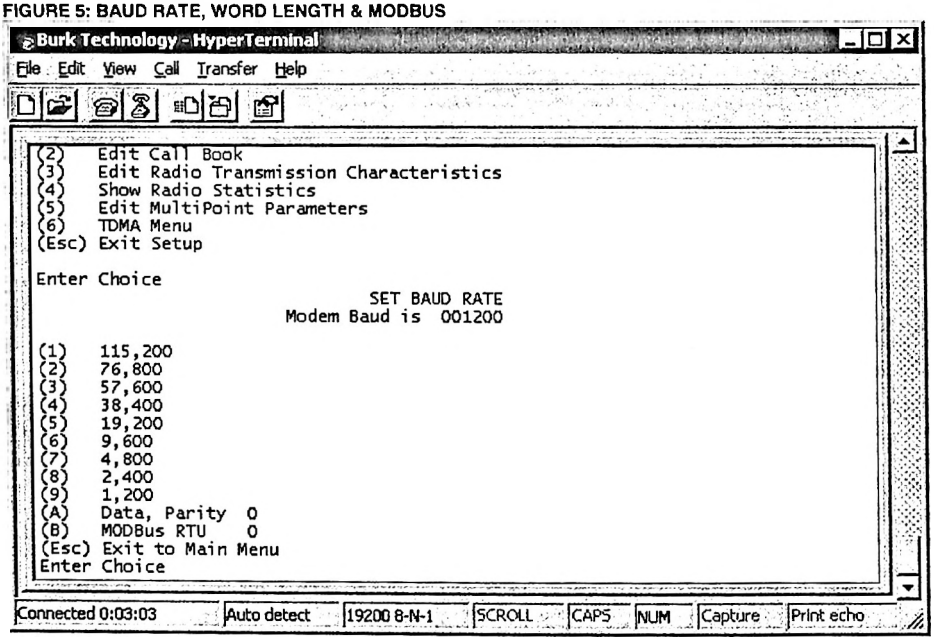
Baud Rate Selections

(1) Set Baud Rate

When item (1) is selected you will be able to change the Transceiver's RS232 baud rate - the communication rate between the Transceiver and the instrument to which it is connected. It is important to note that this is independent of the baud rate for the other Transceiver(s) in the communication loop. For example, the transceiver may be used in an application to send data from remote process instrumentation to an engineer's computer. In this application the baud rate for the Transceiver on the instrumentation might be set to 9600, and the Transceiver on the computer might be set to 57,600 or 115,200.

In general, it is desirable to set the baud rate to the highest level supported by the device to which it is connected. However, please note that this may actually result in slower data communications in certain circumstances (see the Troubleshooting section for more information).

FIGURE 5: BAUD RATE, WORD LENGTH & MODBUS



The Baud Rate section of the user interface provides two other important parameters, the ability to change the transceiver's word length and to put it into ModBus RTU mode.

(2) Data Word Length and Parity

There are six data word length and parity configurations available to be used with the Burk Wireless Transceivers. The default setting is **0** (8,N,1) and is the most commonly used serial communications protocol.

Data word length and parity selections available:

TABLE 4: DATA WORD LENGTH AND PARITY SELECTIONS

Menu Setting	Data Bits	Parity	Stop Bits
0	8	None	1
1	7	Even	1
2	7	Odd	1
3	8	None	2
4	8	Even	1
5	8	Odd	1

(3) ModBus RTU

Support for ModBus RTU protocol is available. The default setting for ModBus RTU is **0** (not enabled).

To enable the ModBus RTU mode:

1. In the **Set Baud Rate** menu enter **(B)** and then select **1**

2. In the **Set Multipoint Parameters** menu, set **Master Packet Repeat** to **3**.

Note: *When using the transceivers in ModBus RTU mode the Master Packet Repeat must be set to 3 regardless of whether the transceivers are being used in Point to Point or Multipoint mode.*

Call Book Selections

The Call Book is an innovative feature that offers both security and flexibility in use. The Call Book accomplishes this by allowing the user to determine with which other Burk Wireless Transceivers a given transceiver will communicate, based on the serial numbers for both the master and slave. The transceiver's serial number is encoded in the microprocessor and identified on the bottom label of the unit. The instructions provided in this section are for point-to-point mode only. Use of the Call Book for Multipoint systems is explained later in this chapter.

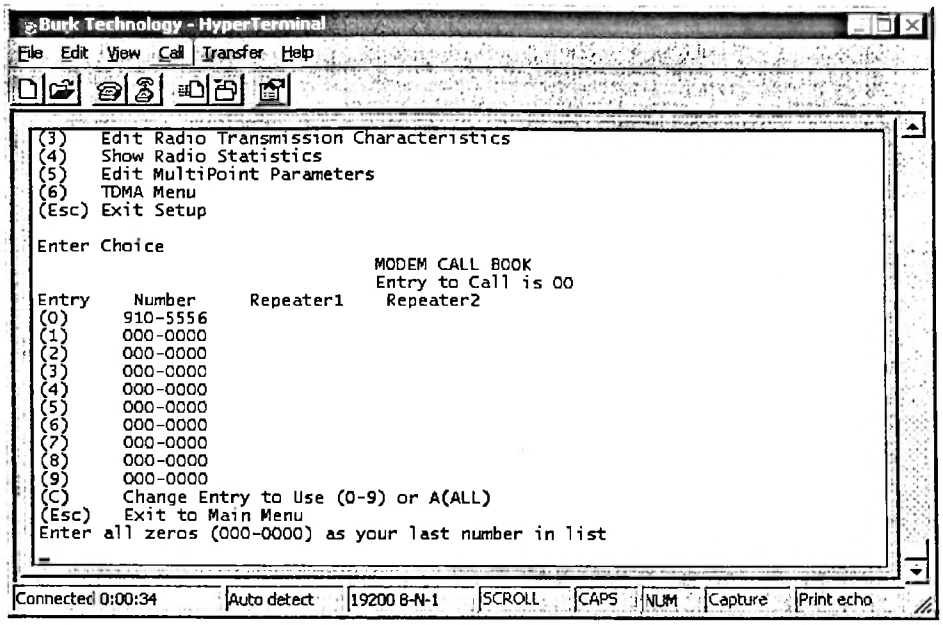
For two transceivers to communicate in point-to-point mode, three events must occur:

1. The serial number for the master must be listed in the slave's Call Book.
2. The serial number for the slave must be listed in the master's Call Book.
3. The master must be programmed to call the slave.

As shown in figure 5, the Call Book allows users to set up a list of up to 10 transceivers with whom they can communicate, designate up to 2 repeaters to be used in communicating with a given transceiver, and tell the master which slave to call. To direct the master to call a slave the user must be in the Call Book Menu. A specific slave may be called by entering C at the prompt, followed by the menu number corresponding to that slave. To call any available slave in the list the user should enter C and then A (for All).

Note: *To call a slave through one or two repeaters you must call that slave directly (as opposed to using the Call All option). When Call All is selected the master is not able to connect with any slaves through repeaters. This is because the master calls every slave in the list when instructed to call all and will connect with the first slave to respond. When calling through a repeater, the master must first call that repeater and establish a communications link with it prior to making contact with the slave.*

FIGURE 6: CALL BOOK MENU



Entering or Modifying numbers in the Call Book

Entering or modifying serial numbers in the Call Book is a straightforward process. When in the Call Book menu enter the position number (0 - 9) you wish to edit. You will be prompted for the new number (formatting is automatic, you do not need to enter the dash). Once the number is entered (unless it is 000-0000) you will be asked for the number for the repeaters to be used. If no repeaters are to be used then enter the escape key; your entry will be complete and you will be back in the Call Book menu screen. If you enter a repeater number you will then be prompted for the number of the second repeater to use. If a second repeater is being used then enter the number at this time, if not then enter the escape key. Once again the modem will retain your entries, as shown in the updated Call Book menu screen.

Important: It is important that the Call Book slots are filled sequentially beginning with 0, the first slot in the book. Serial numbers do not need to be entered in numerical order; however, there must not be any 000-0000 numbers in the middle of the list of good serial numbers. The reason for this is that when a master is instructed to Call All available slaves it will call all slaves listed until it reaches the first phone number of 000-0000. If a valid serial number is entered after the all zero number, it will not be recognized as a valid number to call by the master.

Programming The Call Book in Multipoint Systems

In a Multipoint system the slaves and repeaters are not listed in the master's Call Book. When establishing such a system, it is necessary only to have the master's serial number in each slave's and repeater's Call Book, and to have each repeater's serial number in the Call Book of each slave which may potentially communicate through it.

The following example shows the Call Books of a multipoint system comprised of a master, repeater, and slave in which the slave can communicate either through the repeater or directly to the master:

Multipoint Master Call Book (Unit Serial Number 555-0001)

Entry	Number	Repeater1	Repeater2
(0)	000-0000		
(1)	000-0000		

No serial number entries are necessary in the master's Call Book
The master's Call Book may be programmed to call any entry

Multipoint Repeater Call Book (Unit Serial Number 555-0002)

Entry	Number	Repeater1	Repeater2
(0)	555-0001		
(1)	000-0000		

Multipoint Slave Call Book (Unit Serial Number 555-0003)

Entry	Number	Repeater1	Repeater2
(0)	555-0001		
(1)	555-0002		
(2)	000-0000		

At times it may be desirable to force a slave to go through a specific multipoint repeater. If this is the case that slave's Call Book should contain only the serial number for the repeater in the upper left hand corner.

Note: *If the network ID option is used no entries are needed in the Call Book of any of the transceivers in a multipoint system.*

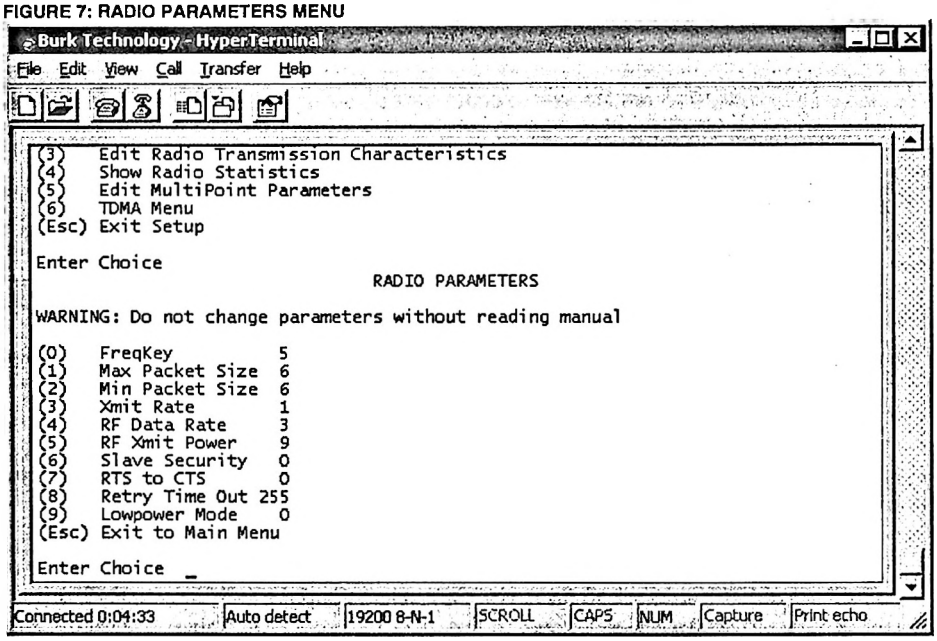
Radio Transmission Parameters

Edit Radio Transmission Characteristics

When item (3) is selected in the main menu, the radio parameters menu (shown below) appears and allows the user to modify the radio transmission characteristics of the transceivers. As stated in the warning, these parameters are for the sophisticated user who has a good understanding of the principles of radio data transmission. They should be changed only after consulting this manual. These parameters are listed on the following pages.

In a point-to-point mode the radio parameters set in the Master will override the settings for the slave and repeater(s) in the link for all but RF Xmit Power, Slave Security, and Retry Time Out.

FIGURE 7: RADIO PARAMETERS MENU



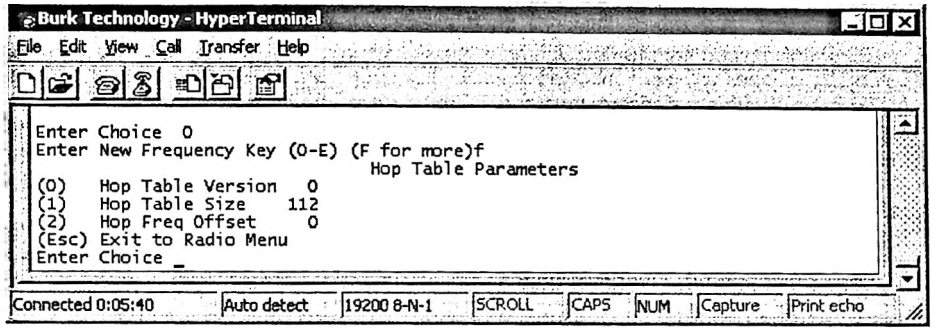
(0) FreqKey

Selection (0) in the Radio Parameters menu allows the user to modify the hopping patterns of the transceivers to minimize the interference with other Burk Wireless Transceivers in operation in the area. For instance, if there were 10 pairs of transceivers in operation within a factory or refinery, changing the Frequency Key would ensure that they would not jump onto the same frequencies at the same time for the same length of time.

There are 15 choices available for the Frequency Key (0-9 and A-E), representing 15 different pseudo-random patterns.

A selection of F provides additional options to use different portions of the 902-928 MHz band.

FIGURE 8: HOP TABLE PARAMETERS



Hop Table Version

Entry 0 allows the user to choose the portion of the band in which the transceiver will operate. These choices are show in the table below:

TABLE 5: 900MHZ FREQUENCY BANDS

Selection	Name	Band
0	Standard	Full 902-928 MHz
1	Australia	915-928 MHz
2	International	902-928 MHz, 16 fewer frequencies than full US set
3	Taiwan	916-920 MHz
4	New Zealand	921-928 MHz
5	Notch	902-928 with center frequencies of 911-919 notched out
6	Brazil	902-915 MHz

Note: *Do NOT use Freq Key 14 (D) with the Australia (915-928MHz) hop table*

Hop Table Size

Within a specified band you may select the number of frequencies to be used, ranging from 50 to 112.

Hop Freq Offset

The Hop Freq Offset option is not functional in the 900 MHz spread spectrum transceiver.

Note: *Irrespective of the Freq Key used, all transceivers in either point to point or point to multipoint networks must be set to identical Hop Tables and Table Size (number of frequencies).*

(1) Max Packet Size and (2) Min Packet Size

Selections (1) and (2) allow the user to designate the size of the packets (in bytes) used by the transceiver in its communication link. This may be of particular

value when using the transceiver with different communications software packages; you may find that throughput is optimized when packet sizes are restricted by the transceiver. It should be noted, however, that in Point to Point modes the Max and Min Packet Settings will not have any material impact on throughput unless 115.2 KBaud is desired.

The combination of Max and Min Packet Size Settings determines the allocation of the communication link from the Master to the Slave and vice versa. With a given Max Packet Setting the master will transmit up to that number of bytes on every hop. If fewer than that number of bytes is transmitted the balance is allocated to the slave's transmission, in addition to the quantity in the Min Packet Size Setting.

Packet size is determined by a combination of the setting entered by the user and the RF Data Rate. Tables 6, 7 and 8 provide the packet sizes for each different combination of settings.

TABLE 6: MIN PACKET SIZE SETTINGS (BYTES)

Setting	Min Packet Size RF Data Rate = 2	Setting	Min Packet Size RF Data Rate = 3
0	16	0	8
1	21	1	12
2	26	2	16
3	32	3	20
4	37	4	24
5	42	5	28
6	48	6	32
7	53	7	36
8	58	8	40
9	64	9	44

TABLE 7: MAX PACKET SIZE SETTINGS (BYTES) RF DATA RATE=2

Min Setting	Max Setting 0	1	2	3	4	5	6	7	8	9
0	15	36	58	79	100	121	143	164	185	206
1	20	42	63	84	105	127	148	169	190	212
2	26	47	68	90	111	132	153	175	196	217
3	31	52	74	95	116	137	159	180	201	222
4	36	58	79	100	121	143	164	185	206	228
5	42	63	84	105	127	148	169	190	212	233
6	47	68	90	111	132	153	175	196	217	238
7	52	74	95	116	137	159	180	201	222	244
8	58	79	100	121	143	164	185	206	228	249
9	63	84	95	127	148	169	190	212	233	254

TABLE 8: MAX PACKET SIZE SETTINGS (BYTES) RF DATA RATE=3

Min Setting	Max Setting 0	1	2	3	4	5	6	7	8	9
0	8	24	40	56	72	88	104	120	136	152
1	12	28	44	60	76	92	108	124	140	156
2	16	32	48	64	80	96	112	128	144	160
3	20	36	52	68	84	100	116	132	148	164
4	24	40	56	72	88	104	120	136	152	168
5	28	44	60	76	92	108	124	140	156	172
6	32	48	64	80	96	112	128	144	160	176
7	36	52	68	84	100	116	132	148	164	180
8	40	56	72	88	104	120	136	152	168	184
9	44	60	76	92	108	124	140	156	172	188

(3) Xmit Rate

There are two settings for the Transmit Rate parameter. For normal operation, the transceiver should be set at Transmit Rate 1. Transmit Rate 0 is useful to qualitatively gauge signal strength. When set to Transmit Rate 0 the Transceivers will transmit data back and forth continuously, and the strength of the signal may be gauged by the Clear to Send LED. A solid red clear to send LED indicates a strong signal, the less the LED is on the weaker the signal.

Because the Transceivers transmit continuously when Transmit Rate is set to 0 (whether or not they have data to send) they use radio frequency spectrum unnecessarily. Therefore, Transmit Rate 0 should be used only as a diagnostic tool and not for normal operation.

(4) RF Data Rate

The transceiver has two settings for the RF Data Rate (not to be confused with the RS232 Baud Rate). Setting 2 should be used when the transceivers are close

together and data throughput is to be optimized. Setting 2 must also be used when full throughput of 115.2 KBaud is necessary. Setting 3 should be used when the transceivers are farther away and a solid data link is preferred over data throughput.

Note: *When using the transceivers in Multipoint mode, the RF Data Rate setting must be identical for all units in the system. Any transceiver with an RF Data Rate different from the master will not establish a communication link.*

(5) RF Xmit Power

You have the ability to modify the Transmission Power of the Transceiver. By reducing the Transmission Power when appropriate, users can ensure the Transceivers do not overwhelm each other when used in close proximity. There are 9 power settings available (1-9) which are roughly linear, therefore a setting of 9 is full power or 1 Watt and 1 is ~10% power or 100 mW. The following guidelines should be followed when setting the RF Transmission Power:

TABLE 9: POWER TRANSMIT SETTINGS

Setting	Power Level	Used When
1 - 3	Low	Pair or pairs of transceivers operating within same or adjoining rooms.
4 - 6	Medium	More than one pair of modems operating within same facility.
7 - 9	Full	Normal operation extending beyond a facility.

(6) Slave Security

With option 6 the user may disable the transceiver's security so it will accept a call from any other BDT-115 transceiver. The default setting is 0 where security is enforced (the caller's serial number must be in the slave's Call Book), with a setting of 1 security is disabled.

As mentioned in mode 6, Slave Security must be set to one when the unit is operating in a point-to-point system where it may need to accept calls from more than 10 different Burk Wireless Transceivers. However, it is important to note that when Slave Security is set to 1 the Transceiver will accept calls from any other BDT-115 Transceiver, and additional system security measures should be taken to prevent unauthorized access.

(7) RTS to CTS

Menu selection 7 in the Radio Parameters provides the option of allowing the RTS line (pin 7) on the Master modem to control the CTS line (pin 8) of the Slave. This pass-through control can be enabled in point-to-point mode as well as point-to-multipoint. In the latter the Master RTS line will control all Slaves' CTS lines. When this mode is enabled the CTS line ceases to function as flow control. Therefore it is not recommended to enable this feature when operating at RS-232 speeds above 38.4 kB.

To enable this mode, enter 7 in the Radio Parameters menu. An entry of 1 will enable the RTS-CTS control, 0 will disable it.

Just before the time the Master is scheduled to transmit a packet, it will sense the state of the RTS line. If the state has changed, the Master will then transmit a message to the Slave with the new status. This transmission will occur regardless of data to be sent or not. In the former case, the RTS status message will be sent in addition to the data. In point-to-point mode the Master will continue sending the new status message until it receives an acknowledgment from the Slave. In point-to-multipoint mode the Master will repeat the message the number of times equal to the Master Packet Repeat number in the Multipoint Setup menu.

Because the Master transmit time is completely asynchronous to the occurrence of any change of the RTS line, the latency time from RTS to CTS is variable. The maximum time, however, is determined by the frequency of Master transmission times. This frequency is determined by the Maximum Packet Size and Minimum Packet Size parameters in the Radio Parameter menu. Setting both parameters to their maximum of 9 and 9 will produce a maximum latency time of approximately 25 mS. At their minimum numbers the time will be approximately 10 mS. Please note that this latency can go up significantly if packets are lost between the Master and Slave. In point-to-multipoint mode, there is no absolute guarantee that the state change will be communicated to all Slaves in the unlikely event that all repeated packets from the master do not get through to all the Slaves.

Note: *The RTS to CTS mode does not function in point to point links that contain a repeater. If this feature is needed in a link with a repeater you should use it in conjunction with point to multipoint mode.*

(8) Retry Time Out

The Retry Time Out parameter allows the user to determine when a slave will drop a connection to a master or repeater in multipoint mode. The default setting is 255, meaning that if one packet in 255 from the master is sent successfully to the slave it will maintain a link. The lowest setting is 8, at which a slave will drop a connection much more quickly.

The Retry Time Out parameter is useful when a multipoint system is used with a moving master or slaves. As the link gets weaker, a lower setting will allow a transceiver to drop a link and search for a stronger connection.

While intended primarily for multipoint systems, the Retry Time Out parameter may also be modified in point to point systems. In point to point mode the Retry Time Out should not be set to a value of less than 151.

(9) Lowpower Mode

The Lowpower Mode is an option that, when enabled, allows the transceiver to function as a multipoint slave while consuming less power.

With a setting of 1 Lowpower Mode saves current consumption primarily by dimming the transceiver's LEDs. When set to higher values (2 through 63) the transceiver will sleep between slots. For example, at a setting of 2 the transceiver sleeps 1 out of 2 slots, at a setting of 3 the transceiver sleeps 2 out of 3 slots, and so on.

Note: *1) The Lowpower Mode is for use only in point to multipoint systems, and only on the multipoint slaves. The power savings occur when the option is*

enabled and the slave is connected to the master or a repeater. There are no power consumption savings when the slave is transmitting data back to the master. Designed primarily for SCADA systems, the Lowpower Mode is of little value when significant amounts of data need to be sent from slave to master.

2) Additional power savings may be realized when the number of repeaters is set to 1 throughout the network, even if no repeaters are being used. This is shown in the following table in the Draw1 column, the Draw0 column shows power draw with a setting of 0 repeaters.

3) Because the Lowpower mode puts the transceiver to sleep, a latency will be introduced before it becomes fully linked to the master. This latency can range from 20 to 200 milliseconds.

4) To communicate to the RS232 port of a transceiver that is in Lowpower Mode the RTS line must be held high to wake it up. The transceiver will wake up within approximately 20 milliseconds or when CTS goes high.

5) If the RTS line on the slave is held high the transceiver will remain in normal operation regardless of the Lowpower Mode setting. Once RTS is dropped it will go back into the lowpower mode that corresponds to its setting.

The following table provides the power consumption figures for a 12-volt RS232 transceiver at different Lowpower Mode settings.

TABLE 10: LOW POWER SETTINGS

Setting	Description	Draw0	Draw1
0	Lowpower disabled	70mA	63mA
1	LEDs dimmed	40mA	33mA
2	LEDs dimmed, transceiver sleeps every other slot	35mA	30mA
3	LEDs dimmed, transceiver sleeps 2 of 3 slots	32mA	29mA
4-63	LEDs dimmed, transceiver sleeps number of slots corresponding to setting. For example, with a setting of 63 the transceiver is sleeping during 62 of the slots.	30-26	28-26

Radio Statistics

Option (4) in the main menu allows the user to view the data transmission statistics that have been gathered by the transceiver during the most recent session. This is important when the user wishes to look at signal strength, noise levels, bytes transmitted, bytes received, and the distance of the link between transceivers. Statistics are gathered during each data link and are reset when the next data link begins.

Ideally, noise levels should be below 30, and the difference between the average signal level and average noise level should be 15 or more. High noise levels tend to indicate other sources of RF interference, while low signal levels indicate a weak link. The following sections provide information useful to the process of troubleshooting and improving radio links.

Average Noise Level

The average noise level indicates the level of background noise and interference at the measurement site. The number is an average of the noise levels measured at each frequency in the modems' frequency hop table. The individual measurement values at each frequency hop channel are shown in the frequency table. The frequency table is accessed by pressing the ENTER key on the computer when the radio statistics menu is displayed.

Average noise levels will typically fall in the range of 15 to 30. Average noise levels significantly higher than this are an indication of a high level of interference that may degrade the performance of the link. High noise levels can often be improved with bandpass filters, antenna placement or antenna polarization. Please contact Burk Technology for more information.

Average Signal Level

The average signal level indicates the level of received signal at the measurement site. The signal source is the slave modem, or if the link includes repeaters, the closest repeater to the measurement site. The number is an average of the received signal levels measured at each frequency in the modem's frequency hop table. The individual measurement values at each frequency hop channel are shown in the frequency table. The frequency table is accessed by pressing the ENTER key on the computer when the radio statistics menu is displayed.

For a reliable link, the average signal level should be at least 15 higher than the average noise level reading. Table 11 provides an approximate conversion of average signal level values into the more common dBm (decibel milliwatts).

TABLE 11: CONVERSION OF AVERAGE NOISE LEVEL TO DBM

Average Signal Level	41	49	60	66	85
Level in dBm	-110	-100	-90	-80	-70

Low Average Signal Levels can often be corrected with higher gain antennas, antenna placement, and use of repeaters or use of antenna amplifiers. Contact Burk Technology for more information.

Overall Rcv Rate (%)

The Overall Rcv Rate measures the percentage of data packets that were successfully transmitted from master to the slave on the first attempt without requiring retransmission. A number of 75 or higher indicates a robust link that will provide very good performance even at high data transmission rates. A number of 25 or lower indicates a weak or marginal link that will provide lower data throughput. An Overall Rcv Rate of 100% will provide approximately 100 Kbaud of bandwidth with an RF data rate of 3 (Radio Transmission Parameters Menu) and approximately 150 Kbaud of bandwidth with an RF Data Rate of 2. These numbers are reduced approximately 50% if there are one or more repeaters in the network.

Number of Disconnects

If, during the course of performing a link test, the link between the master and the slave is broken, and the radios lose carrier detect, the occurrence is recorded in the Number of Disconnects value. The value indicates the total number of disconnects that have occurred from the time the link test started until the radio was put into reset mode. Under normal operating conditions, the number of disconnects should be 0. One or more disconnects may indicate a very weak link, the presence of severe interference problems or loss of dc power to any of the radios in the link.

Radio Temperature

The radio temperature value is the current operating temperature of the radio in degrees C (Celsius.) For proper operation, the Burk Wireless Transceivers must be in the range of –40° to 75°C.

Transceiver Location

Placement of your unit is likely to have a significant impact on its performance. In general, the rule of thumb with the transceivers is that the higher the placement of the antenna the better the communication link. Height is everything! In practice you should also place the transceiver away from computers, telephones, answering machines, and other similar equipment. The included 6-foot RS232 cable should provide you with ample room for placement away from other equipment. To improve your data link, optional directional and omni-directional antennas are available with cable lengths ranging from 3 to 200 feet. *Please contact Burk Technology for more information on available antennas.*

When using an external antenna, placement of that antenna is critical to a solid data link. Other antennas in close proximity are a potential source of interference; use the Radio Statistics to help identify potential problems. It is also possible that slight adjustments in antenna placement (as little as 2 feet) will solve noise problems. In extreme cases, such as when the transceiver is located close to Pager or Cellular Telephone transmission towers, the transceiver offers a band pass filter to reduce the out of band noise.

The standard enclosure for the BDT-115 does not provide protection against water or environmental hazards, and will fade when placed in direct sunlight.

Front Panel LEDs

The LEDs on transceiver's front panel provide important information on the operation of the transceiver. Compare the status of a transceiver's LEDs with the table below to aid you in the troubleshooting process.

TABLE 12: LED STATUS IN POINT-TO-POINT MODE

Point-to-Point Communications

Condition	Master			Slave			Repeater		
	CD	TR	CTS	CD	TR	CTS	CD	TR	CTS
Powered, disconnected	SR	SR	SR	SR	O	BR	SR	O	BR
Connected, no repeater, sending sparse data	SG	IF	IF	SG	IF	IF			
Master calling slave through repeater	SR	SD	SR	SR	O	BR	SR	O	BR
Master connected to repeater, not to slave	FO	SD	SR	SR	O	BR	SR	SD	SR
Repeater connected to slave	SG	IF	IF	SG	IF	IF	SG	IF	IF
Mode 6, disconnected	SR	O	BR	SR	O	BR			
Setup Mode	SG	SG	SG	SG	SG	SG	SG	SG	SG

Legend:

R	Blinking Red
FO	Flashing Orange
IF	Intermittent Flash Red
O	Off
SD	Solid Red, Dim
SG	Solid Green
SR	Solid Red, Bright

LED:

CD	Carrier Detect LED
CTS	Clear to Send LED
TR	Transmit LED

TABLE 13: LED STATUS IN MULTIPOINT MODE

Multipoint Communications

Condition	Master			Slave			Repeater		
	CD	TR	CTS	CD	TR	CTS	CD	TR	CTS
Powered, disconnected	SR	SD	O	SR	O	BR	SR	O	BR
Repeater and slave connected to master, no data	SR	SD	O	SG	O	SR*	SG	SD	SR*
Repeater & slave connected to master, master sending data to slave	SR	SD	O	SG	O	SR*	SG	SD	SR*
Repeater & slave connected to master, slave sending data to master	SG-SR	SD	IF	SG	IF	SR*	SG	SR	SR*

*CTS will be Solid Red with a solid link, as the link weakens the CTS light on the repeater and slave will begin to flash.

Legend:

BR	Blinking Red
FO	Flashing Orange
IF	Intermittent Flash Red
O	Off
SD	Solid Red, Dim
SG	Solid Green
SR	Solid Red, Bright

LED:

CD	Carrier Detect LED
CTS	Clear to Send LED
TR	Transmit LED

Using an External Antenna

The BDT-115 transceivers are equipped with an external jack allowing the use of a directional Yagi or omni-directional antenna. When using an external antenna, the whip antenna on the BDT-115 must be removed.

The use of an external antenna may radically improve the results obtained with Burk Wireless Transceivers. It is highly desirable to obtain line of sight with the antennas, and changes in placement height of as few as a couple of feet may make the difference between no link and one that is solid and reliable.

Per FCC regulations, Burk Technology must provide any antenna used with a Burk Wireless Transceiver. Burk Technology offers a variety of omni-directional and directional external antennas, with both bracket and magnetic mounts. These antennas allow versatility in the transceiver's deployment, extending its range and allowing it to get around obstructions. Any Burk Wireless Transceiver that includes a standard RF connector is for professional installation only, and the professional installer must ensure frequency emission limits are not exceeded.

If external directional antennas are used, FCC regulations concerning effective radiated power limitations must be followed. Table 14 provides the maximum output power settings for a 955 mW 900MHz transceiver given antenna gain and cable loss combinations.

TABLE 14: OUTPUT POWER SETTINGS AT GIVEN ANTENNA GAIN & CABLE LOSS

		Cable Loss			
		1dB	2dB	3dB	4dB
Antenna Gain	10dB	5	6	7	9
	8dB	8	9	9	9
	6dB	9	9	9	9

TABLE 15: EIRP FOR 10DB YAGI ANTENNA, CABLE LOSS VS RF XMIT POWER SETTING

		Cable Loss			
		1dB	2dB	3dB	4dB
RF Xmit Power	9	38.80	37.80	36.80	35.80
	8	38.50	37.50	36.50	35.50
	7	37.75	36.75	35.75	34.75
	6	36.40	35.40	34.40	33.40
	5	34.44	33.44	32.44	31.44

Note: *Shaded area indicates combinations where EIRP limitations exceed FCC regulations and RF Xmit Power must be reduced.*

WARNING: Any antennas placed outdoors must be properly grounded. Use extreme caution when installing antennas and follow all instructions included with the antennas.

The use of external antennas subjects the transceiver to greater exposure to direct lightning strikes.

Long RS232 cable runs should also be avoided in areas with increased lightning activity or static electricity unless they are properly isolated from the transceiver. Nearby lightning strikes or elevated levels of static electricity may lead to voltage spikes on the line, causing failure in the transceiver's RS232 interface.

Please call Burk Technology for information on antennas approved for use with Burk Wireless Transceivers.

Antenna Alignment

Burk Wireless Transceivers have a convenient, built-in tool that simplifies the task of aligning directional antennas. This tool is particularly useful when the antenna on either end is not visible from the other end due to distance or obstructions. To use this feature, the modems must be configured for point-to-point operation.

Setup procedure:

1. Program the modem operation mode (menu 0) for point-to-point operation, i.e., program one modem as a point-to-point master and one modem as a point-to-point slave. This procedure may also be used with intermediate repeaters. If intermediate repeaters are used, program the modem(s) to be used as repeaters for point-to-point repeater operation.

2. Program each modem's call book (menu 2) as necessary for point-to-point communications.

3. On the modem you have programmed as the point-to-point master, set the Xmit Rate parameter on the Radio Transmission Parameters menu (menu 3, item 3) to 0.

4. When the modems are returned to operation, the master modem will transmit a continuous stream of high-speed data. The slave modem sends acknowledgements for each of the data packets received from the master. The CTS LED on either the slave or the master provides and indication of the quality of the link. A solid indication on the CTS LED indicates a strong link with minimum packet retransmissions. A flickering indication on the CTS LED indicates a weaker link with a higher percentage of packet retransmissions. While observing the CTS LED display, adjust the alignment of the directional antenna for the most solid indication.

5. After the antennas have been aligned for optimum performance, restore the Xmit Rate parameter on the master radio to 1 for normal operation.

Point to multipoint procedure

Following the above procedure, each individual slave/master link in a multipoint network can be aligned. After all links have been aligned, all modems in the network are programmed for multipoint operation.

RS232 Pin Assignments

TABLE 16: RS232 PIN ASSIGNMENTS

Pin	Assignment	Signal
1	Carrier Detect	Output
2	Transmit Data	Output
3	Receive Data	Input
4	DTR	Input
5	Ground	
6	Data Set Ready	Output
7	RTS	Input
8	Clear to Send	Output
9	Ground	

Definitions:

Pin 1: Carrier Detect (CD) — Used to show that there is an RF connection between modems.

Pin 2: Transmit Data (TX) — This is used to transmit data bits serially from the modem to the system device connected to the modem.

Pin 3: Receive Data (RX) — This is used to receive data bits serially from the system device to the modem device connected to the modem.

Pin 4: Data Terminal Ready (DTR) — The modem only uses this line in Point-to-Point Slave/Master switchable mode (refer to Operation Mode Selections) or for DTR Connect (refer to Multipoint Operation).

Pin 5: Ground (GND) — Signal return for all signal lines shared with Pin 9.

Pin 6: Data Set Ready (DSR) — Always high when the radio is powered from the 2.5mm power connector. Indicated power is on to the radio. Also, this pin can be used for +12Volts when powering the modem directly through the RS-232 port. Note: This is not used on the OEM module.

Pin 7: Request to Send (RTS) — The modem does not recognize RTS for flow control. RTS is used as a control line in RTS/CTS mode (refer to Radio Transmission Parameters).

Pin 8: Clear to Send (CTS)	This signal is used to tell the system device connected to the modem that the modem is ready to receive data. When asserted, the modem will accept data, when de-asserted, the modem will not accept data. This should always be used for data rates above 38.4KB or there will be a risk of lost data if an RF link is not very robust.
Pin 9: Ground (GND)	Signal return for all signal lines shared with Pin 5.

Data Communications Settings

The device to which the transceiver is connected should be configured to match the settings shown below.

TABLE 17: DATA COMMUNICATION SETTINGS

Parameter	Setting
Baud Rate	Match to BDT-115
Data Bits	8
Parity	None
Stop Bits	1
Parity Check	None / Off
Carrier Detect	None / Off
Flow Control	RTS/CTS / Hardware
Connection Started by	Carrier Detect
Connection Ended by	Carrier Detect
DTR Signal	Always On
RTS Signal	Always On

Establishing Data Communication Links

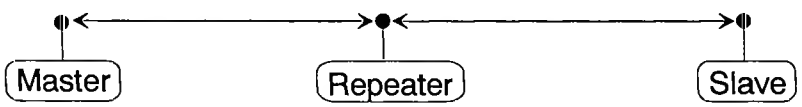
Burk Wireless Transceiver's allow data communication links to be established using a variety of different configurations. This, in turn, makes it possible to extend the range of the transceivers and get around obstacles.

Diagram (A) shows the most common and straightforward link, a master communicating to a slave in a dedicated link.

(A)

Diagram (B) depicts how a link might be set up using a repeater. The repeater may be sitting on a hilltop or other elevated structure to link the master to the slave. In this setup it may be desirable to use an external omni-directional antenna on the repeater; to extend the range Yagi antennas could be used on either or both of the master and slave.

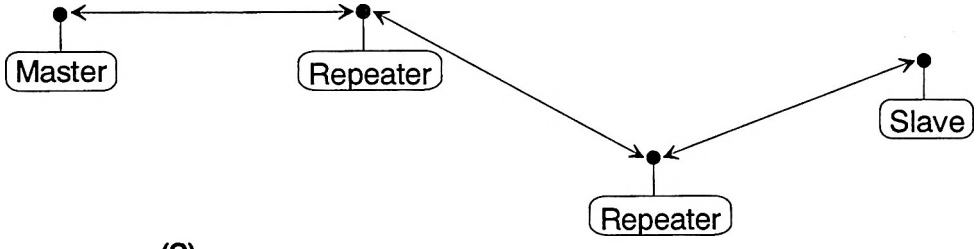
When a repeater is used the RF speed is cut in half, making 115 KBaud uncompressed throughput unachievable. The baud rate, however, may still be set at 115200.



(B)

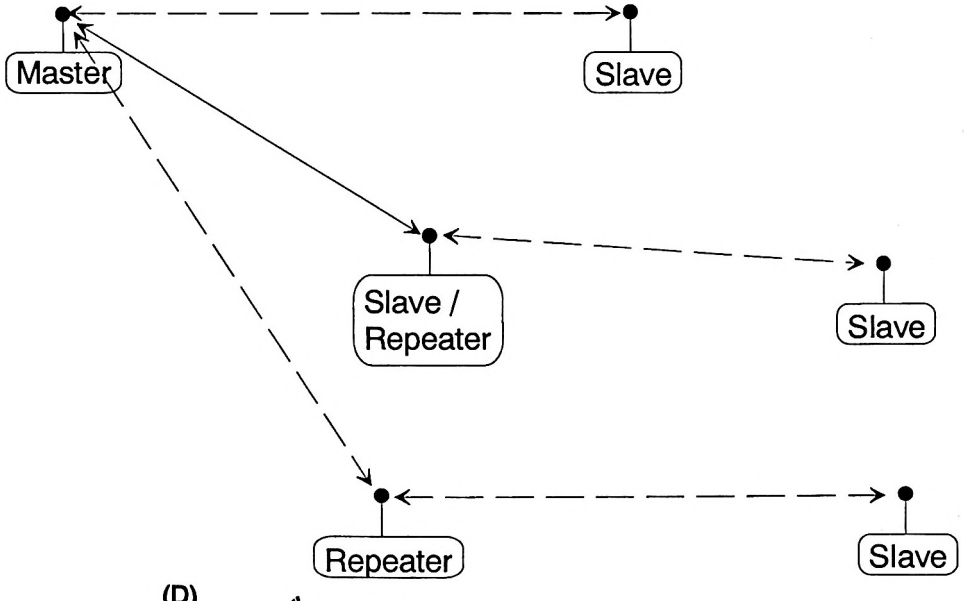
Diagram (C) shows a link with two repeaters between the master and slave. With two repeaters there is clearly more flexibility in getting around obstacles and greater total range is possible. Once again, it would be desirable to use external omni-directional antennas with the repeaters, and attaching a Yagi to the master and slave would increase the range of the link.

When two repeaters are used there is no further degradation in the RF speed of the link.



(C)

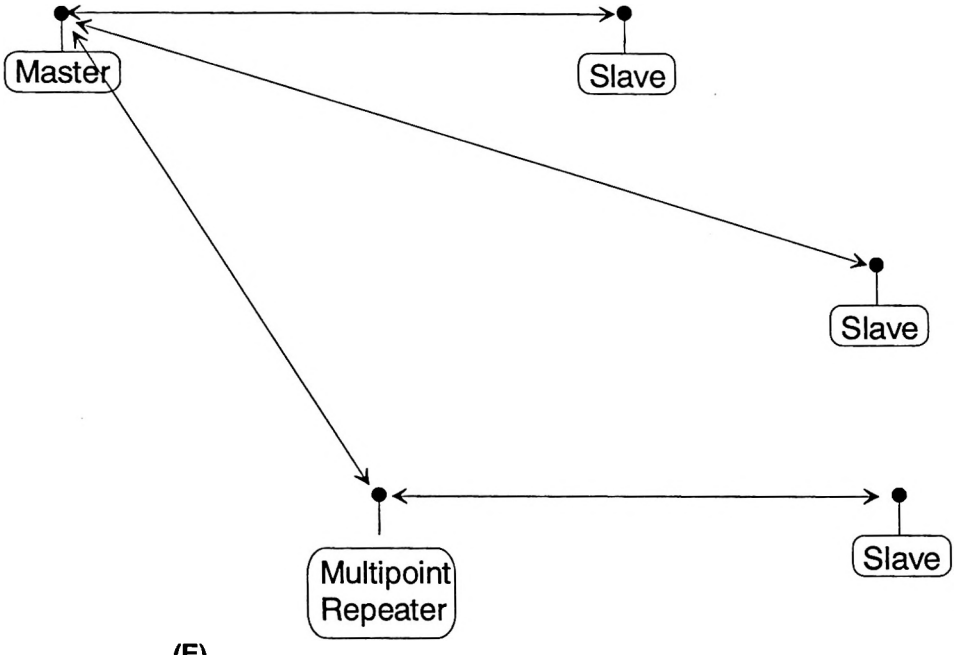
In example (D) a setup is shown where a master routinely calls a number of slaves at different times. The master is communicating with a transceiver designated as a slave/repeater that is connected to a remote instrument in the field. Since this instrument is placed in an elevated location, the transceiver may also be used as a repeater when it is not used as a slave. At any time desirable the master may call any of the slaves, establish a connection, and retrieve and send data.



(D)

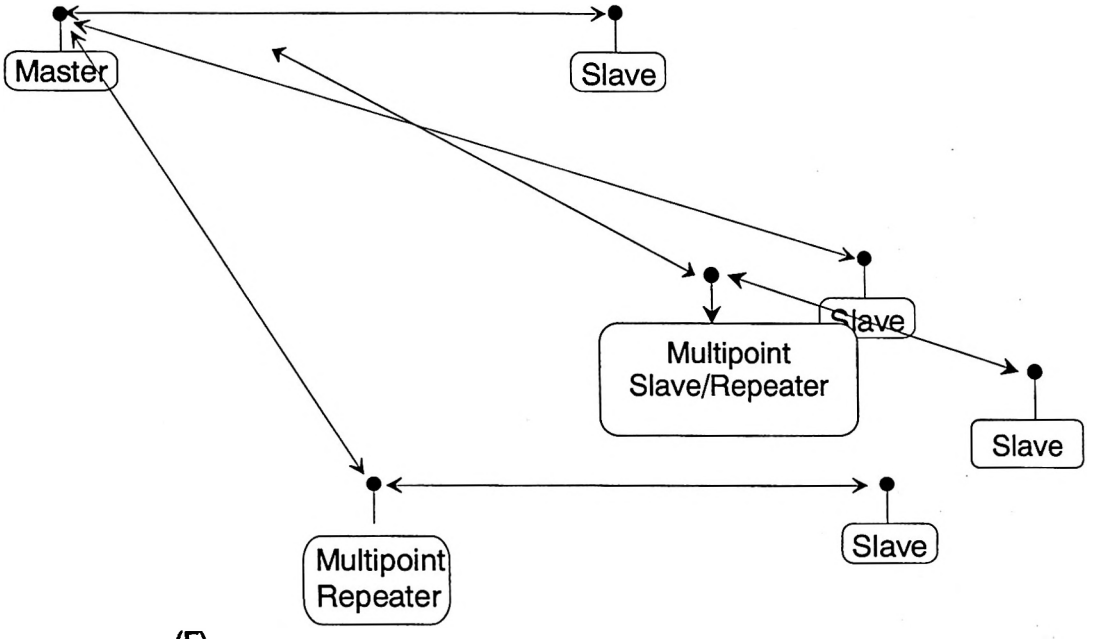
Example (E) depicts a standard point-to-multipoint system. In this example any data sent from the master is broadcast to all three slaves, one of which receives it

through a multipoint repeater. The data is in turn sent out of the RS232 port of each of the three slaves.



(E)

In (F) a point-to-multipoint system is depicted which uses one of the slave sites as a repeater simultaneously, all through the same radio. This system works in a manner very similar to a standard multipoint system with repeaters, however the number of radios needed is reduced with the use of the multipoint slave/repeater feature.



(F)

Other Settings

A number of parameters other those shown in the setup menu may be set on BDT-115 transceivers. The parameters below may be set with DOS based software available by contacting Burk Technology.

Baud Rate

The transceiver's RS232 baud rate may be set to 300, 600, or 900 baud.

Setup Timeout

When enabled this mode invokes a timeout feature for the Setup Menu. If the transceiver goes into setup and does not receive a legitimate menu selection within 3 to 5 seconds it will go back out of setup and into its previous mode.

Technical Specifications

Specification	
Frequency:	902 to 928 MHz
Transmitter:	
Output Power	955 mW (+29.8 dBm) at 9.5 to 14.0 V 400 mW (+26 dBm) at 7.5 to 9.5 V
Range*	20 miles
Modulation	GFSK, 120 kBs – 170 kBs
Occupied Bandwidth	230 kHz
Receiver:	
Sensitivity	-108 dBm at 10-6 raw BER
Selectivity	40 dB at fc ± 230 kHz 60 dB at fc ±460 kHz
Data Transmission:	
Error Detection	32 Bit CRC, resend on error
Data Encryption	Substitution, dynamic key
Link Throughput	115 KBaud
Interface	RS-232 1200 Baud to 115.2 KBaud, asynch, full duplex
Power Requirements:	
Transmit current	650 ma at 12V for 1W 600 ma at 8.5V for 400mW
Receive current	100 ma at 12V
Idle current	65ma at 12 V
Operating Modes:	Point-to Point Point-to-Multipoint Peer-to-Peer Store and Forward Repeater
Operating Environment	-40□C - +75□C

* Line of sight distance with unity gain antenna at 900 MHz, 5 dB omni at 2.4 GHz.
** Throughput measured assuming 75% frequency availability.

Troubleshooting

	BDT-115
Enclosure	Plastic
Dimensions	41mmH x 99mmW x 188mmL
Weight	340 grams
Power Requirements	• 9.5 - 18.0 VDC • Center Pin Positive • AC Wall Adapter Provided • May also be powered through Pin 6 of DB9 connector.
Antenna	3-inch whip provided. Reverse thread SMA connector for external antenna.
FCC Identifier	KNY-DGR-115
DOC Identifier	2329 101 340A

"I am using my Burk Wireless Transceiver to communicate between two PCs. I am using pcANYWHERE, which is set to direct connection. Both pcANYWHERE and the modem are set to 115.2 KBaud, yet throughput is considerably lower."

The communication link between two computers may be slowed considerably by the UART used in the serial port of one or both computers. If you suspect that the serial port on the computer will not support high-speed communications, then try reducing the baud rate for that end of the connection (both on the computer and the transceiver) to see if throughput improves.

"I have two transceivers, one configured as a master and the other as a slave. When they are plugged in, the LEDs indicate they are receiving power, and yet they will not connect. Why not?"

There are several reasons why this may occur:

- The transceivers are running at full power and are too close to each other. If the transceivers are within 5-10 feet of each other and will not link try either reducing the RF power to 1 on each or moving one unit to another room. (This problem occurred on the initial generation of product with the 555 serial number prefix. It has been addressed in transceivers with serial numbers 556 and higher.)
- The transceivers are not in each other's Call Books.
- The number of the slave is in the master's Call Book, but the master's menu is not set to call that number.
- There are several phone numbers in the Call Book, the master is set to Call All, and is connecting with another transceiver in the list first.
- The master is set to Call All and a setting of 000-0000 precedes the phone number of the transceiver with which you are trying to communicate.

"I am able to link to a remote unit within line of sight when my transceiver is outside. However, as soon as I walk inside with it I lose the link, even if I place the transceiver by the window which faces the remote unit."

Many modern buildings use energy efficient glass that wreaks havoc on RF signals. This glass contains a metal film that is very effective in blocking all radio waves. If your situation is as described above the preferable solution is to install an antenna outdoors.

"I have several transceivers set up to communicate with each other in a point-to-multipoint mode, yet they are not establishing contact."

In a Multipoint system there are two critical parameters that must be set correctly to establish a communications link:

1. The slave's Call Book must contain the serial number or Network ID of the master and/or repeaters to which it will be communicating.
2. All radios must be set to run at the same RF data rate. Unlike point-to-point systems, slaves in a Multipoint system do not change their RF data rate to match the master's rate.

"In bench testing several units in a Multipoint system, it appears that they are not communicating through the Multipoint repeater. When all units are powered the slaves' Carrier Detect lights are green, indicating a connection, yet when I unplug the repeater those slaves set up to communicate through that repeater remain connected."

In a Multipoint system a slave will attempt to communicate with any master or repeater (which looks like a master in a Multipoint system) that is in its Call Book. Therefore, it may be that the slaves are communicating with the repeater when it is powered, and when it is unplugged they are establishing a link with the master. To test whether or not this is what is occurring go into the Call Book of the slaves which are set up to communicate through the repeater and remove the master's serial number. When all units are powered the slaves' Carrier Detect lights should be green, when the repeater is unplugged the slaves should lose contact and Carrier Detect should turn red.

"My transceivers have established a solid connection as indicated by the LEDs, yet the application I am running is not transmitting and/or receiving data correctly."

The quickest test in a situation like this is to try to get the application up and running using an RS232 null modem cable before deploying the transceivers in the field. The transceivers essentially functions as a null modem cable. If the application will not work with a hard wire connection then it will not work with the transceivers, and the problem lies within the application or other hardware (such as the computer serial ports).

"I have 2 BDT-115 transceivers set up between two computers and have been unsuccessful in my attempts to establish a link using LapLink."

At various times, difficulty using the transceivers with LapLink has been documented. The cause, while not confirmed, is believed to be due to LapLink changing baud rates, which the modem does not support. If you encounter this problem it is recommended that you test the link with a terminal program such as HyperTerminal or ProComm. If either of these applications is used and characters typed on one computer appear on the screen of the other computer in the link, then the transceivers are functioning properly.

TPA KIT

For the ARC-16 Remote Control System

The TPA Two-Port Adapter Kit is for use with the ARC-16 remote control system and permits a single chassis to control 2 modem boards allowing communication to multiple chassis. The modems may be any combination of 2-wire, subcarriers generators and demodulators, or RS-232 data links.

Contents

The TPA Kit contains the following items:

TPA Board assembly	(#83160007)
MC6850 UART IC (installed in the TPA Board assembly)	(#40066850)
White TPA 10-pin Ribbon/Jumper Assembly	(#84000003)
2 x #6-32 x 3/4" Standoffs	(#52106374)
3 x #6-32 x 1-1/4" Standoff	(#52106324)
3 x #6-32 x 1/4" Machine Screws	(#52006345)
1 x 3-Wire Modem-to-BNC Connector Assembly	(#84000001)
2 x BNC Female Panel Mount Connectors	(#31201002)
2 x Grounding Lugs	(#31210001)

Equipment Required

To install the TPA Kit you will need the following items:

Medium Phillips type screw driver.
Small to medium size adjustable wrench or pliers.
IC extractor or small flat head screwdriver.
Light duty soldering iron.

Installing the New Modem

The decision to install the new modem as Port 1 or Port 2 may be determined by the type of data link used. Because of the size of the board, installation of 2-wire type (WMS/WMT) modems differs slightly from other modem boards. Each type of configuration is covered in the following paragraphs.

Mounting 2 modems of the same style (2 x WMS/WMT Modems or 2 x Universal Modems)

If both ports will contain similar styles of modems, then you will install 1 of the 6-32 x 1/4" machine screws in the front corner of the board (near JP4 on WMS/WMT, near JP3 on Universal Modems). The 3 remaining corners will be supported using 6-32 x 1-1/4" standoffs after the TPA board is installed.

Mounting 1 x WMS/WMT Modem and 1 x Universal Modem

For systems using a single WMS/WMT modem along with a Universal Modem you will install the WMS/WMT on the chassis floor. This modem is designated as Port 1. You will secure the WMS/WMT by using three of the 6-32 x 1/4" machine screws. Use two screws near JP4 and one near JP2. The remaining corner of the board will be secure using one of the 6-32 x 1-1/4" standoffs after the TPA board is installed. 2 more 1-1/4" standoffs support the Universal Modem under its JP8 and JP7 connectors.

Installing the TPA Board

Remove the 10-pin ribbon assembly (if present) which connects the existing modem to the CPU board at J4. This ribbon assembly will not be required.

Remove the 6850 ACIA/UART device from location U13 on the CPU board, and install it in the empty 24-pin socket of the TPA board. Note carefully the location of Pin 1 on the board and on the IC. The 2 ICs should be oriented the same direction.

Remove the 2 #6-32 x 1/4" Phillips type screws located at both ends of U11 on the CPU board, and install the 3/4" standoffs in these locations.

Install the 2 BNC connectors and grounding lugs on the rear panel in the available

Note: U11 is not installed on ARC-16 systems, but the location is clearly labeled on the CPU board. If there is an IC installed in U11, please remove it now.

mounting holes. Use the existing set of BNC connectors as a guide.

Solder the 3-Wire Modem-to-BNC connector assembly to the BNC connectors. The YELLOW lead should meet the BNC connector near the barrier strip assembly, and the RED lead should meet the BNC connector near the power module. Solder the BLACK wire to the pair of ground lugs. (It is not necessary to link this new set of ground lugs to the existing set. They are interconnected through the chassis wall.)

Complete the installation of the first modem board by connecting the barrier strip 5-pin connector to JP4 on Universal Modems, or to JP2 on WMS/WMT modems. Universal modems will also connect to the lower 3-wire Modem-to-BNC connector at JP8.

Using one half of the supplied TPA 10-pin Ribbon/Jumper Assembly connect the CPU board J4 to the installed modem JP4. NOTE: The black conductor lead should meet the CPU board J4 at pin 3, and there should be no connection to pin 3 of the modem connector. (JP3 for Universal Modems or JP4 for WMS/WMT)

Carefully plug the TPA Board gold pins into the socket at location U13 of the CPU board. Secure the board to the standoffs using the original set of screws.

Mount the upper modem to the 3 standoffs using the 6-32 x 1/4" screws. Connect the 3-Wire Modem-to-BNC Connector to JP8 for Universal Modems. Connect the barrier strip 3-pin connector left-justified to JP2 for WMS/WMT or JP4 for Universal Modems.

Connect the remaining half of the TPA 10-pin Ribbon/Jumper Assembly to the TPA board and the upper level modem. The black conductor should meet the modem, not the TPA.

System Configuration

The ARC-16 chassis needs to be programmed to operate with the TPA Option. The following programming items pertain to the use of this option.

> NOTE: Do NOT enable the TPA in the system until the TPA device is actually installed. Attempting to do so may require completely erasing your ARC-16 chassis in order to recover.

Accessing the Programming Menus

Remove power from the ARC-16.
Press and hold the **<MODE>** and **<CLEAR>** switches at the same time and re-apply power.
Release the switches.

Data Reception

You must specify the port from which each remote chassis' data is received. Port 1 is the modem mounted on the chassis floor, and Port 2 is the modem mounted on the 1-1/4" standoffs. Each remote chassis letter may be specified as **Port 1**, **Port 2** or **No Port**. Use the **<CHANNEL>** switches to select each chassis letter, and **<RAISE>** or **<LOWER>** to change the port selection.

Data Transmission

In addition to its own data and commands, the chassis containing the Two Port Adapter is responsible for circulation of remote data to other remote sites. The local chassis should be set up to send its own data out **<PORTS 1+2>** and must 'echo' any data received from other sites out the opposite port. For example, if chassis 'A' is connected to Port 1, rebroadcast 'A DATA' out Port 2.

Options

Enable the Two Port Adapter Option using the following steps:

Press **<MODE>** to advance through the available menus until the display shows:

CH. 1-8	**YES/NO**
OPTION	**SET**

Use the right-hand **<CHANNEL>** switch to step through the available options. The last item in the menu will be **2 PORTS NO**. Change the **NO** to **YES** with the **<RAISE>** switch.

After waiting 10 - 15 seconds for the system to permanently store the change in memory, press **<MODE>** or **<CLEAR>** to exit the programming menus.

BURK TECHNOLOGY

Configuring the ARC-16 System
Firmware Version 5.3

The ARC-16 is available as a single transmitter unit and may be expanded to include up to four sites. Each site can include up to 16 channels and numerous other options. In order for one ARC-16 to communicate properly with another, each chassis must be programmed with a unique identifier called the site designator, and each chassis must also be informed of the options installed in *other* ARC-16 sites throughout the entire system.

There are four possible site designators for the ARC-16 chassis, **A**, **B**, **C** or **D**. Single sites are typically assigned 'A' as a site designator, as are transmitter units in 2-site systems. The site designator 'D' is typically the studio unit. The choice of designators affects how fail-safe operates and which sites are reported on an SSI. Each site within the system must have a unique designator.

Initial setup is performed at the factory, requiring you only to edit your configuration as you add other sites and options.

To enter the configuration menu for editing or to enable field added options, press and hold the '**MAINT**' switch first, then press and hold the '**CLEAR**' switch. Hold both switches for at least three seconds and release. The ARC-16 will boot into the configuration menu, and display the first configuration choice available for editing, **Data Received From**. In the configuration menu, use your CHANNEL switches to move forward and back across the menus, and Raise and Lower will edit the selection. Press the mode button to advance to the next menu.

The ARC-16 configuration menu will advance through seven standard modes, each menu setting a specific choice. *If your desire is to change the site designator or clear all previous programming, enter the configuration menu by applying power to the ARC-16 while pressing BOTH of the white 'CHANNEL' switches. Hold the switches for 2 full seconds once power has been connected. Two additional configuration menus will now present themselves prior to the standard first menu selection. The following are the two advanced menu's.*

MASTER INIT.
↑ XMTR STUDIO ↓

The Master Initialization offers only 2 choices. Select '**RAISE**' for a transmitter unit or select '**LOWER**' for a studio. This will preprogram many of the default settings for you but you will be able to edit any these later in the programming. Once selected, the ARC-16 will automatically advance to the next menu.

A = LOCAL ARC-16
↑↓ EDIT NEXT ⟷

Displayed here is a default site designator for this local site. If you choose XMTR in the previous selection, the default site designator 'A' will appear. 'B' will be displayed it you choose STUDIO. Edit the site designator (A, B, C or D) using RAISE and LOWER switches.

Note: The studio is usually not site B. The most common choice is site 'D'. Refer to your ARC-16 Factory Configuration sheet for the system's original settings or design your site based on any installed SSI or SIO options. After selecting the desired site designator, press 'MODE' to advance to the next menu.

There are seven standard configuration mode menus. (see Figure 1 for an exploded view)

B DATA RCVD FROM
⟷ PORT 1 ↑↓

Menu Item 1) **RECEIVE PORT** assignments tell each unit from which port to receive the selected site from. This port is also the port to which the local chassis will send events back to the remote site. Port 1 for a WIRE modem (WMS or WMT) appears on the rear panel barrier strip. Universal Modems use the lower set of BNC connectors as Port 1. In both cases, Port 1 refers to the modem installed on the chassis floor of the ARC-16. Port 2 is available in a chassis when the TPA - Two Port Adapter Option and additional modem are installed. Port 2 refers to the upper modem board and upper pair of BNC connectors or second set of lugs on the barrier strip. After reviewing or editing the RCVD DATA setting, PRESS MODE to advance to menu item 2.

A DATA SENT OUT
⟷ PORTS 1+2 ↑↓

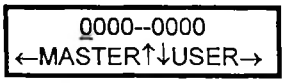
Menu item 2) **SEND PORT** assignments allow you to control the flow of data from unit to unit in multi-site systems. The default setting is to send LOCAL data out all available ports (PORTS 1+2) whether or not the second port exists. Data from other remote sites is not sent out unless the local chassis has the 2-Ports or a Computer Interface (CI or ESI/CI). With 2 Ports, send the remote site data out the opposite port it is received on. This will allow the continuation of that data onto the remaining part of the ARC-16 system. For the Computer Interface to obtain a copy of the readings for each site, data for each remote site must be sent out at least one port. After reviewing or editing the SENT PORT settings, PRESS MODE to advance to menu item 3.

BAUD RATE DIV.
⟷ PORT 1 DIV0 ↑↓

Menu item 3) **BAUD RATE DIVISION** may be used to adjust the baud rate of the three available ports, Port 1, Port 2 and the Computer Interface port. If your CPU is at the factory standard 300 baud, all divisions need to remain at zero. Here, Ports 1 and 2 will operate at the CPU rate of 300BPS, and the Computer Interface will operate at 1200. If you are using the optional 1200 baud rate on your CPU, you can select 300 or 1200 baud for each port. To select 300 baud for a port, set the port to divider 64. For 1200 baud, set the port to divider 16. The Computer Interface baud rate is currently restricted to 1200 baud in all cases. The divider for the CI port should remain at zero. After reviewing or editing the BAUD RATE DIVISION, PRESS MODE to advance to menu item 4.

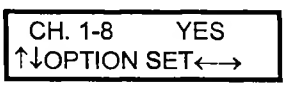
Note :To modify your CPU from 300 baud to 1200 baud, refer to figure 2. You must use digital links at 1200. Audio and Subcarriers will not operate at 1200 baud.

Menu item 4) **SITE NAME** may be customized with 7 characters or less. This feature makes using a multi-site system more understandable when you select each location. Select a character position location using the 'Channel' switches, and edit the displayed character using 'RAISE' and 'LOWER'. After reviewing or editing the SITE NAME settings, PRESS MODE to advance to menu item 5.



Menu item 5) **MASTER and USER** Passwords affect the local chassis only. These are used for access into this site when dialing into the ESI option. They are also used to verify the site by the software AutoPilot for Windows. Use the 'Channel' switches to select a digit to edit, then use 'RAISE' and 'LOWER' to change the numeral as desired. After reviewing or editing the SITE NAME settings, PRESS MODE to advance to menu item 6.

Menu item 6) **HIGHEST CHANNELS** for each site may be assigned to eliminate unused channels from being displayed, and to restrict certain commands from being accessed by particular locations. Limiting each chassis to only the highest channel needed also makes more efficient use of the communications links at each site. Select each available site using 'Channel' and set the numerical value using the 'RAISE' and 'LOWER' switches. After reviewing or editing the HIGHEST CHANNEL settings, PRESS MODE to advance to menu item 7.



Menu item 7) **OPTIONS** require YES/NO responses. Make certain that the desired options are physically installed before attempting to select them within the menu. You may view the available options using the 'Channel' switches and change the desired selection using 'RAISE' and 'LOWER' switches.

The available options are:

CH. 1-8 — First Input/Output board.
Answer YES if this unit contains an I/O card in the lowest slot.
I/O cards connect status and metering inputs and control outputs to the ARC-16.
An I/O card shows on the rear panel one DB-37 Female connector for control output and one DB-37 Male connector for analog and status input connections.

CH. 9-16 — Input/Output board.
Answer YES if this unit contains an I/O card in the middle slot.

LCL ESI — ESI Enhanced Speech Interface.
Answer YES only if an ESI (Enhanced Speech Interface) is installed in this unit.
The presence of two RJ-11 type telephone jacks, a DB-9 connector and a phono jack seen in the back of the ARC-16 confirms that an ESI is installed.

DTMF — Tone Dial/Pulse Dial
If you have LCL ESI selected you may choose pulse dial by selecting NO, or tone dial by selecting YES.

P-1 ESI — Remote speech board (ESI) located at the next logical site.
Answer YES only if you have an ESI installed at the site designated as the next logical site. Refer to Table 1 at the end of this document for logical site designations.

P-2 ESI — Remote speech board (ESI) located at the second logical site.
Answer YES only if you have an ESI installed at the site designated as the second logical site. Refer to Table 1 at the end of this document for logical site designations.

P-3 ESI — Remote speech board (ESI) located at the third-higher site.
Answer YES only if you have an ESI installed at the site designated as the third logical site. Refer to Table 1 at the end of this document for logical site designations.

P-1 SSI — Studio Status to monitor next logical site.
Answer YES to enable the Studio Status Indicator for the unit designated as the next logical site. For this option to take effect, an SSI card must be installed and connected to the middle header on the AUX board inside the ARC-16 chassis. The AUX has three 24-pin headers. An SSI card can be identified from the studio back panel by the presence of only one DB-37-Female connector.

P-2 SSI — Studio Status to monitor second logical site.
Answer YES to enable the Studio Status Indicator for the unit designated as the second logical site. Refer to Table 1 at the end of this document to determine logical site designations. For this option to take effect, an SSI card must be installed and connected to the rear-most header on the AUX board inside the ARC-16 chassis. An SSI card can be identified from the studio back panel by the presence of only one DB-37-Female connector.

2 PORTS — Two-Port Adapter and Second Chassis Modem installed.
Answer YES if the Two Port Adapter is installed on the CPU board. This is a small plug-in card that mounts near the center of the CPU board and connects to two modems for use in multi-site systems.

This concludes the list of available options. Press MODE to return to the normal working menus. The ARC-16 will shut down and reset once you exit the configuration menu.

Tables:

For assistance in determining the target site for particular installed options refer to the following table.

Table 1
Logical Site Designations

Local Site Letter	Next Logical Site P1-SSI or P1-ESI. 'Remote Site 1' for CDL, AutoPilot	Second Logical Site P2-SSI or P2-ESI 'Remote Site 2' for CDL or AutoPilot	Third Logical Site P3-ESI 'Remote Site 3' for CDL or AutoPilot
D	A	B	C
C	D	A	B
B	C	D	A
A	B	C	D

Table 2
Baud Rate Dividers

Physical CPU Baud Rate	Set Port to 300 Baud	Set Port to 1200 Baud	CI port
300	0	N/A	0, (always 1200BPS)
1200	64	16	0, (always 1200BPS)

For additional technical assistance, call Technical Support at (978) 486-0086.
Visit our Web Site at: http://www.burk.com/
Send E-mail to support@burk.com

Figure 1, ARC-16 configuration Menu Explosion

Initialization menu only

MASTER INIT.
↑ XMTR STUDIO ↓

Select if this chassis is a studio or transmitter site.

Initialization menu only

A = LOCAL ARC-16
↑↓ EDIT NEXT ←→

Select proper Site Designator here using your Raise and Lower switches.

Menu 1

B DATA RCVD FROM
←→ NO PORT ↑↓

C DATA RCVD FROM
←→ NO PORT ↑↓

D DATA RCVD FROM
←→ PORT 1 ↑↓

Select the proper receive port for the sites linked to this chassis.

Menu 2

A DATA SENT OUT
←→ PORTS 1 + 2 ↑↓

B DATA SENT OUT
←→ NO PORT ↑↓

C DATA SENT OUT
←→ NO PORT ↑↓

D DATA SENT OUT
←→ NO PORT ↑↓

Select local site to send out ports 1+2, select remaining sites to send opposite port received on so the data will continue out to the next site.

Menu 3

BAUD RATE DIV.
←→ PORT 1DIV 0 ↑↓

BAUD RATE DIV.
←→ PORT 2DIV 0 ↑↓

BAUD RATE DIV.
←→ PORT CIDIV 0 ↑↓

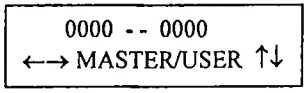
If the physical CPU baud rate is 300, select 0 for all three options. If CPU has been modified to 1200, select 64 to operate the selected port at 300BPS, select 16 to operate the selected port at 1200BPS. CI port rate must remain at 0 regardless of the CPU speed.

Menu 4

XMTR
←→ SITE NAME ↑↓

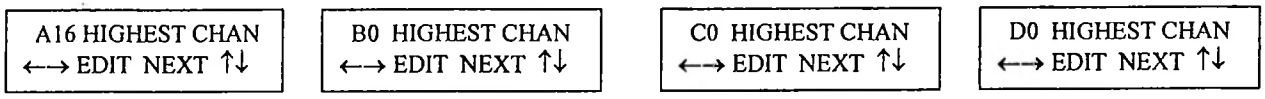
A default name will appear. Edit this name using the RAISE and LOWER switches to select characters, numbers and symbols and your CHANNEL switches to tab left and right.

Menu 5



Set your master and user passwords here, using RAISE and LOWER switches to select number, and CHANNEL switches to tab forward and back.

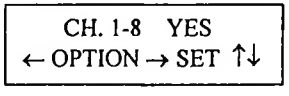
Menu 6



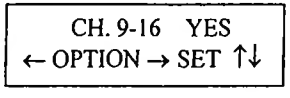
Set the correct highest channel for all sites.

The final configuration mode menu (Menu 7) is for installed options. Use your CHANNEL switches to tab forward across the options menu for each selection. Use RAISE and LOWER to edit the selection.

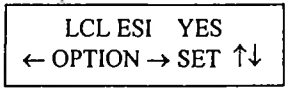
Menu 7



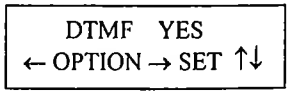
Answer YES if you have the lower I/O card installed in this local chassis. This I/O card plugs into the rear most header on the CPU AUX board.



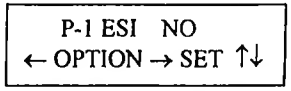
Answer YES if you have the second I/O card installed in this local chassis. This card plugs into the center header on the CPU AUX board.



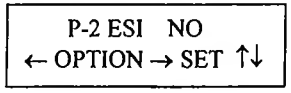
Answer YES if you have an ESI card installed in this local chassis.



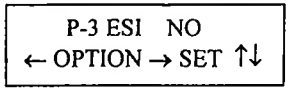
Answer YES if you have LCL ESI enabled and you have tone dial. Leave this option no is pulse dialing is desired.



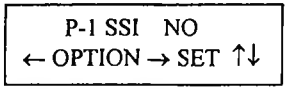
Answer YES if you have an ESI installed in the next logical site. Refer to Table 1 for logical site designations.



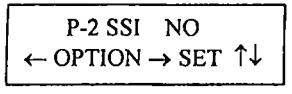
Answer YES if you have an ESI installed in the second logical site. Refer to Table 1 for logical site designations.



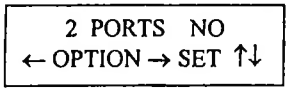
Answer YES if you have an ESI installed in the third logical site. Refer to Table 1 for logical site designations.



Answer YES to enable the Studio Status Indicator Option for the next logical site. This card must be installed and connected to the center header on the CPU AUX board. Refer to Table 1 for logical site designations.

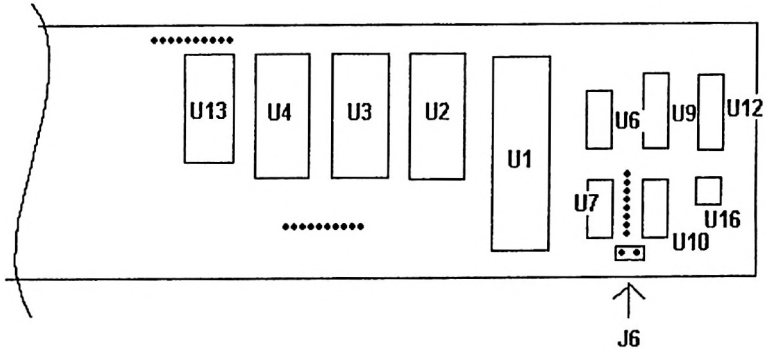


Answer YES to enable the Studio Status Indicator for the unit designated as the second logical site. This card must be installed and connected to the rear most header on the CPU AUX board. Refer to Table 1 for logical site designations.



Answer yes if the Two-Port Adapter is installed in this local chassis.

Figure 2, CPU baud rate adjustment



Cut the link between the two pins of J6. Add a jumper to connect pins 1 and 6 of the baud rate selector for 1200 baud. Note: Pin 1 is the pin closest to J6.

Note: 1200 baud is only allowed if you are using the Universal modem with DIGITAL INPUTs and DIGITAL OUTPUTs. Audio and Subcarrier frequencies are not supported at 1200 baud.