MICROPROCESSOR REMOTE CONTROL

Bulletin 279 A

MRC-2

MOSELEY ASSOCIATES, INC.
A FLOW GENERAL COMPANY

MRC-2

WHY REMOTE CONTROL?

The MRC-2 Microprocessor Remote Control System brings a new level of sophistication to remote control, telemetry and status acquisition. System size and operational capabilities have been greatly expanded over previously available remote control systems, and the use of the CRT option enhances operator interfacing with the system by providing a plain-English display of all desired transmitter plant parameters. This display is user-programmed, allowing maximum flexibility in CRT setup. The Automatic Logging option relieves the operator from the necessity of keeping a manual log by routinely recording all desired parameters as well as automatically printing any alarm conditions. In addition, the Automatic Control option can reduce or eliminate the monitoring of the transmitter plant by the operator while providing quicker response than a human operator could provide.

These features translate into greater transmitter plant control and security at lower cost, two very important factors in today's complex broadcast operations. The MRC-2 System provides the broadcaster with greater control of the transmitter and peripheral equipment through quick, positive monitoring and control of all desired parameters. Critical parameters, such as transmitter power output, can be constantly monitored for compliance with user pre-programmed tolerance limits, allowing maximum performance within regulatory and safe operating limits. The use of dual limits allows the operator (or the system itself, with the optional Automatic Control Unit) to adjust parameters before a critical limit is reached. Plant security is improved by the ability of the MRC-2 to continuously monitor the transmitter facility for intrusion, fire, or any other occurrence that could endanger the transmitter or its surroundings. Multiple communications links may be easily used to improve system integrity.

The MRC-2 does not only move the technical operations of the transmitter site to the studio; it also frees technical personnel from the need to operate the transmitter, reducing or eliminating human intervention from transmitter plant operation. This is accomplished by a highly sophisticated, well-integrated control system described below and on the following pages.

WHY MRC-2?

The MRC-2 is a true building block system. Unlike some previously available systems, the addition of one or more advanced options at a later date does not render existing parts of the system obsolete. The basic MRC-2 System consists of one Control Terminal, normally located at a broadcast studio facility, along with one Remote Terminal and one Data Acquisition/Command Unit, normally located at a broadcast transmitter facility. This is only the beginning; multiple Remote Terminals, each designated as a site, may be added to the system with each Remote Terminal equipped with one or more Data Acquisition/Command Units. These Data Acquisition/Command Units may be equipped with up to 255 command lines, 255 status inputs, and 255 analog telemetry inputs per site. These capacities may be independently expanded to the maximum in increments of 16. Multiple Control Terminals may also be used, with a pre-established hierarchy enabling the delegation of control capability between Control Terminals. All Control Terminals are not required to have access to all Remote Terminals in this system, so installations may be configured exactly as the user desires. Multiple Control Terminals are useful; for example, they may be used in AM/FM or AM/FM/TV operations where it is desirable to shift control from one control room to another, or one location to another, while maintaining fail-safe integrity. This feature may also be used for systems where a particular Control Terminal is located in a control room that is not manned 24 hours a day, or in case of control data link failure, which would normally disable a transmitter not able to receive commands from a single Control Terminal.

Operator control of the MRC-2 System is extremely simple, whether the standard Control Terminal or the optional CRT terminal is used for operator interface. Site selection and channel selection may be accom-

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Interior front view of MRC-2 Terminal (with top removed for photograph) and extender board. Easy access is provided to all components by vertical card cage design.

plished in either case by a simple keyboard entry, while commands are implemented by pressing the raise or lower button on the keyboard. The Control Terminal alphanumeric LED display indicates the selected channel number as well as the type and value of the selected parameter. The CRT display is considerably more extensive, and is described in the options section.

COMMAND, STATUS, TELEMETRY SETUP AND OPERATION

Command, status, and telemetry setup is very straightforward on the MRC-2 System. Using the Remote Terminal keyboard and 48 character alphanumeric LED display, the system provides plain-English prompting and "menu" pages for setup selection. Similar procedures are used at the Control Terminal to set up and verify telemetry limits, assign data links, and to set up controlled access for restricted functions.

Each command line output may be designated latching or momentary, and is assigned to one or more telemetry and/or status channels by keyboard entries, again on the Remote Terminal. Command line "mapping" is unique to the MRC family of microprocessor remote control systems. In the MRC-2 system, command lines are not preassigned to channels, but are associated with the desired channel or channels via keyboard entries. With this approach, status or telemetry channels that do not require control functions do not result in unnecessarily tying up unused command lines. In addition, a command line or pair of command lines (each command line is designated as either a raise or lower function) may be assigned to more than one status and/or telemetry channel. For example, two command lines (one "raise" and one "lower"), associated with raising or lowering the power output of an FM or aural TV transmitter, may be assigned to the telemetry channels monitoring plate current, direct power, and indirect power. This results in a savings in the number of command lines used. Standard command outputs are via transistor switch closures, with optically isolated and relay isolated command line outputs optionally available.

Each status channel may be displayed direct or inverting, and functions in a momentary or latching mode as user selected. Status inputs can be programmed to initiate an event or alarm indication on a rising waveform (on), falling waveform (off), or both. Status channels may also be assigned to disable limit checking on selected telemetry channels. This is useful for avoiding alarms when a transmitter is not being used, either in a single or multiple (alternate/main) transmitter.

For further user convenience, analog telemetry inputs to the MRC-2 Data Acquisition/Command Unit may be calibrated in one of six ways: millivolt, linear, power, product, ratio, or digital word. Millivolt calibration reads the input in millivolts, while linear calibration consists of a keyboard entry corresponding to the desired reading for the input sample. This allows linear tracking above and below the entered value. Power calibration is similar, but the displayed reading varies with the square of the input voltage. Product and ratio calibration both use telemetry inputs to two other channels to provide a third reading, which is scaled by a keyboard-entered value as above. Product calibration may be used for indirect transmitter power reading, while ratio calibration may be used to balance parameters such as dual transmitter output power or AM antenna currents. Using the Digital Telemetry Input option, the digital word calibration mode is used for direct digital input to the MRC-2 System.

A wide selection of words and symbols for telemetry units is available (21 total), including volts, kilovolts,

amperes, watts, kilowatts and degrees. The selected unit word or symbol appears on the Control Terminal and Remote Terminal LED display.

Single or dual, upper and/or lower tolerance limits may be programmed for each telemetry channel. Any excursion beyond the limit will initiate an event and/or alarm indication , depending on how the tolerance limits are programmed during setup. The use of dual upper and lower limits allows the taking of corrective action before a parameter reaches a critical level.

A telemetry tolerance excursion or status change that has been user-designated as an alarm will cause audible and visible indications to the operator at the Remote Terminal, Control Terminal, and optional CRT, with optional logging at an Automatic Logging option. Tolerance excursions and/or status changes programmed as events are routine indications of a change in a parameter of interest, and will generate an entry on the printed log. The returning of a telemetry input within tolerance limits may also be logged at the user's discretion.

FAIL-SAFE PROVISIONS

The MRC-2 System includes control fail-safe operation in compliance with current FCC broadcast rules. Control fail-safe, which causes a relay contact opening at the remote site, is initiated after loss of control to a site from all applicable Control Terminals.

The television telemetry fail-safe option is available to

monitor four pre-programmed television telemetry parameters of up to six transmitters for each Remote Terminal. The option includes a one hour internal timer that will display the time until automatic shutdown if a telemetry fail-safe condition is in progress.

MAINTENANCE OVERRIDE

MRC-2 Remote Terminals are equipped with a Maintenance Override switch for locking out command capability by all Control Terminals and their CRTs. Auxiliary contacts are provided at the Remote Terminal to enable the warning of maintenance personnel that the unit is still in an override condition.

OPTIONS

AUTOMATIC CONTROL UNIT

The MRC-2 Automatic Control Unit option adds both feedback-oriented and time-oriented command functions to the system. Programming for this feature is done by the user at the Remote Terminal using a CRT terminal or logging terminal. A BASIC-like language allows the programmer to use multiple variables to set up simple or complex algorithms for system control. In operation, the system will monitor selected parameters and cause a command or sequence of commands and parameter checking to occur upon user-initiated commands and/or status changes and/or telemetry value changes. The sequence may also be initiated by exact time of day and/or date, and time delays may be programmed to allow parameter settling time or sufficient time for certain functions, such as coaxial switch changes, to occur. The user may also program internal telemetry tolerance values into the Automatic Control Unit for initiating control sequences.

Time-oriented functions may be implemented at an exact time, or may be used to provide a warning to the operator whereby a pre-programmed amount of time is allowed for the operator to manually implement the desired function or functions. The system will automatically implement the function or functions, such as day/night pattern changes for an AM transmitter system, if the operator has not done so manually within the allotted time.

The Automatic Control Unit is capable of multiple steps with logic branching at many levels to accommodate control and switching of multiple transmitters, antennas, etc. User programming as well as factory system programming is stored in non-volatile memory. Memory capacity may be expanded to accommodate larger user-created programs.

The user is cautioned to be certain that all applicable FCC rules are followed in the use of this option. Contact a Moseley Associates representative for details.

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CRT TERMINAL

The MRC-2 CRT option makes the system even more versatile and easy to operate. Each CRT option, with full keyboard, duplicates either all control functions of the Control Terminal or all control functions of the Remote Terminal, depending on where installed. Multiple CRTs may be installed with each Control Terminal and/or Remote Terminal. The CRT will display 32 channels of status, 32 channels of telemetry or a mixture of both on a master page as shown in the photographs. Command lines may also be displayed on the CRT for "housekeeping" purposes.

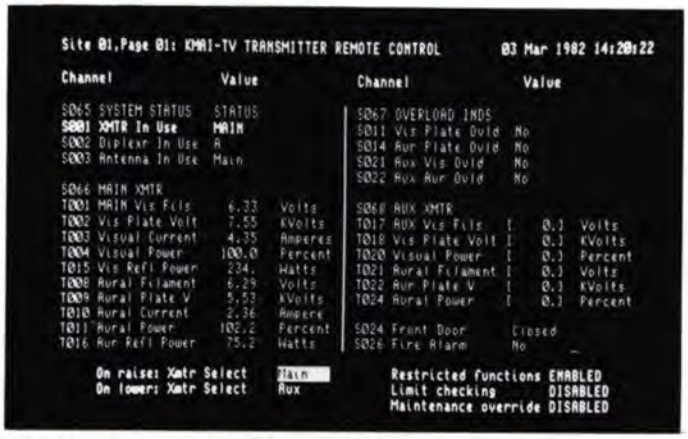
Each CRT option installed with a Control Terminal may be used to display information from any site accessible to the associated Control Terminal. A CRT option installed with a Remote Terminal has access to all data generated at that terminal, and may implement control functions if the Remote Terminal has been placed in the maintenance override condition. Control Terminal CRTs may exercise command functions by implementing the "take control" function, which transfers command capability to one CRT at a time in compliance with the FCC remote control rules. An automatic time-out ensures that a CRT will not take control and be left in that condition, inadvertently locking out control access by other CRTs. The Control Terminal itself always takes command priority over its associated CRTs.

The CRT option is extremely easy to program. Initial page setup is accomplished by answering a series of questions on the CRT screen. Display programming is accomplished by typing descriptors in plain English for parameters, telemetry units, and status conditions. These descriptors, along with telemetry values, are displayed on the CRT along with system status, site status, and alarm conditions. Data link conditions are also displayed on a separate page.

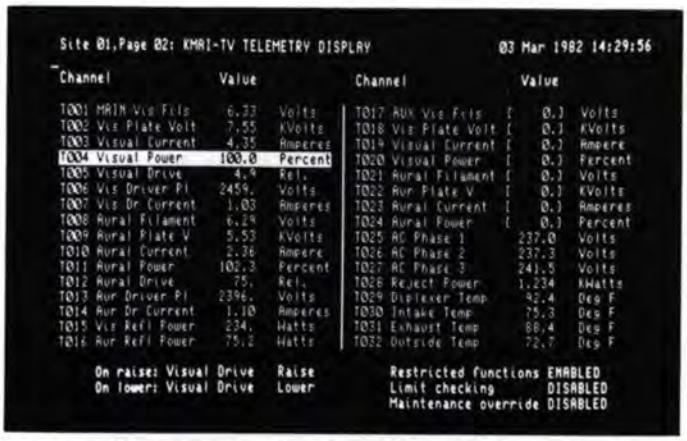
The selected telemetry or status channel on a given page is normally displayed in full intensity video, which changes to reverse video when the CRT is enabled for command functions.

Typical MRC-2 CRT Option Status Page. Note user-generated text, including heading, as well as system status indications.

ADDS Regent 40 terminal with custom function keycaps, used in the CRT option, duplicates full control capabilities of MRC-2 Control Terminal or Remote Terminal.



CRT Master Page, derived from Telemetry and Status Pages. Titles, telemetry, and status information may be intermixed from one site as desired.



Typical MRC-2 CRT Option Telemetry Page showing 32 channels of telemetry. Channel T004 is in "Take Command" mode, with control functions for channel indicated in lower left hand corner.

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AUTOMATIC LOGGING

MRC-2 Automatic Logging Option uses the Teletype Model 43 KSR Printer with full keyboard to log telemetry, status parameters as desired.

The MRC-2 Automatic Logging option provides a printed record of any or all telemetry and/or status channels from one or several sites in a 13 column format. The system will print user-defined header lines, which may be programmed to print at various times of the day. Multiple headers may be used, with each one programmed to print at different times to allow for shift changes as well as the beginning and end of a broadcast day.

Use of the CRT option, in conjunction with the Automatic Logging option, adds the CRT descriptors to the Automatic Logging option for alarm and event descriptions. The MRC-2 Automatic Logging option is available for use with the Control and Remote Terminals (specify when ordering). Up to eight Automatic Logging options may be used with a single terminal, subject to card slot availability.

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10 Mar 1982
     MOSELEY ASSOCIATES, INC.                    MRC-2
     111 CASTILIAN DRIVE                         CONTROL TERMINAL
     GOLETA, CALIFORNIA 93117                    AUTOMATIC LOGGING SYSTEM

                                                 OPERATOR OFF_____________________ OPERATOR ON_____________________

          --------MAIN TRANSMITTER---------- --------AUX TRANSMITTER---------- Key    Outside  Tower   Main    Aux
          Fil Volt Plate V  Via Curr Via Pwr Fil Volt Plate V  Via Curr Via Pwr Switch  Light   Lights  Fan     Fan
          Fil Volt Plate V  Aur Curr Aur Pwr Fil Volt Plate V  Aur Curr Aur Pwr

0525 SITE 01  6.214                                                              OFF     ON      ON      OFF     OFF
0525 SITE 01  6.293

0527 SITE 01 CHANNEL 005 STATUS EVENT: RISING EDGE DETECTED       Visual Plate   On
0527 SITE 01 CHANNEL 007 STATUS EVENT: RISING EDGE DETECTED       Aural Plate    On

0527 SITE 01  6.203   7.531   4.740   099.9                                      OFF     ON      ON      ON      OFF
0527 SITE 01  6.282   5.093   2.358   099.9

0530 SITE 01  6.206   7.534   4.742   098.8                                      OFF     ON      ON      ON      OFF
0530 SITE 01  6.282   5.093   2.358   100.0

0600 SITE 01  6.206   7.534   4.742   093.2                                      OFF     ON      ON      ON      OFF
0600 SITE 01  6.282   5.095   2.359   100.0

0617 SITE 01 CHANNEL 004 ANALOG ALARM: EXCEEDED LOWER RED LIMIT       Main Via Power

0617 SITE 01  6.208   7.536   4.743   088.4                                      OFF     ON      ON      ON      OFF
0617 SITE 01  6.285   5.095   2.359   100.0

0618 SITE 01 CHANNEL 004 ANALOG EVENT: RETURN TO LOWER RED LIMIT      Main Via Power

0618 SITE 01  6.209   7.536   4.744   099.9                                      OFF     ON      ON      ON      OFF
0618 SITE 01  6.287   5.095   2.359   100.0

0700 SITE 01  6.212   7.542   4.747   100.0                                      OFF     ON      ON      ON      OFF
0700 SITE 01  6.289   5.095   2.359   100.0

0722 SITE 01 CHANNEL 027 STATUS EVENT: FALLING EDGE DETECTED      Outside Lights  OFF
0722 SITE 01 CHANNEL 028 STATUS EVENT: FALLING EDGE DETECTED      Tower Lights    OFF

0722 SITE 01  6.214   7.547   4.750   100.0                                      OFF     OFF     OFF     ON      OFF
0722 SITE 01  6.293   5.094   2.359   100.0

0800 SITE 01  6.214   7.547   4.750   100.0                                      OFF     OFF     OFF     ON      OFF
0800 SITE 01  6.293   5.093   2.358   099.9
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MRC-2 Automatic Logging Option provides a clear, easy to read printout with user-created headings automatically printed at the top of each log page.

MULTIPLE DIRECT COMMAND

Site selection, channel selection, and function (raise or lower) may be accomplished with a single button with the addition of the Multiple Direct Command option. This pre-programmed panel contains 16 buttons with true tally back lamps to indicate that a control function has been implemented. This is especially useful for simplified operations of frequently needed or seldom used functions, such as transmitter switching.

MULTIPLE STATUS DISPLAY

Some applications of the MRC-2 may require the ability to simultaneously monitor a number of status channels at either a Control Terminal or Remote Terminal. The optional MRC-2 Multiple Status Display panel permits presentation of a block of 32 status channels from a site, in the form of LEDs, with user-produced labeling. A status output driver for indicators external to the panel is included.

DIGITAL TELEMETRY INPUT

Digital telemetry may be input to the MRC-2 System in the form of four BCD digits or 14-bit binary input with sign, bypassing conversion from analog to digital data. This digital data will be displayed directly on the MRC-2 Control Terminal, Remote Terminal, and CRTs. Each plug-in conversion card will accommodate one digital input.

BARRIER STRIP INPUT/OUTPUT PANEL

A Barrier Strip Input/Output Panel is available to simplify the connection of telemetry and status inputs as well as open collector or optically-isolated command outputs. Each rack-mounted panel includes an interconnecting cable with plug for 16 input or output connections with grounds, and may be expanded up to a total of 64 lines or channels per panel.

COMMAND INTERFACE PANEL

A Command Interface Panel option is available for providing relay-isolated command lines for interconnecting to transmitter or plant control circuits not suitable for standard transistor switching. Each CIP-2 Panel provides 16 relay sockets and power supply with ribbon cable for direct connection to the MRC-2 standard command outputs. The relays are available separately to allow configuring as required.

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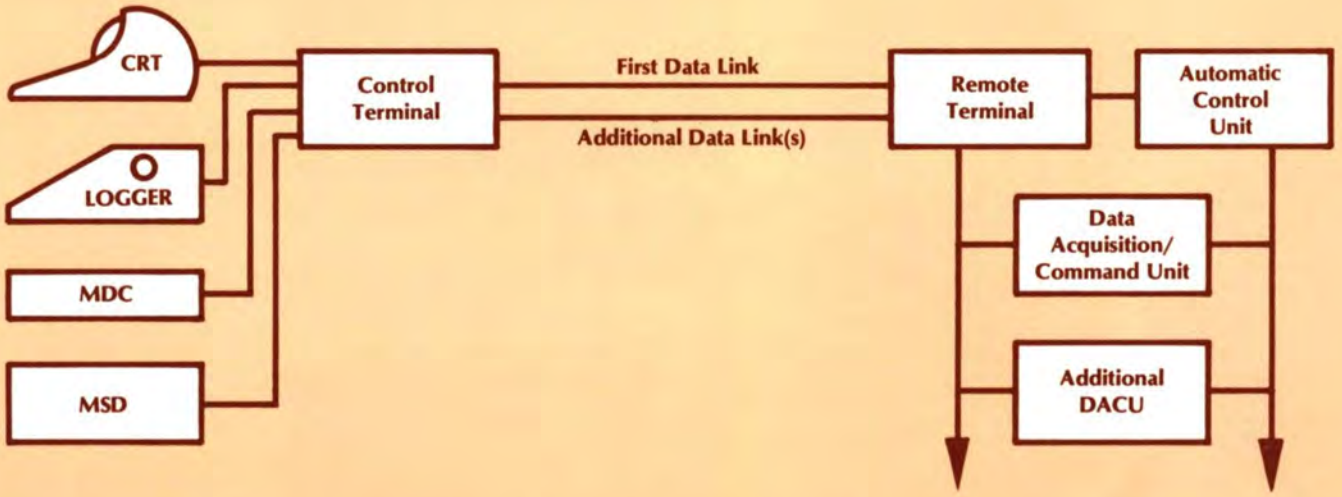
SYSTEM INTERCONNECT

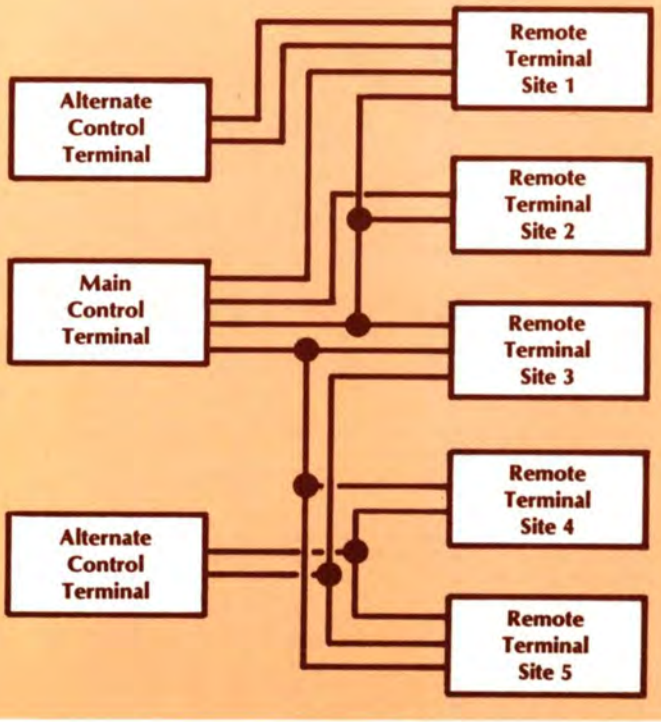
The MRC-2 System allows maximum flexibility in interconnecting Control Terminals and Remote Terminals. The basic system (one Control Terminal, one Remote Terminal) is provided with two wire-line modems on each Terminal. This type of interconnection is intended for use with suitable telephone lines or radio links conveying baseband audio in the 300-3,000 Hz range. Optional FM subcarrier generators and demodulators are available to replace the standard interface on the input and/or output for each modem. These units are available in the 26 kHz to 185 kHz range on standard frequencies suitable for conveyance over aural studio-transmitter links as well as FM or aural TV carriers. An RS-232 option is also available for users desiring to integrate their own modems or specialized forms of transmission into the MRC-2 System.

MRC-2 Systems employing two data links between a given pair of terminals will make use of both data links to enhance system speed as well as reliability. Up to six modems may be used in a Control Terminal, while up to four modems may be used in a Remote Terminal, allowing up to two modems per Control Terminal/Remote Terminal interconnect. As transmission is nonsimultaneous within a given subsystem, Remote Terminals may be paralleled to a Control Terminal modem. Typical MRC-2 multiple Control/Remote Terminal interconnection is shown in the illustration to the right.

MRC-2 SYSTEM BLOCK DIAGRAM



TYPICAL MRC-2 MULTIPLE CONTROL/REMOTE TERMINAL INTERCONNECTION DIAGRAM



SPECIFICATIONS

Type of System:
- Microprocessor-based, distributed intelligence

Types of Memory Used:
- Programmable Read-Only Memory for system firmware
- Electrically-Alterable Read-Only Memory with supplementary Random Access Memory for user programmed functions
- Firmware and user-programming non-volatile, kept intact during power failure, no battery backup required

Real-Time Clock:
- Crystal-controlled with battery power backup for power failure duration of up to one year

Remote Site Capability:
- One to 99 sites, coded protocol

Control Terminal Configuration
- Up to four per Remote Terminal, one functioning as master Control Terminal

Command Lines:
- Programmable momentary, momentary pulse, or latching
- Command response time: 750ms to implementation, nominal
- Momentary pulse duration: 0.1 to 6.4 seconds
- Open collector output standard (will switch up to 250 mA at 48 VDC, user-supplied voltage)
- Front-panel tally-back LED indicators
- 0 to 255 lines per site in 16 line increments, 32 lines per DACU-1 supplied standard
- Optically isolated and relay interfaces optional

Telemetry Channels:
- One-person digital calibration, via Remote Terminal keyboard
- Fully tolerance alarmed, dual high and dual low limits
- Absolute, linear, power-to-linear conversion, indirect power, ratio, digital word calibration
- Full four-digit LED display with decimal point and polarity sign
- Resolution: one part in 1024
- Overall measurement accuracy: better than 0.5%
- Response time: 500 ms, nominal, independent of channel load
- Up to 64 channels per Data Acquisition/Command Unit
- Full scale input level: +300 mV minimum, +1 V minimum recommended, +5 VDC maximum (field-alterable to +10 VDC maximum)
- 0 to 255 channels per site in 16 channel increments, 32 channels per DACU-1 supplied standard
- Digital telemetry input optional

Status Channels:
- User-programmable N.O./N.C., momentary or latching, alarm or event indication
- Status response time: 500 ms, nominal, with up to 64 channels per Data Acquisition/Command Unit
- TTL-compatible input standard (+5 VDC switched by external contacts)
- 0 to 255 channels per site in 16 channel increments, 32 channels per DACU-1 supplied standard
- Optically isolated input optional

Aural Alarms:
- Control and Remote Terminals, defeatable and remotable

Fail-Safe:
- Control: complies with current FCC requirements for AM, FM and TV
- Telemetry: optional, complies with current FCC requirements for TV, includes internal one-hour timer

Maintenance Override:
- Remote Terminal front-panel button
- Provides Remote Terminal "go home" relay closure and Control Terminal alert indication

Number of Data Interconnection Links:
- Up to four per Remote Terminal
- Up to six per Control Terminal
- Two per Terminal supplied standard

Data Transmissions:
- Seven bit ASCII with parity plus Longitudinal Redundancy Character Check
- 1200 baud each direction standard
- Two-way, non-simultaneous via FSK, 1200/2200 Hz

Wire Interconnection:
- Two-wire or four-wire, 600 ohm, balanced
- Series 3002 unconditioned data channel per Bell System Technical Reference Publication 41004 (FCC tariff No. 260) for 1200 baud (standard)
- Two-way, non-simultaneous
- Nominal send level: 0 dBm, minimum receive level: -30 dBm
- RS-232 interconnection optional

Radio Interconnection:
- Single or duplex, internal subcarrier systems available on standard frequencies between 26 and 185 kHz
- Nominal level: 1.5 V P-P at 2 k ohms
- Specify frequency and exact radio link when ordering

Operating Temperature Range:
- 0° - 50°C

Power Requirements:
- Control Terminal, Remote Terminal, Data Acquisition/Command Unit (each): 120/240 VAC, 50/60 Hz, 100 Watts, nominal

Physical Size:
- Control Terminal, Remote Terminal, and Data Acquisition/Command Unit: 17.8 cm H x 48.3 cm W x 39.4 cm D (7" H x 19" W x 15.5 " D), depth less connectors

OPTIONS

Optically Isolated Command Outputs:
- 16 output lines per module, optical isolators driving high-current Darlingtons
- Switches up to 250 mA, 48 VDC, at up to +50 VDC from ground, user-supplied

Relay Isolated Command Outputs (Model CIP-2):
- 16 output lines per panel, one SPDT relay per command line
- Barrier Strip outputs
- Up to 5A, 240 VAC per relay

Optically Isolated Status Inputs:
- 16 lines per module, LED optical isolator
- Input 10-48 VDC (3-15 V strappable), 5-30 mA current, user-supplied voltage
- Maximum voltage to ground: +50 VDC

Multiple Direct Command:
- 16 buttons per unit with LED tally back
- Each switch individually programmable for site and command line, includes external command input

CRT Display/Control:
- ADDS Regent 40 terminal with full ASCII keyboard and 12-inch CRT
- 15-foot cable, interface cards and software
- 9600 baud (960 characters/second)

Automatic Logging:
- Teletype Model 43 KSR printer with full keyboard
- 15-foot cable, interface cards and software
- Logs in "plain-English" with addition of CRT option
- Logs parameters from attached Remote Terminal or any sites accessed by an attached Control Terminal

Automatic Control Unit:
- User-programmed with CRT from CRT option or printer from Automatic Logging option
- Programming in BASIC-like language allows complex algorithms involving commands, status, telemetry, time and date
- Programming held in non-volatile EAROM

Multiple Status Display:
- 32 LEDs per unit
- Displays block of 32 status channels for one site, includes external display output

Digital Telemetry Input:
- Input: Four BCD digits with sign or 14-digit binary
- One input per module
- Card and software

Barrier Strip Input/Output Panel (BSP-1):
- 16 input channels or output lines per panel standard, expandable to 64 in groups of 16
- Panel with 16 barrier strip(s) and interconnecting cable(s)

FOR FURTHER INFORMATION PLEASE

CONTACT OUR MARKETING DEPARTMENT

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