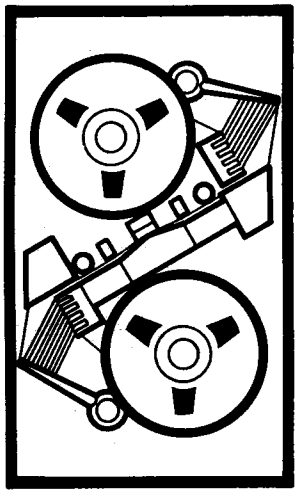
TRW-130 (AN/UYK-1)

DATA PROCESSING SYSTEM

MAGNETIC TAPE SYSTEM



Thompson Ramo Wooldridge Inc.

TRW-130 (AN/UYK-1)

DATA PROCESSING SYSTEM

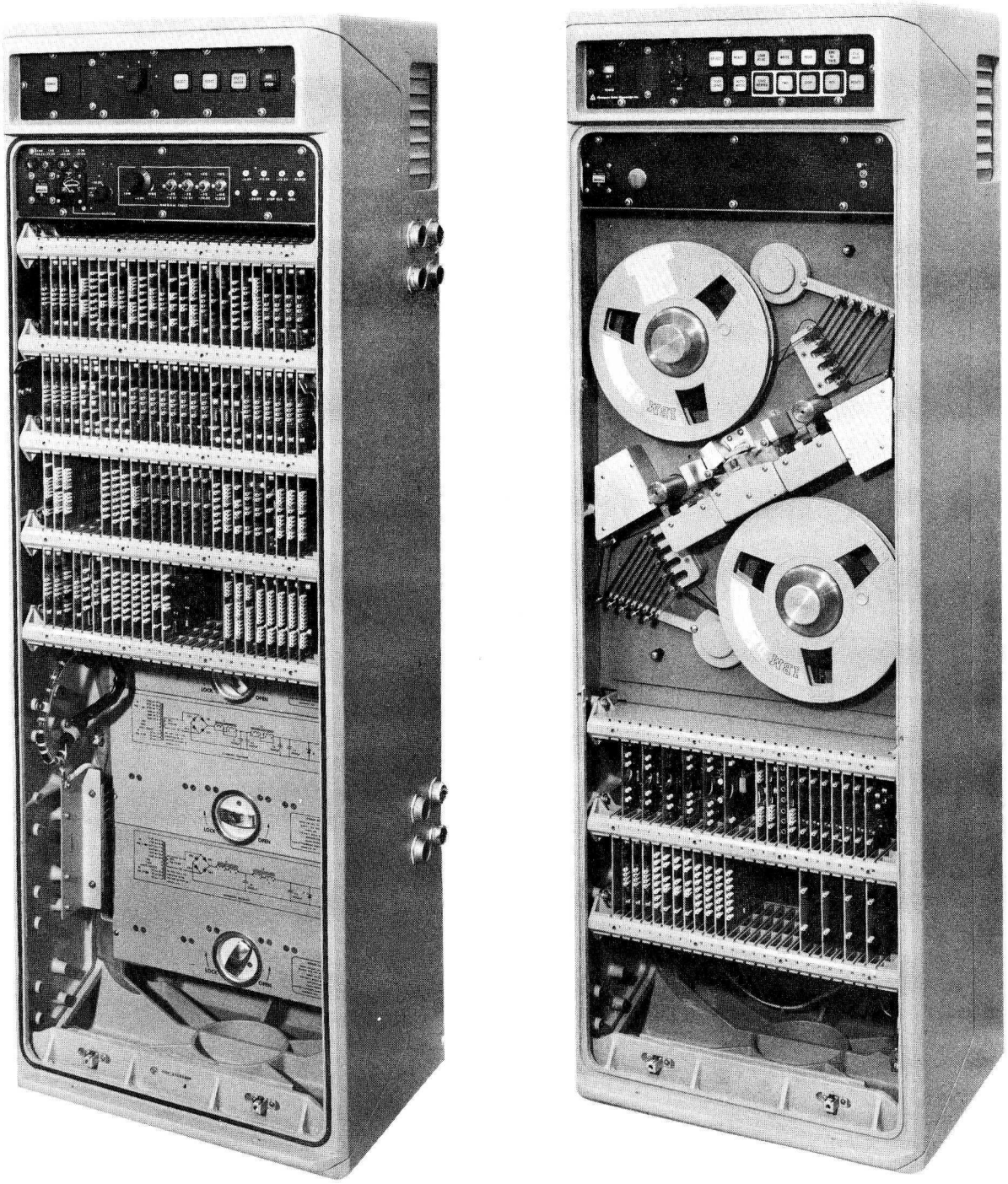
MAGNETIC TAPE SYSTEM

Thompson Ramo Wooldridge Inc.

RW *DIVISION*

8433 FALLBROOK AVENUE • CANOGA PARK, CALIFORNIA • DIAMOND 6-6000

M250-2U39 OCT. 1962



TRW-192 Magnetic Tape Controller and TRW-170 Magnetic Tape Unit
(with covers removed)

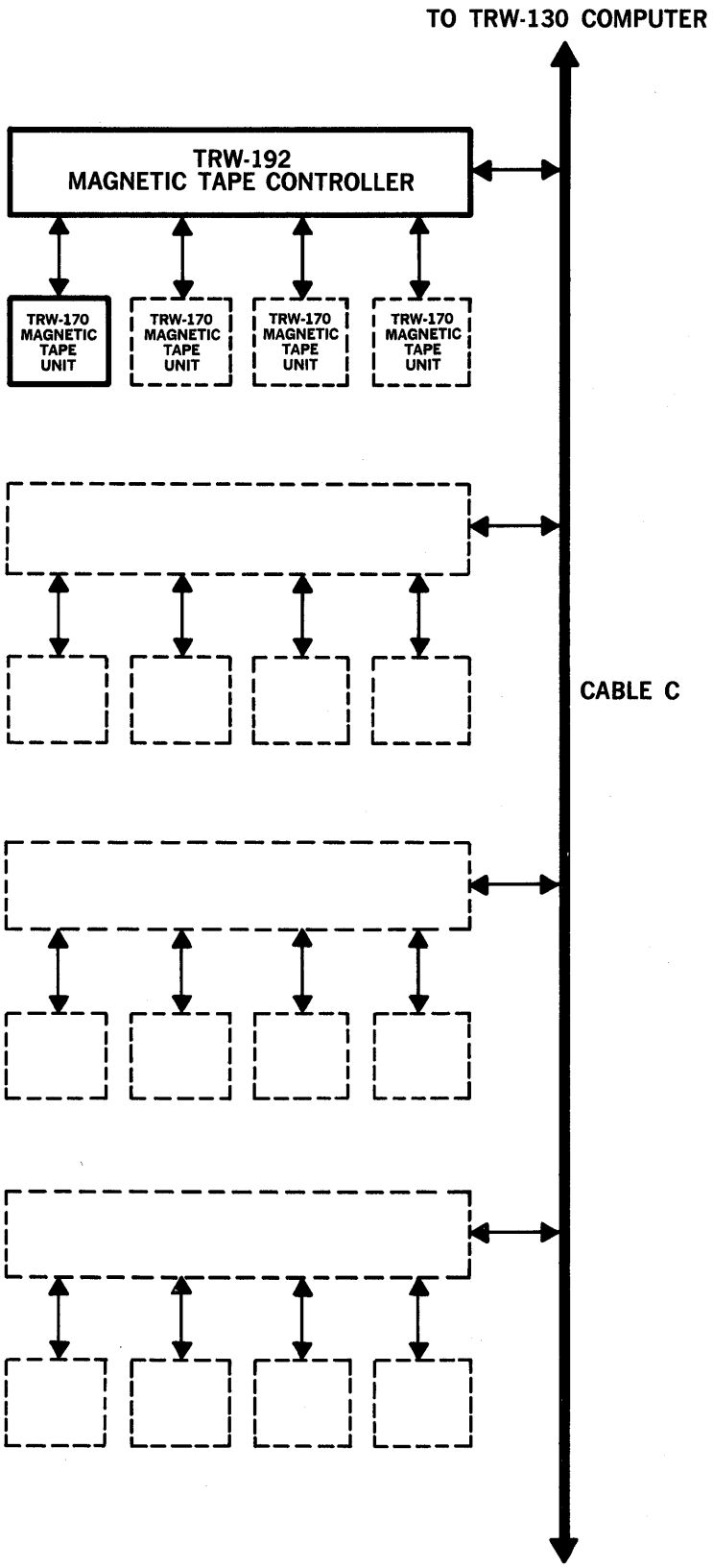
CONTENTS

1. The System 1

2. The Equipment 5

3. Operation 9

4. Specifications 11



Magnetic Tape System, Block Diagram

1. THE SYSTEM

The Magnetic Tape System further extends the capabilities of the TRW-130 Data Processing System in applications with high-speed input and output requirements. Such applications include test data processing; telemetry data editing, scaling, selection, etc.; ground station control; real-time data gathering; file search, sort, and updating; and many others. A single Magnetic Tape System consists of one to four TRW-170 Tape Units and a TRW-192 Magnetic Tape Controller that controls them by program selection. A TRW-130 Digital Computer can accommodate four Controllers, and therefore as many as sixteen Tape Units. An option to the TRW-192 Controller lets either of two computers address a single TRW-192 and so give both computers access to a common file of data. The most important user benefits of the tape system are:

. . . ruggedness. Controller and Tape Units are compactly packaged in a cast aluminum cabinet, virtually identical to that of the militarized TRW-130 Digital Computer, and can thus be used in the same severe environments where the TRW-130 has already proved its worth. They are dripproof, highly shock- and vibration-resistant, and can operate in ambient temperatures from 0°C to 50°C. Tape Units use the Cook Electric Company Model 59 tape transport, noted for its ruggedness.

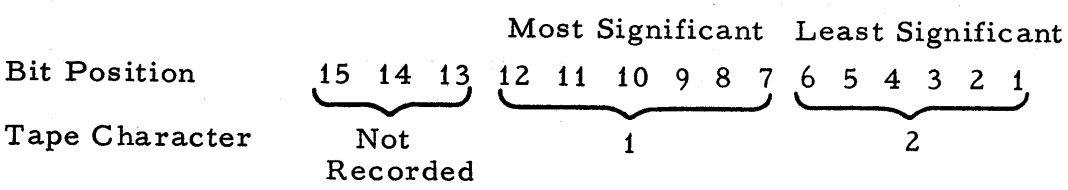
. . . compatibility. System permits information exchange with larger IBM computers because it is compatible with IBM tape equipment in format, photo-sense and write lock-out features.

. . . operational convenience. Programmed control and manual selection switches offer unrestricted addressability. Front access to tape desks and controls make for easy maintenance. Since Tape Units can be installed in any increment from one to sixteen (four per Controller), the system can economically meet auxiliary storage requirements as they arise.

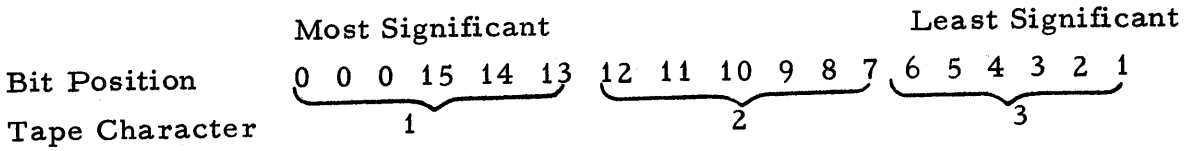
Recording Format

In response to programmed commands, data can be recorded on tapes in either alphanumeric or binary mode.

In the alphanumeric mode, logical elements in the Controller split the 15-bit computer word into two 6-bit characters (the three most significant bits of the word are not recorded). Recording format is then as follows:



In the binary mode, the controller assembles three 6-bit characters from the computer word by filling out the first character with zeros. This permits recording of the entire word, as follows:



During read operations these processes (internal to the Controller) are reversed to form standard Computer words from the tape characters.

Speed, Transfer Rates, Storage Capacities

Tapes can be recorded at alternative packing densities of either 200 or 556 bits per inch (desired density is selected by a switch on the TRW-170 control panel). Speed of tape past the heads is 75 inches per second, and so results in transfer rates of 250,000 bits per second (41.7 kc/sec) at high density, and 90,000 bits per second (15 kc/sec) at low density.

High speed rewind is accomplished at the rate of 225 inches per second, permitting an entire reel to be rewound in 128 seconds.

A single 2400-foot reel of tape, mounted in a single TRW-170, can store fifteen million characters when recorded at high density. This represents seven and a half million computer words in the alphanumeric mode, or five million in binary. The corresponding figures for low density operation are 5,4000,000, 2,700,000, and 1,800,000.

IBM Compatibility

The Magnetic Tape System is capable of writing and reading magnetic tape which is physically identical to tape produced by an IBM 729 Mod II or IV, high or low density, tape unit, operating in the binary mode. With programmed code conversion, compatible BCD tapes can be handled. In addition, the low density mode is identical with IBM Mod I tapes, and the high and low density modes are identical with the two lower density modes of IBM Mod V. The following table illustrates the interchange capability of the TRW Tape System.

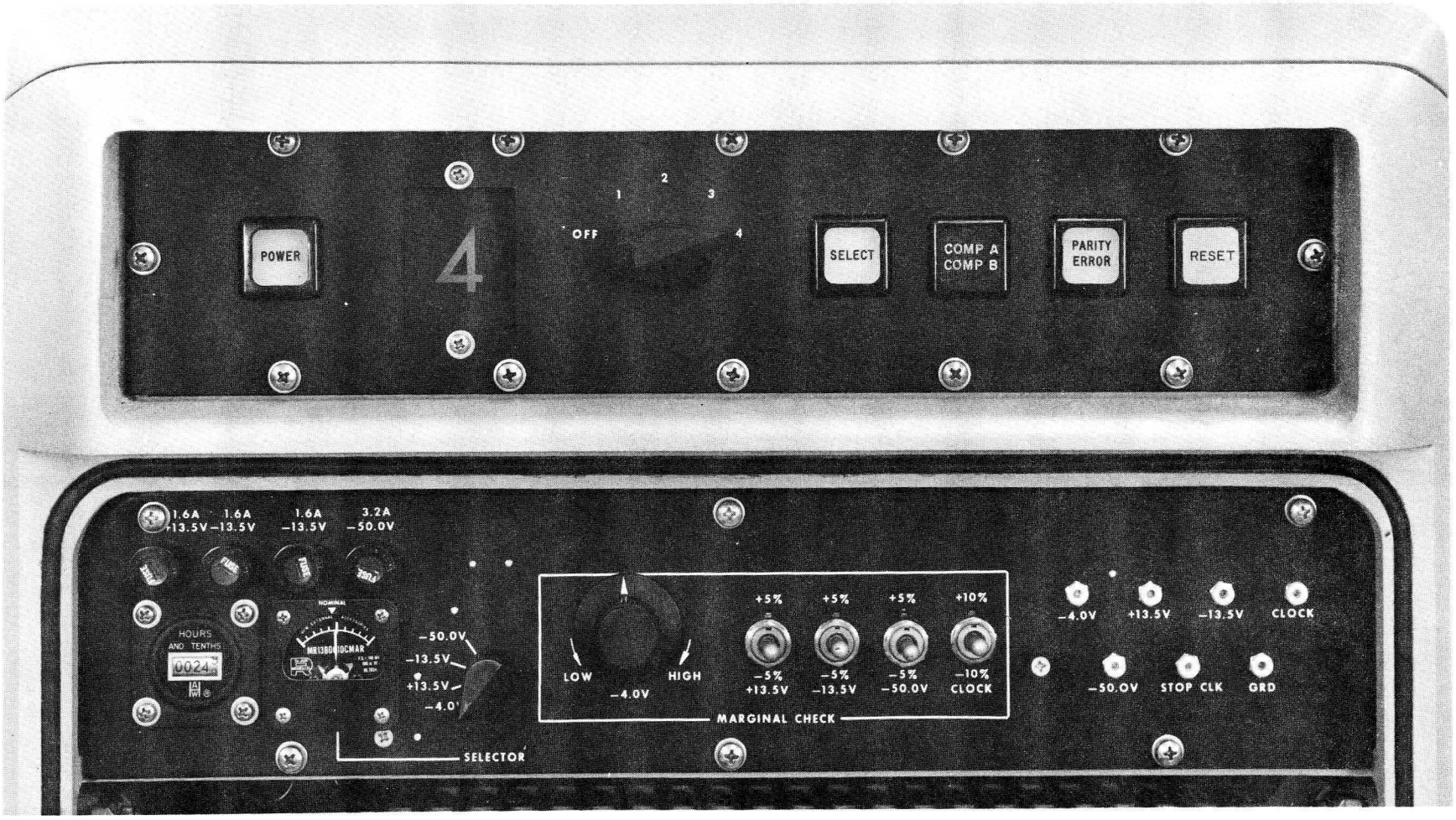
Density (Char/in)	IBM 729 Mod I	IBM 729 Mod II	IBM 729 Mod IV	IBM 729 Mod V
200	Yes	Yes	Yes	Yes
556	X*	Yes	Yes	Yes

*"X" Indicates Mod does not have this density.

Parity

A lateral parity digit (even or odd parity may be selected manually by a switch on the TRW-170 panel) is generated during writing and is recorded along with each six-bit character. A longitudinal parity character is written at the end of each information block.

Lateral parity is checked while writing by employing a set of read heads separated from the write heads so that characters are read and parity checked 4 milliseconds after they are recorded. During read operations both lateral and longitudinal parity are checked. Detection of any parity error causes a "Parity Error" indicator to be set.



Control Panel, TRW-192 Magnetic Tape Controller

2. THE EQUIPMENT

TRW-192 Controller

The Controller is housed in a cabinet nearly identical in size (59" high, $20\frac{1}{2}$" wide, 18" deep), as well as in its cast aluminum construction, to that of the TRW-130 Digital Computer. It contains power supplies and logical circuitry for communicating with the Computer and controlling the Tape Units.

The control panel of the TRW-192 consists of several indicators and switch/indicators that make for simple and reliable operation. Their functions are briefly described below.

Indicators

When illuminated, the indicators listed display the following conditions to the operator:

SELECT. Controller is presently "connected" to one of two Computers, for use in a program.

COMP A/COMP B. Indicates which computer is presently connected to the Controller.

PARITY ERROR. Parity error detected; light is extinguished only by RESET switch or command from computer.

Switch/Indicators

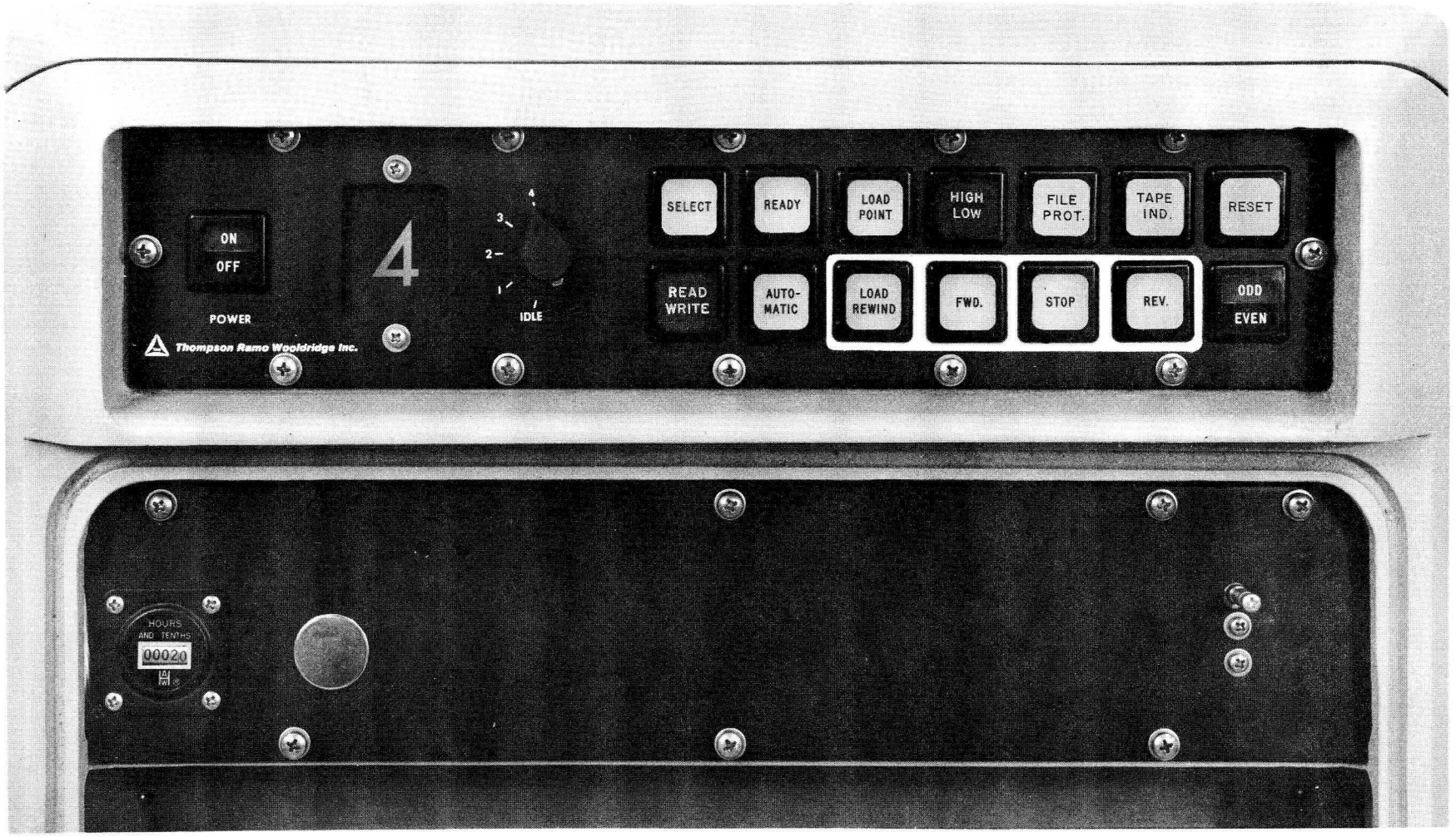
The switch/indicators are pushbutton controls with back-lighted labels. When pressed, the switch /indicators listed cause the following actions:

POWER. Turns power on(and off, when pressed again), for all parts of tape system except transports. Indicator is illuminated when power is on.

RESET. Disconnects Controller from Computer in emergencies and resets indicators used in the connection sequence. Switch stays in depressed position, and RESET indicator stays illuminated, until pressed again.

Tape Controller Selector Switch and Indicator

In systems with more than one controller, the TAPE CONTROLLER SELECTOR SWITCH serves to identify specific controllers to a computer. A computer addressing "Controller No. 3," for example, will connect only to a controller with its switch set to the "3" position. The TAPE CONTROLLER SELECTOR INDICATOR will display the number assigned to the controller.



Control Panel, TRW-170 Magnetic Tape Unit

TRW-170 Magnetic Tape Unit

The Magnetic Tape Unit is housed in a cabinet nearly identical in size (59" high, 20" wide, $16\frac{1}{2}$" deep), as well as in its cast aluminum construction, to that of the TRW-130 Digital Computer. It contains power supplies for the transport and logical circuitry for communicating with the Computer via the Controller.

The control panel of the TRW-170 consists of several indicators and switch/indicators, that make for simple and reliable operation.

Indicators

When illuminated, the indicators listed signal the following conditions to the operator:

SELECT. Tape Unit has been selected for the current or last operation.

READY. Tape Unit is ready for read or write operation (i. e., tape is not being rewound, dust cover is on cabinet, RESET switch is not depressed—a total of eight operating conditions has been met).

LOAD POINT. Tape is positioned at load point (beginning of tape).

READ/WRITE. Tape is being read (upper half of indicator); tape is being written or erased (lower half).

FILE PROT. Tape reel currently on transport has no file-protect ring.

TAPE IND. Tape has reached end-of-tape reflective spot, or end of file mark was the last record read.

Switch/Indicators

The switch/indicators are pushbutton controls with back-lighted labels. (whenever a switch is activated, the associated label is illuminated.)

HIGH/LOW. Selects desired density.

AUTOMATIC. Puts unit under control of TRW-192 Controller; when pressed again, puts unit under control of operator.

LOAD REWIND. Moves tape in reverse at high speed until it reaches load point, or until STOP switch is pressed. Under TRW-192 control (AUTOMATIC), switch is ineffective, though indicator is illuminated when tape is being rewound.

FWD. Moves tape forward. With unit under TRW-192 control, switch is ineffective though indicator is illuminated during forward motion.

STOP. Stops tape motion. With unit under TRW-192 control, switch is ineffective though indicator is illuminated whenever tape is not in motion while power is applied.

REV. Tape moves in reverse (at regular speed). With unit under TRW-192 control, switch is ineffective though indicator is illuminated during reverse motion (indicating the rewind operation).

RESET. Stops tape motion for emergencies, causing READY and AUTOMATIC indicators to be extinguished and the Computer to stop transferring data. When switch is pressed again, tape unit is reset, i. e., ready to respond once more to TRW-192 or operator control signals.

ODD/EVEN. Selects odd or even parity.

ON/OFF. Turns on power for tape transport (and off, when pressed again).

Tape Unit Selector Switch and Indicator

The TAPE UNIT SELECTOR SWITCH serves to identify specific tape units to the Computer for ultimate addressing by the Controller. A Controller addressing "Tape Unit No. 4," for example, will connect only to a Tape Unit with its switch set to the "4" position. The TAPE UNIT SELECTOR INDICATOR will display the number assigned to the unit.

3. OPERATION

Connection to the Computer

Communication between Computer and Controller occurs via Cable C_{in} and Cable C_{out}. Under program control, the Computer can "connect" to the tape system by means of an External Function command that selects a particular tape unit. The following functions can be selected:

Backspace one record
Rewind tape
Read tape alphanumeric
Read tape binary
Erase 8 inches of tape
Write end-of-file
Write tape alphanumeric
Write tape binary
Test tape status

When the Controller accepts an External Function command, it causes the tape to start moving and a status word to be assembled and put on the lines of Cable C_{in}. Inspection and use of the status word is at the option of the programmer.

If the Controller cannot accept a tape motion command, it generates a Type II Interrupt, enabling the computer to read the status word and determine the reason for the interrupt, by executing, under program control, a Type II Interrupt routine. Typical conditions that may start this process are:

1. Any command, except TEST STATUS, given when the tape unit is inoperative.
2. Any WRITE command to a file-protected tape.
3. Any WRITE command except WRITE END-OF-FILE given after the end of tape is sensed.
4. Any command given when Controller or Tape Unit is busy, i.e., REWIND, BACKSPACE, etc.
5. Any read command issued to a Tape Unit to which the last command issued was any of the WRITE commands.

In some of these situations, the final result of the interrupt routine will be an alert signal to the operator, in others a correction of the situation itself.

Data Transfer

If the command is READ, the Controller, after the tape is up to speed, assembles two or three 6-bit characters from the tape into a 15-bit word and transfers it to the computer. The transfer can be by word or block transfer logands.

If the command is WRITE, the Controller, after the tape is up to speed, receives a 15-bit word and breaks it into two or three 6-bit characters, and records them on tape. The transfer from Computer to Controller can be by word or block transfer logands initiated by a Type I Output Interrupt.

Because of IBM compatibility requirements, a delay of at least 7.5 milliseconds occurs between the time the computer issues a WRITE command and the time it starts writing, but—because of the TRW-130 System's interrupt provisions—this 7.5 millisecond interval is put to good use: The Computer returns to its internal processing tasks until it receives a Type I Interrupt to initiate the actual data transfer.

Termination

In the READ mode, tape stopping action begins if the computer does not send a command to continue tape motion within 1.2 milliseconds after the last character has passed under the read heads. In the WRITE mode, the Controller initiates tape stopping action if the Computer stops sending words. Both events signal the completion of transfer of a block of data. When the tape stopping action is initiated, the Controller becomes automatically "disconnected" from the Computer after 4 milliseconds. During WRITE command, disconnection occurs 4 milliseconds after the Computer stops sending data. With a READ command, disconnection occurs immediately (3 microseconds) after the end of a block is detected.

Data Checking

Both lateral and longitudinal parity checks are kept on all information recorded on tape. To check the parity indicator after writing, only a TEST STATUS command need be executed, as the data is read-checked, simultaneously with writing.

Interpretive Routines

The magnetic tape Interpretive Routine presently has the following lograms:

Read one record into memory
Write one record onto tape
Read "n" words into memory
Skip "n" files on tape
Backspace "n" records
Backspace "n" files
Write end of file
Rewind

Additional lograms will be created as required.

4. SPECIFICATIONS

PERFORMANCE

Recording Format

Method:	NRZ (non-return to zero)
Number of Tracks:	7 (6 data, 1 parity)
Inter-Record Gap:	3/4 inch min.
Tape Markers:	"End of Tape, ""Load Point" reflective spots
Compatibility:	IBM 729 Tapes Mod I, II, IV completely compatible; Mod V compatible if recorded at less than 800 bits/inch

Storage Media:

Type:	1-1/2 -mil Mylar tape
Width:	1/2 inch
Length:	2400 feet
Reels:	10-1/2 inch NARTB hub with file-protect ring

Tape Speeds:

Backspace:	75 ips
Read/Write:	75 ips
Rewind:	225 ips
Start Time:	3 millisec max to $\pm$ 10% nominal speed
Stop Time:	1.2 millisec max

Recording Density

High:	556 bits/inch
Low:	200 bits/inch

Character Rate

High Density:	41,700 characters/inch
Low Density:	15,000 characters/inch

Heads

Spacing Between Write and Read Heads:	0.3 inches

PHYSICAL

TRW-192	TRW-170
Height: 59 inches	Height: 59 inches
Depth: 18 inches	Depth: 16-1/2 inches
Width: 20-1/2 inches	Width: 20 inches
Weight: 400 lbs	Weight: 350 lbs
Power: 118 v, 60 cycle, 900 watts	Power: 118 v, 60 cycle, 600 watts average; 1000 watts peak

RW FIELD OFFICES

BOSTON
114 Waltham Street, Lexington 73, Massachusetts

Tel: Volunteer 2-6370
TWX: LEX MASS 1586

DAYTON
211 Talbott Tower, Dayton 2, Ohio

Tel: Baldwin 3-6266
TWX: DY 282

FLORIDA
5600 North Atlantic Avenue, Cocoa Beach, Florida

Tel: Sunset 3-2208

NEW YORK
1071 Main Street, Paterson, New Jersey

Tel: Lambert 5-0770

ROME:
405 North George Street, Rome, New York

Tel: FF 7-6100
TWX: ROME NY 8072

WASHINGTON
905 Sixteenth Street N. W., Suite 506, Washington 6, D. C.

Tel: Sterling 3-5188
TWX: WA 748

RW MAIN OFFICE

LOS ANGELES
8433 Fallbrook Avenue, Canoga Park, California

Tel: Diamond 6-6000