TRW-230 STORED LOGIC MULTIPLE PURPOSE COMPUTER MAGNETIC TAPE SYSTEM

TRW COMPUTER DIVISION
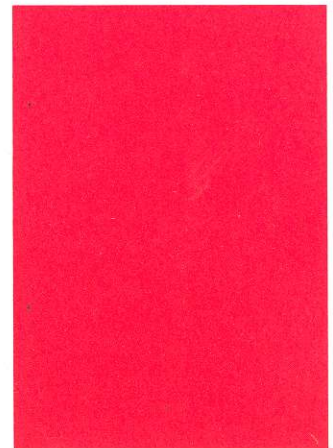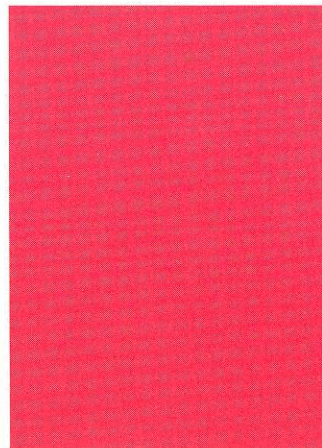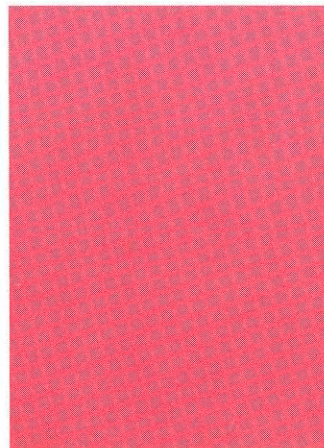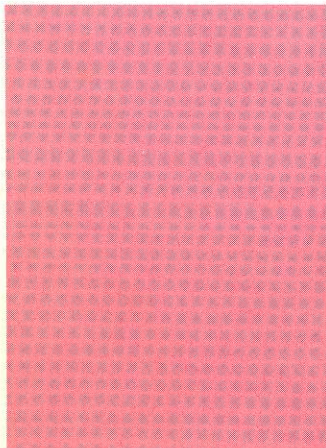
Front to rear:
Computer with 8,192 Word Core Memory, Buffer Channel,
Magnetic Tape Unit, Magnetic Tape Controller, Magnetic Tape Unit,
Controller (with Paper Tape Punch, Reader and Reeler),
24K Extended Memory Unit, I/O Typewriter.

TRW-270 Magnetic Tape Unit

TRW-292 Magnetic Tape Controller

The Magnetic Tape System provides high-speed input and output capabilities for the TRW-230 Data Processing System in applications such as:
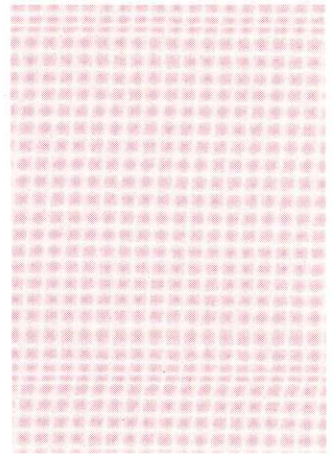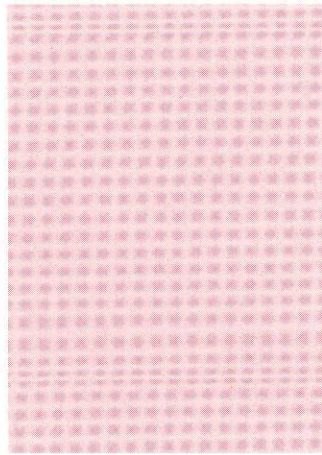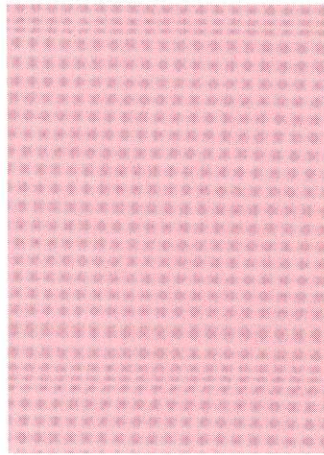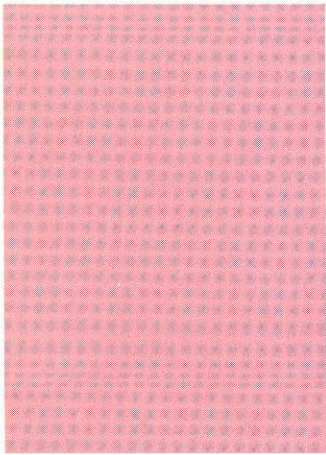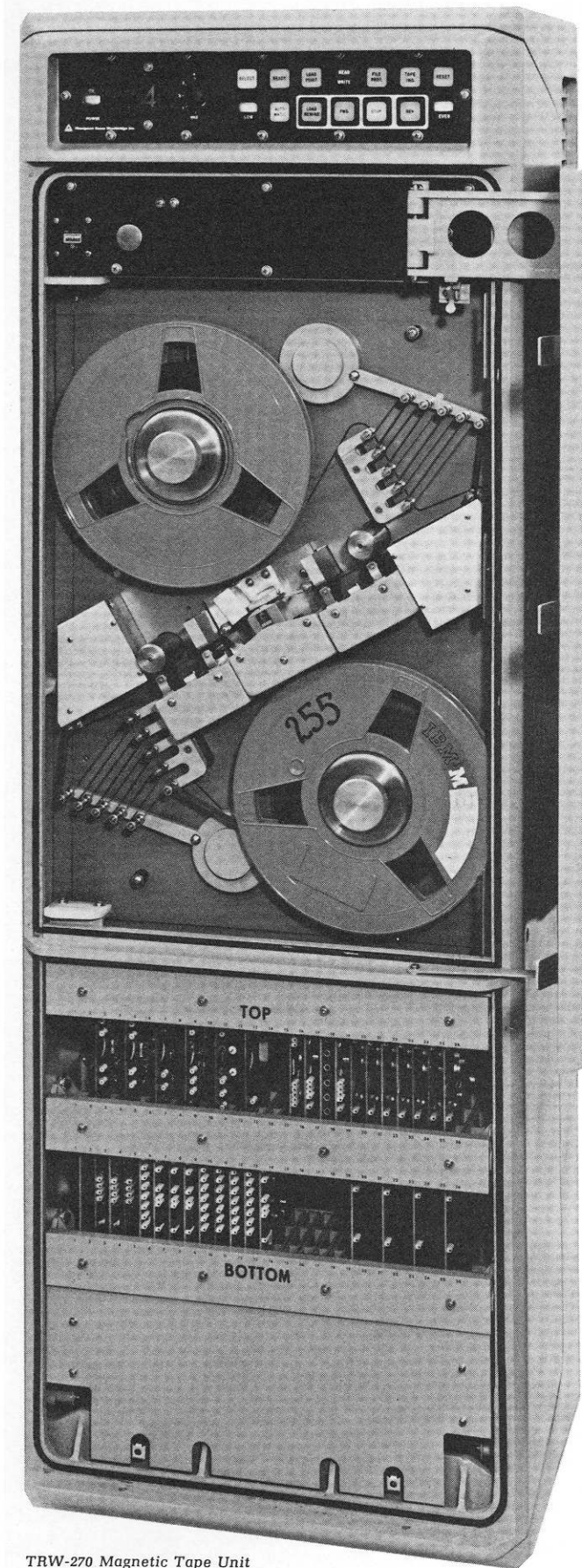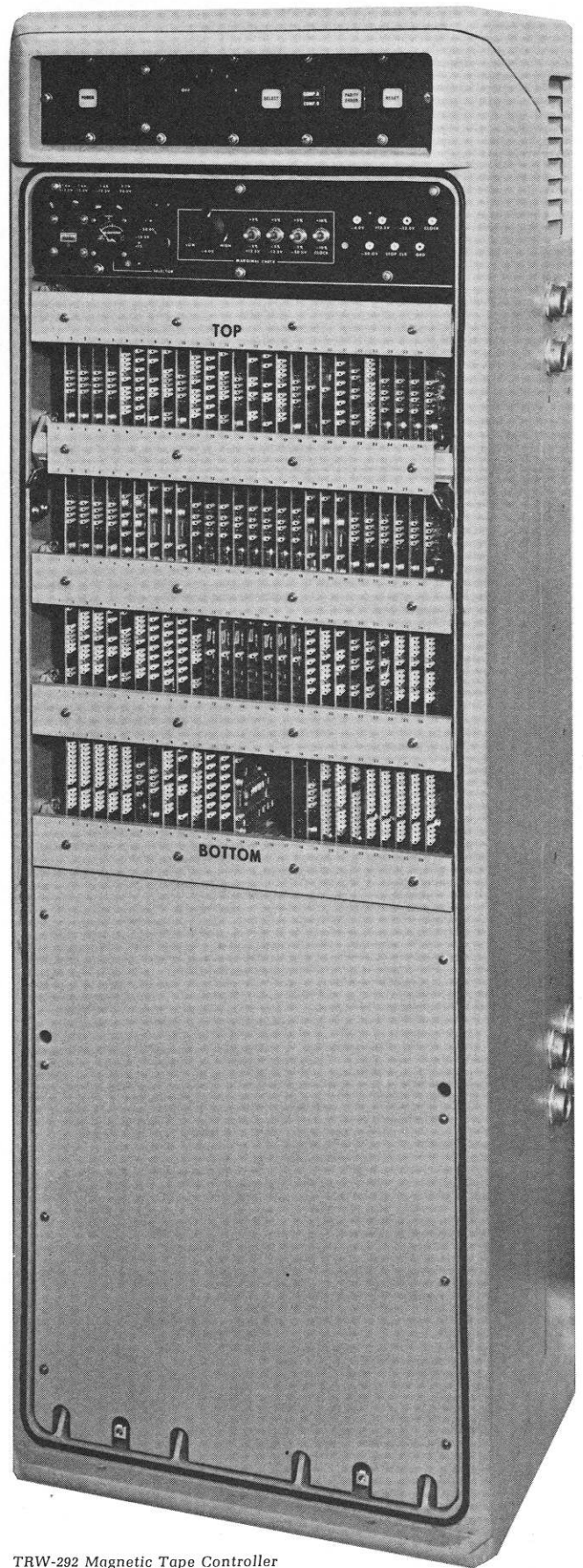
☐ test data processing

☐ telemetry data editing, scaling, selection

☐ ground station control

☐ real-time data gathering

☐ file search, sorting and updating

The Magnetic Tape System consists of multiples of two equipments: the TRW-292 Tape Controller and the TRW-270 Tape Unit. A TRW-230 Digital Computer can accommodate as many as four Controllers, each capable of handling four Tape Units. The System capacity is therefore sixteen Tape Units, all under program control if desired. The Magnetic Tape System features:

☐ *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 drip-proof, highly shock and vibration-resistant, and can operate in ambient temperatures from 32°F to 122°F. 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 switch offer unrestricted addressability. Front access to tape decks and controls makes for easy maintenance. Since Tape Units can be installed in any increment from one to sixteen, 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:

		Most Significant	Least Significant
Bit Position	15 14 13	12 11 10 9 8 7	6 5 4 3 2 1
Tape Character	Not Recorded	1	2

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

	Most Significant		Least Significant
Bit Position	0 0 0 15 14 13	12 11 10 9 8 7	6 5 4 3 2 1
Tape Character	1	2	3

During read operations, these processes are automatically reversed within the Controller, and standard computer words are assembled from either alphanumeric or binary 6-bit characters.

SPEED, TRANSFER RATES AND STORAGE CAPACITIES

Speed of the tape past the heads is 75 ips. High-speed rewind is 225 ips, permitting a 2400-foot reel to be rewound in 128 seconds. Tapes can be recorded at switch-selectable packing densities of either 200 or 556 characters per inch, resulting in the transfer rates and reel capacities shown in the table below.

Packing Density	Information Transfer Rates	Storage Capacity (Per 2400-ft. reel)
200 characters/in 1200 bits/in	15,000 char/sec 90,000 bits/sec	5.4 million characters A/N: 2.7 million computer words Binary: 1.8 million computer words
556 characters/in 3336 bits/in	41,700 char/sec 250,200 bits/sec	15 million characters A/N: 7.5 million computer words Binary: 5 million computer words

COMPATIBILITY

The recording format of the Magnetic Tape System is identical to that of the IBM 729 series tape units, so that tapes produced at either 200 or 556 bpi densities for one system can also be used on the other.

PARITY

A lateral parity digit (even or odd parity may be selected manually by a switch on the TRW-270 panel) is generated during writing and is recorded along with each 6-bit character. A longitudinal parity character is written at the end of each information block.

A set of read heads, in addition to the write heads, enables lateral parity to be checked on each character 4 milliseconds after it is written. At the end of a record (a group of consecutive characters), longitudinal parity is checked on all seven channels. Detection of an error in either lateral or longitudinal parity causes the parity error indicator to be set.
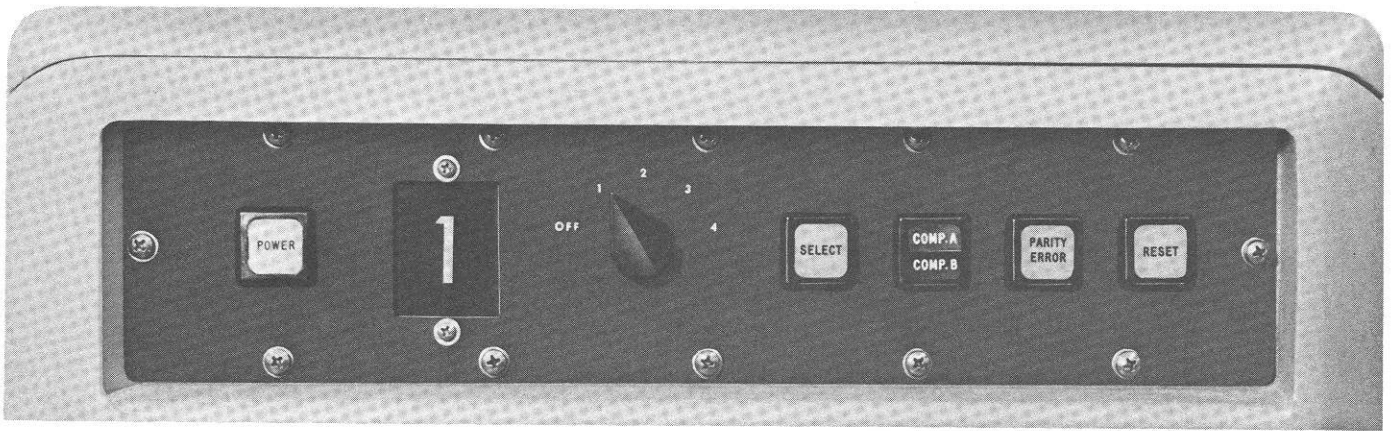
▲ *Control Panel, TRW-292 Magnetic Tape Controller*

Control Panel, TRW-270 Magnetic Tape Unit ▼
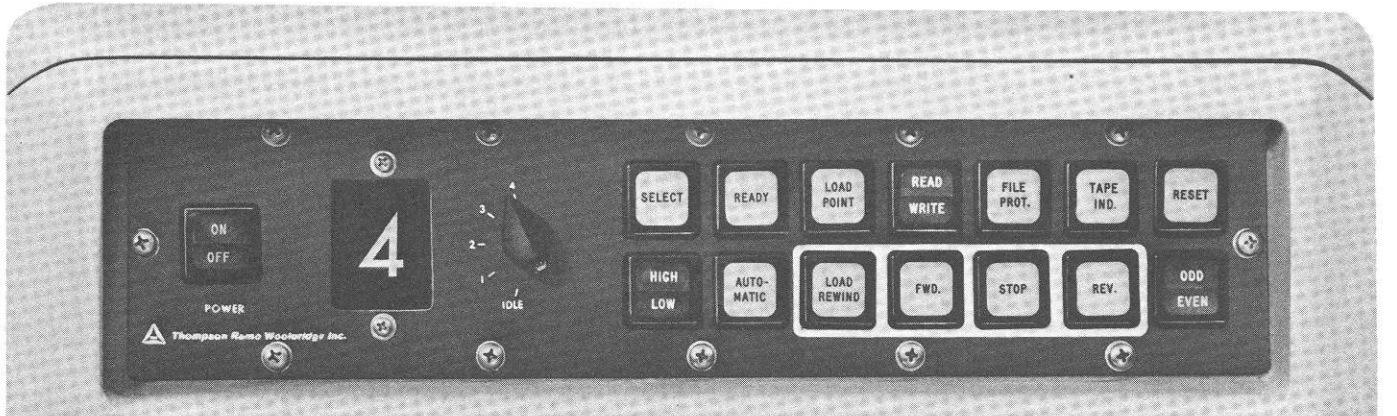
THE EQUIPMENT

TRW-292 CONTROLLER PANEL INDICATORS AND OPERATOR CONTROLS

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

TAPE CONTROLLER SELECTOR SWITCH AND INDICATOR. Selects the number by which the computer program addresses the controller.

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.

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.

TRW-270 MAGNETIC TAPE UNIT PANEL INDICATORS AND OPERATOR CONTROLS

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

TAPE UNIT SELECTOR SWITCH. Selects the number by which computer program addresses the tape unit.

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

READY. Tape Unit is ready for motion initiated under program control (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 or written.

RESET. Stops tape motion for emergencies, causing READY and AUTOMATIC indicators to be extinguished and the Controller to stop transferring data. When switch is pressed again, tape unit is reset, i.e., ready to respond once more to TRW-292 or operator control signals.

HIGH/LOW. Selects desired packing density.

AUTOMATIC. Puts unit under control of TRW-292 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-292 control, switch is ineffective though indicator is illuminated when tape is being rewound.

FWD. Moves tape forward. With unit under TRW-292 control, switch is ineffective though indicator is illuminated during forward motion.

STOP. Stops tape motion. With unit under TRW-292 control, switch is ineffective though indicator is illuminated whenever tape is not in motion while power is applied.

REV. Moves tape in reverse at regular speed. With unit under TRW-292 control, switch is ineffective though indicator is illuminated during reverse motion (at either regular or high speed).

ODD/EVEN. Selects odd or even parity.
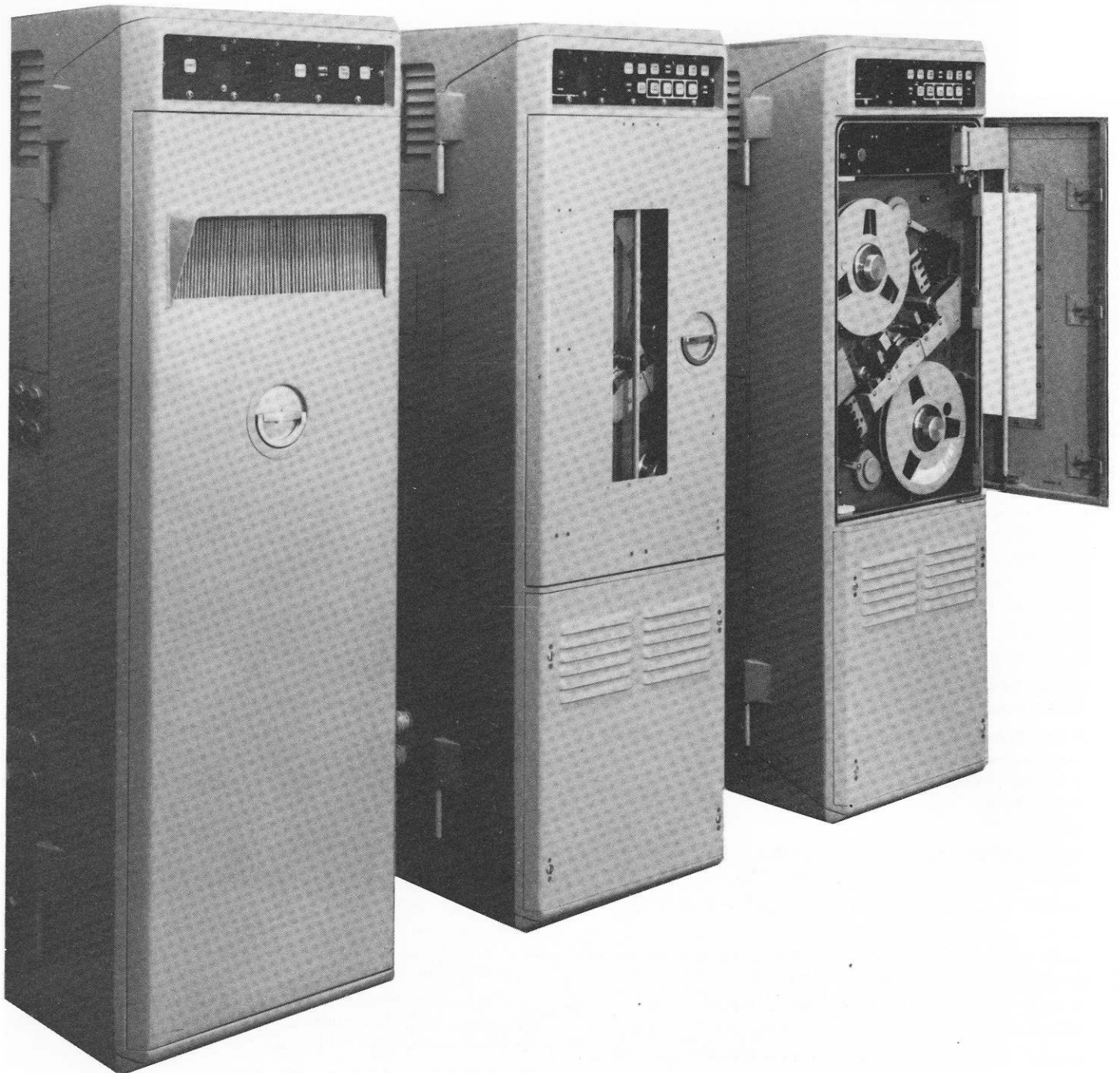
OPERATION

CONNECTION TO THE COMPUTER

Communication between Computer and Controller occurs via Channel C. 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 code
- ☐ Write tape alphanumeric
- ☐ Write tape binary
- ☐ Test tape status

When the Controller accepts any of the first eight External Function commands, it causes the tape to start moving. When the Test Tape Status command is received by the Controller, it places a status word on the input lines of Channel C. 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, in response to which the computer can 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 TAPE 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. Just prior to the transmission of the first word, the Controller generates a signal which, under program control, can cause a Type I Input Interrupt.

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-230 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 Output Interrupt to initiate the actual data transfer. A similar advantage is provided by the Type I Input Interrupt when a READ command is being executed.

CHECKING FOR PARITY ERRORS

Both lateral and longitudinal parity checks are kept on all information recorded on tape. To check the parity error indicator after reading or writing, only a TEST TAPE STATUS command need be executed. (Data is read-checked simultaneously with writing.)

TERMINATION

The Controller automatically becomes disconnected from the Computer at the completion of the execution of a command. During data transfer commands, disconnection occurs 400 microseconds after the last character of a block of data has passed under the read heads in the selected tape unit. Since information written on tape is always checked for possible parity errors, and since 4 milliseconds are required for information to pass from the write heads to the read heads, disconnection after a WRITE command occurs 4.4 milliseconds after the Computer stops sending data.

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
- ☐ Write end of file
- ☐ Rewind

Additional lograms will be created as required.

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; IBM compatible 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 characters/inch
Low:	200 characters/inch

TRANSFER RATE:

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

HEADS:

Spacing Between Write and Read Heads:	0.3 inches

PHYSICAL

TRW-292	TRW-270
Height: 59 inches	Height: 59 inches
Depth: 18 inches	Depth: $16^{1}/_{2}$ inches
Width: $20^{1}/_{2}$ inches	Width: 20 inches
Weight: 510 lbs.	Weight: 400 lbs.
Power: 118 v, 60 cycle, 575 watts	Power: 118 v, 60 cycle, 600 watts average; 1000 watts peak

TRW-230
8192 WORDS

TRW-272
EXTENDED CORE
MEMORY UNIT
8192, 16384,
OR 24576 WORDS

CONNECTOR

BUFFER
TRW-273

D CHANNEL 15 BITS
(MAY SUBSTITUTE FOR C CHANNEL)

C CHANNEL
15 BITS

TRW-251
PAPER TAPE READER
AND REELER

TRW-240
CONTROLLER

TRW-261
PAPER TAPE PUNCH

TRW-285
INPUT-OUTPUT
TYPEWRITER

TRW-286
SEND-RECEIVE SET

TRW-256
CARD
READER

TRW-257
CARD
PUNCH

TRW-266
PLOTTER

C CHANNEL

C CHANNEL

TRW-271
MAGNETIC DRUM
UNIT
65,000 WORDS

TRW-282
LINE PRINTER

TRW-287
FLEXOWRITER
SET

TRW-297
DATA LINE
SYNCHRONIZER

TO ANOTHER TRW-230

TRW-292 MAGNETIC TAPE CONTROLLER

TRW-270
MAGNETIC
TAPE
UNIT

TRW-270
MAGNETIC
TAPE
UNIT

TRW-270
MAGNETIC
TAPE
UNIT

TRW-270
MAGNETIC
TAPE
UNIT

TO OTHER TRW-230'S

C CHANNEL

TRW COMPUTER DIVISION OFFICES

For information or consultation on your computing problems,
contact the TRW-230 Regional Sales Manager at the location nearest you:

ATLANTA
3272 Peachtree Road, N.E.
Atlanta 5, Georgia
Tel.: 233-3292

BOSTON
114 Waltham Street
Lexington 73, Massachusetts
Tel.: VO 2-6370
TWX: 617-862-3219

CHICAGO
400 N. Michigan
Wrigley Bldg., Suite 516
Chicago 11, Illinois
Tel.: 222-1940

CLEVELAND
1070 East 152nd St.
Cleveland 10, Ohio
Tel.: 383-6090
TWX: 383-2005

HOUSTON
4740 Ingersoll St.
Houston 27, Texas
Tel.: 713-666-2303

HUNTSVILLE
3313 Memorial Parkway, S.W.
Huntsville, Alabama
Tel.: 881-1512
TWX: 205-881-3531

LOS ANGELES
8433 Fallbrook Avenue
Canoga Park, California
Tel.: 346-6000
TWX: 213-348-2361

NEW YORK
1071 Main Street
Paterson, N. J.
Tel.: LA5-0770
TWX: 201-278-2417

ROME, N. Y.
1333 E. Dominick Avenue
Rome, New York
Tel.: FF7-6100
TWX: 315-337-7570

WASHINGTON, D. C.
4933 Auburn Avenue
Bethesda, Maryland
Tel.: 654-9025
TWX: 301-365-8883
        or
905—16th Street, N.W., Suite 506
Washington 6, D. C.
Tel.: 783-5188
TWX: 202-965-0494