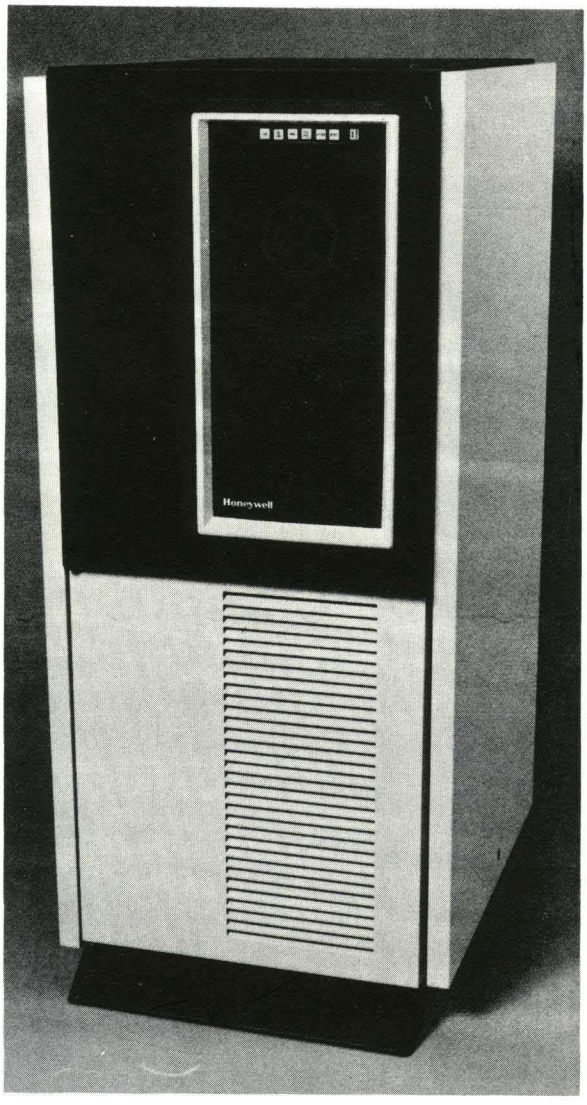
HONEYWELL

DPS 6 & LEVEL 6 NRZI/PE MAGNETIC TAPE UNIT OPERATION



HARDWARE

DPS 6 & LEVEL 6
NRZI/PE
Magnetic Tape Unit Operation

SUBJECT
General Description, Programming, Operation, and Maintenance Procedures for the DPS 6 & Level 6 Magnetic Tape Units

SPECIAL INSTRUCTIONS
This publication supersedes the *DPS 6 MTU9609/9610/9614/9615 Magnetic Tape Unit Operation* manual, Order No. CT65-00, dated April 1981 and the *Level 6 MTU9109/9110/9114/9115 Magnetic Tape Unit Operation* manual, Order No. CC61-00, dated March 1978, and its addendum, CC61-01A, dated November 1980.

Change bars in the margin indicate technical changes and additions; asterisks denote deletions.

Includes Update Pages Issued as Addendum A in September 1983.

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About This Manual

This manual contains hardware-oriented descriptions and instructions for operators of the DPS 6 and Level 6 Magnetic Tape Units. Section 1 outlines the device capabilities. Section 2 describes the various controls and indicators with which an operator should become familiar before operating the unit. Section 3 explains how to operate the unit and what routine preventive maintenance procedures the operator can perform. Appendix A provides programming information for any reader who requires it. Appendix B provides detailed device specifications.

Marketing Identifiers specific to each system are: MTU9609/9610/9614/9615 for the DPS 6 system; MTU9109/9110/9114/9115 for the Level 6 system.

Readers are invited to use the Technical Publications Remarks Form at the end of the manual to note any publication errors or to offer any suggestions for improvement.

File No.: 1R03, 1S03

CT65-01

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Section 1
Introduction

The DPS 6 and Level 6 Magnetic Tape Units are compact, self-contained tape units. Both the Level 6 and the DPS 6 offer single- and dual-density tape drives, 800 or 1600 bits-per-inch (bpi) units with transport speeds of 45 or 75 inches per second (ips) to give a maximum throughput capability of up to 120,000 bytes per second. The recording techniques used on both systems are NRZI (nonreturn-to-zero-inverted) for the 800 bpi units and PE (phase encoded) for the 1600 bpi units.

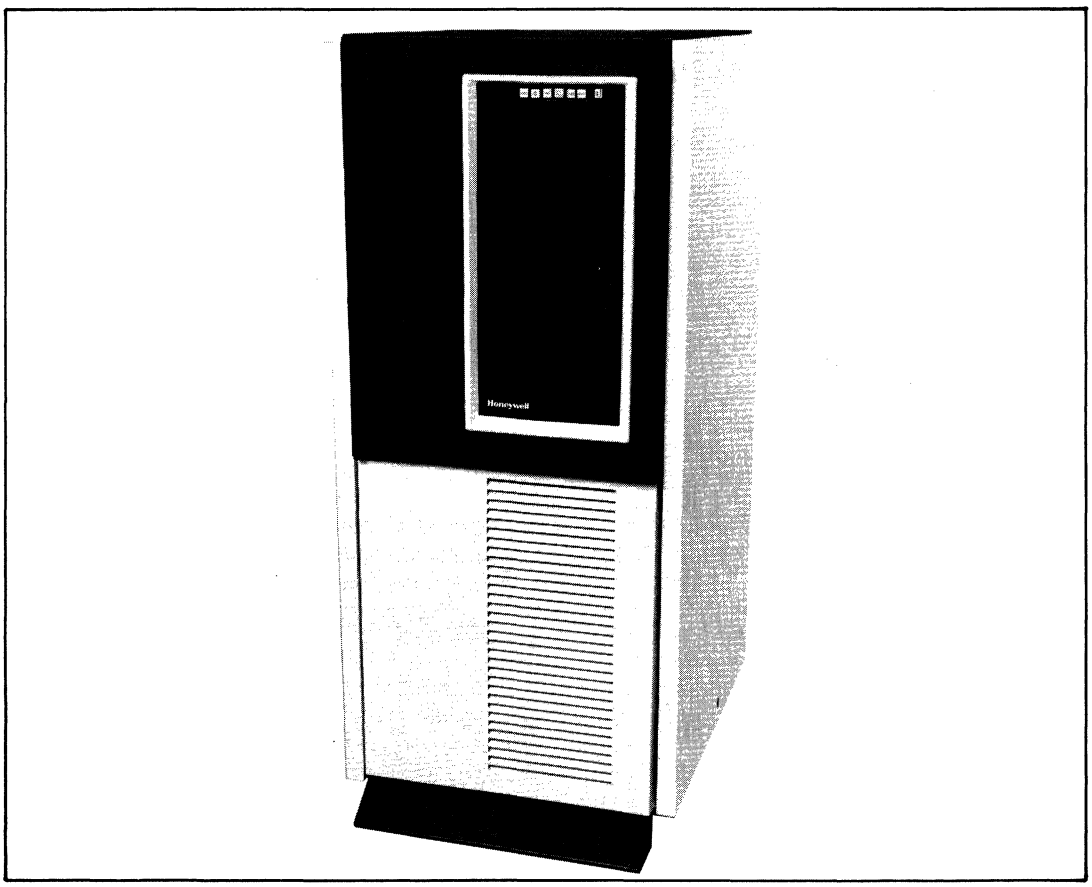


Figure 1-1. DPS 6 and Level 6 Tape Drives

Up to four drives may be used with a system. Each drive is located in a separate cabinet and is physically attached to the right of the Level 6 or DPS 6 cabinet. The first tape drive cabinet must contain a power distribution unit which is attached to the power distribution unit contained in the main CPU cabinet.

Features

The tape drives have simple loading and operating procedures. Each unit has a vacuum tape cleaner and quick-release, reel hold-down hubs. A full set of operator controls and indicators helps with major device functions.

Other specific features include:

- Subsystem magnetic tape error detection to locate problems
- Integrity features to help ensure accuracy of data written and retrieved from storage media
- Write-enable feature to protect files from accidental write operation
- Simultaneous reading or writing on one tape unit while rewinding or unloading other units
- Multiple host code conversions for compatibility with IBM, EBCDIC codes
- Test and maintenance programs to assist in fault isolation and equipment maintenance

Supplies

Supplies for the tape drives and other Honeywell equipment can be ordered through the *Computer Supplies Catalog and Price List* (Order Number BY62), or contact your Honeywell Representative. These units use 2400-foot (731.5 m) reels of ½-inch Mylar-base tape (Catalog Number M1316) certified for 1600 bpi. Tape reels can be diameters of 10½, 8, or 7 inches, and all have IBM-compatible reel hubs.

Accessories that can be ordered include empty reels, file protection rings, tape cleaner fluid, and tape seals.

Section 2
Controls and Indicators

This section describes the various controls and indicators which are necessary to operate the tape units.

Operator Control Panel

Magnetic tape unit controls and indicators are shown in Figure 2-1 and described in Table 2-1.

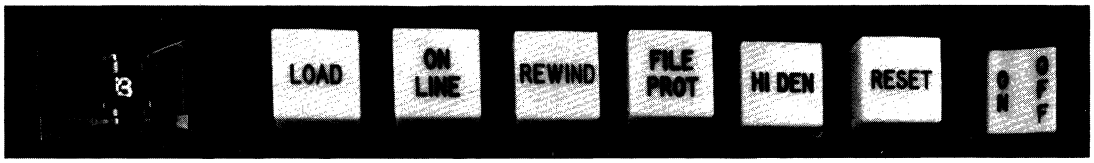


Figure 2-1. Operator Control Panel

Table 2-1. Operator Control Panel Controls and Indicators

Control/Indicator	Description
Unit Select Switch	This thumbwheel switch is used to assign the desired logical unit number (0, 1, 2, or 3). The unit number should only be changed when the tape unit is offline.
LOAD	Pressing LOAD applies vacuum to the loop chamber (after the tape is threaded), cycles up the unit, and places the device online. LOAD lights when the unit is fully cycled up and the tape is positioned at the beginning-of-tape (BOT) mark. LOAD is extinguished whenever the tape moves off BOT.
ON LINE	Pressing ON LINE places the tape unit online if it is offline, or offline if it is online. ON LINE lights whenever the tape unit is online.
REWIND	Pressing REWIND rewinds the unit to BOT. REWIND lights until BOT is sensed. The button is operative only when the unit is offline. The tape rewinds past the BOT tab, then reverses and advances to the BOT tab and stops. If the tape is at BOT when REWIND is pressed, the tape rewinds slowly off the takeup reel.
FILE PROT	When lit, FILE PROT indicates that the tape mounted and cycled up is protected from being written on (write-permit ring not installed).
HI DEN	Pressing HI DEN selects the higher density in those tape units with dual density. HI DEN lights when the higher density is in effect. (This button is inoperative on single density units.)
RESET	Pressing RESET stops tape motion if the tape unit is in the forward, reverse, or rewind mode and places the unit offline if it is online. RESET lights whenever the tape unit is selected.
ON/OFF	Pressing the ON side of the button applies power to the tape unit and the button lights. Pressing the OFF side of the button removes power from the unit.

Section 3
Operation

This section describes the operation and maintenance procedures for the tape units.

Applying Power

Press the ON/OFF switch to ON. ON/OFF lights.

Removing Power

Press the ON/OFF switch to OFF. ON/OFF extinguishes.

Tape Mounting

To mount a tape, follow this procedure.

1. Open the front glass door on the tape unit.
2. Prior to mounting the supply reel, visually examine the condition of the tape. It should be free of kinks and creases. Check condition of the reel as well. It must not be warped or damaged in any way.

Note

If tape is to be written on, install a write-permit ring in back of the tape reel.

3. Open the supply reel hub loading latch and place the supply reel on the hub. Handle the reel by its hub and not by the flanges. Since the flange is the weakest part of the reel, it is more susceptible to damage.

4. Gently press the supply reel onto the supply reel hub and close the loading latch.

5. Refer to "Tape Threading."

Tape Threading

1. Using a clockwise rotation, unwind approximately 3 feet of tape from the supply reel.

2. Thread and feed the tape over the upper roller guides, through the tape head area, and under the capstan and lower roller guide to the takeup reel; see the tape threading diagram located on the inside cover of the handler door and Figure 3-1.

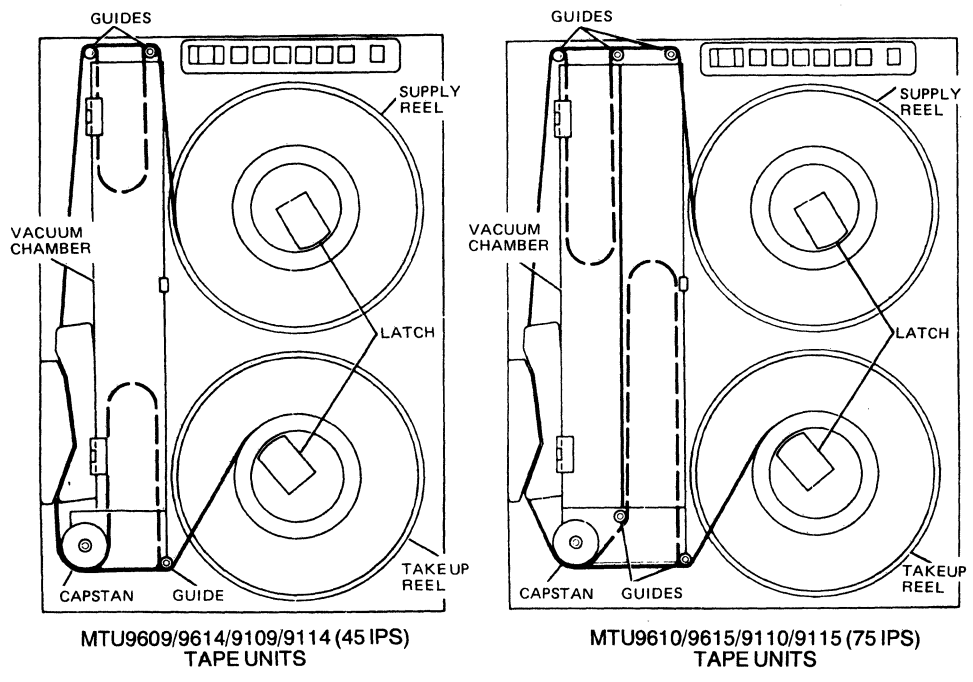


Figure 3-1. Tape Threading Diagram

3. Loop the free end of tape up over the takeup reel in a clockwise direction, making sure that the tape is not twisted or creased in the process. Secure tape end to the reel by holding the tape end with a finger through one of the holes in the reel flange and rotate the takeup reel clockwise, until at least one complete turn of tape is firmly seated on the reel.

4. Remove finger and manually continue to turn the takeup reel clockwise until a minimum of five turns or wraps of tape are on the takeup reel to tension the tape.

Note

Do not manually rotate the file reel while turning the takeup reel, since friction provides the necessary windup tension required on the takeup reel.

5. Make sure the tape is properly aligned on the roller guides and turn the file reel slightly to take up any remaining slack.
6. Close the front door and press LOAD. Vacuum chamber(s) will activate and tape will be tensioned and advanced to the BOT marker. The device is automatically put online.

Note

If, after a few seconds, forward tape motion has not been terminated by the BOT marker, press the REWIND button. When finished with the tape, check the position of the BOT marker and replace it if it is less than 12 feet from BOT. Place the new BOT marker approximately 16 feet from BOT.

7. Select the proper recording density, if applicable, via the HI DEN button.
8. Set unit select switch to desired unit address.
9. Check FILE PROT indicator. If tape is to be written on, the indicator should not be lit.
10. Close front glass door on the tape unit.

Tape Rewinding

The tape unit can unwind tape in either the online or offline mode. During online operation, the handler rewinds tape to the BOT marker under program control.

Offline, the handler automatically rewinds tape to the BOT marker. However, to perform such a function, the handler must be in the offline mode.

1. Press ON LINE button. The indicator will extinguish, indicating that the handler is offline.

2. Press REWIND to rewind tape to the BOT marker.

Note

Tape rewinds at 200/250 inches per second. The tape will rewind past the BOT reflective marker, then reverse and advance to BOT and stop.

Tape Demounting

The following procedure should be performed with the tape unit in the offline mode. (The ON LINE indicator should be extinguished, indicating that the unit is offline.)

If the tape is positioned at BOT:

1. Press REWIND to unwind remaining tape from takeup reel back onto the file reel.
2. Open the front glass door on the tape unit.
3. Open the supply reel hub loading latch and gently pull the supply reel from its reel mount by grasping the opposite sides of the reel with your fingers while pressing firmly with the thumbs against the reel hub.
4. Close the supply reel hub loading latch and front glass door, unless another tape is to be mounted.

If the tape is positioned past the BOT marker:

1. Press REWIND to rewind tape to the BOT marker. Tape motion will automatically stop when the BOT reflective marker is sensed.
2. Press REWIND again to unwind the remaining tape from takeup reel back onto the supply reel.
3. Open the front glass door on the tape unit.
4. Open the supply reel hub loading latch and gently pull the supply reel from its reel mount by grasping the opposite sides of the reel with your fingers while pressing firmly with the thumbs against the reel hub.
5. Close the supply reel hub loading latch and front glass door, unless another tape is to be mounted.

Operator Maintenance

Proper handling of magnetic tape media is crucial for operating efficiency. The *Magnetic Tape Media Maintenance Procedures* guide (Order No. CH76) gives complete instructions in handling magnetic tape, with a section on recognizing and preventing tape damage.

Operators are required to perform a limited amount of maintenance in order to keep the tape unit(s) functioning properly. This maintenance consists of cleaning the following areas: read/write head, tape guides, capstan, tape cleaner, vacuum chamber, erase head, and tape unit surfaces. Cleaning should be performed once a day or as often as required.

Prior to cleaning the unit, remove both supply and takeup reels and then power down the unit.

Cleaning

1. Open front glass door.
2. Remove both head covers (see Figure 3-2.).
3. Use a lint-free cloth moistened with Honeywell Magnetic Tape Cleaner or equivalent solution (such as Freon "TF" solvent) and clean all exposed surfaces of the read/write, head, tape cleaner, erase head, and tape guides shown in Figure 3-2. Cotton swabs dipped in the cleaner solvent can be used to remove oxide buildup in the slotted areas of the tape head. Use a lint-free cloth dipped in the cleaner solvent to clean the capstan wheel.

   Note

   Heads are susceptible to damage. Keep all metallic objects away from tape head area. Do not touch the capstan wheel with fingers. Body oils on the capstan wheel can affect tape drive operation.

4. Replace both head covers.
5. Open the vacuum chamber door and clean vacuum column(s). Use a clean lint-free cloth dampened in one of the cleaner solvents. Cotton swabs may be used to clean walls of the vacuum column(s). Visually check that the air holes are clear.
6. Clean the vacuum chamber glass door and front glass door on the unit, removing all smudge marks with a lint-free cloth and a nonspray liquid window cleaner.

7. Close the vacuum chamber door.

8. The tape unit can now be put back into service.

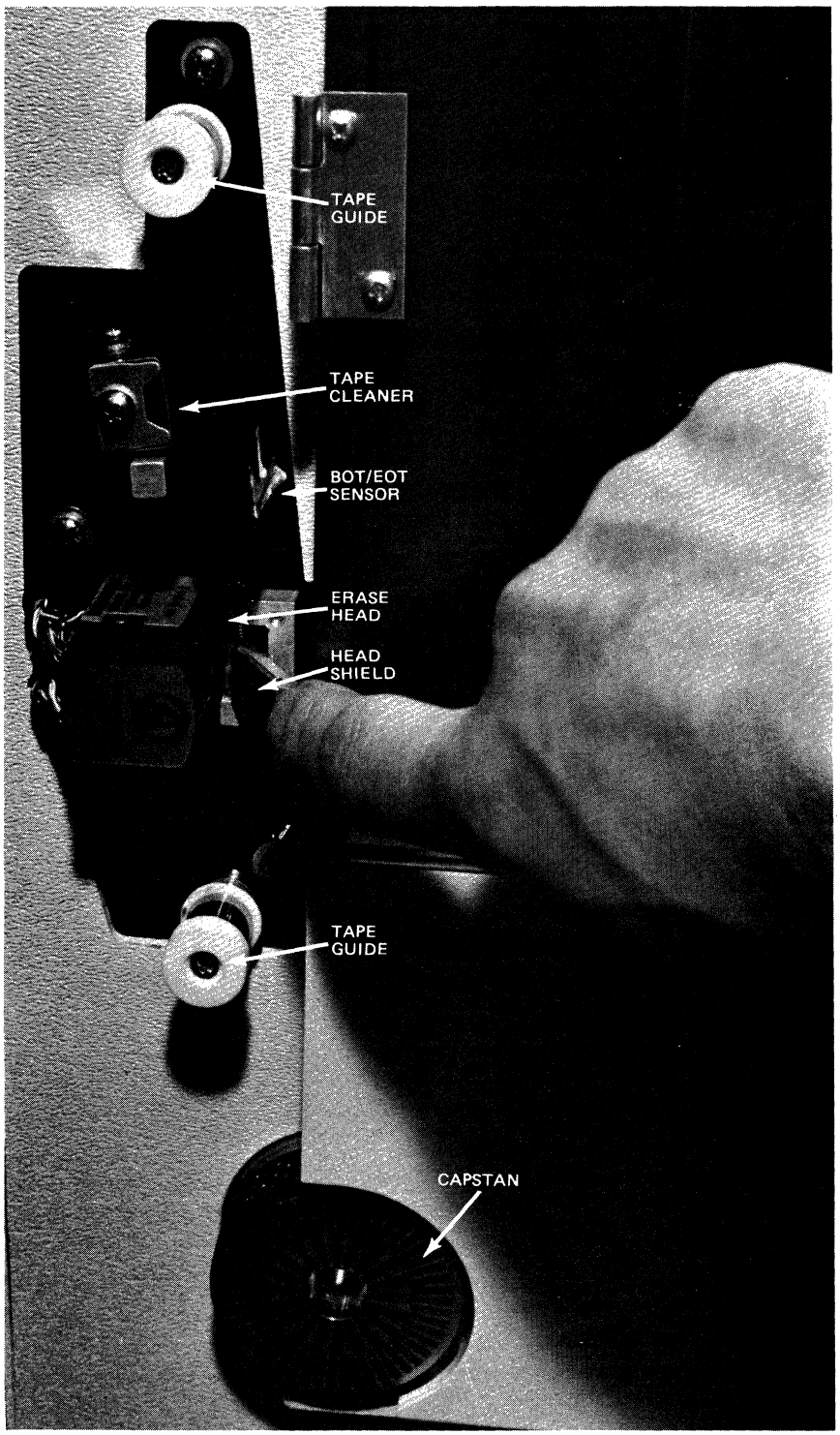


Figure 3-2. Tape Head Assembly

BOT Patch Mounting

The beginning and end of the working storage area on the tape are marked by small, inch-long reflective markers. Marker dimensions are:

Length:	1.1 inch ± 0.2 (27.94 mm ± .5)
Width:	0.19 inch ± 0.02 (4.82 mm ± .05)
Thickness:	0.0008 inch (max.) (.02 mm)

The BOT and the EOT markers are placed on the Mylar-base side of the tape. Take care when placing the markers (see Figure A-2). They must be within 0.03 inch (0.08 cm) of, but not protrude beyond, the reference edge of the tape, and be free of wrinkles and adhesive.

The tape between BOT and physical beginning of tape is referred to as the leader. If bad spots develop on the tape toward the leading edge, the BOT marker can be moved down so that the damaged section of the tape can still be used for information storage in the normal manner. A leader length of about 16 feet (5 m) is recommended for automatic threading.

Tape Handling and Storage

The following rules should be followed in the handling and storage of magnetic tapes.

Keep tapes clean. Dust and dirt can reduce the intensity of reading or recording signals by altering the distance between the head and the tape. Therefore:

- Never touch the tape's oxide coating; body oils on tape attract dust and lint.
- Keep the tape in its dust-proof container until just prior to use on the tape drive.
- Keep tape containers clean and dust-free *inside* and *out.* Don't leave containers open when tape is in use.
- Keep the tape transport door closed when the tape drive is not in use.
- Avoid dangling the free end of the tape on the floor when changing reels.
- Don't smoke in the computer room. Smoke and ashes are dirt; hot ashes are destructive to magnetic tape. Food and drink should not be put near the tape devices.

- Identify reels with adhesive stickers, which are easily removed and leave no residue. Eraser particles are dirt. Change the label; don't erase it.

Handle and store tapes with care. Avoid damaging tapes and reels or placing tapes where temperature, dust, or magnetic fields affect them adversely. Follow these recommendations:

- Make sure that the tape leader is properly wound when tape is returned to its container. This avoids accidental crushing of the tape leader edges and possible damage to the tape itself.
- Whenever possible, store tapes in the controlled environment where they are to be used, so the tapes are not subjected to excessive variations in temperature and humidity. For short-term tape storage, the surrounding atmosphere should be controlled within the following limits:

  Operating Relative Humidity: 40% to 60%

  Operating Temperature: 60°F to 80°F (16°C to 27°C)
- For long-term storage, the reel of tape in its container should be hermetically sealed in a moisture-proof bag. Temperature should be constant somewhere between 60°F and 80°F (16° to 27°C).
- When mounting or demounting tapes, handle the tape reels by the hub and not by the flanges. Squeezed or bent flanges result in damaged tape edges and eventual loss of contact with the magnetic head.
- A routine library inspection of tape reels should be made. Check for protruding tape edges. Exposed edges are vulnerable to damage and cause loss of contact with the tape drive head.
- Avoid dropping reels. If a tape is dropped, the reel may become broken or dirty, resulting in possible damage to the tape. Reel damage can be determined by a visual inspection. Never use a reel that may cause damage to the tape or to the tape drive.
- Always store tapes in containers in a dust-free cabinet. The containers should be placed on edge so that the reel is in an upright position. Do not stack tape reels one on top of the other since the bottom containers could be damaged by the weight of the stacked reels.
- Never place reels of tape on top of a tape drive as this exposes them to heat and dust from the cooling system.

Appendix A
Programming

MTC Memory and Command Interpretation

The MTC9640 (DPS 6) and the MTC9102 (Level 6) have a 128-word Read/Write memory that is divided into 32 registers (16 bits per register) for each of the four MTC ports (or channels). The address of each of the various registers in the MTC ports (or channels). The address of each of the various registers in the MTC is a combination of two bits of the channel number and the five high-order bits of the function code used to write into or read from a particular register.

The central processor (CP) can read or write any register as long as the specific channel is not busy. To write into a register, an I/O *output* command is used; reading is done with an I/O *input* command. Addressing of the various registers relates to the I/O command as shown in Figure A-1.

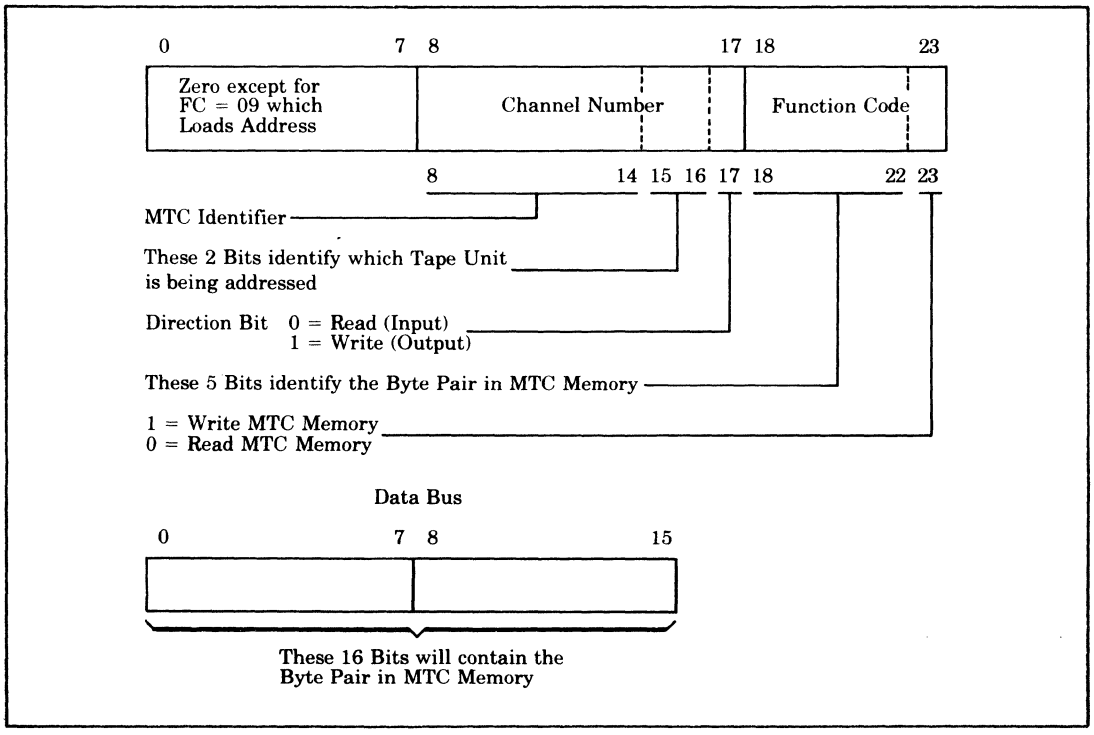


Figure A-1. Register Addressing

The format shown in Figure A-1 is for a Write cycle on the bus. For a Read Cycle, the memory data will be returned from the MTC on a second bus transfer.

To perform a specific operation, software first loads the address, range, and configuration registers. The task register is loaded last and specifies the operation to be performed. The MTC begins command execution when it receives the task word.

Channel Number

Units attached to the MTC9640 (or the MTC9102) are software-addressable via channel numbers. Each tape unit has two such channel numbers assigned, differing only in their low-order bit position called the direction bit.

The channel number for the MTC is separated into three fields:

- MTC Identifier (bits 8-14) — switch-selectable and assigned at system installation time.
- MTC Port (bits 15-16) — identifies which of the four tape units is being addressed.
- Direction Bit (bit 17) — specifies in the IOLD command whether it is an input or output data transfer. For all other commands, the direction bit is ignored by the hardware.

Simultaneity

The MTC9640 and the MTC9102 provide a single level of simultaneity (only one data transfer can be active in the subsystem). However, the MTC will accept a data transfer command to unit B while unit A is performing a data transfer but will not start the data transfer on B until A's data transfer is completed.

Interrupts

An interrupt will be attempted whenever a channel interrupt level is not zero, and an operation initiated by an Output Task Word or Output Control Word instruction is completed or the Attention bit is set in Status Word 1. If a negative response is received during an interrupt cycle, the MTC will store the interrupt until it can be retried. In the meantime, the MTC can receive

commands and/or conduct data transfers on any of the other channels. The channel with the pending interrupt will remain busy and the MTC will not accept any commands issued to that channel except an Output Control Word.

If an interrupt level of a channel is zero (either via initialization or loaded to zero) no interrupts will be attempted for that channel. If a condition or event occurs that would normally cause an interrupt, the appropriate bits in the Status Words will be set, but no interrupt will be attempted or accepted.

If the interrupt level is set to zero when an interrupt is pending via an Output Control Word (Initialize) or a Master Clear, the pending interrupt will be discarded.

Media Interchangeability

Tapes generated by these units are compatible with tapes generated by other units if the other tape units comply with American National Standards Institute recording standards.

Magnetic Tape

The physical layout of half-inch magnetic tape is illustrated in Figure A-2. A full reel of tape has a nominal recording length of 2400 feet (732 m). The entire length of the tape is oxide-coated. Beginning- and end-of-tape sensing is controlled by reflective markers affixed to the Mylar-base side of the tape. The beginning-of-tape (BOT) spot is attached approximately 16 feet (4.88 m) from the physical beginning of the tape, and the end-of-tape (EOT) spot is attached approximately 25 feet (7.62 m) from the physical end of the tape.

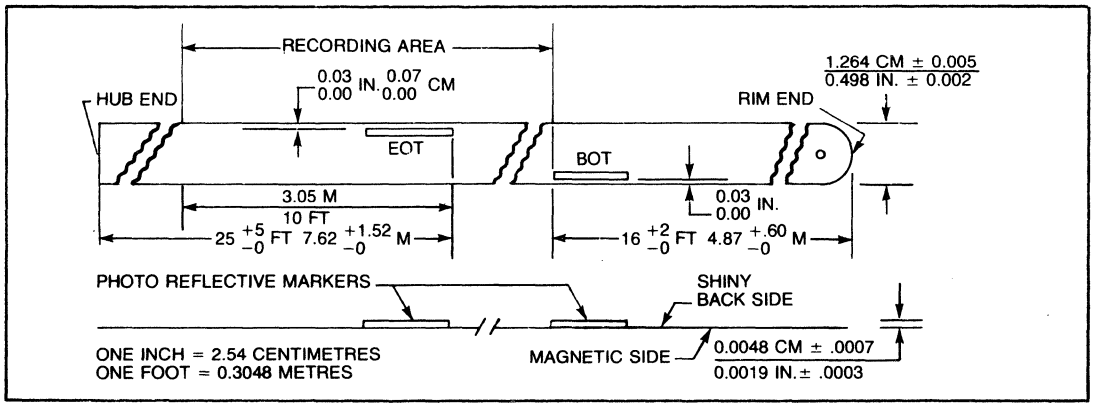


Figure A-2. Magnetic Tape Layout

Beginning and End of Tape

An erased section of tape is required surrounding the BOT marker. This serves as a defined area within which reading can start. This section begins a minimum of 1.3 in. (3.3 cm) before the hub end of the BOT marker and extends a minimum of 3.0 in. (7.6 cm) past the hub end of the BOT marker. This erased section totals about 4.3 in. (10.9 cm).

An unrecorded area must be left in the vicinity of the EOT marker affixed on the opposite edge of tape at the trailing end of a tape reel.

Data Blocks

The data is formatted and recorded on the tape in blocks. On 9-track tape, each block consists of the data, a Cyclic Redundancy Check (CRC) character, and a Longitudinal Redundancy Check (LRC) character. The CRC character is positioned four character spaces after the final data character, and the LRC character must occur four character spaces after the CRC. A nominal spacing of 0.6 in. (1.5 cm) is required between blocks.

The standard block format used for NRZI recording is shown in Figure A-3 and A-4 (data block and tape mark block formats respectively).

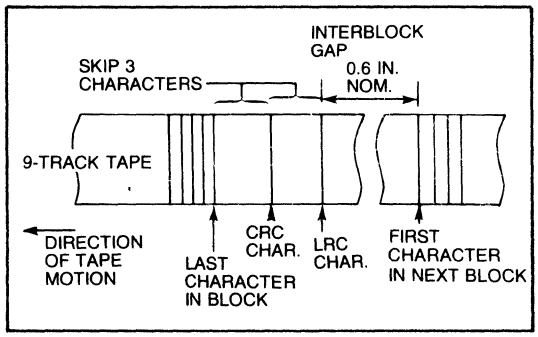


Figure A-3. Data Block Format

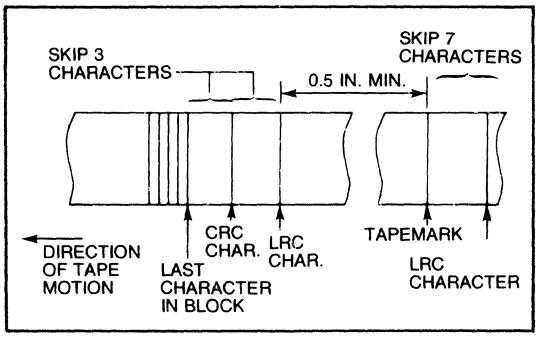


Figure A-4. Tape Mark Block Format

Interblock Gaps

Interblock gaps are areas without data (i.e., all tracks restored to the dc-erased polarity) placed between data blocks or records. The length of the gap is 0.60 in. (1.5 cm) nominal (0.5 in./1.3 cm minimum) for 9-track subsystems. The maximum length should not exceed 25 feet (7.6 m).

Tape Marks

Figure A-4 shows the format of the Tape Mark for 9-track tapes. The distinguishing feature of the block is that it is a single, specific character block with a check character.

NRZI Data Recording Format

In NRZI coding, a logic One bit appears on the interface lines as a low voltage level and a logic Zero as a high voltage level. However, on the tape, a logic One bit is recorded as a flux change and a logic Zero bit as no change. The direction of the change is immaterial; however, the initial flux change direction after BOT conforms to ANSI standards.

Check Characters

The NRZI format provides for both vertical and longitudinal parity checks. In the 9-track system an additional check called the cyclic redundancy check character is used. Refer to Figures A-3 and A-4 for the location of the check characters.

- *Vertical parity* – 9-track tape subsystems use 8 tracks for recording data. The remaining track carries parity information. When performing a Write operation, one parity bit is generated, either odd parity or even parity based on a previously stored Configuration Word, to accompany each character written on tape. The 9-track subsystems read and write odd parity only.

  When performing a Read (including Read-After-Write) operation, the parity read is checked against the parity created from the data portion of the character read. A mismatch causes a Vertical Redundancy Check (VRC) error condition to be set in Status. Note, however, if an even number of bits in the data character are "dropped" or "picked," a VRC error will not be detected; thus additional checking facilities are necessary.

- *Longitudinal Parity* – A Longitudinal Redundancy Check (LRC) character is written following the data portion of each block. It is separated from the end of the data or CRC in each block. This character is made up on a per-track basis. The LRC character written is one calculated so that an even number of "one" bits, including those of the data and LRC character, is recorded in each track of the block. On reading, this is checked and an error is detected if the count is odd in any track. This possibility of detecting an erroneous block still exists if an even number of bits in a given track of a block is dropped or picked. However, when this text is combined with the vertical parity test, the probability of not detecting an error is reduced.
- *Cyclic Redundancy Character Check (CRC)* – In the 9-track system another check character is written. This character is derived with relatively complex logic and, along with the LRC character and vertical parity, minimizes the possibility of undetected errors. The CRC character bits of a Tape Mark Block are all zeros. This check character follows the last data byte of the block by four cell positions.

9-Track Data Format

Data being written on or read from tape is handled on a byte basis. All 16 bits of a data word are transferred to or from the tape as shown in Figure A-5. Odd parity (vertical redundancy check) is written on tape and is checked when read.

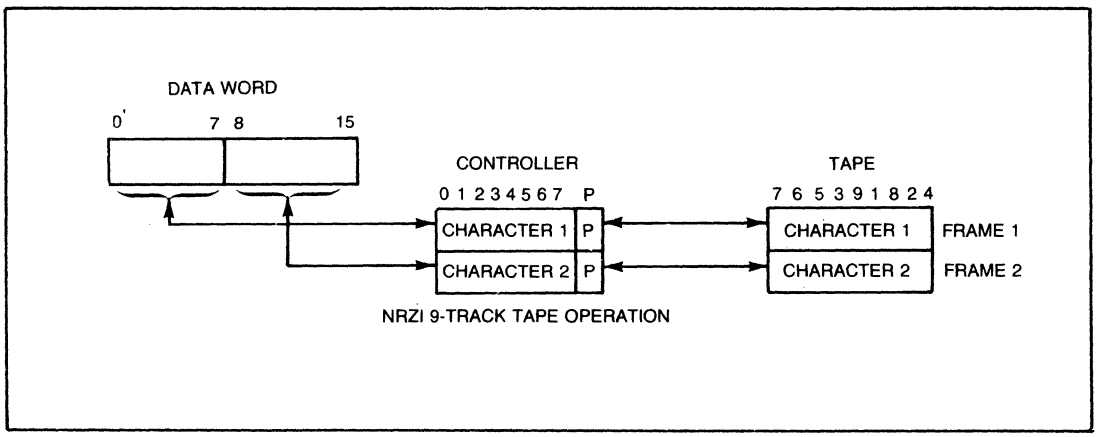


Figure A-5. 9-Track Data Format

Instructions

Table A-1 lists the I/O commands. A detailed description of each command follows this table.

Table A-1. Magnetic Tape Commands

Type	Function Code	Command
Output	09[a]	Output Address
	0D	Output Range
	11	Output Configuration Word
	03	Output Interrupt Control
	07	Output Task Word
	01	Output Control Word
Input	0C	Input Range
	10	Input Configuration Word
	02	Input Interrupt Control
	26	Input Device ID
	06	Input Task Word
	18	Input Status Word 1
	1A	Input Status Word 2

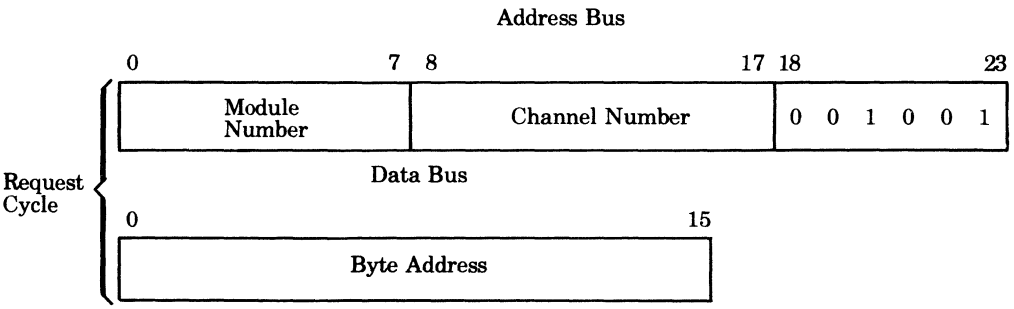
[a]Function Code 09 as executed by the CP will result in execution of functions 09 and 0D.

Output Commands

Command Output Address

Function Code 09

Format



Function

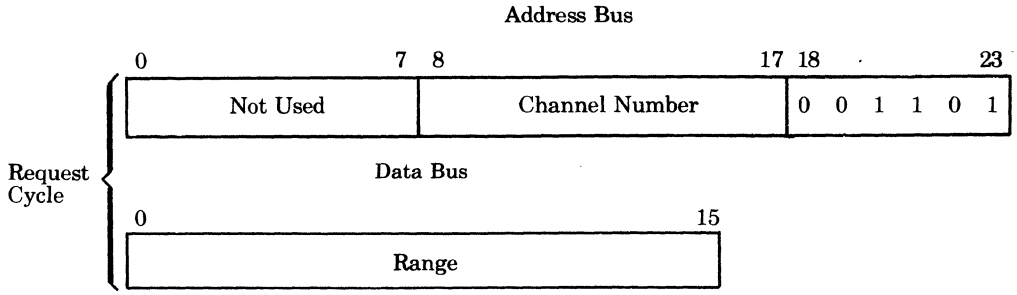
Loads a 24-bit address into the address register associated with the referenced channel (device). The address refers to the starting (byte) location in main

memory where the MTC will commence input or output data transfers. Bits 0-7 of the Address Bus (Module Number) are the most significant bits of the Address. The Data Bus contains the 16 least significant bits. Data transfers to or from memory will normally be on a word basis but byte mode transfers can occur associated with the first and/or last memory cycle of a particular data transfer if the main memory buffer (identified by this instruction) begins or ends on an odd byte boundary.

Command Output Range

Function Code OD

Format



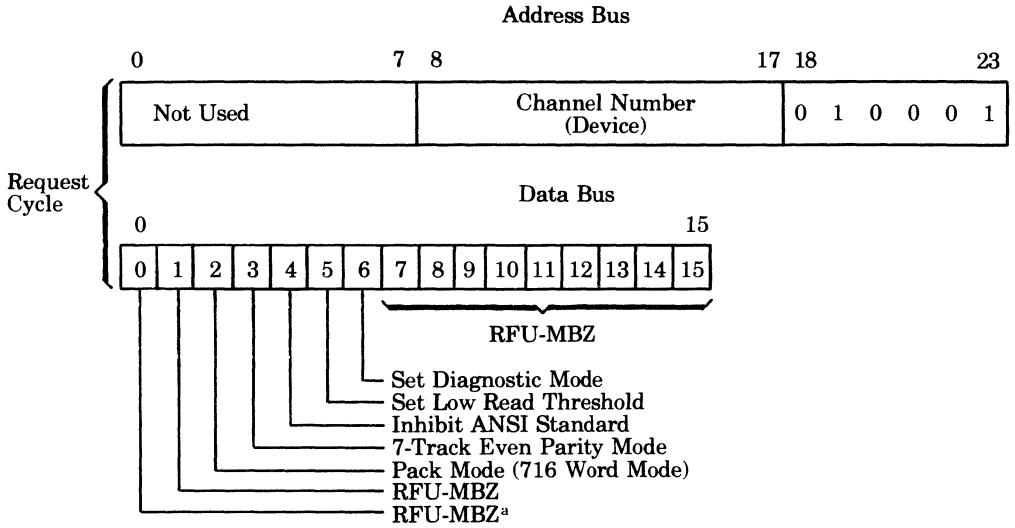
Function

Loads the Range register associated with the referenced channel. The (16-bit) quantity loaded (data bus) is the number of bytes to be transferred during the data transfer that is being set up. The number is a positive binary quantity (bit 0 must be zero) and is decremented by the MTC after each memory transfer. A range of zero results in a subsequently issued Read Forward order to perform the equivalent of a Forward Space Block order transferring no data to memory. A range of zero results in a subsequently issued Write order setting the Operation Check bit of Status Word 1, no data transfer, no tape motion initiated, and termination of the order. Any address and range register residue is applied to the next command unless reset by another Output Range instruction.

Command Output Configuration Word

Function Code 11

Format



[a]Reserved for future use, must be zero.

Function

Loads the Configuration Word for the device corresponding to the referenced channel. Bit descriptions follow.

- *Pack Mode* – The NRZI 9-track subsystem ignores this bit.
- *7-Track Even Parity Mode* – The NRZI 9-track subsystem ignores this bit.
- *Inhibit ANSI Standard* – When this bit is set to zero, the ANSI Standard, (which requires the system to write data blocks of no fewer than 18 bytes from memory) must be adhered to; otherwise an Operation Check occurs. Also, if during reading, 11 or fewer characters from tape are detected, they are interpreted as noise, Status Word 1 bit 4 is set, and the search continues for the next block on tape. This bit set to a one inhibits the ANSI Standard and writing a minimum data block of one or more characters is allowed. Also allowed is the reading of one or more character data blocks.
- *Set Low Read Threshold* – This bit set to one allows the read threshold detection to be reduced during read operations only.

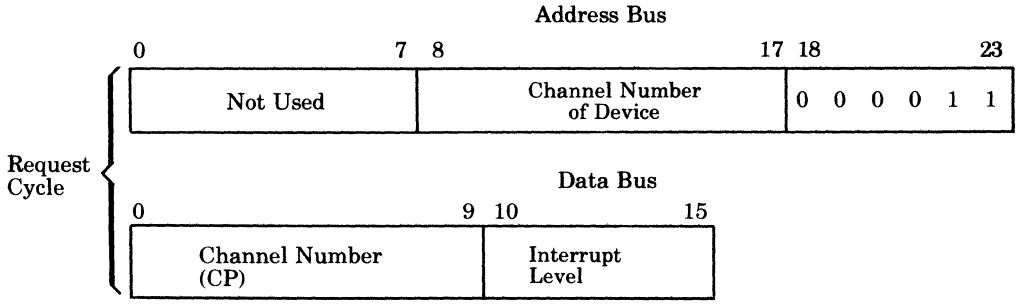
- *Set Diagnostic Mode* – This bit set to one puts the 9-track subsystems into the Diagnostic mode. In this mode:
  - — Subsequently issued write orders generate even vertical parity on 9-track tape (for use in diagnosis; i.e., in the generation on tape of data and check characters with bad parity and blank characters and gaps of specific lengths).
  - — Subsequently issued write orders to 9-track devices generate incorrect CRC characters on tape (for use in diagnosis).
  - — Subsequently issued non-forward motion (Output Task Word) command transfers data stored in the write FIFO adapter buffer to the adapter DLI transmitter/receiver logic and wraps the data around and into the read FIFO adapter buffer.

This bit set to zero puts the NRZI tape adapter subsystem attached to the MTC into its Normal Mode (non-Diagnostic Mode).

Command Output Interrupt Control

Function Code 03

Format



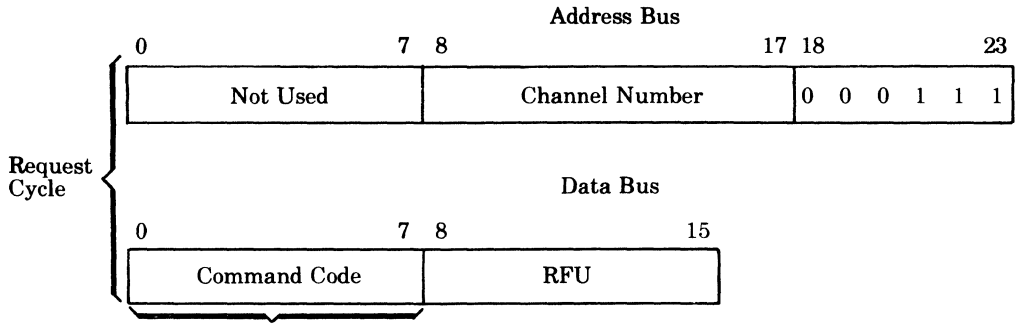
Function

Loads, for the referenced device, the interrupt level and the channel number of the CP to which subsequent interrupts should be sent. The level number is a 6-bit quantity and is positioned on the data bus as illustrated. Bits 0-9 of the data bus contain the channel number of the CP loading the interrupt level. If an interrupt level of zero is loaded, the subsystem will not generate or save interrupts for any events that occur while the interrupt level is zero. For example, if the attention bit in Status Word 1 is set to one with a stored interrupt level of zero, the subsystem will not generate an interrupt on the bus. The interrupt level is set to zero whenever the subsystem is initialized.

Command Output Task Word

Function Code 07

Format



10000000 — Rewind
11000000 — Rewind and Unload
00001000 — Forward-Space Block
00000100 — Backspace Block
00011000 — Forward-Space Tape Mark
00010100 — Backspace Tape Mark
00001001 — Read Forward
00000101 — RFU
00101000 — Erase
00111010 — Write Tape Mark
00101011 — Write
00000000 — No Operation

Function

Outputs a Task Word to the referenced channel. The coding bits 0-7, illustrated above, represent the operations that are to be performed. When this command is accepted, the channel enters the Busy state. All configuration, address, and range information must be loaded prior to execution of this command. The direction of data transfer indicated by the low-order bit of the most recent Output Address command must agree with the direction of transfer (read or write) specified by command code of the Output Task Word. If it does not, Status Word 1 bit 11 Operation Check will be set and a normal termination of the command without data transfer and tape motion will result. These commands addressed to a device not in the online state result in the setting of an Operation Check bit prior to a normal termination of the order.

- *Rewind* – This command rewinds the tape to the BOT marker if the most recent Output Task Command was not a "write order" (Write, Write Tape Mark, Erase). If otherwise, an erase in the forward direction over approximately 1 inch of tape precedes the rewind operation. The drive remains in the Busy state until the completion of the rewind operation or the setting of a Time Out check. The subsequent 10 commands will be NAKed. If the tape on the drive is a BOT when this order is issued, tape motion is not initiated and a normal termination of the order results. Note that the rewinding of a drive via the REWIND button on the drive does not put the

device in the Busy state but activates rewinding (Status Word 2 bit 1), which affects the status of the Device Ready and Attention bits of Status Word 1. When the manually initiated rewind is complete, the Rewinding status condition resets, Device Ready changes state, and the Attention bit is set again.

Note

A rewind of tape without any erase operation may be initiated manually via the REWIND button.

- *Rewind and Unload* – This command implements a Rewind command and, following detection of the BOT marker, activates the drive's unload sequence prior to termination of the order. If the tape on the drive is at BOT when this command is issued, then only the unload sequence is initiated prior to termination of the command. The unload sequence puts the selected tape device into the offline state, extinguishes the online indicator and moves tape in the reverse direction until it is wound off the takeup reel. The tape drive can manually be placed into the online state only from the device control panel.

Note

A tape drive may be put in the offline state without any erase action or tape motion manually via the ONLINE button.

- *Forward-Space Block* – This command results in the drive spacing foward over the next block on tape if the most recent output task command was not a "write order." If otherwise, an erase in the forward direction over approximately 1 inch precedes the forward-space block operation. The order terminates when tape is positioned in the next interblock gap or as a result of a Time Out Check.

- *Backspace Block* – This command results in the drive spacing back over the previous block on tape if the most recent Output Task command was not a "write order." If otherwise, an erase in the forward direction over approximately one inch precedes the backspace block operation. The order terminates when tape is positioned in the previous interblock gap, or when the tape is positioned at BOT, or as a result of a Time Out Check. If the command is issued when the tape is positioned at BOT, tape motion is not initiated and the order is terminated.

- *Forward-Space Tape Mark* – This command results in the drive spacing forward over one or more blocks until a Tape Mark or EOT status is detected on tape if the most recent Output Task command was not a "write order." If otherwise, an erase in the forward direction over approximately 1 inch precedes the forward-space tape mark operation. The command terminates when tape is positioned in the interblock gap following

the block containing a Tape Mark or a data block when EOT (Status Word 1 bit 7) is set or as a result of a Time Out Check.

- *Backspace Tape Mark* – This command results in the drive spacing back over one or more blocks until a tape mark is detected on tape if the most recent Output Task command was not a "write order." If otherwise, an erase in the forward direction over approximately 1 inch precedes the backspace tape mark operation. The command terminates when the tape is positioned in the interblock gap preceding the block containing the tape mark or when the tape is positioned at BOT or as a result of a Time Out Check. If this order is issued when the tape is positioned at BOT, tape motion is not initiated and a normal termination of the order follows.

- *Read Forward* – This command results in the drive reading forward over the next block on tape if the most recent Output Task command was not a "write order." If otherwise, an erase in the forward direction over approximately 1 inch precedes the read forward operation. The order terminates when the tape is positioned in the next interblock gap or as a result of a Time Out Check. The format of the data transferred from tape to memory is a function of the stored Configuration Word. In addition to reading data, the vertical parity, longitudinal parity, and the cyclic redundancy check characters are read and integrity checks are made.

- *Erase* – This command results in the drive erasing tape in the forward direction producing a 2-inch gap on the tape, if the most recent Output Task command was a "write order." If otherwise, an erase in the forward direction over approximately 2 inches precedes the normal 2-inch erase operation. The channel of the device remains busy for the duration of the erase command and terminates normally.

- *Write Tape Mark* – This command results in the drive erasing tape in the forward direction producing a 2-inch gap on the tape followed by the recording of a Tape Mark block if the most recent Output Task command was a "write order." If otherwise, an erase in the forward direction over approximately 2 inches precedes the write tape mark operation (2-inch erase plus write tape mark block). The tape mark format for 9-track tape is shown in Figure A-5. An attempt to write a Tape Mark Block on a tape unit in Write Protect results in no tape motion initiated or block written and the activation of the Operation Check bit of Status Word 1. The order terminates when the tape is positioned in the gap beyond the Tape Mark Block.

- *Write* – With this command, the system writes a data block in a forward direction. The data block will be equal to or greater than the minimum block length specified by the most recently issued configuration word, if the most recent Output Task command was a "write order." If otherwise, an erase in the forward direction over approximately 2 inches precedes the

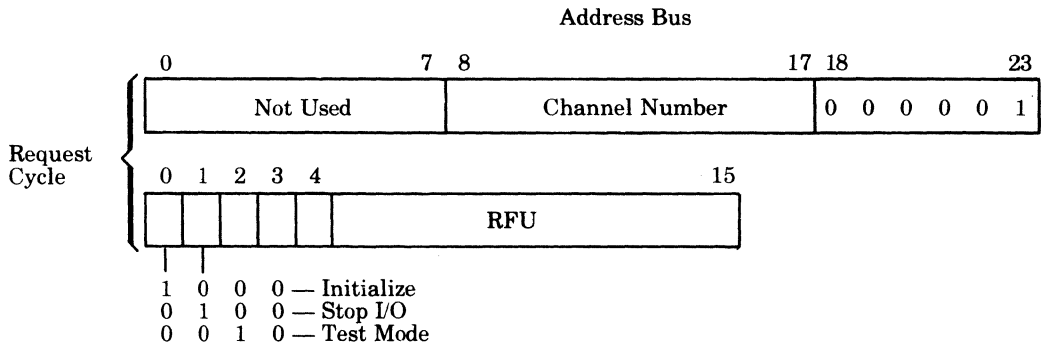
write operation. In addition to writing data, veritical parity, longitudinal parity, and a cyclic redundancy check character are written in the data block and integrity checks are made. An attempt to write a data block of less than the minimum length or to write to a drive in Write Protect results in no data transfer, no tape motion initiated, and the activation of the Operation Check bit of Status Word 1. The order terminates when the tape is positioned in the gap beyond the last data block written.

- *No Operation* – This command or Output Task command code results in no data transfer, no tape motion initiated, the normal reset of Status Word bits upon reception of an Output Task command, and a normal termination of the command.

Command Output Control Word

Function Code 01

Format



Function

Loads a Control Word into the referenced channel. This command will be unconditionally accepted by the channel regardless of its Busy status.

- *Initialize* – This command will cause the MTC to reset to the same state that it enters after power up or Master Clear. When an initialize command is received by the MTC all of its channels are initialized (regardless of which channel the command was received over).

  Operations that are in progress in the MTC at the time of the Initialization will be abruptly terminated and all registers will be initialized, including control registers device select and control signals to the drives. No information about the terminated operations will be retained and no interrupts for the operations will be generated. The interrupt level for all channels will be set to Zero (interrupts blocked).

- *Stop I/O* – This command causes any operation currently active on the specified channel to be abruptly terminated. If a data transfer operation is in progress, it will not be completed. An Interrupt will be generated for the operation terminated by this command as if the operation had come to a normal ending point. Status, Configuration, and Range information, present in the MTC when this command is received, will be retained.
- *Test Mode* – When an Output Control Word command is received with the Test Mode bit on (while the MTC is in normal operating mode), the MTC will enter Test Mode. Once the MTC is in Test Mode, subsequent commands cause the contents of the Data Bus to be loaded into the MTC instruction register (the Data Bus contains the microinstruction). One clock cycle is then issued to execute the microinstruction loaded. This enables a sequence of microinstructions to be executed in a single step mode from a software test routine.

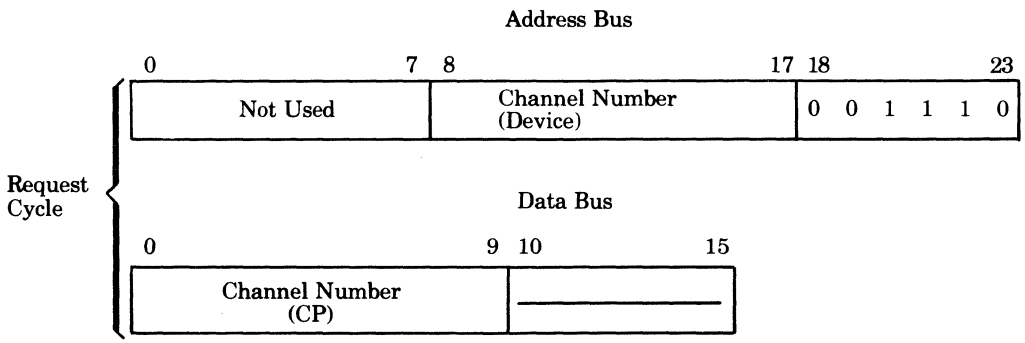
  Test Mode operates on an entire MTC and, therefore, precludes normal usage of other devices on the MTC at the same time. Normal mode is resumed when a "reset test mode" microinstruction is executed or when Master Clear is activated on the Bus. All function codes which are received over the Bus while the MTC is in the Test mode will cause the contents of the Data Bus to be loaded into the MTC instruction register as described above (function code field of the Address Bus is ignored). Note that Response cycles will not be generated for Input commands.

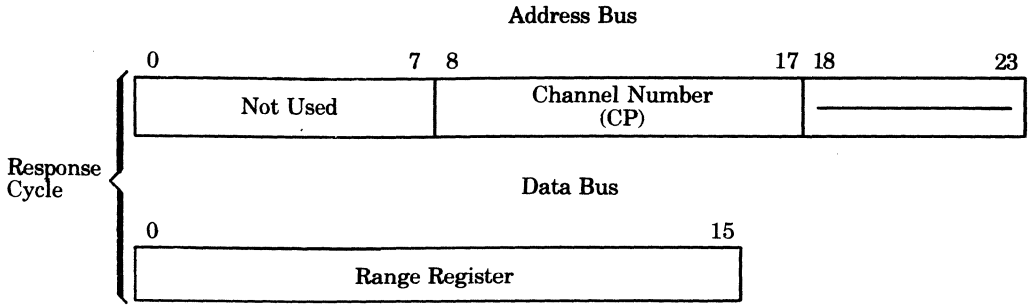
Input Commands

Command Input Range

Function Code 0C

Format





Function

Causes the current contents of the referenced channel's Range Register to be transferred to the requesting channel.

During the Response cycle (Second Half Read), the MTC will return in bits 8-23 of the Address Bus the same data that was received in bits 0-15 of the Data Bus during the Instruction Cycle.

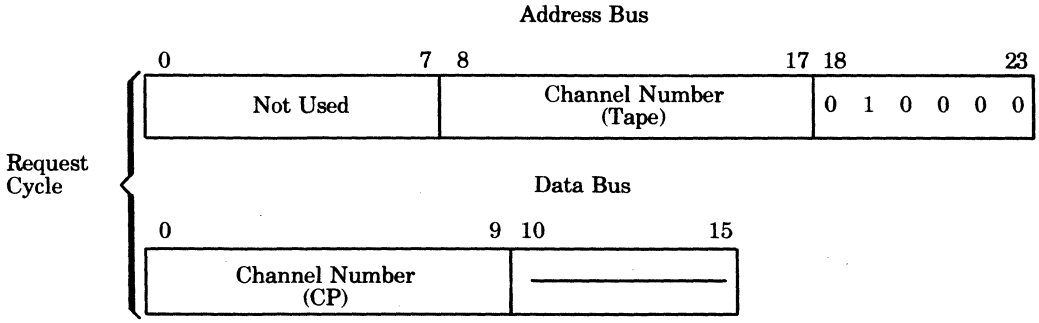
After the completion of a read operation, the contents of the Range Register reflect the status of that transfer with respect to the physical block read.

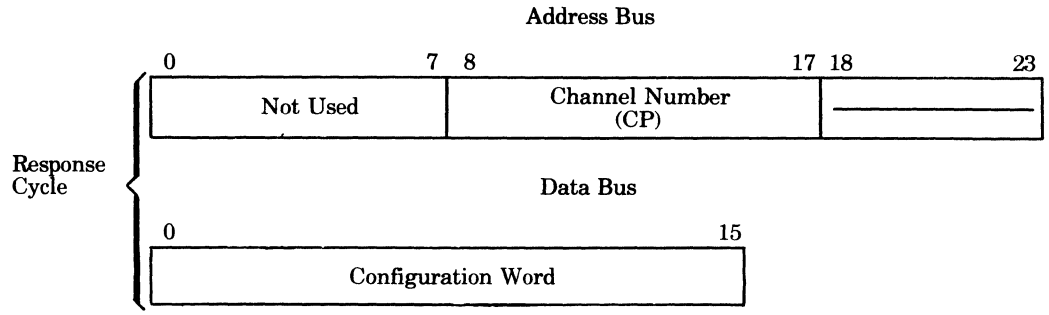
- If the contents are a positive value greater than zero and bit 8 of Status Word 1, Unequal Length Check, is set to a logical One, the length of the physical block was less than the range.
- If the contents are zero and bit 8 of Status Word 1 is equal to One, the length of the physical block was greater than the original range.
- If the contents are zero and bit 8 of Status Word 1 is equal to Zero, the length of the physical block was equal to the original range.

Command Input Configuration Word

Function Code 10

Format





Function

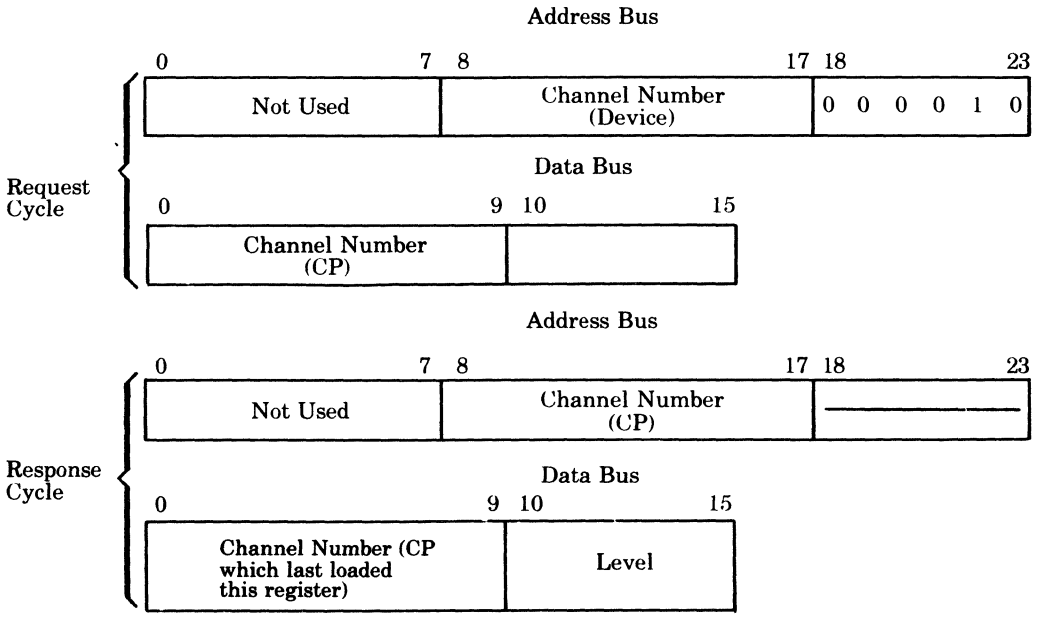
Causes the channel's Configuration Word to be transferred to the requesting channel.

During the Response cycle (Second Half Read) the MTC will return in bits 8-23 of the Address Bus the same data that was received in bits 0-15 of the Data Bus during the Instruction cycle. After the completion of a read operation, the contents of the Configuration Word register reflect the status of that transfer with respect to the physical block read.

Command Input Interrupt Control

Function Code 02

Format



Function

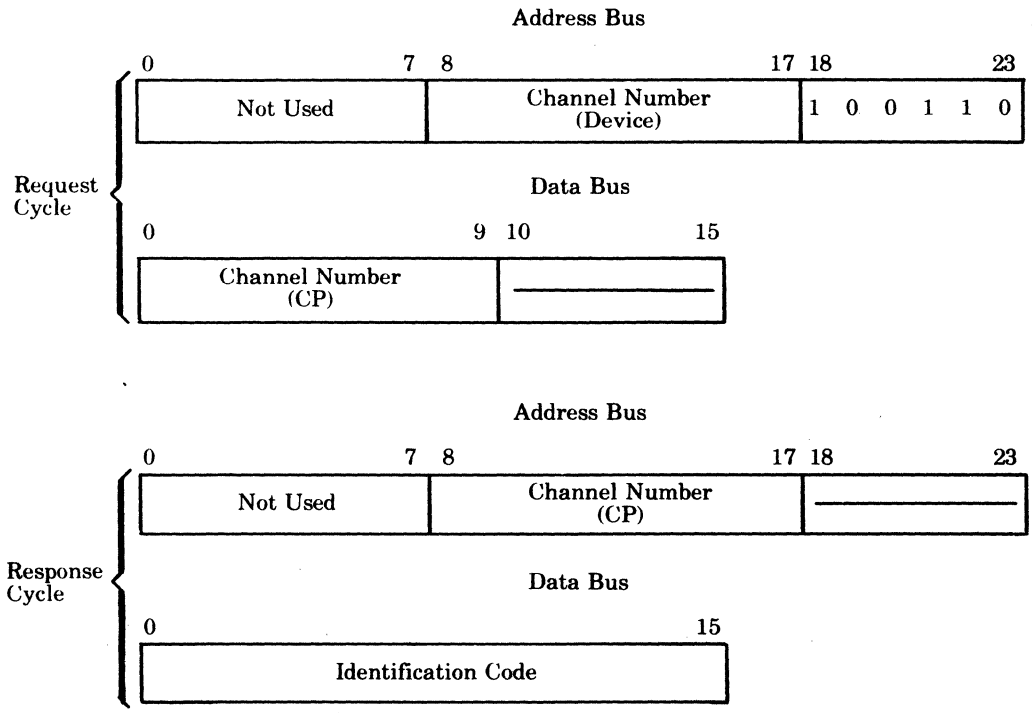
Causes the channel's interrupt level to be transferred to the requesting channel. The level value will be placed on Data Bus bits 10 through 15 with bit 15 as the least significant bit. This quantity is the value previously received in the Output Interrupt Control instruction or a default value of 00. The default value is the interrupt level assumed by the channel when initialized. Note that the channel number returned in bits 0-9 of the Data Bus might be different from the channel number of the CP executing this instruction if more than one CP is attached to the Bus.

During the Response cycle (Second Half Read), the MTC will return in bits 8-23 of the Address Bus the same data that was received in bits 0-15 of the Data bus during the request cycle.

Command Input Device ID

Function Code 26

Format



Function

Causes the referenced channel to transfer its identification code to the requesting channel. The codes for each type of tape device are defined as follows:

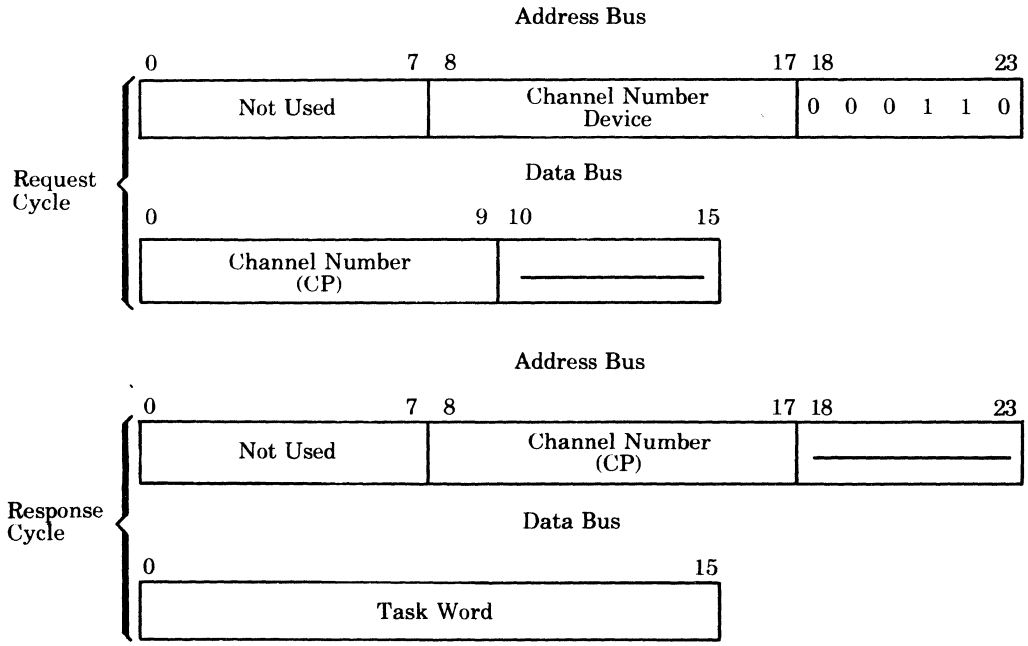
Code (Hex)	Tape Unit
204D	MTU9609/9109 (45 ips, 800/1600 bpi)
204E	MTU9610/9110 (75 ips, 800/1600 bpi)
2049	MTU9614/9114 (45 ips, 1600 bpi)
204A	MTU9615/9115 (75 ips, 1600 bpi)

During the Response cycle (Second Half Read), the MTC returns in bits 8-23 of the Address Bus, the same data that was received in bits 0-15 of the Data Bus during the Request Cycle.

Command Input Task Word

Function Code 06

Format



Function

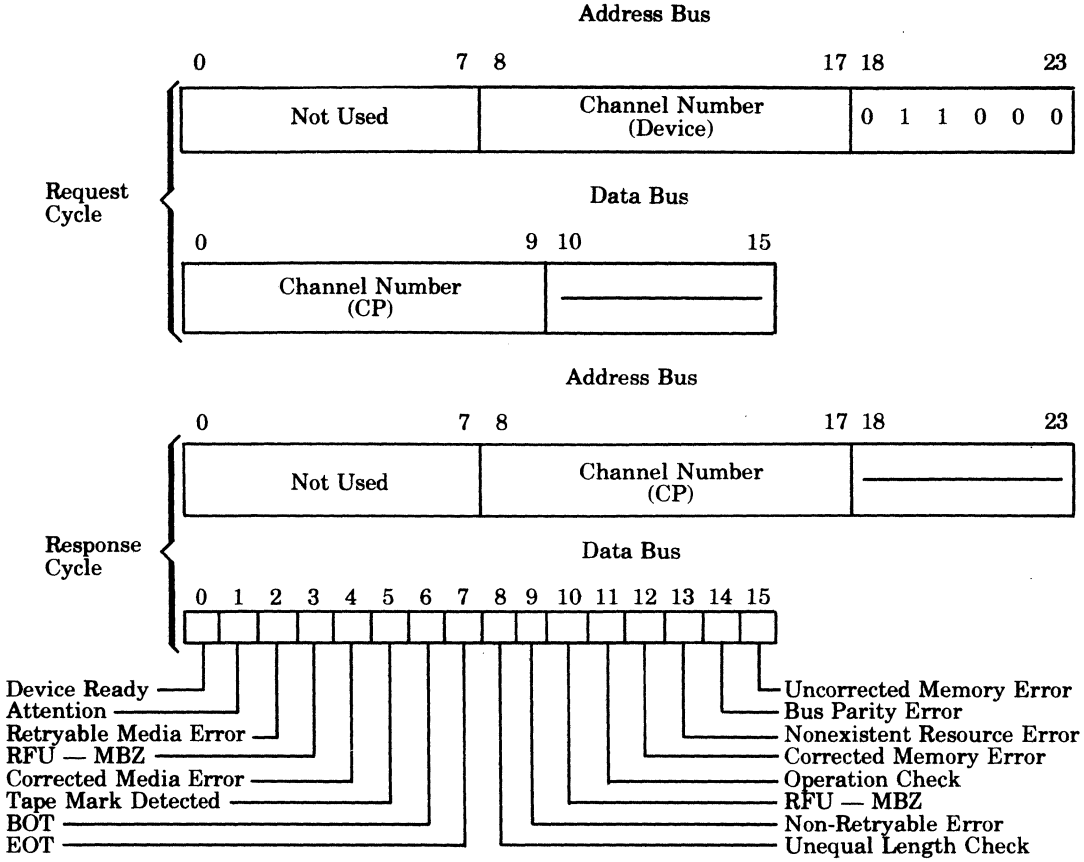
Causes the Task Word of the referenced channel to be transferred to the requesting channel. The Task Word transferred will contain the code for the last operation executed by the channel (unless an Initialize has occurred).

During the Response cycle (Second Half Read), the MTC will return in bits 8-23 of the Address Bus the same data that was received in bits 0-15 of the Data Bus during the Request cycle.

Command Input Status Word 1

Function Code 18

Format



Function

Causes the referenced channel's Status Word 1 to be transferred to the requesting channel. During the Response cycle (Second Half Read), the MTC will return in bits 8-23 of the Address Bus the same data that was received in bits 0-15 of the Data Bus during the Request cycle. Bits 0-7 of the Address Bus and the parity bit associated with these bits are the same data received during the Request cycle. See Table A-2.

Table A-2. Status Bit Definitions – Word 1

Status Condition	Bit	Definition	Reset by
Device Ready	0	Unit is online with tape loaded, is not rewinding, and no further manual intervention is required to place it under program control. This bit will be zero, if either Status Word 2 bit 0 is a zero or Status Word 2 bit 1 is a one.	A change in condition
Attention	1	Indicates an event has occurred at the unit which requires software action. This event, moreover, was not related to a current task but rather was unsolicited. This bit will be set whenever the device changes its ready condition as a result of a non-software-initiated command (i.e., enter or leave the online state, rewinding state, or media loaded state). Attention status may occur following a software initiated Stop I/O or initialize command if the device was performing a Rewind or Rewind and Unload Instruction. Whenever the Attention bit is set, an interrupt is attempted (if the interrupt level is nonzero). If a previously initiated operation is in progress when a device state change is sensed, the resultant interrupt (with the Attention bit set) will serve as notification of both the end of the operation and the device state change.	Initialize, Input Status Word 1, or Output Task Word command
Retryable Media Error	2	Indicates a data error has occurred and will be set whenever Status Word 2 bit 4, 5, 6 or 7 is active.	Initialize or Output Task Work Command
Reserved for Future Use	3	Must be zero.	
Corrected Media Error	4	Indicates an error condition was detected on tape; however, the data read is not lost. For this subsystem, the detected condition is a noise area within an interblock or BOT gap. A noise area may comprise 1 to 11 detectable frames of magnetic transitions on the media when the subsystem is functioning in the minimum data block mode. In the nonminimum data block mode, all detected frames of magnetic transitions are processed as a block.	Initialize or Output Task Word command
Tape Mark	5	Indicates a Tape Mark has been detected during the execution of a Write Tape Mark, Forward-space Tape Mark, or a Backspace Tape Mark order. This status bit will also be active if the block encountered during execution of a Forward-space/Backspace/Read block instruction is a Tape Mark.	Initialize or Output Task Word command
BOT (Beginning of Tape)	6	Indicates the BOT marker is positioned at the BOT sensor. A backspace or rewind order issued to a unit with tape at BOT will result in no tape motion initiated and a normal termination of the order.	

Table A-2 (Cont). Status Bit Definitions – Word 1

Status Condition	Bit	Definition	Reset by
EOT (End of Tape)	7	Indicates the EOT marker is positioned at, or has passed beyond, the EOT sensor. This status bit will remain active until the EOT marker passes back over the sensor as a result of a Tape Backward Motion command (e.g., backspace, rewind). The state of this status bit has no effect on forward motion commands, except the Forward-Space to Tape Mark in which forward motion is terminated in the next interblock gap.	
Unequal Length Check	8	Indicates that for the previous Read Operation, the physical block was either greater or less than the value in the range register, at the beginning of the Read operation. This bit, a 1 and a residue in the range register, indicates that a short block was transferred. This bit active and a range register contents of zero indicate that a long block was transferred.	Initialize or Output Task Word command
Non-Retryable Error	9	Indicates that the position of media under the tape read/write and erase heads is unknown. This bit will be set when a write order RAW [a] failure occurs (i.e., the detection of magnetic transitions on tape before the start or following the completion of a recorded data block, or the failure to detect magnetic transitions in the area where a data block is being written, or the failure to detect an NRZI density identification area on tape when writing an NRZI tape). This bit will also be set when an erase order RAW failure occurs (i.e., the detection of magnetic transitions in the area on tape being erased) or when, during a read order, a split block is detected. A split block is a data block in which its beginning and end positions cannot be guaranteed detectable because of a detected unrecorded area within the block. This status bit also becomes active when Status Word 2 bit 10 (Time Out Check) is set.	Initialize or Output Task Word command
Reserved for Future Use	10	Must be zero.	
Operation Check	11	Indicates a write type order (Write, Write Tape Mark, Erase) was issued to a tape drive in Write Protect (see state of Status Word 2 bit 2); that upon acceptance of an Output Task Word data transfer command, the direction of data transfer is not the same as that specified by the direction bit of the channel number issued by the previous Output Address command; that upon acceptance of an Output Task Word data transfer command, the contents of the range register is zero (for Read or Write) or less than 18 (for write) when the subsystem is in the ANSI configuration mode; or that a command (other than No Operation) was issued to a channel on which the device is in the offline or Not Ready state.	
Corrected Memory Error	12	Indicates that during execution of the previous operation, main memory detected and corrected a memory read error. The data that was delivered to the MTC was assumed to be correct.	Initialize or Output Task Word command

Table A-2 (Cont). Status Bit Definitions – Word 1

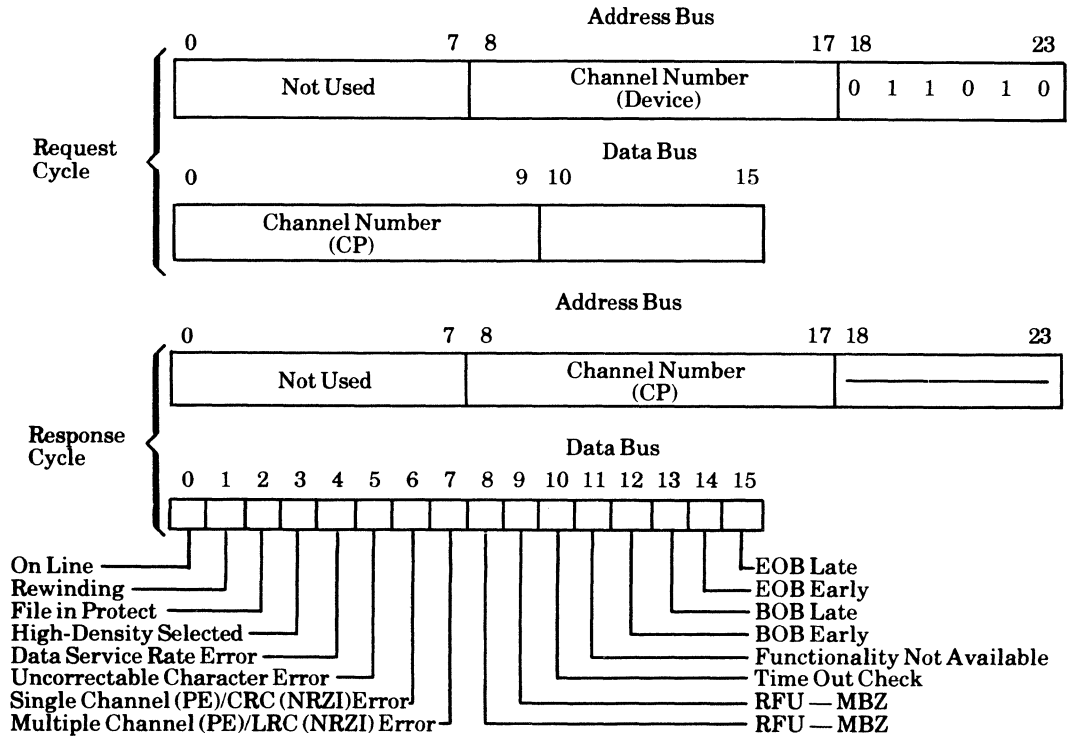
Status Condition	Bit	Definition	Reset by
Nonexistent Resource Error	13	Indicates the MTC attempted a Write or Read request bus cycle and received a NAK response. Occurrence of this condition does not cause a termination of the operation in progress; however, it can result in bad data being written on the tape.	Initialize, Input Status Word 1, or Output Task Word command
Bus Parity Error	14	Indicates the MTC detected a parity error on either byte of the Data Bus during any output bus cycle (i.e., odd function code), during a second-half memory read cycle, or when a parity error is detected in bits 0-7 of the Address Bus during an Output Address command. Occurrence of this condition does not cause a termination of the operation in process; however, it can result in bad data being written on tape.	Initialize, or (error free) Input Status Word 1 command
Uncorrected Memory Error	15	Indicates that during execution of the previous operation, the main memory detected a memory read error which the EDAC algorithm could not correct. The data that was delivered to the MTC was incorrect. Occurrence of this condition does not cause a termination of the operation in progress; however, it can result in bad data being written on tape.	Initialize or Output Task Word command

[a]Read After Write

Command Input Status Word 2

Function Code 1A

Format



Function

Causes the referenced channel's Status Word 2 to be transferred to the requesting channel. During the Response cycle (Second Half Read), the MTC will return in bits 8-23 of the Address Bus the same data received in bits 0-15 of the Data Bus during the Request cycle. Bits 0-7 of the Address Bus and the parity bit associated with these bits are the same data received during the Request cycle. See Table A-3.

Table A-3. Status Bit Definitions – Word 2

Status Condition	Bit	Definition	Reset by
Online	0	Indicates the unit is online to the subsystem via the ONLINE switch on the unit. The unit can also be put into offline status via the Rewind and Unload instruction.	
Rewinding	1	Indicates the unit is processing a rewind operation either via a command issued by the subsystem or the REWIND switch on the unit.	
File in Protect	2	Indicates the unit is in write protect (i.e., the write permit ring is not in position on the mounted file reel).	
High-Density Selected	3	Indicates that in a dual-density unit the HI DEN switch is set to the high-density position. This bit is not set if high-density is not selected or the unit has only a single density.	
Data Service Rate Error	4	Indicates that during a Read or Write operation, data transfer to/from main memory and the unit via the MTC could not maintain the rate in demand. Either data was lost on input because of failure to keep up with device demands or data was unavailable on output when required by the device. The detection of this error condition does not affect the execution of the data transfer operation in process.	Initialize or Output Task Word command
Uncorrectable Character Error	5	Indicates that during a Read or Write operation either a Vertical Redundancy Check (VRC) error and/or a dropped character error was detected. In a VRC error, one or more data chracters were detected with incorrect vertical parity. Data character parity is odd unless bit 3 in the stored configuration word is set. In a dropped character error, one or more data characters following the first contiguous segment of data characters in the block were not read.	Initialize or Output Task Word command
CRC (Cyclic Redundancy Check) Error	6	Indicates that during a Read or Write operation the tape CRC character failed to compare with the reconstructed value.	Initialize or Output Task Word command
LRC (Longitudinal Redundancy Check) Error	7	Indicates that during a Read or Write operation, an incorrect longitudinal parity was detected for any track read. The LRC character written at the end of each block will result in even track parity.	Initialize or Output Task Word command
Reserved for Future Use	8	Must be zero.	

Table A-3 (Cont). Status Bit Definitions – Word 2

Status Condition	Bit	Definition	Reset by
Reserved for Future Use	9	Must be zero.	--
Time Out Check	10	Indicates that during a Read or Space operation, an excessive delay prior to detecting a block has occured and has resulted in a termination of the order. This delay is equivalent to passing over approximately 25 feet of tape. This bit is also set during a Rewind or Rewind and Unload operation following an excessive delay without the device entering a Rewind sequence or at BOT. Positioning of the tape under the read/write and erase heads are unknown. Activation of this bit during a Rewind and Unload operation indicates that an excessive delay has been detected without the device entering the offline state.	Initialize or Output Task Word command
Functionality Not Available	11	Indicates that the Read Backwards order of the Output Task Word is not available for the specified subsystem. A termination of the order without tape motion takes place.	Initialize or Output Task Word command
Beginning of Block (BOB) Early	12	Indicates that the block written on tape was detected by the RAW[a] circuitry to have begun earlier than that specified for the selected device.	
Beginning of Block (BOB) Late	13	Indicates that the block written on tape was detected by the RAW circuitry to have begun later than that specified for the selected device.	
End of Block (EOB) Early	14	Indicates that the block written on tape was detected by the RAW circuitry to have terminated earlier than that specified for the selected device.	
End of Block (EOB) Late	15	Indicates that the block written on tape was detected by the RAW circuitry to have terminated later than that specified for the selected device.	

[a]Read After Write

Appendix B
Specifications

Marketing Identifiers	MTU9609 MTU9109	MTU9610 MTU9110	MTU9614 MTU9114	MTU9615 MTU9115
Performance Characteristics				
Number of Tracks	9	9	9	9
Interblock Gap	0.60 in. (1.52 cm) nominal			
Tape Head	Dual read/write, separate erase head			
Tape Density (bpi)	800/1600	800/1600	1600	1600
Read/Write Speed (ips)	45	75	45	75
Rewind Speed (ips)	200	250	200	250
Transfer Rate (bytes/second)				
800 bpi	36K	60K	—	—
1600 bpi	72K	120K	72K	120K
Vacuum Control	Single	Dual	Single	Dual
Recording Format	Compatible with ANSI standards (X3.22-1973, X.3.39-1973) for recorded magnetic tape information exchange			
Electrical Characteristics				
Voltage (Vac)	120	120	120	120
Frequency (Hz)	60	60	60	60
Power Consumption (kVA)	0.78	0.82	0.78	0.82
Heat Generation (Btu/hr)				
MTU96XX	2130	2228	2130	2228
MTU91XX	2250	2390	2250	2390
Physical Characteristics				
Height	61.5 in. (156.2 cm)			
Width	27.0 in. (68.6 cm)			
Depth	36.1 in. (91.7 cm)			
Weight	394 lb (178.9 kg)			

	MTU9609 MTU9109	MTU9610 MTU9110	MTU9614 MTU9114	MTU9615 MTU9115
Environmental Characteristics				
Operating Temperature	50°F to 100°F (10°C to 38°C)			
Relative Humidity	10% to 90% (noncondensing)			
Cables				
Power Cord	7.5 ft (2.3 m)			
Interconnecting cable	25 ft (7.6 m)			

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