RECORDING METHODS

Before information is written on tape, tape coating is erased to a specified magnetic flux polarity. Erasure is accomplished by passing tape across a dc erase head before it is written. The erase head magnetizes the entire width of the tape so that the end of tape nearest the beginning-of-tape (BOT) marker is a north-seeking magnetic pole. Interblock gap areas have the same magnetic flux polarity that is produced by the erase head.

Both the nonreturn to zero IBM (NRZI) and the phase-encoded (PE) methods record information by producing magnetic flux reversals in the tape coating. The NRZI method uses a flux reversal in either direction to represent a 1-bit. When writing NRZI tape, flux reversals are written only for 1-bits. When reading NRZI tape, the absence of a flux reversal is interpreted as a 0-bit (Ⓐ, Figure 3).

When writing PE tape, flux reversals are written for both 1- and 0-bits. When tape is moving forward, a flux reversal to the magnetic polarity of "erased" tape at bit-shift time is defined as a 1-bit. A flux reversal to a polarity opposite that of erased tape at bit-shift time is defined as a 0-bit (Ⓑ, Figure 3). The comparison of the flux reversals needed to write a series of bits on tape in both NRZI and PE mode is shown on Ⓒ, Figure 3. The extra shifts that occur at bit-cell-boundary time (phase bits) are necessary to maintain the correct direction of shift for each type of bit, when writing two like PE bits (1 and 1 or 0 and 0) in succession.

Each PE data block is preceded and followed by a burst of all-zeros bytes and an all-ones marker (preamble and postamble). The preamble synchronizes the read detection circuits so that 1's and 0's are identified correctly when reading the data bytes which follow. The postamble indicates the end of the data in a tape block. When reading backward, the functions of the preamble and postamble are reversed.

When tape is read, the bits (flux reversals) are sensed by the read head to produce a waveform similar to the waveform which wrote the bits. The waveform is decoded in a 2803/2804 to 0- and 1-bits by comparing it to reference (clock) pulses. Because the sensing and decoding of a bit depend not only on the magnetic strength of the signal but also on the polarity and timing of the recorded signal, the possibility of an error because of weak or extraneous signals is considerably reduced.

The nine-track tape format used with the System/360 eight-bit code and the seven-track tape format used with the six-bit BCD code are shown in Figures 18-20. To increase nine-track reliability, the bit tracks are arranged to place the most-used bits in the center of the tape.

Error Correction

Nine-track NRZI tapes are written with a cyclic redundancy check (CRC) character at the end of each data block (Figure 18). This character, which is used to correct single-track read errors, is generated in the CRC register in the tape control. The contents of the nine positions of the CRC register are designated CP (parity) and C0 through C7.

The CRC character is formed in the following manner:

1. All data characters in the tape block are added to the CRC register without carry (each bit position n is exclusive ORed to Cn).
2. Between additions the CRC register is shifted one position (CP to C1, etc., and C7 to CP).
3. If shifting will cause CP to become a 1, the bits being shifted into positions C2, C3, C4, and C5 are inverted.
4. After the last data character has been added, the CRC register is shifted once more in accordance with steps 2 and 3.
5. To write the CRC character on tape, the contents of all positions except C2 and C4 are inverted. The parity of the CRC character is odd if the number of data characters within the block is even, and the parity is even if the number of data characters within the block is odd. The CRC character may contain all 0-bits only if the number of data characters is odd.

Additional information on nine-track NRZI error correction is in Field Engineering Theory of Operation, *IBM 2803/2804 Model 1 Tape Control and Tape Controls for 2403/2404 Models 1, 2, and 3,* Form Y22-2853.

OPERATOR'S CONTROLS AND INDICATORS

Operator's Panel

The operator's panel is shown in Figure 4. For convenience, the indicators are all in the upper row and the controls are in the lower row.

Select

The select indicator is turned on to show that the tape unit is the one selected to perform the next tape function. The tape unit must be in ready status.

Ready

When on, the ready indicator shows that the tape unit is in ready status; that is, the tape unit is loaded (tape in the vacuum columns and across read/write head), all interlocks are closed, and tape is not rewinding. This indicator is turned on by pressing the start pushbutton, but it will not turn on unless the two preceding conditions are satisfied. Pressing the start pushbutton while the tape is in motion, as in a load/rewind operation, will not turn on this indicator immediately; but the indicator will turn on when the load/rewind is completed.