DEVELOPMENT STANDARD

QIC-171
Revision C
11 Dec 96

MAGNETIC HEAD FOR USE WITH
QIC-3095-MC RECORDING FORMAT

**Quarter-Inch
Cartridge
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(See important notices on the following page)

Important Notices

QIC DEVELOPMENT STANDARDS

Revision History for QIC-171

Rev. Level	Detail	Rev. Date
B	(i) Added Caution Statement to head cleaning provisions	6/20/96
	(ii) Added Figure 2, showing mechanical tolerances for read-while-write functionality version of the magnetic head	
C	(i) Remove drawing proposal RWW	12/11/96
	(ii) Change gap to gap distance RWW configuration	

1.0 GENERAL SPECIFICATIONS

This specification defines a single channel thin film tape head with a configuration choice of either read while write (two bump) or sample write verify (single bump). The head is to be used in a mini-cartridge tape drive as specified in QIC Standard 3095-MC.

1.1 Write Head - Thin film inductive, two terminal.

1.2 Read Head - Thin film magnetoresistive design. The head can be either configured with the magneto resistive structure shielded at the gap surface of the head (Sensor In Gap design), or in some format in a yoked design.

1.3 Tape Transfer - The tape drive class that this head will be used with is a mini-cartridge drive, specifically with drives that use the Travan™ cartridge.

1.3.1 Tape Speed (FWD/REV) There is no specific upper or lower limit on tape speed defined in any drive related documentation for this drive. The drive design point for any particular application could vary through the rated speed range of the cartridge which has an upper limit of 120 IPS. Head designers should be aware that this head could require to be run at this maximum speed and will be read at significantly lower speeds, especially in the various permitted backward compatibility modes.

1.3.2 Tape Backward Compatibility. This head will be required to read older formats. These formats include but are not limited to QIC 3080, 3020, 3010 and QIC 80 in various tape length and width options.

1.4 Tape and Cartridge - Travan™ mini-cartridge tape (as specified in QIC 164) with 740 feet of 0.315" wide tape. This format will record 72 tracks and uses servo bursts for assisting in track location. The media coercivity is 900 Oe, and tape tension is specified at 0.5 Oz to 3.5 Oz at rated speeds.

2.0 ENVIRONMENTAL CONDITIONS

2.1 Operation

2.1.1	Temperature	+5˚C to +45˚C
2.1.2	Temperature Gradient	3˚C per minute, MAX
2.1.3	Relative Humidity	20% to 80%, non condensing 29˚"C MAX Dew Point

2.1.4	Atmospheric Pressure	10.9 to 15. psi

2.2 Storage and Transportation

2.2.1	Temperature	40˚C to +60˚C
2.2.2	Temperature gradient	3˚C per minute, MAX
2.2.3	Relative Humidity	0% to 90%, non condensing
2.2.4	Vibration	5 to 63 Hz, 0.1 in. peak-peak displacement; 63 to 500 Hz, 1.5 g's MAX
2.2.5	Shock	20 g's MAX, 11 msec /2 sine wave

2.3 Test

2.3.1	Temperature	22˚C +5˚C
2.3.2	Relative Humidity	40% - 70% 1 8˚C MAX Dew Point
2.3.3	Acclimation Prior to Testing	24 hours (head, tape cartridge and test equipment)

3.0 MECHANICAL SPECIFICATIONS

3.1 Channel Width

3.1.2	Read	0.00200" +0.00004"
3.1.2	Write	0.00390" +0.00008"

3.2	Gap-to-Gap Distance	0.000350" MAX (SIG) 0.000400" MAX (YOKE)
3.3	Read Channel to Write Channel Centerline Mismatch	0.0001 50" MAX
3.4	Read Gap to Write Gap Parallelism	1 minute MAX

4.0 STATIC TEST SPECIFICATIONS

4.1 DC Resistance

4.1.1	MR Read Element	160 ohms MAX total
4.1.2	Write Coil	10-25 ohms, full coil
4.1.3	Bias Conductor	20 ohms, MAX (Yoke)

4.2 Resonant Frequency

4.2.1	Write(Full Coil)	30 Mhz MIN, measured at connector with 33pF external parallel capacitor

4.3 Inductance

4.3.1	Write Coil (at 2 Mhz)	400-600 nH

5.0 DYNAMIC TEST METHOD

5.1	Tape Speed	78 ips
5.2	Read Load	400 ohms ref
5.3	Tape Cartridge ID	per QIC-164
5.4	Read Sensor Current	12 mA nominal, (SIG) 16 mA nominal, (Yoked)
5.5	Write Equalization	Per QIC-3095-MC See Appendix A

6.0 HEAD CLEANING

CAUTION: The use of any head cleaning system, whether employing wet, dry, or scrubbing actions, must be extremely carefully tested and evaluated far efficiency and validated not to cause damage to the tape head structure in ways outlined below, but not limited to those areas described in the following section.

6.1 The following solvent(s) may be used to clean the head without:

(a) causing damage to its structure;

(b) permitting head fabrication glues and epoxy products to wick to the head to tape interface;

(c) causing damage to the media in the event that small amounts do not evaporate immediately:

1. Reagent grade anhydrous isopropyl alcohol

6.2 Head Cleaning cartridge methods must:

(a) limit the solvent applied to a quantity sufficient to clean the head without leaving or redepositing debris;

(b) not permit solvent to seep into the head surface bondlines and contour airbleed slots; and

(c) not contribute to electrostatic discharge problems which damage the head.

7.0 DYNAMIC TEST SPECIFICATIONS

Notes: 1) Do not expose the head to externally generated fields in excess of 5 Oe. The following tests are to be completed with write equalization, with write current set per item 7.1.

2) During testing, the write current waveform shall conform to the following criteria:

Write Current Rise Time	20 nS MAX
Write Current Overshoot	1O% MAX

3) All static parameters to be measured at the flex or cable connector.

4) All performance criteria shall be met in both forward and reverse directions.

5) All the specifications indicated below in 7.1 to 7.9 are to be attained in either the read while write or sample write verify of this head design. Specification 7.10 applies only to the read while write version of the head.

7.1 Find the lowest write current which produces 95% of the maximum 50,800 ftpi output (IREF).

I-Write: IW = 1.15 x IREF = 10 - 28 mA

NOTE: This write current (IW) shall be used for all subsequent test items.

7.2 Write a write-equalized 12,700 ftpi signal. Read back and compare the amplitude of the positive pulses (PP) and the negative pulses (NP) of a write equalized 12,700 ftpi signal. Compute the amplitude asymmetry per the following equation:

Asymmetry: (PP - NP)/(PP + NP) x 100 = $\pm$10%

7.3 Measure the 50,800 ftpi output (V1).

Output: V1 = 1.O to 3.8 mV

7.4 Measure the write-equalized 12,700 ftpi output (V2).

Resolution: V1N2 x 100 = 85% minimum

For the yoked MR version of this head design, this minimum resolution specification is attained after a 12 dB step applied to the read output in the read amplifier.

7.5 Record a 50,800 ftpi signal in the forward direction, turn off the write head, and measure output (V1). Leave read sense current on, and move the tape over the head 10 times (5 FWD, 5 REV). Read the remaining signal in the forward direction (V3).

Self Erasure: V3N1 x 100 = 90% MIN

7.6 Measure the amplitude of the fundamental (V1) and 2nd Harmonic Component ofthe write-equalized 12,700 ftpi signal (N1).

2nd Harmonic: 20 log N1N1 = -22 dB MAX

7.7 Write a write-equalized 12,700 ftpi signal, measure its fundamental amplitude (V1), then overwrite with a 50,800 ftpi signal. Measure the amplitude of the residual 12,700 ftpi signal (N2).

Overwrite: 20 log N2N1 = -26 dB MAX

7.8 Measure the output of a 50,800 ftpi signal in the forward direction (F1) and in the reverse direction (R).

FWD/REV Ratio: (F1-R1)/MAX,F1,R1) x 100 = $\pm$10%

7.8 Measure the variance in peak-peak envelope of a 50,800 ftpi signal, recording the minimum (VMIN) and maximum (VMAX) envelopes observed.

Modulation: (VMAX-VMIN)/VMAX x 100 = 1O% MAX

7.10 With tape motion stopped, and the write core energized at 50,800 ftpi and at IW, measure the crossfeed noise in the appropriate read element (N3).

Crossfeed: 20 log N3N1 = -30dB MAX

APPENDIX A

METHOD OF VVRITE EQUALIZATION USED IN QIC-3095-MC

The attached appendix references pages 8 to 10 in QIC-3095-MC and defines the write equalization scheme used in this drive.

5. RECORDING

5.1 Method Of Recording

The recording method shall be the Non Return to Zero Mark (NRZI) method where a ONE is represented by a change in direction of longitudinal magnetization.

The recording current shall be 1.15 x I_{sat} + 3%, measured on a standard reference cartridge at 20$\pm$4˚C and 50$\pm$10% R.H., where I_{sat} is the current providing 95% of the maximum output at 50,800 ftpi (2000 ftpmm). The I_{sat} is measured on the non-saturating side of the saturation current curve.

5.2 Write Equalization

To minimize the problems due to the large transition spacing. ratio (4:1) write equalization must be used. Write equalization consists of inserting narrow pulses into the written data stream in such a manner that the resultant write current waveform continues to be bilevel. In addition, when write equalization pulses are added in accordance with this specification the transfer function of the write equalizer will be linear. Refer to Appendix A for write suppression characteristics.

For every "zero" other than the first "zero" following a "one", one or more additional write equalization pulses shall be inserted into the waveform as shown in Figure 5.1 and Figure 5.2 of the inserted pulse (pulses) with reference to the bit cell shall be exactly as specified in the figures.

The width t_w of the equalization pulse (all measurements made from the 50% point ofthe write current waveform) shall be 1/6 of the minimum nominal transition period t_c as shown in Figure 5.2.

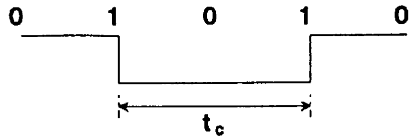


Figure 5.1.1 Pattern ..01010..

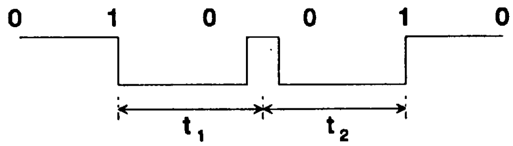


Figure 5.1.2 Pattern ..010010..

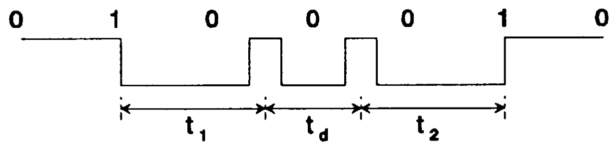


Figure 5.1.3 Pattern ..0100010..

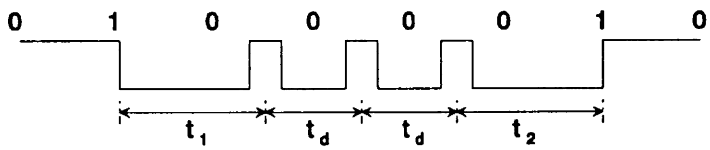


Figure 5.1.4 Pattern ..01000010..

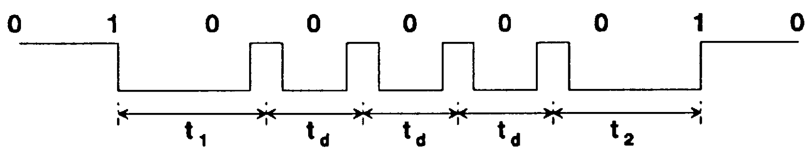


Figure 5.1.5 Pattern ..010000010..

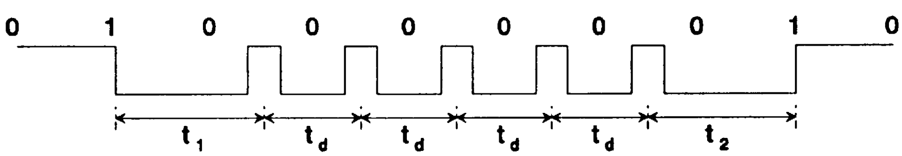


Figure 5.1.6 Pattern ..0100000010..

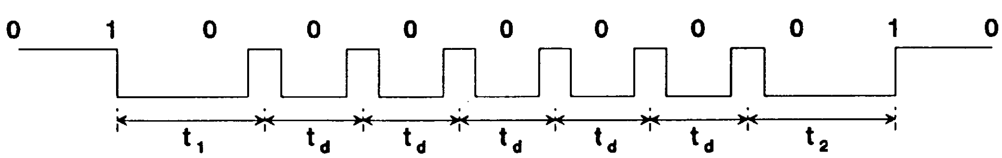
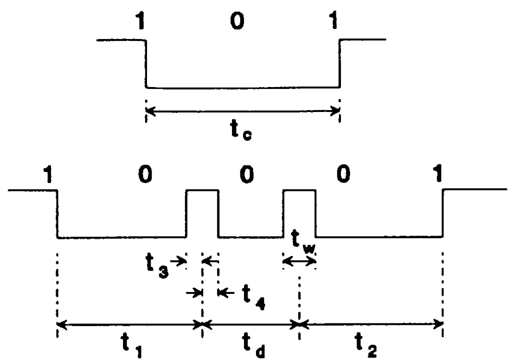


Figure 5.1.7 Pattern ..01000000010..

Figure 5.1 Write Waveforms and Equalization



$$t_d = \frac{t_c}{2}; \quad t_c = 2t_d$$

$$t_1 = \frac{11}{6} \times t_d$$

$$t_1 + t_2 = 3t_d$$

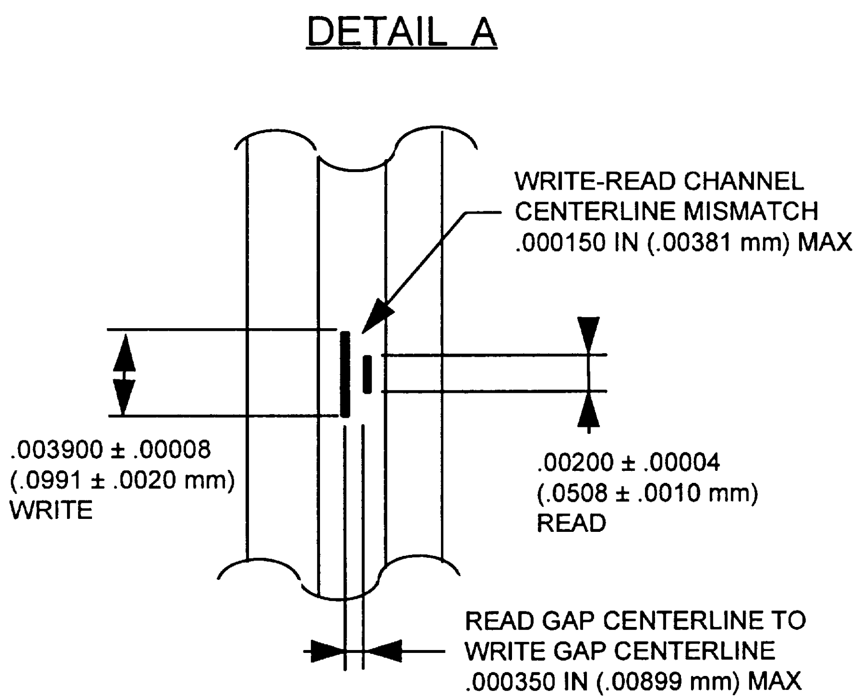
$$t_3 = t_4 = \frac{t_w}{2}$$

$$t_w = t_3 + t_4 = \frac{t_c}{6} = \frac{t_d}{3}$$

Maximum variation of $t_1 + t_2$ is $\pm 0.5\%$ from nominal value.

Maximum variation of t_w is $\pm 2.5\%$ from nominal value.

Figure 5.2 Timing Information, Write Equalization



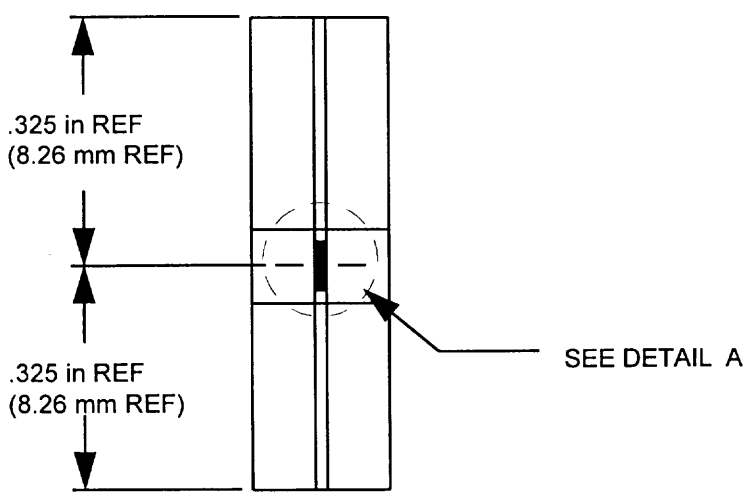
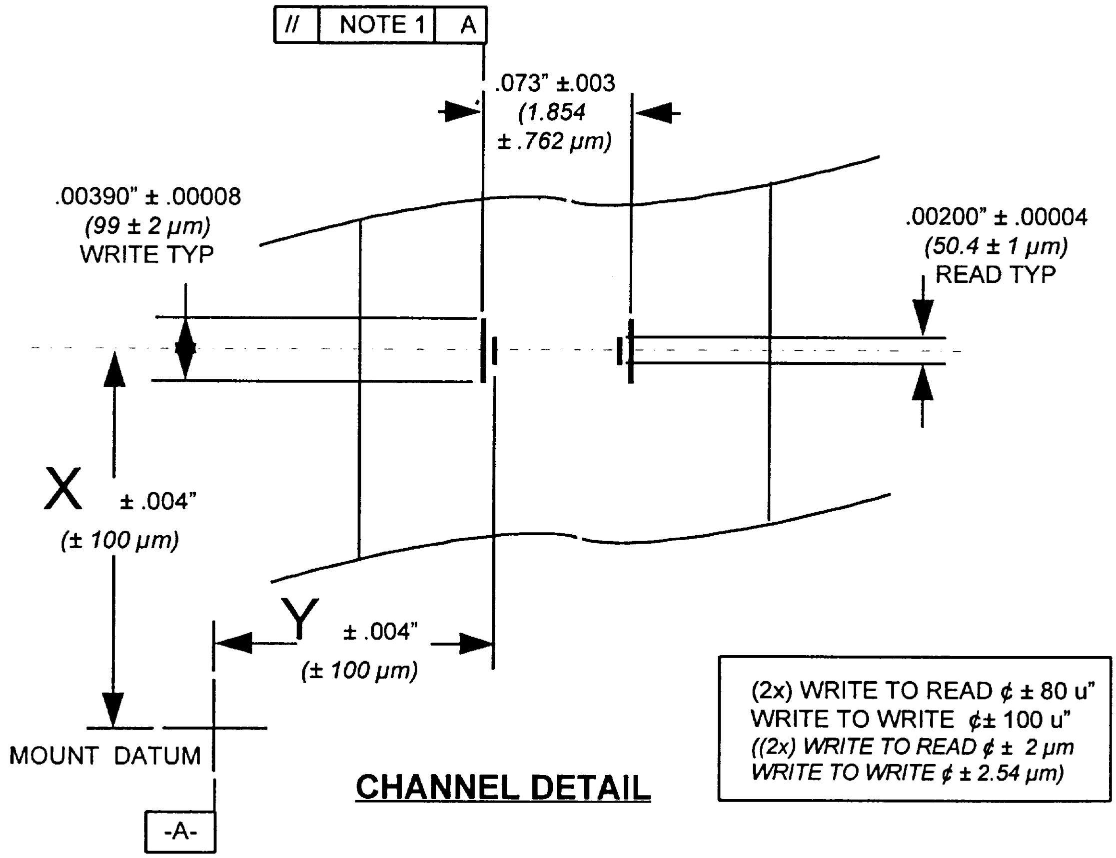
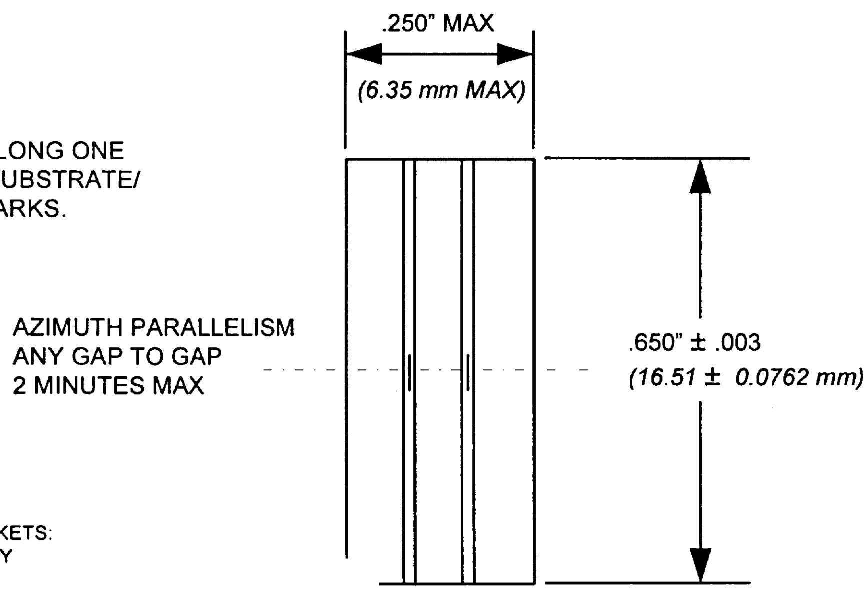


FIGURE 1: MECHANICAL DIMENSIONS
FOR NON READ WHILE WRITE OPTION



NOTES:

1. LOCATE -A- DATUM ALONG ONE GAPLINE-REFERENCE SUBSTRATE/ SPECIAL ALIGNMENT MARKS.



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ITALIC VALUES BETWEEN BRACKETS:
METRIC FOR INFORMATION ONLY

FIGURE 2. MECHANICAL DIMENSIONS FOR READ-WHILE-WRITE OPTION.