DEVELOPMENT STANDARD

QIC-133
Revision G
27 Aug 97

MAGNETIC HEAD FOR USE WITH QIC-3010-MC
AND QIC-3020-MC RECORDING FORMATS

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QIC DEVELOPMENT STANDARDS

REVISION HISTORY

QIC-133

Revision Level	Detail	Revision Date
Rev. D	(1) A separate section added defining head for 3010 drive (255 MB performance).	9/1/93
	(2) Head appellation changed to 3010 and 3020 from 255 and 500.	9/1/93
	(3) Maximum allowable external magnetic field during operation of 5 0e added (paragraph 6.0).	9/1/93
Rev. E	(1) Added definition of write equalization	12/8/93
Rev. F	Added paragraph 8.0; Casution Statement to head cleaning provision	6/20/96
Rev. G	Change reference to head height and position of track to accommodate 0.815" (8mm) wide tape	8/27/97

1.0 GENERAL SPECIFICATIONS

This specification defines a single channel, single bump, thin-film head for 1/4" minicartridge drives, as defined in the QIC Development Standard QIC-3010 and QIC-3020. It features a sample write verify format.

1.1 Write Head - Thin film inductive, 2 terminal.

1.2 Read Head - Thin film magnetoresistive shielded element.

1.3 Transport - Minicartridge drive class.

1.3.1 Speed (fwd./rev.) 22.6, 45.2, and 95.0 IPS.

1.3.2 Backward compatible: Read compatible to QIC-80 and 40 only. In addition, QIC-3020 will also read QIC-3010.

1.4 Tape and Cartridge - DC2000 minicartridge drive with 295' of 900 Oe media. Cartridge I/D is DC2500. Tension is 0.5 oz. to 3.5 oz. at rated speeds.

2.0 ENVIRONMENTAL CONDITIONS

The head shall be required to meet the entire specification only if used, stored, and transported within the environmental conditions described in this section.

2.1 Operation

2.1.1	Temperature	41 to 126 deg. F
2.1.2	Temperature gradient	86 deg. F/hr. maximum
2.1.3	Humidity non-condensing	20 to 80% relative humidity with maximum wet bulb 79 deg. F.
2.1.4	Atmospheric pressure	10.9 to 15.1 psi

2.2	Storage and Transportation		
	2.2.1	Temperature	-40 to 140 deg. F
	2.2.2	Temperature gradient	86 deg. F/hr.
	2.2.3	Humidity	O to 90% non-condensing relative humidity with maximum wet bulb 80.6 deg. F
	2.2.4	Vibration/acceleration	4G maximum
	2.2.5	Shock	20G (half-sine, 11 m sec. delay)
2.3	Test		
	2.3.1	Temperature	68 $\pm$ 7 deg. F
	2.3.2	Humidity	50 $\pm$ 10% non-condensing relative humidity with maximum wet bulb 64 deg. F

3.0 MECHANICAL SPECIFICATIONS

3.1	Channel Width		
	3.1.1	Read	0.0020" $\pm$ 0.00004
	3.1.2	Write	0.0060" $\pm$ 0.00008"
3.2	Gap-to-gap distance		0.0018" max. - QIC-3020 0.0011" mart - QIC-3010
3.3	Read channel to write channel centerline mismatch		0.00015" maximum
3.4	Read gap to write gap parallelism		1 minute maximum

4.0	STATIC TEST SPECIFICATION		
4.1	D.C. Resistance		
	4.4.1	MR element	160 ohms maximum total
	4.1.2	MR center tap balance (if used)	Resistance of the two pair legs to be within 5%
	4.1.3	Write coil	25 ohms maximum (non-center tapped)
4.2	Resonant Frequency		
	4.2.1	Write coil	40 MHz minimum
4.3	Inductance		
	4.3.1	Write coil at 3 MHz	750 nH maximum
4.4	Impedance		
	4.4.1	Write coil at 3 MHz	30 ohms maximum
4.5	Insulation resistance at a breakdown voltage of 15 volts (channel to case)		1 megohm minimum
5.0	DYNAMIC TEST METHOD		
5.1	Tape speed		22.6 IPS
5.2	Read load		1K ohms
5.3	Bandwidth (3 dB points)		50 KHz to 3 MHz
5.4	Tape cartridge I/D		DC 2500

5.5	Read sensor current	14 mA DC nominal
5.6	(See attached Appendix A for full details of write equalization scheme used in the 3010 and 3020 MC drives)	MFM recording format to be used with write equalization

6.0 KEY ELECTRICAL SPECIFICATIONS

Note: Do not expose these heads to externally generated magnetic fields in excess of 5 Oe. The specifications indicated below are those values when the head is tested without the use of write equalization, except in the case of 6.7, the specification for second harmonic distortion.

	Parameter	Units	QIC-3010	QIC-3020
6.1	Recording format	-----	MFM	MFM
6.2	Write equalization (see Appendix A)	-----	yes	yes
6.3	1F recording density	FRPI	22,125	44,250
6.4	1F output	mVp-p	1.0 min.	0.5 min.
6.5	1F/1/2F resolution	%	50 min.	35 min.
6.6	Self erasure	%	90 min.	90 min.
6.7	2nd harmonic distortion	dB	-27 max.	-27 max.
6.8	Overwrite	dB	-27 max.	-27 max.

KEY ELECTRICAL SPECIFICATIONS - Continued

	Parameter	Units	QIC-3010	QIC-3020
6.9	Write current, Iw	mAo-p	35 max.	35 max.
6.10	Write saturation current, Is	mAo-p max.	Iw = 115% x Is	Iw = 115% x Is
6.11	Fwd/Rev. ratio	%	± 20	± 20

7.0 KEY DEFINITIONS

7.1 1F recording density is defined as the maximum recording density permitted by the encoding format for the drive in question.

7.2 Resolution is defined as the ratio of the 1F output to that obtained at 1/2F for the particular format.

7.3 Self erasure is obtained by writing a 1F signal, then turning off the write current, moving the tape over the head 10 times (5 forward and 5 reverse passes) with the bias current switched on. The value for self erasure is the ratio of the remaining 1F signal to that initially obtained.

7.4 The second harmonic specification is defined as the ratio of the amplitude of the second harmonic of the 1/2F signal to the fundamental of that recording density. NOTE: This test to be performed with write equalization enabled.

7.5 Overwrite is defined as the ratio of an original 1/2F signal to the value of that 1/2F signal.

7.6 (Is) While writing a 44,250 FCI signal, increase the write current until 95% of maximum output is obtained. Measure the o-p current at this point.

7.7 (Iw) Write current to be used for all tests.

Write Current: Iw = 1.15 x Is

7.8 Read performance at QIC-80 and 40 formats to be defined as compatible to the head specifications for these formats.

8.0 HEAD CLEANING

CAUTION: The use of any head cleaning system, whether employing wet, dry, or scrubbing actions, must be extremely carefully tested and evaluated for efficacy 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.

8.1 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;

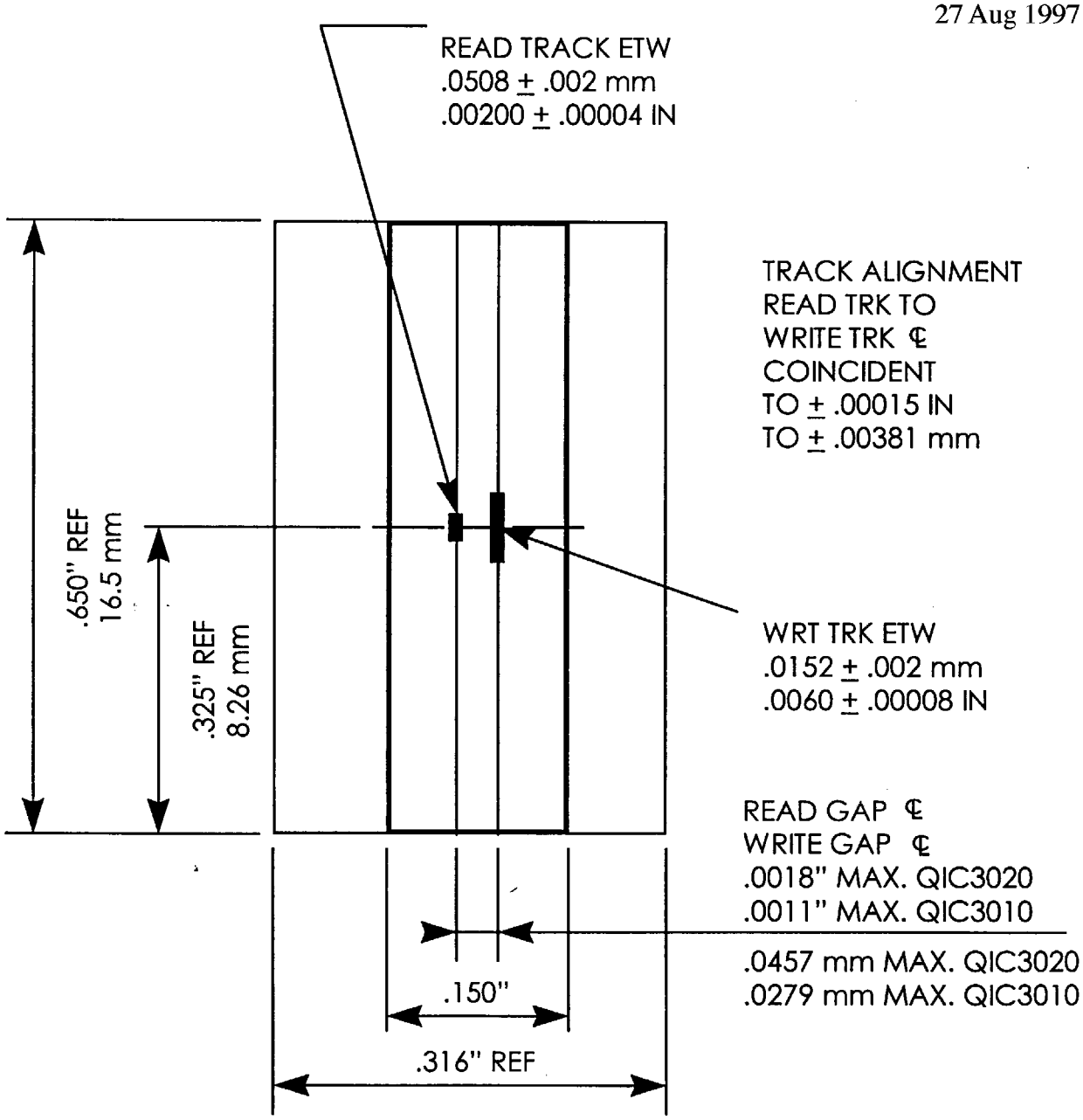
1. Reagent grade anhydrous isopropyl alcohol

8.2 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 bond lines and contourairbleed slots; and

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


READ TRACK ETW
.0508 ± .002 mm
.00200 ± .00004 IN
TRACK ALIGNMENT
READ TRK TO
WRITE TRK ℄
COINCIDENT
TO ± .00015 IN
TO ± .00381 mm
.650" REF
16.5 mm
.325" REF
8.26 mm
WRT TRK ETW
.0152 ± .002 mm
.0060 ± .00008 IN
READ GAP ℄
WRITE GAP ℄
.0018" MAX. QIC3020
.0011" MAX. QIC3010
.0457 mm MAX. QIC3020
.0279 mm MAX. QIC3010
.150"
.316" REF

QIC STANDARD 133

APPENDIX A

NOTE: This appendix defines the write equalization called for in QIC drive standards 3010-MC, revision B and 3020-MC, revision B. The user of this specification should be aware that the magnetic head used in these drives will be subject to this equalization scheme, and should always refer to the above standards for further information relating to this method of working.

This appendix includes the relevant sections from QIC-3010 and QIC-3020, section 3.19 in each standard.

3.13. MEASUREMENT OF SIGNAL AMPLITUDE

The signal amplitude shall be measured at a point in the read channel where the signal is proportional to the rate of change of voltage from the read head.

3.14. AVERAGE STANDARD REFERENCE AMPLITUDE

The average standard reference amplitude is the peak-to-peak output signal read from the Signal Amplitude Reference Tape Cartridge averaged over a minimum of 20,000 bitcells.

3.15. AVERAGE SIGNAL AMPLITUDE

The average peak-to-peak signal amplitude of a tape cartridge re-corded at 22,125 bpi shall deviate no more than ±25% from the ave-rage standard reference amplitude. Averaging shall be done over a minimum of 20,000 bit-cells.

3.16. SIGNAL DECAY

Signal decay is a measurement of loss in signal amplitude of a re-corded tape due to cycling a tape in contact. The tape under test is cycled from BOT to EOT to BOT 55 times. The loss in amplitude from the 5th pass to the 55 pass shall not exceed 15%.

3.17. OVERWRITE AND ERASURE

The overwritten or erased area shall not contain any component of previously recorded information whose amplitude exceeds -30db re-lative to the amplitude of the newly written data (reference section 3.15).

3.18. AZIMUTH

The angular deviation of the mean bit-cell transition line from a line normal to the magnetic tape cartridge reference base shall be less than 10 minutes of arc.

3.19. WRITE EQUALIZATION METHOD

To minimize the amplitude variation of the recorded signal upon playback, due to the variations in transition spacing on the tape (2:1), some form of write pulse equalization shall be used. This section describes the preferred method of write equalization. Other methods of write equalization may be used provided that the recor-ded flux characteristics on the tape matches that of the preferred method.

Regardless ofthe method, the recorded signal must also meet the other requirements specified in this section.

Recommended method: The width of the inserted pulse shall be 1/12 of the minimum nominal transition period (tc). The position ofthe pulses are defined by tl and t2 below. The position of the pulses has been optimized to compensate for phase distortion vhich occurs during the writing of the transitions. The optimal position is that which forces the shoulders of the low frequency signals to occur at the baseline of the recorded signal.

QIC-3010-MC, Revision B

MFM Pattern ..0000... or ...1111...

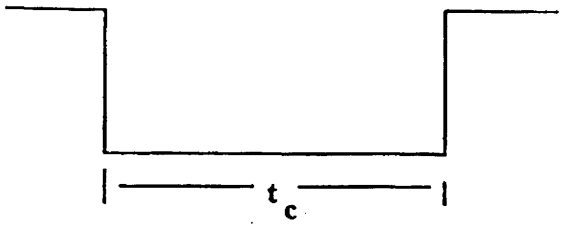


Figure 3.19.1

MFM Pattern ..100100...

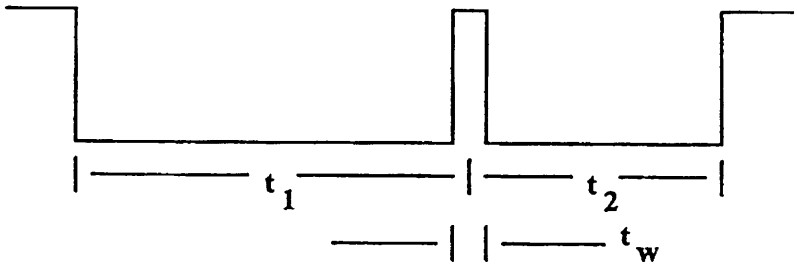


Figure 3.19.2

MFM Pattern ...10101010...

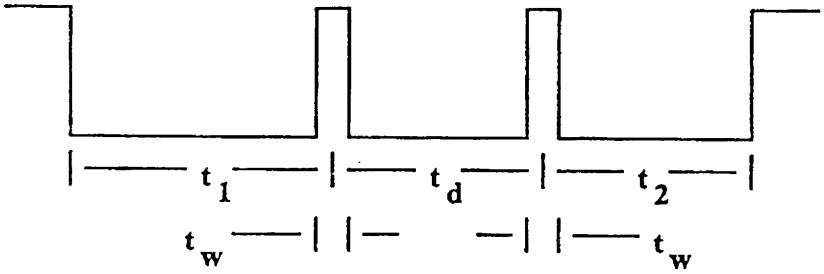


Figure 3.19.3

$t_1 = 0.9583 * t_c \pm 10\%$

$t_2 = 0.5417 * t_c \pm 10\%$

$t_d = 0.5000 * t_c \pm 5\%$

$t_w = 0.0833 * t_c \pm 5\%$

t_1 The distance from the falling edge of the data transition to the center of the first inserted pulse.

t_2 The distance from the center of the inserted pulse to the rising edge of the data transition.

t_d The distance from the center of the first inserted pulse to the center of the second inserted pulse.

t_w The width of the inserted pulse.

3.19.1. MEASUREMENT OF TH]E WRITE EQUALIZATION METHOD

The suppression characteristic ofthe write equalization shall be verified by comparing the amplitude of the fundamentals of an unequalized 11,062.5 KFCI signal to an equalized 11,062.5 KFCI signal using an inductive read head. The suppression characteristic is represented by the following equation:

$$\text{Suppression} = 20 * \log ((F/2 \text{ write equalized})/(F/2 \text{ unequalized}))_{dB}$$

The suppression characteristics ofthe write equalization shall correspond to the table below, within $+ .5_{dB}$ or 1.5_{dB}.

Fd	O_{dB}
Fd/2	$-2.2_{dB} + .5_{dB}$ or -1.5_{dB}

4. TRACKS

There shall be 40 parallel tracks. Even tracks shall be recorded in the forward tape direction. Odd tracks shall be recorded in the reverse tape direction.

4.1. TRACK LOCATIONS

4.1.1. TRACK CENTER LINES

The track center line locations are shown in figure 4.1.1.1 below. Even tracks are relative to the center line of a forward reference burst. Odd tracks are relative to the center line of a reverse reference burst offset from the forward reference burst. Track distances above their reference burst are considered positive. Track distances below their reference burst are considered negative. All track position tolerances are ±.0011 inches (±0.0279 mm) relative to their respective positions.

3.13. MEASUREMENT OF SIGNAL AMPLITUDE

The signal amplitude shall be measured at a point in the read channel where the signal is proportional to the rate of change of voltage from the read head.

3.14. AVERAGE STANDARD REFERENCE AMPILITUDE

The average standard reference amplitude is the peak-to-peak output signal read from the Signal Amplitude Reference Tape Cartridge averaged over a minimum of40,000 bit-cells.

3.15. AVERAGE SIGNAL AMPLITUDE

The average peak-to-peak signal amplitude of a tape cartridge recorded at 44,250 bpi shall deviate no more than ±25% from the average standard reference amplitude. Averaging shall be done over a minimum of 40,000 bit-cells.

3.16. SIGNAL DECAY

Signal decay is a measurement of loss in signal amplitude of a recorded tape due to cycling a tape in contact. The tape under test is cycled from BOT to EOT to BOT 55 times. The loss in amplitude from the 5th pass to the 55 pass shall not exceed 15 %.

3.17. OVERWRITE AND ERASURE

The overwritten or erased area shall not contain any component of previousIy recorded information whose amplitude exceeds -30db relative to the amplitude of the newly written data (reference section 3.15).

3.18. AZIMUTH

The angular deviation of the mean bit-cell transition line from a line normal to the magnetic tape cartridge reference base shall be less than 10 minutes of arc.

3.19. WRlTE EQUALIZATION METHOD

To minimize the amplitude variation of the recorded signal upon playback, due to the variations in transition spacing on the tape (2: 1), some form of write pulse equalization shall be used. This section describes the preferred method of write equalization. Other methods of write equalization may be used provided that the recorded flux characteristics on the tape matches that of the preferred method. Regardless of the method, the recorded signal must also meet the other requirements specified in this section.

Recommended Method:

The width of the inserted pulse shall be 1/6 of the minimum nominal transition period (t_c). The position of the pulses are defined by t_1 and t_2 below. The position of the pulses has been optimized to compensate for phase distortion which occurs during the writing of the transitions. The optimal position is that which forces the shoulders of the low frequency signals to occur at the baseline of the recorded signal.

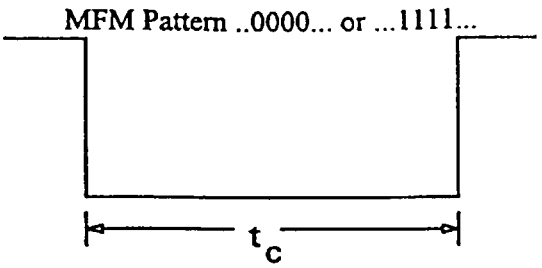


Figure 3.19.1

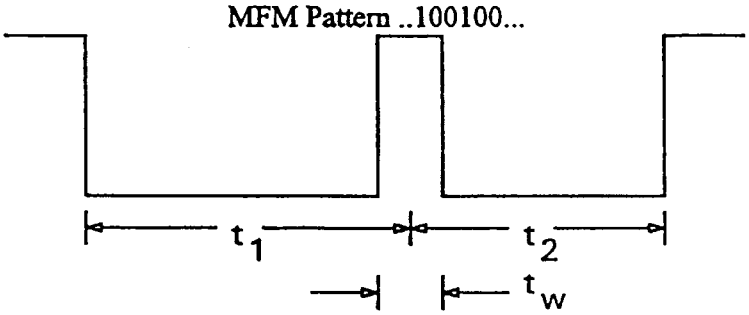


Figure 3.19.2

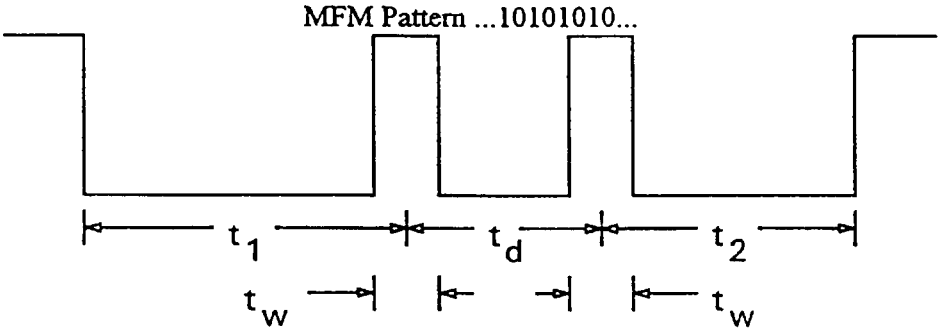


Figure 3.19.3

$t_1 = 0.8333 * t_c \pm 10\%$

$t_2 = 0.6667 * t_c \pm 10\%$

$t_d = 0.5000 * t_c \pm 5\%$

$t_w = 0.1667 * t_c \pm 5\%$

t_1 The distance from the falling edge of the data transition to the center of the first inserted pulse.

t_2 The distance from the center of the inserted pulse to the rising edge of the data transition.

t_d The distance from the center of the first inserted pulse to the center of the second inserted pulse.

t_w The width of the inserted pulse.

3.19.1 MEASUREMENT OF THE WRITE EQUALIZATION METHOD

The suppression characteristic of the write equalization shall be verifed by comparing the amplitude of the fundamentals of an unequalized 22,125 KFCI signal to an equalized 22,125 KFCI signal using an inductive read head. The suppression characteristic is represented by the following equation:

$$\text{Suppression} = 20 * \log ((F/2 \text{ write equalized})/(F/2 \text{ unequalized}))_{dB}$$

The suppression characteristics of the write equalization shall correspond to the table below, within $+0\text{-}5_{dB}$, -1.0_{dB}

Fd	O_{dB}
Fd/2	-5.6_{dB} $+.5_{dB}$ - 1.5_{dB}

4. TRACKS

There shall be 40 paralleltracks. Even tracks shall be recorded in the forward tape direction. Odd tracks shall be recorded in the reverse tape direction.

4.1. TRACK LOCATIONS

4.1.1. TRACK CENTER LINES

The track center line locations are shown in figure 4.1.1.1 below. Even tracks are relative to the center line of a forward reference burst. Odd tracks are relative to the center line of a reverse reference burst offset from the forward reference burst. Track distances above their reference burst are considered positive. Track distances below their reference burst are considered negative. All track position tolerances are ±.0011 inches (±0.0279 mm) relative to their respective positions.