MAGNETIC REFERENCE LABORATORY, INC.
165 Wyandotte Dr ♦ San Jose, CA 95123 ♦ Phone&FAX +1.408.227.8631 ♦ www.mrltapes.com

Publication 313
2008-04-01

Fast Swept-Frequency Reproducer Calibration Tapes With 1 kHz Tone

0 INTRODUCTION

Calibration of a magnetic tape recorder-reproducer requires such mechanical adjustments as head height, vertex angle, azimuth angle, etc., and such electronic adjustments as gain and multiple equalizer responses across the frequency pass-band. Most of these adjustments interact with one another. The usual multifrequency reproducer calibration tape contains a series of discrete frequencies. To perform the adjustments often requires rewinding and replaying the calibration tape several times in order to obtain proper mechanical adjustment and optimum frequency response.

A considerable simplification and time saving is achieved in this adjustment procedure by using a calibration tape containing a fast swept-frequency. View this signal on an oscilloscope or on a real-time a octave spectrum analyzer. It gives the appearance of a continuous display of all frequencies at once; thus the effect of all adjustments and their interactions is immediately apparent. Note that the power spectrum of the fast swept-frequency is the same as that of a pink-noise random signal. The swept frequency has the advantage that it can be read out with either the oscilloscope or the real-time spectrometer, whereas the random noise signal can be read out only with the spectrometer.

An MRL "Multifrequency Calibration Tape" is necessary, however, for all cases where the read-out is to be performed on a meter because no oscilloscope is available.

For measurements below 500 Hz, the MRL "Multifrequency Calibration Tapes" may be used, and if you have a level recorder, the MRL "Slow Swept-Frequency Calibration Tapes" are very convenient.

See "Choosing and Using MRL Calibration Tapes for Audio Tape Recorder Standardization", MRL Publication Choo&U, for more information on choosing and converting between different equalizations and levels, as well as descriptions of other test signals that are available from MRL, and notes on using Calibration Tapes.

Table of Fast Swept-Frequency Reproducer Calibration Tapes for Open-Reel Applications

Medium	Tape Speed	Equalization Standard	Level of Sweeps*	4 minutes total			8 minutes total		
				Catalog Number for Reference Fluxivity of:		Price	Catalog Number for Reference Fluxivity of:		Price
				250 nWb/m ("+3 dB")	355 nWb/m ("+6 dB")		250 nWb/m ("+3 dB")	355 nWb/m ("+6 dB")	
¼ in	**3.75 in/s**	IEC & **NAB**	-10 dB	**221-314-480-102**	**221-314-510-108**	100 $	**221-314-480-128**	**221-314-510-124**	140 $
	7.5 in/s	IEC (IEC1)	-10 dB	231-314-480-109	231-314-510-105		231-314-480-125	231-314-510-121	
		NAB (IEC2)	-10 dB	**233-314-480-105**	**233-314-510-101**		**233-314-480-121**	**233-314-510-127**	
	15 in/s	IEC (IEC1)	0 dB	241-313-480-109	241-313-510-105		241-313-480-125	241-313-510-121	
		NAB (IEC2)	0 dB	**243-313-480-105**	**243-313-510-101**		**243-313-480-121**	**243-313-510-127**	
	30 in/s	**AES** (IEC2)	0 dB	**251-313-480-106**	**251-313-510-102**	105 $	**251-313-480-122**	**251-313-510-128**	155 $
½ in	**3.75 in/s**	IEC & **NAB**	-10 dB	**321-314-480-101**	**321-314-510-107**	145 $	**321-314-480-127**	**321-314-510-123**	225 $
	7.5 in/s	IEC (IEC1)	-10 dB	331-314-480-108	331-314-510-104		331-314-480-124	331-314-510-120	
		NAB (IEC2)	-10 dB	**333-314-480-104**	**333-314-510-100**		**333-314-480-120**	**333-314-510-126**	
	15 in/s	IEC (IEC1)	0 dB	341-313-480-108	341-313-510-104		341-313-480-124	341-313-510-120	
		NAB (IEC2)	0 dB	**343-313-480-104**	**343-313-510-100**		**343-313-480-120**	**343-313-510-126**	
	30 in/s	**AES** (IEC2)	0 dB	**351-313-480-105**	**351-313-510-101**	170 $	**351-313-480-121**	**351-313-510-127**	250 $
1 in	**3.75 in/s**	IEC & **NAB**	-10 dB	**421-314-480-100**	**421-314-510-106**	265 $	**421-314-480-126**	**421-314-510-122**	415 $
	7.5 in/s	IEC (IEC1)	-10 dB	431-314-480-107	431-314-510-103		431-314-480-123	431-314-510-129	
		NAB (IEC2)	-10 dB	**433-314-480-103**	**433-314-510-109**		**433-314-480-129**	**433-314-510-125**	
	15 in/s	IEC (IEC1)	0 dB	441-313-480-107	441-313-510-103		441-313-480-123	441-313-510-129	
		NAB (IEC2)	0 dB	**443-313-480-103**	**443-313-510-109**		**443-313-480-129**	**443-313-510-125**	
	30 in/s	**AES** (IEC2)	0 dB	**451-313-480-104**	**451-313-510-100**	305 $	**451-313-480-120**	**451-313-510-126**	475 $
2 in	**7.5 in/s**	IEC (IEC1)	-10 dB	531-314-480-106	531-314-510-102	375 $	531-314-480-122	531-314-510-128	570 $
		NAB (IEC2)	-10 dB	**533-314-480-102**	**533-314-510-108**		**533-314-480-128**	**533-314-510-124**	
	15 in/s	IEC (IEC1)	0 dB	541-313-480-106	541-313-510-102		541-313-480-122	541-313-510-128	
		NAB (IEC2)	0 dB	**543-313-480-102**	**543-313-510-108**		**543-313-480-128**	**543-313-510-124**	
	30 in/s	**AES** (IEC2)	0 dB	**551-313-480-103**	**551-313-510-109**	420 $	**551-313-480-129**	**551-313-510-125**	645 $

* Because of tape saturation at higher frequencies at lower speeds, some tapes are recorded at 10 dB below the indicated fluxivity.
Prices are in US $, and do not include shipping or applicable taxes. Prices may be changed without notice.

1 DESCRIPTION OF RECORDED SIGNALS

Swept-Frequency Range: 500 Hz to 20 kHz in 33 one-sixth-octave steps. The low-frequency limit is determined by the sweep range and time length of the sweep. When we choose a 100 ms sweep time—appropriate for a "stationary" display without annoying flicker—and a 20 kHz bandwidth, the minimum frequency for meaningful data is about 500 Hz.

Level of Sweeps: At 3.75 and 7.5 in/s, -10 dB. At 15 and 30 in/s, 0 dB.

Timing: Six sweeps per second — sweep 100 ms, retrace (signal blanked) 65 ms; repeated for the duration of the tape.

Synchronization: A 4 kHz burst for 2 ms is recorded at triple amplitude (10 dB above the sweep level) at the beginning of each sweep.

Direction of Sweep: Sync burst, followed by a low- to high-frequency sweep. Tapes are supplied "tail out" for best storage. Rewind tape before using.

1000 Hz Gain Set: A 1000 Hz tone for 30 s, for setting the reproducer gain, is recorded at 0 dB after the Frequency Sweeps.

Playing Time: See Table above. Other times and combinations of Swept-Frequencies and other signals are available on special order.

Fluxivity and Equalization: See Table above.

2 ACCESSORIES REQUIRED

Oscilloscope: A good-quality oscilloscope with a triggered sweep, fitted with the appropriate MRL graticule.

Graticule: The MRL Oscilloscope Graticule for Sweep Tapes is a film-positive which the user attaches to his oscilloscope face. The figure below shows the appearance of this graticule. The horizontal axis is marked with the preferred frequencies of ANSI Standard S1.6, with heavy lines at the octave intervals and light lines at the a-octave intervals. The vertical axis is logarithmically divided, starting at the bottom line (marked "baseline"). Two level ranges are labeled: on the left, from +2 dB to -14 dB; and on the right, from +10 dB to -6 dB. For levels of ±1 dB, these correspond to the scale ratios of 25 dB and 50 dB respectively per decade of frequency, according to ANSI Standard S1.22 and IEC Standard 263.

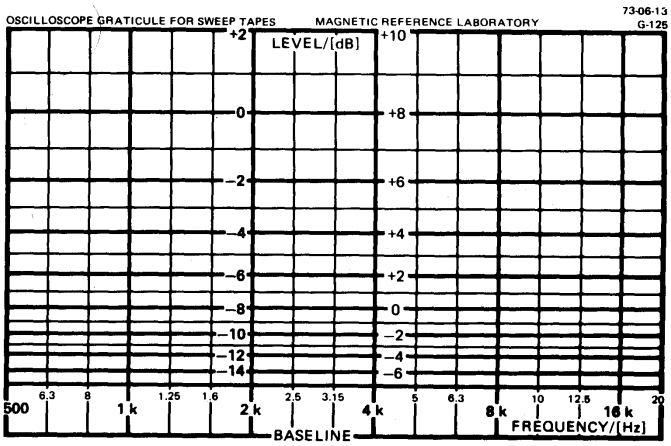

Table of MRL Graticules

Horizontal Dimension of Normal Scope Graticule		MRL Graticule Model Number	Price
80 mm	3.15 inch	G-080	8 $
100 mm	4.0 inch	G-100	
125 mm	5.0 inch	G-125	

Three sizes of graticule are available, to fit the three most popular oscilloscope face-sizes. One graticule is needed for each oscilloscope which will be used to read out the measurements from MRL Fast Swept-Frequency Calibration Tapes.

To select the proper graticule, measure the total horizontal distance between the farthest left and right vertical lines on the graticule normally supplied by the oscilloscope manufacturer with the oscilloscope-face, and choose a graticule with the same width from the table above.

3 USING THE SWEPT-FREQUENCY CALIBRATION TAPE

3.1 Setting the Oscilloscope:

Preliminary: Install the MRL Graticule. With no input signal, or with the input grounded, perform the following steps: Set scope for "auto trig". Set horizontal position control so that the trace starts at the "500 Hz" line. Set vertical position control so that trace lies along the bottom line of the graticule marked "base line". Note that all measurements are made from the base line to the top of the envelope of the image. Put scope in "ac input" mode, so that any dc in the input signal will not shift the base line. Connect the tape reproducer output to the scope input.

Calibrating Scope Time Base: Set horizontal time-base control to "10 ms per div" and the "variable" control to "calibrated", so beam traces the total horizontal graticule distance in 100 ms.

Preliminary reproducer gain setting: The reproducer gain is not critical for setting the mechanical adjustments and the equalizers. If the sweep plays anywhere in the range -12 to +2 dB on the vu meter, the gain need not be adjusted at this time — the gain will be set later with a 1 kHz tone at 0 dB that is recorded after the sweeps.

Calibrating Scope Amplitude Sensitivity (Vertical Scale): Play sweep tape. Set the scope gain control so that the maximum deflection on the scope is approximately to the upper "0 dB" line.

Fine-adjusting Scope Time Base: If the image is not stable, you need to adjust the scope "slope" and/or "level" or perhaps set the scope to "triggered" (not "auto trig") mode. If the display does not end at the "20 kHz" line on the graticule, adjust the "variable time per division" control.

3.2 Tape Machine Adjustments: While playing the fast swept-frequency calibration tape, adjust head azimuth and vertex angle (tape wrap on the head) as required for maximum high-frequency output level. Adjust the reproducer equalizers as necessary for flattest frequency response.

You will find that most of the adjustments, mechanical and electronic, interact. Optimize the mechanical adjustments first, then work with the equalizer adjustments. Usually much time can be saved by generally following the sequence of adjustments given in the manufacturer's instructions for the particular tape machine.

Finally play the 1 kHz tone recorded for the last 30 s of the tape, and adjust the reproducer gain control so that the vu meter deflects to 0 dB.

Note that, because the recorded signal is blanked during the retrace time, a standard volume indicator that reads 0 dB on the sine-wave signal will read about -2 dB on the fast swept-frequency signal if the response is flat. It may read higher or lower if the response rises or falls, respectively.

Notes on the Use of a Octave Filters: When a a octave filter or a a octave real-time analyzer with a true-rms rectifier is used to read out the fast swept-frequency signals, the level in *each* band will be -13.2 dB. Note also that the bandwidth of the 500 Hz filter is 450 Hz to 560 Hz, but the sweeps stop at 500 Hz; and the bandwidth of the 20 kHz filter is 18 kHz to 22.4 kHz, but the sweeps stop at 20 kHz. Therefore these end bands will read low and should be ignored.

Pub 313, 2008-04-01