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BEAM SHAPE AND SYSTEM TEMPERATURE OF 85-3 TELESCOPE AT 610 MHZ

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This report discusses beam shape and system temperature measurements of the 85-3 telescope at 610 MHz. A spectrum analyzer (Anritsu MS2602A) is used as a total power meter for all the measurements. It is configured in the zero span mode. The center frequency is selected as 609.25 MHz and the resolution bandwidth as 3 MHz. This frequency range was relatively free of interference. The calibration noise is switched at $\sim$ 1 sec rate using an $HP(Hewlett-Packard)$ 3310A Function generator. The video bandwidth of the spectrum analyzer is set to 10 Hz. An Epson printer is used to print the spectrum analyzer display.

1 Beam Shape

Radio source Virgo (RA(1950): 12:28:17.6, DEC(1950): 12:40:02; S_{610MHz} = 390 Jy) was used for the beam shape measurement. The scans taken in hour angle (slew rate = 30°/min) and declination (slew rate = 20°/min) for the two orthogonal polarizations (channel A and B) are shown in Figs. 1a, b, c & d.

2 System Temperature

For system temperature measurement, the telescope was pointed to a few positions in the sky and the calibration noise was switched at $\sim$ 1 Hz. The system temperature is calculated using $T_{sys} = v_1/(v_2 - v_1) \times T_{cal}$ where v_1 and v_2 are the voltages measured by the spectrum analyzer when the calibration noise is turned off and on respectively. These voltages are proportional to the total powers. T_{cal} is the measured calibration noise temperature. Table. 1 gives the measured values and the system temperature in terms of the calibration noise temperature. Similar measurements were made towards Virgo which are also included in Table. 1. Figs. 2a to k show the spectrum analyzer outputs corresponding to all these measurements.

The calibration noise temperatures for the 85-3 receiver system were measured earlier by Coe (1989). At 610 MHz these temperatures were 4.6 K and 5.3 K for channel A and B respectively. The mean off-source system temperature obtained using the noise temperature values are 188.6 K for channel A and 295.2 K for channel B. The antenna temperature due to Virgo can be calculated by taking the difference between the off-source system temperature and the system temperature measured towards Virgo. The antenna temperature thus obtained are 112.2 K for channel A and 126.7 K for channel B. These values for antenna temperature cannot be obtained even if the aperture efficiency of the telescope is 100 %. Therefore we conclude that the present values of the calibration noise temperature are not the quoted values in Coe (1989).

The system temperature can indirectly be calculated using the measurements towards

Table 1: Results of the measurements made on 85-3 telescope

RA	DEC	HA	v_1^*		v_2^*		$\frac{v_1}{v_2-v_1}$		Fig. ref
hh:mm:ss	$^o:':''$	(hrs)	Ch A	Ch B	Ch A	Ch B	Ch A	Ch B	
12:08:17.6	12:40:02	~ -3.5	0.849	0.835	0.869	0.85	42.5	55.7	2a,b
12:28:17.6	17:40:02	~ -3.5	0.951		0.975		39.6		2c
12:28:17.6	17:40:02	~ -3.5	0.914		0.936		41.5		2d
$\sim$ 10:00:00	$\sim$ 50:00:00	~ -1	0.93		0.953		40.4		2e
12:28:17.6	12:40:02	~ -3.5	0.969	0.955	0.984	0.967	64.6	79.6	2f,g (Virgo)
12:28:17.6	12:40:02	~ -3	0.95		0.965		63.3		2h (Virgo)
12:28:17.6	12:40:02	~ -3	0.956		0.97		68.3		2j (Virgo)
$\sim$ 13:00:00	$\sim -40:00:00$	-4.6	0.962		0.968		160.3		2k[$]

* All voltages are relative values.

$ Note that the antenna is pointed to ground at this position

Table 2: Estimated System temperature for 85-3 telescope

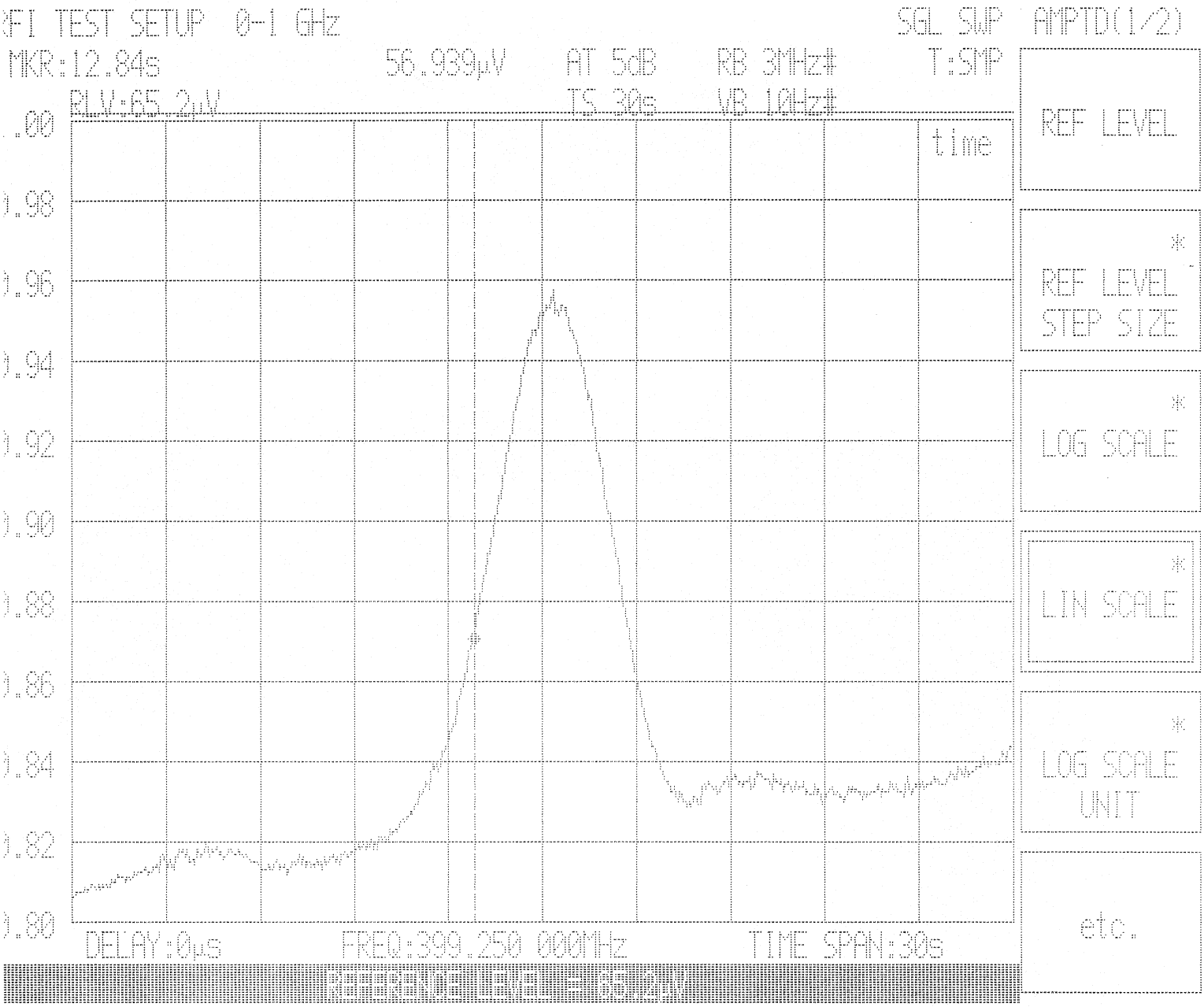
Off-source		$\frac{T_{syson}}{T_{sysoff}}$		T_{sysoff}			
RA(1950)	DEC(1950)			$\eta = 0.4$		$\eta = 0.5$	
hh:mm:ss	$^o:':''$	Ch A	Ch B	Ch A (K)	Ch B (K)	Ch A (K)	Ch B (K)
12:08:17.6	12:40:02	1.54	1.43	55.2	69.3	69.1	86.7
12:28:17.6	17:40:02	1.65		45.9		57.4	
12:28:17.6	17:40:02	1.58		51.4		64.3	
$\sim$ 10:00:00	$\sim$ 50:00:00	1.62		48.1		60.2	

Virgo. The ratio of the system temperature towards Virgo to that at an off-source position is independent of the calibration noise temperature. Using this ratio the system temperature can be estimated if we assume an aperture efficiency (η). Table 2 gives the estimated system temperature for different aperture efficiencies. For these calculations, an average of all the measurements towards Virgo is used.

3 Reference

Coe, J. R. 1989, NRAO memorandum.

Virgo Channel A



~ δ+5°

↑

Virgo DEC

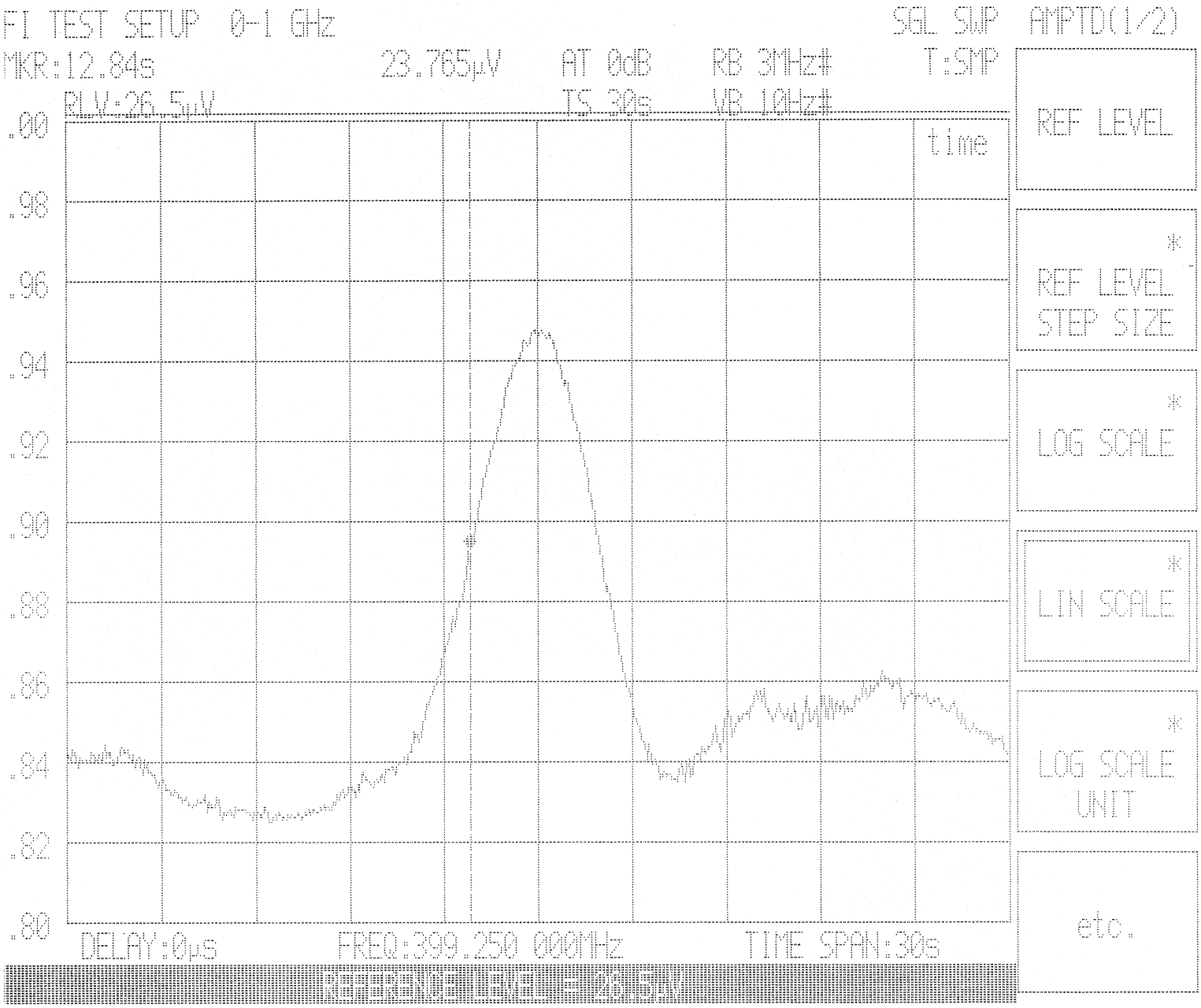
Fig 1a

Slew rate - 20°/min

Channel A

~ δ-5°

Virgo channel B



+δ N in dec

20°/min

~δ+5°

↑

Virgo DEC

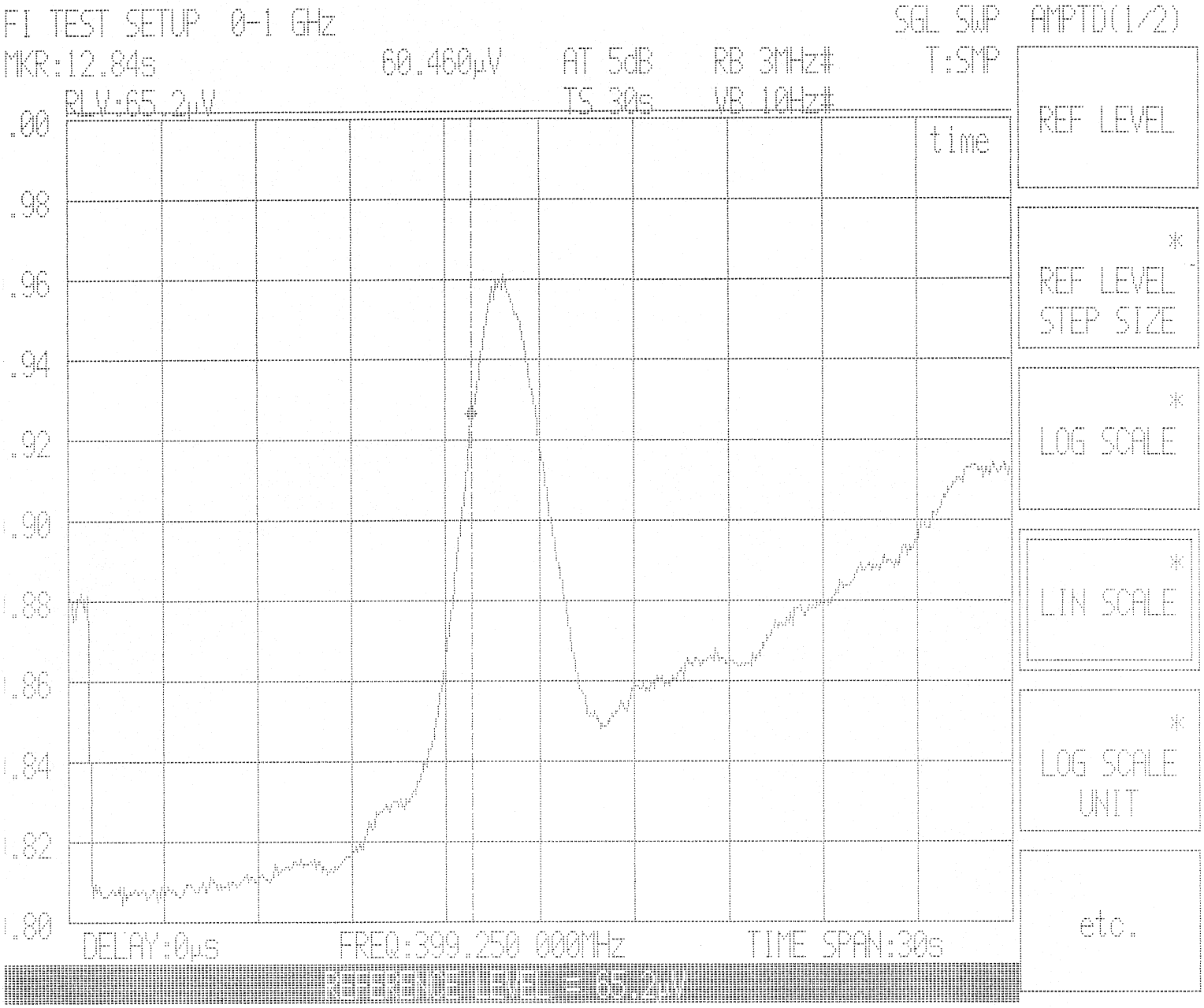
Fig 1 b

Slew rate - 20°/min

Channel B

~δ-5°

Virgo Channel A



20 min

~ RA + 20m

(Virgo RA)

~ RA + 20m

Fig 1c

Slew rate 30°/min

Channel A

Virgo channel B

20 mins 20°/min

RA North

~ RA − 20m

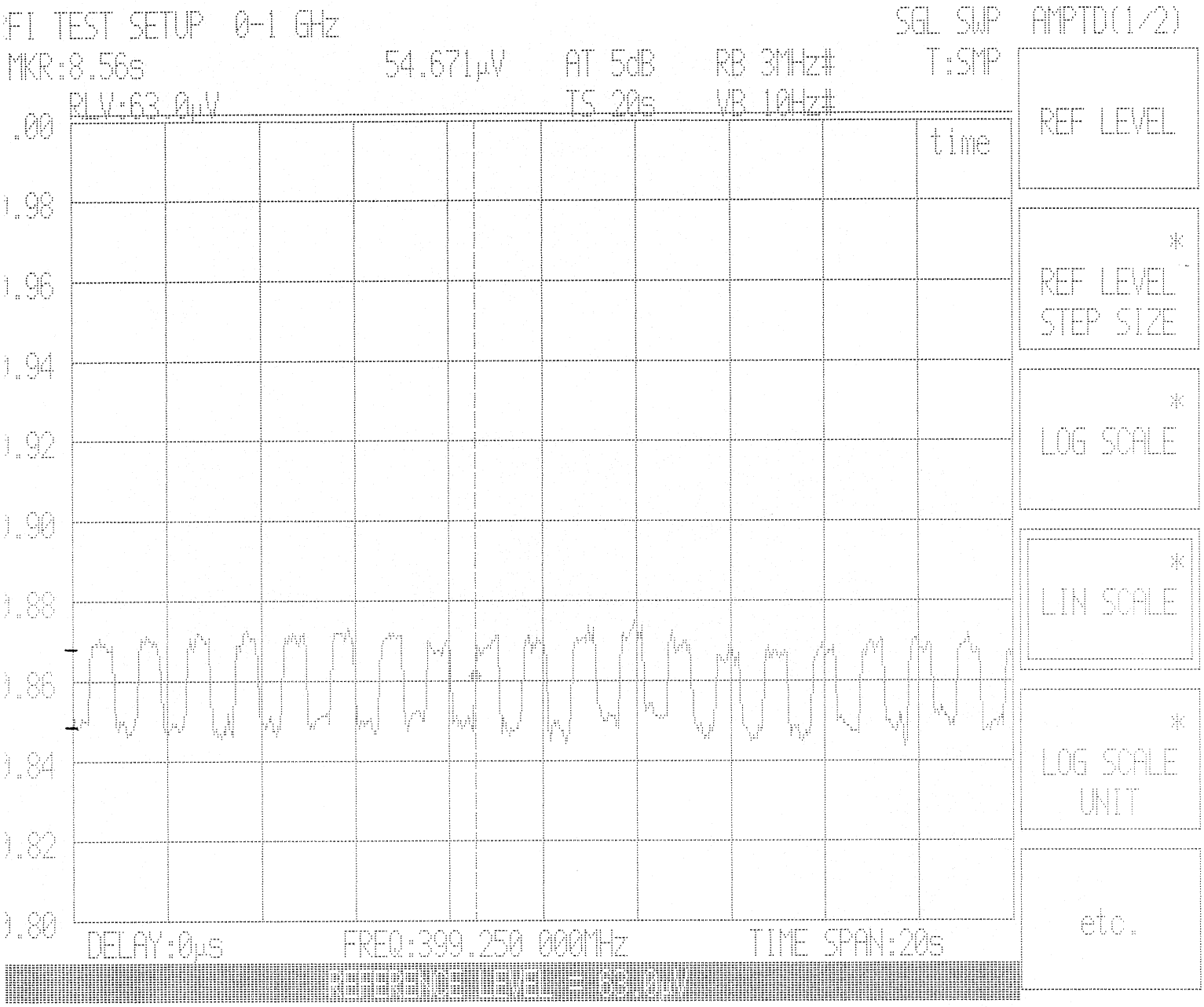
(Virgo RA)

~ RA + 20m

Fig 1d

Slew rate - 30°/min

Channel B

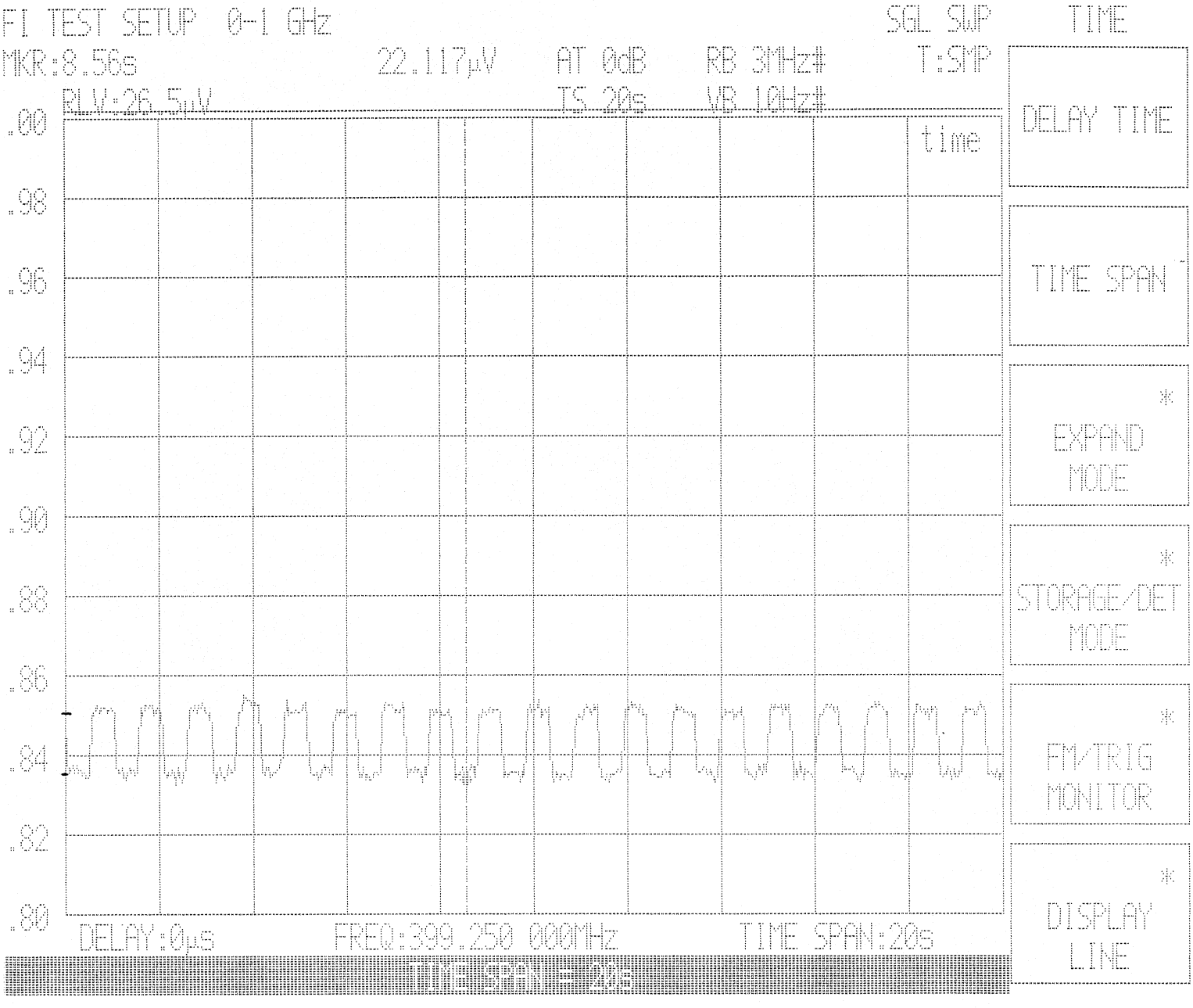


Source Channel A

Virgo RA - 20m

0.8489/0.8689

Fig 2a



Off source Channel B

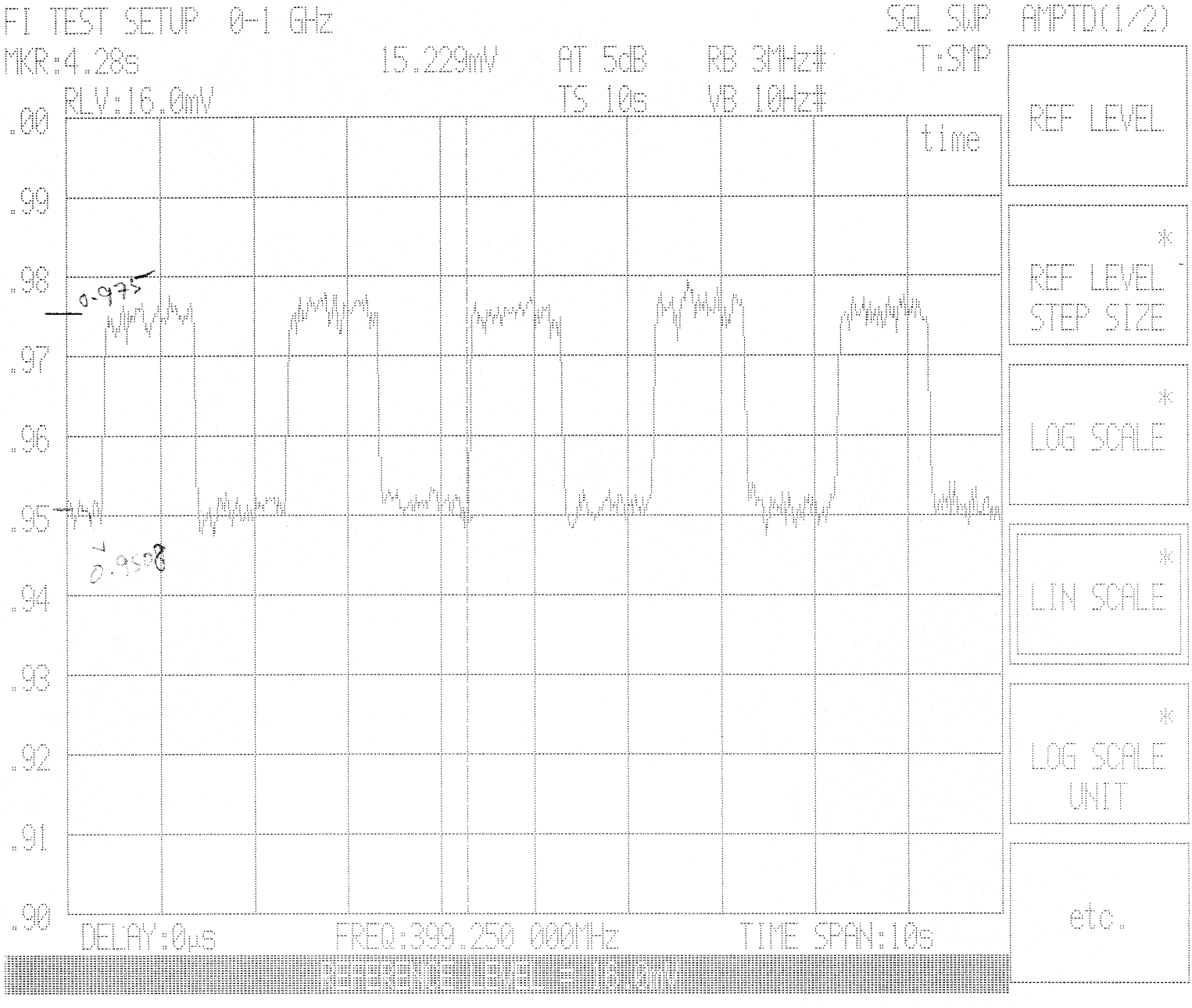
Virgo RA − 20 m

off level = 0.835 / 0.85

ON level = 0.955 / 0.967
(source)

Fig 2b

03/14/2000
20:30 →



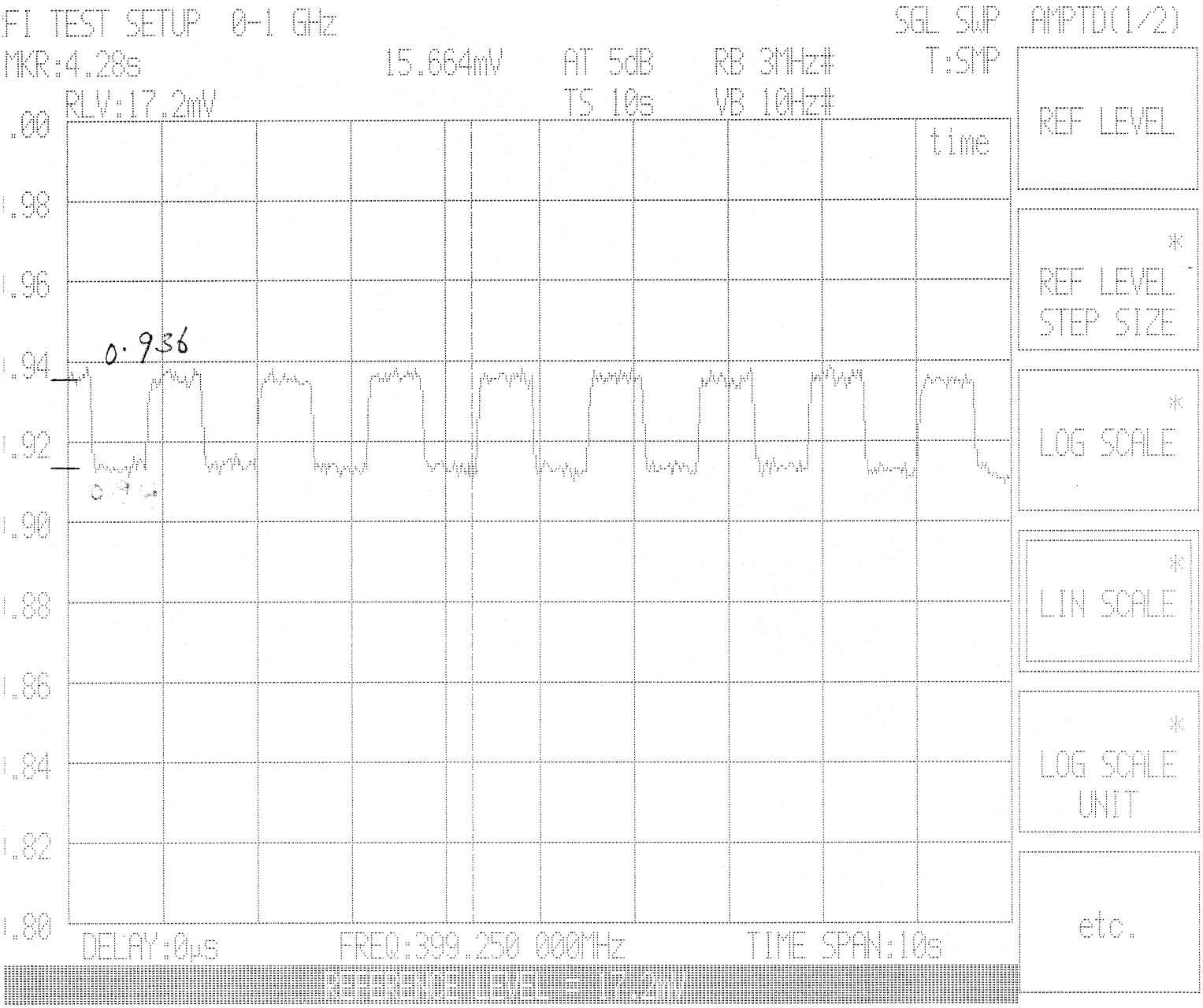
Virgo δ = 5° (Beginner)

Channel A

T_{sys} = 39.3 K (cal)

Fig 2c

03/14/2000



Channel A

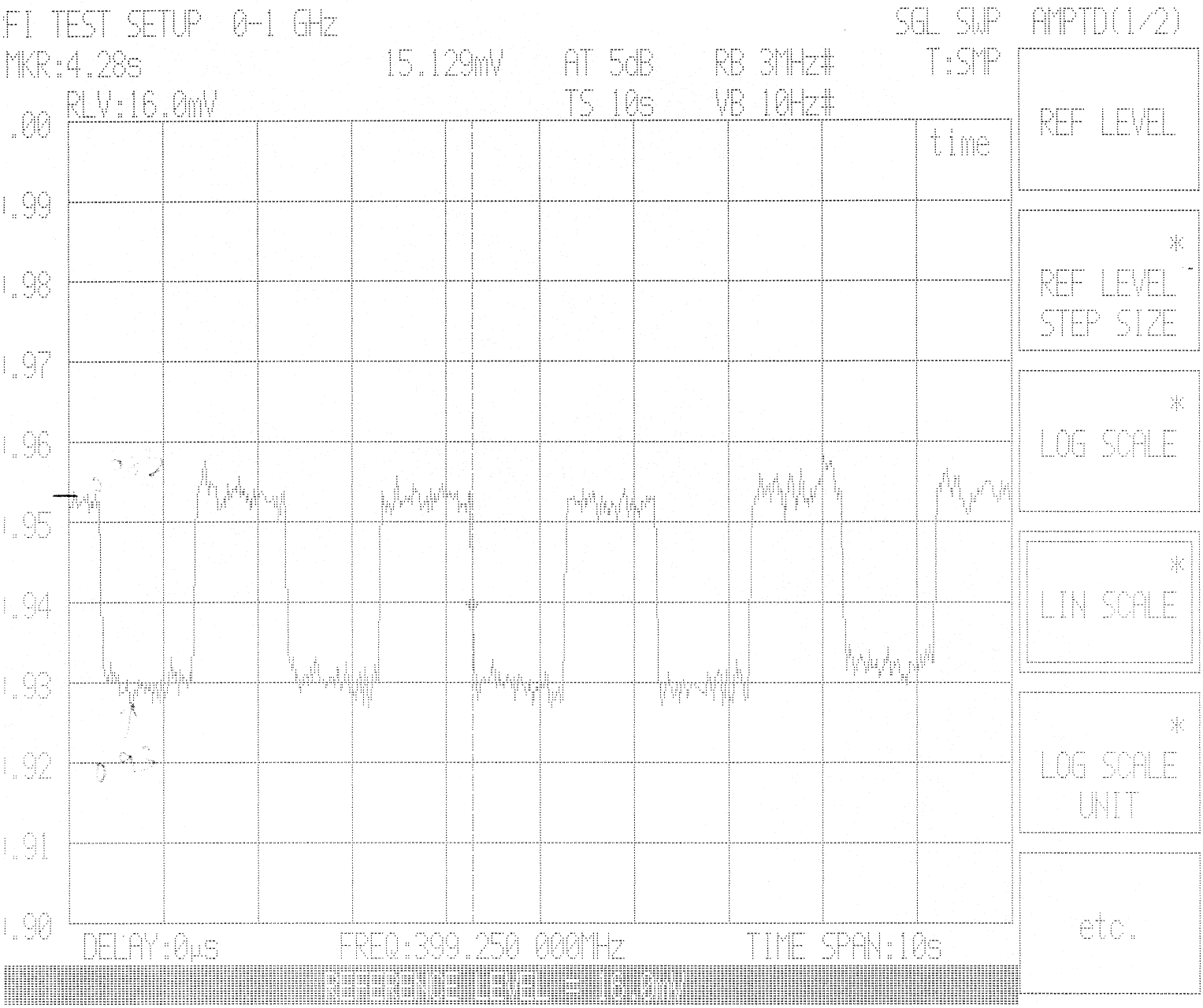
Virgo cell ($\delta + 5^\circ$)

Channel B
Reference to
Cross check

$T_{sys} = 41.6 \times T_{cal}$

Fig 2d

03/14/2000



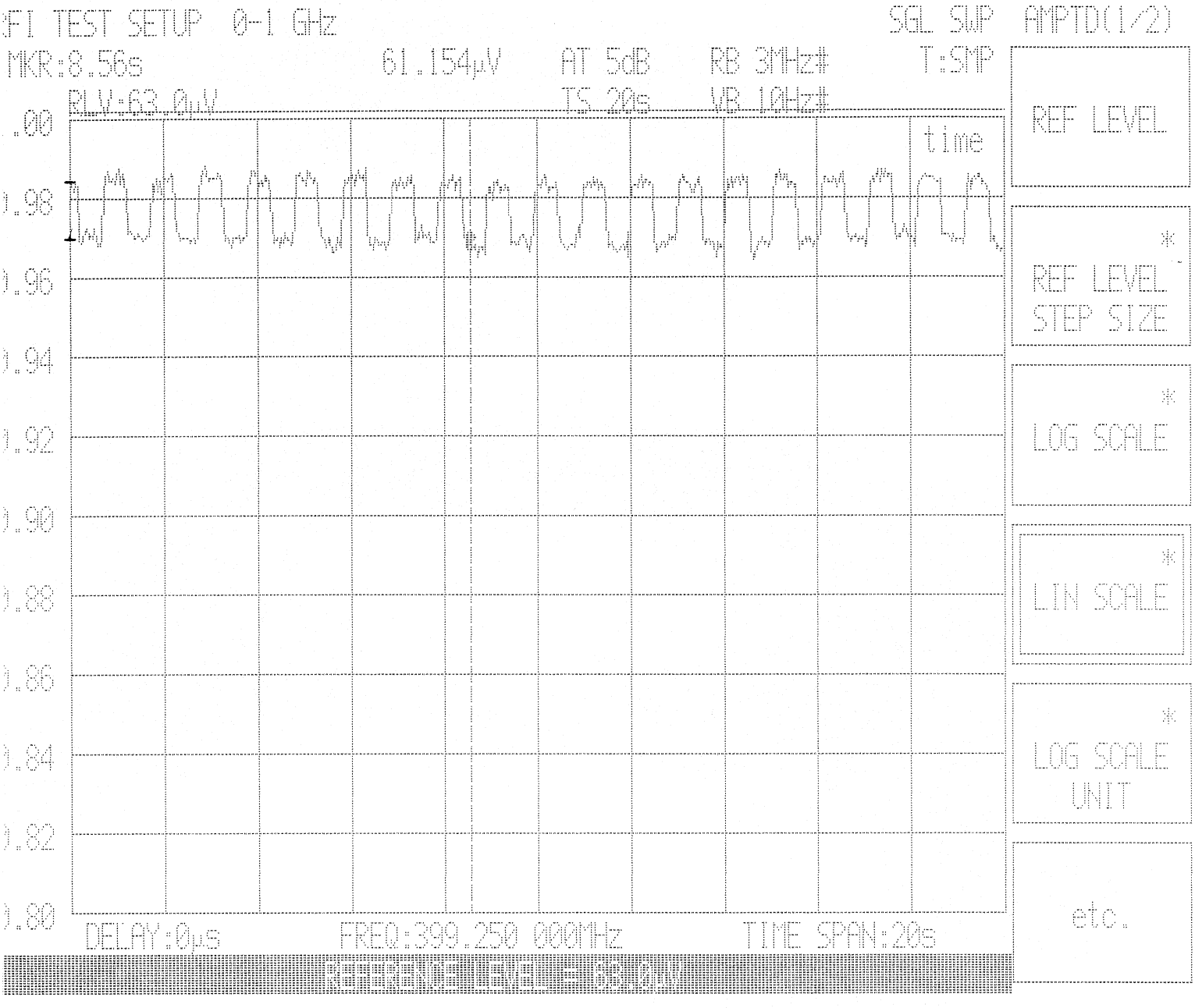
R: ≈ 10 : 50 : 100

δ ~ +50°

"High elevation" signal

Channel A to check the elevation dip on T4ys

Fig 2c

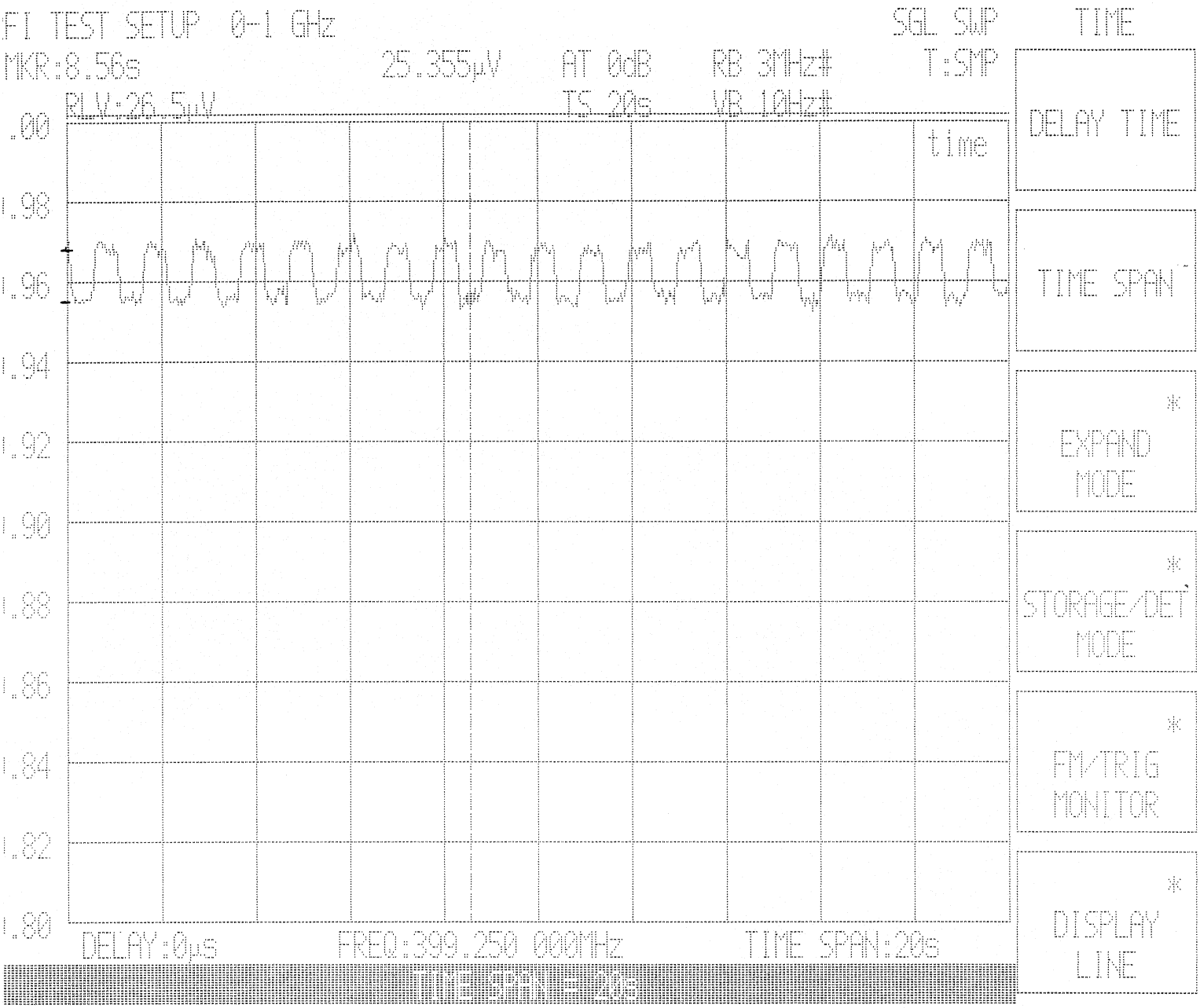


ON source Channel A

0.969/0.984

Virgo

Fig 2f

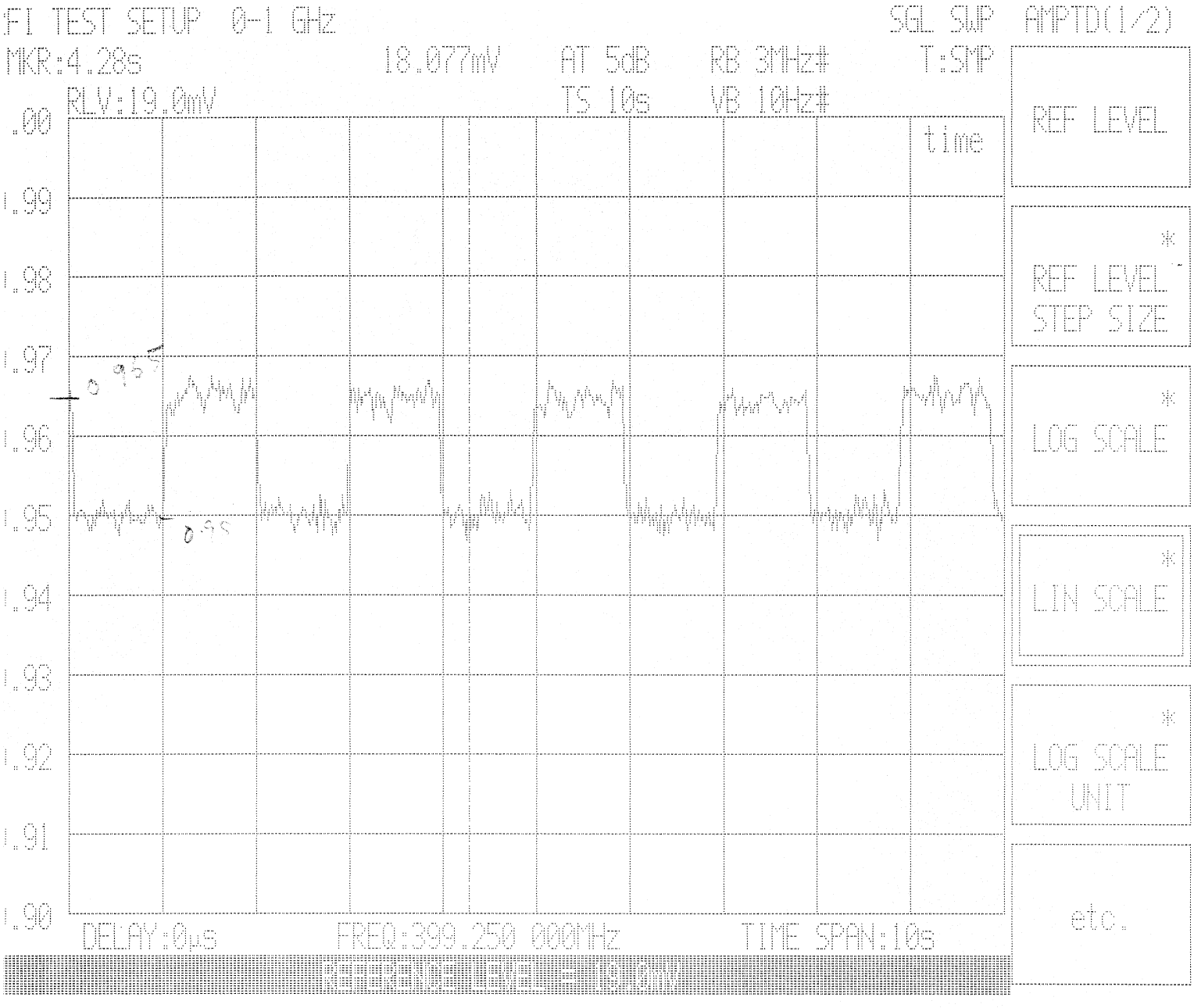


ON Source Channel B (Same scale as OFF source of channel B)

Virgo

Fig 2g.

03/14/2000
20:30 →



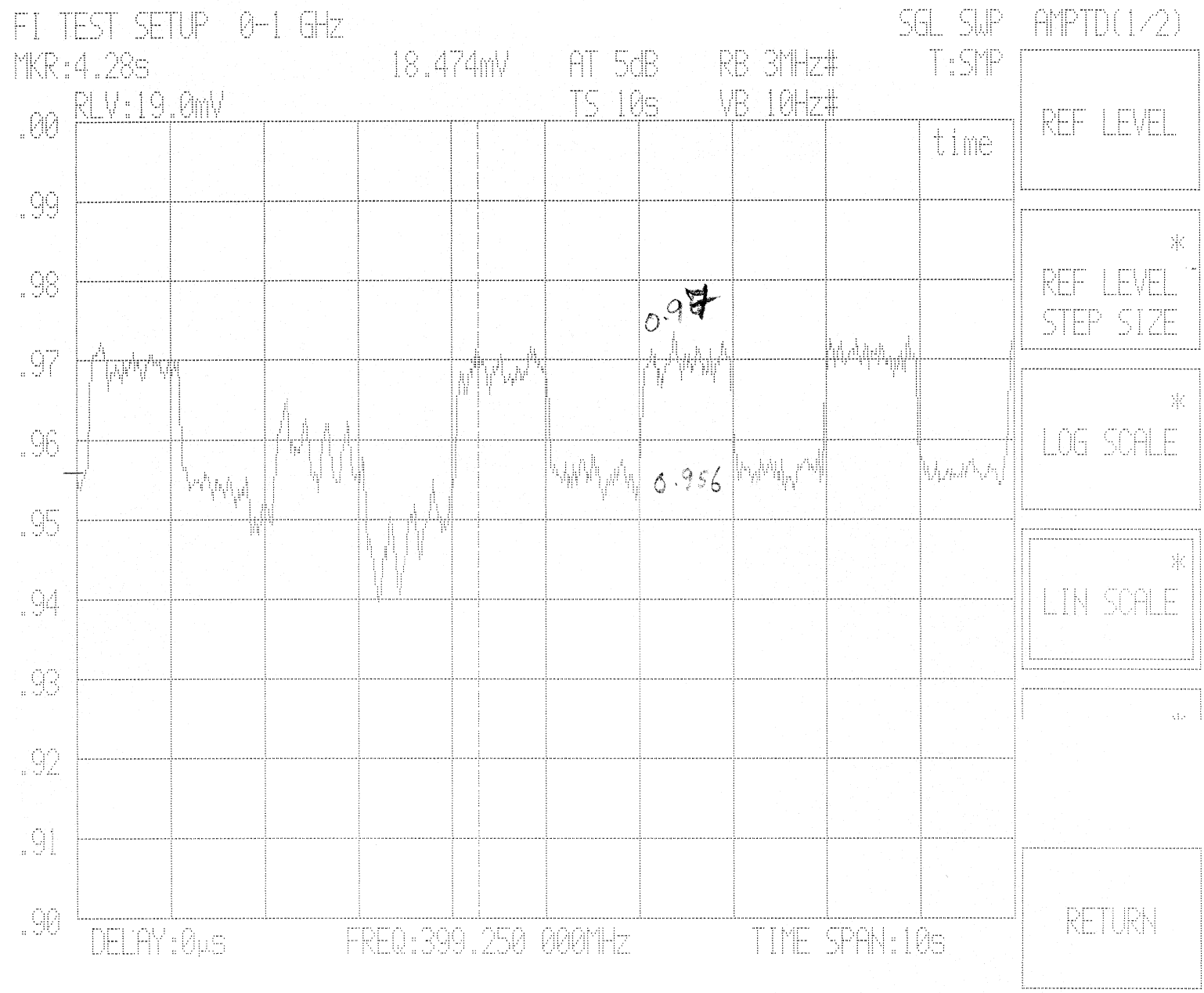
Virgo ON source

Channel A
Reported on Virgo
to cross check

$T_{sys} = 63.3\ T_{cal}$

Fig 2h

03/14/2000
20:30 →



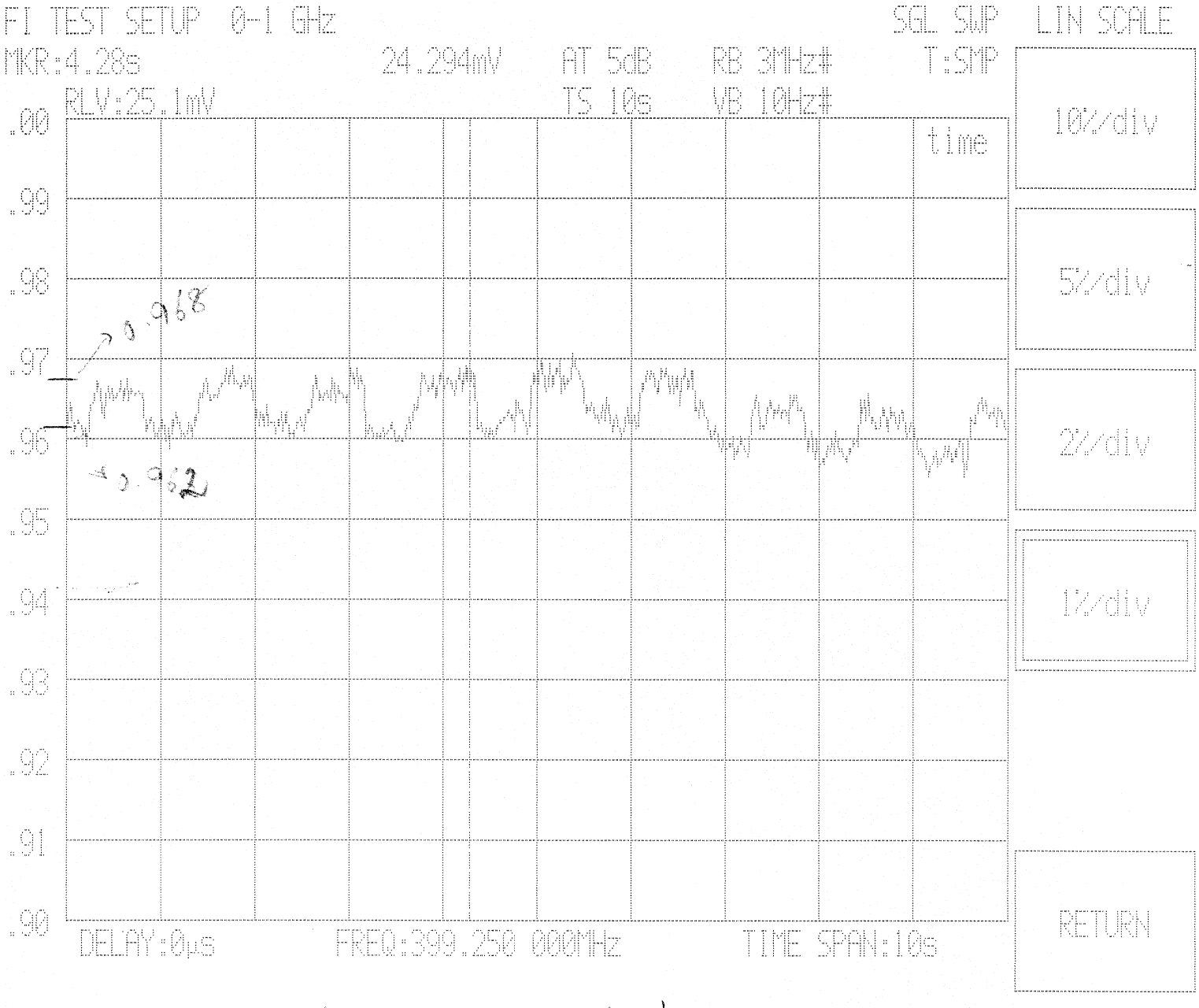
Vinyo 6H Source Channel A

Fig 2j

$T_{sys} = 68.5 \times T_{cal}$

Fig 2j

03/14/2 0850



Channel A
To measure the
GND temperature

Fig 2k