X3T9.2/88-142

BULL

FROM : Christian MOLLARD, BULL SYSTEMES

TO : John LOHMEYER, Chairman X3T9.2

nb of pages : 13

Date : OCTOBER, 26th 88

Subject : SINGLE ENDED TERMINATION FOR SCSI 2

Please find hereafter the proposal for the new termination of SCSI 2,

Attached pages give calculation, result, simulations and schematic.

- The jumper on the schematic allows a device to provide TERMPWR.

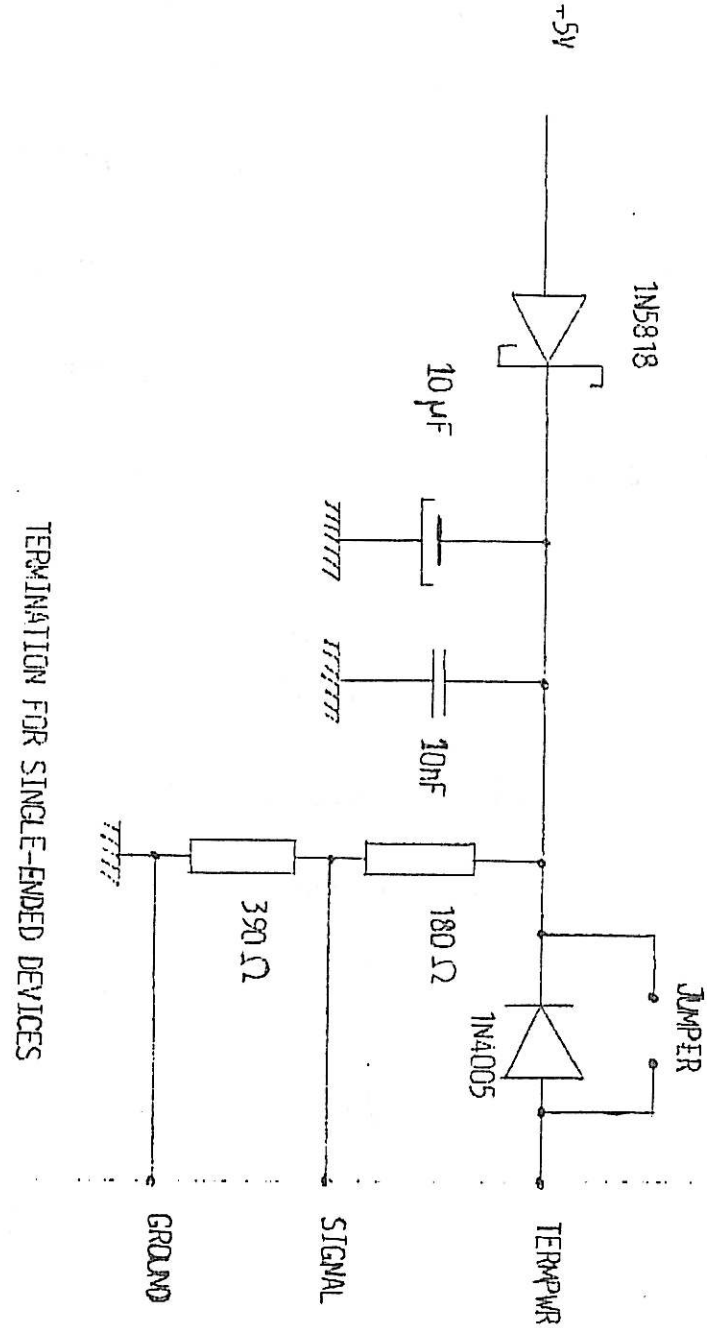
- The Diode 1N4002 allows a wired or arrangement.

If you need more information, my fax number is 33.1 34627908.

Best regards,

Christian MOLLARD

5122


+5V
1N5818
10 µF
10nF
180 Ω
390 Ω
1N4005
JUMPER
TERMPWR
SIGNAL
GROUND
TERMINATION FOR SINGLE-ENDED DEVICES

CALCULATIONS ABOUT SCSI TERMINATION

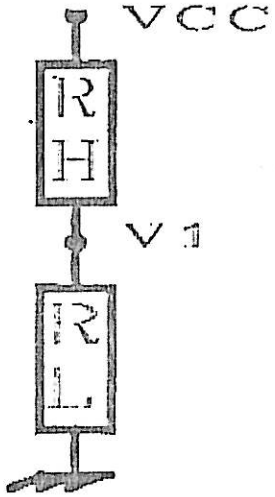
The difficulty of properly matching the bus comes from the limited drive capability of 48 mA.

receiver input current < = 0.4 mA at 0L

for 7 receivers : 2.8 mA (worst-case)

current usable for 2 terminations : 48-2.8 = 45.2 mA

for each termination : 22.5 mA



V1 :1L steady state
RH :higher resistor
RL :lower resistor

I1L = VCC/(RH+RL) = V1/RL (logical 1)

I0L < (VCC-VCEsat)/RH = 22.5 mA (logical 0)

Z = RH*RL/(RH+RL) = RH.V1/VCC (impedance)

= > (1) Z = V1(VCC-0.5)/(VCC*22.5E-3)

(2) RH = Z*VCC/V1

(3) RL = 1/(1/Z-1/RH)

With V1 (1L steady state) from 2.8 to 3.5V and with VCC from 3.0 to 5.0V let us compute all the possible optimun values of Z, RH, RL.

2

VCC	V1	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5
3.0	Z	103.7	107.4	0.0	0.0	0.0	0.0	0.0	0.0
	RH	111.1	111.1	0.0	0.0	0.0	0.0	0.0	0.0
	RL	1555.6	3222.2	0.0	0.0	0.0	0.0	0.0	0.0
3.2	Z	105.0	108.7	112.5	116.2	0.0	0.0	0.0	0.0
	RH	120.0	120.0	120.0	120.0	0.0	0.0	0.0	0.0
	RL	840.0	1160.0	1800.0	3720.0	0.0	0.0	0.0	0.0
3.4	Z	106.1	109.9	113.7	117.5	121.3	125.1	0.0	0.0
	RH	128.9	128.9	128.9	128.9	128.9	128.9	0.0	0.0
	RL	601.5	747.6	966.7	1331.9	2062.2	4253.3	0.0	0.0
3.6	Z	107.2	111.0	114.8	118.6	122.5	126.3	130.1	134.0
	RH	137.8	137.8	137.8	137.8	137.8	137.8	137.8	137.8
	RL	482.2	570.8	688.9	854.2	1102.2	1515.6	2342.2	4822.2
3.8	Z	108.1	111.9	115.8	119.6	123.5	127.4	131.2	135.1
	RH	146.7	146.7	146.7	146.7	146.7	146.7	146.7	146.7
	RL	410.7	472.6	550.0	649.5	782.2	968.0	1246.7	1711.1
4.0	Z	108.9	112.8	116.7	120.6	124.4	128.3	132.2	136.1
	RH	155.6	155.6	155.6	155.6	155.6	155.6	155.6	155.6
	RL	363.0	410.1	466.7	535.8	622.2	733.3	881.5	1088.9
4.2	Z	109.6	113.5	117.5	121.4	125.3	129.2	133.1	137.0
	RH	164.4	164.4	164.4	164.4	164.4	164.4	164.4	164.4
	RL	328.9	366.8	411.1	463.4	526.2	603.0	698.9	822.2
4.4	Z	110.3	114.2	118.2	122.1	126.1	130.0	133.9	137.9
	RH	173.3	173.3	173.3	173.3	173.3	173.3	173.3	173.3
	RL	303.3	335.1	371.4	413.3	462.2	520.0	589.3	674.1
4.6	Z	110.9	114.9	118.8	122.8	126.8	130.7	134.7	138.6
	RH	182.2	182.2	182.2	182.2	182.2	182.2	182.2	182.2
	RL	283.5	310.8	341.7	376.6	416.5	462.6	516.3	579.8
4.8	Z	111.5	115.5	119.4	123.4	127.4	131.4	135.4	139.4
	RH	191.1	191.1	191.1	191.1	191.1	191.1	191.1	191.1
	RL	267.6	291.7	318.5	348.5	382.2	420.4	.464.1	514.5
5.0	Z	112.0	116.0	120.0	124.0	128.0	132.0	136.0	140.0
	RH	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
	RL	254.5	276.2	300.0	326.3	355.6	388.2	425.0	466.7

RESULT

We want a high 1L steady state : V1 > 3.0 V
and a low termination impedance: Z < 132 Ohms

Analysing the result screen we find that the couple 180/390 is very near a best value with a VCC of 4.6V (5V less a schottky diode drop voltage).

Using a serial diode is usefull for a wired-or arrangement, allowing the bus to work even if a part of it is powered off.

Recalculating the maximun current yields :

$$I0L = (4.6 - 0.5)/(180/2) = 45.5 \text{ mA for 2 terminators}$$

For 7 receivers we assume a mean input of 7* 0.3 mA (0.4 mA worst-case):

$$I0LR = 2.1 \text{ mA}$$

$$\text{total } IOL = 47.6 \text{ mA}$$

$$Z = 123 \text{ Ohms}$$

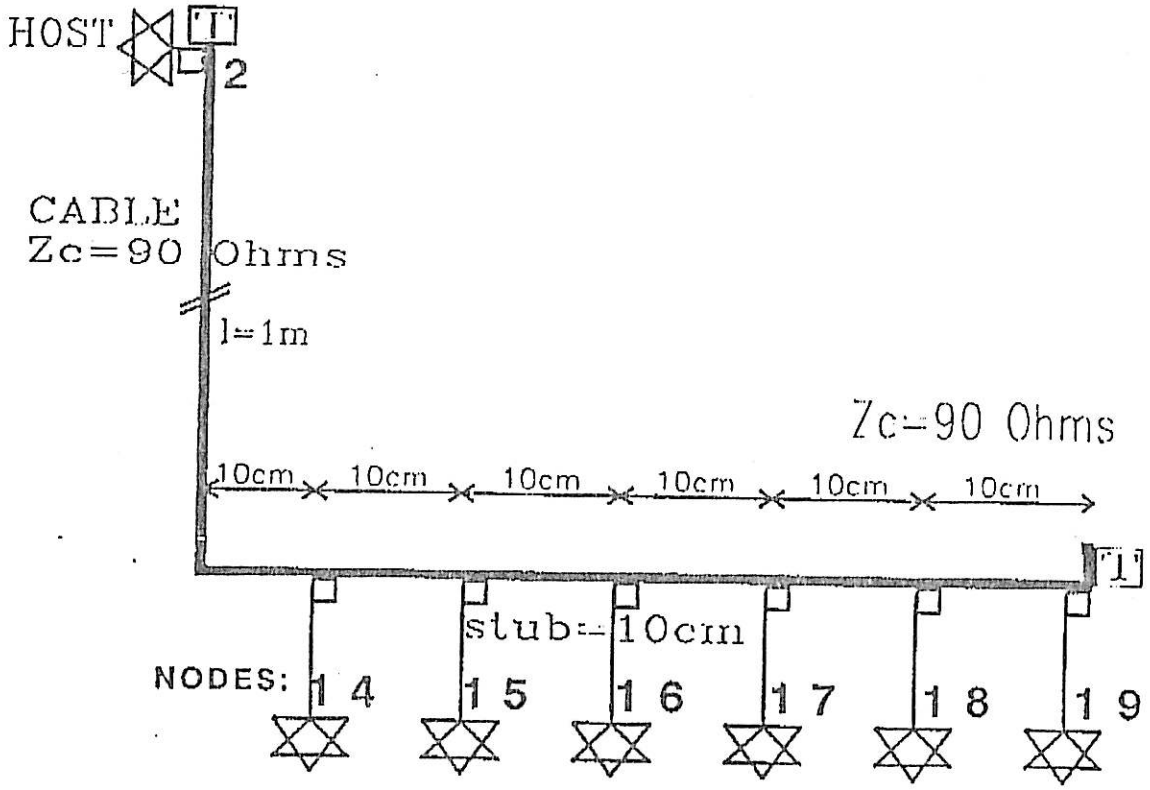
$$V1 = 3.15 \text{ v}$$

With 4.6V and the traditionnal 220/330 we get Z=132 Ohms ,V1=2.76V

Using the 180/390 terminator we improved both the impedance and the 1L steady state, but the current is deliberately closed to the maximun value of 48mA and it can be slightly overcomed depending on resistors tolerance .Fortunately this value is given as a minimun driver output capability.

4

SCSI SIMULATIONS

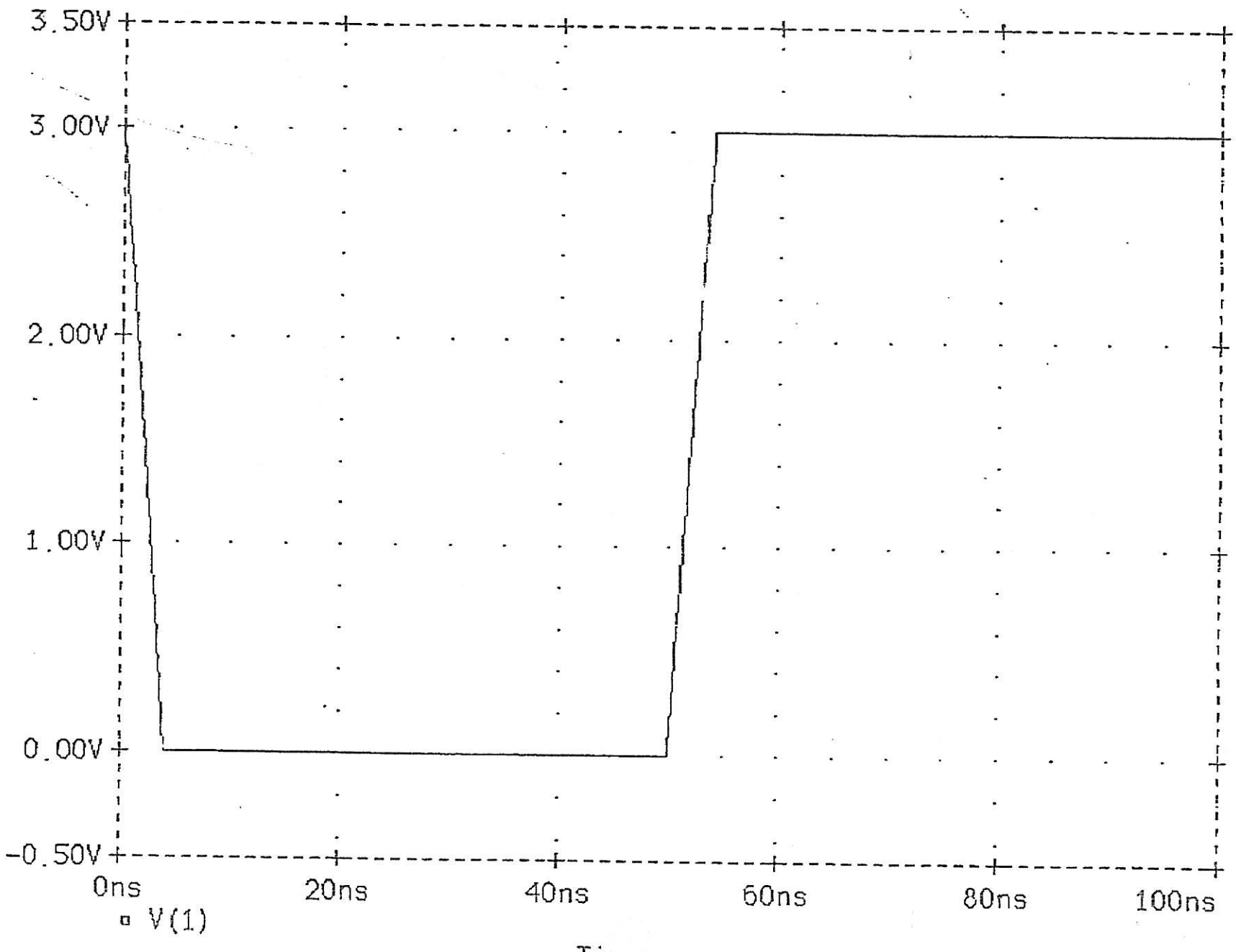


DEVICES

T :TERMINATOR : 180/390 Ohms powered by 1.6V
: 220/330 Ohms powered by 1.6V
: 220/330 Ohms powered by 5.0V

CSCSI DRIVER INPUT SIGNAL FOR EVERY SIMULATION

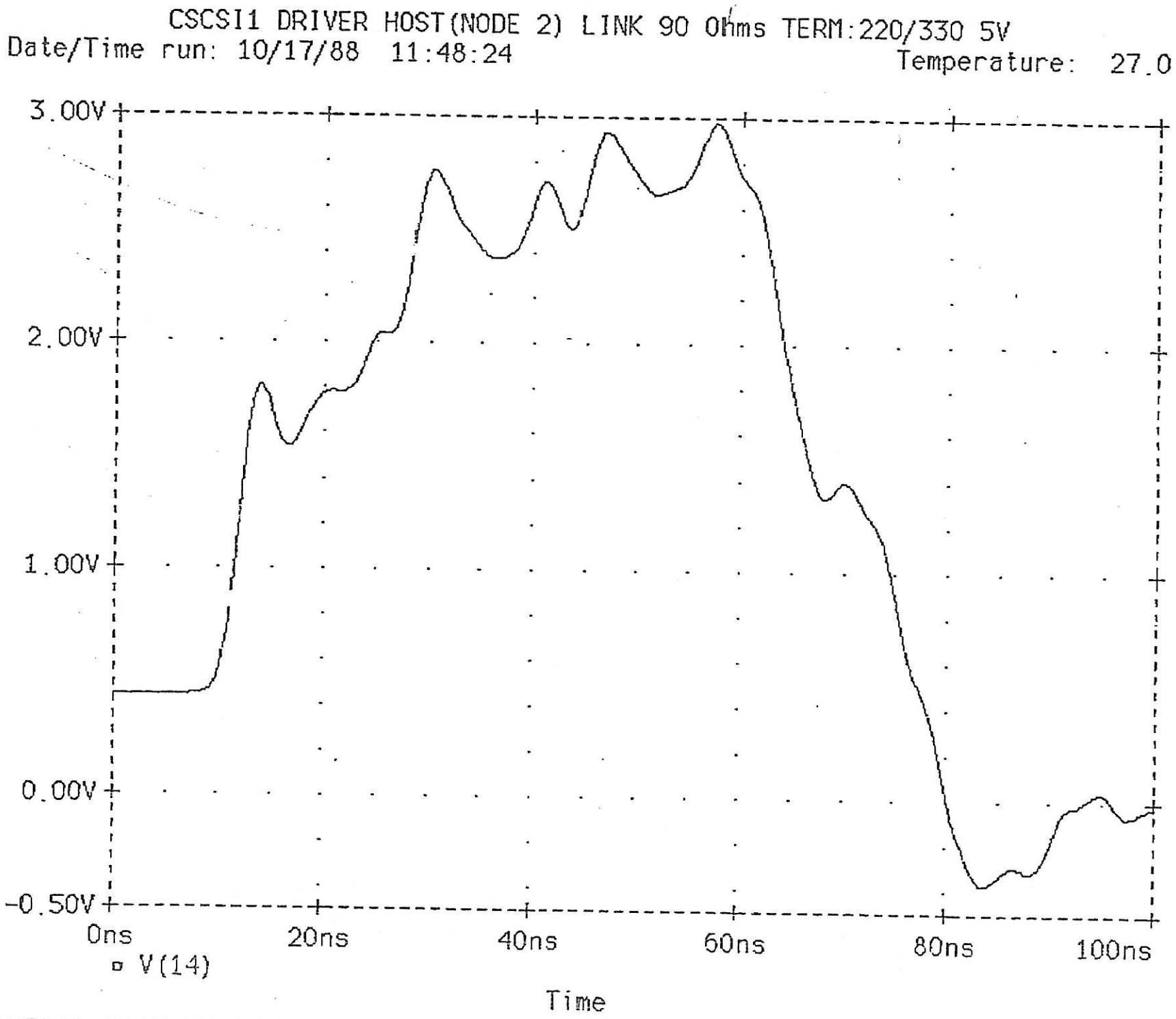
Date/Time run: 10/17/88 14:05:54 Temperature: 27.0



EXP: BULL F.MOTTINI 1988-10-26 14:02 G3-96 S #7

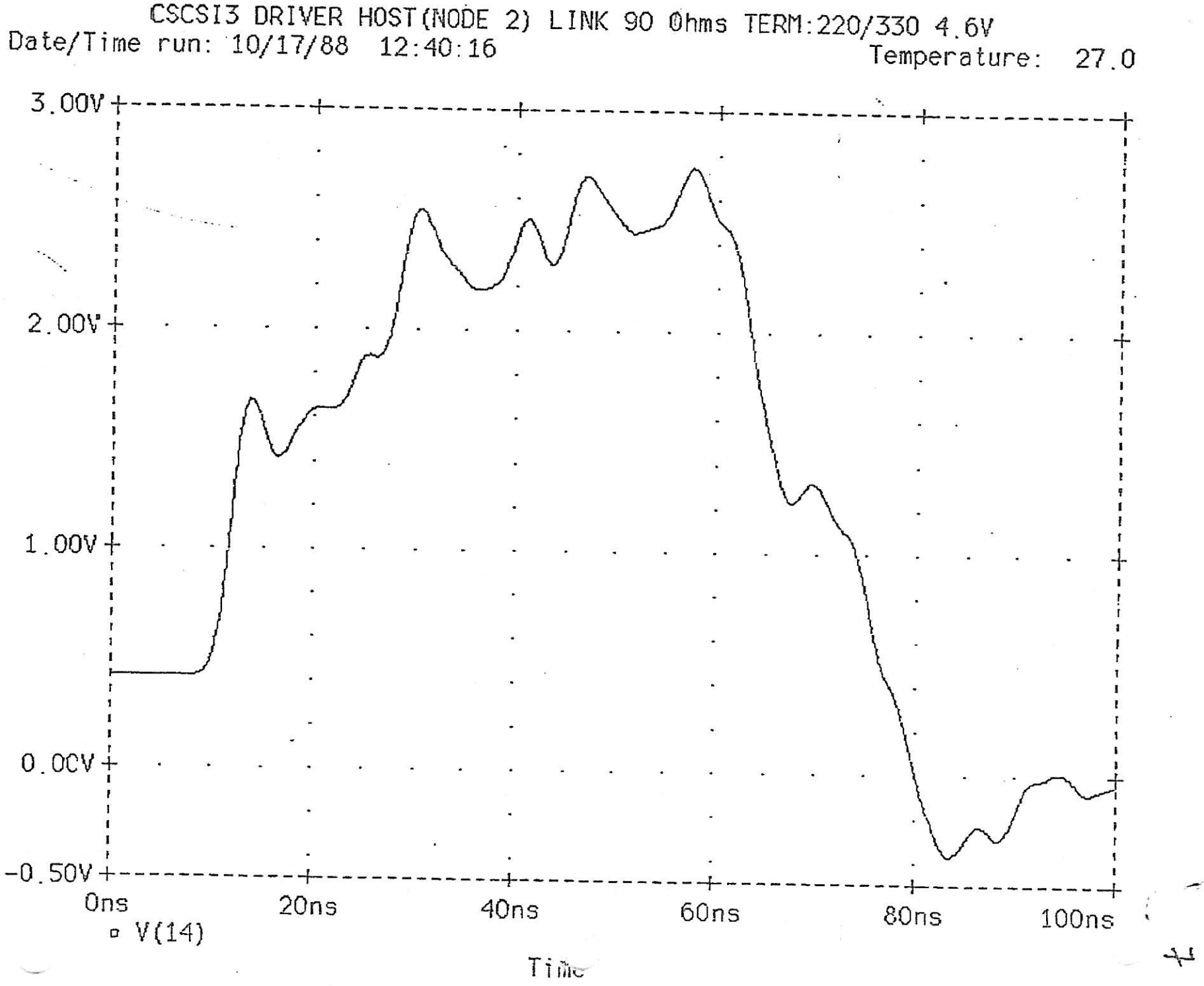
277

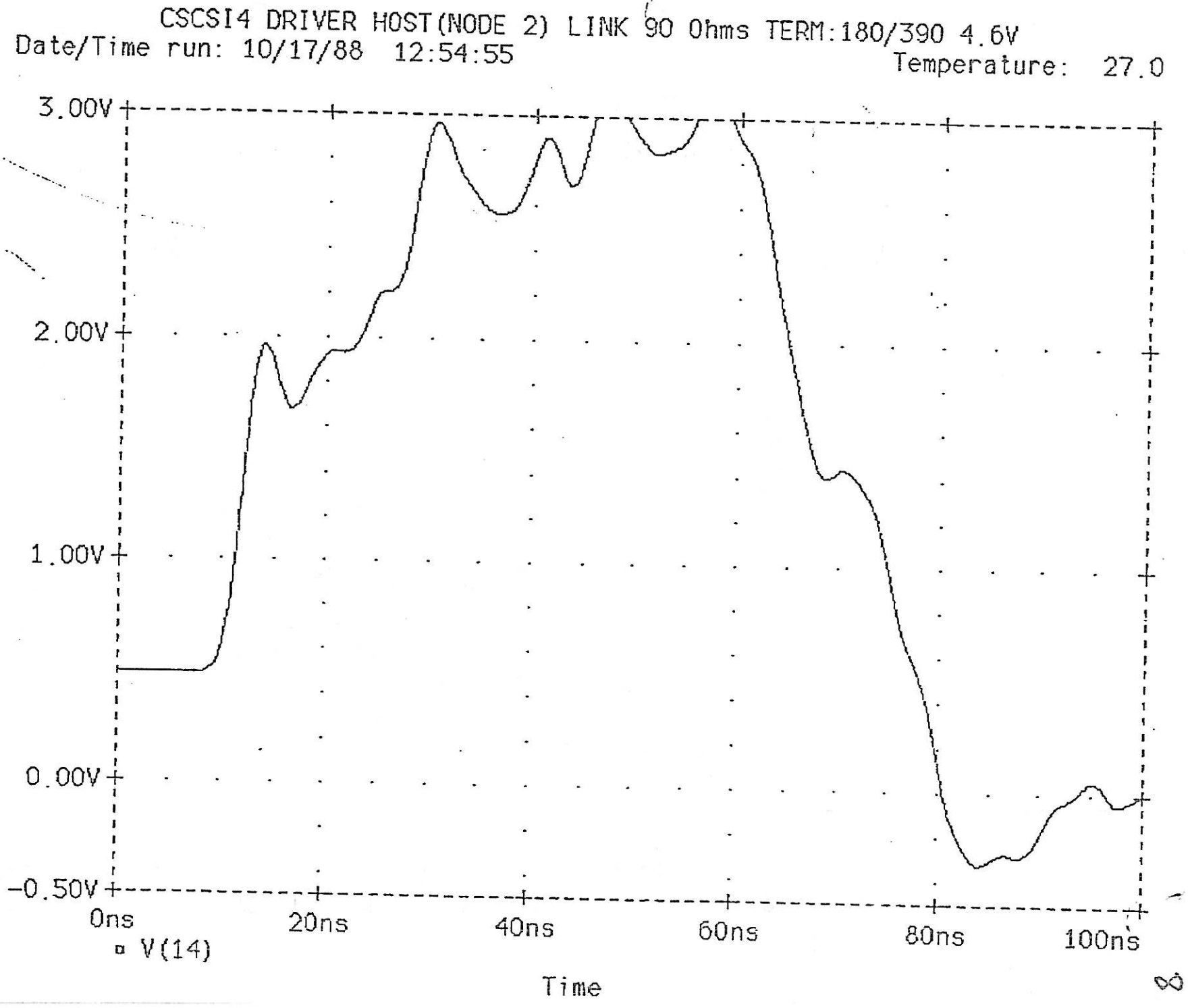
5

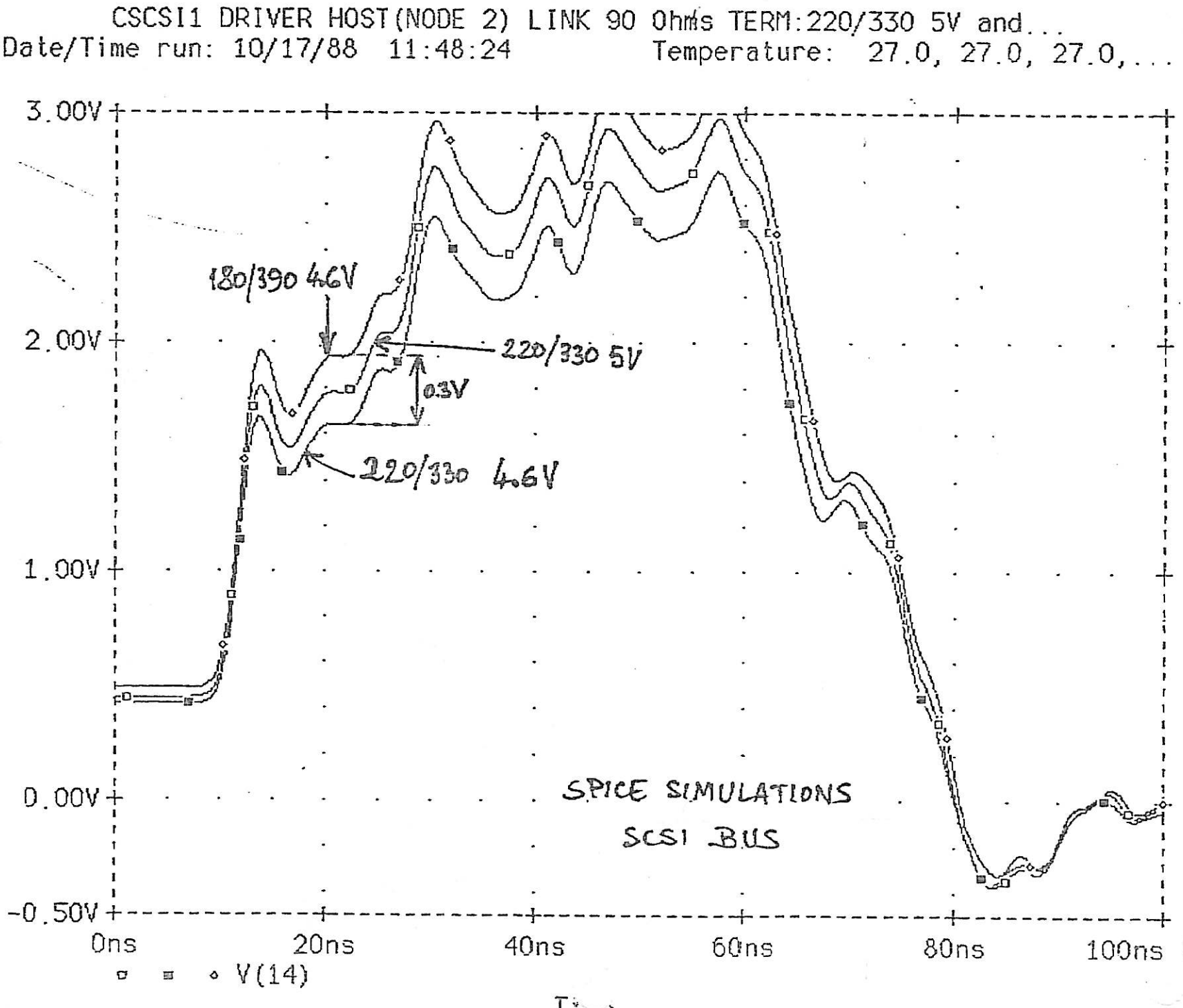


EXP: BULL F.MOTTINI 1988-10-26 14:02 G3-96 S #8

278


CSCSI3 DRIVER HOST(NODE 2) LINK 90 0hms TERM:220/330 4.6V
Date/Time run: 10/17/88 12:40:16
Temperature: 27.0
3.00V
2.00V
1.00V
0.00V
-0.50V
0ns
20ns
40ns
60ns
80ns
100ns
V(14)
Time
EXP: BULL F.MOTTINI 1988-10-26 14:03 G3-96 S #9


CSCSI4 DRIVER HOST(NODE 2) LINK 90 Ohms TERM:180/390 4.6V
Date/Time run: 10/17/88 12:54:55
Temperature: 27.0
3.00V
2.00V
1.00V
0.00V
-0.50V
0ns
20ns
40ns
60ns
80ns
100ns
V(14)
Time
EXP: BULL F.MOTTINI 1988-10-26 14:03 G3-96 S #10

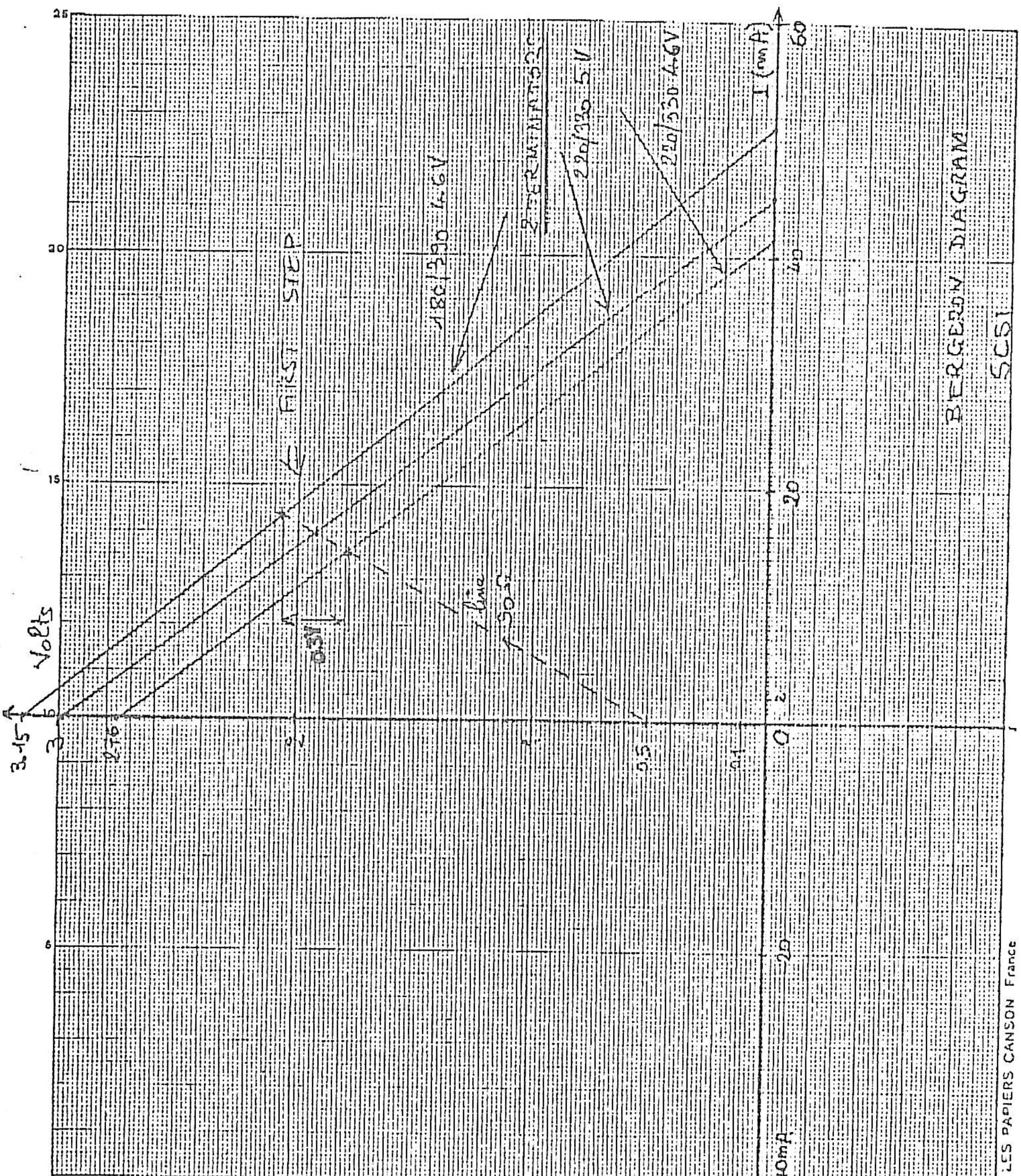


EXP: BULL F.MOTTINI 1988-10-26 14:04 G3-96 S #11

281

9

10


BERGERON DIAGRAM
SCSI
FIRST STEP
180/390 4.6V
220/330 5V
220/330 4.6V
I (mA)
Volts
3.15
3
2.76
40mA
LES PAPIERS CANSON France

CONCLUSIONS

Observing input receiver signal simulated at node 14 with the 3 types of termination we note that we gained 0.3V on the first step using 180/390 instead of 220/330 under 4.6V .

Bergeron diagramm shows us exactly the same gain .

To be sure to swing past the upper threshold (2.0V) the line impedance must be higher than that one we used in this study, because the loadind capacitance of the transceivers, connectors ,... reduce the impedance of the bus.

Voltage V1 (4.6V) must be correctly decoupled by HF and LF capacitors.