NATIONAL SEMICONDUCTOR

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→ SCSI-2 SWIG (On signal quality)

TEST RESULTS; SCSI II USING TRAPEZOIDAL TRANSCEIVERS (DS3862)

Test Objective -

The purpose of the testing described below was to document the signal quality of SCSI II data and clock signals driven by National's Trapezoidal Transceiver. The Trapezoidal driver has a controlled slew rate output which should result in less crosstalk in a SCSI application than a TTL driver.

Test Setup -

The test setup consists of eight peripherals (numbered 0 - 7) connected to a common 6 meter parallel bus. The peripherals are connected every 33 inches along the bus. The bus is sixteen lines wide, with alternating signal and ground lines. Each peripheral is connected to the bus by a 10 centimeter stub. Single-ended SCSI powered terminators are located at each end of the bus. Peripheral 0, located at one end of the bus, drives the cable for all tests.

A word generator running a psuedo-random data pattern provides the input to the 8 drivers on peripheral 0. Line number 3, near the center of the bus, is driven with a pattern that is the compliment of the the other lines. Thus, line number 3 will display the worst crosstalk since its data pattern is opposite to the other 7 lines and it is located near the center of the bus, subjected to the maximum influence of the surrounding lines' induced fields. This is the test configuration for measuring data line signal quality.

The test configuration for testing clock signal quality is the same as above except that line 3 is driven alone. The rationale for driving the clock line alone is that it appears to be electrically isolated by virtue of its assigned position on the SCSI bus. Wheather this is true in practice is unknown. The clock line is 9 lines away from the nearest high speed line, DB(P), on the SCSI bus. This clock line test configuration assumes the clock is isolated on the SCSI bus.

TEST CIRCUIT

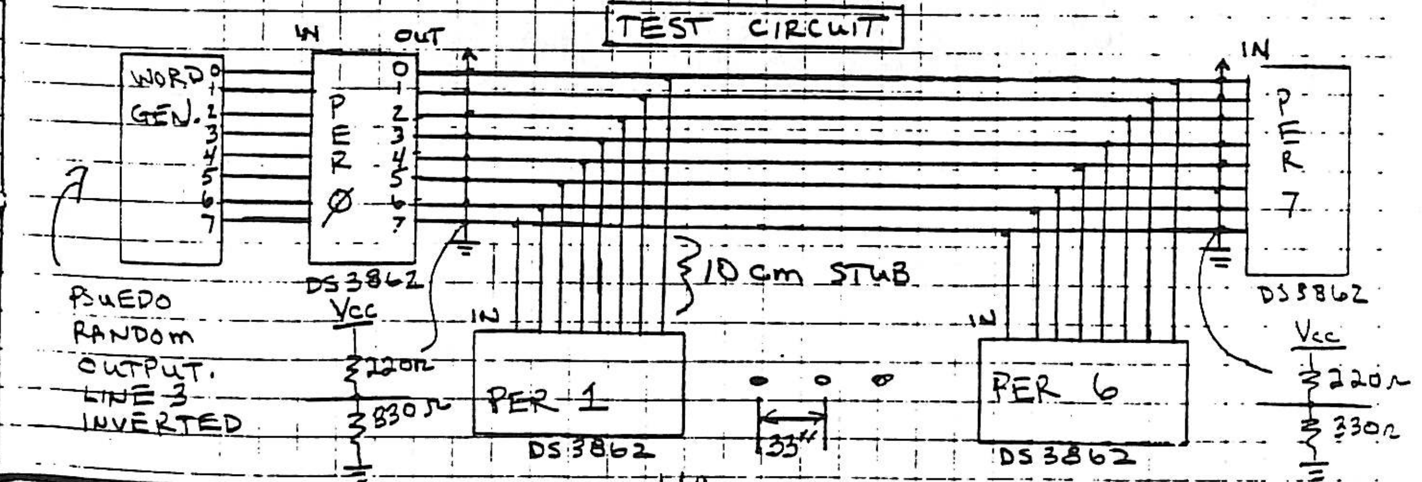
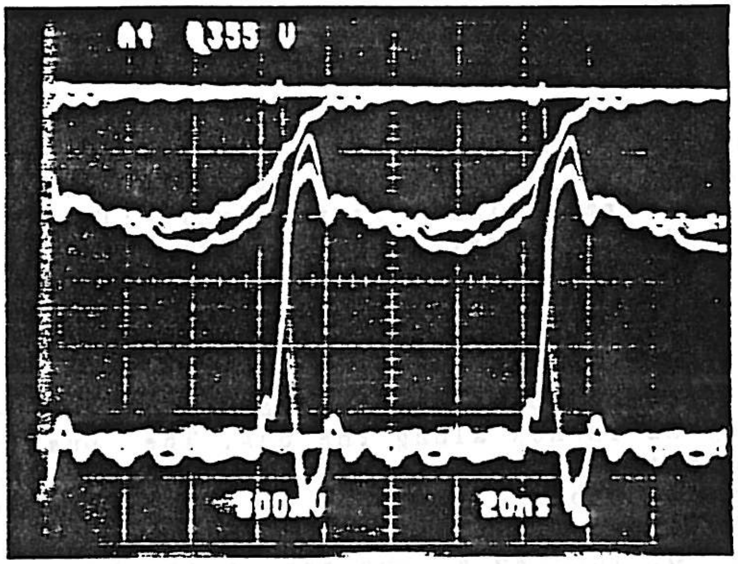


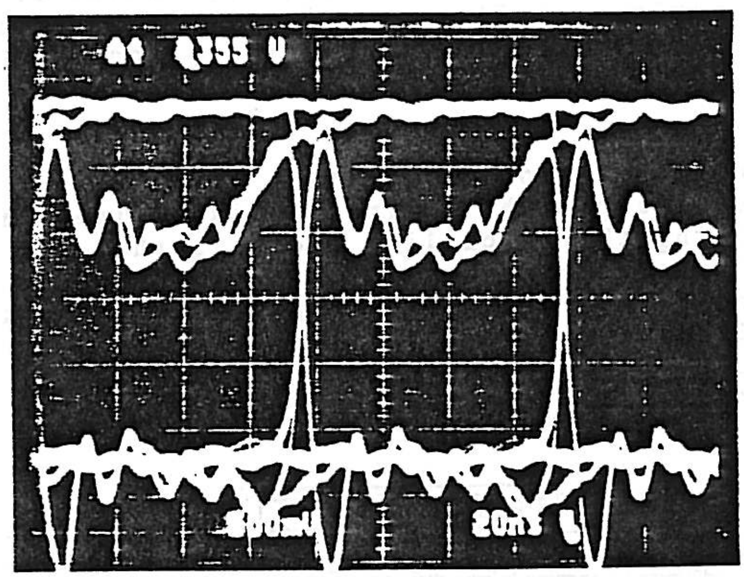
PHOTO 1



- LINE 3
- PERIPHERAL Ø
- 500 mV/DIV
- 20 ns/DIV
- DRIVER OUTPUT
- 80 ns DATA

← ØV

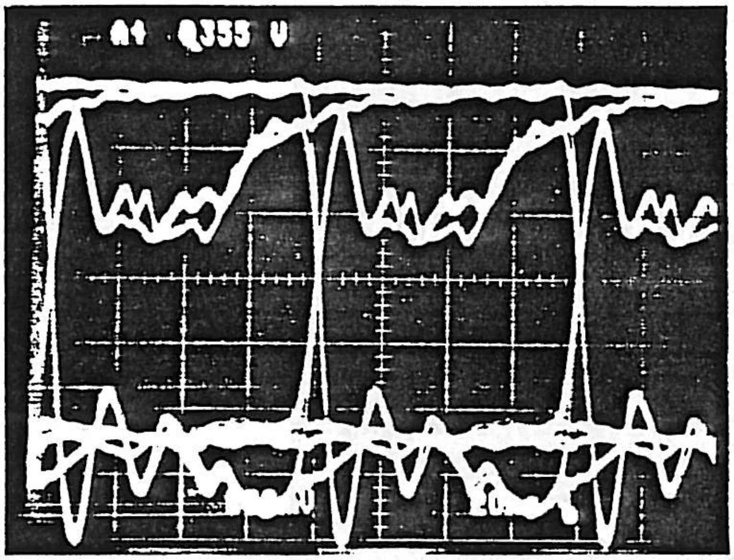
PHOTO 2



- LINE 3
- PERIPHERAL 1
- 500 mV/DIV
- 20 ns/DIV
- RECEIVER INPUT
- 80 ns DATA

← ØV

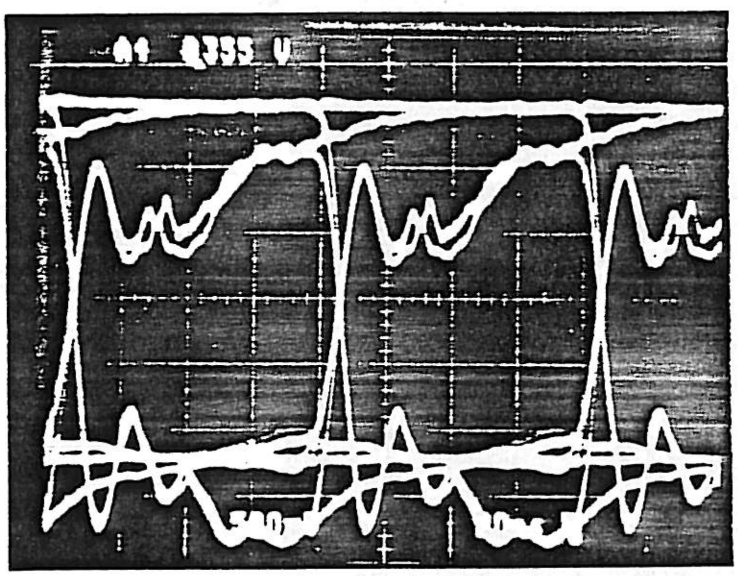
PHOTO 3



- LINE 3
- PERIPHERAL 2
- 500 mV/DIV
- 20 ns/DIV
- RECEIVER INPUT
- 80 ns DATA

← ØV

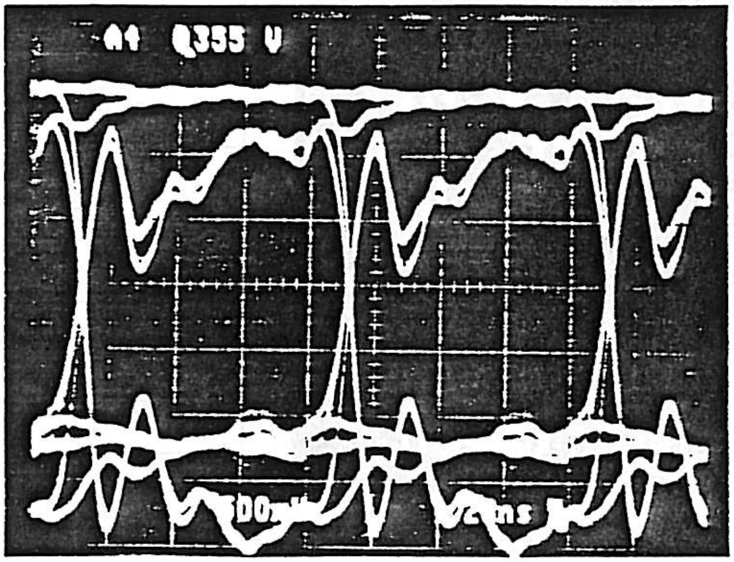
PHOTO 4



- LINE 3
- PERIPHERAL 3
- 500 mV/DIV
- 20 ns/DIV
- RECEIVER INPUT
- 80 ns DATA

← ØV

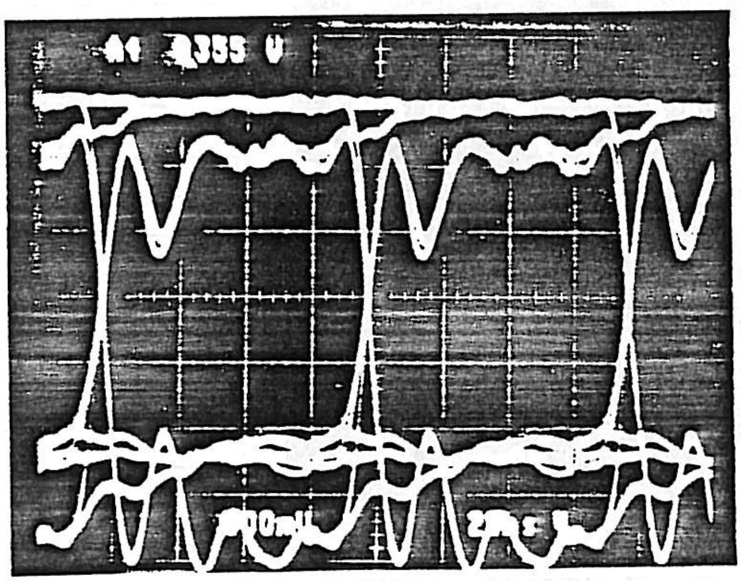
PHOTO 5



- LINE 3
- PERIPHERAL 4
- 500mV/DIV
- 20ns/DIV
- RECEIVER INPUT
- 80ns DATA

← ØV

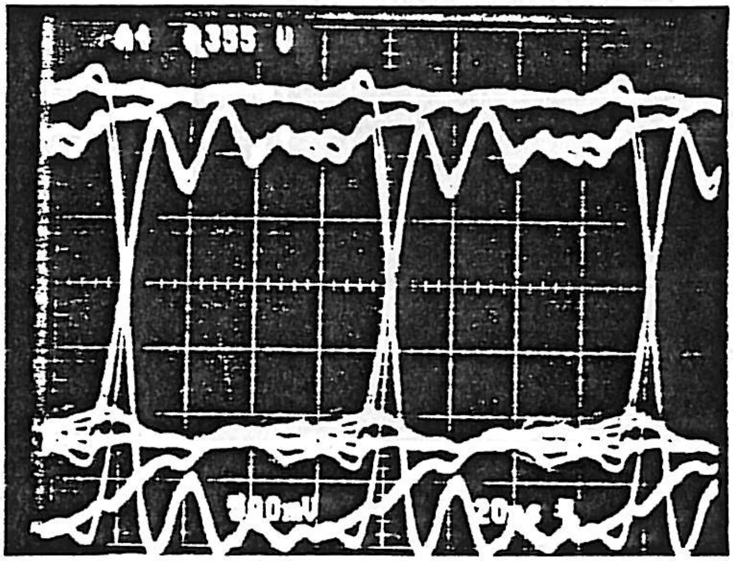
PHOTO 6



- LINE 3
- PERIPHERAL 5
- 500mV/DIV
- 20ns/DIV
- RECEIVER INPUT
- 80 ns DATA

← ØV

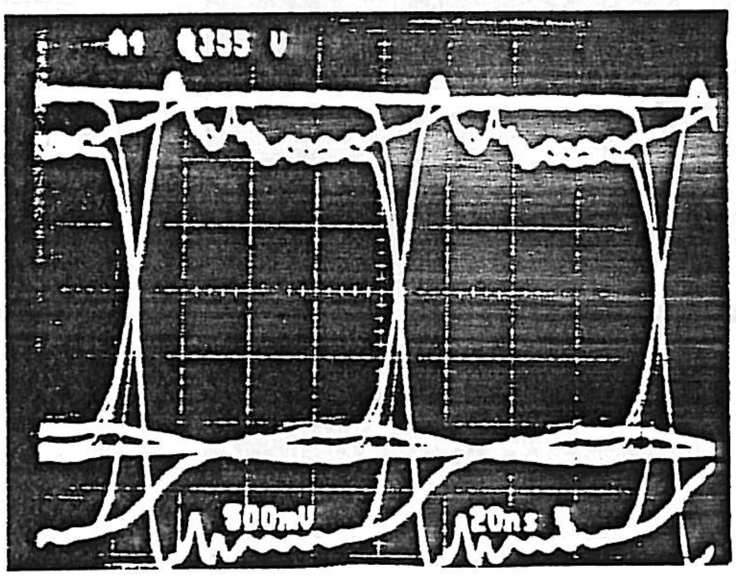
PHOTO 7



- LINE 3
- PERIPHERAL 6
- 500mV/DIV
- 20ns/DIV
- RECEIVER INPUT
- 80 ns DATA

← ØV

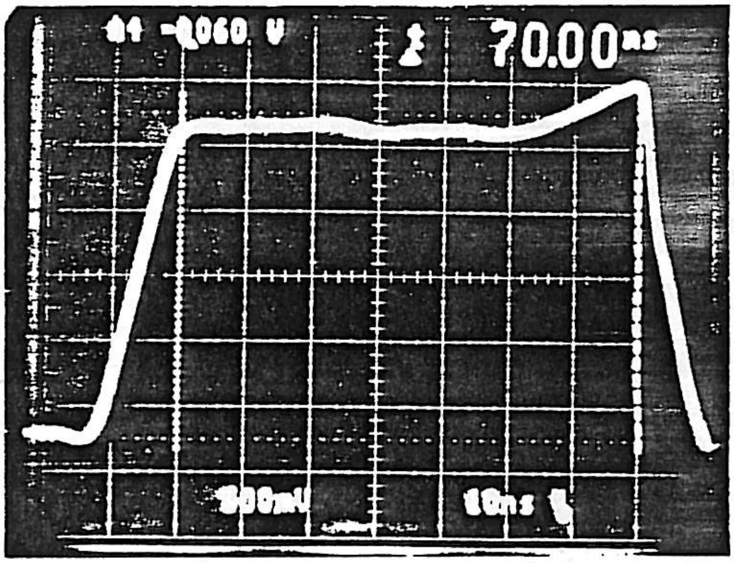
PHOTO 8



- LINE 3
- PERIPHERAL 7
- 500 mV/DIV
- 20ns/DIV
- RECEIVER INPUT
- 80 ns DATA

← ØV

PHOTO 9



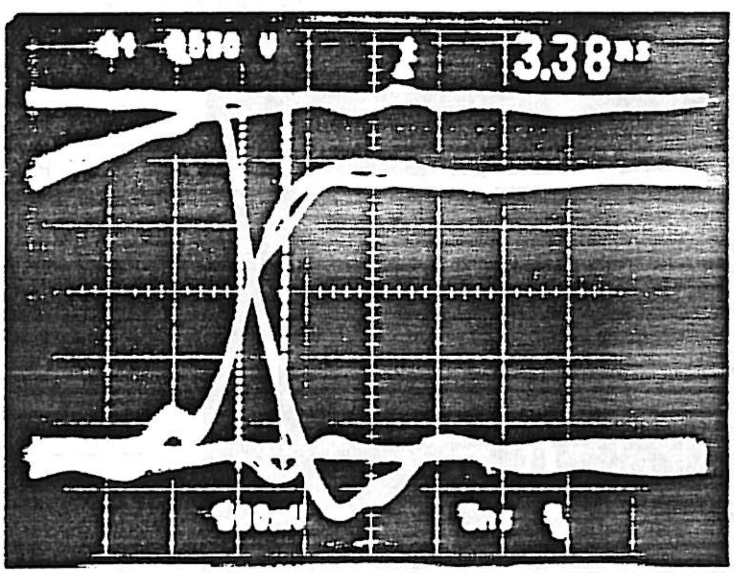
RELECTION

STEP UP TO V_{TERM} = 3V SHOWS MISMATCH BETWEEN LINE AND TERMINATION RESISTANCE.

- TWO PERIPHERALS ATTACHED (#Ø AND #7)
- 500 mV/DIV
- 10ns/DIV
- ONE LINE DRIVEN

← ØV

PHOTO 10

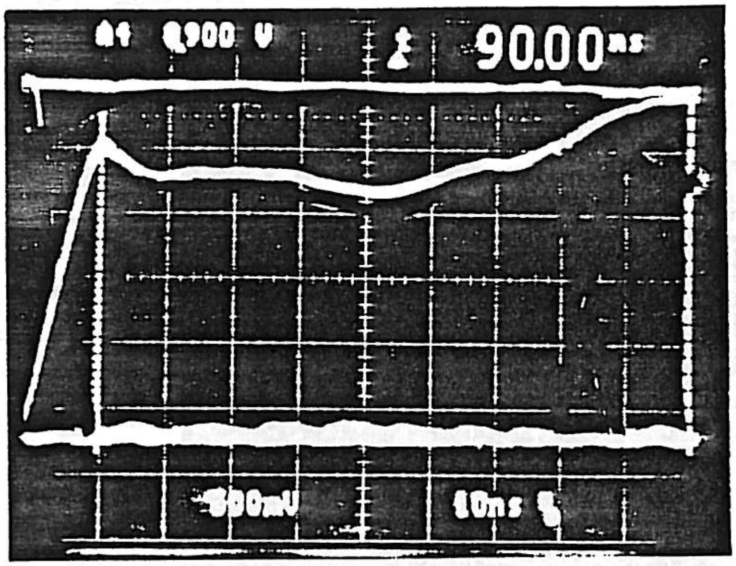


PERIPHERAL Ø, LINE 3 OUTPUT SHOWS EFFECT OF ABOVE REFLECTION MIXED WITH CROSSTALK.

- TWO PERIPHERALS ATTACHED (#0 AND #7)
- 500 mV/DIV
- 5ns/DIV
- ALL LINES DRIVEN

← ØV

PHOTO 11



REFLECTION WORSENS

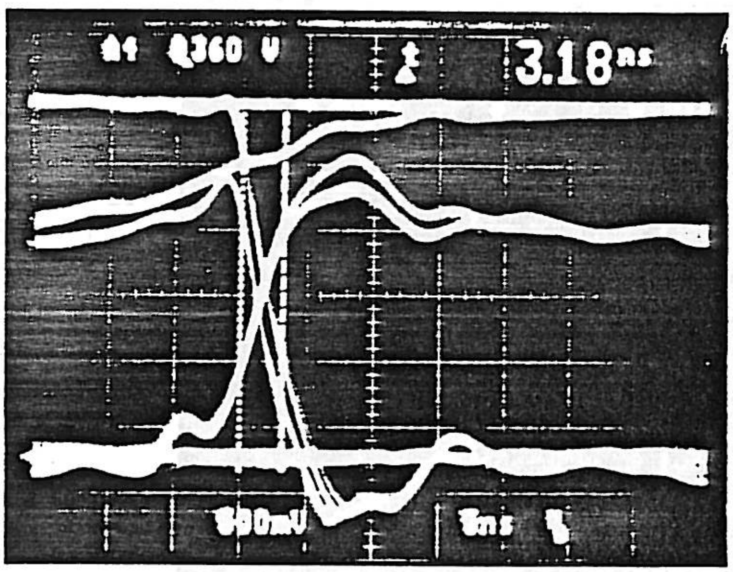
IMPEDANCE OF LINE DROPS WITH ALL PERIPHERALS ATTACHED, INCREASING MISMATCH WITH TERMINATION.

- PERIPHERAL Ø, LINE 3
- 500 mV/DIV
- 10 ns/DIV

← ØV

- ONE LINE DRIVEN

PHOTO 12



ABOVE REFLECTION AND CROSSTALK IN PERIPHERAL Ø, LINE 3 OUTPUT.

- 500 mV/DIV
- 5ns/DIV
- ALL PERIPHERALS ATTACHED.
- ALL LINES DRIVEN

← ØV

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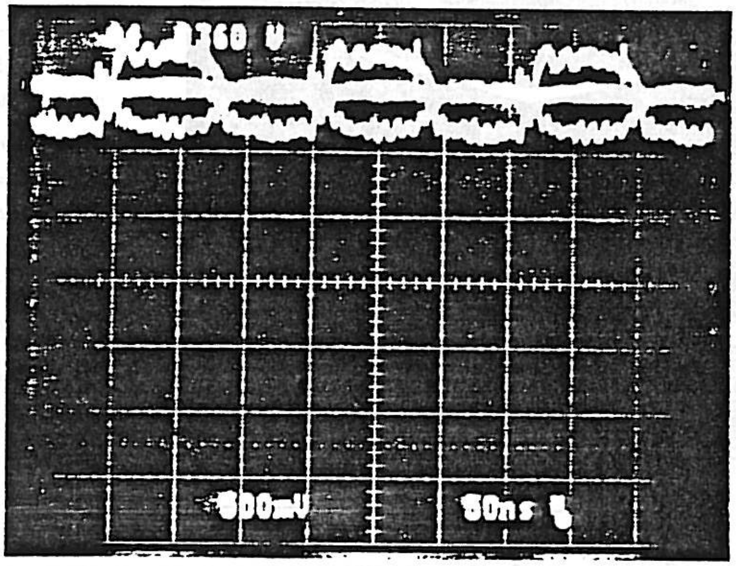
PHOTO 13

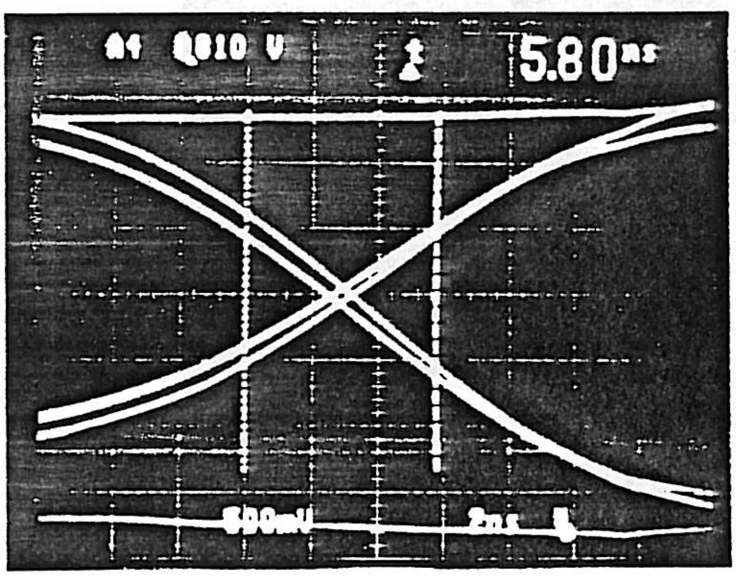


CROSSTALK ON PASSIVE SENSE LINE INDUCED BY SURROUNDING DATA LINES RUNNING PSUEDO RANDOM DATA PATTERN.

- 500mV/DIV
- 50ns/DIV

← ØV

PHOTO 14



CLOCK JITTER
40ns UNIT INTERVAL AT PERIPHERAL 7. ALL PERIPHERALS ATTACHED, ONE LINE DRIVEN.

- 500mV/DIV
- 2ns/DIV

← ØV

Conclusions -

Jitter is low and not a problem. However, reflections and crosstalk significantly reduce noise margin.

The reflections appear to be caused mainly by the mismatch between the impedance of the ribbon cable and the effective impedance of the SCSI terminator. The reflection at the driver end (worst case) is about 750 mV with all peripherals attached (photo 11). The crosstalk measured on a sense line is about 350mV (photo 13). At peripheral 0 a data line driving against all the other lines the signal amplitude is pulled a total of about 750 mV + 350 mV = 1.1V as shown in photo 1. Of course, matching the SCSI terminators to the cable impedance would greatly reduce reflections allowing greater noise margin and more reliable data transmission. The crosstalk is unavoidable. A crosstalk comparison should be made between Trapezoidal and TTL drivers in the same test setup in order to show the effect of the Trapezoidal's controlled edge.

More testing should be done to establish minimum safe spacing between peripherals.