X3T9.2/92-59

ELECTRICAL IMPACTS OF SCSI HOT PLUGGING

X3T9.2 SPI

FEBRUARY 17, 1992

BILL HAM
DIGITAL EQUIPMENT
(508) 841-2629

SCSI HOT PLUGGING

WHAT IS BEING DISCUSSED:

WHAT HAPPENS ELECTRICALLY DURING DEVICE REMOVAL AND REPLACEMENT

WHAT THE IMPLICATIONS ARE FOR THIS ELECTRICAL BEHAVIOR

WHAT IS A WORST CASE DISTURBANCE

STATE OF CHIP KNOWLEDGE TODAY

WHAT IS NOT BEING DISCUSSED:

HOW BUS QUIESCING SCHEMES MIGHT WORK

WHAT SOFTWARE/FIRMWARE SCHEMES COULD BE USED

PACKAGING CONSIDERATIONS

FEBRUARY 17, 1992

SCSI HOT PLUGGING
(CONDITIONS ASSUMED FOR HOT PLUGGING MEASUREMENTS)

.ALL GROUND CONNECTIONS ARE IN PLACE PRIOR TO THE HOT PLUGGING EVENT(S)

.DEVICE POWER TO THE HOT PLUGGED DEVICE IS OFF DURING THE HOT PLUGGING EVENT(S)

.THE SCSI BUS IS ACTIVE (NOT QUIESCED) WHEN THE EVENT OCCURS (COMMUNICATIONS OCCURING BETWEEN DEVICES REMAINING ON THE BUS)

.THERE IS NO (0) PURPOSEFUL LOSS OF BUS ACCESSIBILITY FOR ACTIVE DEVICES DUE TO THE HOT PLUGGING

FEBRUARY 17, 1992

SCSI HOT PLUGGING
(BASIC CIRCUIT FOR CONNECTOR TRANSIENT MEASUREMENTS)

```
5V                                                          5V
|                                                           |
|                                                           |
\                                                           \
/ 120 OHMS                                                  / 120 OHMS
\                                                           \
/                                                           /
|     |-TEST POINT 3    |-TEST POINT 2                      |
-------------------------------------------------------------
|  Z0 = 100 OHMS                |                           |
\                               |                           \
/ 280 OHMS           |---)  ^ TEST POINT 1                  / 280 OHMS
\                    \      |                               \
/          LOAD      /    SCOPE (10 PF/10 MEG)              /
|                    \      |                               |
|                    |      |                               |
---                 ---    ---                             ---
///                 ///    ///                             ///
```

.BASIC CONNECTOR MAKE/BREAK MEASUREMENTS AT TEST POINT 1

.BUS DISTURBANCE MEASURED AT TEST POINTS 2 AND 3

FEBRUARY 17, 1992

SCSI HOT PLUGGING
(OUTLINE)

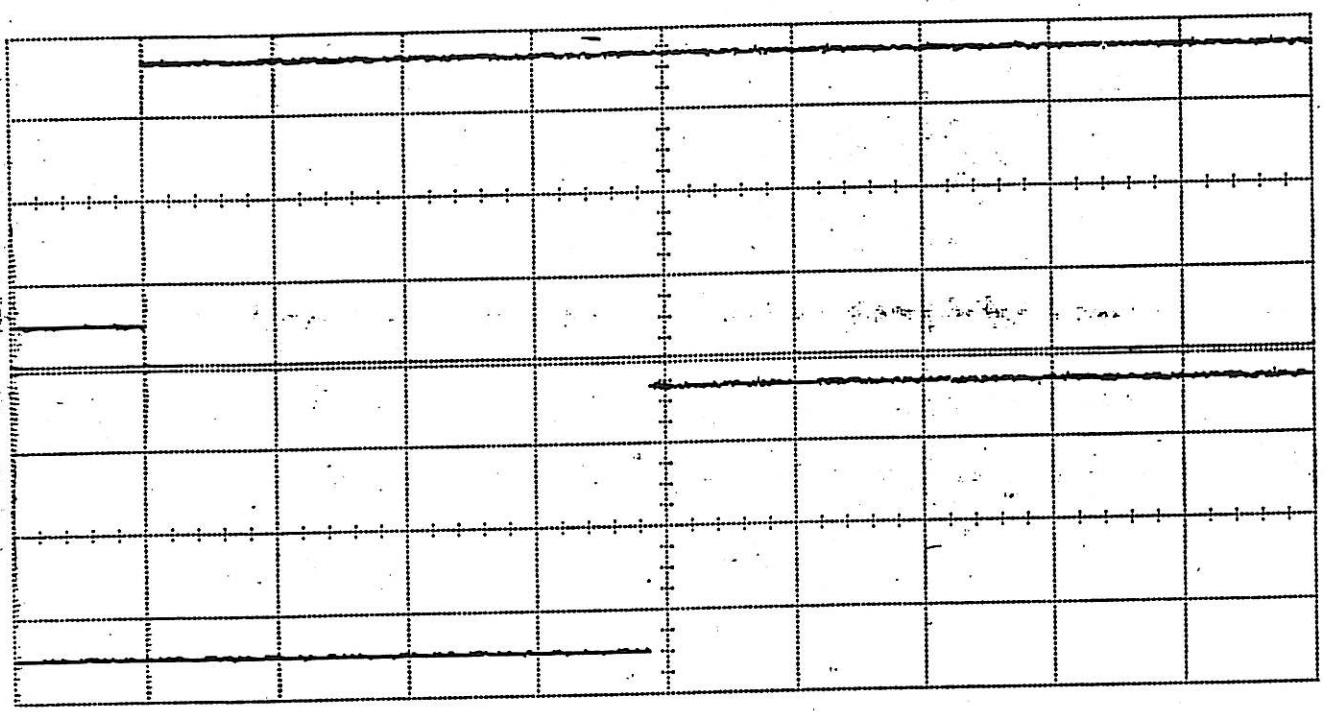
- .BASIC CONNECTOR CHARACTERISTICS DURING MATING AND DEMATING
- .EMPIRICAL BUS DISTURBANCES
- .PHYSICS OF THE TRANSIENT EVENT ITSELF
- .WORST CASE TRANSIENT DESCRIPTION
- .POSSIBLE IMPACT OF THE WARM SWAP DISTURBANCE ON THE SCSI BUS
- .SOME PROPERTIES OF RECEIVERS RE: DETECTABILITY OF WARM SWAP DISTURBANCES

FEBRUARY 17, 1992

DSSI WARM SWAP

TYPICAL CONNECTOR MATING TRANSIENT

MAKE TIMING IS VERY DIFFERENT FOR DIFFERENT CONNECTOR PINS



Ch. 1 = 1.000 volts/div TOP TRACE PIN "1" AT ACCESS POINT 1

Ch. 2 = 1.000 volts/div BOTTOM TRACE PIN "2" AT ACCESS POINT 1

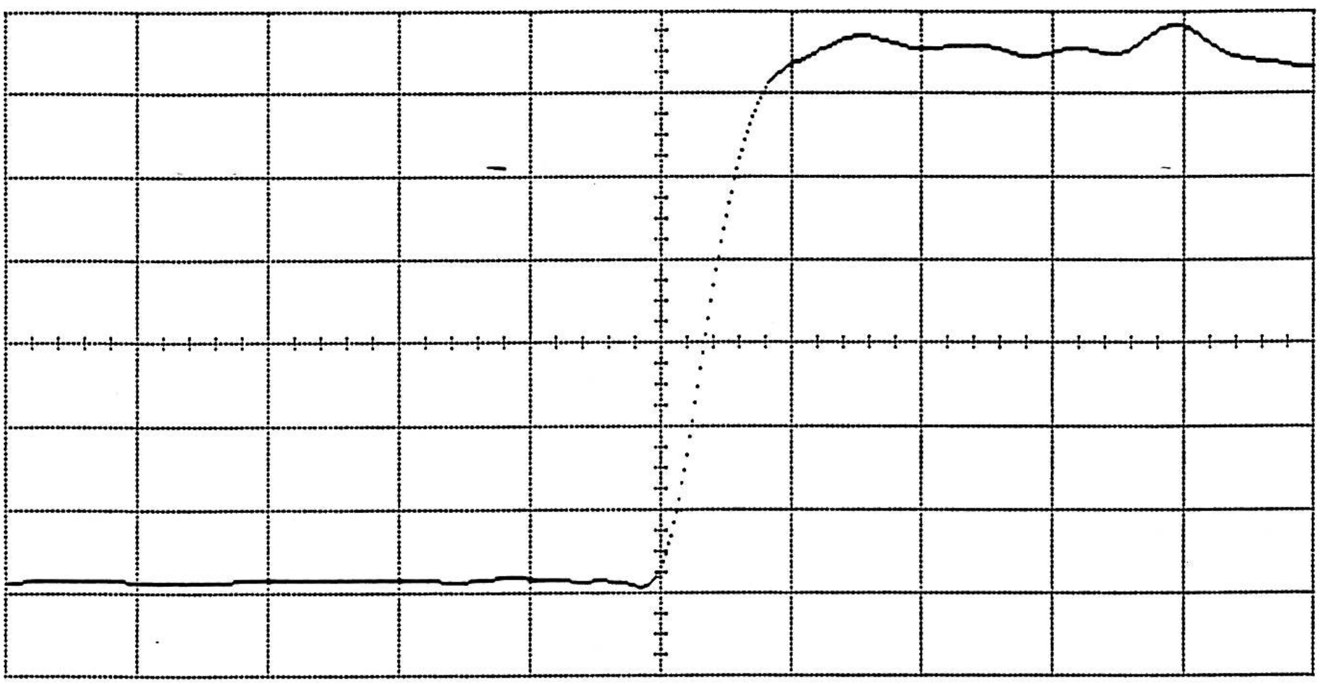
Timebase = 5.00 msec/div

NOTE LACK OF ACTIVITY DURING THE "SLIDE" PORTION OF THE MATING FOR BOTH PINS - ONCE THE INITIAL CONTACT IS MADE THERE ARE NO FURTHER MOMENTARY OPENS

10/22/90

FIGURE 8

"HIGH MAGNIFICATION" VIEW OF THE TYPICAL MATING TRANSIENT



Ch. 1 = 500.0 mVolts/div ACCESS POINT 1 (TRIGGER LEVEL 800 mV)

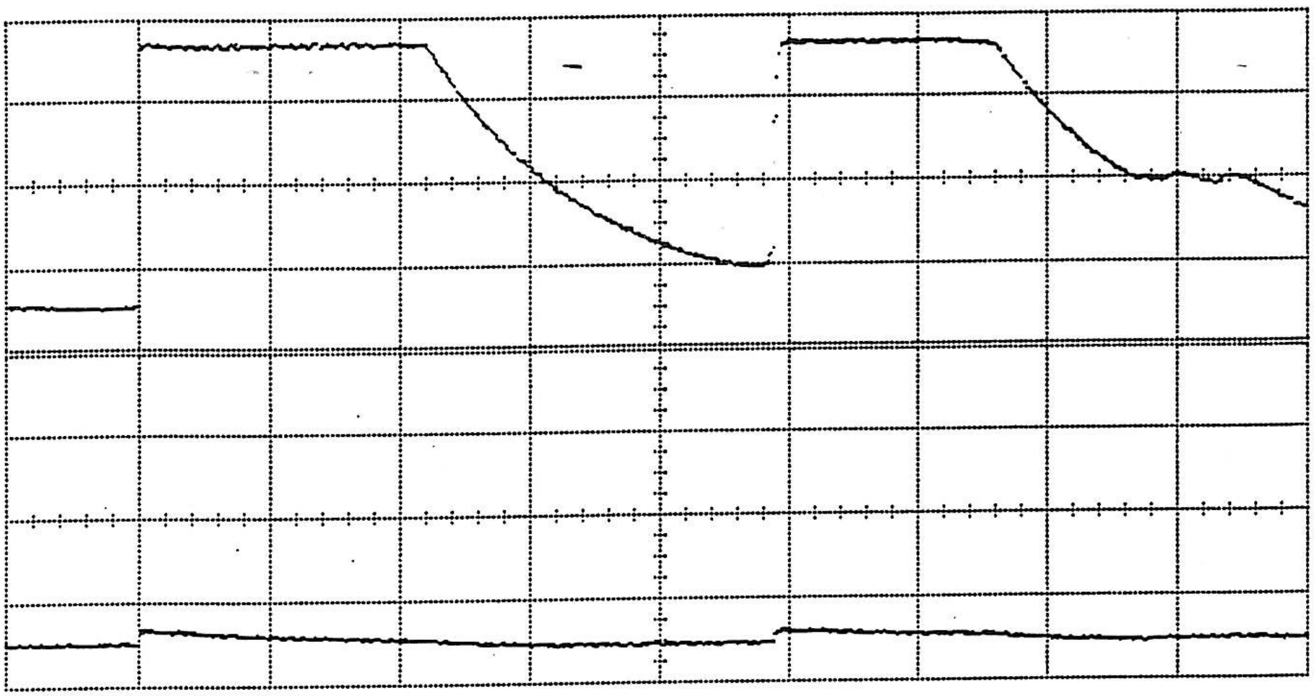
Timebase = 5.00 ns/div

- .TIME CONSTANT FOR TEST CIRCUIT IS APPROXIMATELY THE SAME AS THE RISE TIME ABOVE => INITIAL CONNECTOR MATING IS FASTER THAN 2 nSec
- .NOTE VOLTAGE INSTABILITY AFTER THE INITIAL RISE
- .NOTE OVERSHOOT AFTER INITIAL RISE

DSSI WARM SWAP

CONNECTOR MATING DYNAMICS WITH "BOUNCE" PRESENT

FAST SWEEP CONDITIONS WITH APPROXIMATELY 100 nSec RESOLUTION



Ch. 1 = 1.000 volts/div TOP TRACE PIN "1" AT ACCESS POINT 1

Ch. 2 = 1.000 volts/div BOTTOM TRACE PIN "2" AT ACCESS POINT 1

Timebase = 10.0 usec/div

DECAY TIME IS DETERMINED BY THE SCOPE INPUT CIRCUITRY (1 MEG OHM / 10 pF) TIME CONSTANT OF APPROXIMATELY 10 uSec

NOTE EVIDENCE OF BOTH "IDEAL" SWITCH BEHAVIOR IN THE FIRST BOUNCE EVENT AND NON-IDEAL BEHAVIOR IN THE SECOND BOUNCE EVENT

THE SECOND BOUNCE HAS A MONOTONIC MAKE TRANSIENT LASTING APPROXIMATELY 1 uSec AND A BREAK "SHELF" LASTING APPROXIMATELY 10 uSec

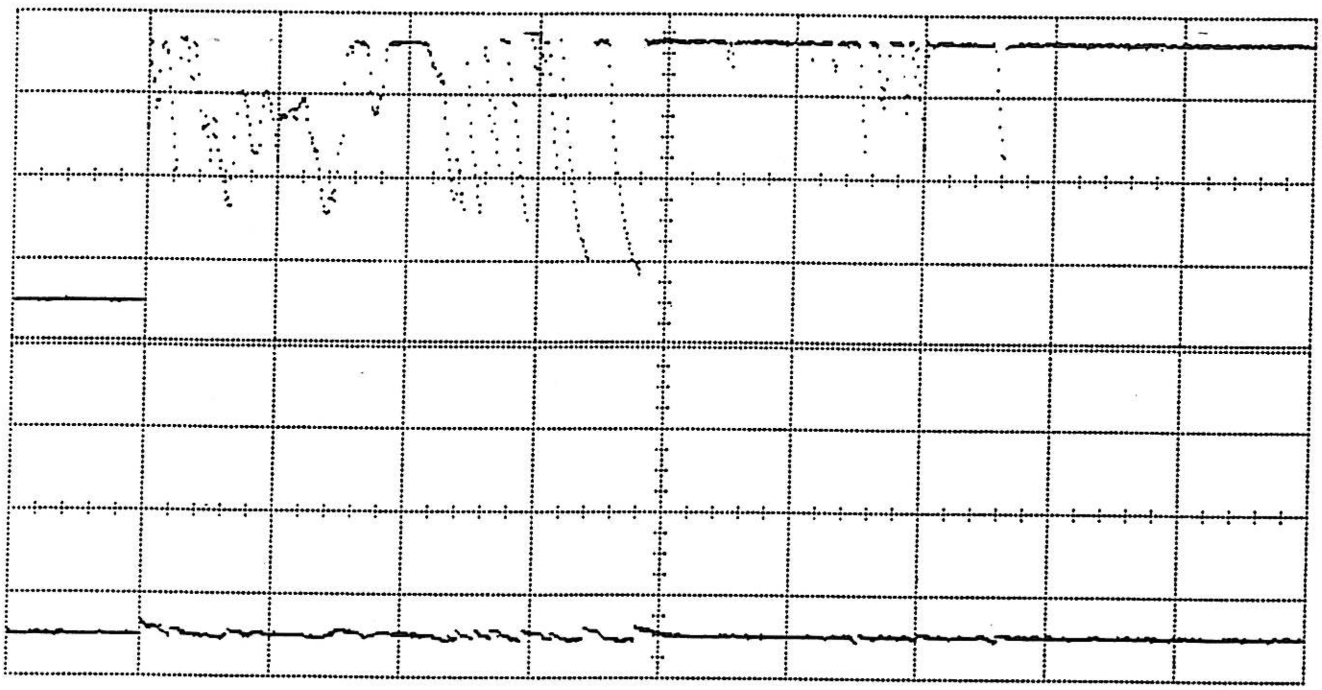
NOTE PIN 2 IS NOT YET ACTIVE BUT SHOWS SOME "CROSS TALK" FROM THE PIN 1 ACTIVITY

DSSI WARM SWAP

CONNECTOR INSERTION TRANSIENT

MICRO

EXTENSIVE MULTIPLE BOUNCE LASTING ~ 700 µSec



Ch. 1 = 1.000 volts/div TOP TRACE PIN "1" AT ACCESS POINT 1

Ch. 2 = 1.000 volts/div BOTTOM TRACE PIN "2" AT ACCESS POINT 1

Timebase = 100 usec/div

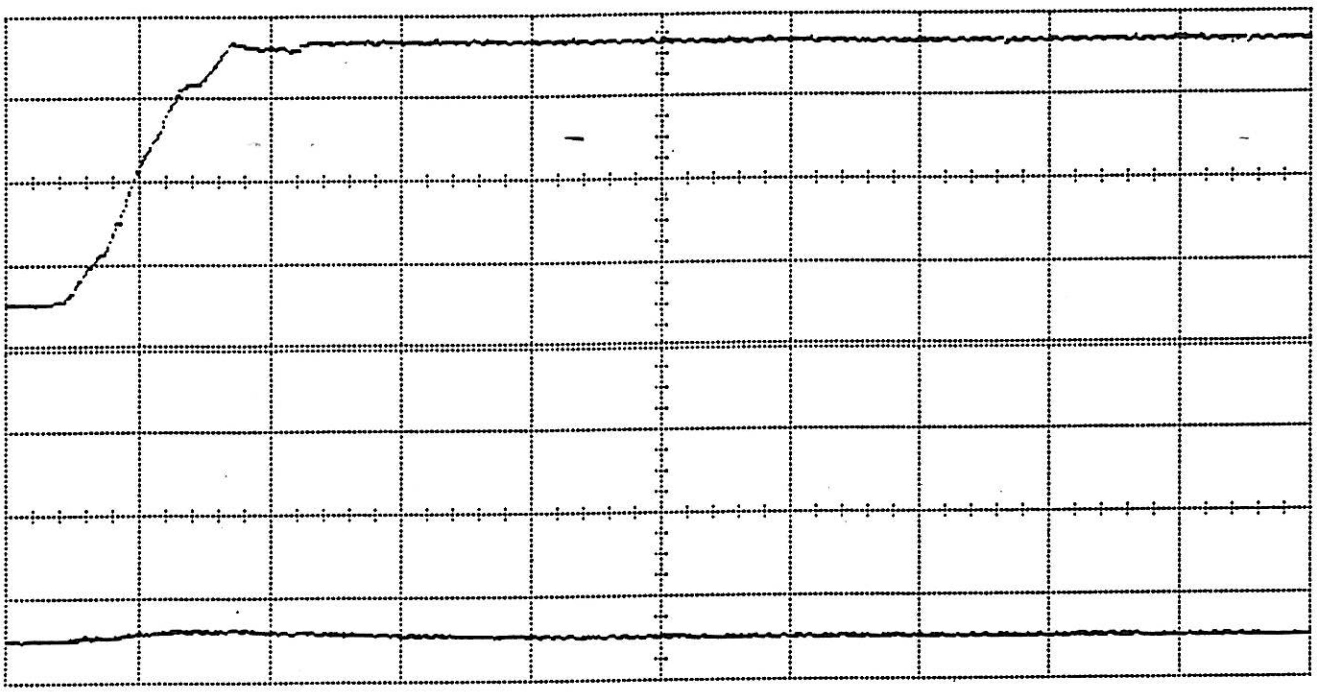
THIS KIND OF INSERTION TRANSIENT IS RARE AND REPRESENTS A WORST CASE

10/22/90

DSSI WARM SWAP

CONNECTOR MATING TRANSIENT

SINGLE MAKE EVENT WITH CONTINUOUSLY DECREASING CONTACT RESISTANCE (NO BOUNCE)



Ch. 1 = 1.000 volts/div TOP TRACE PIN "1" AT ACCESS POINT 1

Ch. 2 = 1.000 volts/div BOTTOM TRACE PIN "2" AT ACCESS POINT 1

Timebase = 10.0 usec/div

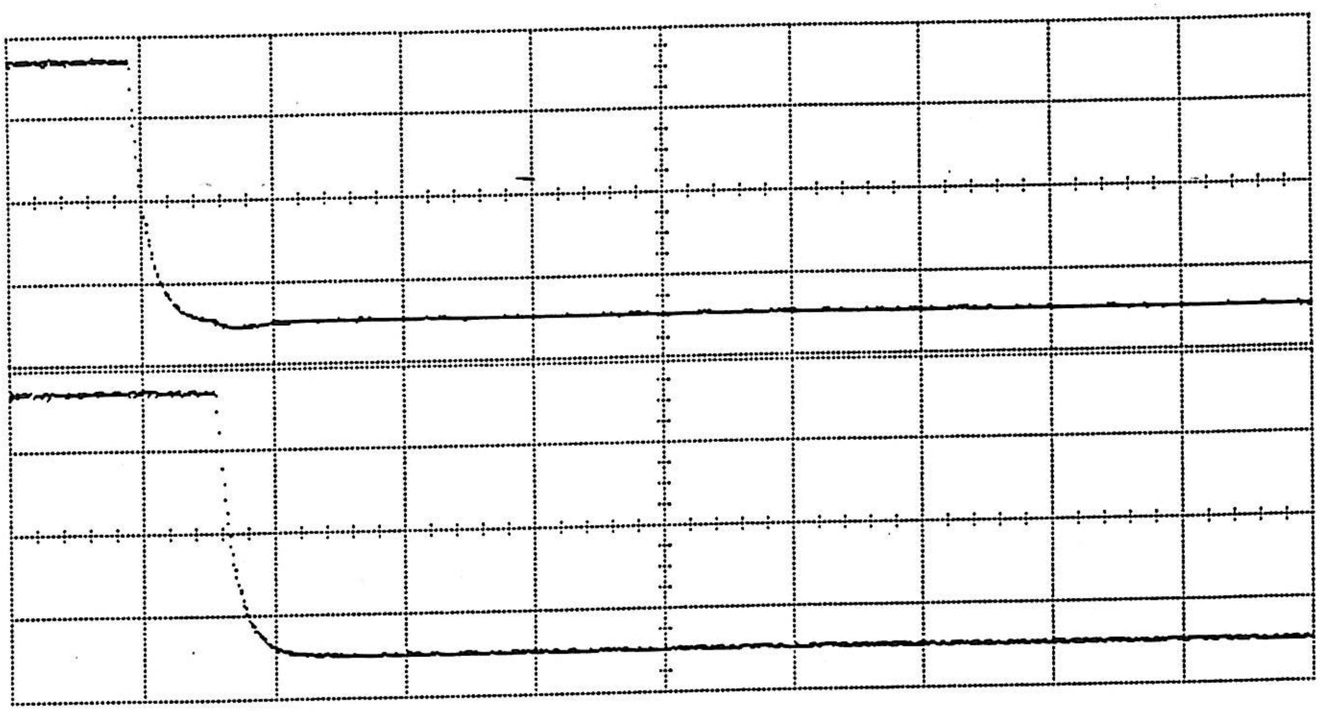
NOTE NO ACTIVITY IN PIN 2 EXCEPT FOR A VERY SMALL HUMP DURING THE TRANSIENT

THIS BEHAVIOR IS QUITE RARE AND CANNOT BE USED FOR CHARACTERIZATION ANALYSIS

10/22/90

DSSI WARM SWAP

CONNECTOR BREAK TRANSIENT



Ch. 1 = 1.000 volts/div TOP TRACE PIN "1" AT ACCESS POINT 1

Ch. 2 = 1.000 volts/div BOTTOM TRACE PIN "2" AT ACCESS POINT 1

Timebase = 100 usec/div

DECAY TIME IS DETERMINED BY THE SCOPE INPUT CIRCUITRY

DEMATING PROCESS IS MECHANICALLY ASSISTED - HAPPENS MORE RAPIDLY THAN THE MATING PROCESS

NOTE APPROXIMATELY 60 uSec DIFFERENCE BETWEEN BREAK EVENTS FOR THE TWO PINS

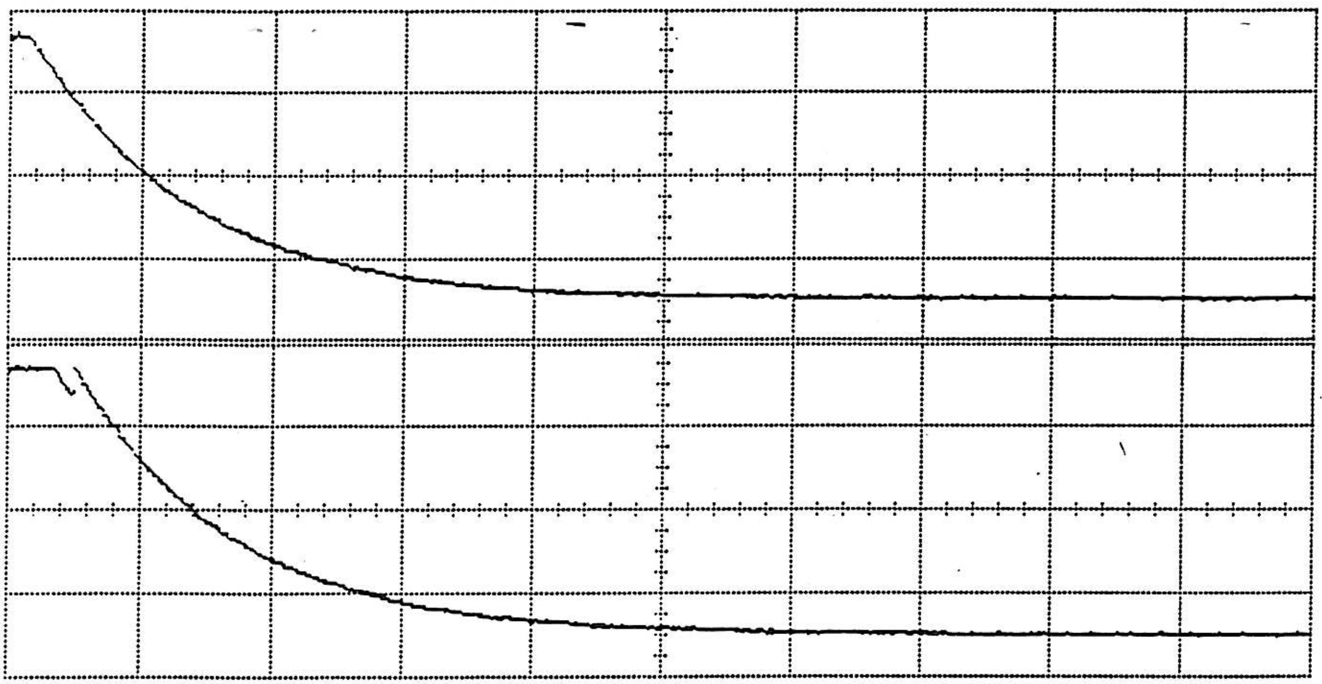
TYPICALLY THERE IS NO BOUNCE OBSERVED ON DEMATING

10/22/90

DSSI WARM SWAP

CONNECTOR BREAK TRANSIENTS

BEST OBSERVED PIN TO PIN SYNCHRONIZATION



Ch. 1 = 1.000 volts/div TOP TRACE PIN "1" AT ACCESS POINT 1

Ch. 2 = 1.000 volts/div BOTTOM TRACE PIN "2" AT ACCESS POINT 1

Timebase = 10.0 usec/div

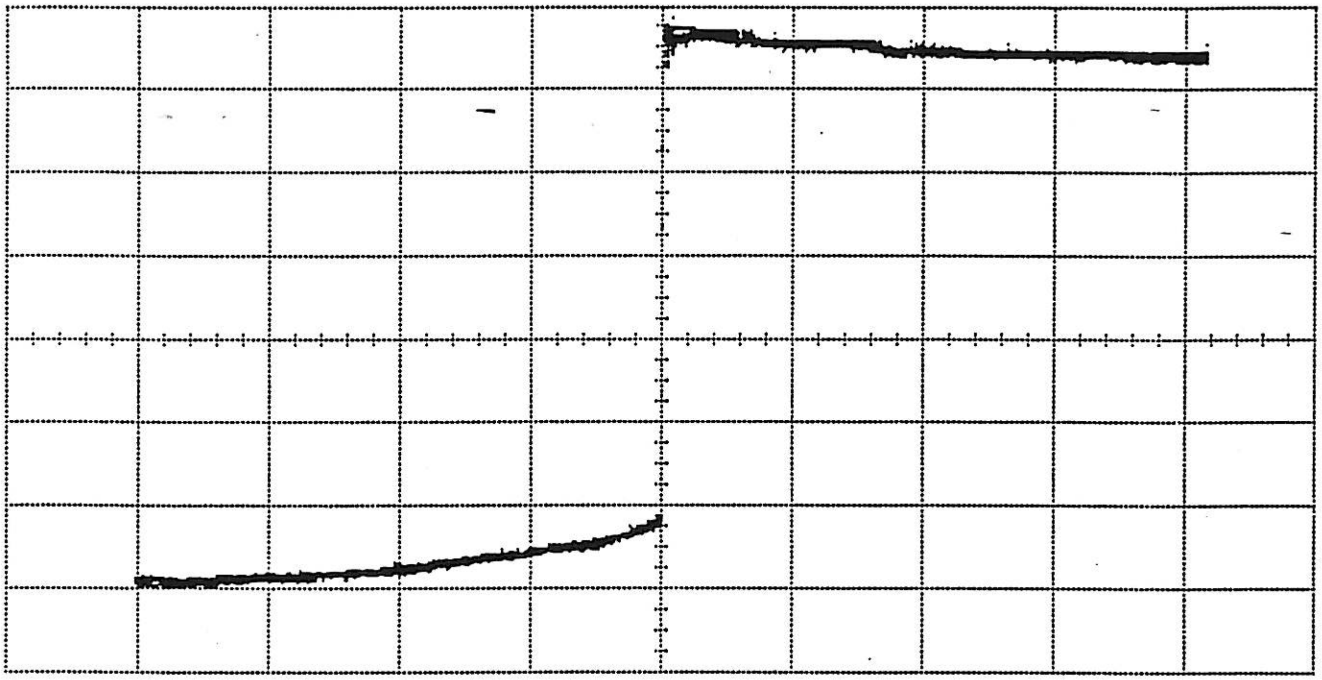
TIME DIFFERENCE NOTED AT APPROXIMATELY 2.5 uSec BETWEEN PINS

NOTE SMALL BOUNCE LASTING APPROXIMATELY 2 uSec IN PIN 2

10/22/90

FIGURE 14

GRADUAL TRANSIENT FOLLOWED BY A RAPID TRANSIENT (SAME MATING EVENT)



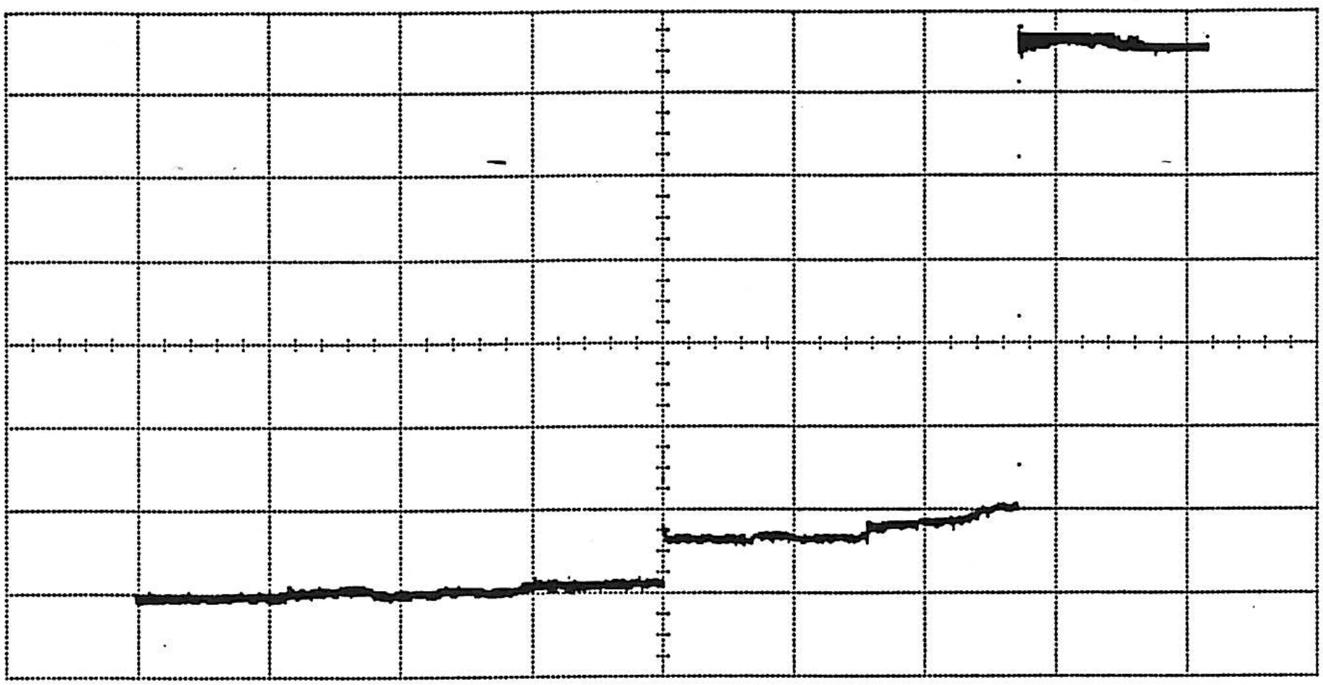
Ch. 1 = 500.0 mVolts/div ACCESS POINT 1 (TRIGGER LEVEL = 800 mV)

Timebase = 1.00 us/div

THE INITIAL TRANSIENT IS GRADUAL FOR APPROXIMATELY 4 MICROSECONDS - IT THEN BECOMES RAPID WITH AN OVERSHOOT AND A VERY LONG "DECAY"

FIGURE 15

LOW MAGNIFICATION OF MATING EVENT EXHIBITING
MULTIPLE RAPID AND GRADUAL TRANSIENTS



Ch. 1 = 500.0 mVolts/div ACCESS POINT 1 (TRIGGER LEVEL 800 mV)

Timebase = 1.00 us/div

NOTE 2 MINOR AND 1 MAJOR RAPID TRANSIENTS

NOTE MONOTONIC VOLTAGE INCREASE AS CAPACITOR CHARGES
(CIRCUIT DISCHARGE TIME CONSTANT = 25 MICROSECONDS)

SCSI HOT PLUGGING
(CURRENT FLOW DURING TRANSIENT)

.A 25 PF CAPACITOR IS BEING CHARGED TO 3.5 VOLTS

.THIS REQUIRES $25 \times 10^{-12} \times 3.5 = 8.75 \times 10^{-11}$ COUL

.THE TIME REQUIRED TO TRANSFER THIS CHARGE IS 2 TO 4 NSEC FOR A RAPID TRANSIENT

.THE AVERAGE CURRENT IS THEREFORE $8.75 \times 10^{-11} / 2 \times 10^{-9} =$

0.044 AMPS (44 MA) (WORST CASE)

.FOR A GRADUAL TRANSIENT THE TRANSITION TIME IS APPROXIMATELY 10 MICROSECONDS AND THE AVERAGE CURRENT IS MUCH LOWER:

$8.75 \times 10^{-11} / 10^{-5} =$ 9 MICROAMP

FEBRUARY 17, 1992

SCSI HOT PLUGGING
(DISTANCES INVOLVED WITH DIFFERENT CONNECTOR TRANSIENT TYPES
(ORDER OF MAGNITUDE ESTIMATES)

TYPE	TRANSIENT TIME	ASSUMED VELOCITY	DISTANCE TRAVELLED DURING TRANSIENT
RAPID	2 TO 4 NSEC	100 CM/SEC	2 TO 4 NM (20 TO 40 A)
GRADUAL	~10 uSEC	10 CM/SEC	1 uM (0.00004")
BOUNCY	~100 uSEC	10 CM/SEC	10 uM (0.0004")

FEBRUARY 17, 1992

SCSI HOT PLUGGING
(ESTIMATES OF CURRENT DENSITY)

. INITIAL CONTACT AREA ASSUMED TO BE SQUARE 20A X 20A TO 40A X 40A

$20X20 = 4(10)^{-14}\ CM^{2}$

$40X40 = 16(10)^{-14}\ CM^{2}$

. THE CURRENT DENSITY IS THEREFORE CRUDELY

$$0.044/4(10)^{-14} = 10^{12}\ AMPS/CM^{2}$$

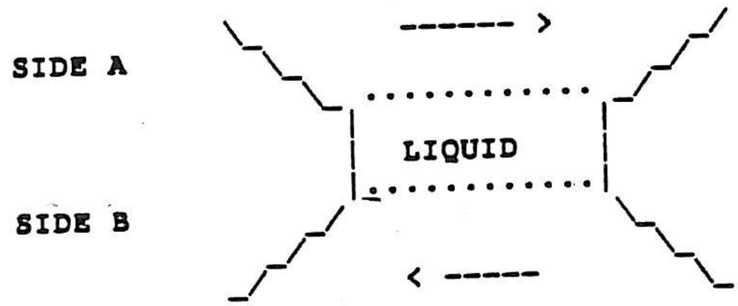
. THIS IS WELL ABOVE THE CURRENT DENSITY AT WHICH COPPER MELTS

. CONCLUSION IS THAT FAIRLY DRAMATIC MICROSCOPIC PHYSICAL DISRUPTIONS ARE OCCURRING WITH RAPID TRANSIENTS (SOMETHING LIKE MICROSCOPIC ARC WELDING)

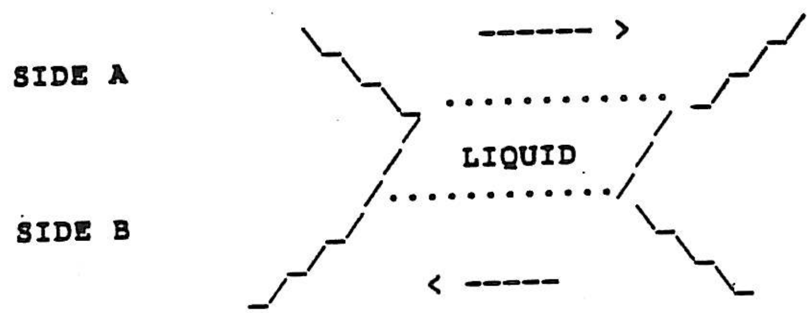
FEBRUARY 17, 1992

MICRO-MELT CONCEPT

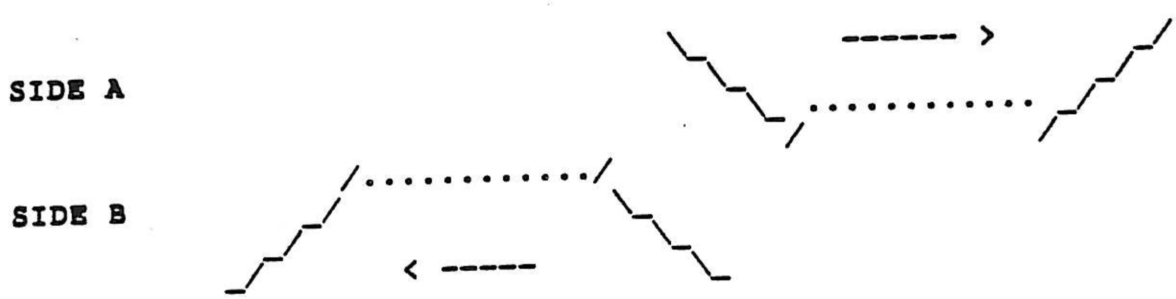
STAGE 1 - INITIAL MELT FORMS BETWEEN "PEAKS": RAPID TRANSIENT BEGINS



STAGE 2 - PIN MOVEMENT PROGRESSES: LIQUID REGION MAY GROW



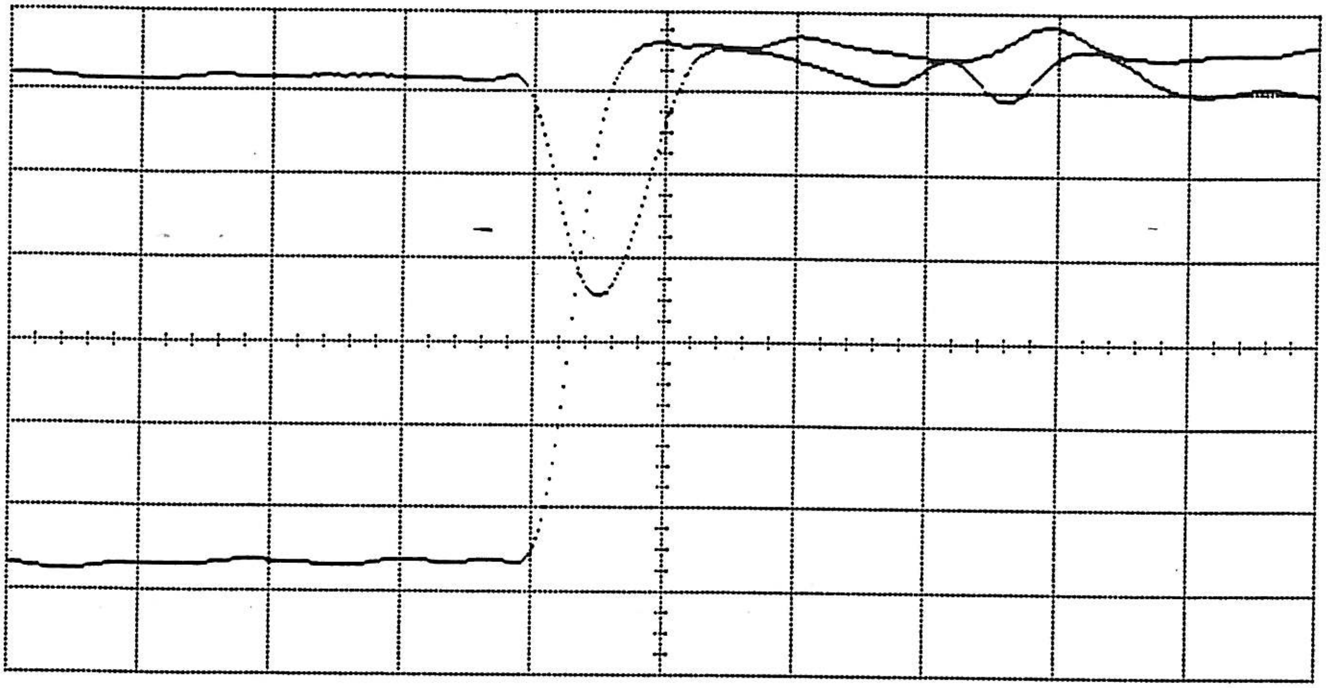
STAGE 3 - MOTION FORCES A BREAK IN THE LIQUID REGION:
GRADUAL TRANSIENT RESUMES



12/6/90
HAM

FIGURE 9

MATING TRANSIENTS FOR BOTH SIDES OF THE SAME PIN



Ch. 1 = 500.0 mVolts/div TOP TRACE: ACCESS POINT 2

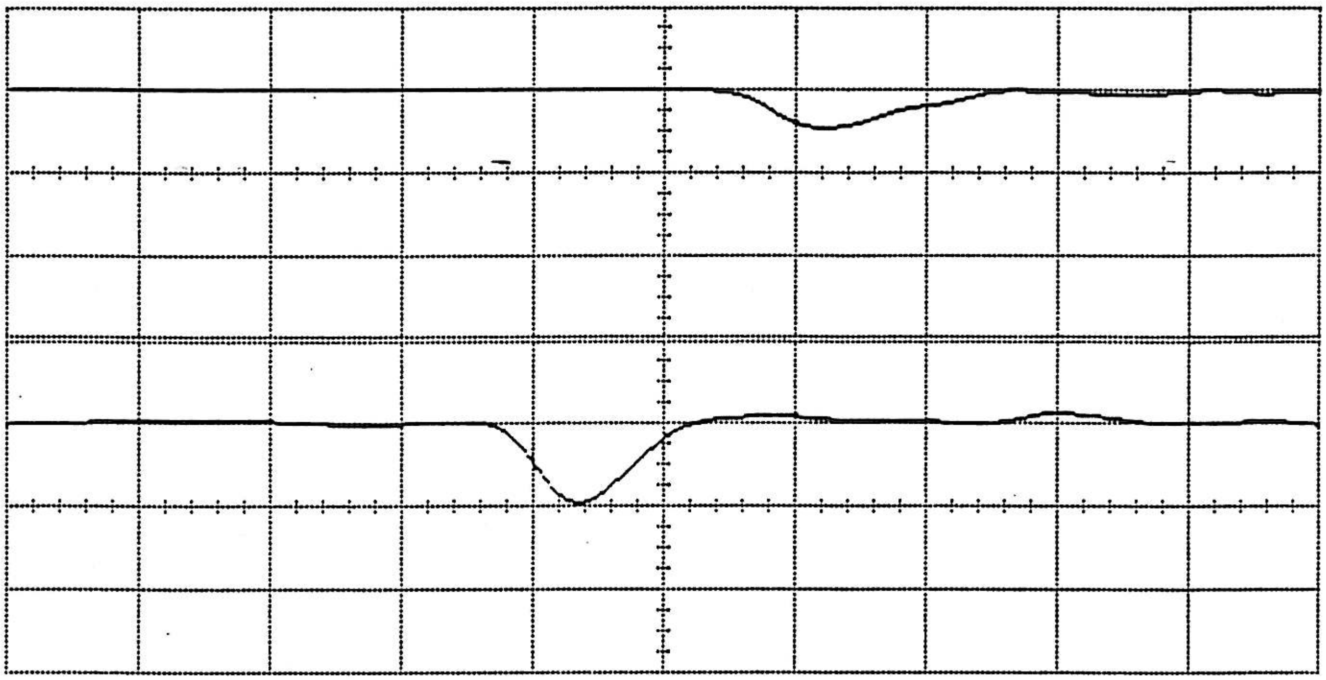
Ch. 2 = 500.0 mVolts/div BOTTOM TRACE: ACCESS POINT 1

Timebase = 5.00 ns/div

- .THE BUS TRANSIENT IS LARGER THAN NORMAL DUE TO THE PRESENSE OF THE SCOPE PROBE ON THE DRIVE SIDE
- .NOTE DELAY IN PRECISE TRACKING AFTER THE INITIAL MATING TRANSIENT
- .PROPAGATION DELAY BETWEEN PROBES LESS THAN 0.1 nSec

FIGURE 10

PROPAGATION OF BUS PULSE FROM SWAPPED DRIVE
TO INPUT OF ANOTHER DRIVE APPROXIMATELY 6 FEET AWAY



Ch. 1 = 500.0 mVolts/div TOP TRACE: ACCESS POINT 3

Ch. 2 = 500.0 mVolts/div BOTTOM TRACE: ACCESS POINT 2

Timebase = 5.00 ns/div

.NO TRIGGER PROBE AT SWAPPED DRIVE INPUT => TYPICAL ACTUAL PULSE

.NOTE PROP DELAY IS APPROXIMATELY 1.5 nSec/Ft

.NOTE PULSE DISPERSION AND AMPLITUDE DECREASE AT DOWNSTREAM DRIVE

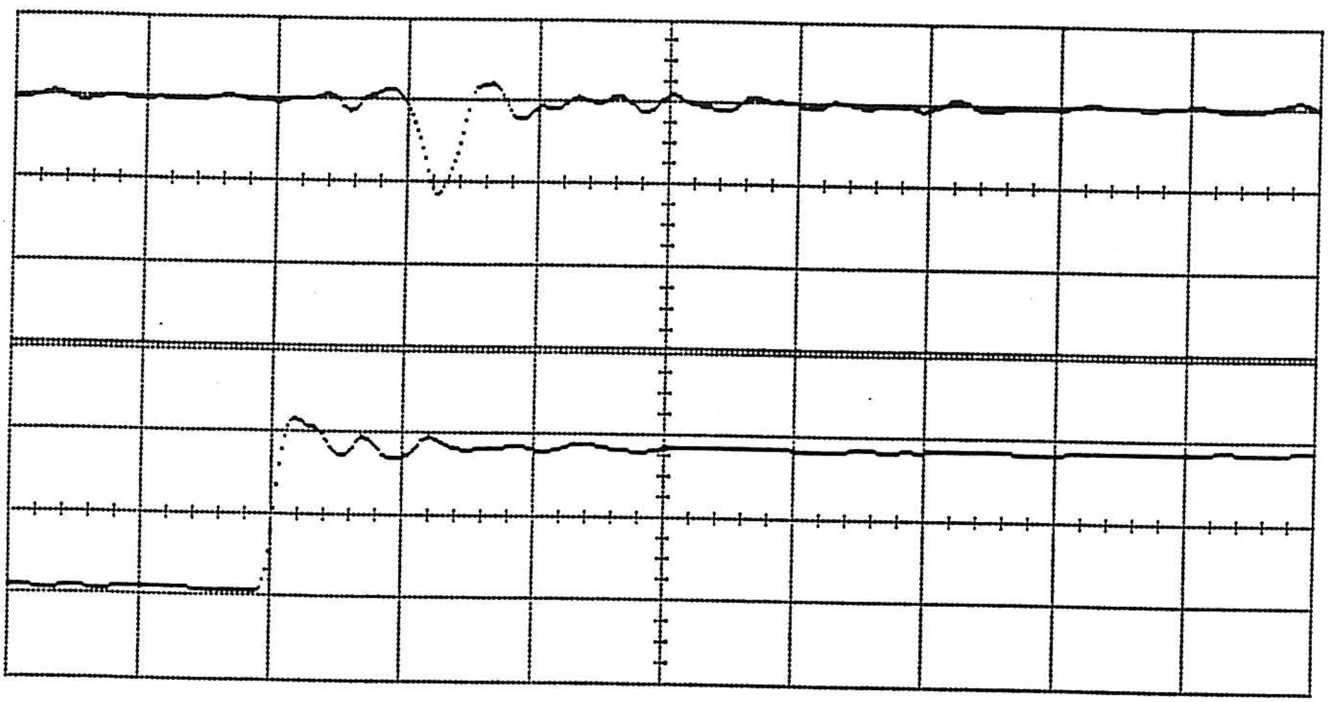
Data File is [CABLE.JUNKOUT]CNFG1_WS.LN03

Subject : DSSI signal measurement of Calypso dual host system.
Test Configuration is: KF1 - TFL - RF1 - RF2 - RF3 - RF4 - KF2.

Measurement date is 16-Nov-90 and the time is 11:47 AM

Measurements of a DASH Dual Host system with four RF drives and one tape loader. Two 6000 cabinets and one SF200 cabinet were used as the DUAL Host system. The external cable is the rev B cable, which does not have ACK twisted with D6. The cable in the SF72 is an unshielded flat cable which has an impedance of 100 ohms. It has been folded in half to facilitate routing in the SF71 box.
The top trace is channel 1 which is connected to DSSI ACK L on the node being warm swapped. Its ground reference is on the upper centerline. The bottom trace is channel 2 which is also connected to DSSI ACK L, but at a different node on the DSSI bus. Its ground reference is on the lower centerline. The device being warm swapped is being inserted onto the bus.

! Channel 1 is at TFL and channel 2 is at RF 3, the device being swapped.



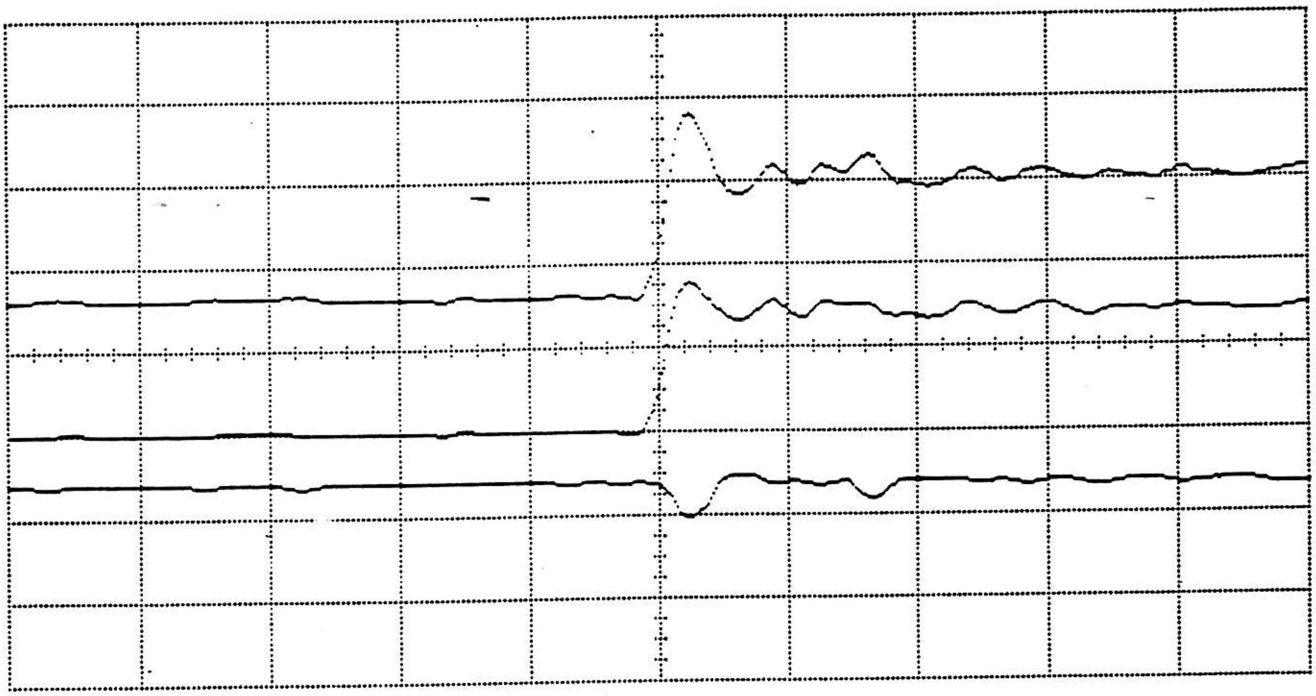
+18Y12Yk4S
-40.000 ns 60.000 ns 160.000 ns

Ch. 1	= 500.0 mVolts/div		Offset	= -500.0 mVolts
Ch. 2	= 2.000 Volts/div		Offset	= 2.000 Volts
Timebase	= 20.0 ns/div		Delay	= 60.000 ns

Trigger mode : Edge
On Pos. Edge on Chan2
Trigger Levels
Chan2 = 1.880 Volts
Holdoff = 70.000 ns

SINGLE ENDED SCSI -

WARM SWAP DISTURBANCES TO NEIGHBORING DRIVES
(APPROXIMATELY ONE FOOT SEPARATION)



Ch. 1 = 2.000 Volts/div MIDDLE TRACE - ACK ON SWAPPED DRIVE
Offset = 2.000 Volts

NOTE: TRIGGERED AT 1.1 VOLTS DURING RISE

Ch. 2 = 2.000 Volts/div LOWER TRACE - ACK ON STATIONARY DRIVE (1' AWAY)
Offset = 6.000 Volts

NOTE: 700+ mV WARM SWAP PULSE WITH APPROXIMATELY 5 NSEC WIDTH

Function1 = 2.000 Volts/div TOP TRACE - CH1-CH2
Offset = -4.000 Volts

NOT VERY MEANINGFUL TRACE FOR THIS TEST

Timebase = 20.0 ns/div

DSSI WARM SWAP

IMPACT OF DRIVE INSERTION/REMOVAL ON THE DSSI BUS SIGNALS -

FOUR CONDITIONS

BUS STATE	DRIVE STATE (CAPACITOR CHARGE)	EXPECTED RELATIVE IMPACT ON BUS SIGNALS *
HI	LO	LARGE *
LO	HI	LARGE *
HI	HI	SMALL
LO	LO	SMALL

HI - LO IS A LIKELY CONNECT STATE WITH NO "BOUNCE" (WORST CASE BUS IMPACT)

HI - HI IS A LIKELY DISCONNECT STATE WITH NO "BOUNCE" (EXPECT NO BUS IMPACT)

LO - HI COULD HAPPEN WITH ACTIVE DATA AND CONNECTOR BOUNCE (POSSIBLE BUT LESS LIKELY CASE - BUS IMPACT MEDIUM)

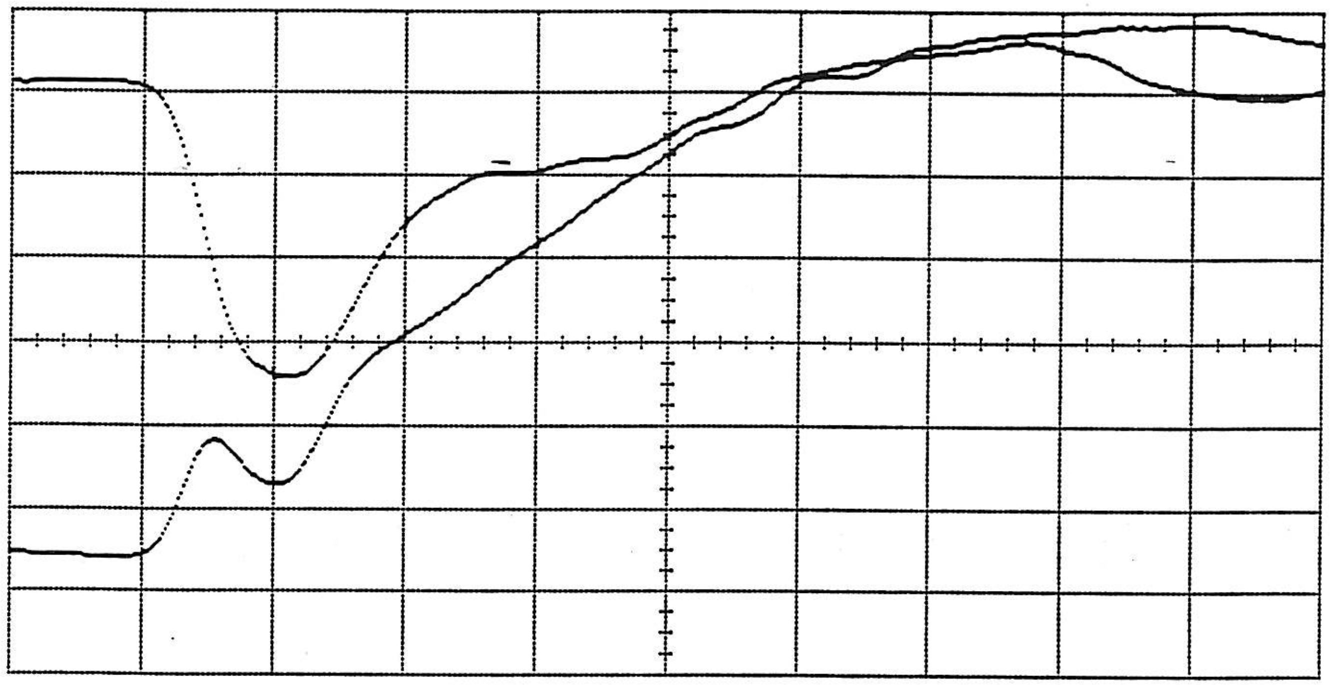
LO - LO IS A POSSIBLE CONNECT STATE WITH ACTIVE DATA (WITH OR WITHOUT BOUNCE) OR A POSSIBLE DISCONNECT STATE WITH ACTIVE DATA (WITH OR WITHOUT BOUNCE) (NO BUS IMPACT IN ANY CASE)

* ACTUAL BUS SIGNAL IMPACT IS MEASURED TO BE VERY LOW IN EVERY CASE (FEW HUNDRED MILLIVOLTS FOR A FEW NANOSECONDS)

10/22/90

FIGURE 23

HIGH MAGNIFICATION MATING TRANSIENT WITH 100 pF LOAD



Ch. 1 = 500.0 mVolts/div UPPER TRACE ACCESS POINT 2

Ch. 2 = 500.0 mVolts/div LOWER TRACE ACCESS POINT 1

Timebase = 5.00 ns/div

NOTE DIP IN LOWER TRACE DUE TO REDUCED "PULL" FROM BUS

TIME SPECTRA FOR SOME CONNECTOR ELECTRICAL TRANSIENT EVENTS

```
LOG TIME =>  -12 -11 -10  -9  -8  -7  -6  -5  -4  -3  -2  -1   0
(SEC)

RAPID                  XXXXXXX
TRANSIENTS

GRADUAL                             XXXXXXXXXX
TRANSIENTS

MACRO BOUNCE                             XXXXXXXXXX

"THERMAL"                              XXXXXXXXXXXXXX
 RELAXATION

PIN-TO-PIN                               XXXXXXXXXXXXXXXXX
SYNCHRONIZATION

WIPE                         ----------------------XXXXXXXXXXXXX

PULSE EDGES                XXXXXX
(DSSI DATA)

PULSE LENGTHS                      XXXX---------------
(DSSI DATA)

PULSE LENGTH                 XXX
(CONNECTOR)

DISTANCES               NANOMETERS    MICROMETERS   MILLIMETERS

SPEED                   100 CM/SEC     10 CM/SEC    1 CM/SEC

LOG TIME =>  -12 -11 -10  -9  -8  -7  -6  -5  -4  -3  -2  -1   0
(SEC)
```

12/6/90
HAM

SCSI HOT PLUGGING
(WORST CASE HOT PLUGGING DISTURBANCE)

. THE AMOUNT OF ENERGY REQUIRED TO CONNECT THE SWAPPED DRIVE TO THE BUS IS HIGHEST UNDER THE FOLLOWING CONDITIONS:

- -MAXIMUM DEVICE CAPACITANCE
- -RAPID CONNECTOR TRANSIENT
- -VICTIM DEVICE CLOSE TO SWAPPED DEVICE
- -INSERTION OR BOUNCE WITH DATA STATE CHANGE
- -HIGH IMPEDANCE CABLES

. THE WORST BUS DISTURBANCE WILL OCCUR WHEN THE HIGHEST ENERGY TRANSFER IS REQUIRED TO EQUALIZE THE BUS WITH THE SWAPPED DEVICE (0 TO 1 OR 1 TO 0)

. THESE WORST CASE CONDITIONS ARE EXACTLY WHAT HAS BEEN TESTED THOROUGHLY FOR DSSI AND SIMULATED FOR ONE SCSI DEVICE

. A PULSE OF APPROXIMATELY 700 MV PEAK INTENSITY AND APPROXIMATELY 5 NSEC WIDE (HALF HEIGHT) OR EQUIVQLENT IS THE WORST CASE WARM SWAP PULSE FOR ANSI COMPLIANT DEVICES (< 25 PF)

FEBRUARY 17, 1992

SCSI WARM SWAP
(IMPACT OF WORST CASE WARM SWAP DISTURBANCES)

. IF RECEIVERS WILL NOT DETECT THESE WORST CASE DISTURBANCES THERE WILL BE NO DETECTABLE IMPACT FROM UNPROTECTED DEVICE REMOVAL AND/OR REPLACEMENT ON THE SCSI BUS

. IN THE DSSI BUS THERE HAVE BEEN NO BUS ERRORS DETECTED DURING UNPROTECTED WARM SWAP (CONDITIONS ARE SOMEWHAT MORE FAVORABLE THAN FOR SCSI)

. IN THE SCSI BUS ONLY PRELIMINARY TESTING HAS BEEN DONE BUT AVAILABLE INDICATIONS ARE THAT WITH LATE GENERATION INTERFACE CHIPS THE RISK OF DETECTING THE WARM SWAP DISTURBANCE AT ALL IS VERY LOW (BOTH SINGLE ENDED AND DIFFERENTIAL)

FEBRUARY 17, 1992

FIGURE 1

PARTIAL SCHEMATIC OF TYPICAL DSSI RECEIVER CIRCUITRY

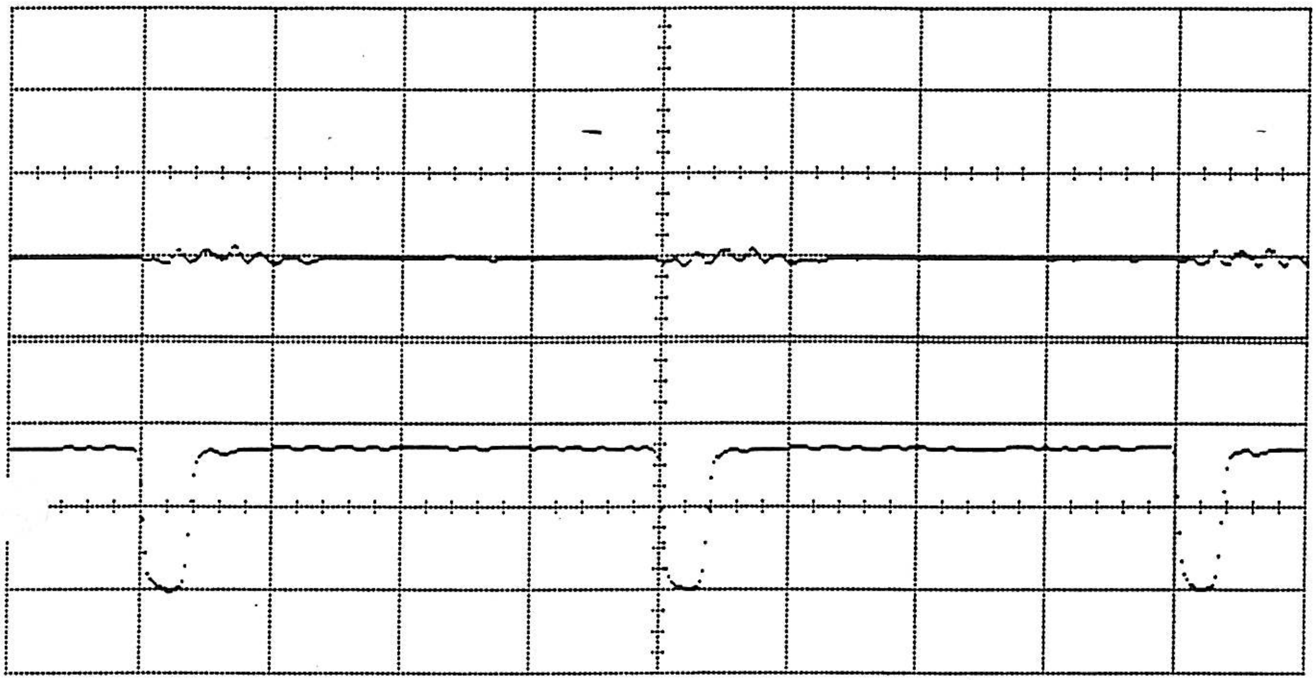
```
                                           VDD
                                            ^
                                            |
                                |-----------------------------|
                                |                             |
                                |-||      DIFF REF         ||-|
                                 P||-----------------|---||P
                                |-||                 |     ||-|
                                |                    |        |
                                |----... > OUT       |--------|
       ~3000 OHMS            ||-|                             |-||
BUS    ---\/\/\/----|-------||N                                N||---VREF
LINE                |        ||-|                             |-||
          ~ 6pF   -----         |-----------------------------|
                  -----                      |-||
                    |                         N||---------VBIAS
                    |                        |-||
                    |                        |
                   ///   <----- VSS ----->///
```

The "..." prior to the electrically accessible output indicates other digital circuitry that will produce delay but not bit errors

DSSI WARM SWAP

RECEIVER SENSITIVITY CHARACTERIZATION

EFFECT OF NEGATIVE-GOING INPUT PULSES



18Y12Yk4S

Ch. 1 = 2.000 Volts/div TOP TRACE PIN "1" RECEIVER OUTPUT (ACCESS POINT 3)

Ch. 2 = 2.000 Volts/div BOTTOM TRACE PIN "1" RECEIVER INPUT (ACCESS POINT 2) DRIVEN BY PULSE GENERATOR

Timebase = 50.0 ns/div

INPUT PULSE WIDTH INCREASED UNTIL SOME RESPONSE WAS DETECTED ON THE OUTPUT

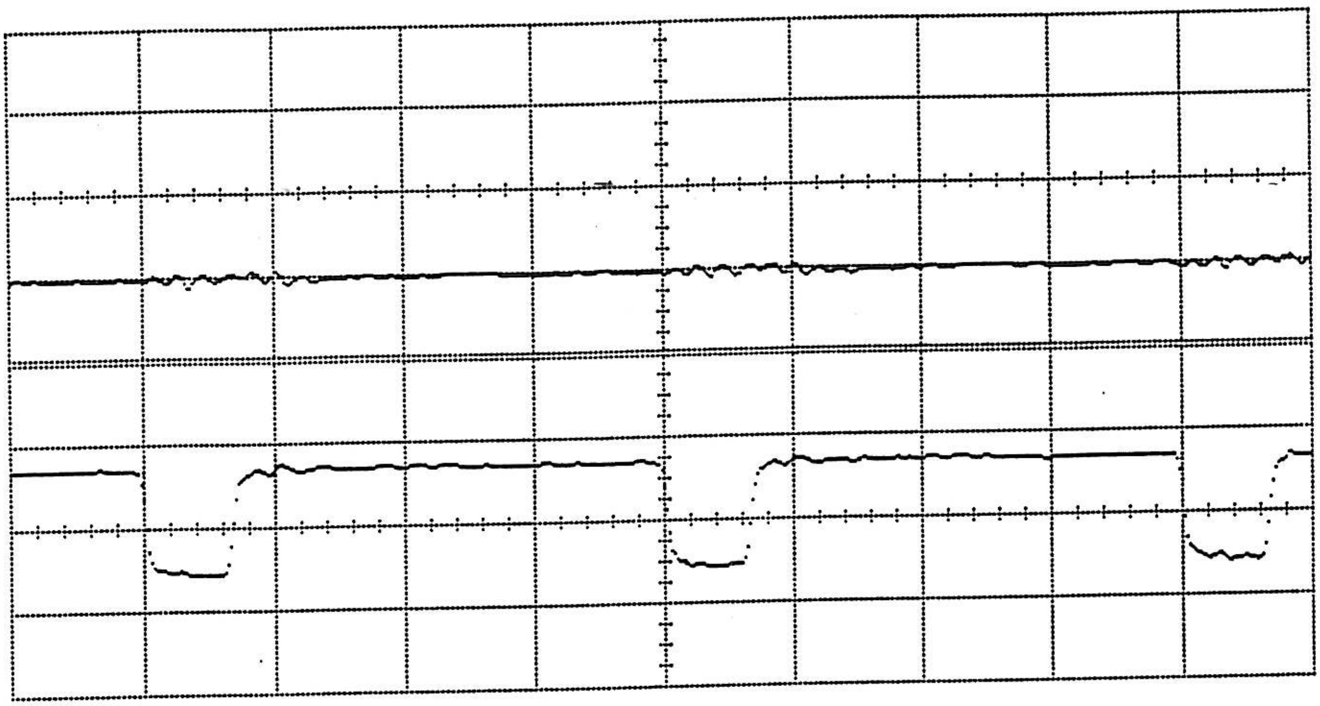
FULL DSSI VOLTAGE SWING USED - PULSES GREATER THAN 17 nSec IN WIDTH CAUSE MINIMAL OUTPUT RESPONSES (UPPER TRACE)

10/22/90

DSSI WARM SWAP

RECEIVER CHARACTERIZATION

EFFECT OF NEGATIVE-GOING PULSES



+18Y12Yk4S

Ch. 1 = 2.000 Volts/div TOP TRACE PIN "1" RECEIVER OUTPUT (ACCESS POINT 3)

Ch. 2 = 2.000 Volts/div BOTTOM TRACE PIN "1" RECEIVER INPUT (ACCESS POINT 2) DRIVEN BY PULSE GENERATOR

Timebase = 50.0 ns/div

INPUT PULSE WIDTH INCREASED UNTIL SOME RESPONSE WAS DETECTED ON THE OUTPUT

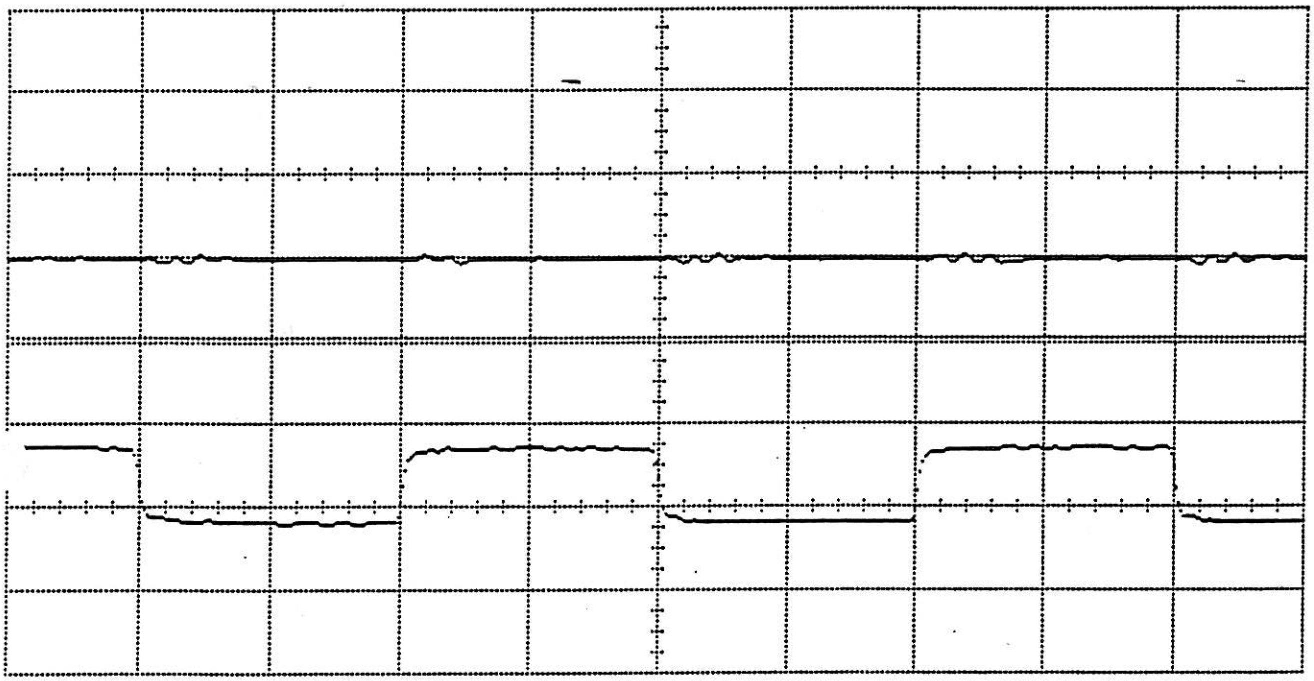
3.5 TO 1.0 VOLT SWING USED - PULSES GREATER THAN 33 nSec IN WIDTH CAUSE MINIMAL OUTPUT RESPONSES (UPPER TRACE)

10/22/90

DSSI WARM SWAP

RECEIVER CHARACTERIZATION

EFFECT OF NEGATIVE-GOING PULSES



+18Y12Yk4S

Ch. 1 = 2.000 Volts/div TOP TRACE PIN "1" RECEIVER OUTPUT (ACCESS POINT 3)

Ch. 2 = 2.000 Volts/div BOTTOM TRACE PIN "1" RECEIVER INPUT (ACCESS POINT 2) DRIVEN BY PULSE GENERATOR

Timebase = 50.0 ns/div

INPUT PULSE WIDTH INCREASED UNTIL SOME RESPONSE WAS DETECTED ON THE OUTPUT

3.5 TO 1.75 VOLTAGE SWING USED - PULSES GREATER THAN 100 nSec IN WIDTH CAUSE MINIMAL OUTPUT RESPONSES (UPPER TRACE)

10/22/90

SCSI HOT PLUGGING
(SUGGESTED ACTIONS NEEDED TO GO FORWARD)

- CREATE A LIST OF ALL SPI CHIPS THAT WILL NOT DETECT THE WORST CASE HOT PLUGGING DISTURBANCE

- CONSIDER ADDING A SECTION TO SCSI-3 SPI OUTLINING THE REQUIREMENTS OF TARGETS AND INITIATORS TO BE GOOD HOT PLUGGING CITIZENS

FEBRUARY 17, 1992