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ELECTRICAL PERFORMANCE
OF
LP1 and ST1 CONNECTORS

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Table of Contents:

Purpose:

This test was performed to gather electrical data for Joy Signal's LP1 and ST1 connectors. The connectors were assembled to 50-ohm coaxial cable. The data collected includes connector impedance, rise time degradation and signal attenuation.

Procedure:

Two assemblies were manufactured with the LP1 connector on both ends, one assembly was 12" long and one was 24" long. Likewise, two assemblies were manufactured with the ST1 connector on both ends, one assembly was 12" long and one was 24" long. All of the assemblies of each length used P/N 700129 26 awg "foamed-core" 50-ohm coax.

Frequency Domain measurements were made with a network analyzer and a 50-ohm S-parameter test set. A full 2 port, 2-path calibration scheme was used to yield the greatest accuracy with the test set. Measurements were made of Attenuation (S21) and Return Loss (S11) for all of the assemblies over the frequency range of 300 kHz to 3 GHz. The connector on each end of the cable assembly was plugged into round vias that were located on a 50-ohm microstrip printed circuit trace. The microstrip traces were connected via SMA and 50 ohm cables to the 50-ohm S-parameter test set. (Figure 1)

Time Domain measurements were made with a Time Domain Reflectometer. Three pulse head rise time configurations were used: 30 psec, 250 psec and 500 psec. Impedance was measured with the connectors mated to round vias, as in the frequency domain measurements; however, the far end of the test setup was terminated with a 50-ohm shunt. Rise time degradation measurements were performed by inserting the cable assemblies between the pulse generator and sampling head on the same test setup as shown in Figure 1.

Equipment:

Hewlett Packard 8753A Network Analyzer (.3-3,000M Hz)
Hewlett Packard 85046A 50 ohm S Parameter Test Set (.3-3,000M Hz)
Tektronix 11801C Digital Sampling Oscilloscope
Tektronix SD24 TDR/Sampling Head
Various precision coax adapters, interconnecting cables and a 50-ohm microstrip test board

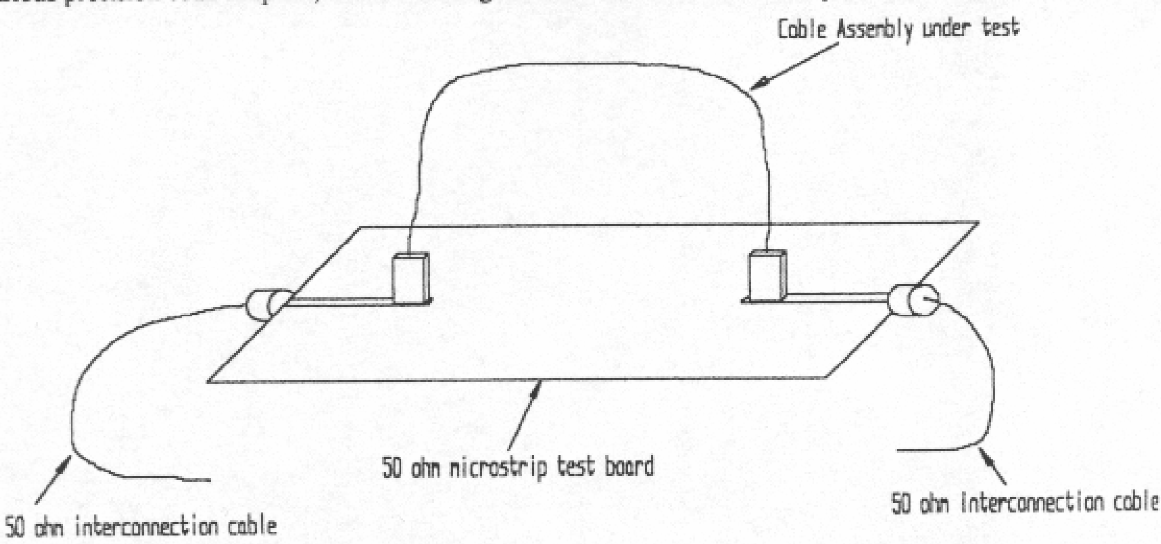

Figure 1

Data Tables

Impedance Measurements

		Zo @ 30pS rise time		Zo @ 250pS rise time		Zo @ 500pS rise time	
Sample #	Length inches	Min ohms	Max ohms	Min ohms	Max ohms	Min ohms	Max ohms
LP1	12	41	87.4	49.8	56.4	49.6	51
LP1	24	46.5	88.9	50.9	57.8	50	52.1
ST1	12	41.2	95.3	47.5	56.9	47.6	51.7
ST1	24	46.4	102.4	51.1	60.1	49.7	53.1

Loss Measurements

Incident pulse rise time = 48 psec

Sample #	Length inches	Measured rise time psec	Rise time degradation psec	-3dB Attenuation GHz	-10dB Return loss GHz	-15dB Return loss GHz
LP1	12	100	52	2.3	1.4	1
LP1	24	106	58	2.1	1.6	.9
ST1	12	116	68	2	1.1	.3
ST1	24	118	70	2	1.8	.6

SUMMARY

This report measured performance of the LP1 and ST1 connectors with short lengths of cable, and carefully controlled interconnects. Both of these connectors are intended to be soldered into printed circuit board vias. Their impedance profile will meld with that of the PCB via/annulus/trace combination. Therefore the performance measured in an actual system will be largely dependent on the geometry of the vias into which they are soldered. For this test report, .036" diameter vias were used in a microstrip trace on a .062" thick PCB.

On its own, the LP1 connector is useful for risetimes in the range of 250-500 psec, and analog frequencies of 1.0-1.5 GHz. The actual performance limit may be pulled slightly higher or lower depending upon the needs of the system in which it is used. The LP1 nominal connector impedance at 30 psec rise time was 52.5 ohms; at 250 psec, 52.5 ohms and at 500 psec, 51 ohms. The risetime degradation was 23 psec/connector. The -3 dB insertion loss frequency exceeded 2 GHz on all samples and the –10 dB reflection loss frequency exceeded 1 GHz on both samples.

On its own, the ST1 connector is useful for risetimes at least as short as 500 psec, and analog frequencies up to 1.0 GHz. The actual performance limit may be pulled slightly higher or lower depending upon the needs of the system in which it is used. The ST1 nominal connector impedance at 30 psec rise time was 54.2 ohms; at 250 psec, 50 ohms and at 500 psec, 50 ohms. The risetime degradation was 33 psec/connector. The -3 dB insertion loss frequency was 2GHz on all samples and the –10 dB reflection loss frequency exceeded 1 GHz on both samples.

11801C DIGITAL SAMPLING OSCILLOSCOPE
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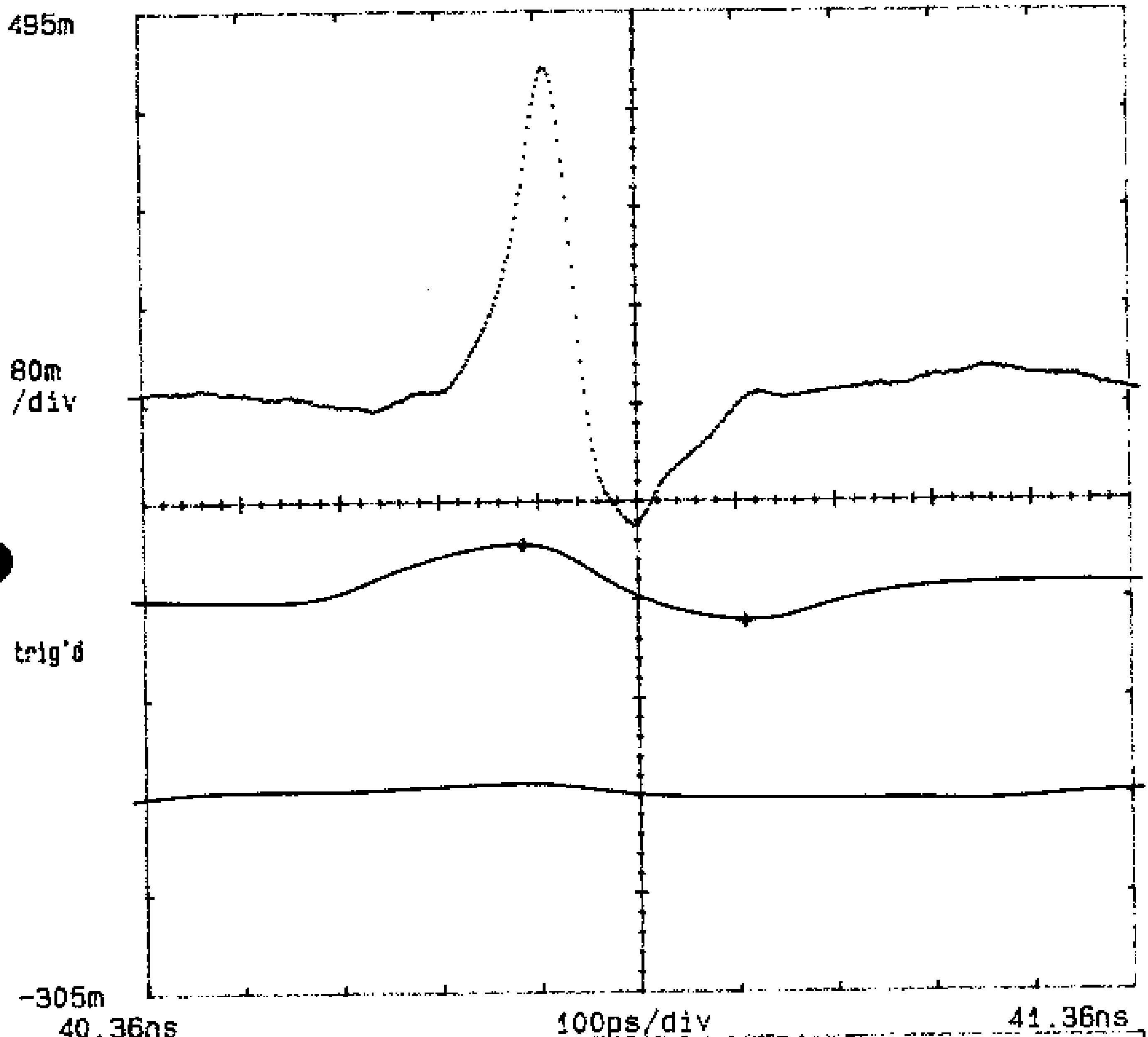
LP1 Assembly, 12" Length
26 awg 50 ohm Coax
Assembly Impedance
Risetime: 30, 250, 500 pS



Cursor Type Paired Dots			x2	
	1 60.125m	56.40	112.8	Cursor 1 40.74700ns
	2 -1.9003m	49.81	99.62	Cursor 2
	-62.025m	-6.587	-13.17	40.97100ns

Exit	Set Zero				Remove/Clr Trace 2 Filter (M1 Main
		t1 40.747ns	t1/2	20.374ns	
		t2 40.971ns	t2/2	20.485ns	
		t 224.00ps	t/2	112.00ps	
		1/ t 4.4643GHz			

LP1 Assembly, 24" Length
26 awg 50 ohm Coax
Assembly Impedance
Risetime: 30, 250, 500 pS

11801C DIGITAL SAMPLING OSCILLOSCOPE
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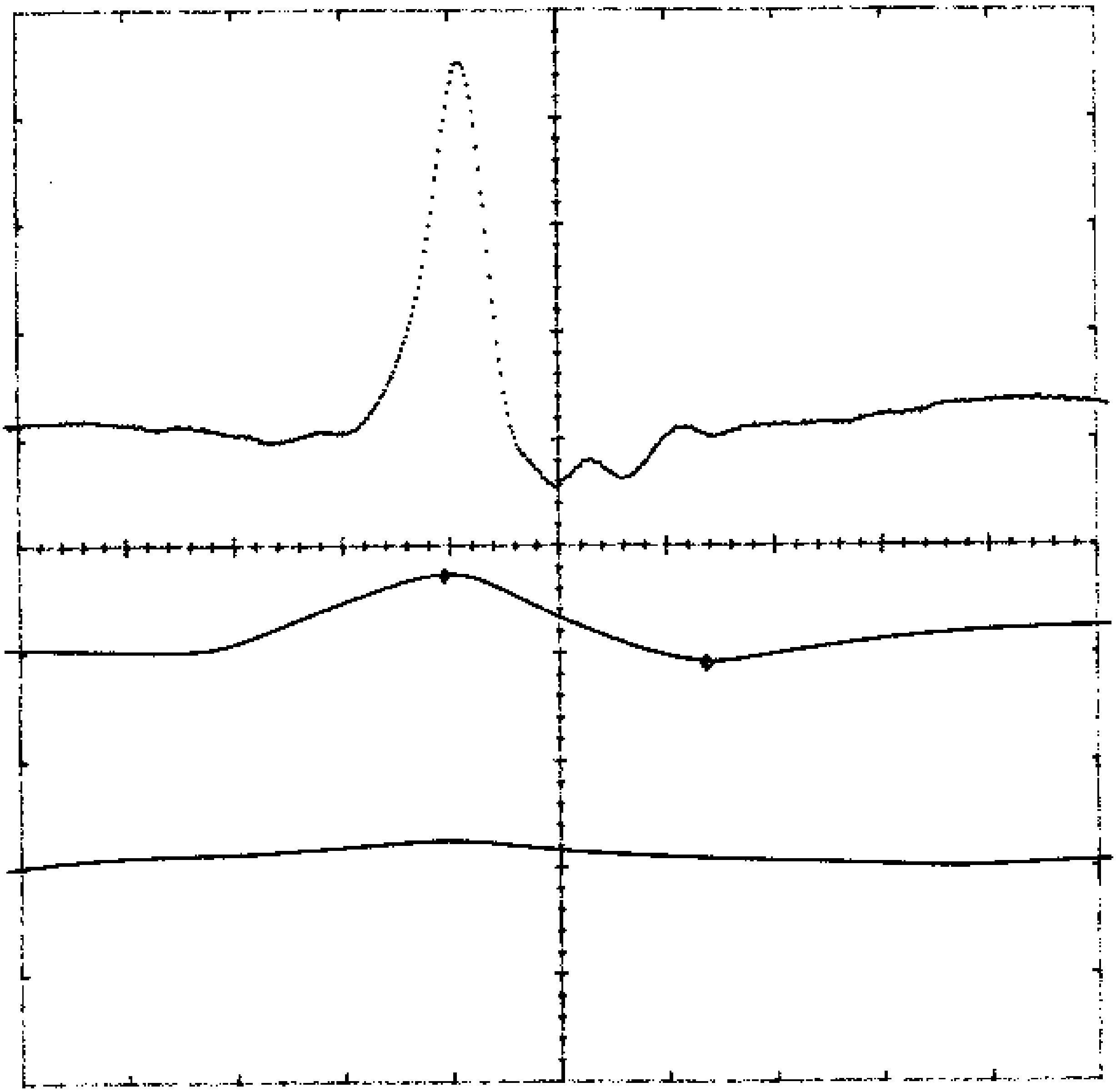
495m

80m
/div

trig'd

-305m



40.36ns 100ps/div 41.36ns

Cursor Type Paired Dots				x2
	1	72.700m	57.84	115.7
	2	8.6371m	50.87	101.7
		-64.063m	-6.969	-13.94

Cursor 1
40.75700ns
Cursor 2
40.99900ns

Exit	Set Zero	t1	40.757ns	t1/2	20.379ns
		t2	40.999ns	t2/2	20.500ns
		t	242.00ps	t/2	121.00ps
		1/ t	4.1322GHz		

Remove/Clr
Trace 2
Filter (M1
Main

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11801C DIGITAL SAMPLING OSCILLOSCOPE
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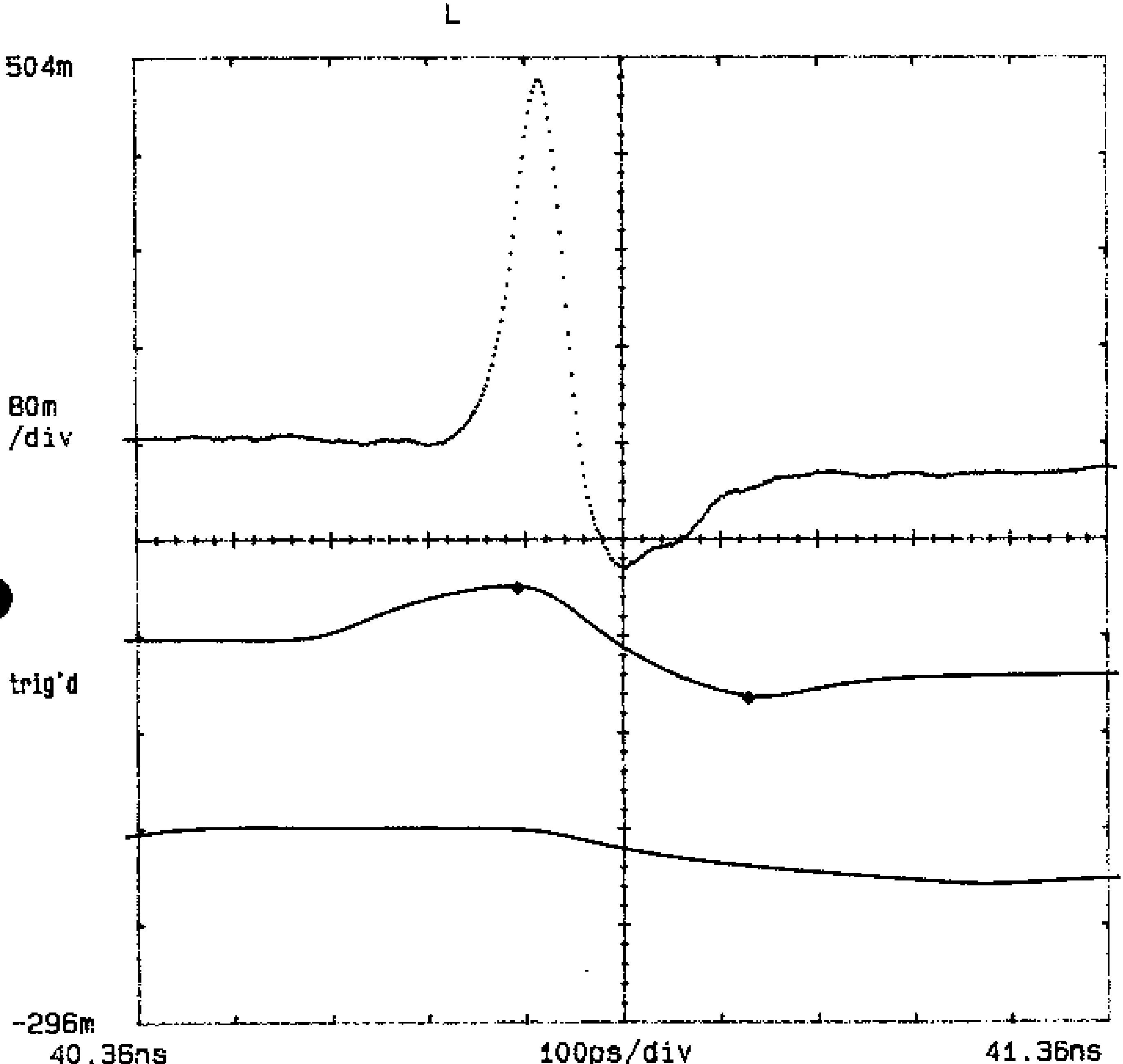
ST1 Assembly, 12" Length
26 awg 50 ohm Coax
Assembly Impedance
Risetime: 30, 250, 500 pS



Cursor Type Paired Dots					Main Size
				x2	
	1	64.800m	56.93	113.9	100ps/div
	2	-25.913m	47.47	94.95	Main Pos
		-90.712m	-9.455	-18.91	40.351ns

Exit	Set Zero						Remove/Clr Trace 2 Filter (M1 Main	Pan/ Zoom Off
		t1	40.755ns	t1/2	20.378ns			
		t2	40.991ns	t2/2	20.496ns			
		t	236.00ps	t/2	118.00ps			
		1/ t	4.2373GHz					

11801C DIGITAL SAMPLING OSCILLOSCOPE
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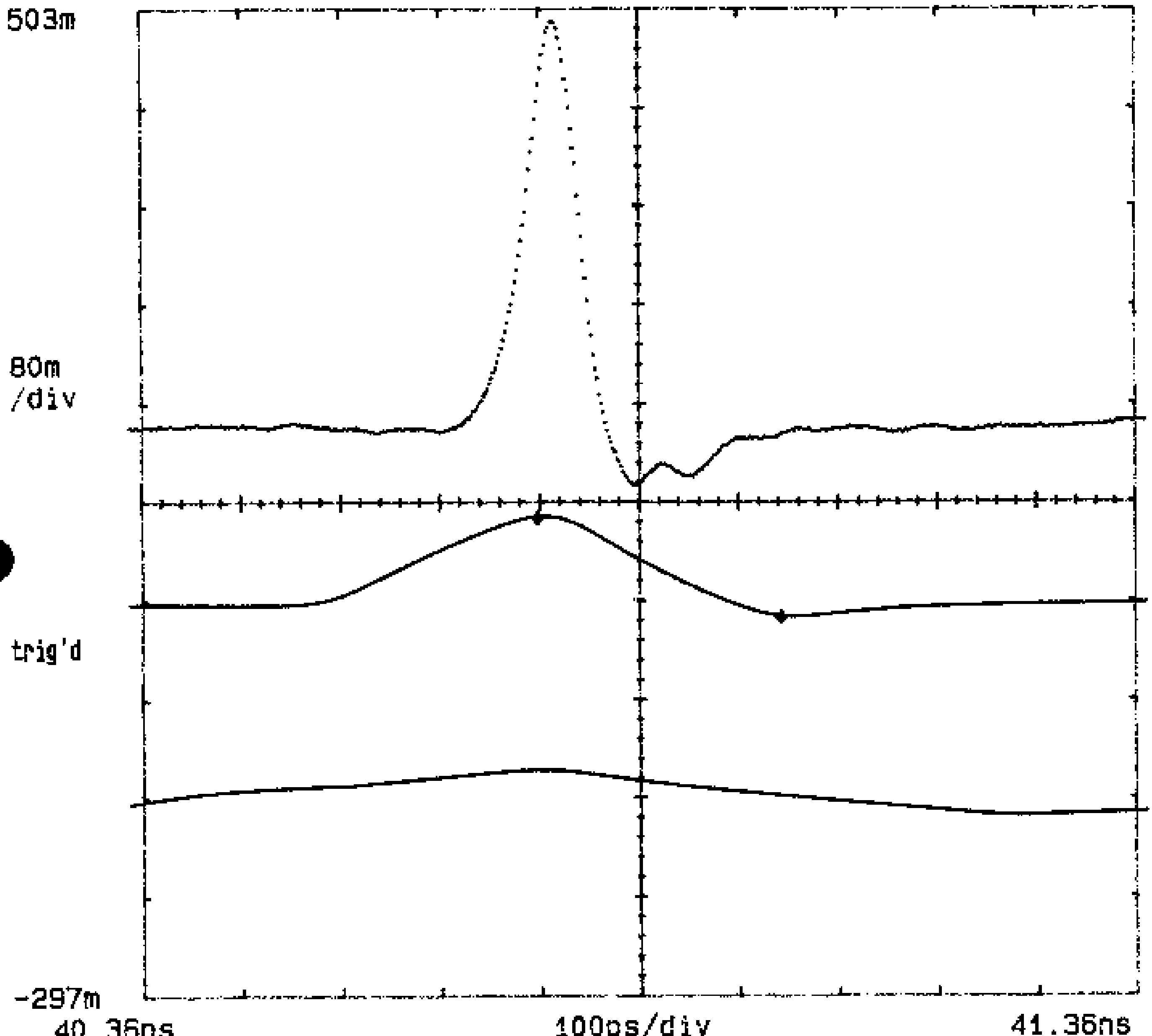
ST1 Assembly, 24" Length
26 awg 50 ohm Coax
Assembly Impedance
Risetime: 30, 250, 500 pS



Cursor Type Paired Dots				x2	Cursor 1 40.76100ns
	1	91.325m	60.05	120.1	
	2	10.400m	51.05	102.1	Cursor 2
		-80.925m	-8.999	-18.00	41.00500ns

Exit	Set Zero	t1	40.761ns	t1/2	20.381ns	Remove/Clr	
		t2	41.005ns	t2/2	20.503ns	Trace 2	
		t	244.00ps	t/2	122.00ps	Filter (M1	
		1/ t	4.0984GHz			Main	

ST1 & LP1 Fixture Reference
26 awg 50 ohm Coax
Risetime Degradation
Fixture Risetime: 48 pS

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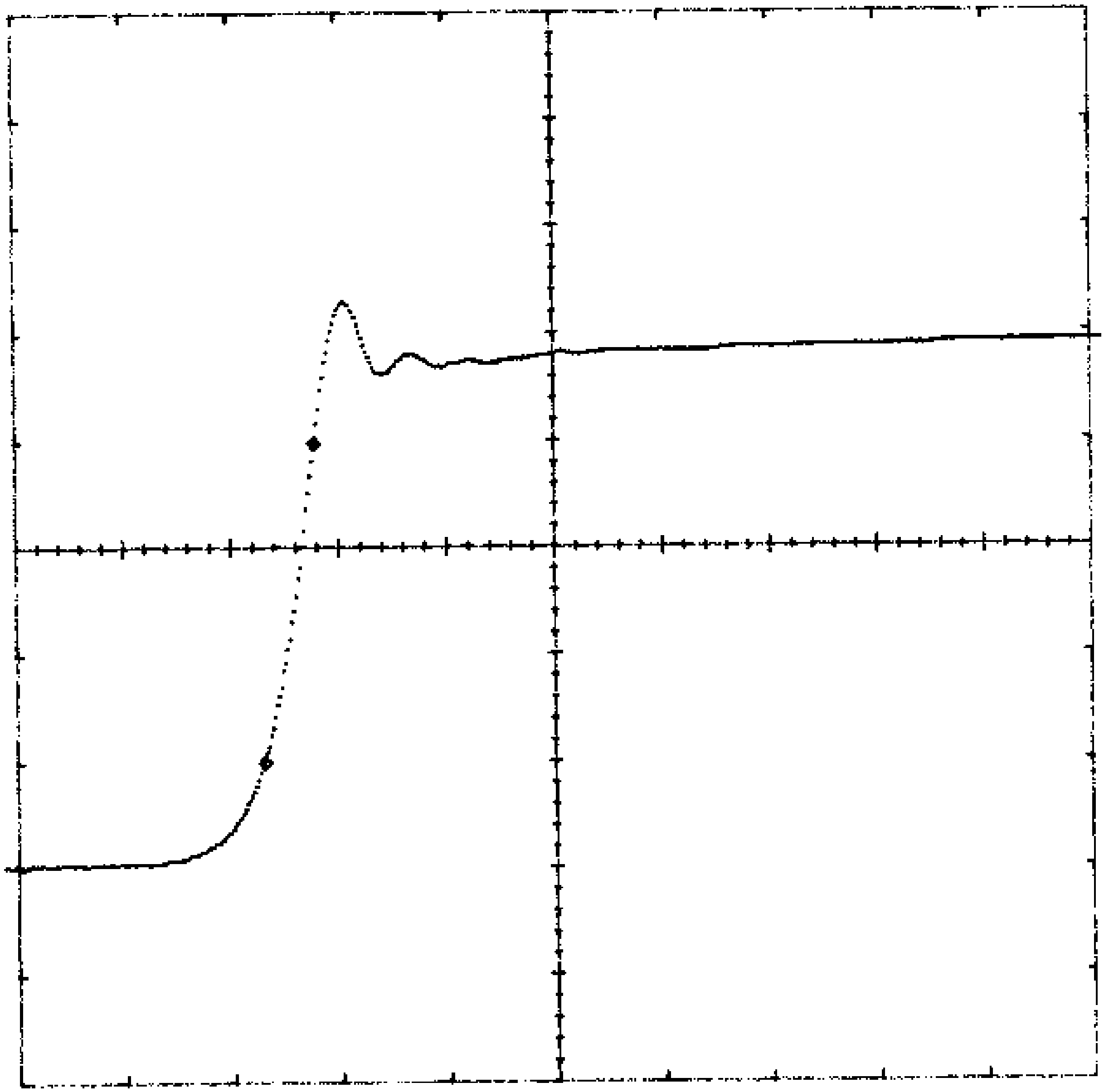

Cursor Type Paired Dots		v1 -198.64mV v2 -48.953mV v 149.69mV		Cursor 1 39.01800ns Cursor 2 39.06600ns
Exit	Set Zero	t1 39.018ns t1/2 19.509ns t2 39.066ns t2/2 19.533ns t 48.001ps t/2 24.000ps 1/ t 20.833GHz		Remove/Clr Trace 1 Avg (M2) Main

LP1 Assembly, 12" Length
26 awg 50 ohm Coax
Risetime Degradation
Fixture Risetime: 48 pS

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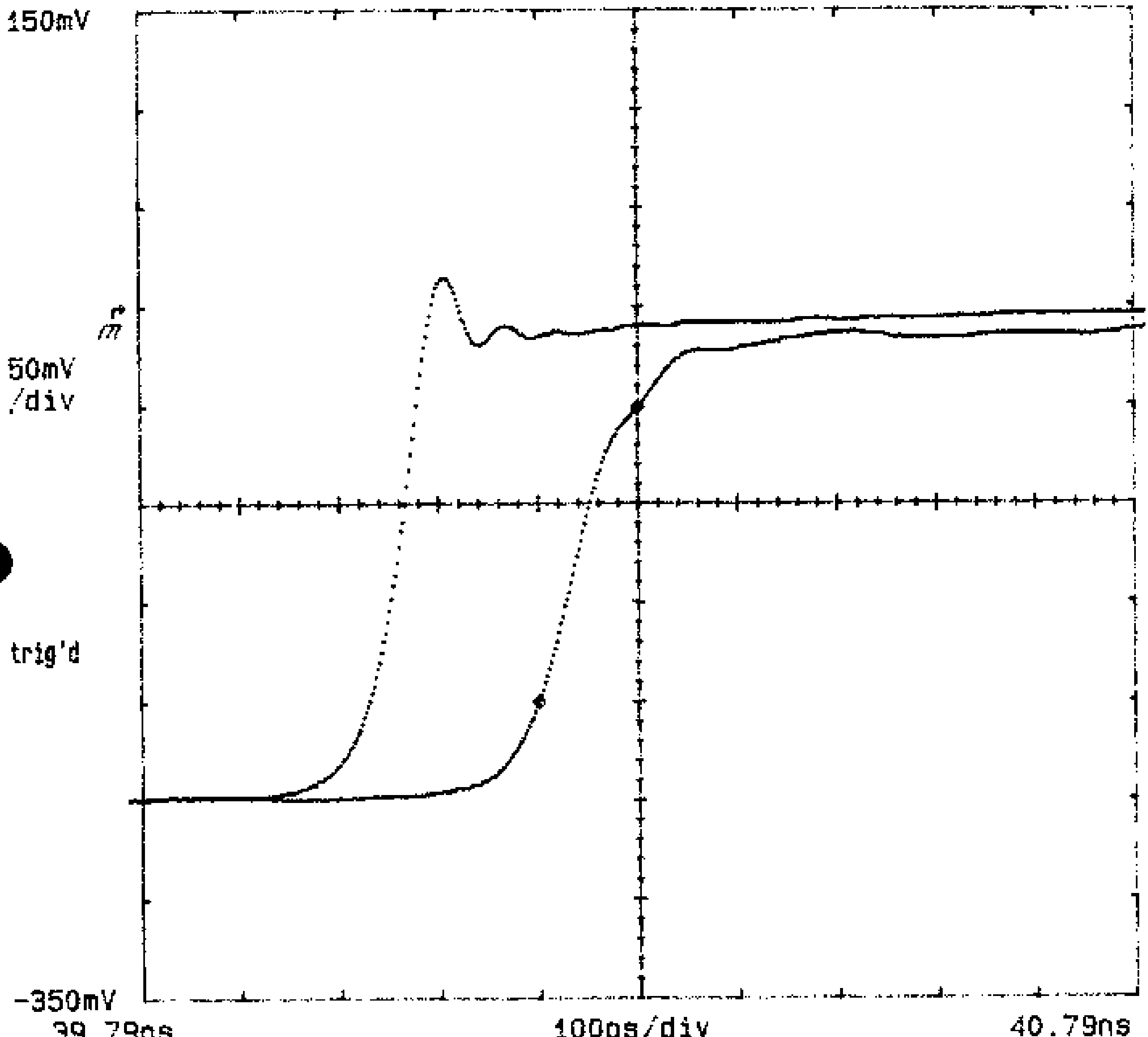

Cursor Type Paired Dots	v1 -199.74mV			Cursor 1 40.18800ns
	v2 -50.579mV			Cursor 2 40.28800ns
	v 149.16mV			
Exit	Set Zero	t1 40.188ns	t1/2 20.094ns	Remove/Clr Trace 1 Avg (M2) Main
		t2 40.288ns	t2/2 20.144ns	
		t 99.998ps	t/2 49.999ps	
		1/ t 10.000GHz		

11801C DIGITAL SAMPLING OSCILLOSCOPE
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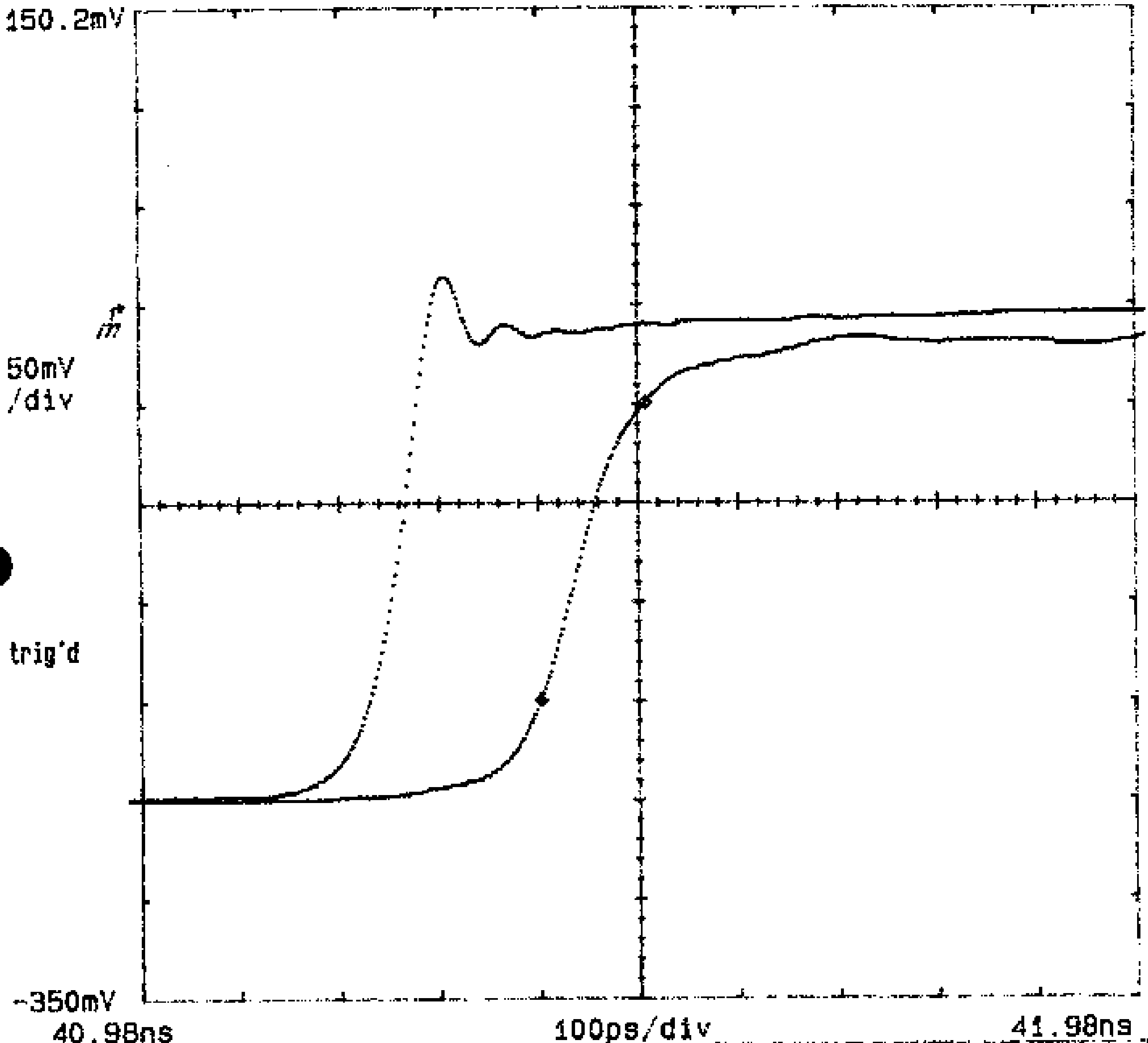
LP1 Assembly, 24" Length
26 awg 50 ohm Coax
Risetime Degradation
Fixture Risetime: 48 pS



Cursor Type Paired Dots	v1 -199.37mV v2 -49.118mV v 150.59mV			Cursor 1 41.38000ns Cursor 2 41.48600ns
Exit	Set Zero	t1 41.380ns t2 41.486ns t 106.00ps 1/ t 9.4341GHz	t1/2 20.690ns t2/2 20.743ns t/2 52.999ps	Remove/Clr Trace 1 Avg (M2) Main

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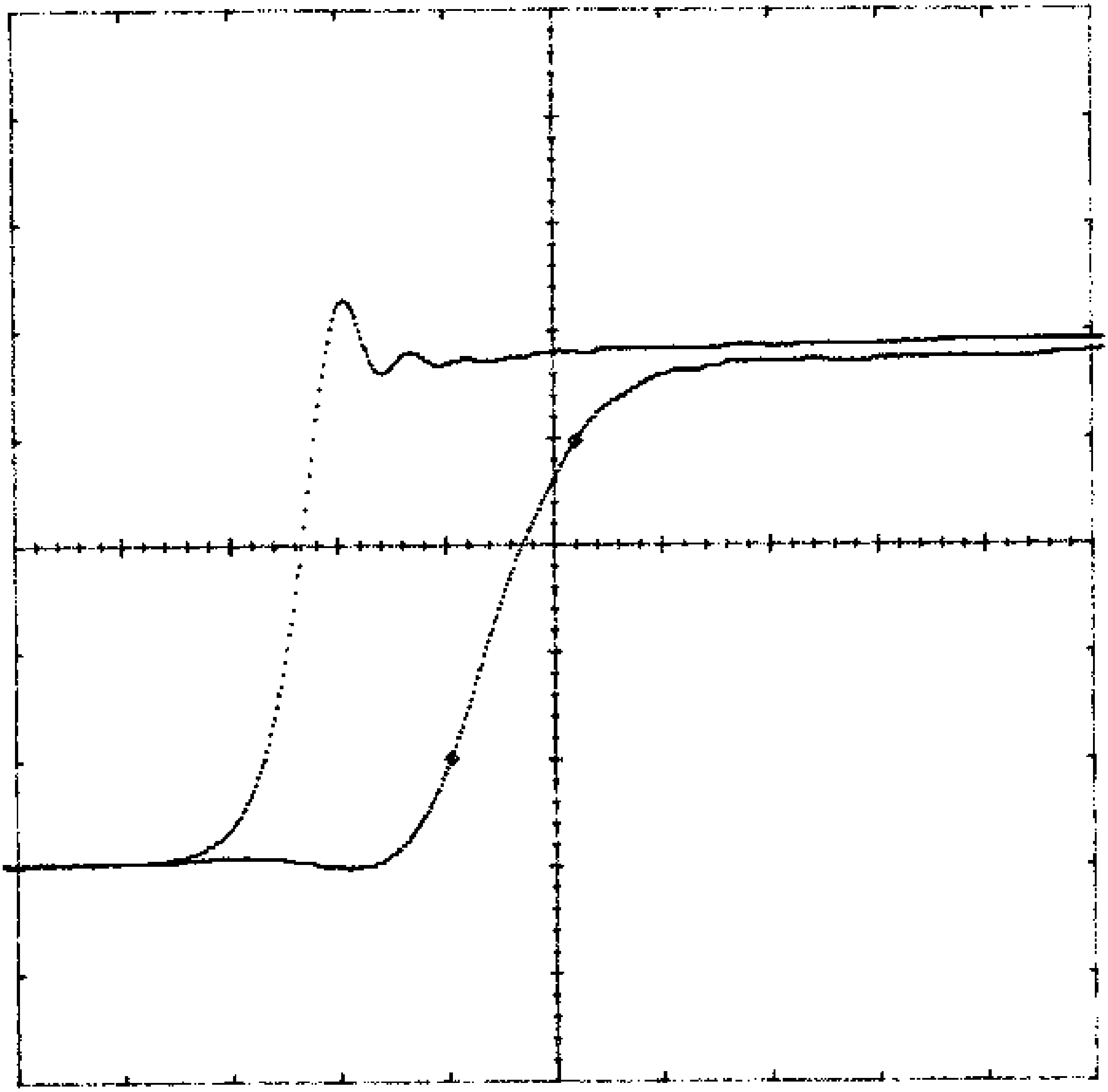
ST1 Assembly, 12" Length
26 awg 50 ohm Coax
Risetime Degradation
Fixture Risetime: 48 pS



Cursor Type Paired Dots	v1 -198.86mV			Cursor 1 40.06200ns
	v2 -50.727mV			Cursor 2 40.17800ns
	v 148.13mV			
Exit	Set Zero	t1 40.062ns	t1/2 20.031ns	Remove/Clr Trace 1 Avg (M2) Main
		t2 40.178ns	t2/2 20.089ns	
		t 116.00ps	t/2 58.000ps	
		1/ t 8.6207GHz		

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ST1 Assembly, 24" Length
26 awg 50 ohm Coax
Risetime Degradation
Fixture Risetime: 48 pS

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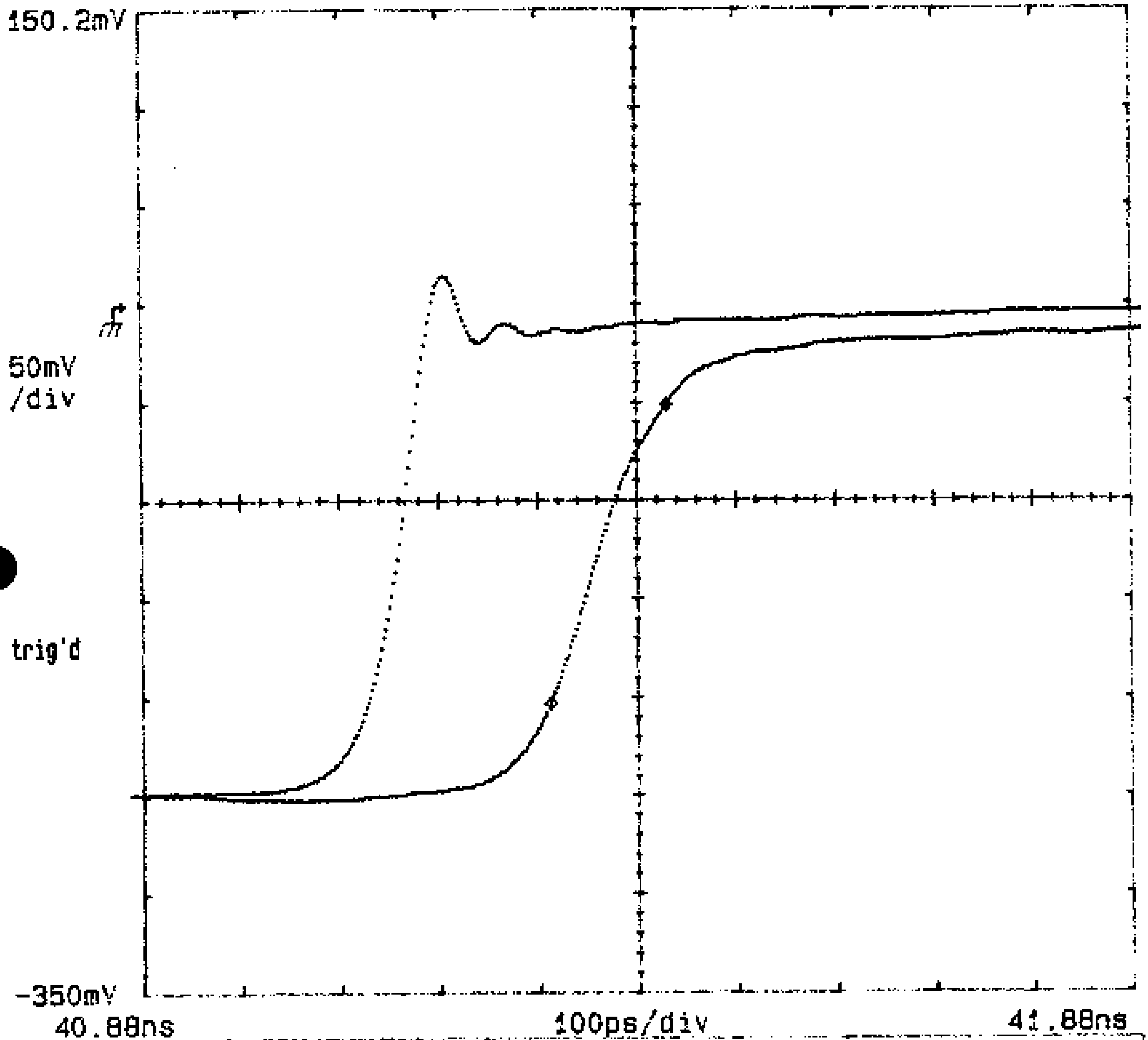
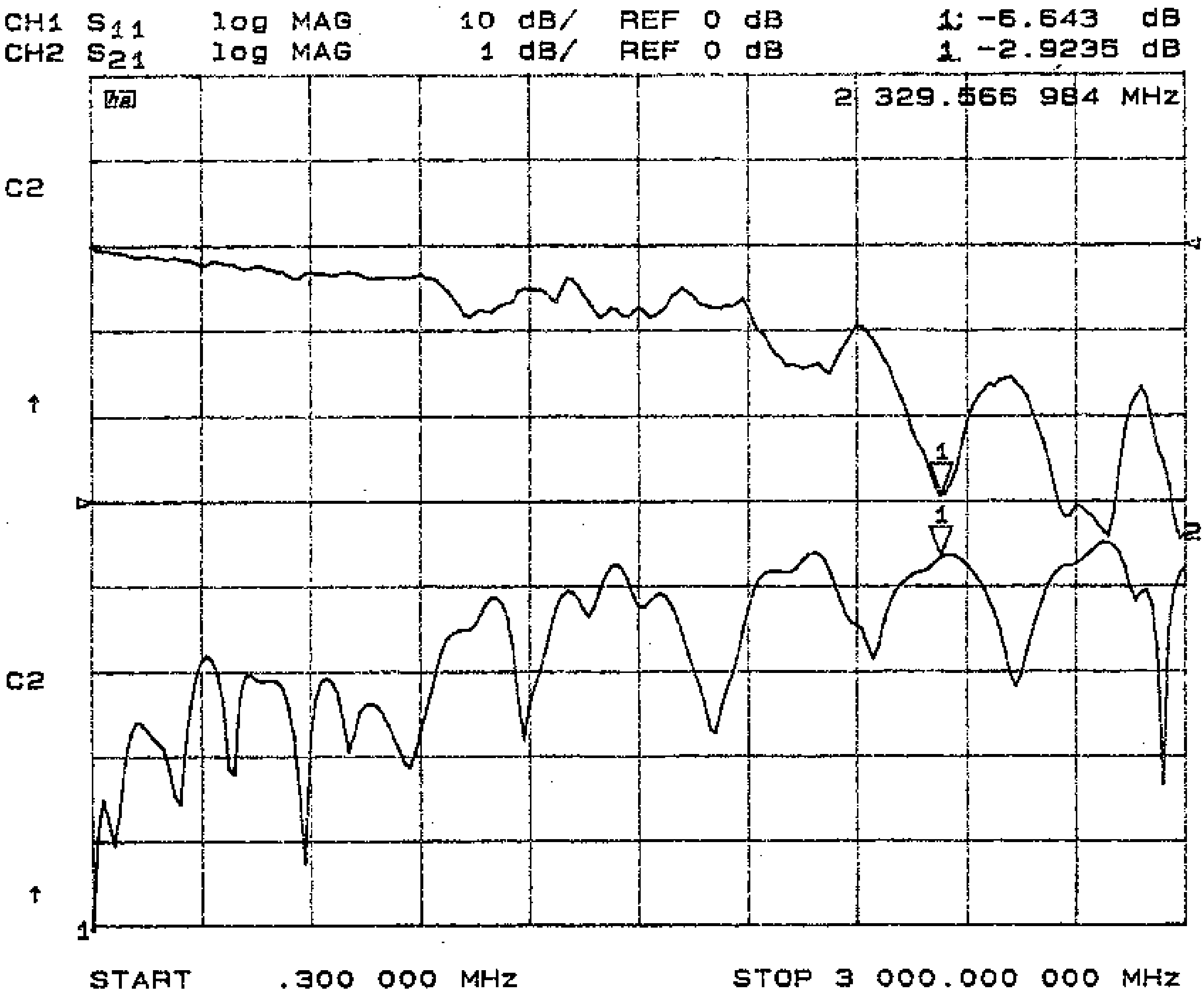


Cursor Type Paired Dots		v1 -201.82mV v2 -50.180mV v 151.64mV			Cursor 1 41.29000ns Cursor 2 41.40800ns
Exit	Set Zero	t1 41.290ns t2 41.408ns t 118.00ps 1/ t 8.4746GHz	t1/2 t2/2 t/2	20.645ns 20.704ns 59.000ps	Remove/Clr Trace 1 Avg (M2) Main

LP1 Assembly, 12" Assembly, 26 awg 50 ohm Coa



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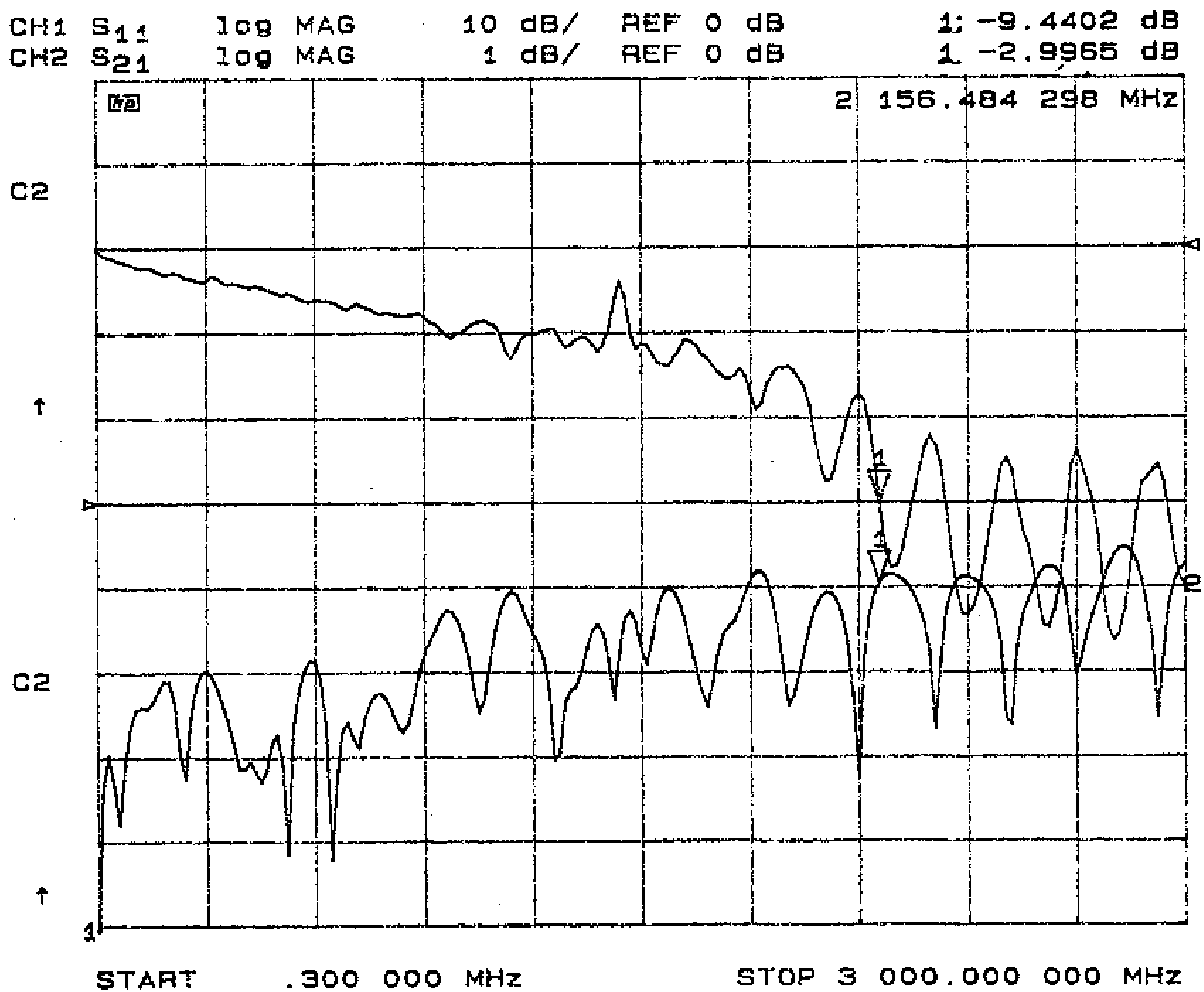
LP1 Assembly, 24" Assembly, 26 awg 50 ohm Co



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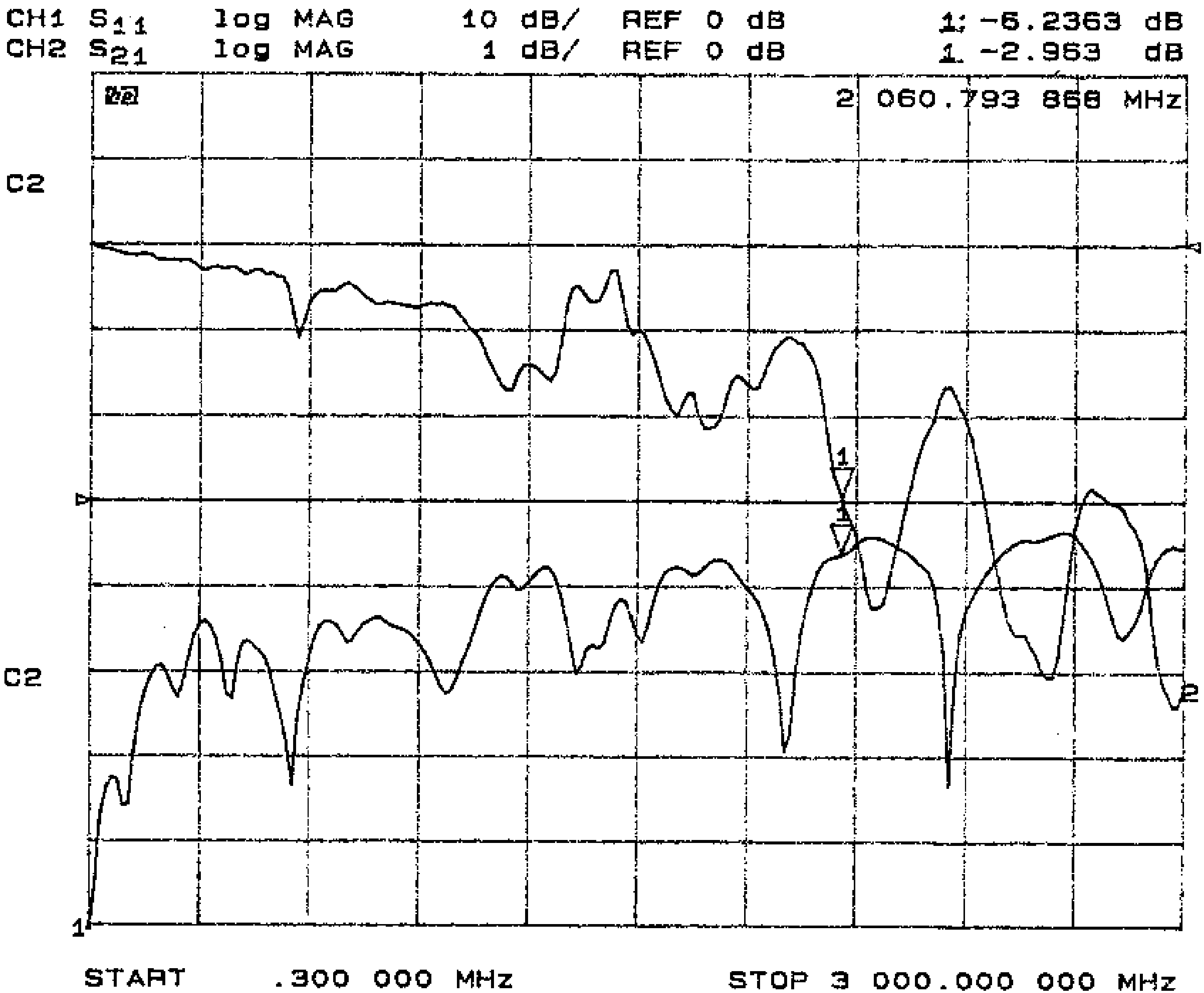
ST1 Assembly, 12" Assembly, 26 awg 50 ohm Co



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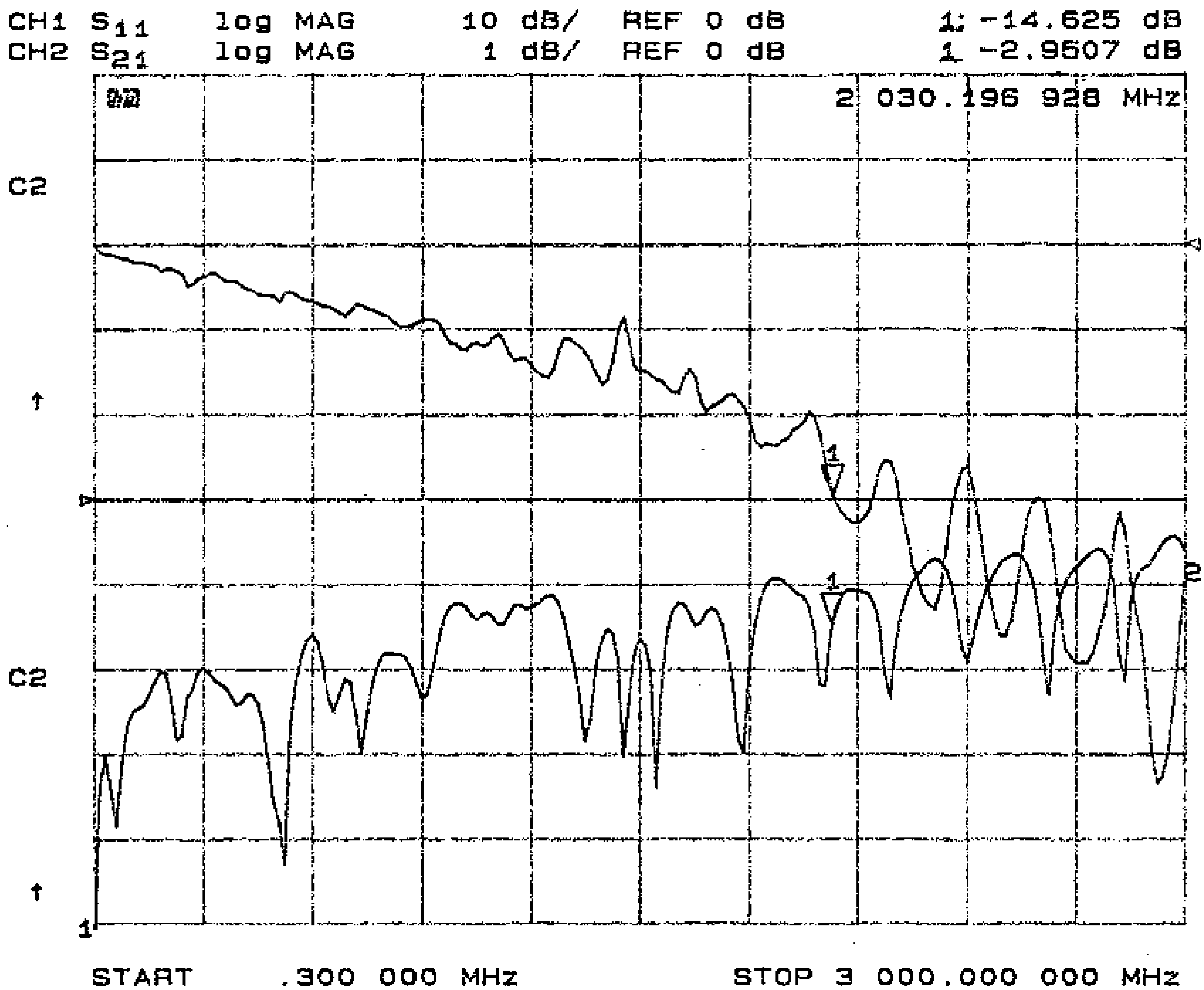
ST1 Assembly, 24" Assembly, 26 awg 50 ohm Co



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