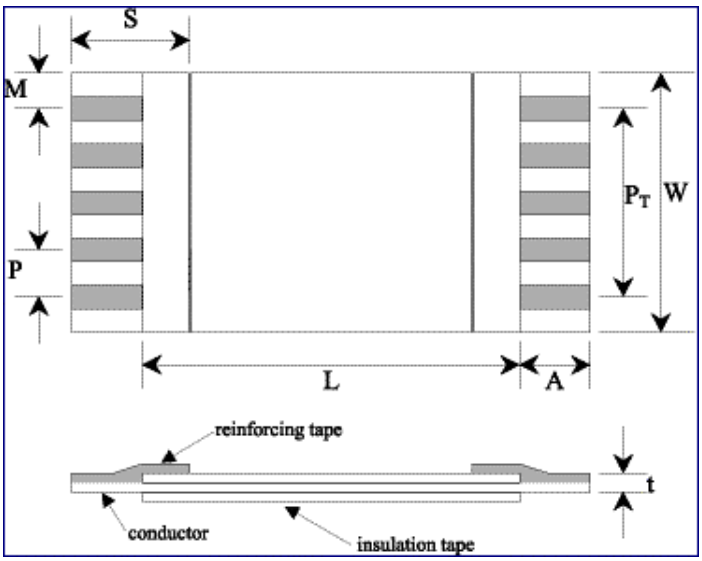
Characteristic Impedance of flex foil cable transmission line arrangements with 0.3mm track width, 0.5mm pitch.

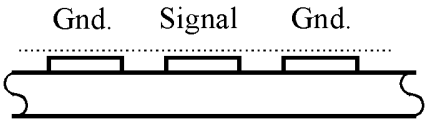
Construction specification, Fujikura flex foil cable.

Item	Unit	Specification				
Conductor pitch	mm	1.25	1.00	0.80	0.50	0.30
Conductor size (tin coated copper tape)	-	0.1x0.8 0.05x0.8 0.035x0.8	0.1x0.6 0.05x0.6 0.035x0.6	0.05x0.5 0.035x0.5	0.05x0.3 0.035x0.3	0.035x0.2
Insulation	-	0.1mm flame retardant polyester				
No. of conductors	mm	4~40		5~50	6~50	17~50
Insulation (L)	mm	25~3000			25~2000	20~1000
Pitch (P)	mm	1.25±0.10	1.00±0.10	0.80±0.06	0.50±0.05	0.30±0.03
Total pitch (Pt)	mm	1.25(N-1)±0.15	1.00(N-1)±0.10	0.80(N-1)±0.06	0.50(N-1)±0.05	0.30(N-1)±0.03
Margin (M)	mm	1.25±0.20	1.00±0.15	0.80±0.12	0.50±0.07	0.30±0.05
Width (W)	mm	1.25(N-1)±0.15	1.00(N-1)±0.12	0.80(N-1)±0.07	0.50(N-1)±0.07	0.30(N-1)±0.03
Stripped conductor (A)	mm	2.00±0.50,2.50±0.50,3.00±0.50,3.50±0.50,4.00±0.50,5.00±0.50,6.00±1.00				
Terminal thickness (t)	mm	0.30±0.05				0.20±0.03
Reinforcing tape (S)	mm	5.00±1.00,6.00±1.00,8.00±1.50,10.00±2.00				

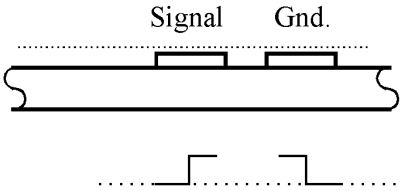


Measurement Summary sheet for 0.3mm track width, 0.5mm pitch flex foil cables.

Single ended arrangements.



Measurement by TDR. **Zo 83 Ohms**, **Er(eff)7.4**
Measurement by Network Analyzer[1]. **Zo 79 Ohms.**
Measurement by Network Analyzer[2]. **Zo 89 Ohms.**



Measurement by TDR. **Zo 118 Ohms.**
Measurement by Network Analyzer[1]. **Zo 97 Ohms.**
Measurement by Network Analyzer[2]. **Zo 104 Ohms.**

Note: Network analyzer measurements were made as detained in:
Technical Data and Tips – RF Engineering - How to measure characteristic impedance.
[1] This value produced with the measurement test fixture includes the influence of the flex cable PCB socket.
[2] This value produced with the flex mounted on a SMA connector.

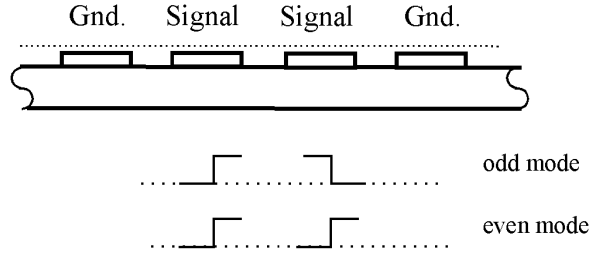
Measurement Summary sheet for 0.3mm track width, 0.5mm pitch flex foil cables, continued.

Differential impedance is defined as the impedance between the two transmission lines when the two lines are driven differentially (i.e. 180 deg. out-of-phase) and the odd-mode impedance is the impedance of a single line in the differential pair under this condition.

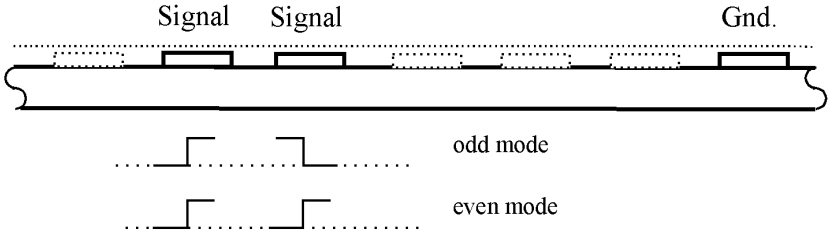
Common-mode impedance is the impedance between the two lines when the two lines are driven with a common-mode (even-mode) signal and the even-mode impedance is the impedance of a single line in the differential pair under this condition.

Differential arrangements.

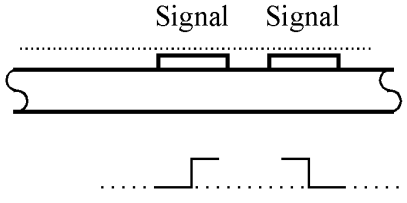
All differential measurement by TDR.



Zodd = 58 Ohms
Zdiff = 116 Ohms.



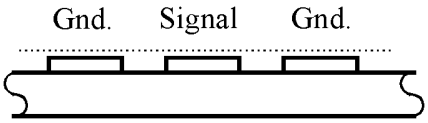
Zodd = 64 Ohms
Zdiff= 128 Ohms.



Zodd = 67 Ohms
Zdiff = 134 Ohms.

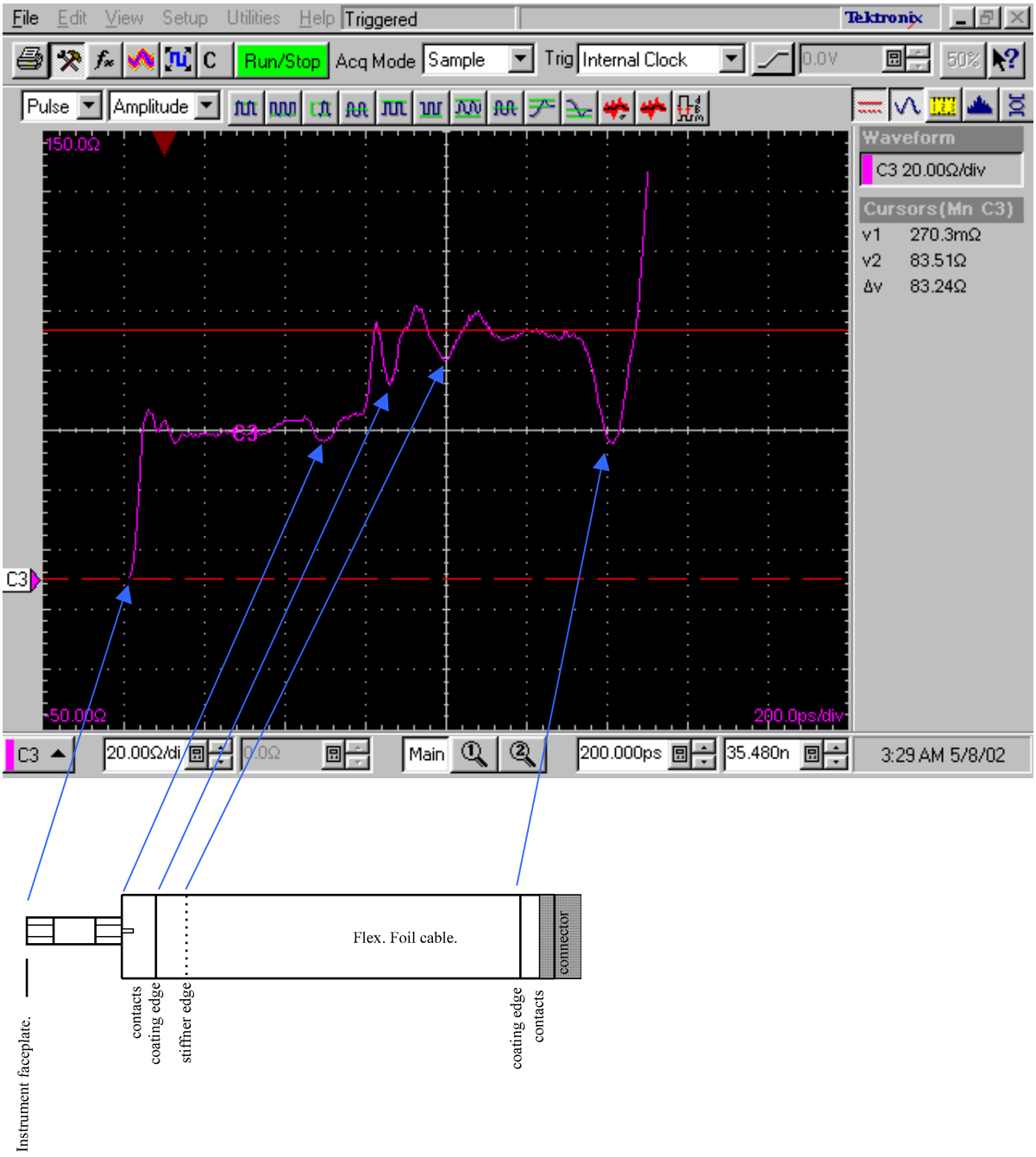
Measurements in detail:

Single ended signal with 2 (i.e. unbalanced in number) ground returns. 0.3mm tracks, 0.2mm gap. Measurement with TDR.

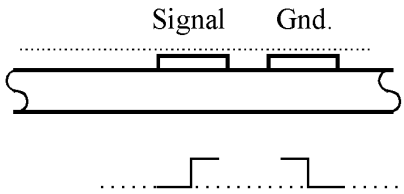


Zo 83 Ohms.

Effective dielectric constant **Er(eff)7.4**



Single ended signal with 1 (i.e. balanced in number) ground return.
0.3mm track, 0.2mm gap. Measurement with TDR.

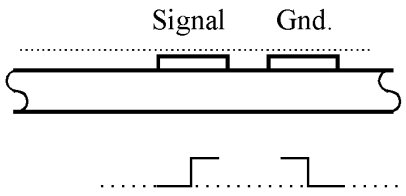


Zo 118 Ohms.

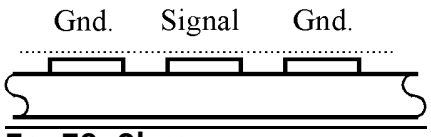
Single ended signal with 1 (i.e. balanced in number) and with 2 (i.e. unbalanced in number) ground returns.
0.3mm tracks, 0.2mm gap. Measurement with Network Analyzer.

Note: Network analyzer measurements were made as detained in:
Technical Data and Tips – RF Engineering - How to measure characteristic impedance.
Smith charts show input impedance of flex, with short circuit on end.
Marker 1 at 1/4 wavelength. Marker 2 at 1/8 wavelength measurement point.

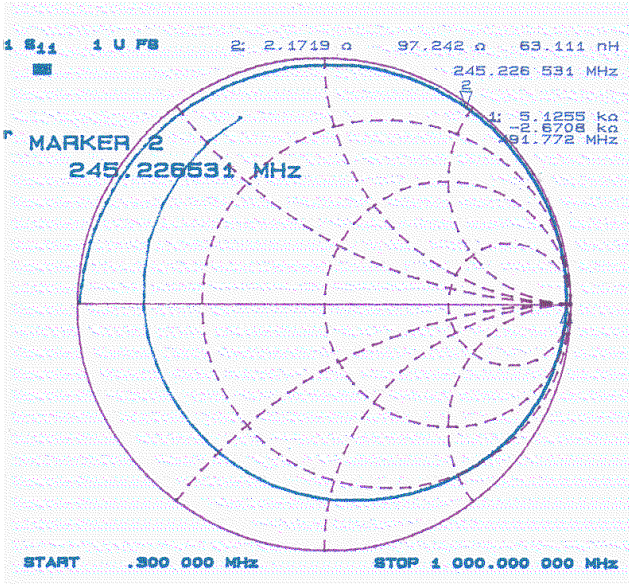
Measurement 1, including flex socket in test fixture.
The calibration prior to measurement was made using a secondary reference test fixture for normalization, without a flex cable PCB socket present. The value then produced with the measurement test fixture, therefore includes the influence of the flex cable PCB socket.

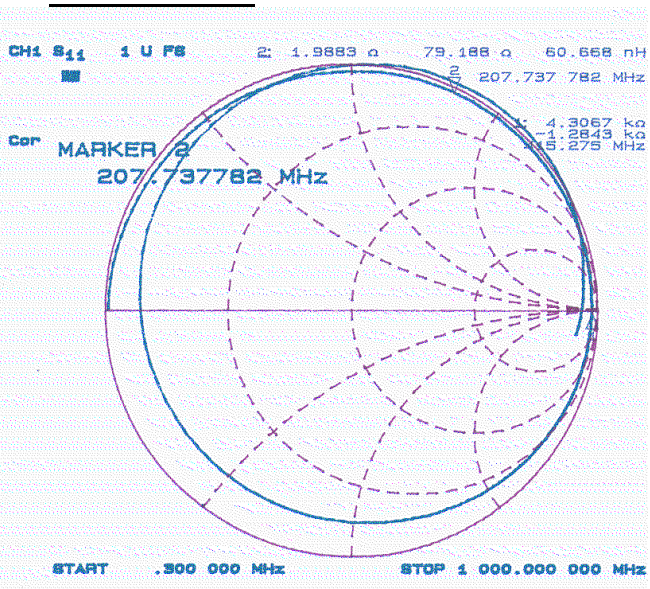


Zo 97 Ohms.



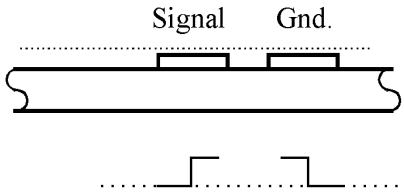
Zo 79 Ohms.



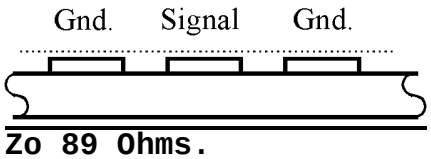


Single ended signal with 1 (i.e. balanced in number) and with 2 (i.e. unbalanced in number) ground returns.
0.3mm tracks, 0.2mm gap. Measurement with Network Analyzer, continued.

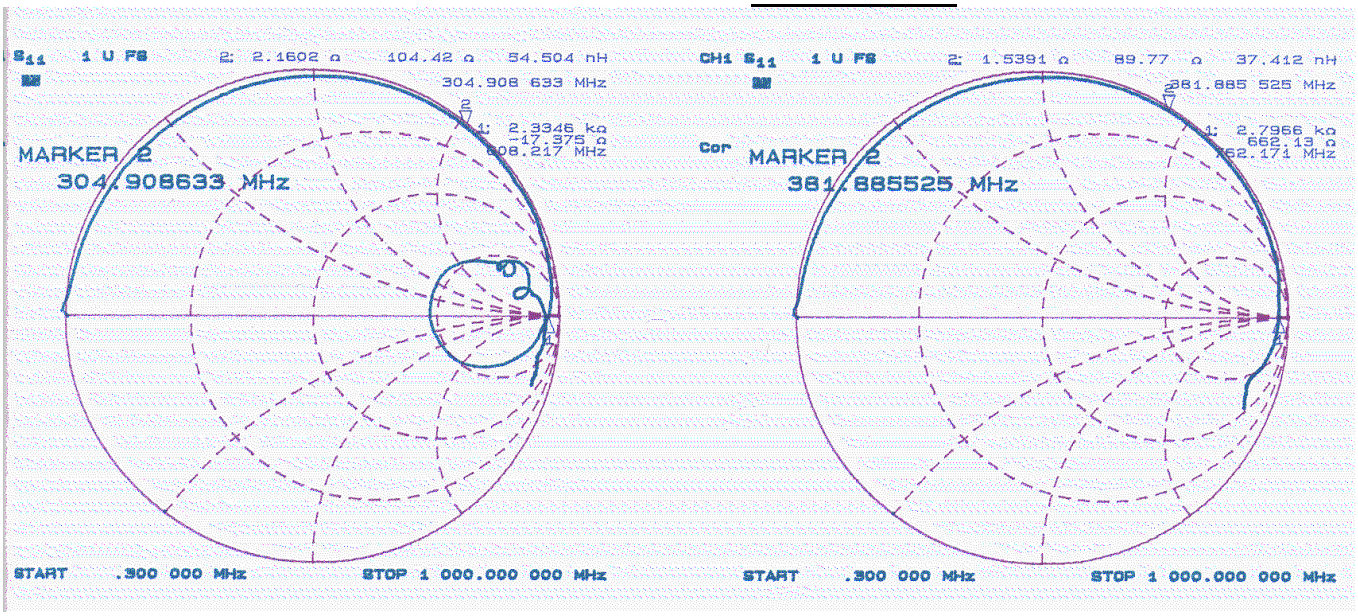
Measurement 2, with flex on SMA connector.
It helps if the flex is electrically long i.e. 100mm. The 1/4 wavelength point is then kept to a lower more manageable frequency and parasitic effects with connector contacts are less of a problem.



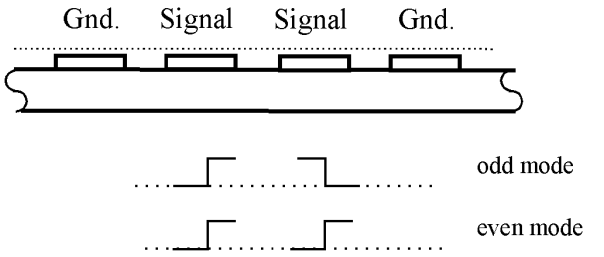
Zo 104 Ohms.

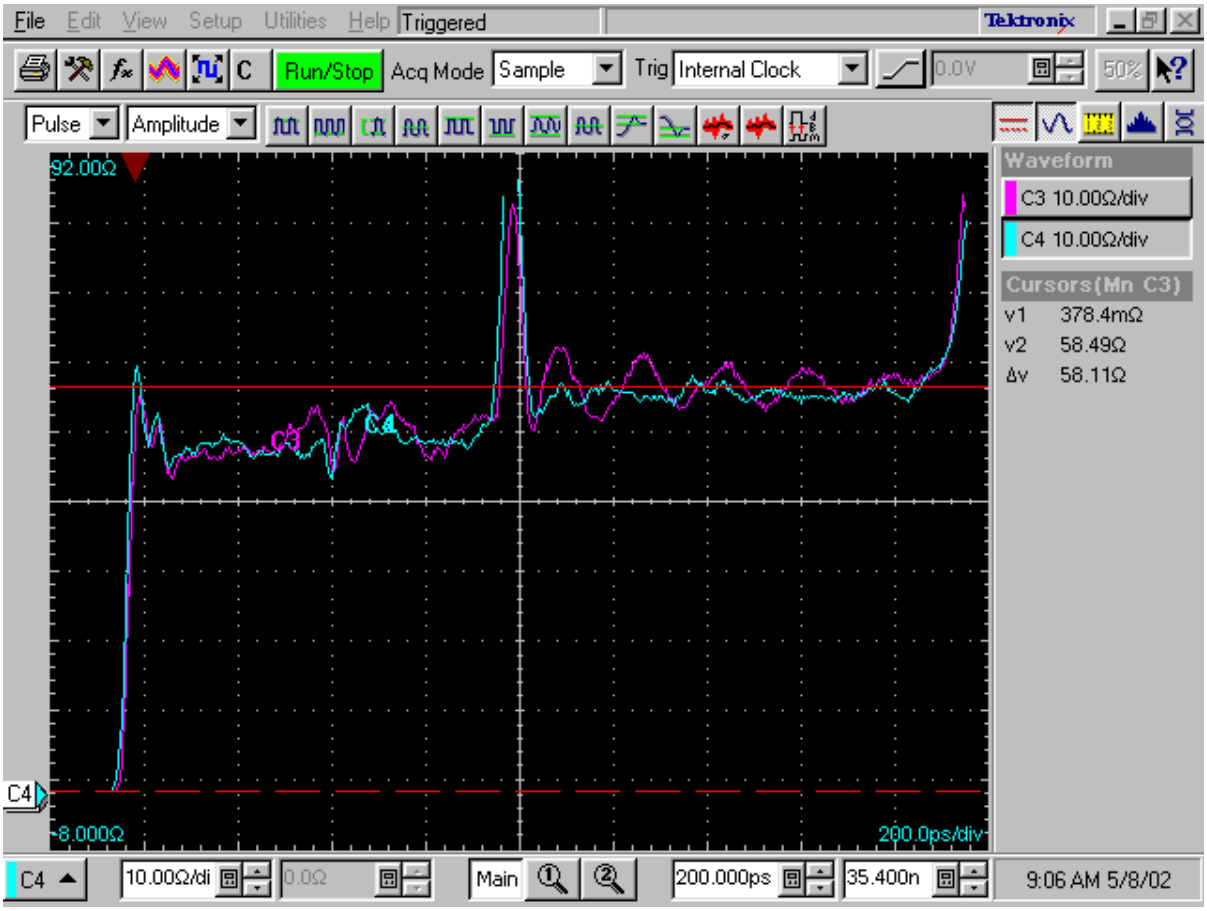


Zo 89 Ohms.



Differential odd mode signal with 2 (i.e. balanced in number) adjacent grounds.
0.3mm track, 0.2mm gap. Measurement with TDR.





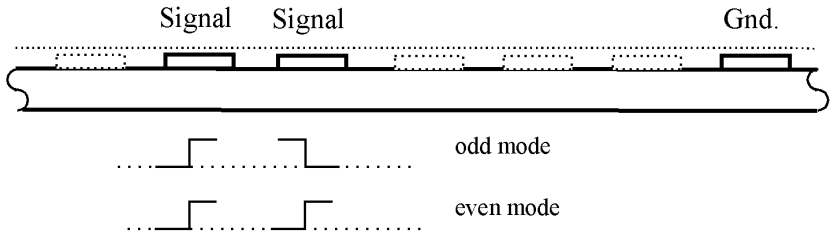
Zdifferential odd = 2*Zodd[line1]

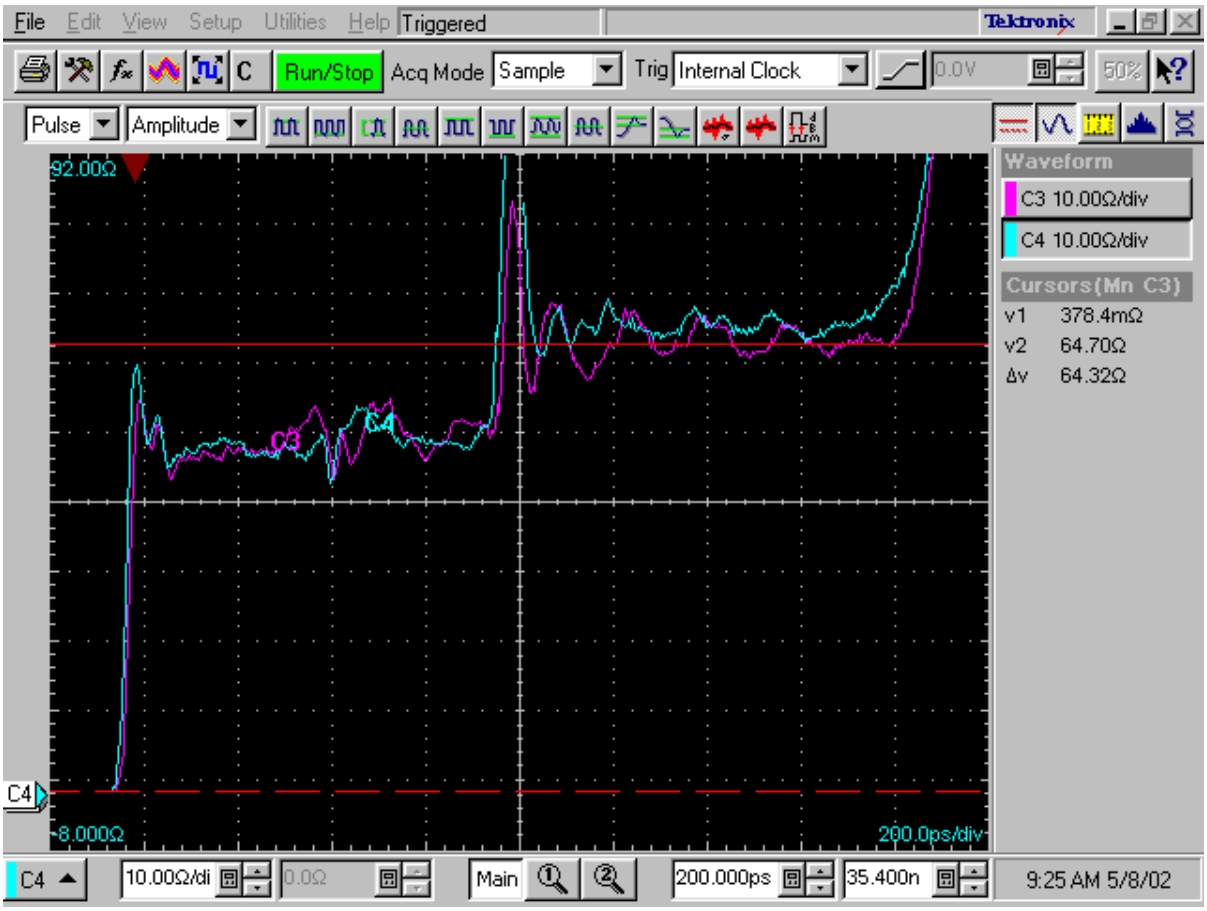
= 2*58

Zdiff = 116 Ohms.

Differential odd mode signal with 1 ground spaced a distance of 4 tracks away.

0.3mm track, 0.2mm gap. Measurement with TDR.



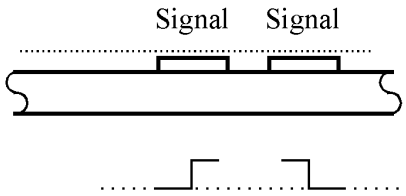


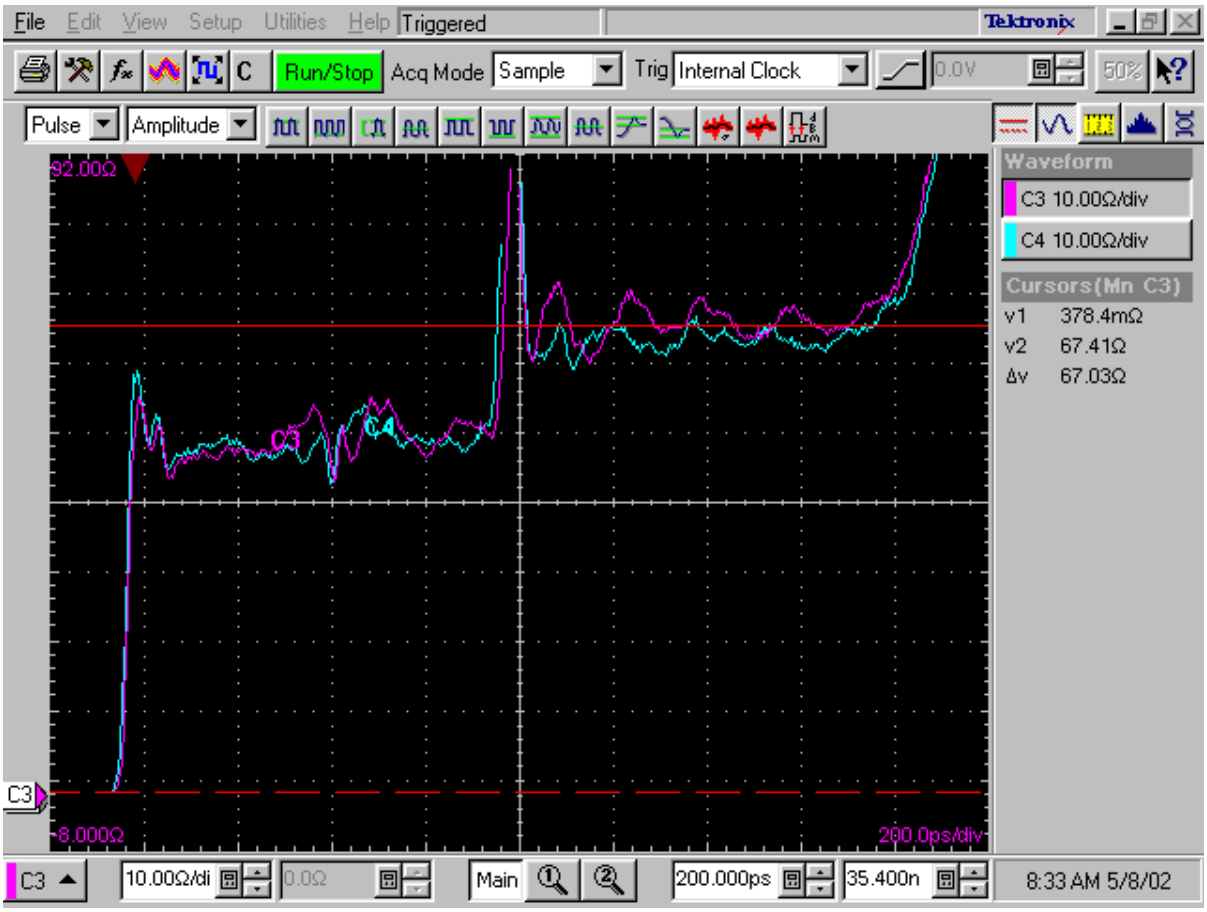
Zdifferential odd = 2*Zodd[line1]

= 2*64

Zdiff = 128 Ohms.

Differential odd mode signal with no ground.
0.3mm track, 0.2mm gap. Measurement with TDR.





Zdifferential odd = 2*Zodd[line1]

= 2*67

Zdiff = 134 Ohms.