Ultra-3 Cable Tests

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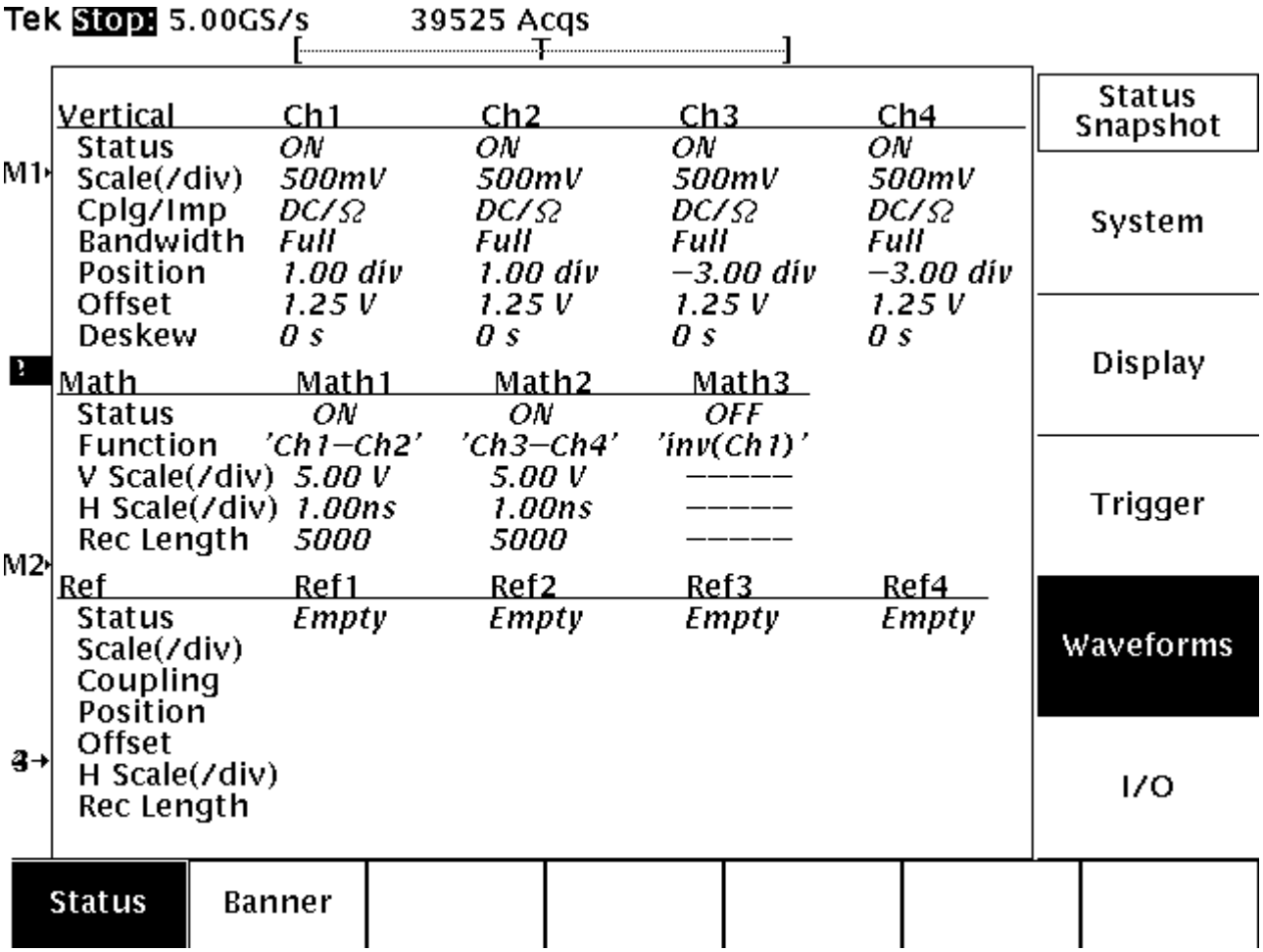
Premise:

The Ultra-3 cable environment and beyond will require a certain frequency response to reliably carry the intended signals. To further understand the capabilities of an existing Ultra-2 style cable, these tests attempt to define the response of the cable at various frequencies. These tests are not conclusive and further S-parameter tests are needed to precisely define the needs at higher frequencies. These tests were not performed in a controlled environment (shielded), so the results contain whatever RF noise was present during the tests.

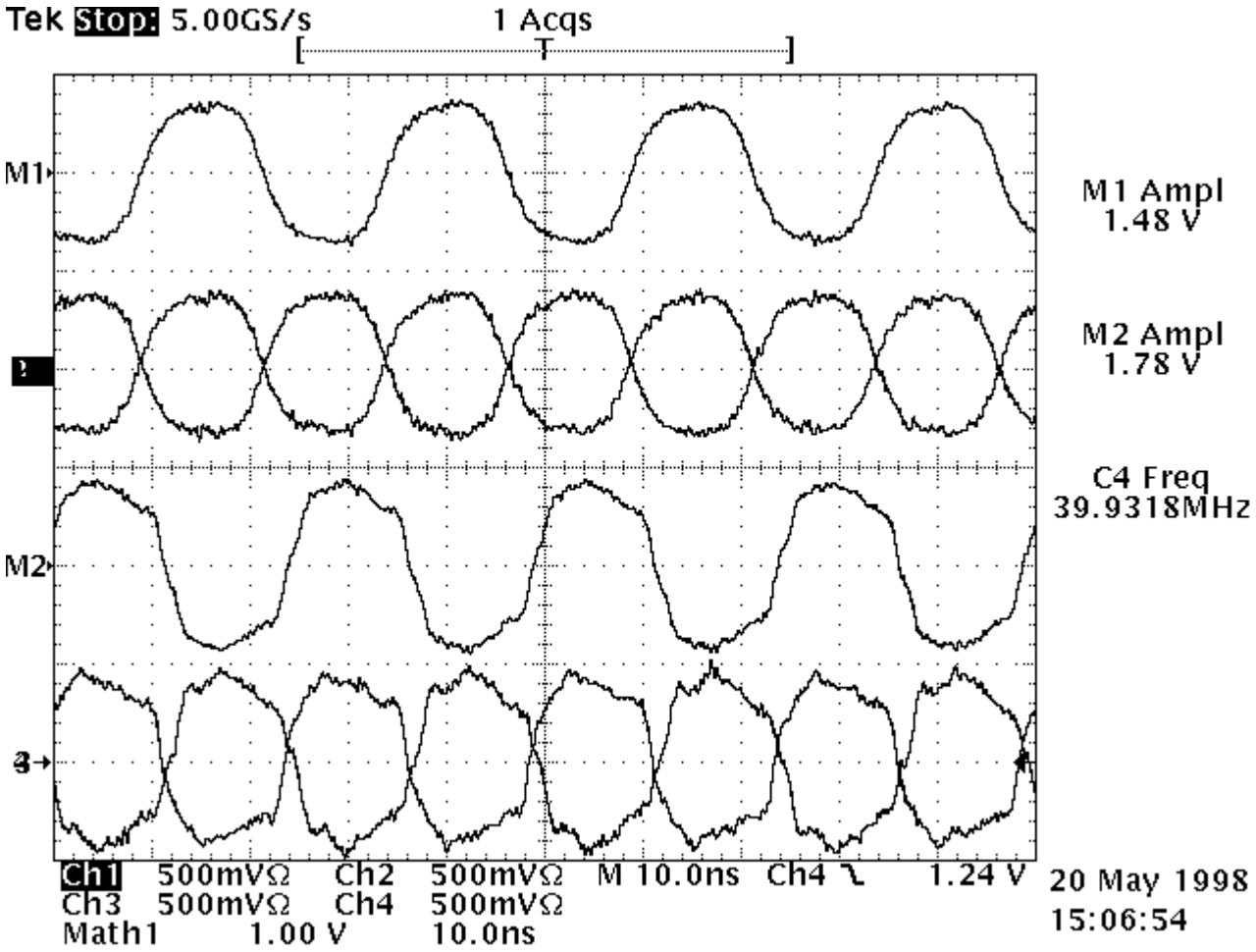
Setup:

- Signal Generator Driven; LeCroy 9210.
- 12 meter cable; terminated at the far end with 100 ohms into 1.25 volts.
- Generator set to 2.00V into 50 ohms, complementary outputs drving each of the 100 ohms connected to the differential pair on the cable with square waves having a rise fall time of 1ns (10%/90% points).
- Flat, ribbon cable, 68-pin, solid conductor, PVC dielectric.
- Cable driven from extreme end with 15 dummy loads clustered nearby. Clustering was spaced at 0.3 meters and another at 2 inch intervals.
- Where loading was used, it was done with PC boards containing 22pF capacitors to ground.
- Measurements were made with a Tektronix TDS684B scope using FET probes with < 2pF of capacitance. The probes were summed using the math function of the scope. Whenever possible, single-ended and differential traces are shown simultaneously. (See setup screen for scope below)
- Single ended probes were attached to the cable side of the 100 ohm resistor at the far end with no grounds attached to the cable setup. Likewise, the signal generator outputs were attached to the 100 ohm resistors with coax shield connected together for better referencing but no ground connection to the cable system. All ground connections in the probes/cables were done with heavy braiding and close proximity to limit RF effects. The tests were performed without Faraday shielding due to lack of time and resources.

Scope Setup:


Tek Stop: 5.00GS/s 39525 Acqs
Vertical Ch1 Ch2 Ch3 Ch4
Status ON ON ON ON
Scale(/div) 500mV 500mV 500mV 500mV
Cplg/Imp DC/Ω DC/Ω DC/Ω DC/Ω
Bandwidth Full Full Full Full
Position 1.00 div 1.00 div −3.00 div −3.00 div
Offset 1.25 V 1.25 V 1.25 V 1.25 V
Deskew 0 s 0 s 0 s 0 s
Math Math1 Math2 Math3
Status ON ON OFF
Function 'Ch1−Ch2' 'Ch3−Ch4' 'inv(Ch1)'
V Scale(/div) 5.00 V 5.00 V −−−−−
H Scale(/div) 1.00ns 1.00ns −−−−−
Rec Length 5000 5000 −−−−−
Ref Ref1 Ref2 Ref3 Ref4
Status Empty Empty Empty Empty
Scale(/div)
Coupling
Position
Offset
H Scale(/div)
Rec Length
M1
M2
Status Snapshot
System
Display
Trigger
Waveforms
I/O
Status
Banner

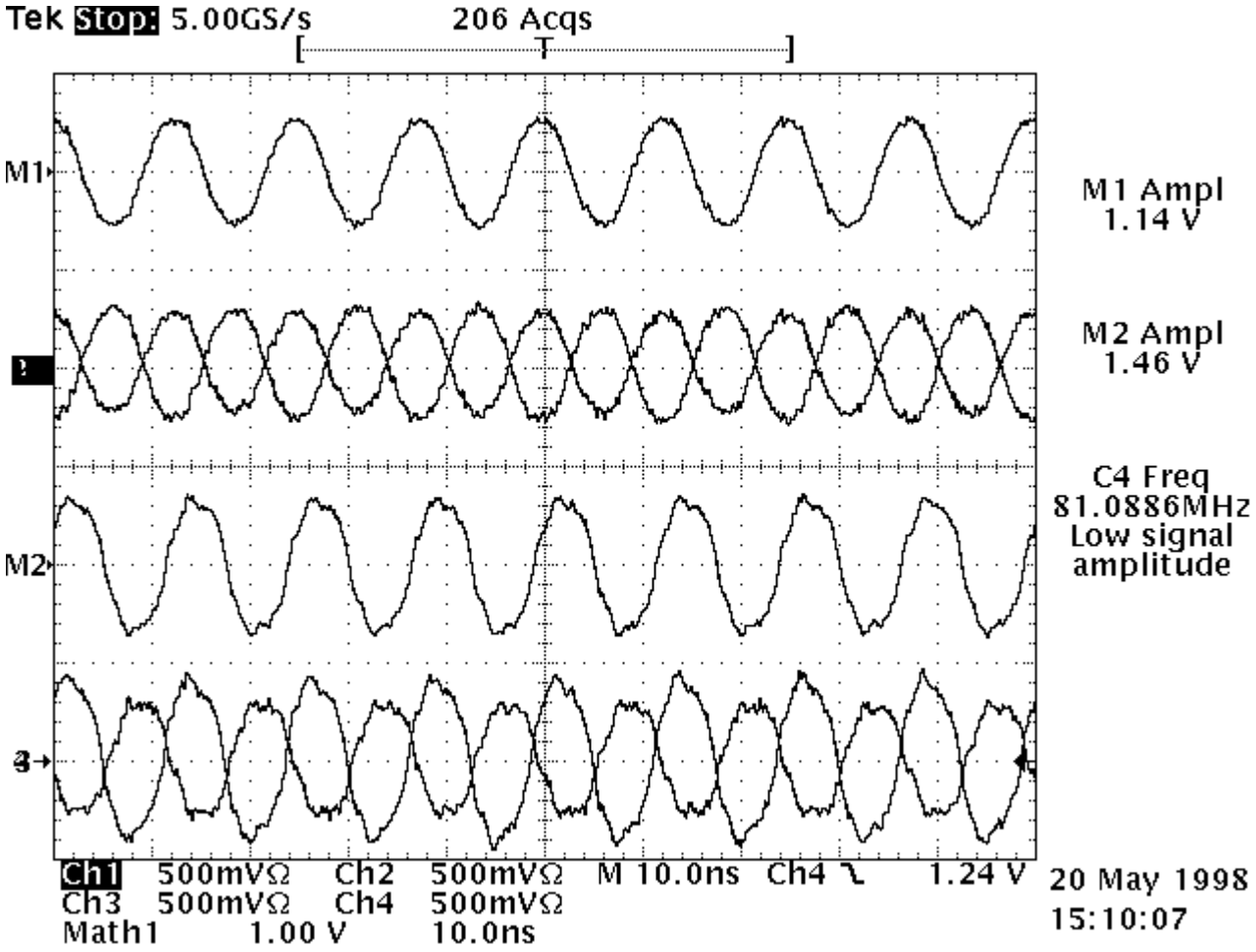
12 meter cable, no extra loading, 40MHz driven



(fr1.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

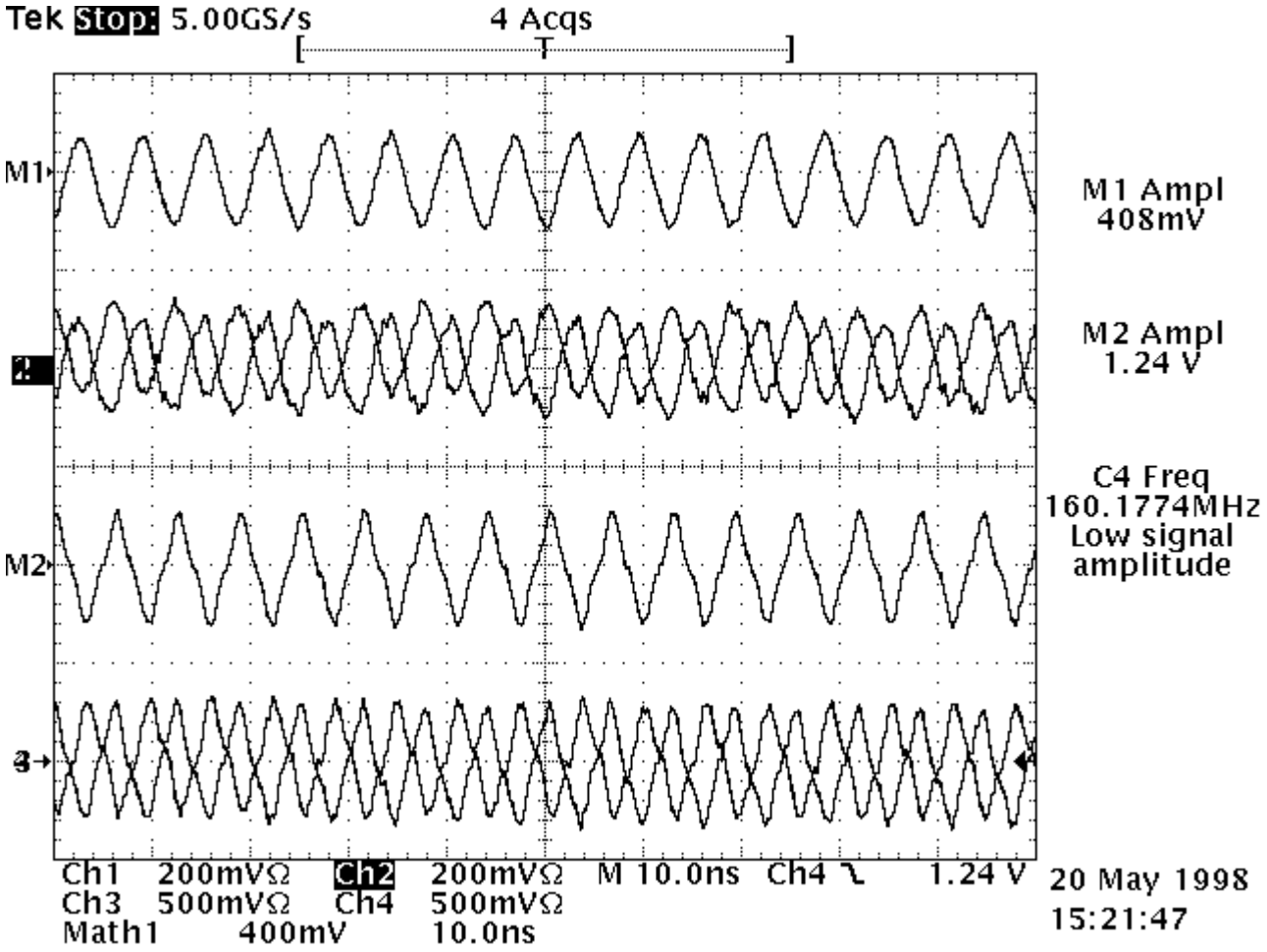
12 meter cable, no extra loading, 80MHz driven



(fr2.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

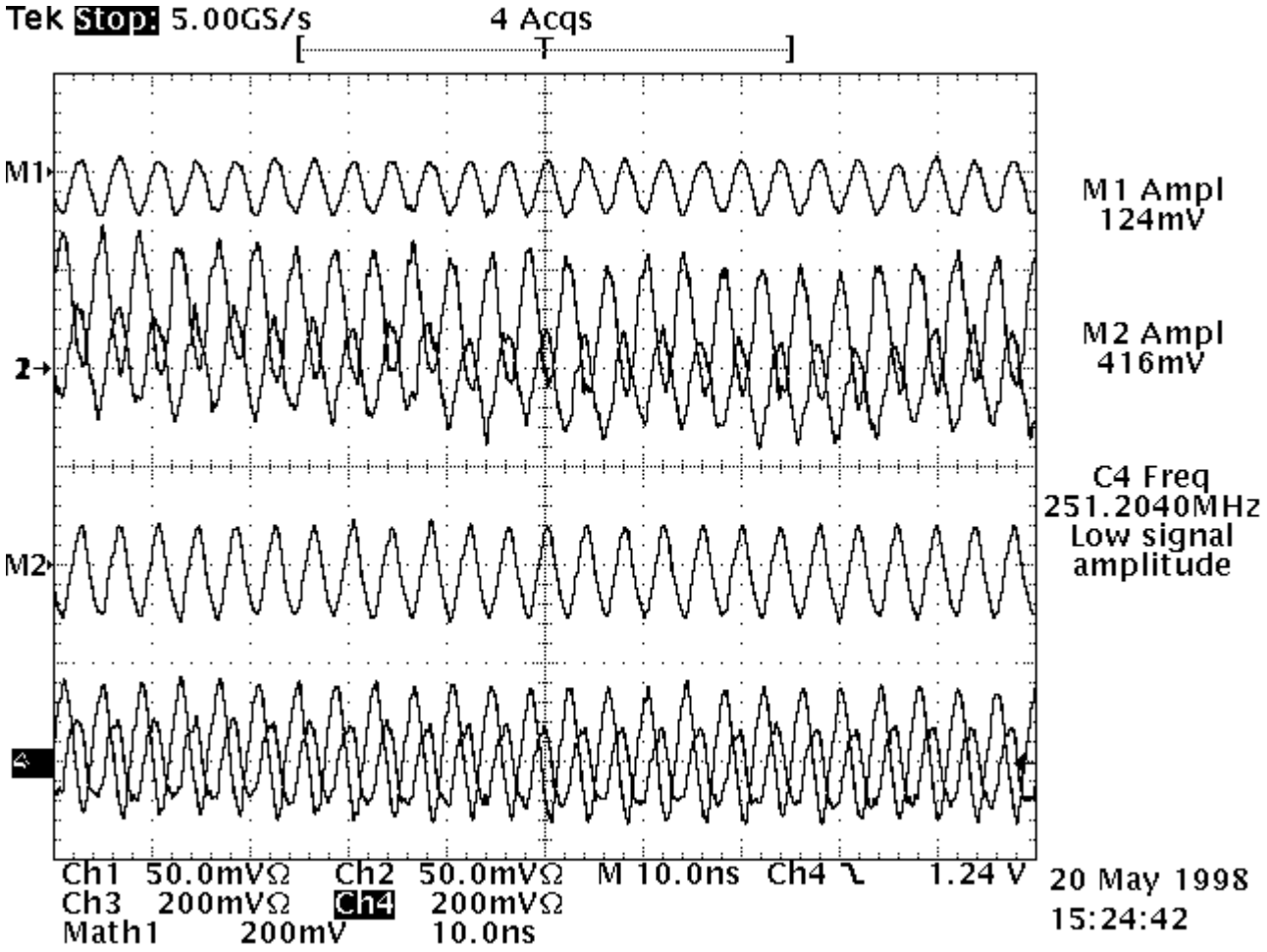
12 meter cable, no extra loading, 160MHz driven



(fr3.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

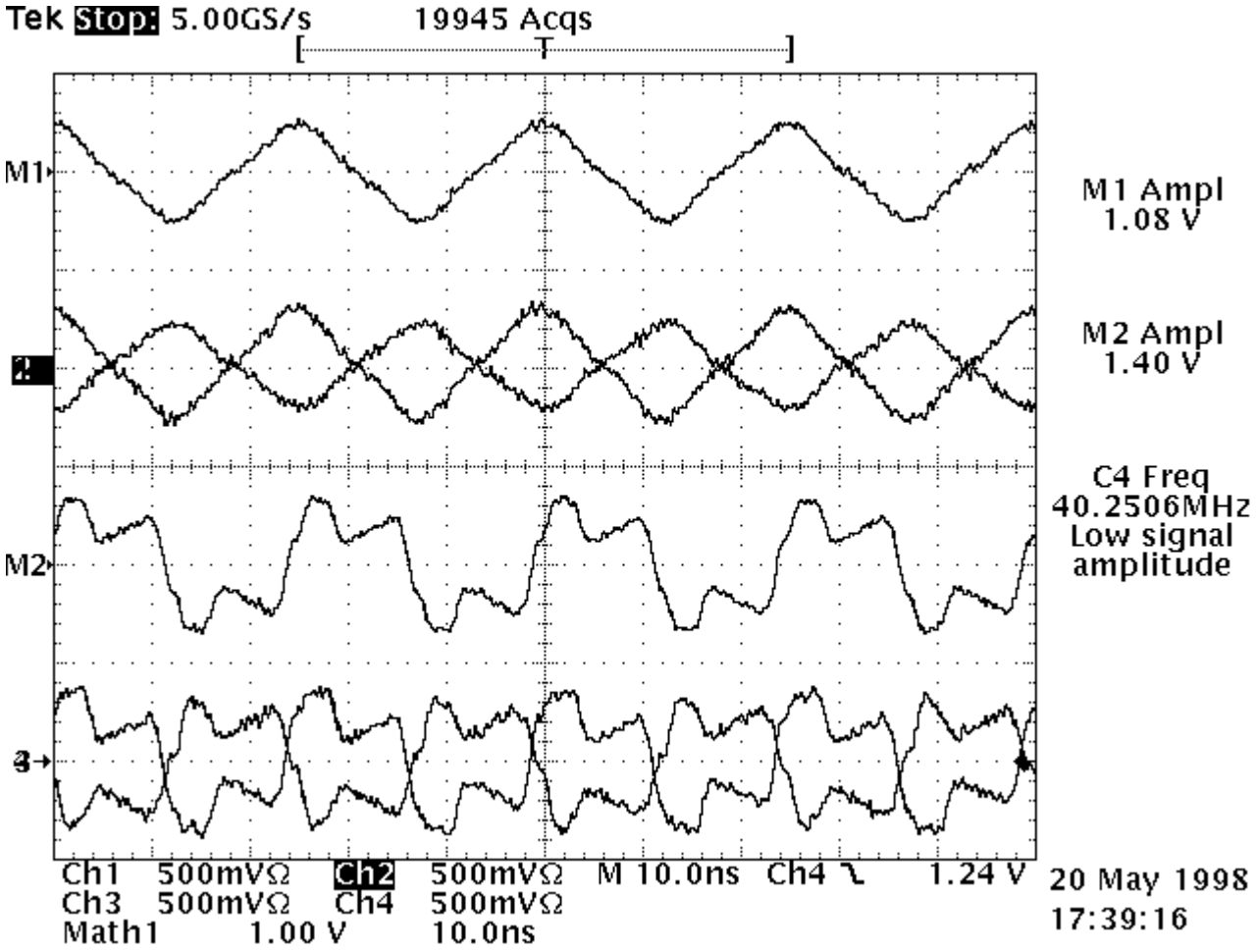
12 meter cable, no extra loading, 250MHz driven (generator's max)



(fr4.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

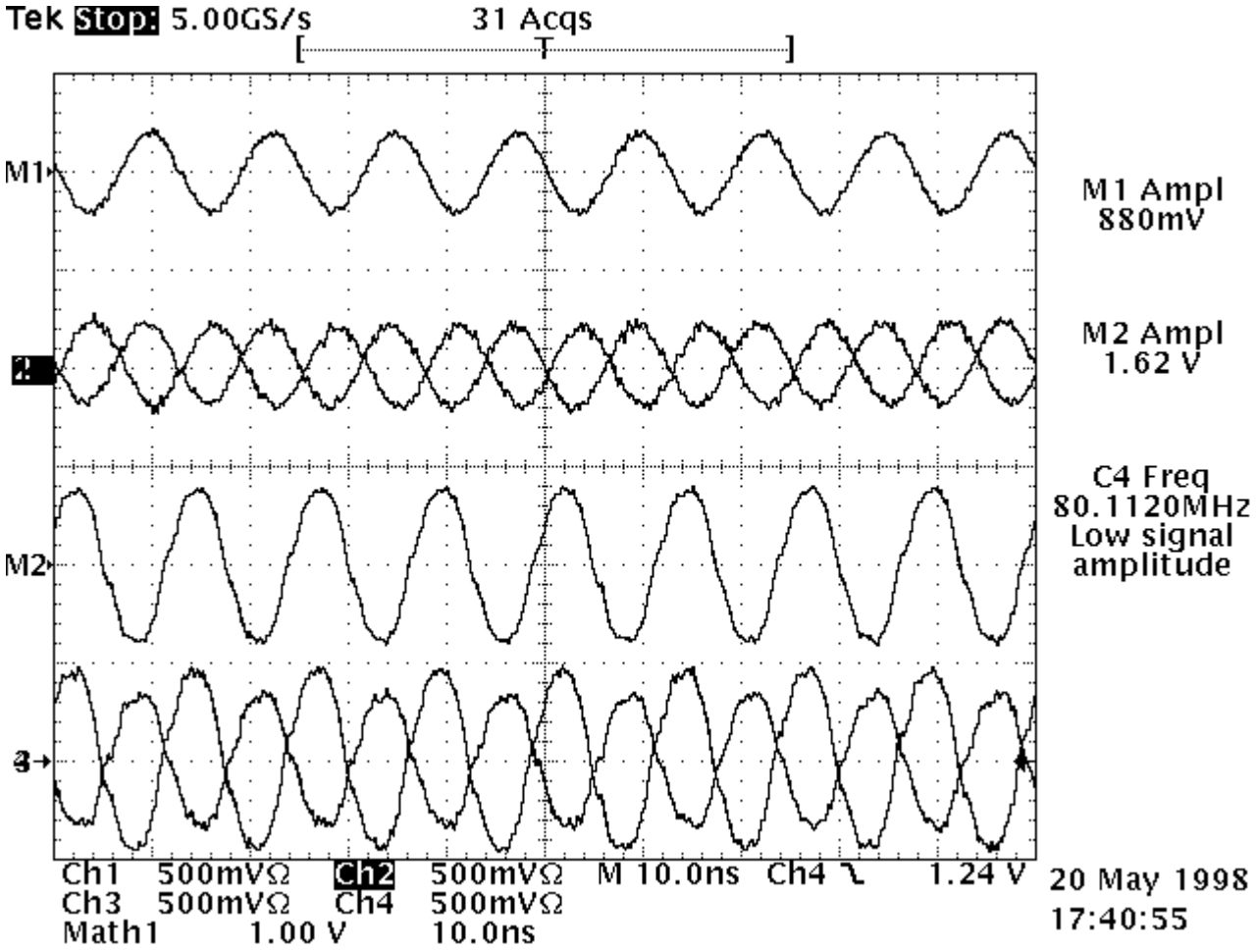
12 meter cable, 0.3 meter spacing, 40MHz driven



(fr5.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

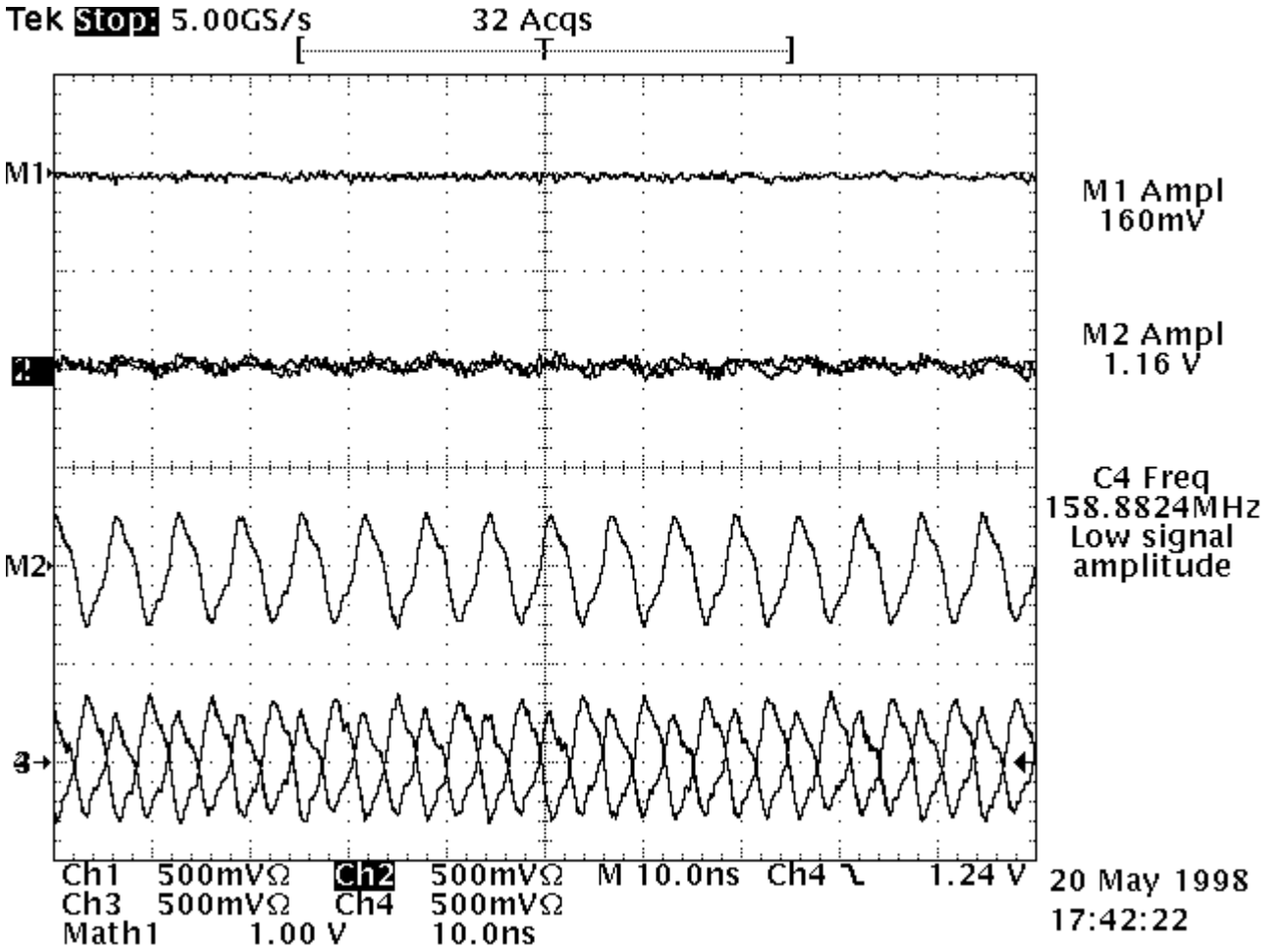
12 meter cable, 0.3 meter spacing, 80MHz driven



(fr6.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

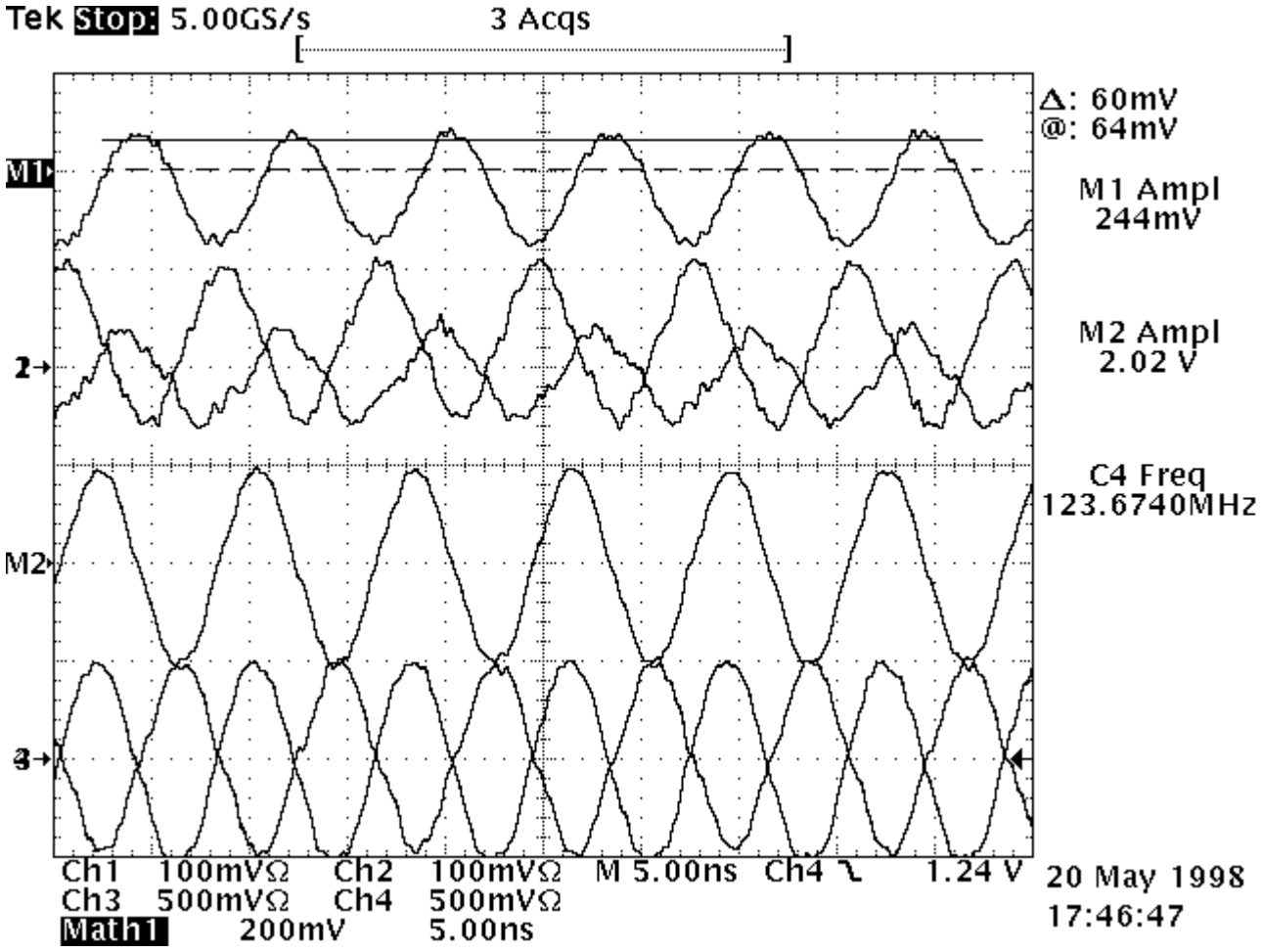
12 meter cable, 0.3 meter spacing, 160MHz driven



(fr7.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

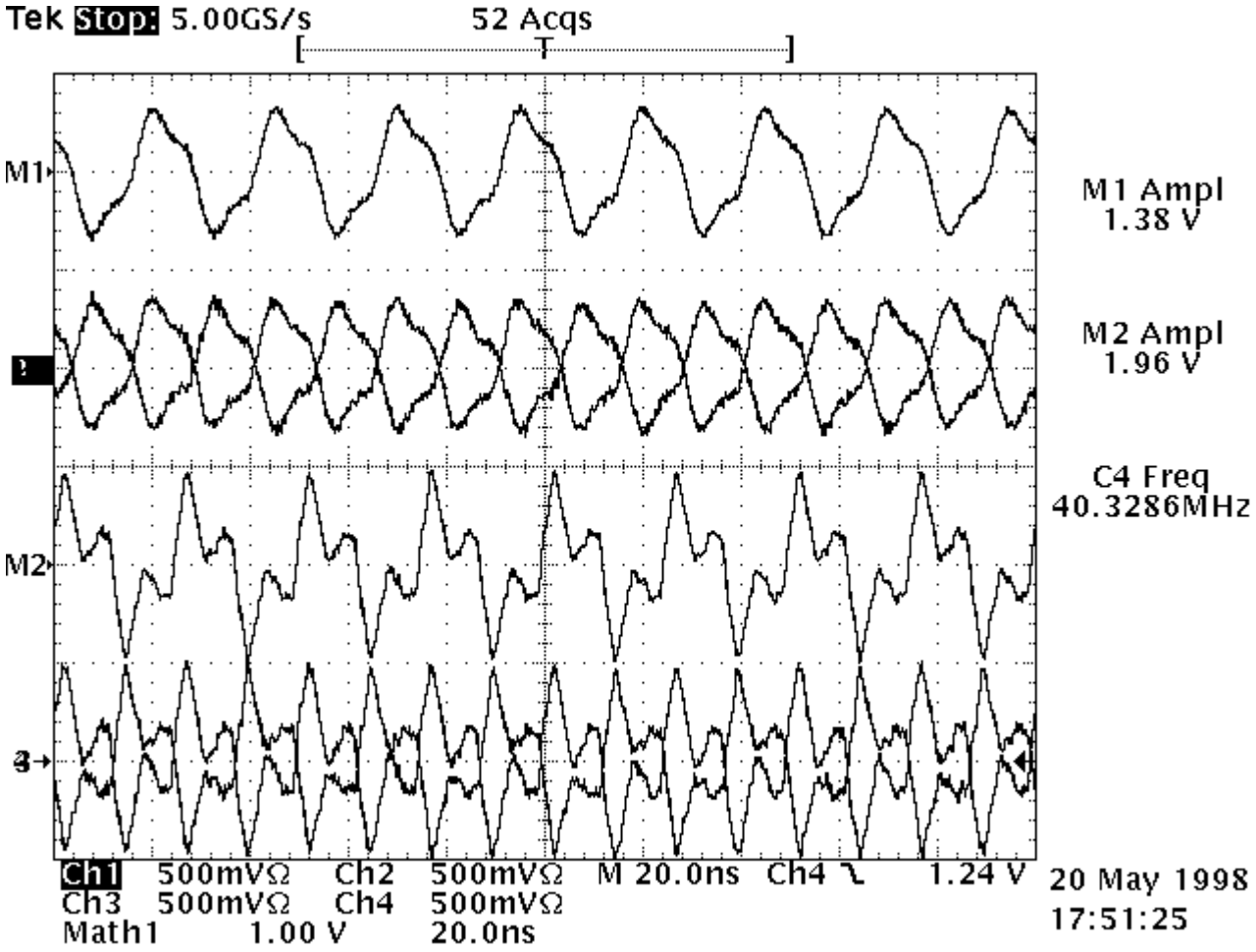
12 meter cable, 0.3 meter spacing, 123.7MHz driven



(fr8.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

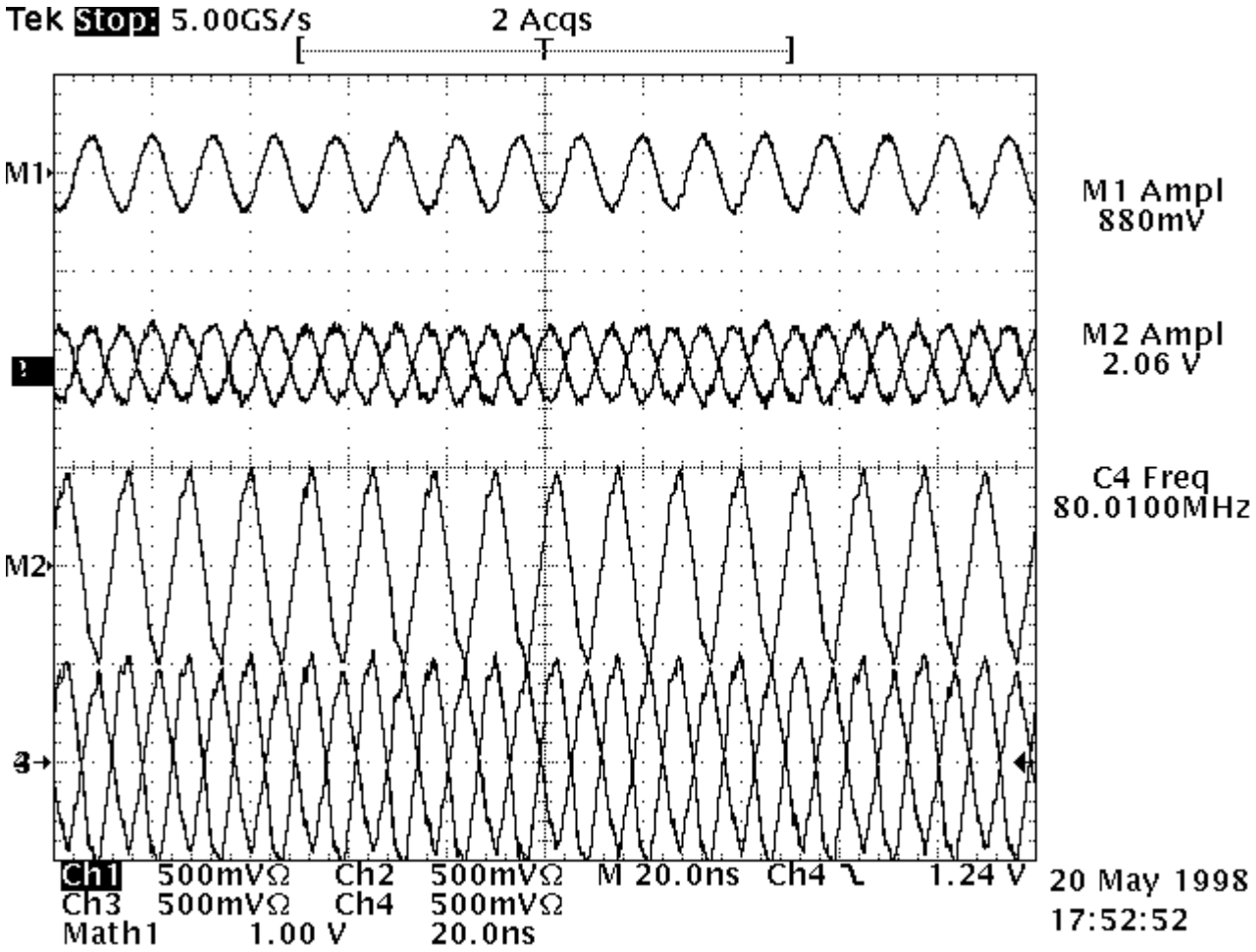
12 meter cable, 2 inch spacing, 40MHz driven



(fr9.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

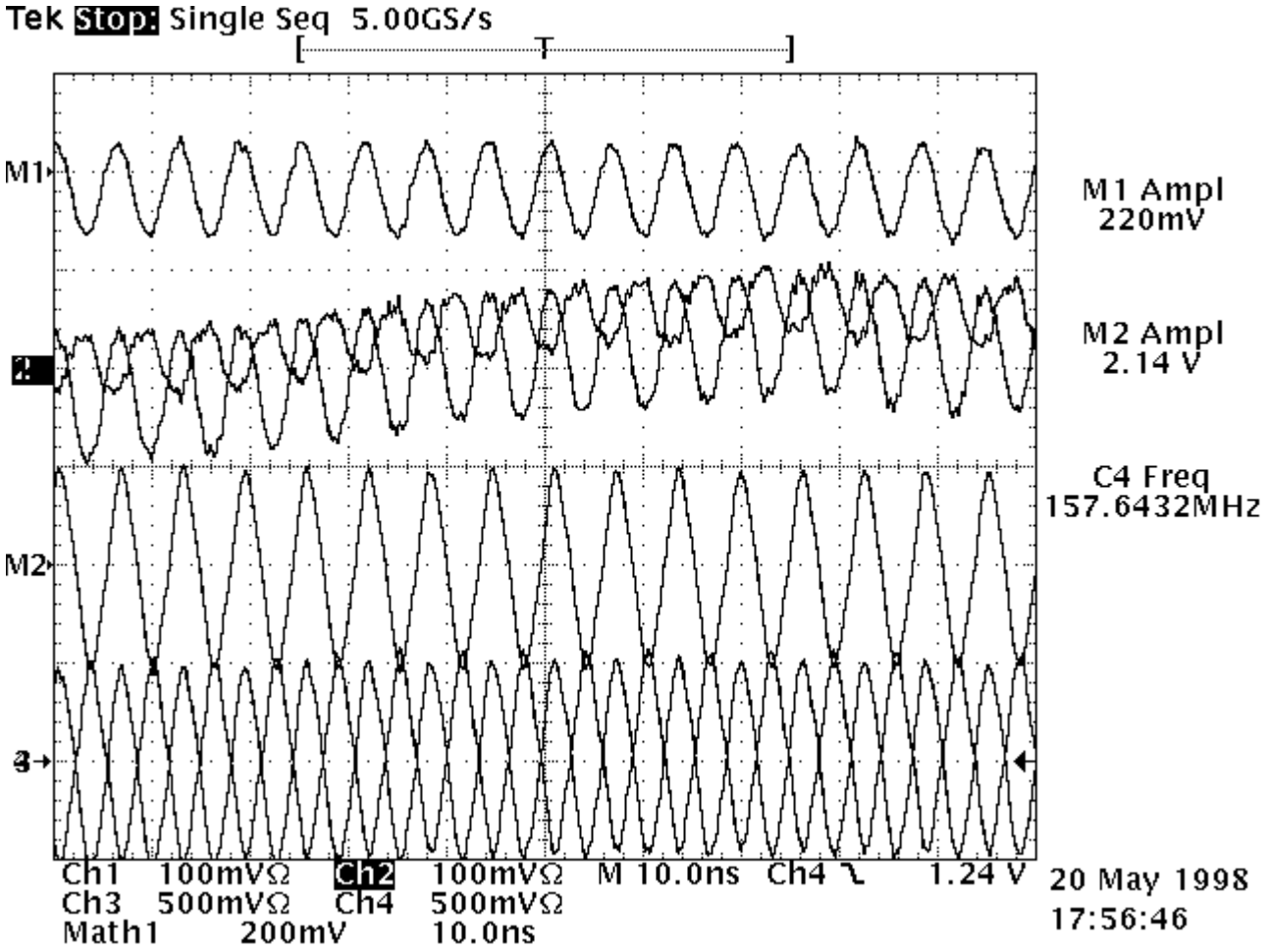
12 meter cable, 2 inch spacing, 80MHz driven



(fr10.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

12 meter cable, 2 inch spacing, 160MHz driven

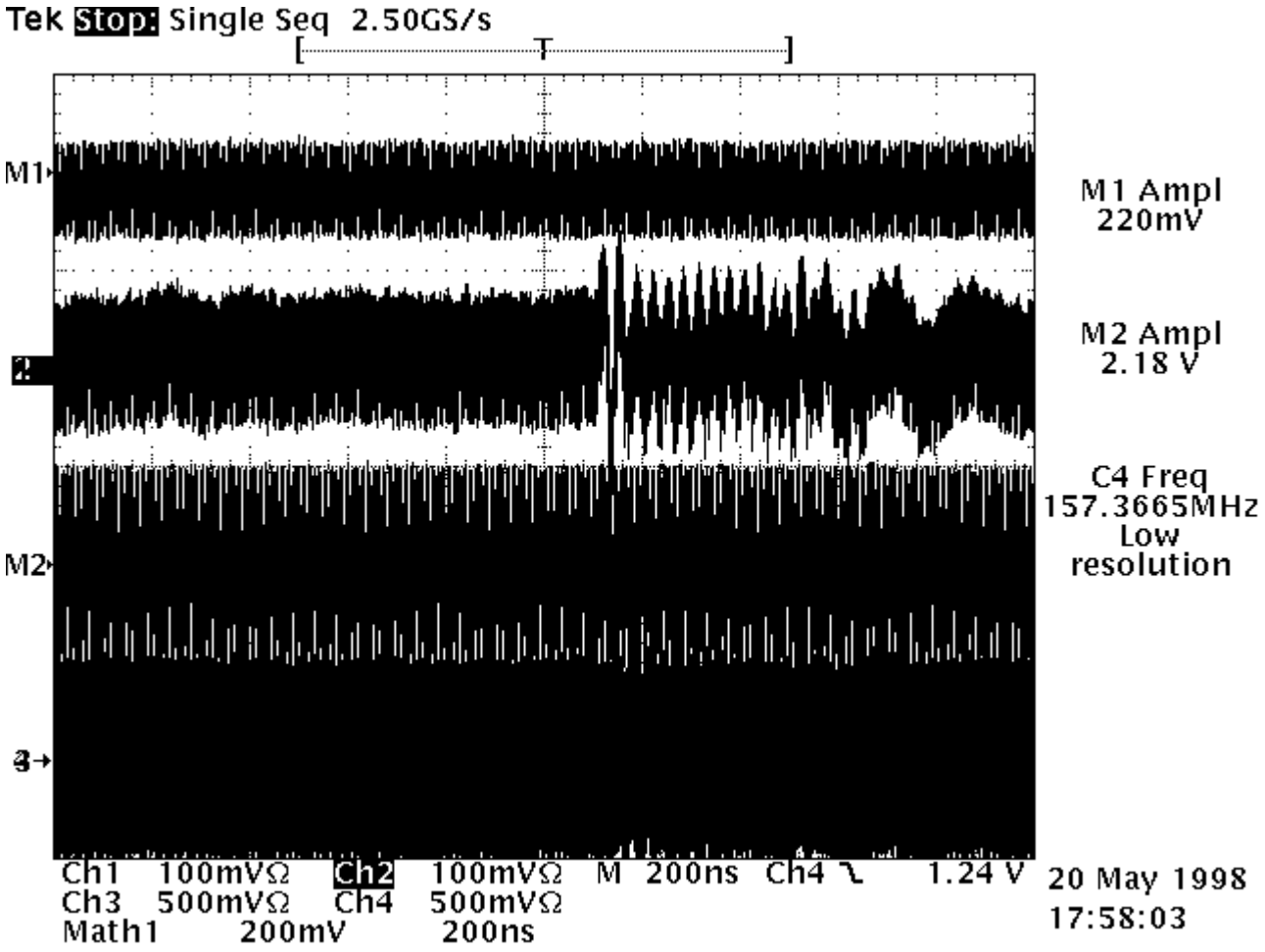


(fr11.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

Notice the amplitude modulation due to external RF influence. The lab is physically located near a police and fire station. Can you guess what this modulation is coming from?

12 meter cable, 2 inch spacing, 160MHz driven (broad view)

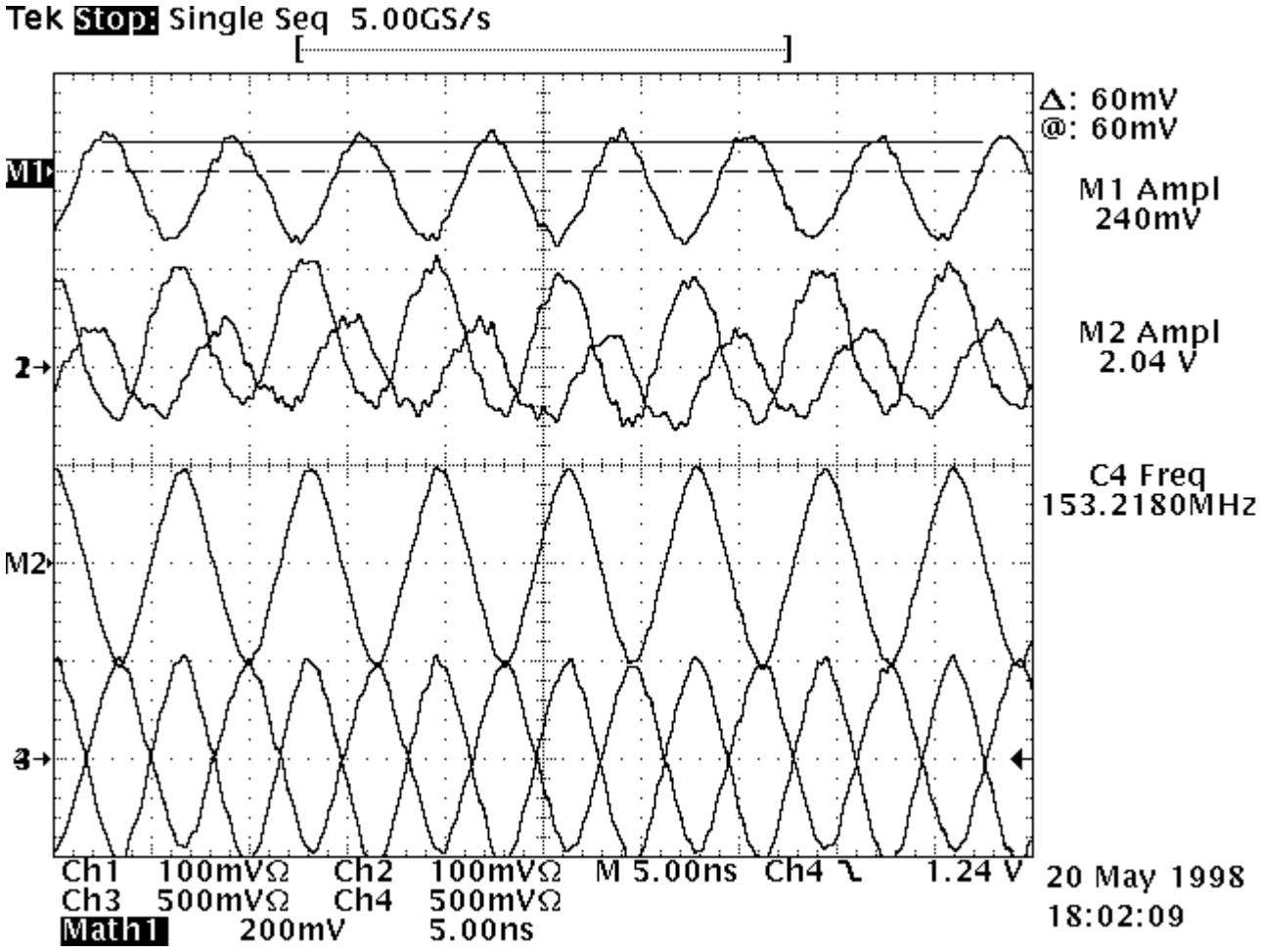


(fr12.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end

Here the modulation is seen at a broader viewing range. If you look close, you can see the fireman's radio call to his buddy.

12 meter cable, 2 inch spacing, 153.2MHz driven (60mV threshold)



(fr13.pcx)

top trace: differential signal, far end (done with scope math)
second down: single-ended signals, far end
third down: differential signal, near end (done with scope math)
fourth down: single-end signals, driven end