FOUNDED IN 2002

ANALOG POWER

10+ YEARS OF GROWTH

Effect of di/dt and If on trr

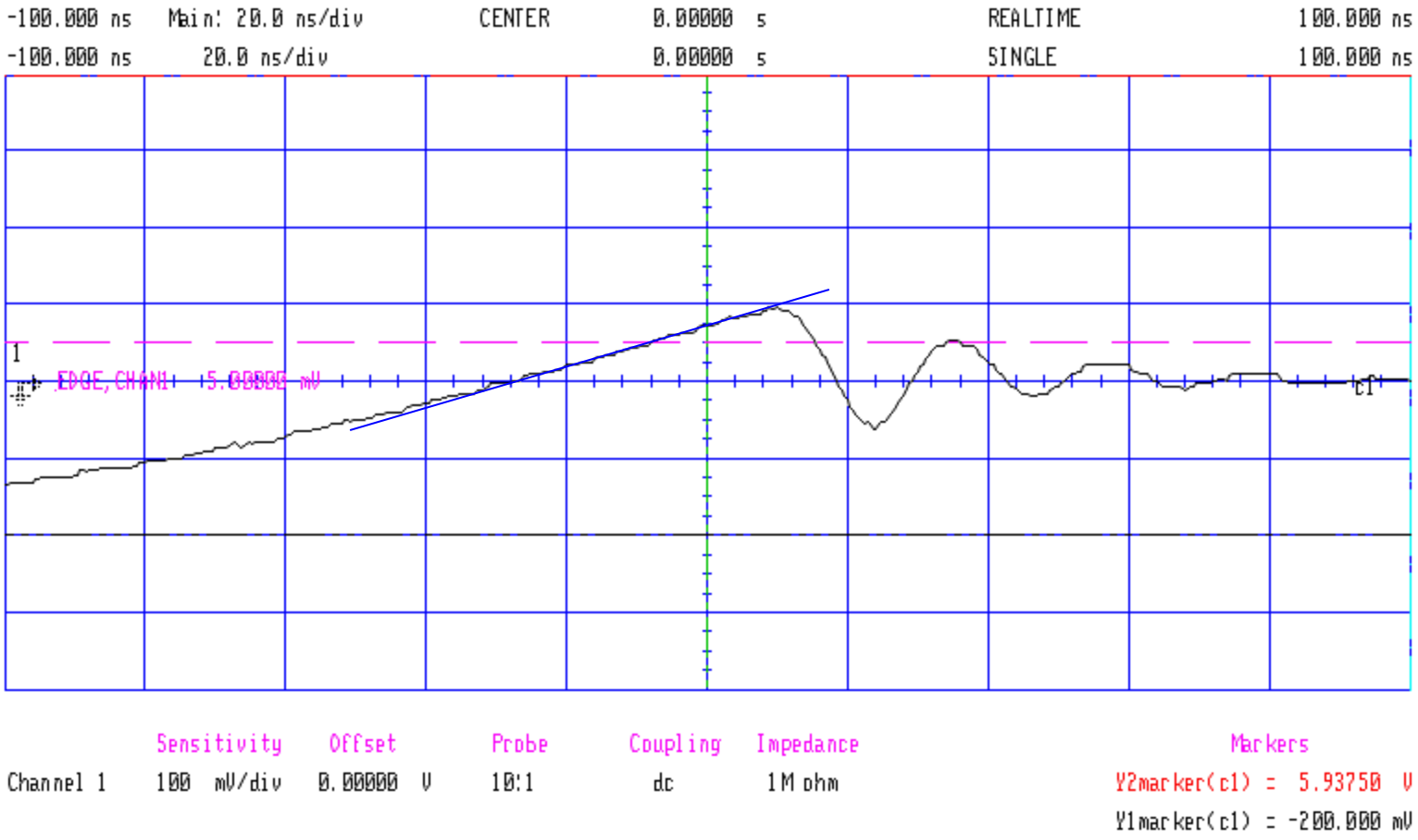
8/17/2015

Effect of di/dt

Conditions

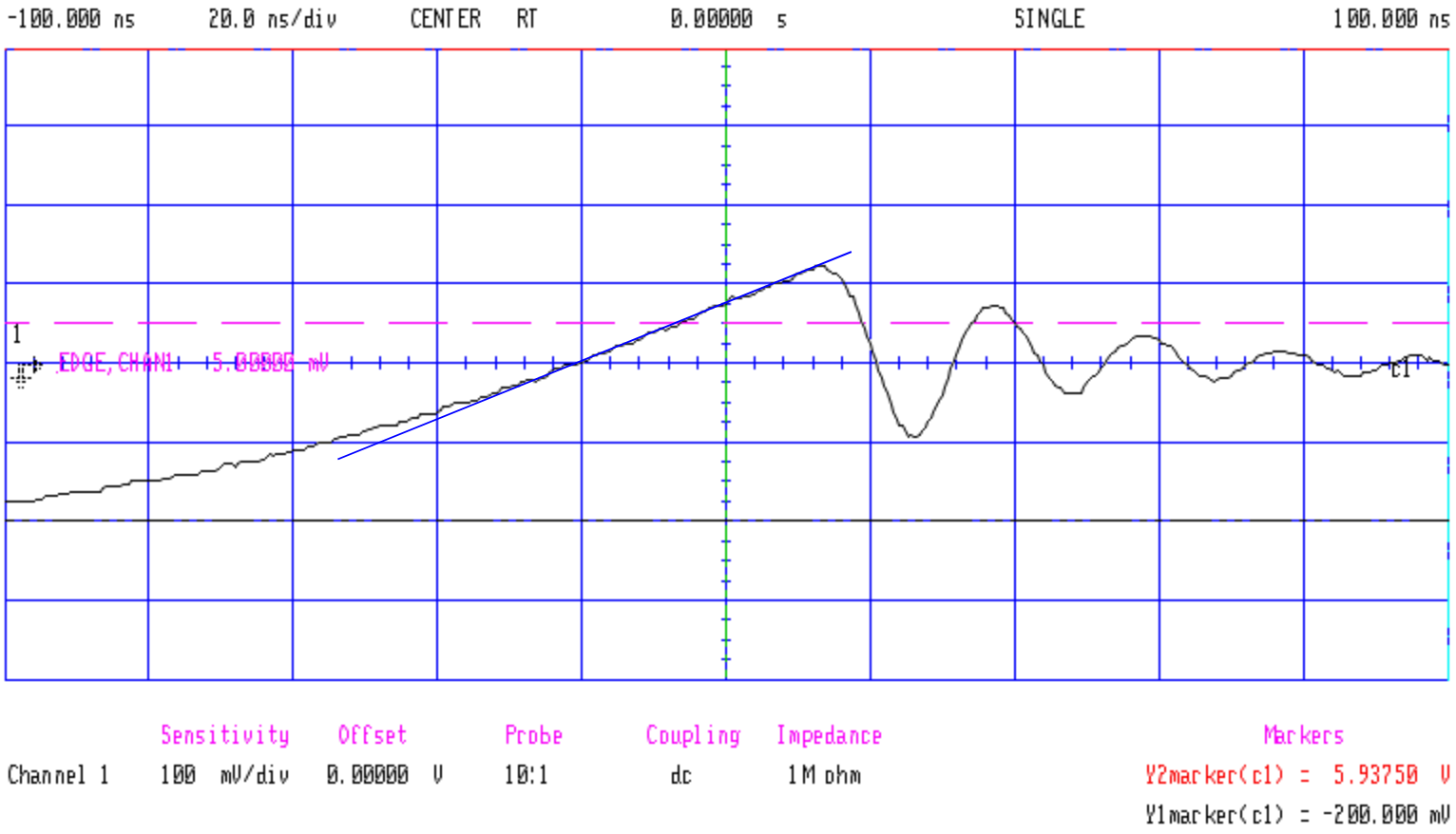
- IF = 10A
- VDS = 12V
- AMR438N
- Sense = 20 m Ohm

Results



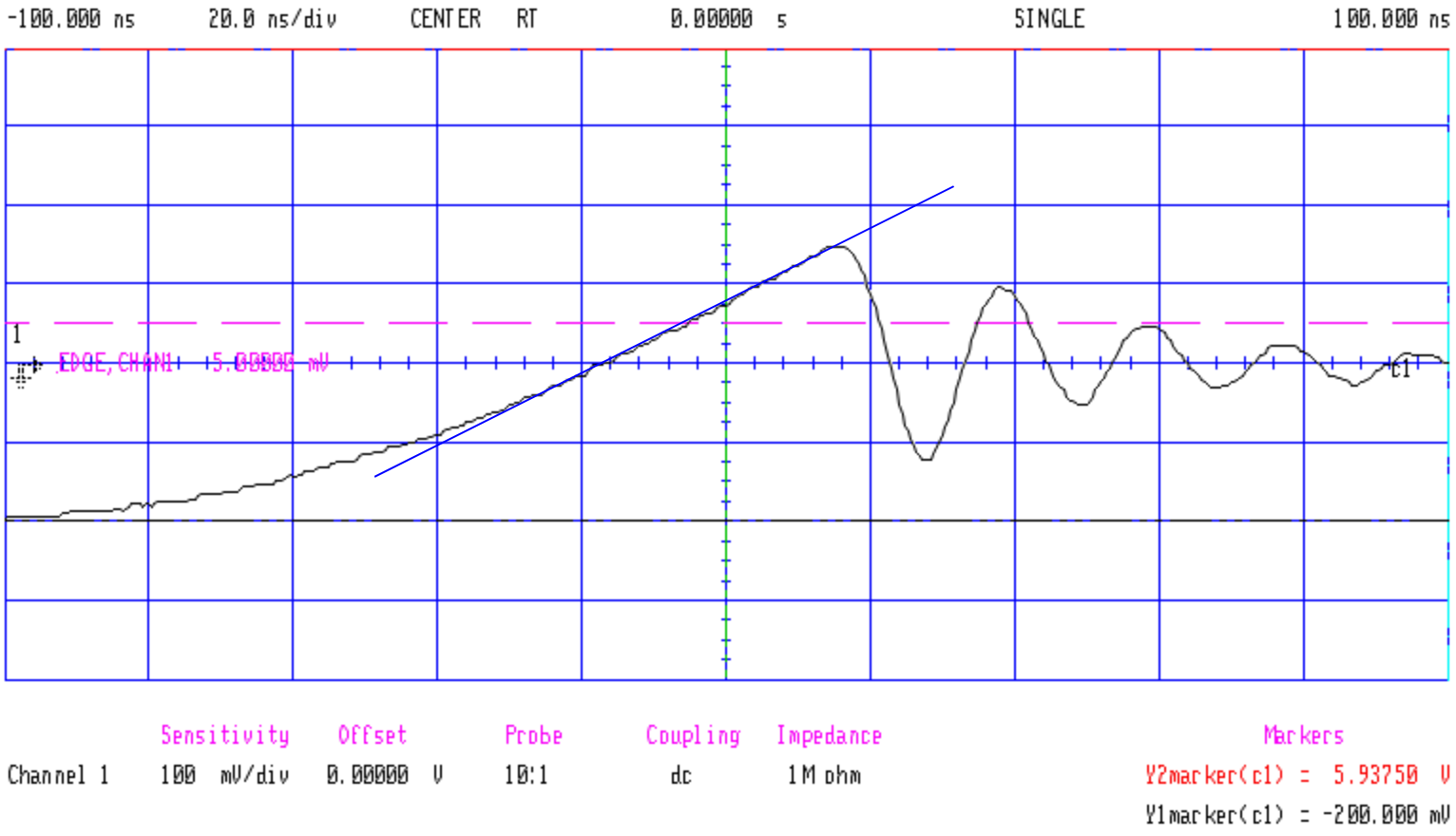
di/dt = 5/40 = 0.125A/ns IRR = 4A ta = 40ns

Results



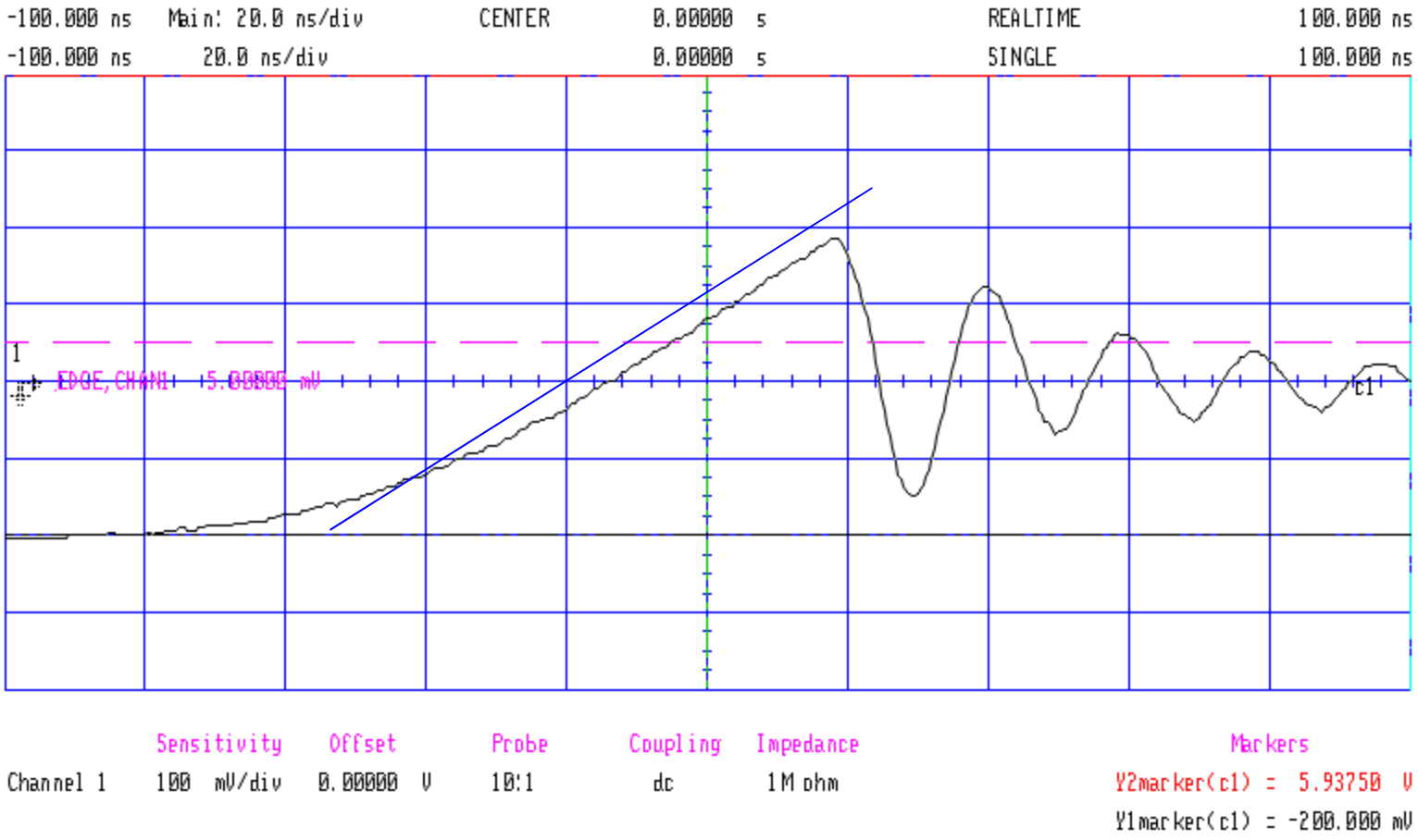
di/dt = 5/28 = 0.18A/ns IRR = 6A ta = 33ns

Results



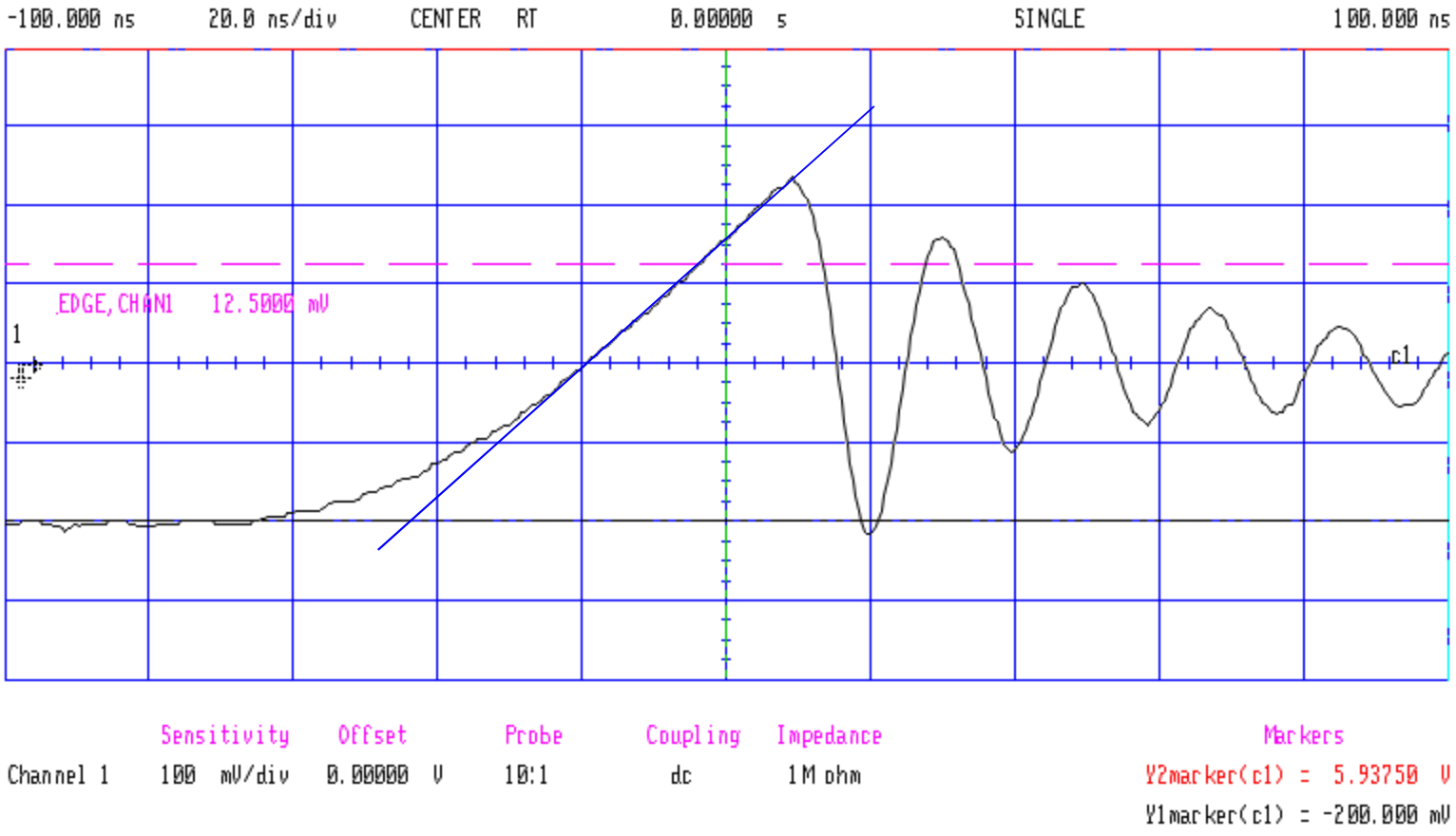
di/dt = 10/46 = 0.22A/ns IRR = 7A ta = 32ns

Results



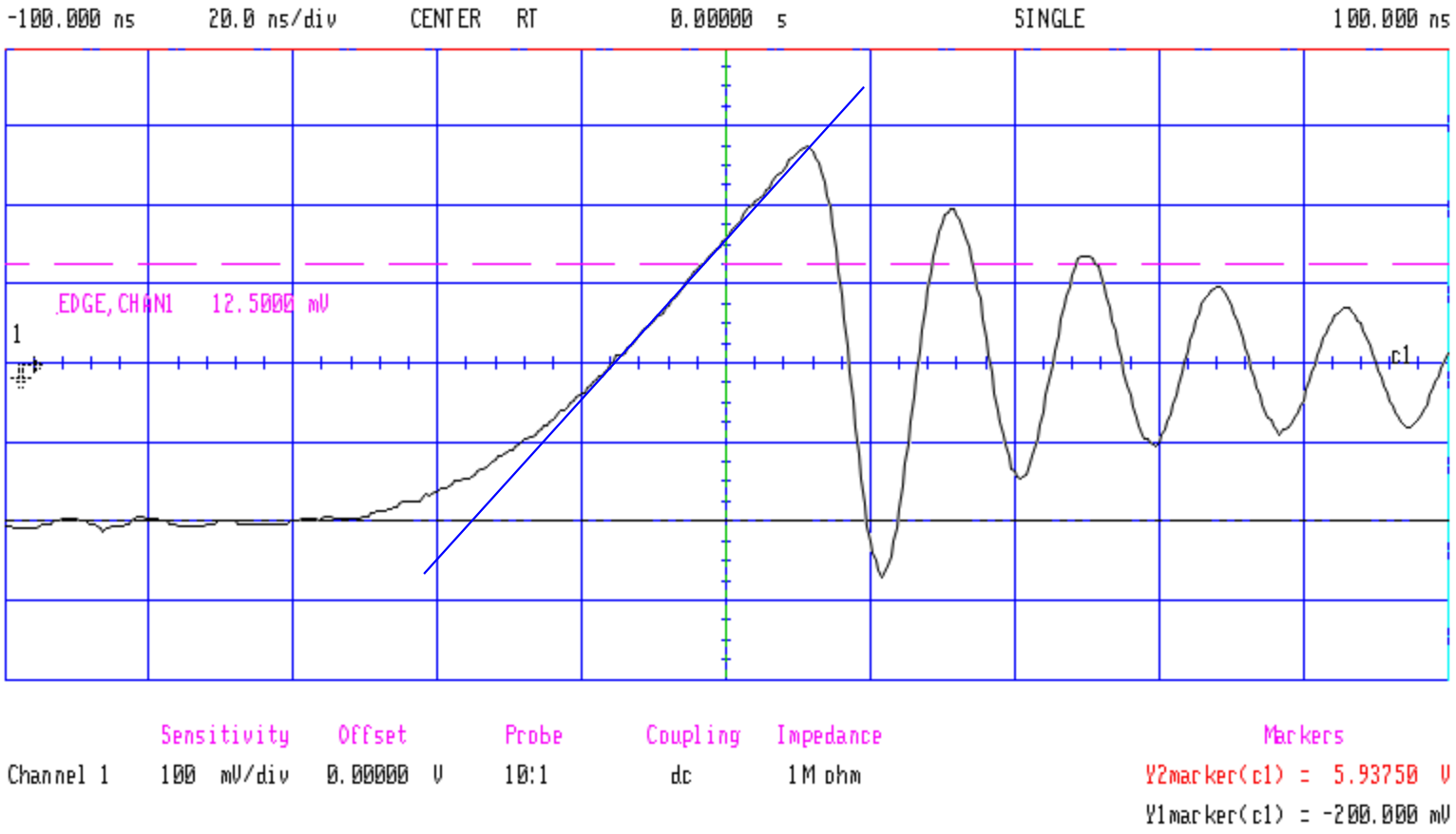
di/dt = 10/34 = 0.3A/ns IRR = 8.5A ta = 32ns

Results



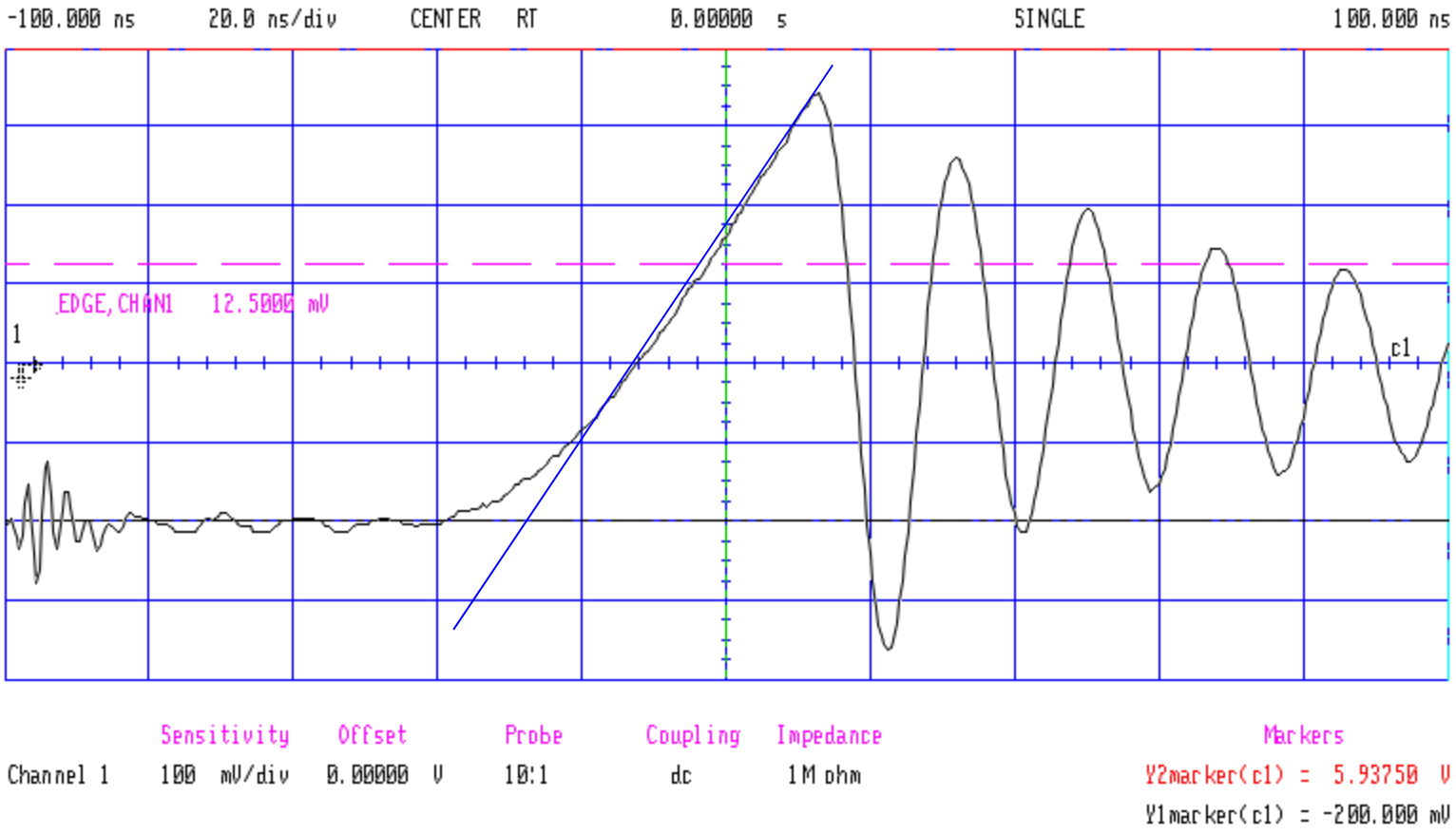
di/dt = 10/24 = 0.4A/ns IRR = 12A ta = 30ns

Results



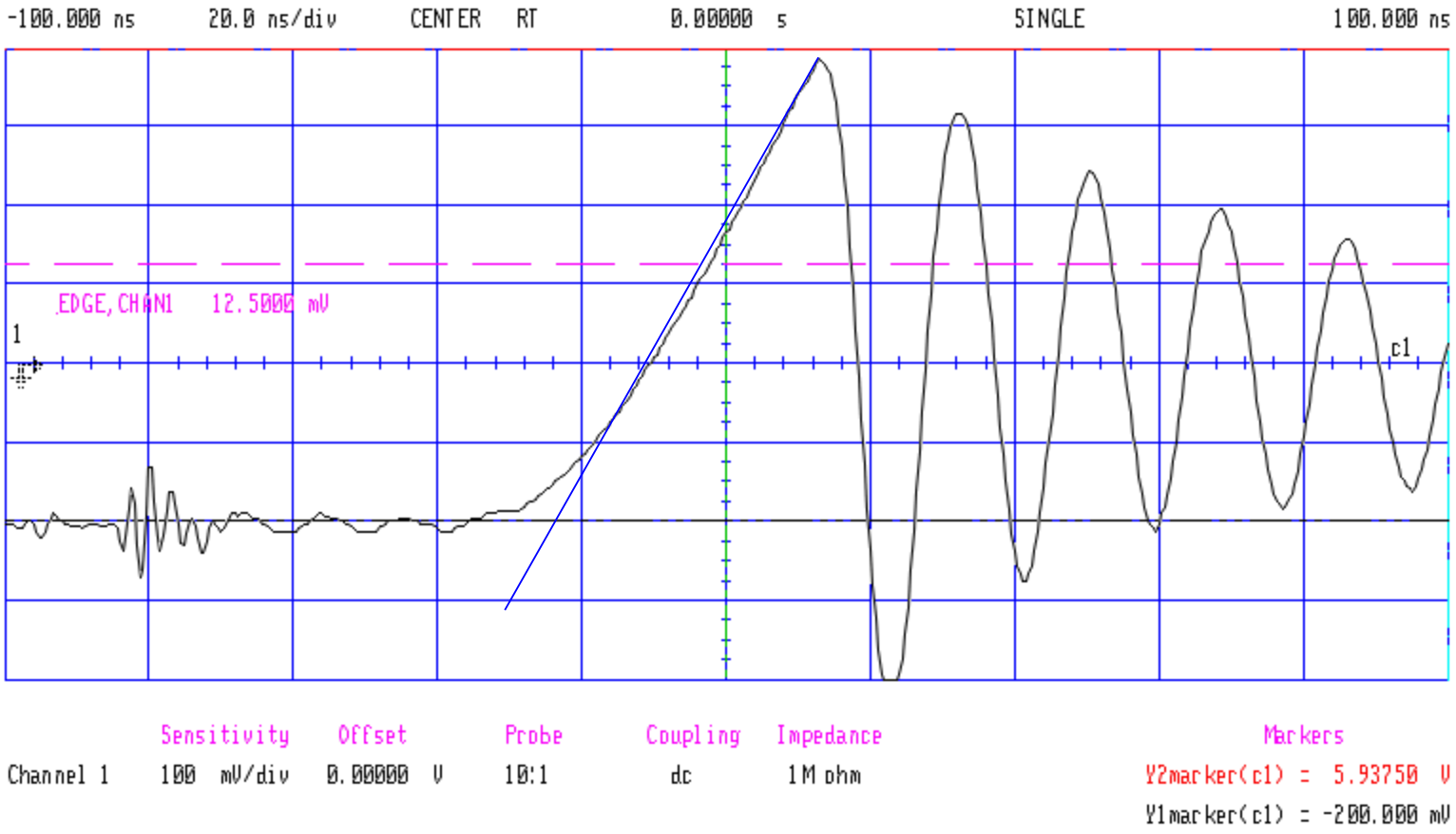
di/dt = 10/2 = 0.5A/ns IRR = 13.5A ta = 28ns

Results



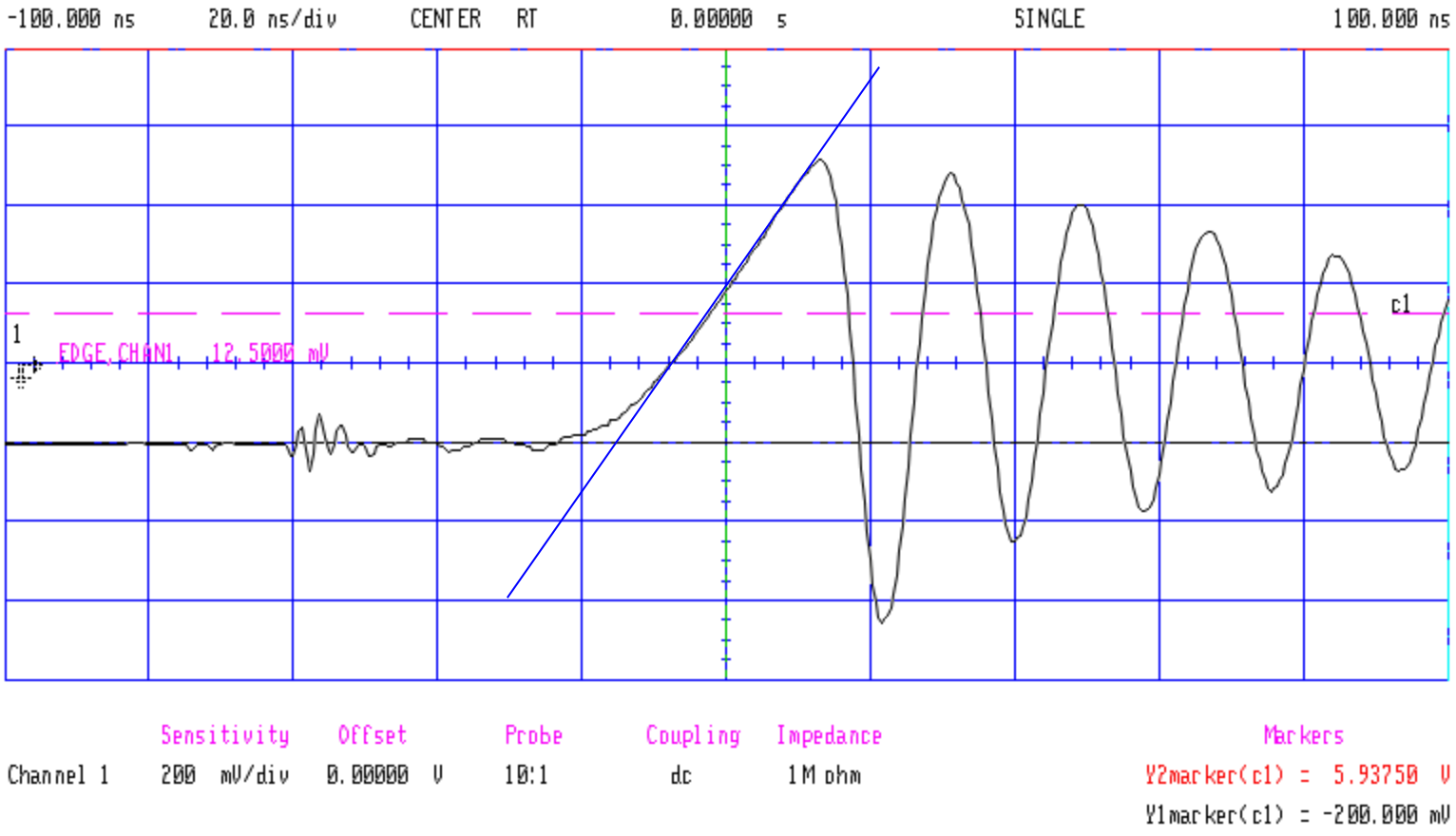
di/dt = 10/15 = 0.66A/ns IRR = 17A ta = 26ns

Results



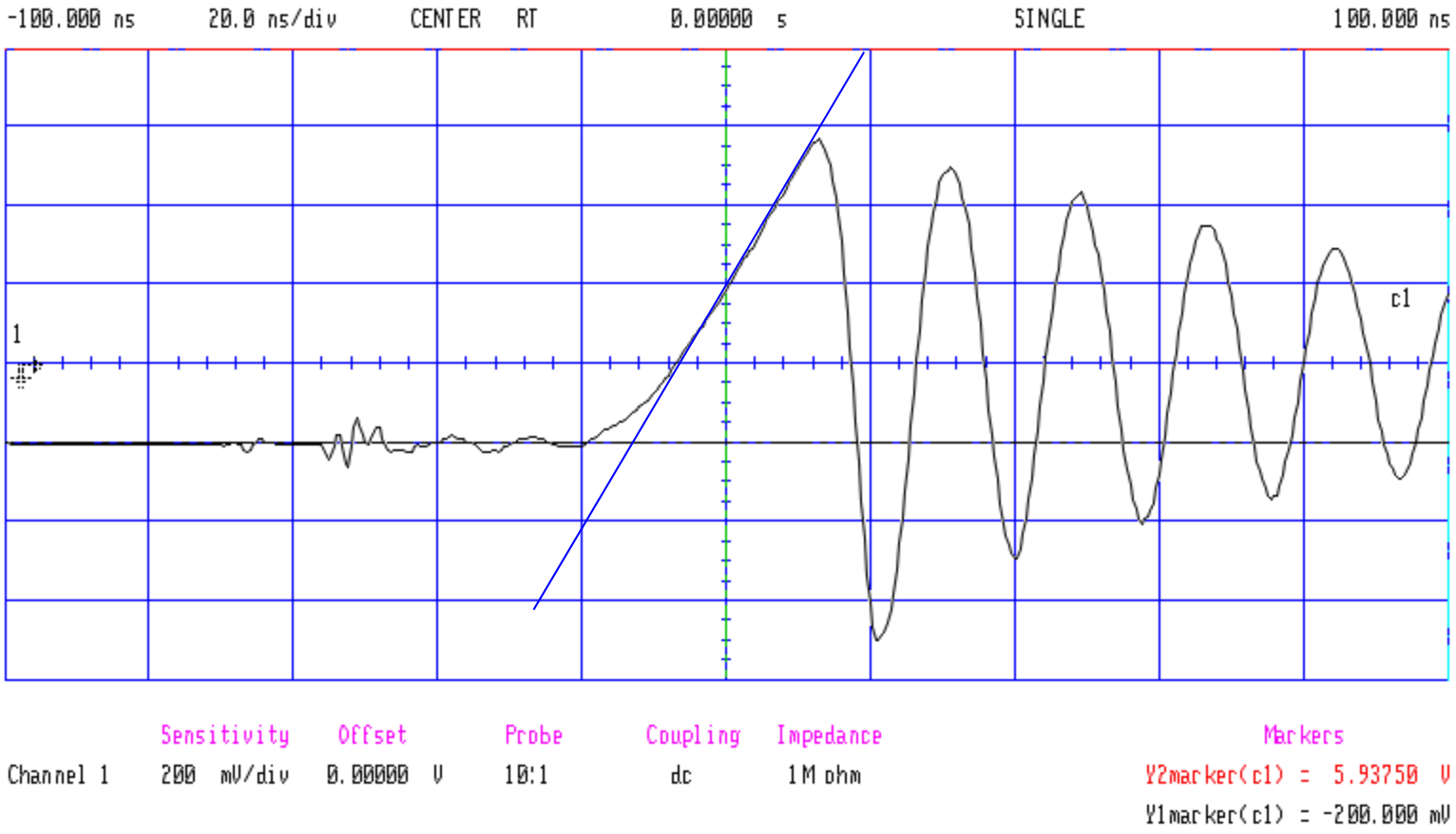
di/dt = 15/19 = 0.8A/ns IRR = 19A ta = 23ns

Results



di/dt = 20/14 = 1.4A/ns IRR = 25A ta = 21ns

Results



di/dt = 20/12 = 1.66A/ns IRR = 28A ta = 18ns

Summary of Results

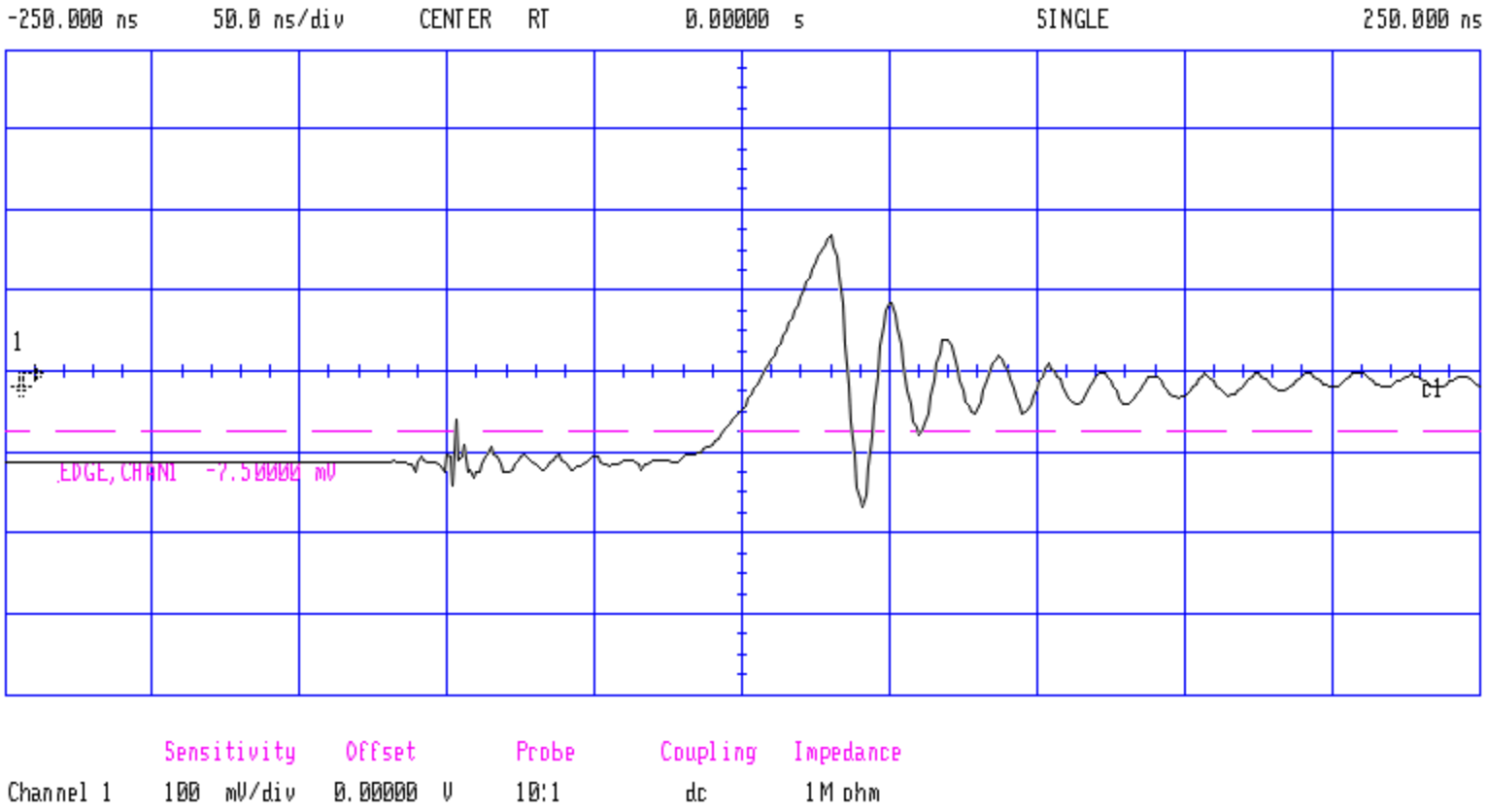
di/dt A/ns	irr A	ta ns	Qrr: 0.5 x irr x ta nC	Irr / di/dt
0.125	4	40	80	32
0.18	6	33	99	33.3
0.22	7	32	112	31.8
0.3	8.5	32	136	28.3
0.4	12	30	180	30
0.5	13.5	28	189	27
0.66	17	26	221	25.8
0.8	19	23	218.5	23.8
1.4	25	21	262.5	17.9
1.66	28	18	252	16.9

Conclusion: di/dt

- Irr increases nearly linearly with di/dt at di/dt <0.5A/ns
- At higher di/dt, Irr / didt decreases
  - At very high di/dt Irr is much lower than would be expected using classic fixed qrr model
- Likewise trr does not decrease as much as expected at high di/dt
  - Therefore Qrr does increase with di/dt for low di/dt (<~0.66A/ns)
  - Qrr does not seem to increase significantly with di/dt for dit/dt > 1 ns

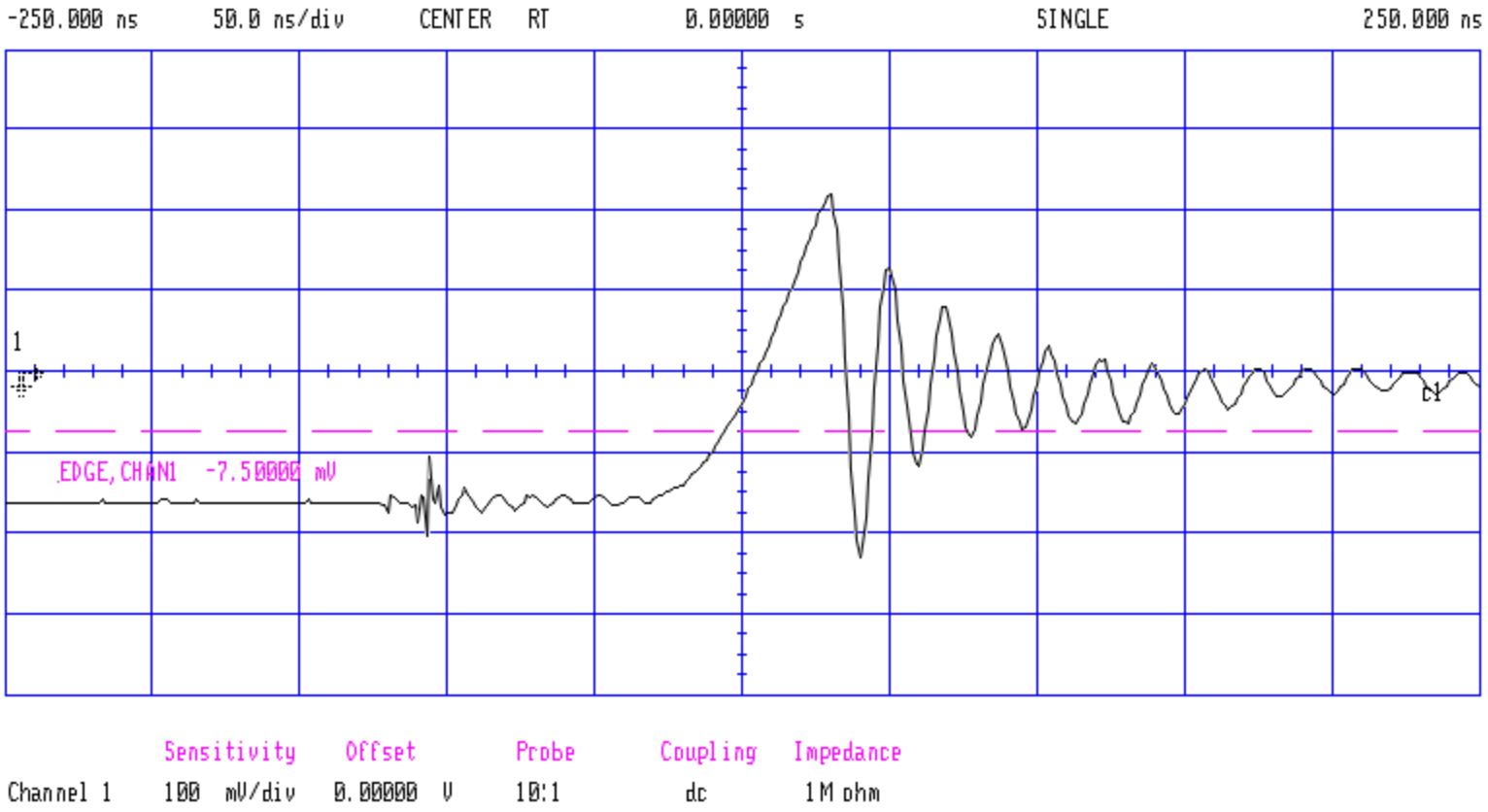
Effect of If on Irr

Results



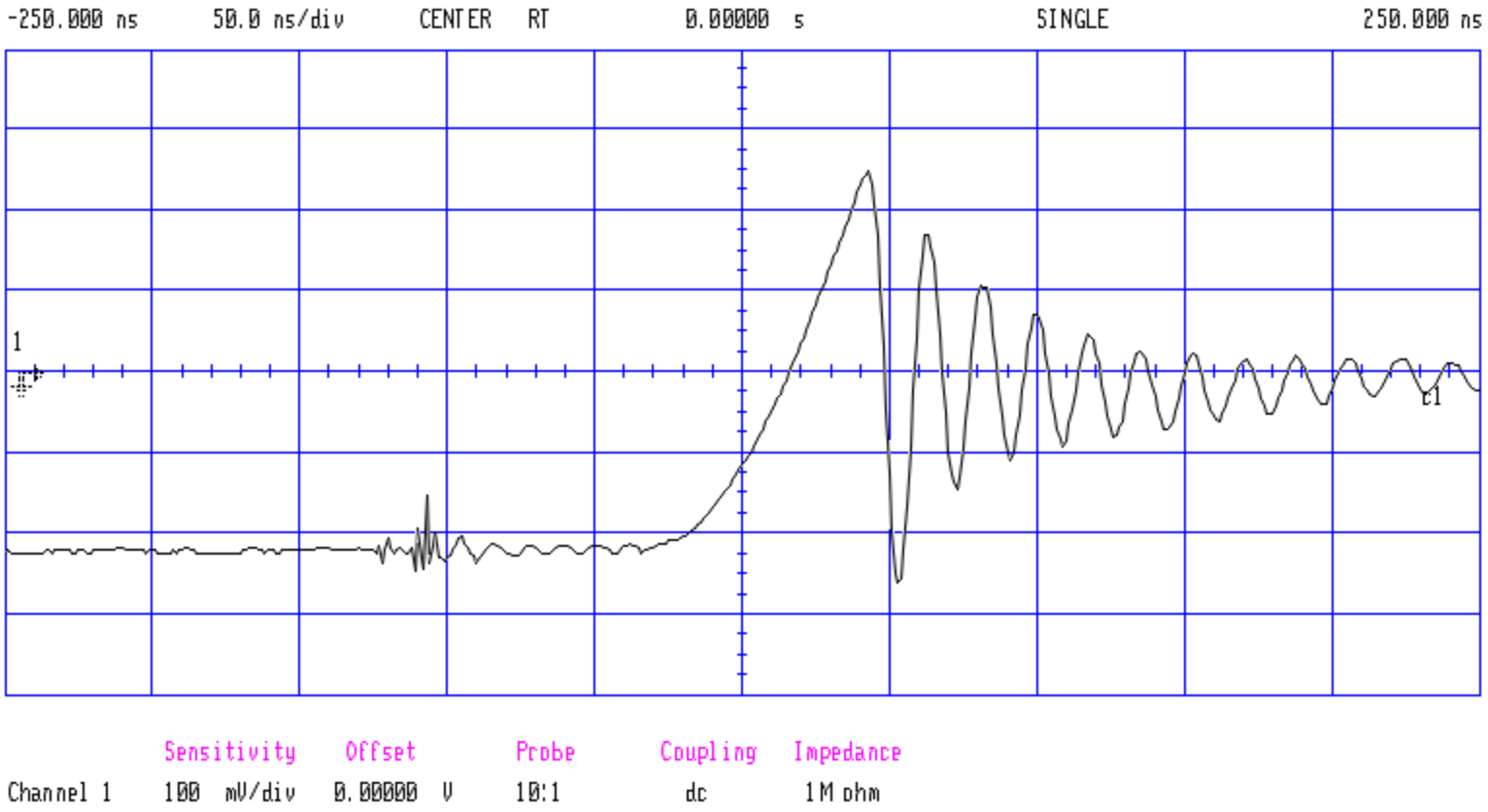
If = 6A, irr = 8A

Results



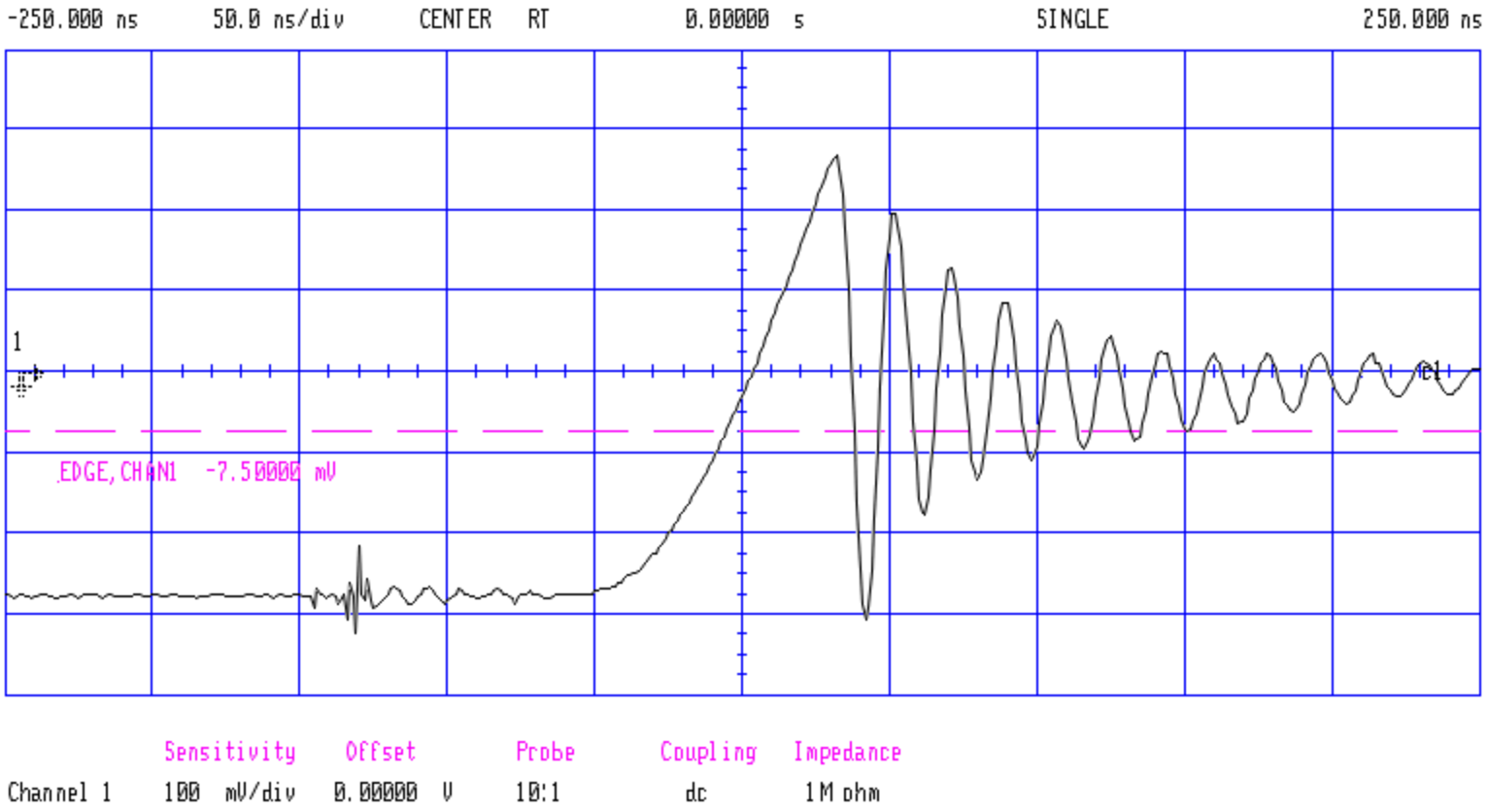
If = 8A, irr = 11A

Results



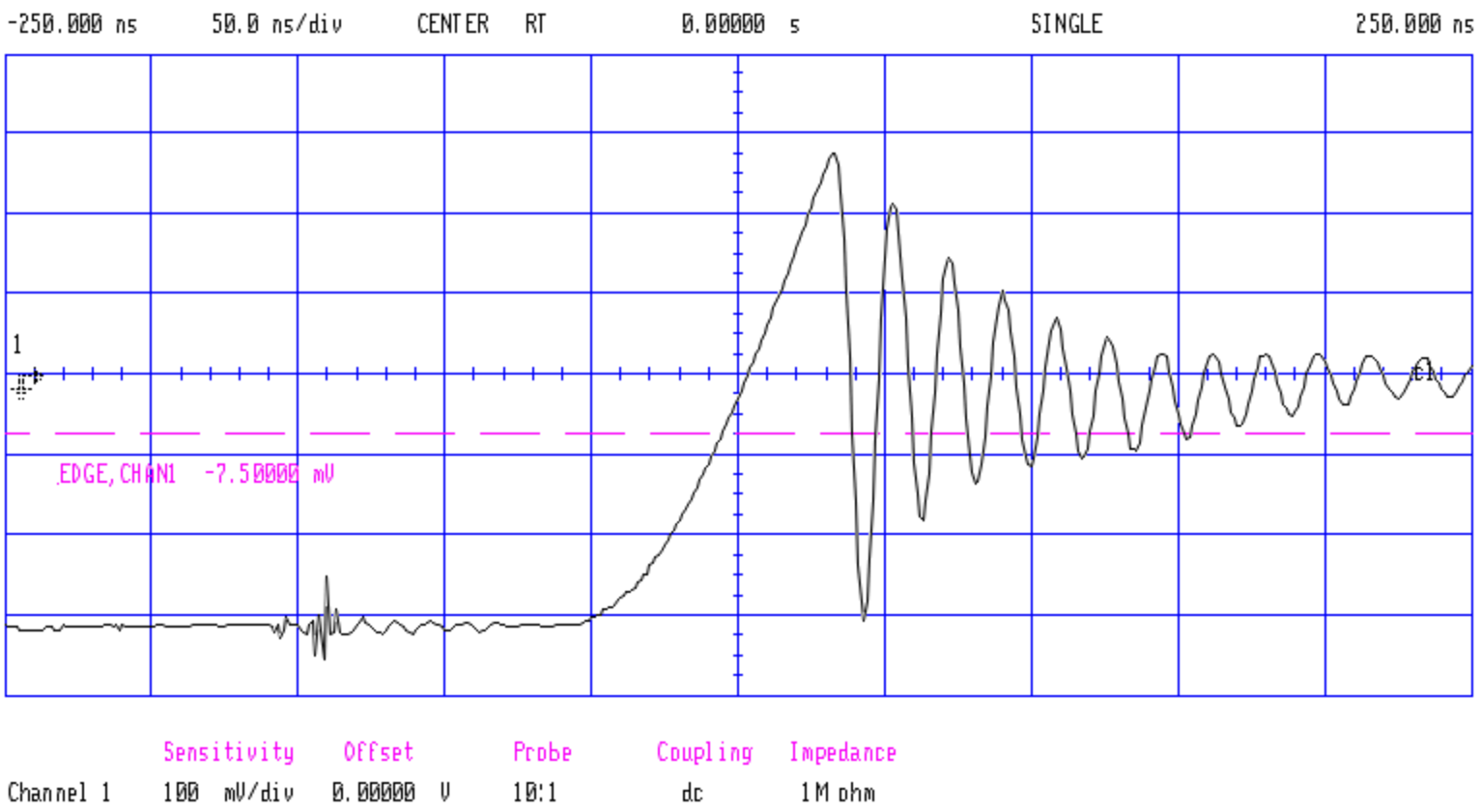
If = 12A, irr = 12.5A

Results



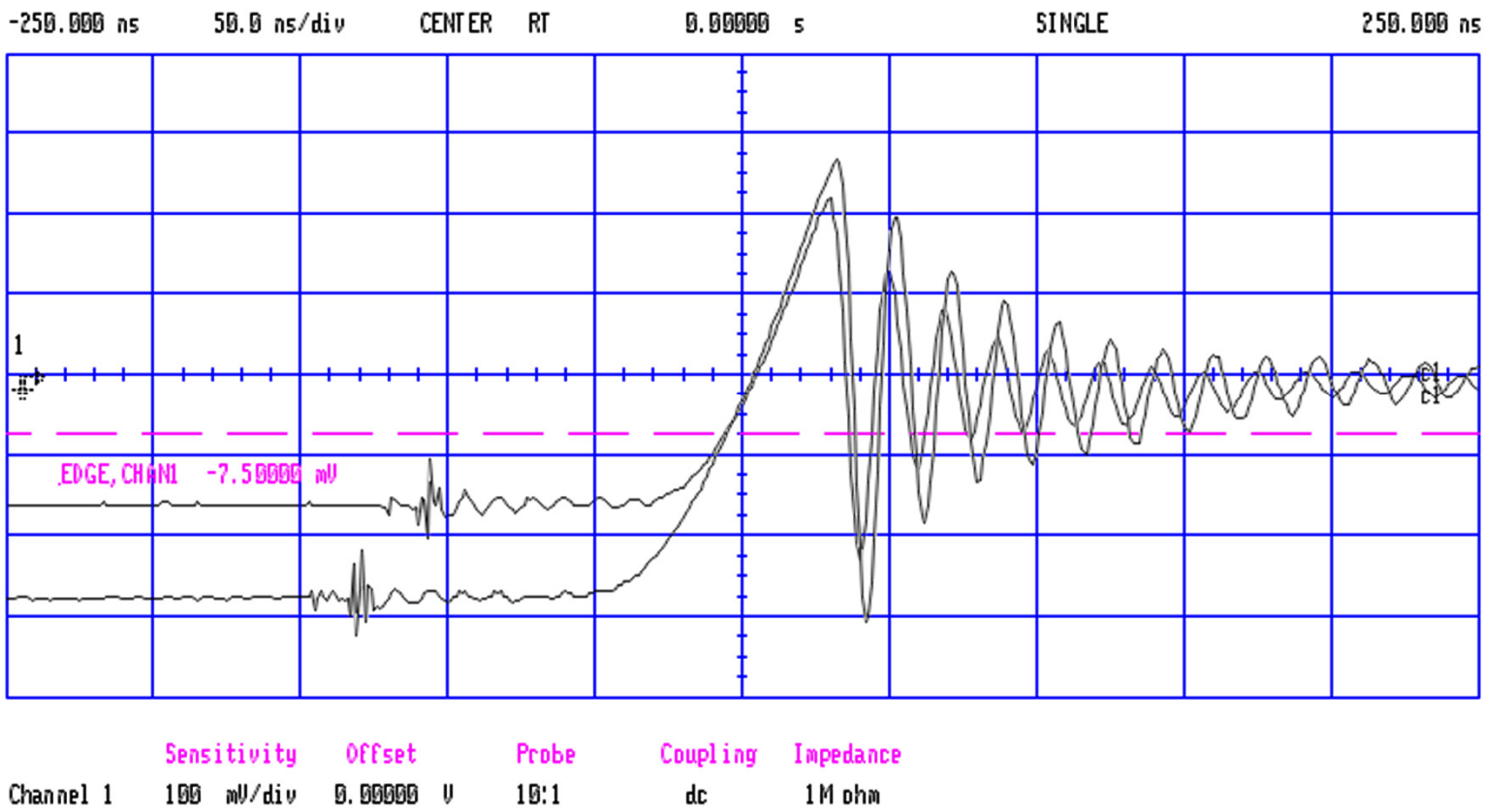
If = 14A, irr = 13A

Results



If = 16A, irr = 14A

Overlay



Di/dt changed as If is changed, magnifying the effect. Increase in irr due to IF is negligable

Conclusion

- At typical full load operating currents seen in DC DC converters, the increase in irr with current is fairly small
- At lower currents, say < half typical operating current, the irr does reduce as current is reduced