A Pathetically Simple Charge Sensitive Amplifier

The schematic above shows an extremely simple charge sensitive amplifier with only two active components. To my chagrin, this circuit performs almost as well as a more complicated circuit using an expensive 300 V/usec opamp. The whole thing was thrown together on a piece of perf board in about a half an hour, and it performed admirably as soon as the power was switched on. Mosfet Q1 is the main gain element. It is connected as a common source amplifier. Resistor R6 sets the quiescent current in Q1 to approximately 10 ma. Capacitor C3 bypasses R6 to boost high frequency gain. R4 sets the bias point of emitter follower Q2, and acts to set the gain of the input stage. Inductor L1 further boosts high frequency gain without affecting the bias point of Q2. Transistor Q2 buffers the output signal. Resistor R3 provides DC feedback to help set the Q1 bias point, and also resets charge storage capacitor C1. Capacitor C2 provides input DC isolation. It is located inside the AC feedback loop to reduce its effect on the input signal. Resistor R1, D1, and D2 protect the Q1 gate from high voltage transients. R2 helps prevent high frequency oscillations in Q1. It may be possible to reduce R2 to boost the slew rate of Q1 – 47 ohms was a rough-cut first choice. R5 isolates Q2 from Q1 and helps to prevent high frequency parasitic oscillations in Q2. R7 sets the Q2 bias current to approximately 5 ma. The oscilloscope trace shows the output of this amplifier when driven by an NaI(Tl) scintillator. The output decay time is almost exactly the time constant of C1 and R3 (27 usec).