

Stepper Motor System with Medium Torque Drive

Tests performed:

1. Torque versus Regulated Current
2. Maximum RPM
3. Thermal Imaging
4. Current waveforms using 12V, 700mA, 100 RPM
 - a. Full step, fast decay with synchronous rectification
 - b. Full step, fast decay without synchronous rectification
 - c. Full step, mixed decay (DECAY = 1V)
 - d. Full step, mixed decay (DECAY = 1.3V)
 - e. Full step, slow decay
 - f. 1/2 microstep, fast decay with synchronous rectification
 - g. 1/2 microstep, fast decay without synchronous rectification
 - h. 1/2 microstep, mixed decay (DECAY = 1V)
 - i. 1/2 microstep, mixed decay (DECAY = 1.3V)
 - j. 1/2 microstep, slow decay
 - k. 1/4 microstep, fast decay with synchronous rectification
 - l. 1/4 microstep, fast decay without synchronous rectification
 - m. 1/4 microstep, mixed decay (DECAY = 1V)
 - n. 1/4 microstep, mixed decay (DECAY = 1.3V)
 - o. 1/4 microstep, slow decay
 - p. 1/8 microstep, fast decay with synchronous rectification
 - q. 1/8 microstep, fast decay without synchronous rectification
 - r. 1/8 microstep, mixed decay (DECAY = 1V)
 - s. 1/8 microstep, mixed decay (DECAY = 1.3V)
 - t. 1/8 microstep, slow decay
5. Current ramp rate versus VM
 - a. VM = 8V
 - b. VM = 12V
 - c. VM = 20V
6. Current regulation (zoomed-in)
 - a. Fast decay with synchronous rectification, $t_{OFF} = 20\mu s$
 - b. Fast decay with synchronous rectification, $t_{OFF} = 47\mu s$
 - c. Fast decay without synchronous rectification, $t_{OFF} = 47\mu s$
 - d. Mixed decay (DECAY = 1V), $t_{OFF} = 47\mu s$
 - e. Mixed decay (DECAY = 1.3V), $t_{OFF} = 47\mu s$
 - f. Slow decay, $t_{OFF} = 47\mu s$
 - g. $t_{BLANK} = 1.4\mu s$, Fast decay
 - h. $t_{BLANK} = 1.4\mu s$, Mixed decay (DECAY = 1V)
 - i. $t_{BLANK} = 1.4\mu s$, Mixed decay (DECAY = 1.7V)
 - j. $t_{BLANK} = 7\mu s$, Fast decay
 - k. $t_{BLANK} = 7\mu s$, Mixed decay (DECAY = 1V)
 - l. $t_{BLANK} = 7\mu s$, Mixed decay (DECAY = 1.7V)

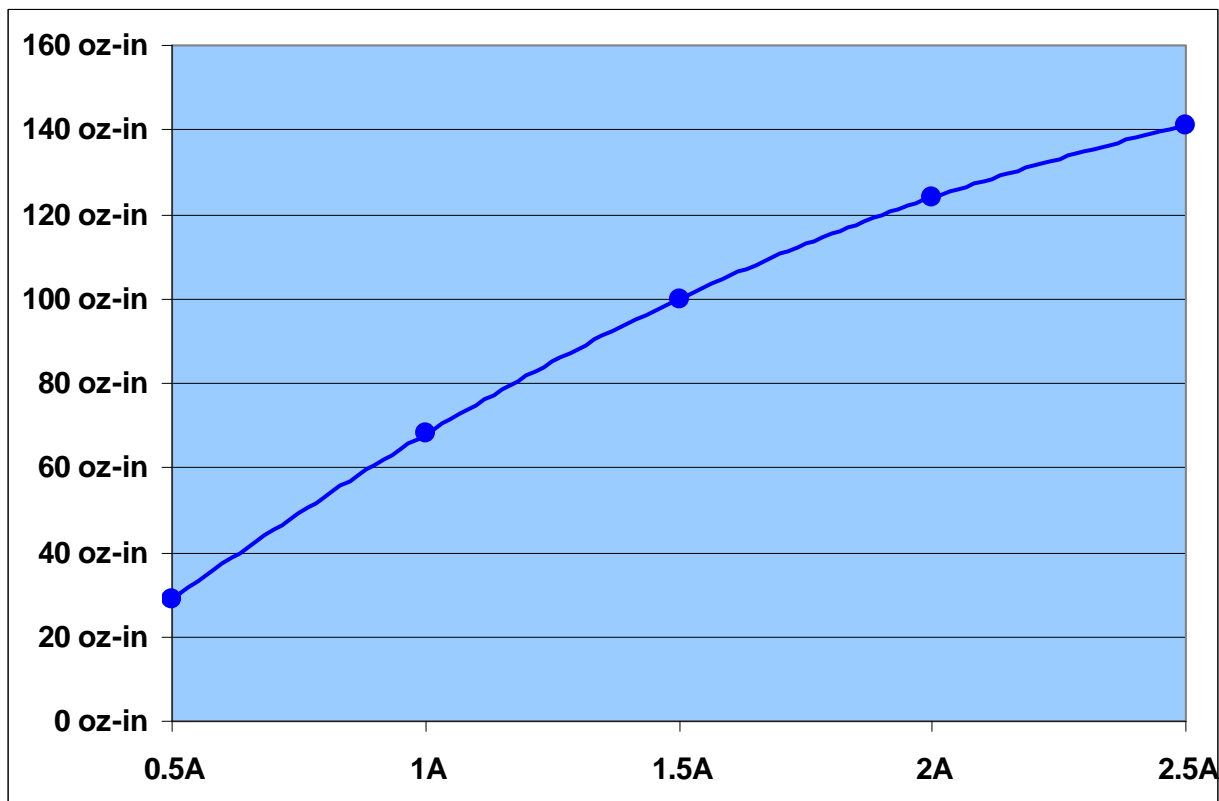
Recommended baseline settings:

1/8 microstep, synchronous rectification enabled, mixed decay with DECAY = 1V, $I_{CHOP} = 700\text{mA}$, $t_{OFF} = 47\mu\text{s}$, $t_{BLANK} = 1.4\mu\text{s}$, STEP frequency = 2.7kHz.

Section 1: Torque versus Regulated Current

Data was collected at 60 RPM, 1/2 microstep, using a magnetic particle brake load. Loading was increased until rotor stall. These torque values are approximations.

I_{CHOP}	Torque	
0.5A	29 oz-in	205 mNm
1A	68 oz-in	480 mNm
1.5A	100 oz-in	703 mNm
2A	124 oz-in	876 mNm
2.5A	141 oz-in	994 mNm



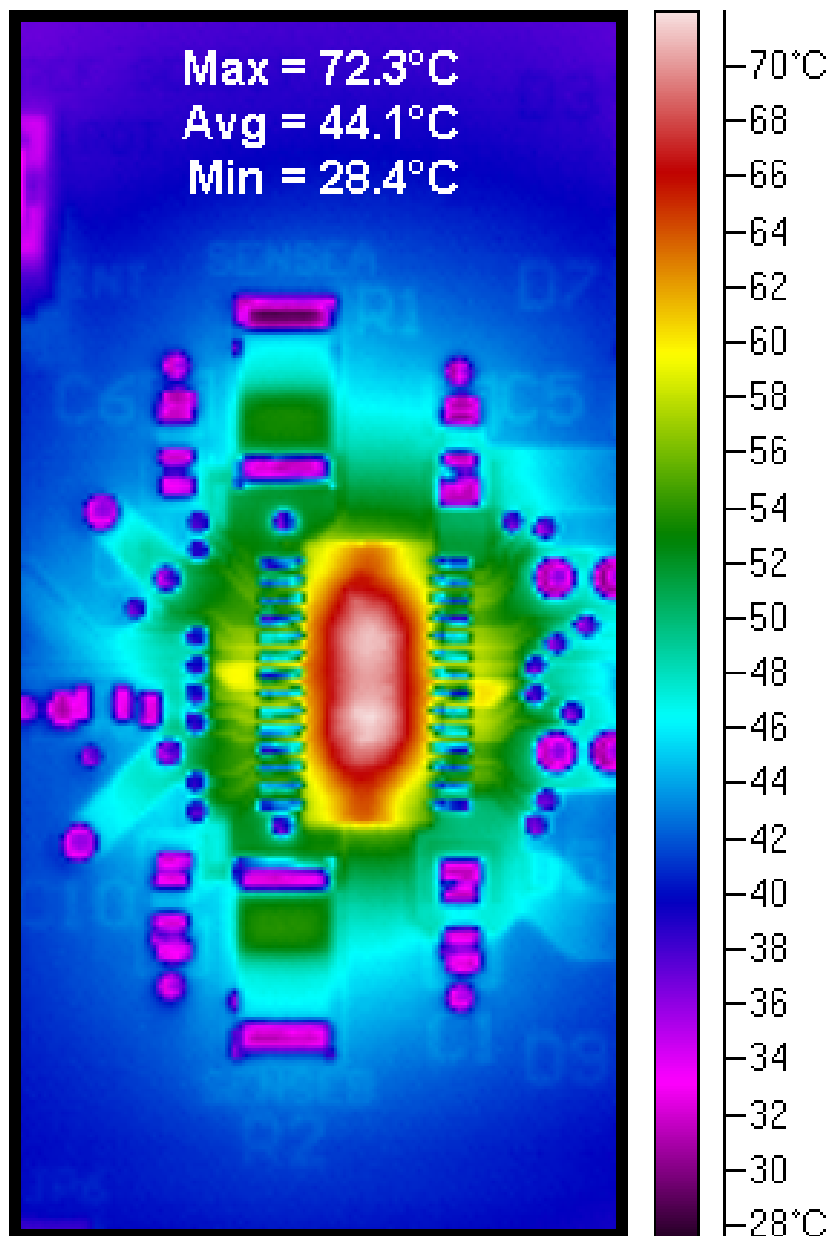
Section 2: Maximum RPM

Using $V_M = 12V$, 1/8 microstepping, and $I_{CHOP} = 0.92A$:

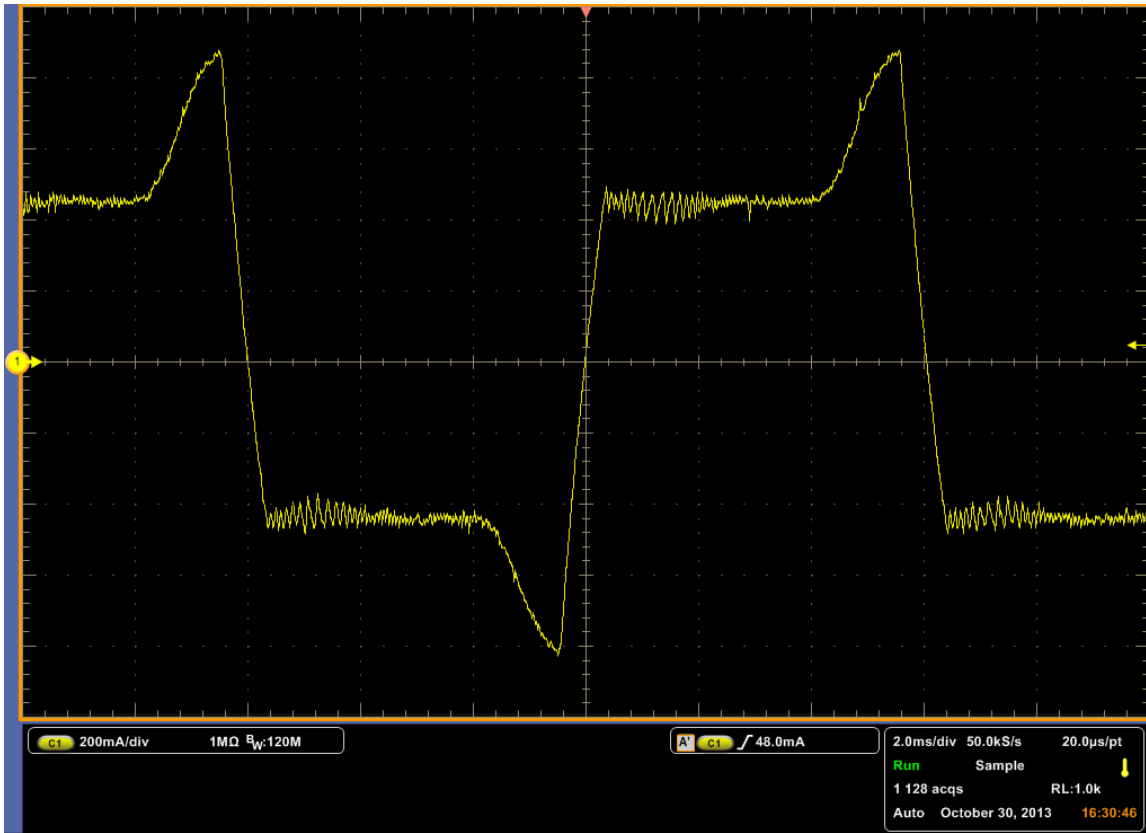
855 RPM

Section 3: Thermal Imaging

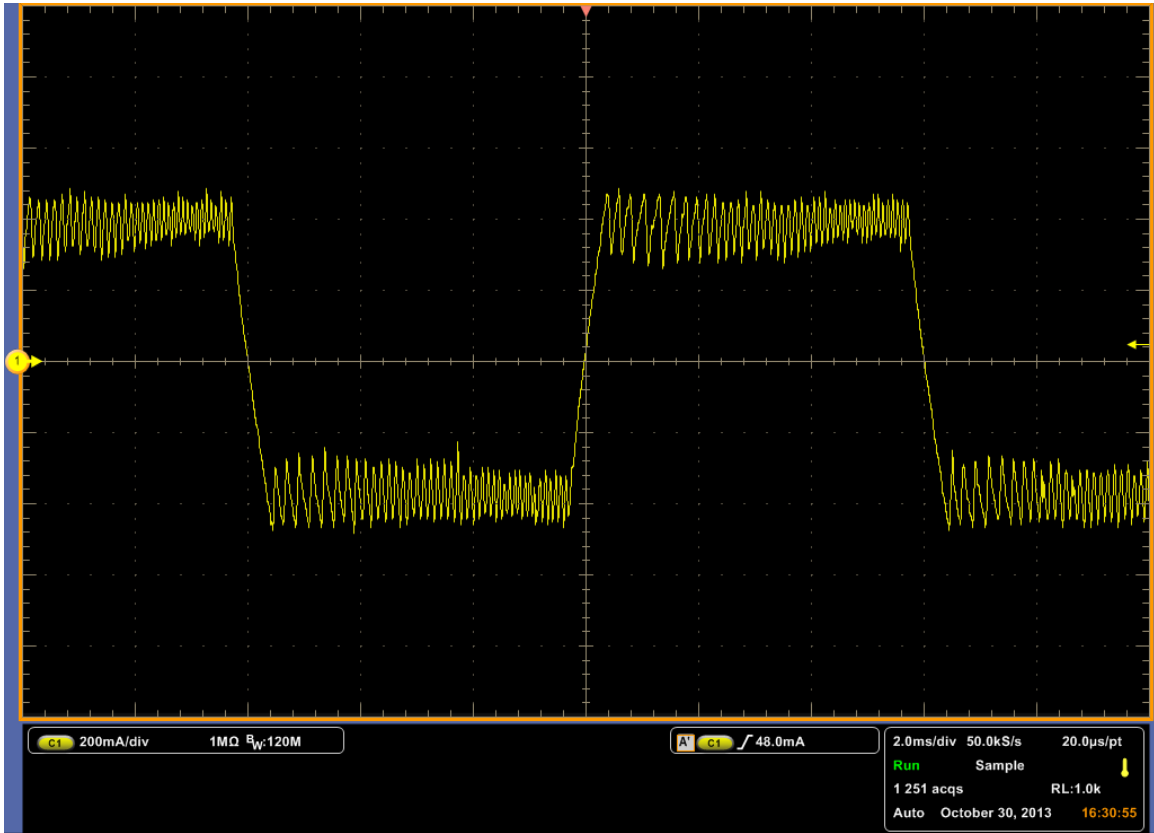
Data was collected with $V_M = 12V$, $I_{CHOP} = 2.5A$.



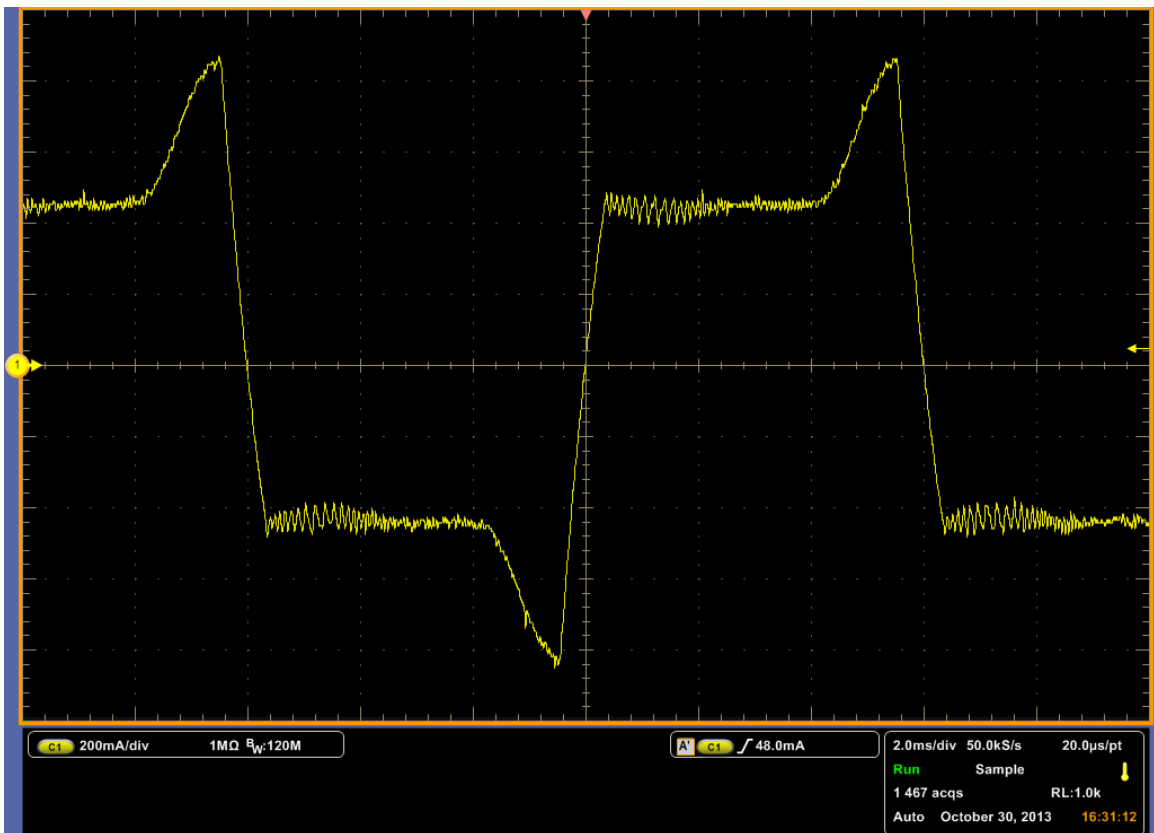
Section 4: Current waveforms using 12V, 700mA, 100 RPM



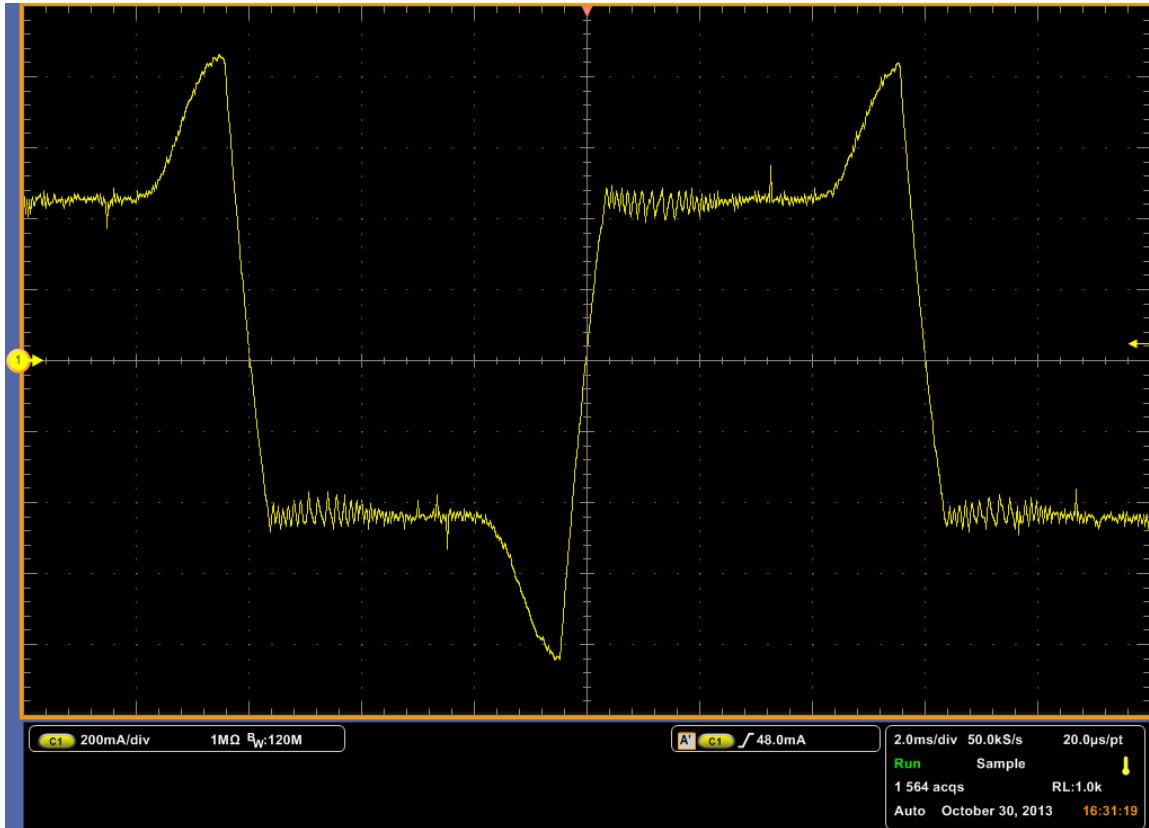
Full step, fast decay with synchronous rectification



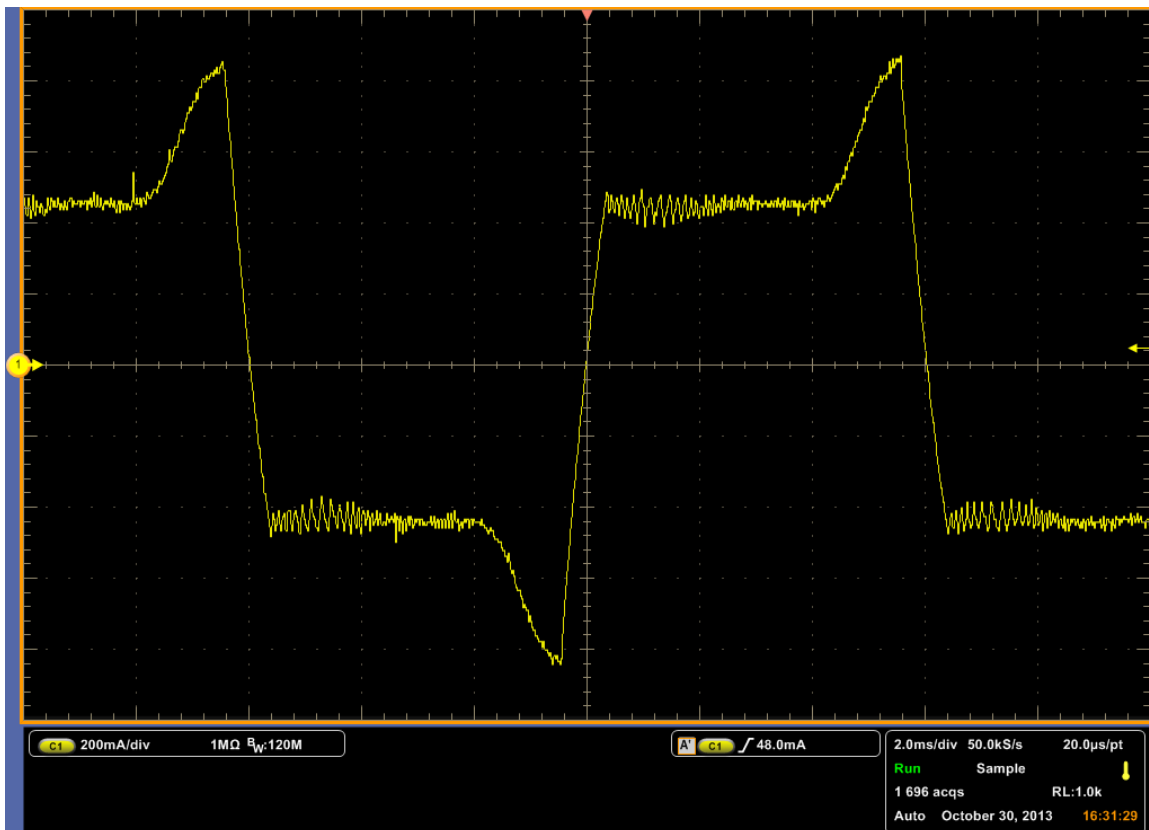
Full step, fast decay without synchronous rectification



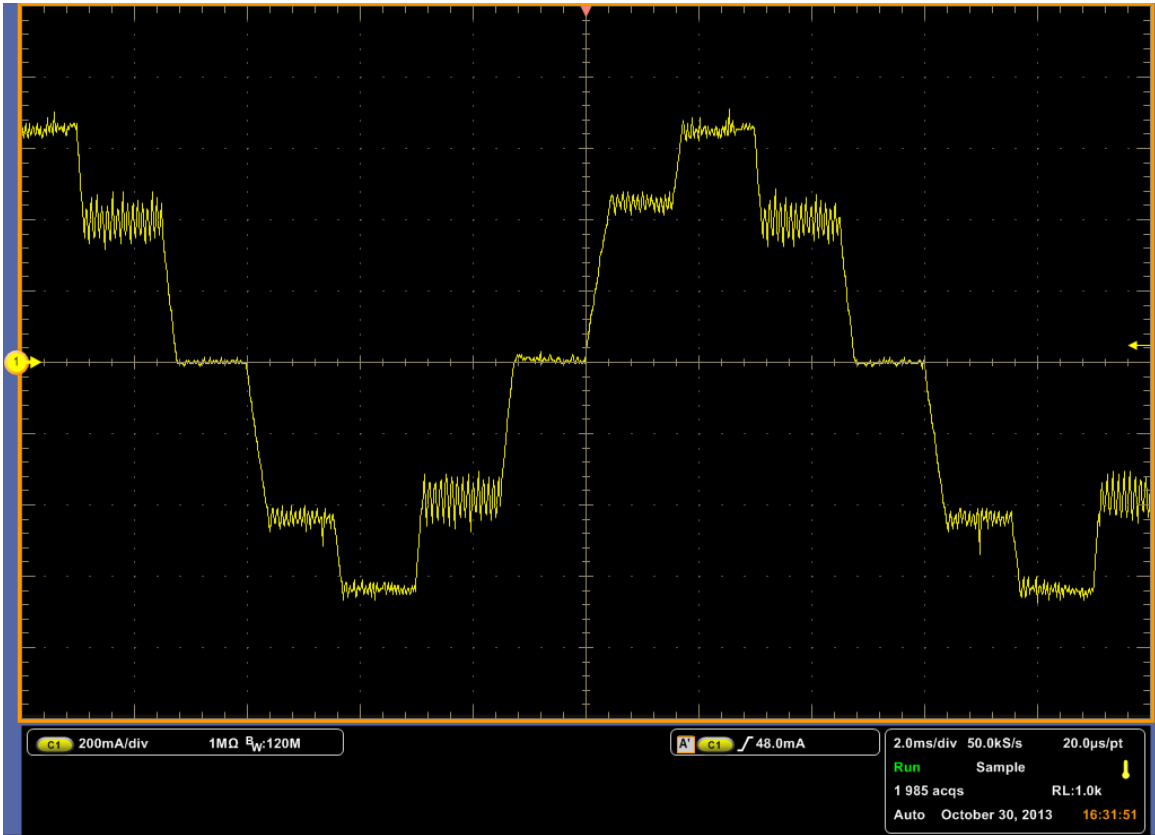
Full step, mixed decay (DECAY = 1V)



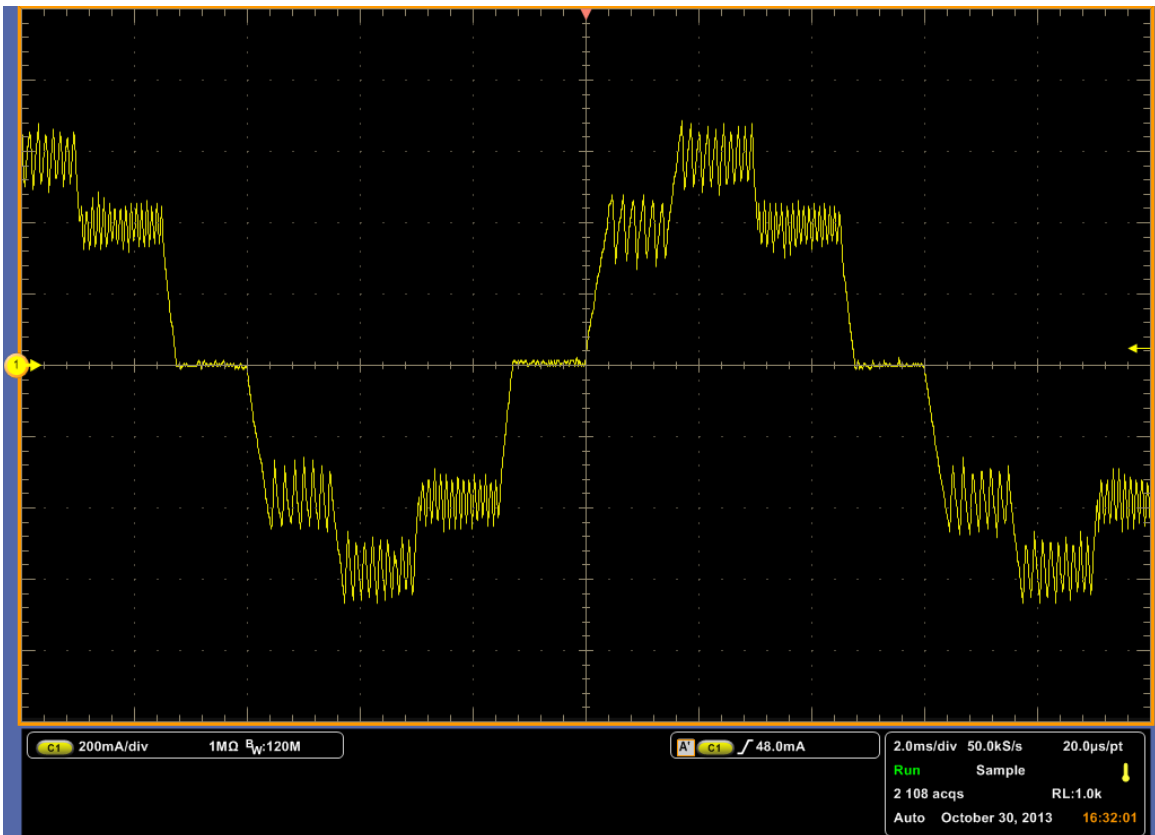
Full step, mixed decay (DECAY = 1.3V)



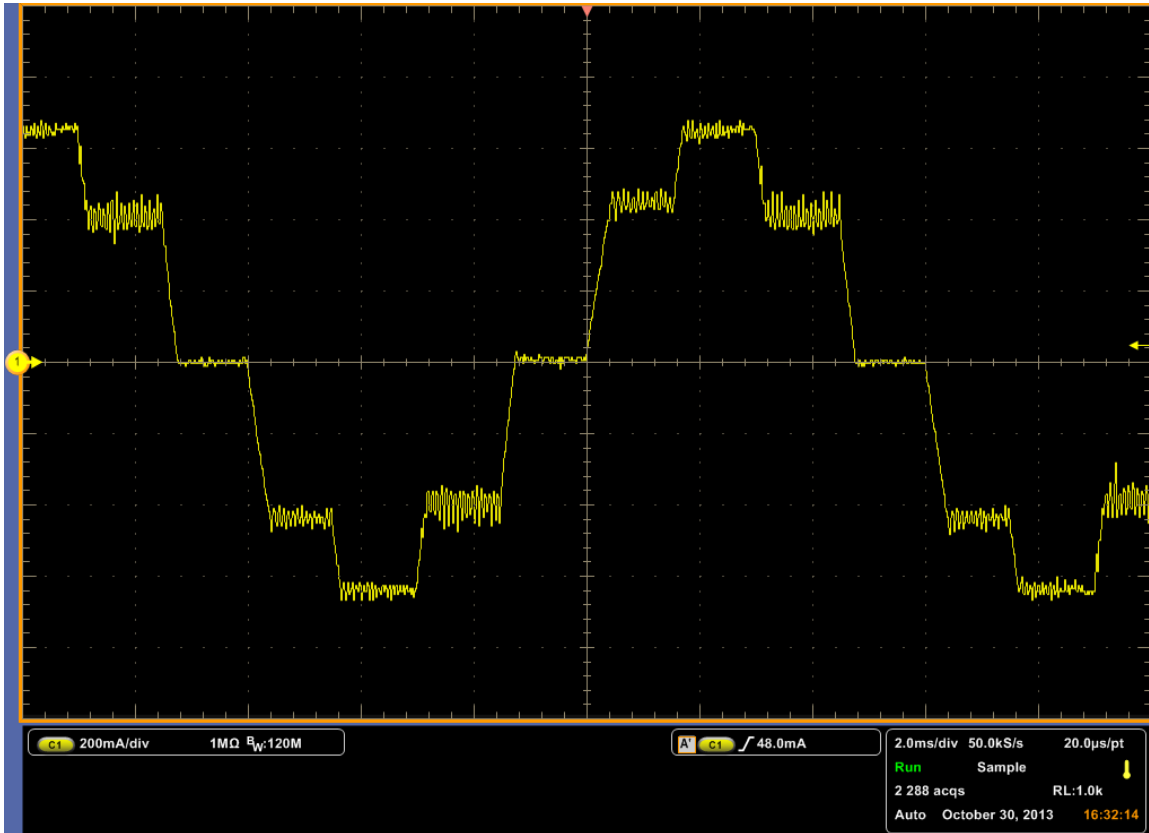
Full step, slow decay



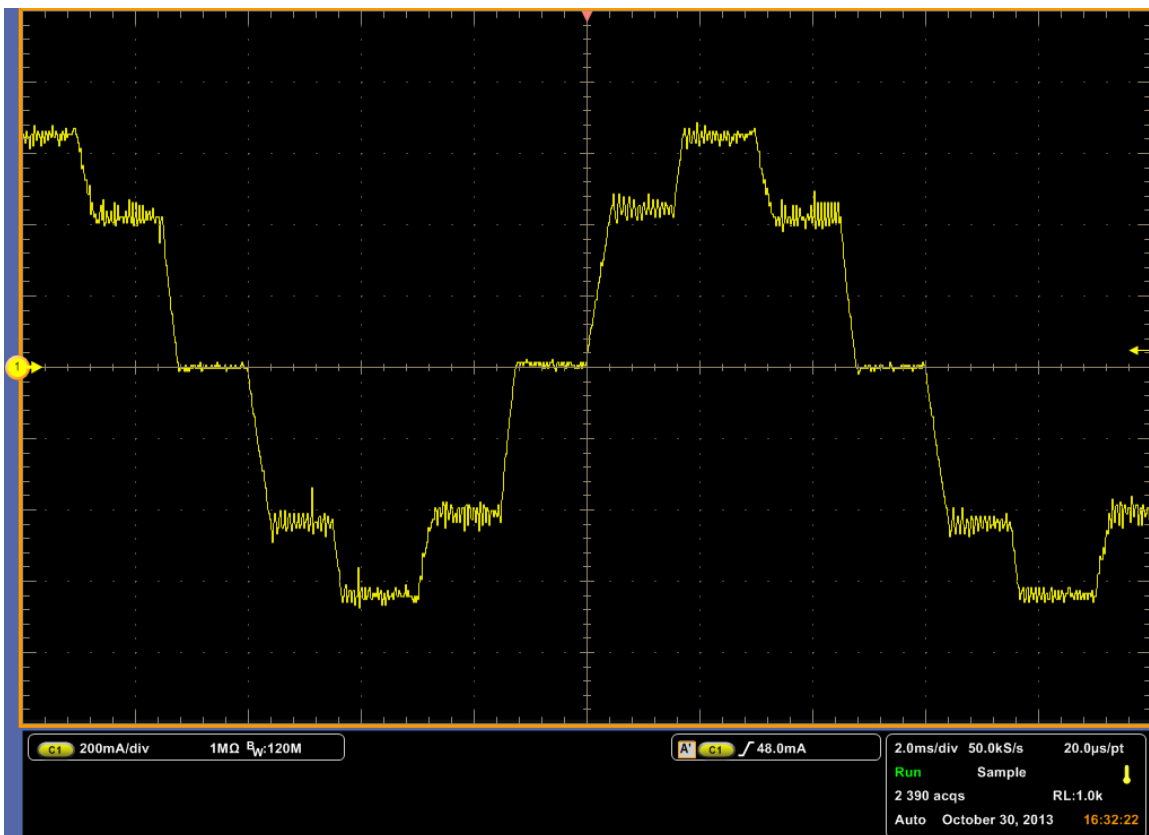
1/2 microstep, fast decay with synchronous rectification



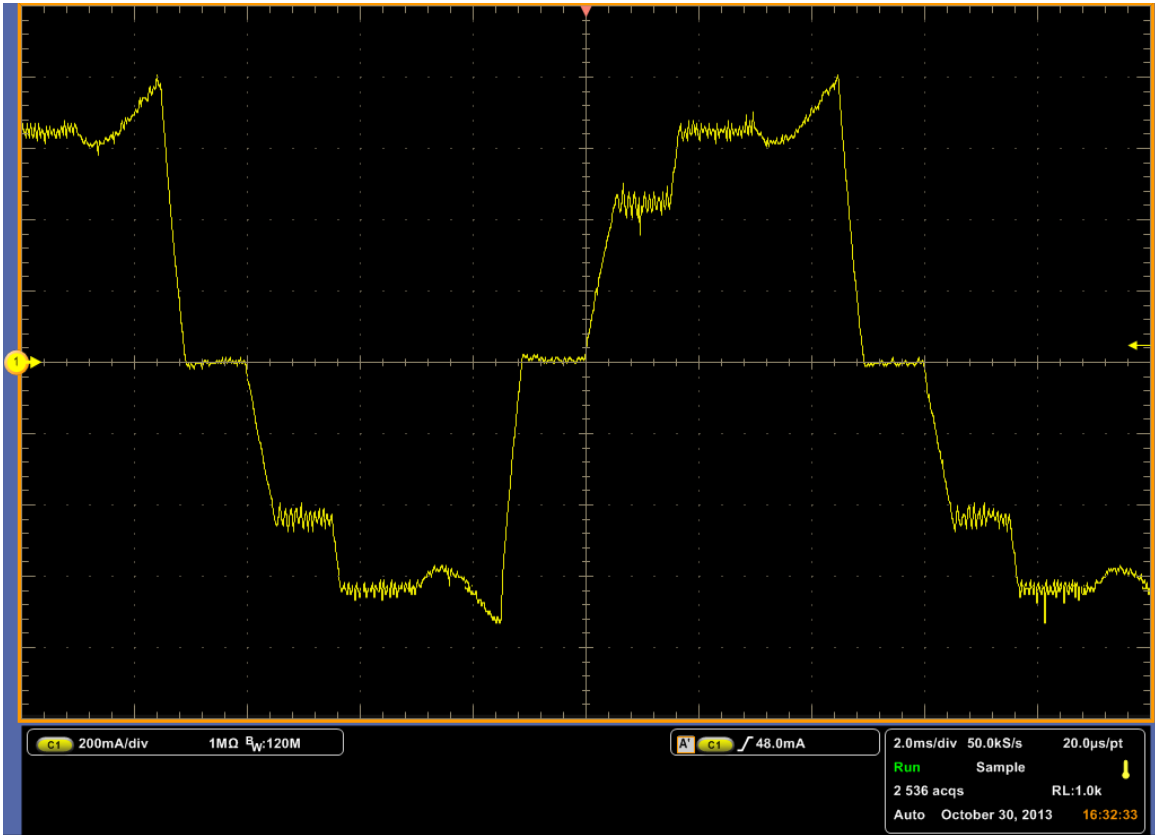
1/2 microstep, fast decay without synchronous rectification



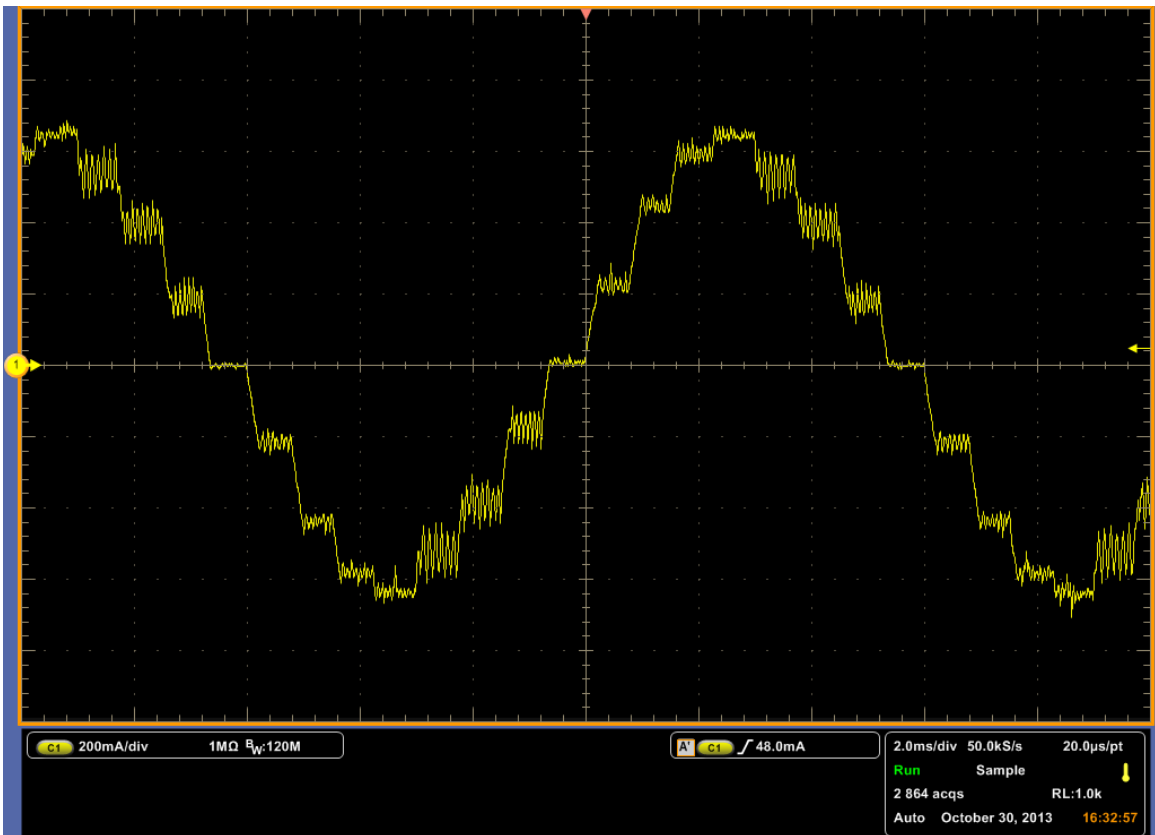
1/2 microstep, mixed decay (DECAY = 1V)



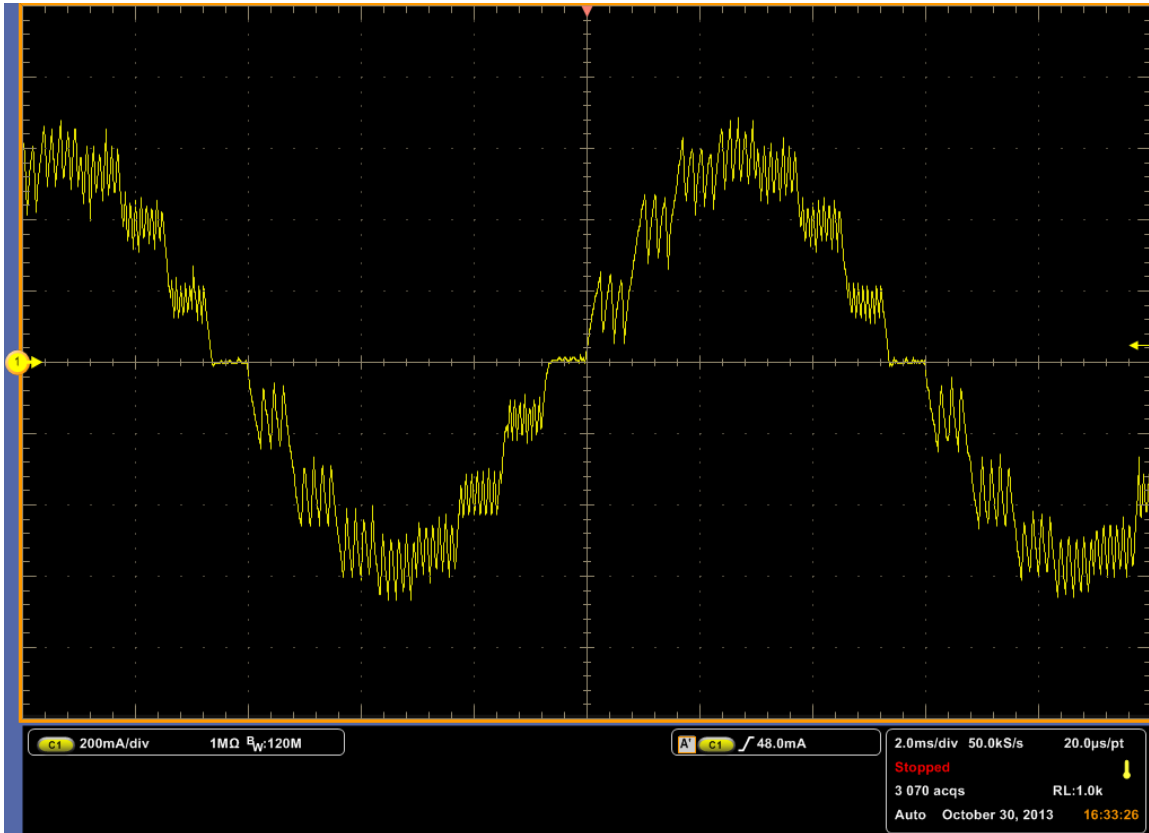
1/2 microstep, mixed decay (DECAY = 1.3V)



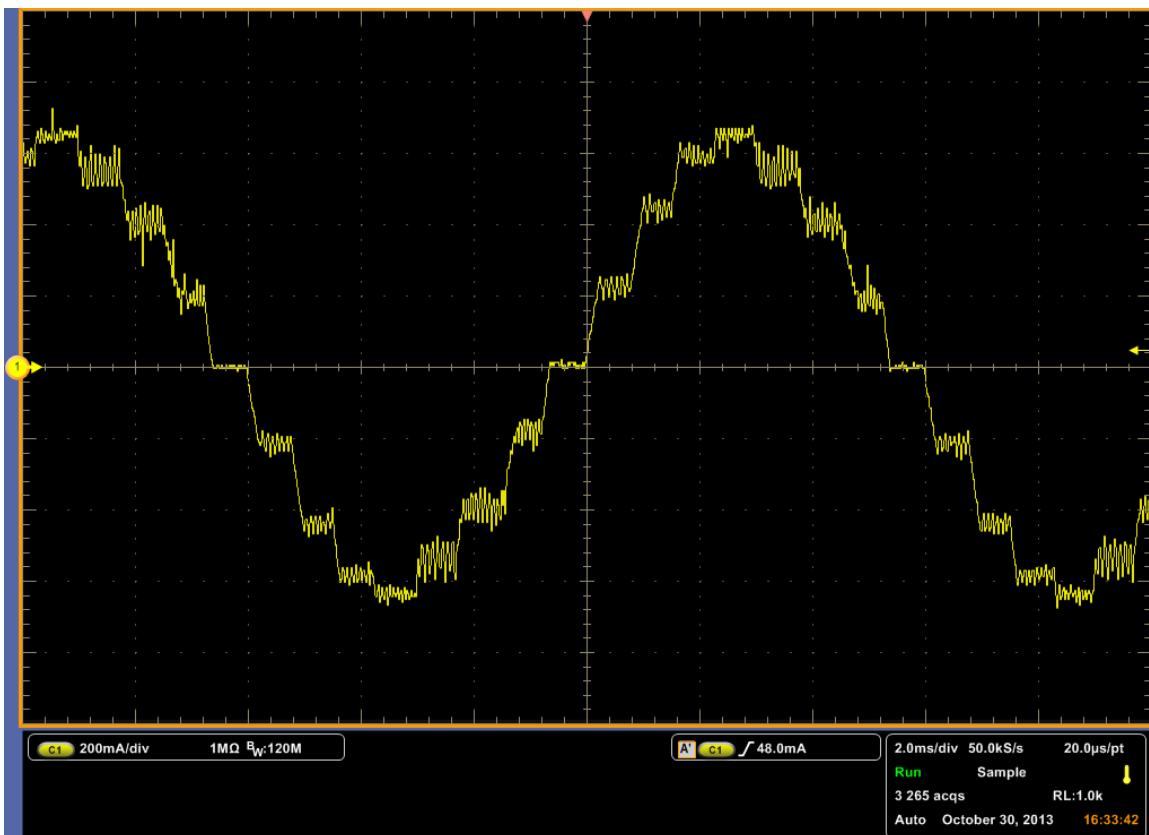
1/2 microstep, slow decay



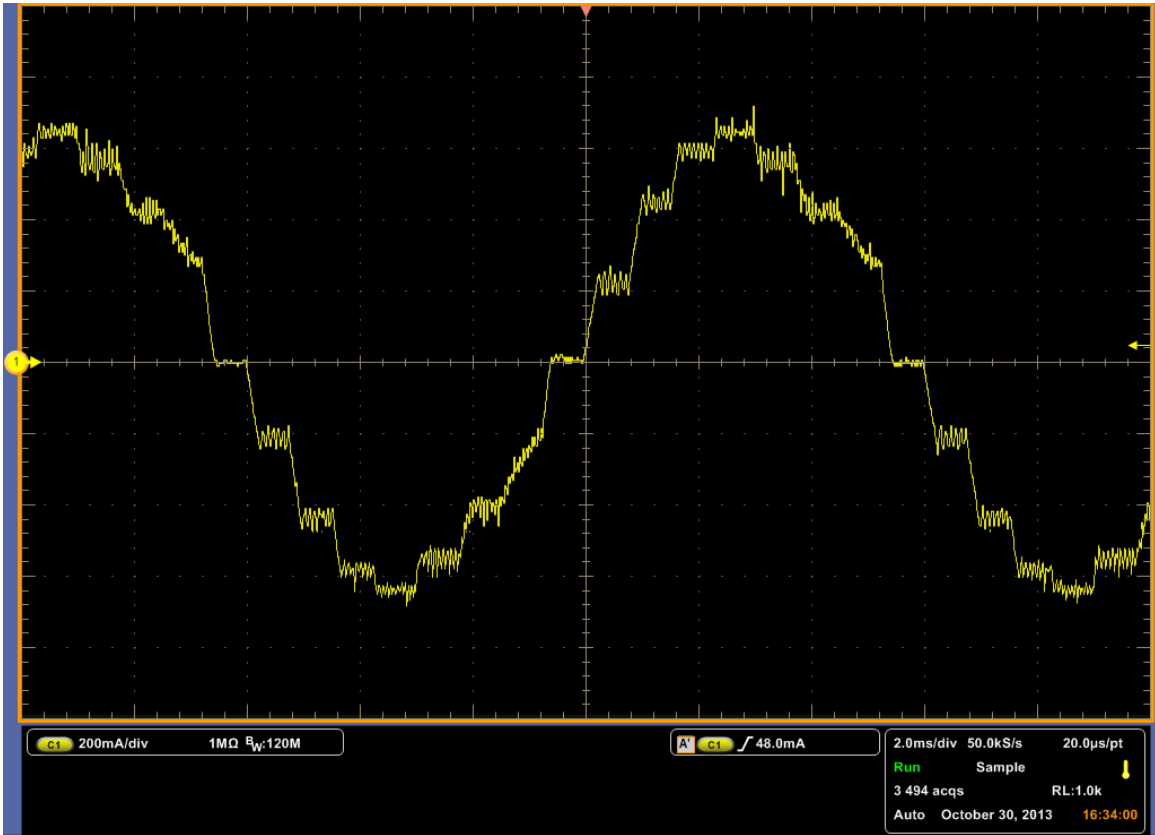
1/4 microstep, fast decay with synchronous rectification



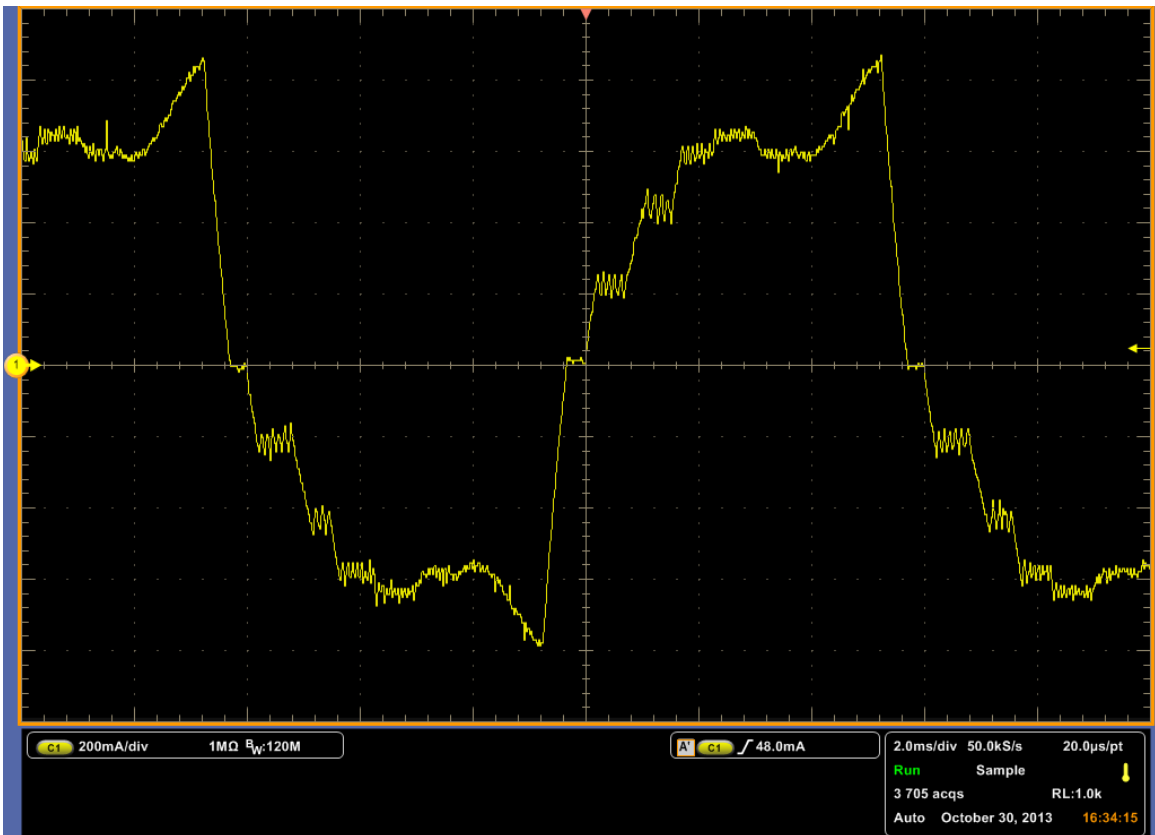
1/4 microstep, fast decay without synchronous rectification



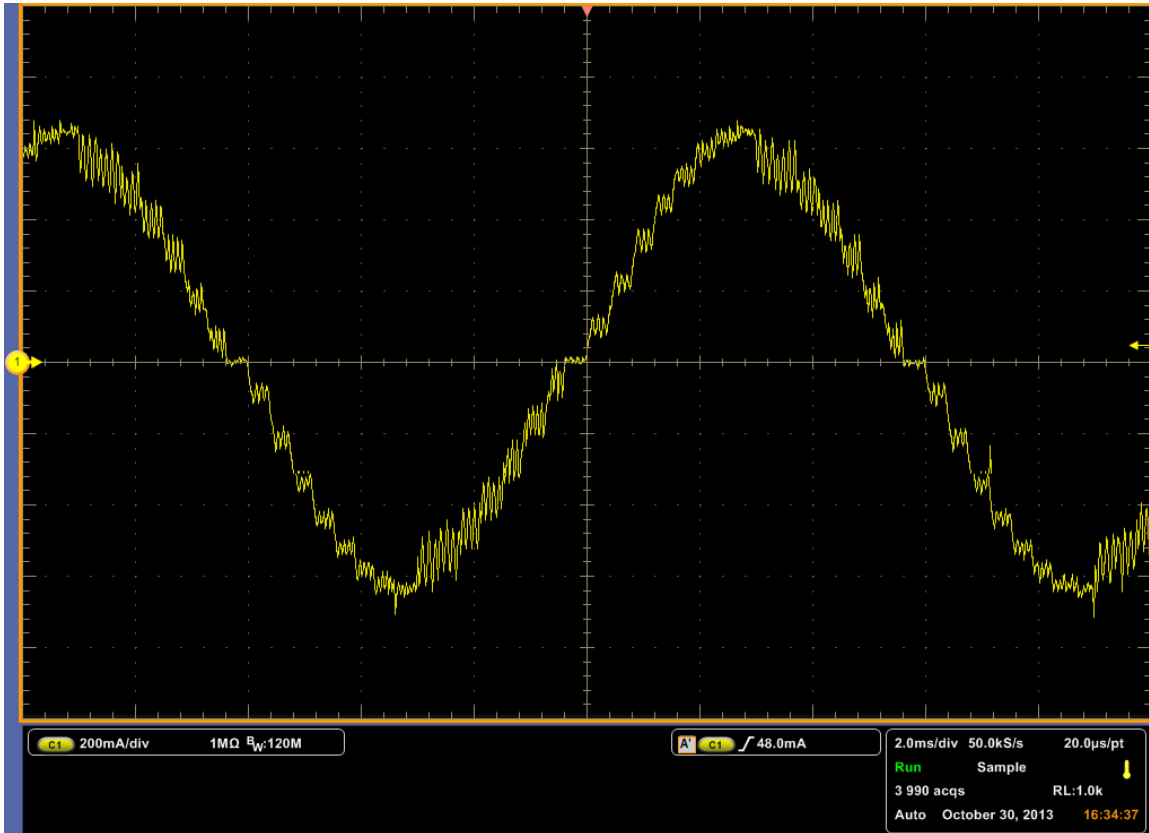
1/4 microstep, mixed decay (DECAY = 1V)



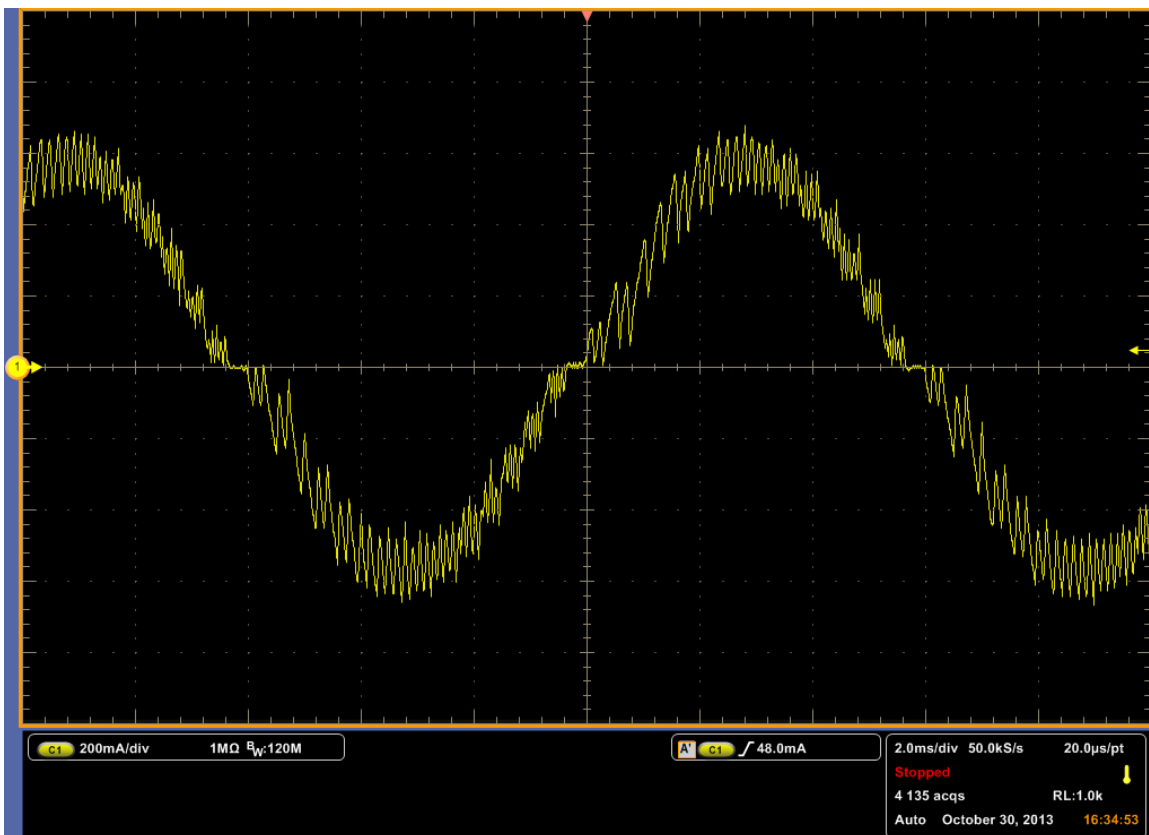
1/4 microstep, mixed decay (DECAY = 1.3V)



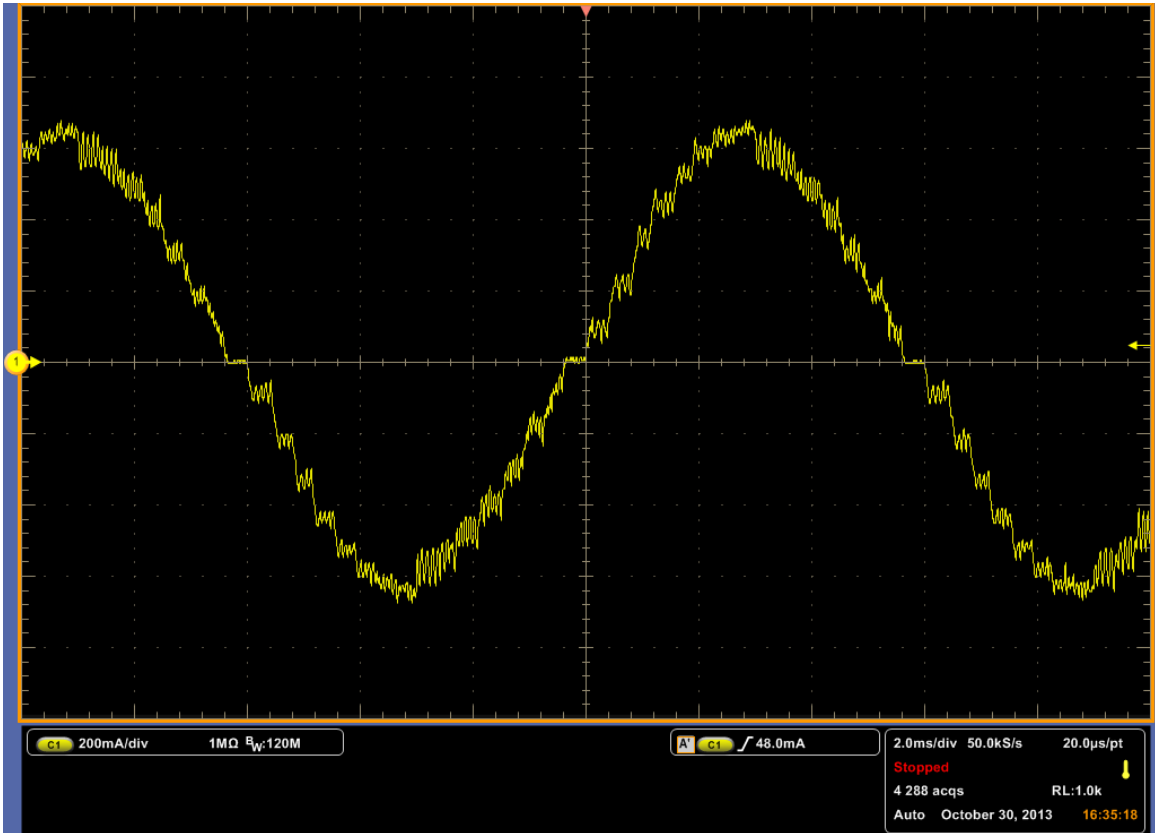
1/4 microstep, slow decay



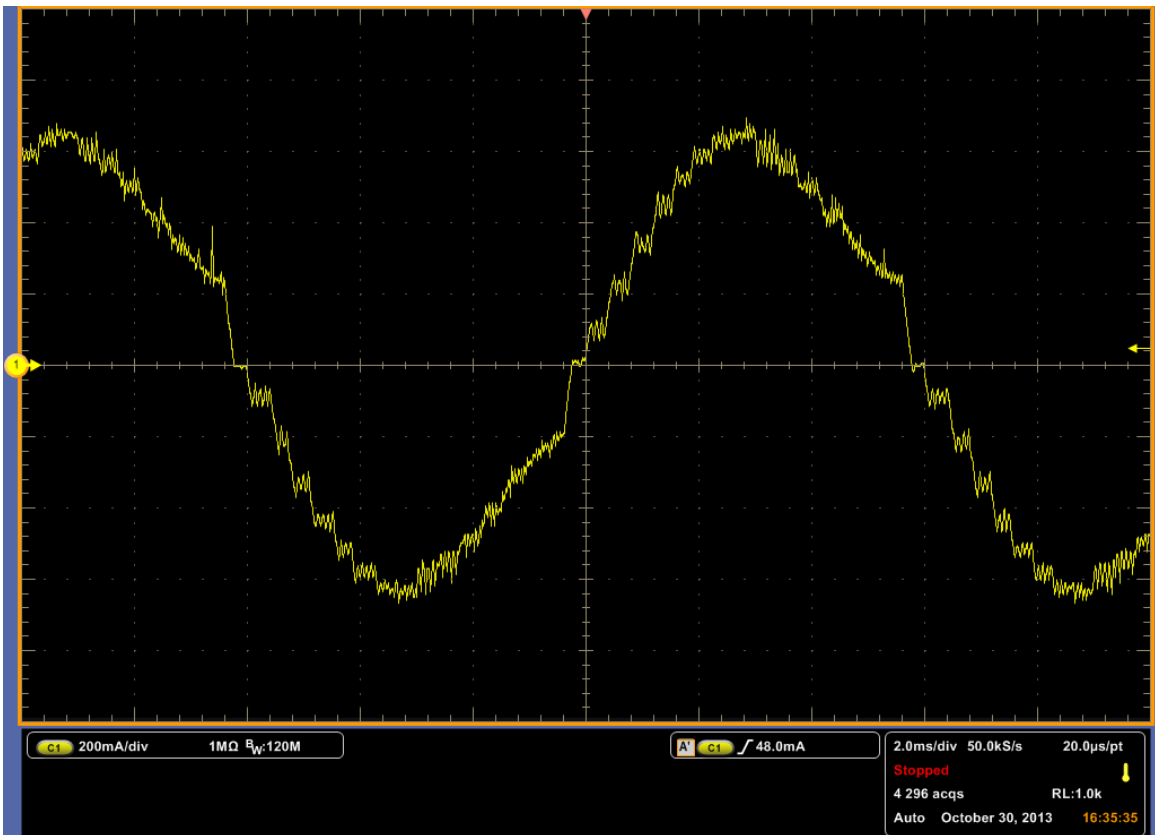
1/8 microstep, fast decay with synchronous rectification



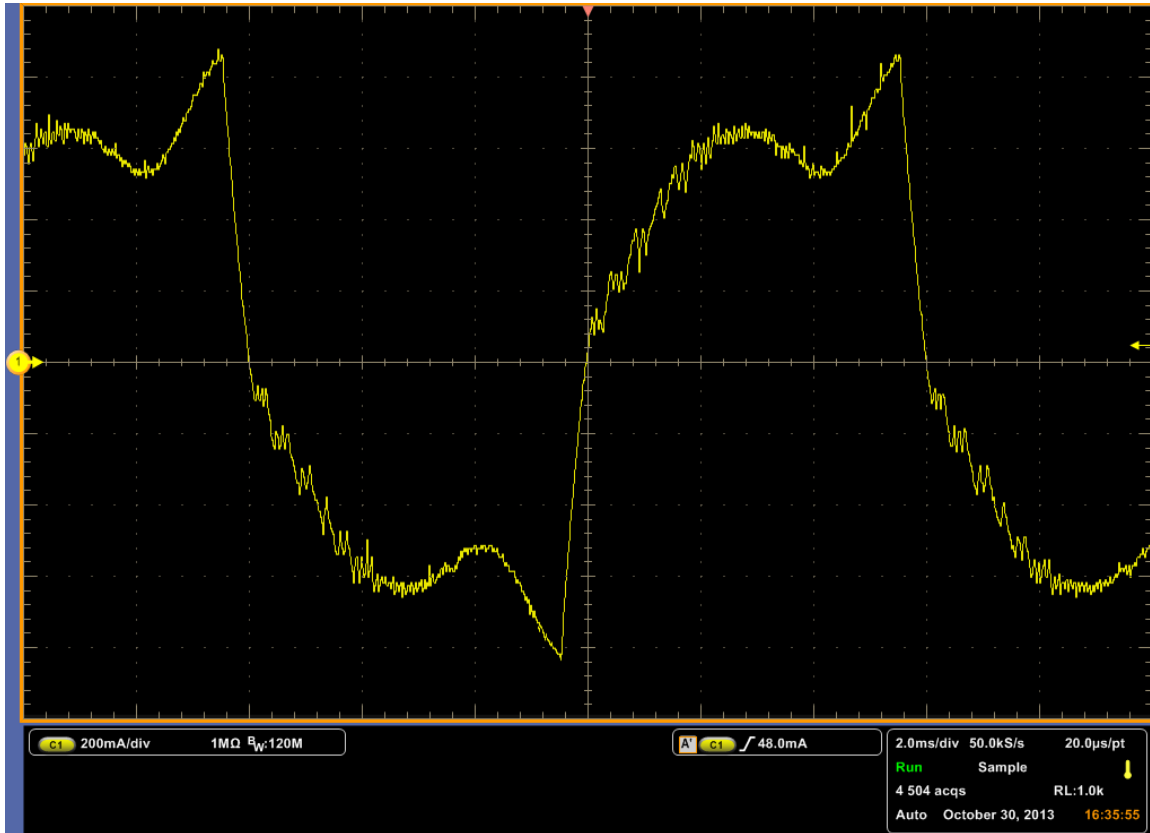
1/8 microstep, fast decay without synchronous rectification



1/8 microstep, mixed decay (DECAY = 1V)

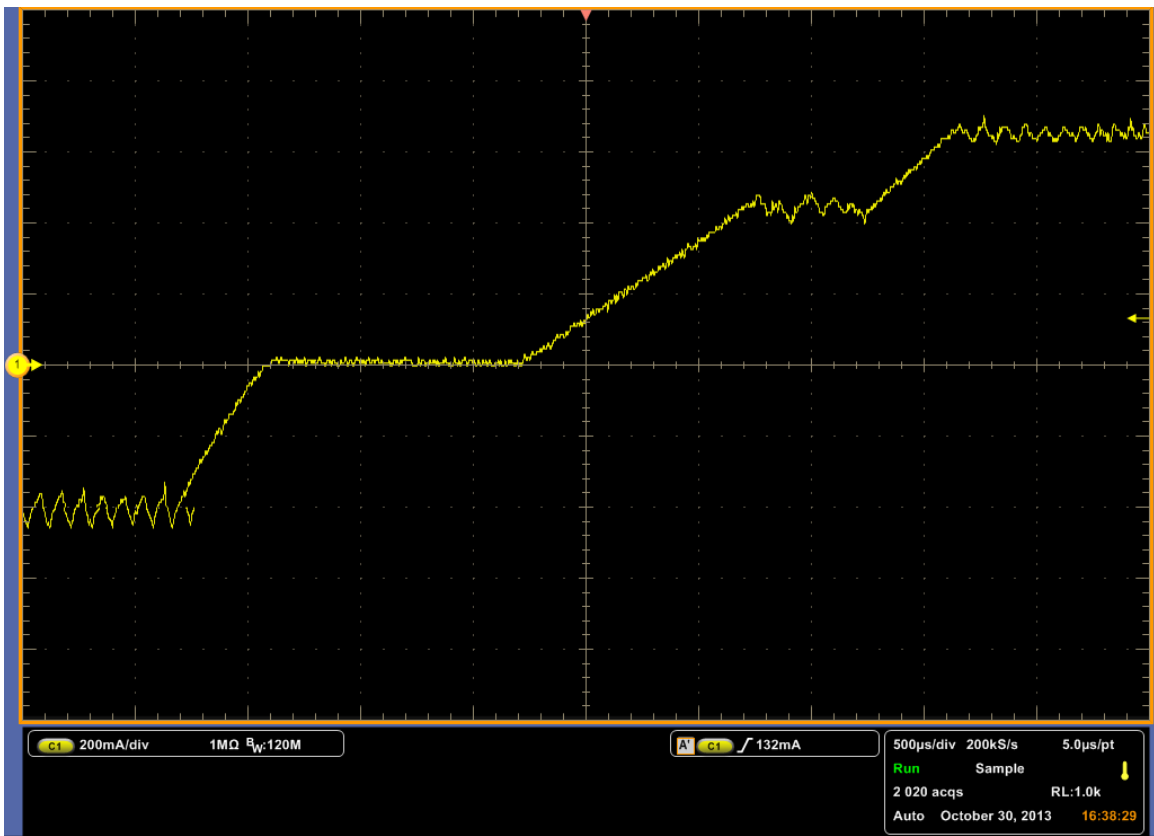


1/8 microstep, mixed decay (DECAY = 1.3V)

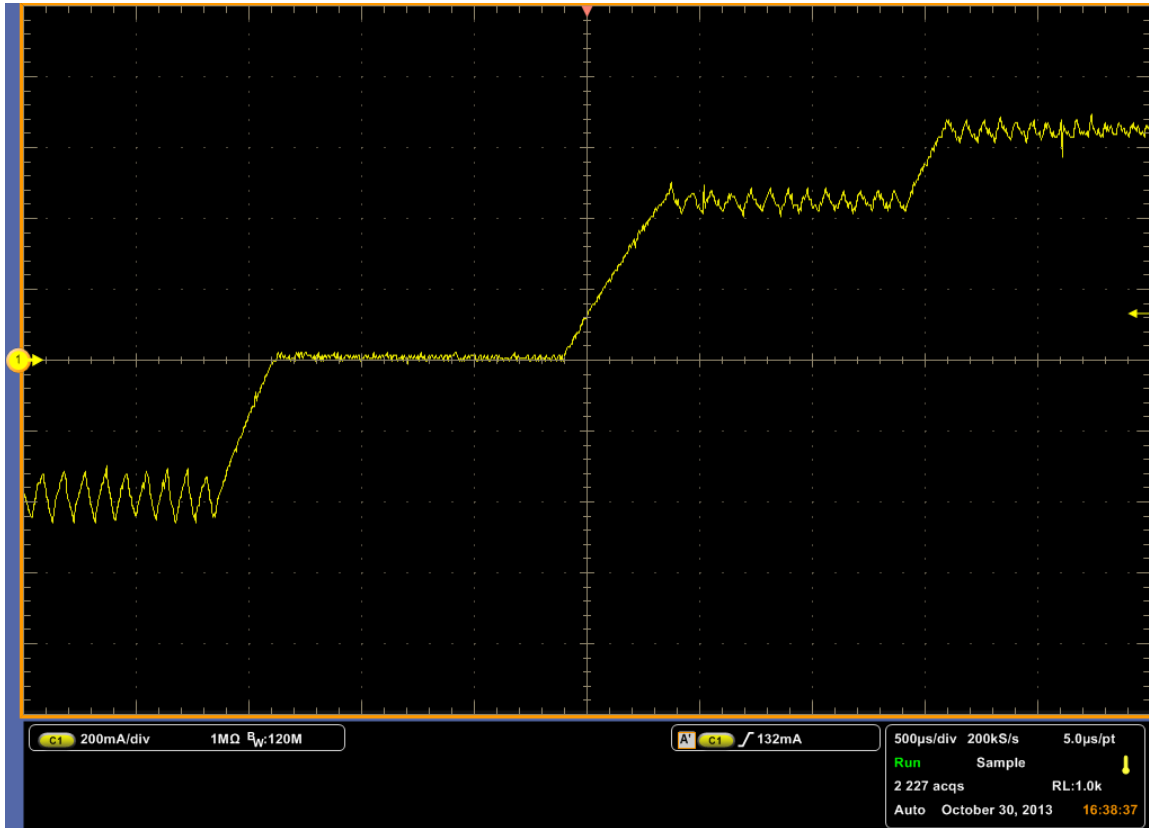


1/8 microstep, slow decay

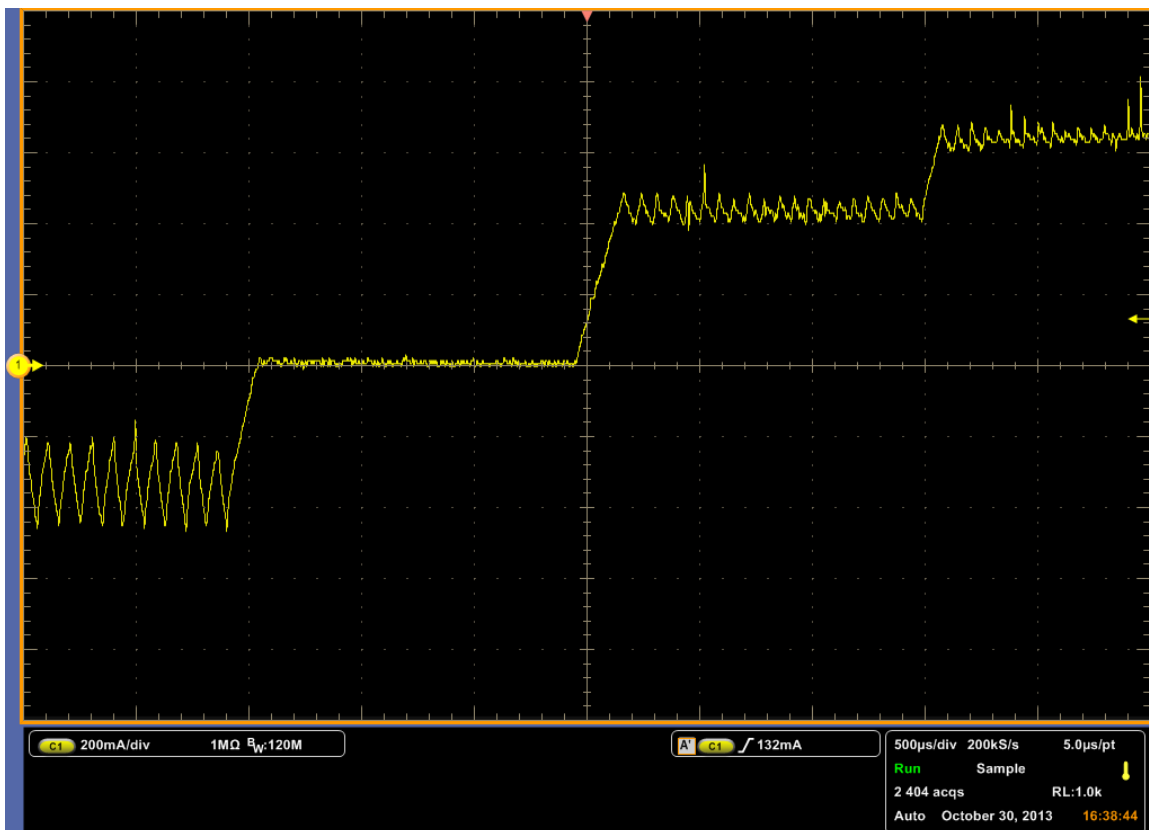
Section 5: Current ramp rate versus VM



VM = 8V

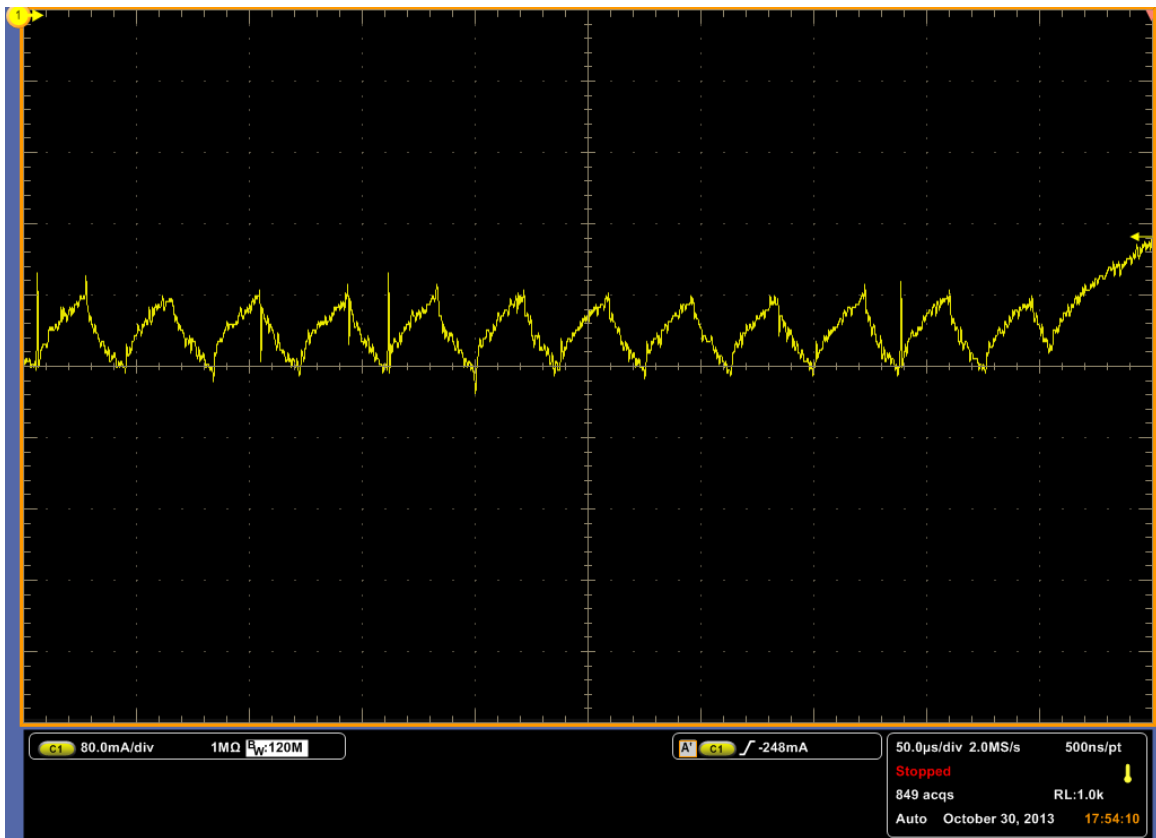


VM = 12V

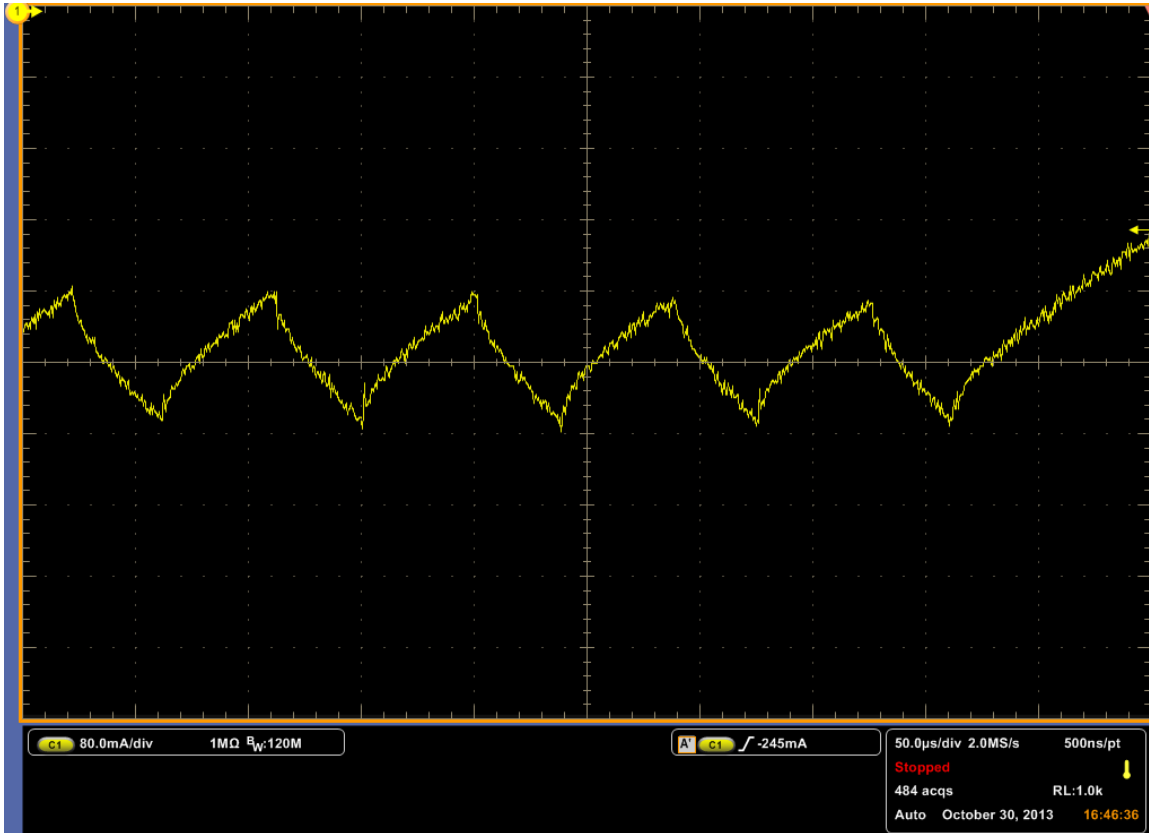


VM = 20V

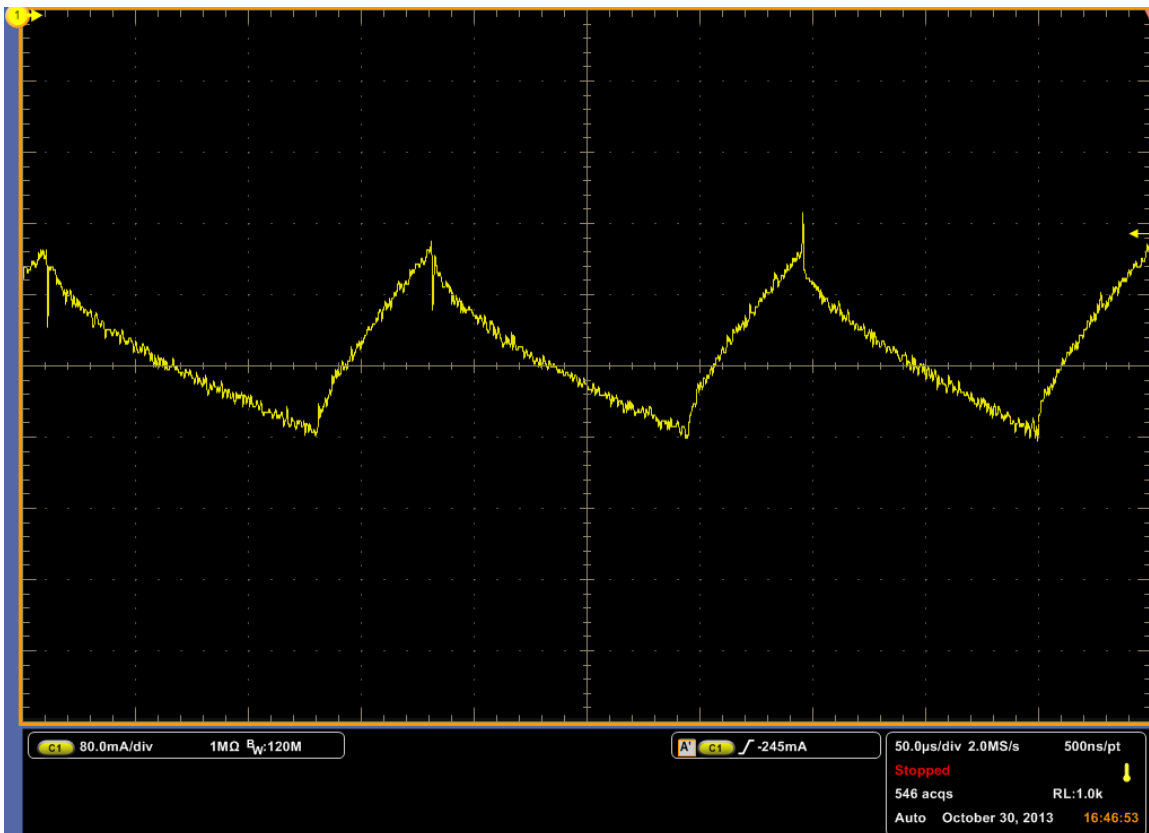
Section 6: Current regulation (zoomed-in)



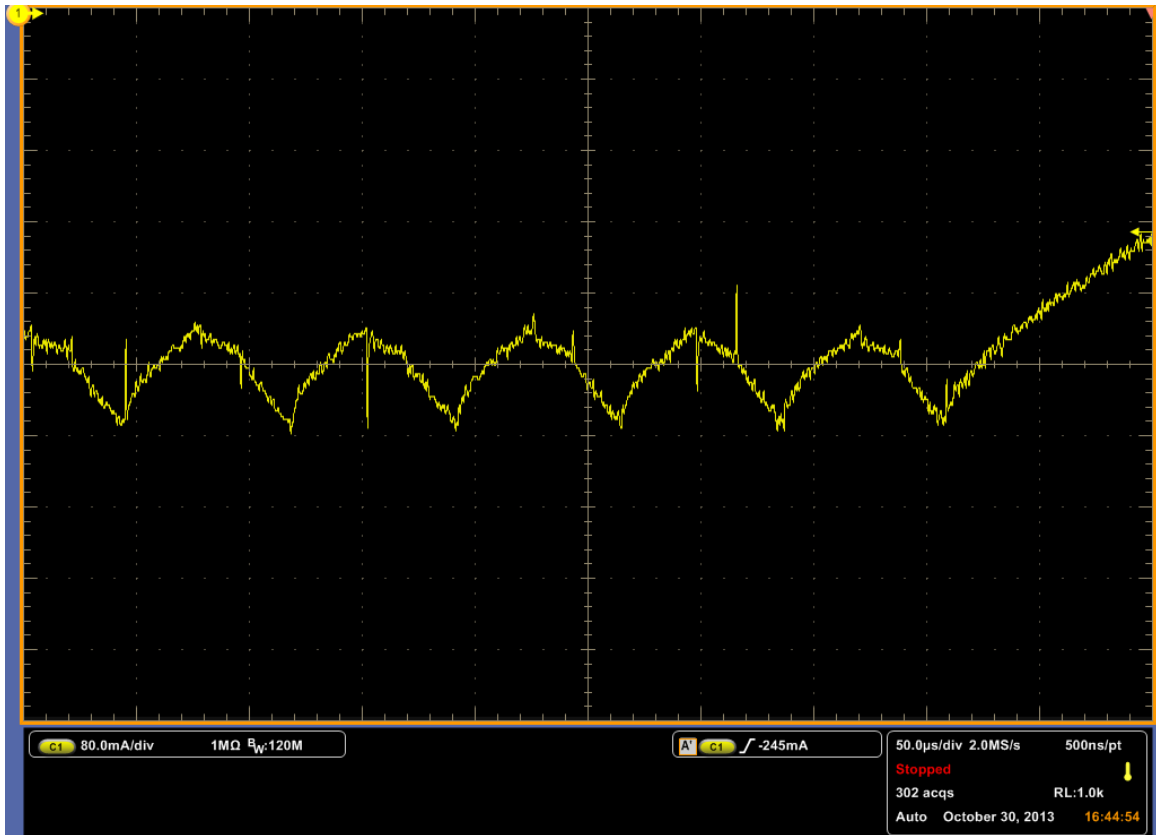
Fast decay with synchronous rectification, $t_{OFF} = 20\mu s$



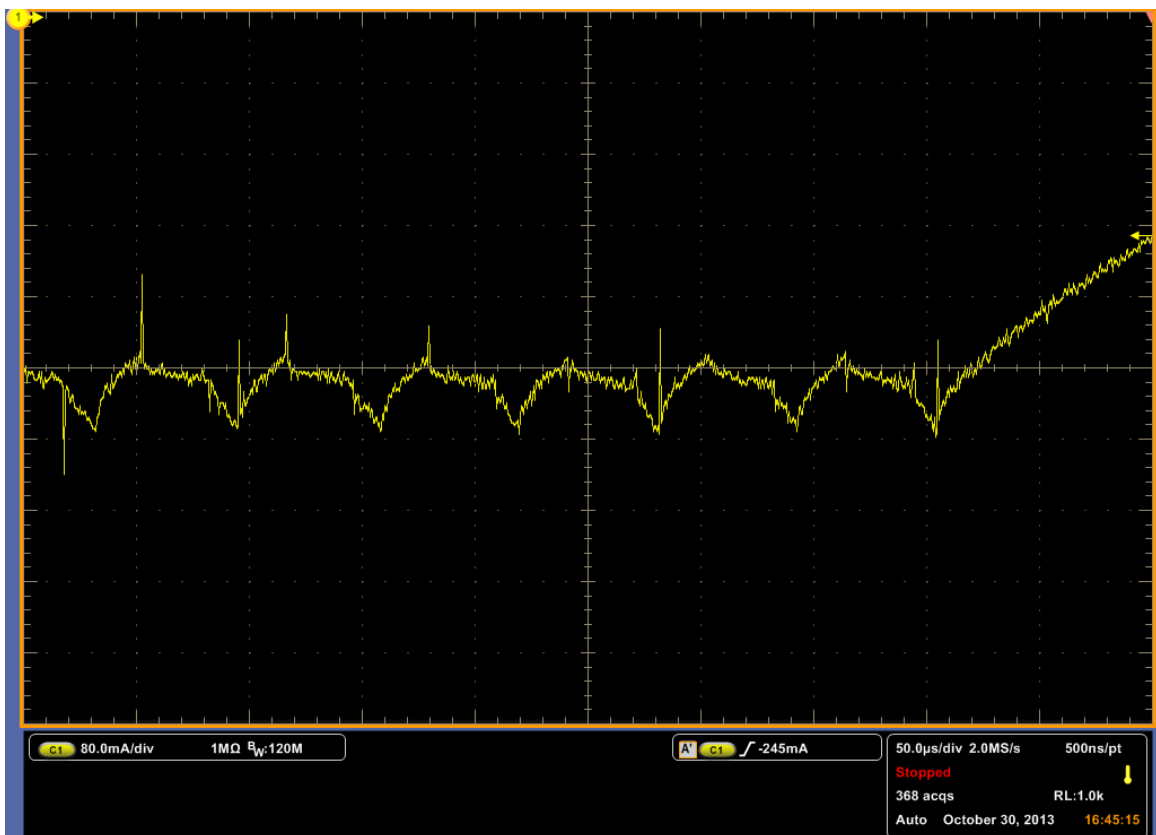
Fast decay with synchronous rectification, $t_{OFF} = 47\mu s$



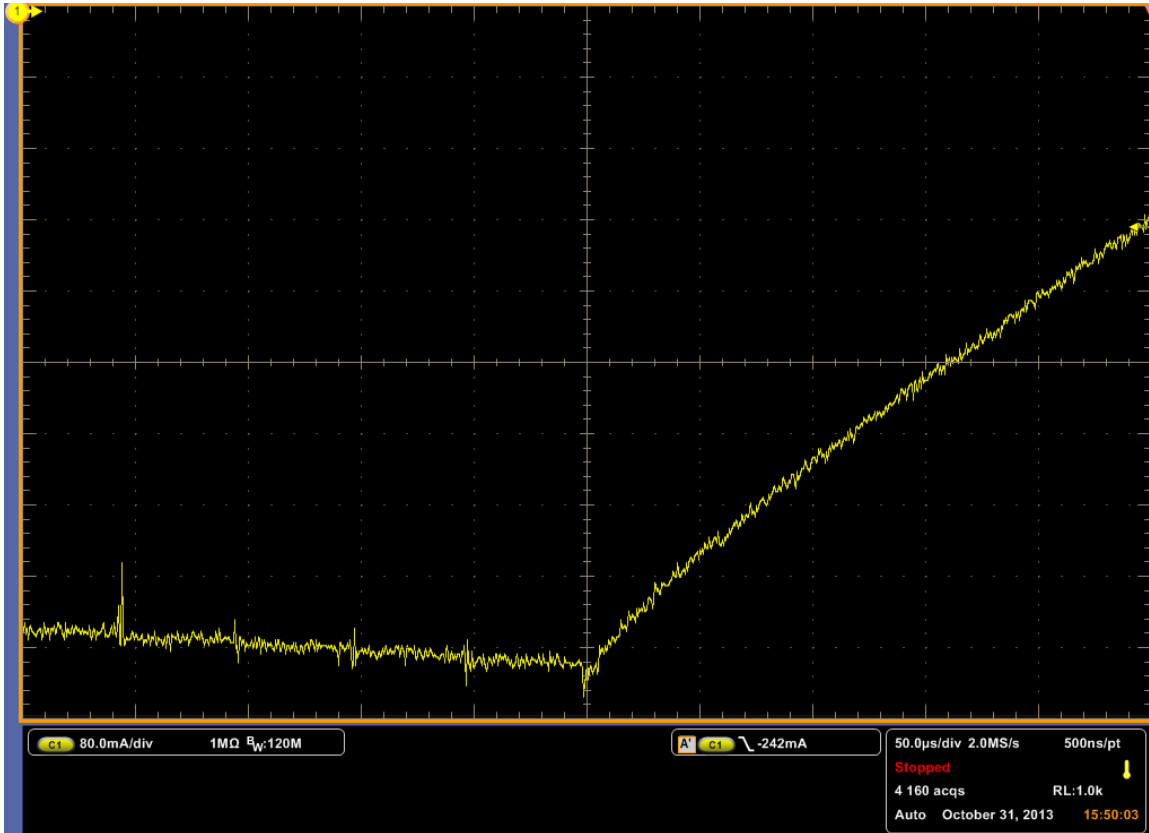
Fast decay without synchronous rectification, $t_{OFF} = 47\mu s$



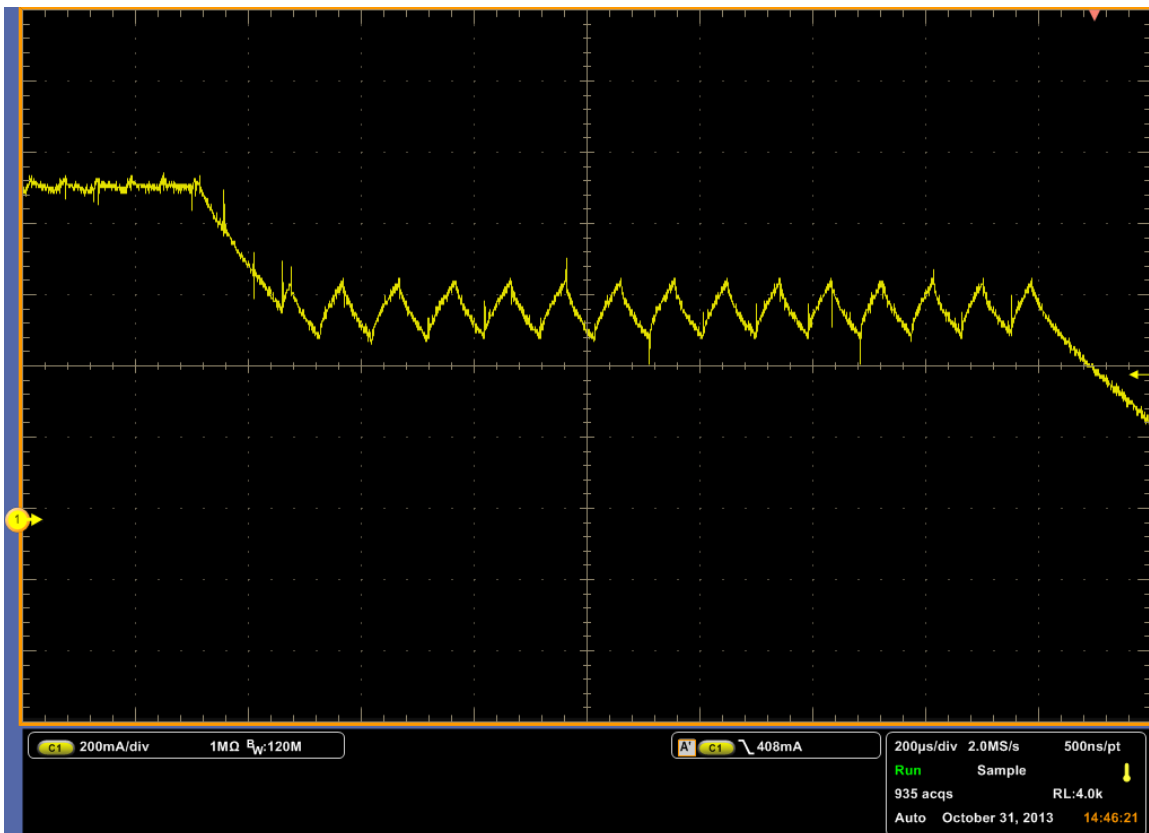
Mixed decay (DECAy = 1V), $t_{OFF} = 47\mu s$



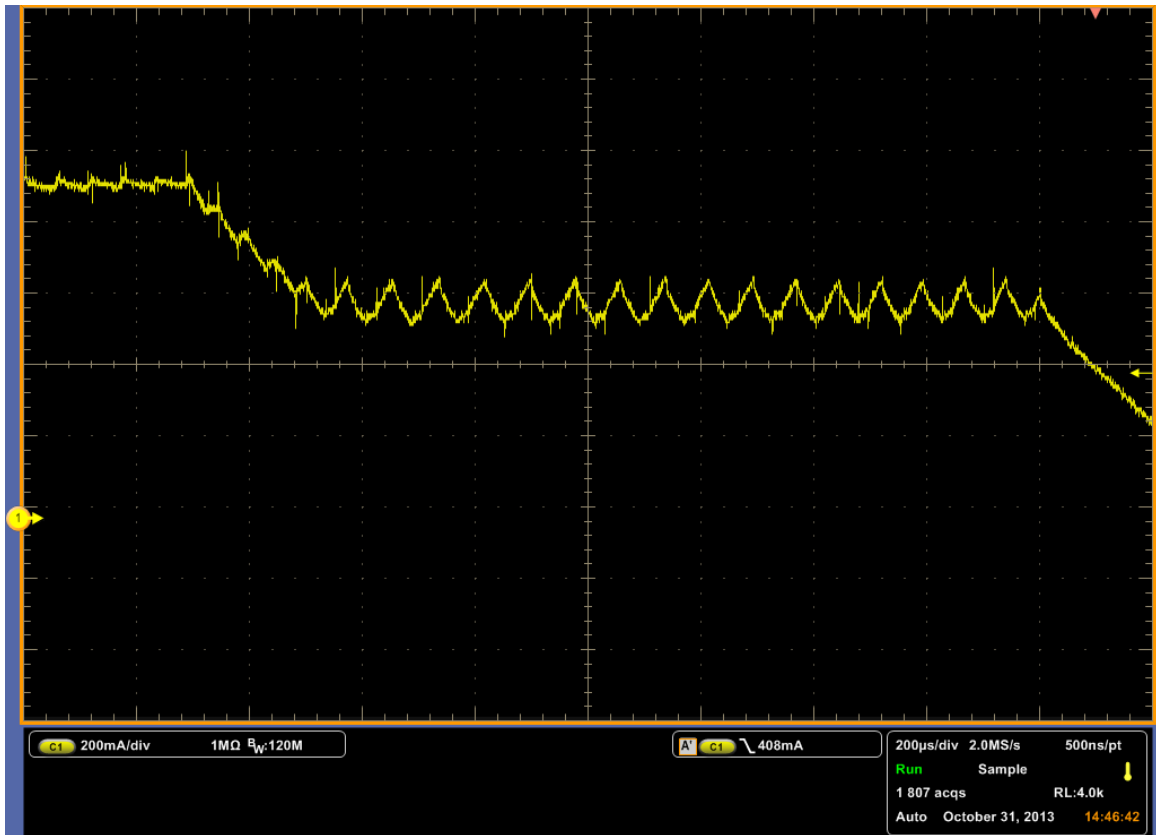
Mixed decay (DECAy = 1.3V), $t_{OFF} = 47\mu s$



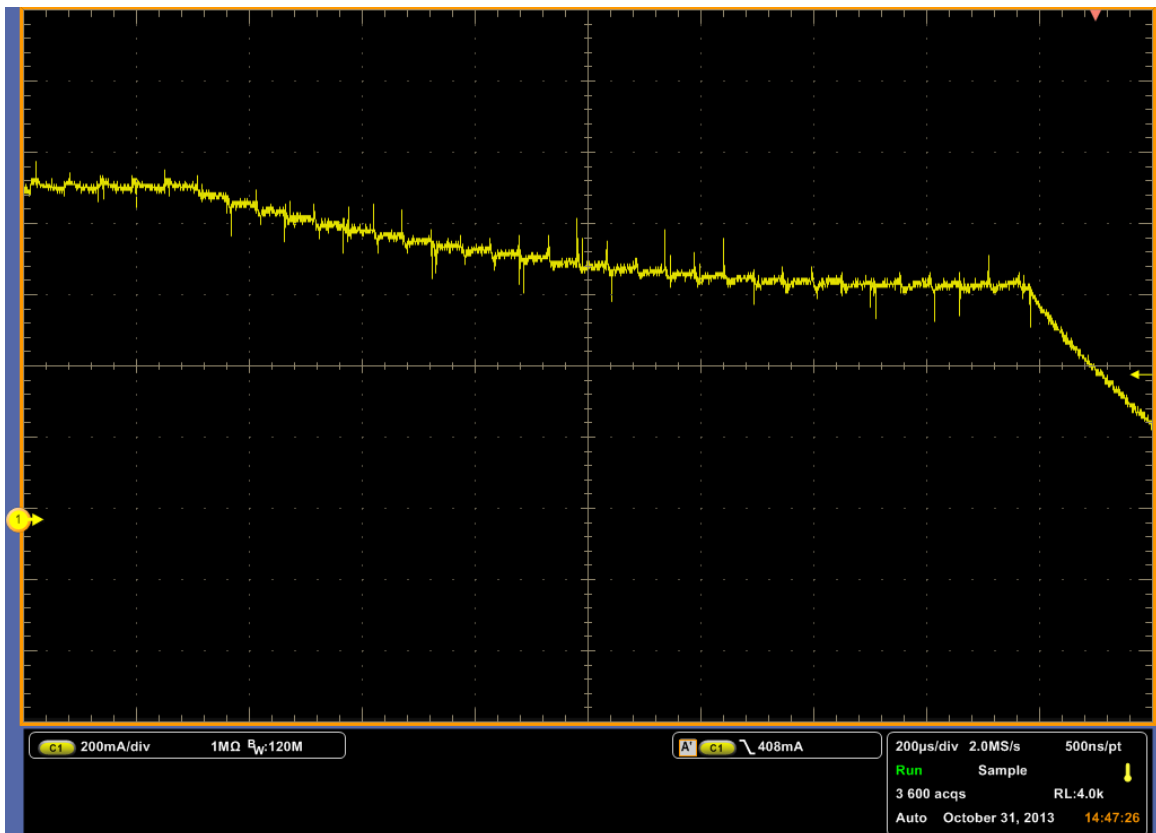
Slow decay, $t_{OFF} = 47\mu s$



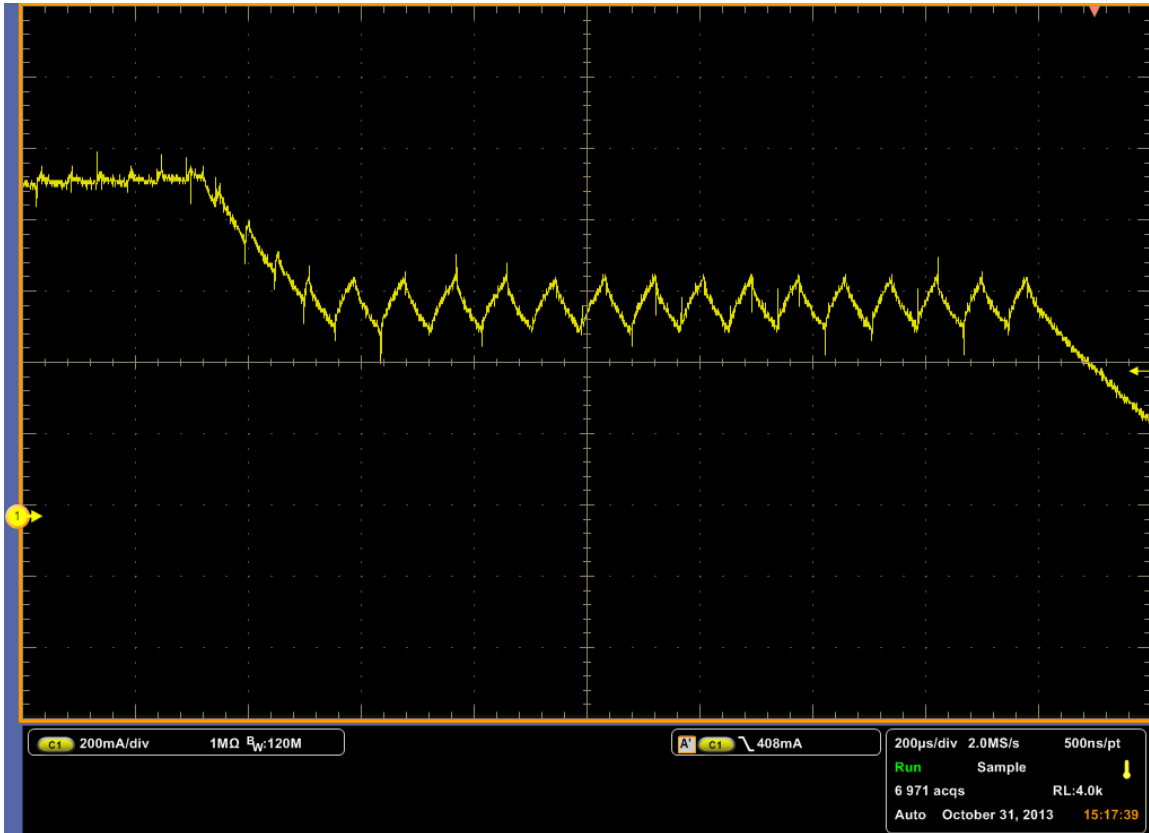
$t_{BLANK} = 1.4\mu s$, Fast decay



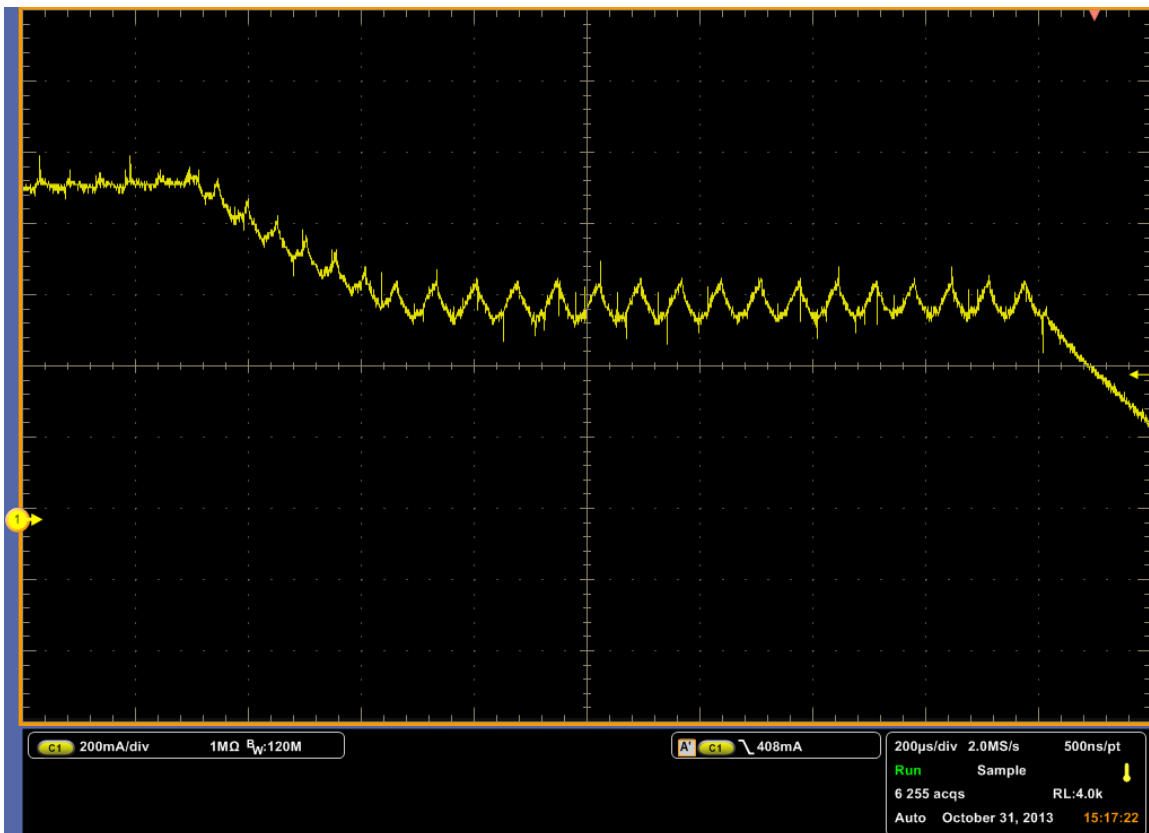
$t_{\text{BLANK}} = 1.4\mu\text{s}$, Mixed decay (DECAY = 1V)



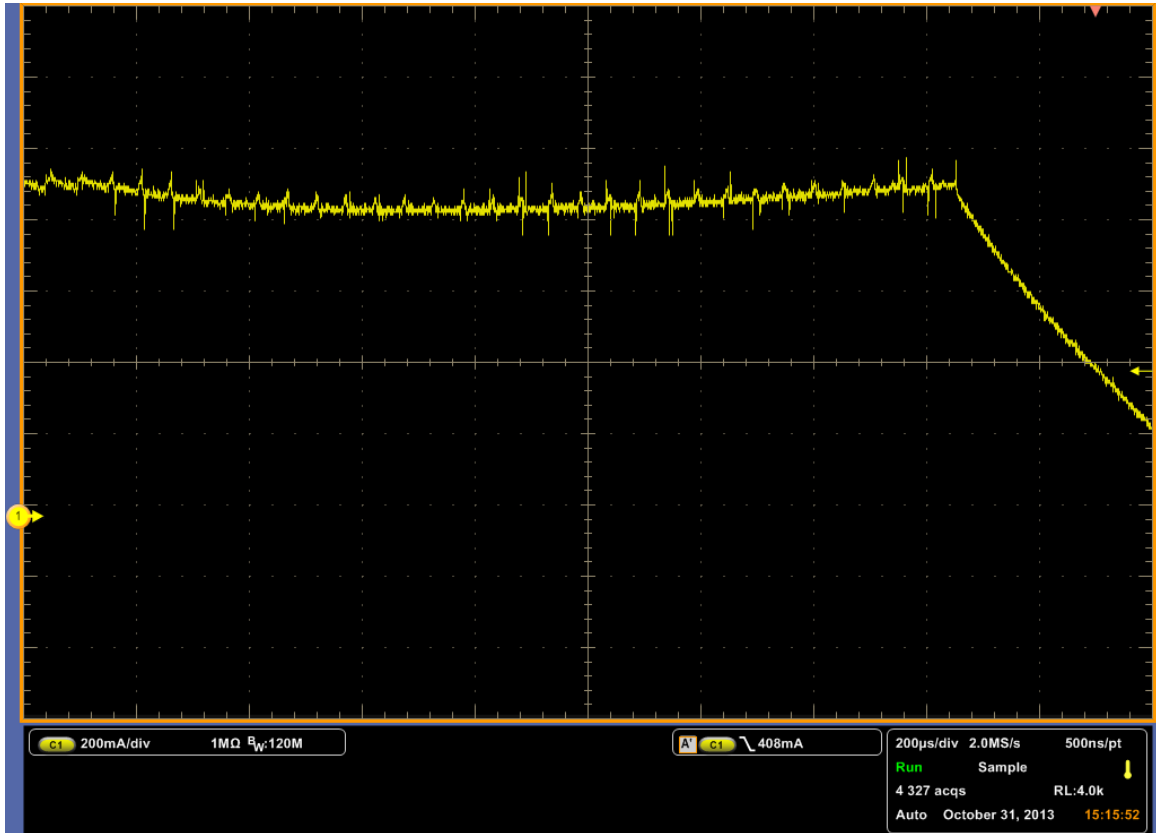
$t_{\text{BLANK}} = 1.4\mu\text{s}$, Mixed decay (DECAY = 1.7V)



$t_{\text{BLANK}} = 7\mu\text{s}$, Fast decay



$t_{\text{BLANK}} = 7\mu\text{s}$, Mixed decay (DECAY = 1V)



$t_{\text{BLANK}} = 7\mu\text{s}$, Mixed decay (DECAY = 1.7V)

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