

LCLS Kickers: BXKIK & BYKIK

■ Physics Requirements

	BXKIK	BYKIK	unit
Location	25	<i>Upstream undulator</i>	
Min. Beam Energy	4.0	4	GeV
Max. Beam Energy	6.0	17	GeV
Max. $\int Bds$	0.04	1	kG-m
Max. deflection angle	0.2	1.8	mrad
Magnet Length	0.25	1	m

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■ Physics Requirements

	BXKIK	BYKIK	unit
Rise & Fall times	< 2	< 1	ms
Pulse-to-pulse repeatability	< 0.5	< 1	%
Flat top duration	> 1	> 1	μs
Flat top variation	0.1	0.1	%
Max. trigger rate	120	120	Hz

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■ Electrical Requirements

	BXKIK	BYKIK	unit
Peak Current	<i>42</i>	263	A
Magnet Inductance	<i>0.15</i>	0.6	mH
Magnet Resistance	5	20	mΩ

LCLS Kickers: BXKIK & BYKIK

Trigger Requirements

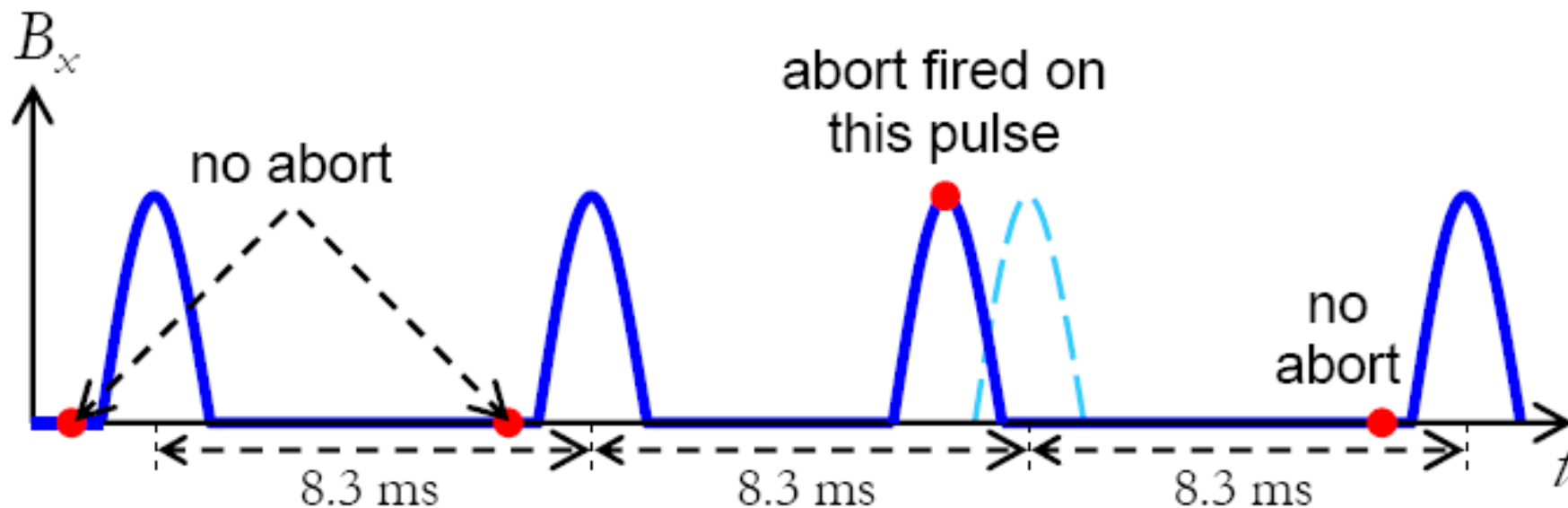
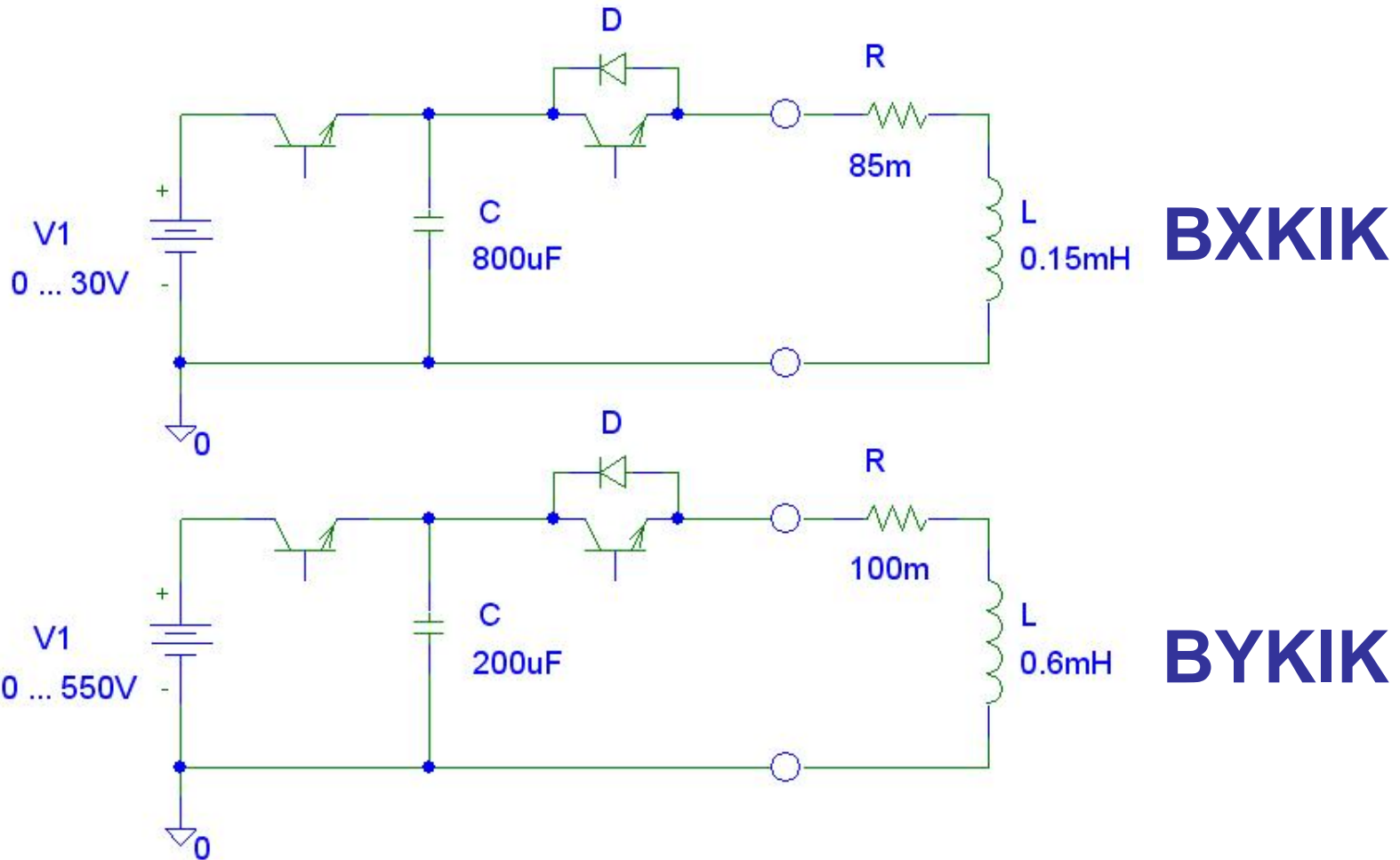


Fig. 1. Time line of abort kicker at 120-Hz repetition rate showing a 2-ms early time-shift of only the third pulse, thereby aborting only that beam pulse.

Source: PRD # 1.3-014 by P. Emma

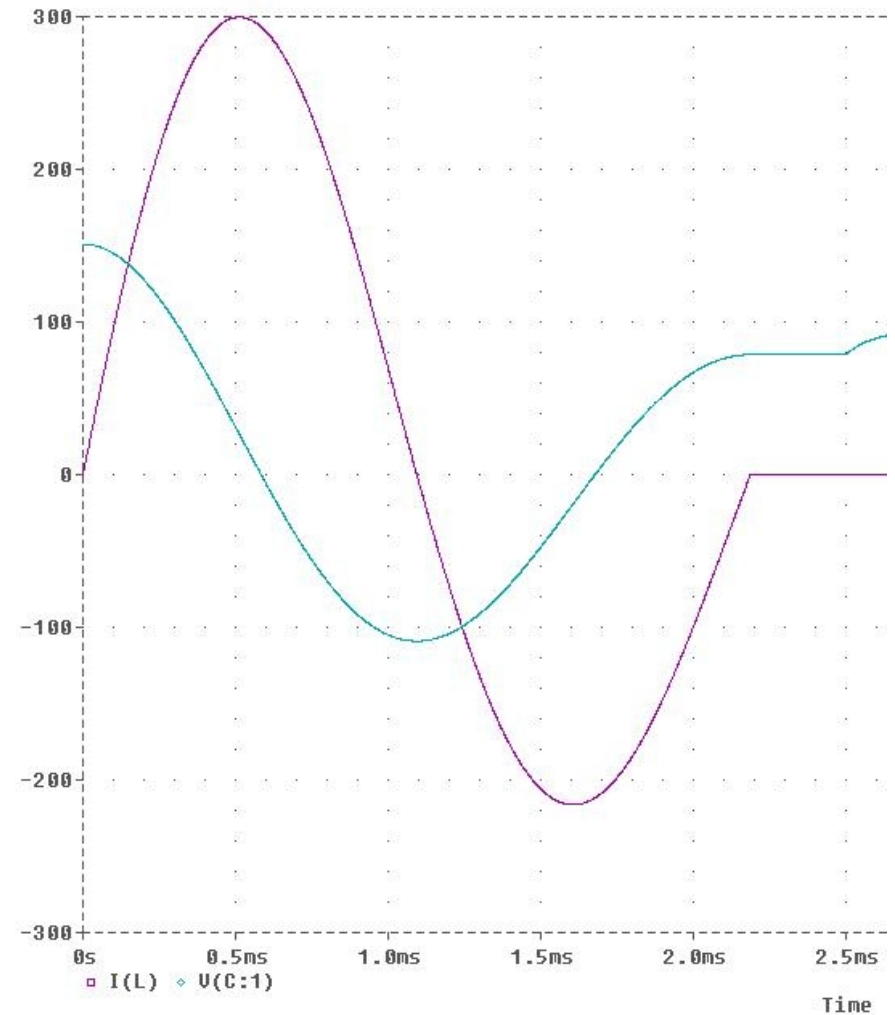
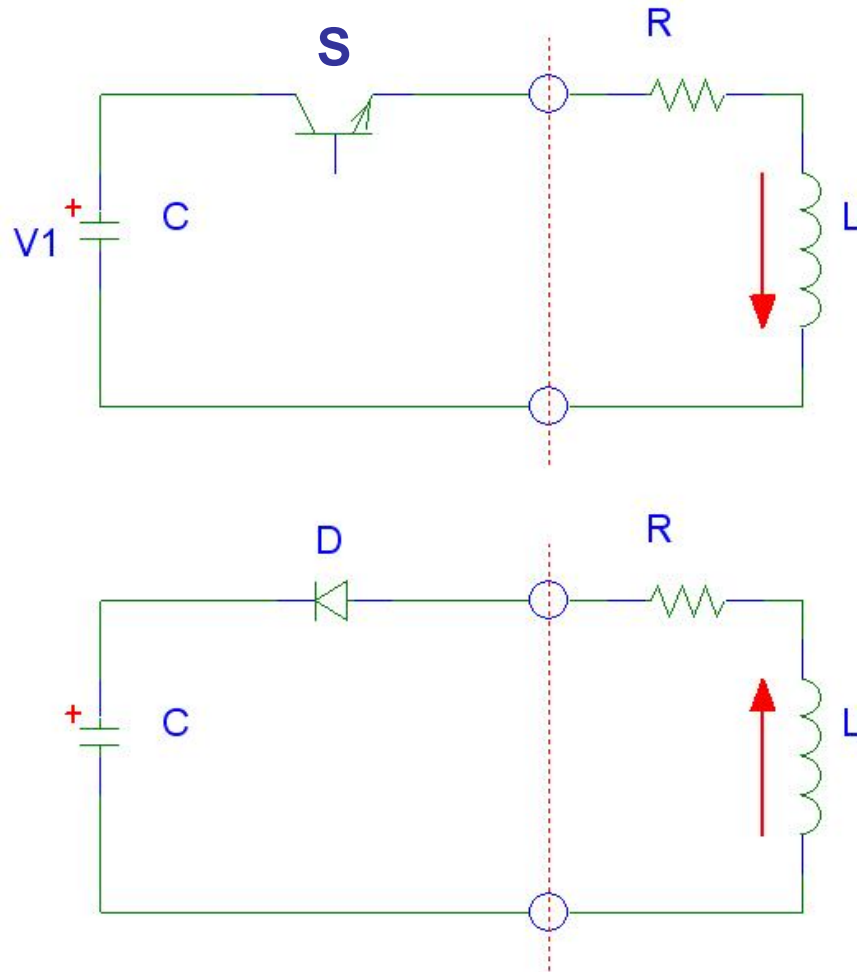
LCLS Kickers: BXKIK & BYKIK

Proposed Topology



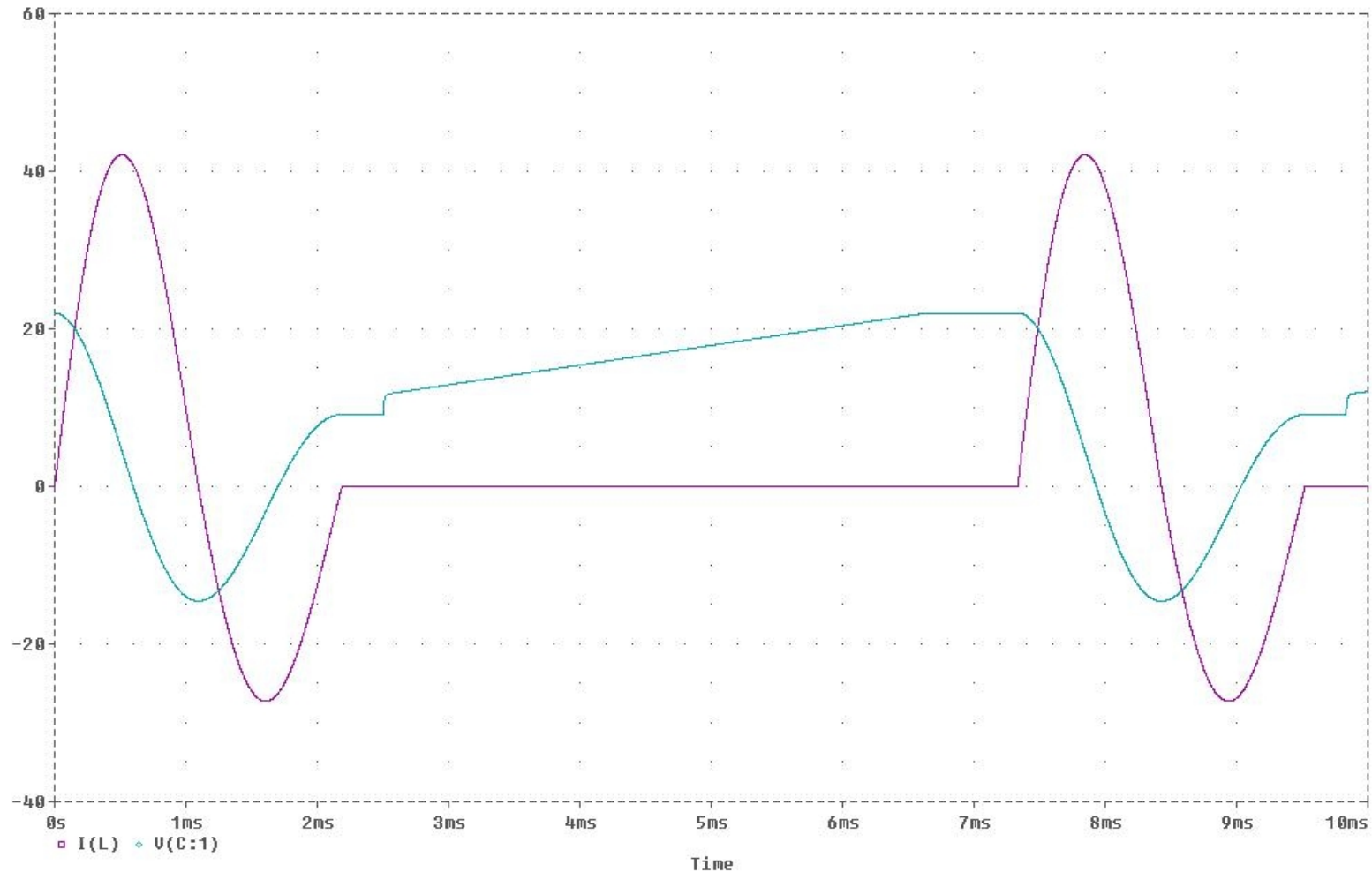
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Principle of Operation



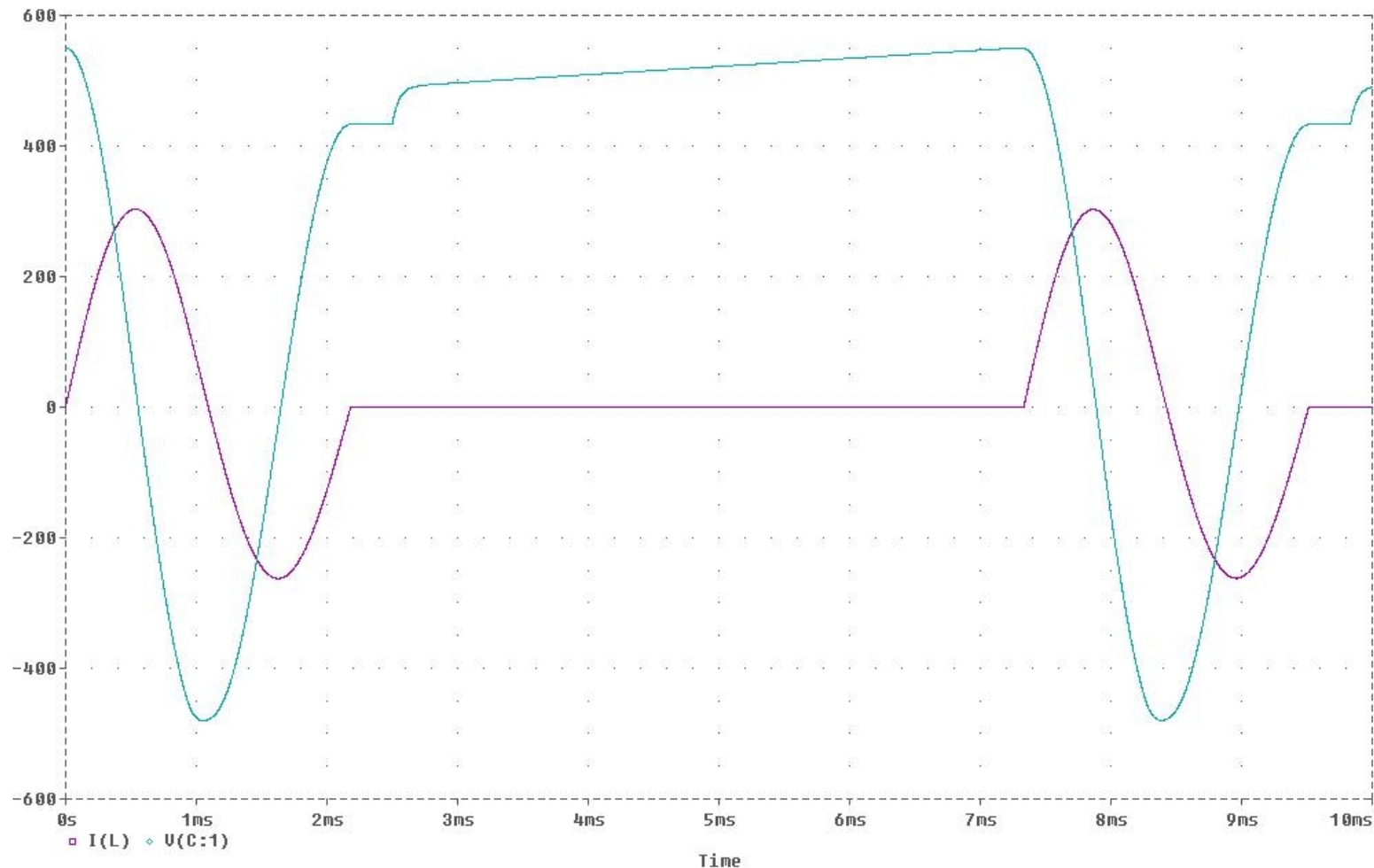
LCLS Kickers: BXKIK & BYKIK

■ BXKIK Waveforms



LCLS Kickers: BXKIK & BYKIK

■ BYKIK Waveforms



LCLS Kickers: BXKIK & BYKIK

■ Key Components

- Cap charging power supply
- Pulse discharge capacitor
- Solid-state switches

LCLS Kickers: BXKIK & BYKIK

■ Cap charging power supply (for BYKIK)



- Peak charging rate: 2.2 kJ/s
- Voltage range: 0 - 1 kV
- Charging current: 4.4 A
- pulse-to-pulse repeatability: 0.1%
- Low stored energy: < 0.3 J
- Parallel operation
- Remote control
- Unit price: \$ 3k

LCLS Kickers: BXKIK & BYKIK

■ Power supply (for BXKIK)



Lambda – Genesys 750W

- Voltage range: 0 – 30V
- Current range: 0 – 25A
- Stability: <math><0.1\%</math>
- Remote control
- Unit price: \$ 2.5k

LCLS Kickers: BXKIK & BYKIK

■ Pulse discharge capacitor



General Atomics Series DM

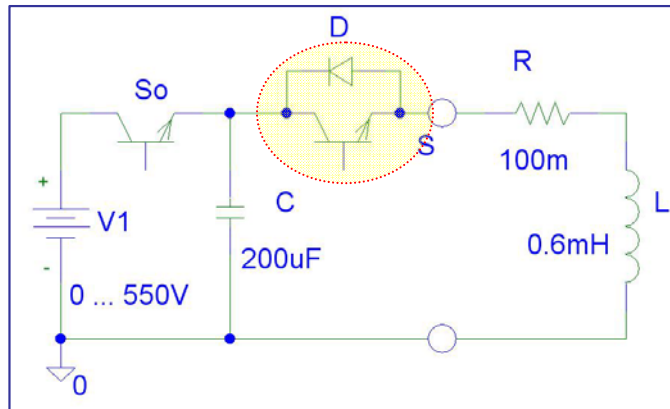
- Capacitance: 100 μF
- Rated Voltage: 1 kV
- Peak current: 1.5 kA
- Max. RMS current: 23 A
- Voltage reversal: 20 %
- Design life: > 300M charge/discharge cycles
- Unit price: \$ 95

LCLS Kickers: BXKIK & BYKIK

■ Solid-state switch



Powerex CM400HA-24H



- 400 Amperes
- 1200 Volts
- Peak current: 800 A
- Low Power Gate Drive
- Free-wheeling diode
- Unit price: \$ 260

LCLS Kickers: BXKIK & BYKIK

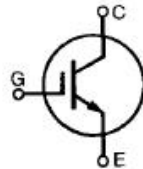
■ Solid-state switch



Advance Technical Data

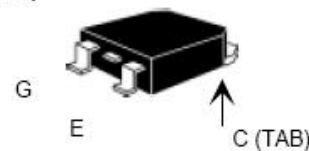
High Voltage
IGBT

IXGH 24N170 $V_{CES} = 1700 \text{ V}$
 IXGT 24N170 $I_{C25} = 50 \text{ A}$
 $V_{CE(sat)} = 3.3 \text{ V}$
 $t_{fi(typ)} = 290 \text{ ns}$

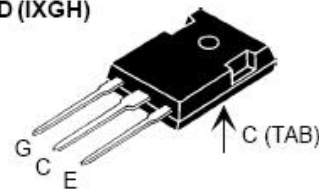


Symbol	Test Conditions	Maximum Ratings
V_{CES}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}$	1700 V
V_{CGR}	$T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1 \text{ M}\Omega$	1700 V
V_{GES}	Continuous	$\pm 20 \text{ V}$
V_{GEM}	Transient	$\pm 30 \text{ V}$
I_{C25}	$T_C = 25^\circ\text{C}$	50 A
I_{C90}	$T_C = 90^\circ\text{C}$	24 A
I_{CM}	$T_C = 25^\circ\text{C}, 1 \text{ ms}$	150 A
SSOA (RBSOA)	$V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 5 \Omega$ Clamped inductive load	$I_{CM} = 50 \text{ A}$ @ $0.8 V_{CES}$
P_C	$T_C = 25^\circ\text{C}$	250 W

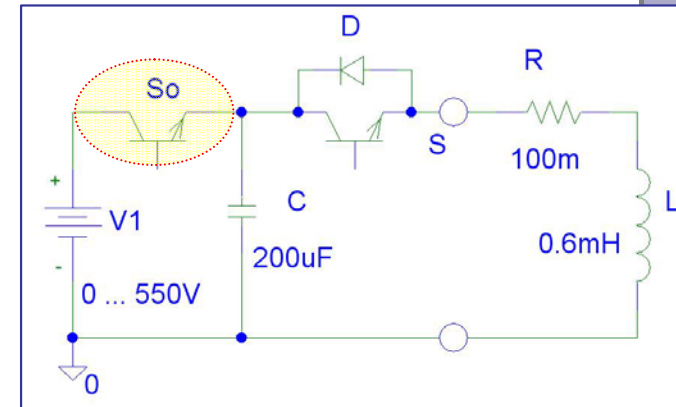
TO-268 (IXGT)

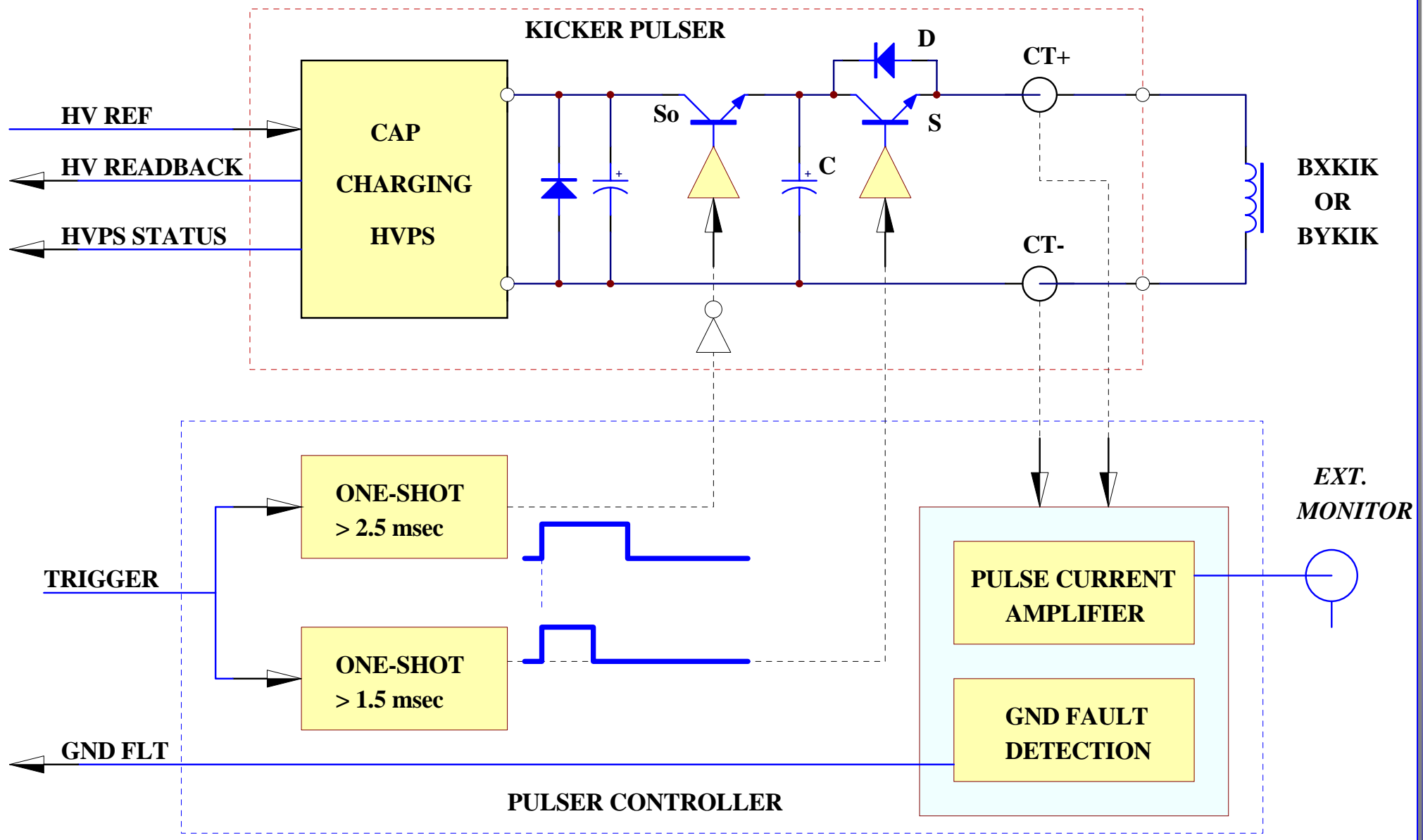


TO-247 AD (IXGH)



G = Gate, C = Collector,





LCLS Kickers: BXKIK & BYKIK

■ Controls - Protections

■ Internal

- Overcurrent
- Ground fault
- Cap overvoltage
- Automatic discharge switch

■ External

- MPS
- PPS (?)

LCLS Kickers: BXKIK & BYKIK

■ Controls

■ Analog Adjusts

- HVPS voltage reference

■ Analog Monitoring

- Cap voltage
- Magnet current waveform
- Magnet peak current

LCLS Kickers: BXKIK & BYKIK

■ Controls

■ Digital Commands

- HVPS Enable/Reset

■ Digital Monitoring

- HVPS status & fault signals
- Pulser controller status & fault signals

■ Trigger

- Initiate the pulse current

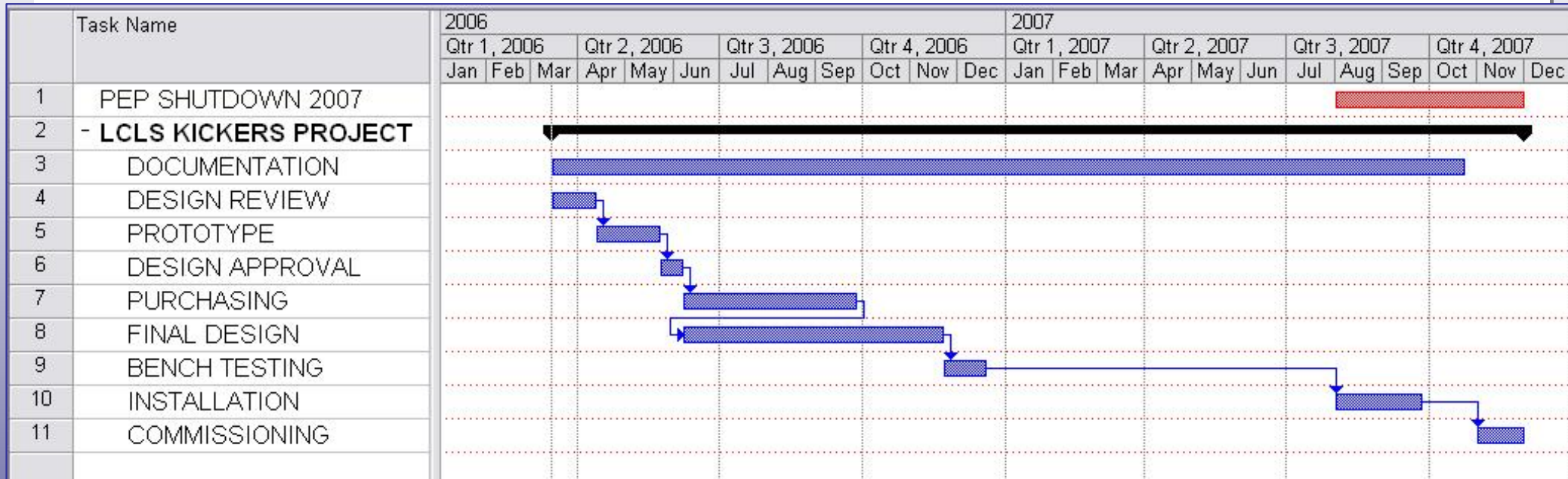
LCLS Kickers: BXKIK & BYKIK

■ Cost Estimate

	Unit Price	BXKIK	BYKIK	BXKIK	BYKIK	
MATERIAL		<i>Qty</i>	<i>Qty</i>			
HVPS	\$2,950	1	2	\$2,950	\$5,900	
Caps & accessories	\$115	10	26	\$1,150	\$2,990	
IGBT's & accessories	\$525	1	1	\$525	\$525	
Current Xducers	\$150	2	2	\$300	\$300	
Controller	\$1,500	1	1	\$1,500	\$1,500	
Material SUBTOTAL				\$6,425	\$11,215	
w/ contingency	20%			\$7,710	\$13,458	
w/ overhead	7%			\$8,250	\$14,400	
LABOR		<i>hrs</i>	<i>hrs</i>			
Engineering	\$86	83	83	\$7,138	\$7,138	
Technician	\$48	166	166	\$7,968	\$7,968	
Coordinator	\$62	41	42	\$2,542	\$2,604	
Labor SUBTOTAL				\$17,648	\$17,710	
w/ overhead	34%			\$23,648	\$23,731	
Project TOTAL				\$31,898	\$38,131	\$70,029

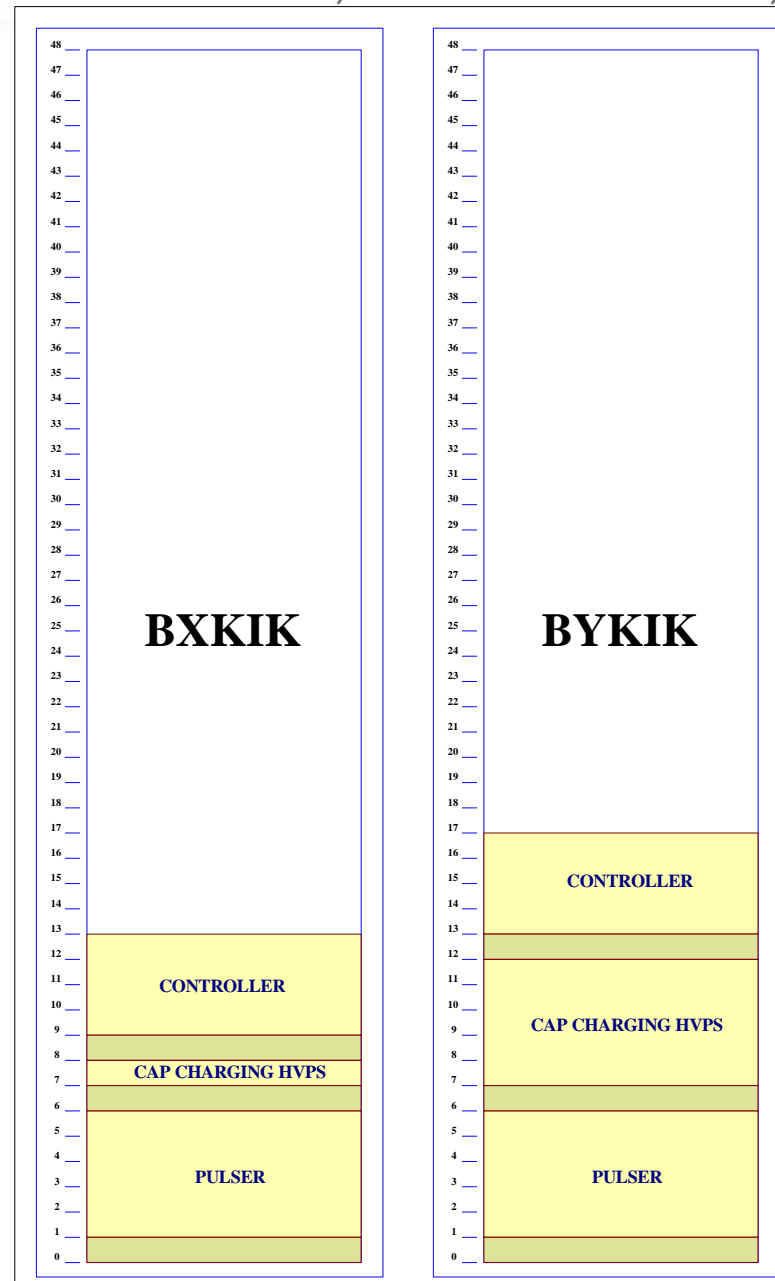
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■ Project Schedule



LCLS Kickers:

■ Rack Distribution



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■ TBD

- MPS

- PPS

- Rack locations

- AC Power

- Controls

 - VDAC + VSAM + Digital I/O

 - Trigger signal

 - Remote monitoring