

Testing of Cables for KPiX Pulse Load

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Power Topics

- Voltage Kick / Overshoot @ turn off
- ICs Operating = 2.5 V Max Operating = 2.75V Abs max = 3 V Life tests
- Power Efficiency / Inefficiency / wasted Power
- Cable Tests. No KPiX Chip current
- DC-DC Converter with Air Core Coil
- Radiation Tolerance Why Thin Oxides ?

CMS ECAL: 5 Oodles (50 Kamps) .

Power Supply output	= 315 KW
Power loss in Leads to SM	= 100 KW
Power loss in Regulator Card	= 90 KW
Power Delivered @ 2.5 V	= 125 KW

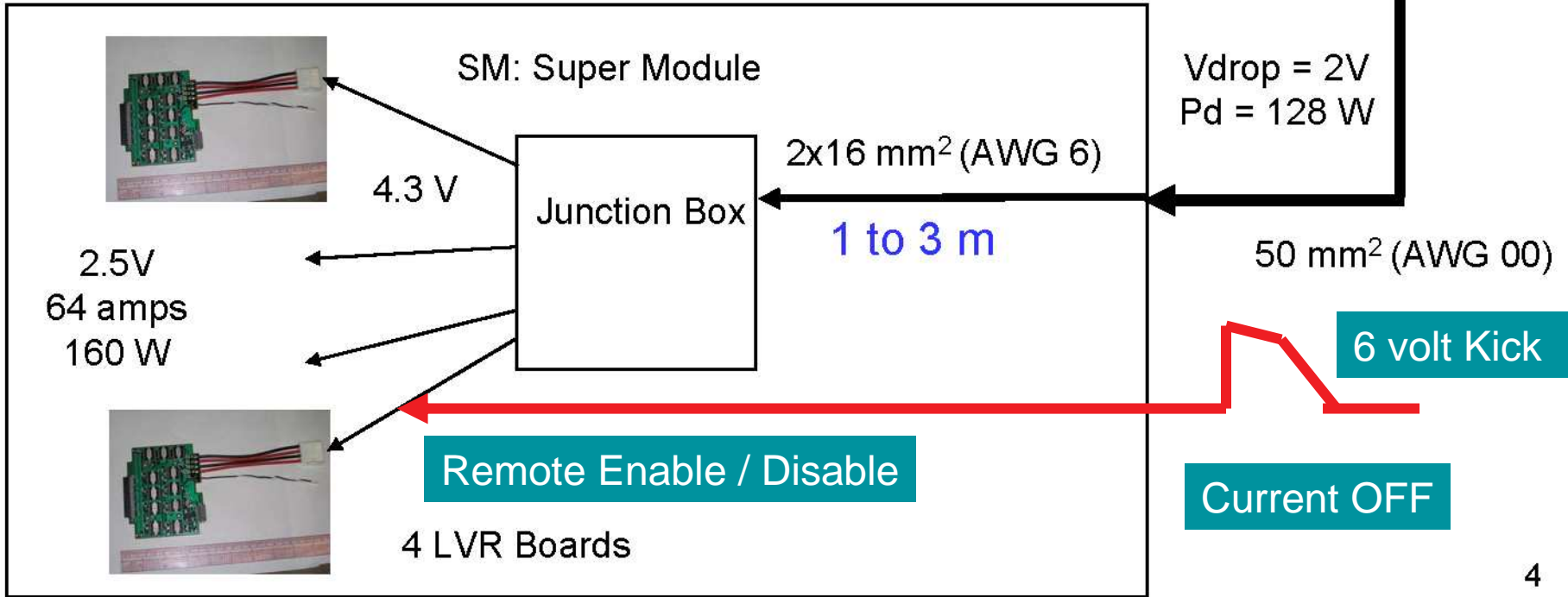
1 Oodle = 10,000 amps

of Power Supplies ~ 700
 # of ST LDO Chips = 35 K LHC Radiation Hard made by ST Microelectronics
 # of LVR Cards = 3.1 K.
Yale: Designed, built, burn-in and Tested.

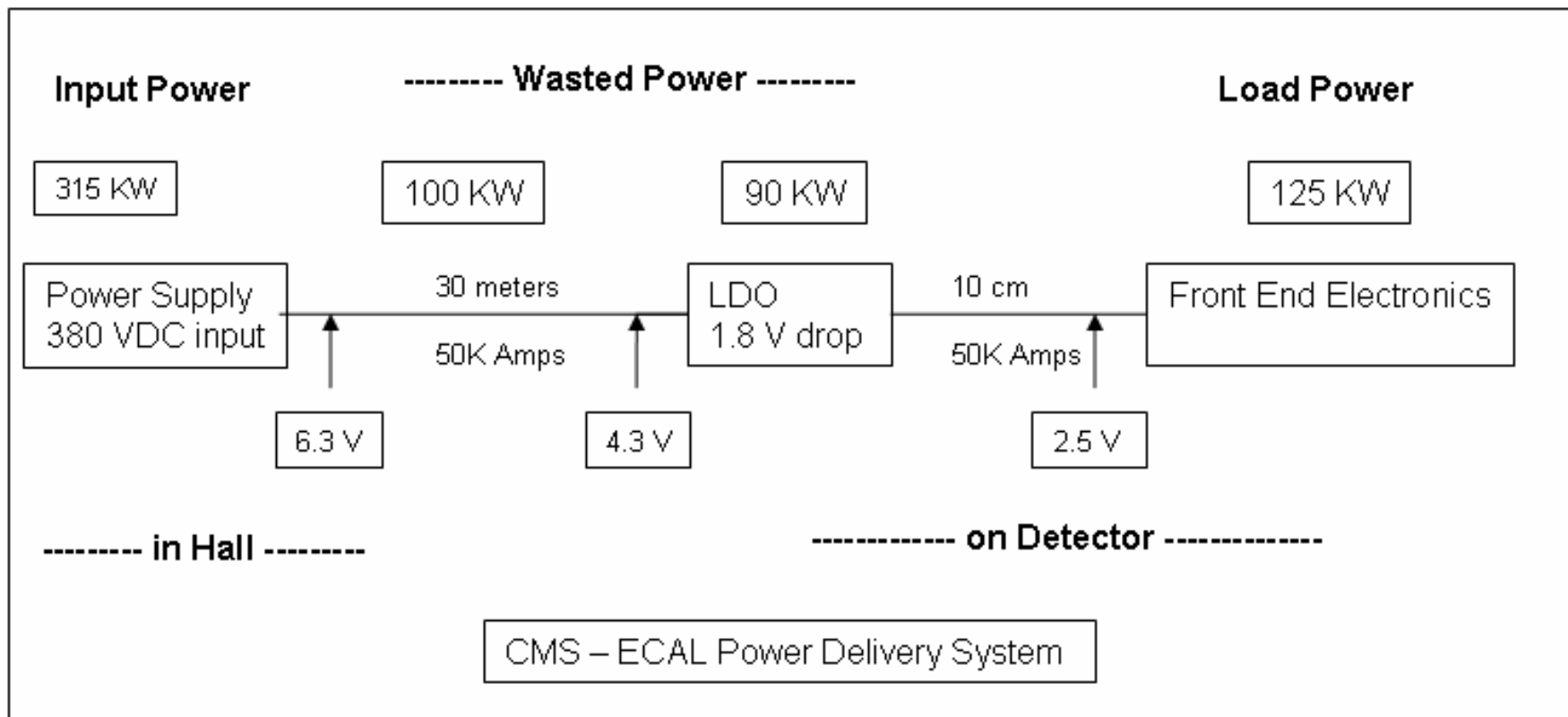
Power Supply
6.3 V

64 Amps

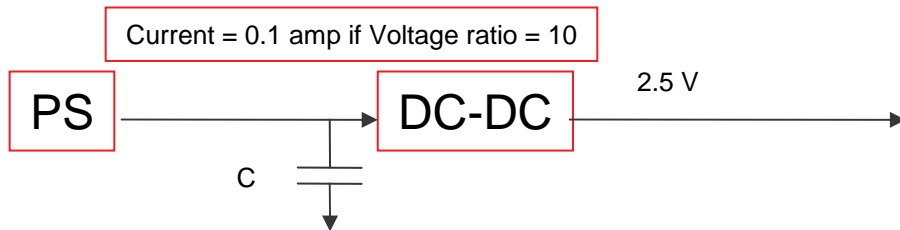
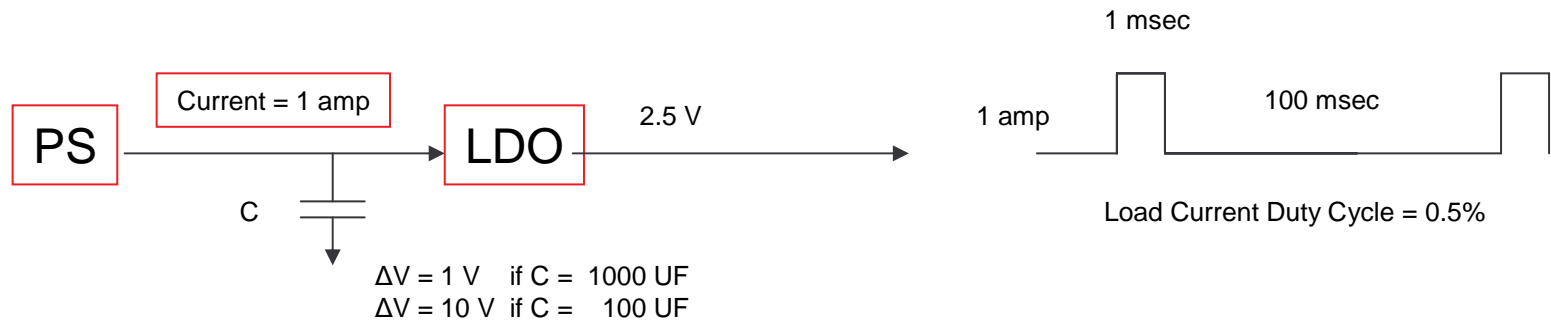
30 m

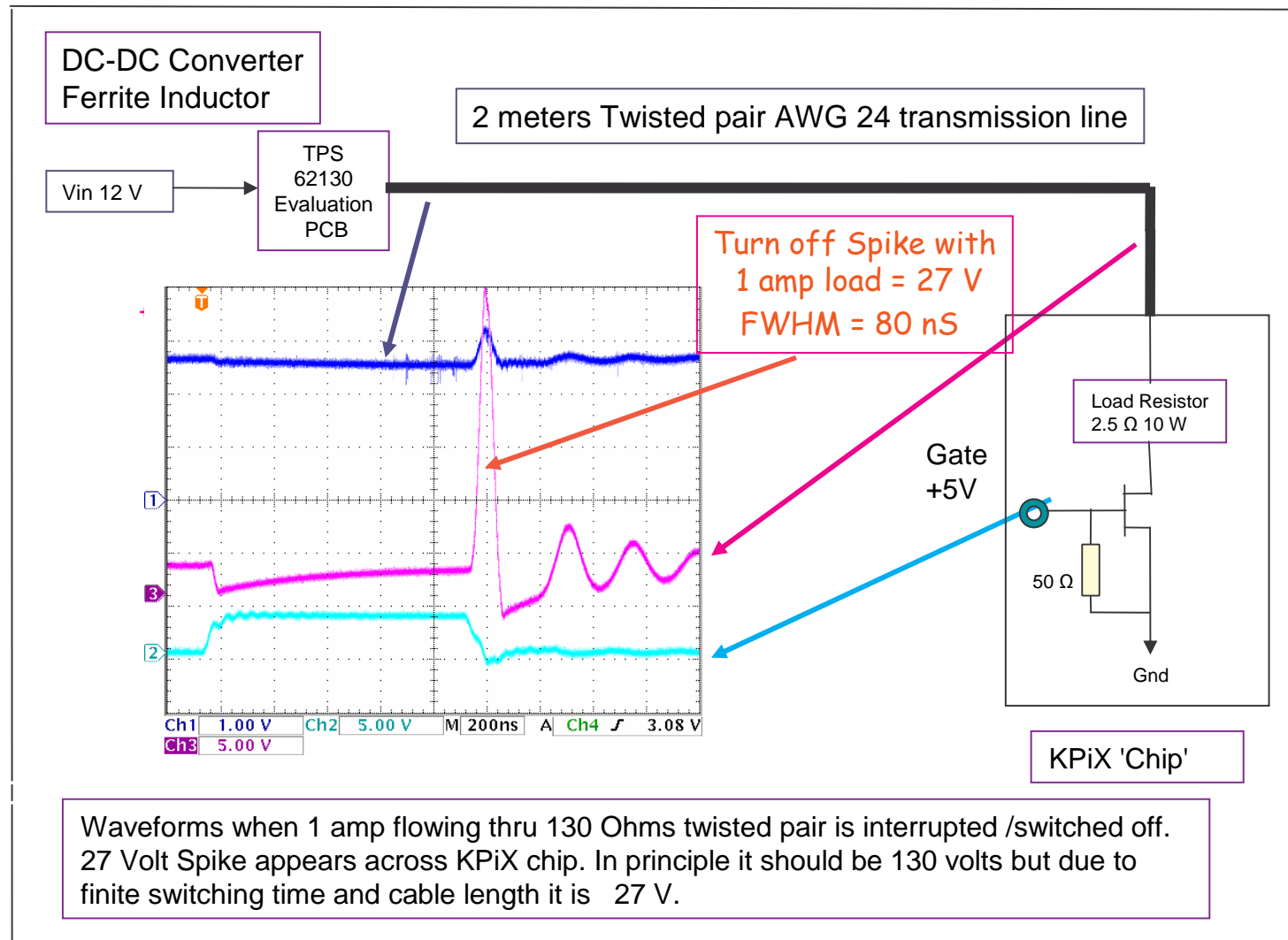


Power Efficiency _ Inefficiency _ Wasted Power



Why use DC-DC for Pulse powering ?





GOERTZ audiophile speaker cable
Copper or Silver (Need good ears & Deep pockets)



ALPHA-Core Interconnect Pairs

JAN 14 2011

"Analogue-like dynamics from CD, seamless top-to-bottom smoothness, 3D imaging, dead silent background..."
Ed Osborne, Executive Producer BMG Special Products

Stereo Pairs	1m	1.5m	2m	2.5m	3m	4m	5m	6m	7m	8m	9m	10m
	3.3ft	4.9ft	6.5ft	8.1ft	9.7ft	13.1ft	16.4ft	19.7ft	23ft	26.2ft	29.5ft	32.8ft
COPPER INTERCONNECT (Micro Purl-25 awg, TQ2 Copper-21awg, Tourmaline - 18awg)												
Micro Purl Cu RCA	\$101	\$121	\$157	\$194	\$216	\$255	\$334	\$413	\$470	\$549	\$628	\$708
Micro Purl Cu XLR	\$133	\$166	\$201	\$243	\$269	\$318	\$405	\$502	\$550	\$664	\$943	\$1,077
Triode Quartz TQ2/Cu RCA	\$148	\$190	\$234	\$280	\$324	\$381	\$444	\$539	\$632	\$702	\$797	\$893
Triode Quartz TQ2/Cu XLR	\$195	\$242	\$292	\$342	\$393	\$460	\$534	\$640	\$735	\$872	\$1,207	\$1,367
Tourmaline RCA	\$178	\$228	\$280	\$336	\$388	\$457	\$533	\$647	\$759	\$843	\$956	\$1,071
Tourmaline XLR	\$234	\$291	\$351	\$410	\$471	\$552	\$640	\$768	\$882	\$1,046	\$1,448	\$1,640
SILVER INTERCONNECT (Micro Purl - 25 awg, TQ2 - 21awg, Sapphire - 18awg)												
Micro Purl Ag RCA	\$165	\$198	\$256	\$316	\$351	\$416	\$545	\$673	\$766	\$894	\$1,023	\$1,153
Micro Purl Ag XLR	\$217	\$270	\$328	\$397	\$438	\$517	\$660	\$818	\$896	\$1,082	\$1,537	\$1,754
Triode Quartz TQ2/Ag RCA	\$242	\$309	\$381	\$456	\$527	\$621	\$724	\$878	\$1,030	\$1,143	\$1,298	\$1,454
Triode Quartz TQ2/Ag XLR	\$318	\$395	\$476	\$557	\$640	\$749	\$869	\$1,042	\$1,197	\$1,420	\$1,966	\$2,226
Sapphire RCA	\$443	\$633	\$805	\$848	\$891	\$1,188	\$1,489	\$1,599	\$1,997	\$2,053	\$2,308	\$2,566
Sapphire XLR	\$566	\$793	\$1,000	\$1,040	\$1,123	\$1,453	\$1,742	\$2,032	\$2,214	\$2,490	\$2,800	\$3,111

Shaded area: Recommended Interconnects, function of length



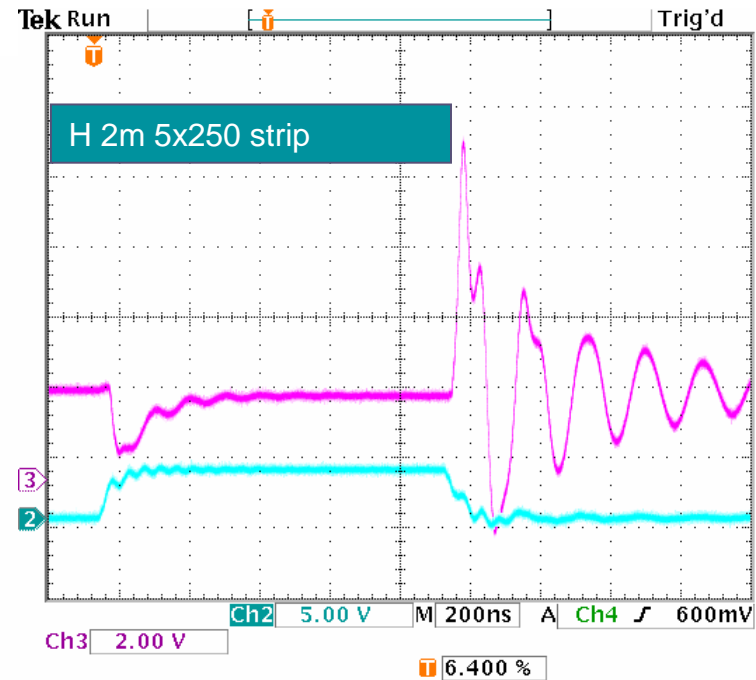
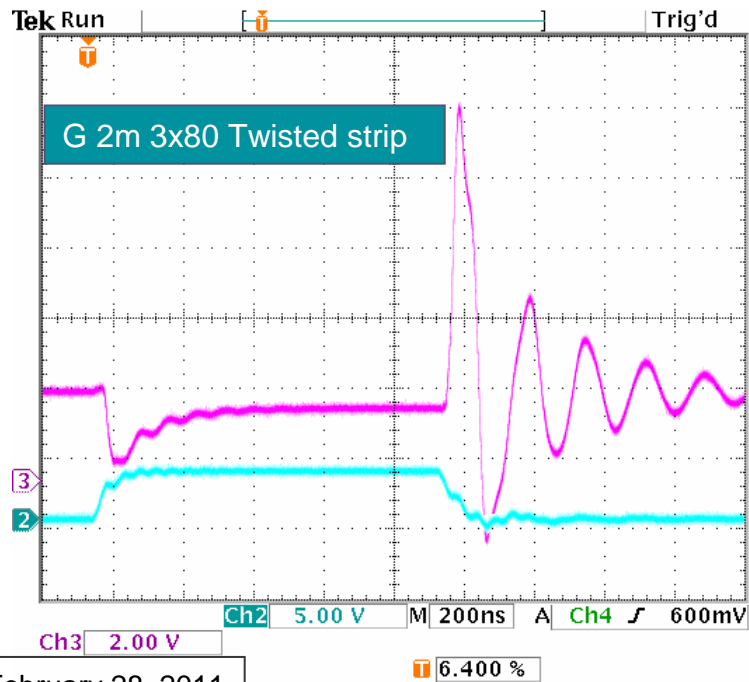
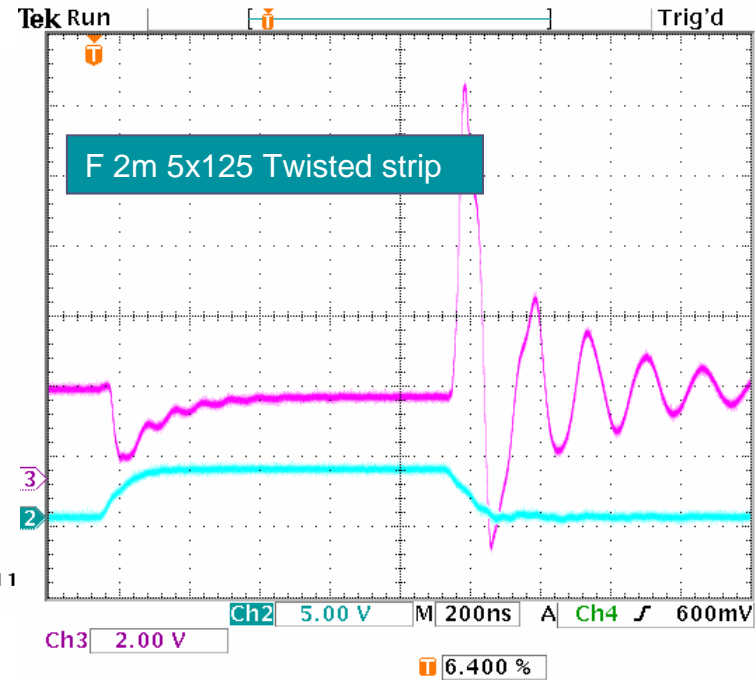
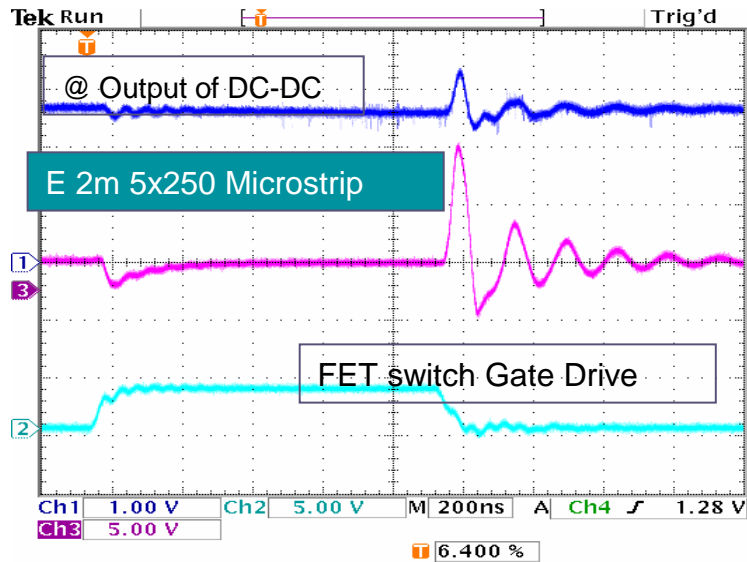
1/13/2011

Cable Parameters

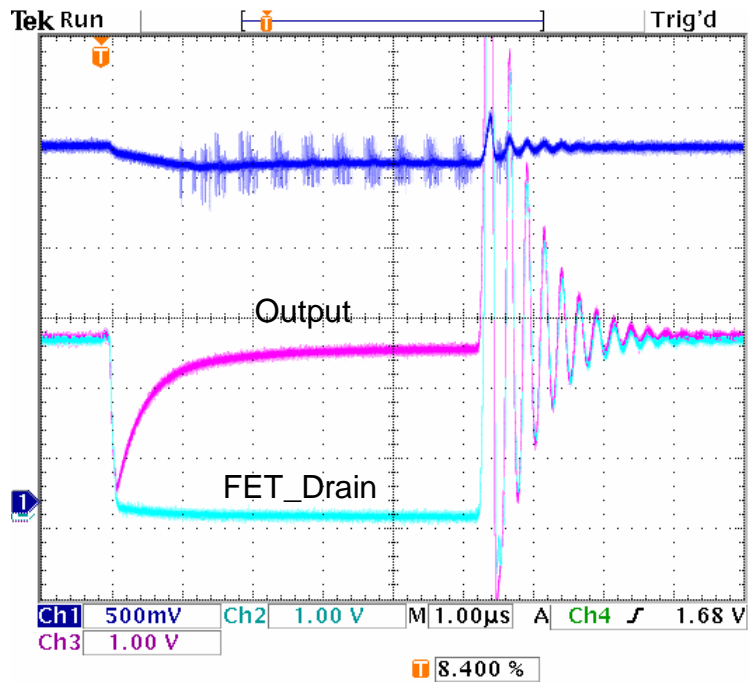
Cable Type	# of	Cross Section	C	L	R	DCR	Z	Reflection	Label
Length = 2 meters	Conductors	mils	pF	nH	1 MHz	Ohms	Ohms	Peak V	
Twisted Pair	2	AWG 22	95.6	1100	0.734	0.197	130	27	
Micro Strip	2	5 x 250	1440	168	0.171	0.105	10.8	10	E
Strip Line	3	5 x 250	4930	103	0.092	0.066	4.6	7.4	H
Strip Line -Twisted	3	5 x 125	2520	154	0.195	0.142	7.8	9	F
Strip Line -Twisted	3	3 x 80	2353	177	0.544	0.420	8.7	8.8	G

All Cables 2 meter long.
 HP 4284A Precision LCR Meter 20 Hz - 1 MHz. Test Fixture 16047C

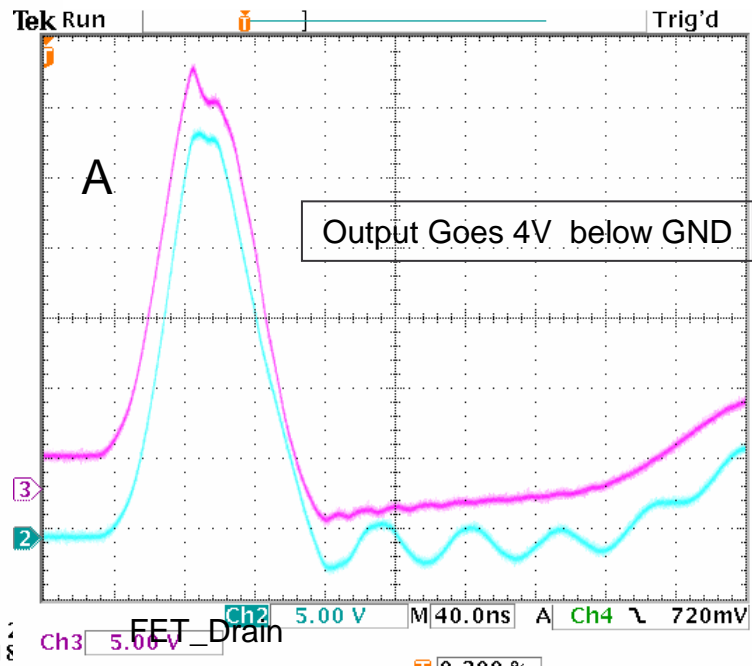
February 28, 2011



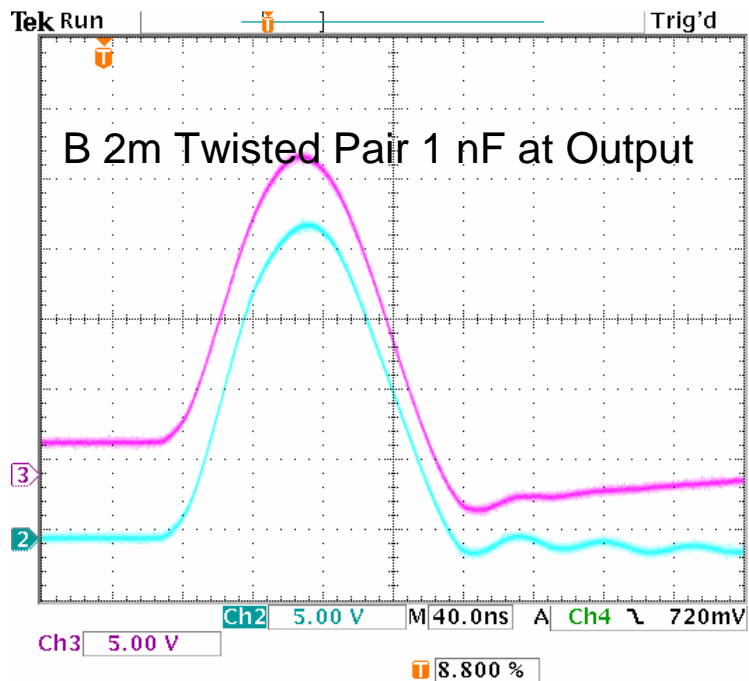
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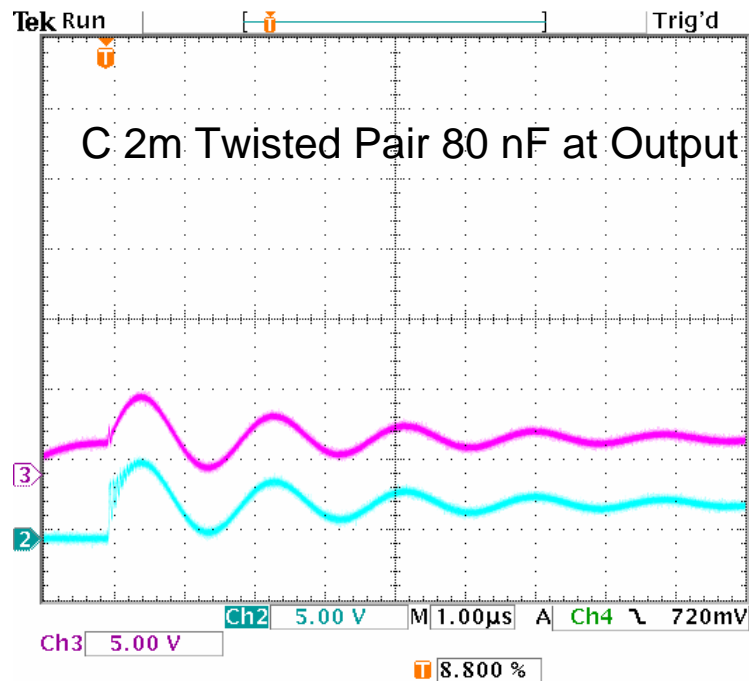
27 Feb 2011
05:08:18



27 Feb 2011
06:18:36



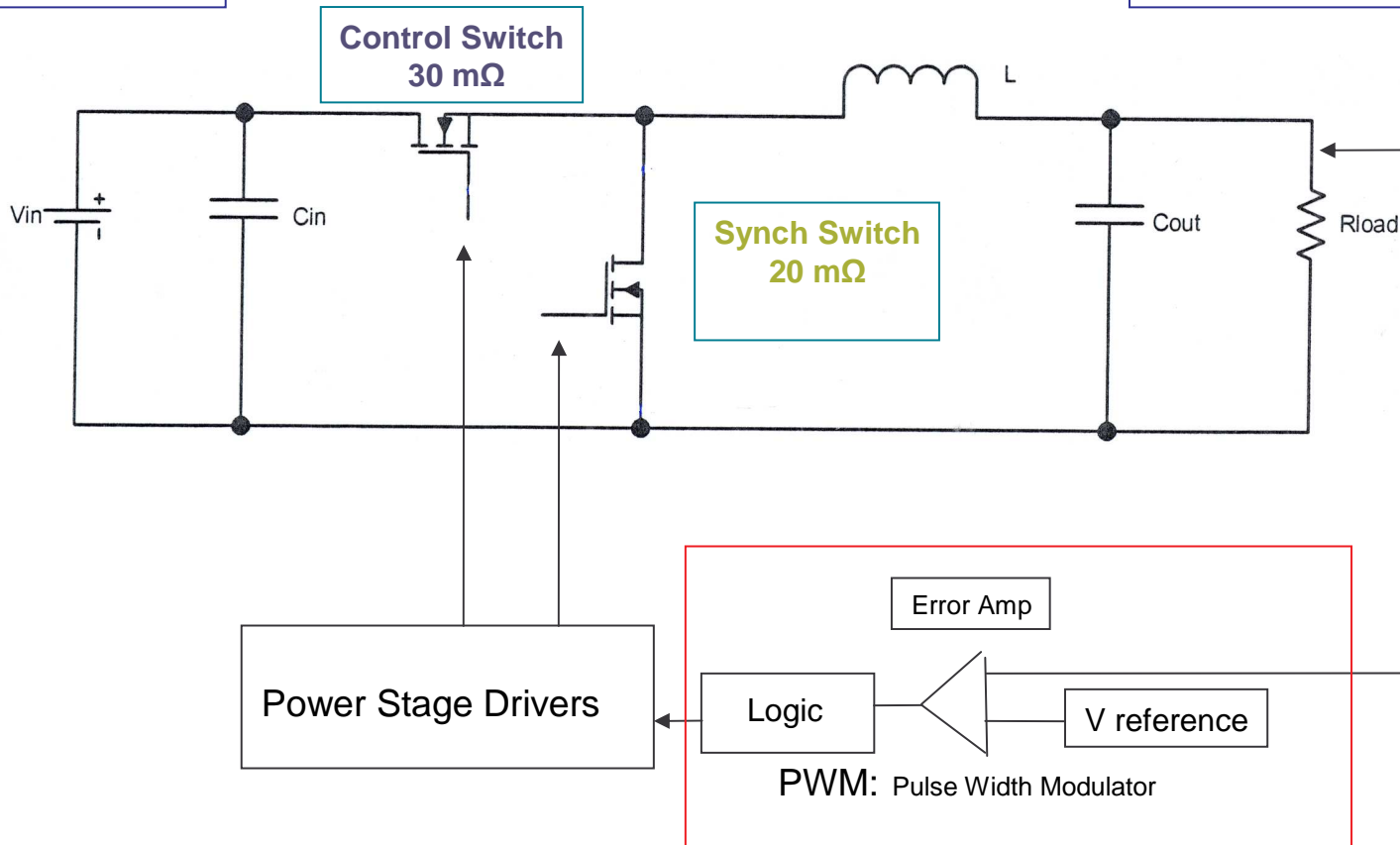
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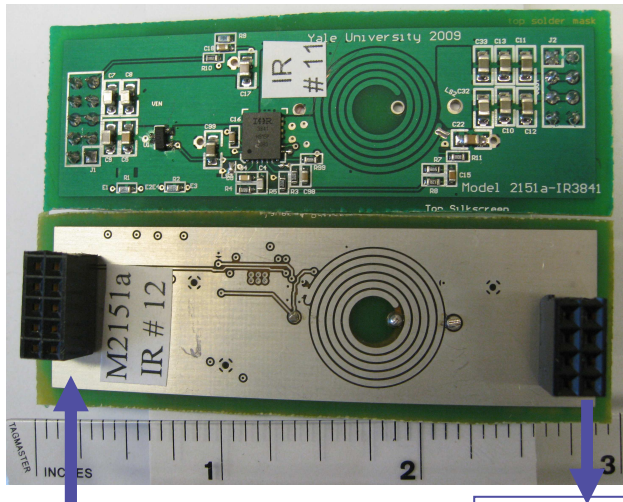
27 Feb 2011
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High Voltage
Low Current
Input

Low Voltage
High Current
Output



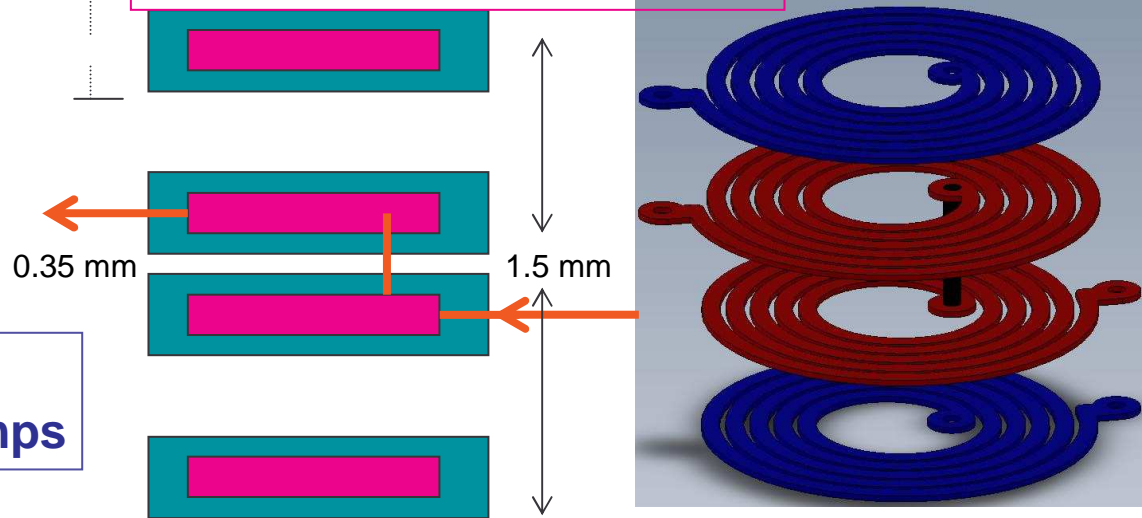
Plug In Card with Shielded Buck Inductor



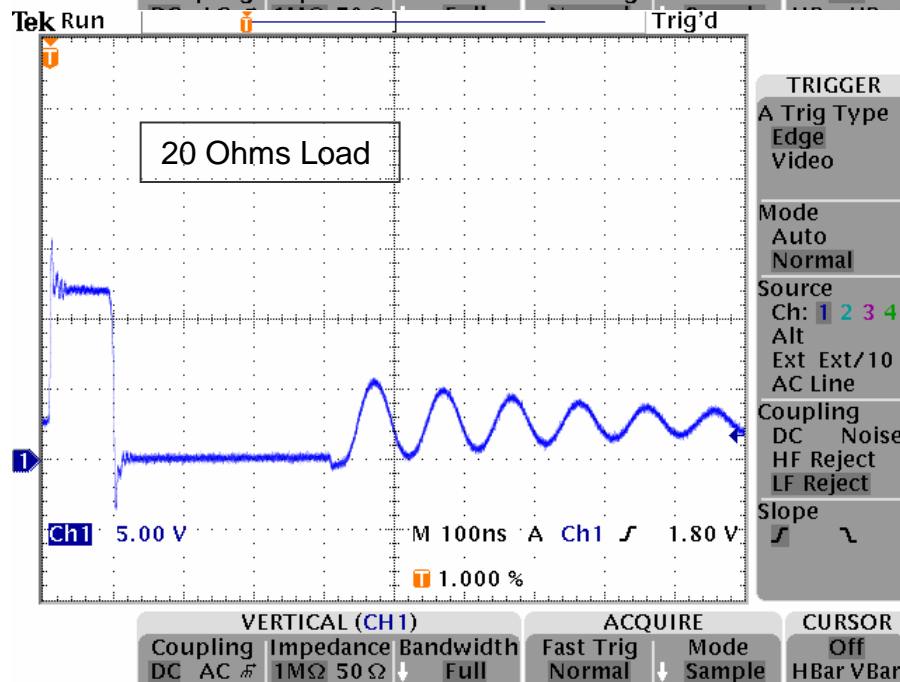
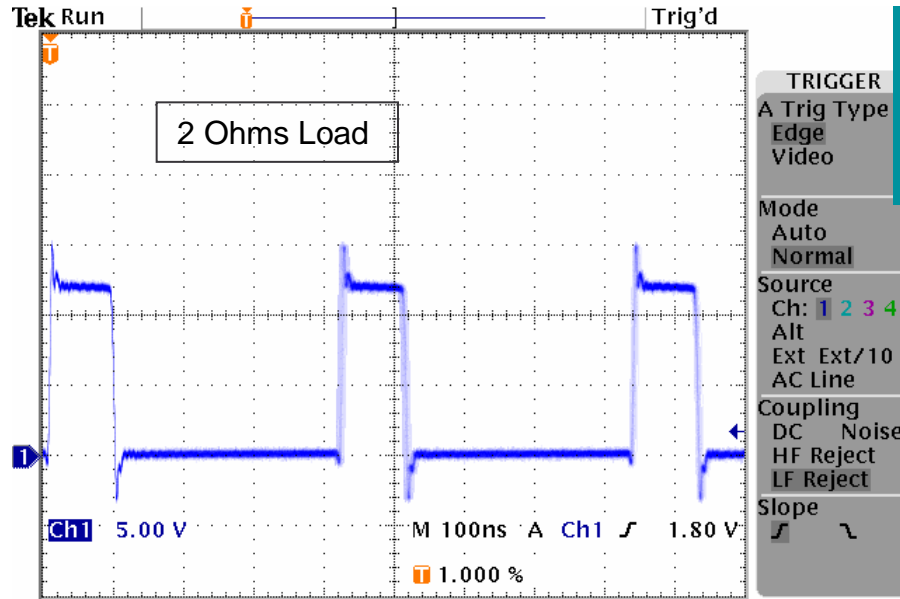
12 V

2.5 V
@ 6 amps

Coupled Air Core Inductor
Connected in Series

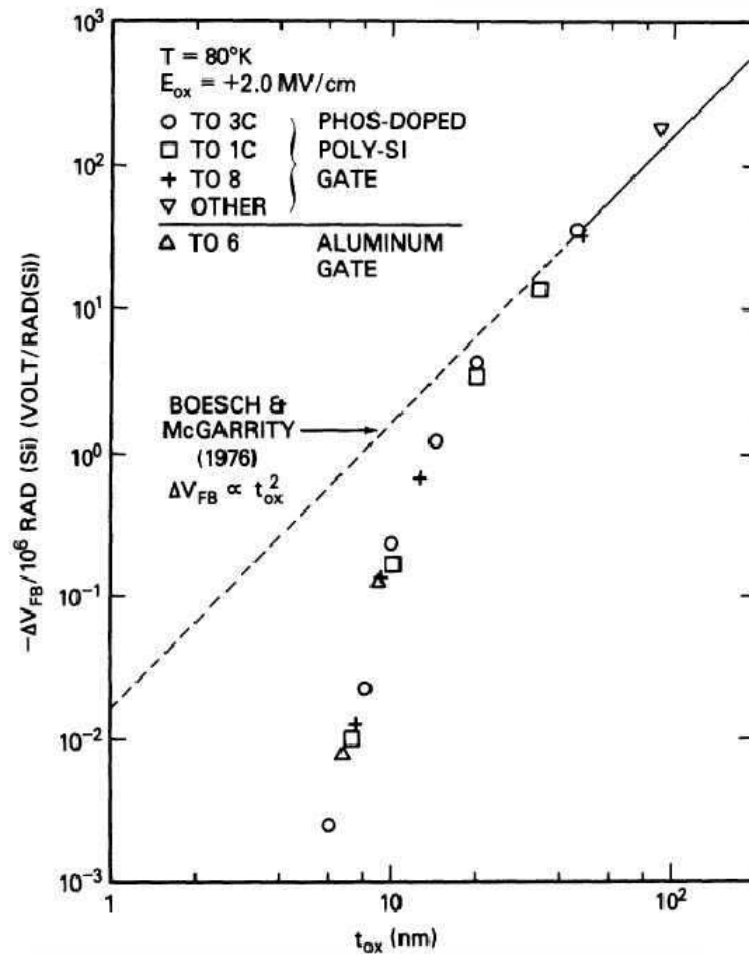


TI Device in Development Fast Transient Response

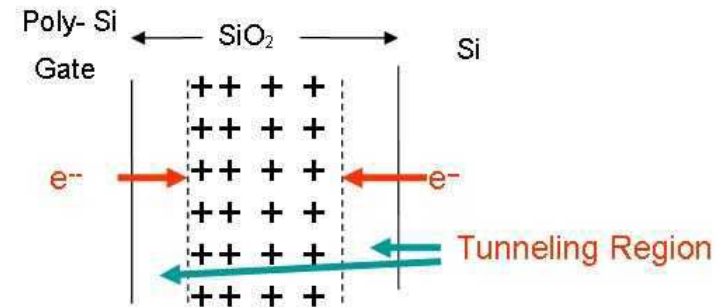


Threshold shift in MOS transistors with Radiation vs Oxide Thickness

Threshold Shift vs Gate Oxide Thickness

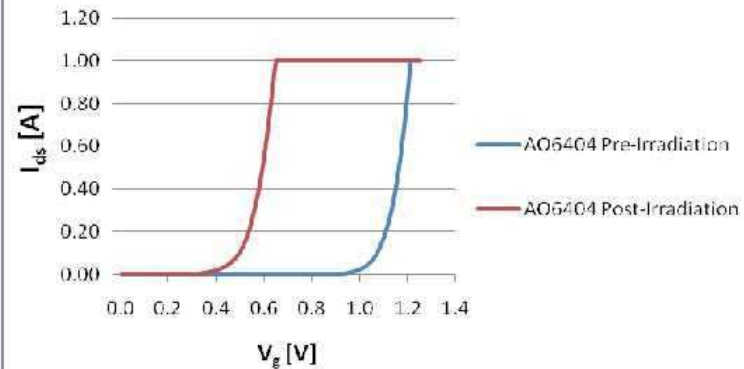


Sachs et. al. IEEE Trans. Nuclear Science NS-31, 1249 (1984)



Hole removal process by tunneling in thin-oxide MOS Structures

Shifting V_t of MOSFET With Gammas



Book. Timothy R Oldham "Ionizing Radiation Effects in MOS Oxides" 1999 World Scientific

Radiation Tolerance of CMOS Devices

Company	Device	Process	Foundry	Oxide	Dose before	Observation
		Name/ Number	Name	nm	Damage seen	Damage Mode
IHP	ASIC custom	SG25V GOD 12 V	IHP, Germany	5	53 MRads	Minimal Damage
XySemi	FET 2 A	HVMOS20080720 12 V	China	7	52 Mrads	Minimal Damage
XySemi	XP5062	HVMOS20080720	China	12	44 Krads	Loss of output regulation
Enpirion	EN5365	CMOS 0.25 μ m	Dongbu HiTek, Korea	5	64 Krads	Increasing input current
Enpirion	EN5382	CMOS 0.25 μ m	Dongbu HiTek, Korea	5	111 Krads	Loss of output regulation
Enpirion	EN5360	SG25V (IHP)	IHP, Germany	5	100 Mrads	Minimal Damage
National	LM2864	PVIP25	In House	11.8	3 Mrads	Loss of output. Short after power off/on

Table I. Radiation Tolerance of Devices with thin oxide

Next

- ❖ Measure KPiX turn off spikes
- ❖ Movement of Pulsed Current Conductors in 7T
Suggestions are welcome
- ❖ Test new commercial converters oxides < 15 nm

More Information

<http://shaktipower.sites.yale.edu/>