LTC7000-1
Fast High Voltage Protected High Side NMOS Static Switch Driver

DESCRIPTION

Demonstration circuit 2492A is a 135V protected, high side switch featuring the LTC®7000-1. The demo board is designed to switch a 5.5A output load from input voltages from 8V to 135V. The wide input range and low shutdown current (1µA typical) make it suitable for automotive, industrial, medical instrument and telecom applications. This board offers a low 50ns (typical) propagation delay, fast switching times (<10ns) and 100% duty cycle operation.

The LTC7000-1 is a fast high voltage protected high side N-channel MOSFET driver with high voltage pin spacing (0.657mm). An internal charge pump fully enhances an external N-channel MOSFET switch, allowing it to remain on indefinitely. A powerful gate driver can drive large gate capacitance MOSFETs with very short transition times, ideal for both high frequency switching and static switch applications. The LTC7000-1 operates over a 3.5V to 135V input supply range. When an external current sense resistor and internal comparator sense that the switch current has exceeded a preset level, a fault flag is asserted and the switch is turned off after a period of time set by an external timing capacitor. After a cooldown period, the LTC7000-1 can be configured to automatically retry or remain off until the input is re-cycled.

The demo board includes input capacitors and an output diode to accommodate input and output supply inductance when switching loads. The switch can be controlled directly with external signal or using the on-board on/off switch. A single-shot pulse generator is included for evaluating switching times while limiting output power. Optional auxiliary V_{CC} input accommodates gate power associated with high frequency switching. Positions for RC delay network to control inrush current are also included.

The LTC7000-1 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this demo manual for demo circuit 2492A. Proper board layout is essential for maximum thermal and electrical performance. See the data sheet sections for details. The LTC7000-1 is available in 16-lead MSOP package and three operating junction temperature grades, extended and industrial from –40°C to 125°C, high temp automotive version from –40°C to 150°C and a military grade from –55°C to 150°C.

Design files for this circuit board are available at http://www.linear.com/demo/DC2492A

PERFORMANCE SUMMARY

SYMBOL	PARAMETER	CONDITIONS Specifications are at T_A = 25°C	MIN	TYP	MAX	UNITS
V_{IN}	Input Voltage		8.0		135	V
I_{OUT}	Output Current		5.5			A
	Insertion Drop	$V_{IN} – V_{OUT}$, 5.5A Load, Input to Output Terminals		150		mV
V_{IN}	Start-Up Voltage	100kΩ Load, V_{INP} = 4V		7.0	8.0	V
V_{CCUV}	V_{CC} Undervoltage Lockout	V_{CC} Rising V_{CC} Falling Hysteresis	6.5 5.8	7.0 6.4 0.6	7.5 6.9	V V V
	Overcurrent to V_{OUT} Low	Turn-On into a 10A Resistive Load		19		µs
	Input to Output Propagation Delay	V_{IN} = 135V, 50Ω Load, INP = 2.2V to V_{OUT} = 13.5V		50		ns
	Output Rise Time	V_{IN} = 135V, 50Ω Load, 10% to 90%		6.5		ns

QUICK START PROCEDURE

Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the output voltage during switching transitions, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the output voltage by touching the probe tip and ground ring directly across the output capacitor as shown in Figure 2.

1. Place SW1 to OFF position. Move JP1 from the PULSE (default position) to ON/OFF position (load on continuously when SW1 is ON).
2. With input power supply set to zero volt and power off, connect the input power supply to +VIN and GND.
3. With power off, connect load from +VOUT to GND.
4. Turn on the input power supply and increase the input voltage slowly to 8V minimum. The input range is up to 135V but hot-plugging with long leads may result in input voltages in excess of 135V.
5. Place SW1 to ON position.
6. Check for the proper output voltage using a voltmeter. Output voltage should be close to input voltage.

   NOTE: If there is no output, temporarily disconnect the load and cycle SW1 (the ON/OFF switch) or press reset pushbutton SW2. If output is good, the load may be set too high.
7. Once the proper output voltage is established, adjust the load, if desired, to test current limit.
8. Placing SW1 to OFF position, moving JP1 to PULSE position then placing SW1 in ON position will allow pulse operation. Pushing SW2 will turn the high side switch on for 300µs time.
9. Placing SW1 to OFF position, moving JP1 to INPUT position connects INPUT terminal to LTC7000-1 INP pin. An INPUT pin voltage of 2.2V or more will turn-on the high side switch.

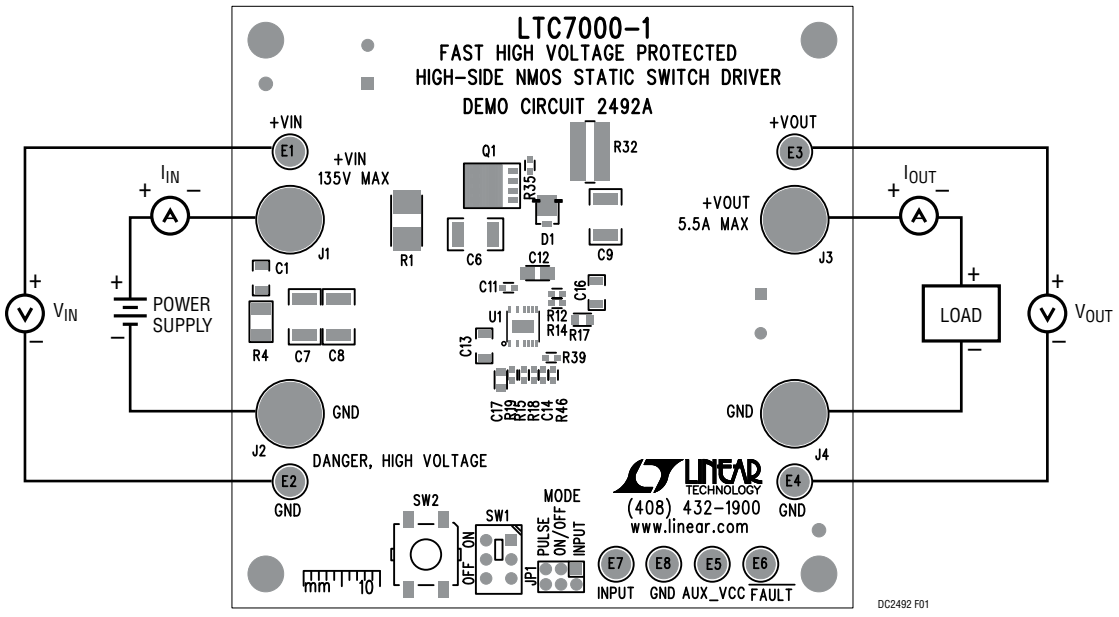


Figure 1. Proper Measurement Equipment Setup

QUICK START PROCEDURE

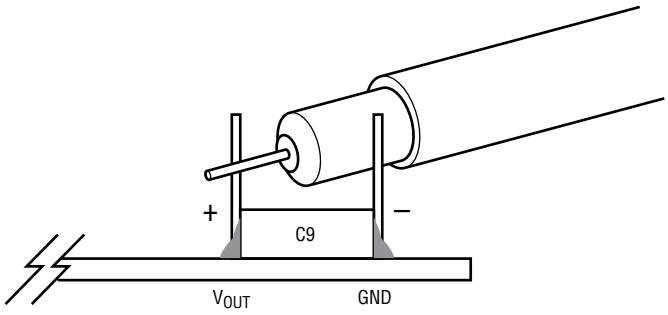


Figure 2. Measuring Output Voltage During Switching across C9. Note that C9 May Not Be Installed

TYPICAL PERFORMANCE CHARATERISTICS

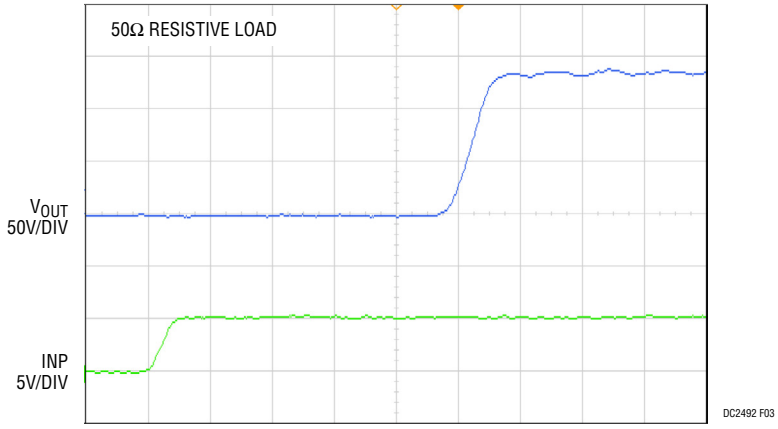


Figure 3. Rise Time into 50Ω Load (V_{IN} = 135V, V_{INP} 5V/DIV, V_{OUT} 50V/DIV, 10ns/DIV)

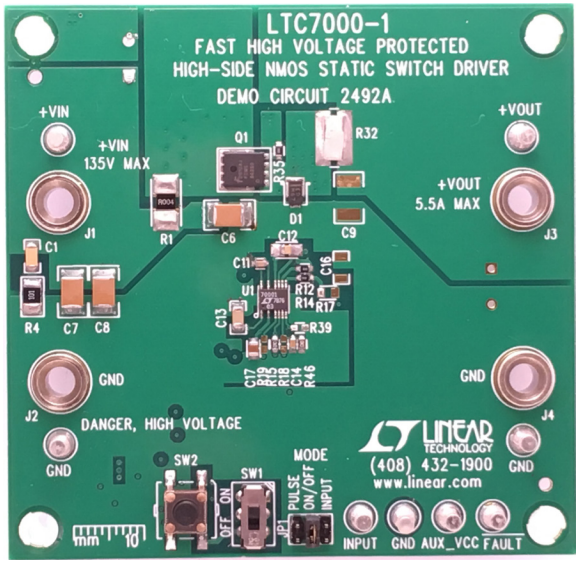


Figure 4. Board Photo

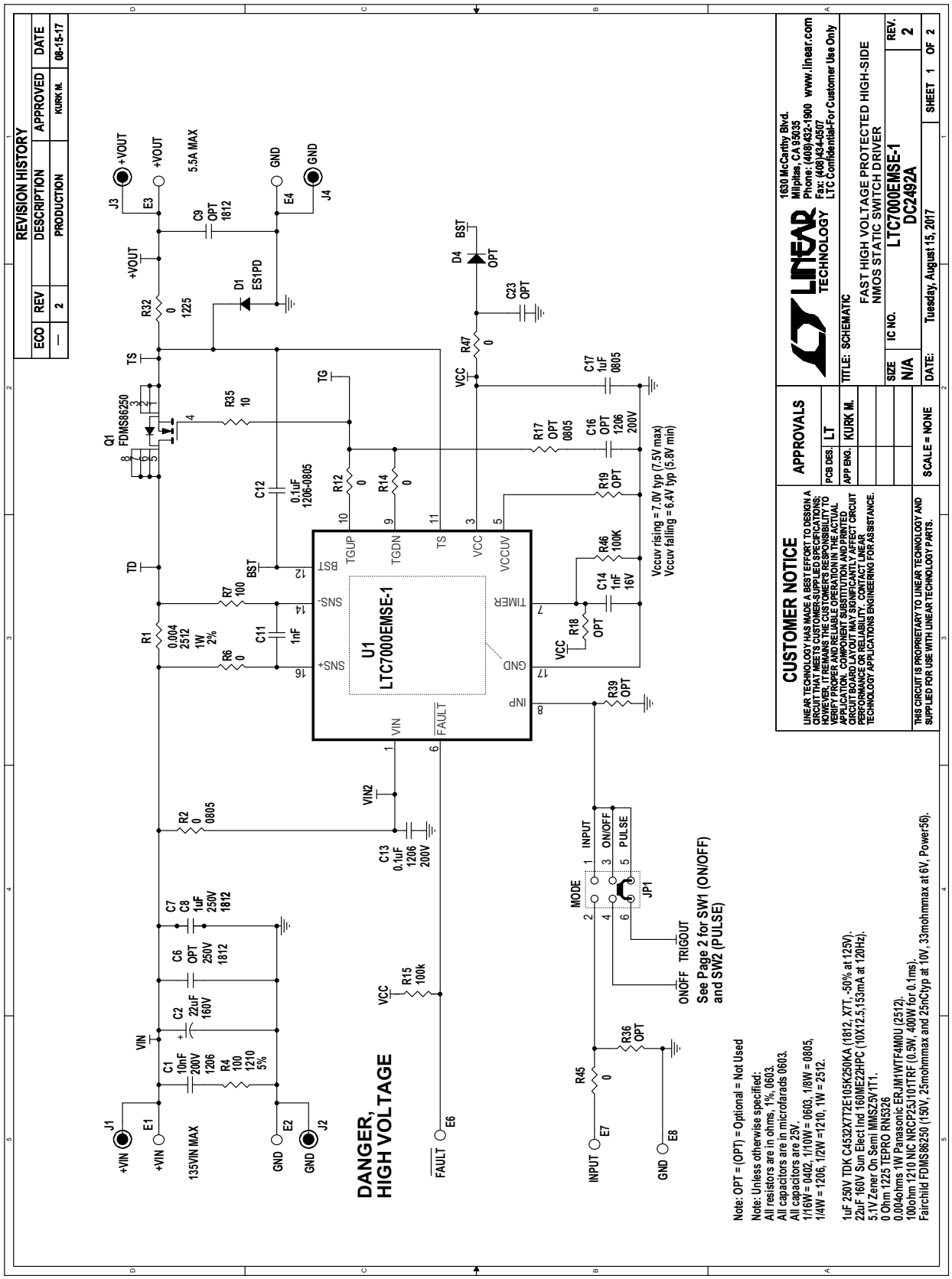
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	5	C3, C4, C5, C7, C8	CAP., 1µF, X7T, 250V, 1812	TDK, C4532X7T2E105K250KA
2	2	C11, C14	CAP., 1000pF, X7R, 25V, 10%, 0603	MURATA, GRM188R71E102KA01D
3	1	C12	CAP., 0.1µF, X7R, 25V, 10%, 0805	AVX, 08053C104KAT2A
4	1	C13	CAP., 0.1µF, X7R, 200V, 10%, 1206	AVX, 12062C104KAT2A
5	1	C17	CAP., 1µF, X7R, 25V, 10%, 0805	AVX, 08053C105KAT2A
6	1	D1	DIODE, ES1PD, 200V, 1A, DO-220AA	VISHAY, ES1PD-M3/84A
7	1	Q1	MOSFET, N-CH, 150V, POWERPAK-SO-8	FAIRCHILD, FDMS86250
8	1	R1	RES., SENSE, 0.004Ω, 1W, 2%, 2512	PANASONIC, ERJM1WTF4M0U
9	2	R7	RES., 100Ω, 1/10W, 1%, 0603	VISHAY, CRCW0603100RFKEA
10	1	R35	RES., 10Ω, 1/10W, 1%, 0603	VISHAY, CRCW060310R0FKEA
11	1	U1	IC, LTC7000EMSE-1, MSE-16L(12)	LINEAR TECH., LTC7000EMSE-1#PBF
Additional Demo Board Circuit Components				
1	1	C1	CAP., 10nF, X7R, 200V, 10%, 1206	AVX, 12062C103KAZ2A
2	1	C2	CAP., 22µF, ALUM, 160V, 20%, TH C-10X12.5	SUN ELECT., 160ME22HPC
3	0	C6, C9	CAP., OPTIONAL, 1812	OPTIONAL
4	0	C10	CAP., OPTIONAL, TH C-10X12	OPTIONAL
5	0	C16	CAP., OPTIONAL, 1206	OPTIONAL
6	2	C18, C19	CAP., 0.1µF, X7R, 25V, 10%, 0603	AVX, 06033C104KAT2A
7	0	C23	CAP., OPTIONAL, 0603	OPTIONAL
8	0	D2, D3, D4	DIODE, OPTIONAL, SOT23	OPTIONAL
9	1	D5	DIODE, MMSZ5V1T1, SOD-123	ON SEMICONDUCTOR, MMSZ5V1T1G
10	1	D6	DIODE, MMBD4148, SOT23	DIODES INC., MMBD4148-7-F
11	0	D7	DIODE OPTION, PDS4150, POWERDI5	OPTIONAL
12	0	D8	DIODE, OPTION, BAS21, SOT23	OPTIONAL
13	0	D9	DIODE., OPTION, CMMR1U, SOD-123F	OPTIONAL
14	0	Q2	MOSFET, N-CH, 80V, PSOF08A	FAIRCHILD, FDBL86361_F085
15	1	Q4	XSTR, PNP, 0.2A, MMBT3906, SOT23	FAIRCHILD, MMBT3906
16	1	Q5	MOSFET, P-CH, -200V, SOT23	DIODES INC., ZXMP2120FFTA
17	1	R2	RES., 0Ω, 1/10W, 1%, 0805	VISHAY CRCW08050000Z0EA
18	1	R4	RES., 100Ω, 1/2W, 5%, 1210	NIC, NRCP25J101TRF
19	7	R6, R12, R14, R22, R25, R45, R47	RES., 0Ω, 1/10W, 0603	VISHAY, CRCW06030000Z0EA
20	0	R9, R17	RES., OPTIONAL, 0805	OPTIONAL
21	0	R13, R18, R19, R33, R34, R36, R39	RES., OPTIONAL, 0603	OPTIONAL
22	5	R15, R21, R37, R38, R46	RES., 100k, 1/10W, 1%, 0603	VISHAY, CRCW0603100KFKEA
23	1	R23	RES., 787Ω, 1/10W, 1%, 0603	VISHAY, CRCW0603787RFKEA

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
24	2	R27, R31	RES., 240k, 1/10W, 1%, 0805	VISHAY, CRCW0805240KFKEA
25	1	R28	RES., 976k, 1/10W, 1%, 0603	VISHAY, CRCW0603976KFKEA
26	1	R29	RES., 232k, 1/10W, 1%, 0603	VISHAY, CRCW0603232KFKEA
27	1	R30	RES., 182k, 1/10W, 1%, 0603	VISHAY, CRCW0603182KFKEA
28	1	R32	RES., SENSE, 0Ω, 1/2W, 1%, 1225	TEPRO, RN5326
29	1	SW1	SWITCH, SUB MINIATURE SLIDE	C&K COMPONENTS, JS202011CQN
30	1	SW2	SWITCH, MICRO MINIATURE PUSHBUTTON	TE CONNECTIVITY, FSM4JSMA
31	1	U2	IC, LTC6993CS6-3, TSOT23-6	LINEAR TECH., LTC6993CS6-3#PBF
Hardware: For Demo Board Only				
1	8	E1-E8	TESTPOINT, TURRET 0.094"	MILL MAX 2501-2-00-80-00-00-07-0
2	1	JP1	CONN., HEADER, 2X3, 2mm	WURTH ELEKTRONIK, 62000621121
3	4	J1, J2, J3, J4	CONN, BANANA JACK	KEYSTONE, 575-4
4	1	XJP1	SHUNT, 2mm	WURTH ELEKTRONIK, 60800213421
5	4	MH1, MH2, MH3, MH4	STAND-OFF, NYLON 0.559" tall	WURTH ELEKTRONIK, 702935500

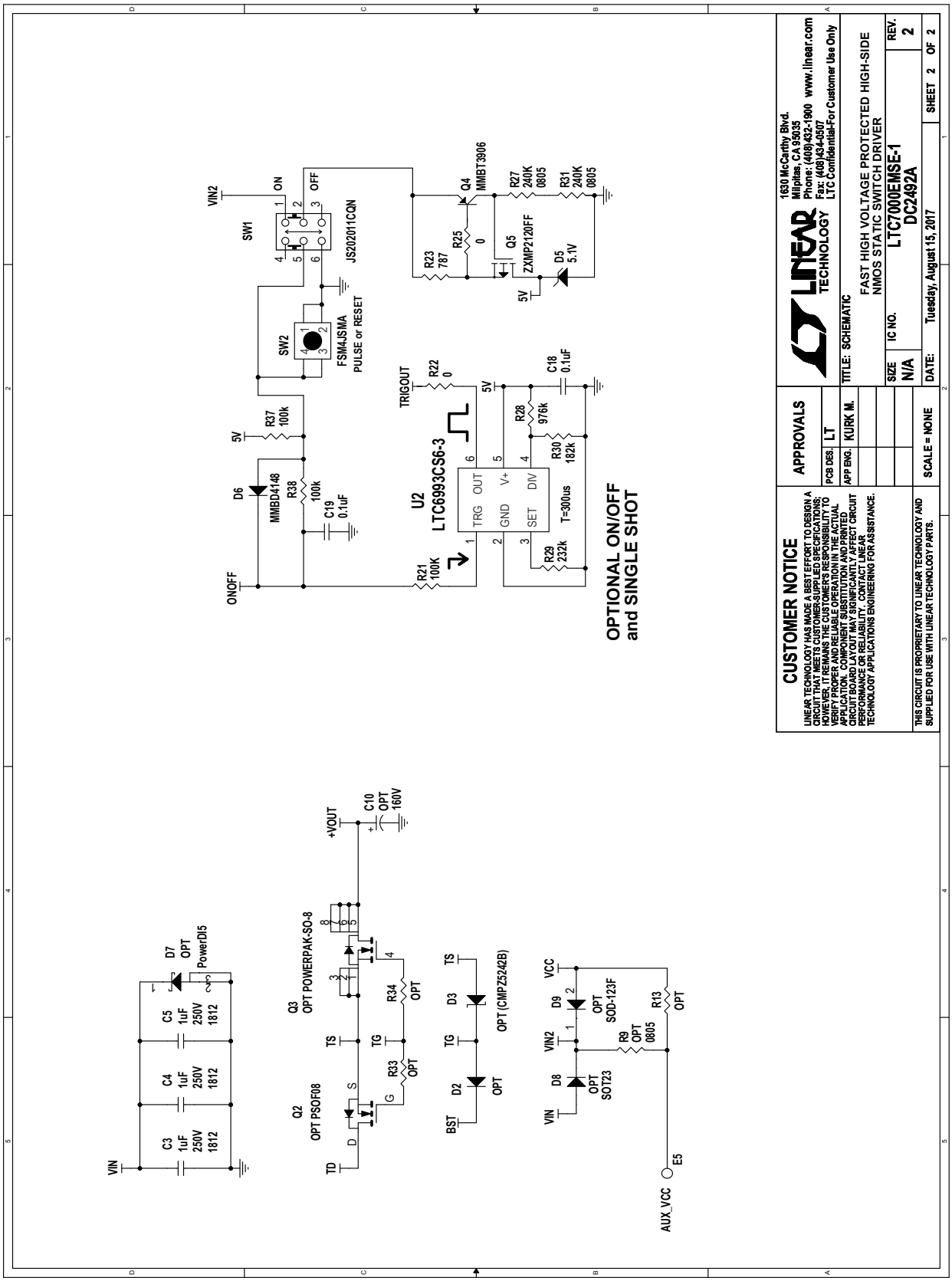
SCHEMATIC DIAGRAM



Note: OPT = (OPT) = Optional = Not Used
Note: Unless otherwise specified:
All resistors are in ohms, 1%, 0603.
All capacitors are in microfarads 0603.
All capacitors are 25V.
1/16W = 0402, 1/10W = 0603, 1/8W = 0805, 1/4W = 1206, 1/2W =1210, 1W = 2512.

1uF 250V TDK C4532X7T2E105K250KA (1812, X7T, -50% at 125V).
22uF 160V Sun Elect Ind 160ME22HPC (10X12.5,153mA at 120Hz).
5.1V Zener On Semi MMSZ5V1T1.
0 Ohm 1225 TEPRO RN5326
0.004ohms 1W Panasonic ERJM1WTF4M0U (2512).
100ohm 1210 NIC NRCP25J101TRF (0.5W, 400W for 0.1ms).
Fairchild FDMS86250 (150V, 25mohmmax and 25nCtyp at 10V, 33mohmmax at 6V, Power56).

SCHEMATIC DIAGRAM



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Linear Technology
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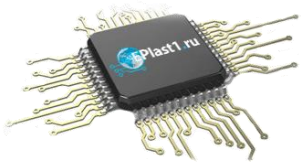

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Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.