Application Report
SLVU172–June 2006

TFT-LCD Power Supply Using the TPS65120 Single Inductor Quadruple-Output Power Supply

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ABSTRACT

The reference design and application examples shown in this document help design a TFT-LCD power supply, as well as show implementations of power-down sequencing, programmable sequencing, and boosting output current.

1 FEATURES

- Main Output, V_{MAIN}
  - Adjustable Voltage, 3.0 V to 5.6 V/25 mA
  - Post-Regulated for Low Ripple ($5mV_{PP}$)
  - ±0.8% Typical Accuracy
  - Efficiency up to 83%
- Positive Output, V_{GH}
  - Adjustable Voltage up to 20 V/2 mA
  - ±3% Typical Accuracy
- Negative Output, V_{GL}
  - Adjustable Voltage down to -18 V/2 mA
  - ±3% Typical Accuracy
- Auxiliary 1.8 V/3.3 V Linear Regulator

?. Automatic or Programmable Power Sequencing

1. Complete 1 mm Component Profile Solution
2. 2.5 V to 5.5 V Input Voltage Range
3. Output Short Circuit Protected
4. 16-Pin QFN Package (3 × 3 × 0,9 mm)

2 TPS65120 Reference Design

The reference design shown in Figure 1 uses a TPS65120 single inductor, multichannel output IC to provide the three output voltages necessary to power amorphous silicon (a-Si) and low-temperature polysilicon (LTPS) TFT-LCD displays. The TPS65120 has integrated power-up/down sequencing and an auxiliary linear regulator providing an additional 3.3-V rail.

2.1 Bill of Materials and Schematic

This chapter provides the TPS65120EVM and TPS65124EVM bill of materials and schematic.

2.1.1 Bill of Materials

Table 1. HPA076 Bill of Materials

Count		RefDes	Description	Size	MFR	Part Number
–001	–002					
1	1	C1	Capacitor, ceramic, 2.2-µF, 6.3-V, X5R, 10%	603	TDK	C1608X5R0J225KT
1	1	C10	Capacitor, ceramic, 0.47-µF, 16-V, X5R, 1	603	TDK	C1608X5R1C474KT
1	1	C16	Capacitor, ceramic, 0.1-µF, 25-V, X7R, 10%	603	TDK	C1608X7R1E104KT
1	0	C12	Capacitor, ceramic, 0.22-µF, 16-V, X5R, 10%	603	AVX	0603YD224KAT2A
2	2	C2, C13	Capacitor, ceramic, 0.22-µF, 16-V, X5R, 10%	603	AVX	0603YD224KAT2A
1	0	C6	Capacitor, ceramic, 0.1-µF, 25-V, X7R, 10%	603	TDK	C1608X7R1E104KT
0	0	C3, C4, C7, C9, C11, C14, C15	Capacitor, ceramic, xxx-µF, vv-V	603		
0	0	C5	Capacitor, ceramic, xxx-µF, vv-V	805		
1	1	C8	Capacitor, ceramic, 1.0-µF, 16-V, X5R, 10%	603	TDK	C1608X5R1C105KT
1	0	D1	Diode, Schottky, 200-mA, 30-V	LLP75-3B	Vishay	BAT54-HT3-GS08
0	1	D2	Diode, Dual Schottky, 200-mA, 30-V	LLP75-3B	Vishay	BAT54A-HT3-GS08
0	0	J5, J6	Header, 2-pin, 100 mil spacing, (36-pin strip)	0.100 × 2		
9	9	J1-J4, J7-J11	Header, 2-pin, 100 mil spacing, (36-pin strip)	0.100 × 2	Sullins	PTC36SAAN
0	0	JP3, JP4	Header, 3-pin, 100 mil spacing, (36-pin strip)	0.100 × 3		
4	4	JP1, JP2, JP5, JP6	Header, 3-pin, 100 mil spacing, (36-pin strip)	0.100 × 3	Sullins	PTC36SAAN
1	1	L1	Inductor, 10-µH, 500-mΩ, 200-mA	805	Taiyo Yuden	CB2012T100M
0	0	Q1	MOSFET, P-ch, -20V, –150 mA, 8 Ω	SC89-3	Siliconix	Si1031X
0	0	Q2	MOSFET, N-ch, 20V, 200 mA, 5 Ω	SC89-3	Siliconix	Si1032X
0	0	Q3	MOSFET, Dual Nch, 20V, 0.6A, 0.7Ω, Pch, –20V, –0.4 A, 1.2Ω	SOT-563	Siliconix	Si1016X
3	3	R1, R2, R3	Resistor, chip, 100 kΩ, 1/16-W, 1%	603	Std	Std
0	2	R23, R24	Resistor, chip, 100 kΩ 1/16-W, 1%	603	Std	Std
1	1	R14	Resistor, chip, 365 kΩ, 1/16-W, 1%	603	Std	Std
3	3	R4, R8, R13	Resistor, chip, 887 kΩ, 1/16-W, 1%	603	Std	Std
0	0	R5, R6, R10–R12, R16, R17, R19, R20	Resistor, Chip, xx-Ω, 1/16-W	603		
1	0	R7	Resistor, Chip, 0-Ω, 1/16-W, 1%	603	Std	Std
0	2	R21, R22	Resistor, Chip, 0-Ω, 1/16-W, 1%	603	Std	Std
2	2	R15, R18	Resistor, Chip, 0-Ω, 1/16-W, 1%	603	Std	Std
1	1	R9	Resistor, Chip, 287 kΩ, 1/16-W, 1%	603	Std	Std
1		U1	IC, Single Inductor Quadruple-Output TFT LCD Power Supply	QFN16	TI	TPS65120QFN
	1					TPS65124QFN
0	0	U2	IC, 100 mA Negative Output LDO Linear Regulators	SOT23-5	TI	TPS72301DBV
0	0	U3	IC, High PSRR, Low Noise LDO, Adj Output, 100-mA	SOT23-6	TI	TPS79201DBV
1	1	—	PCB, 2.5 In x 2.2 In x .062 In		Any	HPA076
2	4	—	Shunt, 100-mil, Black	0.100	3M	929950-00

2.1.2 Schematic

The HPA076 schematic (Figure 1) appears on the following page.

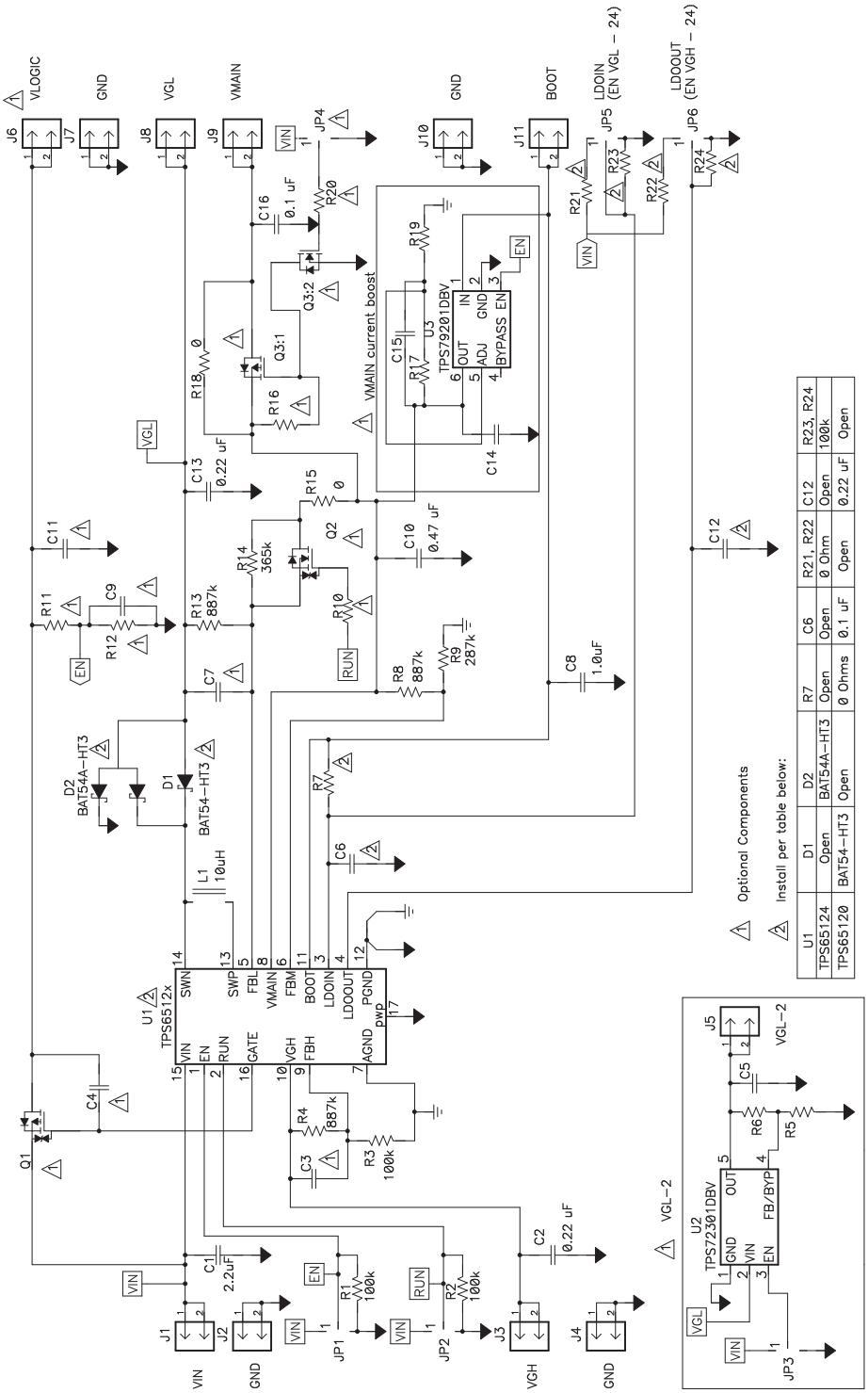


Figure 1. HPA076 Schematic

2.2 Modified Designs for the TPS65120

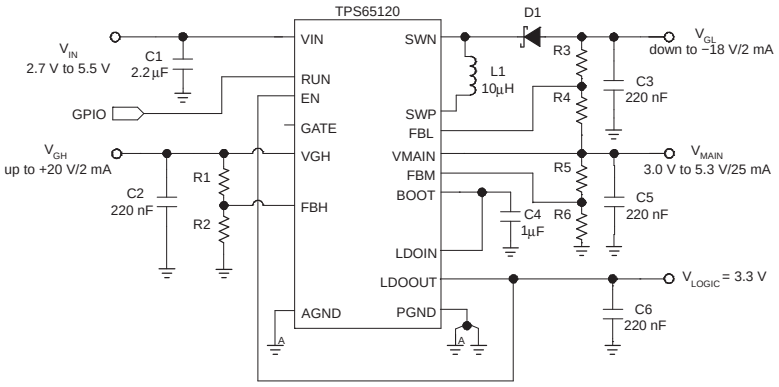
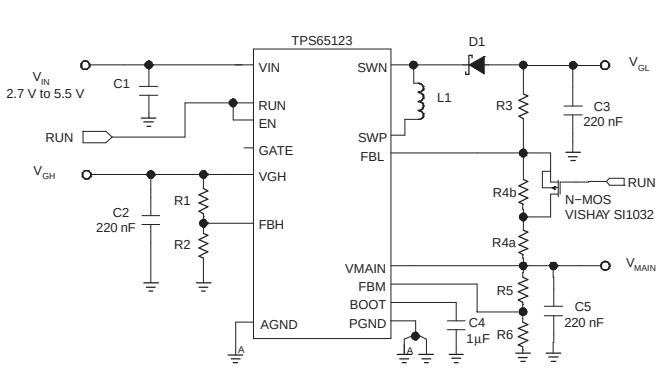
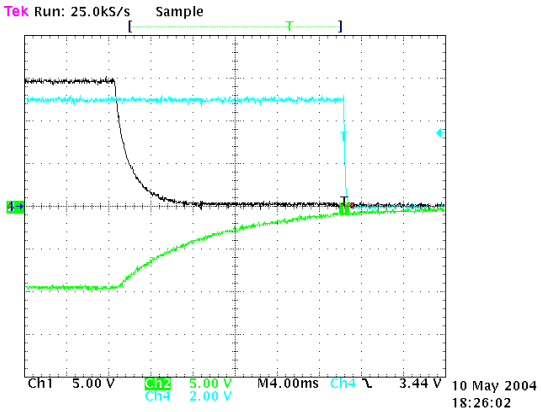


Figure 2. Complete TFT-LCD Power Supply from 1 cell Li-Ion

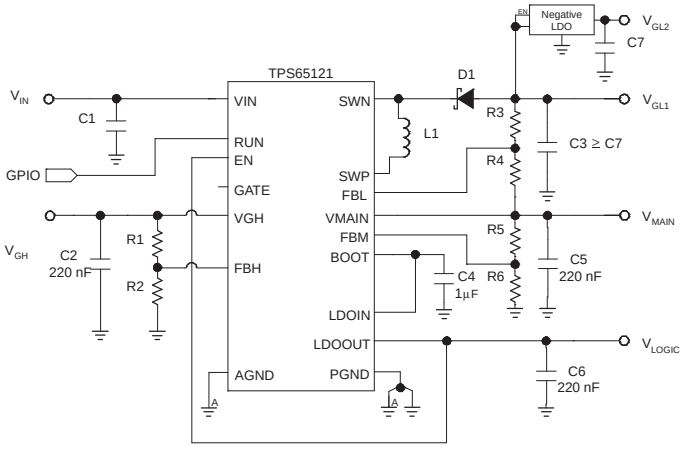




$$\left|V_{GL}\right| = V_{MAIN} \times \frac{R_3}{R_{4a}} \qquad R_{4b} = R_3\left(\frac{1.2 - V_{MAIN}}{V_{GL\_OFFThreshold} - 1.2}\right) - R_{4a}$$

V_{MAIN} = 5.0 V, V_{GH} = 15 V, V_{GL} = −10 V
R_3 = 540 kΩ, R_{4a} = 270 kΩ, R_{4b} = 680 kΩ

Figure 3. $V_{GL} \rightarrow V_{MAIN}$ Power Down-Sequencing Threshold Shifting



Negative LDO = TPS723xx series

Figure 4. Additonal Negative Gate Driver Voltage

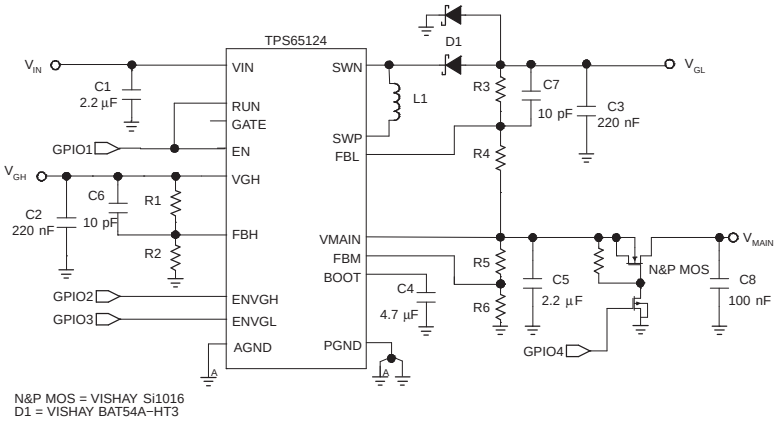


Figure 5. Fully Programmable Sequencing Featuring Very Low Gate Ripple Voltage

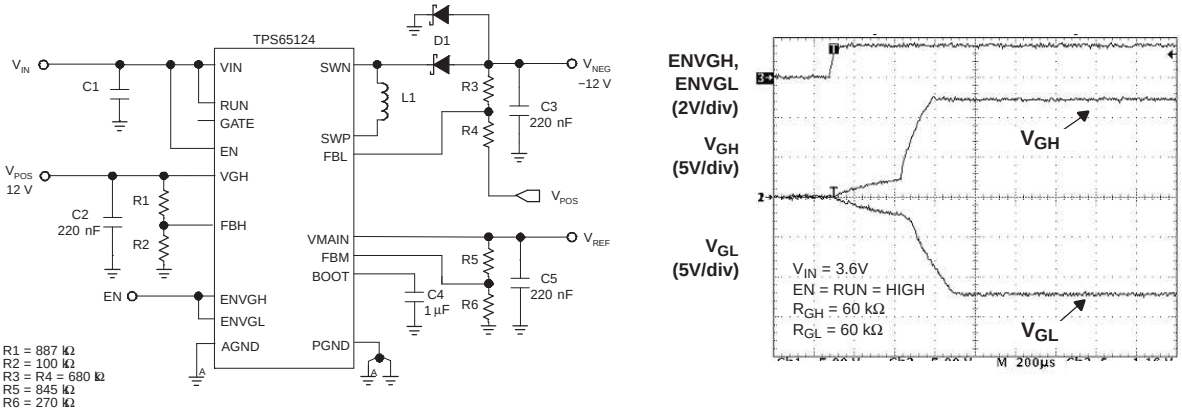


Figure 6. Dual Output Tracking Regulator with High Accuracy Reference Voltage

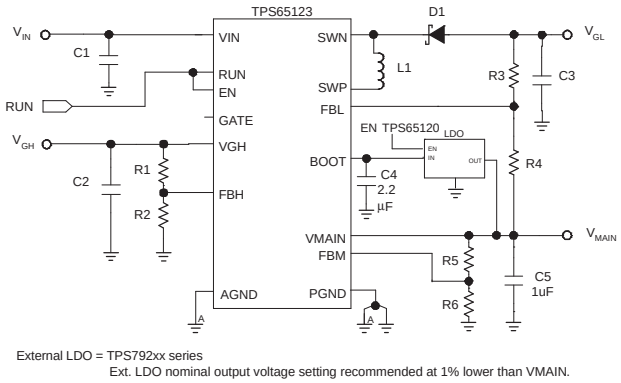


Figure 7. Boosting Main Output Current, I_{MAIN} > 25mA

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