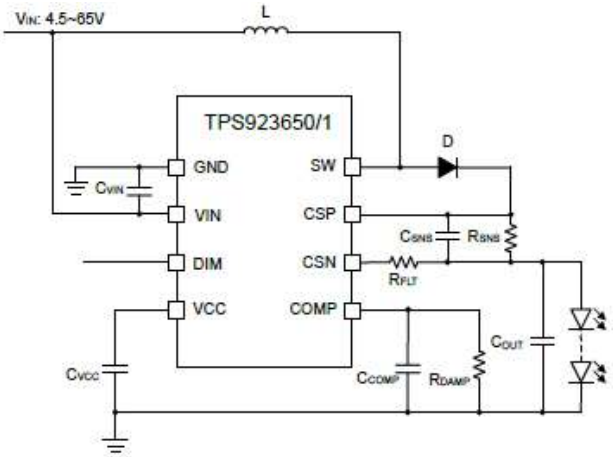
TPS923651D1DGNR

Constant Current LED Backlight Driver

21" Display



Simplified Schematic

$V_{in} := 12\ V$

$f_{sw} := 400\ kHz$ Switching Frequency

$V_{ref} := 200\ mV$ Internal voltage reference

$I_{cs21} := 320\ mA$ 21 Inch Monitor

$R_{cs21} := \frac{V_{ref}}{I_{cs21}} = 0.625\ \Omega$ Use 634 mOhm part

$R_{cs21} := 634\ m\Omega$ Use this for Rcs

$P_{rcs21} := I_{cs21}^{2} \cdot R_{cs21} = 0.0649\ W$ use .125W 0805

$\eta := 90\ \%$ Expected Efficieny

$V_{oled21} := 55\ V$ Maximum Voltage on Vout for the string current

$V_{fd} := 0.6\ V$ Vorward Vf of the output schottky diode. Use 100V SMC

$P_{o21} := V_{oled21} \cdot I_{cs21} = 17.6\ W$ Output power required

$0.62 \cdot \frac{.28}{.32} = 0.5425$

$Idc_{in21} := \frac{P_{o21}}{\eta \cdot V_{in}} = 1.6296\ A$ Input current

$K_{ripple21} := 30.5\ \%$ Ripple Current factor

$\Delta I_{L21} := Idc_{in21} \cdot K_{ripple21} = 0.497\ A$

$I_{pk21} := Idc_{in21} + \frac{\Delta I_{L21}}{2} = 1.8781\ A$ Peak Current through the switch

$L_{boost21} := \frac{V_{in} \cdot \left(V_{oled21} - V_{in} \right)}{V_{oled21} \cdot K_{ripple21} \cdot Idc_{in21} \cdot f_{sw}} = 47.1887\ \mu H$

$L_{boost} := 47\ \mu H$

$I_{oled15r6} := 280\ mA$ 15.6" Display

$V_{oled15r6} := 30\ V$

$R_{cs15r6} := \frac{V_{ref}}{I_{oled15r6}} = 0.7143\ \Omega$

$P_{rcs15r6} := I_{oled15r6}^{2} \cdot R_{cs15r6} = 0.056\ W$ Use 0805 .125W

$P_{o15r6} := V_{oled15r6} \cdot I_{oled15r6} = 8.4\ W$

$Idc_{in15r6} := \frac{P_{o15r6}}{\eta \cdot V_{in}} = 0.7778\ A$

$K_{ripple15r6} := 49\ \%$

$\Delta I_{ripple15r6} := Idc_{in15r6} \cdot K_{ripple15r6} = 0.3811\ A$

$I_{pk15r6} := Idc_{in15r6} + \frac{\Delta I_{ripple15r6}}{2} = 0.9683\ A$

$L_{boost15r6} := \frac{V_{in} \cdot \left(V_{oled15r6} - V_{in} \right)}{V_{oled15r6} \cdot K_{ripple15r6} \cdot Idc_{in15r6} \cdot f_{sw}} = 47.2303\ \mu H$

12.1" inch Display

$I_{oled12r1} := 280\ mA$

$V_{oled12r1} := 33\ V$

$R_{cs12r1} := \frac{V_{ref}}{I_{oled12r1}} = 0.7143\ \Omega$

$P_{rcs12r1} := I_{oled12r1}^{2} \cdot R_{cs12r1} = 0.056\ W$ Use 0.125W 0805

$P_{o12r1} := V_{oled12r1} \cdot I_{oled12r1} = 9.24\ W$

$Idc_{in12r1} := \frac{P_{o12r1}}{\eta \cdot V_{in}} = 0.8556\ A$

$K_{ripple12r1} := 47.4\ \%$

$\Delta I_{ripple12r1} := Idc_{in12r1} \cdot K_{ripple12r1} = 0.4055\ A$

$I_{pk12r1} := Idc_{in12r1} + \frac{\Delta I_{ripple12r1}}{2} = 1.0583\ A$

$L_{boost12r1} := \frac{V_{in} \cdot \left(V_{oled12r1} - V_{in} \right)}{V_{oled12r1} \cdot K_{ripple12r1} \cdot Idc_{in12r1} \cdot f_{sw}} = 47.0761\ \mu H$

10.1" Display from +5V

$V_{in} := 5\ V$

$I_{oled10r1} := 260\ mA$

$V_{oled10r1} := 9.6\ V$

$R_{cs10r1} := \frac{V_{ref}}{I_{oled10r1}} = 0.7692\ \Omega$

$P_{rsc10r1} := I_{oled10r1}^{2} \cdot R_{cs10r1} = 0.052\ W$ Use 1206 0.25W

$P_{o10r1} := V_{oled10r1} \cdot I_{oled10r1} = 2.496\ W$

$Idc_{in10r1} := \frac{P_{o10r1}}{\eta \cdot V_{in}} = 0.5547\ A$

$K_{ripple10r1} := 23\ \%$

$\Delta I_{ripple10r1} := Idc_{in10r1} \cdot K_{ripple10r1} = 0.1276\ A$

$I_{pk10r1} := Idc_{in10r1} + \frac{\Delta I_{ripple10r1}}{2} = 0.6185\ A$

$L_{boost10r1} := \frac{V_{in} \cdot \left(V_{oled10r1} - V_{in} \right)}{V_{oled10r1} \cdot K_{ripple10r1} \cdot Idc_{in10r1} \cdot f_{sw}} = 46.9501\ \mu H$

8" Display from +5V

$I_{oled8} := 600\ mA$

$V_{oled8} := 10.5\ V$

$R_{cs8} := \frac{V_{ref}}{I_{oled8}} = 0.3333\ \Omega$

$P_{rcs8} := I_{oled8}^{2} \cdot R_{cs8} = 0.12\ W$ Use 1206, 0.25W

$P_{o8} := V_{oled8} \cdot I_{oled8} = 6.3\ W$

$Idc_{in8} := \frac{P_{o8}}{\eta \cdot V_{in}} = 1.4\ A$

$K_{ripple8} := 10\ \%$

$\Delta I_{ripple8} := Idc_{in8} \cdot K_{ripple8} = 0.14\ A$

$I_{pk8} := Idc_{in8} + \frac{\Delta I_{ripple8}}{2} = 1.47\ A$

$L_{boost8} := \frac{V_{in} \cdot \left(V_{oled8} - V_{in} \right)}{V_{oled8} \cdot K_{ripple8} \cdot Idc_{in8} \cdot f_{sw}} = 46.7687\ \mu H$

7" Display from +5V

$I_{oled7} := 180\ mA$

$V_{oled7} := 9.3\ V$

$R_{cs7} := \frac{V_{ref}}{I_{oled7}} = 1.1111\ \Omega$

$P_{rcs7} := I_{oled7}^{2} \cdot R_{cs7} = 0.036\ W$ Us an 0603 0.063W

$P_{o7} := V_{oled7} \cdot I_{oled7} = 1.674\ W$

$Idc_{in7} := \frac{P_{o7}}{\eta \cdot V_{in}} = 0.372\ A$

$K_{ripple7} := 33\ \%$

$\Delta I_{ripple7} := Idc_{in7} \cdot K_{ripple7} = 0.1228\ A$

$I_{pk7} := Idc_{in7} + \frac{\Delta I_{ripple7}}{2} = 0.4334\ A$

$L_{boost7} := \frac{V_{in} \cdot \left(V_{oled7} - V_{in} \right)}{V_{oled7} \cdot K_{ripple7} \cdot Idc_{in7} \cdot f_{sw}} = 47.0802\ \mu H$

Parallel Combinations

To Decrease the likelyhood of a mistake on the factory floor we will have the default configuration be the 5V rail and 180mA.

This way a 21" screen will be dim but still display something

$R_{cs7} = 1.1111\ \Omega$ $P_{rcs7} = 0.036\ W$ Use a 1.1 ohm 0603 for this

$R_{cs8} = 0.3333\ \Omega$

$R_{cs10r1} = 0.7692\ \Omega$

$R_{cs12r1} = 0.7143\ \Omega$

$R_{cs15r6} = 0.7143\ \Omega$

$R_{cs21} = 0.634\ \Omega$

$R_{pcs8} := \frac{R_{cs7} \cdot R_{cs8}}{R_{cs7} - R_{cs8}} = 0.4762\ \Omega$ Use 0.47

$P_{prcs8} := \frac{V_{ref}^{2}}{R_{pcs8}} = 0.084\ W$ Use an 0805 0.125W

$R_{pcs10r1} := \frac{R_{cs7} \cdot R_{cs10r1}}{R_{cs7} - R_{cs10r1}} = 2.5\ \Omega$ Use 2.5 ohm

$P_{prcs10r1} := \frac{V_{ref}^{2}}{R_{pcs10r1}} = 0.016\ W$ Use an 0402 0.032W

$R_{pcs12r1} := \frac{R_{cs7} \cdot R_{cs12r1}}{R_{cs7} - R_{cs12r1}} = 2\ \Omega$ Use 2 ohm

$P_{prcs12r1} := \frac{V_{ref}^{2}}{R_{pcs12r1}} = 0.02\ W$ Use an 0603 0.063W

$R_{pcs15r6} := \frac{R_{cs7} \cdot R_{cs15r6}}{R_{cs7} - R_{cs15r6}} = 2\ \Omega$ Use 2 ohm

$P_{prcs15r6} := \frac{V_{ref}^{2}}{R_{pcs15r6}} = 0.02\ W$ Use an 0603 0.063W

$R_{pcs21} := \frac{R_{cs7} \cdot R_{cs21}}{R_{cs7} - R_{cs21}} = 1.4765\ \Omega$ Use 1.47 ohm

$P_{prcs21} := \frac{V_{ref}^{2}}{R_{pcs21}} = 0.0271\ W$ Use an 0603 0.063W

Diode Selection

$I_{dpk} := I_{pk21} = 1.8781\ A$ Maximum Peak Current through the diode

$V_{rrr} := V_{oled21} = 55\ V$ Select a 3A, 100V, SMB Diode like a SK310