EPS Rev E Calcs and configuration check

★ OBC Subsystem (Page 1)

TPS1HB08BQPWRQ1

★ Note: If you see page #'s next to a pin or part, its referencing to a page in their datasheet.

☑ VGG → to vbatt

☑ En → Always pulled up with respect to vbatt based on Lipo max and min levels, we set a safe voltage divider range to keep the voltage low levels above 2v (page 9) of datasheet → The WD_EN line is also connected to this, so when there is a system reset, this pin is pulled

$R_1 = 56.2k$, $R_2 = 10k$

Lipo max = 33.6 → $33.6v\left(\frac{10k}{66.2k}\right) = 5.0755\,V > 2v$

Lipo min = 24.0 → $24v\left(\frac{10k}{66.2k}\right) = 3.625377\,V > 2v$

This ensures that this load switch is always on

☑ SNS Pin

Since we are not using the SNS feature, ground through a 1k resistor

☑ Latch

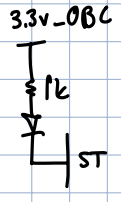
With Latch unused, the device will auto retry after a fault

Float or ground through 150kΩ resistor

☑ $\overline{ST}$ Pin

Using for fault indication, leave floating. Since it behaves as an active low, it must be an open collector.

Change this to:



Max current through $\overline{ST}$ is around 5mA

use a 1k for 3.3mA

☑ Vout

Goes to the input of the switching regulator

☑ Dia_En

Not using these diagnostics features, so short to ground through 15k

☑ SEL 1 and SEL2

Not using either sensing features, so short each with a 15k to ground

LT8612EUDE#PBF

Vin

Output of load switch must go to this, include the required 22nF cap from the TPS datasheet on page 38

EN/UVLO (Pg 15.)

Relative to vin this sets the undervoltage lock out threshold

how to set R3 and R4 (en pin goes to VD in the middle)

$$V_{in(en)} = \left(\frac{R_3}{R_4} + 1\right) \cdot 1.0V$$

UVLO @ 24V

$$24V = \frac{R_3}{R_4} V + 1V$$

$$23V = \frac{R_3}{R_4} V$$

Let $R_3 = 47k$, $R_4 = 2k$

$$23V = \frac{47k\Omega}{2k\Omega} V$$

$$\approx 23.5V$$

Sync

Send in a signal from a clock this is being done by the LTC6902

input sync range:

Low < 0.4V
High > 2V

RT should set lower or equal to input clock freq

Based on table @ Pg. 12

0.4 MHz > 110 kHz

TR/SS (Page 15)

Tracking soft start capacitor

Voltage at pin: 0.97V

Current through pin: 2.1μA

Let startup time be 1 second

$$\text{time (s)} = \frac{C \times V}{A}$$

$$1 = \frac{C \times 0.97}{2.1 \times 10^{-6}}$$

$$2.1 \times 10^{-6} = C \times 0.97$$

$$2.16 \times 10^{-6} = C$$

$$\approx 2.2\mu F$$

FB pin (Pg. 12)

Sets the output voltage, going for 3.3V here

$$R_1 = R_2\left(\frac{V_{out}}{0.970V} - 1\right)$$

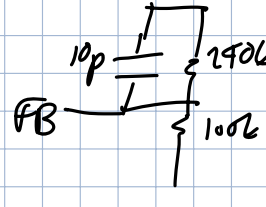
Let $R_1 = 240k$, $R_2 = 100k$

$$(0.97)\left(\frac{R_1}{R_2} + 1\right) = V_{out}$$

$$(0.97)\left(\frac{240k}{100} + 1\right) = V_{out} \Rightarrow 3.3$$

$$\approx 3.33$$

Check that you have a 10pF cap in parallel with



(Pg 12.)

✓ PG Pin (Page 8)

Leave unconnected, not using

✓ Bias Pin (Page 8)

If output is equal to or higher than 3.3V

tie to Vout

✓ INTVCC (Page 8)

Decouple this to Ground using a 1 µF capacitor

✓ BST Pin (Page 8)

Place a 0.1 µF Boost capacitor as close as possible to the IC

✓ SW Pin (Page 8 and 13)

Use 2x47nH caps at Vout → SW

Inductor Selection

$$L = \frac{V_{out} + V_{SW(Bot)}}{f_{SW}} \cdot 0.7$$

where $f_{SW} = 0.4\,MHz$ and $V_{SW(Bot)} = 0.18$, $V_{out} = 3.3V$

* L will be in µH

$$L = \frac{3.3v + 0.18}{0.4} \cdot 0.7$$

$= 6.09\,\mu H$

- Subharmonic oscillation check

Subharmonic oscillation if $\frac{V_{out}}{V_{in}} > 0.5$

$\frac{3.3}{28v}$ is < 0.5

so no subharmonic oscillation. We good

INA260

I2C Address: 1000001

A1 → GND

A0 → VS

I2C Buffer: (Page 1)

Vcc → 3.3V

EN → 4.7k → 3.3V

SCL IN → 4.7 → 3.3V

SDA IN → 4.7k → 3.3V

READY → 4.7k → 3.3V

SCL OUT → 4.7k → 3.3V

SDA out → 4.7k → 3.3V

LTC6902

Step 1: Select Multiphase Mode (Page 5)

Div → open

PH → open

3-Phase: Leave PH open M=3

Step 2: Choosing programmable divider setting N (Page 5)

For SSFM

Divider Setting	(Freq Range Fout · M)
N=10 → Leave Div open	200kHz to 2MHz

Step 3 calculating the Rset resistor value

From before M=3, N=10

$f_{out} = 400kHz$

$$R_{set} = 20k\Omega \cdot \left(\frac{10MHz}{N \cdot M \cdot f_{out}}\right)$$

$$R_{set} = 20k\Omega \left(\frac{10MHz}{10 \cdot 3 \cdot 0.4MHz}\right)$$

$$R_{set} = 20k\Omega \left(\frac{10}{30 \cdot 0.4}\right)$$

$R_{set} = 16.666\,k\Omega$

$\approx 17k\Omega$

Step 4: Calculating the Rmod Resistor Value

$$R_{mod} = \frac{20 \cdot 16.666k\Omega}{25}$$

Let spreading % be 25%

$= 13.33k\Omega$

$R_{mod} \approx 14k\Omega$

in Conclusion:

- ✓ Div → Open
- ✓ Ph → open
- ✓ Add 0.1μF bypass cap
- ✓ Rset → 17k
- ✓ Rmod → 14k

} pull up to V_{LL}

★ Peripheral Subsystem

Use the checklist above for the general pins for each component, and differences will be written here because I'm lazy

TPS1HB08BQPWRQ1 → Almost exactly the same,

some minor differences in how the en pin is used, pulled down but enabled by the adc, disabled by either UV or OSC.

LT8612 uses the same UV/LO Calc.

✓ FB (Pg. 12) Sets output voltage

$$R_1 = R_2\left(\frac{V_{out}}{0.970v} - 1\right)$$

Let $R_1 = 20.8k$, $R_2 = 5k$

$$(0.970v)\left(\frac{R_1}{R_2} + 1\right) = V_{out} \qquad V_{out} = 5v$$

$$(0.970v)\left(\frac{20.8}{5k} + 1\right) = 5.0052$$

✓ SW Pin (Page 8 and 13)

Inductor Selection

$$L = \frac{V_{out} + V_{sw(Bot)}}{f_{sw}} \cdot 0.7$$

where $f_{sw} = 0.4MHz$ and $V_{sw(Bot)} = 0.18$, $V_{out} = 5v$

* L will be in μH

$$L = \frac{5v + 0.18}{0.4MHz} \cdot 0.7$$

$L = 9.065\,\mu H$

Check Subharmonic oscillation

$$\frac{V_{out}}{V_{in}} = \frac{5v}{28} < 0.5,$$ no minimum inductance

JETSON SW system:

TPS1HB08BQPWRQ1 → Almost exactly the same, same style as prif. En held by ABE

CT86/ZSEV:

☐ FB (Pg. 12)

$R_1 = R_2\left(\frac{V_{out}}{0.970v} - 1\right)$ Let $R_1 = 196k$

$R_2 = 10k$

$\left(\frac{R_1}{R_2} + 1\right)(0.970v) = V_{out}$

$\left(\frac{196}{10k} + 1\right)(0.970v) = 19.982v$

☐ SW pin (Page 8 and 13)

Inductor Selection

$L = \frac{V_{out} + V_{sw(Bot)}}{f_{sw}} \cdot 0.7$

where $f_{sw} = 0.4MHz$ and $V_{sw(Bot)} = 0.18$, $V_{out} = 5v$

* L will be in μH

$L = \frac{20 + (0.18)}{0.4MHz} \cdot 0.7 = 35\,\mu H$

Rev D calcs are away, way off

Subharmonic Oscillation Check

$\frac{V_{out}}{V_{in}} > 0.5?$

$\frac{20}{28} = 0.714.$

Find minimum inductance