



About

Input Box

TERMS OF USE

Step 1: Operating Specifications

Input Voltage – Min, $V_{IN(min)}$	46 V
Input Voltage – Nom, $V_{IN(nom)}$	50 V
Input Voltage – Max, $V_{IN(max)}$	54 V
Output Voltage, V_{OUT}	24 V
Maximum Output Current, I_{OUT}	24 A
Free-running Switching Frequency, F_{SW}	250 kHz
SYNC Frequency (if used), $F_{SW-SYNC}$	250 kHz
Frequency Set Resistor, R_{RT}	40.2 kΩ

Step 2: Filter Inductor

Recommended Filter Inductance	6.2 μH
Inductance, L_F	6.8 μH
Inductor DCR	12 mΩ
Pk-to-Pk Ripple Current at $V_{IN(nom)}$, ΔI_L	7.5 A _{pk-pk}
Inductor Ripple Current as a % of Max I_{OUT}	31 %

Step 3: $R_{DS(on)}$ or Shunt-Based Current Limit

Shunt sensing	Shunt, R_S	2 mΩ
Required Current Limit Setpoint		24 A
Current Limit Set Resistor, R_{ILIM}		402 Ω
Min Inductor Sat Current, $I_{L(SAT)}$		33.6 A
Power Loss in R_S at Full Load, Max V_{IN}		0.36 W

Step 4: Output Capacitance

Output Voltage Ripple Specification	100 mV _{pk-pk}
Minimum Ideal Output Capacitance	37 μF
Total Output Capacitance (Derated), C_{OUT}	100 μF
Maximum Permitted ESR	12 mΩ
Output Capacitor ESR	5 mΩ
Resulting Output Voltage Ripple	53 mV _{pk-pk}
Output Capacitor Ripple Current	2.2 A (rms)

Step 5: Input Capacitance

Input Voltage Ripple Specification	500 mV _{pk-pk}
Minimum Ideal Input Capacitance	48 μF
Total Input Capacitance (Derated), C_{IN}	100 μF
Maximum Permitted ESR	9 mΩ
Input Capacitor ESR	1 mΩ
Resulting Input Voltage Ripple	268 mV _{pk-pk}
Input Capacitor Ripple Current	12.0 A (rms)

Step 6: Soft-start, UVLO

Soft-Start Time, t_{SS}	4 ms
Soft-Start Capacitance, C_{SS}	47 nF
Input Voltage UVLO Turn-On	56 V
Input Voltage UVLO Turn-Off	46 V
UVLO Upper Resistor, R_{UV1}	1000 kΩ
UVLO Lower Resistor, R_{UV2}	22.1 kΩ

If the SYNC feature is not required, connect SYNCIN to GND or VCC for DCM or CCM operation, respectively

Step 7: Compensation Design

LC Complex Pole Frequency	6.1 kHz
ESR Zero Frequency	318 kHz
Desired Crossover Frequency	50 kHz
Appropriate Midband Gain	0.54 V/V
Upper Feedback Resistor, R_{FB1}	25 kΩ
Lower Feedback Resistor, R_{FB2}	0.866 kΩ
Actual Output Voltage, V_{OUT}	23.895 V

Pole & Zero Placement	F_{Z1}	4.3 kHz
Baseline P/Z Frequencies:	F_{Z2}	5.5 kHz
	F_{P1}	318 kHz
	F_{P2}	125 kHz

Compensation Components

Calculated / Std Values	Selected	Actual P/Z Frequencies
R_{C1} 13.6	13.7	13.7 kΩ
C_{C1} 2728	2700	2700 pF
C_{C2} 97	100	82 pF
R_{C2} 441	442	442 Ω
C_{C3} 1135	1200	1200 pF

** Specify Inductor Core Loss ** 0.4 W

Efficiency / Power Loss Analyzer

Step 8: Efficiency

High-Side MOSFET (Q_1) Specifications CSD19533Q5AT

On-State Resistance, $R_{DS(on)}$	7.8 mΩ
Total Gate Charge, Q_G	27 nC
Gate-Drain Charge, Q_{GD}	4.9 nC
Gate-Source Charge, Q_{GS}	7.9 nC
Output Capacitance, C_{OSS}	395 pF
Gate Resistance, R_G	1.2 Ω
Transconductance, g_{FS}	63 S
Gate-Source Threshold Voltage, $V_{GS(th)}$	2.8 V
Body Diode Forward Voltage, V_{BD1}	0.8 V
Thermal Resistance, θ_{JA}	50 °C/W

Low-Side MOSFET (Q_2) Specifications BSC037N08NS5

On-State Resistance, $R_{DS(on)}$	3.7 mΩ
Total Gate Charge, Q_G	46 nC
Output Charge, Q_{OSS}	56 nC
Output Capacitance, C_{OSS}	530 pF
Body Diode Forward Voltage, V_{BD2}	0.9 V
Body Diode Recovery Charge, Q_{RR2}	36 nC
Thermal Resistance, θ_{JA}	40 °C/W

Antiparallel Schottky Diode (if applicable)

Schottky Diode Forward Voltage, V_{SD}	0 V
Schottky Diode Recovery Charge, Q_{RR2}	0 nC

