

LM(2)5117 Wide Input Range Synchronous Buck Controller with Analog Current Monitor

Revision: 09/20/2013 ver 1.5 by Eric Lee

Note: The components calculated in this worksheet are reasonable starting values for a design using the LM(2)5117. They are not optimized for any particular performance attribute. The most recent version of this excel file can be found in the product folder of the part at national.com. Make sure to input or select values in all of the blue shaded cells even if a value already exists in that cell. Blue shaded cells require input from user. Do not over write equations in cells, as this may result in calculation errors. To activate all functions, **Macro should be enabled and Analysis Toolpak should be added in.**

Step 1 - General Requirements

Max input voltage, $V_{IN(MAX)}$ [V]	55
Min input voltage, $V_{IN(MIN)}$ [V]	35
Target output voltage, V_{OUT} [V]	30
Full load current, I_{OUT} [A]	5
Recommended IC	LM5117

Step 2 - Switching Frequency

Switching frequency, F_{SW} [kHz]	80
Max duty cycle, D_{MAX}	0.86
Min duty cycle, D_{MIN}	0.55
RT resistor, R_T [kΩ]	64.2

Step 3 - Inductor Value

Max ripple current % of full load current [%]	30
Recommended output inductor, L_O [uH]	113.6
User selection, L_O [uH]	100.0
Min load current in CCM @ $V_{IN(MAX)}$ [A]	0.9
Min load current in CCM @ $V_{IN(MIN)}$ [A]	0.3

Step 4 - Current Limit

Target (% beyond full load @ $V_{IN(MIN)}$)	30
K Factor	1
Recommended current sense resistor, R_S [Ω]	0.0120
User selection, R_S [Ω]	0.01
Max output current @ $V_{IN(MIN)}$ [A]	8.5
Max output current @ $V_{IN(MAX)}$ [A]	9.1
Peak inductor current with output hard short [A]	12.1
Full load power dissipation of R_S @ $V_{IN(MAX)}$, P_{RS} [W]	0.11

Step 5 - Ramp Configuration

Ramp capacitor, C_{RAMP} [pF]	1000
Ramp resistor, R_{RAMP} [kΩ]	1000.0

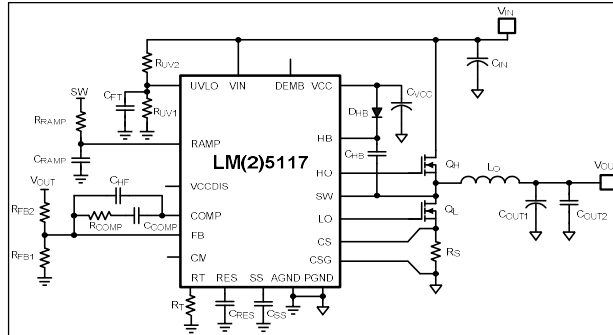
Step 6 - VIN UV Shutdown

Desired minimum start-up voltage, $V_{IN(STARTUP)}$ [V]	15
Desired UV hysteresis, V_{HYS} [V]	2
R_{UV2} [kΩ]	100
R_{UV1} [kΩ]	9.09
Max C_{FT} (optional) [pF]	375

Step 7 - NMOS gate charge

High-side MOSFET Q_g @ V_{VCC} (nC)	76
Low-side MOSFET Q_g @ V_{VCC} (nC)	7
Gate charging current [mA]	7

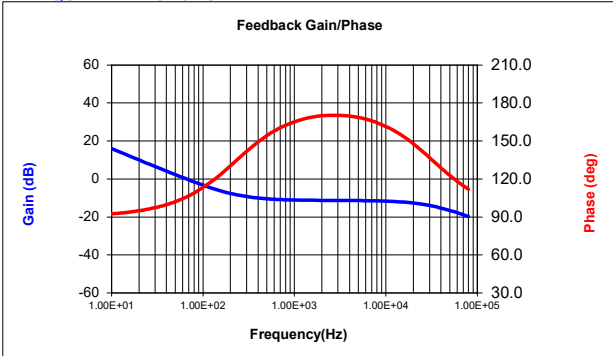
TYPICAL APPLICATION CIRCUIT



LIST OF COMPONENTS AND PARAMETERS

Components	Description	Value	Min Rating
IC	Buck controller	LM5117	
C_{IN}	Input capacitor	2μF	55V
C_{OUT1}	Output capacitor	220μF	30V
C_{OUT2}	Output capacitor	2μF	30V
C_{VCC}	VCC capacitor	0.55μF Min	10V
C_{HB}	Bootstrap capacitor	0.51μF Min	9V
C_{SS}	Softstart capacitor	1.25μF	6V
C_{RES}	Restart capacitor	0.80μF	6V
C_{RAMP}	RAMP capacitor	1000pF	16V
C_{COMP}	Compensation Capacitor	25.00nF	6V
C_{HF}	Compensation Capacitor	180pF	6V
C_{FT}	Optional filter capacitor	375pF Max	16V
R_{UV1}	UVLO divider resistor	9.09kΩ	1/16W
R_{UV2}	UVLO divider resistor	100.0kΩ	1/8W
R_{FB1}	Feedback divider resistor	2740Ω	1/16W
R_{FB2}	Feedback divider resistor	100000Ω	1/16W
R_S	Current sense resistor	0.0100Ω	0.11W
R_T	Oscillator timing resistor	64.2kΩ	1/16W
R_{RAMP}	RAMP resistor	1000kΩ	1/8W
R_{COMP}	Compensation Resistor	27.40kΩ	1/16W
L_O	Output inductor	100.0μH	9A~12A
D_{HB}	Bootstrap diode	1A	25V
Q_H and Q_L	NMOS		55V

FREQUENCY RESPONSE



Step 8 -Bootstrap capacitor and VCC capacitor

Min C_{HB} [μ F]	0.51
Min C_{VCC} [μ F]	0.55

Step 9 -Output Capacitors

Output capacitor with ESR, C_{OUT1} [μ F]	220
Ceramic output capacitor, C_{OUT2} [μ F]	2
Max ESR of C_{OUT1} , R_{ESR} [Ω]	0.02
Effective total C_{OUT} [μ F]	222
Peak-Peak output voltage ripple @ $V_{IN(MAX)}$ [mV]	36
RMS output current ripple [A]	0.5

Step 10 -Input Capacitors

Input capacitor(ceramic), C_{IN} [μ F]	2
Peak-Peak input voltage ripple [V]	7.81
RMS input current ripple [A]	2.5

Step 11 -Soft Start

Desired soft-start time, T_{SS} [ms]	100
Soft-start capacitor, C_{SS} [μ F]	1.250

Step 12 -Hiccup mode restart time

Desired restart time, T_{RES} [ms]	100
Restart capacitor, C_{RES} [μ F]	0.80

Step 13 - Feedback Resistors

R_{FB2} [Ω]	100000
R_{FB1} [Ω]	2740

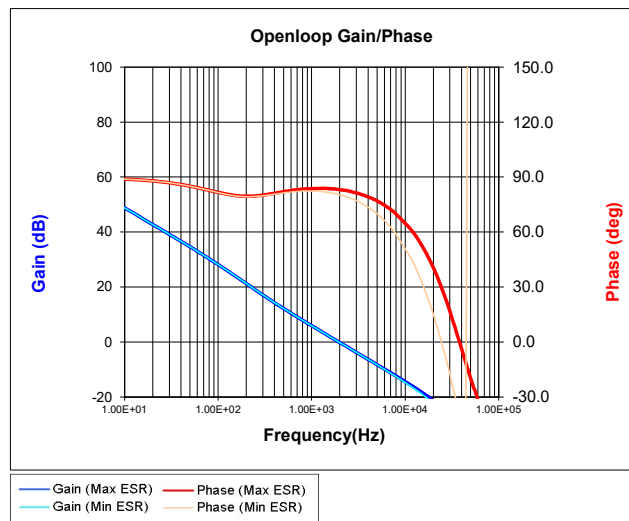
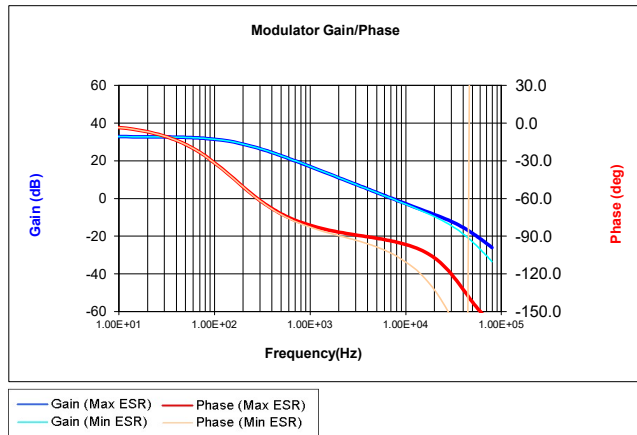
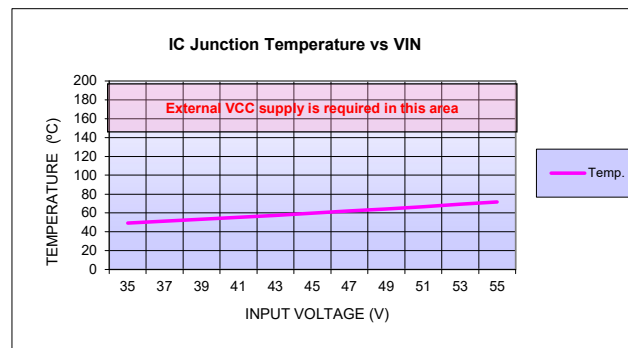
Step 14 - Compensation Network

Openloop crossover frequency, F_{CROSS} [kHz]	23
R_{COMP} [Ω]	320657
User selection, R_{COMP} [Ω]	27400
C_{COMP} [pF]	48613
User selection, C_{COMP} [pF]	25000
Max C_{HF} [pF]	163
Min C_{HF} [pF]	16
User selection, C_{HF} [pF]	180

Step 14 - Controller Power Dissipation

Ambient temperature [$^{\circ}$ C]	25
External VCC Select "Yes" or "No"	No

Typical High-side MOSFET C_{gs} (pF)	7920
Typical High-side MOSFET C_{gd} (pF)	2090
Typical Low-side MOSFET C_{gs} (pF)	1600
Typical Low-side MOSFET C_{gd} (pF)	360
Total power loss @ $V_{IN(MAX)}$ [W]	1.2
IC temperature @ $V_{IN(MAX)}$ [$^{\circ}$ C]	72

**IC TEMPERATURE****PRINT****Simulate This Design Using WEBENCH® Tools**

To further optimize the design, please visit:

<http://webench.national.com/>

Optimization graphs, charts, and electrical/thermal simulation capabilities are available.

Note: The WEBENCH recommended BOM may be different than what is recommended in this spreadsheet.