LM5069 Hot Swap Design Tool

Note: The components calculated in this worksheet are reasonable starting values for a design using the LM5069 Hot-swap Controller. As such, they are not optimized for any particular performance attribute. Tolerances of the components are not included in the calculations. See the Instructions tab for additional information.
Consult the LM5069 datasheet for more detail.

	Enter Values in Green Shaded Cells
	Calculated Values are shown in White Cells
	Yellow and Red cells highlight potential issues with the design. Red highlights items that are higher risk.

Step 0: Calculator Tutorials

Note: Before proceeding, please watch the video tutorials listed to ensure accurate results from this tool!

Steps 1 & 2: Operating Conditions, Current Limit, & Circuit Breaker (7:41)
Step 3: MOSFET Selection (9:58)
Step 4: Startup (10:32)
Step 5: UVLO, OVLO & PGD Thresholds (4:20)
LM5069 Datasheet

I understand and agree to watch the video tutorials if help is needed. (Choose Yes to enable the calculator.)	***Yes***
Assure to follow the layout and application guidelines listed on the datasheet.	***Yes***

*For additional questions not addressed in the videos, please post on E2E.ti.com

Step 1: Operating Conditions

Hot Swap Design Calculator Tutorial Steps 1 & 2 — Operating Conditions, Current Limit and Circuit Breaker — TIHotSwap — Texas Instruments

Steps 1 & 2: Operating Conditions, Current Limit, & Circuit Breaker

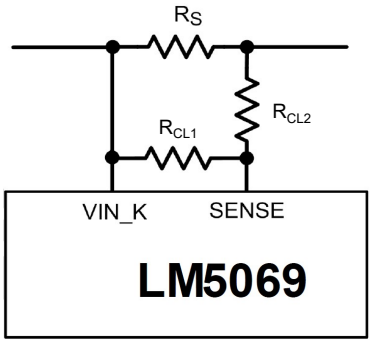
Minimum Input Operating Voltage: $V_{IN(MIN)}$	40	V
Nominal Input Operating Voltage: $V_{IN(NOM)}$	50	V
Maximum Input Operating Voltage: $V_{IN(MAX)}$	60	V
Maximum Load Current: $I_{OUT(MAX)}$	0.73333	A
Maximum Output Load Capacitance: C_{LOAD}	160	µF
Maximum Ambient Operating Temperature: T_{MAX}	105	°C

Step 2: Current Limit and Circuit Breaker

Hot Swap Design Calculator Tutorial Steps 1 & 2 — Operating Conditions, Current Limit and Circuit Breaker — TIHotSwap — Texas Instruments

Steps 1 & 2: Operating Conditions, Current Limit, & Circuit Breaker

Current Limit Threshold Voltage	55 mV	
Maximum Recommended Value for Effective Sense Resistance	65.48	mΩ
Use External Resistor Divider to Reduce Effecitve R_S	No	
Enter the Resistance for R_S	65	mΩ
Resulting Minimum Current Limit	0.7	A
Resulting Typical Current Limit	0.8	A
Resulting Maximum Current Limit	0.9	A
Maximum Power Dissipation in R_S	0.1	W
Fault Response	Retry	
Circuit Breaker to Current Limit Raitio	1.9 x Current Limit	



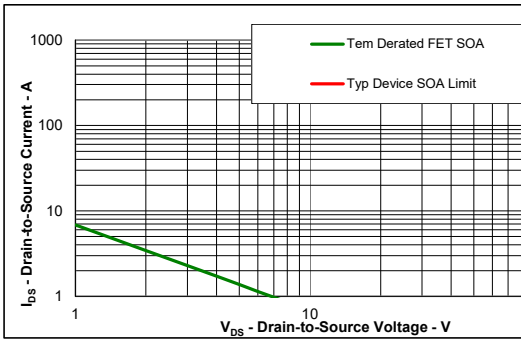
Step 3: MOSFET Selection

Hot Swap Design Calculator Tutorial Step 3 — MOSFET Selection — TIHotSwap — Texas Instruments

Step 3: MOSFET Selection

Q1 FET Name	Si7450DP	
Estimated MOSFET $R\Theta_{JA}$	30	°C/W
Number of MosFETs	1	#
MOSFET On resistance @ $T_{J,DC}$	136	
Maximum FET Junction Temperature	150	
100µs SOA Current (re-use 1ms data if unavailable) @ $V_{IN(MAX)}$	7	
1ms SOA Current @ $V_{IN(MAX)}$	7	
10ms SOA Current @ $V_{IN(MAX)}$	1.33	
100ms Current at @ $V_{IN(MAX)}$ (enter 'NA' if not available)	0.34	
1s or DC SOA Current at @ $V_{IN(MAX)}$ (enter 'NA' if not available)	0.115	
FET Power dissapation at full load (per FET)	0.1	W
Maximum steady state FET Junction Temperature ($T_{J,DC}$)	107.2	°C
Minimum Power Limit to Ensure Vsns > 5mV ($P_{LIM,MIN}$)	4.6	W
Target Power Limit	4.70	W
Calculated R_{PWR}	38.19	kΩ
Actual R_{PWR}	39	kΩ
Actual PLIM	4.80	W

Note: TI recommends choosing a FET with SOA current specified for 100ms and/or 1s or DC. If choosing a FET without these parameters, this calculator will estimate the values via extrapolation, which leaves an inherent associated risk.

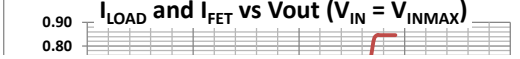


Note: Hover here to see the 3 values affecting this curve, consult a thermal expert if you are unsure!

Step 4: Startup

Hot Swap Design Calculator Tutorial Step 4 — Startup

Load Turn-On Threshold	0	V
Startup Load Type	Constant Current	
Startup Load Value	0	A
Use External Soft-Start Control (dv/dt)	No	



Startup

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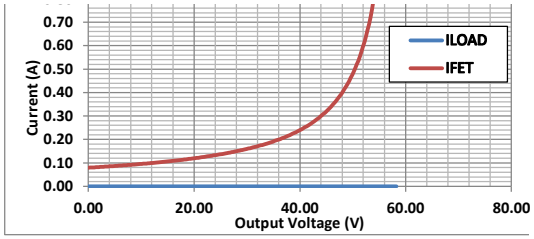
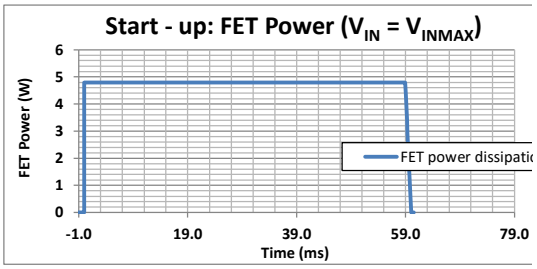
Step 4: Startup

Typical Start Time with Vinmax (Tstart)	60.01	ms
IFET - ILOAD margin (lowest for Vout range)	100%	
Target Fault Timer: Tstart + Margin	101.56	ms
Target Timer capacitance	1912.97	nF
Selected Timer capacitance	2200	nF
Final Fault Timer(Tfault)	103.53	ms
Derated SOA / PLIM	1.43	
Resulting Typical Insertion Delay Time	1600	ms
Resulting Typical Restart Time	20694.24	ms





Step 5: UVLO, OVLO & PGD Thresholds

Hot Swap Design Calculator Tutorial
Step 5
UVLO, OVLO & PGD Thresholds

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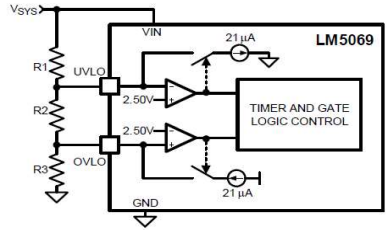
Step 5: UVLO, OVLO & PGD Thresholds

Select Option A or Option B	Option A	
Desired Upper UVLO Threshold	44.5	V
Desired Lower UVLO Threshold	42.4	V
Desired Upper OVLO Threshold	53.6	V
Recommended Resistance for: R1	100.00	kΩ
R2	1.31	kΩ
R3	4.96	kΩ
Enter the Resistance for R1	99.7	kΩ
Enter the Resistance for R2	1.5	kΩ
Enter the Resistance for R3	4.75	kΩ

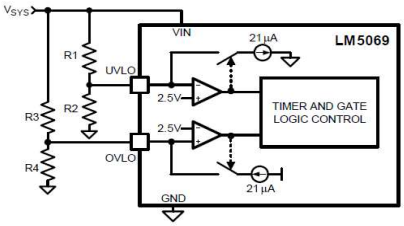


Option A: UVLO/OVLO set by R1 – R3

Resulting Thresholds:	Minimum	Typical	Maximum	
Resulting Upper UVLO Threshold =	42.73	44.47	46.22	V
Resulting Lower UVLO Threshold =	41.53	42.38	43.23	V
Resulting Upper OVLO Threshold =	54.65	55.76	56.88	V
Resulting Lower OVLO Threshold =	51.61	53.64	55.66	V

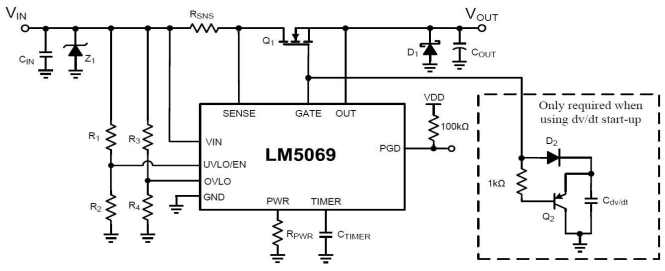
Note: If any of the cells above are yellow, then these values are outside of the device's operating range. This will result in the device turning either on or off at its operating limits rather than at the user selected values in yellow.

Enter the Resistance for R_{PG}: 100 kΩ



Option B: UVLO/OVLO set by R1 – R4

Design Summary



R_{SNS} =	65	mΩ
R_{CL1} =	DNP	Ω
R_{CL2} =	0	Ω
R_{PWR} =	39	kΩ
C_{TIMER} =	2200.00	nF
R1 =	99.7	kΩ
R2 =	1.5	kΩ
R3 =	4.75	kΩ
R4 =	N/A	kΩ
$C_{dv/dt}$ =	DNP	nF
C_{IN} =	0.01	µF
D1	B380-13-F	
D2	DNP	
Q1	Si7450DP	
Q2	DNP	
Z1	5.0SMDxx	

	Settings	Units
Current limit	0.8	A
Power Limit	5	W
Circuit Breaker Current	0.8	A
Startup Time	60.01	ms
Insertion Delay	1600.0	ms
Fault Timeout	103.53	ms
Restart Time During Fault	20694.235	ms
Upper UVLO Threshold	44.474	V
Lower UVLO Threshold	42.380	V
Upper OVLO Threshold	55.763	V
Lower OVLO Threshold	53.638	V

Notes: 1. Although not mandatory, C_{IN} provides transient suppression at the VIN pin
2. A TVS clamp from VIN to GND is absolutely mandatory to clamp the voltage overshoot upon MOSFET turn-off, e.g. during circuit breaker
3. Componet tolerances not accounted for in Min/Max Calculations.