



ON Semiconductor®

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FPF2895C 28 V / 5 A Rated Current Limit Switch with OVP and TRCB

Features

- 28 V / 5 A Capability
- Wide Input Voltage Range: 4 V ~ 22 V
- Ultra Low On-Resistance
 - Typ. 27 mΩ at 5 V and 25 °C
- Adjustable Current Limit with external RSET
 - 500 mA ~ 5 A
- Selectable OVLO with OV1 and OV2 Logic Input
 - 5.95 V ± 50 mV
 - 10 V ± 100 mV
 - 16.8 V ± 300 mV
 - 23 V ± 460 mV
- Selectable ON Polarity
- Selectable Over-Current Behavior
 - Auto-Restart Mode
 - Current Source Mode
- True Reverse Current Block
- Thermal Shutdown
- Open Drain Fault FLAGB Output
- UL60950-1 & IEC 60950-1 Certification 5 A Max Loading
- Robust ESD Capability
 - 2 kV HBM & 1 kV CDM
 - 15 kV Air Discharge & 8 kV Contact Discharge under IEC 61000-4-2

Description

The FPF2895C features a 28 V and 5 A rated current limit power switch, which offers Over-Current Protection (OCP), Over-Voltage Protection (OVP), and True Reverse Current Block (TRCB) to protect system. It has low On-resistance of typical 27 mΩ with WL-CSP can operate over an input voltage range of 4 V to 22 V.

The FPF2895C supports ±10% of current limit accuracy, over-current range of 500 mA to 2 A and ±5% of current limit accuracy, over-current range of 2 A to 5 A , flexible operations such as selectable OVP, selectable ON polarity and selectable OCP behavior, which can be optimized according to system requirements.

The FPF2895C is available in a 24-bump, 1.67 mm x 2.60 mm Wafer-Level Chip-Scale Package (WL-CSP) with 0.4 mm pitch.

Applications

- Laptop, Desktop Computing and Monitor
- Power Accessories

Ordering Information

Part Number	Operating Temperature Range	Top Mark	Package	Packing Method
FPF2895CUCX	-40°C – +85°C	3G	24-Ball, 0.4 mm Pitch WLCSP	Tape & Reel

FPF2895C — 28 V/5 A Rated Current Limit Switch with OVP and TRCB

Application Diagram

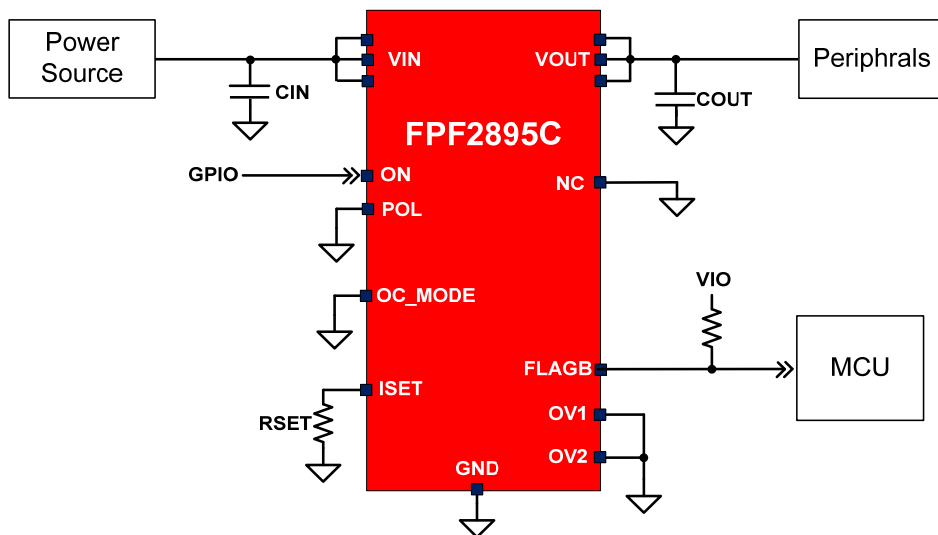


Figure 1. Typical Application

Block Diagram

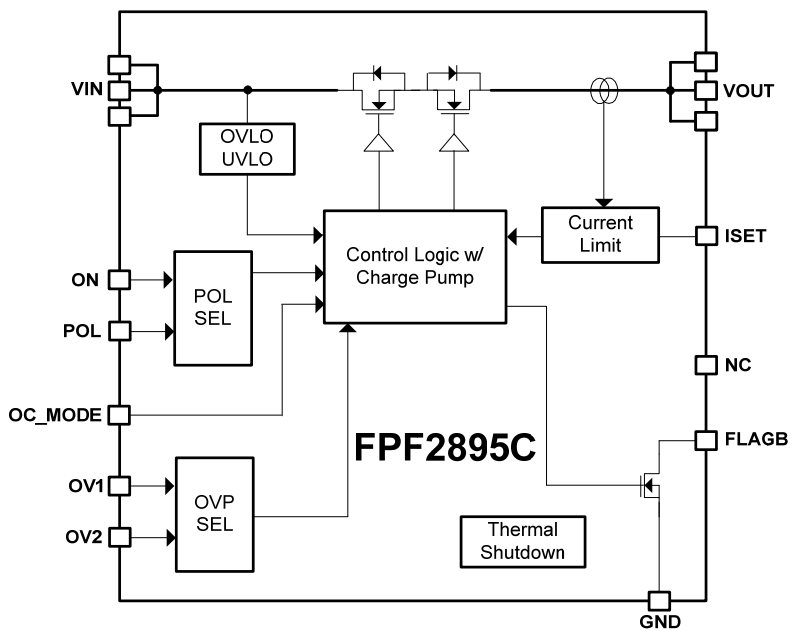


Figure 2. Functional Block Diagram

Pin Configuration

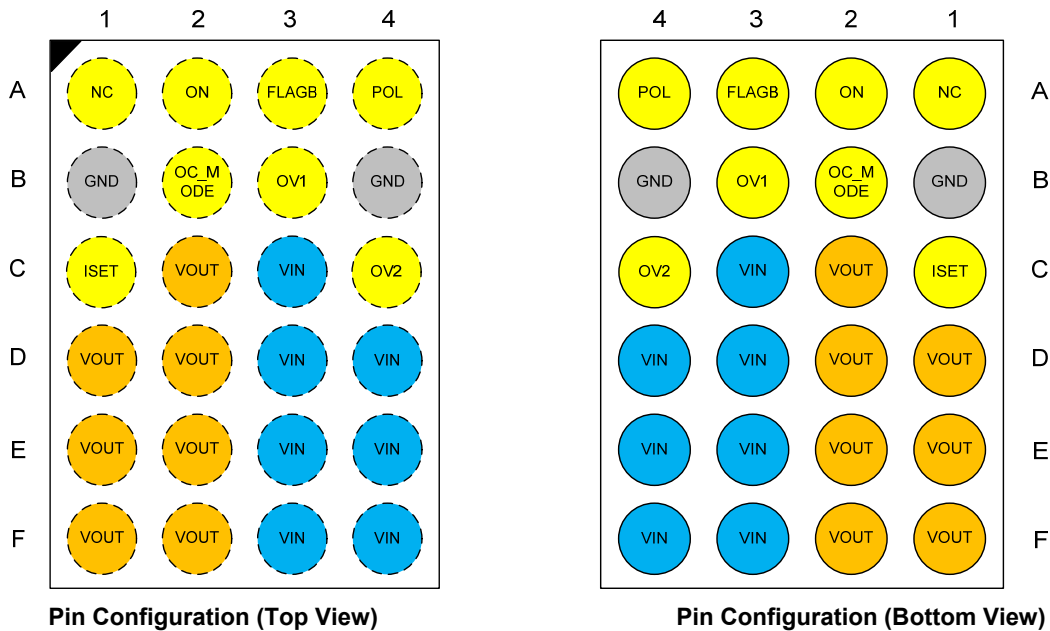


Figure 3. 24 Ball WL_CSP, 4 x 6 Array, 0.4 mm Pitch, 250 μm Ball

Pin Definitions

Name	Bump	Type	Description
VIN	C3, D3, D4, E3, E4, F3, F4	Input/Supply	Switch Input and Device Supply
VOUT	C2, D1, D2, E1, E2, F1, F2	Output	Switch Output to Load
NC	A1	Dummy	Recommended to connect to GND
ON	A2	Input	Internal pull-down resistor of 1 MΩ is included. Active polarity is depending on POL state. ⁽¹⁾
POL	A4	Input	Enable Polarity Selection. Internal pull-up of 1 MΩ is included. HIGH (or Floating): Active LOW LOW: Active HIGH ⁽¹⁾
FLAGB	A3	Output	Active LOW, open drain output indicates an over-current, under-voltage, over-voltage, or over-temperature state.
ISET	C1	Input	A resistor from ISET to ground set the current limit for the switch. See below selection table 1.
OC_MODE	B2	Input	OCP behavior can be selected. Internal pull-up of 1 MΩ is included. HIGH (or Floating): Auto-restart mode during over-current condition. LOW: Current source mode during over-current condition. ⁽¹⁾
OV1	B3	Input	Over-Voltage Selection Input 1. Internal pull-up of 1 MΩ is included and see below selection table 2. ⁽¹⁾
OV2	C4	Input	Over-Voltage Selection Input 2. Internal pull-up of 1 MΩ is included and see Table 2. ⁽¹⁾
GND	B1, B4	GND	Device Ground

Note:

- To avoid external noise influence when floating, recommend to connect these pins to a certain level.

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameters	Min.	Max.	Unit	
V _{IN} , V _{OUT}	V _{IN} , V _{OUT} to GND	-0.3	28.0	V	
V _{PIN}	ON, POL, OC_MODE, ISET, FLAGB and OVn to GND	-0.3	6.0	V	
I _{SW}	Continuous Switch Current		5.5	A	
t _{PD}	Total Power Dissipation at T _A =25°C		2.08	W	
T _{STG}	Storage Junction Temperature	-65	+150	°C	
T _J	Operating Junction Temperature		+150	°C	
T _L	Lead Temperature (Soldering, 10 Seconds)		+260	°C	
Θ _{JA}	Thermal Resistance, Junction-to-Ambient (1in. ² pad of 2 oz. copper)		60 ⁽²⁾	°C/W	
ESD	Electrostatic Discharge Capability	Human Body Model, ANSI/ESDA/JEDEC JS-001	2		kV
		Charged Device Model, JESD22-C101	1		
	IEC61000-4-2 System Level	Air Discharge	15		
		Contact Discharge	8		

Note:

- Measured using 2S2P JEDEC std. PCB.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. ON does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Min.	Max.	Unit
V _{IN}	Supply Voltage	4.0	22.0	V
C _{IN} / C _{OUT}	Input and Output Capacitance	1.0		μF
T _A	Ambient Operating Temperature	-40	+85	°C

Electrical Characteristics

Unless otherwise noted, $V_{IN}=4$ to 22 V, $T_A=-40$ to 85°C; typical values are at $V_{IN}=5$ V, $C_{IN}=C_{OUT}=1$ μ F, ON=HIGH, POL=OV1=OV2=OC_MODE=GND and $T_A = 25^\circ\text{C}$.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit	
Basic Operation							
V_{IN}	Input Voltage		4		22	V	
I_{SD_IN}	V_{IN} Shutdown Current	$V_{ON}=\text{OFF}$, $V_{IN}=5.5$ V, $V_{OUT}=\text{Short to GND}$		75	100	μ A	
I_Q	Quiescent Current	$I_{OUT}=0$ mA, $V_{ON}=\text{ON}$	$V_{IN}=5$ V	270	330	μ A	
			$V_{IN}=12$ V	300	400		
			$V_{IN}=20$ V	350	450		
R_{ON}	On Resistance	$T_A=25^\circ\text{C}$, $I_{OUT}=1$ A	$V_{IN}=5$ V	27	39	m Ω	
			$V_{IN}=12$ V	27	39		
			$V_{IN}=20$ V	27	39		
I_{ON}	ON Input Leakage	$V_{ON}=V_{IN}$ or GND			10	μ A	
V_{IH}	ON Input Logic High Voltage	$V_{IN}=3$ V~23 V	1.2			V	
V_{IL}	ON Input Logic Low Voltage	$V_{IN}=3$ V~23 V			0.4	V	
V_{P_LOW}	FLAGB Output Logic Low Voltage	$V_{IN}=5$ V, $I_{SINK}=5$ mA		0.1	0.2	V	
I_{LKG}	FLAGB Output High, Leakage Current	$V_{IN}=5$ V, Switch ON			1	μ A	
Protections							
I_{LIM}	Current Limit ⁽³⁾	$V_{IN}=5$ V, $V_{OUT}=4$ V, $R_{SET}=3.01$ k Ω , $T_A=-40$ to 85°C	1.35	1.50	1.65	A	
		$V_{IN}=5$ V, $V_{OUT}=4$ V, $R_{SET}=1.54$ k Ω , $T_A=-40$ to 85°C	2.85	3.00	3.15		
V_{FOLD}	ILIM Foldback Trip Voltage ⁽³⁾	V_{OUT} under ILIM Mode		2		V	
I_{FOLD}	ILIM Foldback Current ⁽³⁾	$V_{IN}=5$ V, $V_{OUT} < V_{FOLD}$, $T_A=25^\circ\text{C}$, OC_MODE=HIGH		500		mA	
		$V_{IN}=5$ V, $V_{OUT} < V_{FOLD}$, $T_A=25^\circ\text{C}$, OC_MODE=LOW		250		mA	
V_{UVLO}	Under-Voltage Lockout	V_{IN} Increasing		2.70	2.95	V	
		V_{IN} Decreasing		2.5			
	UVLO Hysteresis			200		mV	
V_{OVLO}	Over-Voltage Lockout	OV1=LOW, OV2=LOW	V_{IN} Rising	22.54	23.00	23.46	V
			V_{IN} Falling	22.34			
		OV1=LOW, OV2=HIGH	V_{IN} Rising	9.90	10.00	10.10	
			V_{IN} Falling	9.85			
		OV1=HIGH, OV2=LOW	V_{IN} Rising	16.50	16.80	17.10	
			V_{IN} Falling	16.40			
OV1=HIGH, OV2=HIGH	V_{IN} Rising	5.90	5.95	6.00			
	V_{IN} Falling	5.85					
t_{OVP}	OVP Response Time ⁽³⁾	$R_L=100$ Ω , $C_L=0$ μ F, $V_{IN} > V_{OVLO}$ to $V_{OUT}=0.9 \times V_{IN}$			150	ns	
V_{T_RCB}	TRCB Protection Trip Point	$V_{OUT} - V_{IN}$		25	40	mV	
V_{R_RCB}	TRCB Protection, Release Point	$V_{IN} - V_{OUT}$		25	40	mV	
t_{RCB}	TRCB Response Time ⁽³⁾	$V_{IN}=5$ V, $V_{ON}=\text{HIGH/LOW}$		5		μ s	
$t_{RCB_Release}$	TRCB Release Time ⁽³⁾	$V_{IN}=5$ V, Enabled		1		μ s	
t_{OC}	Over Current Response Time ⁽³⁾	$V_{IN}=5$ V, Moderate OC		20		μ s	
		$V_{IN}=5$ V, Hard Short		5			

Electrical Characteristics

Unless otherwise noted, $V_{IN}=4$ to 22 V, $T_A=-40$ to 85°C ; typical values are at $V_{IN}=5$ V, $C_{IN}=C_{OUT}=1$ μF , $ON=HIGH$, $POL=OV1=OV2=OC_MODE=GND$ and $T_A = 25^\circ\text{C}$.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I_{SD_OUT}	VOUT Shutdown Current	$V_{ON}=OFF$, $V_{OUT}=5$ V, $V_{IN}=\text{Short to GND}$			2	μA
TSD	Thermal Shutdown ⁽³⁾	Shutdown Threshold		150		$^\circ\text{C}$
		Hysteresis		20		
Dynamic Behavior						
t_{DON}	Delay On Time	$R_L=100$ Ω , $C_L=1$ μF		1		ms
t_R	V_{OUT} Rise Time	$R_L=100$ Ω , $C_L=1$ μF		1		ms
t_{ON}	Turn-On Time	$R_L=100$ Ω , $C_L=1$ μF		2		ms
t_{DOFF}	Delay Off Time	$R_L=100$ Ω , $C_L=1$ μF		10		μs
t_F	V_{OUT} Fall Time	$R_L=100$ Ω , $C_L=1$ μF		200		μs
t_{OFF}	Turn-Off Time	$R_L=100$ Ω , $C_L=1$ μF		210		μs
t_{BLANK}	Over-Current Blanking Time ⁽³⁾	$OC_MODE=HIGH$		5		ms
t_{RSTRT}	Auto-Restart Time ⁽³⁾	$OC_MODE=HIGH$		200		ms
t_{QUAL}	Over-Current Qualification Time ⁽³⁾	$OC_MODE=LOW$		5		ms
t_{DEB}	FLAGB De-bounce Time ⁽³⁾	Restart-up during or after OC		3		ms
		Restart-up during or after Thermal shutdown		15		
		Restart-up during or after UVLO		1		

Note:

- Guaranteed by characterization and design, not production test.

Setting Current Limit

FPF2895C current limit is set with an external resistor connected between I_{SET} and GND. This resistor is selected using the following equation:

$$R_{SET}(k\Omega) = \left(\frac{4674.89}{I_{SET} \text{ mA}} \right)^{1/1.0326} \quad (1)$$

Resistor tolerance of 1% or less is recommended. 5% tolerance can be achieved only when ILIM is set to larger than 2A.

Table 1. ILIM vs. RSET Look-up Table

RSET [kΩ]	ILIM [mA]		
	Min.	Typ.	Max.
8.75	450	500	550
7.35	540	600	660
6.30	630	700	770
5.55	720	800	880
4.95	810	900	990
4.45	900	1000	1100
4.06	990	1100	1210
3.73	1080	1200	1320
3.45	1170	1300	1430
3.21	1260	1400	1540
3.01	1350	1500	1650
2.82	1440	1600	1760
2.66	1530	1700	1870
2.52	1620	1800	1980
2.39	1710	1900	2090
2.28	1900	2000	2100
2.17	1995	2100	2205
2.07	2090	2200	2310
1.99	2185	2300	2415
1.91	2280	2400	2520
1.83	2375	2500	2625
1.77	2470	2600	2730
1.70	2565	2700	2835
1.64	2660	2800	2940
1.59	2755	2900	3045
1.54	2850	3000	3150
1.49	2945	3100	3255
1.44	3040	3200	3360
1.40	3135	3300	3465
1.36	3230	3400	3570
1.32	3325	3500	3675
1.29	3420	3600	3780
1.25	3515	3700	3885
1.22	3610	3800	3990
1.19	3705	3900	4095
1.16	3800	4000	4200
1.14	3895	4100	4305
1.11	3990	4200	4410
1.08	4085	4300	4515
1.06	4180	4400	4620

Table 1. ILIM vs. RSET Look-up Table (Continued)

RSET [kΩ]	ILIM [mA]		
	Min.	Typ.	Max.
1.04 ⁽⁴⁾	4275	4500	4725
1.02	4370	4600	4830
0.99	4465	4700	4935
0.97	4560	4800	5040
0.96	4655	4900	5145
0.94	4750	5000	5250 ⁽⁵⁾

Note:

4. Passed UL&CB certification with max. 5 A output current.
5. 6 A absolute limit current value. See Figure 9. for protection timing diagram.

Table 2. OVLO Level Selection

OV1	OV2	OVLO
LOW	LOW	23 V ±460 mV
LOW	HIGH (Floating)	10 V ±100 mV
HIGH (Floating)	LOW	16.3 V ±300 mV
HIGH (Floating)	HIGH (Floating)	5.95 V ±50 mV

Table 3. Device Enable Polarity Selection

POL	ON	Device State	ON Polarity
LOW	LOW (Floating)	OFF	Active HIGH
LOW	HIGH	ON	
HIGH (Floating)	LOW (Floating)	ON	Active LOW
HIGH (Floating)	HIGH	OFF	

Timing Diagrams

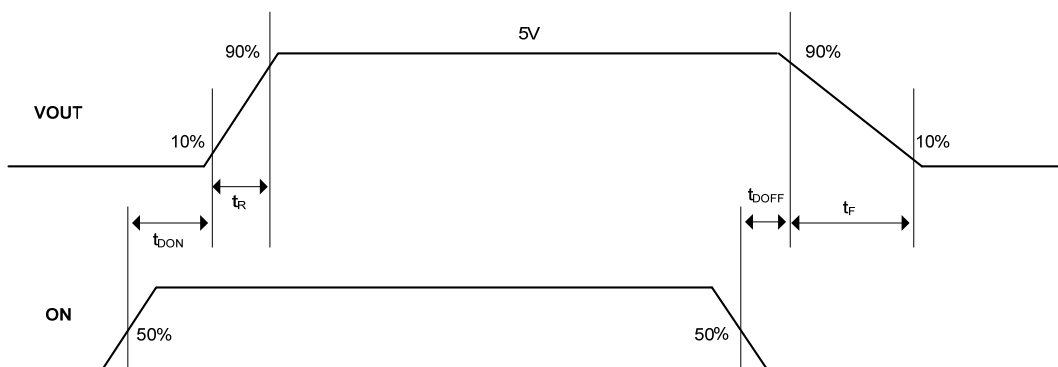


Figure 4. Normal ON/OFF Operation by ON (POL=GND)

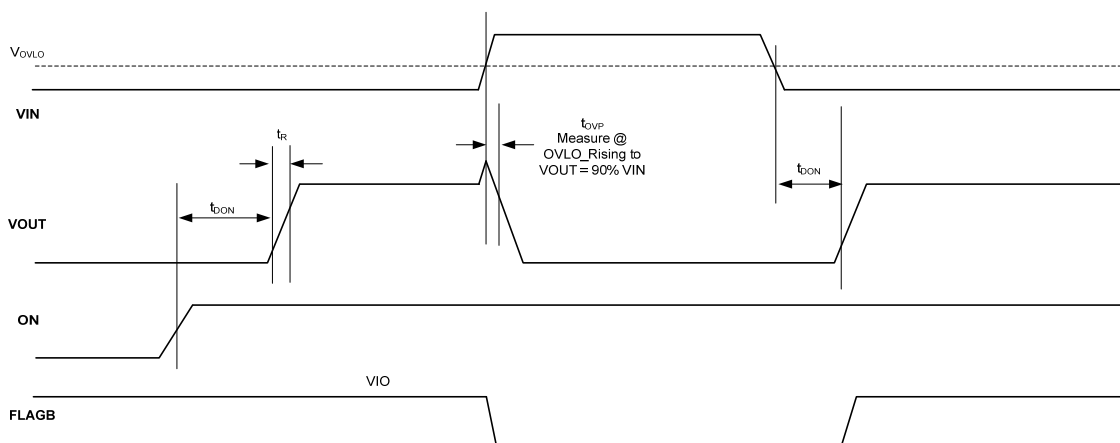


Figure 5. OVLO Operation (POL=GND & FLAGB is pulled up with an external VIO)

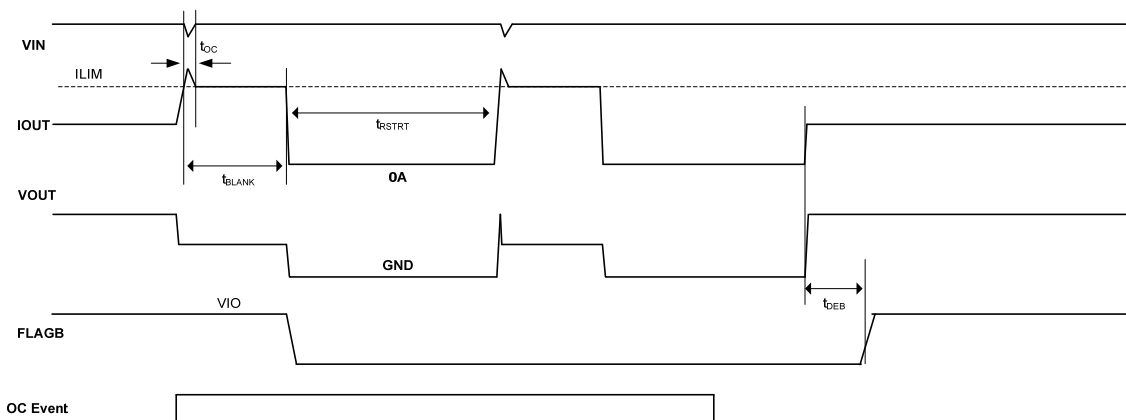


Figure 6. Current Limit Operation (OC_MODE=HIGH & FLAGB is pulled up with an external VIO)

Timing Diagrams (Continued)

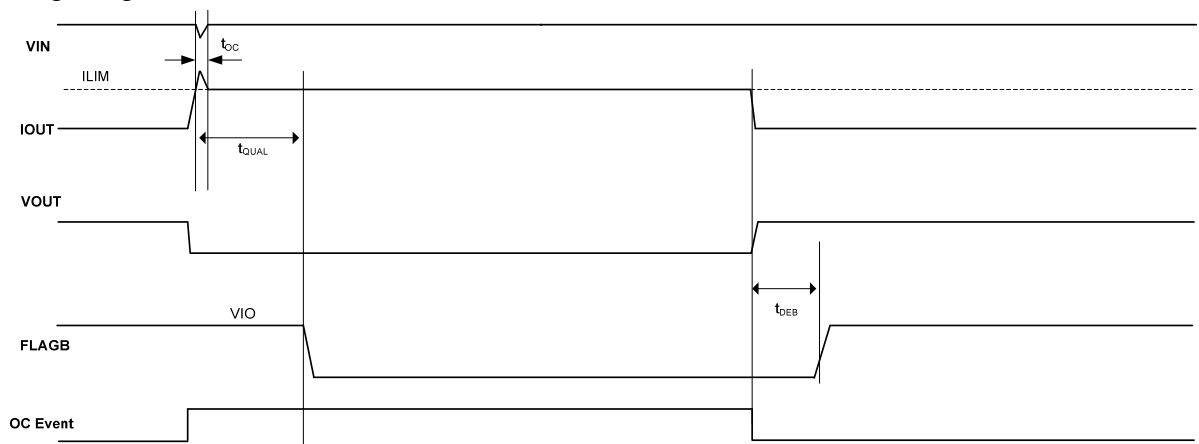


Figure 7. Current Limit Operation (OC_MODE=LOW & FLAGB is pulled up with an external VIO)

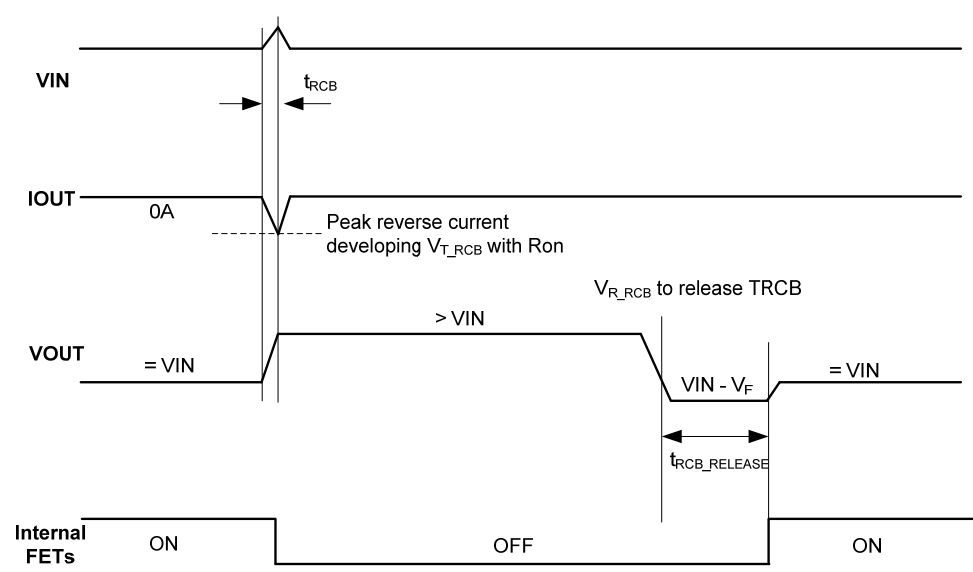


Figure 8. TRCB Operation (Device is Enabled)

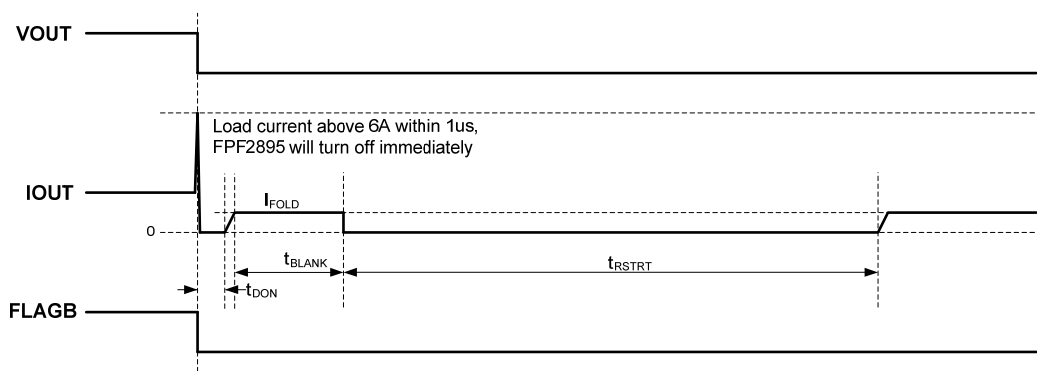


Figure 9. VOUT Hard Short to GND (OC_MODE=HIGH & FLAGB is pulled up with an external VIO)

The table below pertains to the Marketing outline drawing on the following page.

Product-Specific Dimensions

D	E	X	Y
2600 $\mu\text{m} \pm 30 \mu\text{m}$	1670 $\mu\text{m} \pm 30 \mu\text{m}$	235 $\mu\text{m} \pm 18 \mu\text{m}$	300 $\mu\text{m} \pm 18 \mu\text{m}$

Physical Dimensions

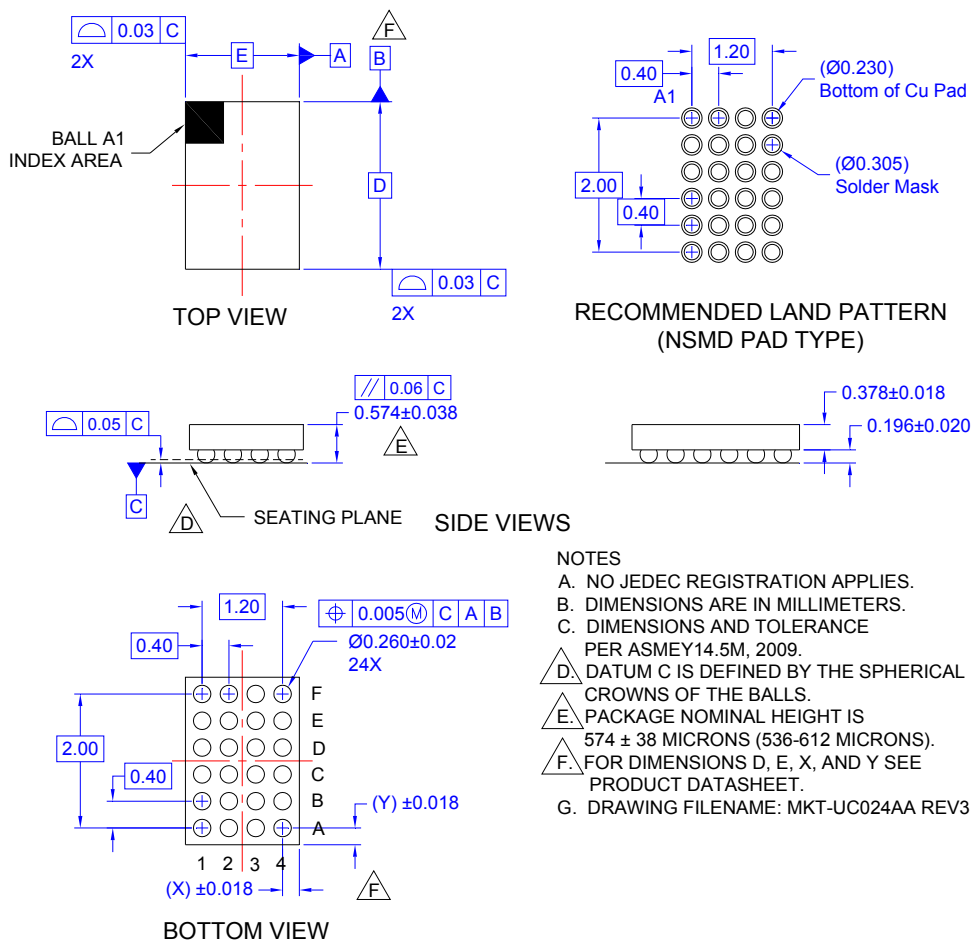


Figure 10 – 24-Ball, 4x6 Array, 0.4 mm Pitch, Wafer-Level Chip-Scale Package (WLCSP)

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