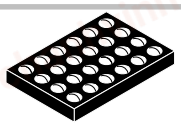
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Current Limit Switch, with OVP and TRCB, 28 V / 5 A Rated

FPF2895V

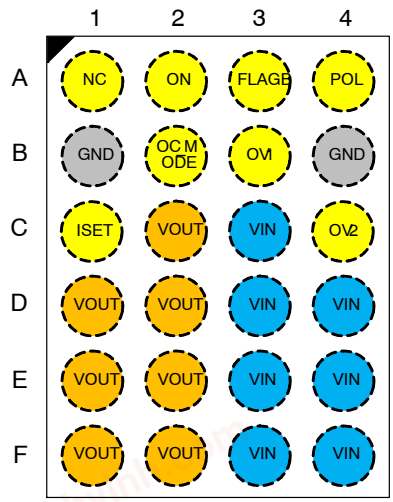
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WLCSP24 2.6x1.67x0.612
CASE 567TQ

PIN CONFIGURATION



ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

Features

- AEC−Q100 Qualified (Grade 2)
- 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

Applications

- Laptop, Desktop Computing and Monitor
- Power Accessories
- Automotive

Description

The FPF2895V 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 Ωm with WL−CSP can operate over an input voltage range of 4 V to 22 V.

The FPF2895V supports ±15% of current limit accuracy, over-current range of 500 mA to 2 A and ±10% 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 FPF2895V 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.

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Table 1. ORDERING INFORMATION

Part Number	Operating Temperature Range	Top Mark	Package	Packing Method
FPF2895VUCX	−40°C – +105°C	3K	24−Ball, 0.4 mm Pitch WLCSP	Tape & Reel

Application Diagram

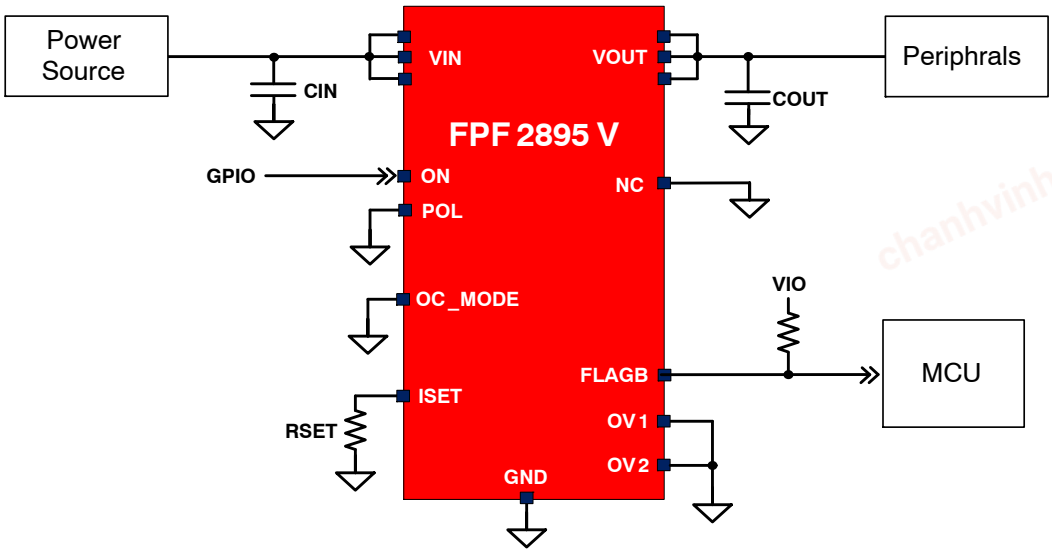


Figure 1. Typical Application

Block Diagram

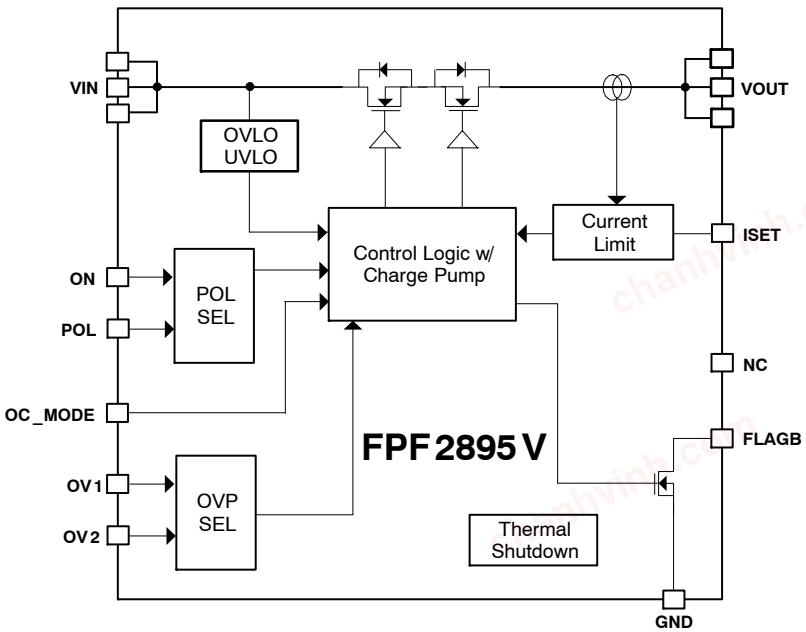
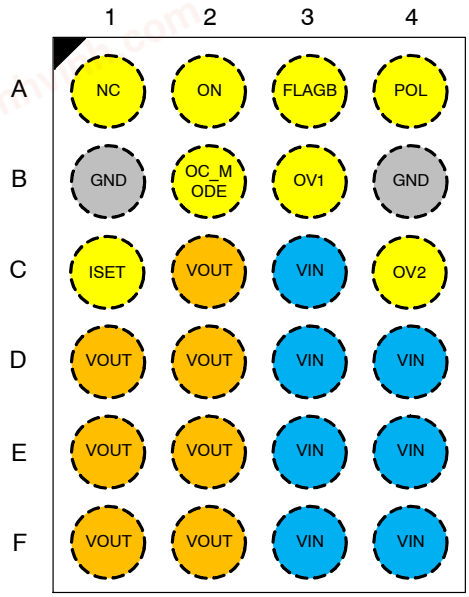


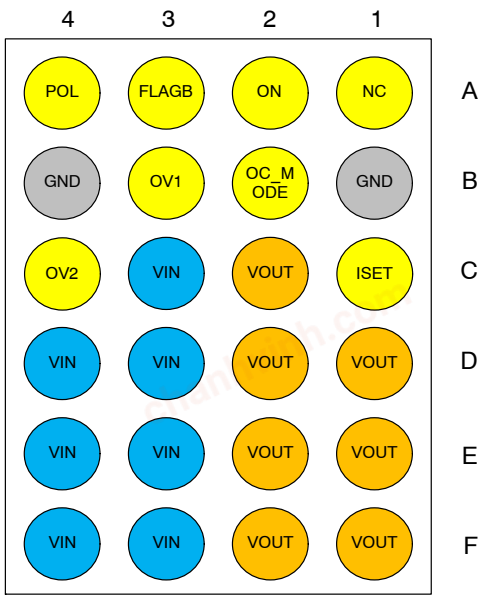
Figure 2. Functional Block Diagram

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PIN CONFIGURATION



Pin Configuration (Top View)



Pin Configuration (Bottom View)

Figure 3. Pin Configuration

Table 2. 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 (Note 1)
POL	A4	Input	Enable Polarity Selection. Internal pull/up of 1 MΩ is included. HIGH (or Floating): Active LOW LOW: Active HIGH (Note 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 6.
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. (Note 1)
OV1	B3	Input	Over−Voltage Selection Input 1. Internal pull−up of 1 MΩ is included and see below selection Table 7. (Note 1)
OV2	C4	Input	Over−Voltage Selection Input 2. Internal pull−up of 1 MΩ is included and see Table 7 (Note 1)
GND	B1, B4	GND	Device Ground

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

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Table 3. ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Min.	Max.	Unit
VIN, VOUT	VIN, VOUT 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
ΘJ_A	Thermal Resistance, Junction−to−Ambient (1in.^{2} pad of 2 oz. copper)			60 (Note 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		

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
2. Measured using 2S2P JEDEC std. PCB.

Table 4. RECOMMENDED OPERATING CONDITIONS

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	+105	°C

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

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Table 5. ELECTRICAL CHARACTERISTICS (Unless otherwise noted, V_{IN} = 4 to 22 V, T_A = −40 to 105°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°C.)

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
BASIC OPERATION							
V_{IN}	Input Voltage (Note 4)			4		22	V
I_{SD_IN}	V_{IN} Shutdown Current	V_{ON} = OFF, V_{IN} = 5.5 V, V_{OUT} = Short to GND			75	100	μA
I_Q	Quiescent Current	I_{OUT} = 0 mA, V_{ON} = ON	V_{IN} = 5 V		270	400	μA
			V_{IN} = 12 V		300	450	
			V_{IN} = 20 V		350	500	
R_{ON}	On Resistance	T_A = 25°C, I_{OUT} = 1 A	V_{IN} = 5 V		27	39	mΩ
			V_{IN} = 12 V		27	39	
			V_{IN} = 20 V		27	39	
I_{ON}	ON Input Leakage	V_{ON} = V_{IN} or GND				10	μA
V_{IH}	Logic Pin Input (ON, POL, OV1, OV2, OC_MODE) High Voltage	V_{IN} = 3 V ~ 23 V		1.2			V
V_{IL}	Logic Pin Input (ON, POL, OV1, OV2, OC_MODE) 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	μA
PROTECTIONS							
I_{LIM}	Current Limit (Note 3)	V_{IN} = 5 V, V_{OUT} = 4 V, R_{SET} = 3.01 kΩ, T_A = −40 to 105°C		1.275	1.50	1.725	A
		V_{IN} = 5 V, V_{OUT} = 4 V, R_{SET} = 1.54 kΩ, T_A = −40 to 105°C		2.70	3.00	3.30	
V_{FOLD}	ILIM Foldback Trip Voltage (Note 3)	V_{OUT} under ILIM Mode			2		V
I_{FOLD}	ILIM Foldback Current (Note 3)	V_{IN} = 5 V, V_{OUT} < V_{FOLD}, T_A = 25°C, OC_MODE = HIGH			500		mA
		V_{IN} = 5 V, V_{OUT} < V_{FOLD}, T_A = 25°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	22.20	23.00	23.46	V
			V_{IN}Falling	22.00			
		OV1 = LOW, OV2 = HIGH	V_{IN}Rising	9.80	10.00	10.10	
			V_{IN}Falling	9.75			
		OV1 = HIGH, OV2 = LOW	V_{IN}Rising	16.30	16.80	17.10	
			V_{IN}Falling	16.10			
		OV1 = HIGH, OV2 = HIGH	V_{IN}Rising	5.85	5.95	6.00	
			V_{IN}Falling	5.80			
T_{OVP}	OVP Response Time (Note 3)	R_L = 100 Ω, C_L = 0 μF, V_{IN} > V_{OVLO} to V_{OUT} = 0.9 × V_{IN}				150	ns
V_{T_RCB}	TRCB Protection Trip Point	V_{OUT} − V_{IN}			25	40	mV

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Table 5. ELECTRICAL CHARACTERISTICS (Unless otherwise noted, V_{IN} = 4 to 22 V, T_A = −40 to 105°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°C.)

V_{R_RCB}	TRCB Protection, Release Point	V_{IN} – V_{OUT}		25	40	mV
t_{RCB}	TRCB Response Time (Note 3)	V_{IN} = 5 V, V_{ON} = HIGH/LOW		5		μs
$t_{RCB_Release}$	TRCB Release Time (Note 3)	V_{IN} = 5 V, Enabled		1		μs
t_{OC}	Over Current Response Time (Note 3)	V_{IN} = 5 V, Moderate OC		20		μs
		V_{IN} = 5 V, Hard Short		5		
I_{SD_OUT}	VOUT Shutdown Current	V_{ON} = OFF, V_{OUT} = 5 V, V_{IN} = Short to GND			2	μA
TSD	Thermal Shutdown (Note 3)	Shutdown Threshold		150		°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 (Note 3)	OC_MODE = HIGH		5		ms
t_{RSTRT}	Auto−Restart Time (Note 3)	OC_MODE = HIGH		200		ms
t_{QUAL}	Over−Current Qualification Time (Note 3)	OC_MODE = LOW		5		ms
t_{DEB}	FLAGB De−bounce Time (Note 3)	Restart−up during or after OC		3		ms
		Restart−up during or after Thermal shutdown		15		
		Restart−up during or after UVLO		1		

3. Guaranteed by characterization and design, not production test.
4. To avoid output voltage is coupled to high during cold start, the slew rate of Vin should be less than 10 mV/μs

Setting Current Limit

FPF2895V current limit is set with an external resistor connected between I_{SET} and GND. This resistor is selected using the following equation:

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

Resistor tolerance of 1% or less is recommended. 10% tolerance can be achieved only when ILIM is set to larger than 2 A.

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Table 6. ILIM VS. RSET LOOK−UP TABLE

RSET [kΩ]	ILIM [mA]		
	Min.	Typ.	Max.
8.75	425	500	575
7.35	510	600	690
6.30	595	700	805
5.55	680	800	920
4.95	765	900	1035
4.45	850	1000	1150
4.06	935	1100	1265
3.73	1020	1200	1380
3.45	1105	1300	1495
3.21	1190	1400	1610
3.01	1275	1500	1725
2.82	1360	1600	1840
2.66	1445	1700	1955
2.52	1530	1800	2070
2.39	1615	1900	2185
2.28	1700	2000	2300
2.17	1890	2100	2310
2.07	1980	2200	2420
1.99	2070	2300	2530
1.91	2160	2400	2640
1.83	2250	2500	2750
1.77	2340	2600	2860
1.70	2430	2700	2970
1.64	2520	2800	3080
1.59	2610	2900	3190
1.54	2700	3000	3300
1.49	2790	3100	3410
1.44	2880	3200	3520
1.40	2970	3300	3630
1.36	3060	3400	3740
1.32	3150	3500	3850
1.29	3240	3600	3960
1.25	3330	3700	4070
1.22	3420	3800	4180
1.19	3510	3900	4290
1.16	3600	4000	4400
1.14	3690	4100	4510
1.11	3780	4200	4620
1.08	3870	4300	4730
1.06	3960	4400	4840
1.04 (Note 5)	4050	4500	4950

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Table 6. ILIM VS. RSET LOOK−UP TABLE

RSET [kΩ]	ILIM [mA]		
	Min.	Typ.	Max.
1.02	4140	4600	5060
0.99	4230	4700	5170
0.97	4320	4800	5280
0.96	4410	4900	5390
0.94	4500	5000	5500 (Note 6)

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

Table 7. 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 8. 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	

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TIMING DIAGRAMS

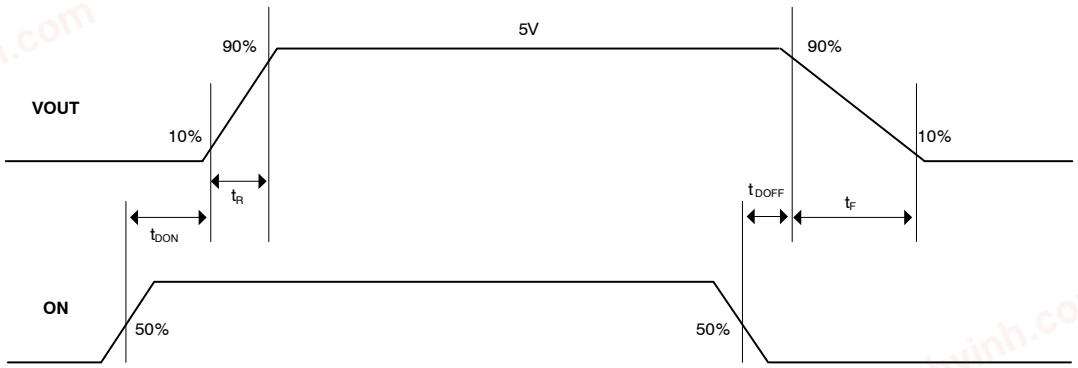


Figure 4. Normal ON/OFF Operation by ON (POL = GND)

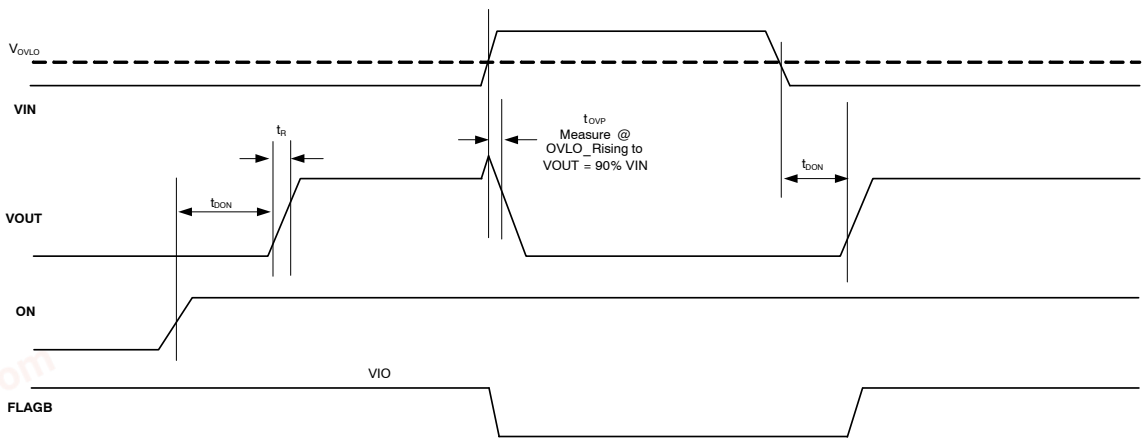


Figure 5. OVLO Operation (POL = GND & FLAGB is pulled up with an external VIO)

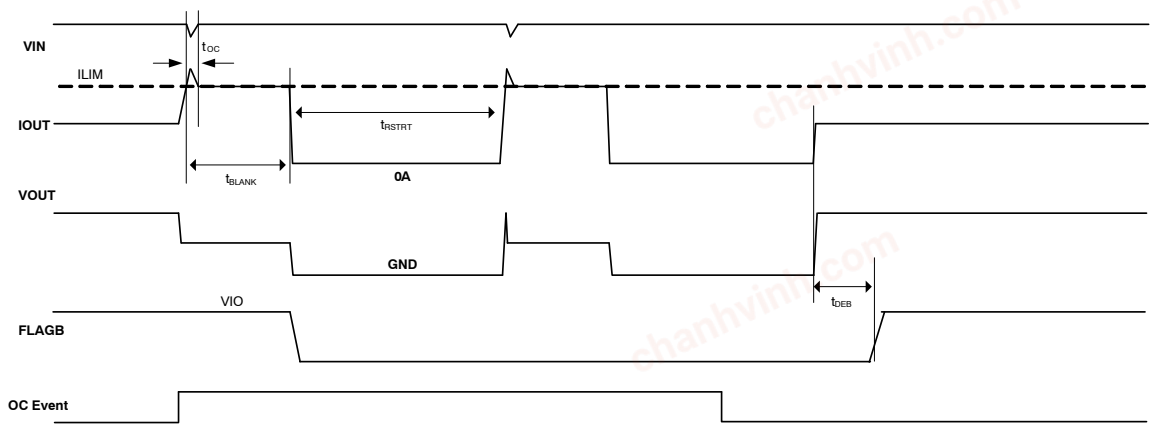


Figure 6. Current Limit Operation (OC_MODE = HIGH & FLAGB is pulled up with an external VIO)

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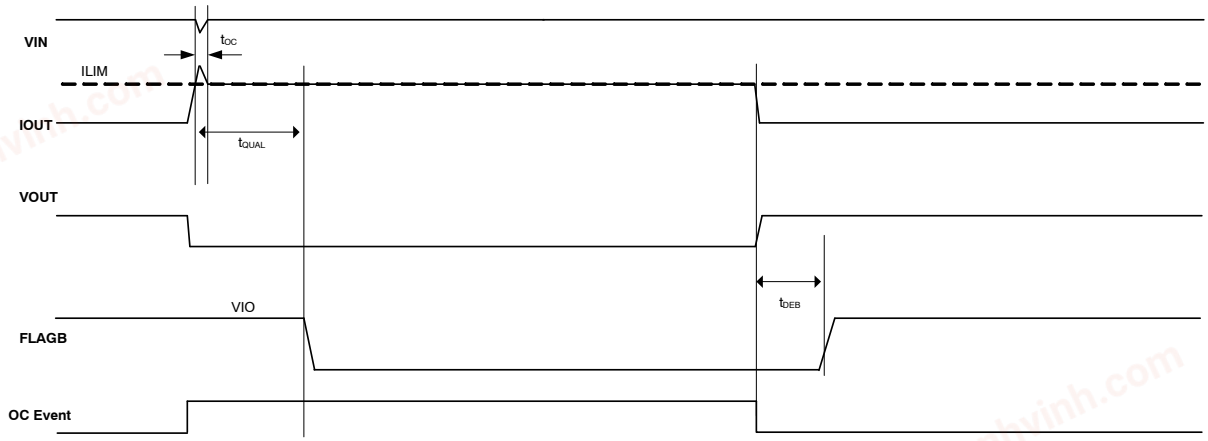


Figure 7. Current Limit Operation (OC_MODE = LOW & FLAGB is pulled up with an external VIO)

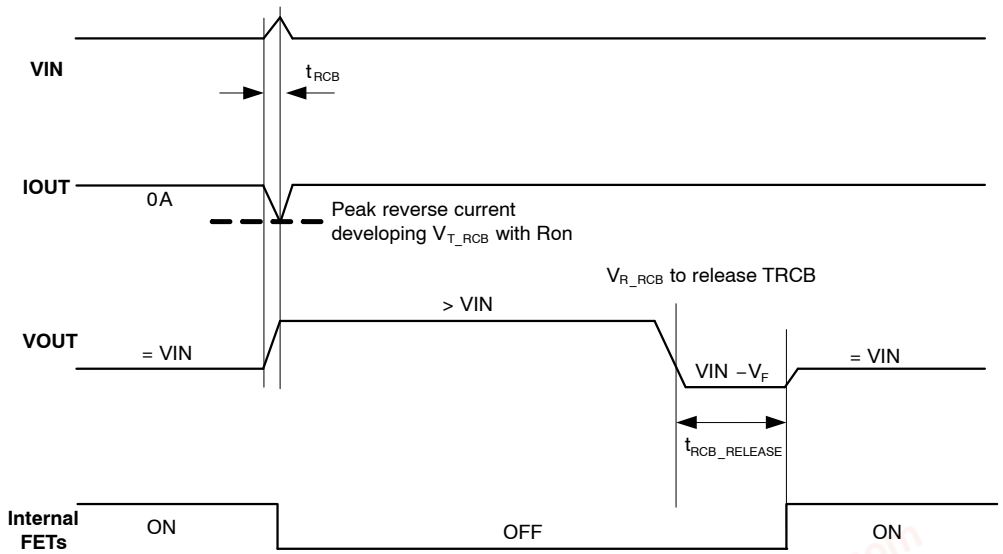


Figure 8. TRCB Operation (Device is Enabled)

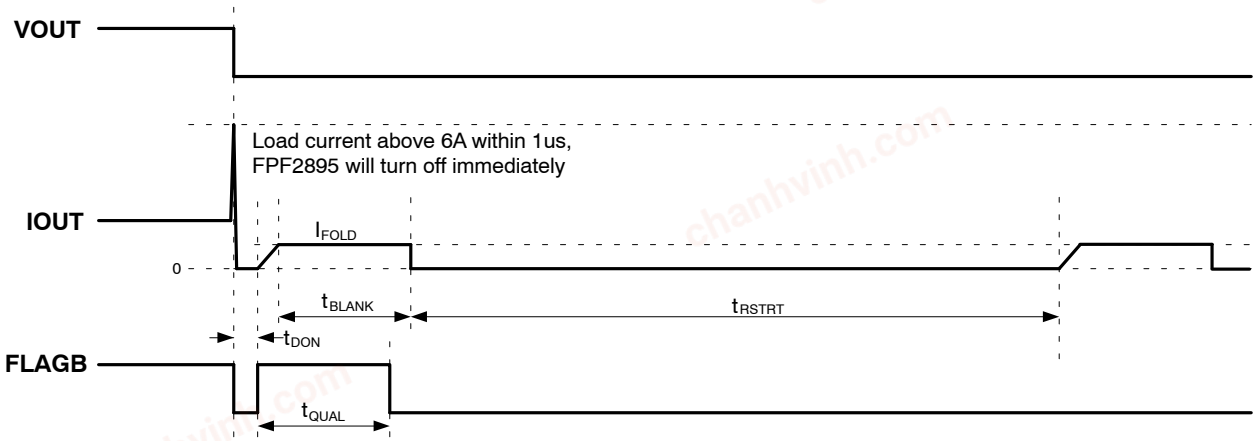


Figure 9. VOUT Hard Short to GND (OC_MODE = HIGH & FLAGB is pulled up with an external VIO)

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PRODUCT−SPECIFIC DIMENSIONS

D	E	X	Y
2600 μm ± 30 μm	1670 μm ± 30 μm	235 μm ± 18 μm	300 μm ± 18 μm