

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



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FPF2895V

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.

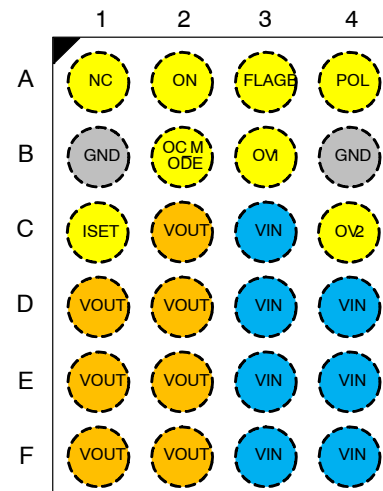
The FPF2895V supports ±15% of current limit accuracy, over-current range of 500 mA to 2 A and ±10% of current limit accuracy, over-current range of 2 A to 5 A, flexible operations such as selectable OVP, selectable ON polarity and selectable OCP behavior, which can be optimized according to system requirements.

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.



WLCSP24 2.6x1.67x0.612
CASE 567TQ

PIN CONFIGURATION



ORDERING INFORMATION

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

FPF2895V

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

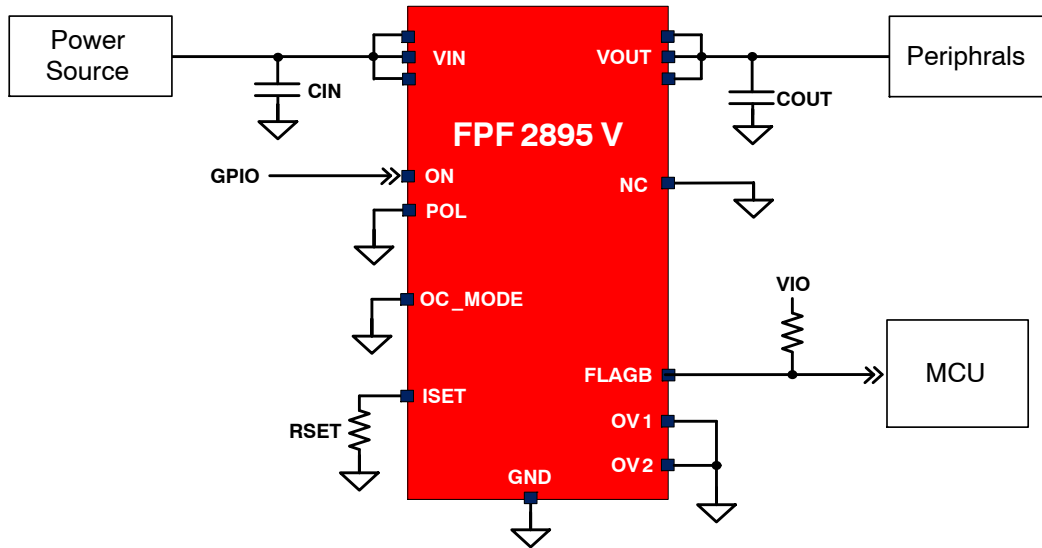


Figure 1. Typical Application

Block Diagram

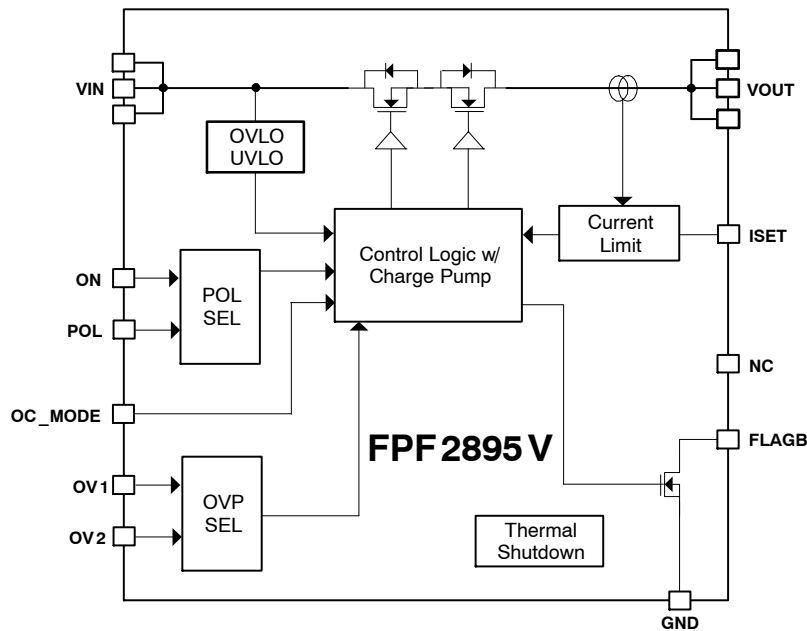


Figure 2. Functional Block Diagram

PIN CONFIGURATION

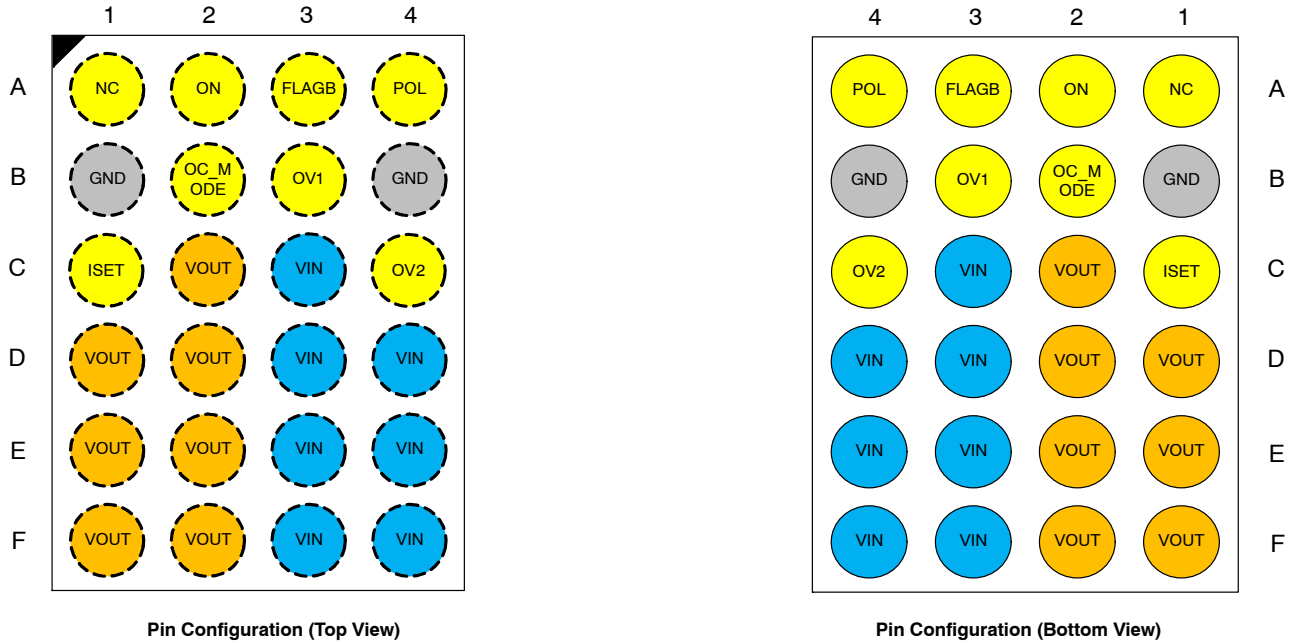


Figure 3. Pin Configuration

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 |
|------------------------------------|---|--|------|-------------|------|
| V _{IN} , V _{OUT} | V _{IN} , V _{OUT} to GND | | -0.3 | 28.0 | V |
| V _{PIN} | ON, POL, OC_MODE, ISET, FLAGB and OV _n 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 (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, $C_{IN} = C_{OUT} = 1$ 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 (Note 4) | | 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 | μA | |
| I_Q | Quiescent Current | $I_{OUT} = 0$ mA, $V_{ON} = \text{ON}$ | $V_{IN} = 5$ V | 270 | 400 | μA | |
| | | | $V_{IN} = 12$ V | 300 | 450 | | |
| | | | $V_{IN} = 20$ V | 350 | 500 | | |
| R_{ON} | On Resistance | $T_A = 25^\circ\text{C}$, $I_{OUT} = 1$ 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 | 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, $R_{SET} = 3.01$ k Ω , $T_A = -40$ to 105°C | 1.275 | 1.50 | 1.725 | A | |
| | | $V_{IN} = 5$ V, $V_{OUT} = 4$ V, $R_{SET} = 1.54$ k Ω , $T_A = -40$ 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, $V_{OUT} < V_{FOLD}$, $T_A = 25^\circ\text{C}$, 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 | 22.20 | 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 $V_{OUT} = 0.9 \times V_{IN}$ | | | 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 $T_A = 25^\circ\text{C}$.)

| | | | | | | |
|--------------------|-------------------------------------|---|--|-----|----|------------------|
| 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, $V_{ON} = \text{HIGH/LOW}$ | | 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 | $V_{ON} = \text{OFF}$, $V_{OUT} = 5$ V, $V_{IN} = \text{Short to GND}$ | | | 2 | μA |
| TSD | Thermal Shutdown (Note 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 | VOUT 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 | VOUT 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 V_{in} 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:

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

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 | |

TIMING DIAGRAMS

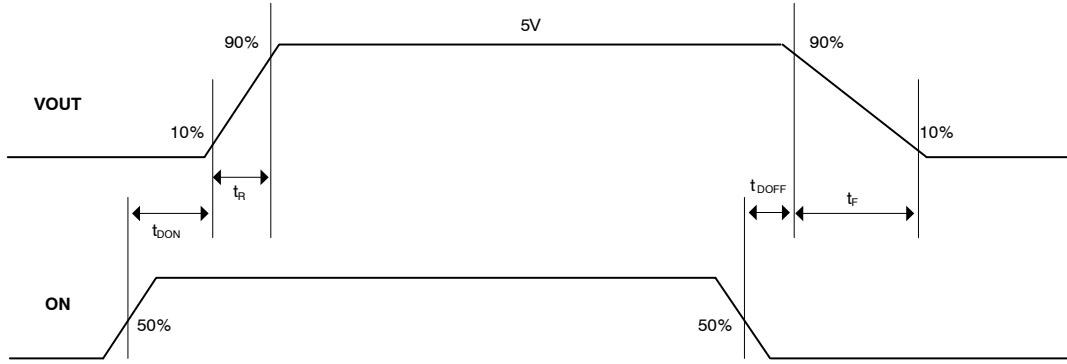


Figure 4. Normal ON/OFF Operation by ON (POL = GND)

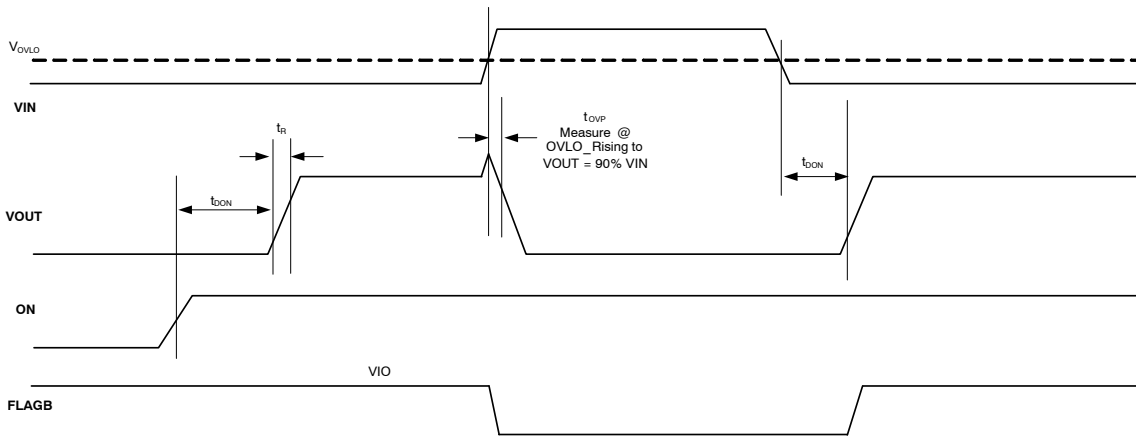


Figure 5. OVLO Operation (POL = GND & FLAGB is pulled up with an external VIO)

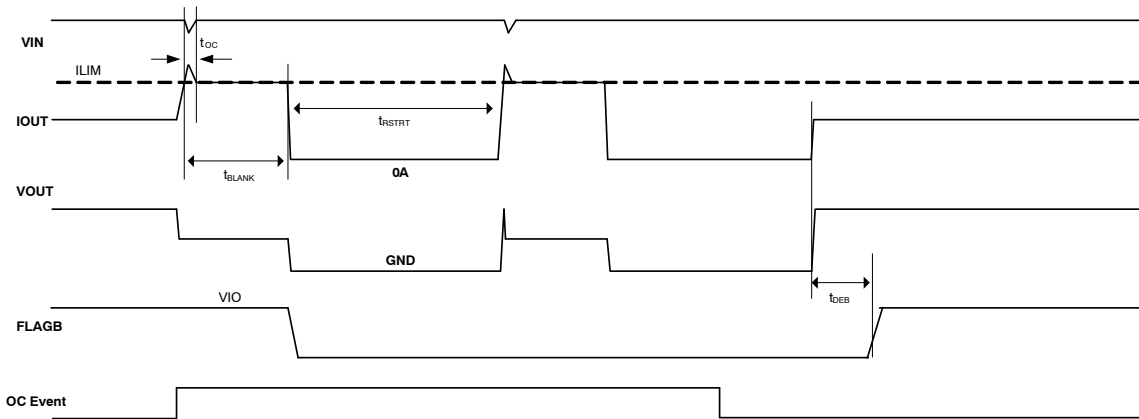


Figure 6. Current Limit Operation (OC_MODE = HIGH & FLAGB is pulled up with an external VIO)

FPF2895V

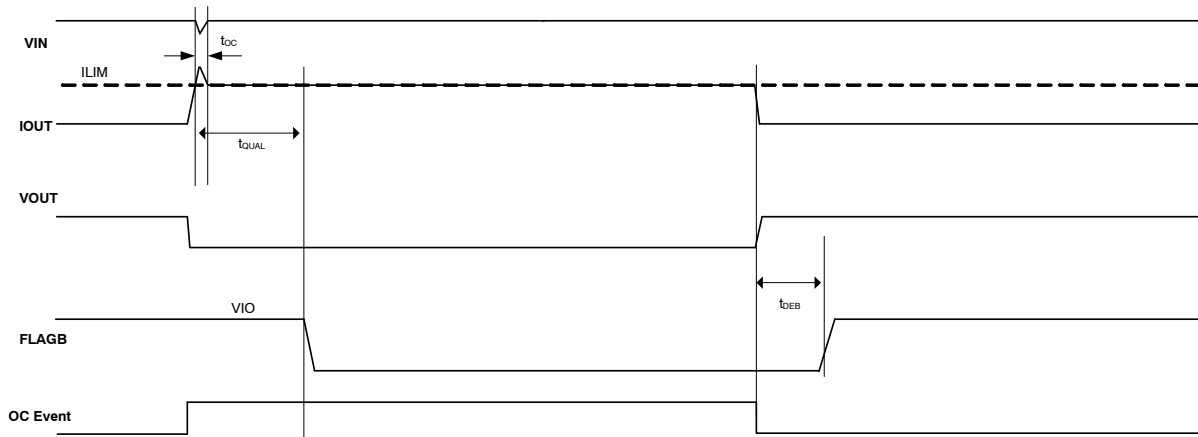


Figure 7. Current Limit Operation (OC_MODE = LOW & FLAGB is pulled up with an external VIO)

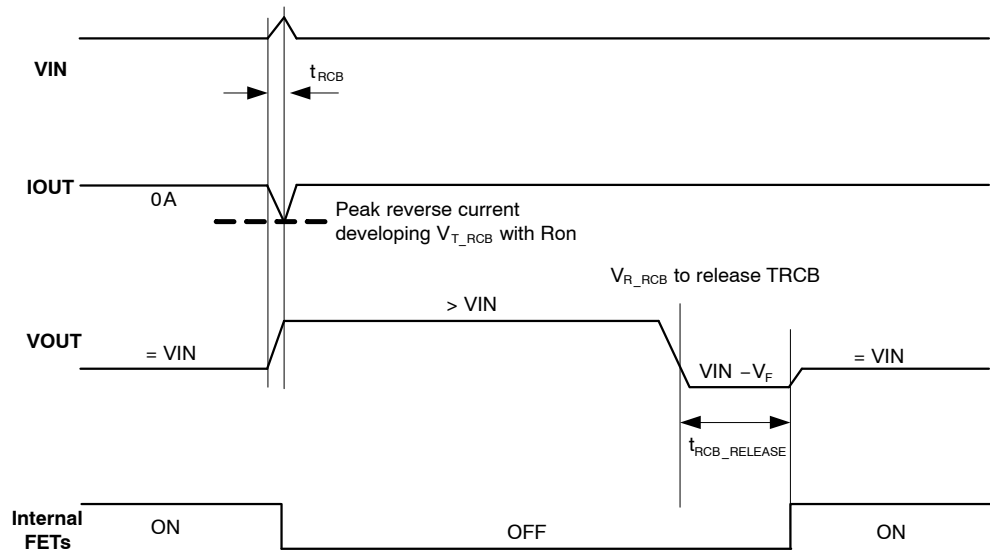


Figure 8. TRCB Operation (Device is Enabled)

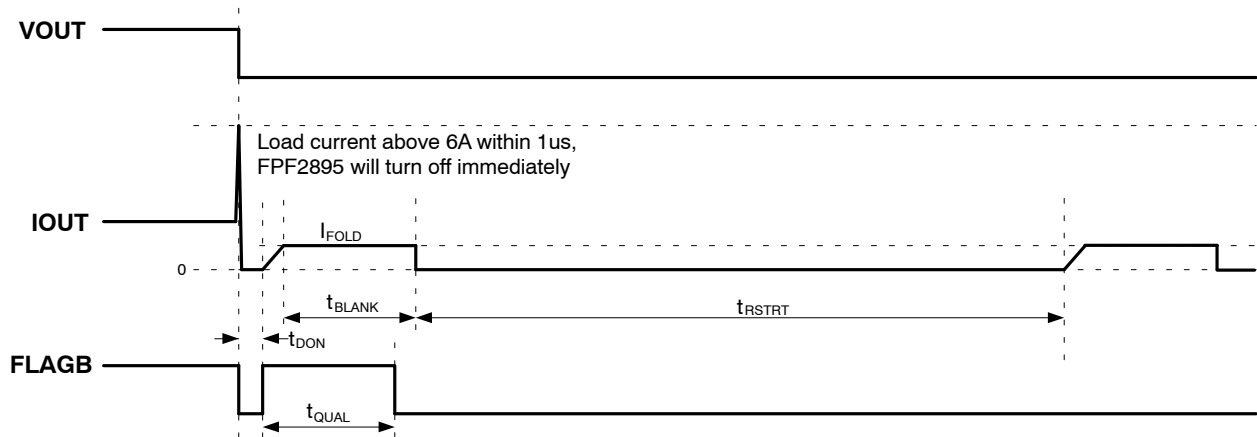


Figure 9. VOUT Hard Short to GND (OC_MODE = HIGH & FLAGB is pulled up with an external VIO)

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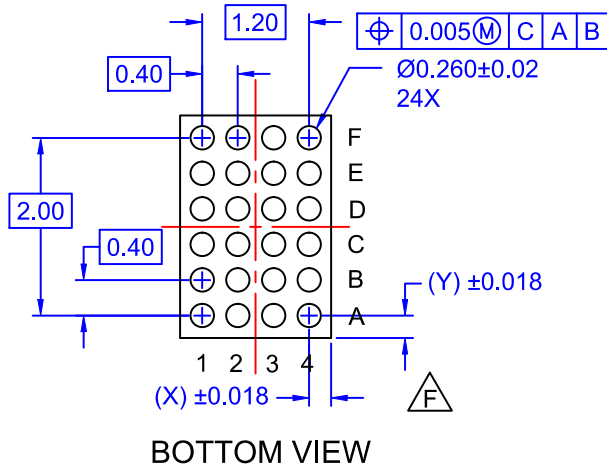
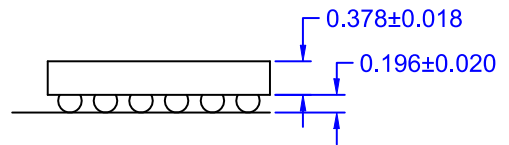
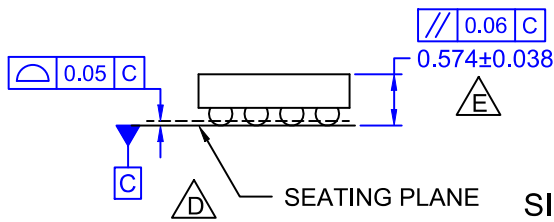
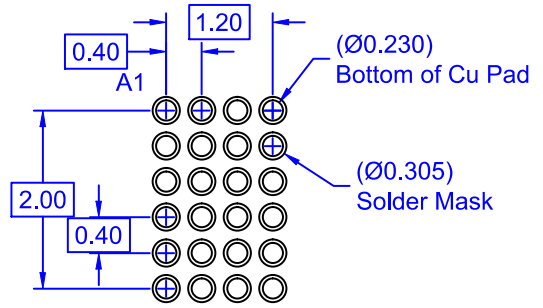
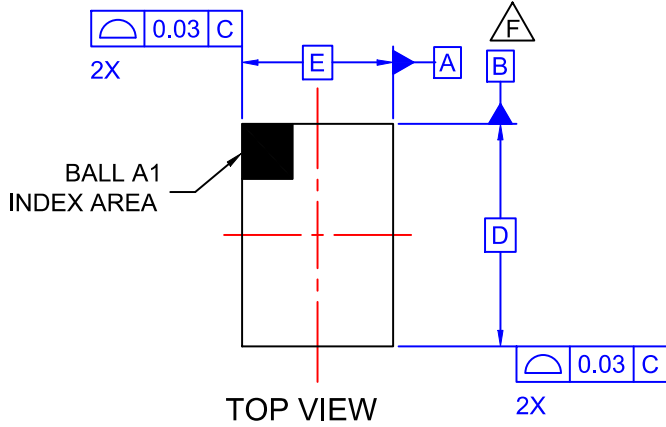
PRODUCT-SPECIFIC DIMENSIONS

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



WLCSP24 2.6x1.67x0.612
CASE 567TQ
ISSUE O

DATE 31 MAR 2017



NOTES

- A. NO JEDEC REGISTRATION APPLIES.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCE PER ASMEY14.5M, 2009.
- D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.
- E. PACKAGE NOMINAL HEIGHT IS 574 ± 38 MICRONS (536-612 MICRONS).
- F. FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.

| | | |
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