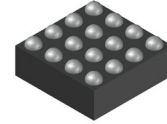


Protection Switch, with OVP/OTP/OCP Function, 24 V, 4.5 A

FPF2266UCX



WLCSP16
 CASE 567UX

General Description

The FPF2266 features 4.5 A continuous current for USB charging port application, which offers Over-Voltage Protection (OVP), over current protection (OCP), also NTC block to monitor system temperature. It has low On-resistance of typical 15 mohms that can operate over an input voltage range of 3.6 V to 24 V and up to 28 V absolute maximum.

The FPF2266 also provides an open-drain output (BATT_SHDN) for system battery disconnect and a bi-directional interface (ALERT/KILL) with SOC, MCU, or other external source (provides temperature fault condition to external source or it can receive system KILL signal to turn OFF internal switch and disconnect battery).

The FPF2266 is available in a 4x4 balls 0.4 mm pitch WLCSP package which can operate over -40°C to +125°C junction temperature range.

Features

- 24 V/4.5 A OTP/OVP/OCP Power Switch
- 2 Channels NTC Detection for System Thermal Monitoring
- Input voltage Range:
 - ◆ V_{IN} : 3.6 V ~ 24 V
 - ◆ V_{BAT} : 2.7 V – 5.5 V
- Ultra-Low On-Resistance
 - ◆ Typical 15 mΩ
- Up to 28 V Input/Output Voltage AMR
- Active Discharge
- Integrated Inrush Control
- Thermal Shutdown
- Hard Short Protection
- BO Detection to Check VIN Drop Off, Battery Disconnect
 Control Pin BATT_SHDN, Bi-direction I/O ALERT/KILL Pins
- WLCSP 4x4 Balls 0.4 mm Pitch Package
- This is a Pb-Free Device

Applications

- Mobile Phone
- Tablet
- Notebook PC
- Media Player

MARKING DIAGRAM



- 26 = Device Part Number
- KK = Lot Run Code
- A = Assembly Location
- YY = Year of Production
- WW = Work Week

ORDERING INFORMATION

See detailed ordering and shipping information on page 20 of this data sheet.

FPF2266UCX

APPLICATION DIAGRAM

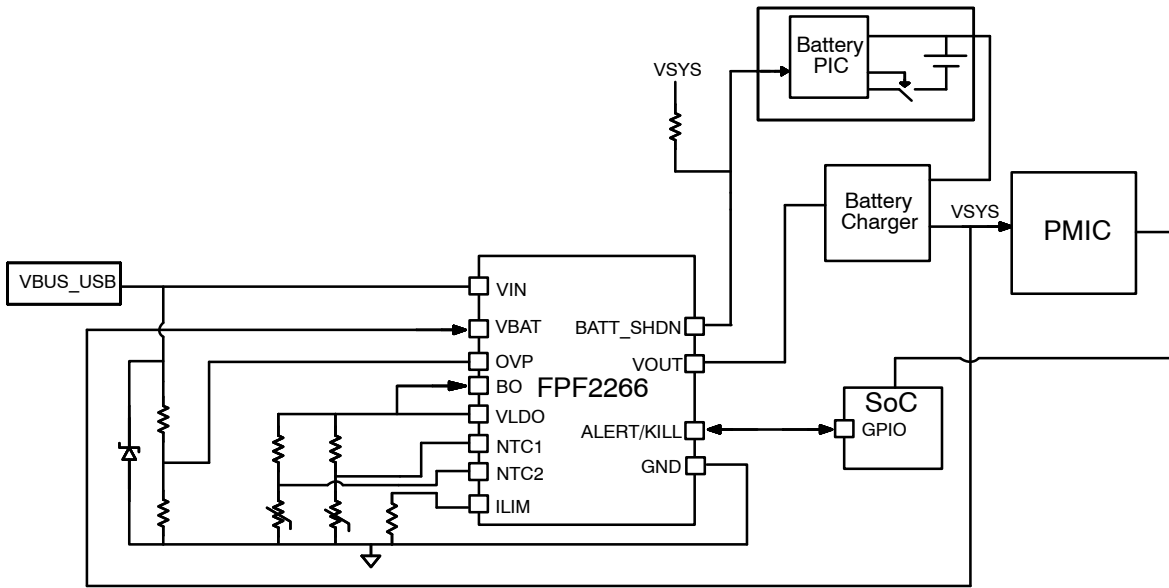


Figure 1. Typical Application 1

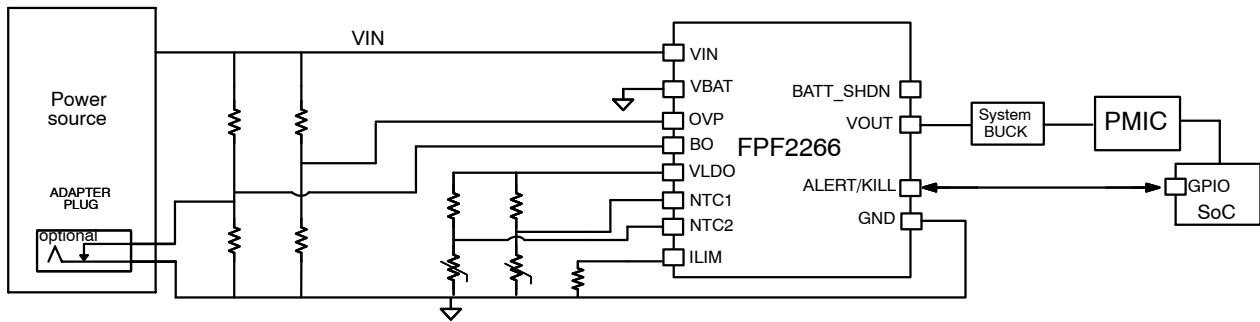


Figure 2. Typical Application 2

FPF226UCX

BLOCK DIAGRAM

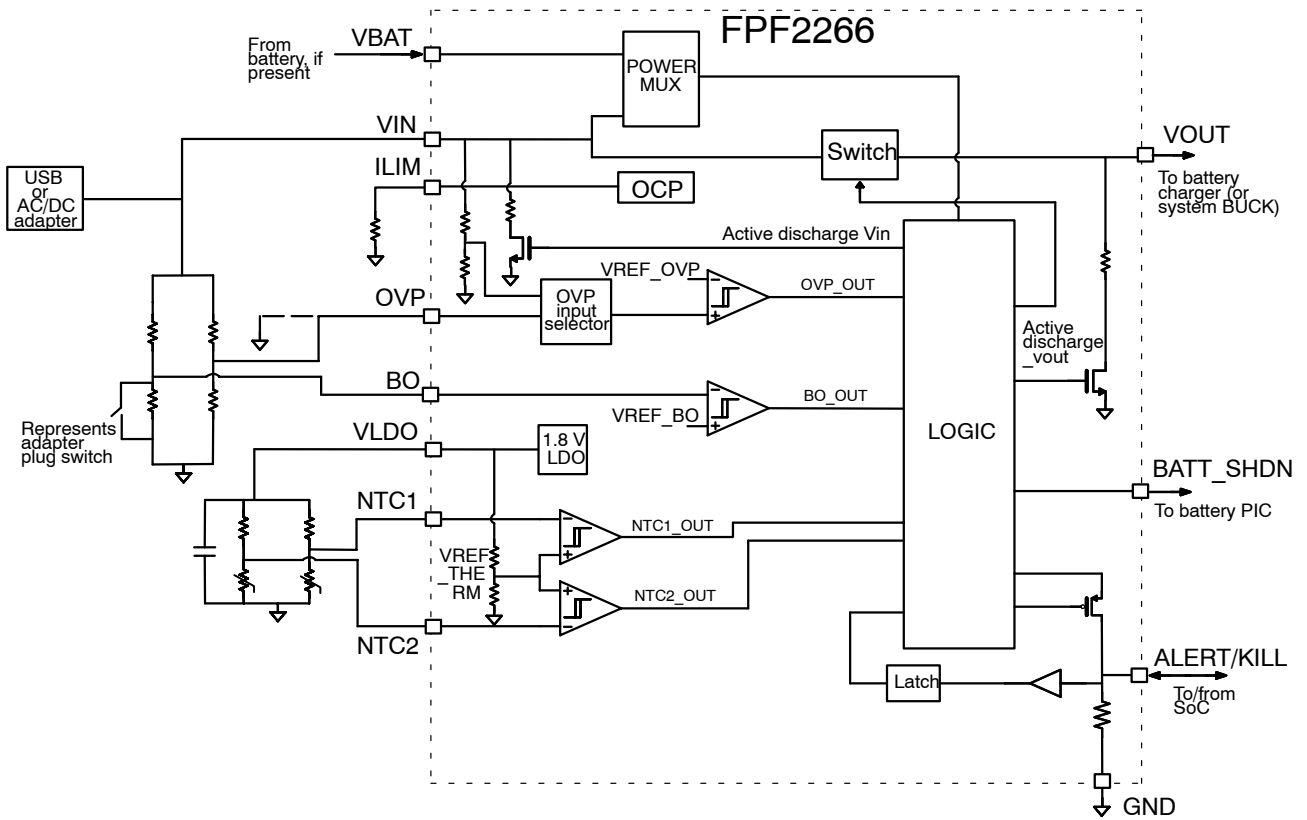


Figure 3. Functional Block Diagram

FPF2266UCX

PIN CONFIGURATION

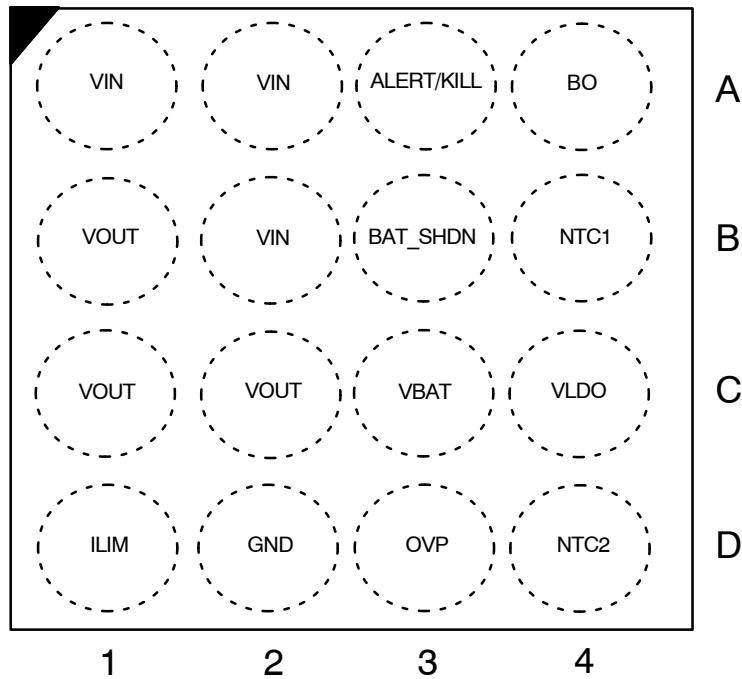


Figure 4. Pin Configuration (Top View)

PIN DESCRIPTION

Pin #	Pin Name	Type	Description
D3	OVP	Input	Input to over-voltage protection circuit, when this pin tied to ground, internal OVP threshold is used.
B4	NTC1	Input	Input to NTC sensing comparator 1
D4	NTC2	Input	Input to NTC sensing comparator 2
C4	VLDO	Output (power)	Voltage rail for NTC thermistor sensing
A3	ALERT/KILL	Input/Output	ALERT (output): provides temp fault status to SoC KILL (input): kill signal from SoC to shut off system power
B3	BATT_SHDN	Output	Open-drain output to disconnect battery pack from charger
A1/A2/B2	VIN	Input (power)	Dedicated power to protection IC. Input to internal switch.
A4	BO	Input	Input to brownout detection
D2	GND		IC ground
B1/C1/C2	VOUT	Output (power)	Output of internal switch
C3	VBAT	Input (power)	Input from battery
D1	ILIM	Input	Pin to set OCP limit threshold using an external resistor, once tie it to GND, then OCP limitation will be removed.

FPF2266UCX

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Unit	
V _{IN}	VIN to GND & VIN to VOUT = GND or Float	-0.3	28	V	
V _{OUT}	VOUT to GND & VOUT to VIN = GND or Float	-0.3	28	V	
V _{IO} /V _{BAT}	OVP, ALERT/KILL, BATT_SHDN, BO, OVP, NTC1/2, VBAT to GND	-0.3	6	V	
I _{IN_VIN_VOUT}	Continuous VIN to VOUT Current	-	5	A	
T _{PD}	Total Power Dissipation at T _A = 25°C	-	1	W	
T _{STG}	Storage Junction Temperature	-65	+150	°C	
T _J	Junction Temperature	-	+150	°C	
T _L	Lead Temperature (Soldering, 10 Seconds)	-	+260	°C	
Θ _{JA}	Thermal Resistance, Junction-to-Ambient (2S2P.1in. (Note 1) pad of 2 oz. Copper)	-	100	°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 at VIN and VOUT (Note 2)	15	-	
		Contact Discharge at VIN and VOUT (Note 2)	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.

1. Measured using 2S2P JEDEC std. PCB.
2. External TVS is required to guarantee.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
V _{IN} /V _{OUT}	VIN/VOUT Operating Voltage	3.6	-	24	V
V _{IO}	ALERT/KILL, BATT_SHDN, OVP, BO, ILIM	0	-	5.5	V
V _{BAT}	VBAT to GND	2.7	-	5.5	V
I _{SW}	DC Switch Current (ISW)	0	-	4.5	A
T _A	Ambient Operating Temperature, T _A	-40	-	85	°C
T _J	Operating Junction Temperature	-	-	125	°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.

FPF2266UCX

ELECTRICAL CHARACTERISTICS

(Typical values are $V_{IN}/V_{BAT} = 5\text{ V}$, $C_{OUT} = 100\ \mu\text{F}$ and $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{UVLO_VBAT}	Under-voltage Lockout Threshold	V_{BAT} falling	2.3	-	2.5	V
$V_{UVLO_HYS_VBAT}$	Under-voltage Lockout Hysteresis	V_{BAT} rising	-	200		mV
$I_{VIN_ON_5V}$	Input Quiescent Current on VIN	$V_{IN} = 5\text{ V}$; $V_{BAT} = 0\text{ V}$, Switch closed, OVP/BO/OCP/NTC detection enabled, $T_A = 25^\circ\text{C}$, without NTC resistor	-	240	277	μA
$I_{VIN_ON_24V}$	Input Quiescent Current on VIN	$V_{IN} = 24\text{ V}$; $V_{BAT} = 0\text{ V}$, Switch closed, OVP/BO/OCP/NTC detection enabled, $T_A = 25^\circ\text{C}$, without NTC resistor	-	330	433	μA
I_{VBAT_ON}	Input Quiescent Current on VBAT	$V_{IN} = 0\text{ V}$; $V_{BAT} = 5\text{ V}$; Switch opened, only NTC detection enabled; $T_A = 50^\circ\text{C}$; $R_{NTC} + R_{BIAS} = 43.7\text{ k}\Omega$, 0.2% duty cycle	-	2.8	3.5	μA
$I_{VBAT_ON_NTC_ON}$	Input Quiescent Current on VBAT	$V_{IN} = 0\text{ V}$; $V_{BAT} = 5\text{ V}$; Switch opened, only NTC detection enabled; $T_A = 50^\circ\text{C}$; without NTC resistor	-	39.1	-	μA
$I_{VBAT_ON_NTC_OFF}$	Input Quiescent Current on VBAT	$V_{IN} = 0\text{ V}$; $V_{BAT} = 5\text{ V}$; Switch opened, only NTC detection enabled; $T_A = 50^\circ\text{C}$; without NTC resistor	-	2.1	-	μA
R_{ON_5V}	On Resistance	$V_{IN} = 5.0\text{ V}$; $I_{OUT} = 500\text{ mA}$; $T_A = 25^\circ\text{C}$	-	15	20	m Ω
R_{ON_24V}	On Resistance	$V_{IN} = 24\text{ V}$; $I_{OUT} = 500\text{ mA}$; $T_A = 25^\circ\text{C}$	-	15	20	m Ω
$R_{ON_5V_3.5A}$	On Resistance	$V_{IN} = 5.0\text{ V}$; $I_{OUT} = 3500\text{ mA}$; $T_A = 25^\circ\text{C}$ (Note 3)	-	15	20	m Ω
$R_{ON_24V_3.5A}$	On Resistance	$V_{IN} = 24\text{ V}$; $I_{OUT} = 3500\text{ mA}$; $T_A = 25^\circ\text{C}$ (Note 3)	-	15	20	m Ω
I_{INRUSH}	Current Level Limited when Start Up	$V_{IN} = 5\text{ V}$; $C_{OUT} = 1\text{ mF}$ (Note 3)	150	175	210	mA
		$V_{IN} = 20\text{ V}$; $C_{OUT} = 1\text{ mF}$ (Note 3)	180	220	265	mA
R_{DISC_VOUT}	Resistance for Active Discharge	$V_{BAT} = 5\text{ V}$, switch is off, $T_A = 25^\circ\text{C}$	230	300	400	Ω
R_{DISC_VIN}	Resistance for Active Discharge	$V_{BAT} = 5\text{ V}$, switch is off, $T_A = 25^\circ\text{C}$	8	10	12	k Ω

OVER TEMPERATURE (OT) PROTECTION

V_{LDO}	VLDO Output Voltage	$V_{BAT} = 2.7\text{ V}$, $I_{load} > 2\text{ mA}$	1.71	1.8	1.89	V
I_{LDO}	VLDO Output Current	$V_{BAT} = 2.7\text{ V}$, $V_{LDO} > 1.71\text{ V}$	2	-	-	mA
C_{VLDO}	VLDO Output Capacitance		0.047	-	0.47	μF
R_{DIS_VLDO}	Discharge Resistance when LDO is Disable	$V_{BAT} = 3.6\text{ V}$, $V_{LDO} = 1.8\text{ V}$	-	7.3	-	k Ω
OTP_TRIP_SYS	Thermal Trip System	With $R_{bias} = 10.5\text{ k}\ 1\%$, and NCP15WF104F03RC NTC resistor (Note 3)	-3	-	3	$^\circ\text{C}$
OTP_TRIP_IC	Thermal Trip IC		-0.8	-	0.8	$^\circ\text{C}$
T_HYS	Thermal Hysteresis	With $R_{bias} = 10.5\text{ k}\ 1\%$, and NCP15WF104F03RC NTC resistor (Note 3)	23	24	25	$^\circ\text{C}$
α_{TRIP} VREF_THERM		Internal reference for comparators used for temperature sensing.	0.495	0.500	0.505	V/V

FPF2266UCX

ELECTRICAL CHARACTERISTICS (continued)

(Typical values are $V_{IN}/V_{BAT} = 5\text{ V}$, $C_{OUT} = 100\ \mu\text{F}$ and $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
--------	-----------	-----------------	-----	-----	-----	------

OVER TEMPERATURE (OT) PROTECTION

$V_{REF_THERM_REL}$	Internal reference for comparators used for temperature sensing release		0.702	0.709	0.716	V/V
-----------------------	---	--	-------	-------	-------	-----

OVER VOLTAGE (OV) PROTECTION

V_{IH_OVP}	External / Internal OVP selection, Voltage Increasing, Logic High	High	0.3	-	-	V
V_{IL_OVP}	External / Internal OVP selection, Voltage Decreasing, Logic Low	Low	-	-	0.15	V
V_{offset_ovp}	Offset of OVP Comparator (Note 3)		-	2	25	mV
V_{REF_OVP}	Internal Reference Voltage of OVP Detection		1.17	1.19	1.21	V
V_{OVP_Trip}	Over-voltage Protection Threshold Accuracy	V_{IN} rising	-5	-	5	%
V_{OVP_hysis}	Over-voltage Protection Hysteresis	V_{IN} falling	-	100	-	mV
$V_{ovp_internal}$	Internal Fixed OVP Threshold (V_{IN} Rising)	V_{IN} rising	5.8	6	6.2	V
$V_{hysis_internal}$	Over-voltage Protection Hysteresis	V_{IN} falling	-	200	-	mV
T_{ovp}	Over-voltage Protection Response Time	$R_L = 10$, $C_L = 0\text{ F}$, time from $V_{IN} > V_{OVLO}$ to V_{OUT} start to drop down	-	100	-	ns
$T_{ovp_rec_}$	Over-voltage Protection Recover time	$R_L = 10$, $C_L = 0\text{ F}$, time from $V_{IN} < V_{OVLO}$ to $V_{OUT} = 0.1 \times V_{IN}$	-	30	-	ms
C_{OVP}	Capacitance on OVP Pin	OVP = 0.1 V, Freq. = 1 MHz, $T_A = 25^\circ\text{C}$ (Note 3)	-	5	6	pF
$V_{OUT_LEAKAGE_OVP}$	V_{OUT} Leakage Resistance when OVP Event Triggered	$V_{OUT} = 0\sim 20\text{ V}$, $T_A = -40 \sim 85^\circ\text{C}$	125	-	-	k Ω

OVER CURRENT PROTECTION (OCP)

I_{LIMIT}	Current Limit	$V_{IN} = 5\text{ V}$, $V_{OUT} - V_{IN} = 1\text{ V}$, $R_{SET} = 288\ \Omega$, $T_A = 25^\circ\text{C}$	1.8	2	2.2	A
T_{ocp_deb}	OCP Debounce Time	Moderate Over-Current Condition, $I_{OUT} \geq I_{LIM}$; $V_{OUT} \leq V_{IN} - 1$	-	100	-	ms

BROWNOUT DETECTION (BO)

V_{REF_BO}		$V_{IN} = 3.6\text{ V}\sim 24\text{ V}$, BO Falling	1.17	1.19	1.21	V
V_{hysis_BO}	BO Detection Hysteresis	BO Rising	-	100	-	mV
V_{BO}	Brownout (BO) Trip Point Accuracy	$V_{IN} = 3.6\text{ V}\sim 24\text{ V}$	-5	-	5	%
V_{offset_BO}	Offset of Comparator for BO Detection (Note 3)		-	-1.5	-	mV
$T_{d_bo_rec}$	Brownout Recovery Delay	$V_{IN} = 5\text{ V}$, from BO rising over V_{hysis_BO} to 10% V_{OUT} rising	-	500	-	ms

THERMAL SHUTDOWN (TSD)

TSD_Trip	Trip Point	Thermal shut down threshold	-	135	-	$^\circ\text{C}$
TSD_Hys	Hysteresis	Thermal shut down hysteresis	-	25	-	$^\circ\text{C}$

BASIC OPERATION

R_{pd}	Pull Down Resistance of BATT_SHDN	$V_{IN} = 5.5\text{ V}$, $T_A = -40$ to 85°C , $I_{FORCE} > 15\text{ mA}$	-	15	30	Ω
----------	-----------------------------------	--	---	----	----	----------

FPF2266UCX

ELECTRICAL CHARACTERISTICS (continued)

(Typical values are $V_{IN}/V_{BAT} = 5\text{ V}$, $C_{OUT} = 100\ \mu\text{F}$ and $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
BASIC OPERATION						
$I_{IN_BATT_SHDN}$	BATT_SHDN Output HIGH-Z Leakage Current	BATT_SHDN = 0 to 5.5 V	-1	-	1	μA
$V_{switchover}$	Threshold of Power Switch to VBAT	V_{IN} Falling	2.7	3	3.3	V
$V_{hys_switchover}$	Hysteresis Voltage of Switch over to VBAT	V_{IN} Rising	0.45	0.6	0.7	V
$V_{OH_ALERT/KILL}$	Output Logic High Voltage	$V_{BAT} = 2.7\text{ V to }5.5\text{ V}$, $I_o = -2\text{ mA}$	1.5	1.7	1.95	V
$V_{IL_ALERT/KILL}$	Input Logic Low Voltage	$V_{BAT} = 2.7\text{ V to }5.5\text{ V}$	-	-	0.5	V
$V_{IH_ALERT/KILL}$	Input Logic High Voltage	$V_{BAT} = 2.7\text{ V to }5.5\text{ V}$	1.3	-	-	V
$R_{pd_ALERT/KILL}$	Weak Pulldown Resistance	$V_{BAT} = 2.7\text{ V to }5.5\text{ V}$	100	230	350	$\text{k}\Omega$

DYNAMIC PARAMETERS

T_{d_on}	Turn On Delay	$V_{IN} = 5\text{ V}$, $R_L = 100\text{ W}$, $C_L = 100\ \mu\text{F}$, $T_A = 25^\circ\text{C}$, from V_{IN} valid to V_{OUT} start to ramp up (Note 3)	15	20	25	ms
T_{d_alert}	Delay Time between ALERT and BATT_SHDN	From 90% ALERT rising to 90% BATT_SHDN falling (Note 3)	400	500	600	ms
T_{d_kill}	Delay Time between KILL and BATT_SHDN	From 90% KILL rising to 90% BATT_SHDN falling (Note 3)	800	1000	1200	ms
T_{rel_deb}	Thermal Release Debounce Time		-	50	-	ms
T_{NTC_SAMPLE}	NTC Checking Period	(Note 3)	-	2.5	5	s
T_{NTC_ON}	VLDO On Time		-	5	-	ms
T_{NTC_SETTLE}	Settle Down Time before ADC Sampling		-	1.6	-	ms
$Duty_NTC_DET$	Duty Cycle of NTC Detection by $T_{NTC_ON}/T_{NTC_SAMPLE}$	(Note 3)	-	0.2	0.25	%

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

3. Guaranteed by design. Characterized on the Bench.

TYPICAL CHARACTERISTICS

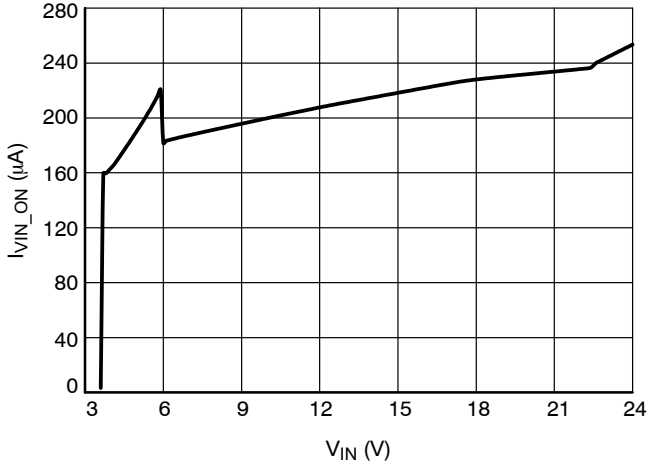


Figure 5. I_{VIN_ON} vs. V_{IN} @ 25°C

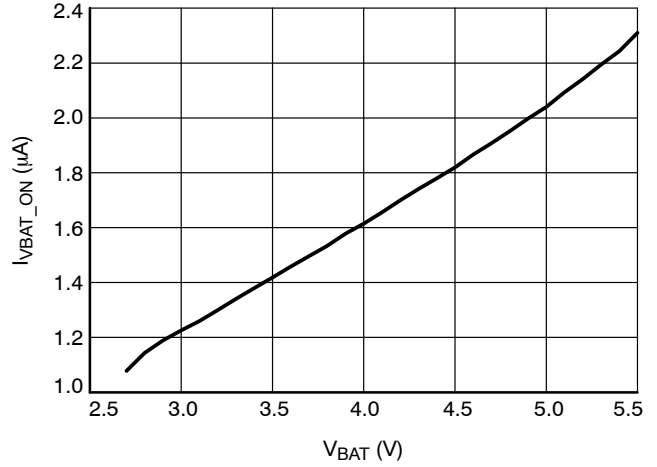


Figure 6. I_{VBAT_ON} vs. V_{BAT} @ 25°C

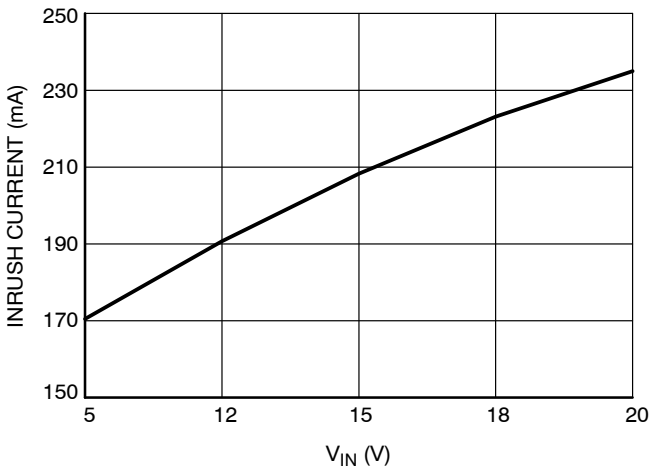


Figure 7. Inrush Current vs. V_{IN} for $C_{LOAD} = 1000 \mu F$ @ 25°C

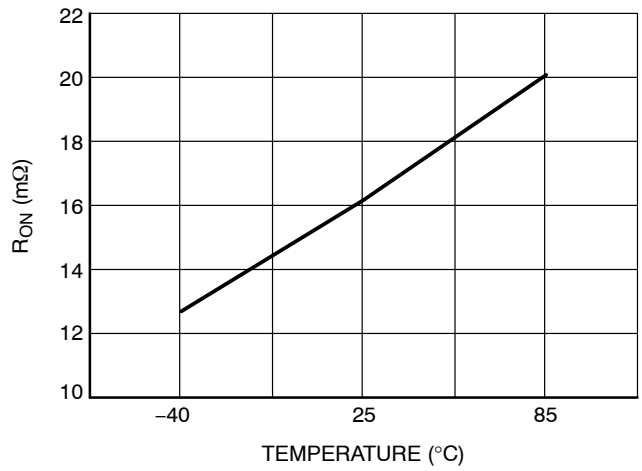


Figure 8. R_{ON} vs. Temperature @ $I_{LOAD} = 1 A$

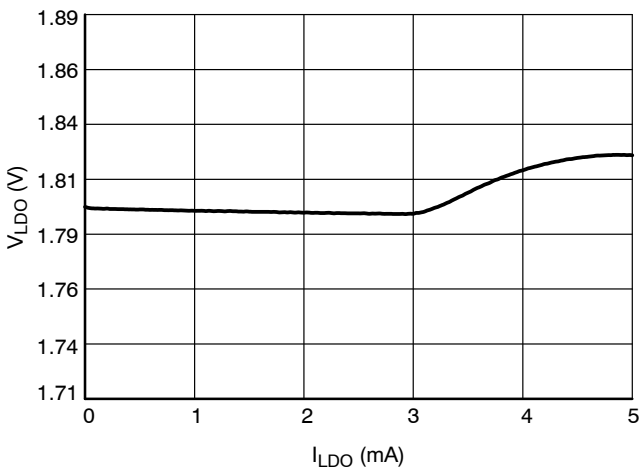


Figure 9. LDO vs. Load Current @ 25°C
 $V_{IN} = 0 V, V_{BAT} = 2.7 V$

TYPICAL CHARACTERISTICS

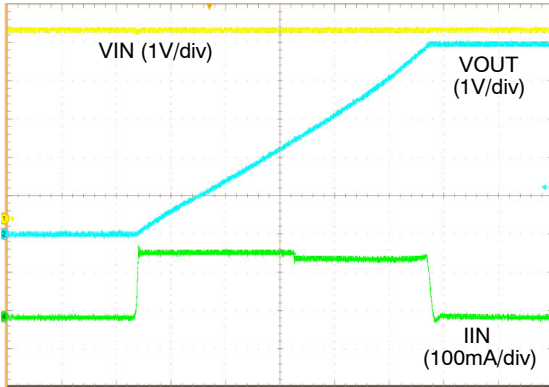


Figure 10. Start-up Test @25°C $V_{IN} = 5\text{ V}$, $C_{Load} = 100\ \mu\text{F}$, CH1:VIN, CH2:VOUT,CH4:IIN

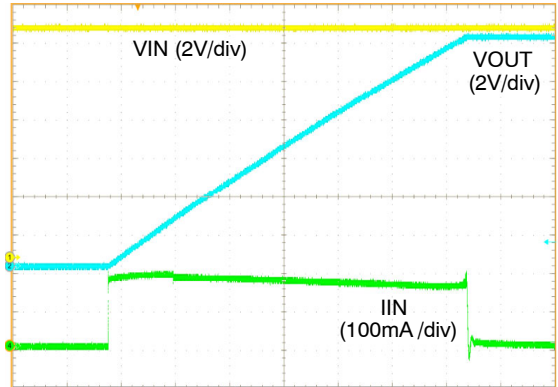


Figure 11. Start-up Test @25°C $V_{IN} = 12\text{ V}$, $C_{Load} = 1000\ \mu\text{F}$, CH1:VIN, CH2:VOUT,CH4:IIN

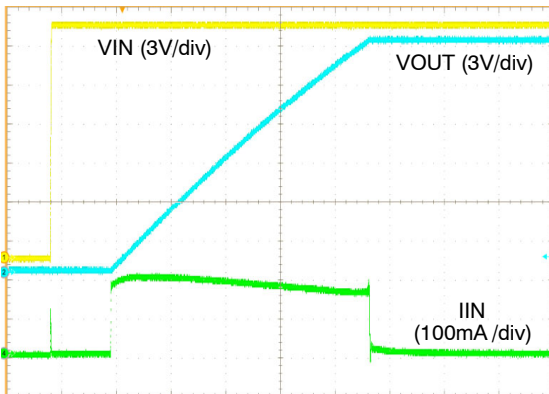


Figure 12. Start-up Test @25°C $V_{IN} = 18\text{ V}$, $C_{Load} = 1000\ \mu\text{F}$, CH1:VIN, CH2:VOUT,CH4:IIN

FPF2266UCX

Power On/Off

FPF2266 control block can sink power from both VBAT and VIN through internal power mux. Once VIN is valid which means higher than Vswitchover + Vhys_switchover, then 20 ms turn on delay will be started, and if no fault

(including OV/OT/BO events) being detected after 20 ms delay, then switch will be closed automatically (OV/OT/BO event was masked during this 20ms delay), and inrush current will be limited to a fixed level to avoid any potential damage. The internal VLDO is powered by power mux.

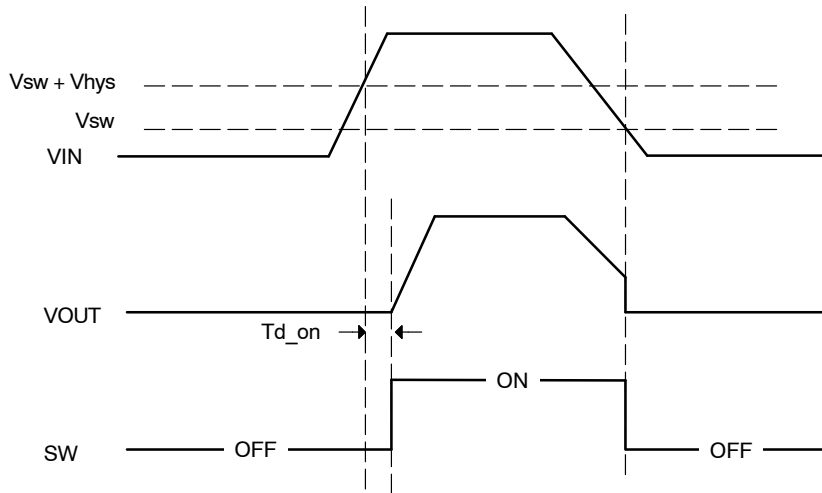


Figure 13. VIN to VOUT Power Up/Down

Brownout Detection

Brownout event is sensed via an external resistor divider connected between VIN and GND and compared with an internal reference (VREF_BO). Brownout trip point is set by selecting resistor ratio with respect to VREF_BO. When a brownout event is detected, internal switch is turned OFF and Auto discharge enabled. After brownout event is

removed and discharge disabled (rises above internal hysteresis threshold), there is a delay before internal switch is turned on for recover. The Td_bo_rec will be applied at both normal mode and Vin power up stage.

$$VIN < \left(1 + \frac{R_{BO1}}{R_{BO2}}\right) V_{REF_BO} \text{ (trip)} \quad (\text{eq. 1})$$

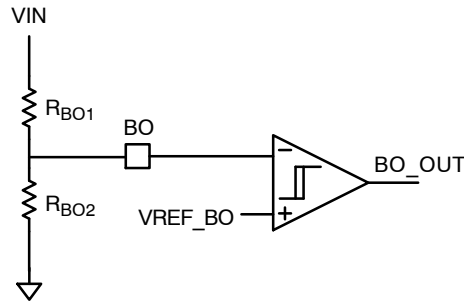


Figure 14. Brownout Detection

FPF2266UCX

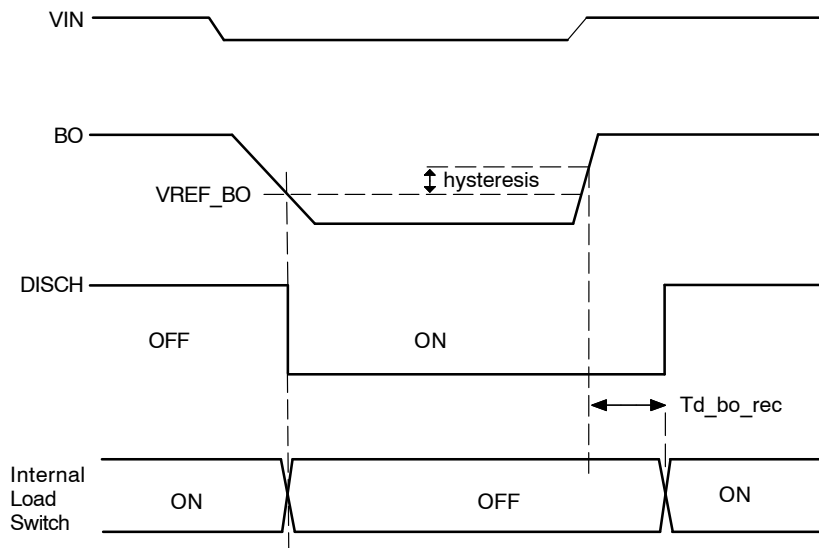


Figure 15. Brownout Detection in Normal Mode

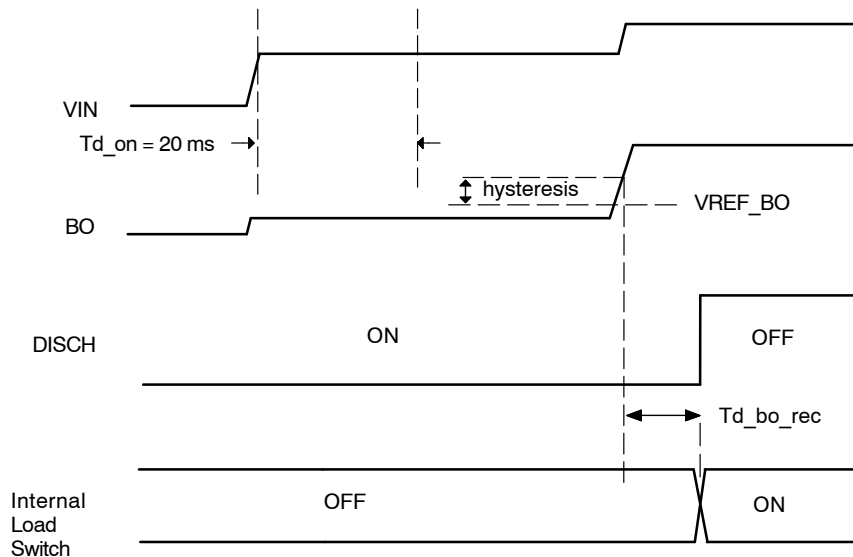


Figure 16. Brownout Detection in VIN Power Up

Active Discharge on VIN/VOUT

Internal resistive discharge path from VOUT/VIN to GND is enabled when internal switch is turned off for all fault conditions except OVP, TSD and Short Protection. Discharge path should be enabled for BO and OT, KILL events. Additional discharge resistance on Vin needs to be enabled as well when discharge on VOUT is enabled. Also enabled when power MUX selects VBAT and $V_{IN} < V_{phys_switchover}$ (VIN rising).

Power MUX Function

For USB/battery configuration, a power MUX is used to select between 2 inputs: VIN and battery source (VBAT).

Priority is given to VIN when it is above a certain threshold ($V_{switchover}$). If VIN is not present or falls below a certain threshold, then priority is given back to VBAT input and Kill latch need to be reset by $V_{switchover}$.

Internal blocks to drive internal switch, support in-rush control, brownout detector, and OVP/OCP function are powered only from VIN. All other features such as over temperature protection and logic are powered from power MUX.

FPF2266UCX

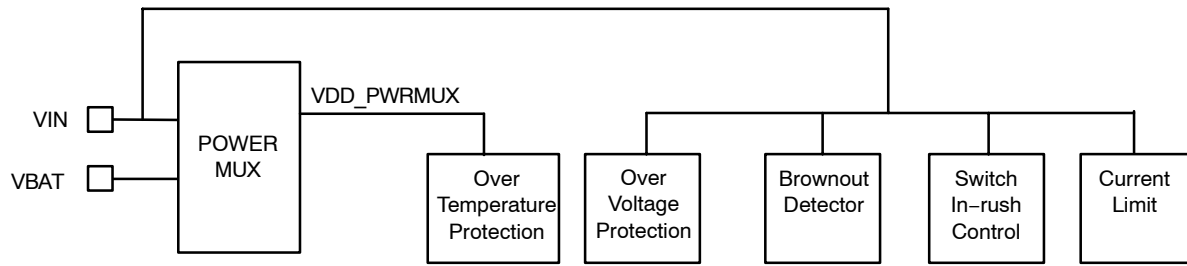


Figure 17. Power Mux Function

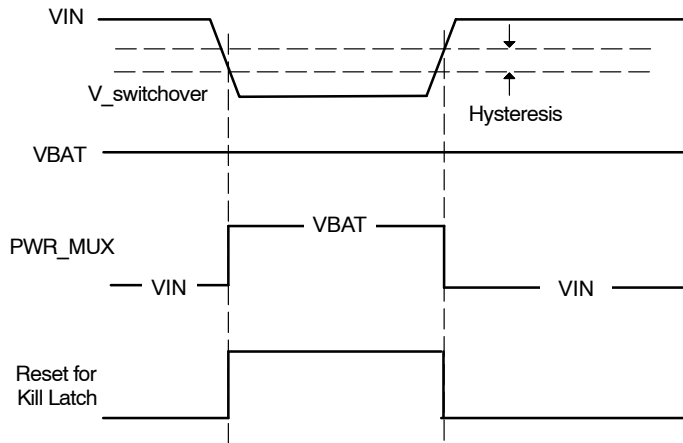


Figure 18. Power Mux Switch Over and Kill Reset

KILL Function

KILL signal is from an external source such as a SOC or MCU. When KILL signal is asserted HIGH by SOC internal switch is turned OFF after some delay.

1. *VIN Applied (VBAT may or may not be applied)*
 - a. Condition is latched after some debounce time, internal switch is turned off and BATT_SHDN is pulled low.

b. Because of latching condition, it requires VIN to be power cycled to reset/clear latch in AC/DC adapter systems. For USB/battery configuration, latch should be cleared after unplugging and re-plugging USB adapter.

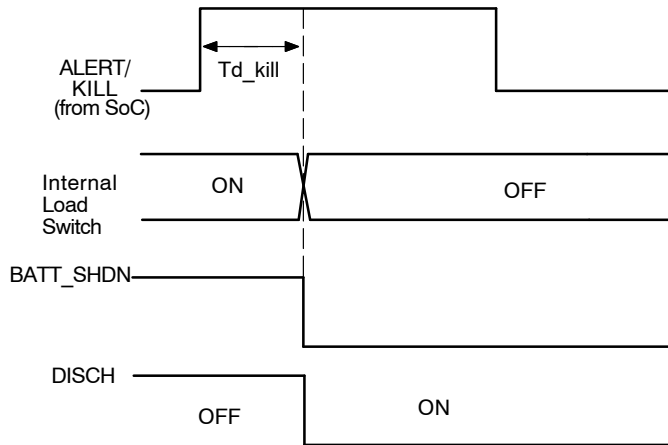


Figure 19. KILL Function Timing Diagram

For Vswitchover behavior with/without Kill latch in detail, please refer to below diagram:

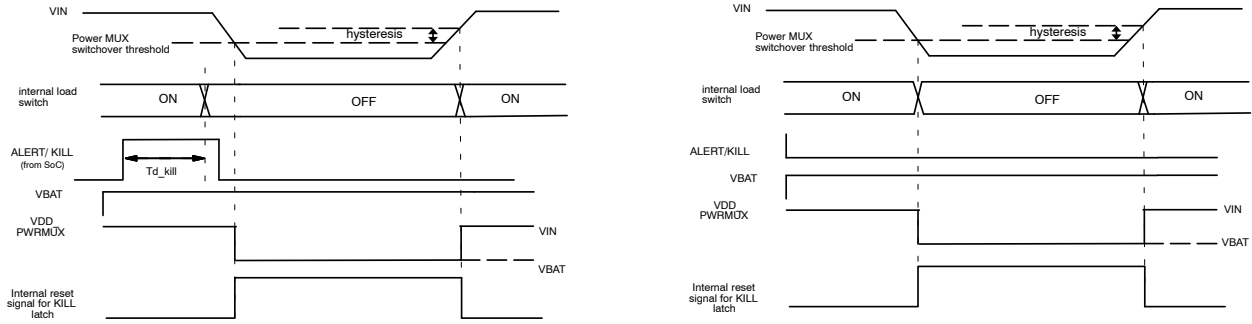


Figure 20. Vswitchover Behavior with/without Kill Latch in Detail

2. Only VBAT is present

a. Condition is NOT latched after some debounce time (T_{d_kill}), and after debounce time, internal switch is turned OFF and BATT_SHDN goes LOW.

b. If KILL signal from SOC goes LOW, BATT_SHDN goes HIZ (pulled up by external resistor).

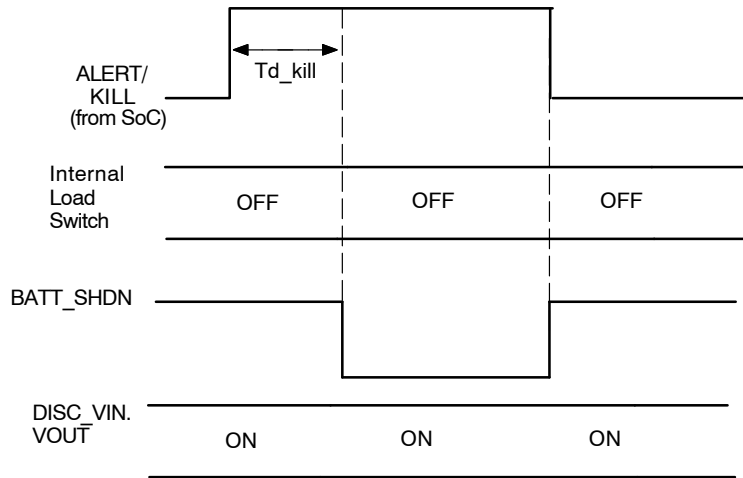


Figure 21. KILL Function Timing Diagram When VBAT is Present

Battery Disconnection (USB/Battery Configuration)

For over temperature condition or KILL signal, BATT_SHDN sends signal to battery PIC to disconnect battery.

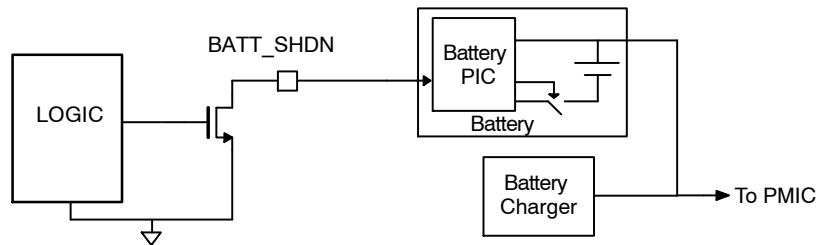


Figure 22. Battery Disconnect Diagram

FPF2266UCX

Over Temperature Protection (OTP)

When an over temperature condition is detected by any of NTC channel, ALERT/KILL is pulled HIGH alerting SOC that a temperature fault condition has occurred. After Td_alert from ALERT/KILL goes HIGH and if over temperature condition is still present, internal switch is

turned OFF and BATT_SHDN is pulled LOW. Once temperature fault is no longer present, internal switch shall be turned ON and BATT_SHDN output is goes to High-Z and pulled HIGH by external source with minimal delay. Also, for OT behavior under power up stage, please refer to below diagram.

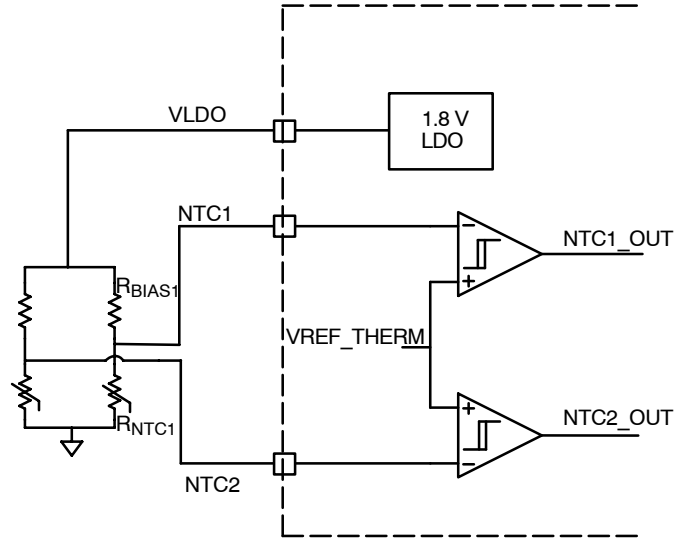


Figure 23. Over Temperature Detection Diagram

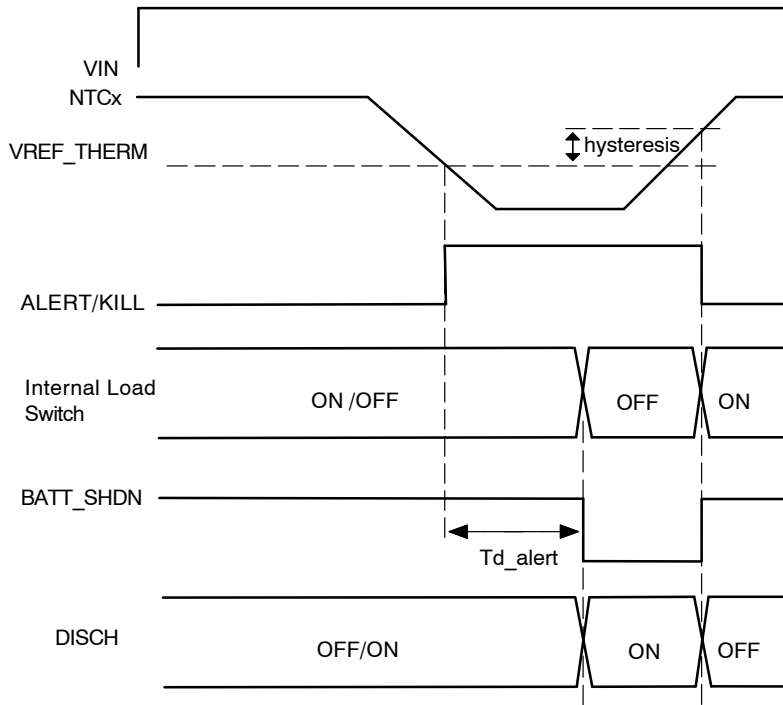


Figure 24. Over Temperature Detection Flow in Normal Case

FPF2266UCX

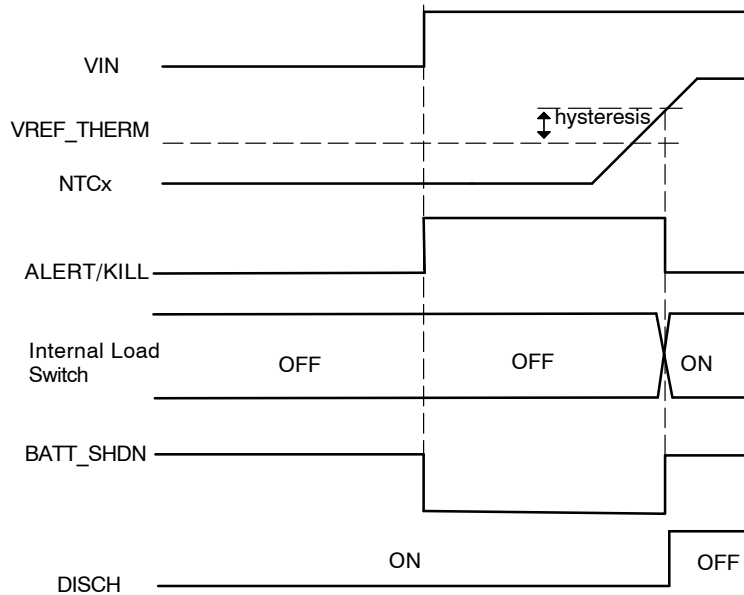


Figure 25. Over Temperature Detection Flow in Power Up Stage

Thermal Shut Down (TSD)

To protect the device from over temperature, the power switch turns OFF immediately when the junction

temperature exceeds TSD and no need to enable VIN/VOUT discharge, the device can be only re-enabled with a delay once temperature drop down below threshold.

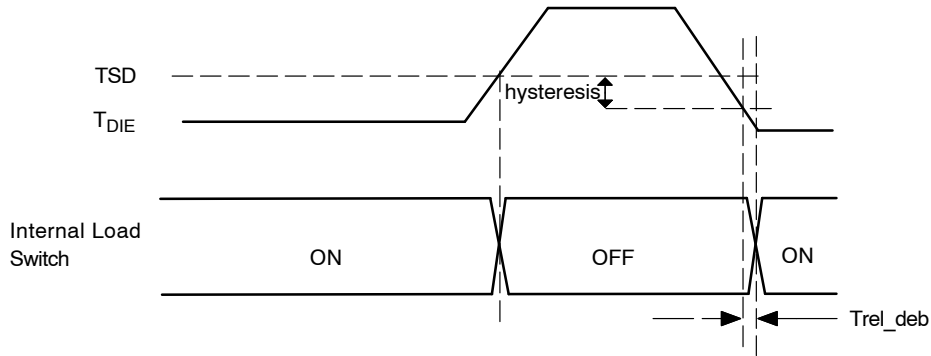


Figure 26. Thermal Shut Down and Timing Diagram

Over-voltage Protection (OVP)

Over-voltage (OV) condition can be sensed via an external resistor divider connected between VIN and GND and compared with an internal reference (VREF_OVP), or via an internally fixed threshold. Internal fixed OV threshold is selected by tying OVP pin to GND. External OV trip point is set by selecting resistor ratio with respect to

VREF_OVP. When an OV condition is detected, internal switch is turned OFF in less than 100 ns. After OV condition is removed (falls below internal hysteresis threshold), there is a delay before internal switch is turned ON, VIN/VOUT discharge resistor keep off during OVP event.

$$VIN > \left(1 + \frac{R_{ov1}}{R_{ov2}}\right) V_{REF_OVP} \text{ (trip)} \quad (\text{eq. 2})$$

FPF2266UCX

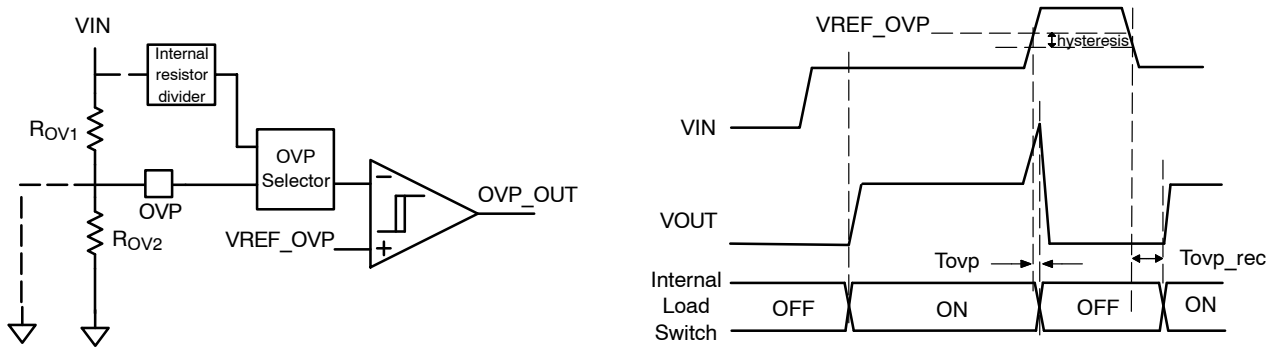


Figure 27. Over Voltage Detection and Timing Diagram

NTC Detection

For achieving low standby current, once power mux switch to VBAT, FPF2266 will start to toggle VLDO output which used as power source of NTC and bias resistor ON and OFF with a fixed period $T_NTC_SAMPLE = 2.5\text{ s}$ and

$T_NTC_ON = 5\text{ ms}$ on time, also internal comparator will sample the voltage level of Pin NTC1/2 after $T_NTC_SETTLE = 1.6\text{ ms}$ settle timer. If power mux was powered by VIN, then no need to toggle VLDO.

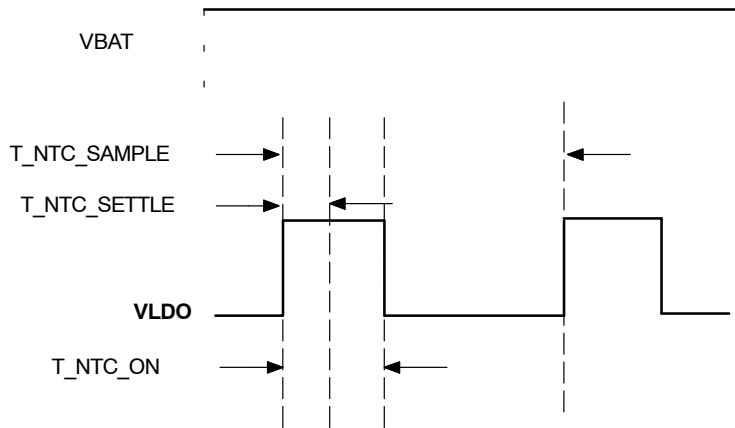


Figure 28. NTC Sample Timing (VBAT Only)

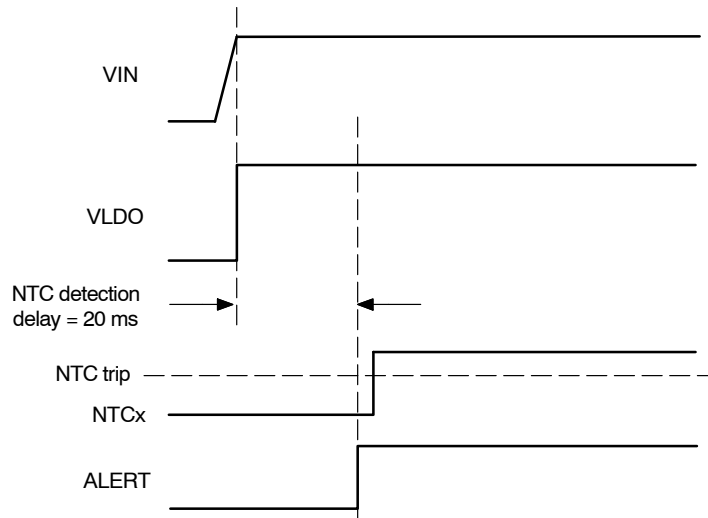


Figure 29. NTC Sample Timing (VIN Power Up)

FPF2266UCX

Over Current Protection (OCP)

The current limit ensures that the current through the switch does not exceed the maximum setting value, while not limit the minimum value. The current at which the part's limit is adjustable through the selection of the external resistor connected to the ILIM pin. The device acts as a constant-current source when the load draws more than

the maximum value set by the device until thermal shutdown occurs. The device recovers if the die temperature drops below the threshold temperature. The current limit is set with an external resistor connected between the ILIM and GND pins. The resistor is selected using the formula:

$$\text{Typ ILIM} = \frac{576}{\text{RSET}} \quad (\text{eq. 3})$$

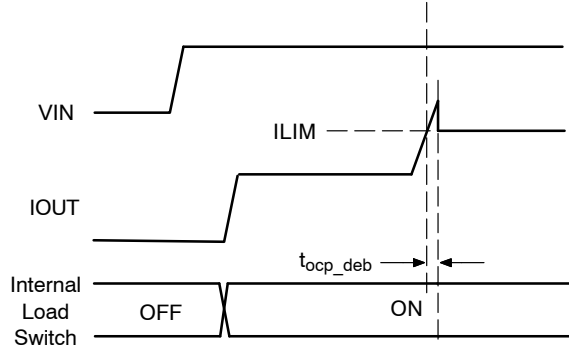


Figure 30. OCP Timing

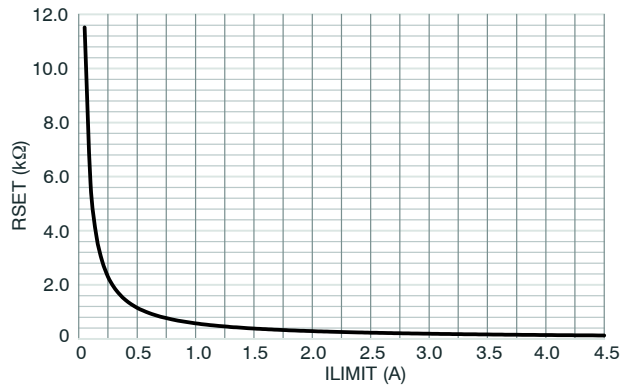


Figure 31. Current Limit Settings by RSET (Note 4)

4. Values based on 1% tolerance resistor.

Soft-Start and Inrush Current Limitation

FPF2266 integrates inrush current control block to control the inrush current might happens during VOUT start up with up to 2.2 mF COUT, also FPF2266 will clamp the inrush

current to around the 175 mA typical during soft start active period, until the thermal shutdown happens and switch open, once the temperature back to normal condition, then switch will be enabled again.

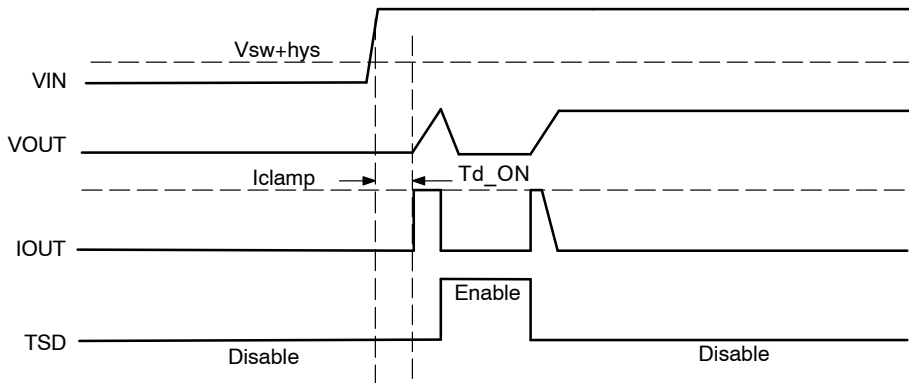


Figure 32. Inrush Control

Hard Short Protection

FPF2266 implements hard short protection feature in case of any short event happens after switch closed. Once the VOUT drops below 2.35 V at this condition, the hard short protection will be active and internal switch will be opened in less than 5 μ s. It will release and take another try to close

back switch after 30 ms delay, if the short still present, then inrush protection will be triggered, and inrush current will be limited to a safe level. Please note External TVS at VIN is recommended to prevent the VIN overshoot caused by parasitic inductance on the power line.

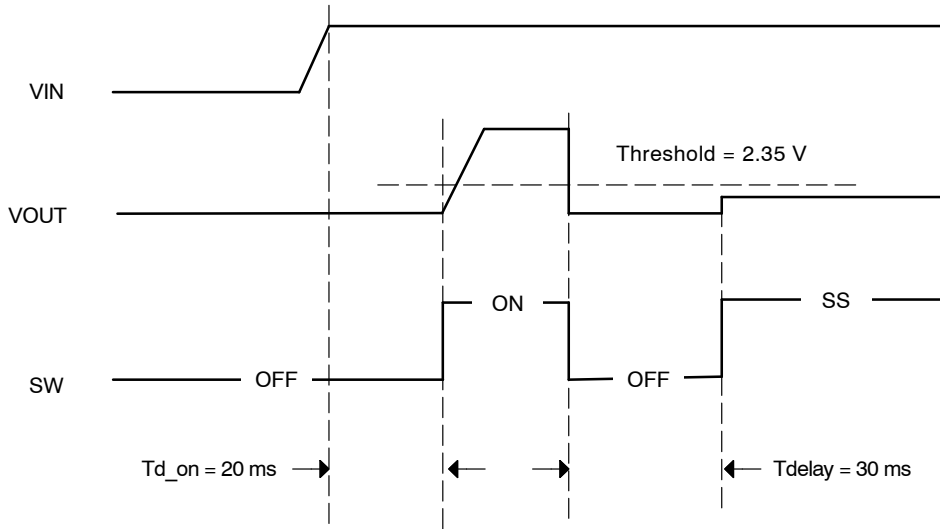


Figure 33. Hard Short Protection Flow

Component Selection:

1. Resistors being used for OVP / BO / NTC event detection is recommended to select $\pm 1\%$ accuracy for better performance.
2. The minimum of Input decoupling cap (Cin) and output decoupling cap (Cout) can be 0.57 μ F and 0.1 μ F if OCP (over current protection) is disabled

in particular application to guarantee normal functionality. For regular application, no lower than 1 μ F and 10 μ F is recommended, all caps will be good to go with 50 V rating voltage to minimize impact for capacitance from bias voltage.

FPF226UCX

Working Flow

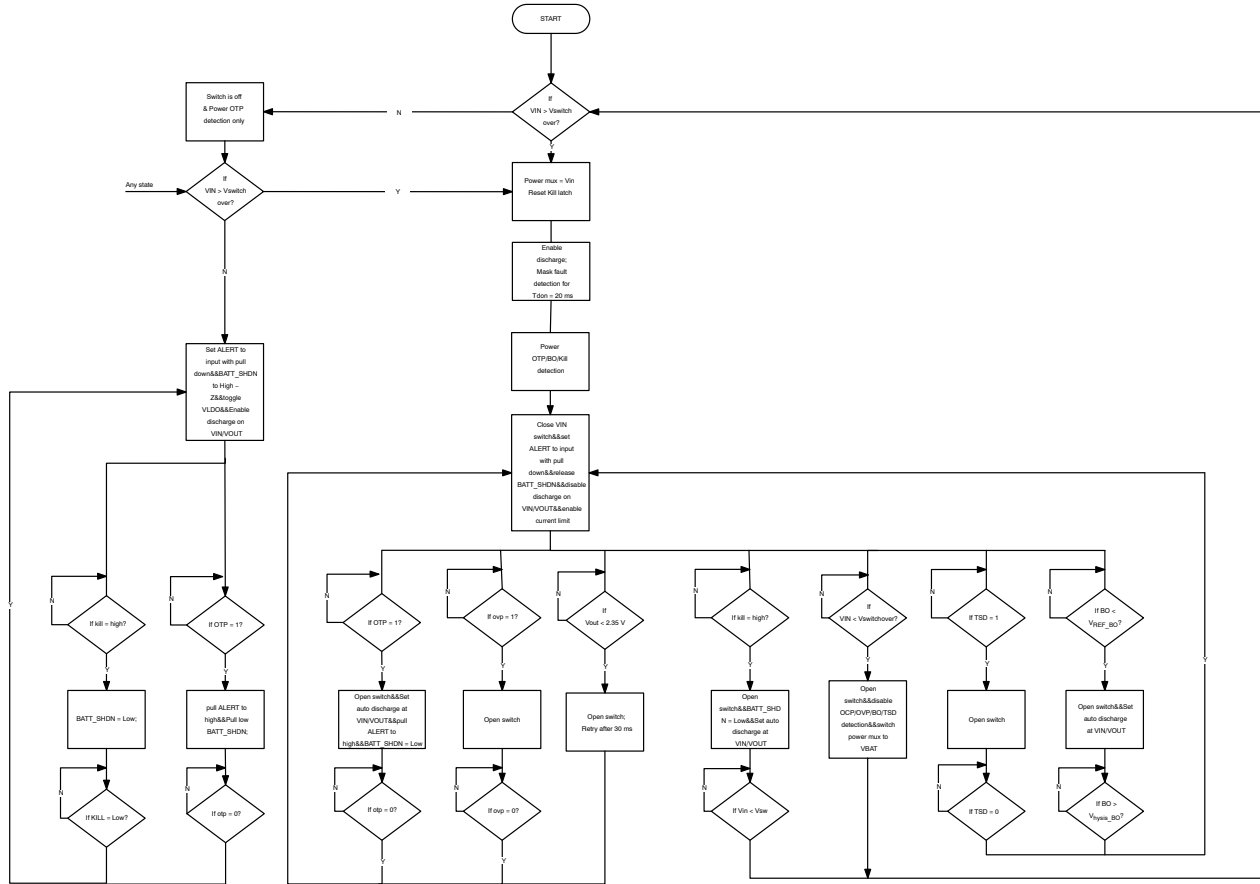
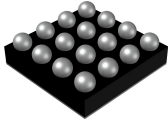


Figure 34. Working Flow

ORDERING INFORMATION

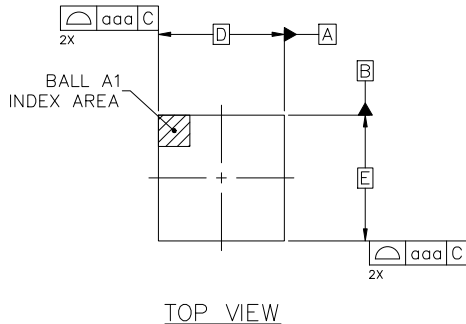
Part Number	Marking	Operating Temperature Range	Package	Shipping [†]
FPF226UCX	26	-40°C to +85°C	WLCSP16 (4×4 – 16 Balls) (Pb-Free)	3,000 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](#).

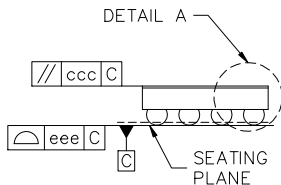


WLCSP16 1.56x1.56x0.29, 0.40P
CASE 567UX
ISSUE A

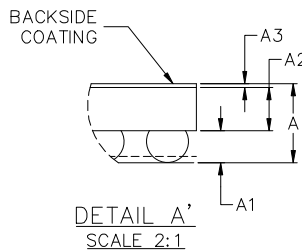
DATE 31 MAY 2024



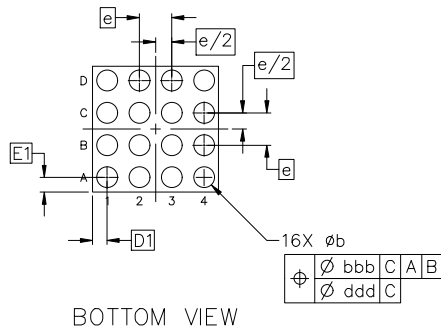
TOP VIEW



SIDE VIEW



DETAIL A'
SCALE 2:1

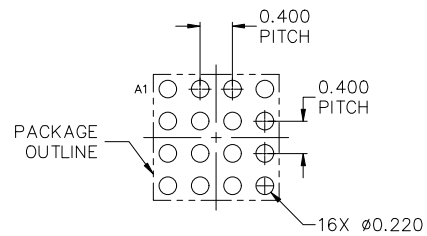


BOTTOM VIEW

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5M-2018.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER PARALLEL TO DATUM C.
4. COPLANARITY APPLIES TO THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. DATUM C, THE SEATING PLANE IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.452	0.490	0.528
A1	0.178	0.198	0.218
A2	0.252	0.267	0.282
A3	0.022	0.025	0.028
b	0.240	0.260	0.280
D	1.560 BSC		
D1	0.180 BSC		
E	1.560 BSC		
E1	0.180 BSC		
e	0.400 BSC		
TOLERANCES OF FORM AND POSITION			
aaa	0.030		
bbb	0.050		
ccc	0.050		
ddd	0.030		
eee	0.050		



RECOMMENDED MOUNTING FOOTPRINT*

*FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



XXXX = Specific Device Code
A = Assembly Location
YY = Year
WW = Work Week

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	98AON87373G	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	WLCSP16 1.56x1.56x0.29, 0.40P	PAGE 1 OF 1

onsemi and ONSEMI are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales