ULTRA- LOW ON RESISTANCE, 4A LOAD SWITCH WITH CONTROLLED TURN-ON

FEATURES

- Integrated 4A Single Channel Load Switch
- Input Voltage Range: 0.8V to 5.5V
- Low Threshold Control Input
- Quick Output Discharge Transistor
- Over-Temperature Protection
- Over Current Protection
- Short Circuit Protection
- Open-Drain Fault Flag Output
- Ultra-low ON-Resistance R_{ON} = 7.7mΩ
- Halogen Free Product

APPLICATIONS

- Telecom Systems
- Industrial Systems
- Consumer Electronics
- Notebooks / Netbooks

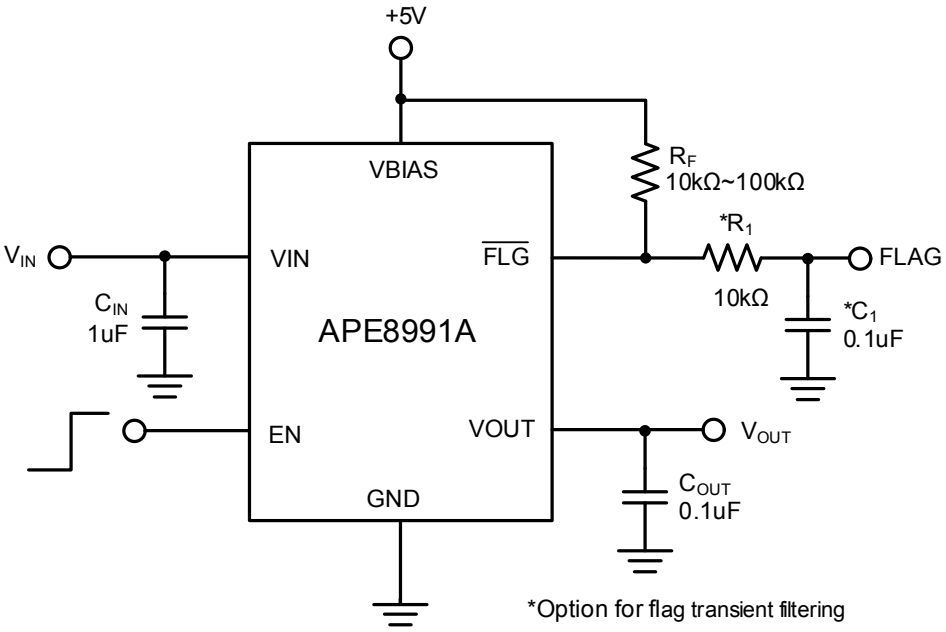
DESCRIPTION

The APE8991A is a small, ultra-low R_{ON} load switch with controlled turn on. It contains one N-channel MOSFET that can operate over an input voltage range of 0.8V to 5.5V and support maximum continuous current up to 4A. The switch is controlled by an on/off input (EN), which is capable of interfacing directly with low-voltage control signals.

Additional features include a 330Ω on-chip load resistor is added for output quick discharge when switch is turned off. A well protection is equipped when the device enters hard short circuit and thermal shutdown.

The APE8991A is available in 8-pin DFN 3x3-8L package with smallest components.

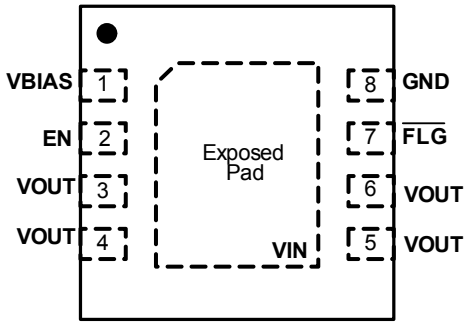
TYPICAL APPLICATION



ORDERING / PACKAGE INFORMATION

APE8991AX
Package Type
GN3: DFN 3x3-8L

Top View
DFN 3x3-8L



ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

VIN	-0.3V to 6V
VOUT	VIN+0.3V
EN, /FLG	-0.3V to 6V
VBIAS	-0.3 to 6V
Storage Temperature Range (T_{ST})	-65 to +150°C
Junction Temperature (T_J)	150°C
Lead Temperature (Soldering, 10sec.)	260°C
Thermal Resistance from Junction to Ambient ($R\theta_{JA}$)	
DFN 3x3-8L	43°C/W

RECOMMENDED OPERATING CONDITIONS

VIN	0.8V to 5.5V
VBIAS	4.5V to 5.5V (VBIAS≧VIN)
VOUT	V_{IN}
CIN	≧0.1uF
Junction Temperature (T_J)	125°C
Operating Temperature Range (T_A)	-40°C to 85°C

ELECTRICAL SPECIFICATIONS

(V_{IN}=0.8V to 5.5V, V_{BIAS}=5V, C_{IN}=1uF, C_{OUT}=0.1uF, T_A =25°C, unless otherwise specified)

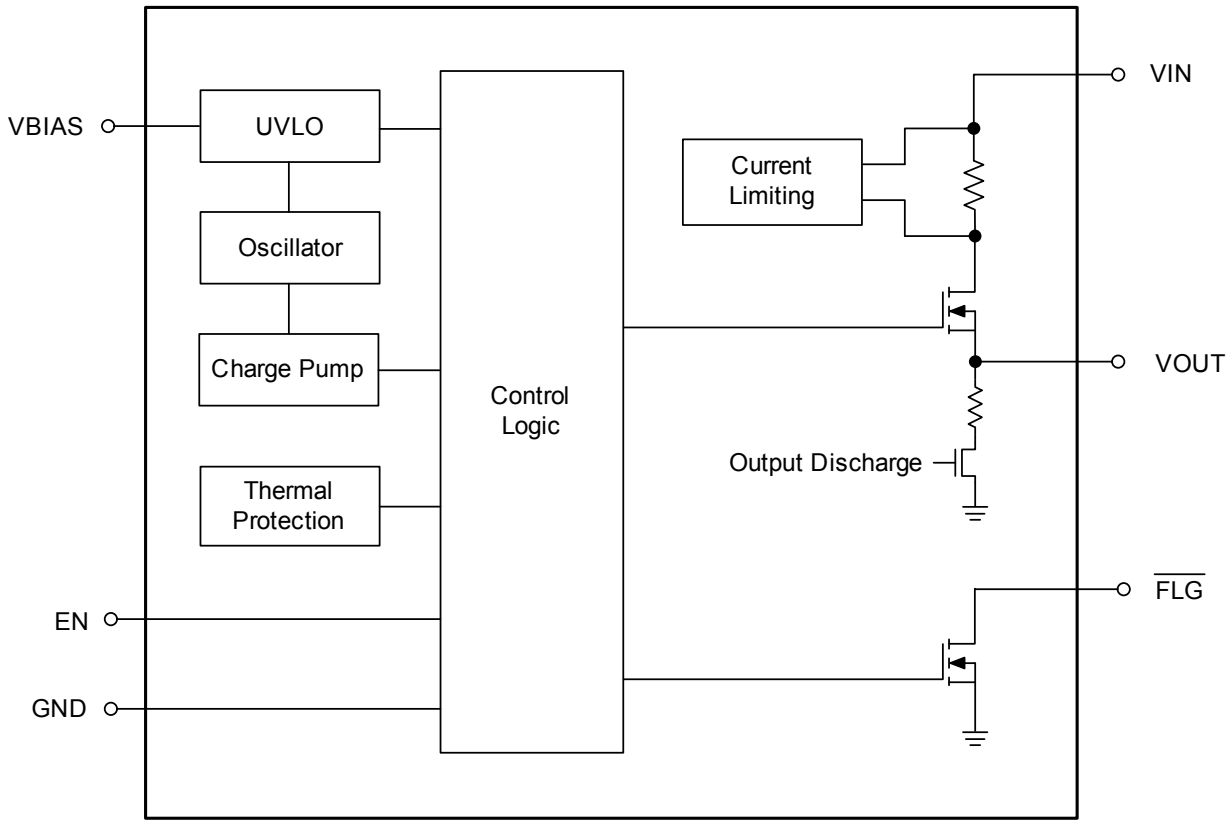
PARAMETER	SYM	TEST CONDITION	MIN	TYP	MAX	UNIT
Quiescent Current	I_{BIAS}	V_{BIAS}=V_{EN}=5V, I_{OUT}=0A		30	50	uA
Shutdown Current	I_{SD}	V_{EN}=GND			1	uA
Under-Voltage Lockout	V_{UVLO}	Threshold	3.2	3.6	4.0	V
	V_{HYS}	Hysteresis		0.4		V
Switch ON Resistance	R_{ON}	V_{EN}=V_{BIAS}, I_{OUT}=200mA		7.7	9.6	mΩ
Current Limit Threshold	I_{LM}		5			A
Soft-Start Time (Note1)	t_{SS}	V_{IN}=5V		6		ms
Output Pull-Down Resistance	R_{OPD}	V_{IN}=5V, V_{EN}=0V		330	400	Ω
FLAG Delay Time (Note1)	t_{DELAY}	from fault condition to FLAG assert		3		ms
FLAG ON Resistance	R_{FLG}			20	50	Ω
EN Input Leakage Current	I_{EN}	V_{EN}=5V or GND			1	uA
EN Threshold	V_{IH}	on	1.6			V
	V_{IL}	off			0.6	V
Thermal Shutdown Threshold (Note1)	T_{SD}			140		°C
		Hysteresis		30		°C

Note1: Guarantee by design, not production tested.

PIN DESCRIPTIONS

PIN No.	PIN SYMBOL	PIN DESCRIPTION
1	VBIAS	Bias Voltage
2	EN	Switch control input, active high. Do not leave floating.
3,4,5,6	VOUT	Switch output
7	/FLG	Open-drain fault flag output
8	GND	Ground
Exposed pad	VIN	Input Power Supply

BLOCK DIAGRAM



TYPICAL PERFORMANCE CHARACTERISTICS

VBIAS=5V, Iout=3A, Cin=1uF, Cout=0.1uF, ch1: V_{EN}, ch2: FLAG, ch3: V_{OUT}, ch4:I_{IN}

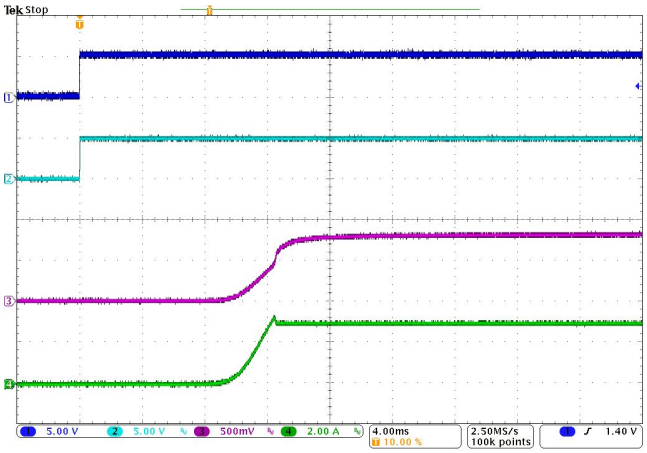


Fig1 VIN=0.8V

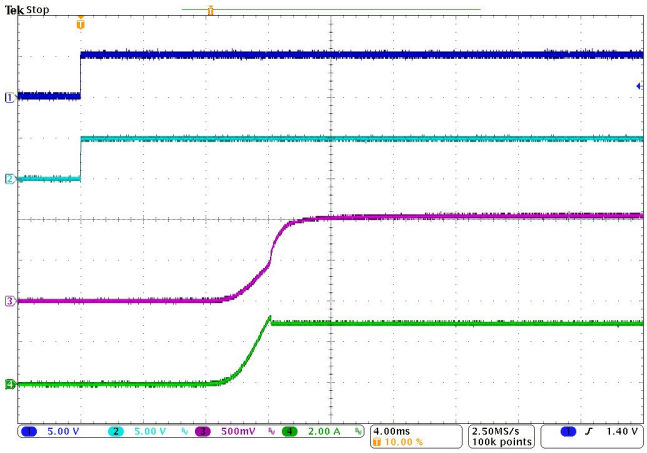


Fig2 VIN=1.2V

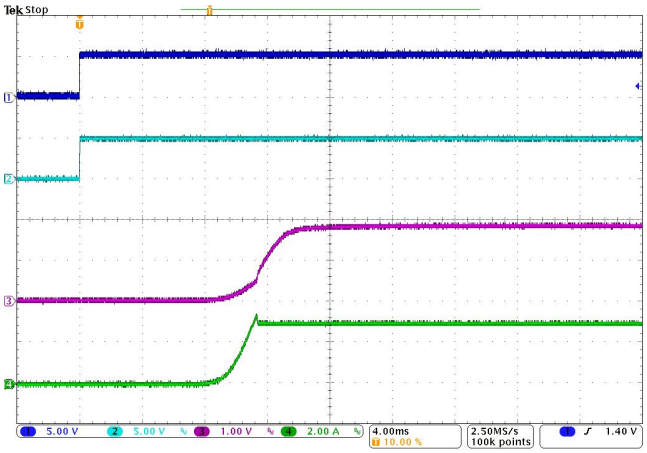


Fig3 VIN=1.8V

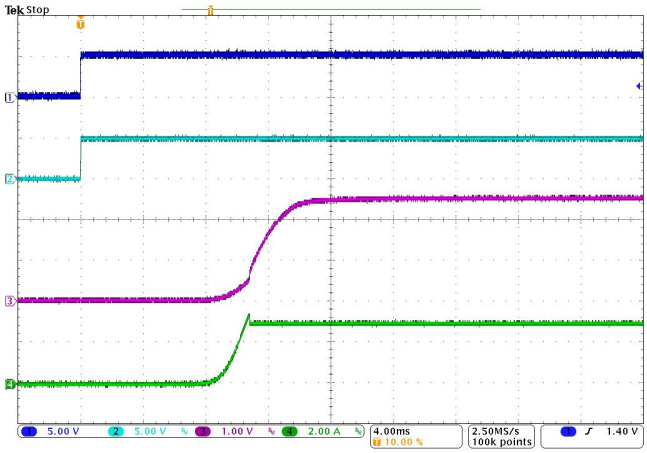


Fig4 VIN=2.5V

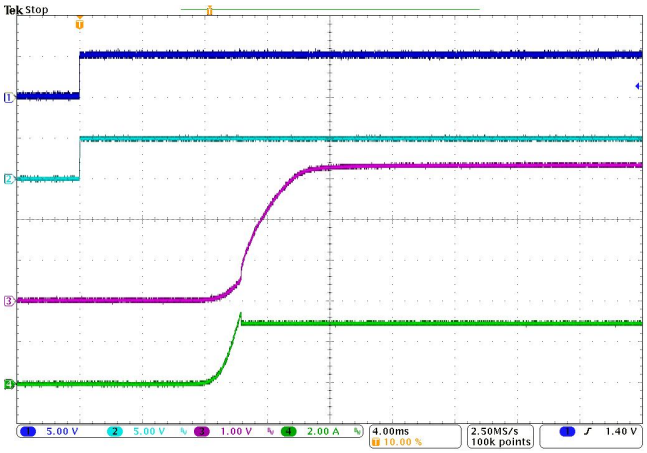


Fig5 VIN=3.3V

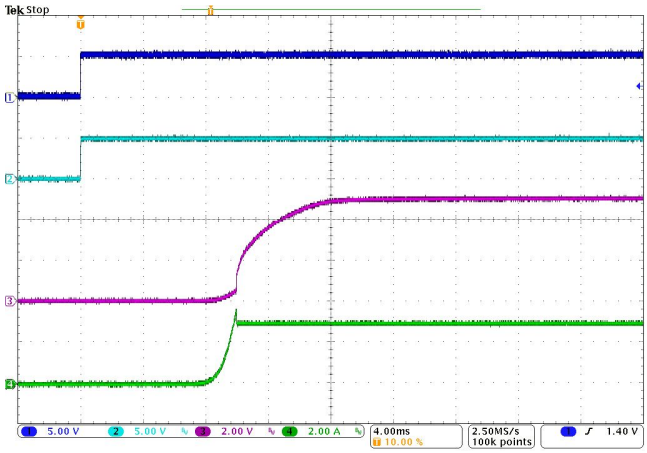


Fig6 VIN=5V

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

VBIAS=5V, Iout=3A, Cin=1uF, Cout=0.1uF, ch1: V_{EN}, ch2: FLAG, ch3: V_{OUT}, ch4:I_{IN}

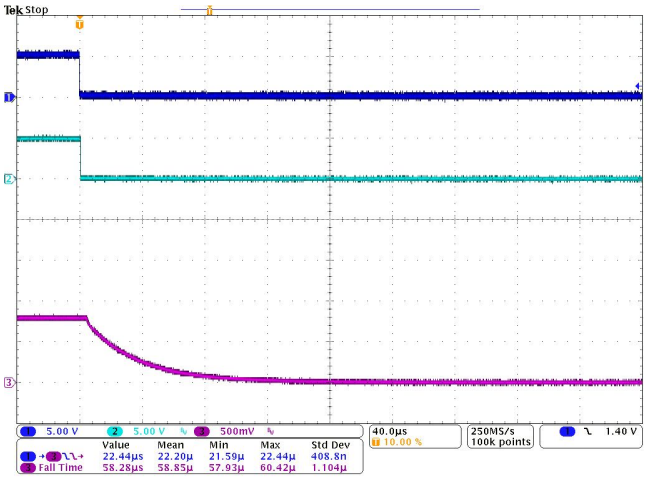


Fig7 VIN=0.8V

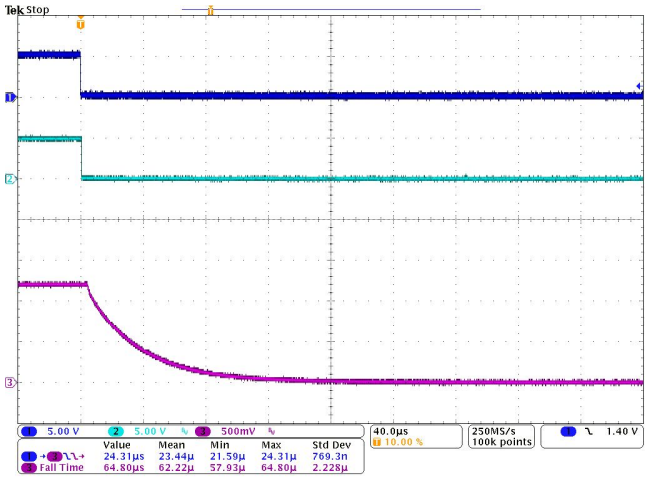


Fig8 VIN=1.2V

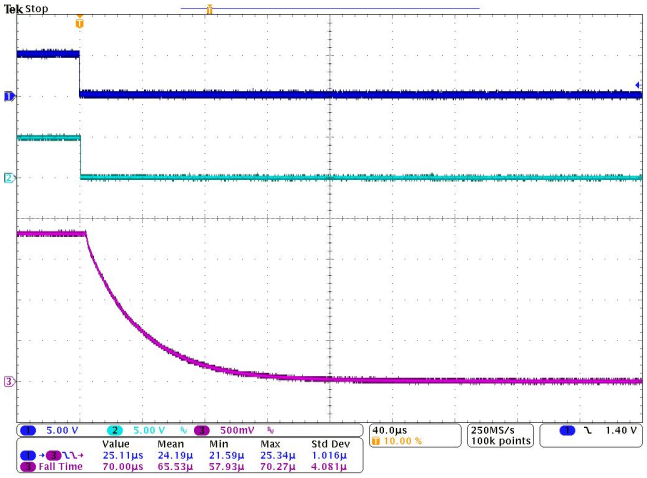


Fig9 VIN=1.8V

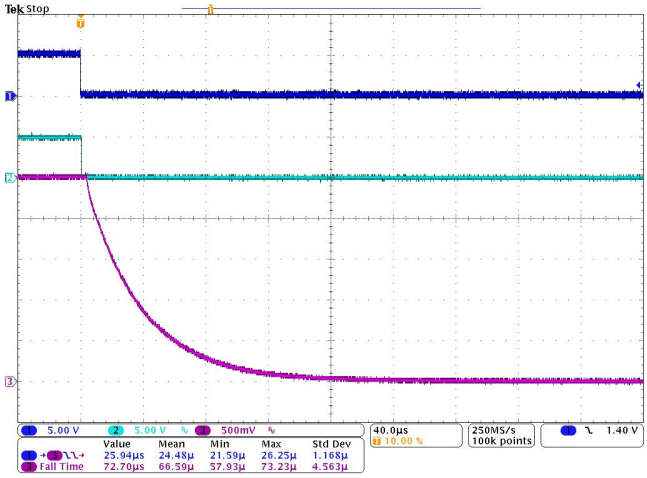


Fig10 VIN=2.5V

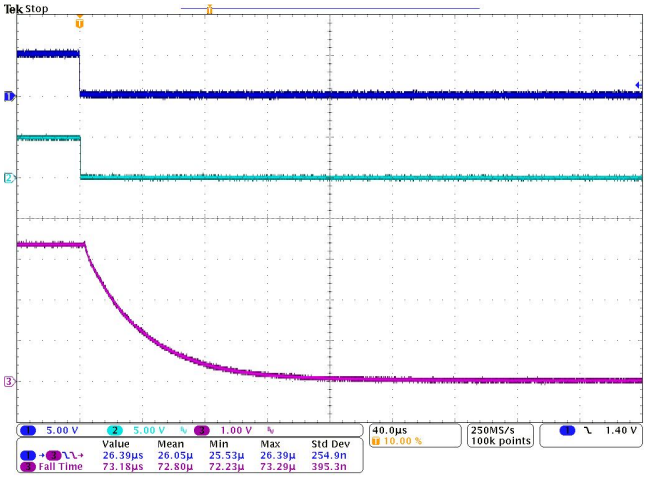


Fig11 VIN=3.3V

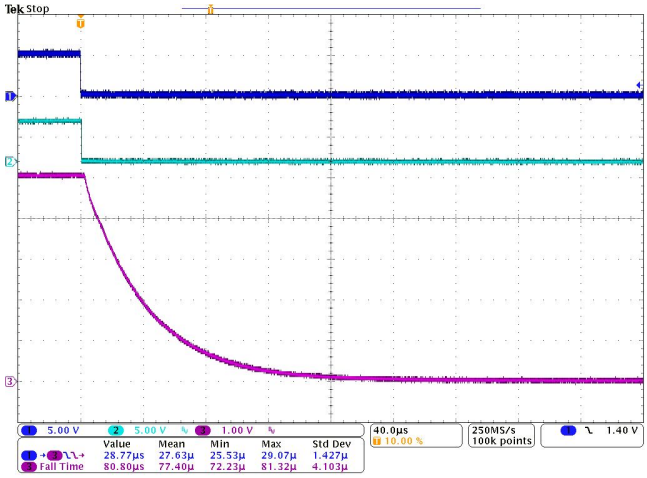


Fig12 VIN=5V

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

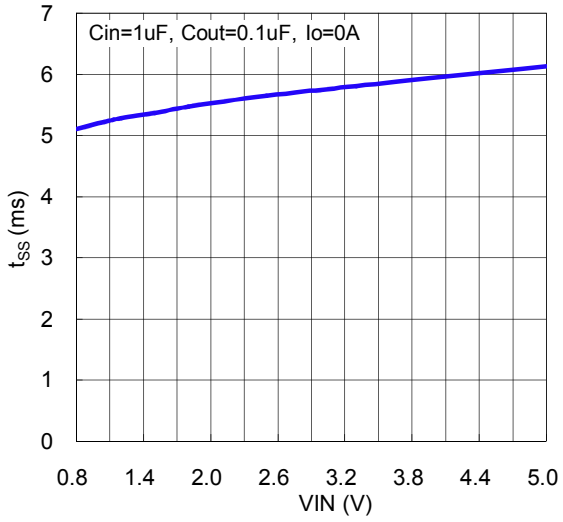


Fig.13 Soft Start Time vs. VIN

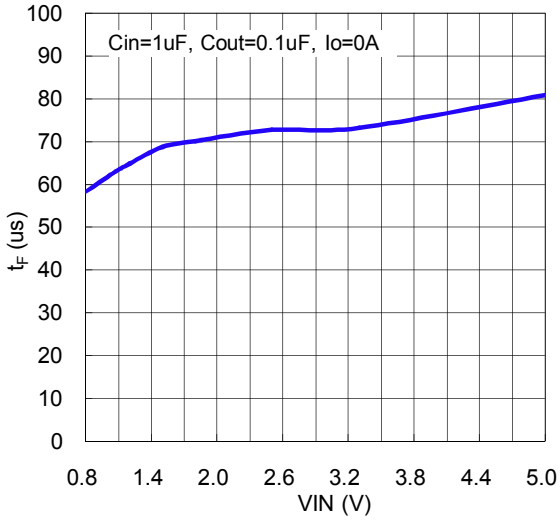


Fig.14 Output Fall Time vs. VIN

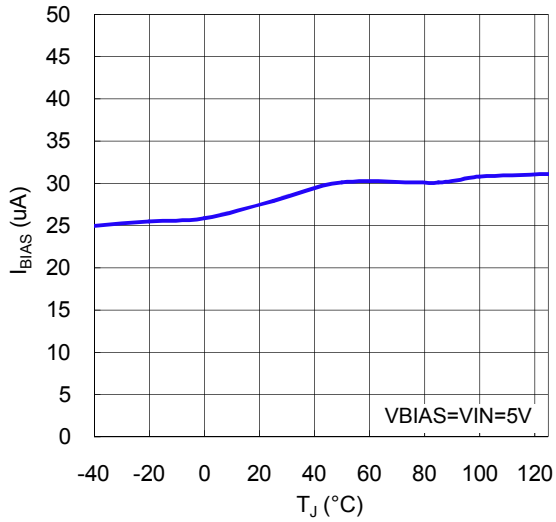


Fig.15 VBIAS Current vs. Temperature

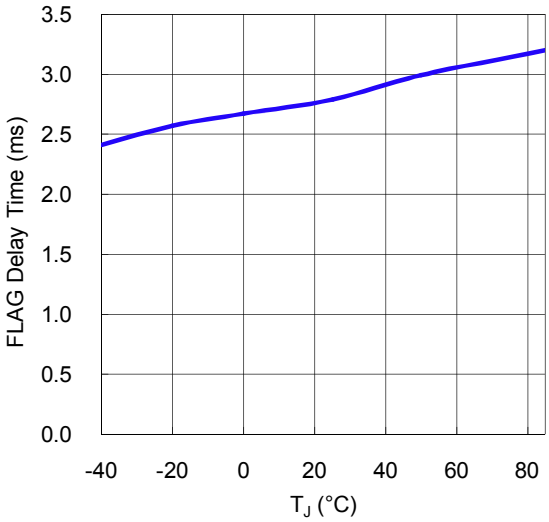


Fig.16 FLAG Delay Time vs. Temperature

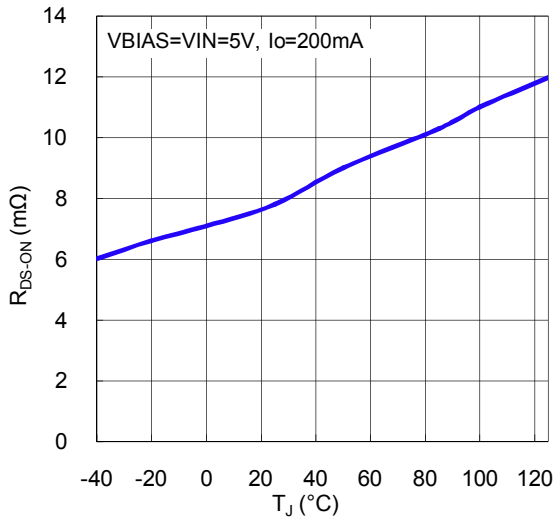


Fig.17 R_{ON} vs. Temperature

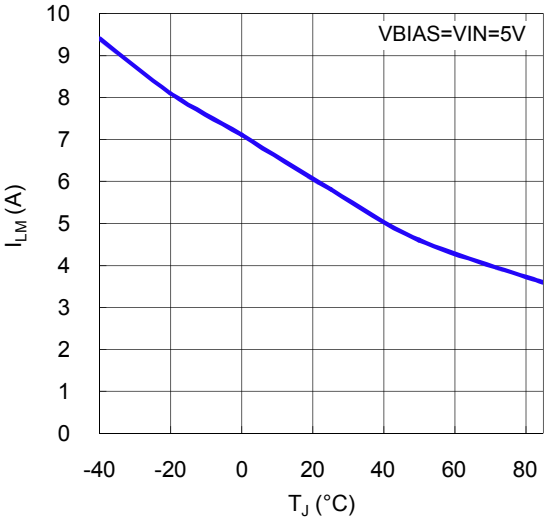


Fig.18 Current Limit vs. Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

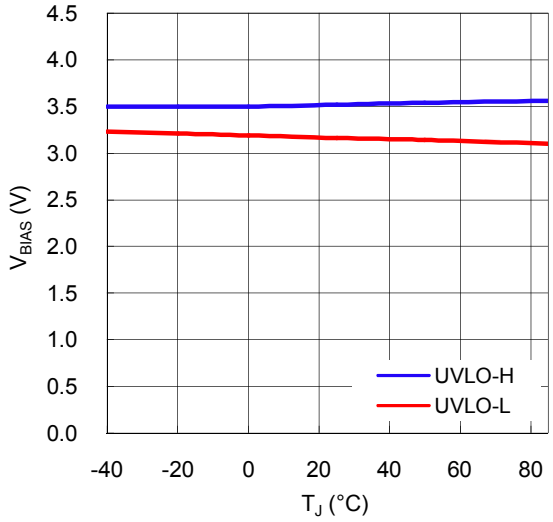


Fig.19 UVLO Threshold vs. Temperature

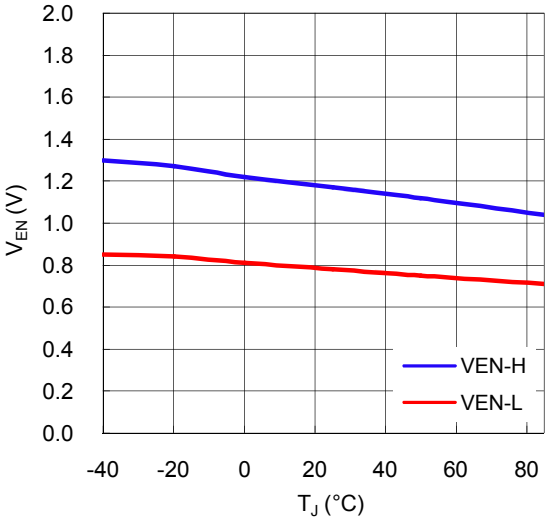


Fig.20 EN Threshold vs. Temperature

APPLICATION INFORMATION

On/Off Control

The load switch is controlled by the EN pin. The EN pin is active high and has a low threshold making it capable of interfacing with low voltage signals. The EN pin can be used with standard 1.8V, 2.5V or 3.3V GPIO logic threshold. Do not leave the EN pin float.

The Figure21 shows the VOUT on/off definition.

t_{SS}: Soft Start Time

t_{OFF}: VOUT Turn off Time

t_F: VOUT Fall Time

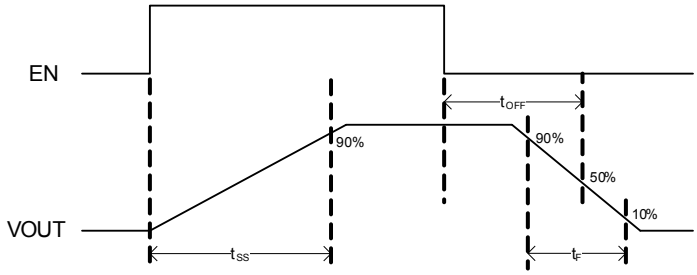


Fig.21 ON/OFF Waveform

FLAG Indicator

The APE8991A provides an error indicator (/FLG) output, which is an open-drain output requiring a pull-up resistor. Typically connect to +5V bias supply through a 10kΩ resistor. The FLAG comparator continuously monitors the fault condition for over current, short circuit and thermal shutdown conditions. If the fault condition keeps for 3ms, /FLG becomes low immediately.

Input Capacitor

An input capacitor is recommended to be placed between VIN and GND to limit the voltage drop on the input supply during high current application.

Output Capacitor

Setting a C_{IN} greater than the C_{OUT} is highly recommended. Since the internal body diode is in the NMOS switch, this prevents the current flows through the body diode from VOUT to VIN when the system supply is removed.

APPLICATION INFORMATION (Continued)

Layout Considerations

Follow the below guidelines for PCB layout to achieve stable operation. Take below figure for reference.

1. Keep the high current paths (VIN, VOUT and GND) wide and short to obtain the best effect.
2. The input and output capacitors should be close to the device as possible to minimize the parasitic trace inductances.

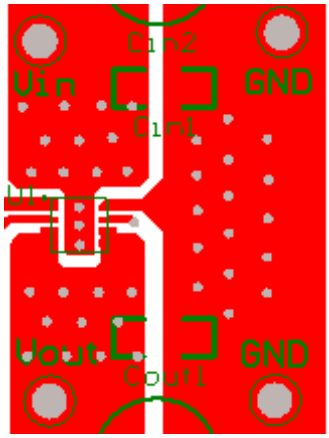


Fig.22 Reference layout

MARKING INFORMATION

DFN 3x3-8L