



FEATURES

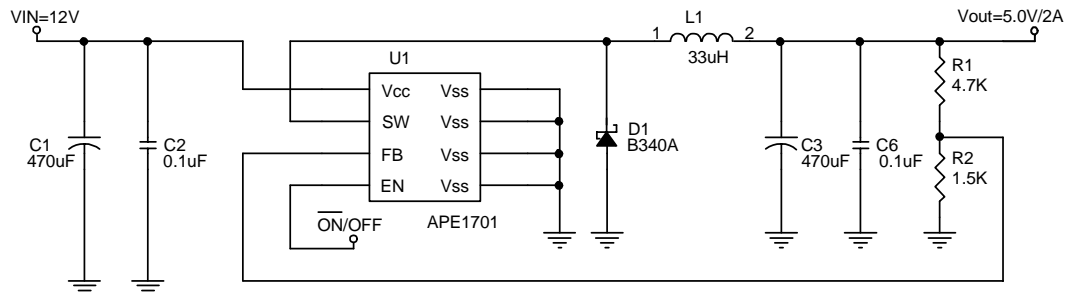
- Output Voltage : 3.3V, 5V, 12V and Adjustable Output Voltage
- Adjustable Version Output Voltage Range, 1.23V to 19.5V
- 150KHz Fixed Switching Frequency.
- Voltage Mode Non-synchronous PWM Control.
- Thermal-shutdown and Current-limit Protection.
- ON/OFF Shutdown Control Input.
- Short Circuit Protect(SCP)
- Operating Voltage can be up to 22V
- Output Load Current 2A
- SO-8 Package
- Low Power Standby Mode.
- Built-in Switching Transistor on Chip
- RoHS Compliant

DESCRIPTION

The APE1701 series are monolithic IC designed for a step-down DC/DC converter, and own the ability of driving a 2A load without additional transistor. It saves board space. The external shutdown function can be controlled by logic level and then come into standby mode. The internal compensation makes feedback control having good line and load regulation without external design. Regarding protected function, thermal shutdown is to prevent over temperature operating from damage, and current limit is against over current operating of the output switch. If current limit function occurs and VFB is down below 0.5V, the switching frequency will be reduced. The APE1701 series operates at a switching frequency of 150KHz thus allow smaller sized filter components than what would be needed with lower frequency switching regulators. The output version included fixed 3.3V, 5V, 12V, and an adjustable type. The chips are available in a standard SO-8 package.

TYPICAL APPLICATION

1. ADJUSTABLE OUTPUT VOLTAGE VERSION



$$V_{OUT} = V_{FB} (1 + R1/R2)$$

$$V_{FB} = 1.23V$$

$$R2 = 0.47K \sim 2.6K$$

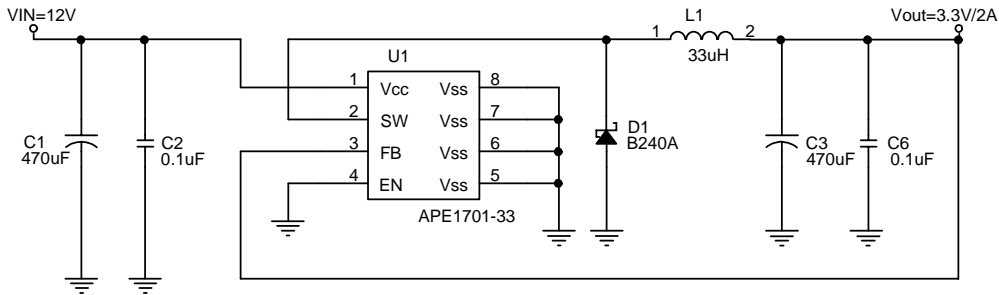
Table 1 Resistor select for output voltage setting

V _{OUT}	R2	R1
5V	1.5K	4.7K
	1.8K	5.6K
3.3V	1.5K	2.5K
	1.8K	3.0K
2.5V	1.8K	1.8K
1.8V	1.8K	0.82K

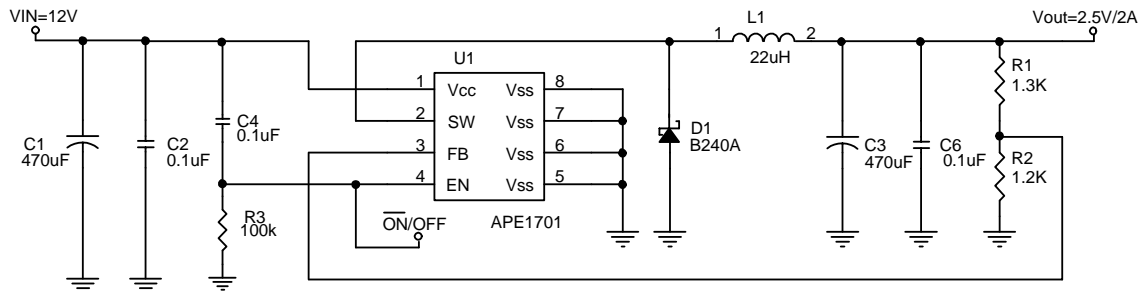


TYPICAL APPLICATION

2. FIXED OUTPUT VOLTAGE VERSION



3. ADJUSTABLE OUTPUT VOLTAGE VERSION WITH DELAYED STARTUP

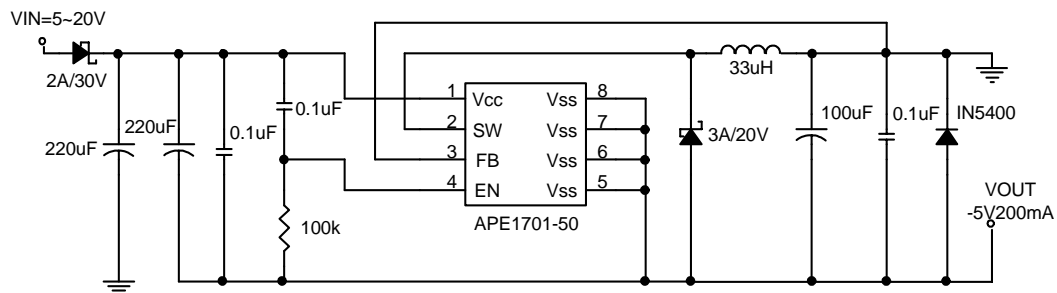


$$V_{OUT} = V_{FB} (1 + R1/R2)$$

$$V_{FB} = 1.23V$$

$$R2 = 0.47K \sim 2.6K$$

4. INVERTING -5V REGULATOR WITH DELAYED STARTUP



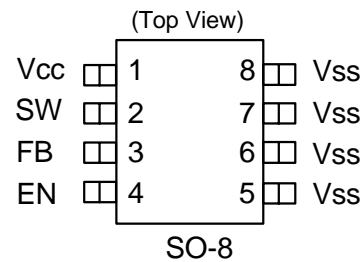
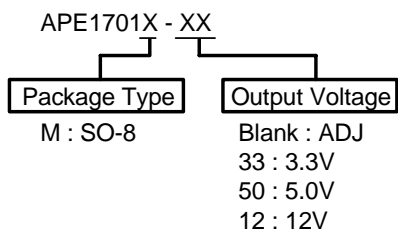


ABSOLUTE MAXIMUM RATINGS (at $T_A=25^{\circ}\text{C}$)

Maximum Supply Voltage(V_{CC})	-----	+24V
ON/OFF PIN Input Voltage(V_{EN})	-----	-0.3V to V_{CC}
Feedback PIN Voltage(V_{FB})	-----	-0.3V to 16V
Output Voltage to Ground(V_{OUT})	-----	-0.8V
Power Dissipation(P_D)	-----	$(T_J-T_A)/R_{thJA}$
Storage Temperature Range(T_{ST})	-----	-65°C To 150°C
Operating Temperature Range(T_{OP})	-----	-20°C To 125°C
Operating Supply Voltage(V_{OP})	-----	+4.5V to +22V
Thermal Resistance from Junction to Case(R_{thJC})		20°C/W
Thermal Resistance from Junction to Ambient(R_{thJA})		60°C/W

Note. R_{thJA} is measured with the PCB copper area(need connect to VSS pins) of approximately 1.5 in² (Multi-layer).

ORDERING / PACKAGE INFORMATION



ELECTRICAL SPECIFICATIONS

(Unless otherwise specified, $T_A=25^{\circ}\text{C}$, $V_{CC}=12\text{V}$ for 3.3V, 5V, adjustable version and $V_{CC}=18\text{V}$ for the 12V version. $I_{LOAD} = 0.2\text{A}$)

Parameter	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
Quiescent Current	I_Q	$V_{FB}=12\text{V}$ force driver off	-	4	8	mA
Feedback Bias Current	I_{FB}	$V_{FB}=1.3\text{V}$ (ADJ Version Only)	-	-10	-50	nA
Shutdown Supply Current	I_{SD}	$V_{EN}=5\text{V}$, $V_{CC}=22\text{V}$	-	35	100	uA
Current Limit	I_{CL}	Pear Current, No outside circuit $V_{FB}=0\text{V}$ force driver on	2.4	-	-	A
Max. Duty Cycle (ON)	DC	$V_{FB}=0\text{V}$ force driver on	-	100	-	%
Min. Duty Cycle (OFF)		$V_{FB}=12\text{V}$ force driver off	-	0	-	%
Oscillation Frequency	F_{OSC}		127	150	173	KHz
Oscillation Frequency of Short Circuit Protect	F_{SCP}	(Adjustable) When $V_{FB} < 0.5\text{V}$	-	50	-	KHz
		(Fixed) When $< V_{OUT} \times 40\%$	-	50	-	KHz
Saturation Voltage	V_{SAT}	$I_{OUT}=2\text{A}$, No outside circuit $V_{FB}=0\text{V}$ force driver on	-	1.2	1.4	V
SW PIN=0V	SW PIN Leakage Current	No outside circuit	-	-	-200	uA
SW PIN=-0.8V		$V_{CC}=22\text{V}$ force driver off	-	-5	-	mA



ELECTRICAL SPECIFICATIONS(Cont.)

Parameter	SYM	TEST CONDITION	MIN	TYP	MAX	UNITS
EN PIN Logic Input Threshold Voltage	V_{IL}	Low (regulator ON)	-	1.3	0.6	V
	V_{IH}	High (regulator OFF)	2		-	V
EN PIN Input Current	I_H	$V_{EN}=2.5V(OFF)$	-	-0.1	-0.5	μA
	I_L	$V_{EN}=0.5V(ON)$	-	-	-0.01	μA
Thermal Shutdown Temp.	TSD		-	135	-	$^{\circ}C$

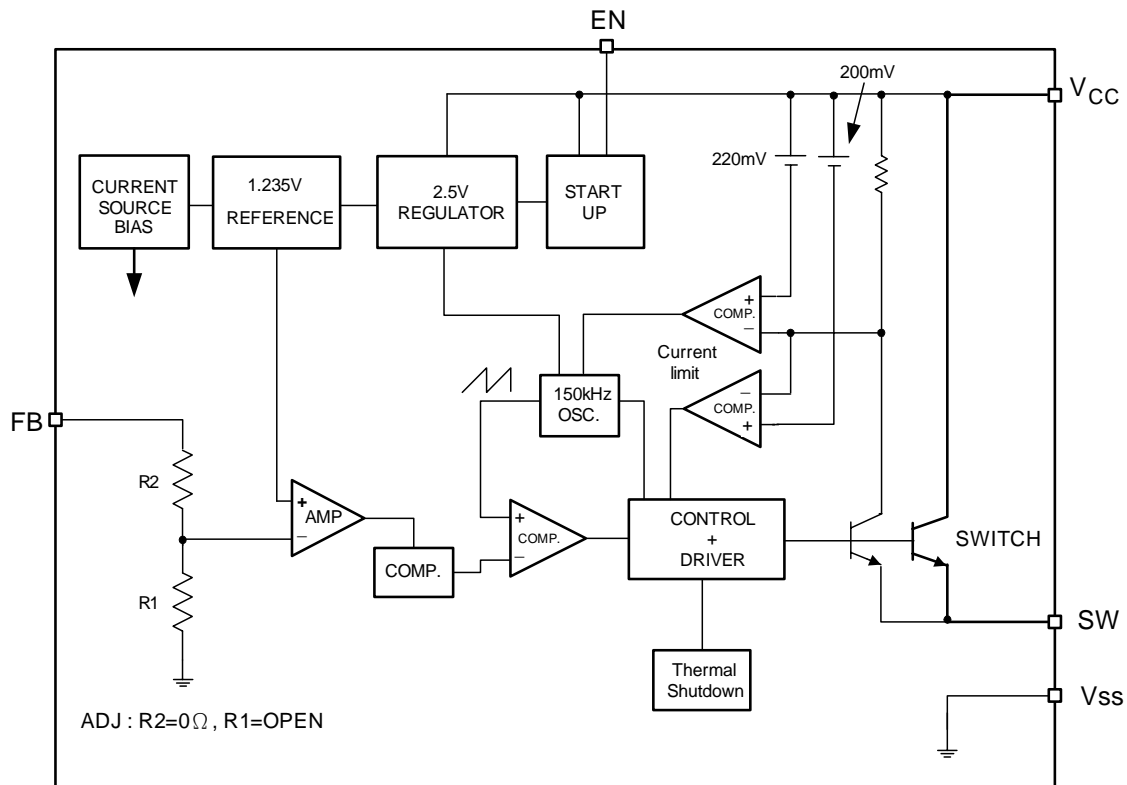
Version	Characteristics	Symbol	Conditions	MIN	TYP	MAX	UNITS
APE1701-ADJ	Output Feedback Voltage	V_{FB}	$I_{LOAD}=0.2A$ V_{OUT} programmed for 3.3V	1.193	1.23	1.267	V
	Efficiency	η	$V_{CC}=12V, I_{LOAD}=2A$	-	79	-	%
APE1701-3.3V	Output Voltage	V_{OUT}	$I_{LOAD}=0.2A$	3.2	3.3	3.4	V
	Efficiency	η	$V_{CC}=12V, I_{LOAD}=2A$	-	80	-	%
APE1701-5.0V	Output Voltage	V_{OUT}	$I_{LOAD}=0.2A$	4.85	5.0	5.15	V
	Efficiency	η	$V_{CC}=12V, I_{LOAD}=2A$	-	84	-	%
APE1701-12V	Output Voltage	V_{OUT}	$I_{LOAD}=0.2A$	11.64	12	12.36	V
	Efficiency	η	$V_{CC}=15V, I_{LOAD}=2A$	-	90	-	%

PIN DESCRIPTIONS

PIN SYMBOL	PIN DESCRIPTION
V_{SS}	GND Pin
FB	Control Voltage Feedback Control
EN	ON/OFF Shutdown
SW	Switching Output
V_{CC}	IC Power Supply Pin



BLOCK DIAGRAM



FUNCTION DESCRIPTION

VCC

This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be presented at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.

VSS

Circuit ground.

SW

Internal switch. The voltage at this pin switches between $(+VCC - VSAT)$ and approximately $-0.5V$, with a duty cycle of approximately $VOUT / VCC$. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be minimized.

FEEDBACK

Senses the regulated output voltage to complete the feedback loop.

EN

Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately $100\mu A$. Pulling this pin below a threshold voltage of approximately $1.3V$ turns the regulator on, and pulling this pin above $1.3V$ (up to a maximum of VCC) shuts the regulator down. If this shutdown feature is not needed, the EN pin can be wired to the ground pin.



FUNCTION DESCRIPTION

THERMAL CONSIDERATIONS

The SO-8 package needs a heat sink under most conditions. The size of the heat sink depends on the input voltage, the output voltage, the load current and the ambient temperature. The APE1701 junction temperature rises above ambient temperature for a 2A load and different input and output voltages.

The data for these curves was taken with the APE1701 (SO-8 package) operating as a buck-switching regulator in an ambient temperature of 25°C (still air). These temperature increments are all approximate and are affected by many factors. Higher ambient temperatures requires more heat sinker.

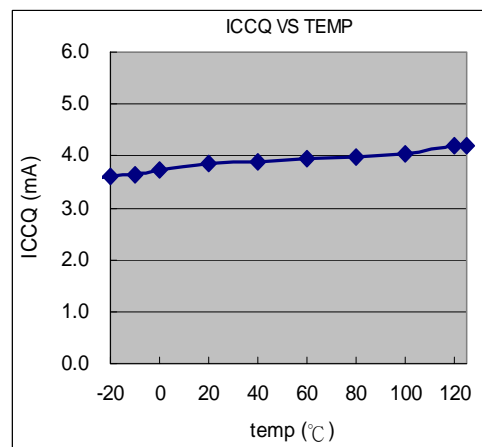
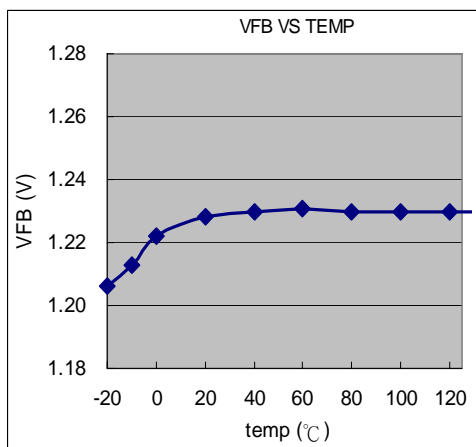
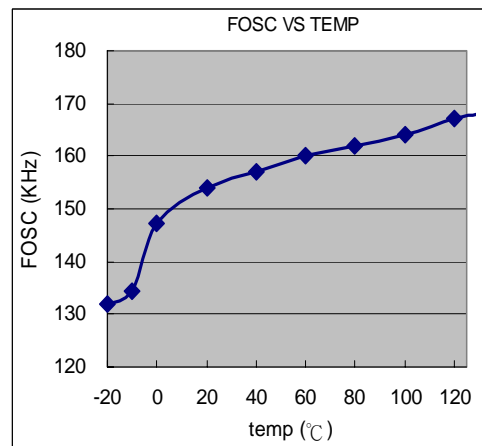
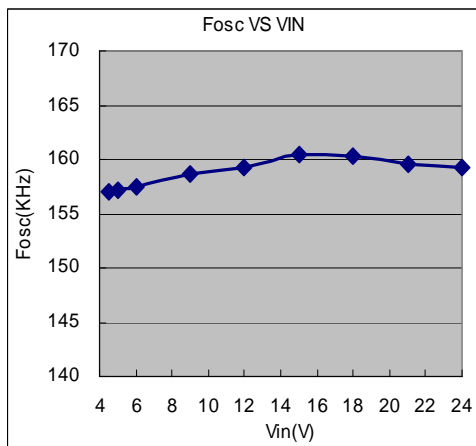
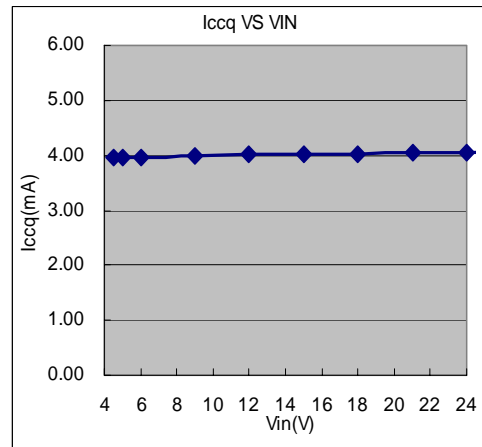
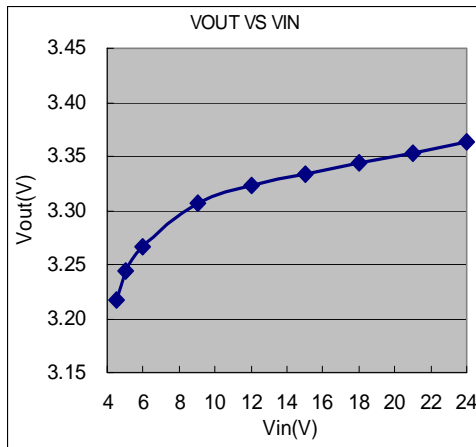
For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper (need connect to the V_{SS} pins) should be used in the board layout, (One exception is the SW(switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

Package thermal resistance and junction temperature increments are all approximate. The increments are affected by a lot of factors. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multi-layer board and the amount of solder on the board.

The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as whether the surrounding air is still or moving. Furthermore, some of these components such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

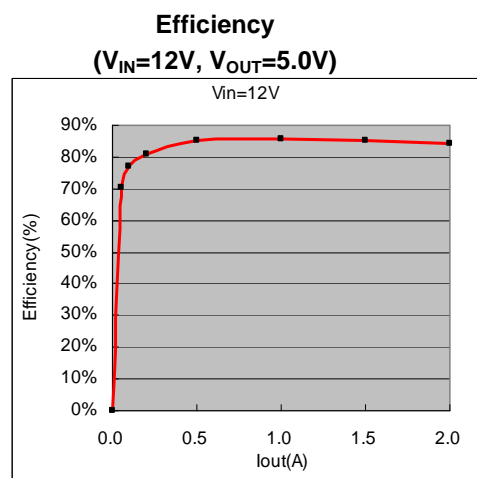
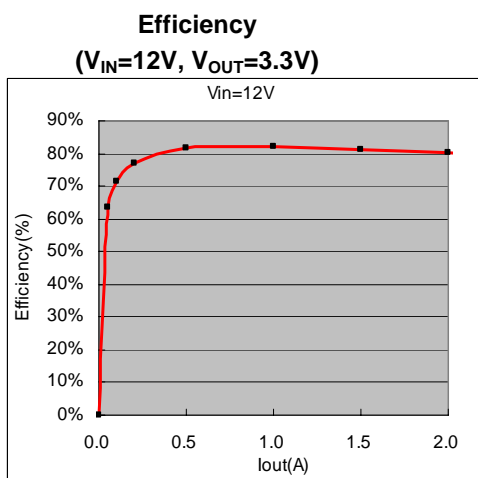
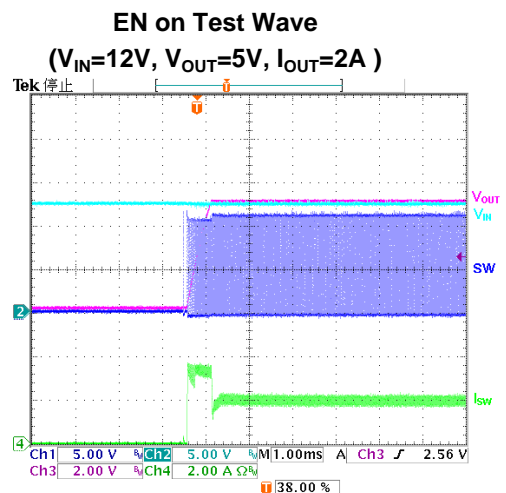
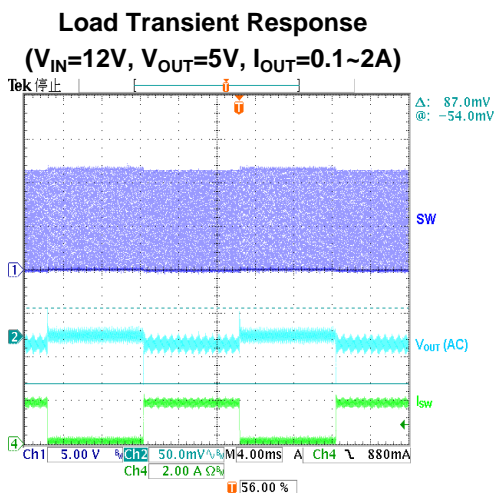
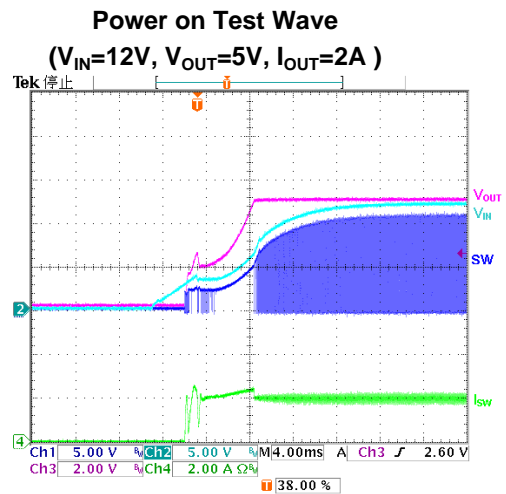
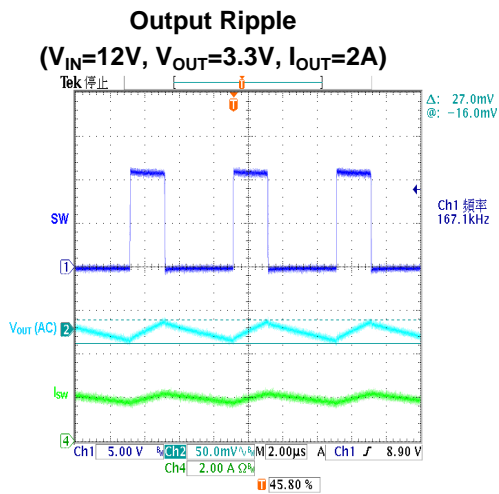


TYPICAL PERFORMANCE CHARACTERISTICS





TYPICAL PERFORMANCE CHARACTERISTICS





MARKING INFORMATION

SO-8

