1.6X Linear Fan Driver with VO Fully On Control

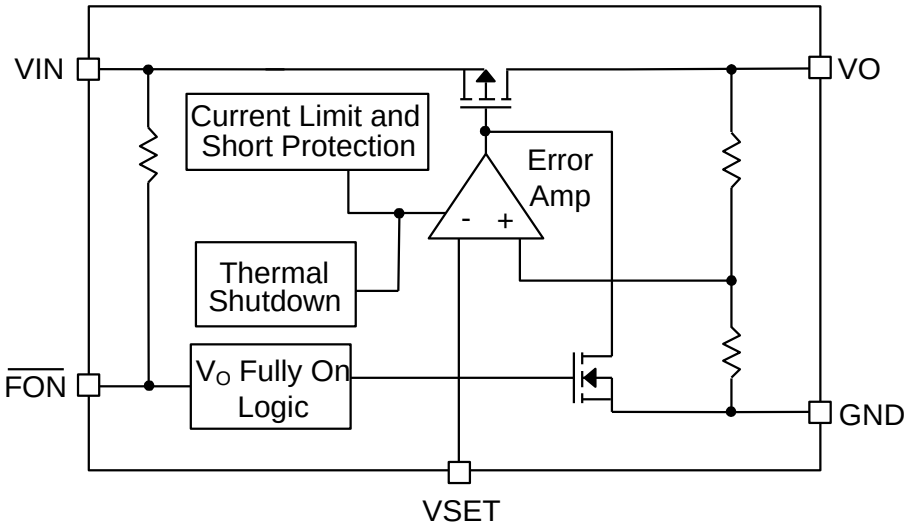
❖ GENERAL DESCRIPTION

The AX995 is a low dropout linear regulator which is designed to power a DC fan and delivers up to 600mA output current. The output voltage follows the 1.6 times of VSET voltage and typical dropout voltage is only 150mV (typical) at 600mA output current. The VSET voltage must be larger than 1V to guarantee V_O 1.6 times of VSET. A $\overline{FON}$ pin turns V_O output fully on when given low. The features of current limit (with fold back current) and over temperature protection protect the device against current over-loads and over temperature. The AX995 is available in a SOP-8 package.

❖ FEATURES

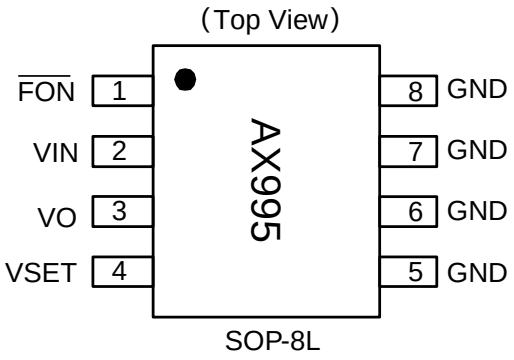
- Low Dropout Voltage: 150mV@0.6A
- V_O Follows 1.6 times of VSET
- $\overline{FON}$ Pin to Turn V_O Fully On
- Stable with Low ESR Ceramic Capacitors
- Current-Limit and Thermal Shutdown Protection
- SOP-8 Pb-Free Package

❖ BLOCK DIAGRAM



❖ PIN ASSIGNMENT

The package of AX995 is SOP-8L; the pin assignment is given by:



Name	Description
GND	GND pin
VIN	IC power supply pin
VO	Output Pin. Its voltage is 1.6 times of VSET
VSET	This pin sets the output voltage. Its voltage must be larger than 1V to guarantee VO 1.6 times of VSET
$\overline{\text{FON}}$	$\overline{\text{FON}}$ Input. Pulling this pin below 0.4V turns the regulator fully on. Internally pulled high.

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
AX995 X X Package Type S : SOP-8L Packing Blank : Tube A : Taping	Logo ← AX995 → Part number YYWWX → ID code:internal WW: 01~52 Year: 10=2010 11=2011

❖ ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

Characteristics	Symbol	Rating	Unit
VIN Supply Voltage	V_{IN}	-0.3 to 6.5	V
$\overline{\text{FON}}$ Input Voltage	V_{FON}	-0.3 to VIN	V
VSET Voltage	V_{SET}	-0.3 to VIN	V
Power Dissipation	PD	Internally limited	W
Storage Temperature Range	T_{ST}	-65 to +150	°C
Junction Temperature Range	T_J	-40 to 125	°C
Operating Temperature Range	T_{OP}	-40 to +85	°C
Thermal Resistance from Junction to case	θ_{JC}	20	°C/W
Thermal Resistance from Junction to ambient	θ_{JA}	60	°C/W

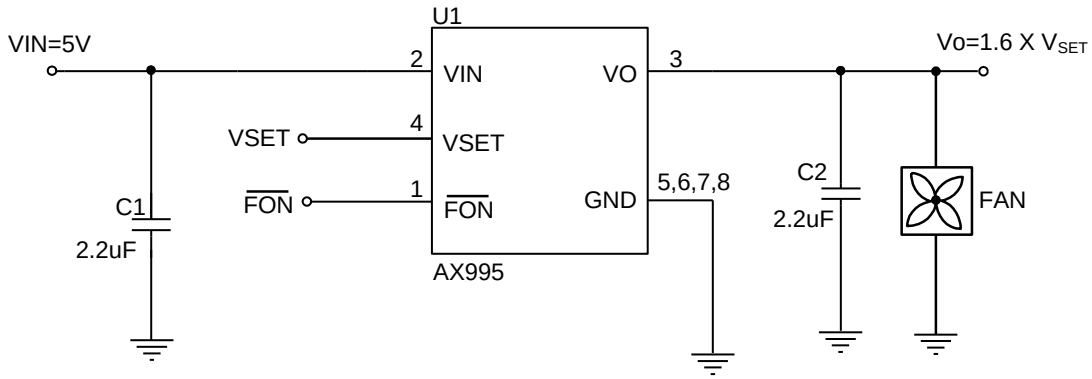
Note: θ_{JA} is measured with the PCB copper area approximately 1.5 in^2 (Multi-layer)

❖ ELECTRICAL CHARACTERISTICS

(V_{SET}=2V, V_{IN}=5V, I_{OUT}= 0.5A, C_{IN}=C_{OUT}=2.2uF, T_A=25°C unless otherwise specified)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
VIN Supply Voltage Range	V_{IN}		4.5	-	5.5	V
Quiescent Current	I_{CCQ}	VO=5V, No Load	-	70	-	uA
Output Voltage/V_{SET} Voltage	V_O/V_{SET}	V_{IN}=5.5V, V_{SET}=1V~3.2V	1.552	1.6	1.648	V/V
Line Regulation		V_{IN}=4.5V to 5.5V	-	0.2	0.5	%
Load Regulation		I_{OUT} =10mA ~ 0.6A	-	0.2	0.5	%
Output Resistance	$R_{DS(ON)}$	I_{OUT}=0.6A, V_{SET}=3.4V	-	240	320	mΩ
Current Limit	I_{Limt}		-	1	-	A
Short Circuit Current	I_{Short}	Vo<0.6V	-	0.5	-	A
Minimum V_{SET} Voltage	V_{SET}		-	1	-	V
V_{SET} Pin Current	I_{SET}		-	80	200	nA
$\overline{FON}$ Pin Logic Threshold Voltage	V_{FON-H}	Normal Operating	2.0	-	-	V
	V_{FON-L}	Regulator Fully On	-	-	0.8	
$\overline{FON}$ Pin Bias Current	I_{FON}	$\overline{FON}$=0V	-	1	5	uA
Thermal shutdown Temp	T_{SD}		-	140	-	°C
Thermal Shutdown Hysteresis			-	30	-	°C

❖ APPLICATION CIRCUIT



❖ FUNCTION DESCRIPTIONS

Output Voltage Regulation

The Output Voltage is set by VSET voltage. VO output voltage follows the 1.6 times of VSET voltage until it reaches VIN voltage.

Fully-On Control

If the $\overline{FON}$ pin logic level smaller than 0.8V, the output voltage can be promoted near to VIN voltage. Otherwise, V_{OUT} is normal operating by $\overline{FON}$ larger than 2.0V.

Current-Limit

The AX995 monitors the current via the output PMOS and limits the maximum current to prevent load and AX995 from damages during overload or short circuit conditions.

Short Current Protection

When the output voltage drops below 0.6V (typical), which is caused by over load or short circuit, the fold back current limit circuitry limits the output current to 500mA. The fold back current limit is used to reduce the power dissipation during short circuit condition.

Thermal Shutdown

A thermal shutdown circuit limits the junction temperature of AX995. When the junction temperature exceeds +140°C, a thermal sensor turns off the output PMOS, allowing the device to cool down. The regulator regulates the output again through initiation of a new soft-start cycle after the junction temperature cools by 30°C, resulting in a pulsed output during continuous thermal overload conditions.

❖ APPLICATION INFORMATION

Capacitor Selection

Normally, use a 2.2μF capacitor on the input and a 2.2μF capacitor on the output of the AX995. In order to insure the circuit stability, the proper output capacitor value should be larger than 1uF. With X5R and X7R dielectrics, 2.2uF is sufficient at all operating temperatures.

Thermal Considerations

The AX995 series can deliver a current of up to 500mA over the full operating junction temperature range. However, the maximum output current must be dated at higher ambient temperature to ensure the junction temperature does not exceed 125°C. With all possible conditions, the junction temperature must be within the range specified under operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across regulator.

$$PD = (V_{IN} - V_O) I_O$$

The final operating junction temperature for any set of conditions can be estimated by the following thermal equation:

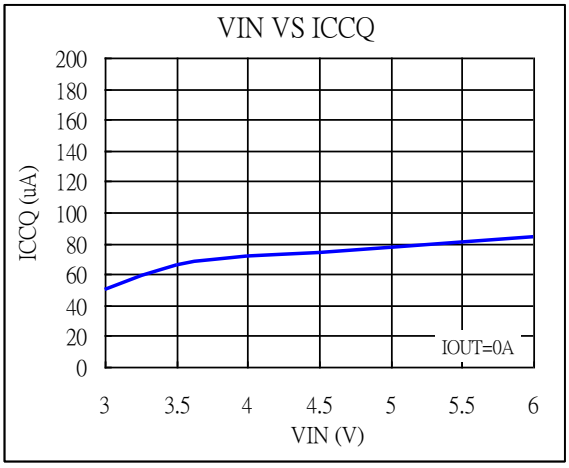
$$PD\ (MAX) = (T_{J\ (MAX)} - T_A) / \theta_{JA}$$

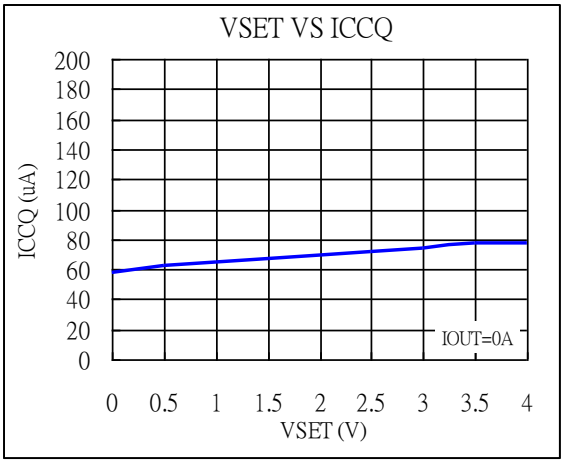
Where $T_{J\ (MAX)}$ is the maximum junction temperature of the die (125°C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA}) for SOP-8L package at recommended minimum footprint is 60°C/W. Visit our website in which “Recommended Footprints for Soldering Surface Mount Packages” for detail.

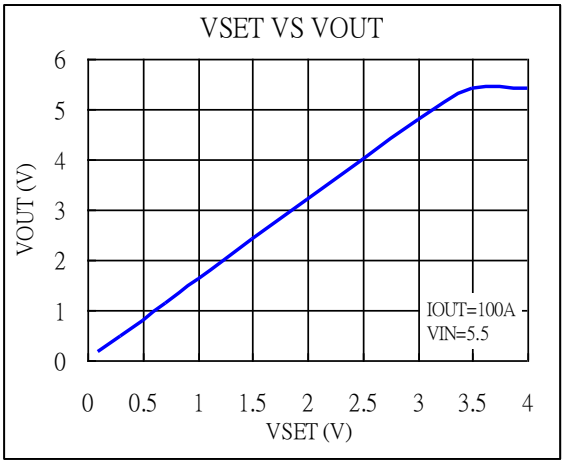
PCB Layout

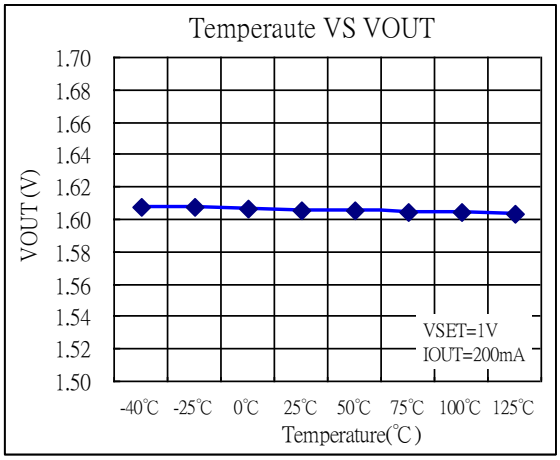
1. Please place the input capacitors close to the V_{IN}
2. Ceramic capacitors for load must be placed near the load as close as possible
3. To place AX995 and output capacitors near the load is good for performance.
4. Large current paths that V_{IN} and Output lines must have wide tracks.
5. GND connect large copper area can reduced IC temperature.

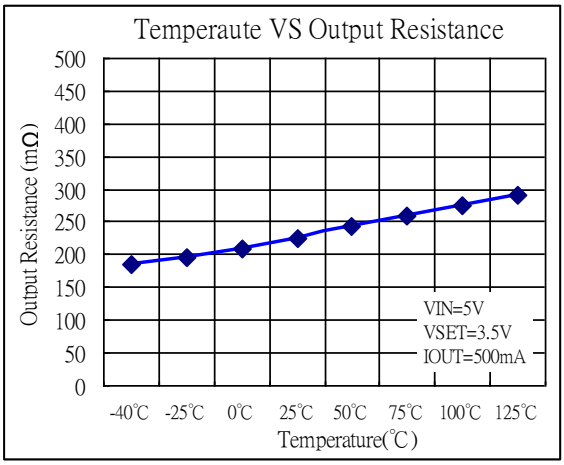
❖ TYPICAL CHARACTERISTICS

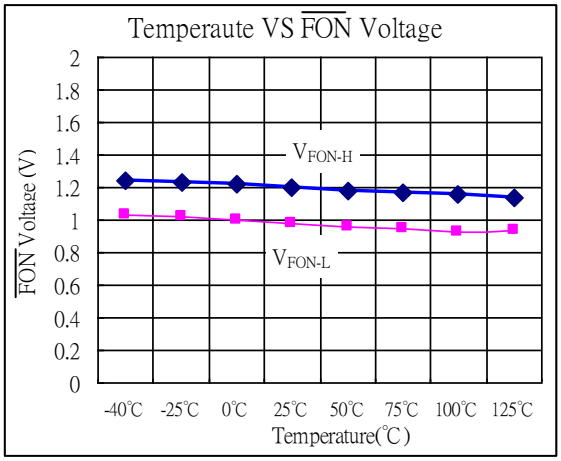






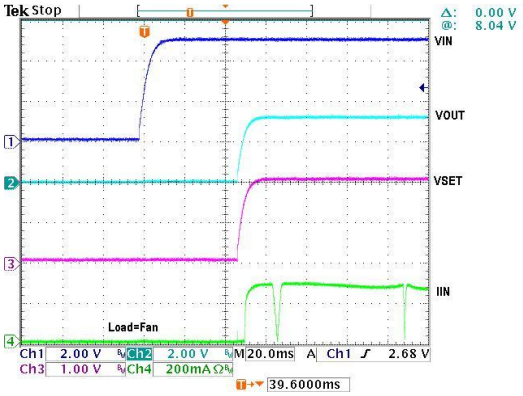




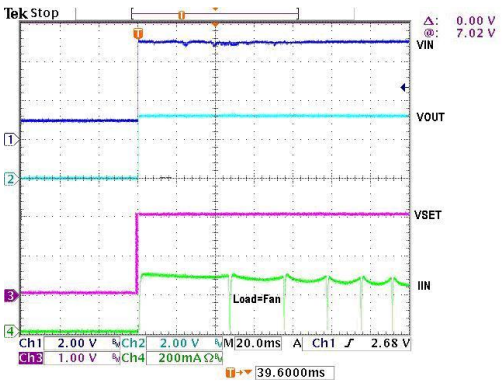


❖ TYPICAL CHARACTERISTICS (CONTINUOUS)

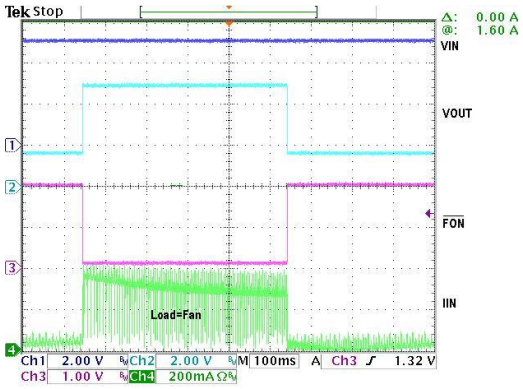
Power ON



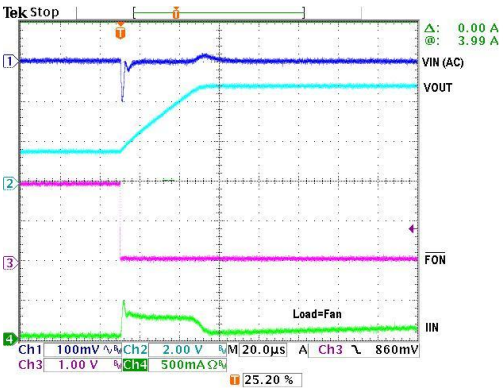
Power ON



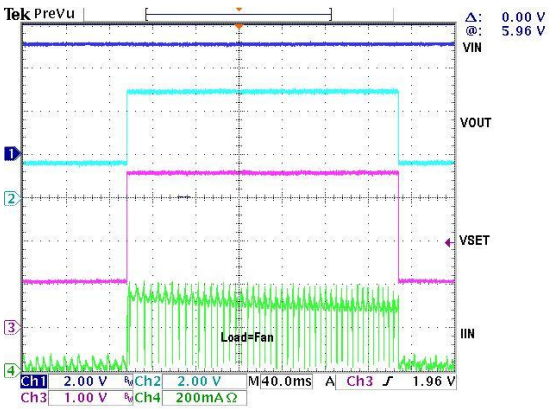
Fully-On



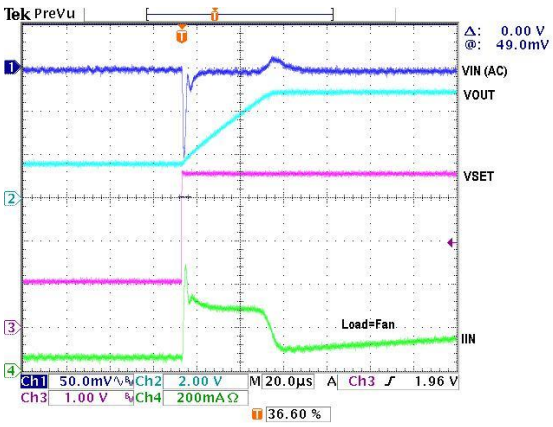
Fully-On(VIN Drop)



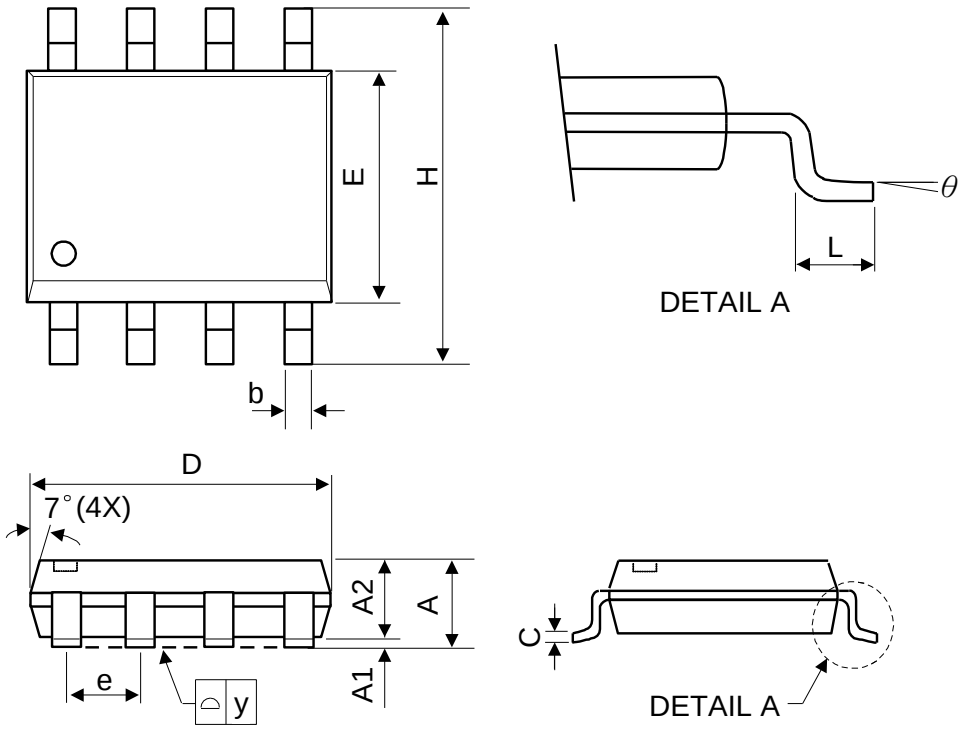
Load Transient



Load Transient (VIN Drop)



❖ PACKAGE OUTLINES



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.75	-	-	0.069
A1	0.1	-	0.25	0.04	-	0.1
A2	1.25	-	-	0.049	-	-
C	0.1	0.2	0.25	0.0075	0.008	0.01
D	4.7	4.9	5.1	0.185	0.193	0.2
E	3.7	3.9	4.1	0.146	0.154	0.161
H	5.8	6	6.2	0.228	0.236	0.244
L	0.4	-	1.27	0.015	-	0.05
b	0.31	0.41	0.51	0.012	0.016	0.02
e	1.27 BSC			0.050 BSC		
y	-	-	0.1	-	-	0.004
θ	0^o	-	8^o	0^o	-	8^o

Mold flash shall not exceed 0.25mm per side

JEDEC outline: MS-012 AA