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FAN7527

Power Factor Correction Controller

Features

- Internal Startup Timer
- Internal R/C filter eliminates the Need for an External R/C filter
- Very Precise Adjustable Output Over Voltage Protection
- Zero Current Detector
- One Quadrant Multiplier
- Trimmed 1.5% Internal Bandgap Reference
- Under Voltage Lock Out with 3V of Hysteresis
- Totem Pole Output with High State Clamp
- Low Startup and Operating Current
- 8-Pin DIP or 8-Pin SOP

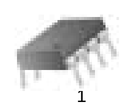
Applications

- Electronic Ballast
- SMPS

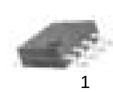
Description

The FAN7527 provides simple and high performance active power factor correction. FAN7527 is optimized for electronic ballast and low power, high density power supplies which require minimum board area reduced component count and low power dissipation. Internal R/C filter eliminates the need for an external R/C filter. Internally clamping the error amplifier and multiplier outputs, improves turn on overshoot characteristics and current limiting. Special circuitry has also been added to prevent no load runaway conditions. Independent of supply voltage, the output drive clamping circuit limits overshoot of the power MOSFET gate drive. This greatly enhances the system reliability.

8-DIP

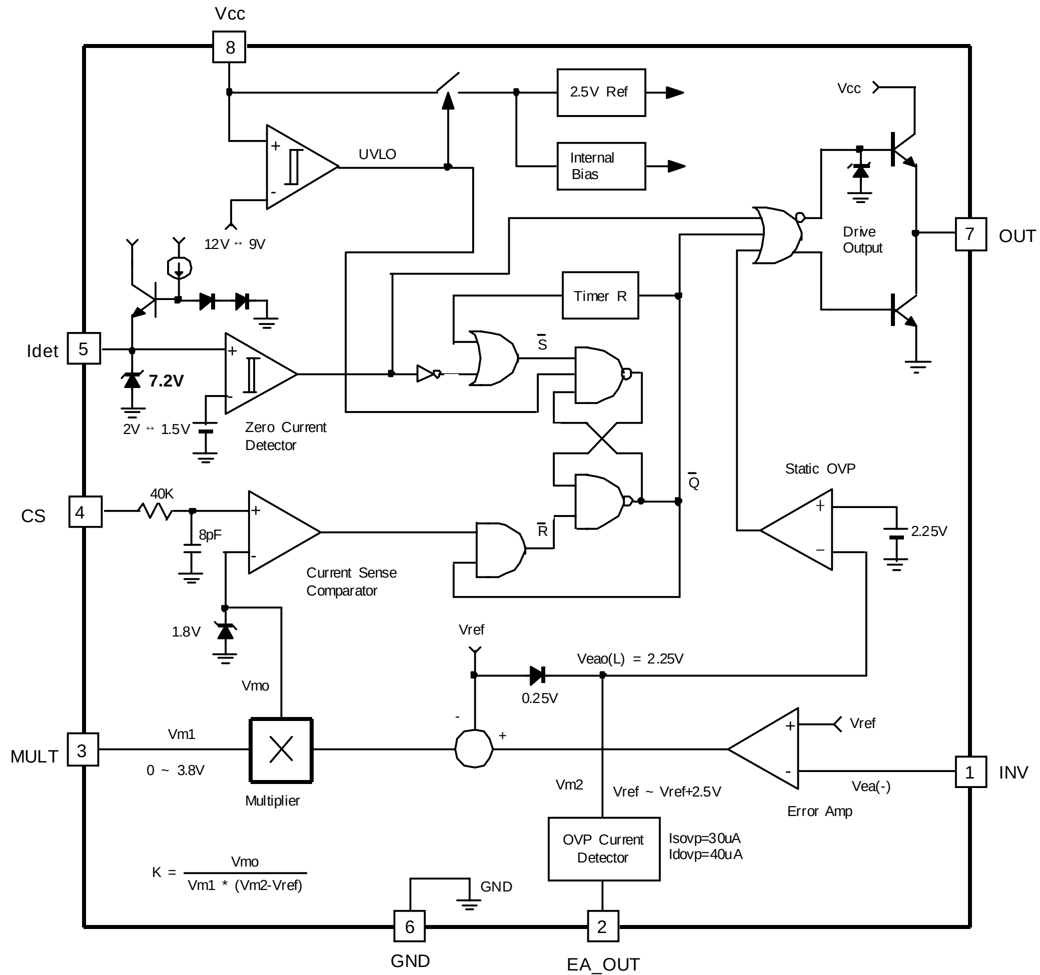


8-SOP

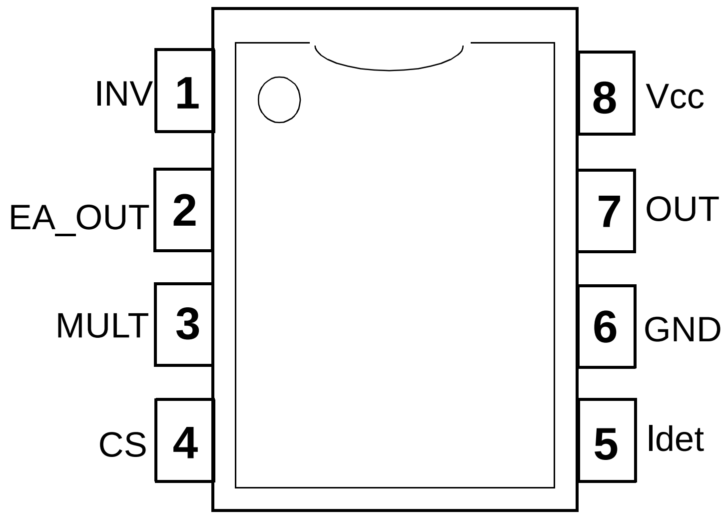


Rev 1.0.3

Internal Block Diagram



PIN Description



(Top View)

Pin Number	Pin Name	Pin Function Descrition
1	INV	Inverting input of the error amplifier. The output of the boost converter should be resistively divided to 2.5V and connected to this pin.
2	EA_OUT	The output of the error amplifier. A feedback conpensation network is placed between this pin and the INV pin.
3	MULT	Input to the multiplier stage. The full-wave rectified AC is devided to less than 2V and is connected to this pin.
4	CS	Input to the PWM comparator. Current is sensed in the boost stage MOSFET by a resistor in the source lead. An internal leading edge blanking circuitry has been included to reject any high frequency noise present on the current waveform.
5	Idet	The zero current detector senses the inductor current by monitoring when the boost inductor auxilary winding voltage falls below 1.8V. If it is connected to GND, the device is disabled.
6	GND	The ground potential of all the pins.
7	OUT	Gate driver output . A push pull output stage is able to drive the Power MOSFET with peak current of 400mA.
8	Vcc	Supply voltage of driver and control circuits.

Absolute Maximum Ratings (Ta=25°C)

Characteristics	Symbol	Value	Unit
Supply Voltage	V_{CC}	30	V
Peak Drive Output Current	I_{OH},I_{OL}	±500	mA
Driver Output Clamping Diodes Vo > Vcc or Vo < -0.3V	Iclamp	±10	mA
Detector Clamping Diodes	Idet	±10	mA
Error Amp, Multiplier And Comparator Input Voltages	Vin	-0.3 to 6	V
Operating Junction Temperature	Tj	150	°C
Operating Temperature Range	Topr	-25 to 125	°C
Storage Temperature Range	Tstg	-65 to 150	°C
Power Dissipation	Pd	0.8	W

Temperature Characteristics (-25°C ≤ Ta ≤ 125°C)

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Temperature Stability for Reference Voltage (V_{ref})	Δ Vref	-	20	-	mV
Temperature Stability for Multiplier Gain (K)	Δ K/ΔT	-	0.2	-	%/°C

Electrical Characteristics

V_{CC}= 14V, -25°C ≤ Ta ≤ 125°C, unless otherwise stated.

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
< UNDER VOLTAGE LOCK OUT SECTION>						
Start Threshold Voltage	$V_{th(st)}$	Vcc Increasing	10.5	11.5	12.5	V
UVLO Hysteresis	HY(st)	-	2	3	4	V
< SUPPLY CURRENT SECTION >						
Start-up Supply Current	I_{st}	Vcc =Vth(st) -0.2V	20	60	100	uA
Operating Supply Current	I_{cc}	Output not switching	-	3	6	mA
Operating Current at OVP	$I_{cc(ovp)}$	Vinv = 3V	-	1.7	4	mA
Dynamic Operating Supply Current	I_{dcc}	50KHz, CI = 1nF	-	4	8	mA
< ERROR AMPLIFIER SECTION >						
Voltage Feedback Input Threshold	V_{ref}	Iref =0mA, Ta =25°C	2.465	2.5	2.535	V
		0 ≤ Ta ≤ 125°C	2.44	2.5	2.56	V
Line Regulation	$\Delta V_{ref}1$	14V ≤ Vcc ≤ 25V	-	0.1	10	mV
Temperature Stability Of Vref (Note1)	$\Delta V_{ref}3$	-25 ≤ Ta ≤ 125°C	-	20	-	mV
Input Bias Current	$I_{b(ea)}$	-	-0.5	-	0.5	uA
Output Source Current	I_{source}	Vm2 = 4V	-2	-4	-	mA
Output Sink Current	Isink	Vm2 = 4V	2	4	-	mA
Output Upper Clamp Voltage (Note2)	Veao(H)	Isource = 0.1mA	-	6	-	V
Output Lower Clamp Voltage (Note3)	Veao(L)	Isink = 0.1mA	-	2.25	-	V
Large Signal Open Loop Gain (Note4)	G_V	-	60	80	-	dB
Power Supply Rejection Ratio (Note5)	PSRR	14V ≤ Vcc ≤ 25V	60	80	-	dB
Unity Gain Bandwith (Note6)	GBW	-	-	1	-	MHz
Slew Rate (Note7)	SR	-	-	0.6	-	V/us
< MULTIPLIER SECTION>						
Input Bias Current (Pin3)	$I_{b(m)}$	-	-0.5	-	0.5	uA
M1 Input Voltage Range (Pin3)	ΔV_m1	-	0	-	3.8	V
M2 Input Voltage Range (Pin2)	ΔV_m2	-	Vref	-	Vref+2.5	V
Multiplier Gain (Note8)	K	Vm1 = 1V, Vm2 = 3.5V	0.36	0.44	0.52	1/V
Maximum Multiplier Output Voltage	Vomax(m)	Vinv =0V, Vm1 = 4V	1.65	1.8	1.95	V
Temperature Stability Of K (Note9)	ΔK/ΔT	-25 ≤ Ta ≤ 125°C	-	-0.2	-	%/°C

Electrical Characteristics(Continued)

V_{CC}= 14V, -25°C ≤ Ta ≤ 125°C, unless otherwise stated.

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
< CURRENT SENSE SECTION>						
Input Offset Voltage (Note8)	$V_{io(cs)}$	Vm1=0V , Vm2 = 2.2V	-10	3	10	mV
Input Bias Current	$Ib_{(cs)}$	0V ≤ Vcs ≤ 1.7V	-1	-0.1	1	uA
Current Sense Delay To Output (Note11)	$tb_{(cs)}$	-	-	200	500	ns
< DETECT SECTION >						
Input Voltage Threshold	$Vth_{(det)}$	Vdet Increasing	1.7	2	2.3	V
Detect Hysteresis	$HY_{(det)}$	-	0.2	0.5	0.8	V
Input Low Clamp Voltage	Vclamp(l)	Idet = -100uA	0.45	0.75	1	V
Input High Clamp Voltage	Vclamp(h)	Idet = 3mA	6.5	7.2	7.9	V
Input Bias Current	Ib(det)	1V ≤ Vdet ≤ 5V	-1	-0.1	1	uA
Input High/low Clamp Diode Current (Note12)	Iclamp(d)	-	-	-	±3	mA
< OUTPUT SECTION >						
Output Voltage High	V_{oh}	Io = -10mA	10.5	11	-	V
Output Voltage Low	V_{ol}	Io = 10mA	-	0.8	1	V
Rising Time (Note13)	tr	Cl = 1nF	-	130	200	ns
Falling Time (Note14)	tf	Cl = 1nF	-	50	120	ns
Maximum Output Voltage	Vomax(o)	Vcc = 20V, Io = 100uA	12	14	16	V
Output Voltage With UVLO Activated	Vomin(o)	Vcc = 5V , Io = 100uA	-	-	1	V
< RESTART TIMER SECTION>						
Restart Time Delay	$td_{(rst)}$	Vm1 = 1V, Vm2 = 3.5V	-	500	-	us
<OVER VOLTAGE PROTECTION SECTION>						
Soft OVP Detecting Current	I_{sovp}	-	25	30	35	uA
Dynamic OVP Detecting Current	I_{dovp}	-	35	40	45	uA
Static OVP Threshold Voltage	Vovp	Vinv = 2.7V	2.1	2.25	2.4	V

Note : 1 ~ 14 These parameters, although guaranteed, are not 100% tested in production.

$$\text{Multiplier Gain: } K = \frac{\text{Pin4\_Threshold}}{\text{Vm1} \times (\text{Vm2} - \text{Vref})} ......(\text{Vm1} = \text{Vpin3}, \text{Vm2} = \text{Vpin2})$$

Typical Performance Characteristics

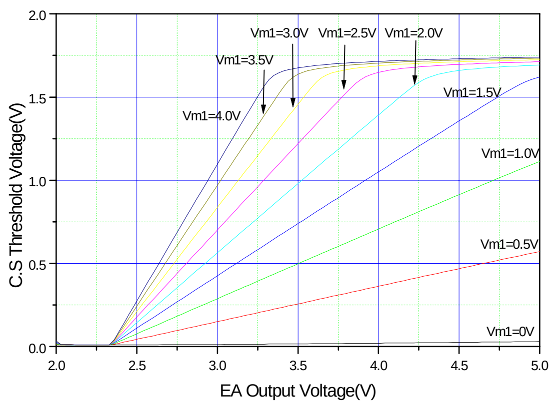


Figure 1. Error Amplifier Output Voltage vs Current Sensing Threshold

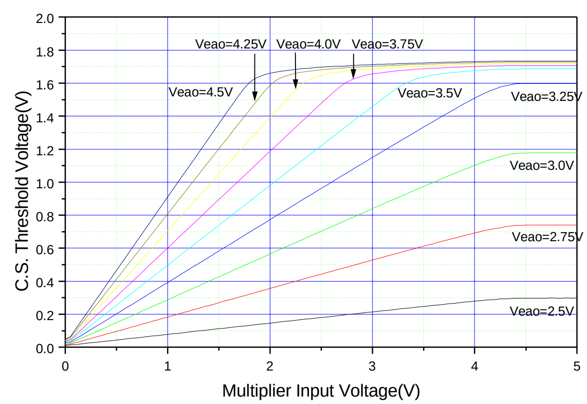


Figure 2. Multiplier Input Voltage vs Current Sensing Threshold

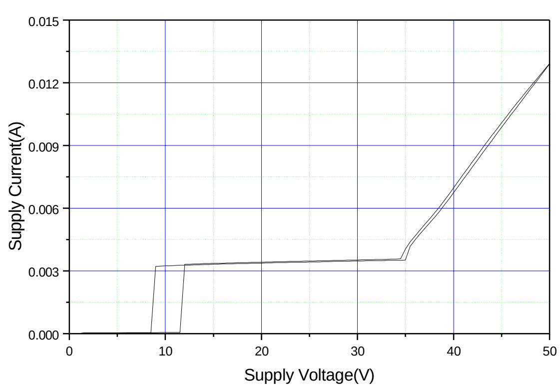


Figure 3. Supply Current vs Supply Voltage

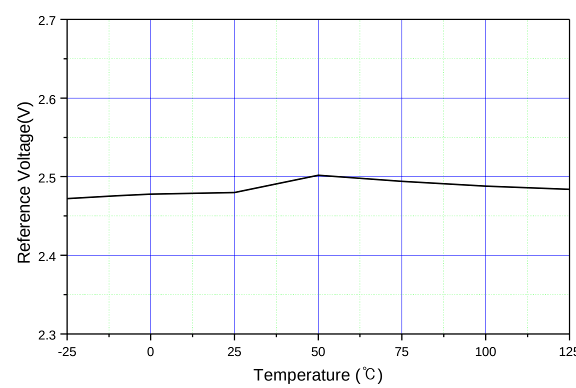


Figure 4. Reference Voltage vs Temperature

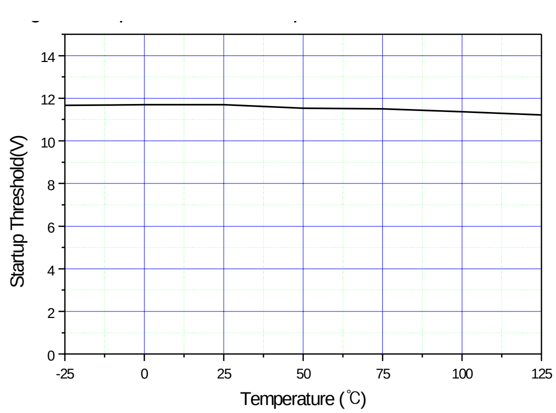


Figure 5. Start-Up Threshold vs Temperature

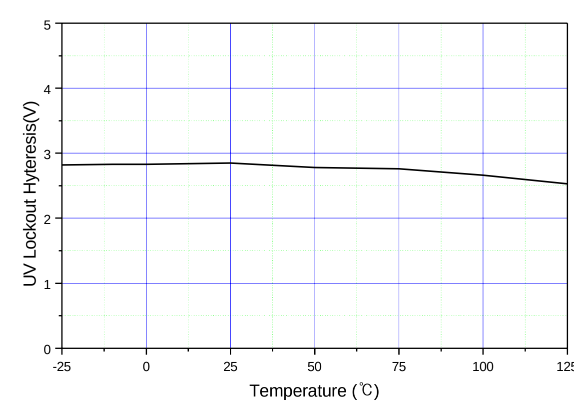


Figure 6. UV Lockout Hysteresis vs Temperature

Typical Performance Characteristics (continued)

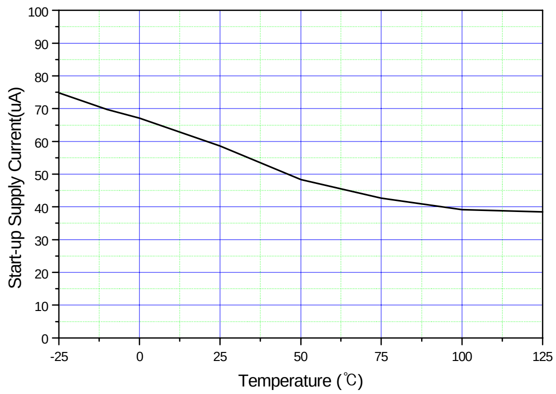


Figure 7. Start-Up Supply Current vs Temperature

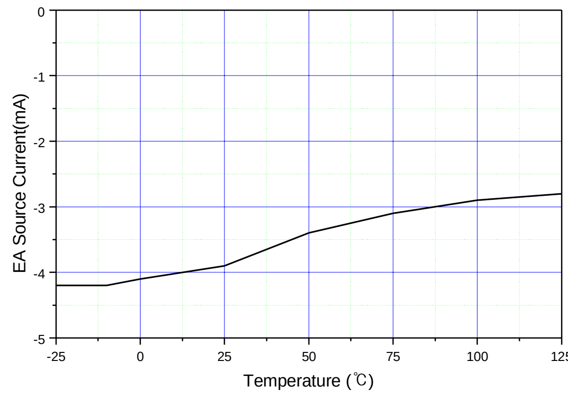


Figure 8. Error Amplifier Source Current vs Temperature

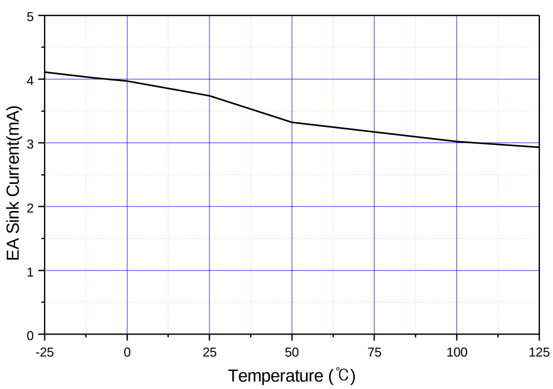


Figure 9. Error Amplifier Sink Current vs Temperature

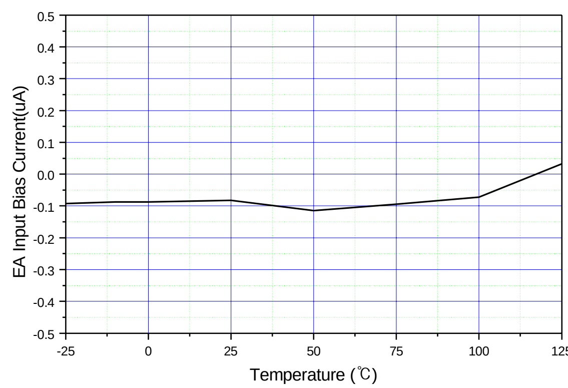


Figure 10. Error Amplifier Input Bias Current vs Temperature

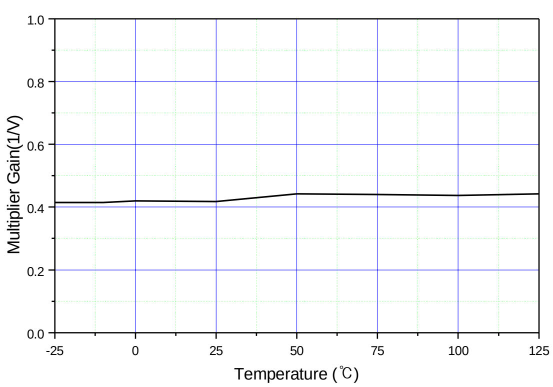


Figure 11. Multiplier Gain vs Temperature

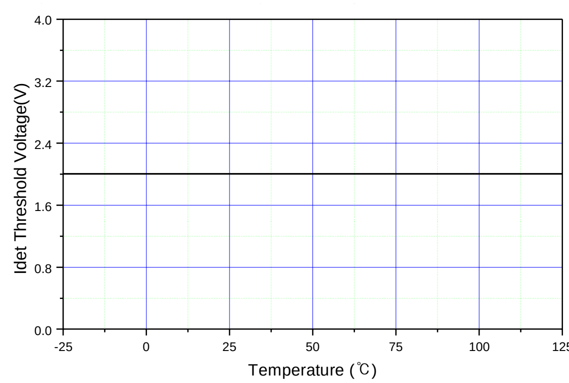


Figure 12. Idet Threshold Voltage vs Temperature

Typical Performance Characteristics (continued)

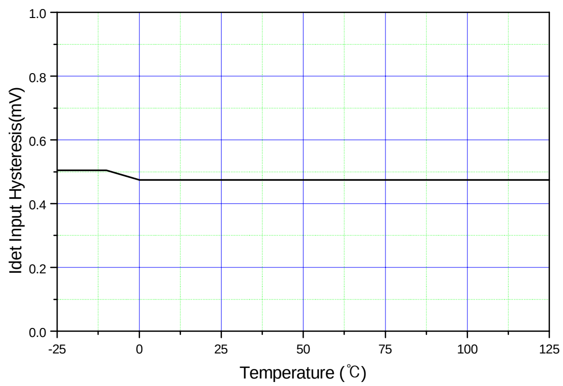


Figure 13. Idet Input Hysteresis vs Temperature

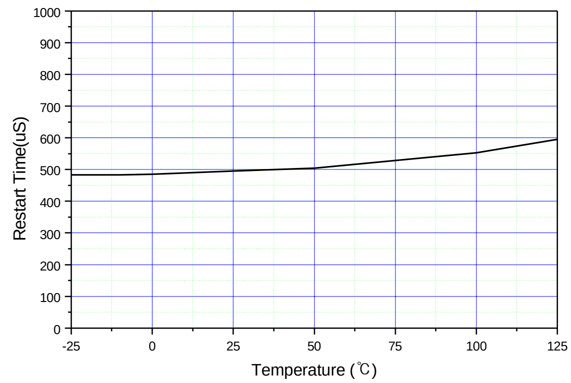


Figure 14. Restart Time vs Temperature

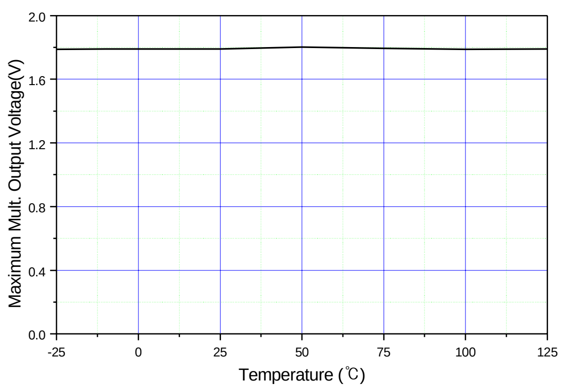


Figure 15. Max.Mult.Output Voltage vs Temperature

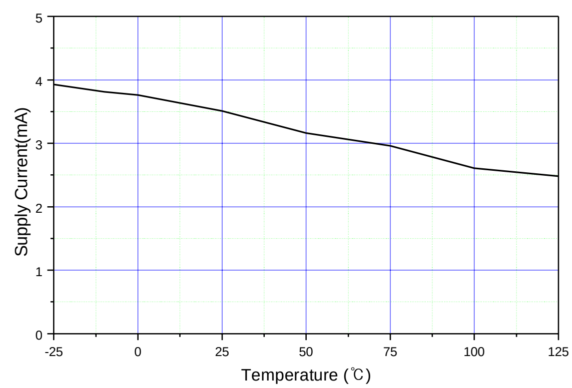


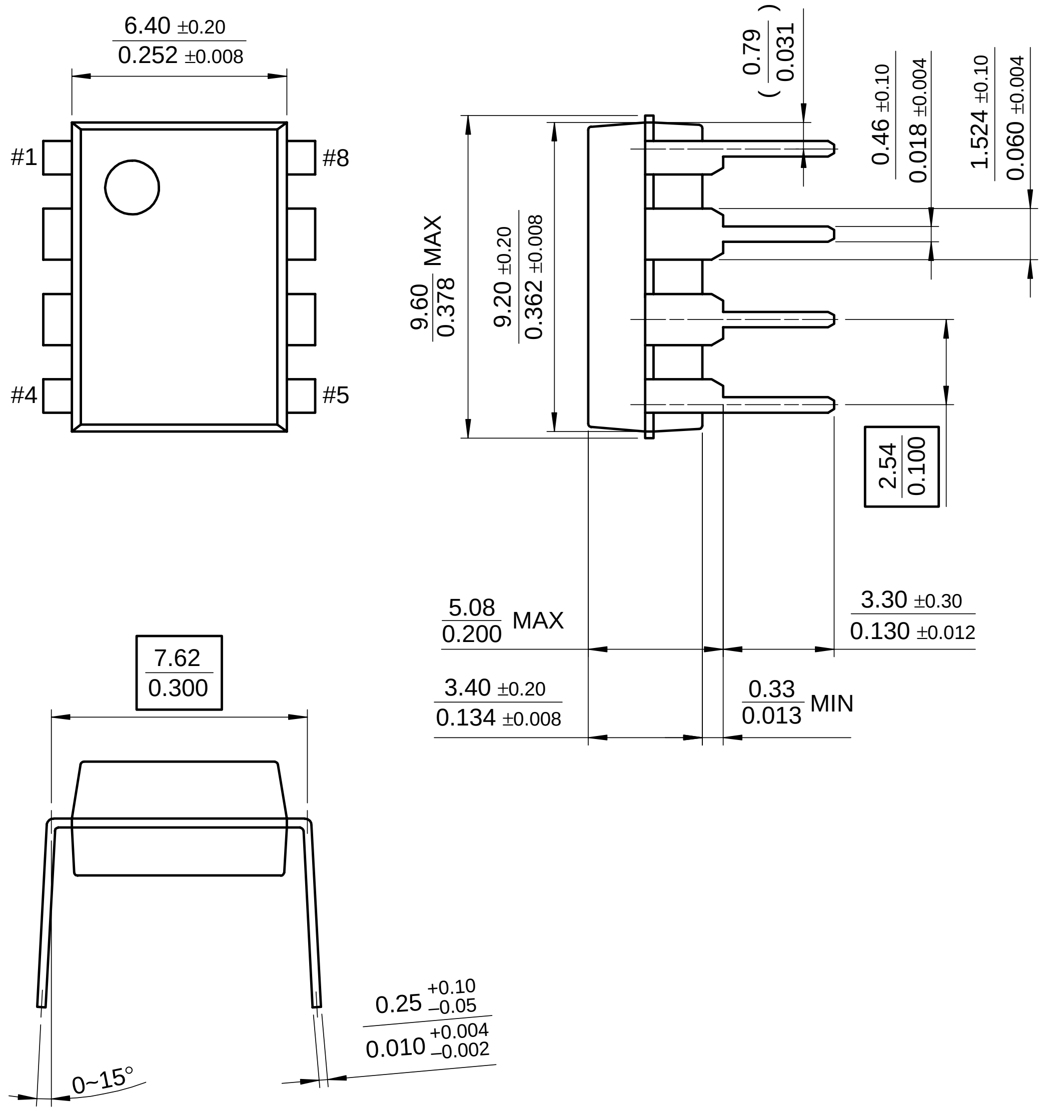
Figure 16. Supply Current vs Temperature

Mechanical Dimensions

Package

Dimensions in millimeters

8-DIP

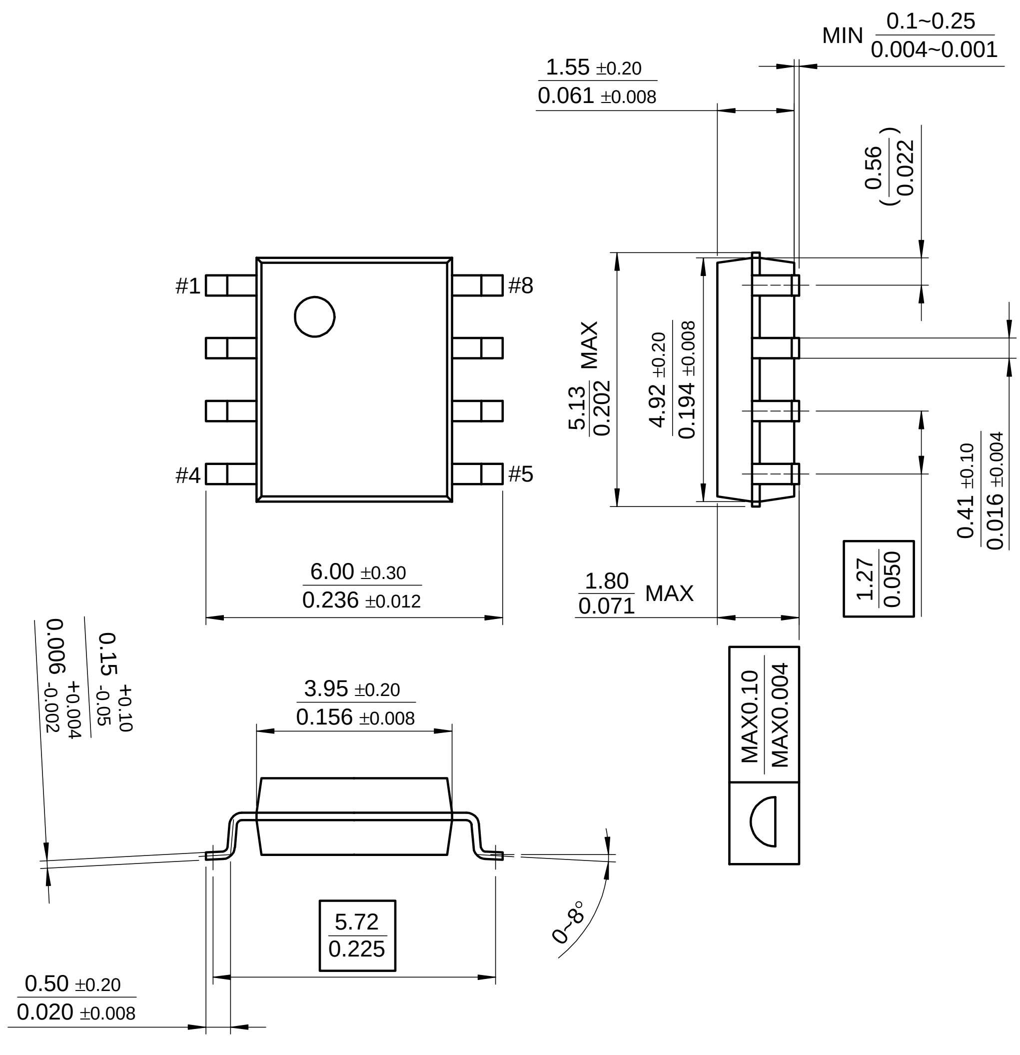


Mechanical Dimensions (Continued)

Package

Dimensions in millimeters

8-SOP



Ordering Information

Product Number	Package	Operating Temperature
FAN7527	8-DIP	-25 ~ +125^{o}C
FAN7527D	8-SOP	

DISCLAIMER

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