GENERAL DESCRIPTION

The 3HV96K series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V, 5V, 12V, and an adjustable output version.

Available in a standard 5-lead TO-220 package, 5-lead TO-263 surface mount package and SOP-8 package.

External shutdown is included, featuring typically 30 µA standby current. The output switch includes cycle-by-cycle current limiting, as well as thermal shutdown, and protection from output short for full protection under fault conditions.

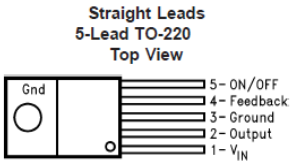
FEATURES

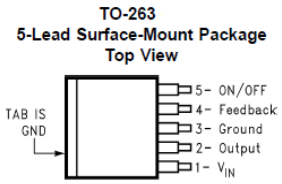
- 3.3V, 5V, 12V, and adjustable output versions
- Adjustable version output voltage range, 1.2V to 57V
- ±4% maximum over line and load conditions
- Available in TO-220 and TO-263 packages and SOP-8 (for Iload<2A)
- Guaranteed 3A output load current
- Input voltage range up to 60V
- Requires only 4 external components
- Excellent line and load regulation specifications
- 150 kHz fixed frequency internal oscillator
- Low power standby mode, I_{stb} typically 30 µA
- High efficiency
- Thermal shutdown and current limit protection
- Output short protection by reduction of frequency by 3 times.

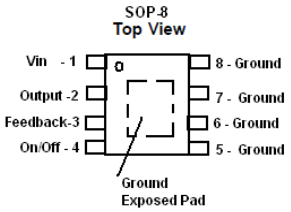
APPLICATIONS

- Simple high-efficiency step-down (buck) regulator
- On-card switching regulators
- Efficient pre-regulator for linear regulators

PIN CONFIGURATION



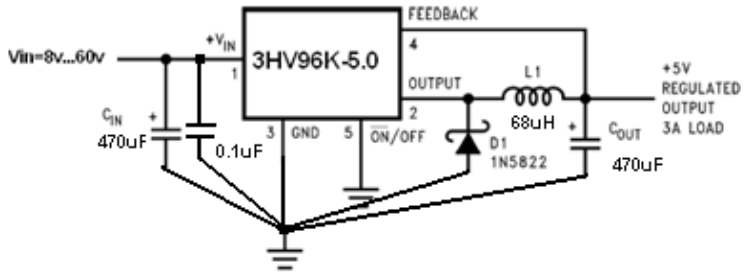




PIN ASSIGNMENT

Pin	SOP-8 (for Iload<2A)	Pin	TO-220, TO-263
1	Vin	1	Vin
2	Output	2	Output
3	FB	3	Gnd
4	On/Off	4	FB
5 to 8	Gnd	5	On/Off

Typical Application (Fixed Output Voltage Versions)



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Maximum supply voltage	V_{IN}	63	V
ON/OFF Pin input voltage	$V_{ON/OFF}$	-0.3 to 60, ≤ Vin	V
FB (Feedback) pin voltage	V_{FB}	-0.3 to 25, ≤ Vin	V
Output voltage to GND	V_{OUT}	-1	V
Power dissipation	P_D	Internally limited	W
Minimum ESD rating HBM (C=100pF, R=1.5k)	ESD	2.0	kV
Maximum junction temperature	$T_{J,max}$	150°C	°C

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Ratings	Unit
Temperature range	T_J	-40°C ≤ Tj ≤ +125°C	°C
Supply voltage	Vop	4.5 to 60	V
I_{LOAD}	I_{LOAD}	I_{LOAD} ≤ 3.0	A

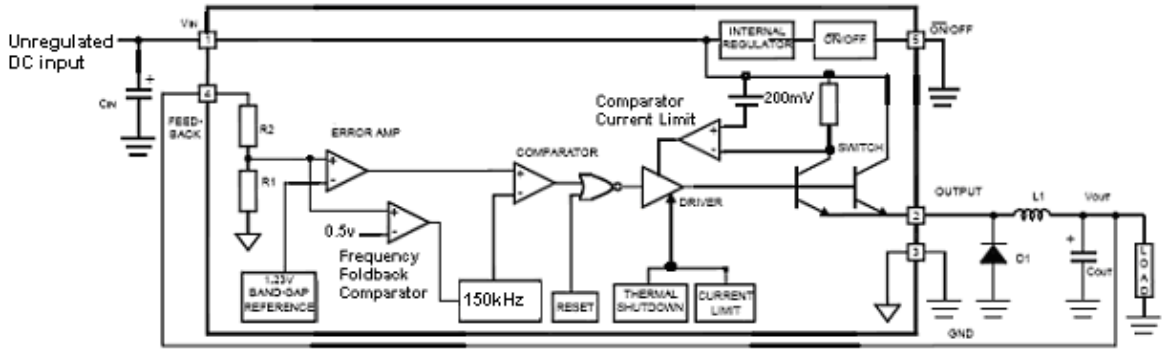
ELECTRICAL CHARACTERISTICS

Unless specified otherwise, V_{IN}=12V for the 3.3V, 5V and adjustable versions, I_{LOAD}=0.5A, V_{IN}=18V for 12V version.
The * denotes the specifications, which apply over full operating temperature range T_J = -40 to +125°C.

Parameter		Symbol	Conditions	*	Min	Typ	Max	Unit
SYSTEM PARAMETERS Test Circuit Figure 1								
Output voltage	3HV96K-3.3	V_{OUT}	5.5V ≤ V_{IN} ≤ 60V, 0.2A ≤ I_{LOAD}≤ 3A		3.185	3.300	3.432	V
				*	3.152		3.465	
	3HV96K-5.0		8V ≤ V_{IN} ≤ 60V, 0.2A ≤ I_{LOAD} ≤ 3A		4.825	5.00	5.20	V
				*	4.775		5.25	
	3HV96K-12		15V ≤ V_{IN} ≤ 60V, 0.2A ≤ I_{LOAD} ≤ 3A		11.58	12.00	12.48	V
				*	11.46		12.60	
	3HV96K-adj		8V ≤ V_{IN} ≤ 60V, 0.2A ≤ I_{LOAD} ≤ 3A		1.193	1.230	1.273	V
				*	1.180		1.285	
Line Regulation		Line Reg	8 ≤ V_{IN} ≤ 60V, I_{LOAD} = 0.2A			0.3		%
Load Regulation		Load Reg	10mA≤ I_{LOAD} ≤ 3A, V_{IN} = 12V			0.3		%
Efficiency	3HV96K -3.3	η	V_{IN}=12V, I_{LOAD}=3A			77		%
	3HV96K -5.0		V_{IN}=12V, I_{LOAD} =3A			79		
	3HV96K -12		V_{IN}=15V I_{LOAD}=3A			83		
	3HV96K -adj		V_{IN}=12V, I_{LOAD}=3A V_{OUT}=5V			79		
DEVICE PARAMETERS								
Quiescent current		I_Q	V_{FB}=12V force driver off			5	8	mA
Feedback bias current		I_{FB}	V_{FB}=1.3V (Adjustable version only)		-250	-70		nA
				*	-450			
Shutdown supply current		I_{STB}	$V_{ON/OFF}$=5V, V_{IN}=60V			30	220	µA
				*			280	
Oscillator frequency		F_{OSC}			133	150	168	kHz
				*	120		180	
Oscillator frequency of Short Circuit Protect (SCP)		F_{SCP}	When V_{OUT}<40% from nominal, I_{OUT}= CL			50		kHz
Max. duty cycle		$DC_{(Max)}$	V_{FB}=0V force driver on	*	100			%
Min. duty cycle		$DC_{(Min)}$	V_{FB}=12V force driver off (V_{FB}=15V for -12V version)	*			0	%

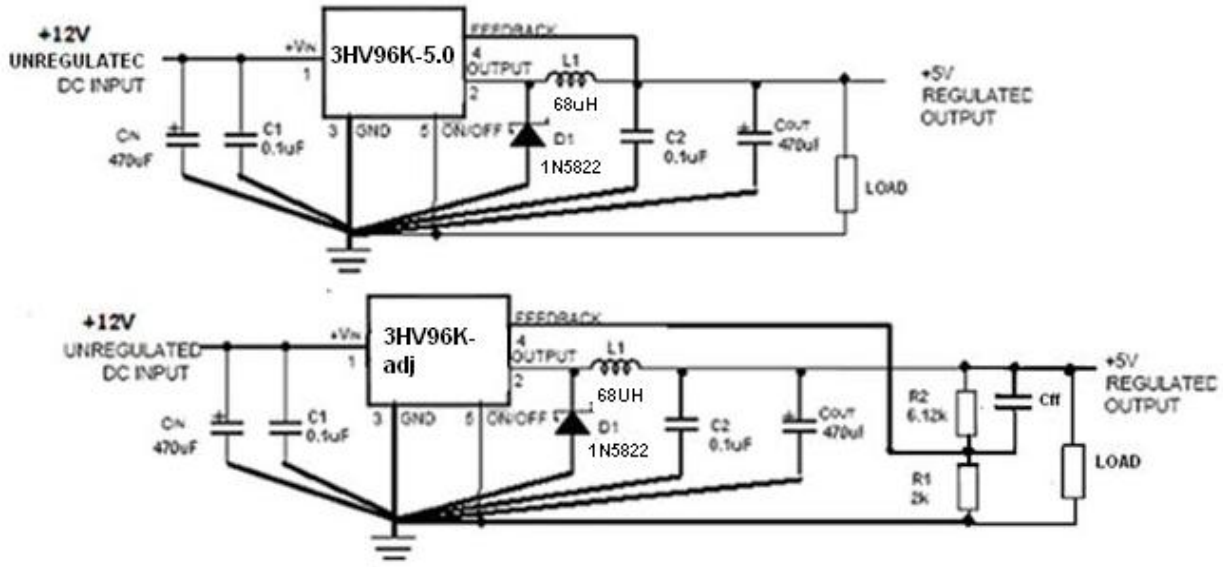
Current limit	CL	Peak current. No outside circuit. V_{FB}=0V		4.1	5.3	6.7	A
			*	3.8		7.0	
Saturation voltage	V_{SAT}	I_{OUT}=3A. No outside circuit. V_{FB}=0V			1.35	1.50	V
			*			1.70	
Output leakage current	I_L	V_{OUT}=0V. No outside circuit. V_{FB}=12V		-300	-50		µA
Output leakage current	I_{L1}	V_{OUT}=-1V. No outside circuit. V_{FB}=12V		-30	-3		mA
ON/OFF input threshold	V_{TH}		*	0.6	1.3	2.0	V
ON/OFF input current	I_H	$V_{ON/OFF}$=2.5V		-5	-0.1	5	µA
ON/OFF input current	I_L	$V_{ON/OFF}$=0.5V		-1	-0.01	1	µA
Thermal shutdown temperature	T_{SD}	T_J			160		°C

BLOCK DIAGRAM



For ADJ Version
R1 = Open, R2 =0Ω

TEST CIRCUIT AND LAYOUT GUIDELINES



Vout =Vref*(1+R2/R1), where Vref=1.23V; R1 between 1k and 5k.

FIGURE 1.

For minimal inductance and ground loops, the wires indicated by **heavy lines should be wide printed circuit traces and kept as short as possible.** Keep the FEEDBACK wiring away from the inductor flux.
Cff~1 to 10nF – as option.

TYPICAL CHARACTERISTICS

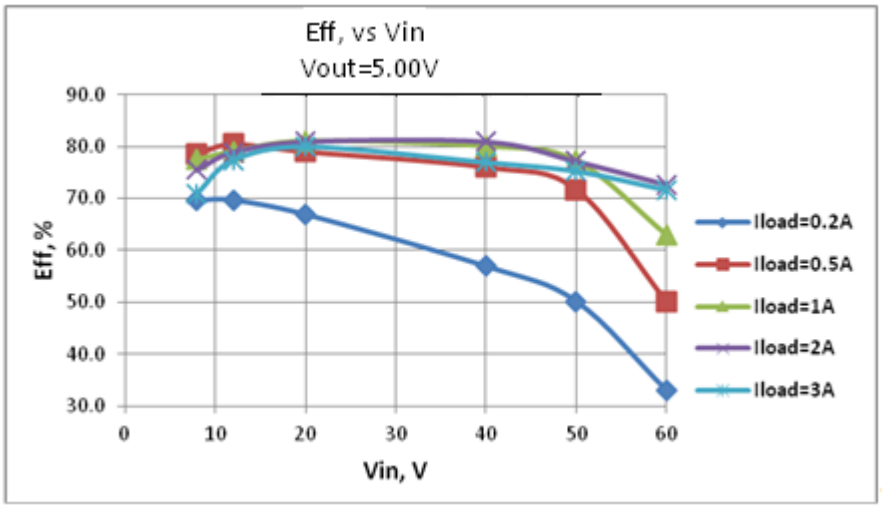


Fig.1. Eff, vs Vin

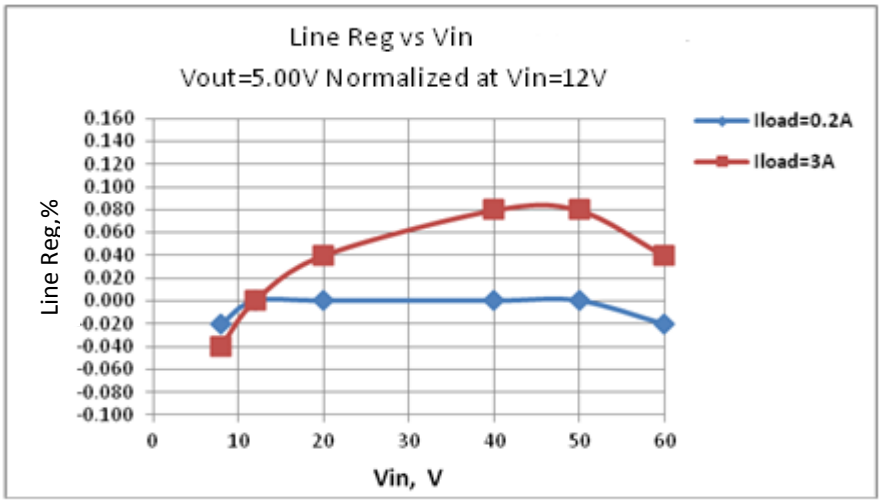


Fig.2. Line Reg vs Vin

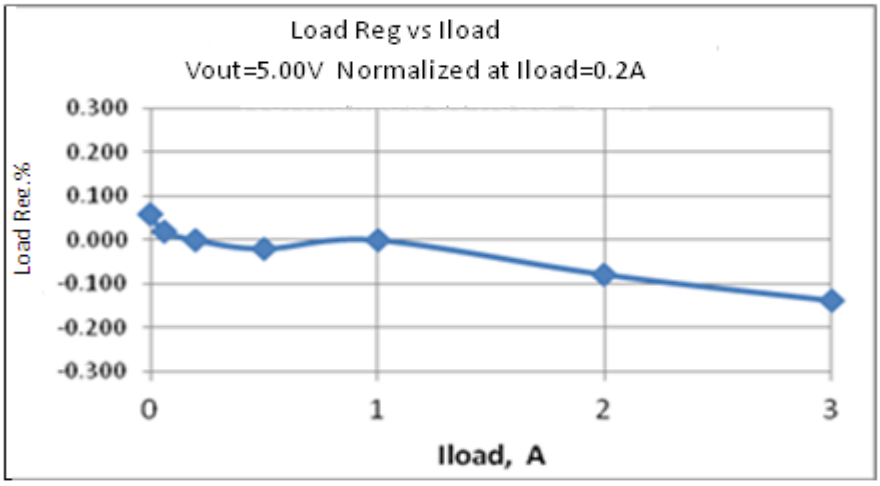


Fig.3. Load Reg vs Iload

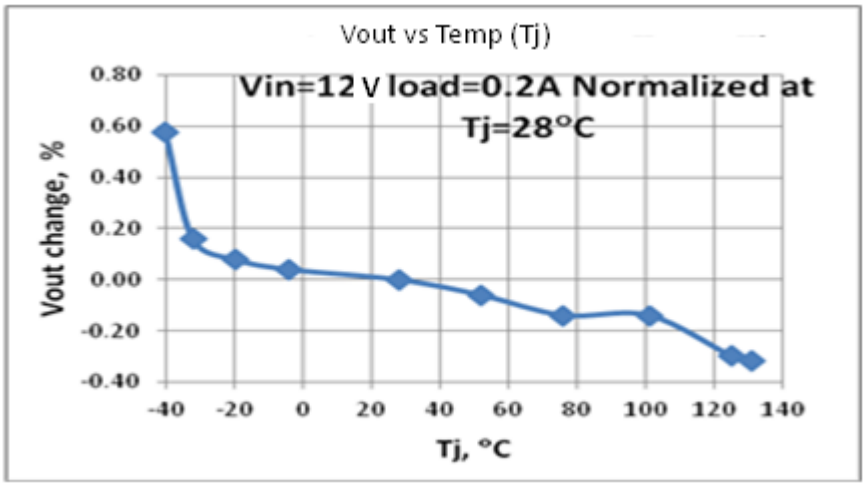


Fig.4. Vout vs Temp (Tj)

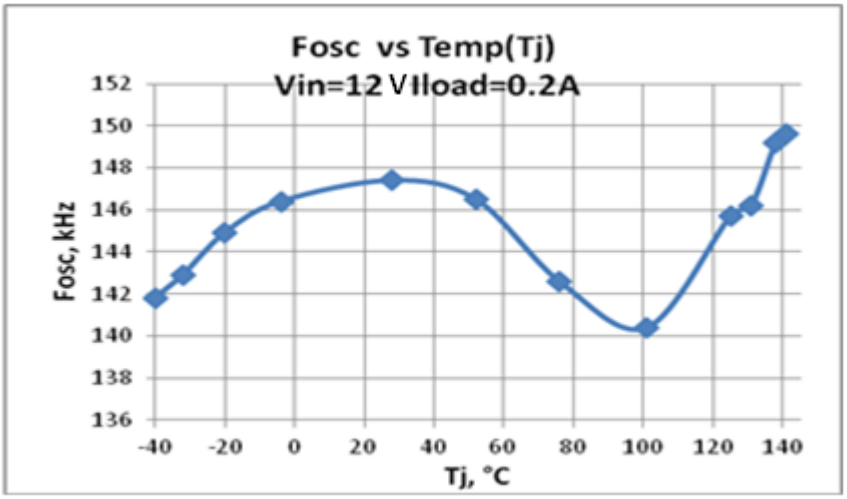


Fig.5. Fosc vs Temp (Tj)

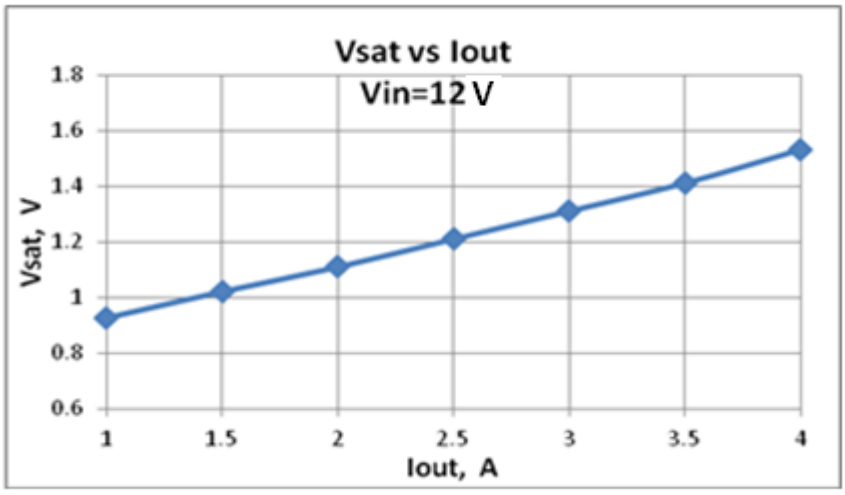


Fig.6. Vsat vs Iout

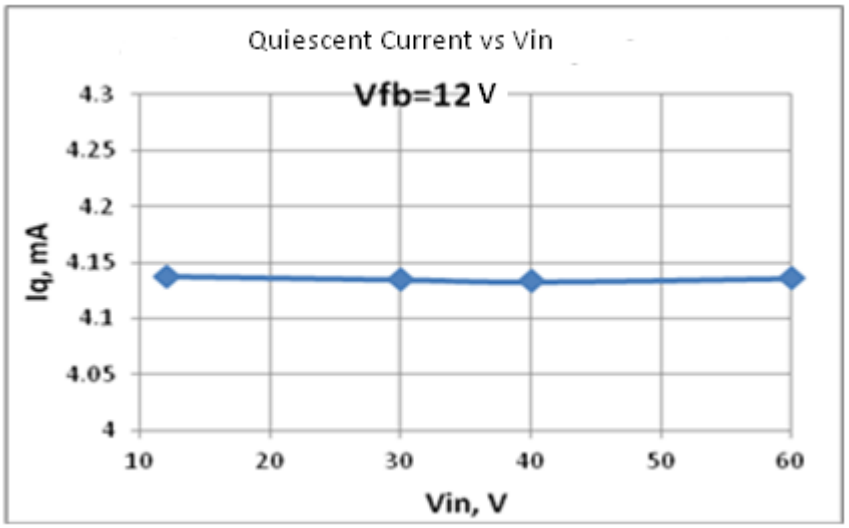


Fig.7. Quiescent Current vs Vin

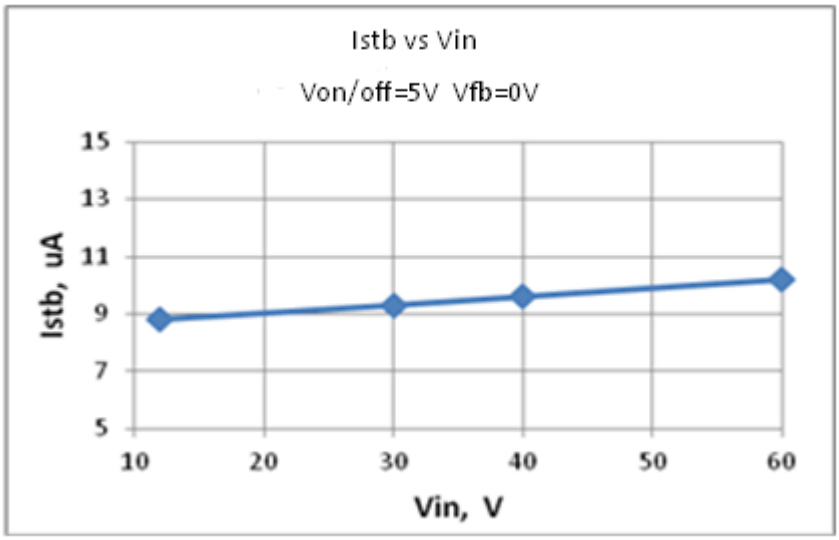
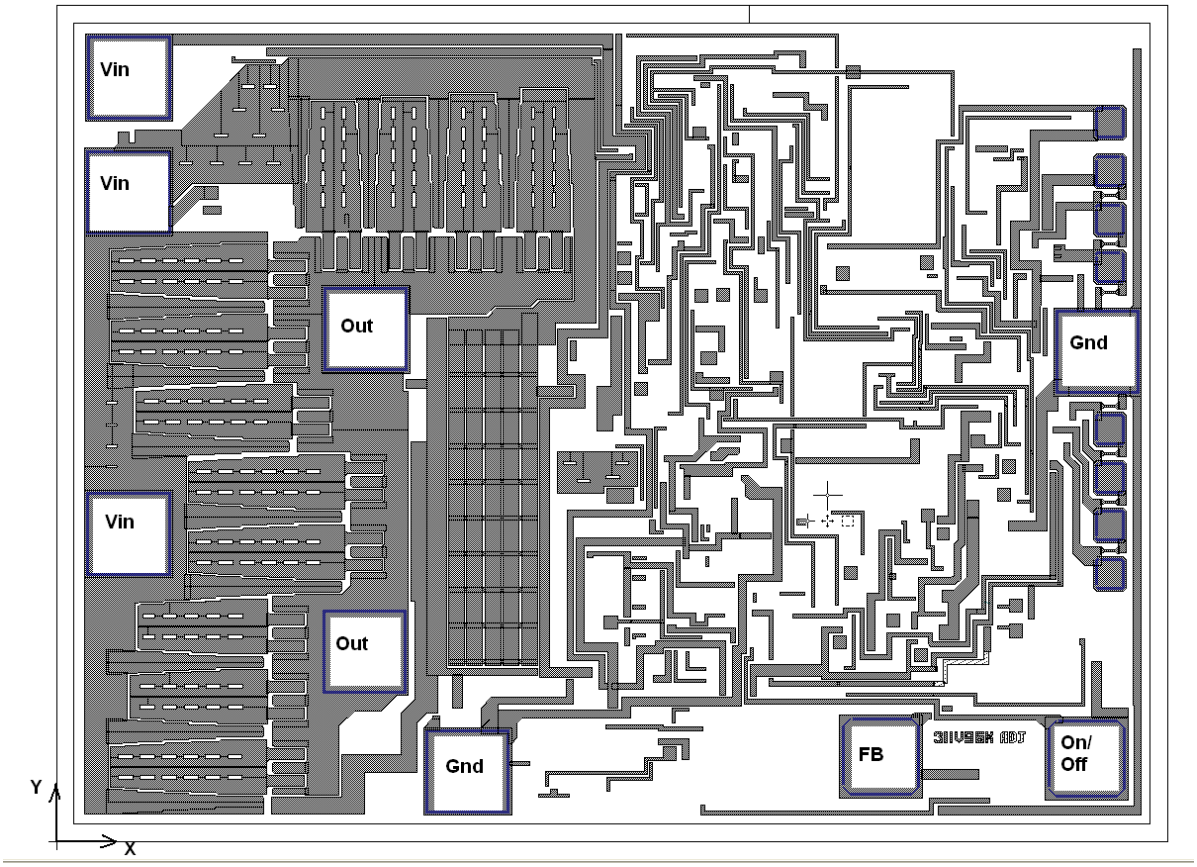


Fig.8. Istb vs Vin

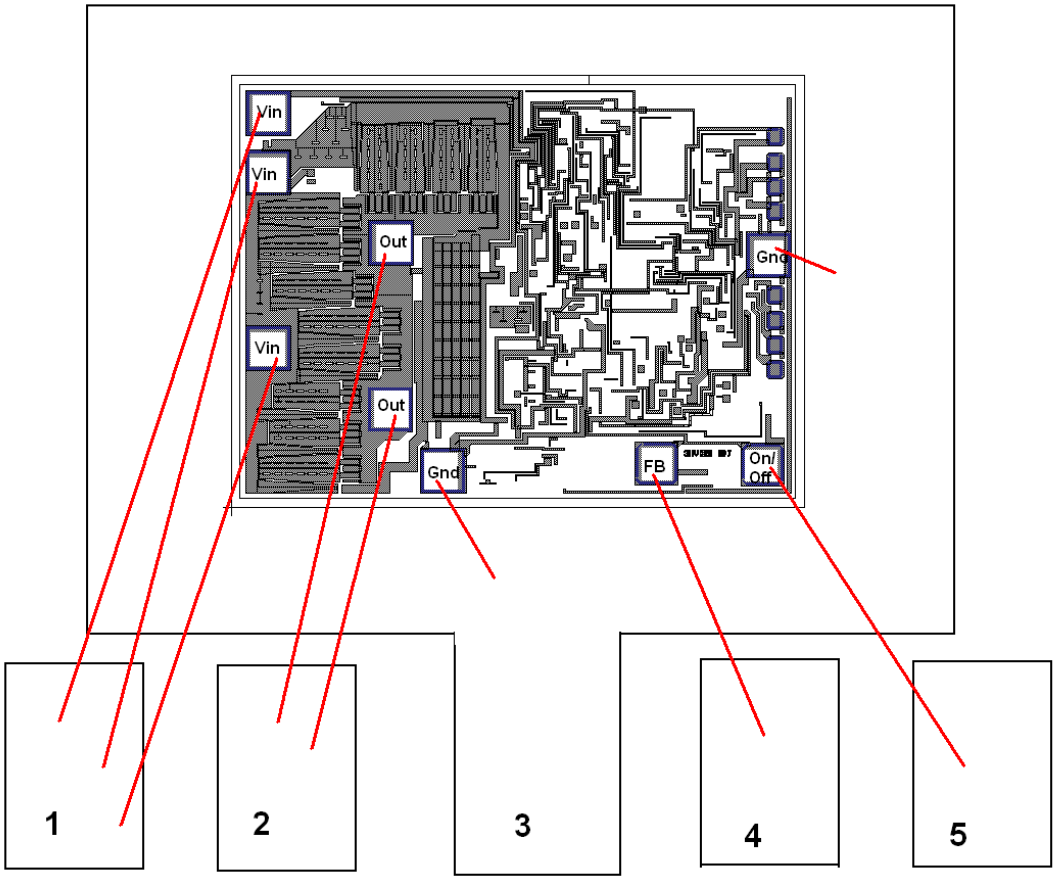
PAD LOCATION AND COORDINATES



Die size (including scribe line): 2.54×1.91mm^2

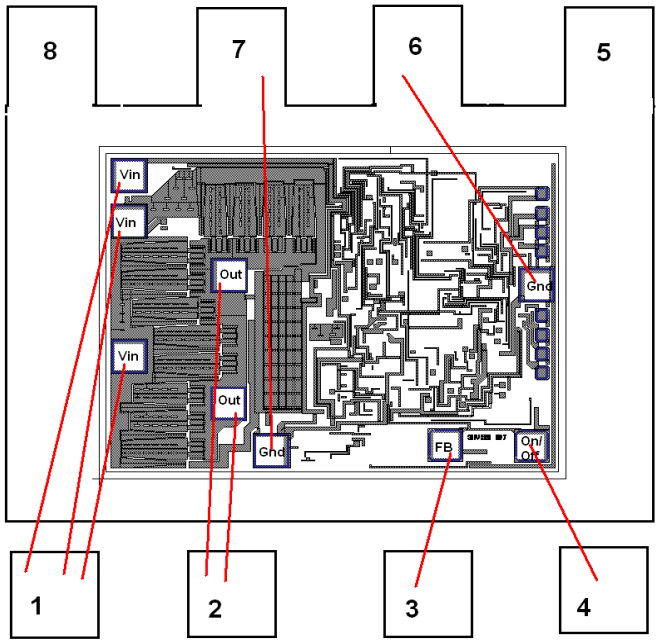
Name (Package)	Pad centers coordinates (µm)		Pad Size (µm×µm)
	X	Y	
Vin	165	703	190×190
Vin	165	1483	190×190
Vin	165	1745	190×190
Output	704	434	190×190
Output	707	1170	190×190
Gnd	940	160	190×190
FB	1885	194	178×178
On/Off	2355	189	178×178
Gnd	2380	1117	190×190

BONDING DIAGRAM



TO-220, TO-263 Package

BONDING DIAGRAM



SOP-8 Package (for Iload<2A)

ASSEMBLY CHARACTERISTICS

No.	Assembly Characteristics	Value
1	Wafer Size	6 Inch
2	Wafer Thickness before Grinding	675 +/-25 µm
3	Scribe Street Width	80 µm
4	Chip Size (including Scribe Line)	2.54×1.91 mm^2
5	Die Attach Material	Substrate is connected to GND
6	Quantity of Bond Pad Metal Layers	2
7	Pad Thickness	2.25 µm
8	Composition of Metal Layers	Al+Si(1.0%)+Ti(0.5%)
9	Min. Bond Pad Opening Size	178×178 µm
10	Min. Bond Pad Pitch	261 µm
11	Min. Wire Diameters	3 mil (76.2 µm) – for Iload =3A 2 mil (50.8 µm) – for Iload =2A
12	Circuit Under Pad Design (CUP)	No

ADDITIONAL INFORMATION

Pb-free products:

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.

Green products:

- Lead-free (RoHS compliant)
- Halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

The appearance complies with the requirements of the company standards