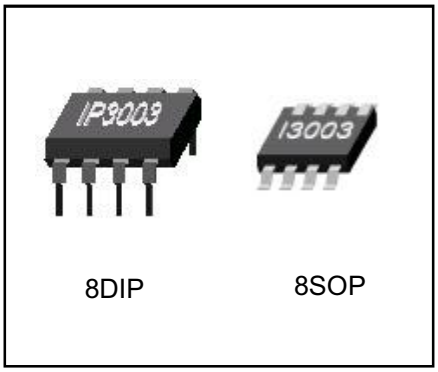
IP3003 / I3003

Power Factor Correction

DESCRIPTIONS

It is Adaptable to a Discontinuous Mode of Operation that the IP3003 is Advanced PFC (Power Factor Correction) Controller for the High Density Switching Mode Power Supply and Electronic Ballast systems. The Bulky External components are eliminated in the Internal Start-up circuits, though it is taken in Independent Boost Converter Operation. What is more, instead of the External components, the Low Pass Filter is mounted in Internal Current Sense block. Internal Clamping of the Error Amplifier and Multiplier Output improve turn on Overshoot Characteristics and Current Limiting. The One of features is able to prevent Abnormal Condition, Open Lamp & Over Voltage.



APPLICATIONS

- Switching Mode Power Supply (SMPS)
- Electronic Ballast

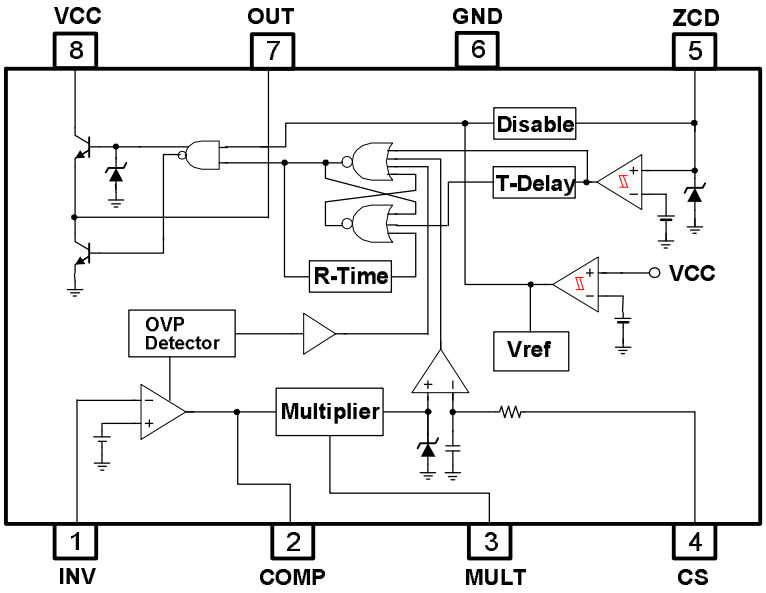
FEATURES

- Very Precise Adjustable Output OVP (Dynamic & Static OVP Function)
- Extremely Low Start-Up Current
- Low Operating Supply Current
- Internal Start-Up Timer
- Power Factor Maximizer & THD Minimizer Circuit
- Complete Wide Range Operation
- Feedback Open Protection
- Minimum On Timer
- Current Sense Filter On Chip
- Disable Function
- Extremely Minimized External Part Counts

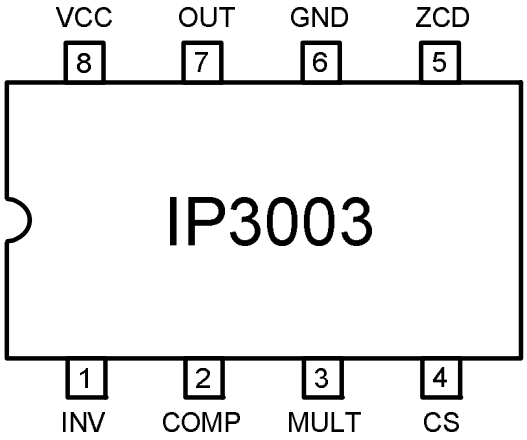
ORDER INFORMATION

Order Part	PKG	Marking	Plating	Packing
IP3003	8DIP	IP3003	-	Tube
IP3003L		IP3003L	Lead Free	Tube
I3003	8SOP	I3003	-	Tube
I3003-TF			-	T & R
I3003L		I3003L	Lead Free	Tube
I3003L-TF				T & R

BLOCK DIAGRAM



PIN CONNECTIONS



PIN DESCRIPTIONS

NO	SYMBOL	I/O	DESCRIPTION
1	INV	I	Inverting Input of Error Amplifier
2	COMP	O	Output of Error Amplifier
3	MULT	I	Multiplier Input
4	CS	I	Current Sense Input
5	ZCD	I	Zero Current Detect
6	GND	–	Ground
7	OUT	O	Totem-Pole Output
8	VCC	–	Power Supply Voltage

ABSOLUTE MAXIMUM RATINGS

CHARACTERISTICS	SYMBOL	VALUE	UNIT
Maximum Supply Voltage	Vccmax	27	V
Output Peak Current	Ipeak	±500	mA
Analog Inputs & Outputs (Pin 1,2,3,4,5)	Vinmax	–0.3 ~ 7	V
ZCD Input Maximum Current	Izcd	±10	mA
Power Dissipation (8DIP)	Pdmax	800	mW
Power Dissipation (8SOP)	Pdmax	600	mW
Operating Junction Temperature	Tj	–35 ~ 150	°C
Storage Temperature	Tstg	–55 ~ 150	°C

ELECTRICAL CHARACTERISTICS

(Ta = –25°C to 125°C, VCC=14V unless otherwise specified.)

CHARACTERISTICS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage & Current Section						
Vcc Tun-On Threshold	Vcc(On)	VCC Increasing	11	12	13	V
Vcc Tun-Off Threshold	Vcc(Off)	VCC Decreasing	8.7	9.5	10.3	V
Hysteresis Voltage	HYS		2	2.5	3	V
Start-Up Current	Ist	Before Turn-On	20	40	70	uA
Quiescent Current	Iq	No Switching	1	4	6	mA
Operating Supply Current	Icc	CL=1nF, fsw=50KHz	2	5	8	mA
Operating Current at OVP	Icc_ovp	Vinv=2.7V	0.5	2	4	mA
Operating Current at Disable	Icc_dis	Vzcd<150mV	0.5	2	4	mA
Error Amplifier Section						
Input Volatge	Vinv	Ta=25°C	2.465	2.5	2.535	V
Line Regulation	dVinv	VCC=12 ~ 27V	–	0.1	5	mV
Input Bias Current	Iinv		–0.5	–0.1	0.5	uA
Open Loop Gain	Av		60	80	–	dB
Gain Bandwidth	GB		–	1	–	MHz
Output Source Current	Isource	Vcomp=4V,Vinv=2.4V	–2	–4	–	mA
Output Sink Current	Isink	Vcomp=4V,Vinv=2.6V	3	5	–	mA
Upper Clamp Voltage	Vupper	Io=–100uA,Vinv=2.4V	–	5.6	–	V
Lower Clamp Voltage	Vlower	Io=100uA,Vinv=2.6V	–	2.25	–	V
Feedback Open Protection Threshold Voltage	Vfo	Vinv Decreasing	150	200	250	mV

ELECTRICAL CHARACTERISTICS (Continued)

(Ta = –25°C to 125°C, VCC=14V unless otherwise specified.)

CHARACTERISTICS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Multiplier Section						
Linear Operating Voltage	Vmult		2.8	3.2	–	V
Output Maximum Slope	dVcs/dVmult	Vmult=0.5~0.9V, Vcomp=Upper Clamp	1.3	1.5	1.7	V/V
Multiplier Gain	K	Ta=25°C Vmult=1V, Vcomp=3.5V	0.5	0.65	0.75	1/V
Current Sense (CS) Section						
Reference Clamp Volatge	Vcs	Vmult=2.5V, Vcomp=Upper Clamp	1.65	1.75	1.85	V
Input Bias Current	Ics	Vcs=0~1.6V	-0.5	-0.1	0.5	uA
Delay to Output	TdHL		–	200	–	ns
Zero Current Detector (ZCD) Section						
Input Threshold Voltage	Vzcd	Vzcd Increasing	1.8	2.1	2.4	V
Hysteresis Voltage	HY(zcd)		–	0.5	–	V
Upper Clamp Voltage	Vclamp(H)	Izcd=3mA	4.8	5.4	6	V
Lower Clamp Voltage	Vclamp(L)	Izcd=–3mA	0.3	0.6	–	V
Input Bias Current	Izcd	Vzcd=1~3V	–	1	–	uA
Source Current	Isource(zcd)		–3	–	–	mA
Sink Current	Isink(zcd)		3	–	–	mA
Disable Input Voltage	Vdis	Vzcd Decreasing	150	200	250	mV
Reset Current after Disable	Idis	Pin5=0V	–30	–80	–	uA
Restart Timer Section						
Restart Time delay	trst		70	130	300	us

ELECTRICAL CHARACTERISTICS (Continued)

(Ta = −25°C to 125°C, VCC=14V unless otherwise specified.)

CHARACTERISTICS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Output Section						
Output High Voltage	Voh	Io=−10mA	10.5	11.5	12.5	V
		Io=−100mA	10	11	12	V
Maximum Voltage	Vomax	VCC=20V,Io=−1mA	11	13	15	V
Output Low Voltage	Vol	Io=10mA	–	0.1	0.6	V
		Io=100mA		1.2	2.5	V
Output Voltage with UVLO Activated	Vo(uv)	Io=1mA	–	–	1	V
Minimum On Time	Ton(min)		–	150	–	ns
Output Rising Time	tr	CL=1nF	–	50	–	ns
Output Falling Time	tf	CL=1nF	–	50	–	ns
Over Voltage Protector (OVP) Section						
Dynamic OVP Current	Iovp		35	40	45	uA
Dynamic OVP Current Hysteresis	Iovp(hys)		–	30	–	uA
Static OVP Threshold Voltage	Vovp	Vinv=2.7V	2.1	2.25	2.4	V

APPLICATION INFORMATIONS

1. Main Inductor

$$L = \eta * (V_O - V_P) * V_P^2 / (4 * V_O * P_O * f)$$

Where,
- η: Efficiency (0.95)
- V_O: DC Link Voltage
- V_P: Input Peak Voltage
- P_O: Output Power
- f: Switching Frequency

2. Resistor for Current Sense

$$R_S = 1.75 / I_{LP}$$

Where,
- I_{LP}: Inductor Peak Current

3. Resistors for Multiplier

$$R_{ML} < 0.69 * R_{MU} / (V_P - 0.69)$$

Where,
- R_{MU}: Upper Resistor for Multiplier Input
- R_{ML}: Lower Resistor for Multiplier Input

4. Resistors for Error Amplifier

$$R_{EL} = 2.5 * R_{EU} / (V_O - 2.5)$$

Where,
- R_{EU}: Upper Resistor for Error Amplifier Inverting Input
- R_{EL}: Lower Resistor for Error Amplifier Inverting Input

APPLICATION INFORMATIONS (Continued)

5. Over Voltage Protector (OVP)

$\Delta V_O[V] = R_{EU}[\Omega] * 40[uA]$

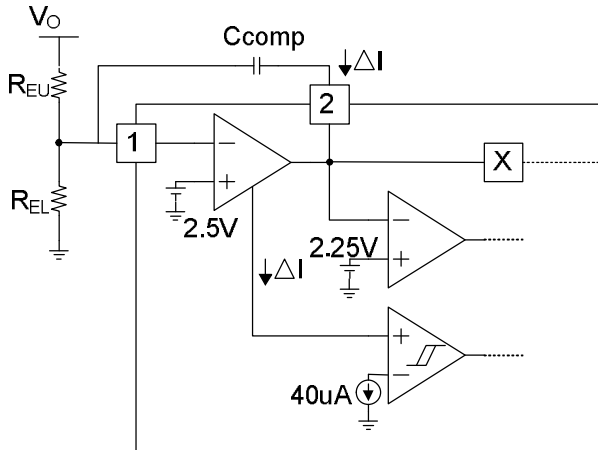


Fig.1 : Over Voltage Protection Circuit

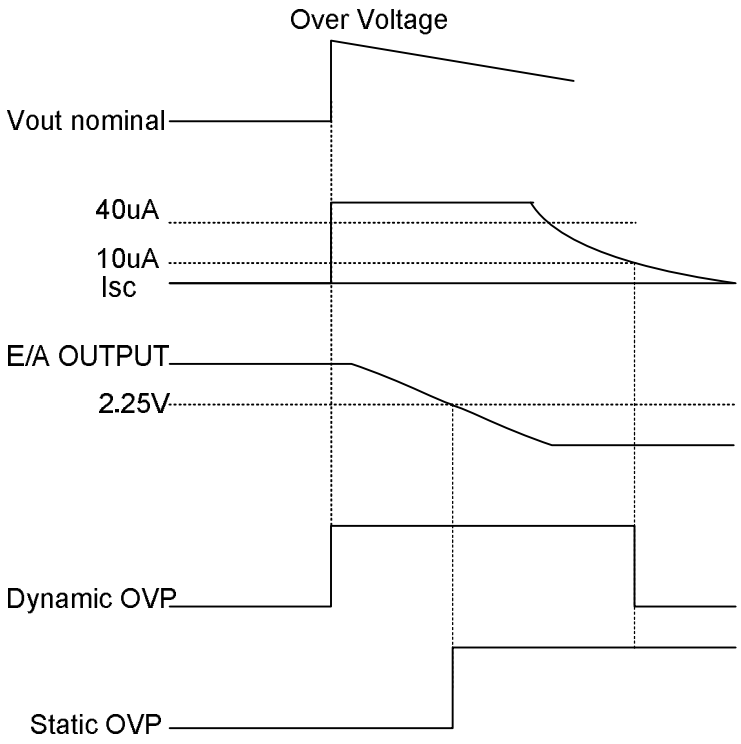
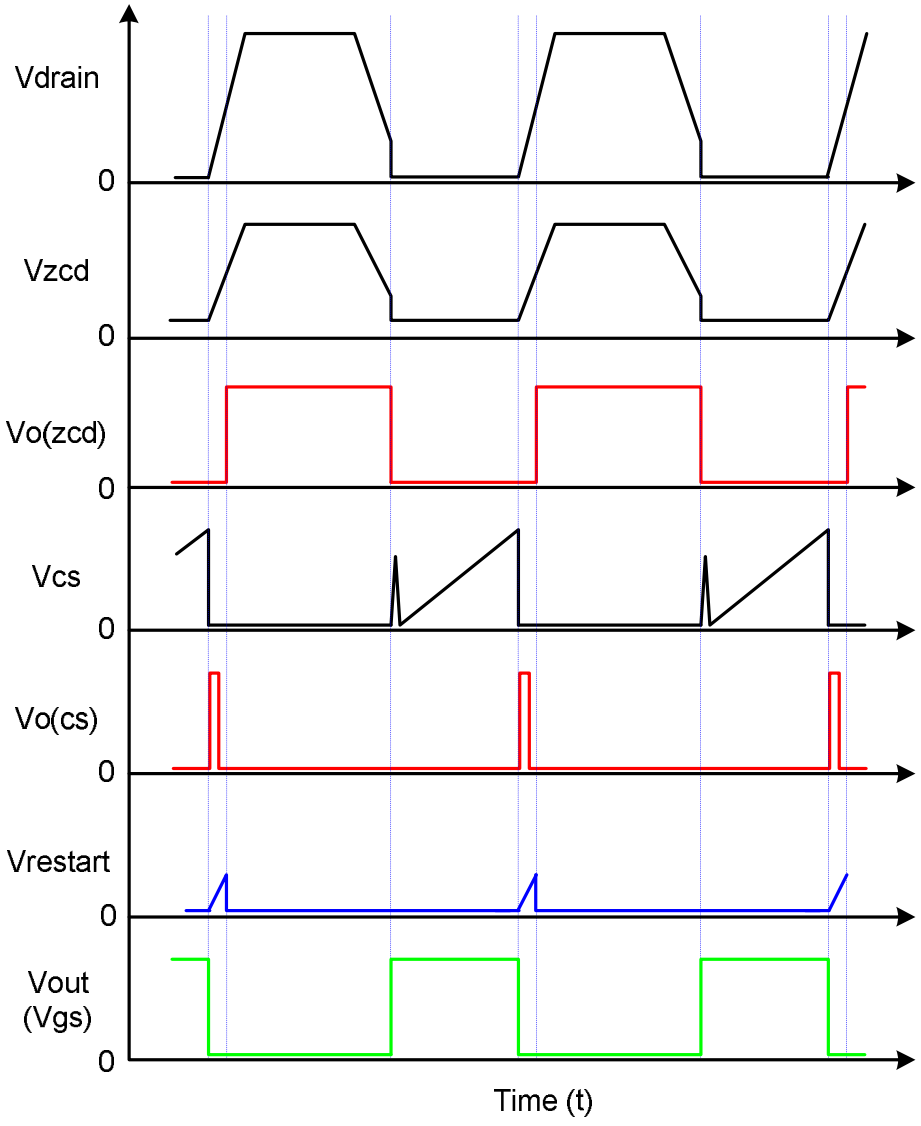
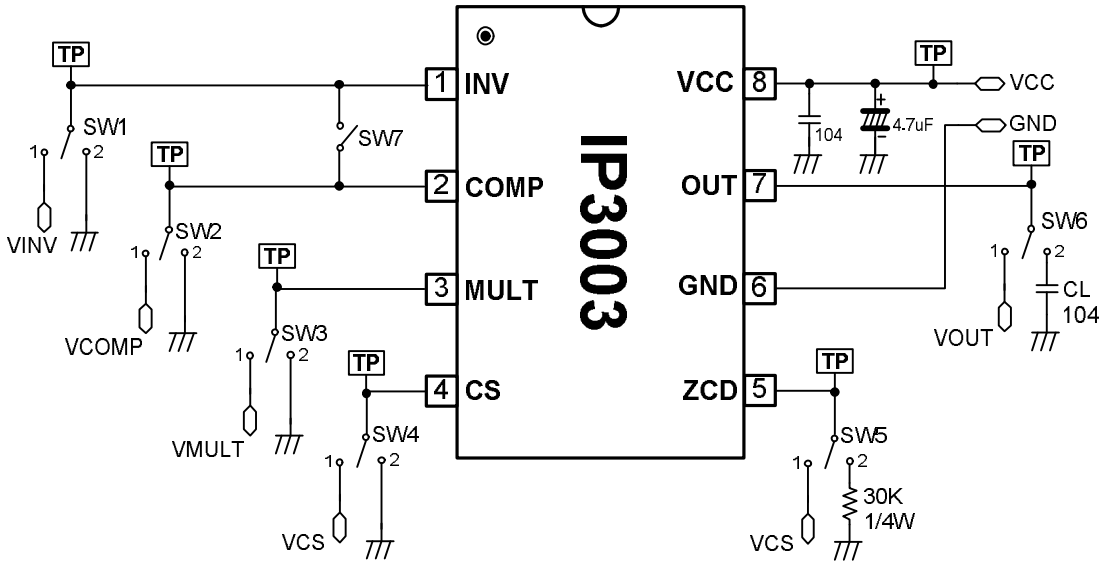


Fig.2: OVP Operation Timing Chart

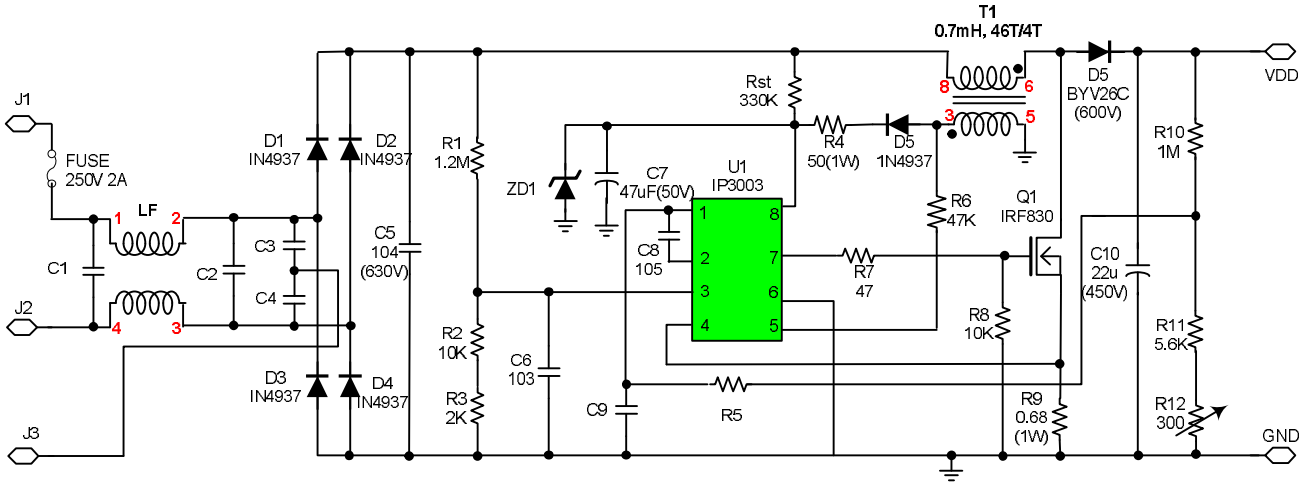
OPERATING TIMING CHART



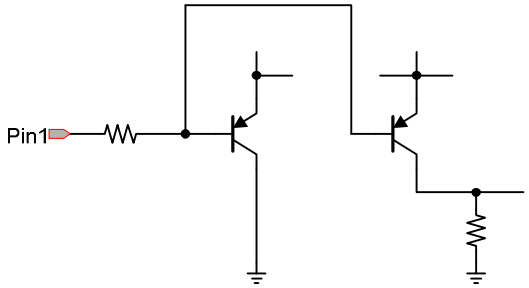
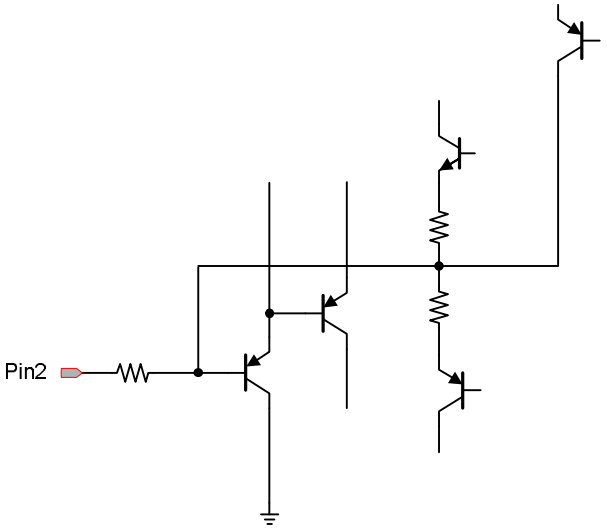
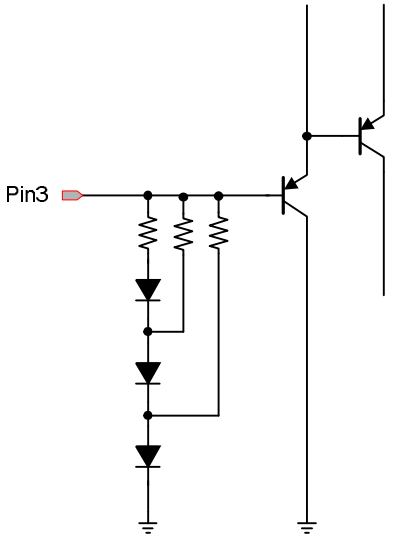
TEST CIRCUITS



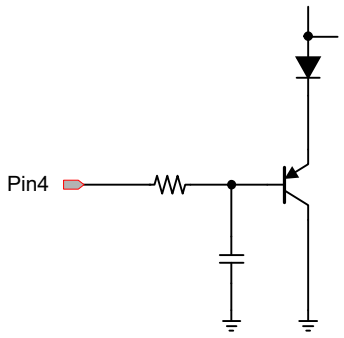
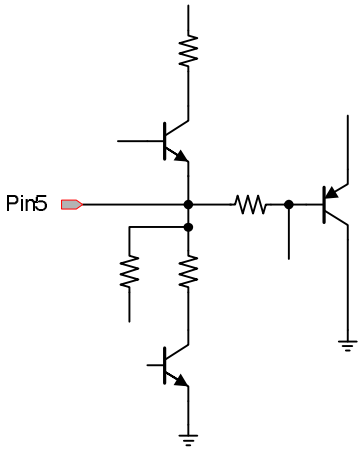
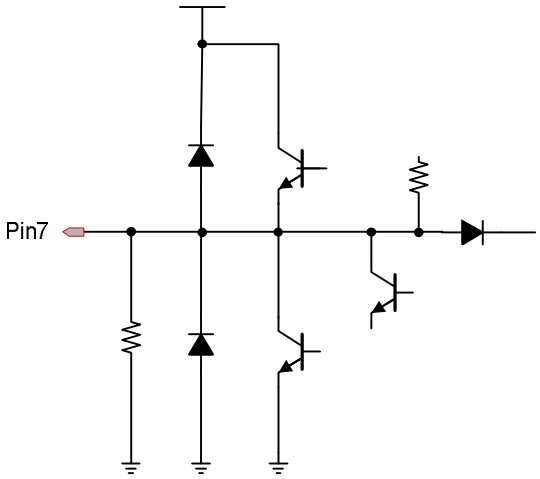
TYPICAL APPLICATION CIRCUIT (90VAC ~ 270VAC, 80W)



INTERNAL CIRCUIT

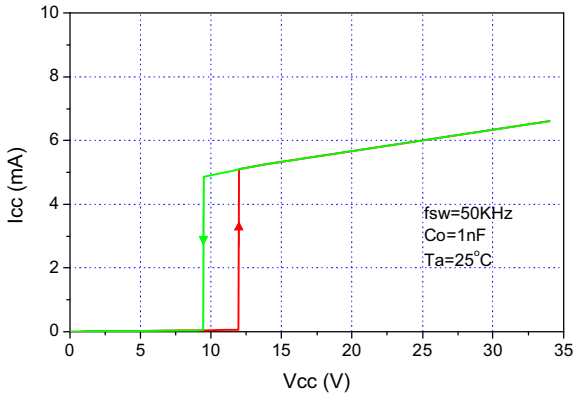
Pin no	Pin name	Internal circuit
1	INV	
2	COMP	
21	MULT	

INTERNAL CIRCUIT

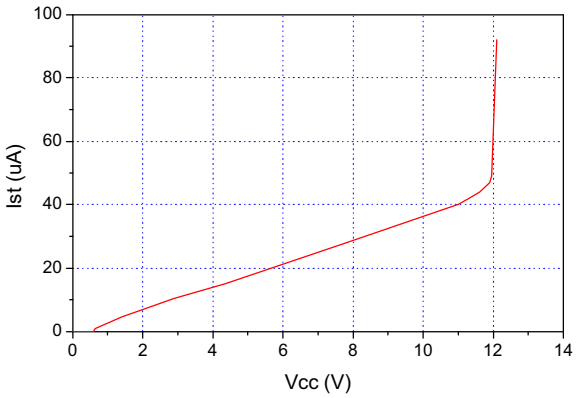
Pin no	Pin name	Internal circuit
4	CS	
5	ZCD	
7	OUT	

ELECTRICAL CHARACTERISTICS CURVES

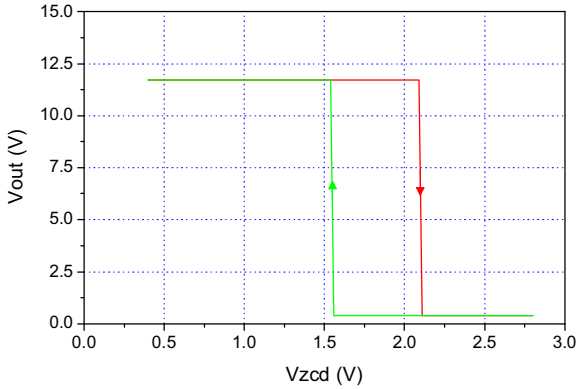
Operating Supply Current



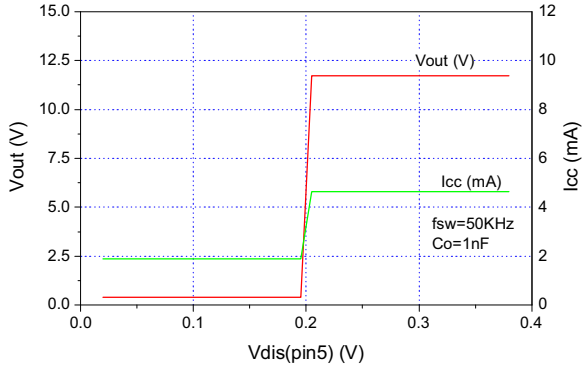
Vcc Start-up Current



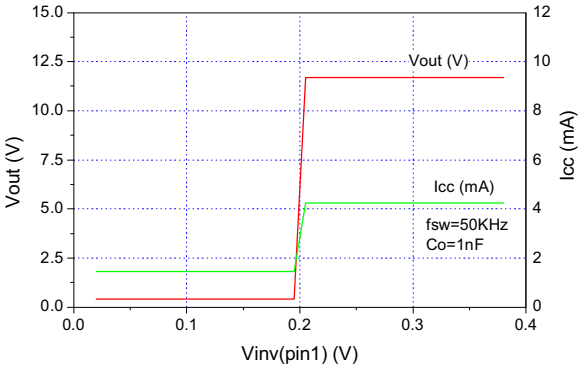
ZCD Input Threshold Voltage



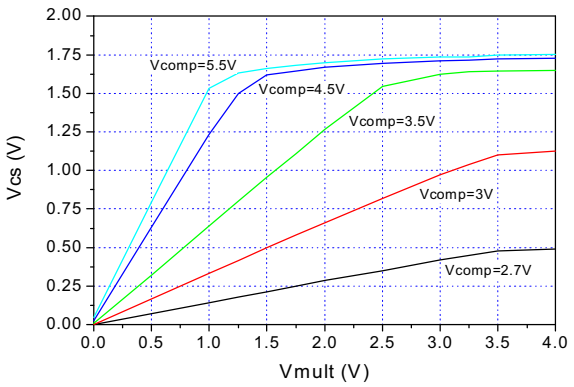
Disable Input Threshold Voltage



Feedback Open Protection Voltage

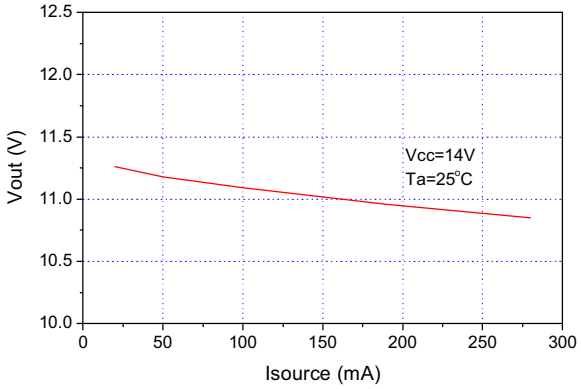


Multiplier Input vs. CS Threshold Voltage

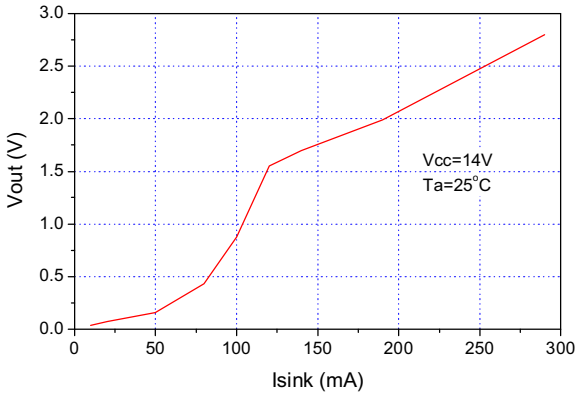


ELECTRICAL CHARACTERISTICS CURVES (Continue)

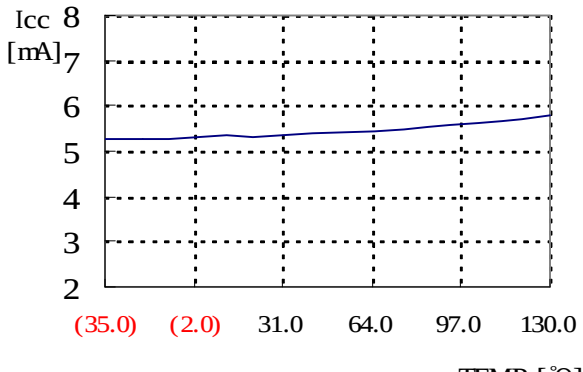
Output High Voltage



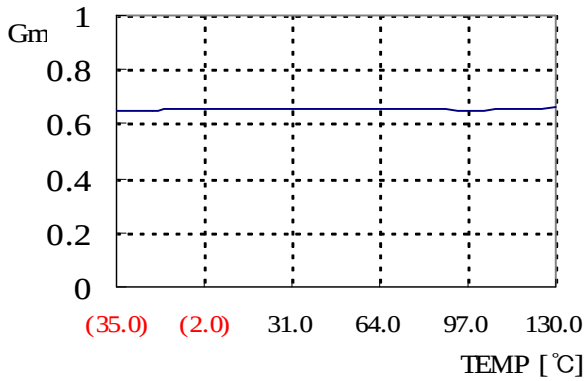
Output Low Voltage



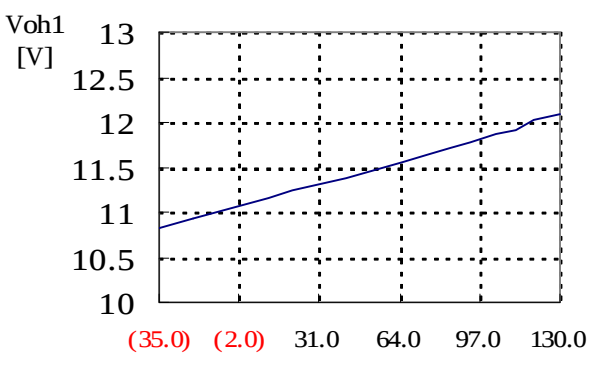
ICC vs TEMP



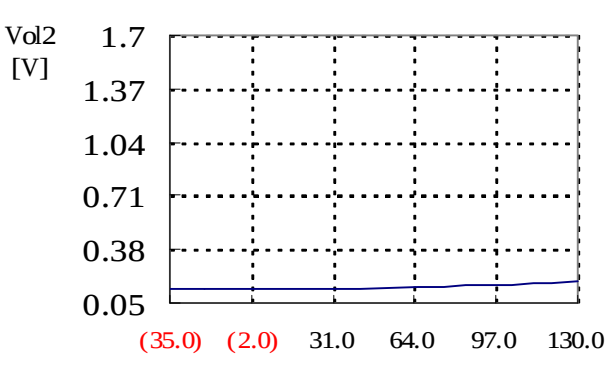
GM vs TEMP.



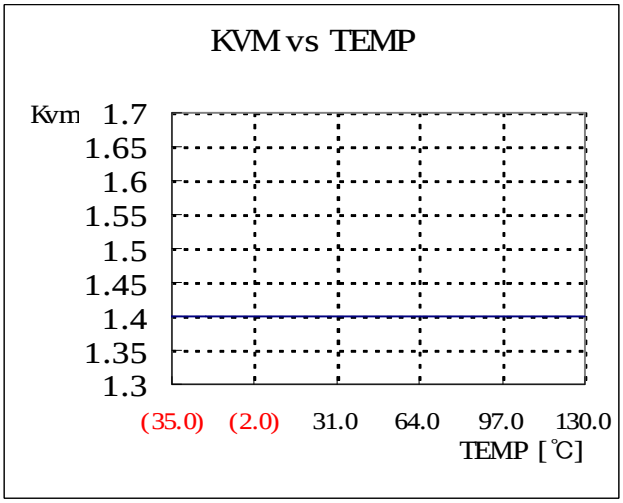
VOH1 vs TEMP

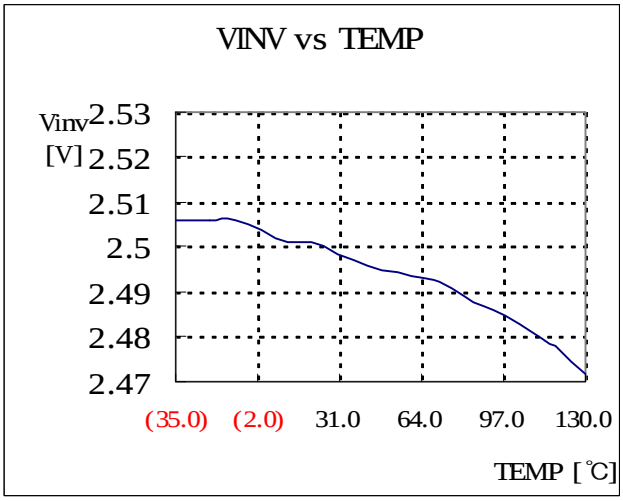


VOL2 vs TEMP

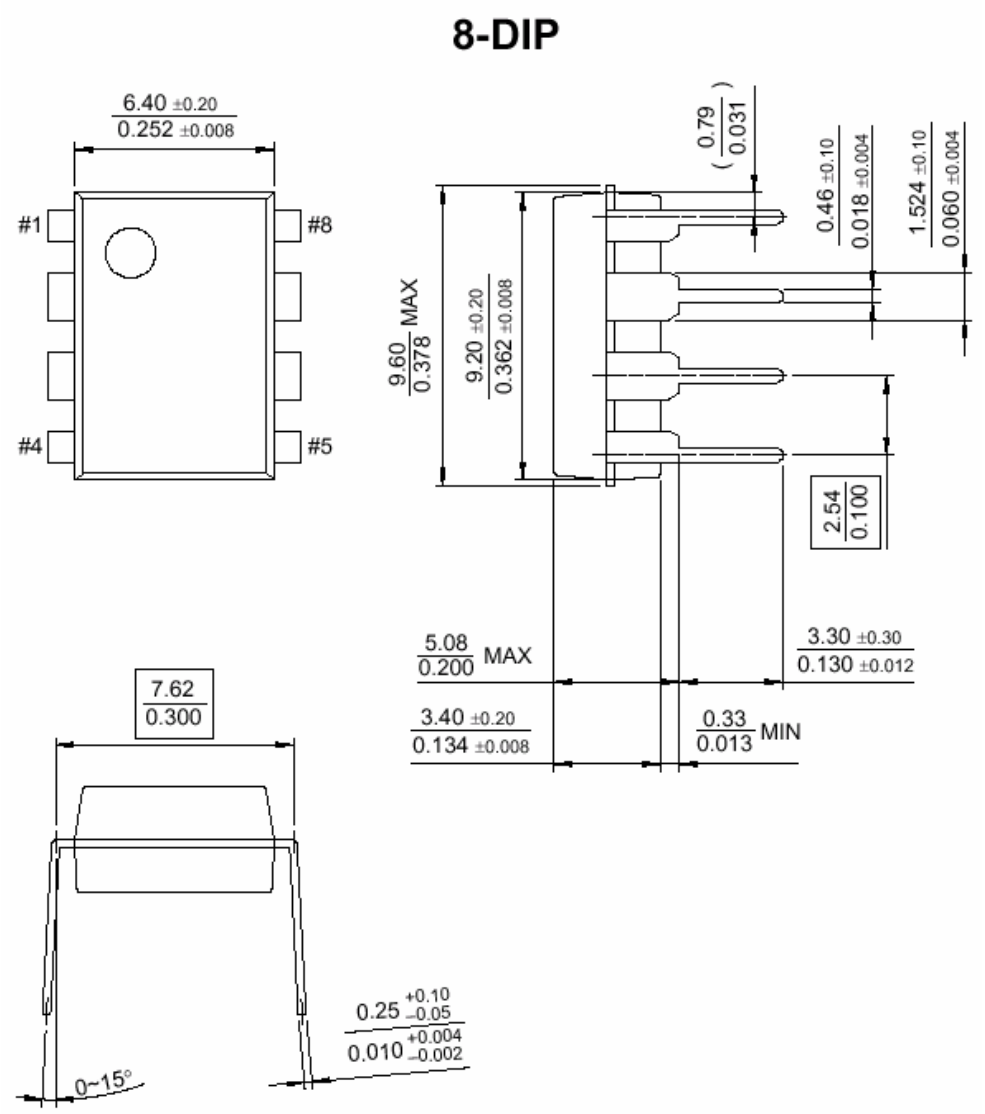


ELECTRICAL CHARACTERISTICS CURVES (Continue)





PACKAGE DIMENSION



PACKAGE DIMENSION