

## Power Factor Controller IC for High Power Factor

### Features

- Critical conduction mode of PFC pre-regulators
- Very low startup current (<30uA)
- Under-voltage lockout with hysteresis
- Zero current detector for critical conduction mode
- Dynamic and static output over-voltage protection
- Gate output maximum voltage clamped
- Internal restart timer
- Internal leading-edge blanking
- ±500mA totem pole output with active shut down

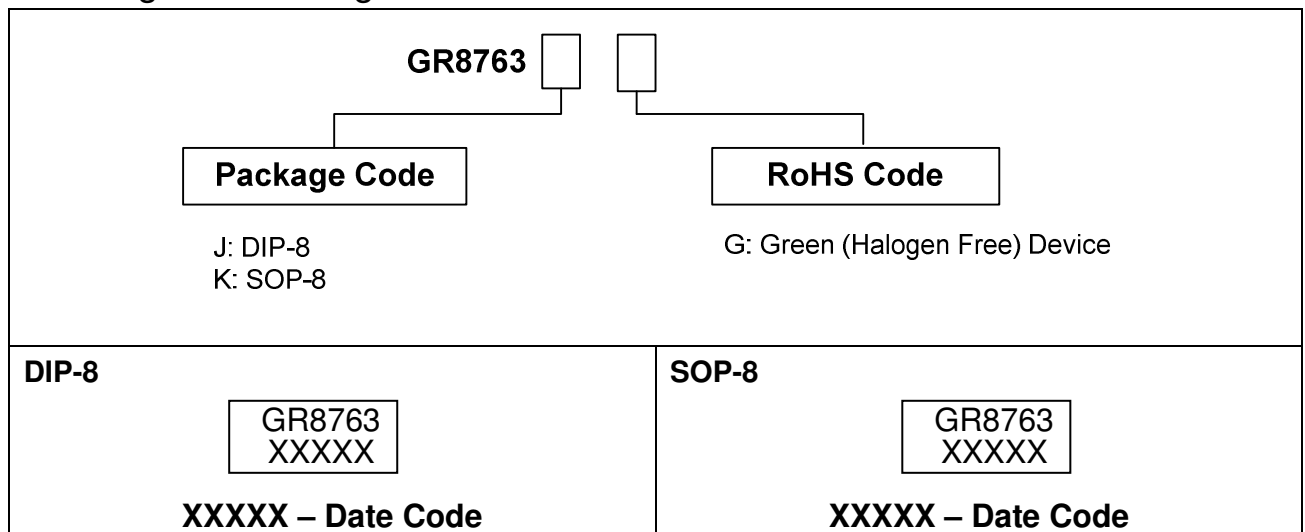
### Applications

- Open-frame power supply and power adapter
- Flat TV monitor
- Desktop PC
- Electronic lamp ballast

### Description

The GR8763 is a current-mode PFC controller operating in critical conduction mode. The sinusoidal current is taken from the single phase line supply and stabilized DC voltage is available at the output. The IC includes a highly linear multiplier which can reduce AC input current distortion, that allows wide-range-mains operation with an extremely low THD, even over a large load range. The output voltage is controlled by an error amplifier and an internal voltage reference. An effective two-step (dynamic and static) OVP enables to safely handle over voltages either occurring at start-up or resulting from load disconnection. The totem-pole output stage capable of ±500mA driving capability is suitable for big MOSFET or IGBT. It is available in both 8-pin DIP and 8-pin SOP package.

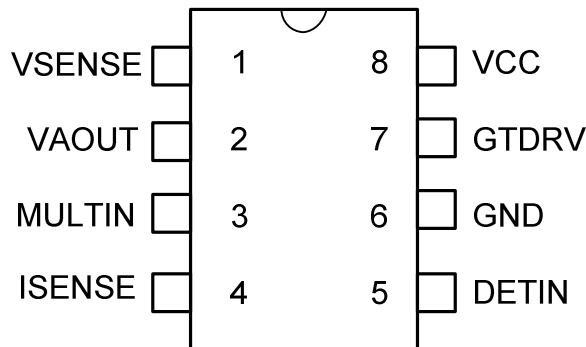
### Ordering and Marking Information



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## Pin Configuration

### TOP VIEW



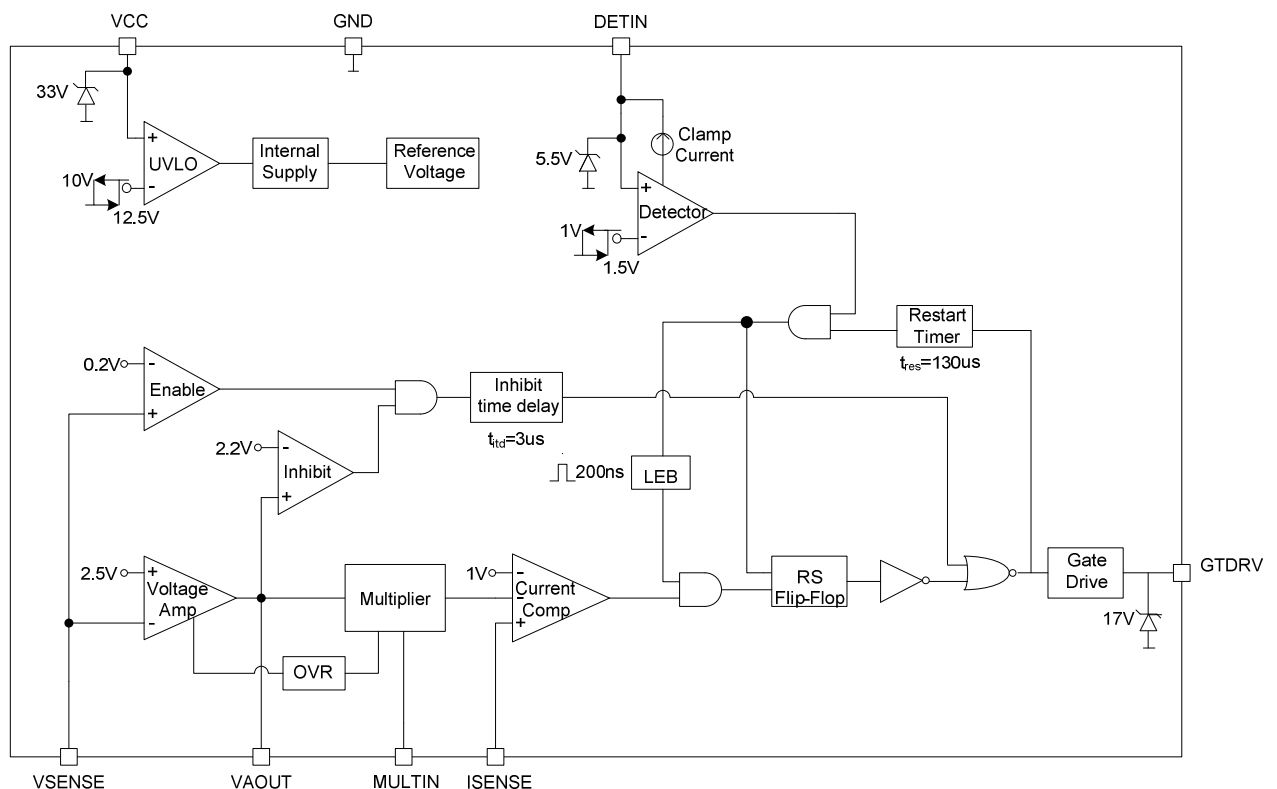
## Pin Description

Pin	Symbol	Description
1	VSENSE	Voltage Amplifier Inverting Input. VSENSE is connected via a resistive divider to the boost convert output, With a capacitor connected to VAOUT, The internal error amplifier acts as an integrator.
2	VAOUT	Voltage Amplifier Output. This is the first multiplier input. If the current flowing into this pin is exceeding an internal threshold, the multiplier output voltage is reduced to prevent the MOSFET from over-voltage damage.
3	MULTIN	Multiplier Input, Which is the second multiplier input and is connected via a resistive divider to the rectifier output voltage.
4	ISENSE	Current Sense Input, Which is connected to a sense resistor controlling the MOSFET source current .A leading edge blanking circuitry, suppresses voltage spits when turning the MOSFET on. Its max voltage is internally limited at 1V.
5	DETIN	Zero Current Detector Input, Which is connected to an auxiliary winding monitoring the zero crossing of the inductor current.
6	GND	Ground
7	GTDRV	Gate Drive Output, Which is the output of a totem-pole circuitry for direct driving a MOSFET.
8	VCC	Positive Voltage Supply. If VCC exceeds the UVLO (on) threshold, the IC is switched on. When VCC falls below the UVLO (off) threshold, it is switched off and power consumption is very low. VCC is internally clamped 28V.

## Absolute Maximum Ratings

Vcc supply + zener current	-----	20mA
Voltage at Pin 1, 3, 4	-----	6.5V
Junction temperature	-----	150°C
Operating junction temperature	-----	-20°C ~ 150°C
Storage temperature range	-----	-50°C ~ 150°C
SOP-8 package thermal resistance	-----	160°C/W
DIP-8 package thermal resistance	-----	100°C/W
Power dissipation (SOP-8, at ambient temperature = 85°C)	-----	400mW
Power dissipation (DIP-8, at ambient temperature = 85°C)	-----	650mW
Lead temperature (SOP-8 & DIP-8, soldering, 10sec)	-----	230°C
Lead temperature (All Pb free packages, soldering, 10sec)	-----	260°C
ESD voltage protection	-----	3 KV

## Block Diagram



**Electrical Characteristics** (T = 25°C unless otherwise stated, Vcc = 14.5V)

Parameter	Symbol & Condition	Min.	Typ.	Max.	Unit
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**SUPPLY VOLTAGE**

Zener Voltage	Vz; Icc+Iz=20mA	26	28	30	V
UVLO on Voltage	Vcc-on		12.5		V
UVLO off Voltage	Vcc-off		10		V
Vcc Hysteresis	Vcc-HY		2.5		V

**SUPPLY CURRENT**

Startup Current	ICCL		10	30	µA
Operating Current	ICCH		2.5		mA

**VOLTAGE AMPLIFIER**

Voltage feedback Input Theshold	VFB	2.475	2.5	2.525	V
Line Regulation(VFBLR)	Vcc = 12V~16V			5	mV
Enable Threshold	Vsense		0.2		V
Inhibit Threshold Voltage	VVAOUT		2.2		V
Voltage Gain	Gv		90		dB
Gain – Bandwidth	Bw		3		MHz
Output Current Source (IVAOUTH)	VVAOUT = 0V; Vsense = 2.3V;		4		mA
Output Current Sink (IVAOUTL)	VVAOUT = 4V; Vsense = 2.8V;		4		mA
Upper Clamper Voltage	VVAOUTH		5.4		V
Lower Clamp Voltage	VVAOUTL		2.2		V

**MULTIPLIER INPUT**

Dynamic Voltage Range Multin	VMultin		0~3.5		V
Dynamic Voltage Range VAOUT	Vmultin=1V,		VFB ~ VFB+1.5V		
Multiplier Gain	Klow VAOUT<3.5,Vmultin=1V		0.2		
	KHigh VAOUT<3.5,Vmultin=1V		0.5		

**OVER-VOLTAGE REGULATOR**

Threshold Current	IOVR	25	30	35	µA
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## Electrical Characteristics (Cont.)

Parameter	Symbol & Condition	Min.	Typ.	Max.	Unit
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**CURRENT COMPARATOR**

Max Threshold Voltage	V <sub>Isense</sub>	0.95	1.0	1.05	V
Leading Edge Blanking	T <sub>LEB</sub>	100	200	300	ns
Shut Down Delay	T <sub>delay</sub>		130		ns

**DETECTOR**

Upper Threshold Voltage	V <sub>DETU</sub>		1.5		V
Lower Threshold Voltage	V <sub>DETL</sub>		1.0		V
Hysteresis	HYS		0.5		V
Zener Voltage	V <sub>Z-Detin</sub>	5.2	5.5	5.8	V

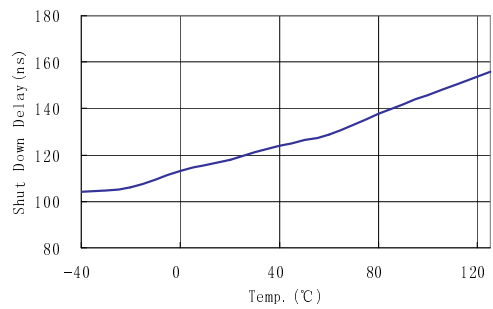
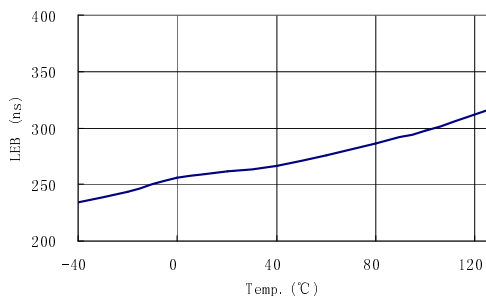
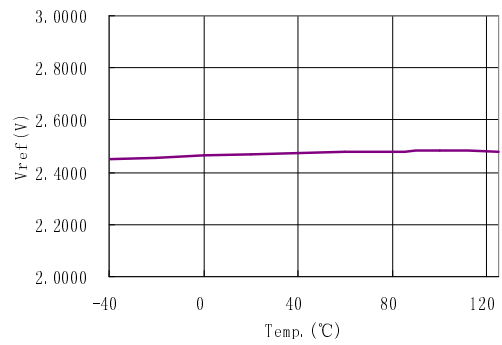
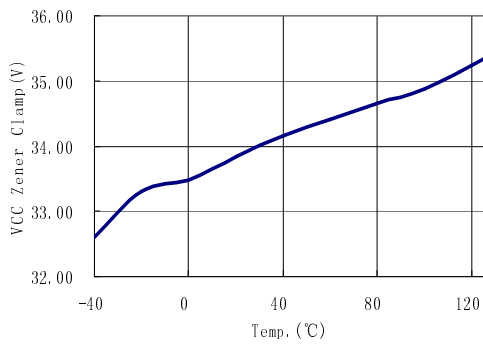
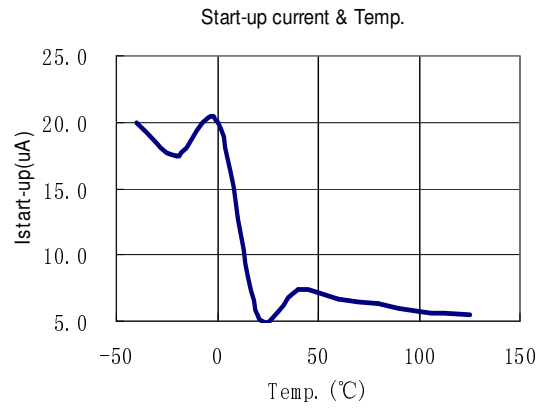
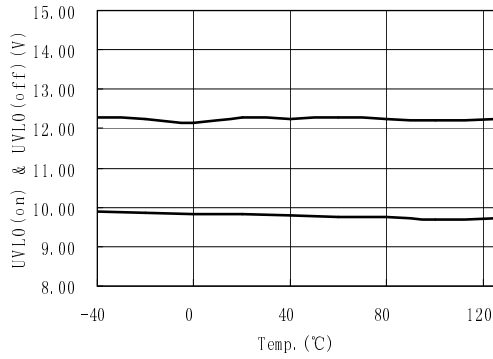
**RESTART TIME**

Restart Time	T <sub>RES</sub>		130		us
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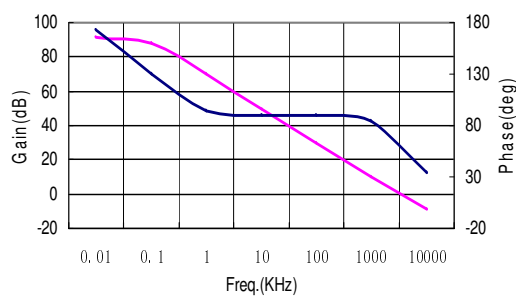
**GATE DRIVER**

Output Low Voltage	I <sub>o</sub> = 20mA			1	V
Output High Voltage	I <sub>o</sub> = 20mA	8			V
Rising Time	T <sub>RISE</sub> ; Load=1nF		50		ns
Falling Time	T <sub>FALL</sub> ; Load=1nF		30		ns
Clamp	V <sub>clamp</sub>		17		V

## Typical Performance Characteristics



Open Loop Gain and Phase vs Frequency



## Functional Description

### Overview

The GR8763 contains an one quadrant multiplier with a wide linear operating range, a voltage amplifier used in a feedback loop, an overvoltage regulator, a current sense comparator, a zero current detector, a PWM and logic circuit, a totem pole MOSFET driver, an internal voltage reference, a restart timer and under voltage lockout circuit.

### Multiplier

The one quadrant multiplier has two inputs M1 and M2. The input M1 (MULTIN Pin) provides the information of the waveform of the input voltage. Its range is from 0 to 3.5V being referenced to ground. The input M2 (VAOUT Pin) is the voltage amplifier output, which provides the information of the DC output voltage. Both inputs are designed to achieve good linearity over a wide dynamic range to represent an AC line free from distortion.

### Voltage Amplifier

With an external capacitor between the pins VSENSE and VAOUT the voltage amplifier forms an integrator. The integrator monitors the average output voltage over several line cycles. Typically the integrator's bandwidth is set below 20Hz in order to suppress the 100Hz ripple of the rectified line voltage. The non-inverting input is biased internally at 2.5V. The output is directly connected to the multiplier input.

The gate drive is disabled when VSENSE voltage is less than 0.2V or VAOUT voltage is less than 2.2V.

### Overvoltage Regulator

Because of the integrator's low bandwidth fast changes of the output voltage cant's be regulated within an adequate time. Fast output changes occur

during initial start-up, sudden load removal. While the integrator's differential input voltage remains zero.

During this fast changes, a peak current is flowing through the external capacitor into pin VAOUT. If this current exceeds an internal defined margin the overvoltage regulator circuit reduces the multiplier output voltage. As a result the on time of the MOSFET is reduced.

### Current Sense Comparator

An external sense resistor transfers the source current of the MOSFET into a sense voltage. The multiplier output is compared with this sense voltage. The switch-on peak current of the MOSFET is blanked out via a leading edge blanking circuit with a blanking time of typically 200ns.

### Zero Current Detector

The zero current detector senses the inductor current via an auxiliary winding and ensures that the next on-time of the MOSFET is initiated immediately when the inductor current has reached zero. This diminishes the reverse recovery losses of the boost converter diode. The MOSFET is switched off when the voltage drop of the sense resistor reaches the voltage level of the multiplier output. So the boost current waveform has a triangular shape and there are no dead-time gaps between the cycles. This leads to a continuous AC line current limiting the peak current to twice of the average current.

To prevent false tripping the zero current detector is designed as a Schmitt-Trigger with a hysteresis of 0.5V. An internal 5.5V clamp protects the input from overvoltage breakdown. An external resistor has to

be used in series with the auxiliary winding to limit the current through the clamps.

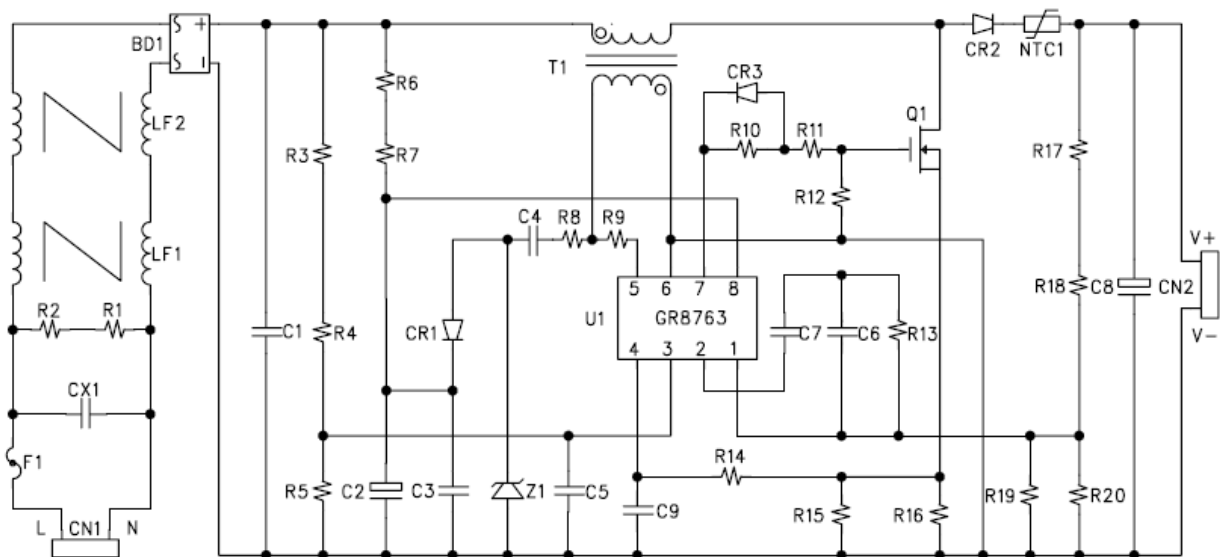
### Restart Timer

The restart timer function eliminates the need of an oscillator. The timer starts or restarts the GR8763 when the drive output has been off for more than 160us after the inductor current reaches zero.

### Under-voltage Lockout

An under voltage lockout circuit switches the IC on when Vcc reaches the UVLO(ON) threshold and switches the IC off when Vcc is falling below the UVLO(OFF) threshold. During star up the supply current is less than 30uA. An internal voltage clamp has been added to protect the IC from Vcc overvoltage.

## Typical Application Circuit



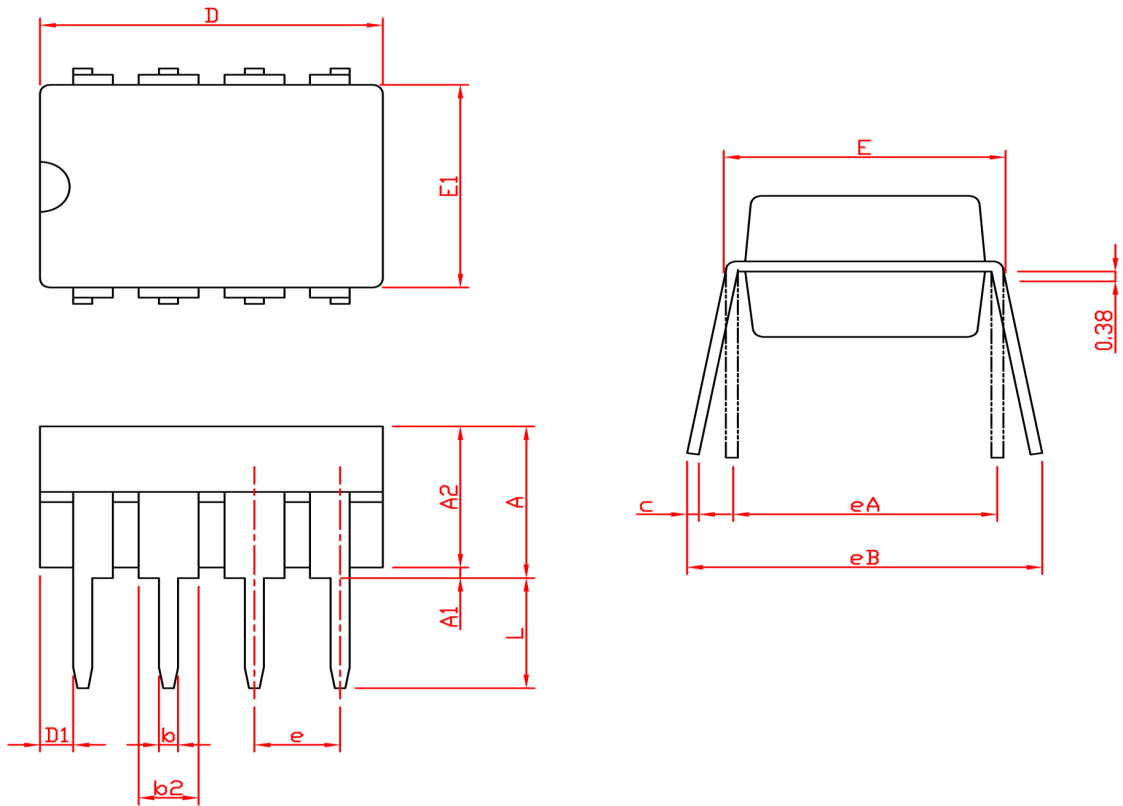


**Bom List**

No.	Part	Description	Quan.
1	BD1	PBL405 4A 600V	1
2	CN1,CN2	2/3pin 3.96 180° 白色	1
3	C1	474K 400V Pitch=15mm	1
4	C2	47uF 35V 6*12mm 105°C	1
5	C3	0805 104K 50V X7R	1
6	C4	103K 100V X7R	1
7	C5,C6	0805 103K 50V X7R	2
8	C7	0805 225K 50V X7R	1
9	C8	47uF/450V 22*26(max) 105°C	1
10	C9	NC	1
11	CX1	474K/275V	1
12	CR1	FR104 1A 400V	1
13	CR2	ER506 5A/800V DO-201	1
14	CR3	LL4148 DO-80	1
15	F1	4*8mm T3.15A/250V 塑膠方形	1
16	HS1	鋁擠型 15*10.5*25mm 黑色烤漆	1
17	LF1	T12*10*8c 0.7mH	1
18	LF2	T16*12*8c 15mH	1
19	NTC1	SCK2R55A	1
20	Q1	2SK2842 12A/500V TO-220	1
21	R1,R2,R3,R4	1206 1M 5%	4
22	R5	20K 0805 5%	1
23	R6,R7	1206 240K 5%	2
24	R8	100R 1206 5%	1
25	R9	39K 1206 5%	1
26	R10	33R 1206 5%	1
27	R11	0R 1206 5%	1
28	R12	100K 0805 5%	1
29	R13	4.7K 0805 5%	1
30	R14	0R 0805 5%	1
31	R15	0.27R 2WS 5%	1
32	R16	NC	0
33	R17, R18	330K 1206 1%	2

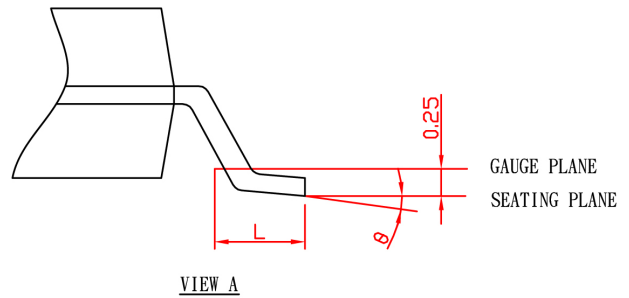
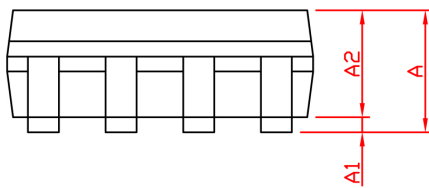
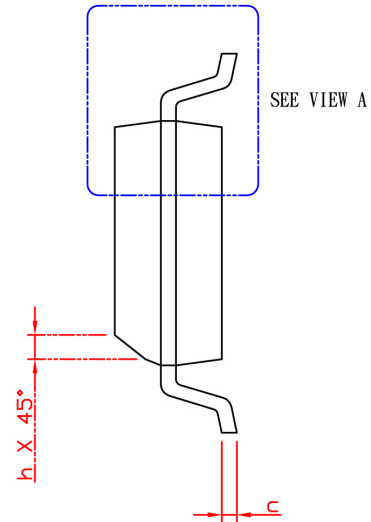
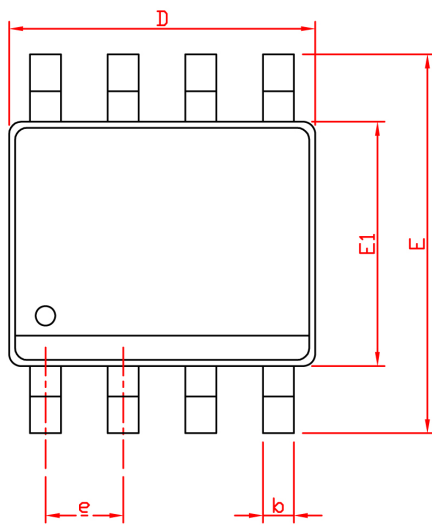
34	R19	4.3K 0805 1%	1
35	R20	91K 0805 1%	1
36	T1	PQ2620 0.7mH	1
37	U1	SOP-8 GR8763	1
38	Z1	18V 1W	1
39	PCB	CEM-1 2oz 1mm 110*56mm	1

## Package Information



SYMBOL	DIP-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		5.33		0.210
A1	0.38		0.015	
A2	2.92	4.95	0.115	0.195
b	0.36	0.56	0.014	0.022
b2	1.14	1.78	0.045	0.070
c	0.20	0.35	0.008	0.014
D	9.01	10.16	0.355	0.400
D1	0.13		0.005	
E	7.62	8.26	0.300	0.325
E1	6.10	7.11	0.240	0.280
e	2.54 BSC		0.100 BSC	
eA	7.62 BSC		0.300 BSC	
eB		10.92		0.430
L	2.92	3.81	0.115	0.150

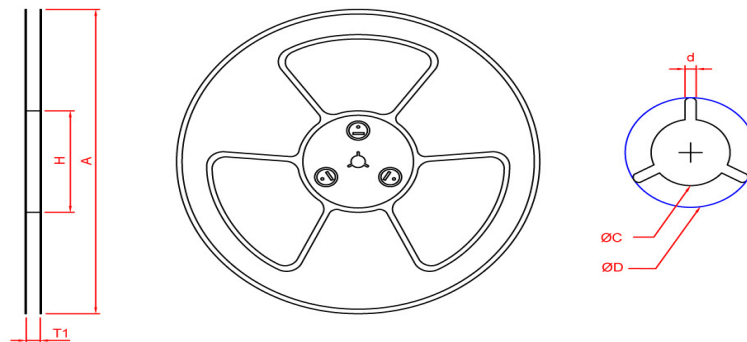
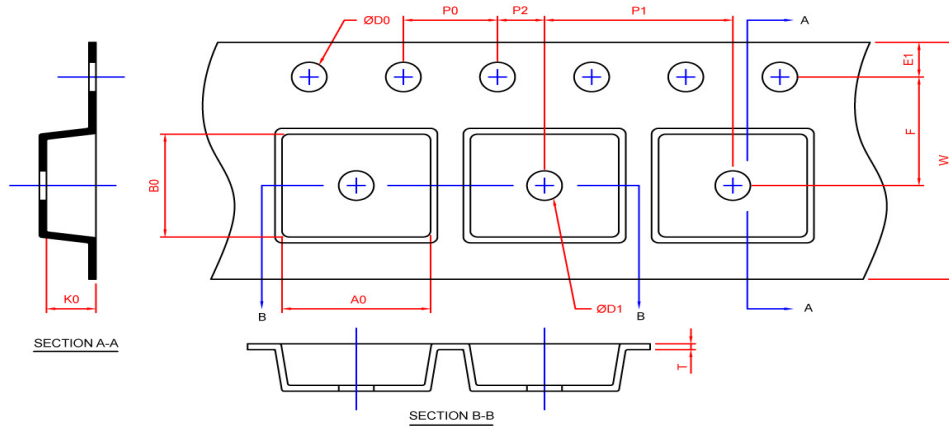
## Package Information



SYMBOL	SOP-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.75		0.069
A1	0.10	0.25	0.004	0.010
A2	1.25		0.049	
b	0.31	0.51	0.012	0.020
c	0.17	0.25	0.007	0.010
D	4.80	5.00	0.189	0.197
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
h	0.25	0.50	0.010	0.020
L	0.40	1.27	0.016	0.050
$\theta$	0°	8°	0°	8°

## Carrier Tape & Reel Dimensions

### SOP-8



Application	A	H	T1	C	d	D	W	E1	F
SOP-8	330.0±2.0	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0±0.30	1.75±0.10	5.5±0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0±0.10	8.0±0.10	2.0±0.05	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	6.40±0.20	5.20±0.20	2.10±0.20

(mm)

### Devices Per Unit

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOP-8	12	-	2500

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