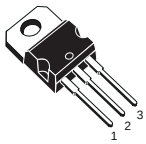
VB408
VB408B

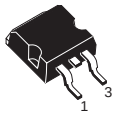
HIGH VOLTAGE LINEAR REGULATOR POWER I.C.

TYPE	$\Delta V_{IN,OUT}$	I_{LIM}	V_{OUT}
VB408 VB408B	400 V	40 mA	1.25 to V_{IN}-30 V

- INPUT VOLTAGE UP TO 400 V DC OR 285 V RMS RECTIFIED
- OUTPUT VOLTAGE ADJUSTABLE FROM 1.25 TO V_{IN}-30V
- TYPICAL OUTPUT CURRENT 40 mA
- THERMAL SHUT-DOWN PROTECTION
- SHORT CIRCUIT PROTECTION



TO-220



D^2PAK

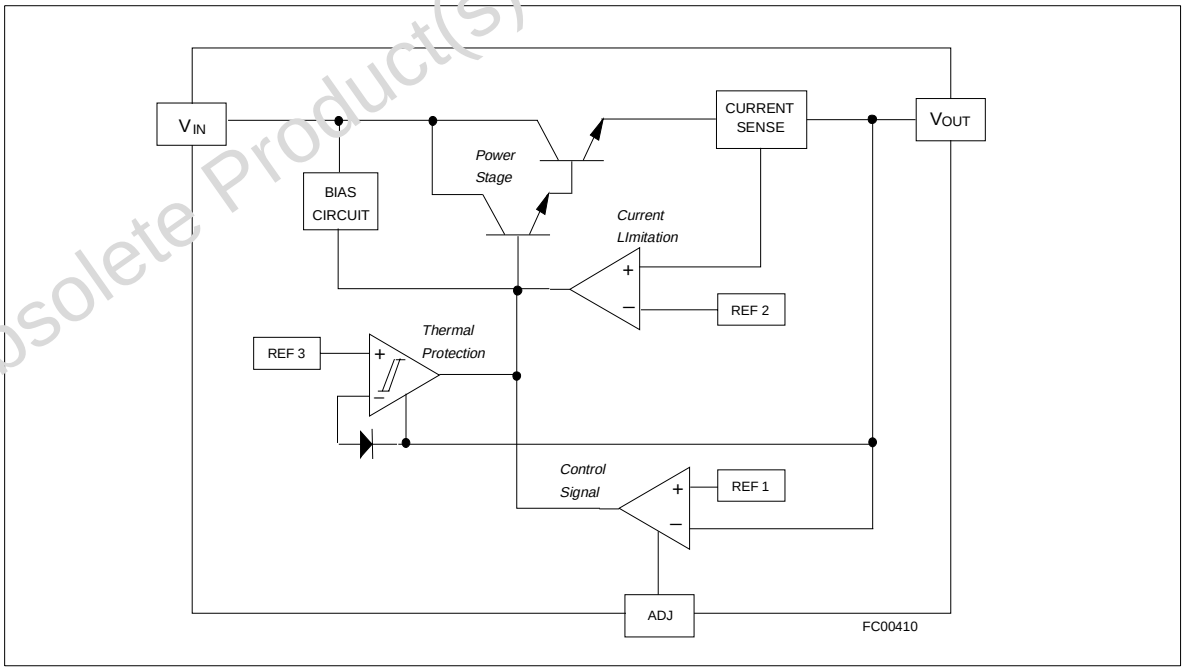
ORDER CODES:

TO-220	VB408
D^2PAK	VB408B

DESCRIPTION

The VB408, VB408B are fully protected positive adjustable voltage regulators made using a proprietary High Voltage VIPower™ technology. The device can be connected to a DC source (up to 400V) or in off-line application directly to the rectified main (110V/230V). It is particularly suitable to be used in the manufacture of DC/DC converters, AC/DC converters, start-up circuits, pneumatic valve drivers and current sources. The device is able to drive resistive or inductive loads with an output voltage from 1.25V to VIN-30V providing an internally limited output current; it has built in short circuit and thermal shutdown protections. The device does not provide galvanic insulation from main.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

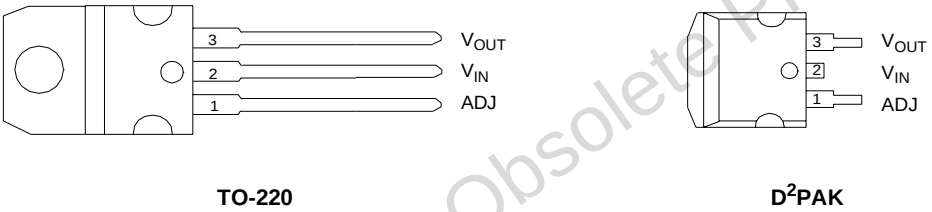
Symbol	Parameter	Value	Unit
$V_{IN,OUT}$	Input to output voltage at 20 mA	- 0.2 to 420	V
Δ I_{OUT}	Output current	Internally limited	mA
V_{ESD}	Electrostatic discharge (R=1.5kΩ, C=100pF)	2000	V
P_{tot}	Power dissipation at T_C=25°C	89	W
T_j	Junction operating temperature	- 40 to 150	°C
T_{STG}	Storage temperature	- 55 to 150	°C

THERMAL DATA

Symbol	Parameter		Value		Unit
			TO-220	D^2PAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case	(MAX)	1.4	1.4	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	(MAX)	60	35 (*)	°C/W

(*) When mounted using the minimum recommended pad size on FR-4 board (1 $inch^2$)

CONNECTION DIAGRAM

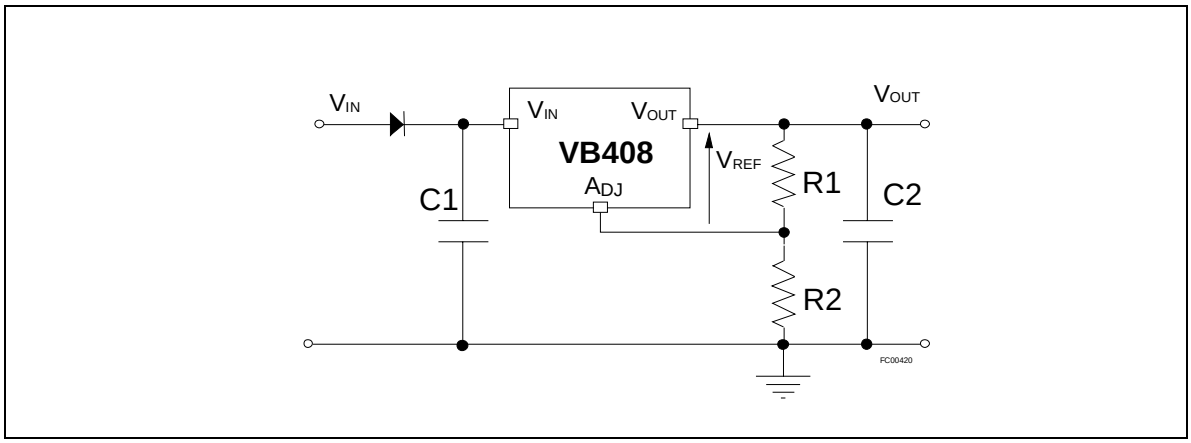


TO-220 **D^2PAK**

ELECTRICAL CHARACTERISTICS (V_{IN}=300VDC; -25°C<Tj<125°C; I_{LOAD}=15mA; V_{ADJ}=0V unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input voltage		30		400	V
V_{IN}-V_{OUT}	Input to output voltage				30	V
V_{REF}	Output reference voltage	V_{ADJ}=0V	1.20	1.24	1.28	V
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	V_{ADJ}=0V; V_{IN}=30 to 400 VDC			100	µV/V
$\Delta V_{OUT}/\Delta I_{LOAD}$	Load regulation	V_{ADJ}=0V; I_{LOAD}=1 to 20mA			6	mV/mA
I_{ADJ}	Adjustment pin current		50	70	90	µA
I_{BIAS}	Minimum load current		1.2			mA
I_{LIM}	Output current limit		40		60	mA
T_{jsh}	Junction temperature shutdown limit		135	150		°C
ΔT_{jsh}	Junction temperature shutdown hysteresis			25		°C

Figure 1: Typical application diagram



OPERATION DESCRIPTION

The VB408, VB408B are positive voltage regulators continuously adjustable from 1.25V to the input voltage minus a dropout of 30V by an external divider. In order to set the proper internal reference voltage, a typical 70µA current has to be drawn from the ADJ pin. Considering that, it results:

$V_{OUT} = V_{REF}(1+R_2/R_1) + I_{ADJ}R_2$

To simplify this formula, neglecting I_{ADJ} with respect to the term

V_{REF}/R_1

R1 must be chosen so to obtain a minimum 1.2mA current flowing through the divider. In such a way the V_{OUT} value will be affected by an error <5%. The current set resistor R_1 should be tied directly to the output terminal of the regulator rather than near the load. This eliminates line drops from appearing in series with the reference and degrading regulation. The output voltage can also be set by a zener diode put between the adjustment pin and ground (Figure 2). The biasing current of the zener is properly chosen by R1 resistor. The zener diode improves the ripple rejection and reduces the value of the worst case output voltage error. In this case the output voltage is given by

$V_{OUT} = V_{REF}+V_Z$

In order to reduce excessive output ringing, a minimum output capacitor C_2 of 0.1µF is suggested. This capacitor will improve loop stability and output impedance. The VB408/VB408B can be connected both to a DC source or to a 285V r.m.s. line by a rectifier diode that prevents a negative voltage to be applied to the device. In the first case the input capacitor C_1 is not needed, whereas in the second case a high value of C_1 (>1µF) must be chosen. In fact, in this kind of application, C_1 has to supply to the input pin the minimum allowed voltage during the negative half wave. Obviously bigger C_1 value, more constant the input voltage is and consequently smaller the output voltage ripple. For the right choice of the input capacitor, you have also to remember that increasing its value you will obtain an increased power dissipation, and a heatsink could be required. The right heatsink is determined by the load current, input voltage and ambient temperature. In case of pulse or AC operation the junction temperature is limited by the thermal capacitances since the package and the heatsink masses are able to absorb heat. If the junction temperature reaches the thermal shutdown limit the output stage of the regulator is turned-off so that only the biasing current of the device can flow into the input pin. Thermal hysteresis is added just to prevent oscillations. The device is able to provide typical 40 mA for a time that is function of dissipated power and consequently of the used heatsink. In general the device is also suitable in electronically switched motor housekeeping supply, consumer equipments controls power supply or constant current source.

APPLICATION EXAMPLE

The most common application for the device is in the DC/DC converters with an input voltage up to 400 VDC. and a C_2 suggested value of 0,1µF.

Using an external rectifier an AC/DC converter can be easily implemented, in this case the device can operate with an AC voltage up to 285VRMS. In this case must be used a minimum 1µF input capacitor to provide the load current during the negative half cycle of the main. Another important circuit that can be implemented is the start up function for low voltage input PWM ICs directly from a high voltage source (see Figure 3).

Figure 2: Regulation with Zener

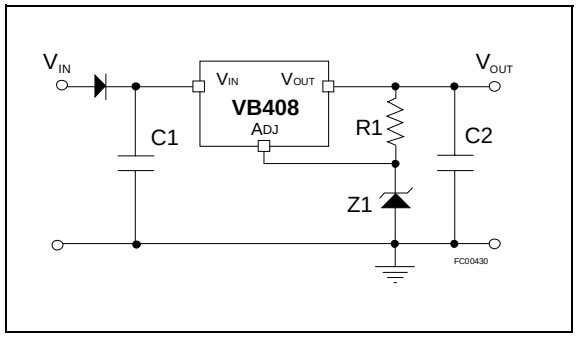
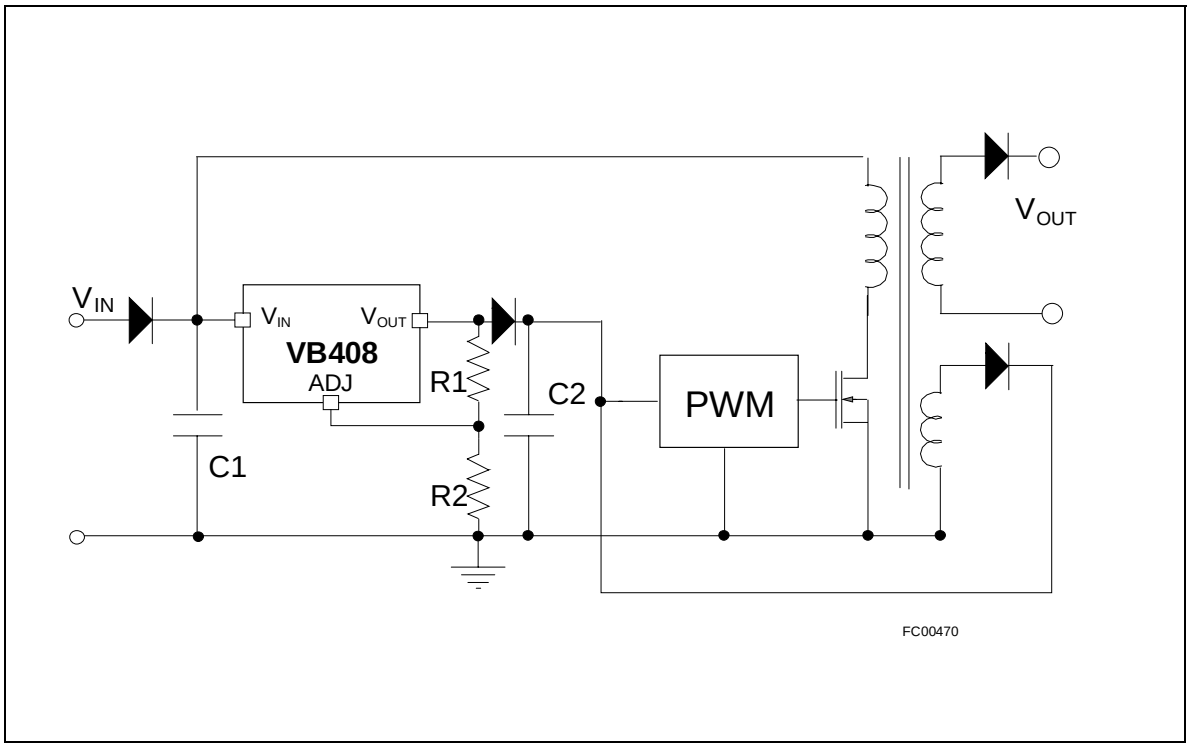
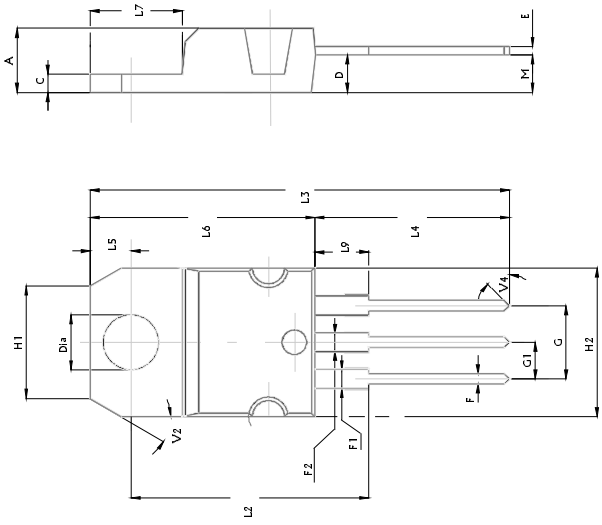


Figure 3: Start-up circuit



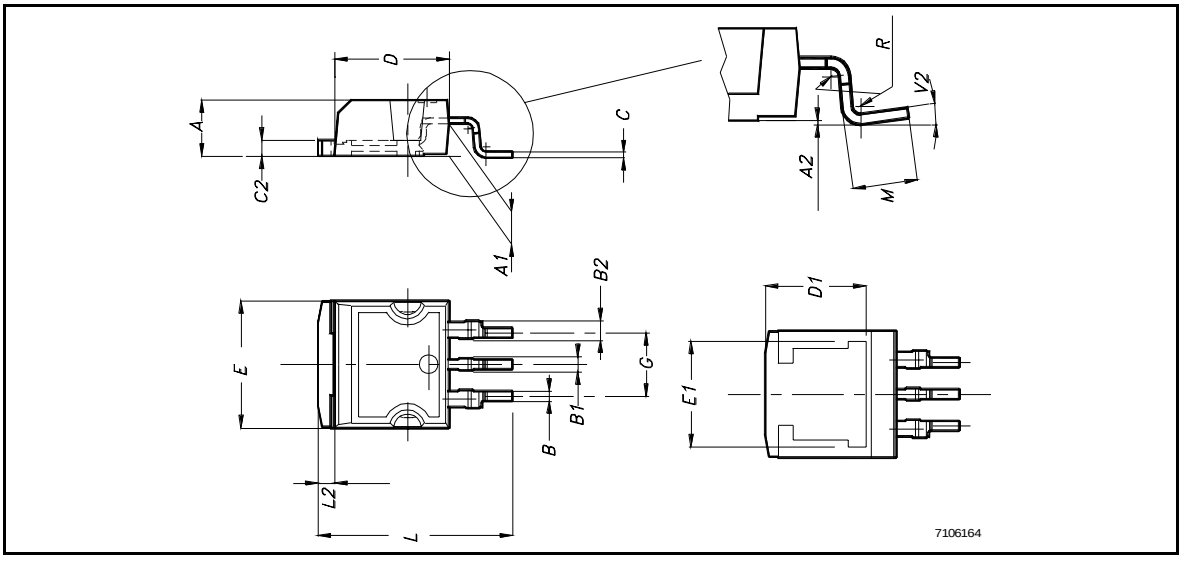
TO-220 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137	0.154	
M		2.6			0.102	
DIA.	3.75		3.85	0.147		0.151

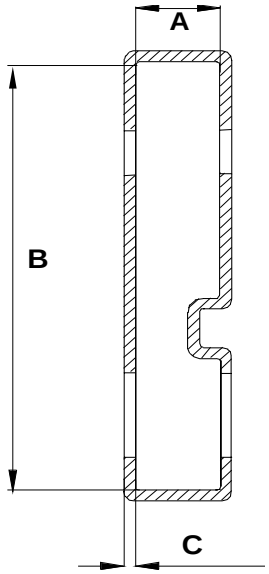


D²PAK MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B1	0.8		1.3	0.031		0.051
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		8°			



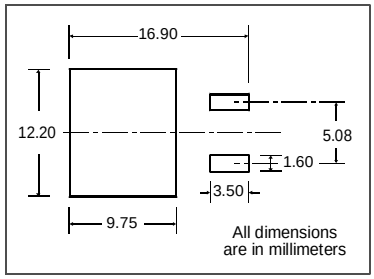
TO-220 TUBE SHIPMENT (no suffix)



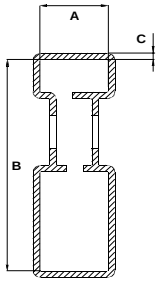
Base Q.ty	50
Bulk Q.ty	1000
Tube length (± 0.5)	532
A	5.5
B	31.4
C (± 0.1)	0.75

All dimensions are in mm.

D²PAK FOOTPRINT



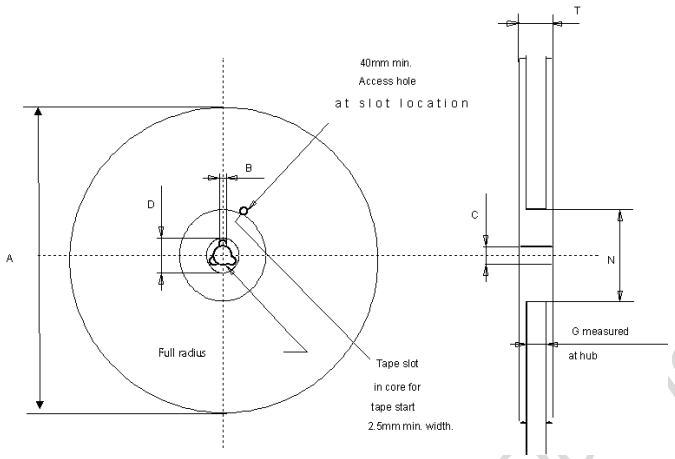
TUBE SHIPMENT (no suffix)



Base Q.ty	50
Bulk Q.ty	500
Tube length (± 0.5)	532
A	6
B	21.3
C (± 0.1)	0.6

All dimensions are in mm.

TAPE AND REEL SHIPMENT (suffix "13TR")



REEL DIMENSIONS

Base Q.ty	1000
Bulk Q.ty	1000
A (max)	330
B (min)	1.5
C (± 0.2)	13
F	20.2
G (+ 2 / -0)	24.4
N (min)	60
T (max)	30.4

All dimensions are in mm.

TAPE DIMENSIONS

According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

Tape width	**W**	24
Tape Hole Spacing	**P0 (± 0.1)**	4
Component Spacing	**P**	16
Hole Diameter	**D (± 0.1/-0)**	1.5
Hole Diameter	**D1 (min)**	1.5
Hole Position	**F (± 0.05)**	11.5
Compartment Depth	**K (max)**	6.5
Hole Spacing	**P1 (± 0.1)**	2

All dimensions are in mm.