Datasheet
Rev 2, 10/2004
PRELIMINARY

ACT32/32B

ACT32/32B TINY CV/CC CONTROLLER FOR ADAPTORS AND CHARGERS

FEATURES

- **Lowest Total Cost Solution**
- **Lowest Component Count (only 3 including IC!)**
- **Ideal for Use with ACT30 ActiveSwitcher™ AC/DC Converters**
- **Green, Low Power Consumption**
- **Adjustable Output Voltage**
- **Adjustable Current Limit**
- **Small-Size TO-92 Package**

APPLICATIONS

- **Battery Chargers**
- **Power Adaptors**

GENERAL DESCRIPTION

The ACT32/32B are complete solutions for constant-voltage/constant-current regulation in a battery charger or adaptor. With their proprietary architecture (US patent pending), the ACT32/32B require fewest external components (only 3 including IC) to replace other solutions needing as many as 11 components. This translates to lowest cost as well as reduction in power waste and heat generation in the current sense resistor. The regulation voltage can be externally adjusted to as low as 4V output for ACT32B. The current limit value is externally determined via a current sense resistor.

The ACT32/32B are available in a low-cost TO-92 package.

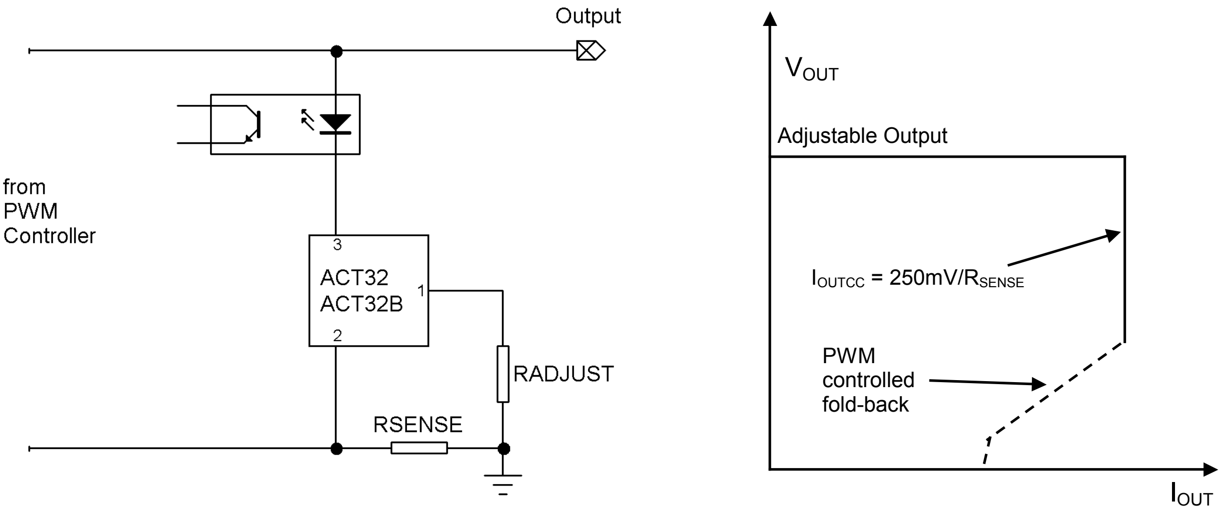
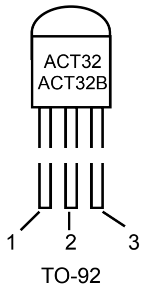


Figure 1. Simplified Application Circuit

ORDERING INFORMATION

PART NUMBER	OUTPUT VOLTAGE	TEMPERATURE RANGE	PACKAGE	PINS
ACT32HT	Adjustable from 4.8V	-40°C to 85°C	TO-92	3
ACT32BHT	Adjustable from 4V	-40°C to 85°C	TO-92	3

PIN CONFIGURATION



PIN DESCRIPTION

PIN NUMBER	PIN NAME	PIN DESCRIPTION
1	SENSE	Sense Pin. Used for sensing ground voltage and for programming regulation voltage.
2	SOURCE	Regulator Source. Used for sensing the negative side of current sense resistor.
3	OPTO	Optocoupler Connection. Connect to the optocoupler LED's cathode.

ABSOLUTE MAXIMUM RATINGS

(Note: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

PARAMETER	VALUE	UNIT
OPTO Voltage to SOURCE	-0.3 to 12	V
SENSE Voltage to SOURCE	-0.3 to 6	V
SENSE Voltage to OPTO	-12 to 0.3	V
OPTO Sink Current	50	mA
Maximum Power Dissipation	0.6	W
Operating Junction Temperature	-40 to 150	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	300	°C

ELECTRICAL CHARACTERISTICS

(T_J = 25°C unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
OPTO Breakdown Voltage				12			V
OPTO Regulation Voltage	V_{OPTO}	R_{ADJUST} = 0	ACT32	3.66	3.80	3.94	V
			ACT32B	2.93	3.05	3.17	
		R_{ADJUST} = 12kΩ	ACT32	4.27	4.37	4.47	V
			ACT32B	3.43	3.51	3.59	
		R_{ADJUST} = 22kΩ	ACT32		4.85		V
			ACT32B		3.89		
OPTO Adjustment Factor Internal Resistance	R_{INT}			73	80	87	kΩ
OPTO Temperature Coefficient		R_{ADJUST} = 0			0.66		mV/°C
OPTO Adjustment Range		R_{ADJUST} = 0 to 30kΩ	ACT32	3.8		5.2	V
			ACT32B	3.05		4.2	V
Sink Current		V_{OPTO} = 4V, V_{SENSE} = V_{SOURCE}		12	32		mA
SENSE Current Limit Threshold				225	250	275	mV
SENSE Short Circuit Current Threshold		When there is no PWM controlled fold-back			670		mV
Supply Current					116	160	uA

FUNCTIONAL DESCRIPTION

The ACT32/32B use time-multiplexing to share the SENSE pin for current and voltage regulation loops (Figure 2, *Functional Block Diagram*). This multiplexing is done at very high frequency so that the sampling rate is much faster than most AC-DC converter switching frequencies and therefore is transparent to the external circuit.

During Phase 1 of the time-multiplexing period, the SENSE input voltage is sampled. This current sense signal is continuously compared to 250mV and one output MOSFET turns on if the current sense signal exceeds that value. This will increase current through the optocoupler and result in current regulation at 250mV.

During Phase 2 of the time-multiplexing period, the resistance of R_{ADJUST} is measured relative to an internal 80kΩ resistor. This ratio is then sampled and used to correct the OPTO feedback voltage to the Voltage Loop Amplifier. Because the voltage loop still mainly relies on the feedback resistor divider for regulation, this time-multiplexing method does not affect the switching dynamics of the AC/DC converter. In addition, the regulation voltage is based on OPTO to SENSE voltage, so it is independent of output current.

VOLTAGE REGULATION ADJUSTMENT

The simplest application circuit is as in Figure 1, where the OPTO pin (pin 3) is connected to the cathode of the optocoupler LED. The constant voltage (CV) in this application for ACT32 is:

$V_{OUTCV} = 3.8V \bullet (1 + R_{ADJUST}/80k\Omega) + V_{FLED}$,

and for ACT32B is

$V_{OUTCV} = 3.05V \bullet (1 + R_{ADJUST}/80k\Omega) + V_{FLED}$,

where V_{OUTCV} is measured relative to the output ground connection. V_{FLED} is the forward voltage drop across the optocoupler's LED (typically 1V). The adjustable output voltage range for circuit of Figure 1 is 4V to 5.2V (ACT32B) and 4.8V to 6.2V (ACT32).

To achieve optimal accuracy for V_{OPTO} for most applications, V_{OPTO} is trimmed with tightest tolerance at R_{ADJUST} = 12kΩ. Thus, V_{OPTO} tolerance is ±2.3% at R_{ADJUST} = 12kΩ and increases linearly to ±3.7% at R_{ADJUST} = 0 or 22kΩ. For other trim requirements, contact factory for information.

CURRENT REGULATION ADJUSTMENT

The constant current threshold is 250mV for V_{OPTO} > 1.4V (V_{OUT} > 2.5V). Below that, the current limit threshold voltage is no longer accurate, and the adaptor/charger must rely on the current fold-back behavior of the PWM controller to limit the output current.

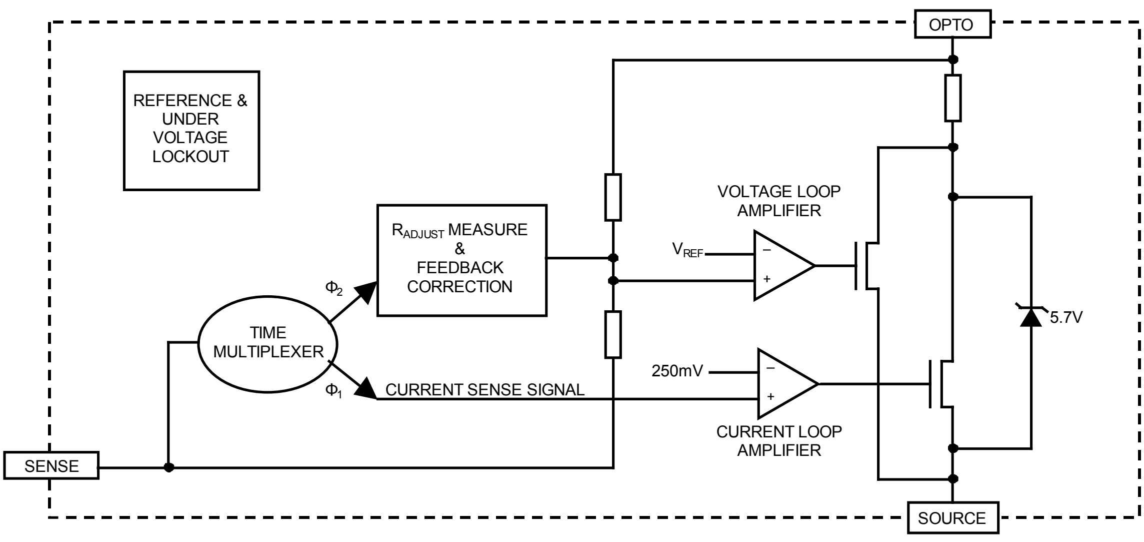


Figure 2. Functional Block Diagram

APPLICATION INFORMATION

TYPICAL APPLICATION (4V TO 6.2V)

Figure 3 shows a complete application circuit using the ACT32 in combination with the ACT30A ActiveSwitcher™ AC/DC Converter to generate a 5V/0.75A constant voltage/constant current output.

To set constant output voltage to a different value, choose R7 based on the following equation (assuming optocoupler LED voltage V_{FLED} = 1V):

$R7 = 80k\Omega \bullet [(V_{OUTCV} - 1V)/3.8V - 1]$ (ACT32)

using ACT32 for output voltage from 5V to 6.2V. For lower output voltage, change IC3 to the ACT32B. The output voltage is then selected via the following equation:

$R7 = 80k\Omega \bullet [(V_{OUTCV} - 1V)/3.05V - 1]$ (ACT32B)

To set constant current to a different value, change R6 as following:

$R6 = 250mV/I_{OUTCC}$

The transformer and ACT30A are designed so that when the output voltage is low, the PWM switcher enters hiccup mode and the average output current is less than the constant current value.

HIGH OUTPUT VOLTAGE APPLICATION (>6.2V)

To generate output voltage higher than 6.2V, use the configuration of Figure 4. In this circuit, the output voltage is first divided down via the R_{FB1} and R_{FB2} resistor divider, with the tap voltage equal to $V_{OPTO} + V_{BEQ2}$ = 4.45V. Choose R_{FB2} between 2.7kΩ and 5.1kΩ. The other resistors are determined by:

$R_{FB1} = R_{FB2} \bullet (V_{OUTCV}/4.45V - 1)$

$R_{SENSE} = 250mV/I_{OUTCC}$

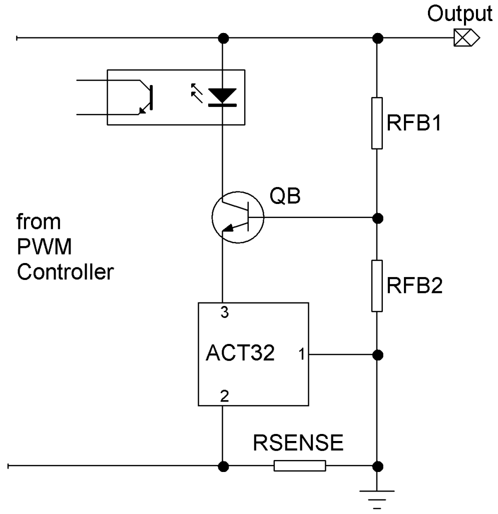


Figure 4. High Output Voltage (>6.2V) Application

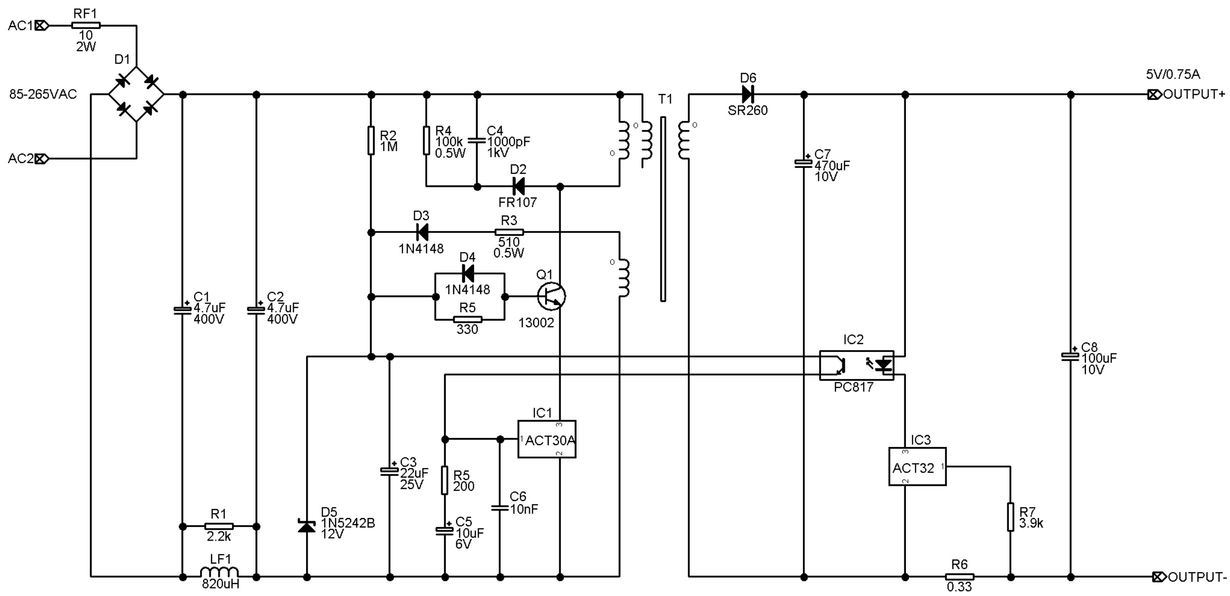
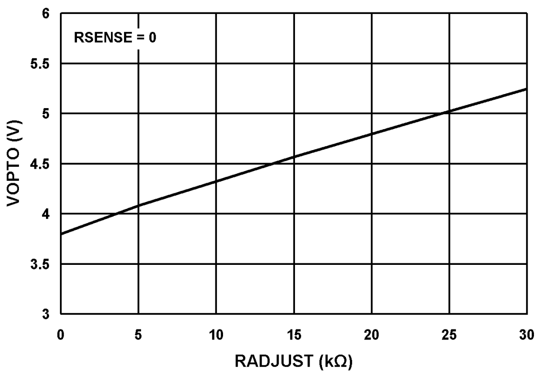


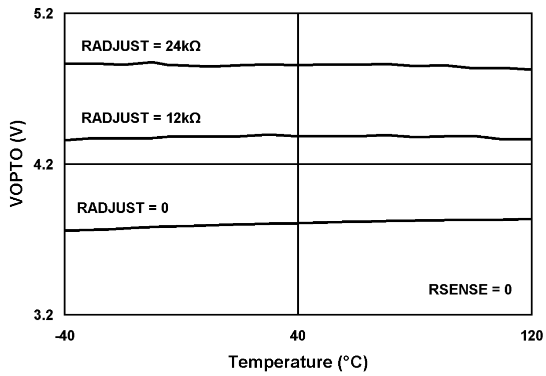
Figure 3. A 3.75W Battery Charger using ACT32 with ACT30A

TYPICAL PERFORMANCE CHARACTERISTICS

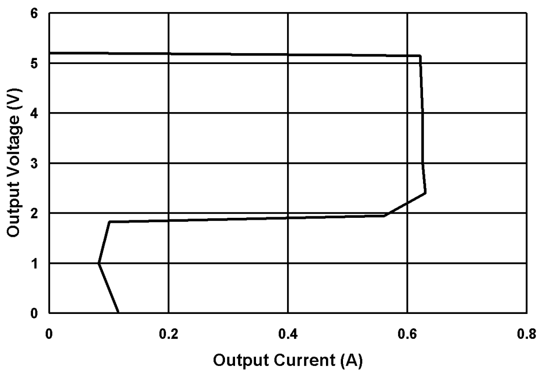
ACT32 OPTO Voltage vs. RADJUST



ACT32 OPTO Voltage vs. Temperature

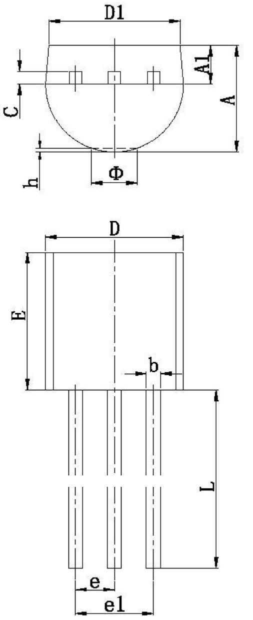


Output Voltage vs. Output Current



PACKAGE OUTLINE

TO-92 PACKAGE OUTLINE AND DIMENSIONS



SYMBOL	DIMENSION IN MILIMETERS		DIMENSION IN INCHES	
	MIN	MAX	MIN	MAX
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.400	4.700	0.173	0.185
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ		1.600		0.063
h	0.000	0.380	0.000	0.015