

2-Cell, Step-Up DC/DC Converter Controller

FEATURES

- Adjustable Output Voltage with Two Resistors (AIC1630A).
- Power-Saving Shutdown Mode (7 μ A typical).
- 120KHz Switching Rate.
- On-Chip Low Battery Detector.

APPLICATIONS

- Palmtop & Notebook Computers.
- Battery Charger Supply.
- Cellular Telephone.
- LCD Contrast Supply.
- Flash Memory Programmer.
- Battery Backup Supplies.
- Portable Instruments.

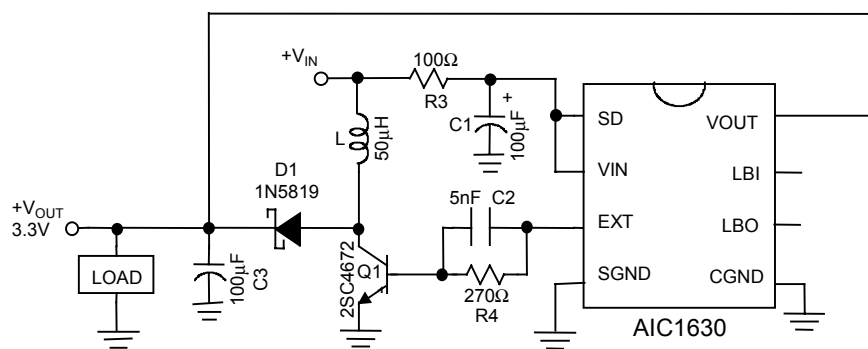
DESCRIPTION

The AIC1630 is a DC-DC converter designed to drive an external power switch for more flexibility, especially in higher voltage and larger power applications. Typically six components are required to set up a step up configuration easily achieving efficiency beyond 80%. A few more components are required to set up a step down configuration delivering 4A load current with 83% typical efficiency, 86% at 2A load, and 300 μ A quiescent current.

The output voltage is internally set to 3V, 3.3V, 5V or externally set to an arbitrary value below breakdown voltage of the power switch. Logic-controlled shutdown mode is provided for power saving. The low battery detector can be also configured as a linear regulator.

120KHz switching rate reduces the inductor size. Inductors of 25 μ H to 50 μ H inductance are recommended for most applications.

TYPICAL APPLICATION CIRCUIT

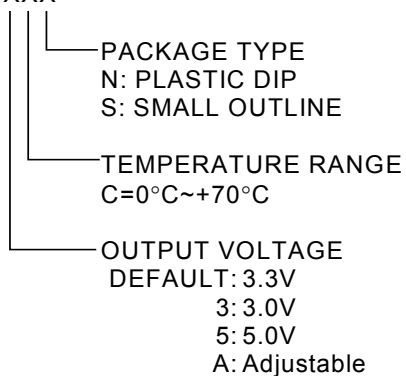


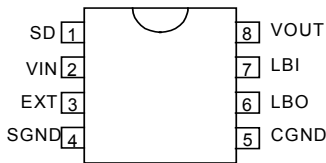
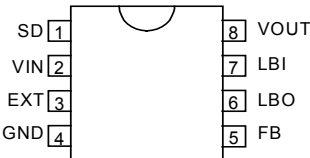
Note : $V_{IN} \geq 1.8V$, $V_{OUT} \leq 7V$

High Efficiency Step-Up DC/DC Converter

ORDERING INFORMATION

AIC1630 XXX



ORDER NUMBER	PIN CONFIGURATION
AIC1630CN AIC1630-3CN AIC1630-5CN (PLASTIC DIP)	TOP VIEW 
AIC1630CS AIC1630-3CS AIC1630-5CS (PLASTIC SO)	
AIC1630ACN (PLASTIC DIP)	TOP VIEW 
AIC1630ACS (PLASTIC SO)	

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	7.0V
DC Voltage Applied On All Other Pins	7.0V
Operating Temperature Range	-20°C~80°C
Storage Temperature Range	-65°C ~150°C

TEST CIRCUIT

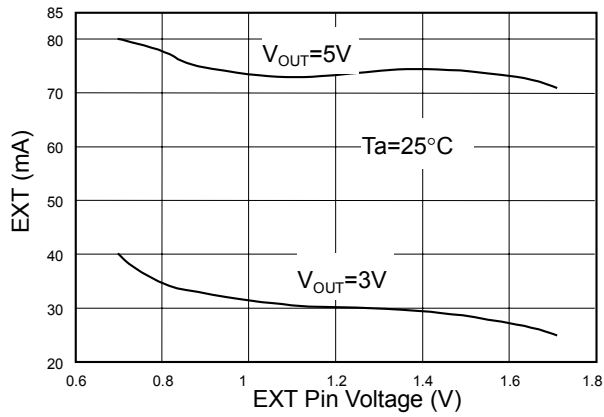
Refer to Typical Application Circuit.

■ **ELECTRICAL CHARACTERISTICS** ($V_{IN}=3.0V$, $T_a=25^{\circ}C$, unless otherwise specified.)

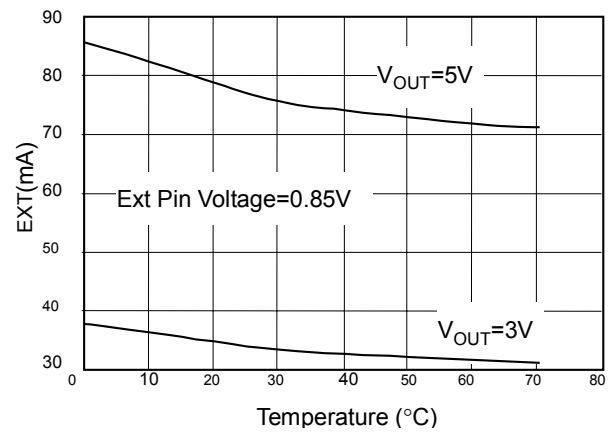
PARAMETER	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Input Voltage		1.8		7	V
Default Output Voltage	$I_L=200mA$ AIC1630 AIC1630-3 AIC1630-5	3.16 2.88 4.80	3.3 3.0 5.0	3.44 3.12 5.20	V
Switch Off Current			105	140	μA
Shutdown Mode Current			7	15	μA
Recovery Time from Shutdown	$V_{IN}=2.5V$, $I_L=200mA$		0.4		mS
Efficiency	$I_L=300mA$ Fig. 1 in Appl. Examples		85		%
Line Regulation	$V_{IN}=2.2\sim 3.3V$ $V_{OUT}=5V$, $I_L=100mA$		0.6		% V_{OUT}
Load Regulation	$I_L=10mA\sim 500mA$ $V_{OUT}=5V$		2.5		% V_{OUT}
Oscillator Frequency		90	120	150	KHz
LBI Pin Trip Point		1.17	1.22	1.27	V
FB Threshold Voltage	AIC1630A	0.598	0.617	0.636	V
EXT Pin Driving Capability	Pin 8=5V, Pin 3= 0.85V Sourcing Sinking		80 50		mA mA
LBO "ON Resistance"	$V_{IN}=2V$		45		Ω
Input Pin Bias Current				10	nA/Pin
Output Pin Leakage				10	nA/Pin

■ TYPICAL PERFORMANCE CHARACTERISTICS

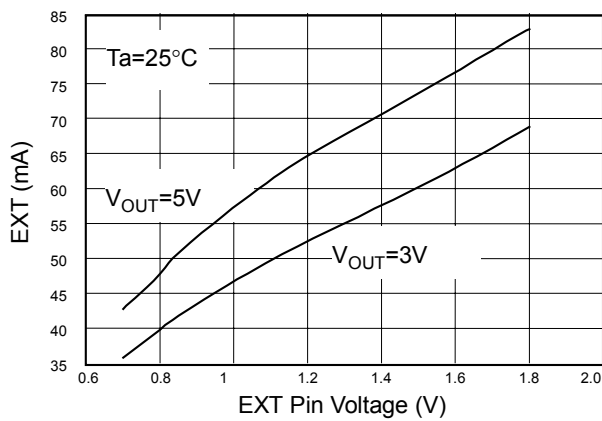
Ext Pin Sourcing Capability



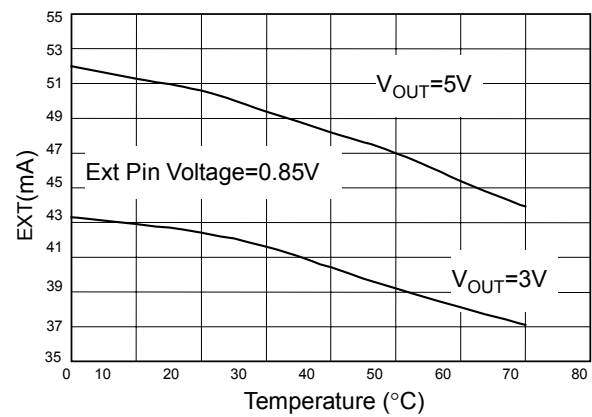
Ext Pin Sourcing Capability vs Temperature



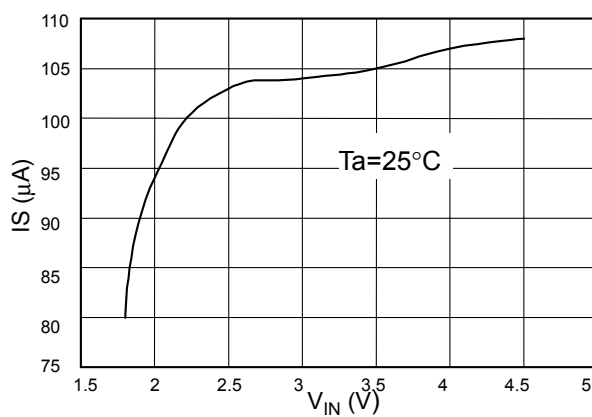
Ext Pin Sinking Capability



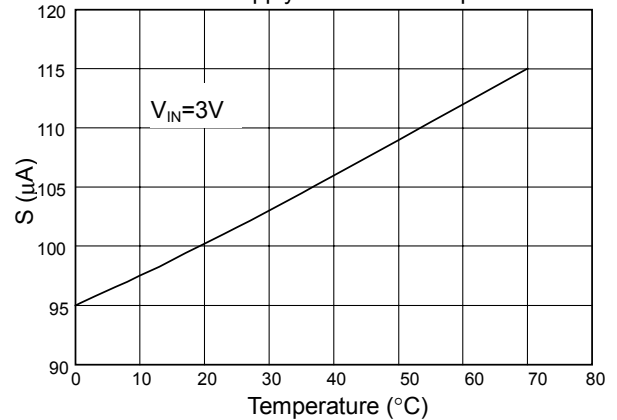
Ext Pin Sinking Capability vs Temperature



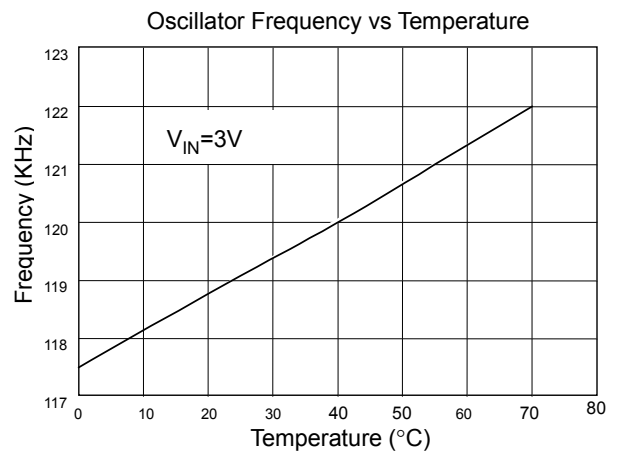
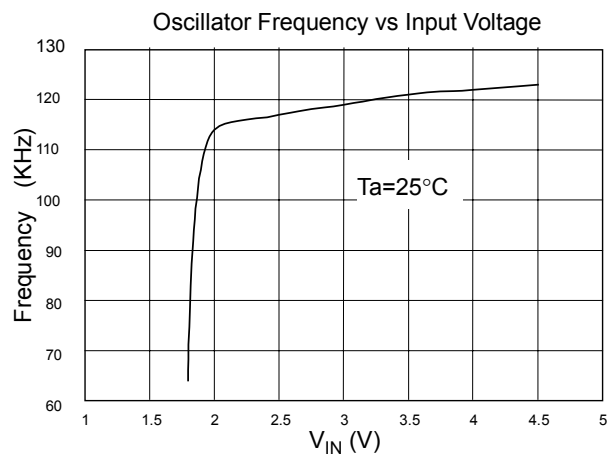
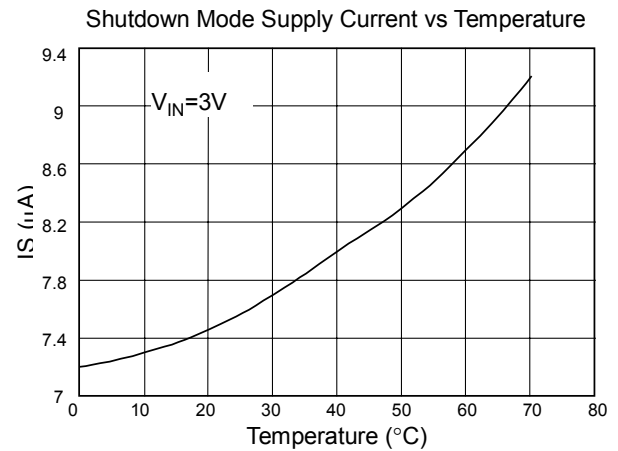
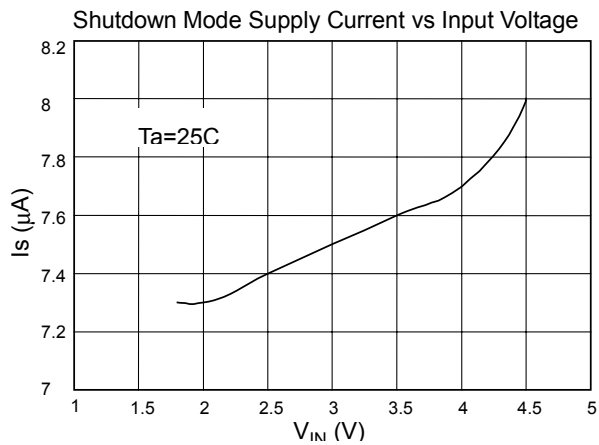
Switch off Supply Current vs Input Voltage



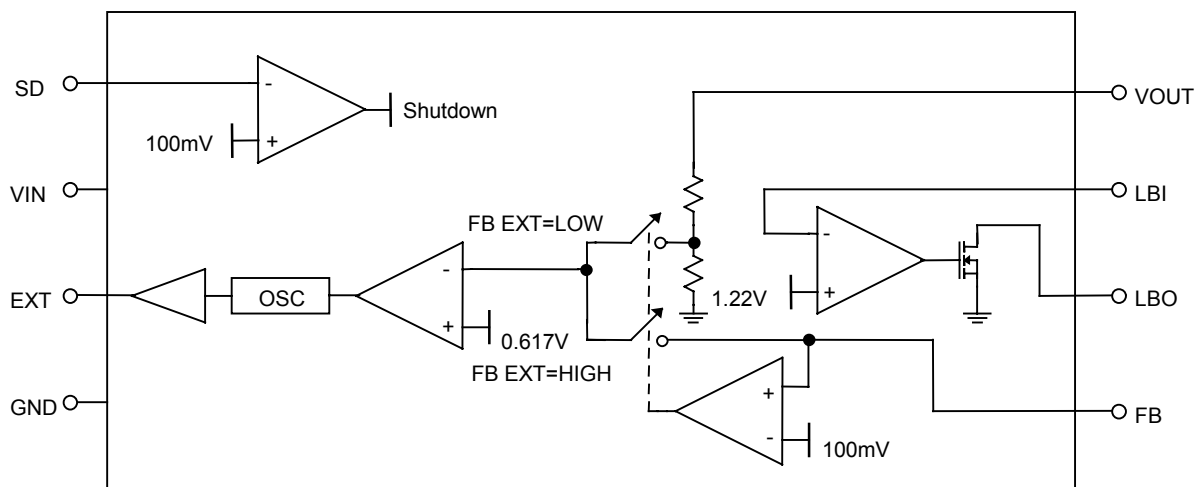
Switch Off Supply Current vs Temperature



■ TYPICAL PERFORMANCE CHARACTERISTICS (CONTINUED)



■ BLOCK DIAGRAM



PIN DESCRIPTION

AIC1630/ AIC1630-3 / AIC1630-5

- PIN 1: SD - The AIC1630 goes in shutdown mode and consumes less than 10 μ A when SD pin is pulled to ground and it goes in normal operating mode when the SD pin is pulled to a positive voltage above 100mV.
- PIN 2: VIN - Input supply.
- PIN 3: EXT - Push-pull drive output to drive external power switch.
- PIN 4:SGND - Ground connected to source of power switch.
- PIN 5:CGND - Ground for control circuits of the IC. It should be separated from SGND to avoid the interference.
- PIN 6:LBO - Open drain output of the battery low detector, with 45 Ω "ON resistance" at $V_{IN}=2V$. It is pulled low when the voltage on LBI pin is below 1.22V.
- PIN 7:LBI - The noninverting input of the battery low detector, of which the inverting input is internally connects to 1.22V voltage reference.
- PIN 8:VOUT - The output voltage feedbacks to the IC through this pin.

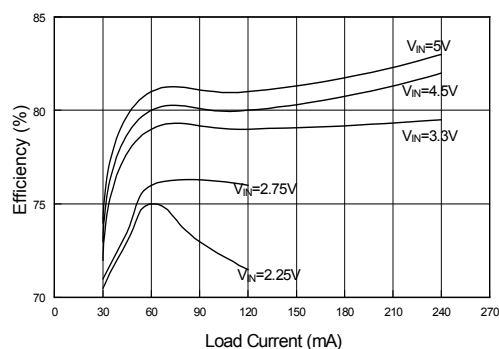
AIC1630A

- PIN 1: SD - The AIC1630A goes in shutdown mode and consumes less than 10 μ A when SD pin is pulled to ground and it goes in normal operating mode when the SD pin is pulled to a positive voltage above 100mV.
- PIN 2: VIN - Input supply.
- PIN 3: EXT - Push-pull drive output to drive external power switch.
- PIN 4: GND - Ground.
- PIN 5: FB - Output voltage can either be internally set to 5 volt by grounding FB pin, or be externally set to an arbitrary voltage by applying to FB pin the divider voltage of two divider resistors.

 V_{OUT} voltage is given by the following equation:

$$\frac{R1}{R2} = \frac{V_{OUT}}{0.617} - 1$$
 where R1 = Resistor connected between FB pin and VOUT pin.
 R2= Resistor connected between FB pin and ground.
 V_{OUT} =Output voltage to be set.
- PIN 6: LBO - Open drain output of the battery low detector, with 45 Ω "ON resistance" at $V_{IN}=2V$. It is pulled low when the voltage on LBI pin is below 1.22V.
- PIN 7: LBI - The noninverting input of the battery low detector, of which the inverting input is internally connects to 1.22V voltage reference.
- PIN 8: VOUT- The output voltage feedbacks to the IC through this pin. If output voltage was externally set, the VOUT pin can be tied to any low impedance node with voltage between the external power switch threshold and 7V

Load Current (mA)	$V_{IN} = 2V$	$V_{IN} = 2.2V$	$V_{IN} = 3V$	$V_{IN} = 3.3V$	$V_{IN} = 4.5V$
0	63	70	78	82	86
100	80	84	86	88	90
200	81	86	88	90	91
300	81	85	87	89	90
400	81	84	86	88	89
500	81	83	85	87	88
600	81	82	84	86	87
700	81	81	83	85	86



The schematic diagram illustrates a boost converter circuit. The input voltage V_{IN} is connected to the VIN pin of the AIC1630A IC. A series inductor L (220 μ H) is placed between the input and the IC. The output of the IC is connected to the output voltage V_{OUT} (+36V) through a 1M Ω resistor $R1$. The feedback network consists of a 17.8K Ω resistor $R2$ connected to the FB pin and a 120 Ω resistor $R3$ connected to the EXT pin. The IC is powered by a +3.5V supply $VS(+3.5V)$ connected to the SD pin. The GND pin is connected to ground. The output of the IC is also connected to a load through a 33 μ F capacitor $C3$. The input of the IC is connected to ground through a 47 μ F capacitor $C1$. The IC is labeled AIC1630A.

Figure 10 is a line graph showing Efficiency (%) on the y-axis (ranging from 70 to 95) versus Load Current (mA) on the x-axis (ranging from 0 to 70). The graph displays five curves for different input voltages (V_{IN}) while the output voltage (V_S) is constant at 5V. The curves are labeled with their respective V_{IN} values: 20V, 16V, 12V, 8V, and 5V. Efficiency generally increases with load current and decreases as V_{IN} increases.

Load Current (mA)	$V_{IN} = 20V$ (%)	$V_{IN} = 16V$ (%)	$V_{IN} = 12V$ (%)	$V_{IN} = 8V$ (%)	$V_{IN} = 5V$ (%)
10	91.5	87.5	82.5	74.5	72.0
20	92.0	88.5	84.5	80.5	75.5
30	92.5	89.0	85.5	83.5	78.0
40	93.0	89.5	86.5	84.5	81.5
50	93.5	90.0	87.0	85.0	-
60	94.0	90.5	87.5	85.5	-

APPLICATION EXAMPLES (CONTINUED)

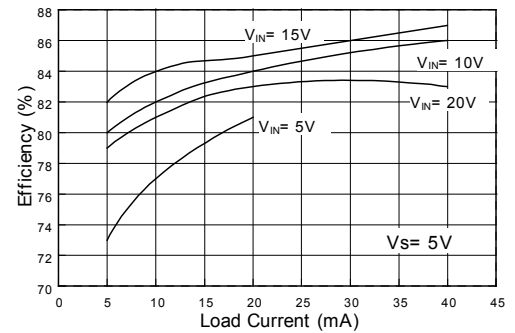
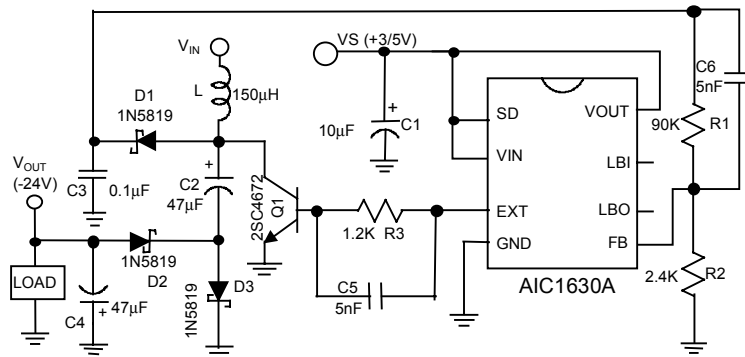


Fig. 4 -24V Output Inverting Converter for LCD

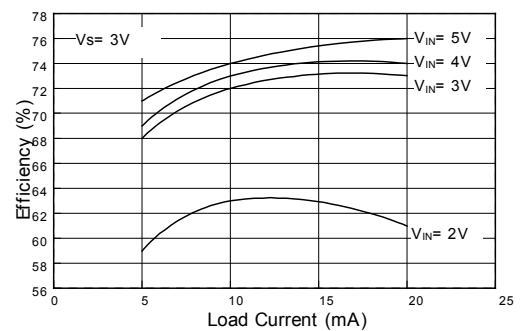
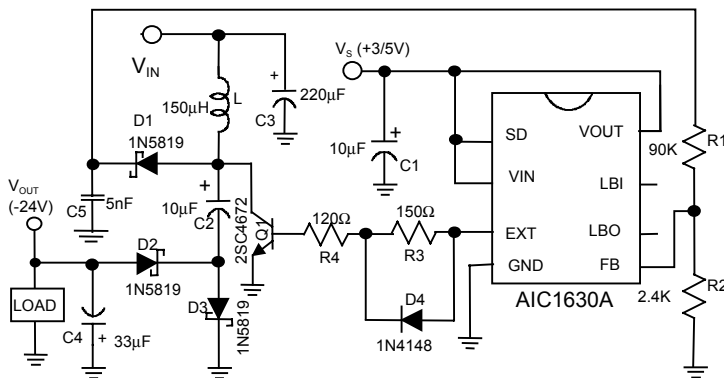


Fig. 5 2V Input 20mA Load -24V Output Inverting Converter for LCD

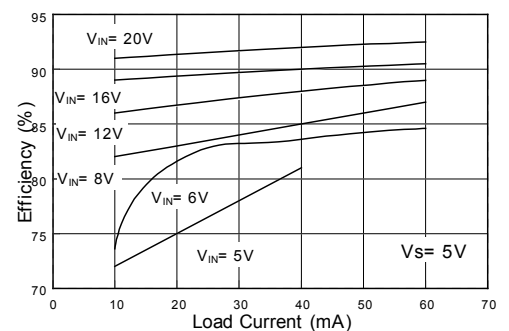
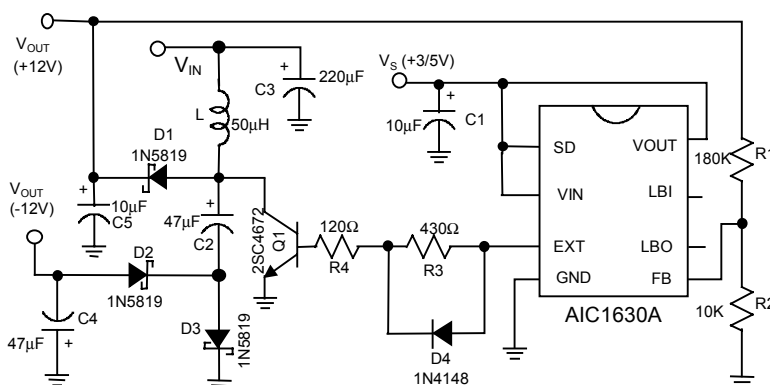


Fig. 6 12V Dual Output Converter for computer for computer Interfacing

APPLICATION EXAMPLES (CONTINUED)

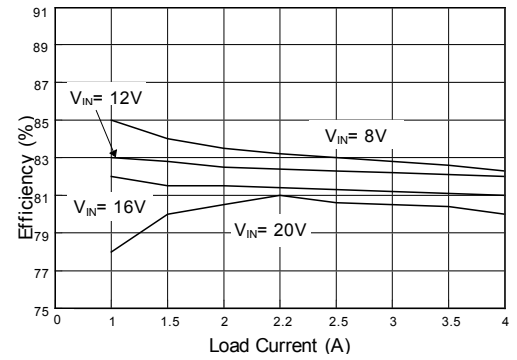
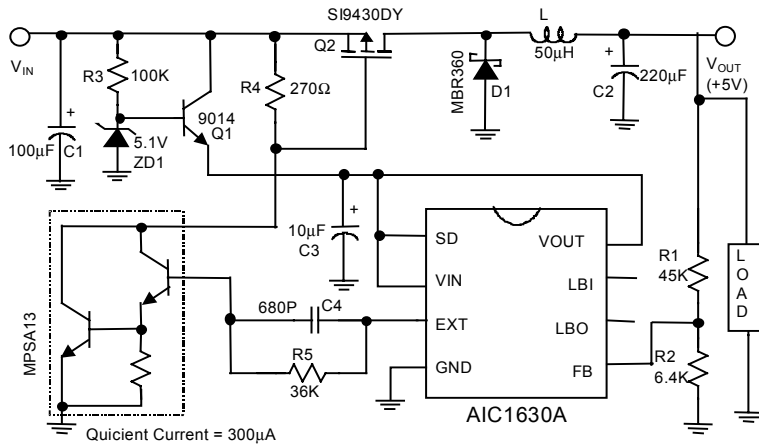


Fig. 7 5V Output Step-Down Converter -1

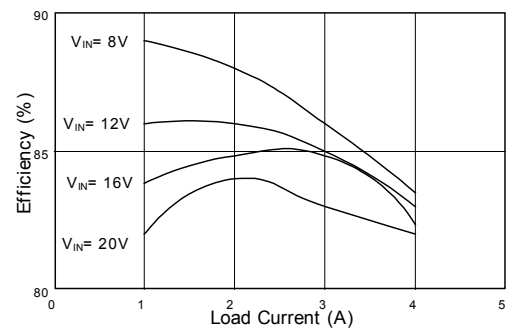
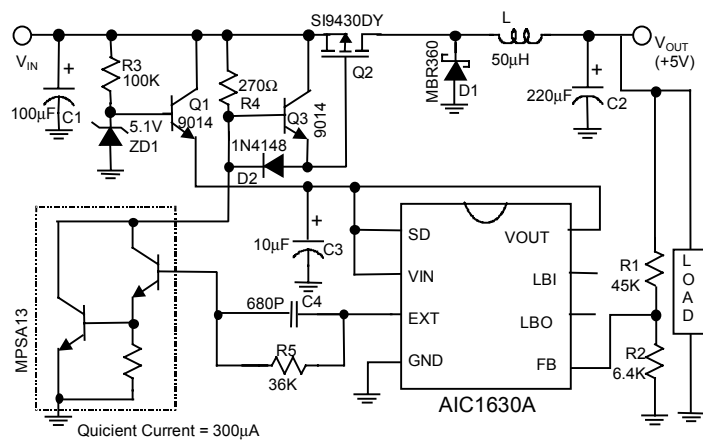
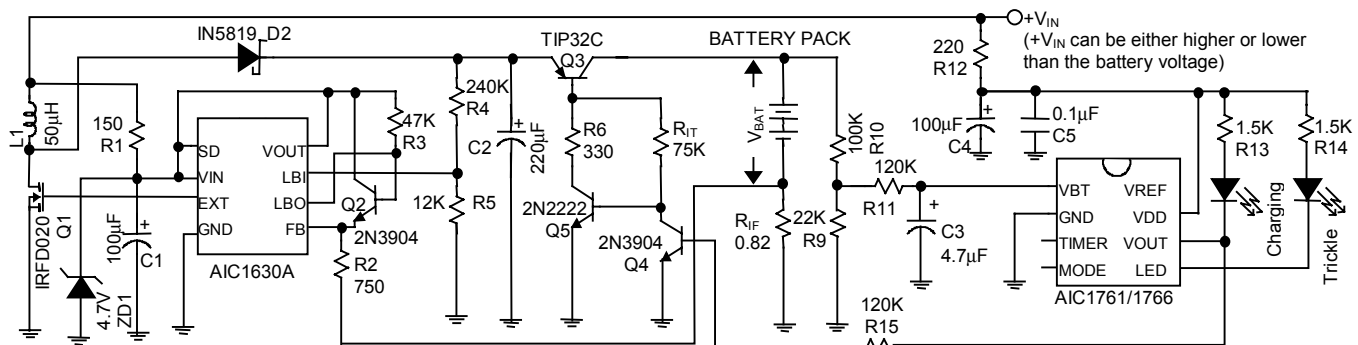


Fig. 8 5V Output Step-Down Converter -2

[illegible]

Charging current = 0.8A, Auto-Cut-Off at 0.75/0.25% - ΔV point and Fault Conditions.
(R_{IF} sets the Charging Current)
 V_{IN} must be lower than V_{BAT} .
Short Circuit Condition is protected with a 2A Fuse.

Fig. 9 Step-Up Rechargeable Battery Charger

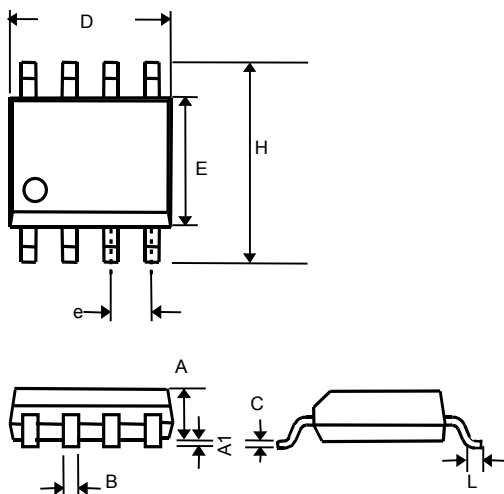


Note: Fast Charge Current = $0.8A @ V_{IN} < V_{BAT}$
 $= (V_{IN} - V_{BAT} - 0.5) / 0.82 @ V_{IN} > V_{BAT}$
 Trickle charge Current = 30mA.
 (R_{IF} sets Fast Charge Current, R_{IT} sets Trickle Charge Current)
 Typical Efficiency = 75%.
 With Short Circuit Protection.

Fig. 10 Step-Up/Down Rechargeable Battery Charger

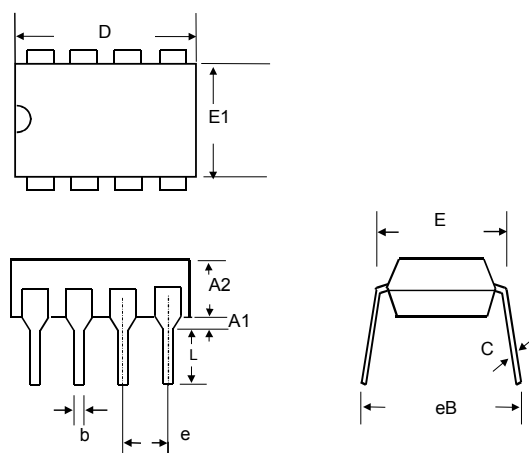
■ PHYSICAL DIMENSIONS

● 8 LEAD PLASTIC SO (unit: mm)



SYMBOL	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27(TYP)	
H	5.80	6.20
L	0.40	1.27

● 8 LEAD PLASTIC DIP (unit: mm)



SYMBOL	MIN	MAX
A1	0.381	—
A2	2.92	4.96
b	0.35	0.56
C	0.20	0.36
D	9.01	10.16
E	7.62	8.26
E1	6.09	7.12
e	2.54 (TYP)	
eB	—	10.92
L	2.92	3.81