DALLAS SEMICONDUCTOR

DS1633x High–Speed Battery Charger

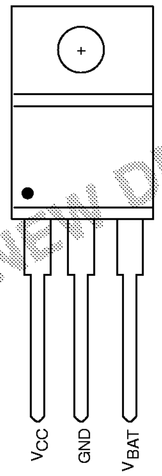
FEATURES

- Preprogrammed versions of DS1633
- Recharges lithium, NiCad, and lead acid batteries
- Retains battery and power supply limits in onboard memory
- Timer–terminated standard charge followed by trickle charge
- 3–pin TO–220 package
- Operating range 0 to 70°C
- Applications include consumer electronics, portable/cellular phones, pagers, medical instruments, backup memory systems, security systems
- Available in six different preprogrammed variations to meed the needs of 3–cell NiCad battery packs

PRODUCT SELECTION GUIDE Table 1

PART NUMBER	I_{MAX} (mA)	V_{MAX} (V)	TIMER (hours)
DS1633–A	100	4.65	8
DS1633–B	80	4.65	8
DS1633–C	60	4.65	8
DS1633–D	40	4.65	8
DS1633–E	20	4.65	8

PIN ASSIGNMENT TO–220



See Mech. Drawings Section

PIN DESCRIPTION

V_{CC}	Input Voltage, +
V_{BAT}	Battery Voltage Input, +
GND	Ground

DESCRIPTION

The DS1633x High–Speed Battery Recharger automatically provides a constant current recharge to a battery as long as the battery's voltage is below the specified maximum voltage. The DS1633x charges the battery using its V_{CC} input as a source. When V_{CC} is floated, the DS1633x is dormant. When V_{CC} is reapplied, the DS1633x begins charging.

Although a variety of load curves can be used to charge a battery, most do not take advantage of the fact that a battery can accept its maximum current rating for charging purposes over its entire voltage range. The DS1633x takes advantage of this opportunity by constantly readjusting the current supplied to the battery being charged. As the voltage level of the battery being charged rises, and the supply current drops, the DS1633x adjusts to boost the charging current back to its maximum.

This feature greatly decreases the recharge time required to fully charge a lithium, NiCad, or lead acid type cell.

The DS1633x provides a designer with the ability to use an optimized battery load line by selecting a preprogrammed DS1633x from Dallas Semiconductor. Refer to Table 1 to assist in the selection of the appropriate device. Each DS1633x is designed to constantly adjust the open circuit voltage and supply current to regulate the current flow to the battery being charged. As the battery is being charged, its voltage is being measured. When the voltage has reached a factory-defined voltage breakpoint on its load line, the open circuit voltage and supply current are modified according to the factory pre–set values. The DS1633x uses these new values until the next breakpoint is reached, allowing more adjustments.

The DS1633x Current Supply Diagram and Traditional Battery Charge Load Line illustrate this concept and how it differs from an non–controlled recharge. In the traditional resistor limited battery charge load line (Figure 1), a battery has a specified maximum current and voltage at which it may be recharged. A charging voltage source begins charging the dead or near zero voltage battery at its maximum current rating. As the battery begins to charge, and its voltage increases, the voltage difference across the resistor begins to diminish, decreasing the current supplied to the battery. This costs time because the battery is being charged at a slower rate as time goes on. The DS1633x circumvents this deficiency by modifying the load curve to be pseudo–constant current (Figure 2). Rather than using a very steep load line which terminates at the open circuit voltage of the battery to be charged, the DS1633x uses a shallow load curve, which intersects the voltage axis well beyond the maximum voltage of the battery being charged. The net effect produced is that when the battery is at a very low voltage, it will receive its maximum current at an open circuit charge voltage significantly higher than its rated supply. As the battery being charged begins to gain voltage the load line will begin to reduce the current the battery is receiving to less than its maximum acceptable rate. By periodically decreasing the value of R_N, the current flow between V_{CC} and the battery is increased to compensate for the increase in battery voltage.

OPERATION

Upon power–up, the DS1633x does a dummy cycle of eight seconds with the charge current set to 0 to determine where to start the charging curve. In normal operation the part measures the battery voltage every eight seconds to find what V_{OC}, R_{TH}, and charging duty cycle should be applied to the battery. This continues as long as V_{CC} is greater than 5.7V.

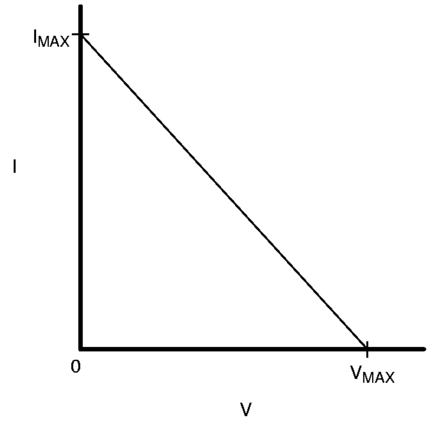
Figure 3, the DS1633x Operational Flow Chart, shows how the DS1633x functions as it charges a battery. The charging termination methods available in the DS1633x are charging time and maximum battery voltage. Each DS1633x when programmed retains the maximum charging current and maximum charge voltage limit of the battery pack according to Table 1. The packs trickle charge requirements is also retained. Lastly, the DS1633x maintains an internal timebase of how long it has been charging a given battery pack, and will terminate high current charging if the maximum allowable time has been exceeded. DS1633's are capable of charging single rechargeable lithium 3.0V cells, or from 1 to 3 Nicad cells (usually 1.55V max/cell) at a maximum current of 100 mA.

The DS1633 is suited for charging a variety of rechargeable lithium chemistry and NiCad chemistry batteries. In order to make implementation as easy as possible, Dallas Semiconductor offers DS1633x's preprogrammed to meet the charging requirements of a variety of industry standard 3–cell pack NiCad batteries.

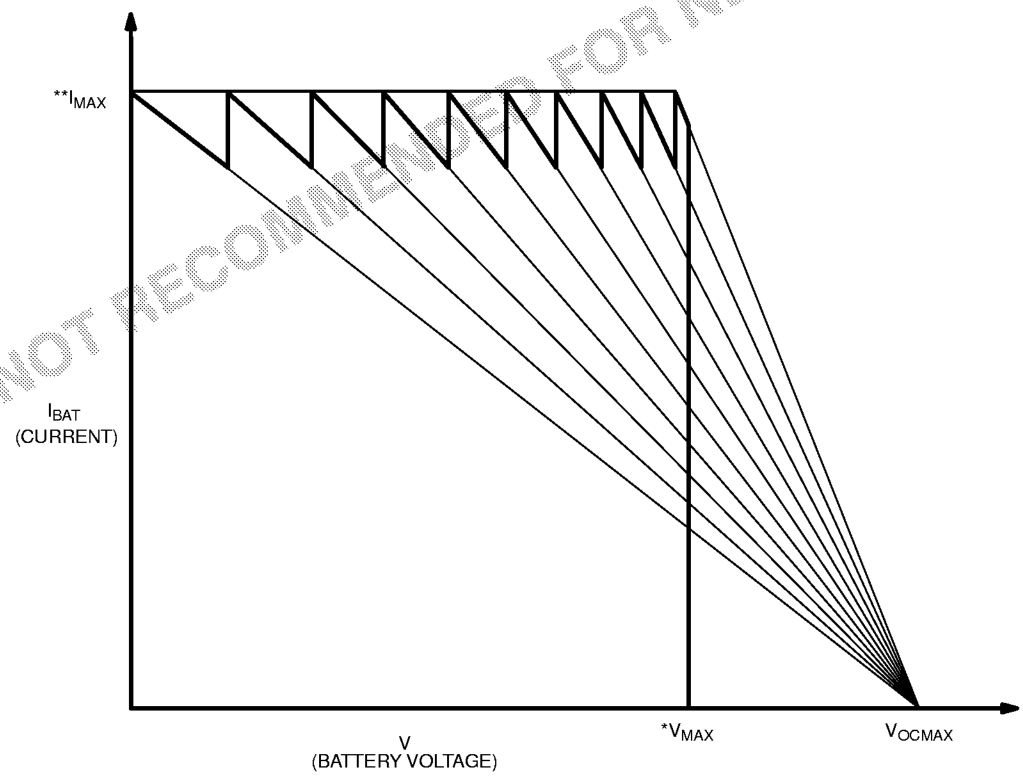
If you would like to create your own load line and test it in DS1633x's, you may purchase a DS1633K kit from Dallas Semiconductor. The kit contains unprogrammed or "blank" DS1633x's, DOS software for helping generate and test your load line in a mouse driven environment, and the necessary interface hardware for taking your unique load line requirement and programming DS1633x's directly through an IBM personal computer serial port.

If you choose to purchase a kit, decide upon a load line, and want to program parts yourself, you can purchase "blank" DS1633x's from Dallas Semiconductor and program your own.

TRADITIONAL BATTERY CHARGE LOAD LINE Figure 1



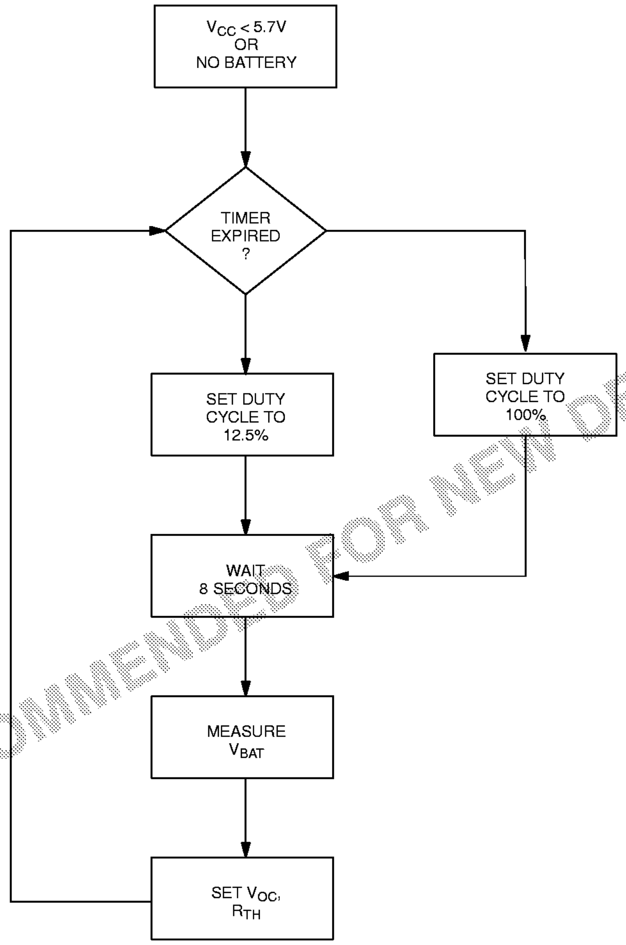
MAXIMUM CURRENT LOAD LINE Figure 2



*The vertical line marked V_{MAX} represents the maximum voltage which the battery may accept.

** The horizontal line marked I_{MAX} represents the maximum current which the battery may accept.

DS1633x OPERATION FLOW CHART Figure 3



ABSOLUTE MAXIMUM RATINGS*

Voltage on Any Pin Relative to Ground	–1V to +7.0V
Operating Temperature	0°C to 70°C
Storage Temperature	–55°C to +125°C
Soldering Temperature	260°C for 10 seconds

* This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

RECOMMENDED DC OPERATING CONDITIONS (0°C to+70°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Supply Voltage	V_{CC}	5.7	6.0	6.5	V	

DC ELECTRICAL CHARACTERISTICS (0°C to +70°C; $V_{CC} \pm 5\%$)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Battery Charge Current	I_{BAT}				mA	
DS1633–A		90	100	110		
DS1633–B		72	80	88		
DS1633–C		54	60	66		
DS1633–D		36	40	44		
DS1633–E		18	20	22		
Supply Current	I_{CC}			I_{BAT} + 2	mA	
Charge Cutoff Voltage	V_{MAX}	4.50	4.65	4.80	V	
Battery Leakage Current	I_{LKG}			100	nA	1

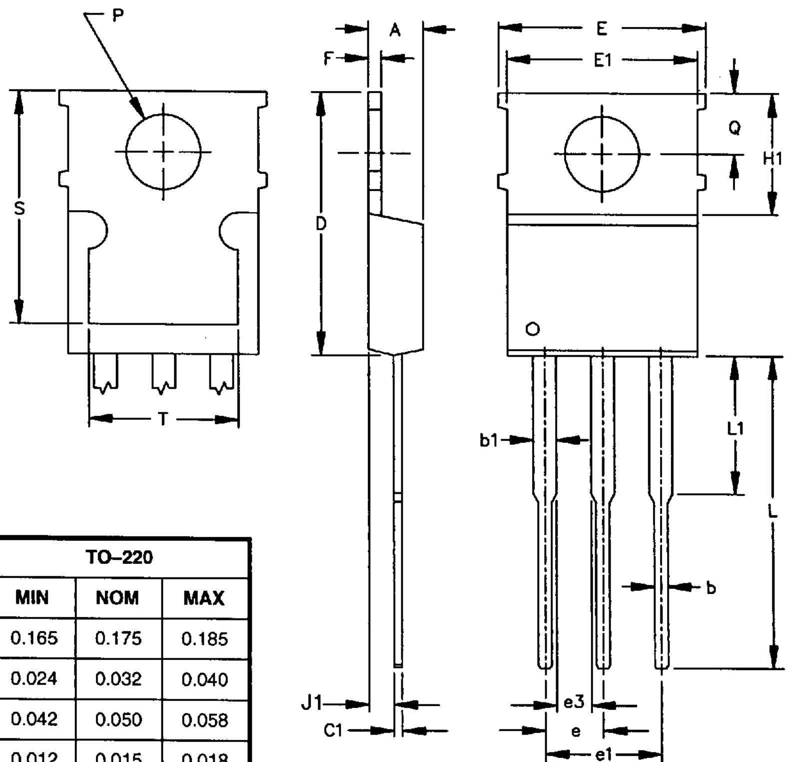
AC ELECTRICAL CHARACTERISTICS (0°C to +70°C; $V_{CC} \pm 5\%$)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Standard Charge TIme Limit	t_{CHG}	7.2	8.0	8.8	hours	
Trickle Charge Duty Cycle		12.5			%	

NOTE:

1. V_{CC} = 0V.

3L TO–220



Includes:
DS1633
DS1821T
DS1837

PKG	TO–220		
DIM	MIN	NOM	MAX
A	0.165	0.175	0.185
b	0.024	0.032	0.040
b1	0.042	0.050	0.058
C1	0.012	0.015	0.018
D	0.573	0.588	0.603
E	0.394	0.404	0.414
E1	0.390	0.400	0.410
e	0.090	0.100	0.110
e1	0.190	0.200	0.210
e3	0.045	0.050	0.055
F	0.045	0.050	0.055
H1	0.236	0.248	0.260
J1	0.095	0.105	0.115
L	0.535	0.545	0.555
L1	0.220	0.230	0.240
P	0.146	0.151	0.156
Q	0.100	0.108	0.116
S	0.465	0.475	0.485
T	0.195	0.205	0.215

All dimensions are shown in inches.