

# 33340, 33342

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The MC33340 and MC33342 are monolithic control IC's that are specifically designed as fast charge controllers for Nickel Cadmium  
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# MC33340, MC33342

## MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
Power Supply Voltage (Pin 8)	$V_{CC}$	18	V
Input Voltage Range			V
Time/Temperature Select (Pins 5, 6, 7)	$V_{IR(t/T)}$	-1.0 to $V_{CC}$	
Battery Sense, (Note 2) (Pin 1)	$V_{IR(sen)}$	-1.0 to $V_{CC} + 0.6$ or -1.0 to 10	
$V_{sen}$ Gate Output (Pin 2)			
Voltage			
Current			

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**ELECTRICAL CHARACTERISTICS** ( $V_{CC} = 6.0\text{ V}$ , for typical values  $T_A = 25^\circ\text{C}$ , for min/max values  $T_A$  is the operating ambient temperature range that applies (Note 3), unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>BATTERY SENSE INPUT</b> (Pin 1)					
Input Sensitivity for $-\Delta V$ Detection	$-\Delta V_{th}$	-	-4.0	-	mV
Overvoltage Threshold	$V_{th(OV)}$	1.9	2.0	2.1	V

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## INTRODUCTION

Nickel Cadmium and Nickel Metal Hydride batteries require precise charge termination control to maximize cell capacity and operating time while preventing overcharging. Overcharging can result in a reduction of battery life as well as physical harm to the end user. Since most portable applications require the batteries to be charged rapidly, a primary and usually a secondary or redundant charge sensing technique is employed into the charging system. It is also desirable to disable rapid charging if the battery voltage or temperature is either too high or too low. In order to address these issues, an economical and flexible fast charge controller was developed.

The MC33340/342 contains many of the building blocks and protection features that are employed in modern high performance battery charger controllers that are specifically designed for Nickel Cadmium and Nickel Metal Hydride batteries. The device is designed to interface with either primary or secondary side regulators for easy implementation of a complete charging system. A representative block diagram in a typical charging application is shown in Figure 8.

The battery voltage is monitored by the  $V_{sen}$



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Negative slope voltage detection starts after 60 ms have elapsed in the fast charge mode. This does not affect the Fast/Trickle output until the holdoff time ( $t_{\text{hold}}$ ) has elapsed during the fast charge mode. Two scenarios then exist. Trickle mode holdoff is implemented to ignore any initial drop in voltage that may occur when charging batteries that have been stored for an extended time period. If the negative slope voltage detector senses that initial drop during the holdoff time, and the input voltage rises as the battery charges, the Fast/Trickle output will remain open. However, if the negative slope voltage detector senses a negative drop

in voltage during the holdoff time and the input voltage never rises above that last detected level, the Fast/Trickle output will latch into a low state. The negative slope voltage detector has a maximum resolution of 2.0 V divided by 1023 mV, or 1.955 mV per count with an uncertainty of  $\pm 1.0$  count. This yields a detection range of 1.955 mV to 5.865 mV. In order to obtain maximum sensing accuracy, the R2/R1 voltage divider must be adjusted so that the  $V_{\text{sen}}$  input voltage is slightly less than 2.0 V when the battery pack is fully charged. Voltage variations due to temperature and cell manufacturing must be considered.

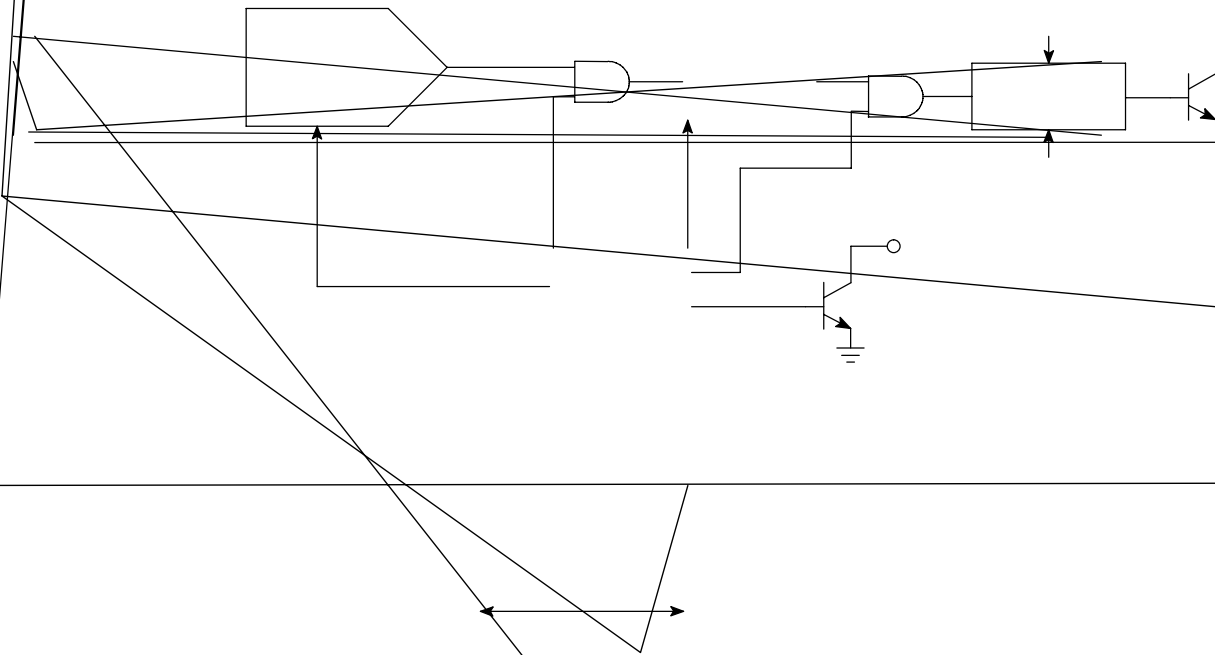


Figure 10. Negative Slope Voltage Detector

switching between the fast and trickle modes as the lower temperature limit is crossed. The amount of temperature rise to overcome the hysteresis is determined by the thermistor's rate of resistance change or sensitivity at the under temperature trip point. The required resistance change is:

$$\Delta R(T_{\text{Low}} \rightarrow T_{\text{High}}) = \frac{V_H(T)}{I_{\text{in}}} = \frac{44 \text{ mV}}{30 \text{ } \mu\text{A}} = 1.46 \text{ k}$$

The resistance change approximates a thermal hysteresis of 2°C with a 10 kΩ thermistor operating at 0°C. The under temperature fast charge inhibit feature can be disabled by biasing the t3/T<sub>ref</sub> Low input to a voltage that is greater than that present at t2/T<sub>sen</sub>, and less than V<sub>CC</sub> – 0.7 V. Under extremely cold conditions, it is possible that the thermistor resistance can become too high, allowing the t2/T<sub>sen</sub> input to go above V<sub>CC</sub> – 0.7 V, and activate the timer. This condition can be prevented by placing a resistor in parallel with the thermistor. Note that the time/temperature threshold of V<sub>CC</sub> – 0.7 V is a typical value at room temperature. Refer to the Electrical Characteristics table and to Figure 4 for additional information.

The upper comparator senses the presence of an over temperature condition. When the upper temperature limit is exceeded, the comparator output sets the Overtemperature Latch and the charger is switched to trickle mode. Once the latch is set, the charger cannot be returned to fast charge, even after the temperature falls below the limit. This feature prevents the battery pack from being continuously temperature cycled and overcharged. The latch can be reset

by removing and reconnecting the battery pack or by cycling the power supply voltage.

If the charger does not require either the time or temperature backup features, they can both be easily disabled. This is accomplished by biasing the t3/T<sub>ref</sub> Low input to a voltage greater than t2/T<sub>sen</sub>, and by grounding the t1/T<sub>ref</sub> High input. Under these conditions, the Time/Temp Select comparator output is low, indicating that the temperature mode is selected, and that the t2/T<sub>sen</sub> input is biased within the limits of an artificial temperature window.

Charging of battery packs that are used in portable power tool applications typically use temperature as the only means for fast charge termination. The MC33340/342 can be configured in this manner by constantly resetting the –ΔV detection logic. This is accomplished by biasing the V<sub>sen</sub> input to ≈1.5 V from a two resistor divider that is connected between the positive battery pack terminal and ground. The V<sub>sen</sub> Gate output is also connected to the V<sub>sen</sub> input. NowH the 510 0 0 1



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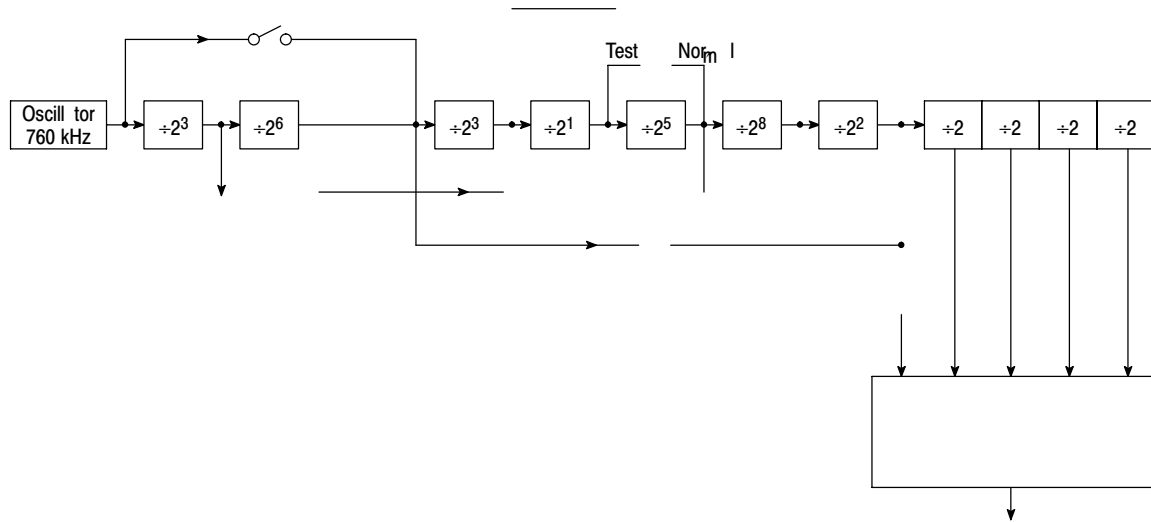
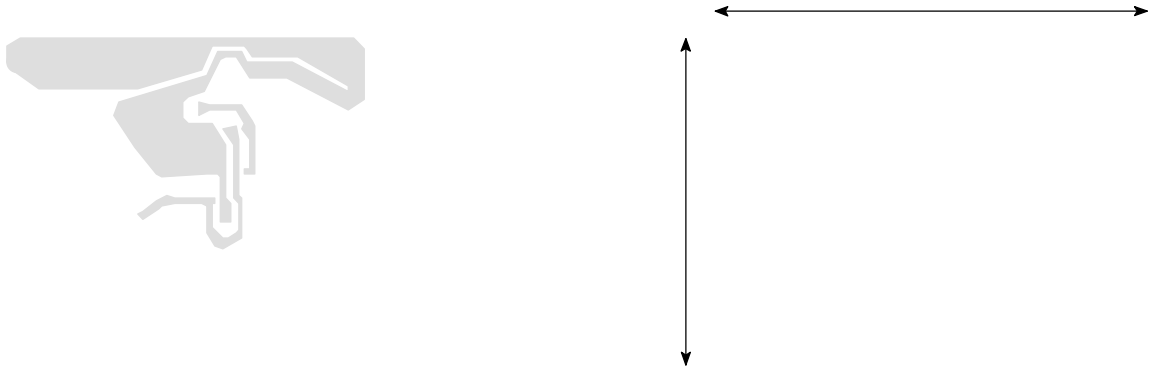


Figure 11. Timer Functional Block Diagram

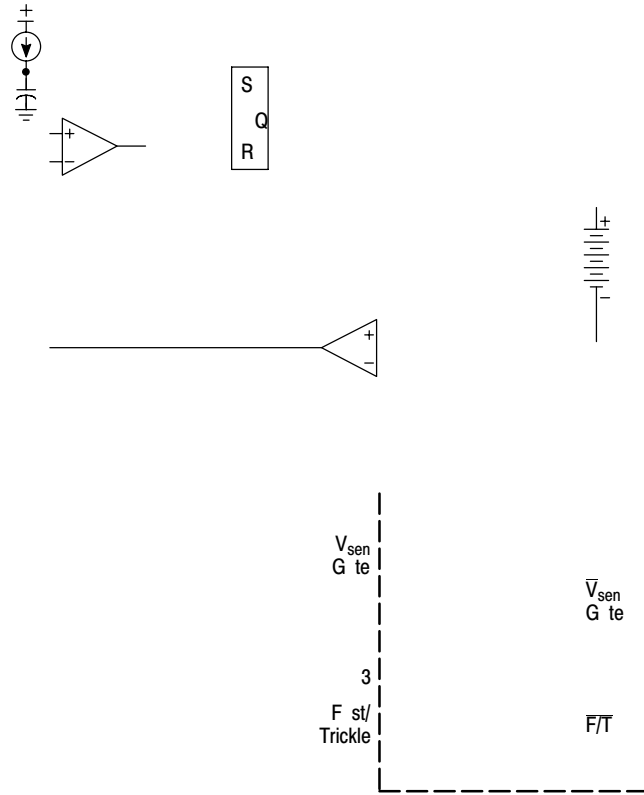
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AAVID #	$\theta_{SA}$ °C/W
592502B03400	24.0
593002B03400	14.0
590302B03600	9.2



**Figure 13. Printed Circuit Board and Component Layout  
(Circuit of Figure 12)**

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The MC33340/342 can be used to control the MC34166 or MC34167 power switching regulators to produce an economical and efficient fast charger. These devices are capable of operating continuously in current limit with an input voltage range of 7.5 to 40 V. The typical charging current for the MC34166 and MC34167 is 4.3 A and 6.5 A respectively. Resistors R2 and R1 are used to set the battery pack fast charge float voltage. If precise float voltage control is not required, components R1, R2, R3 and C1 can be deleted, and Pin 1 must be grounded. The trickle current level is set by resistor R4. It is recommended that a redundant charge termination method be employed for end user protection. This is especially true for fast charger systems. For additional converter design information, refer to the MC34166 and MC34167 data sheets.

**Figure 15. Switch Mode Fast Charger**

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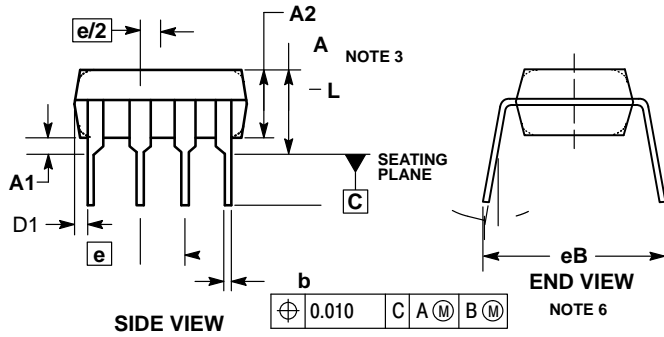
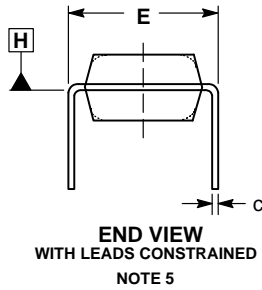
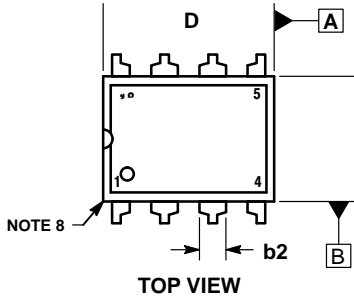
### ORDERING INFORMATION

Device	Package	Shipping†
MC33340D	SO-8	98 Units / Rail
MC33340DG	SO-8 (Pb-Free)	
MC33340DR2	SO-8	2500 / Tape & Reel
MC33340DR2G	SO-8 (Pb-Free)	
MC33340P	PDIP-8	1000 Units / Rail
MC33340PG	PDIP-8 (Pb-Free)	
MC33342D	SO-8	98 Units / Rail
MC33342DG	SO-8 (Pb-Free)	
MC33342DR2	SO-8	2500 / Tape & Reel
MC33342DR2G	SO-8 (Pb-Free)	
MC33342P	PDIP-8	1000 Units / Rail
MC33342PG	PDIP-8 (Pb-Free)	

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

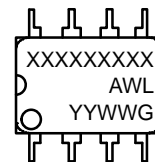
**PDIP 8**  
CASE 626-05  
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DATE 22 APR 2015



DIM	INCHES			
	MIN	MAX		
A	-----	0.210		
A1	0.015	-----		
A2	0.115	0.195	2.92	4.95
b	0.014	0.022		
C	0.008	0.014		
D	0.355	0.400		
D1	0.005	-----		
E	0.300	0.325		
e	0.100 BSC			
L	0.115	0.150	2.92	3.81

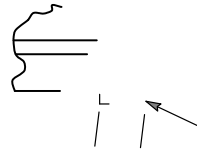
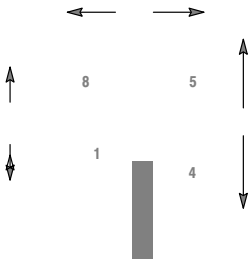
**GENERIC  
MARKING DIAGRAM\***



- XXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

**SOIC 8 NB**  
CASE 751-07  
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DATE 16 FEB 2011



SEATING  
PLANE







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