

BATCHARGER_controller

Datasheet

Systems On-Chip

Group nr.: 3

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1 General Description

The battery charger controller block is the digital block that controls the mode that the power block operates in. It uses monitored values for the battery temperature, voltage and current provided by the ADC, and operates like a moore finite state machine. The output signals cc, tc and, cv respectively represent what charging mode the power block operates in; constant current, trickle charge or constant voltage. The controller also enables and disables the measurements in the ADC. The functionality of the controller block is based on the flow chart shown in [Figure 1](#).

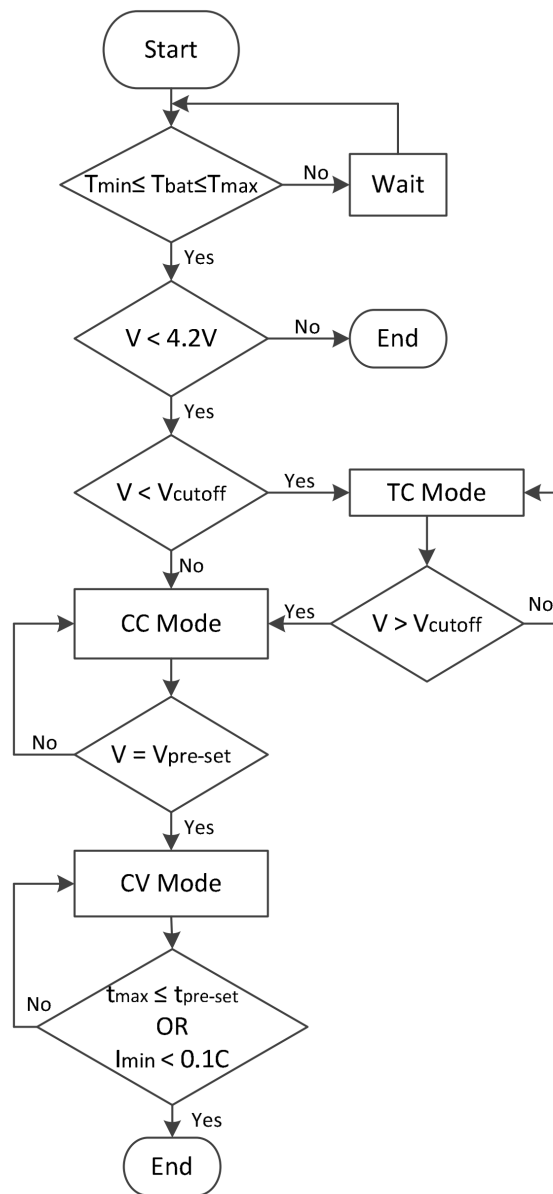


Figure 1: Flow chart of the behavior of a CC/CV charger

2 Block diagram

The charger controller block is presented in [Figure 2](#).

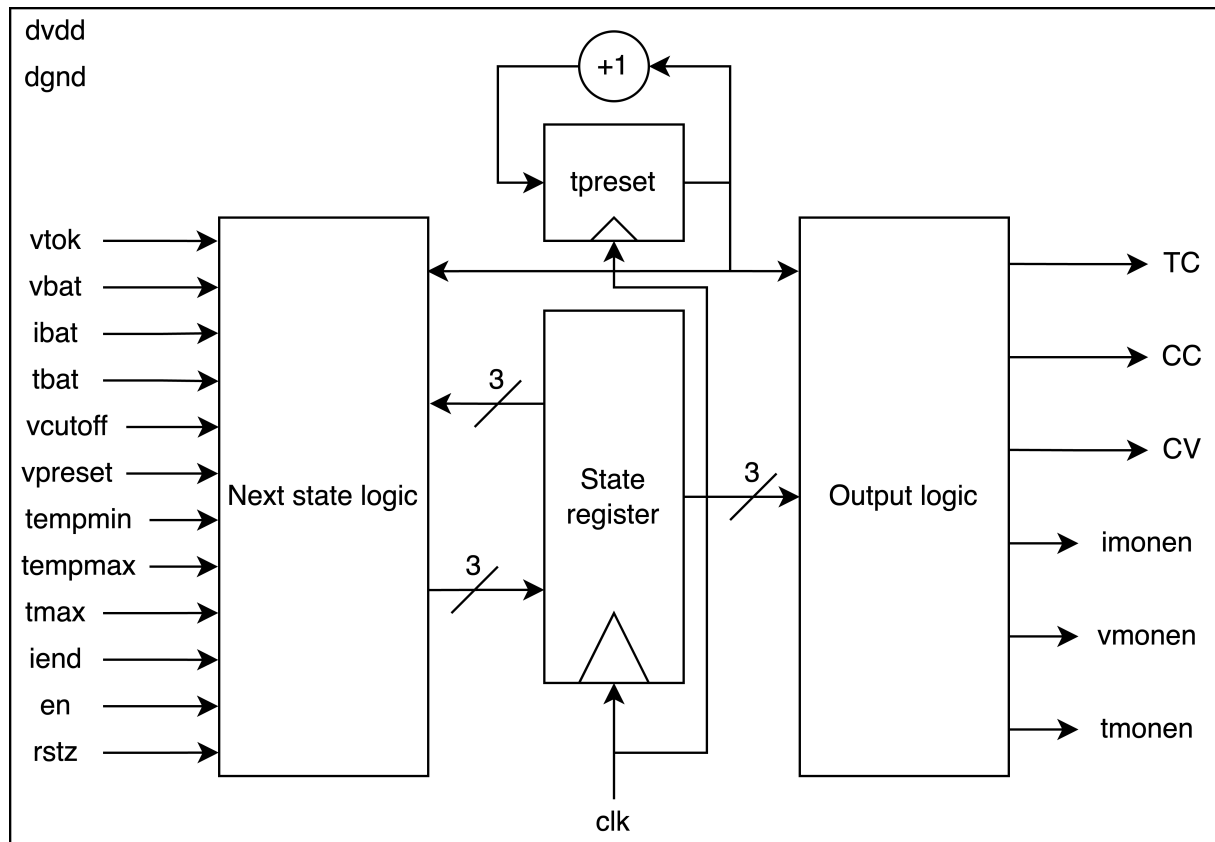


Figure 2: Charger controller block diagram

3 Pinning

Pin	Type	Dir	Supply	Description
dvdd	Power	I\O	-	Digital supply
dgnd	Ground	I\O	dvdd	Digital ground
vtok	Digital	I	dvdd	Signals that voltage and temperature values are valid
vbat	Digital	I	dvdd	8 bits data from ADC with battery voltage $vbat = adc(vref=0.5V, battery_voltage / 10)$
ibat	Digital	I	dvdd	8 bits data from ADC with battery current $ibat = adc(vref=0.5V, battery_current * Rsens);$
tbat	Digital	I	dvdd	8 bits data from ADC with battery current $ibat = adc(vref=0.5V, battery_current * Rsens)$ $Rsens = 0.5 * vref / (0.5 * C)$ C = nominal capacity of battery $vadc(Ibat=0.5C) = vref / 2$
vcutoff	Digital	I	dvdd	Constant from OTP: voltage threshold for exiting trickle mode $vcutoff = Vcutoff_dec * 255 / 5 = 51 * Vcutoff_dec$, e.g., 2.9V -> 1001_0011
vpreset	Digital	I	dvdd	Constant from OTP: voltage for constant voltage mode $vpreset = Vpreset_dec * 255 / 5 = 51 * Vpreset_dec$, e.g., 3.7V -> 1011_1100
tempmin	Digital	I	dvdd	Constant from OTP: minimum temperature; see tbat for scaling
tempmax	Digital	I	dvdd	Constant from OTP: maximum temperature; see tbat for scaling
tmax	Digital	I	dvdd	Constant from OTP: maximum charge time unit is $2^{time_div_bits}$ clock cycles (time_div_bits=8)
iend	Digital	I	dvdd	Charge current threshold for end of charging e.g., $0.01C = 0.01 * 3.5 = 0.035$ -> 0000_0010
en	Digital	I	dvdd	State machine clock
rstz	Digital	I	dvdd	Enables the module
clk	Digital	I	dvdd	System reset
tc	Digital	O	dvdd	Output to analog block: trickle mode with 0.1 x ich current
cc	Digital	O	dvdd	Output to analog block: constant current mode with ich current
cv	Digital	O	dvdd	Output to analog block: constant voltage mode vpreset voltage
imonen	Digital	O	dvdd	Enables current monitor
vmonen	Digital	O	dvdd	Enables voltage monitor
tmonen	Digital	O	dvdd	Enables temperature monitor

4 Detail description

The charger controller block has six different states of operation. START, WAIT, TC, CC, CV and FINISHED. These are related to different output signals. It is the responsibility of the controller to output the correct signals to the power block which charges the battery. The different states and state transitions are shown in [Figure 3](#).

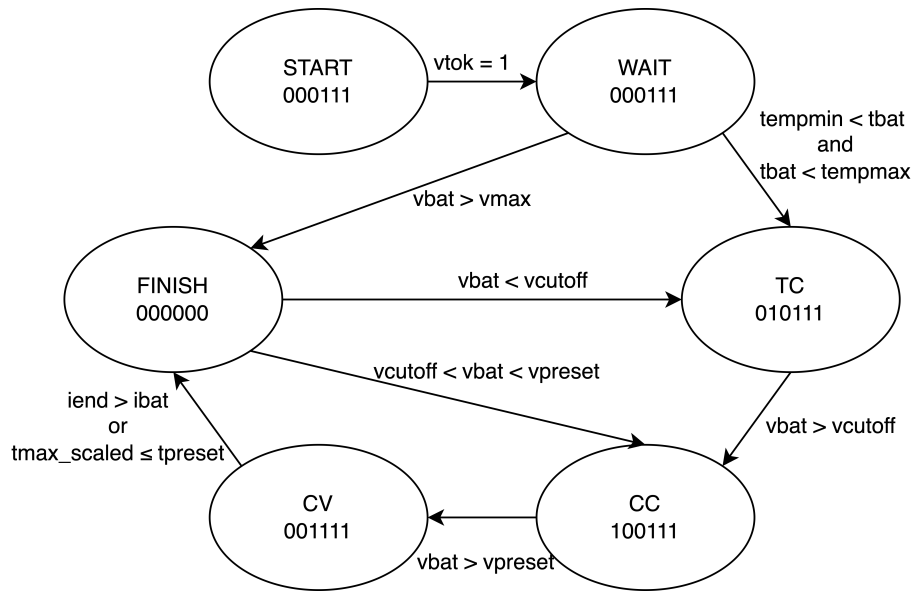


Figure 3: Controller state diagram

The output for the different states is shown in the figure below the name of the state in the following order: cc, tc, cv, imonen, vmonen, tmonen. The conditions for the state transitions are noted by the arrows between states. When nothing else is implied, the controller will by default stay in its current state.

5 Characteristics

Parameter	Min	Typ	Max	Unit
dvdd	0.9	1	1.1	V
clk period	3.244	10		ns

6 Assembly Guidelines

Pin	Recommendation
dvdd	Consider as noisy supply signal
dgnd	Consider as noisy supply signal
vtok	Digital signal. No special recommendation
vbat	Digital signal. No special recommendation
ibat	Digital signal. No special recommendation
tbat	Digital signal. No special recommendation
vcutoff	Digital signal. No special recommendation
vpreset	Digital signal. No special recommendation
tempmin	Digital signal. No special recommendation
tempmax	Digital signal. No special recommendation
tmax	Digital signal. No special recommendation
iend	Digital signal. No special recommendation
en	Digital signal. No special recommendation
rstz	Digital signal. No special recommendation
clk	Digital signal. No special recommendation
tc	Digital signal. No special recommendation
cc	Digital signal. No special recommendation
cv	Digital signal. No special recommendation
imonen	Digital signal. No special recommendation
vmonen	Digital signal. No special recommendation
tmonen	Digital signal. No special recommendation

7 Test

To test the controller module, scan be used by controlling the scan enable and scan input bits. This will result in a scan output value. The length of the scan chain is 19.