Remaining Battery Power Display
Monolithic IC MM1210 Series

Outline

This IC detects battery voltage and displays the remaining power in the battery using an LCD. Long life and light weight are emphasized in the most recent portable equipment, which increasingly use nickel cadmium and nickel hydrogen batteries. For these batteries, the discharge characteristics mean that extremely precise detection of the remaining battery power is required.
This IC enables detection of this type through high precision voltage detection.

Features

1. Two built-in detection voltages — 1.18V / 1.06V typ.
2. High precision detection voltages — ±1% typ.
3. Low current consumption — During detection ; 15 µA typ.
   During waiting ; 15 µA typ.
4. Setting possible during non-induction
   It is possible to set a time period for which detection is ignored, as for example when voltage drops due to temporary heavy loads.
5. Ripple absorption pins
   It is possible to check fluctuations in detection through continuous rippling.
6. Built-in hysteresis voltage

Package

SOP-8D (MM1210XF)

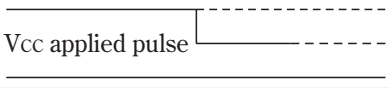
Absolute Maximum Ratings

Item	Rating
Storage temperature	–40~+125°C
Operating temperature	–20~+70°C
Input voltage	5V
Output pin voltage	5V
Allowable loss	300mW

Electrical Characteristics (Unless otherwise specified Ta=25°C, V_{CC}=1.5V, V_{CE}=V_{CC})

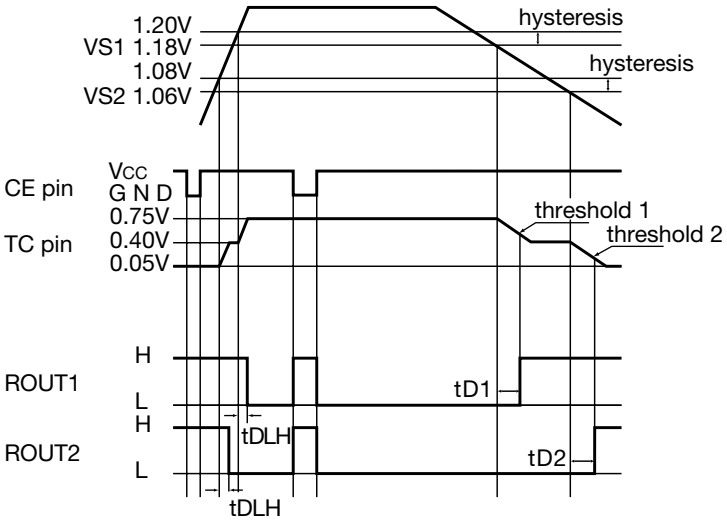
Item		Symbol	Measurement Conditions	Min.	Typ.	Max.	Unit
Current consumption		$I_{CC}1$	V_{CC}=1.5V		15	25	μA
Current consumption during waiting		$I_{CC}2$	V_{CC}=1.3V, V_{CE}=0.3V		1.5	2.5	μA
Detection voltage Ⅰ		$V_{TH}1$	V_{CC}=H→L	1.169	1.180	1.191	V
Detection voltage Ⅱ		$V_{TH}2$	V_{CC}=H→L	1.050	1.060	1.070	V
Detection voltage Difference		ΔV_T	ΔV_T=$V_{TH}1$–$V_{TH}2$	100	120	140	mV
Detection voltage temperature factor					±200		PPM/°C
Hysteresis voltage		V_{HYS}		10	20	35	mV
Output sink current Ⅰ		I_S1	V_{CC}=1.3V, V_O1=0.3V	40			μA
Output sink current Ⅱ		I_S2	V_{CC}=1.3V, V_O2=0.3V	40			μA
Output saturation voltage Ⅰ		V_O1	I_{SINK}=30UA		150	250	mV
Output saturation voltage Ⅱ		V_O2	I_{SINK}=30UA		150	250	mV
Output leak voltage Ⅰ		$I_{LE}1$	V_{CC}=1.0V, V_O1=0.5V			1	μA
Output leak voltage Ⅱ		$I_{LE}2$	V_{CC}=1.0V, V_O2=1.5V			1	μA
Power supply voltage operating limit		V_{OPL}	V_{CC}=variable, V_O < 0.4V		0.70	0.75	V
CE pin	Input H voltage	V_{CEH}		–0.3	V_{CC}	0.3	V
	Input L current	I_{CEH}	V_{CC}=1.5V, V_{CE}=0V	100	300	500	nA
	Input L voltage	V_{CEL}		–0.3	0	0.3	V
TC pin	Threshold value Ⅰ	V_{THT}	V_{CC}=1.0V, V_{TC}=variable	0.34	0.42	0.50	V
	Threshold value Ⅱ	V_{THT}	V_{CC}=1.0V, V_{TC}=variable	0.04	0.12	0.20	V
	Discharge current	I_{DIS}	V_{CC}=1.0V, V_{TC}=0.5V	30	60	90	nA
	Charge current	I_{CHA}	V_{CC}=1.5V, V_{TC}=0.5V	0.40	0.80	1.20	μA
Non-induction time		td	V_{CC}=1.5V, C=0.033UF	120	180	240	mS
L transmission delay time		tdLH	V_{CC}=L→H, C=0.033UF	1.0	2.0	4.0	mS
Ripple absorption resistance		RRIP	measure resistance between pins 8-6	70	100	130	kΩ

Note : V_{CC} applied pulse conditions



td1	td2
1.25V	1.15V
1.10V	1.00V

Timing Chart



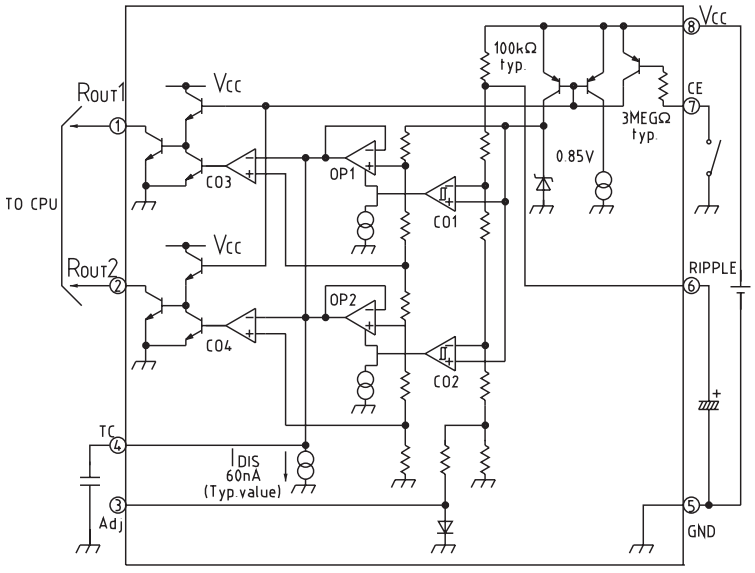
*Delay time is calculated by the following formula :

$tD1=tD2\ (S)=C_T\ (F)\times(5.4\times10^6)$

$tDLH\ (S)=C_T\ (F)\times(6.3\times10^4)$

C_T, TC pin connection capacitance

Block Diagram, Example of Application Circuit



Output

Vcc	1.18	1.06
ROUT 1	L	H	H
LED 2	L	L	H

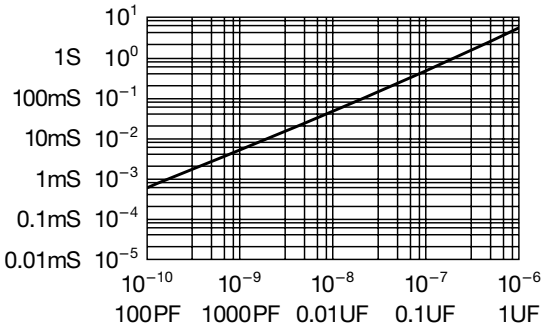
CE pin

H	Operation
L	Waiting

Note 1 : Please connect the CE pin to Vcc when not using.

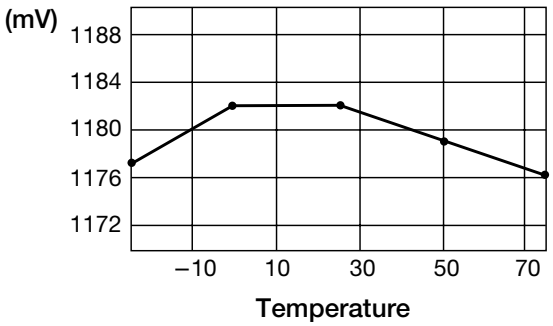
Note 2 : The Adj terminal is used in the product inspection process, so please do not connect it to other wiring.

Capacitance of external capacitor for non-induction time

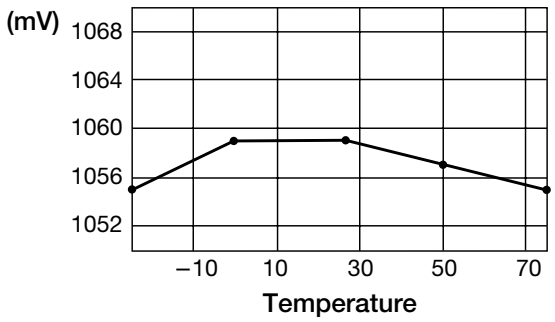


Characteristics

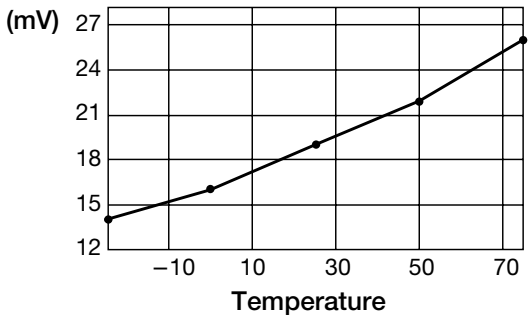
Detection voltage 1 Temperature characteristics



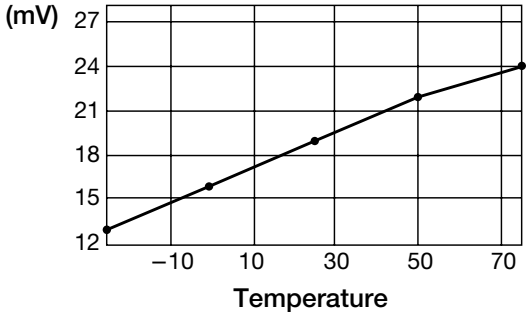
Detection voltage 2 Temperature characteristics



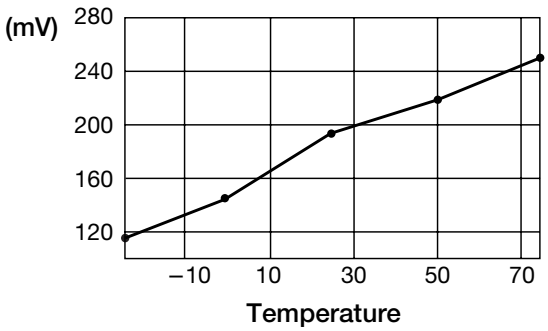
Hysteresis voltage 1 Temperature characteristics



Hysteresis voltage 2 Temperature characteristics



Output sink current 1 Temperature characteristics



Output saturation voltage 1 Temperature characteristics