

IC for Control of Lithium-ion Batteries Charging

Monolithic IC MM1438

Outline

This IC is used to control charging of lithium-ion batteries consisting of a single cell. It is a modification of the previous MM1332 charging-control IC, with improved charging voltage accuracy and a smaller package.

Features

- | | |
|--|------------------------|
| 1. Charging voltage accuracy ($T_a=25^{\circ}\text{C}$) | $\pm 25\text{mV/cell}$ |
| 2. Charging voltage accuracy ($T_a=0$ to 50°C) | $\pm 30\text{mV/cell}$ |
| 3. Consumption current (charging on) | $250\mu\text{A typ.}$ |
| 4. Consumption current (charging off) | $2\mu\text{A typ.}$ |
| 5. Low-voltage detection | 2.15V typ. |
| 6. Leakage current between CEL and CS | $1\mu\text{A max.}$ |

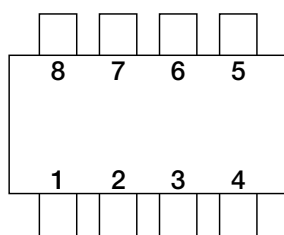
Package

VSOP-8B

Applications

IC for control of lithium-ion batteries charging.

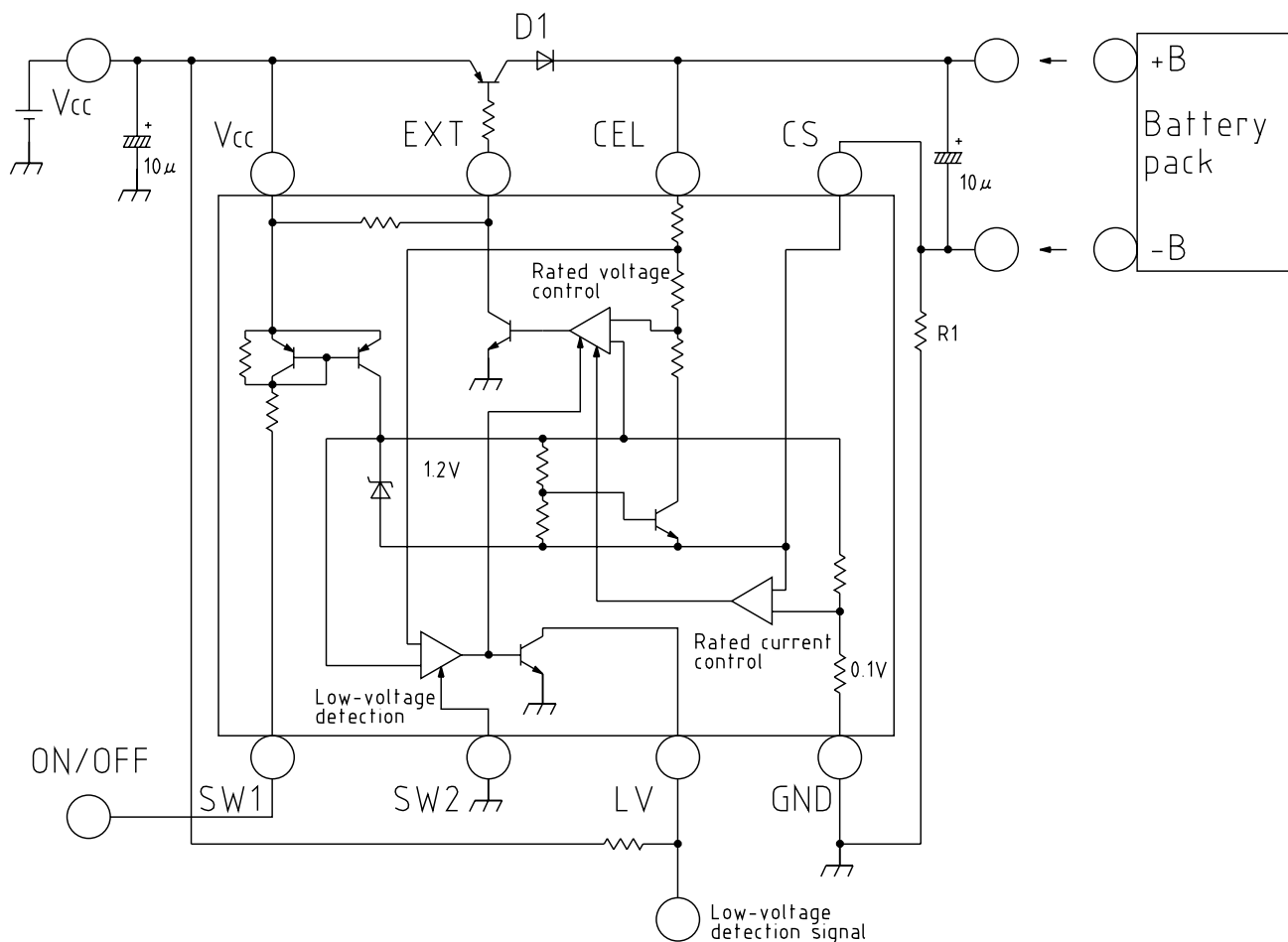
Pin Assignment



VSOP-8B

1	GND
2	LV
3	SW2
4	SW1
5	V _{CC}
6	EXT
7	CEL
8	CS

Block Diagram



Pin Description

Pin No.	Pin name	I/O	Pin Description
1	GND	Input	Ground pin
2	LV	Output	Low voltage detection circuit output pin ON with NPN-Tr open collector output at low voltage
3	SW2	Input	Low voltage detection circuit ON/OFF control input pin SW2 = Vcc: OFF, SW2 = GND: ON
4	SW1	Input	ON/OFF control input pin for the IC SW1 = Vcc: OFF, SW1 = GND: ON
5	Vcc	Input	Power supply input pin
6	EXT	Output	Charging control output pin Controls external PNP-Tr to control charging.
7	CEL	Input	Battery voltage input pin Detects battery voltage and controls rated voltage to the prescribed voltage value.
8	CS	Input	Current detection pin Detects current by drop in external resistor voltage and controls rated current. Current value can be set at $0.1V/R1$ typ.

Absolute Maximum Ratings (Ta=25°C)

Item	Symbol	Ratings	Unit
Storage temperature	T _{STG}	-40~+125	°C
Operating temperature	T _{OPR}	-20~+70	°C
Power supply voltage	V _{CC} max.	-0.3~+18	V
CFL pin input voltage	V _{CEL} max.	-0.3~+13	V
SW input voltage	V _{SW}	-0.3~V _{CC} +0.3	V
Allowable loss	P _d	300	mW

Recommended Operating Conditions

Item	Symbol	Ratings	Unit
Operating temperature	T _{OPR}	-20~+70	°C
Charging control operating voltage	V _{OPR}	2.5~+17	V

Note: Operating voltage minimum value is during rated current control.

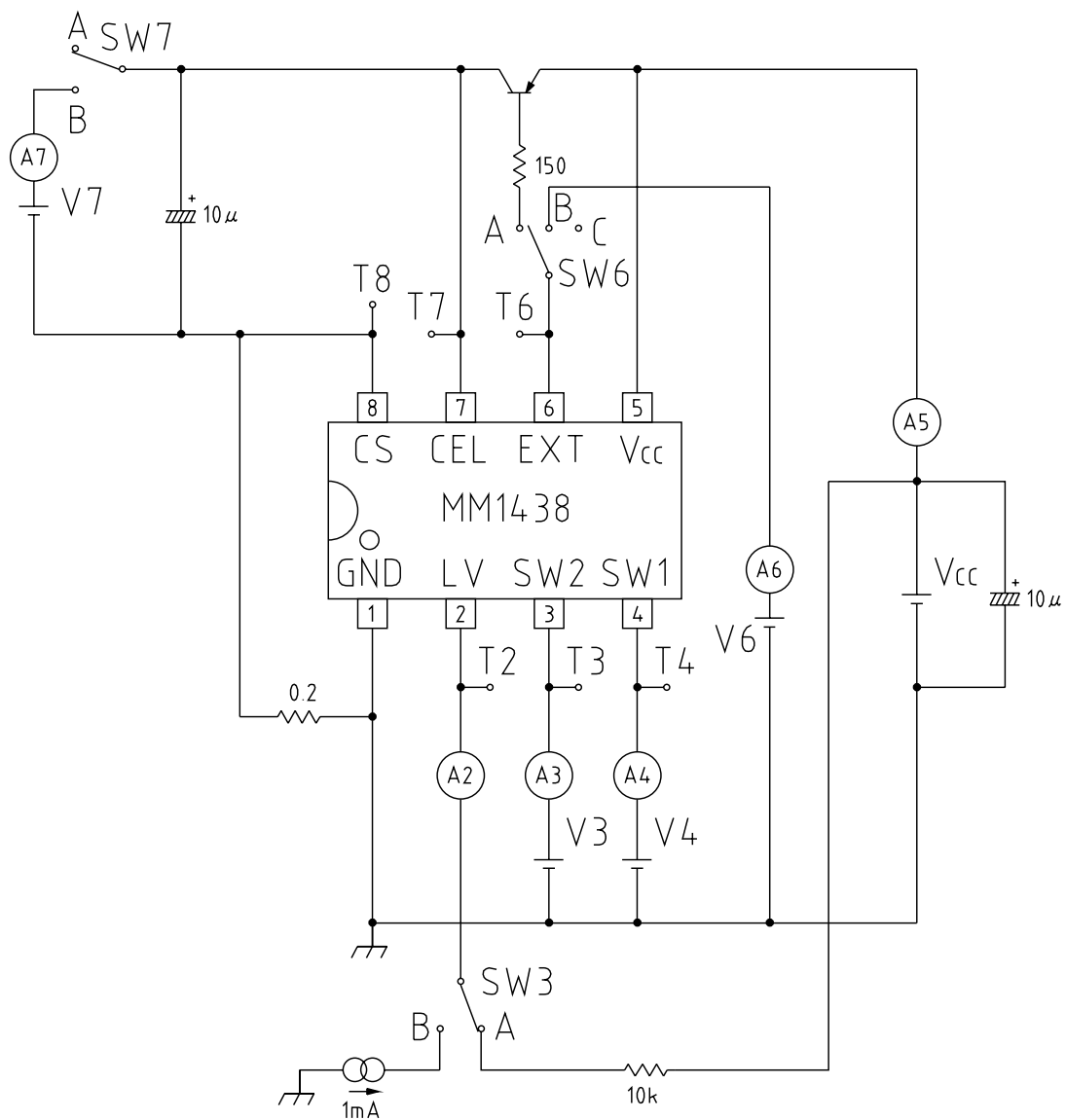
Electrical Characteristics (Except where noted otherwise, Ta=25°C, V_{CC}=5V, SW3 : A, SW6 : A, SW7 : A)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit
Consumption current 1	I _{CC1}	V _{SW1} =V _{SW2} =0V (Charge : ON)		250	400	μA
Consumption current 2	I _{CC2}	V _{SW1} =V _{SW2} =V _{CC} (Charge : OFF)		2	10	μA
Output voltage 1	V _{O1}	Ta=25°C	4.100	4.125	4.150	V
Output voltage 2	V _{O2}	Ta=0~50°C	4.095	4.125	4.155	V
Current limit	V _{CL}		90	100	110	mV
Inflow current between CEL-CS during operation	I _{CEL1}		3.0	5.0	7.0	μA
Leak current between CEL-CS	I _{CEL2}	V _{CC} =0V or OPEN		0.01	1	μA
SW1 input current	I _{SW1}			20	30	μA
SW1 input voltage L	V _{L1}	Charge : ON	-0.3		2.0	V
SW1 input voltage H	V _{H1}	Charge : OFF	V _{CC} -0.1		V _{CC} +0.3	V
Low voltage detection voltage	V _L		2.0	2.15	2.3	V
SW2 input current	I _{SW2}			20	30	μA
SW2 input current L	V _{L2}	Low voltage detection circuit: ON	-0.3		2.0	V
SW2 input current H	V _{H2}	Low voltage detection circuit: OFF	V _{CC} -1.0		V _{CC} +0.3	V
Low voltage detection output leak current	I _{LV}				0.5	μA
Low voltage detection output saturation voltage	V _{LV}	I _{SINK} =1mA		0.2	0.4	V
EXT pin inflow current	I _{EXT}		10	20		mA
EXT pin output voltage	V _{EXT}	For no load	0.3		V _{CC} -0.3	V

Note 1: Please insert a capacitor of several μF between power supply and ground when using.

Note 2: Be sure that CS pin potential does not fall below -0.5V.

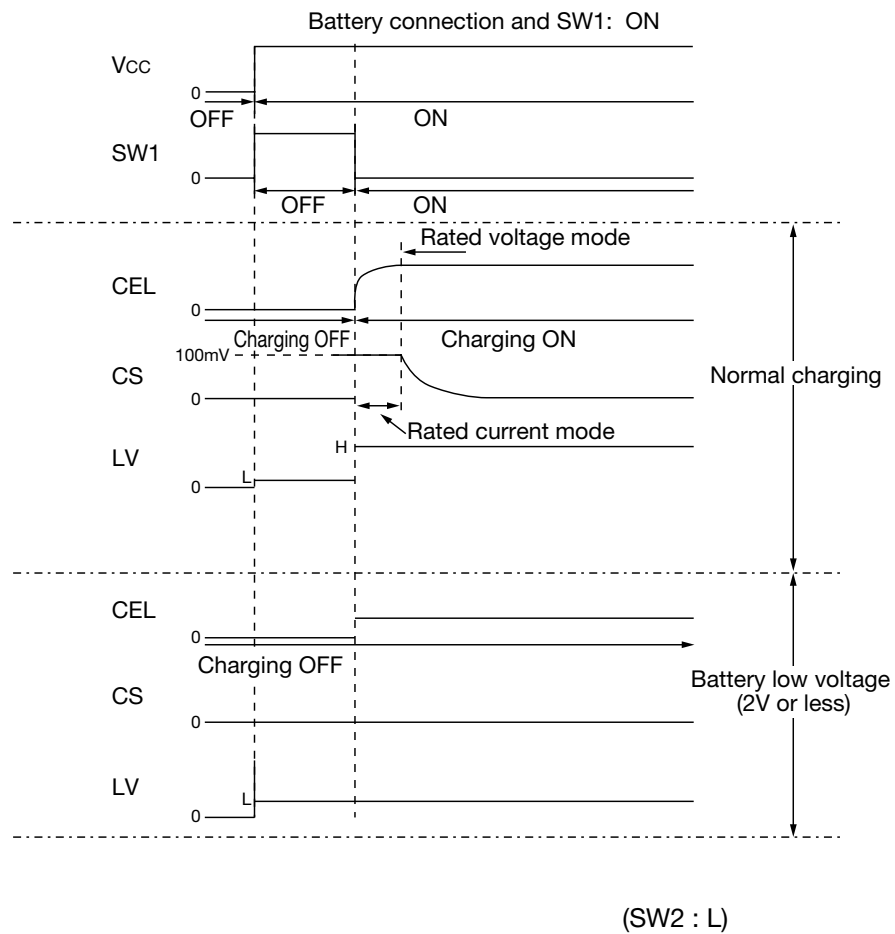
Note 3: If the IC is damaged and control is no longer possible, its safety can not be guaranteed. Please protect with something other than this IC.



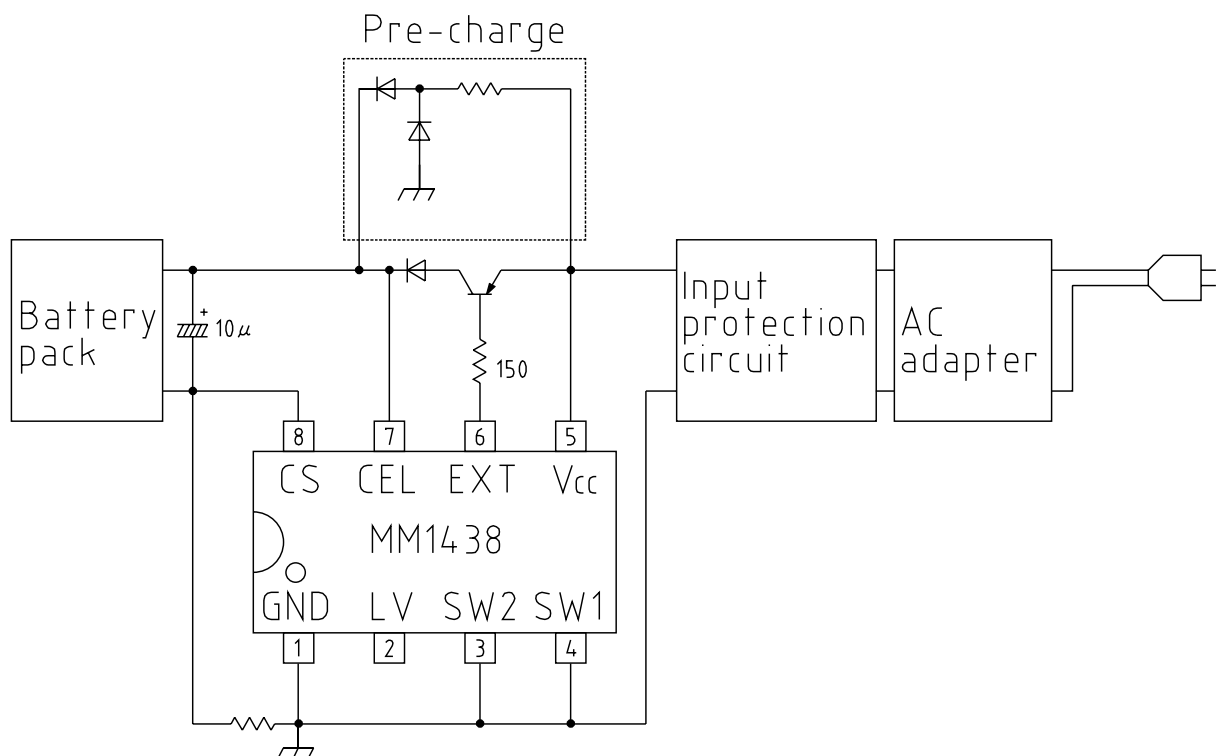
Measurement Procedures (Except where noted otherwise, $T_a=25^{\circ}\text{C}$, $V_{CC}=5\text{V}$, SW3 : A, SW6 : A, SW7 : A)

Item	Measurement Procedures
Consumption current 1	$V_3 = V_{CC}$, $V_4 = 0\text{V}$. Next, measure A5 current value I_{CC1} when V_3 is changed from $V_{CC} \rightarrow 0\text{V}$.
Consumption current 2	$V_3 = V_d = V_{CC}$. Measure A6 current value I_{CC2} at this time.
Output voltage	$V_3 = V_{CC}$, $V_4 = 0\text{V}$. Measure T7 voltage V_o at this time.
Current limit	$V_3 = V_{CC}$, $V_4 = 0\text{V}$. Set V7 voltage 1V lower than T7 (output voltage) potential and set SW7 to B. Measure T8 voltage V_{CL} at this time.
Inflow current between CEL-CS during operation	$V_3 = V_{CC}$, $V_4 = 0\text{V}$, SW6: C. $V_7 = 4.5\text{V}$, SW7: B. Measure A7 current value I_{CEL1} at this time.
Leak current between CEL-CS	$V_3 = V_4 = V_{CC} = 0\text{V}$, SW6: C. $V_7 = 4.5\text{V}$, SW7: B. Measure A7 current value I_{CEL2} at this time.
SW1 input current	Measure A4 current value I_{SW1} when $V_4 = 0\text{V}$.
SW1 input voltage	$V_3 = V_{CC}$. Charge: ON (V_{L1}) when V_4 potential is varied and T7 voltage is the prescribed output voltage; Charge OFF (V_{H1}) when $0 \sim 0.05\text{V}$.
Low voltage detection voltage	$V_3 = V_4 = 0\text{V}$. Set V7 voltage 1V lower than T7 (output voltage) potential, and SW7: B. Next gradually lower V7 voltage; V7 voltage is V_L when A7 current value is within $\pm 10\mu\text{A}$.
SW2 input current	Measure A3 current value I_{SW2} when $V_3 = 0\text{V}$.
SW2 input voltage	$V_4 = 0\text{V}$, $V_7 = 1\text{V}$, SW7: B. Low voltage detection circuit: ON (V_{L2}) when V_3 voltage is varied and A7 current value is within $\pm 10\mu\text{A}$; low voltage detection circuit: OFF (V_{H2}) otherwise.
Low voltage detection output leak current	$V_3 = V_{CC}$, $V_4 = 0\text{V}$. Measure A2 current value I_{LV} when V_3 is changed from $V_{CC} \rightarrow 0\text{V}$.
Low voltage detection output saturation voltage	$V_3 = V_4 = 0\text{V}$. SW3: B, SW7: B. Measure T2 voltage V_{LV} when V7 voltage is 0V .
EXT pin inflow current	$V_3 = V_4 = 0\text{V}$. SW6: B, SW7: B, $V_6 = 4\text{V}$, $V_7 = 3\text{V}$. Measure A6 current value I_{EXT} .
EXT pin output voltage	$V_3 = V_4 = 0\text{V}$. SW6: C, SW7: B. T6 voltage when $V_7 = 3\text{V}$ and $V_7 = 5\text{V}$ is V_{EXT} .

Timing Chart

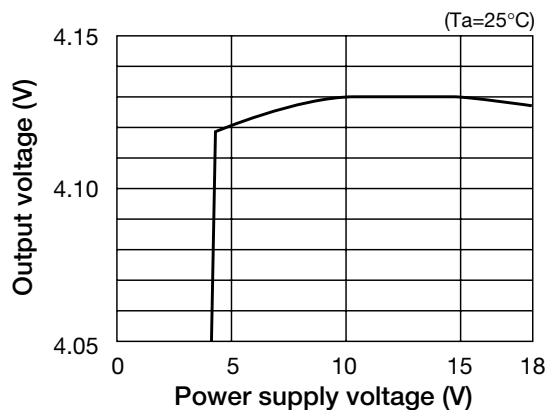


Application Circuit

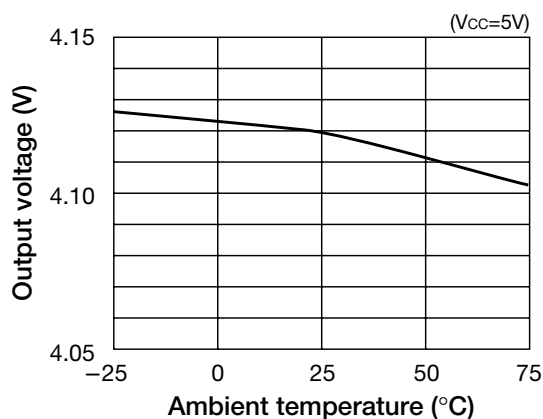


Characteristics

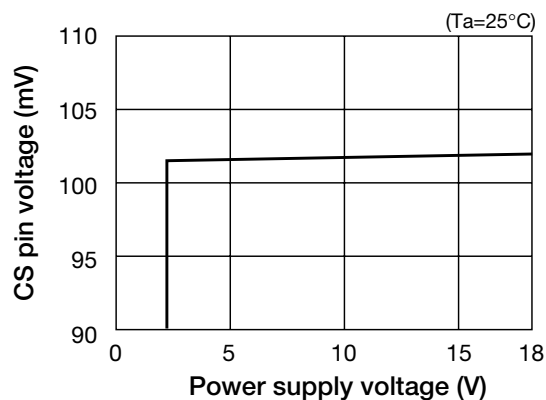
■ Output voltage vs Power supply voltage



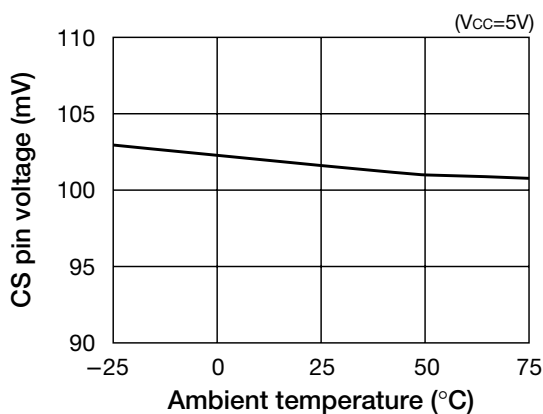
■ Output voltage vs Ambient temperature



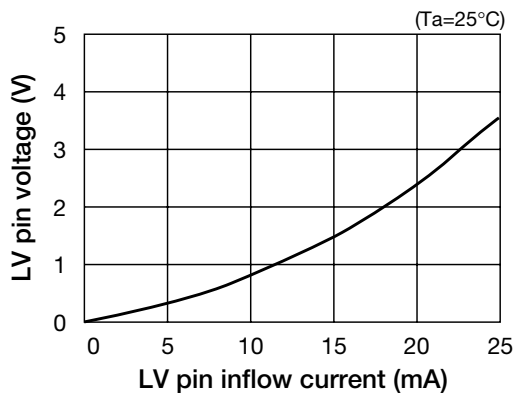
■ CS pin voltage vs Power supply voltage



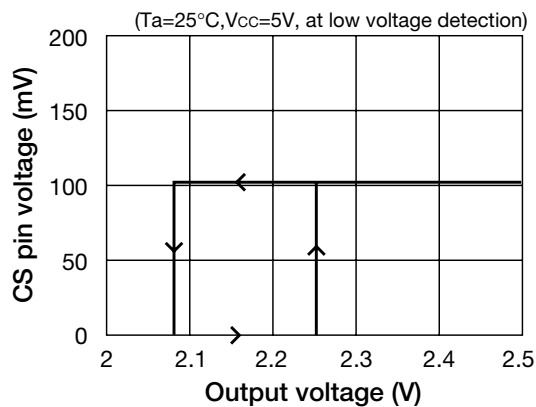
■ CS pin voltage vs Ambient temperature



■ LV pin voltage vs LV pin inflow current



■ CS pin voltage vs Output voltage



■ EXT pin voltage vs EXT pin inflow current

