IC for Control of Lithium-ion Betteries Charging (one cell)
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.
A low voltage circuit is built in (operates at SW2 = “L”) that can prohibit low voltage battery (2.15V typ.) charging. When SW2 = “H”, the low voltage circuit is turned off and even a low voltage battery can be charged.

Series Table

Temperature conditions A: Ta=−25~75°C, B: Ta=−20~70°C, C: Ta=0~50°C, D: Ta=0~40°C

	Package				Output voltage (V)	Output voltage temperature conditions	Full charge detection voltage (mV)	Over voltage detection voltage (v)	Remarks *
	SOP-8C, 8E	VSOP-8A, 8B	TSOP-16A	TSOP-24A					
MM1438		AW			4.125±0.030	C			1cell
		BW			4.225±0.030	C			1cell

Features

1. Charging voltage accuracy (Ta=25°C)	±25mV/cell
2. Charging voltage accuracy (Ta=0 to 50°C)	±30mV/cell
3. Consumption current (charging on)	250μA typ.
4. Consumption current (charging off)	2μA typ.
5. Low-voltage detection	2.15V typ.
6. Leakage current between CEL and CS	1μA max.

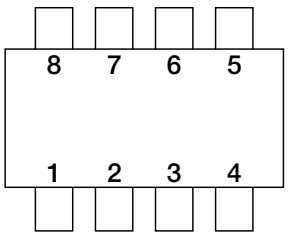
Package

VSOP-8B

Applications

IC for control of lithium-ion batteries charging.

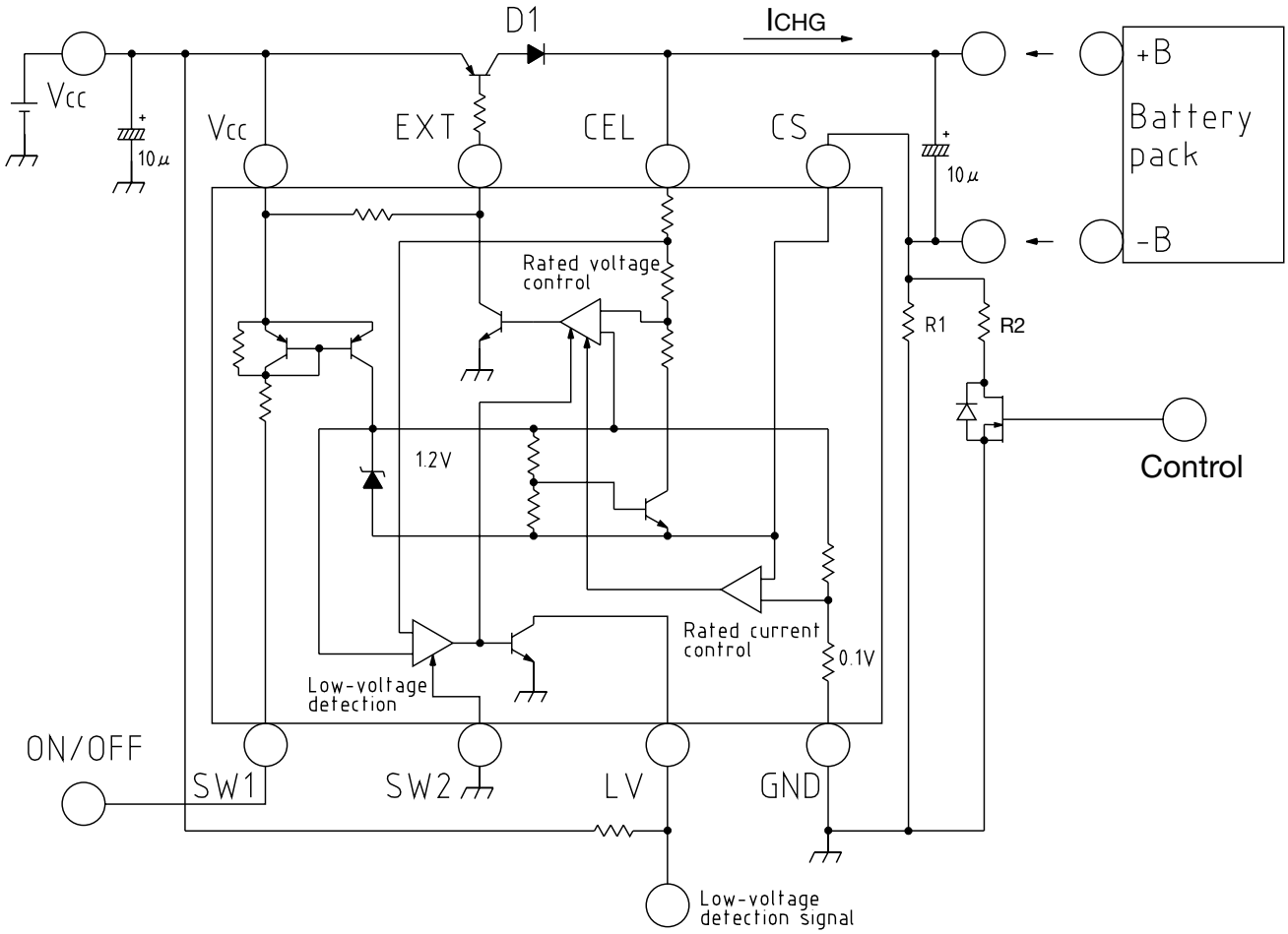
Pin Assignment



VSOP-8B

1	GND
2	LV
3	SW2
4	SW1
5	Vcc
6	EXT
7	CEL
8	CS

Block Diagram



*1 For example, if charging current (I_{CHQ}) is set at 0.5A, R_1 = 0.2 Ω can be set. ($V_{CL}/I_{CHQ}=0.1V/0.5A=R_1$)

*2 Charging current can be controlled by varying resistance value with R_1 and R_2.

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	Pd	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) Models listed MM1438A

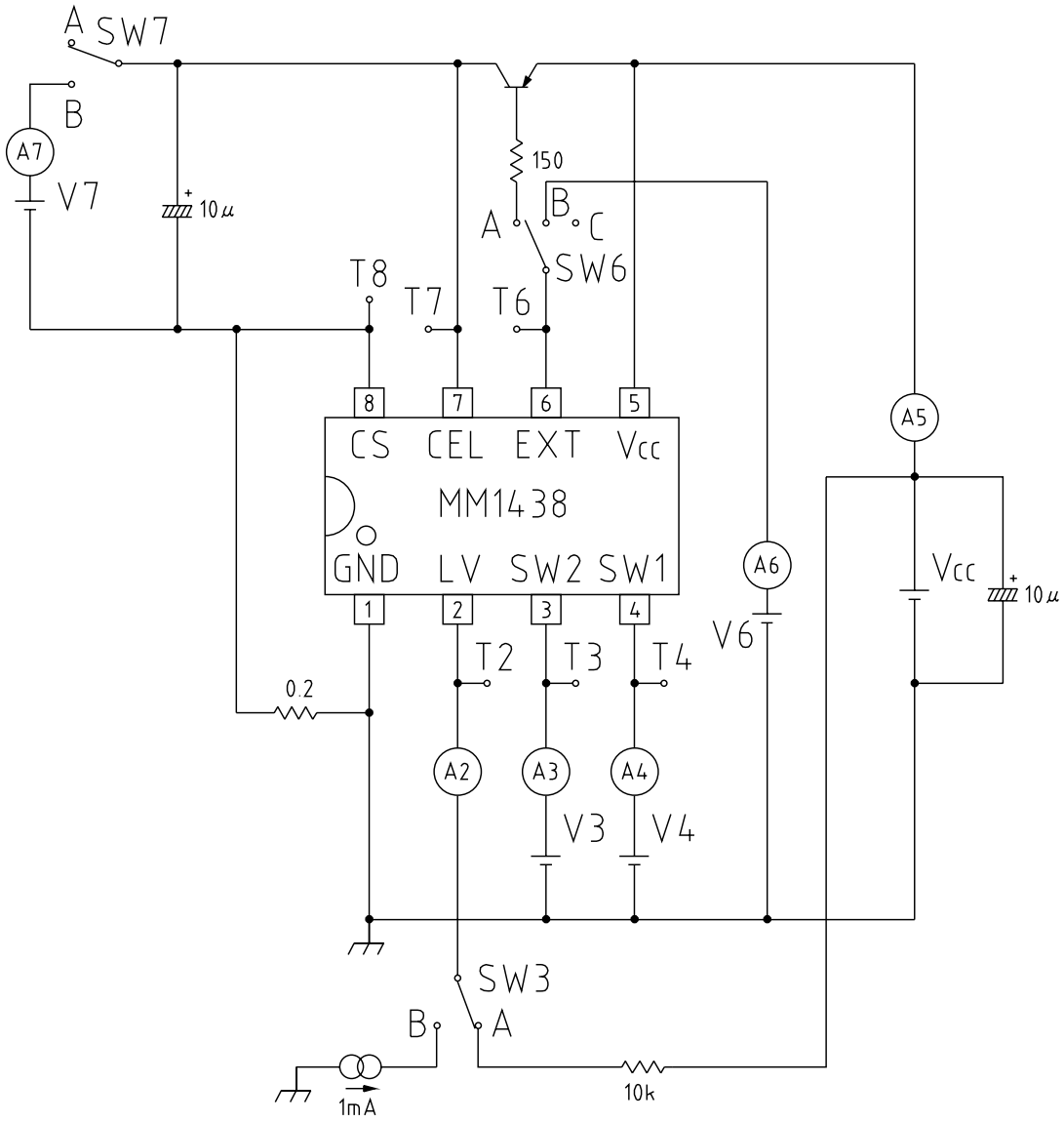
Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Unit
Consumption current 1	I_{CC1}	VSW1=VSW2=0V (Charge : ON)		250	400	µA
Consumption current 2	I_{CC2}	VSW1=VSW2=V_{CC} (Charge : OFF)		2	10	µA
Output voltage 1	V_{O1}	Ta=25°C	4.100	4.125	4.150	V
Output voltage 2	V_{O2}	Ta=0~50°C	4.095	4.125	4.155	V
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}–1.0		V_{CC}+0.3	V
Low voltage detection voltage	L_V		2.0	2.15	2.3	V
SW2 input current	I_{SW2}			20	30	µA
SW2 input voltage L	V_{L2}	Low voltage detection circuit: ON	–0.3		2.0	V
SW2 input voltage 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.

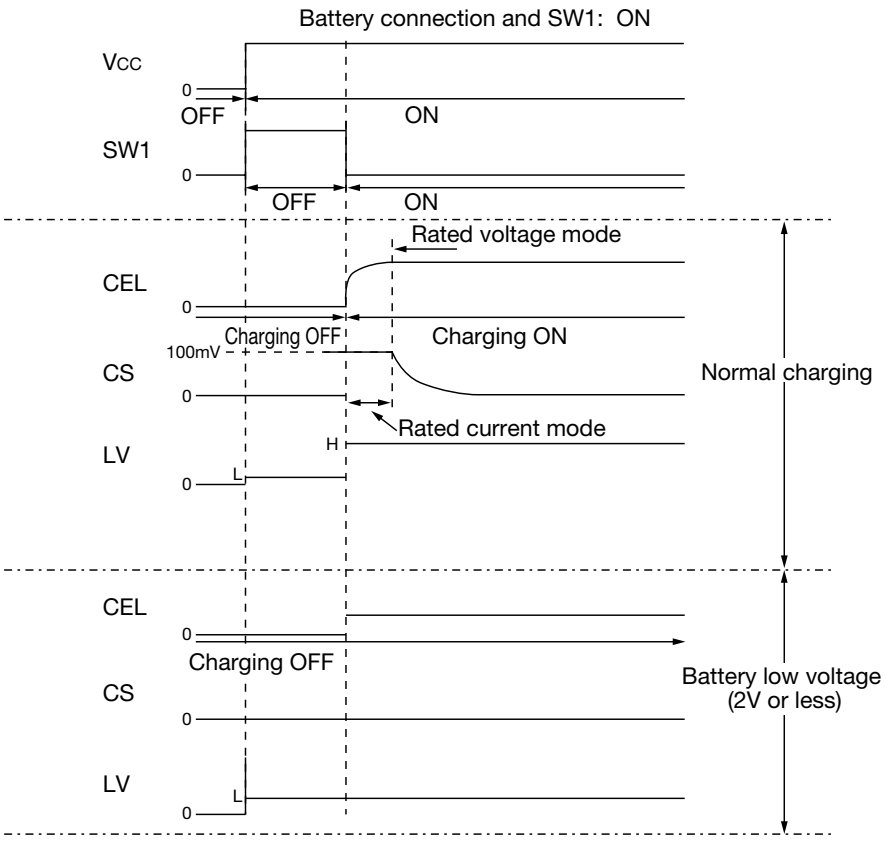
Measuring Circuit



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

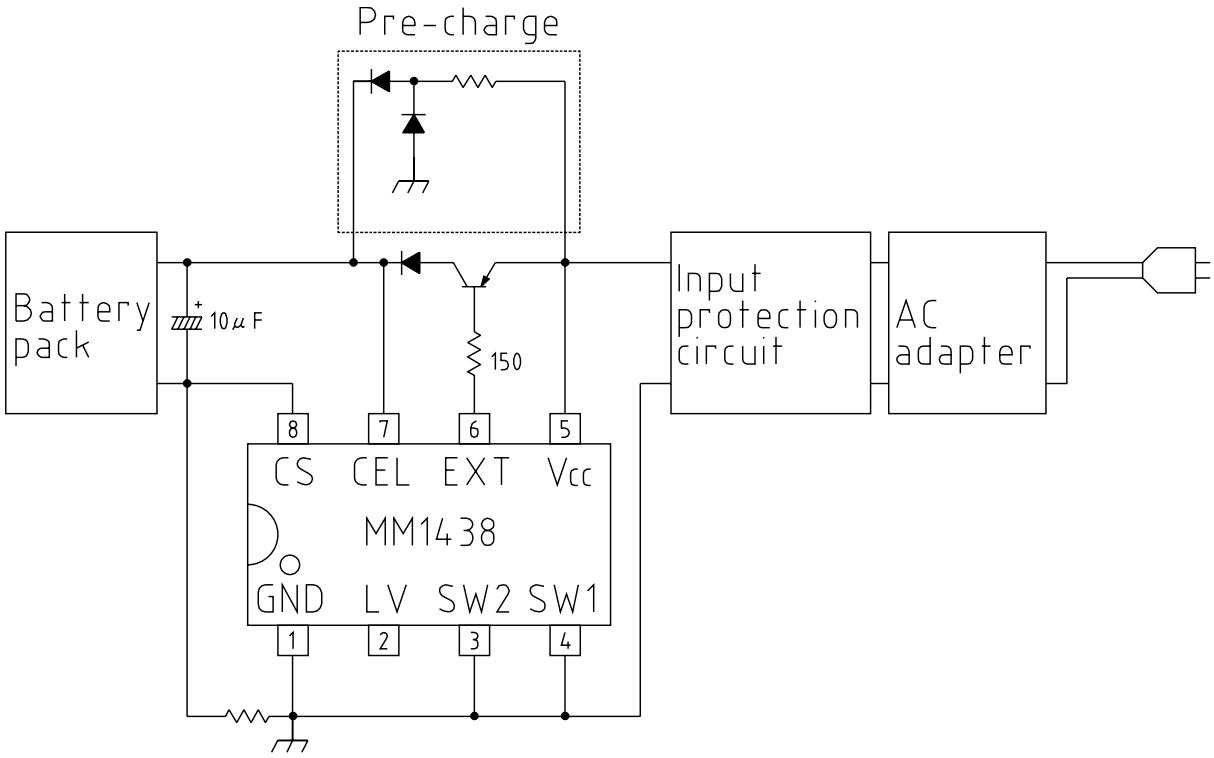
Item	Measurement Procedures
Consumption current 1	V3 = V_{CC}, V4 = 0V. Next, measure A5 current value Icc1 when V3 is changed from V_{CC} → 0V.
Consumption current 2	V3 = Vd = V_{CC}. Measure A6 current value I_{CC2} at this time.
Output voltage	V3 = V_{CC}, V4 = 0V. Measure T7 voltage V_O at this time.
Current limit	V3 = Vcc, V4 = 0V. 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	V3 = V_{CC}, V4 = 0V, SW6: C. V7 = 4.5V, SW7: B. Measure A7 current value I_{CEL1} at this time.
Leak current between CEL-CS	V3 = V4 = V_{CC} = 0V, SW6: C. V7 = 4.5V, SW7: B. Measure A7 current value I_{CEL2} at this time.
SW1 input current	Measure A4 current value I_{SW1} when V4 = 0V.
SW1 input voltage	V3 = V_{CC}. Charge: ON (V_{L1}) when V4 potential is varied and T7 voltage is the prescribed output voltage; Charge OFF (V_{H1}) when 0 ~ 0.05V.
Low voltage detection voltage	V3 = V4 = 0V. Set V7 voltage 1V lower than T7 (output voltage) potential, and SW7: B. Next gradually lower V7 voltage; V7 voltage is L_V when A7 current value is within ±10μA.
SW2 input current	Measure A3 current value I_{SW2} when V3 = 0V.
SW2 input voltage	V4 = 0V, V7 = 1V, SW7: B. Low voltage detection circuit: ON (V_{L2}) when V3 voltage is varied and A7 current value is within ±10μA; low voltage detection circuit: OFF (V_{H2}) otherwise.
Low voltage detection output leak current	V3 = V_{CC}, V4 = 0V. Measure A2 current value I_{LV} when V3 is changed from Vcc 0V.
Low voltage detection output saturation voltage	V3 = V4 = 0V. SW3: B, SW7: B. Measure T2 voltage V_{LV} when V7 voltage is 0V.
EXT pin inflow current	V3 = V4 = 0V. SW6: B, SW7: B, V6 = 4V, V7 = 3V. Measure A6 current value I_{EXT}.
EXT pin output voltage	V3 = V4 = 0V. SW6: C, SW7: B. T6 voltage when V7 = 3V and V7 = 5V is V_{EXT}.

Timing Chart



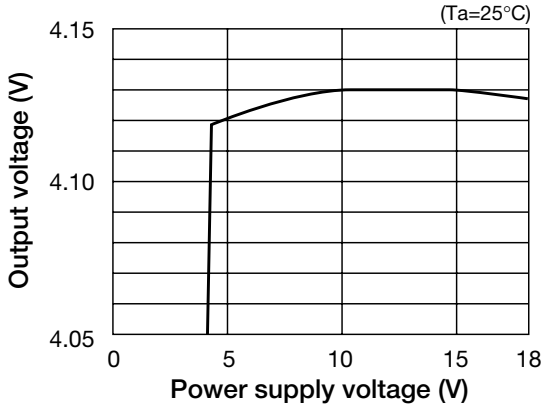
(SW2 : L)

Application Circuit

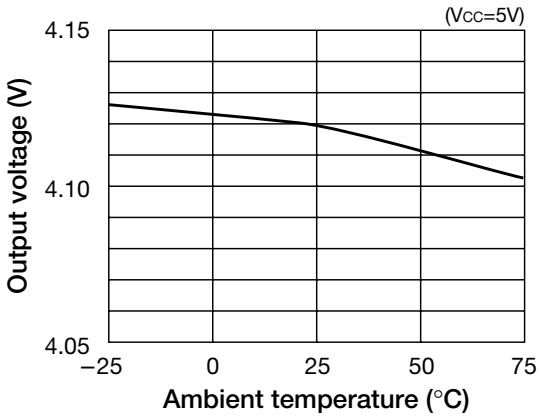


Characteristics

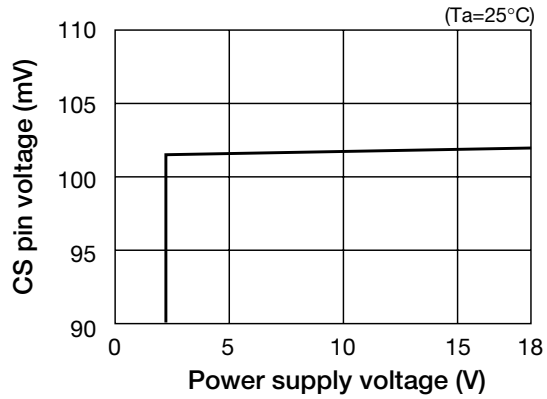
Output voltage vs Power supply voltage



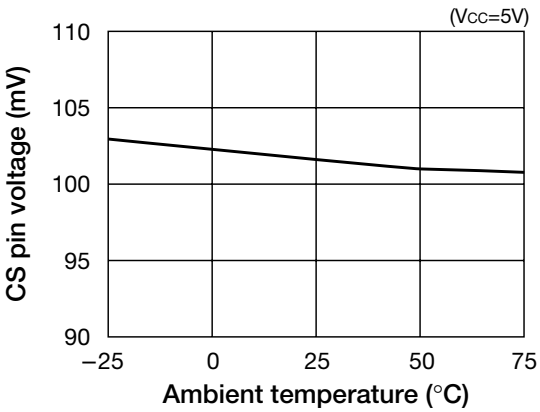
Output voltage vs Ambient temperature



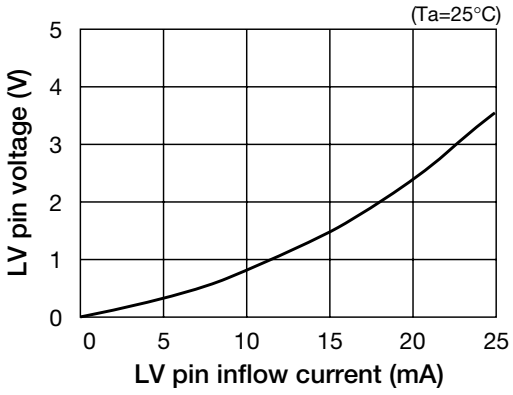
CS pin voltage vs Power supply voltage



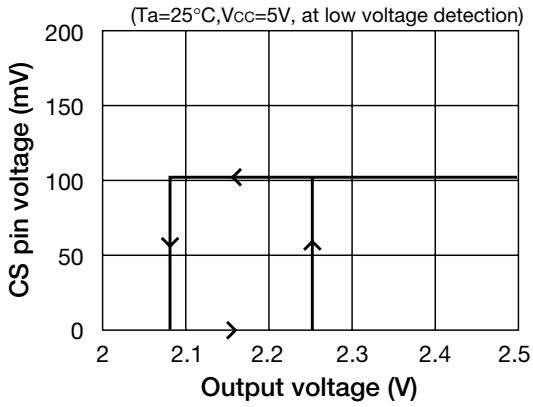
CS pin voltage vs Ambient temperature



LV pin voltage vs LV pin inflow current



CS pin voltage vs Output voltage



EXT pin voltage vs EXT pin inflow current