



CW1243

4 Cell Li-Ion/Polymer Battery Pack Protection IC

Features

- Overcharge protection
 - Threshold from 4.175V to 4.350V, 25mV steps, $\pm 25\text{mV}$ accuracy
- Over discharge protection
 - Threshold from 2.300V to 3.000V, 25mV steps, $\pm 80\text{mV}$ accuracy
- Excess current protection
 - Excess current 1:
Threshold from 0.030V to 0.100V, 10mV steps, $\pm 5\text{mV}$ accuracy
 - Excess current 2:
Threshold from 0.060V to 0.200V, 20mV steps, $\pm 5\text{mV}$ accuracy
 - Short circuits protection:
Threshold from 0.090V to 0.600V, 30mV steps, $\pm 10\text{mV}$ accuracy
- Charge and discharge over temperature protection
- Automatic recovery after excess current protection
- Ultra low power dissipation
 - Normal working $15\mu\text{A}$ (25°C)
 - Sleep mode $5\mu\text{A}$ (25°C)
- Package type: SSOP16 /SOP16/QFN16L

Applications

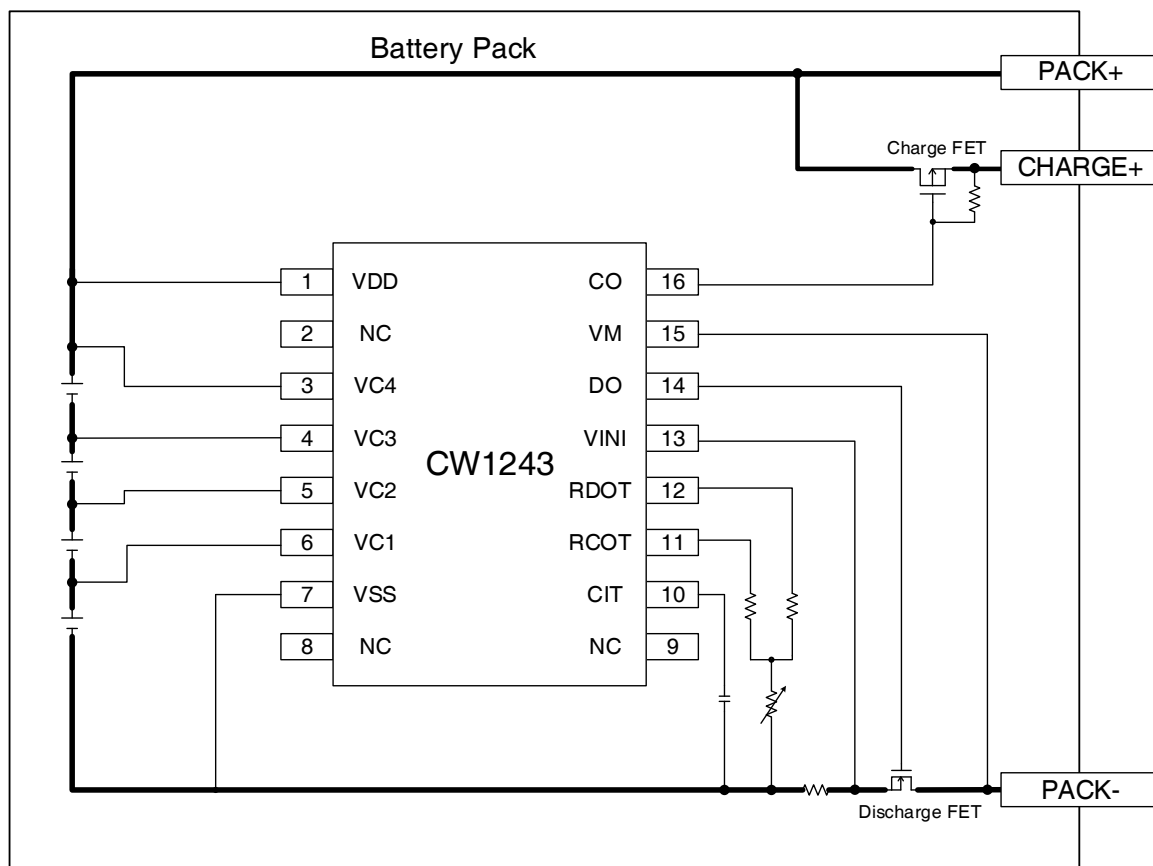
- Power tools
- E-bike
- Backup power supply
- Other lithium-ion or lithium polymer battery packs

General Description

The CW1243 series products are highly integrated protection ICs for 4 lithium-ion and lithium polymer battery packs connected in series.

CW1243 provides complete protection for battery pack by measuring the voltage, current and temperature.

Typical Application



Product Name

CW1243 X X X X

Package type, S: SSOP16; P: SOP16; Q: QFN16L
 Parameter option, from A to Z
 Battery type, L: Lithium T: Charge low temperature protection
 Function and revision option, from A to Z

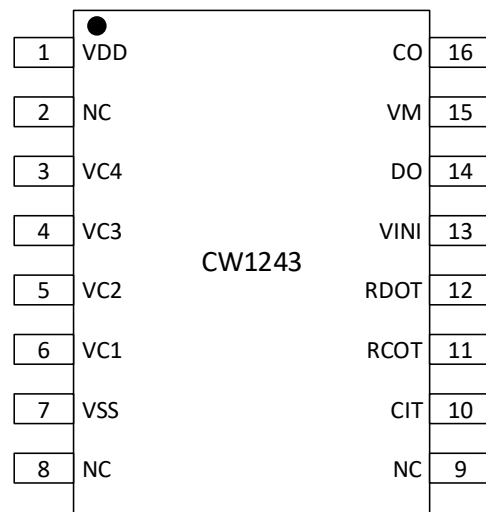
Ordering Information

PART	OVER CHARGE DETECTION VOLTAGE [Voc]	OVER CHARGE RELEASE VOLTAGE [Vocr]	OVER DISCHARGE DETECTION VOLTAGE [Vod]	OVER DISCHARGE RELEASE VOLTAGE [Vodr]	DISCHARGE OVERCURRENT DETECTION VOLTAGE1 [Vec1]	DISCHARGE OVERCURRENT DETECTION VOLTAGE2 [Vec2]	SHORT CIRCUIT DETECTION VOLTAGE [Vshr]	CHARGE LOW TEMPERATURE PROTECTION
CW1243ALAS	4.200V	4.100V	2.700V	3.000V	0.050V	0.100V	0.250V	NO
CW1243ALBP	4.250V	4.150V	2.700V	3.000V	0.100V	0.200V	0.500V	NO
CW1243ALBS	4.250V	4.150V	2.700V	3.000V	0.100V	0.200V	0.500V	NO
CW1243ALDS	4.300V	4.200V	2.500V	3.000V	0.100V	0.200V	0.400V	NO
CW1243ALJP	4.225V	4.125V	2.700V	3.000V	0.100V	0.200V	0.500V	NO
CW1243ALJS	4.225V	4.125V	2.700V	3.000V	0.100V	0.200V	0.500V	NO
CW1243ALLS	4.200V	4.100V	2.500V	3.000V	0.100V	0.200V	0.500V	NO
CW1243ATJP	4.225V	4.125V	2.700V	3.000V	0.100V	0.200V	0.500V	YES
CW1243ALIP	4.225V	4.025V	2.700V	3.000V	0.100V	0.200V	0.400V	NO
CW1243ATHP ^{*1}	4.175V	3.975V	2.700V	3.000V	0.050V	0.100V	0.250V	YES
CW1243ATGS	4.225V	4.125V	2.700V	3.000V	0.050V	0.100V	0.200V	YES
CW1243ATGQ	4.225V	4.125V	2.700V	3.000V	0.050V	0.100V	0.200V	YES
CW1243ALOP	4.200V	4.000V	2.700V	3.000V	0.100V	0.200V	0.400V	NO

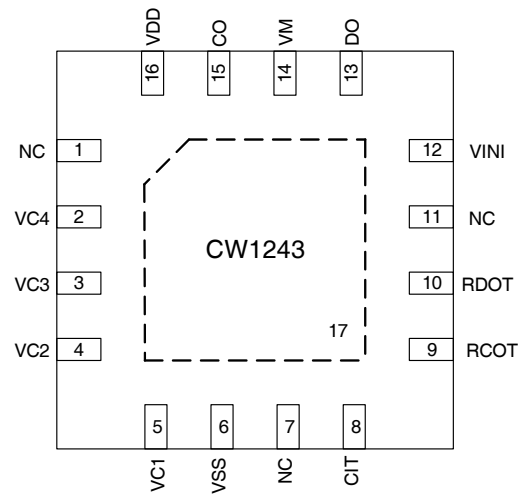
^{*1} CW1243ATHP Excess Current 2 Delay is 1 / 5 of the Excess Current 1 Delay

Pin Configuration

CW1243 (TOP VIEW)



SOP16/SSOP16



QFN16L

Pin Descriptions

PIN(SOP)	PIN(QFN)	NAME	DESCRIPTION
1	16	VDD	Power supply, connect to the most positive voltage
2	1	NC	No connection
3	2	VC4	Voltage measurement input of the 4 th cell
4	3	VC3	Voltage measurement input of the 3 rd cell
5	4	VC2	Voltage measurement input of the 2 nd cell
6	5	VC1	Voltage measurement input of the 1 st cell
7	6	VSS	Ground
8	7	NC	No connection
9	11	NC	No connection
10	8	CIT	Excess current delay set pin
11	9	RCOT	Charge over temperature resistor connect point
12	10	RDOT	Discharge over temperature resistor connect point
13	12	VINI	Excess current detect input
14	13	DO	Over-discharge protection output
15	14	VM	P- voltage detect input
16	15	CO	Over charge protection output, open-drain output
	17	VSS	Ground

Note: The pin arrangements of SOP16 and SSOP16 package are same.

Absolute Maximum Ratings

		VALUE		UNITS
		MIN	MAX	
PIN voltage range respect to VSS	VDD, VM, CO	-0.3	30	V
PIN voltage range respect to VSS	RCOT, RDOT, CIT	-0.3	6	V
PIN voltage range	VC1, VC2, VC3, VC4, DO, VINI	VSS-0.3	VDD+0.3	V
Operation Temperature	T1	-30	85	°C
Storage Temperature	T2	-40	125	°C

Caution:

Stresses beyond "Absolute Maximum Ratings" condition may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD Ratings

			MAX	UNITS
V _(ESD) Rating	Electrostatic discharge	Human body model (HBM) ESD stress voltage	±4000	V
		Charged device model (CDM) ESD stress voltage	±1000	V

Recommended DC Operating Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
VDD Input Voltage Range	V _{DD}		4		18	V
VCELL Input Voltage Range	V _{CELL}		0		4.5	V
PIN Input Voltage Range	V _{CIT} , V _{RCOT} , V _{RDOT}		0		5	V

Electrical Characteristics

Operation under 25°C unless otherwise specified

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
POWER SUPPLY						
Operation Current	I _{OPR}	VC1=VC2=VC3=VC4= 3.7V		15	20	μA
Sleep Current	I _{SLEEP}	VC1=VC2=VC3=VC4= 2.0V		5		μA
VOLTAGE/TEMPERATURE DETECT AND PROTECTION THRESHOLD						
Overcharge Threshold	V _{OC} *1	VC1=VC2=VC3= 3.7V Sweep VC4 from 3.7V to 4.5V	V _{OC} - 0.025	V _{OC}	V _{OC} + 0.025	V
OC release threshold	V _{OCR}	VC1=VC2=VC3= 3.7V Sweep VC4 from 4.5V to 3.7V	V _{OCR} - 0.050	V _{OCR}	V _{OCR} + 0.050	V

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Over Discharge Threshold	V_{OD}	VC1=VC2=VC3= 3.7V Sweep VC4 from 3.7V to 2.0V	$V_{OD}-0.080$	V_{OD}	$V_{OD}+0.080$	V
OD Release Threshold	V_{ODR}	VC1=VC2=VC3= 3.7V Sweep VC4 from 2.0V to 3.7V	$V_{ODR}-0.100$	V_{ODR}	$V_{ODR}+0.100$	V
Excess Current 1 Threshold	V_{EC1}	VC1=VC2=VC3=VC4= 3.7V Sweep VINI from 0V to 0.15V	$V_{EC1}-0.005$	V_{EC1}	$V_{EC1}+0.005$	V
Excess Current 2 Threshold	V_{EC2}	VC1=VC2=VC3=VC4= 3.7V Sweep VINI from 0V to 0.3V	$V_{EC2}-0.005$	V_{EC2}	$V_{EC2}+0.005$	V
Short Circuits Protection	V_{SHR}	VC1=VC2=VC3=VC4= 3.7V Sweep VINI from 0V to 0.6V	$V_{SHR}-0.010$	V_{SHR}	$V_{SHR}+0.010$	V
Charge Over Temperature	T_{COT}^{*2}	VDD=14.8V	$T_{COT}-2$	T_{COT}	$T_{COT}+2$	°C
COT Release	T_{COTR}			5		°C
Discharge Over Temperature	T_{DOT}^{*2}	VDD=14.8V	$T_{DOT}-2$	T_{DOT}	$T_{DOT}+2$	°C
DOT Release	T_{DOTR}			5		°C
ACTION DELAY						
Overcharge Delay	T_{OC}	VC1=VC2=VC3= 3.7V Sweep VC4 from 3.7V to 4.5V	$0.5^{*}T_{OC}$	T_{OC}	$1.5^{*}T_{OC}$	s
Overcharge Reset Delay	T_{RESET}			20		ms
Overcharge Release Delay	T_{OCR}	VC1=VC2=VC3= 3.7V Sweep VC4 from 4.5V to 3.7V		280		ms
Over Discharge Delay	T_{OD}	VC1=VC2=VC3= 3.7V Sweep VC4 from 3.7V to 2.0V	$0.5^{*}T_{OD}$	T_{OD}	$1.5^{*}T_{OD}$	s
Over Discharge Release delay	T_{ODR}	VC1=VC2=VC3= 3.7V Sweep VC4 from 2.0V to 3.7V		560		ms
Excess Current 1 Delay	T_{EC1}	CIT Capacitor 0.1μF		1		s
Excess Current 2 Delay ^{*5}	T_{EC2}	CIT Capacitor 0.1μF		100		ms
Short Protection Delay	T_{SHORT}			280		μs
Excess Current Release Delay	T_{ECR}^{*3}			80		ms
Load it Locked Release Delay	T_{LLR}	VC1=VC2=VC3=VC4= 3.7V VM<VDD/3		280		ms
Sleep Delay	T_{SLP}			30		s
COT Protection Delay	T_{COT}			1		s
COT Release Delay	T_{COTR}			1		s
DOT Protection Delay	T_{DOT}			1		s
DOT Release Delay	T_{DOTR}			2		s

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Open-wire Protection Delay	T _{OW}	V _{CELL} Capacitor 0.1μF		8		s
Open-wire Protection Release Delay	T _{OWR}			20		ms
0V CHARGE FUNCTION						
0V Charging Start Voltage	V _{0V}		1.5			V
VM						
VM/VSS internal resistance	R _{VMVSS}			66		kΩ
PIN OUTPUT VOLTAGE						
CO Logic Low Output	CO			VSS		V
DO Logic High Output	DO	V _{DD} ≥11V		10		V
DO Logic High Output		V _{DD} <11V		VDD - 0.7		V
DO Logic Low Output				VSS		V
PIN DRIVE ABILITY						
CO Output Drive Ability	CO	CO logic HIGH*4		--		μA
		CO logic LOW		50		μA
D0 Output Drive Ability	DO	DO logic HIGH		50		μA
		DO logic LOW		-150		μA

*1 Specified protection threshold is determined by device selection. Please refer to the selection guide table.

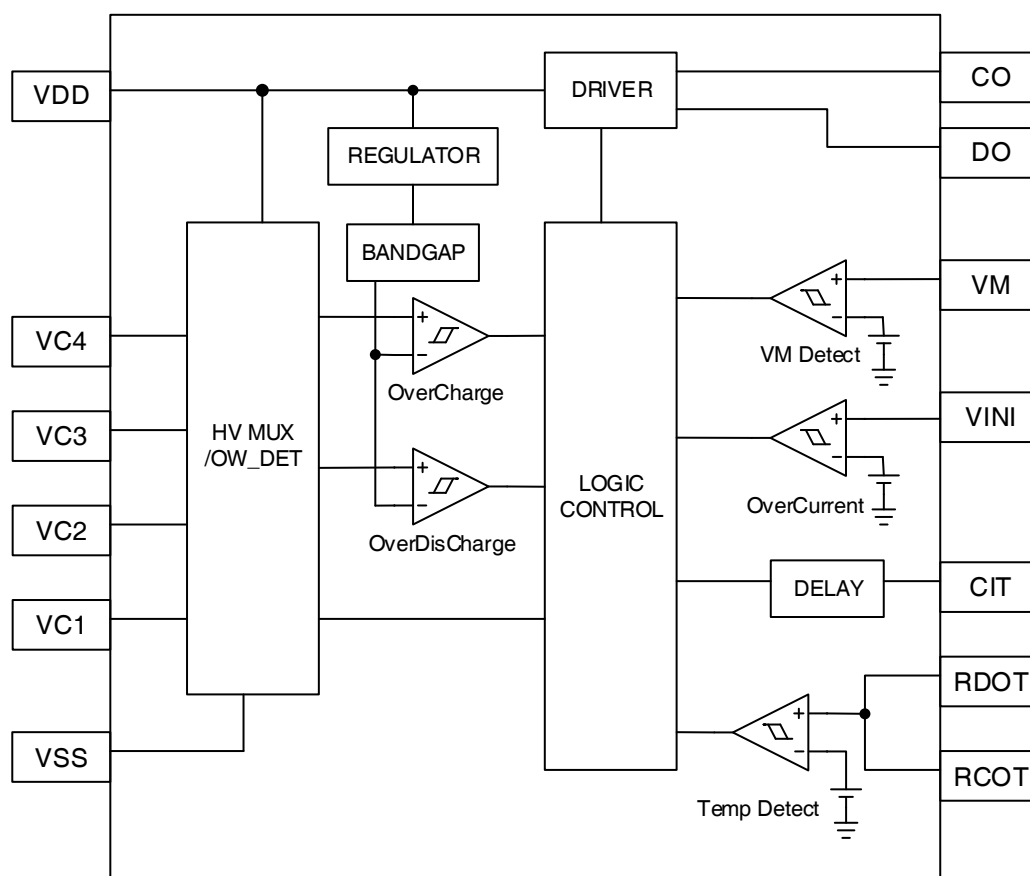
*2 Protection threshold is determined by the actual resistor net. Different charge and discharge over temperature protection threshold is only available for the different charge and discharge port application scheme.

*3 All the excess current (including EC1, EC2 and short) release delay time are 80ms.

*4 Logic high output of CO pin is High-Z.

*5 Excess Current 2 Delay is 1 / 10 and 1 / 5 of Excess Current 1 Delay

Functional Block Diagram



Detailed Description

Normal State

All the battery voltages are between V_{OC} and V_{OD} , VINI is lower than the V_{EC1} , CW1243 works under the normal state.

Overcharge State

Any cell input voltage becomes higher than overcharge threshold voltage (V_{OC}) and stays longer than overcharge protection delay time (T_{OC}), CO outputs a high-resistance state to cut off the charging MOSFET, CW1243 enters over charge state. If within T_{OC} , any cell voltage drops lower than V_{OC} but stays shorter than overcharge reset delay time (T_{RESET}) before rising up over V_{OC} again, this spike will be ignored. Otherwise, accumulated delay time of overcharge will be reset.

The overcharge protection state release when:

All the cell voltages are less than the overcharge release threshold (V_{OCR}) and stay longer than the release delay time (T_{OCR}).

Over Discharge State

Any cell input voltage becomes lower than over discharge threshold voltage (V_{OD}) and stays longer than over discharge protection delay time (T_{OD}), DO outputs a logic low voltage to cut off the discharging MOSFET, CW1243 enters over discharge state.

The over discharge protection state releases when:

All the cell voltages are high than the over discharge release threshold (V_{ODR}) and stays longer than the release delay time (T_{OCR}), and, VM is lower than the $V_{DD}/3$.

Over Discharge Protection Locking State

Sometimes, CW1243 enters the over discharge protection with a load. In this condition, if all cell voltages are higher than over discharge release Threshold (V_{ODR}) and stays longer than the release delay time (T_{ODR}), IC will enter over discharge protection locking state. DO keeps logic low output even if the cell voltage is higher than release threshold. (V_{ODR}).

The protection locking state release when:

VM lower than the $V_{DD}/3$, and stays longer than the release delay time (T_{LLR}).

Sleep State

When CW1243 already entered over discharge state and stays longer than sleep delay (T_{SLP}), CW1243 will enter sleep state. DO keeps logic low voltage to cut off the discharge MOSFET.

The sleep state release when:

All cell voltages are high than the over discharge release threshold (V_{ODR}) and stays longer than the release delay time (T_{OCR}), and, VM is lower than the $V_{DD}/3$.

Excess Current State

CW1243 integrates 3 level excess current protection, excess current 1, excess current 2 and short circuits.

All the protection mechanism and sequence are same. Take EC1 for example.

Discharging current is vary with the external load, when the voltage drop on current sense resistor is bigger than excess current protection threshold (V_{EC1}) and stays longer than the delay time (T_{EC1}), DO outputs a logic low voltage to cut off the discharging MOSFET, CW1243 enters the excess current protection state.

The excess current protection state releases when:

VM is lower than $V_{DD}/3$ and stays longer than the release delay time (T_{ECR})

0V Charge

CW1243 allows charging a 0V battery. If VDD is less than 0V charge start voltage V_{OV} , and we connect a charger which output voltage higher than MOSFET turn-on threshold, 0V battery is charged.

Delay Time Setting

Delay time is the interval between the protection threshold triggered and CO/DO output voltage changed. The delay time of excess current 1 and excess current 2 are all configured by the external capacitors.

Over Temperature Setting

When the voltage of COT and DOT achieves the internal compare threshold, charging over temperature or discharging over temperature protection triggered.

While the temperature decreases, and the difference is bigger than the release hysteresis (T_{COR} or T_{DOR}), and stays longer than the release delay time (T_{CORT} or T_{DORT}), over temperature protection releases.

Over temperature protection release integrates a load detection function. Protection state will be locked until the external load is removed.

Threshold setting steps:

1. Choose NTC first
2. Define the charging over temperature protection threshold, for example, 50°C
3. Look up the NTC Resistor-Temperature table or curve, find out the resistor value corresponding to 50°C, for example, 35k Ω
4. Adopt a same value normal resistor connect to RCOT pin
5. Discharging over temperature setting use the same method, but the normal resistor connect to the RDOT pin
6. Detailed circuits refer to the Application Circuits. Choose the resistor net to match the over temperature function.

One NTC for different over temperature protection threshold in charge and discharge state is only available for different charge and discharge port application. If use the same charge and discharge port, RCOT and RDOT must be set to the same value.

Open-wire Detection

Each wire connected between the battery cell and IC will be monitored.

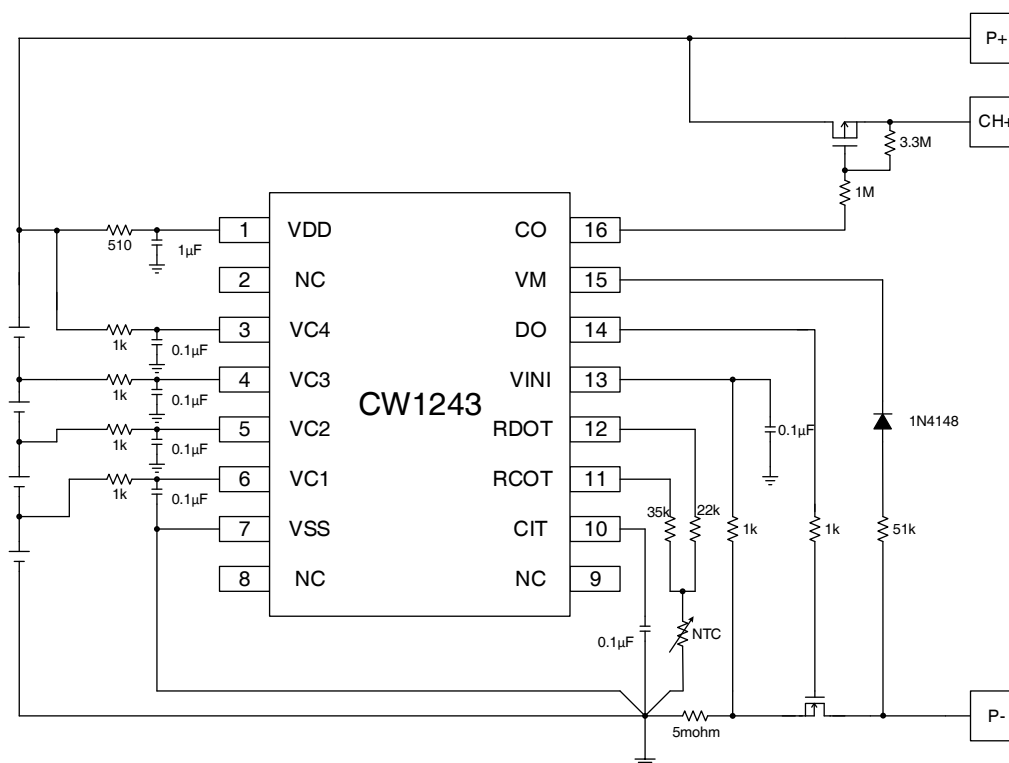
When the wire disconnects and maintains (T_{OW}) time, IC will enter to the open-wire protection state.

CO outputs a high-level voltage to cut off the charge loop. DO outputs a logic low voltage to cut off the discharging MOSFET.

Open-wire protection will release when all wires reconnect and stay longer than the release delay time.

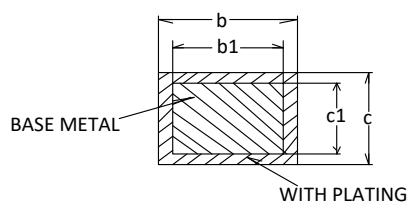
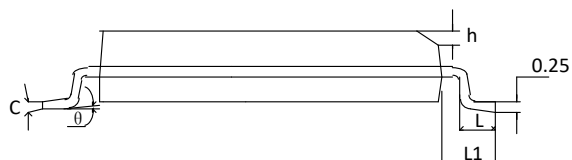
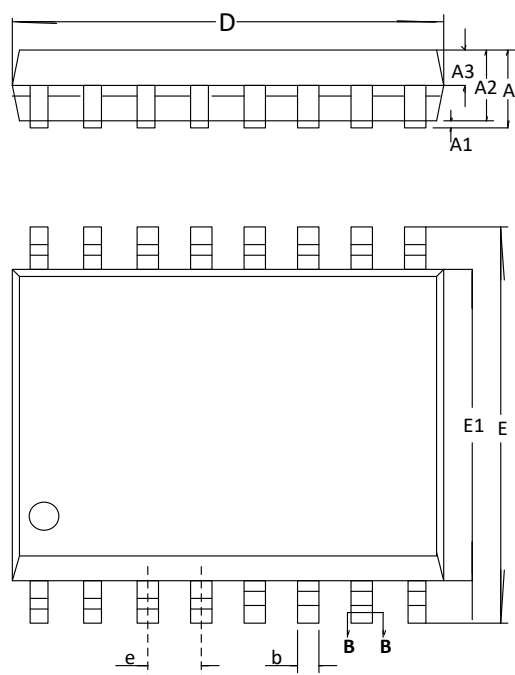
Open-wire protection release integrates a load detection function. Protection state will be locked until the external load is removed.

Reference Schematic



Package Information

SSOP16 Package

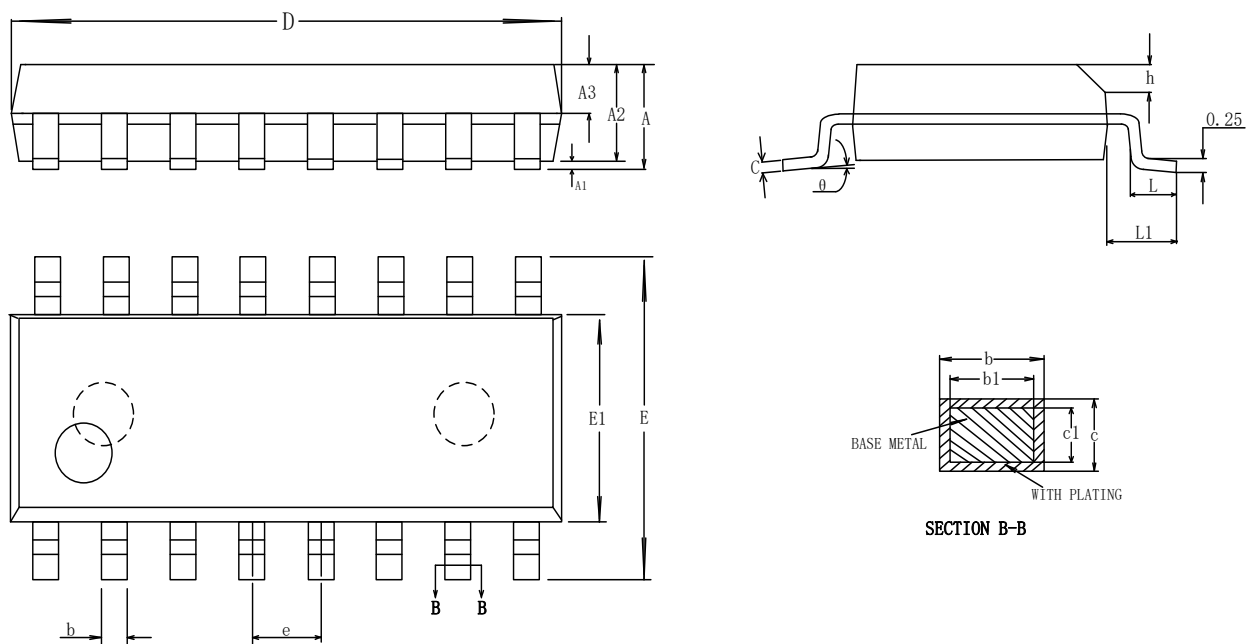


SECTION B-B

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	----	----	1.75
A1	0.10	----	0.225
A2	1.30	1.40	1.50
A3	0.50	0.60	0.70
b	0.24	----	0.30
b1	0.23	0.254	0.28
c	0.20	----	0.25
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	----	4.00
e	0.635BSC		
h	0.25	----	0.50
L	0.50	0.65	0.80
L1	1.05BSC		
θ	0	-----	8°

Package Information

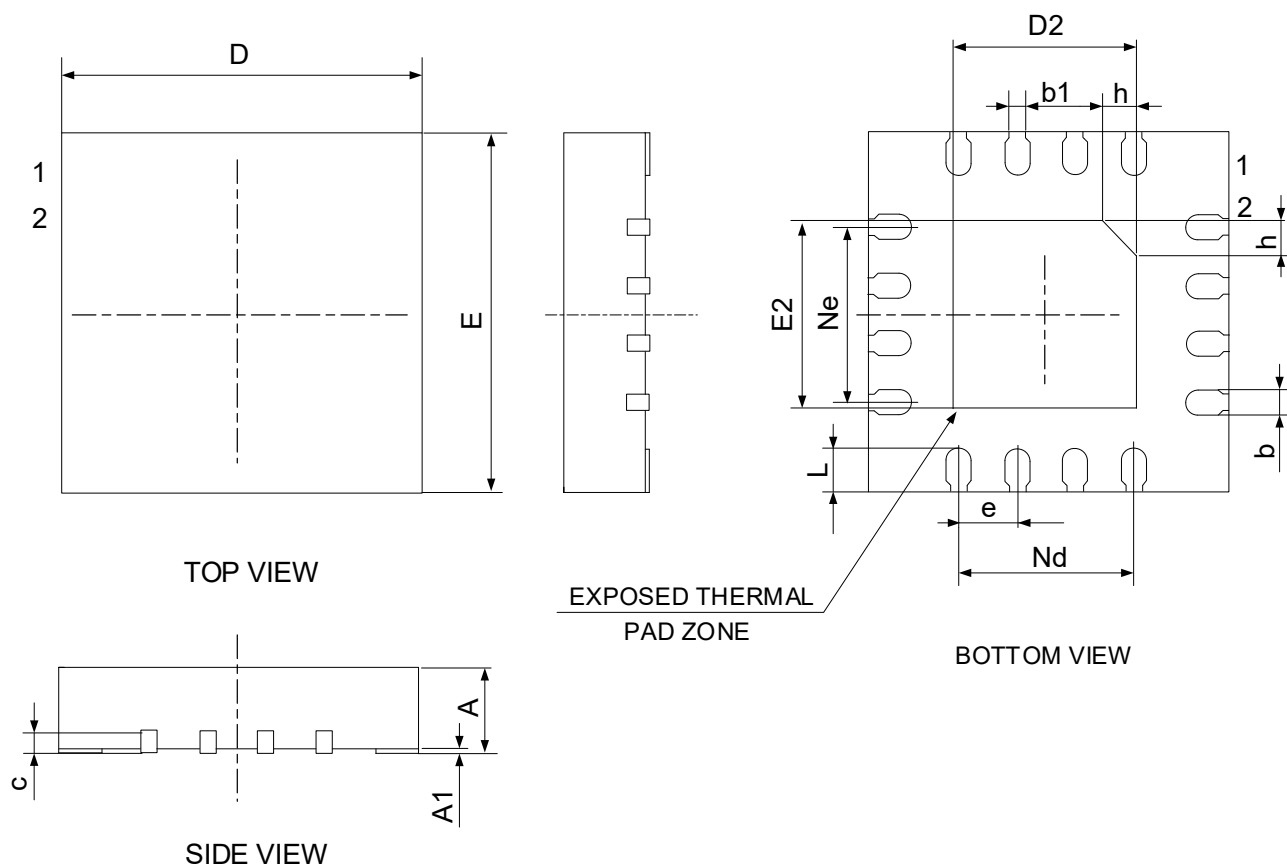
SOP16 Package



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	----	----	1.75
A1	0.05	----	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	----	0.48
b1	0.38	0.41	0.43
c	0.21	----	0.26
c1	0.19	0.20	0.21
D	9.70	9.90	10.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
h	0.25	----	0.50
L	0.50	----	0.80
L1	1.05BSC		
θ	0	-----	8°

Package Information

QFN16L Package



SYMBOL	MILLIMETER		
	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	--	0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	2.90	3.00	3.10
D2	1.55	1.65	1.75
e	0.50BSC		
Ne	1.50BSC		
Nd	1.50BSC		
E	2.90	3.00	3.10
E2	1.55	1.65	1.75
L	0.35	0.40	0.45
h	0.25	0.30	0.35

Revision History

Release No.	Date	Revision Description
1.0	2016.06.01	Initial Release
1.1	2016.12.30	Add CW1243ATJP
1.2	2017.06.19	Add CW1243ALBP
1.3	2017.08.21	Add CW1243ALBS
1.4	2018.07.12	Add CW1243ALDS, CW1243ALJS
1.5	2018.12.23	1. Add CW1243ALIP, CW1243ATHP 2. Add ESD Ratings 3. Add Excess Current 2 Delay Description 4. Revised CO Output Drive Ability 5. Revised Excess Current Release Delay
1.6	2019.06.18	Add CW1243ALOP, ATGS
1.7	2021.06	Add CW1243ATGQ Add QFN16L Package

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