

4/5 Cells Li-Ion and Li-Polymer Battery Protector

1. Features

- High Accuracy Voltage Detection
 - Charge over voltage protection
 V_{OV} : 3.2V - 4.4V(Step: 25mV)
 - Charge over voltage protection accuracy: $\pm 15\text{mV}$
 - Release hysteresis voltage: 0 - 400mV
 - Discharge under voltage Protection
 V_{UV} : 2.0V - 3.6V (Step: 100mV)
 - Discharge under voltage protection accuracy: $\pm 50\text{mV}$
 - Discharge under voltage protection release hysteresis voltage: 0 - 1.6V
- Discharge Over Current Detection:
 - Discharge over current 1 protection voltage
 V_{DOC1} : 0.025V - 0.400V (Step: 12.5mV)
 - Discharge over current 1 protection voltage accuracy: $\pm 10\text{mV}$
 - Discharge over current 1 protection voltage
 V_{DOC2} : $2 \times V_{DOC1}$ (Step: 25mV)
 - Discharge over current 2 protection voltage accuracy: $\pm 15\text{mV}$
- Short Protection:
 - Short protection voltage
 V_{SC} : $4 \times V_{DOC1}$ (Step: 50mV)
 - Short protection voltage accuracy: $\pm 15\text{mV}$
- Charge Over Current Protection:
 - Charge over current protection voltage V_{COC} :
 10mV - 50mV (Step: 10mV)
 - Charge over current protection voltage accuracy:
 10mV: $\pm 5\text{mV}$, 20mV - 50mV: $\pm 10\text{mV}$
- Open Wire Detection
- Battery Cell Balance:
 - Balance operation voltage threshold:
 3.2V - 4.375V (25mV step)
 - Balance operation voltage accuracy: $\pm 25\text{mV}$
- Temperature Protection:
 - Charging high temperature protection : 50°C
 Protection accuracy: $\pm 4^\circ\text{C}$ (Max.)
 - Charging low temperature protection : -5°C
 Protection accuracy: $\pm 4^\circ\text{C}$ (Max.)
 - Discharging high temperature protection: 70°C
 Protection accuracy: $\pm 4^\circ\text{C}$ (Max.)
- External capacitor to set over discharge voltage protection delay time, over discharge current 1 protection delay time and over discharge current 2 protection delay time
- Fixed over charge voltage, over charge current protection delay time, short protection delay time and temperature protection delay time
- Low Power Consumption
 - Normal operation mode current: 20 μA (Max)
 - Sleep mode current: 3 μA (Max)
- Operation Temperature Range: -40°C ~ 85°C
- Operation Voltage Range: 3V ~ 40V
- Package: 20-pin TSSOP20
- SEL pin to configure 4/5 cells application

2. General Description

- SIT8995 integrates high accuracy voltage detection circuits and time delay circuits to monitor battery cell voltage, current and temperature and to protect Li-Ion and Li-Polymer battery package safety. SIT8995 has function with charging from 0V which can increase battery pack service life.
- SIT8995 has three operation mode: normal mode, sleep mode and shutdown mode. SIT8995 enters sleep mode to reduce system power consumption when any battery cell is in low battery status.

3. Typical Application Circuits

5 cells application with same charge and discharge port

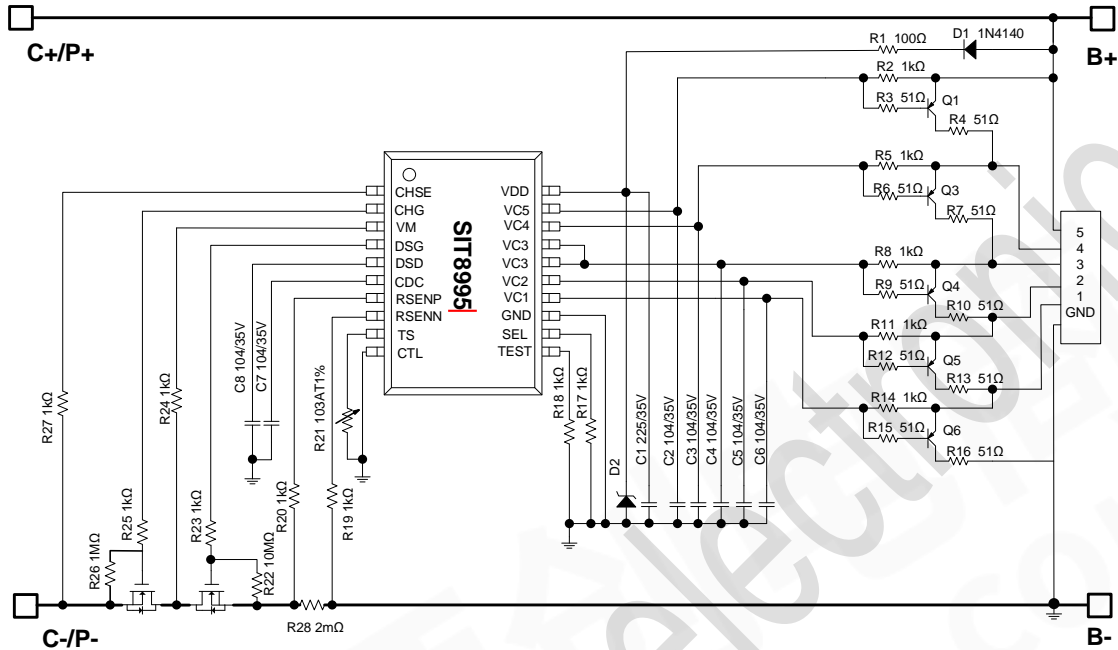


Figure 1. SIT8995 Typical Application Circuits (5 cells application with same charge and discharge port)

4 cells application with same charge and discharge port

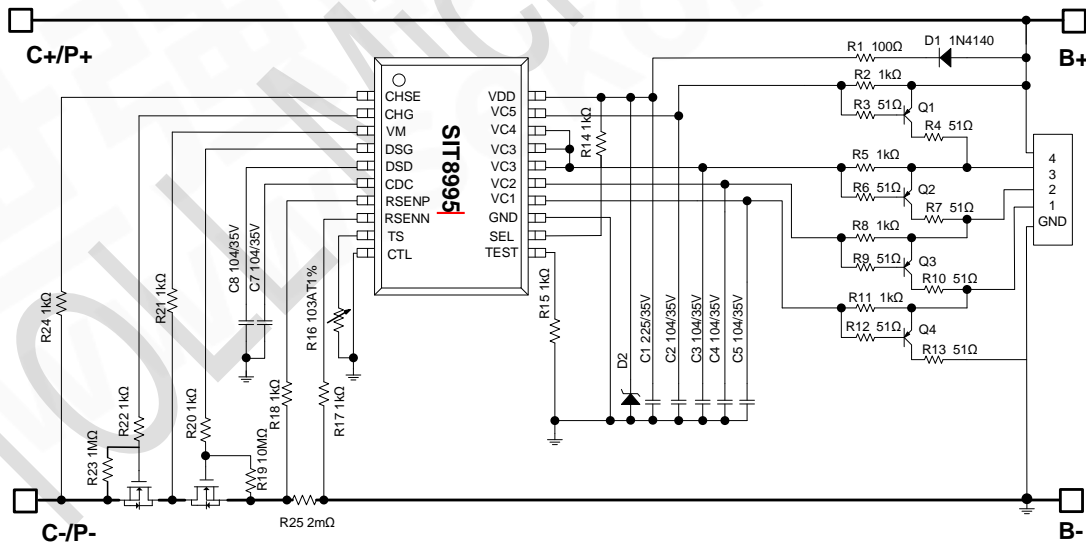


Figure 2. SIT8995 Typical Application Circuits (4 cells application with same charge and discharge port)

5 cells application with different charge and discharge port

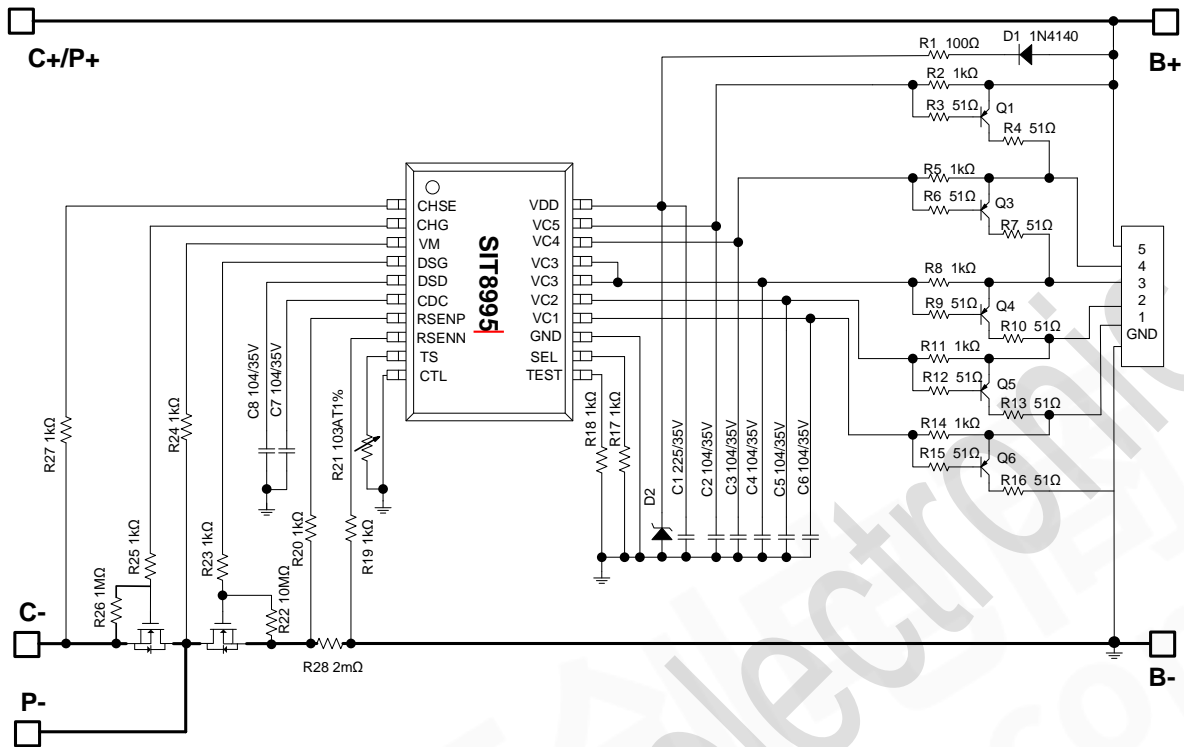


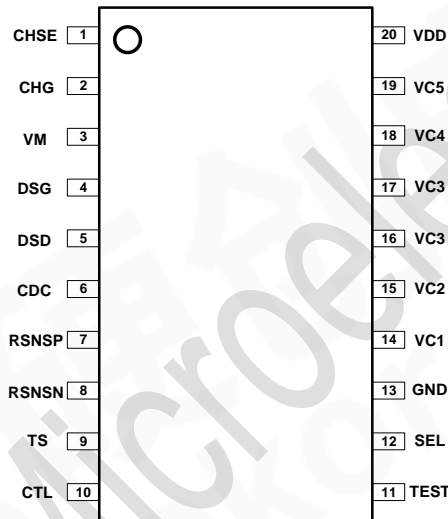
Figure 3. SIT8995 Typical Application Circuits (5 cells application with different charge and discharge port)

4. Absolute Maximum Ratings

Parameters	Symbol	Max	Min	Unit
VDD input voltage	V_{DD}	-0.3	40	V
High voltage port	DSG/VC1-VC5/SEL	GND-0.3	$V_{DD}+0.3$	V
	VDD/VM/CHG/CHSE	$V_{DD}-40$	$V_{DD}+0.3$	
Low voltage port	CDC/DSD/TS/TEST/ CTL/RNSNP/RNSN	GND-0.3	5.5	V
Operation temperature	T_{OP}	-40	85	°C
Storage temperature	T_{STR}	-40	125	°C

Note 1: Application cannot exceed the maximum ratings in case damage the device.

5. Pin Map



Top View

Package: TSSOP20

6. Order Information

Part Number	V_{OVP} (V)	V_{OVR} (V)	V_{BL} (V)	V_{UVP} (V)	V_{UVR} (V)	V_{DOCP} (V)	V_{COCP} (V)	Load Lock	Open Wire Detection	Quantity
SIT8995A	4.250	4.150	4.200	2.700	3.000	0.100	0.050	Yes	Yes	3000
SIT8995B	3.900	3.600	3.850	2.200	2.700	0.100	0.050	Yes	Yes	3000
SIT8995C	3.850	3.750	3.650	2.000	2.500	0.100	0.015	Yes	Yes	3000
SIT8995D	3.750	3.550	3.515	2.200	2.700	0.100	0.040	Yes	Yes	3000
SIT8995F	4.175	4.075	4.125	2.700	3.000	0.100	0.040	Yes	Yes	3000
SIT8995G	4.225	4.125	4.175	2.700	3.000	0.100	0.040	Yes	Yes	3000

7. Pin Configuration

Pin	Name	I/O	Function Description
1	CHSE	I	Charger detection pin
2	CHG	O	Charging MOSFET control pin
3	VM	I	Load detection pin
4	DSG	O	Discharging MOSFET control pin
5	DSD	I/O	Discharge delay time capacitor set pin
6	CDC	I/O	Over discharge current 1/2 delay time capacitor set pin
7	RSNSP	I	Positive current sense pin
8	RSNSN	I	Negative current sense pin
9	TS	I	NTC resistor connection pin
10	CTL	I	DSG, CHG output control pin
11	TEST	I	Test pin
12	SEL	I	Selection pin for 4 or 5 cells
13	GND		Power ground
14	VC1	I	The first battery cell positive connection pin
15	VC2	I	The second battery cell positive connection pin
16	VC3	I	The third battery cell positive connection pin
17	VC3	I	The third battery cell positive connection pin
18	VC4	I	The fourth battery cell positive connection pin
19	VC5	I	The highest battery cell positive connection pin
20	VDD	I	Power connection pin

8. ESD Rating

Parameters	Description	Value	Unit
V_{ESD}	Human Body Model for all pins	± 2000	V

JEDEC specification JS-001

9. Electrical CharacteriSITcs

(T_A = 25°C, unless otherwise noted.)

Parameters	Symbol	Condition	Min	Typ	Max	Unit
Charge Over Voltage Protection						
Charge over voltage protection voltage	V _{OV}	—	3.200		4.400	V
Charge over voltage protection voltage accuracy	V _{OVA}	—	-15		15	mV
Charge over voltage protection voltage step	V _{OVs}	—		25		mV
Charge over voltage protection release voltage	V _{OVR}	—	3.200		4.400	V
Charge over voltage protection release voltage accuracy	V _{OVRA}		-25		25	mV
Charge over voltage protection release voltage step	V _{OVRS}			25		mV
Charge over voltage protection delay time	T _{OV}		0.5	1	1.5	s
Charge over voltage protection release delay time	T _{OVR}		0.5	1	1.5	ms
Discharge Under Voltage Protection						
Discharge under voltage protection voltage	V _{UV}	—	2.000		3.600	V
Discharge under voltage protection voltage accuracy	V _{UVA}	—	-50		50	mV
Discharge under voltage protection voltage step	V _{UVS}	—		100		mV
Discharge under voltage protection release voltage	V _{UVR}	—	2.000		3.700	V
Discharge under voltage protection release voltage accuracy	V _{UVRA}		-50		50	mV
Discharge under voltage protection release voltage step	V _{UVRS}			100		mV
Discharge under voltage protection delay time	t _{UV}	0.1μF capacitor on DSD pin with ±10% accuracy	0.5	1	1.5	s
Discharge under voltage protection release delay time	t _{UVR}	0.1μF capacitor on DSD pin with ±10% accuracy	50	100	150	ms
Charge Over Current Protection						
Charge over voltage protection voltage	V _{COC}		10		50	mV
Charge over voltage protection voltage accuracy	V _{COCA}	10mV/step	-5		5	mV
		20mV-50mV/step	-10		10	mV
Charge over voltage protection voltage step	V _{COCS}			10		mV
Charge over voltage protection delay time	t _{COC}		0.5	1	1.5	s
Charge over voltage protection release delay time	t _{COCR}		50	100	150	ms
Discharge Over Current Protection						
Discharge over current 1 protection voltage	V _{DOC1}		25		400	mV
Discharge over current 1 protection voltage accuracy	V _{DOC1A}		-10		10	mV

9. Electrical CharacteriSITcs

($T_A = 25^\circ\text{C}$, unless otherwise noted.)

Parameters	Symbol	Condition	Min	Typ	Max	Unit
Discharge over current 1 protection voltage step	V_{DOC1S}			12.5		mV
Discharge over current 1 protection delay time	t_{DOC1}	0.1 μF capacitor on CDC pin with $\pm 10\%$ accuracy	0.5	1	1.5	s
Discharge over current 2 protection voltage	V_{DOC2}			$2 \cdot V_{\text{DOC1}}$		mV
Discharge over current 2 protection voltage accuracy	V_{DOC2A}		-15		15	mV
Discharge over current 2 protection voltage step	V_{DOC2S}			$2 \cdot V_{\text{DOC1S}}$		mV
Discharge over current 2 protection delay time	t_{DOC2}	0.1 μF capacitor on CDC pin with $\pm 10\%$ accuracy	50	100	150	ms
Discharge over current protection release voltage	t_{DOCR}		50	100	150	ms
Short protection voltage	V_{SC1}			$4 \cdot V_{\text{DOC1}}$		mV
Short protection voltage accuracy	V_{SC1A}		-15		15	mV
Short protection voltage step	V_{SC1S}			$4 \cdot V_{\text{DOC1S}}$		mV
Short protection delay time	t_{SC}		200	250	300	μs
Discharge over current protection release delay time	t_{SCR}		50	100	150	ms
Temperature Protection						
Charging high temperature protection threshold	T_{COT}		46	50	54	$^\circ\text{C}$
Charging high temperature protection release threshold	T_{COTR}		41	45	49	$^\circ\text{C}$
Discharging high temperature protection threshold	T_{DOT}		66	70	74	$^\circ\text{C}$
Discharging high temperature protection release threshold	T_{DOTR}		51	55	59	$^\circ\text{C}$
Charging low temperature protection threshold	T_{CUT}		-10	-5	0	$^\circ\text{C}$
Charging low temperature protection release threshold	T_{CUTR}		-5	0	5	$^\circ\text{C}$
Temperature protection delay time	t_{T}		1.5	3	5.5	s
Temperature protection release delay time	t_{TR}		1.5	3	5.5	s
Discharge status detection voltage	V_{DCH}		2.5	5	7.5	mV
Battery Cell Balance						
Balance operation voltage threshold	V_{OB}		3.2		4.375	V
Balance operation voltage accuracy	V_{OBA}		-25		25	mV
Balance operation delay time	t_{BL}			250		ms
Balance impedance 1	RBL1	$V_{\text{CN}}=4.2\text{V}(N=1)$		1	1.4	k Ω
Balance impedance 2	RBL2	$V_{\text{CN}}=4.2\text{V}(N=2,3,4,5)$	75	100	140	Ω

9. Electrical CharacteriSITcs

($T_A = 25^\circ\text{C}$, unless otherwise noted.)

Parameters	Symbol	Condition	Min	Typ	Max	Unit
Others						
Operation voltage	V_{DD}	CHG and DSG has correct output status	3		40	V
Operation current (normal mode)	I_{DD}				20	μA
Operation current (sleep mode)	I_{IDLE}				5	μA
Sleep delay time	t_{UVP}		20	30	40	s
Lowest adapter voltage	V_{OCHA}			1	1.5	V
Pull up resistor on CHSE	R_{CHSE}		800	1300	1800	$\text{k}\Omega$
Pull down resistor on VM	R_{VM}		250	500	700	$\text{k}\Omega$
Logic high voltage of test pin	V_{TESTH}		3.5	4	4.5	V
Logic low voltage of test pin	V_{TESTL}		0		0.3	V
Logic high voltage of SEL	V_{SELH}		$V_{DD}-0.6$	$V_{DD}-0.1$		V
Logic low voltage of SEL	V_{SELL}				0.6	V
Output current on CHG pin	I_{CHG}		4	5	6	μA
High voltage 1 output on DSG pin	V_{DSG-1}	$V_{DD} > 13\text{V}$	11.5	12.5	13.5	V
High voltage 2 output on DSG pin	V_{DSG-2}	$V_{DD} < 13\text{V}$	$V_{DD}-1$	$V_{DD}-0.7$		V
Low voltage output on DSG pin	V_{DSG-L}				0.2	V
Detect voltage threshold on CHSE pin	V_{CHSE}	Charge adapter detection	0.6	1	1.5	V
Detect voltage threshold on VM pin	V_{VM}	Load detection	1.05	1.20	1.35	V

10. Block Diagram

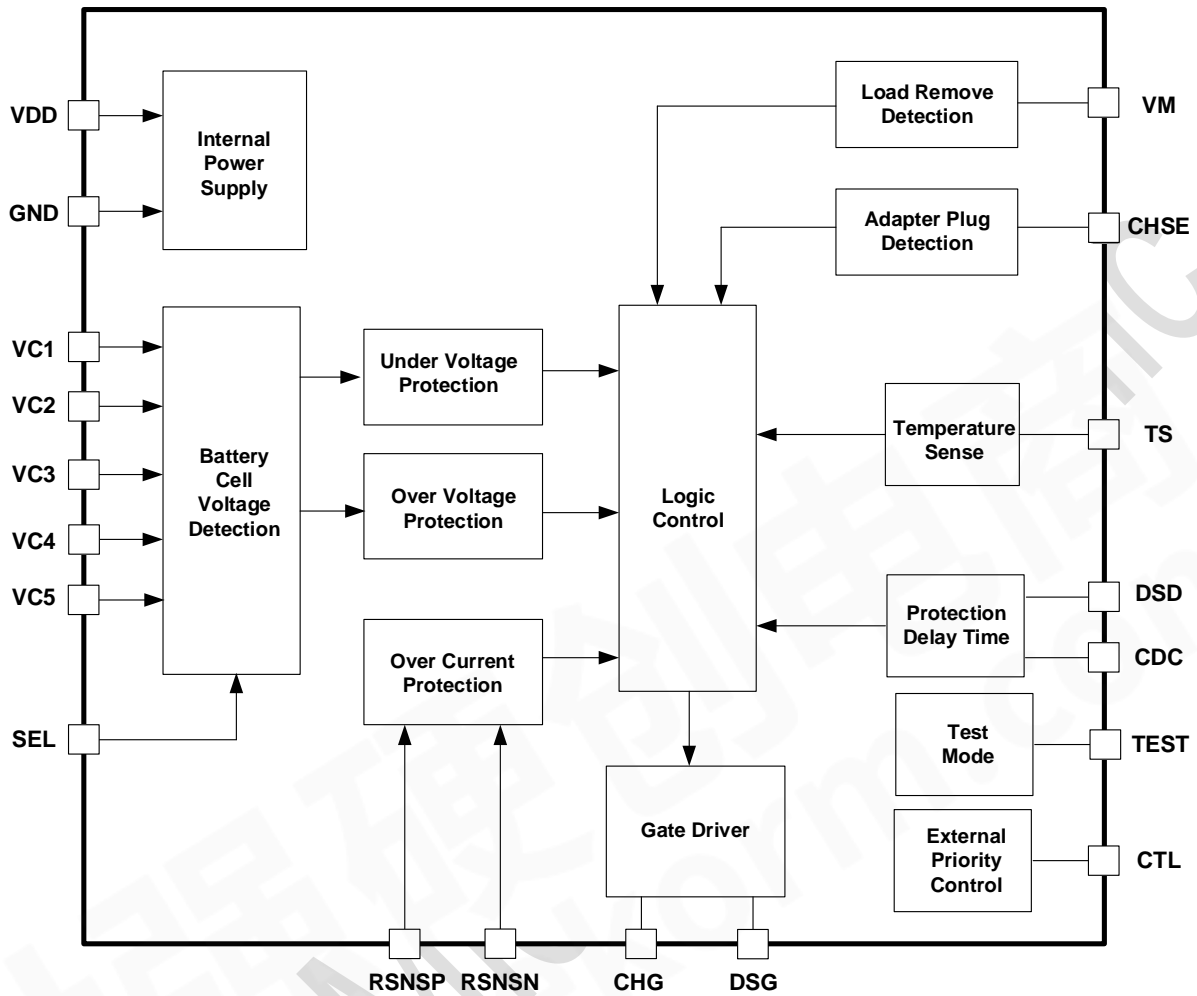


Figure 4. SIT8995 block diagram

11. Function Description

1. Normal Mode

SIT8995 enters normal mode if the following conditions are met:

- (1) All battery cell voltage is within over charge protection (V_{OV}) and over discharge protection (V_{UV});
- (2) Differential voltage on RSNP and RSNSN pins is smaller than over discharge current 1 protection voltage V_{DOC1} ;
- (3) Temperature detected from TS pin within charging high temperature protection T_{COT} and charging low temperature protection T_{CUT} ;
- (4) No any safety protection issue is noted.

2. Charge Over Voltage Protection Status

SIT8995 enters into Charge Over Voltage Protection Status if the following conditions are met:

- (1) Any battery cell voltage is higher than charge over voltage protection V_{OV} ;
- (2) Duration time of condition (1) is longer than charge over voltage protection delay time t_{OV} .

In charge over voltage protection status, CHG pin of SIT8995 is high impedance status.

Charge over voltage protection status is released if the following conditions are met:

- (1) All battery cell voltage is lower than V_{OV} when adapter is removed or all battery cell voltage is lower than charge over voltage protection release voltage V_{OVR} when adapter is plugged in.
- (2) Duration time of condition (1) is longer than charge over voltage protection release delay time t_{OVR} .

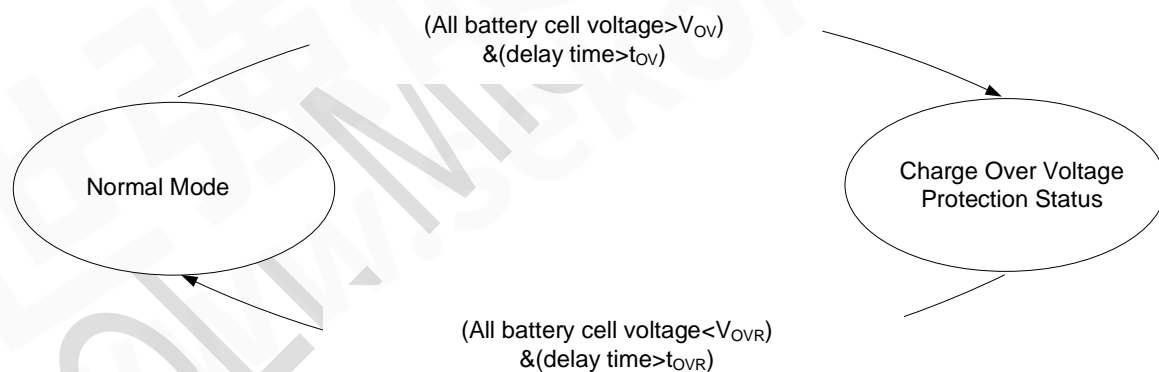


Figure 5. Charge over voltage protection status state transition diagram

3. Discharge Under Voltage Protection Status

SIT8995 enters into Discharge Under Voltage Protection Status if the following conditions are met:

- (1) Any battery cell voltage is lower than over discharge protection V_{UV} ;
- (2) Duration time of condition (1) is longer than over discharge under voltage protection release delay time t_{UV} , CHG pin of SIT8995 is high impedance status and DSG pin output is low.

After load lock is released, the discharge under voltage protection status is released if the following conditions are met:

(1) Adapter plugged in is detected and all battery cells voltage is higher than V_{UV} , or the load is removed and all battery cells voltage is higher than discharge under voltage protection release voltage V_{UVR} ;

(2) Duration time of condition (1) is longer than over discharge protection release delay time t_{UVR} .

Note 3: Load lock status is released and 64ms duration time after Load lock status is released if the following conditions are met:

- (1) Load is removed;
- (2) Adapter is plugged in.

4. Sleep Mode

SIT8995 enters into Sleep Mode if the following conditions are met:

(1) Duration time of discharge under voltage protection status is longer than sleep delay time t_{UVP} (32s Typ.);

(2) No adapter is plugged in (condition of no adapter is plugged in: $CHSE\ Voltage > V_{CHSEH}$).

Note 4: If duration time of over discharge under voltage protection status is longer than 30s after discharge status, SIT8995 pulls internal resistor up to VDD on CHSE pin to detect adapter is plugged in or not.

In sleep mode, SIT8995 shuts down almost system block. Voltage, current and temperature detection ceases. CHG pin of SIT8995 is high impedance status and DSG pin output is low.

SIT8995 exits sleep mode if the following conditions are met:

Adapter is plugged in (Condition of adapter is plugged in: $CHSE\ voltage \leq V_{CHSE}$).

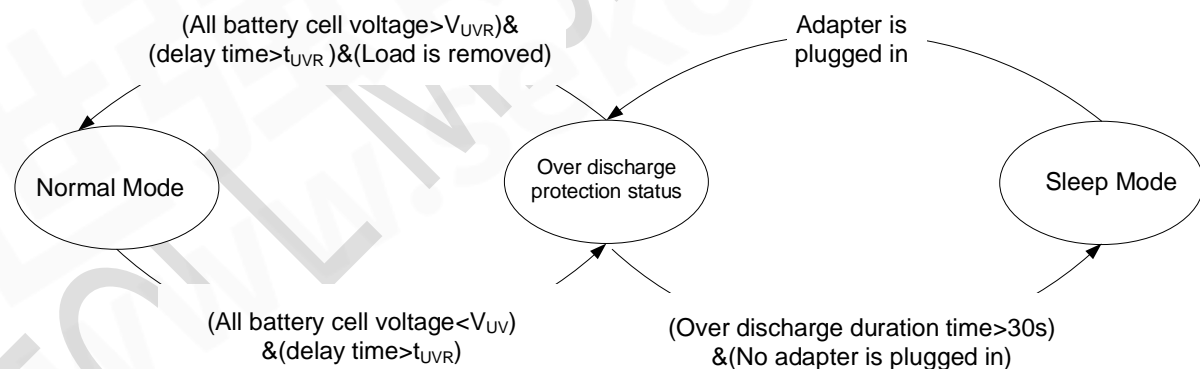


Figure 6. Discharge under voltage protection status state transition diagram

5. Discharge Over Current Protection Status

SIT8995 has two stage discharge over current protection. Over current 1 protection voltage V_{DOC1} is smaller than over current 1 protection voltage V_{DOC2} , and delay time of over current 1 protection t_{DOC1} is longer than delay time of over current 1 protection t_{DOC2} .

SIT8995 enters into discharge over current protection status if the following conditions are met:

- (1) Differential voltage on RSNSP and RSNSN pin is higher than discharge over current 1 protection

voltage V_{DOC1} (or discharge over current 2 protection voltage V_{DOC2});

(2) Duration time of condition (1) is longer than delay time of over current 1 protection t_{DOC1} (or delay time of over current 2 protection t_{DOC2}).

CHG pin of SIT8995 is high impedance status and DSG pin output is low.

Discharge over current protection status is released if the following conditions are met:

- (1) The load is removed (Condition of load is removed: voltage on VM is lower than V_{VM});
- (2) Duration time of condition (1) is longer than discharge over current protection released delay time t_{DOCR} .

Note 5: After discharge over current protection happens, VM pin of SIT8995 is pulled down to GND by internal resistor to detect that the load is removed or not.

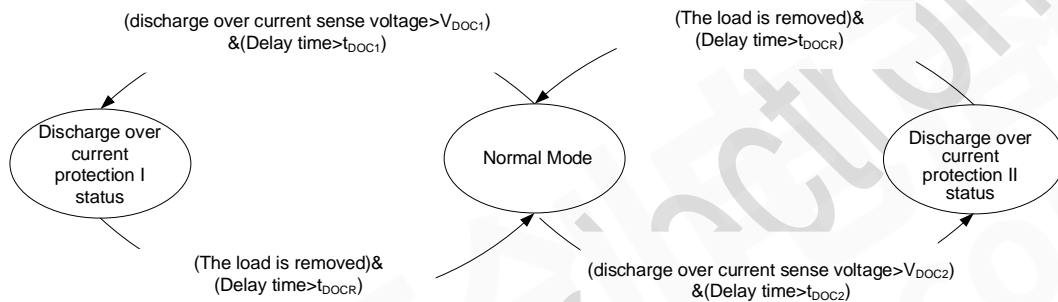


Figure 7. Discharge over current protection status state transition diagram

6. Short Protection Status

SIT8995 enters into short protection status if the following conditions are met:

- (1) Differential voltage on RSNP and RSNS pin is higher than short protection voltage V_{SC} ;
- (2) Duration time of condition (1) is longer than short protection delay time t_{SC} .

Short protection status is released if the following conditions are met:

- (1) The load is removed (Condition of load is removed: voltage on VM is lower than V_{VM});
- (2) Duration time of condition (1) is longer than discharge over current protection released delay time t_{SCR} .

Note 6: After short protection happens, VM pin of SIT8995 is pulled down to GND by internal resistor to detect that the load is removed or not.

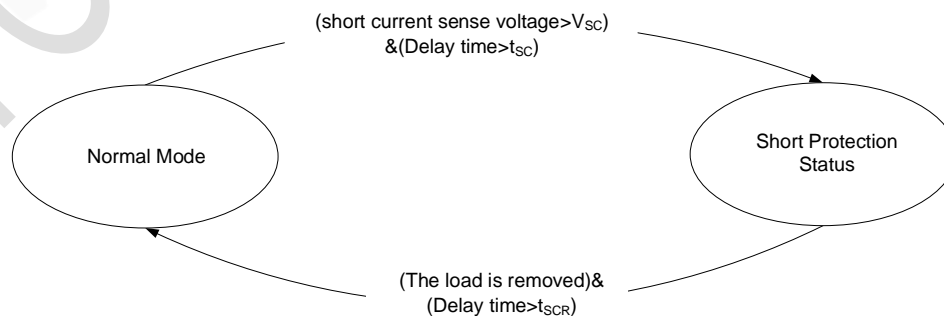


Figure 8. Short protection status state transition diagram

7. Charge Over Current Protection

SIT8995 enters charge over current protection status if the following conditions are met:

- (1) Differential voltage on RSNSP and RSNSN pin is higher than charge over current protection voltage V_{COC} ;
- (2) Duration time of condition (1) is longer than charge over current protection delay time t_{COC} .

In charge over current protection status, CHG pin of SIT8995 is high impedance status.

Charge over current protection status is released if the following conditions are met:

- (1) Charger adapter is plugged out;
- (2) Delay time is longer than charge over current protection release delay time t_{COCR} .

8. Temperature Protection

When NTC resistor (103AT ($\beta = 3435$) is recommended) is used, SIT8995 temperature protection is active. It includes charging high temperature protection, charging low temperature protection and discharging high temperature protection. The temperature protection function is described as below:

8.1 Charging High Temperature Protection Status

SIT8995 enters charging high temperature protection status if the following conditions are met:

- (1) Sense temperature is higher than charging high temperature protection threshold T_{COT} ;
- (2) the duration time is longer than 3s.

CHG pin of SIT8995 is high impedance status in charging condition.

Charging high temperature protection status is released if the following conditions are met:

- (1) Sense temperature is lower than charging high temperature protection release threshold T_{COTR} ;
- (2) The duration time is longer than 3s.

8.2 Charging Low Temperature Protection Status

SIT8995 enters charging low temperature protection status if the following conditions are met:

- (1) Sense temperature is lower than charging low temperature protection threshold T_{CUT} ;
- (2) The duration time is longer than 3s.

CHG pin of SIT8995 is high impedance status in charging condition.

Charging low temperature protection status is released if the following conditions are met:

- (1) Sense temperature is lower than charging high temperature protection release threshold T_{CUTR} ;
- (2) The duration time is longer than 3s.

8.3 Discharging High Temperature Protection Status

SIT8995 enters charging high temperature protection status if the following conditions are met:

- (1) Sense temperature is higher than charging high temperature protection threshold T_{DOT} ;
- (2) The duration time is longer than 3s.

CHG pin of SIT8995 is high impedance status and DSG output is low in discharging condition.

Discharging high temperature protection status is released if the following conditions are met:

- (1) Sense temperature is lower than charging high temperature protection release threshold T_{DOTR} ;
- (2) The duration time is longer than 3s.

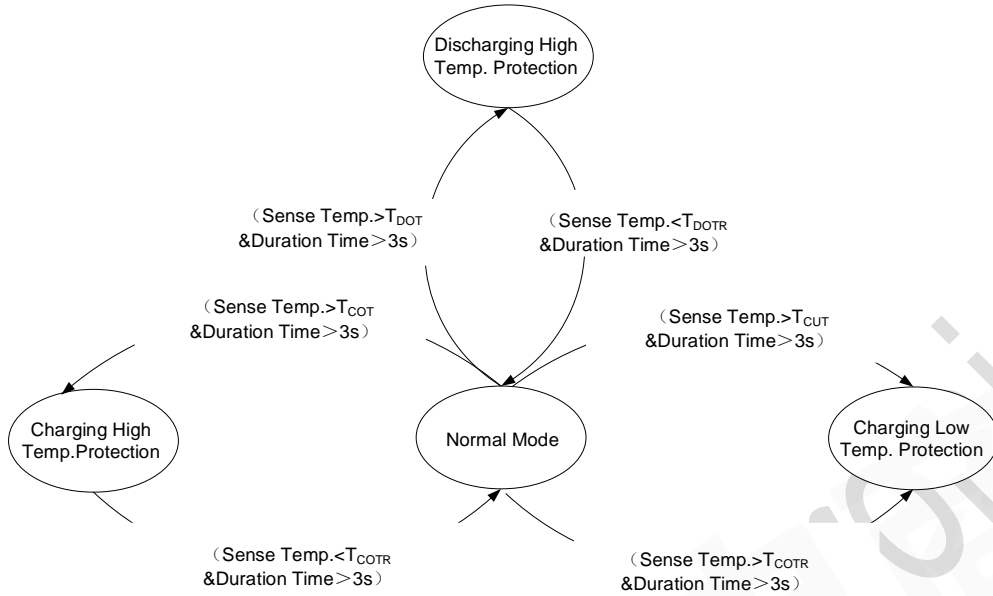


Figure 9. Temperature Protection Status State transition diagram

NTC thermal resistor 103AT ($\beta = 3435$) is recommended in SIT8995 application. The below table shows NTC resistance vs. Temperature.:

Temperature (°C)	103AT Resistance(kΩ)	Resistance Tolerance (kΩ)
-20	67.77	72.72-63.20
-15	53.41	57.11-49.98
-10	42.47	45.27 - 39.86
-5	33.90	36.02 - 31.92
0	27.28	28.90 - 25.76
5	22.05	23.29 - 20.88
25	10	9.700 - 10.30
45	4.911	5.094 - 4.735
47	4.554	4.691 - 4.417
50	4.16	4.306 - 4.018
55	3.536	3.654 - 3.421
60	3.02	3.115 - 2.927
65	2.588	2.665 - 2.513
70	2.288	2.291 - 2.167

Table 1. 103AT ($\beta = 3435$) resistance vs temperature

9. Battery Cell Voltage Balance

In SIT8995 application, when any battery cell voltage is higher than balance operation voltage threshold V_{OB} and duration time is longer than balance active delay time T_{BL} , the internal balance circuits in SIT8995 is active to balance charging current of battery cell. The function calls battery cell voltage balance. SIT8995 adapts parity balance method. The adjacent battery cell balance is not occurring at the same time. Balance cycle is 250ms.

The system exits battery balance condition if the following conditions are met:

- (1) Battery cell voltage is lower than V_{OB} ;
- (2) Temperature protection, discharge protection or charge protection events occurrence.

10. Charge and Discharge Status Detection

Charge and discharge status are determined by RSNP pin voltage. If the voltage on RSNP pin is higher than discharge status detection voltage V_{DCH} , SIT8995 is in discharging status. SIT8995 system is in charge status except discharge status.

11. 0V Charge Function

Battery pack voltage cannot be smaller than 1.5V, when adapter voltage is larger than V_{OCHA} . SIT8995 enable charging from adapter to battery pack. Requirement to lowest voltage of adapter depends on turn on threshold voltage of charge MOSFET used in application

12. Function Configuration

1. SEL Pin Configuration

SEL pin of SIT8995 selects 4 cells or 5 cells application. Please follows the below table:

SEL	Function
GND	5 cells protection
VDD	4 cells protection

2. CTL Pin Configuration

CTL pin selects output status of CHG and DSG pin, and it has higher priority than internal protection circuits.

CTL	DSG	CHG
VDD	GND	Hi-Z
GND	Normal	Normal

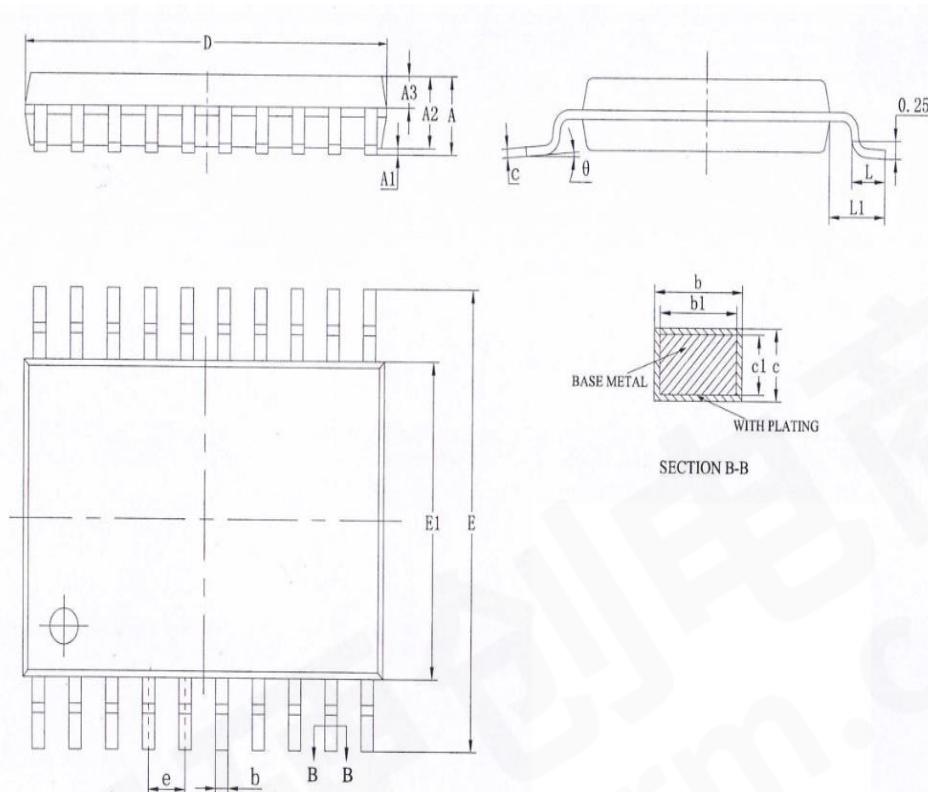
3. Delay Time Setting

In SIT8995 application, partly protection delay time and protection release delay time can be set by external capacitor. The delay time can refer the below table:

Item	Symbol	Related Setup	Delay time
Charge over voltage protection delay time	t_{OV}	Internal fixed	1s
Charge over voltage protection release delay time	t_{OVR}	Internal fixed	160ms
Charge over current protection delay time	t_{COC}	Internal fixed	1s
Charge over current protection release delay time	t_{COCR}	Internal fixed	100ms
Discharge under voltage protection delay time	t_{UV}	External capacitor C_{DSD} on DSD pin	$1s \times C_{DSD}/0.1\mu F$
Discharge under voltage protection release delay time	t_{UVR}	External capacitor C_{DSD} on DSD pin	$100ms \times C_{DSD}/0.1\mu F$
Discharge over current 1 protection delay time	t_{DOC1}	External capacitor C_{CDC} on CDC pin	$1s \times C_{CDC}/0.1\mu F$
Discharge over current 2 protection delay time	t_{DOC2}	External capacitor C_{CDC} on CDC pin	$0.1s \times C_{CDC}/0.1\mu F$ 或 $0.35s \times C_{CDC}/0.1\mu F$
Discharge over current protection release delay time	t_{DOCR}	External capacitor C_{CDC} on CDC pin	$0.1s \times C_{CDC}/0.1\mu F$
Short protection delay time	t_{SC}	Internal fixed	250 μs
Short protection release delay time	t_{SCR}	External capacitor C_{CDC} on CDC pin	$1s \times C_{CDC}/0.1\mu F$ 或 $0.1s \times C_{CDC}/0.1\mu F$
Temperature protection delay time	t_T	Internal fixed	3s
Temperature protection release delay time	t_{TR}	Internal fixed	3s
Sleep mode delay time	t_{UVP}	Internal fixed	32s

13. Package Information

TSSOP20



Unit: mm

Symbol	Dimensions In Millimeters			Symbol	Dimensions In Millimeters		
	Min	Nom	Max		Min	Nom	Max
A	-	-	1.20	D	6.40	6.50	6.60
A1	0.05	-	0.15	E1	4.30	4.40	4.50
A2	0.80	1.00	1.05	E	6.20	6.40	6.60
A3	0.39	0.44	0.49	e	0.65BSC		
b	0.2	-	0.30	L	0.45	0.60	0.75
b1	0.19	0.22	0.25	L1	1.00REF		
c	0.13	-	0.19	θ	0	-	8°
c1	0.12	0.13	0.14				

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