This IC is a battery monitoring IC developed using CMOS technology. Compared with conventional CMOS voltage detectors, this IC is ideal for the applications that require high-withstand voltage due to its maximum operation voltage as high as 24 V.
This IC is capable of confirming the voltage in stages since it detects five voltage values.
The S-82F9A Series has an EN pin, allowing for reduction of current consumption by using an external signal to turn off this IC.
The S-82F9B Series has a SENSE pin, and the SENSE pin and external components enable battery monitoring equal to or higher than the rated voltage of the IC.

■ Features

- Detection voltage accuracy: ±1.0%
- Hysteresis characteristics: $V_{HYS1(S)}$ to $V_{HYS5(S)}$ = 0 mV, 50 mV, 300 mV, 400 mV, 500 mV
- Current consumption: During operation: I_{DD1} = 10 μA max.
  During power-off: I_{DD2} = 0.1 μA max.
- Operation voltage range: V_{DD} = 3.6 V to 24 V
- Detection voltage: $V_{DET1(S)}$ to $V_{DET5(S)}$ = 7.5 V to 21.5 V (0.1 V step)
- Output form: Nch open-drain output
- Output logic*1: Full charge all on, Individual step voltage on
- SENSE pin power-off voltage: V_{SENSE} < 0.3 V (S-82F9B Series)
- Voltage detection pin: S-82F9A Series: VDD pin
  S-82F9B Series: SENSE pin
- Operation temperature range: Ta = -40°C to +85°C
- Lead-free (Sn 100%), halogen-free

*1. Full charge all on: The multiple output pins become V_{SS} output depending on the input voltage.
When the input voltage is equal to or higher than each of the five detection voltage values, $V_{OUT1} = V_{OUT2} = V_{OUT3} = V_{OUT4} = V_{OUT5} = V_{SS}$.
Individual step voltage on: According to the input voltage, only one output pin is a V_{SS} output.
Set the detection voltage to $V_{DET1} > V_{DET2} > V_{DET3} > V_{DET4} > V_{DET5}$ and $V_{DETn} > V_{DETn+1} + V_{HYSn+1}$.
$V_{OUT1} = V_{SS}$ and $V_{OUT2} = V_{OUT3} = V_{OUT4} = V_{OUT5}$ = High-Z when the input voltage is equal to or higher than detection voltage 1 (V_{DET1}).

■ Application

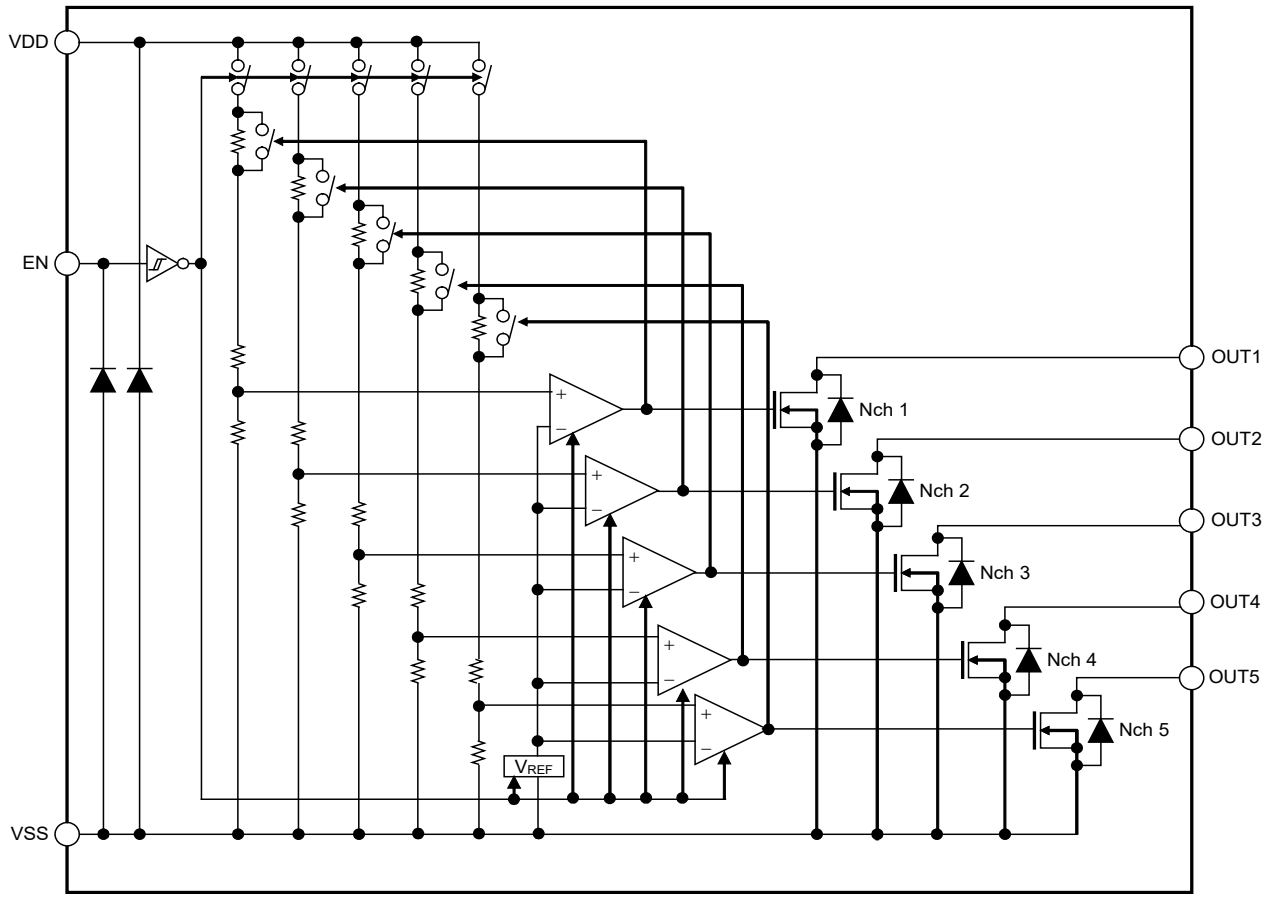
- Rechargeable lithium-ion battery pack

■ Package

- HTMSOP-8

■ Block Diagram

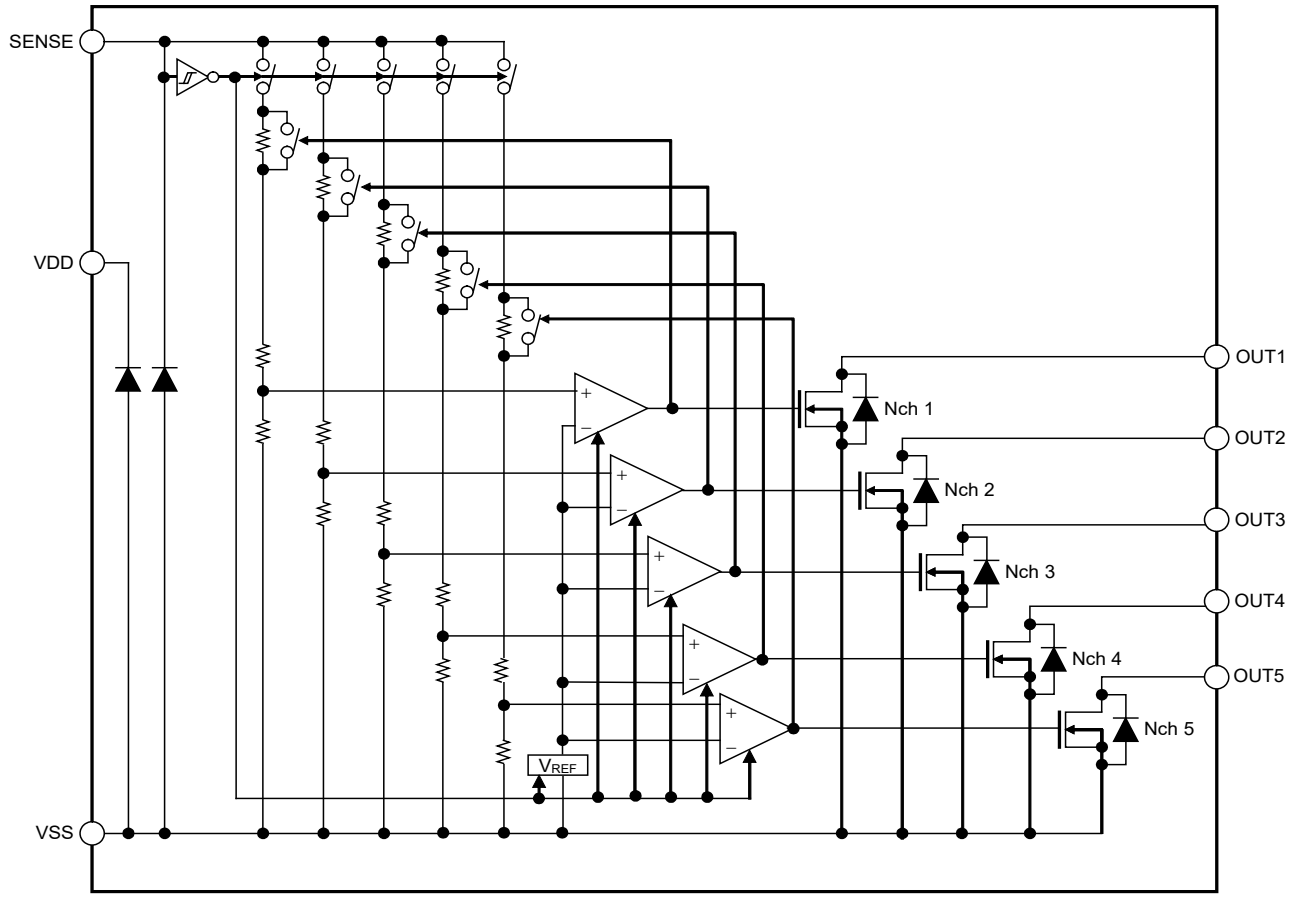
1. S-82F9A Series



Remark Diodes in the figure are parasitic diodes.

Figure 1

2. S-82F9B Series

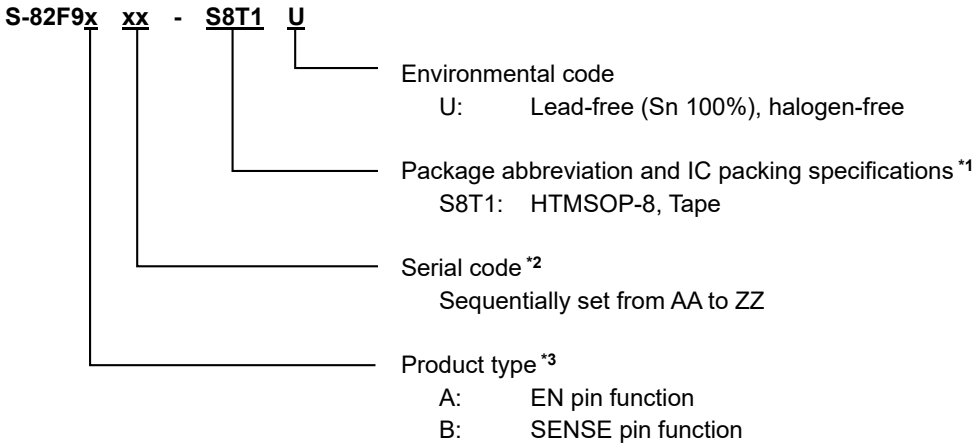


Remark Diodes in the figure are parasitic diodes.

Figure 2

■ Product Name Structure

1. Product name



***1.** Refer to the tape drawing.
***2.** Refer to "**3. Product name list**".
***3.** EN pin function: The EN pin can control the state of the IC.
SENSE pin function: The SENSE pin can monitor the battery voltage.

2. Package

Table 1 Package Drawing Codes

Package Name	Dimension	Tape	Reel	Land
HTMSOP-8	FP008-A-P-SD	FP008-A-C-SD	FP008-A-R-SD	FP008-A-L-SD

3. Product name list

3. 1 S-82F9A Series

Table 2 (1 / 2)

Product Name	Detection Voltage 1 [$V_{DET1(S)}$]	Detection Voltage 2 [$V_{DET2(S)}$]	Detection Voltage 3 [$V_{DET3(S)}$]	Detection Voltage 4 [$V_{DET4(S)}$]	Detection Voltage 5 [$V_{DET5(S)}$]
S-82F9AAA-S8T1U	21.5 V	18.0 V	14.5 V	11.0 V	7.5 V

Table 2 (2 / 2)

Product Name	Hysteresis Width 1 [$V_{HYS1(S)}$]	Hysteresis Width 2 [$V_{HYS2(S)}$]	Hysteresis Width 3 [$V_{HYS3(S)}$]	Hysteresis Width 4 [$V_{HYS4(S)}$]	Hysteresis Width 5 [$V_{HYS5(S)}$]	Output Logic*1
S-82F9AAA-S8T1U	50 mV	50 mV	50 mV	50 mV	50 mV	Full charge all on

3. 2 S-82F9B Series

Table 3 (1 / 2)

Product Name	Detection Voltage 1 [$V_{DET1(S)}$]	Detection Voltage 2 [$V_{DET2(S)}$]	Detection Voltage 3 [$V_{DET3(S)}$]	Detection Voltage 4 [$V_{DET4(S)}$]	Detection Voltage 5 [$V_{DET5(S)}$]
S-82F9BAA-S8T1U	21.5 V	18.0 V	14.5 V	11.0 V	7.5 V

Table 3 (2 / 2)

Product Name	Hysteresis Width 1 [$V_{HYS1(S)}$]	Hysteresis Width 2 [$V_{HYS2(S)}$]	Hysteresis Width 3 [$V_{HYS3(S)}$]	Hysteresis Width 4 [$V_{HYS4(S)}$]	Hysteresis Width 5 [$V_{HYS5(S)}$]	Output Logic*1
S-82F9BAA-S8T1U	50 mV	50 mV	50 mV	50 mV	50 mV	Full charge all on

***1.** Output Logic: Full charge all on, Individual step voltage on

Remark Please contact our sales representatives for products other than the above.

■ Pin Configurations

1. HTMSOP-8

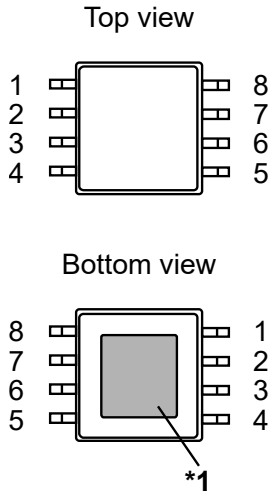


Figure 3

Table 4 S-82F9A Series

Pin No.	Symbol	Description
1	OUT1	Voltage detection output pin 1
2	OUT2	Voltage detection output pin 2
3	OUT3	Voltage detection output pin 3
4	OUT4	Voltage detection output pin 4
5	OUT5	Voltage detection output pin 5
6	VSS	GND pin
7	EN	EN signal input pin
8	VDD	Positive power supply input pin

Table 5 S-82F9B Series

Pin No.	Symbol	Description
1	OUT1	Voltage detection output pin 1
2	OUT2	Voltage detection output pin 2
3	OUT3	Voltage detection output pin 3
4	OUT4	Voltage detection output pin 4
5	OUT5	Voltage detection output pin 5
6	VSS	GND pin
7	SENSE	Detection voltage input pin
8	VDD	Positive power supply input pin

***1.** Connect the heat sink of backside at shadowed area to the board and set electric potential open or V_{DD}. However, do not use it as the function of electrode.

■ Absolute Maximum Ratings

Table 6

(Ta = +25°C unless otherwise specified)

Item	Symbol	Absolute Maximum Rating	Unit
Input voltage between VDD pin and VSS pin	V_{DD}	V_{SS} - 0.3 to V_{SS} + 28	V
EN pin input voltage (S-82F9A Series)	V_{EN}	V_{SS} - 0.3 to V_{SS} + 28	V
SENSE pin input voltage (S-82F9B Series)	V_{SENSE}	V_{SS} - 0.3 to V_{DD} + 0.3	V
Output voltage n	V_{OUTn}	V_{SS} - 0.3 to V_{SS} + 28	V
Operation ambient temperature	T_{opr}	-40 to +85	°C
Storage temperature	T_{stg}	-40 to +125	°C

Caution **The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.**

Remark n = 1 to 5

■ Thermal Resistance Value

Table 7

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Junction-to-ambient thermal resistance*1	θ_{JA}	HTMSOP-8	Board A	-	159	-	°C/W
			Board B	-	113	-	°C/W
			Board C	-	39	-	°C/W
			Board D	-	40	-	°C/W
			Board E	-	30	-	°C/W

***1.** Test environment: compliance with JEDEC STANDARD JESD51-2A

Remark Refer to ■ **Power Dissipation**" and "**Test Board**" for details.

■ Electrical Characteristics

Table 8

(Ta = +25°C unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Common							
Detection voltage n*1	V_{DETn}	-	$V_{DETn(S)}$ × 0.99	$V_{DETn(S)}$	$V_{DETn(S)}$ × 1.01	V	1
Hysteresis width n*2	V_{HYSn}	300 mV ≤ $V_{HYSn(S)}$ ≤ 500 mV	$V_{HYSn(S)}$ × 0.8	$V_{HYSn(S)}$	$V_{HYSn(S)}$ × 1.2	V	1
		0 V ≤ $V_{HYSn(S)}$ ≤ 50 mV	$V_{HYSn(S)}$ - 0.025	$V_{HYSn(S)}$	$V_{HYSn(S)}$ + 0.025	V	1
Operation voltage range between VDD pin and VSS pin	V_{DD}	Fixed output pin voltage	3.6	-	24	V	-
Current consumption during operation*3	I_{DD1}	V1 = 23 V, V2 = 23 V	-	-	10	µA	1
Current consumption during power-off	I_{DD2}	V1 = 23 V, V2 = 0 V	-	-	0.1	µA	1
Output sink current n	I_{OUTn}	Full charge all on, V1 = 23 V, V2 = 23 V, V3 = 1 V	10	-	-	mA	2
		Individual step voltage on V1 = V2 = V_{DETn} + V_{HYSn}, V3 = 1 V	10	-	-	mA	2
Output leak current n	I_{LEAKn}	V1 = 23 V, V2 = 0 V, V3 = 23 V	-	-	0.1	µA	2
S-82F9A Series							
EN pin input voltage "H"	V_{SH}	V1 = 23 V	1.5	-	-	V	1
EN pin input voltage "H"	V_{SL}	V1 = 23 V	-	-	0.3	V	1
S-82F9B Series							
SENSE pin current	I_{SENSE}	V1 = 23 V, V2 = 23 V	-	-	10	µA	1
SENSE pin input voltage "H"	V_{SH}	V1 = 23 V	7	-	-	V	1
SENSE pin input Voltage "L"	V_{SL}	V1 = 23 V	-	-	0.3	V	1

***1.** V_{DETn}: Actual detection voltage value, $V_{DETn(S)}$: Set detection voltage
***2.** V_{HYSn}: Actual hysteresis width, $V_{HYSn(S)}$: Set hysteresis width
The relationship between V_{DETn} and V_{HYSn} is as follows.
$V_{DETn} < V_{DETn} + V_{HYSn}$
***3.** Current consumption = I_{VDD} + I_{EN} (S-82F9A Series)
Current consumption = I_{VDD} + I_{SENSE} (S-82F9B Series)

Remark n = 1 to 5

■ Test Circuits

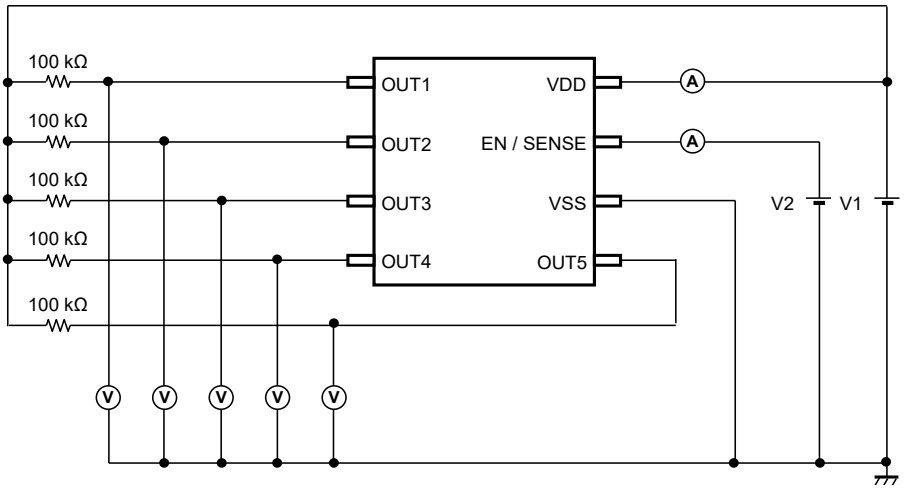


Figure 4 Test Circuit 1

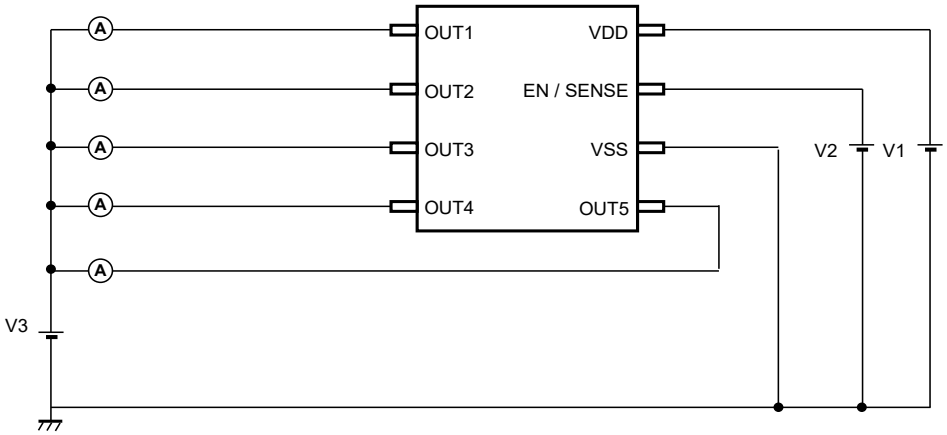


Figure 5 Test Circuit 2

■ Standard Circuit

1. S-82F9A Series

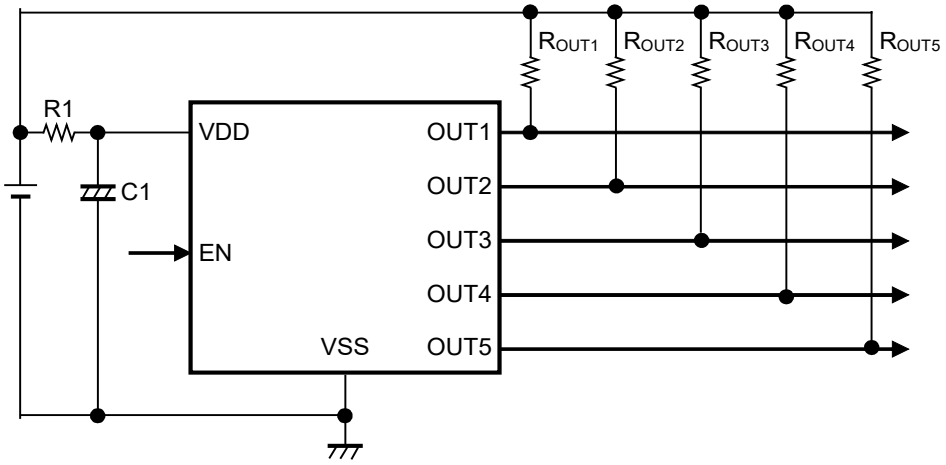


Figure 6

2. S-82F9B Series

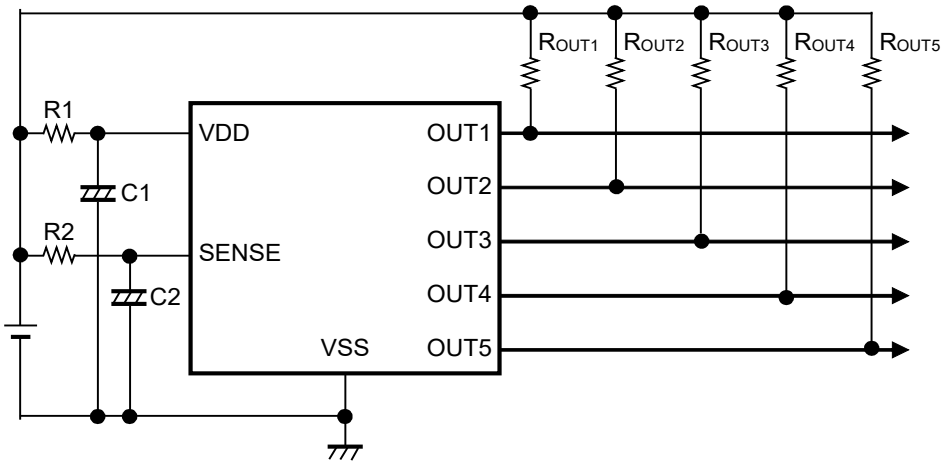


Figure 7

Table 9 Constants for External Components

Symbol	Purpose	Typ.	Remark
R1, R2*1	For power fluctuation	470 Ω	Set the value as small as possible to prevent deterioration of the detection voltage.
C1, C2	For power fluctuation	0.1 μF	-
R_{OUTn}*2	For output pin pull-up	1 kΩ	Make sure the power dissipation of this IC is not exceeded.

***1.** Set up R1, R2 as 100 kΩ or less to prevent oscillation.

***2.** Set up each of R_{OUTn} as 620 Ω or more so that the power dissipation is not exceeded.

Caution 1. The constants may be changed without notice.
2. It has not been confirmed whether the operation is normal or not in circuits other than the connection example. In addition, the connection example and the constants do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constants.

Remark n = 1 to 5

■ Operation

1. Basic operation

1. 1 S-82F9A Series

1. 1. 1 When the power supply voltage (V_{DD}) decreases

The OUTn pin becomes detection status if V_{DD} is equal to or lower than the detection voltage (V_{DETn}).

1. 1. 2 When the power supply voltage increases

The OUTn pin becomes release status if V_{DD} is equal to or higher than the release voltage ($V_{DETn} + V_{HYSn}$).

1. 1. 3 When V_{DD} ≤ minimum operation voltage

The OUTn pin voltage is indefinite.

1. 2 S-82F9B Series

1. 2. 1 When the SENSE pin voltage (V_{SENSE}) decreases

The OUTn pin becomes detection status if V_{SENSE} is equal to or lower than the detection voltage (V_{DETn}).

1. 2. 2 When the SENSE pin voltage increases

The OUTn pin becomes release status if V_{SENSE} is equal to or higher than the release voltage ($V_{DETn} + V_{HYSn}$).

1. 2. 3 When V_{SENSE} ≤ minimum operation voltage

Even if V_{SENSE} further decreases to the IC's minimum operation voltage or lower, the output from the OUTn pin is stable when V_{DD} is minimum operation voltage or higher.

2. EN pin (S-82F9A Series)

This pin starts and stops this IC.
When $V_{EN} \leq V_{SL}$ is set, all internal circuits stop operating, and Nch transistor n (refer to **Figure 1** in "■ **Block Diagram**") is turned off, reducing current consumption significantly.
When not using the EN pin, connect it to the VDD pin.
Refer to the circuit diagram in **Figure 11** for the circuit connection example.

3. SENSE pin (S-82F9B Series)

This pin starts and stops this IC and monitors the battery voltage.
When $V_{SENSE} \leq V_{SL}$ is set, all internal circuits stop operating, and Nch transistor n (refer to **Figure 2** in "■ **Block Diagram**") is turned off, reducing current consumption significantly.
Refer to the circuit diagram in **Figure 12** and **Figure 13** for the circuit connection example.

Remark n = 1 to 5

■ Timing Charts

1. S-82F9A Series (Full charge all on, $V_{EN} \geq V_{SH}$)

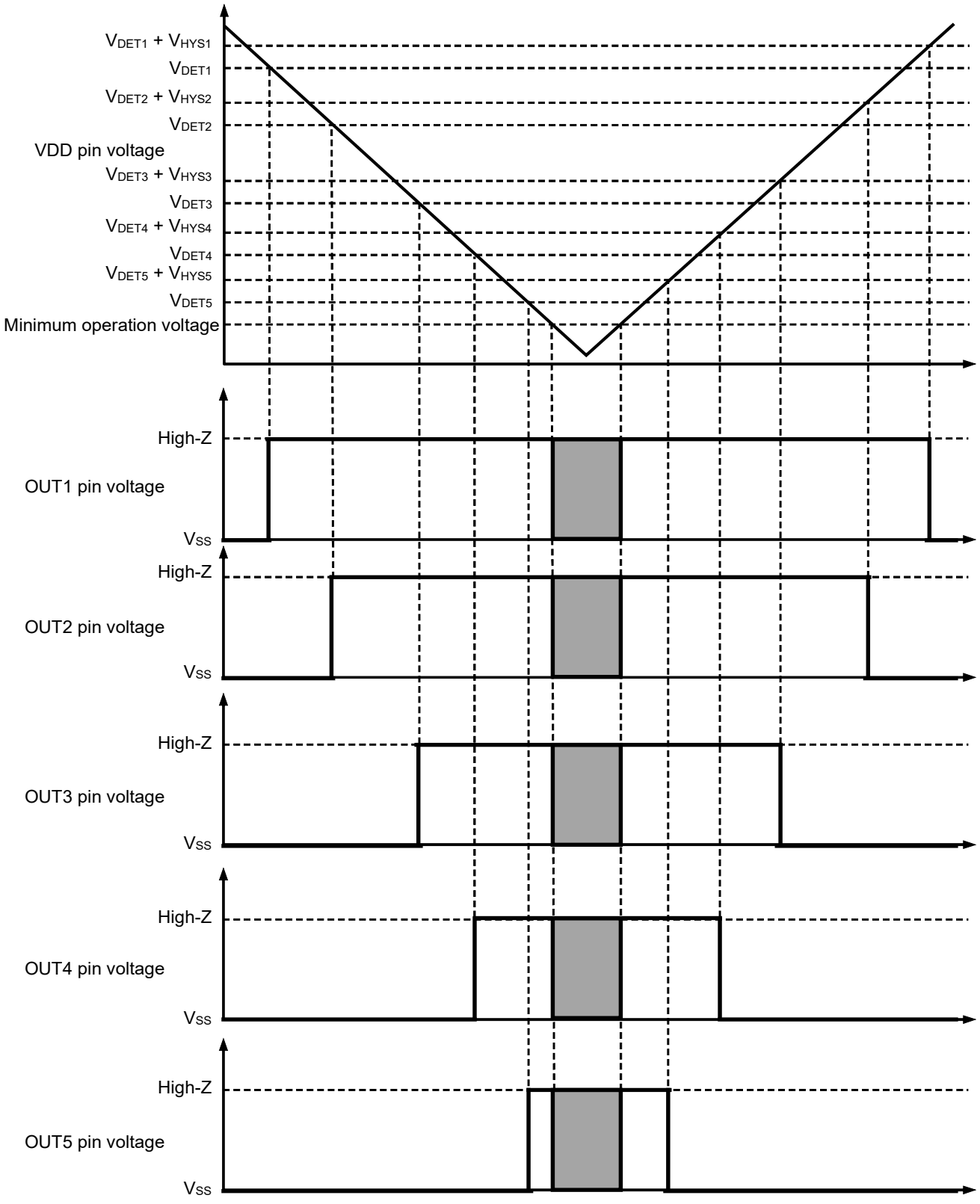


Figure 8

Remark When V_{DD} is equal to or lower than the minimum operation voltage, the output voltage from the OUT1 pin to the OUT5 pin is indefinite in the shaded area.

2. S-82F9A Series (Individual step voltage on, $V_{EN} \geq V_{SH}$)

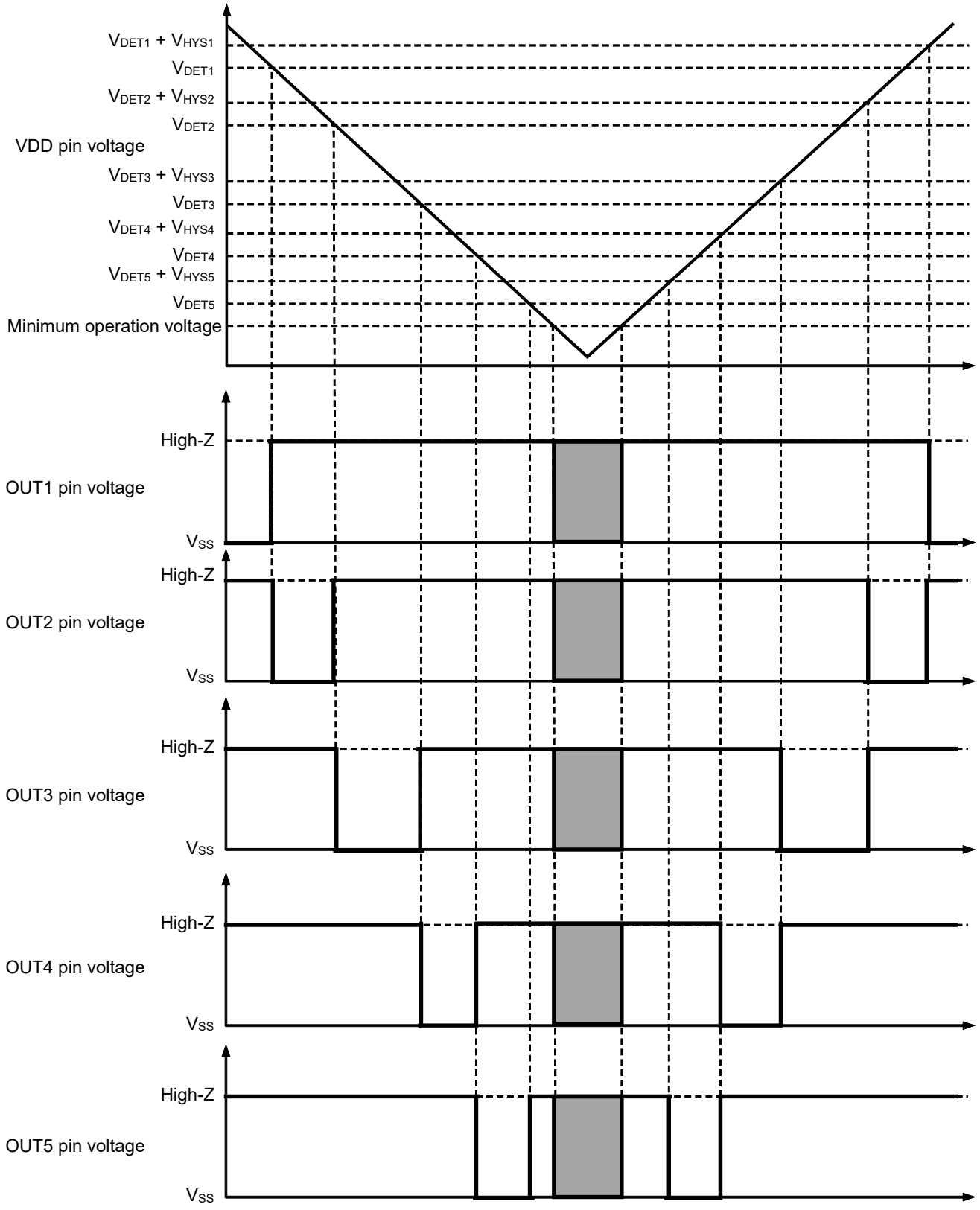


Figure 9

Remark When V_{DD} is equal to or lower than the minimum operation voltage, the output voltage from the OUT1 pin to the OUT5 pin is indefinite in the shaded area.

3. S-82F9B Series (Full charge all on, $V_{SENSE} \geq V_{SH}$)

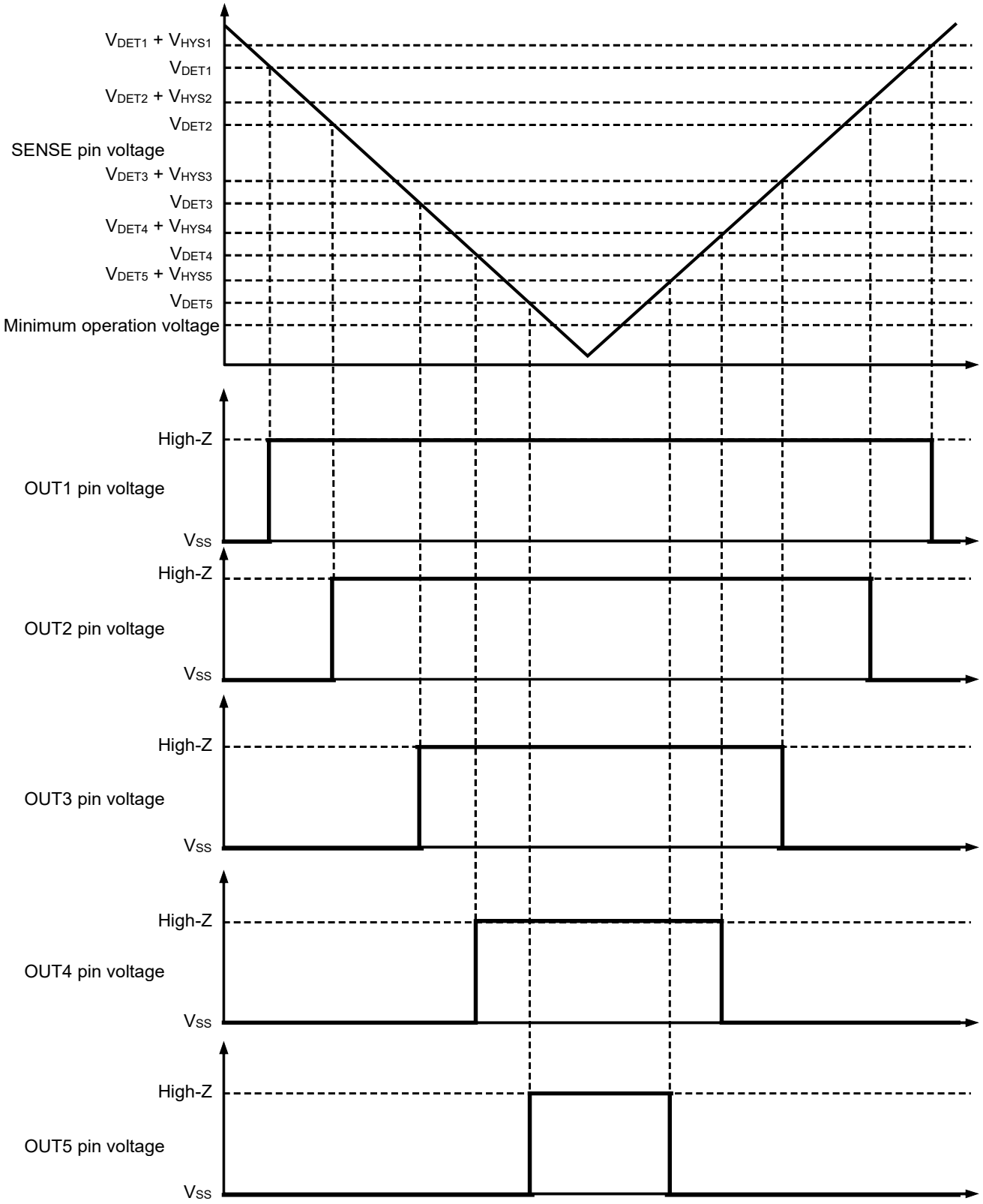


Figure 10

Remark Even if V_{SENSE} is below the minimum operating voltage of the IC, the output voltage from the OUT1 pin to OUT5 pin are stable when V_{DD} is minimum operation voltage or higher.

■ Application Circuits

1. LED battery level Indicator

1. 1 S-82F9A Series

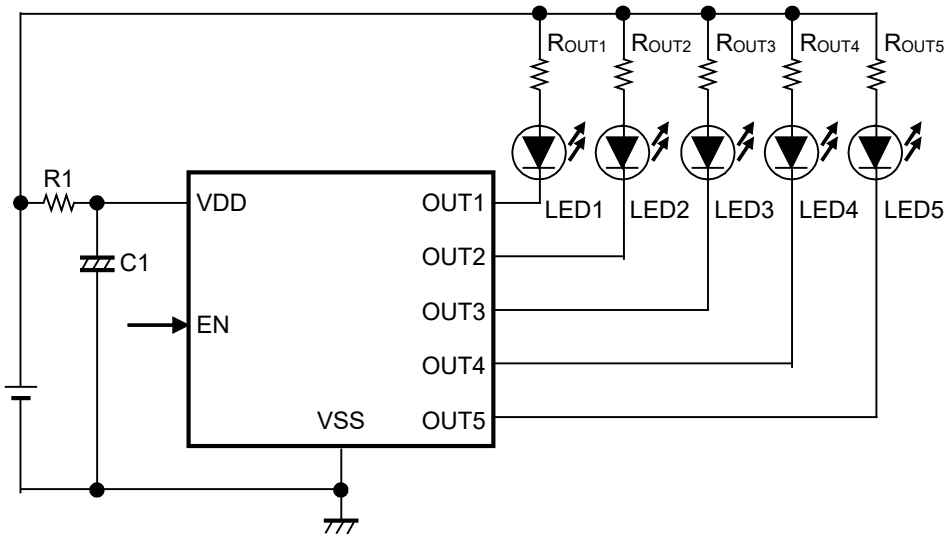


Figure 11

Caution **It has not been confirmed whether the operation is normal or not in circuits other than the connection example. In addition, the connection example and the constants do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constants.**

1. 2 S-82F9B Series

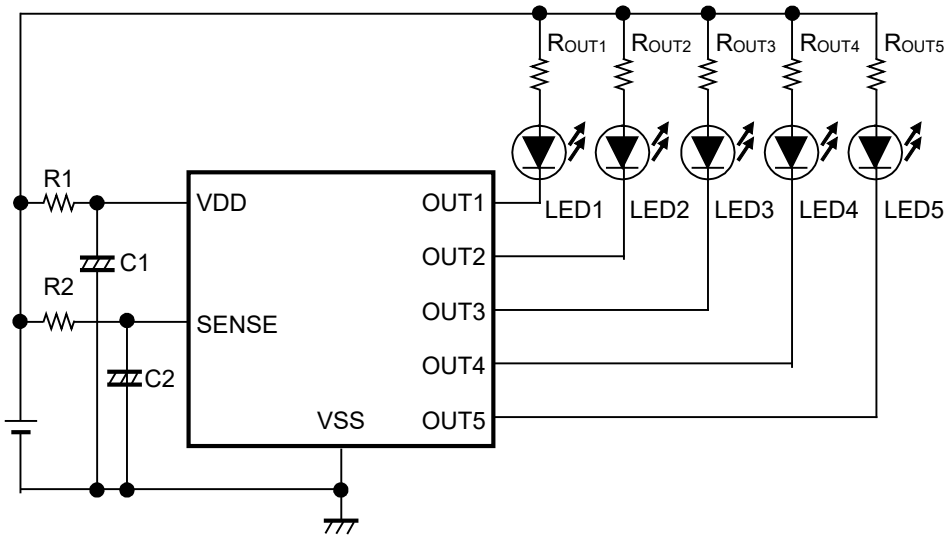


Figure 12

Caution **It has not been confirmed whether the operation is normal or not in circuits other than the connection example. In addition, the connection example and the constants do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constants.**

2. Change of detection voltage using S-82F9B Series

This IC can monitor battery voltage equal to or higher than the rated voltage of the IC by making the connection shown in **Figure 13.**

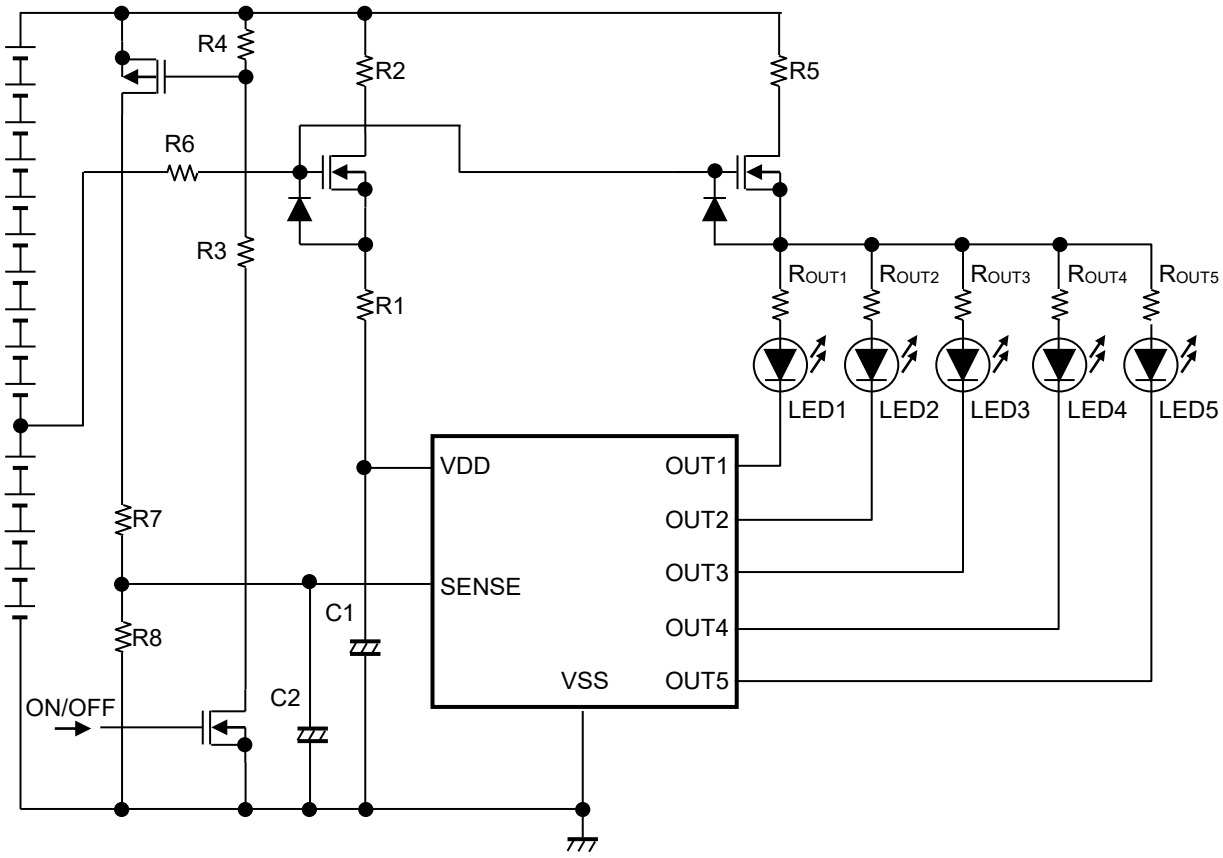


Figure 13

Caution It has not been confirmed whether the operation is normal or not in circuits other than the connection example. In addition, the connection example and the constants do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constants.

■ Precautions

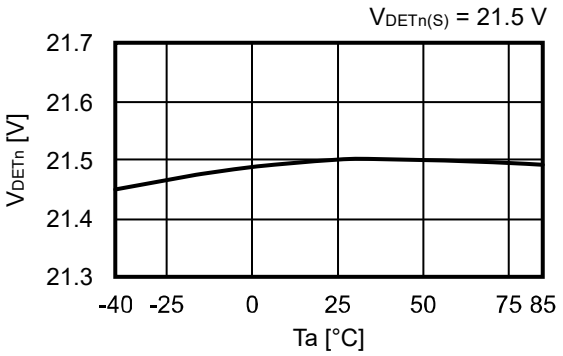
- The application conditions for the input voltage, output voltage, and output pin pull-up resistance should not exceed the package power dissipation.
- Wiring patterns for the VDD pin, the VOUTn pin and the VSS pin should be designed so that the impedance is low.
- Note that the detection voltage may deviate due to the resistance component of output sink current and the VSS pin wiring.
- In applications where a resistor is connected to the input (refer to **Figure 11** in "**■ Application Circuit**"), the feed-through current which is generated when the output switches causes a voltage drop equal to feed-through current × input resistance. After the output switches, the feed-through current stops and its resultant voltage drop disappears, and the output switches. The feed-through current is then generated again, a voltage drop appears. Note that an oscillation may be generated for this reason.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
- ABLIC Inc. claims no responsibility for any disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

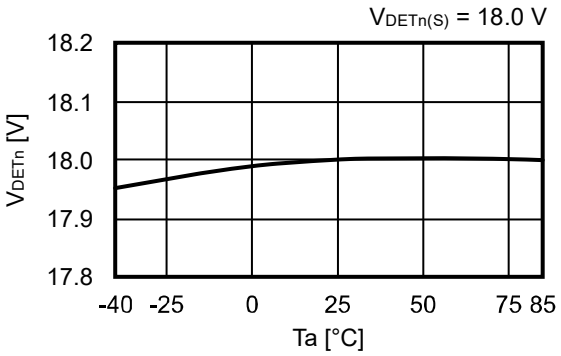
Remark n = 1 to 5

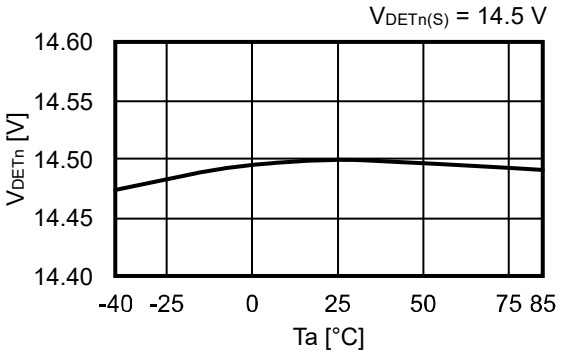
■ Characteristics (Typical Data)

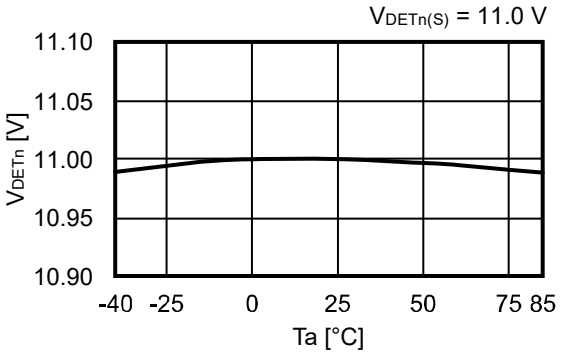
1. Detection voltage

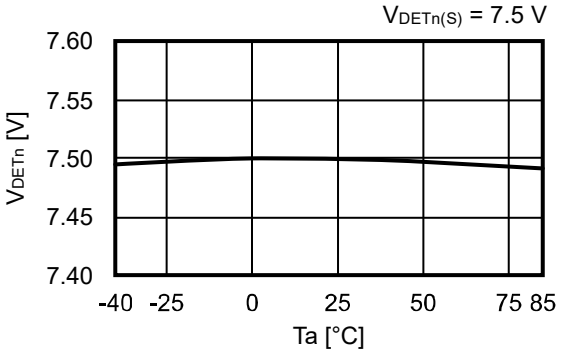
1. 1 V_{DETn} vs. Ta





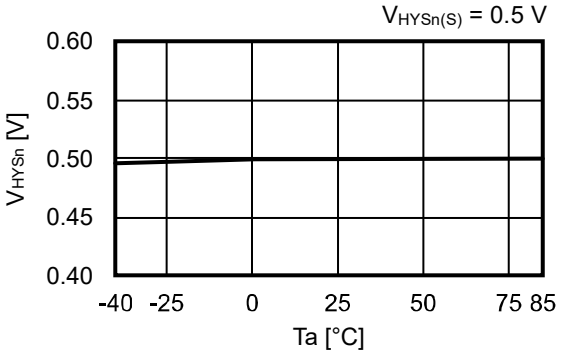


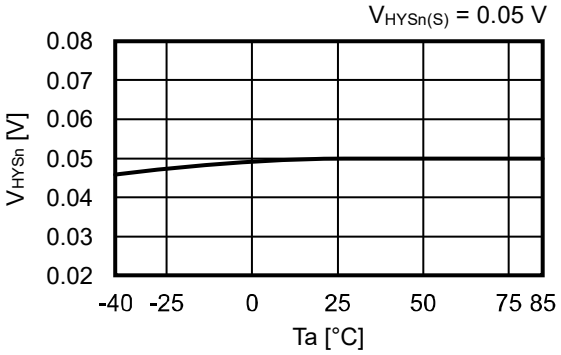




2. Hysteresis width

2. 1 V_{HYSn} vs. Ta

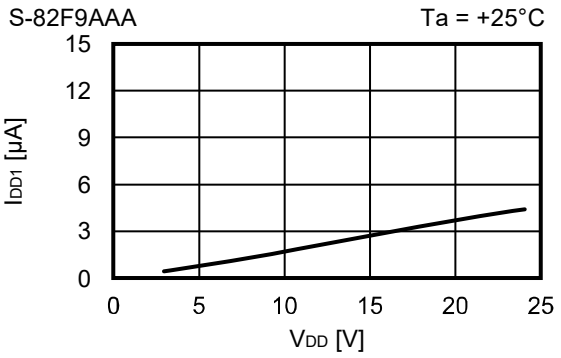




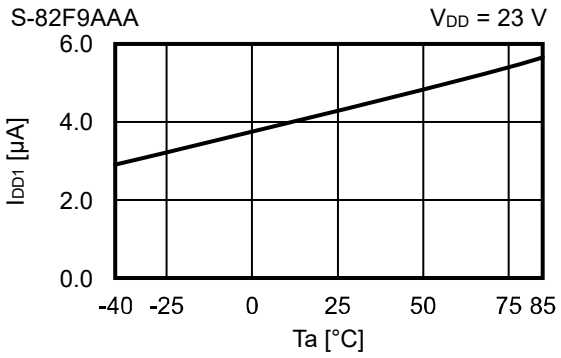
Remark n = 1 to 5

3. Current consumption

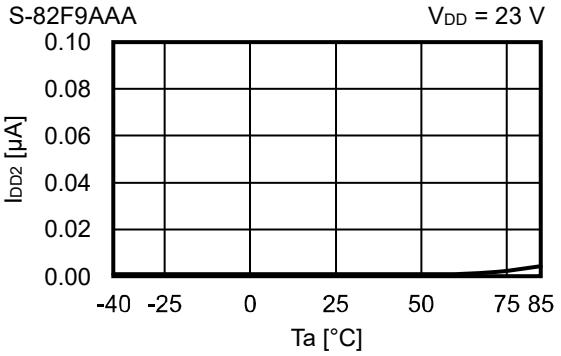
3. 1 I_{DD1} vs. V_{DD}



3. 2 I_{DD1} vs. Ta

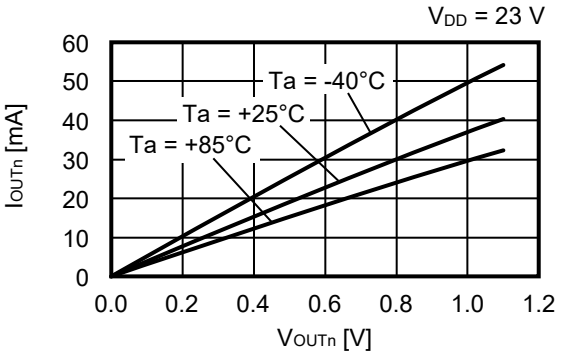


3. 3 I_{DD2} vs. Ta

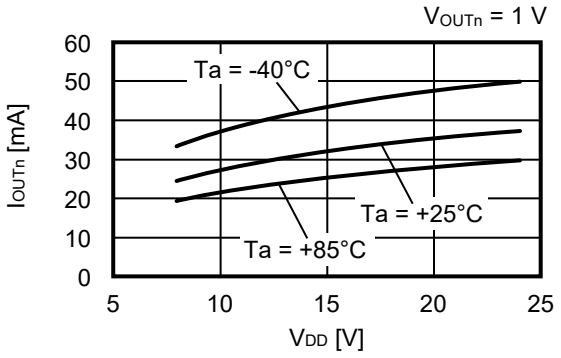


4. Output current

4. 1 I_{OUTn} vs. V_{OUTn}



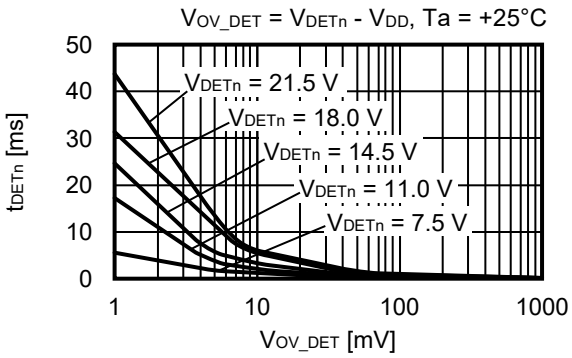
4. 2 I_{OUTn} vs. V_{DD}



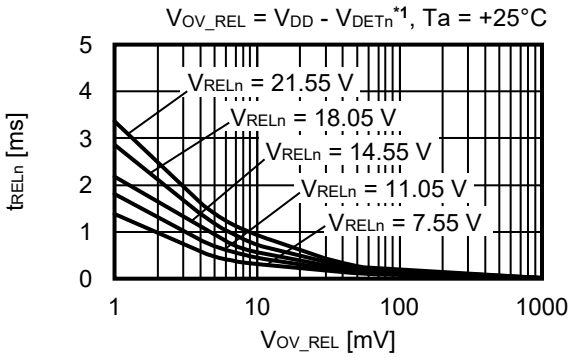
Remark n = 1 to 5

5. Response time

5. 1 t_{DETn} vs. V_{OV_DET}



5. 2 t_{RELn} vs. V_{OV_REL}



***1.** $V_{RELn} = V_{DETn} + V_{HYSn}$

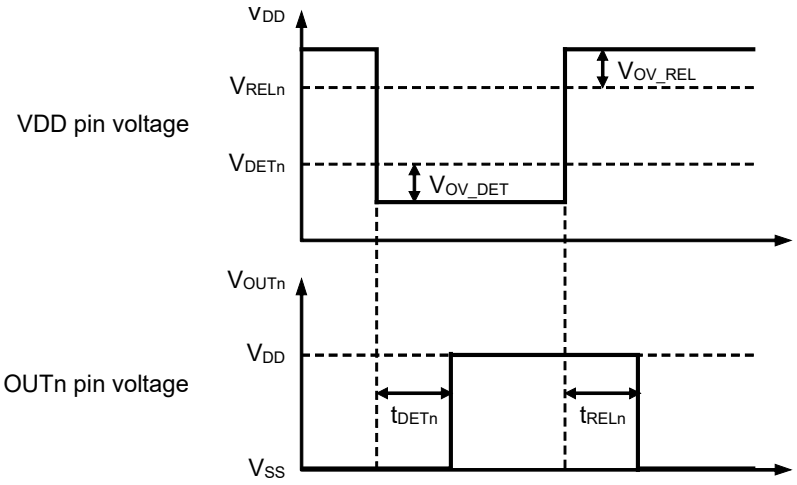
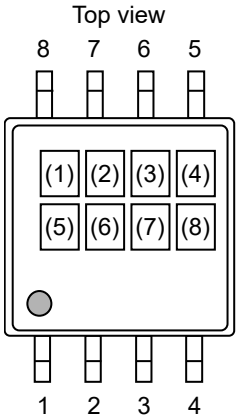


Figure 14 Test Condition of Response Time

Remark 1. Refer to "**Figure 4 Test Circuit 1**" for the test condition of the response time.
2. n = 1 to 5

■ Marking Specifications

1. HTMSOP-8



(1): Blank
(2) to (4): Product code (Refer to **Product name vs. Product code**)
(5): Blank
(6) to (8): Lot number

Product name vs. Product code

1. 1 S-82F9A Series

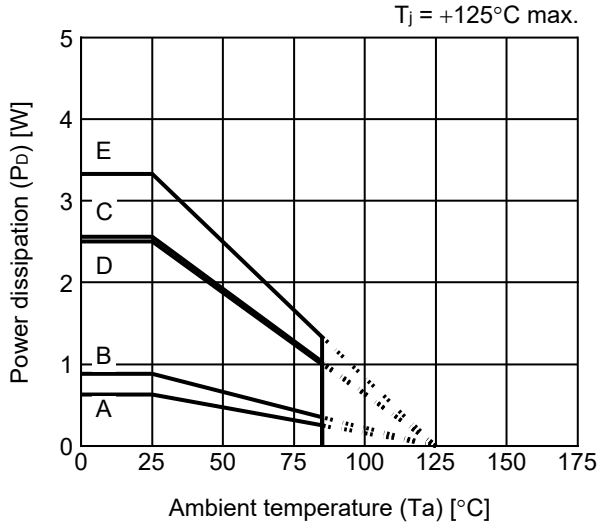
Product Name	Product Code		
	(2)	(3)	(4)
S-82F9AAA-S8T1U	9	Y	B

1. 2 S-82F9B Series

Product Name	Product Code		
	(2)	(3)	(4)
S-82F9BAA-S8T1U	9	Y	D

■ Power Dissipation

HTMSOP-8

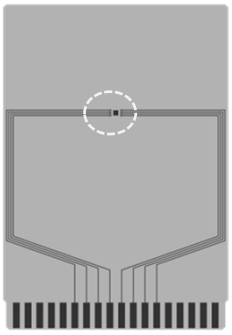


Board	Power Dissipation (P_D)
A	0.63 W
B	0.88 W
C	2.56 W
D	2.50 W
E	3.33 W

HTMSOP-8 Test Board

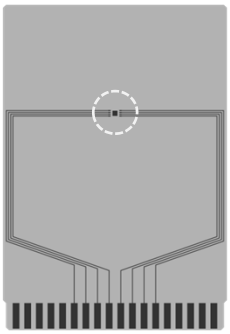
IC Mount Area

(1) Board A



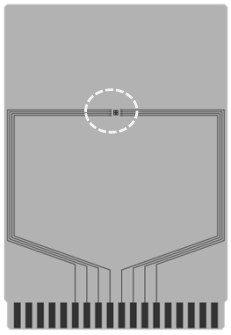
Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		2
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	-
	3	-
	4	74.2 x 74.2 x t0.070
Thermal via		-

(2) Board B



Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		-

(3) Board C



enlarged view

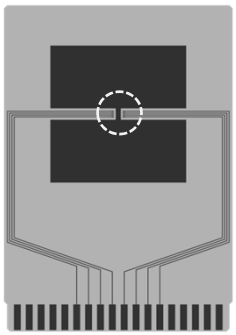
Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		Number: 4 Diameter: 0.3 mm

No. HTMSOP8-A-Board-SD-1.0

HTMSOP-8 Test Board

IC Mount Area

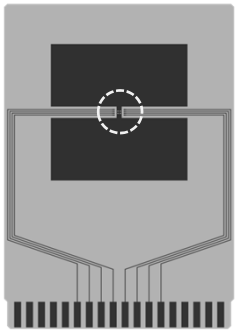
(4) Board D



enlarged view

Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Pattern for heat radiation: 2000mm^2 t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		-

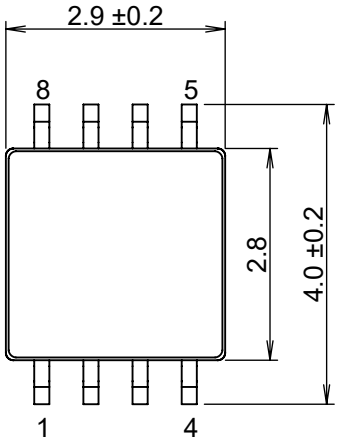
(5) Board E

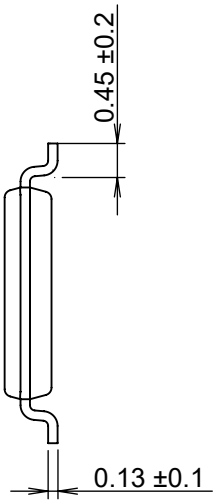


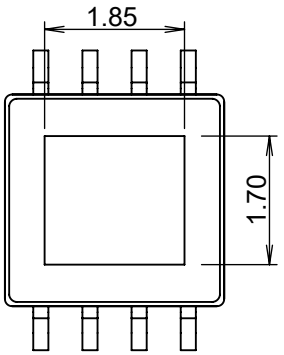
enlarged view

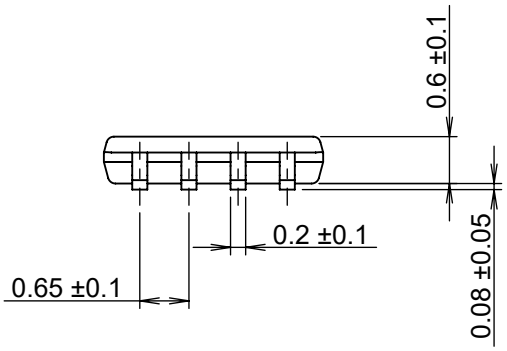
Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Pattern for heat radiation: 2000mm^2 t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		Number: 4 Diameter: 0.3 mm

No. HTMSOP8-A-Board-SD-1.0



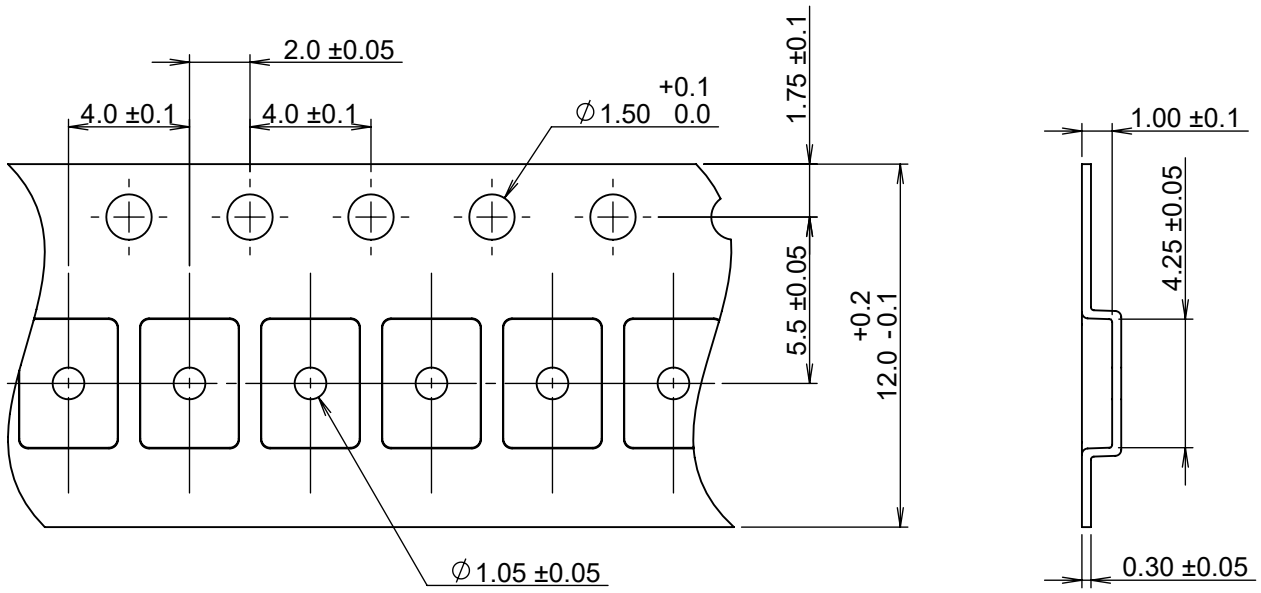


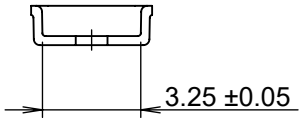


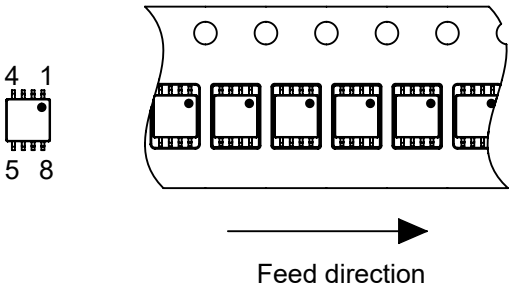


No. FP008-A-P-SD-2.0

TITLE	HTMSOP8-A-PKG Dimensions
No.	FP008-A-P-SD-2.0
ANGLE	
UNIT	mm
ABLIC Inc.	

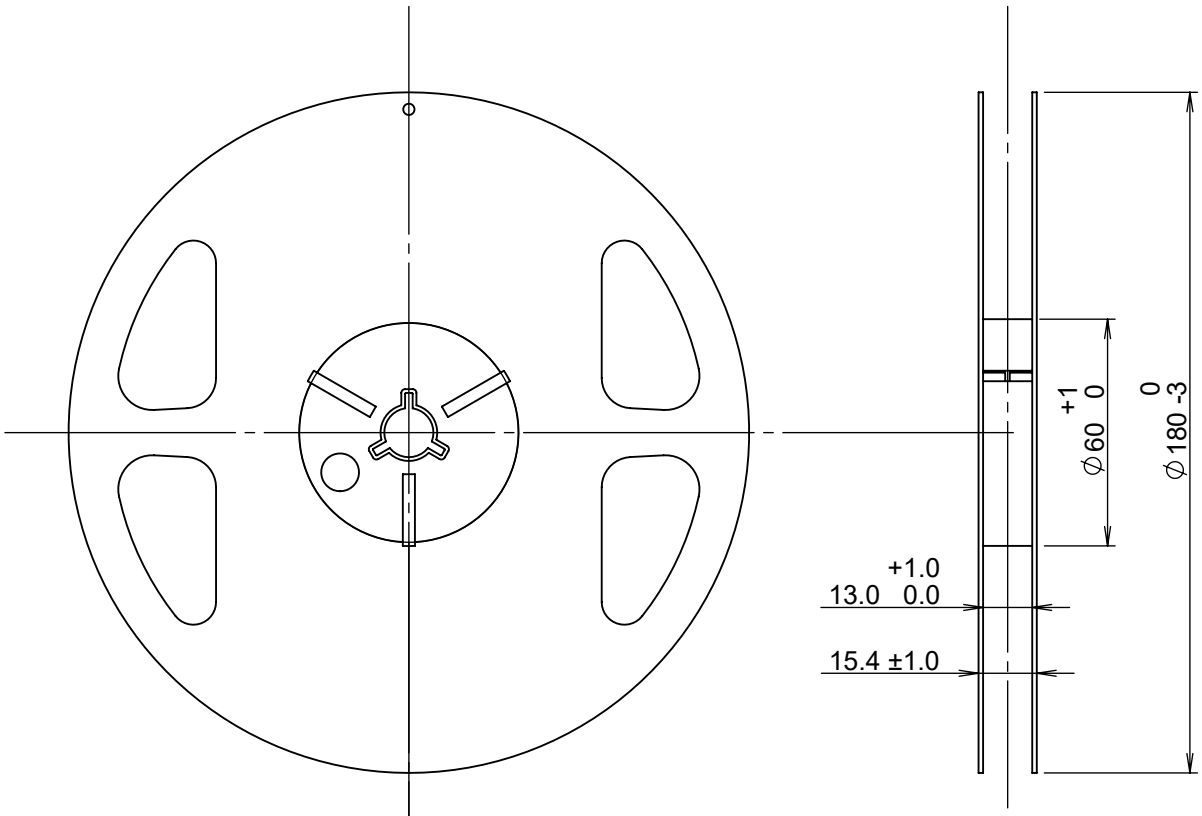




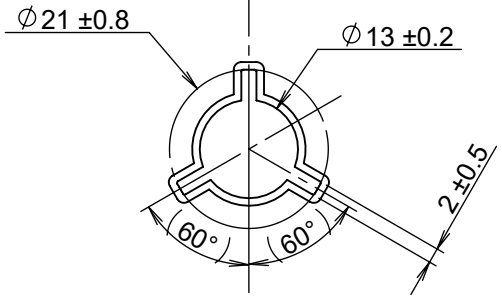


No. FP008-A-C-SD-1.0

TITLE	HTMSOP8-A-Carrier Tape
No.	FP008-A-C-SD-1.0
ANGLE	
UNIT	mm
ABLIC Inc.	

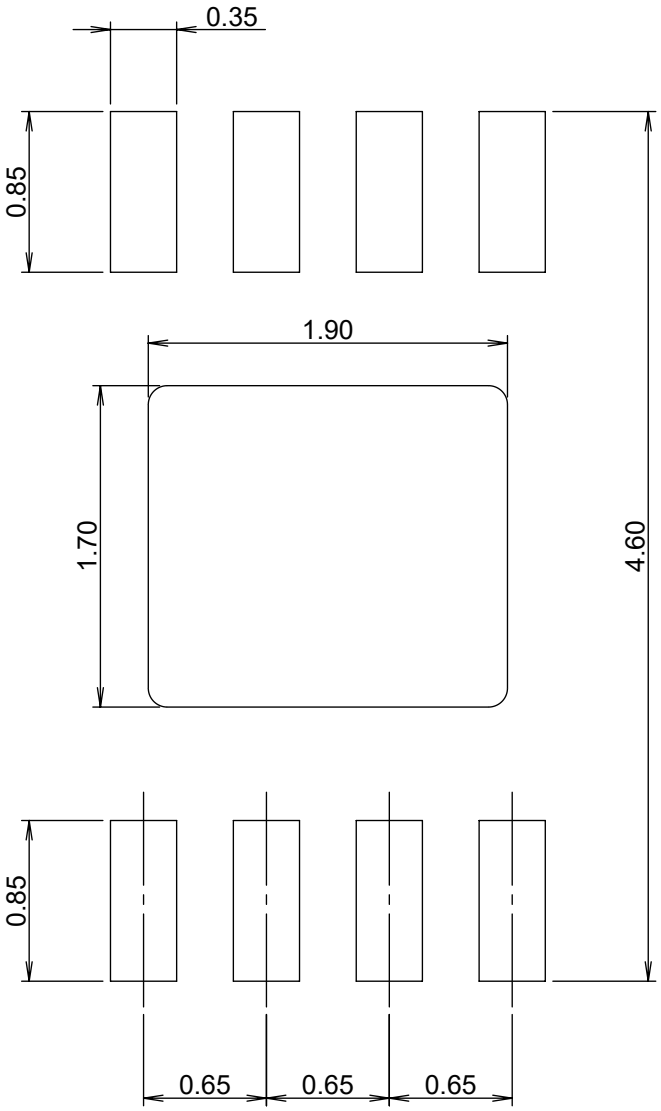


Enlarged drawing in the central part



No. FP008-A-R-SD-2.0

TITLE	HTMSOP8-A-Reel		
No.	FP008-A-R-SD-2.0		
ANGLE		QTY.	4,000
UNIT	mm		
ABLIC Inc.			



No. FP008-A-L-SD-2.0

TITLE	HTMSOP8-A -Land Recommendation
No.	FP008-A-L-SD-2.0
ANGLE	
UNIT	mm
ABLIC Inc.	

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2.4-2019.07