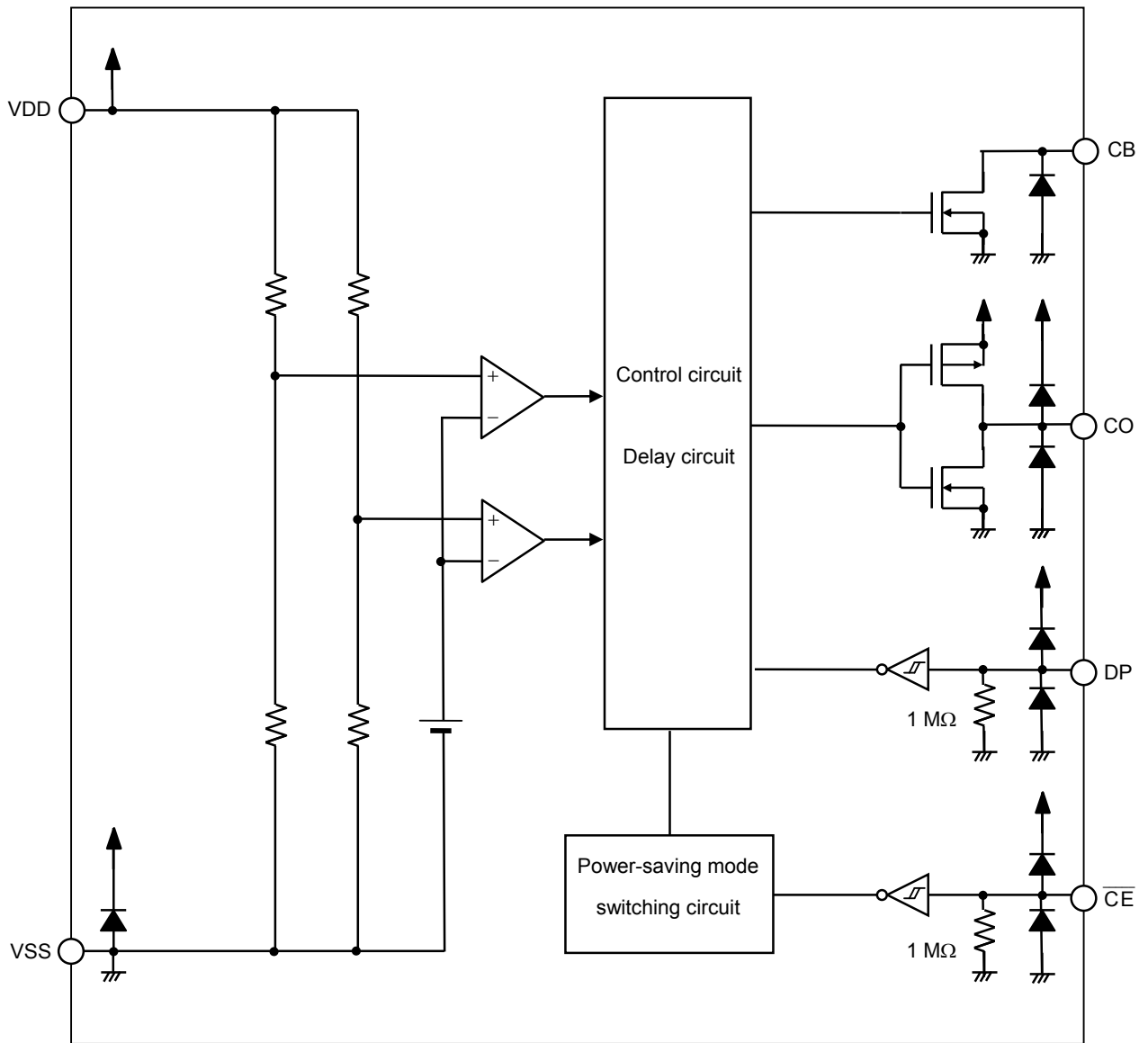


■ **Block Diagram**



*1. All diodes shown in the figure are parasitic diodes.

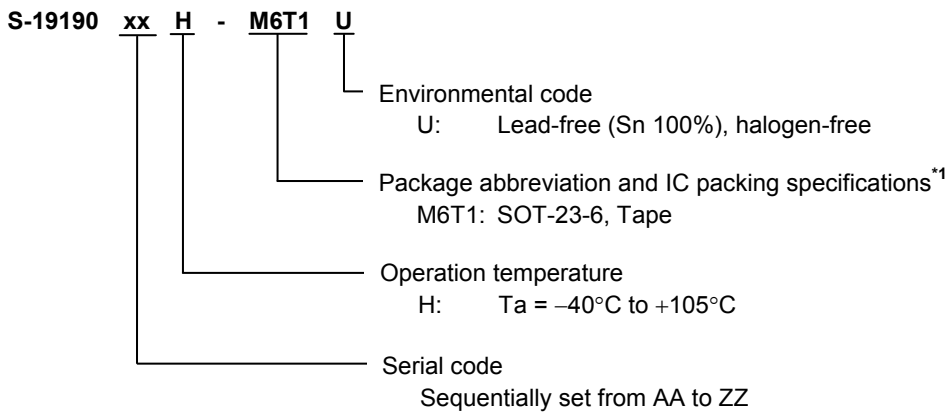
Figure 1

■ AEC-Q100 Qualified

This IC supports AEC-Q100 for operation temperature grade 2.
 Contact our sales office for details of AEC-Q100 reliability specification.

■ Product Name Structure

1. Product name



*1. Refer to the tape drawing.

2. Package

Table 1 Package Drawing Codes

Package Name	Dimension	Tape	Reel
SOT-23-6	MP006-A-P-SD	MP006-A-C-SD	MP006-A-R-SD

3. Product name list

Table 2 (2 / 1)

Product Name	Cell Balancing Detection Voltage [V _{BU}]	Cell Balancing Release Voltage [V _{BL}]	Overcharge Detection Voltage [V _{CU}]	Overcharge Release Voltage [V _{CL}]	CO Pin Output Form	CO Pin Output Logic	Combination of Delay Time
S-19190AAH-M6T1U	2.600 V	2.600 V	2.750 V	2.750 V	CMOS output	Active "H"	(1)
S-19190ABH-M6T1U	3.000 V	3.000 V	3.150 V	3.150 V	CMOS output	Active "H"	(1)
S-19190ACH-M6T1U	3.000 V	3.000 V	3.200 V	3.200 V	CMOS output	Active "H"	(1)
S-19190ADH-M6T1U	3.100 V	3.100 V	3.250 V	3.250 V	CMOS output	Active "H"	(1)
S-19190AEH-M6T1U	3.100 V	3.100 V	3.300 V	3.300 V	CMOS output	Active "H"	(1)
S-19190AFH-M6T1U	2.600 V	2.600 V	2.800 V	2.800 V	CMOS output	Active "H"	(1)
S-19190AGH-M6T1U	2.400 V	2.400 V	2.900 V	2.900 V	CMOS output	Active "H"	(1)
S-19190AHH-M6T1U	2.400 V	2.400 V	3.000 V	3.000 V	CMOS output	Active "H"	(1)
S-19190AIH-M6T1U	2.100 V	2.100 V	3.000 V	3.000 V	CMOS output	Active "H"	(1)
S-19190AKH-M6T1U	2.400 V	2.400 V	3.200 V	3.200 V	CMOS output	Active "H"	(1)
S-19190ALH-M6T1U	2.100 V	2.000 V	3.200 V	3.200 V	CMOS output	Active "H"	(1)
S-19190AMH-M6T1U	2.620 V	2.520 V	2.800 V	2.700 V	CMOS output	Active "H"	(1)
S-19190ANH-M6T1U	3.300 V	3.300 V	4.080 V	3.930 V	CMOS output	Active "H"	(1)
S-19190AOH-M6T1U	2.000 V	2.000 V	3.000 V	3.000 V	CMOS output	Active "H"	(1)
S-19190APH-M6T1U	3.700 V	3.700 V	4.500 V	4.500 V	CMOS output	Active "H"	(1)
S-19190AQH-M6T1U	3.800 V	3.800 V	4.080 V	3.930 V	CMOS output	Active "H"	(1)
S-19190ARH-M6T1U	2.800 V	2.800 V	3.150 V	3.150 V	CMOS output	Active "H"	(1)

Table 2 (2 / 2)

Product Name	Cell Balancing Detection Voltage [V _{BU}]	Cell Balancing Release Voltage [V _{BL}]	Overcharge Detection Voltage [V _{CU}]	Overcharge Release Voltage [V _{CL}]	CO Pin Output Form	CO Pin Output Logic	Combination of Delay Time
S-19190ASH-M6T1U	2.800 V	2.800 V	3.200 V	3.200 V	CMOS output	Active "H"	(1)
S-19190ATH-M6T1U	2.800 V	2.800 V	3.100 V	3.100 V	CMOS output	Active "H"	(1)
S-19190AUH-M6T1U	2.500 V	2.400 V	3.800 V	3.700 V	CMOS output	Active "H"	(1)
S-19190AVH-M6T1U	2.300 V	2.200 V	3.800 V	3.700 V	CMOS output	Active "H"	(1)
S-19190AWH-M6T1U	2.650 V	2.600 V	2.750 V	2.650 V	Nch open-drain output	Active "L"	(1)
S-19190AXH-M6T1U	2.400 V	2.400 V	2.950 V	2.950 V	CMOS output	Active "H"	(1)
S-19190AYH-M6T1U	4.150 V	4.150 V	4.275 V	4.275 V	CMOS output	Active "H"	(2)
S-19190AZH-M6T1U	2.450 V	2.450 V	2.500 V	2.500 V	CMOS output	Active "H"	(3)
S-19190BDH-M6T1U	2.300 V	2.300 V	2.600 V	2.600 V	CMOS output	Active "H"	(1)
S-19190BEH-M6T1U	4.400 V	4.200 V	4.600 V	4.600 V	CMOS output	Active "H"	(3)
S-19190BFH-M6T1U	3.550 V	3.200 V	4.080 V	3.380 V	CMOS output	Active "L"	(4)
S-19190BGH-M6T1U	2.700 V	2.000 V	4.400 V	3.700 V	CMOS output	Active "H"	(3)
S-19190BHH-M6T1U	3.550 V	3.550 V	3.800 V	3.700 V	CMOS output	Active "L"	(4)
S-19190BIH-M6T1U	2.700 V	2.000 V	4.400 V	4.200 V	CMOS output	Active "H"	(3)
S-19190BJH-M6T1U	2.725 V	2.675 V	2.775 V	2.725 V	CMOS output	Active "L"	(4)

- Remark**
1. Contact our sales office for the products with detection voltage values other than those specified above.
 2. Set $V_{CU} > V_{BU}$.
 3. Refer to **Table 3** for details about combinations of delay times.

Table 3

Combination of Delay Time	Cell Balancing Detection Delay Time [t _{BU}]	Cell Balancing Release Delay Time [t _{BL}]	Overcharge Detection Delay Time [t _{CU}]	Overcharge Release Delay Time [t _{CL}]
(1)	128 ms	1.0 ms	128 ms	1.0 ms
(2)	128 ms	1.0 ms	1024 ms	1.0 ms
(3)	64 ms	0.5 ms	64 ms	0.5 ms
(4)	128 ms	1.0 ms	1024 ms	2.0 ms

Remark The delay times can be changed within the ranges listed above. For details, please contact our sales office.

Table 4

Delay Time	Symbol	Selection Range					Remark
Cell balancing detection delay time*1	t _{BU}	64 ms	128 ms*2	256 ms	512 ms	1024 ms	Select a value from the left.
Cell balancing release delay time	t _{BL}	0.5 ms		1.0 ms*2		2.0 ms	Select a value from the left.
Overcharge detection delay time*1	t _{CU}	64 ms	128 ms*2	256 ms	512 ms	1024 ms	Select a value from the left.
Overcharge release delay time	t _{CL}	0.5 ms		1.0 ms*2		2.0 ms	Select a value from the left.

*1. Set $t_{CU} \geq t_{BU}$.

*2. The value is the delay time of the standard products.

■ Pin Configuration

1. SOT-23-6

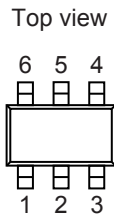


Figure 2

Table 5

Pin No.	Symbol	Description
1	CO	Output pin for overcharge signal
2	VSS	Input pin for negative power supply
3	DP	Test mode switching pin "H": Test mode (used to shorten the delay time) "L": Normal operation mode
4	$\overline{\text{CE}}$	Power-saving mode switching pin "H": Power-saving mode "L": Normal operation mode
5	VDD	Input pin for positive power supply
6	CB	Output pin for cell balancing signal (Nch open-drain output)

■ **Absolute Maximum Ratings**

Table 6

(Ta = +25°C unless otherwise specified)

Item	Symbol	Applied Pin	Absolute Maximum Rating	Unit
Input voltage between VDD pin and VSS pin	V _{DS}	VDD	V _{SS} - 0.3 to V _{SS} + 6.0	V
Input pin voltage	V _{IN}	CE, DP	V _{SS} - 0.3 to V _{DD} + 0.3 ≤ V _{SS} + 6.0	V
Output pin voltage	V _{OUT}	CO, CB	V _{SS} - 0.3 to V _{DD} + 0.3 ≤ V _{SS} + 6.0	V
Output pin current	I _{CB}	CB	100 (-40°C to +105°C)	mA
Operation ambient temperature	T _{opr}	-	-40 to +105	°C
Storage temperature	T _{stg}	-	-55 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.

■ **Thermal Resistance Value**

Table 7

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Junction-to-ambient thermal resistance*1	θ _{JA}	SOT-23-6	Board A	-	159	-	°C/W
			Board B	-	124	-	°C/W
			Board C	-	-	-	°C/W
			Board D	-	-	-	°C/W
			Board E	-	-	-	°C/W

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

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

■ **Electrical Characteristics**

For details about the test circuits and testing method, refer to "■ Test Circuit".

Caution Unless otherwise specified in Table 8 and Table 9, set V2 = V3 = 0 V, and SWn (n = 1 to 4) = OFF.

1. Ta = +25°C

Table 8 (1 / 2)

(Ta = +25°C unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Detection voltage							
Cell balancing detection voltage	V _{BU}	SW1 = ON	2.0 V ≤ V _{BU} < 2.4 V	V _{BU} - 0.012	V _{BU}	V _{BU} + 0.012	V
			2.4 V ≤ V _{BU} ≤ 4.6 V	V _{BU} × 0.995	V _{BU}	V _{BU} × 1.005	V
Cell balancing release voltage	V _{BL}	SW1 = ON	2.0 V ≤ V _{BL} < 2.4 V	V _{BL} - 0.024	V _{BL}	V _{BL} + 0.024	V
			2.4 V ≤ V _{BL} ≤ 4.6 V	V _{BL} × 0.99	V _{BL}	V _{BL} × 1.01	V
Overcharge detection voltage	V _{CU}	2.0 V ≤ V _{CU} < 2.4 V		V _{CU} - 0.012	V _{CU}	V _{CU} + 0.012	V
		2.4 V ≤ V _{CU} ≤ 4.6 V		V _{CU} × 0.995	V _{CU}	V _{CU} × 1.005	V
Overcharge release voltage	V _{CL}	2.0 V ≤ V _{CL} < 2.4 V		V _{CL} - 0.024	V _{CL}	V _{CL} + 0.024	V
		2.4 V ≤ V _{CL} ≤ 4.6 V		V _{CL} × 0.99	V _{CL}	V _{CL} × 1.01	V
Input voltage							
Operation voltage between VDD pin and VSS pin	V _{DS}	Voltages output from CO pin and CB pin are fixed		1.5	-	5.0	V
$\overline{\text{CE}}$ pin voltage "H"	V _{CEH}	-		-	-	V _{DD} × 0.9	V
$\overline{\text{CE}}$ pin voltage "L"	V _{CEL}	-		V _{DD} × 0.1	-	-	V
DP pin voltage "H"	V _{DPH}	-		-	-	V _{DD} × 0.9	V
DP pin voltage "L"	V _{DPL}	-		V _{DD} × 0.1	-	-	V
Input current							
Current consumption during operation	I _{OPE}	I _{VDD} when V1 = V _{BL} - 0.1 V		-	1.2	2.0	μA
Current consumption during power-saving	I _{PSV}	I _{VDD} when V1 = V2 = V _{BL} - 0.1 V		-	-	0.1	μA

Table 8 (2 / 2)

(Ta = +25°C unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Delay time						
Cell balancing detection delay time	t _{BU}	–	t _{BU} × 0.8	t _{BU}	t _{BU} × 1.2	ms
Cell balancing release delay time	t _{BL}	–	t _{BL} × 0.8	t _{BL}	t _{BL} × 1.2	ms
Overcharge detection delay time	t _{CU}	–	t _{CU} × 0.8	t _{CU}	t _{CU} × 1.2	ms
Overcharge release delay time	t _{CL}	–	t _{CL} × 0.8	t _{CL}	t _{CL} × 1.2	ms
Output current						
CB pin output current						
CB pin sink current	I _{CBS}	V1 = V _{BU} + 0.1 V, SW2 = ON, V4 = 0.5 V	30	–	–	mA
CB pin leakage current	I _{CBL}	V1 = V _{BL} – 0.1 V, SW2 = ON, V4 = 6.0 V	–	–	0.1	μA
CO pin output current (output form: CMOS output, output logic: active "H")						
CO pin sink current	I _{COL}	V1 = V _{CL} – 0.1 V, SW4 = ON, V5 = 0.5 V	5.0	–	–	mA
CO pin source current	I _{COH}	V1 = V _{CU} + 0.1 V, SW4 = ON, V5 = V1 – 0.5 V	1.0	–	–	mA
CO pin output current (output form: CMOS output, output logic: active "L")						
CO pin sink current	I _{COL}	V1 = V _{CU} + 0.1 V, SW4 = ON, V5 = 0.5 V	5.0	–	–	mA
CO pin source current	I _{COH}	V1 = V _{CL} – 0.1 V, SW4 = ON, V5 = V1 – 0.5 V	1.0	–	–	mA
CO pin output current (output form: Nch open-drain output, output logic: active "H")						
CO pin sink current	I _{COL}	V1 = V _{CL} – 0.1 V, SW4 = ON, V5 = 0.5 V	5.0	–	–	mA
CO pin leakage current	I _{COHL}	V1 = V _{CU} + 0.1 V, SW4 = ON, V5 = 6.0 V	–	–	0.1	μA
CO pin output current (output form: Nch open-drain output, output logic: active "L")						
CO pin sink current	I _{COL}	V1 = V _{CU} + 0.1 V, SW4 = ON, V5 = 0.5 V	5.0	–	–	mA
CO pin leakage current	I _{COHL}	V1 = V _{CL} – 0.1 V, SW4 = ON, V5 = 6.0 V	–	–	0.1	μA

2. Ta = -40°C to +105°C

Table 9 (1 / 2)

(Ta = -40°C to +105°C unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	
Detection voltage							
Cell balancing detection voltage	V _{BU}	SW1 = ON	2.0 V ≤ V _{BU} < 2.4 V	V _{BU} - 0.040	V _{BU}	V _{BU} + 0.040	V
			2.4 V ≤ V _{BU} ≤ 4.6 V	V _{BU} × 0.984	V _{BU}	V _{BU} × 1.016	V
Cell balancing release voltage	V _{BL}	SW1 = ON	2.0 V ≤ V _{BL} < 2.4 V	V _{BL} - 0.080	V _{BL}	V _{BL} + 0.080	V
			2.4 V ≤ V _{BL} ≤ 4.6 V	V _{BL} × 0.968	V _{BL}	V _{BL} × 1.032	V
Overcharge detection voltage	V _{CU}	2.0 V ≤ V _{CU} < 2.4 V		V _{CU} - 0.040	V _{CU}	V _{CU} + 0.040	V
		2.4 V ≤ V _{CU} ≤ 4.6 V		V _{CU} × 0.984	V _{CU}	V _{CU} × 1.016	V
Overcharge release voltage	V _{CL}	2.0 V ≤ V _{CL} < 2.4 V		V _{CL} - 0.080	V _{CL}	V _{CL} + 0.080	V
		2.4 V ≤ V _{CL} ≤ 4.6 V		V _{CL} × 0.968	V _{CL}	V _{CL} × 1.032	V
Input voltage							
Operation voltage between VDD pin and VSS pin	V _{DS}	Voltages output from CO pin and CB pin are fixed		1.5	-	5.0	V
$\overline{\text{CE}}$ pin voltage "H"	V _{CEH}	-		-	-	V _{DD} × 0.9	V
$\overline{\text{CE}}$ pin voltage "L"	V _{CEL}	-		V _{DD} × 0.1	-	-	V
DP pin voltage "H"	V _{DPH}	-		-	-	V _{DD} × 0.9	V
DP pin voltage "L"	V _{DPL}	-		V _{DD} × 0.1	-	-	V
Input current							
Current consumption during operation	I _{OPE}	I _{VDD} when V1 = V _{BL} - 0.1 V		-	1.2	2.1	μA
Current consumption during power-saving	I _{PSV}	I _{VDD} when V1 = V2 = V _{BL} - 0.1 V		-	-	0.15	μA

Table 9 (2 / 2)

(Ta = -40°C to +105°C unless otherwise specified)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Delay time						
Cell balancing detection delay time	t _{BU}	-	t _{BU} × 0.5	t _{BU}	t _{BU} × 1.5	ms
Cell balancing release delay time	t _{BL}	-	t _{BL} × 0.5	t _{BL}	t _{BL} × 1.5	ms
Overcharge detection delay time	t _{CU}	-	t _{CU} × 0.5	t _{CU}	t _{CU} × 1.5	ms
Overcharge release delay time	t _{CL}	-	t _{CL} × 0.5	t _{CL}	t _{CL} × 1.5	ms
Output current						
CB pin output current						
CB pin sink current	I _{CBS}	V1 = V _{BU} + 0.1 V, SW2 = ON, V4 = 0.5 V	30	-	-	mA
CB pin leakage current	I _{CBL}	V1 = V _{BL} - 0.1 V, SW2 = ON, V4 = 6.0 V	-	-	0.15	μA
CO pin output current (output form: CMOS output, output logic: active "H")						
CO pin sink current	I _{COL}	V1 = V _{CL} - 0.1 V, SW4 = ON, V5 = 0.5 V	5.0	-	-	mA
CO pin source current	I _{COH}	V1 = V _{CU} + 0.1 V, SW4 = ON, V5 = V1 - 0.5 V	1.0	-	-	mA
CO pin output current (output form: CMOS output, output logic: active "L")						
CO pin sink current	I _{COL}	V1 = V _{CU} + 0.1 V, SW4 = ON, V5 = 0.5 V	5.0	-	-	mA
CO pin source current	I _{COH}	V1 = V _{CL} - 0.1 V, SW4 = ON, V5 = V1 - 0.5 V	1.0	-	-	mA
CO pin output current (output form: Nch open-drain output, output logic: active "H")						
CO pin sink current	I _{COL}	V1 = V _{CL} - 0.1 V, SW4 = ON, V5 = 0.5 V	5.0	-	-	mA
CO pin leakage current	I _{COHL}	V1 = V _{CU} + 0.1 V, SW4 = ON, V5 = 6.0 V	-	-	0.15	μA
CO pin output current (output form: Nch open-drain output, output logic: active "L")						
CO pin sink current	I _{COL}	V1 = V _{CU} + 0.1 V, SW4 = ON, V5 = 0.5 V	5.0	-	-	mA
CO pin leakage current	I _{COHL}	V1 = V _{CL} - 0.1 V, SW4 = ON, V5 = 6.0 V	-	-	0.15	μA

■ Test Circuit

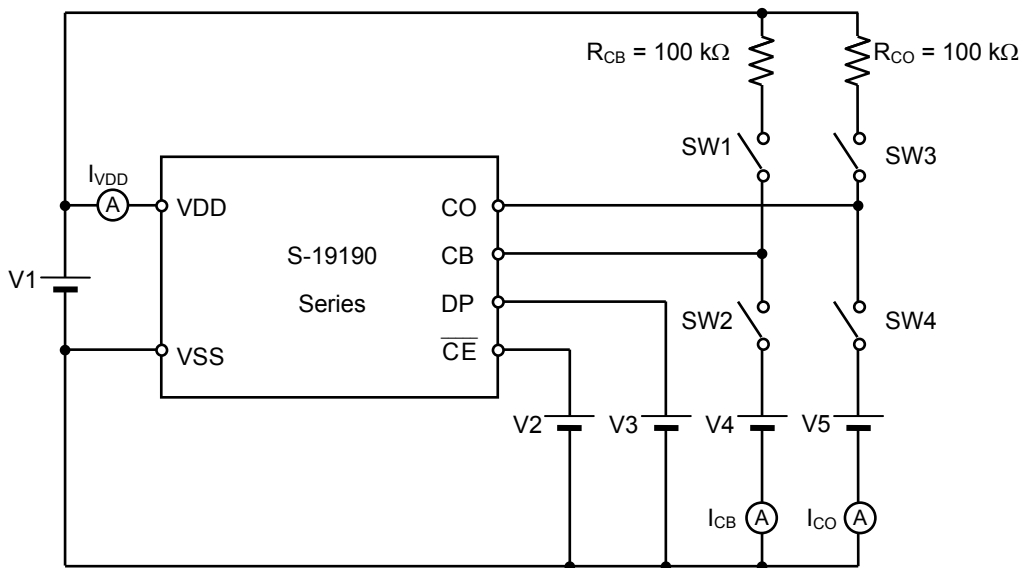


Figure 3

Caution Unless otherwise specified in Table 8, set $V2 = V3 = 0\text{ V}$, and SWn ($n = 1$ to 4) = OFF.

1. \overline{CE} pin voltage "H"

\overline{CE} pin voltage "H" ($V_{\overline{CEH}}$) is defined as the voltage at which I_{VDD} is changed from I_{OPE} to I_{PSV} when $V2$ is increased from 0 V after setting $V1 = V_{BL} - 0.1\text{ V}$.

2. \overline{CE} pin voltage "L"

\overline{CE} pin voltage "L" ($V_{\overline{CEL}}$) is defined as the voltage at which I_{VDD} is changed from I_{PSV} to I_{OPE} when $V2$ is decreased from $V_{BL} - 0.1\text{ V}$ after setting $V1 = V2 = V_{BL} - 0.1\text{ V}$.

3. DP pin voltage "H"*1

DP pin voltage "H" (V_{DPH}) is defined as the voltage at which the test mode is switched when $V3$ is increased from 0 V after setting $V1 = V_{BL} - 0.1\text{ V}$.

4. DP pin voltage "L"*1

DP pin voltage "L" (V_{DPL}) is defined as the voltage at which the normal operation mode is switched when $V3$ is decreased from $V_{BL} - 0.1\text{ V}$ after setting $V1 = V3 = V_{BL} - 0.1\text{ V}$.

5. Cell balancing detection delay time

Cell balancing detection delay time (t_{BU}) is defined as the time from when $SW1$ is set to ON and $V1$ is set to $V_{BU} - 0.1\text{ V}$ to when the CB pin output is inverted after setting $V1$ to $V_{BU} + 0.1\text{ V}$.

6. Cell balancing release delay time

Cell balancing release delay time (t_{BL}) is defined as the time from when $SW1$ is set to ON and $V1$ is set to $V_{BL} + 0.1\text{ V}$ to when the CB pin output is inverted after setting $V1$ to $V_{BL} - 0.1\text{ V}$.

7. Overcharge detection delay time

Overcharge detection delay time (t_{CU}) is defined as the time from when $SW1$ is set to ON and $V1$ is set to $V_{CU} - 0.1\text{ V}$ to when the CO pin output is inverted after setting $V1$ to $V_{CU} + 0.1\text{ V}$.

8. Overcharge release delay time

Overcharge release delay time (t_{CL}) is defined as the time from when $SW1$ is set to ON and $V1$ is set to $V_{CL} + 0.1\text{ V}$ to when the CO pin output is inverted after setting $V1$ to $V_{CL} - 0.1\text{ V}$.

*1. For details about switching to the test mode by using the DP pin, refer to "5. DP pin" in "■ Operation".

■ **Standard Circuit**

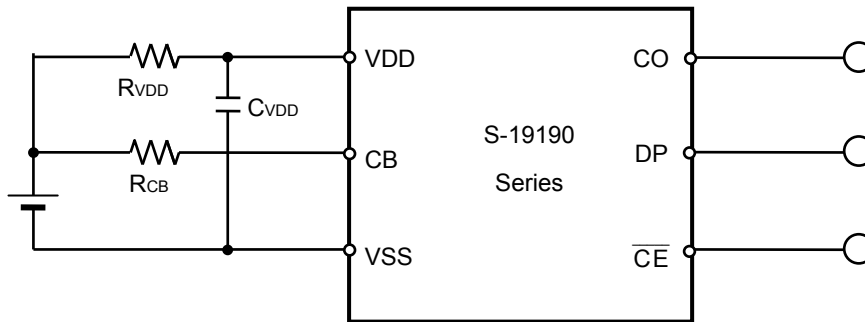


Figure 4

Table 10 Constants for External Components

Symbol	Part	Purpose	Min.	Typ.	Max.	Remark
R _{VDD}	Resistor	ESD protection, for power fluctuation control	150 Ω	330 Ω	1.0 kΩ	Resistance should be as small as possible to avoid worsening the overcharge detection accuracy due to current consumption.*1
C _{VDD}	Capacitor	For power fluctuation control	0.068 μF	0.1 μF	1.0 μF	Connect a capacitor of 0.068 μF or more between VDD pin and VSS pin.*1
R _{CB}	Resistor	For setting the cell balancing current value	—	—	—	Set the required cell balancing current value depending on "2. Cell balancing status" in "■ Operation".*2

*1. When connecting a resistor less than 150 Ω to R_{VDD} or a capacitor less than 0.068 μF to C_{VDD}, the S-19190 Series may malfunction when power is largely fluctuated.

*2. Set the cell balancing current value so that R_{CB} does not exceed the power dissipation.

Cautions 1. The above constants may be changed without notice.

2. The example of connection shown above and the constant do not guarantee proper operation. Perform thorough evaluation using the actual application to set the constant.

■ **Operation**

Remark Refer to "■ Standard Circuit".

1. Normal status

In the S-19190 Series, if the voltage between the VDD pin and the VSS pin (V_{DS}) has not reached the cell balancing detection voltage (V_{BU}), the CB pin output is in the high-impedance status. The CO pin output status varies according to the output form and output logic selected, as shown in **Table 11**. This is the normal status.

Table 11

CO Pin Output Form and Output Logic	CB Pin Output	CO Pin Output
CMOS output, active "H"	"H"	"L"
CMOS output, active "L"	"H"	"H"
Nch open-drain output, active "H"	"H"	"L"
Nch open-drain output, active "L"	"H"	"H"

2. Cell balancing status

In the S-19190 Series, if V_{DS} is V_{BU} or higher and this status continues for the cell balancing detection delay time (t_{BU}) or longer, the CB pin output becomes "L". This is the cell balancing status.

The cell balancing status is released when V_{DS} drops to the cell balancing release voltage (V_{BL}) or lower and this status continues for the cell balancing release delay time (t_{BL}) or longer.

The S-19190 Series includes an Nch transistor with ON resistance of 5Ω typ. (R_{CBON}) between the CB pin and the VSS pin, thus causing the cell balancing current (I_{CB}) to flow in cell balancing status, and the cell balancing operation to start.

By connecting a resistor (R_{CB}) to the CB pin, I_{CB} in cell balancing status can be calculated by using the following equation.

$$I_{CB} = V_{BU} / (R_{CBON} + R_{CB})$$

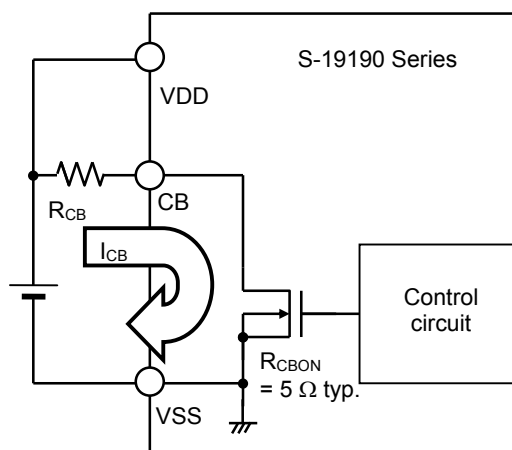


Figure 5

3. Overcharge status

In the S-19190 Series, if V_{DS} is the overcharge detection voltage (V_{CU}) or higher and this status continues for the overcharge detection delay time (t_{CU}) or longer, the CO pin output is inverted. The CO pin output status varies according to the output form and output logic selected, as shown in **Table 12**. This is the overcharge status. In the overcharge status, the CB pin output becomes "L".

Table 12

CO Pin Output Form and Output Logic	CB Pin Output	CO Pin Output
CMOS output, active "H"	"L"	"H"
CMOS output, active "L"	"L"	"L"
Nch open-drain output, active "H"	"L"	"H"
Nch open-drain output, active "L"	"L"	"L"

The overcharge status is released when V_{DS} drops to the overcharge release voltage (V_{CL}) or lower and this status continues for the overcharge release delay time (t_{CL}) or longer.

4. \overline{CE} pin

The S-19190 Series has the \overline{CE} pin (Power-saving mode switching pin). The S-19190 Series is set to power-saving mode by inputting a voltage of $V_{\overline{CEH}}$ or higher to the \overline{CE} pin.

Table 13

\overline{CE} Pin	Status
Open ($V_{\overline{CE}} = V_{SS}$)	Normal operation mode
"H" ($V_{\overline{CE}} \geq V_{\overline{CEH}}$)	Power-saving mode
"L" ($V_{\overline{CE}} \leq V_{\overline{CEL}}$)	Normal operation mode

In power-saving mode, the current consumption is decreased to current consumption during power-saving (I_{PSV}). The CB pin or the CO pin output in power-saving mode is the same as that in the normal status.

The \overline{CE} pin is pulled down to V_{SS} by the internal resistor. When in a mode other than power-saving mode, leave the \overline{CE} pin open or short it with V_{SS} .

5. DP pin

The S-19190 Series has the DP pin (Test mode switching pin). The S-19190 Series is set to test mode (used to shorten the delay time) by inputting a voltage of V_{DPH} or higher to the DP pin.

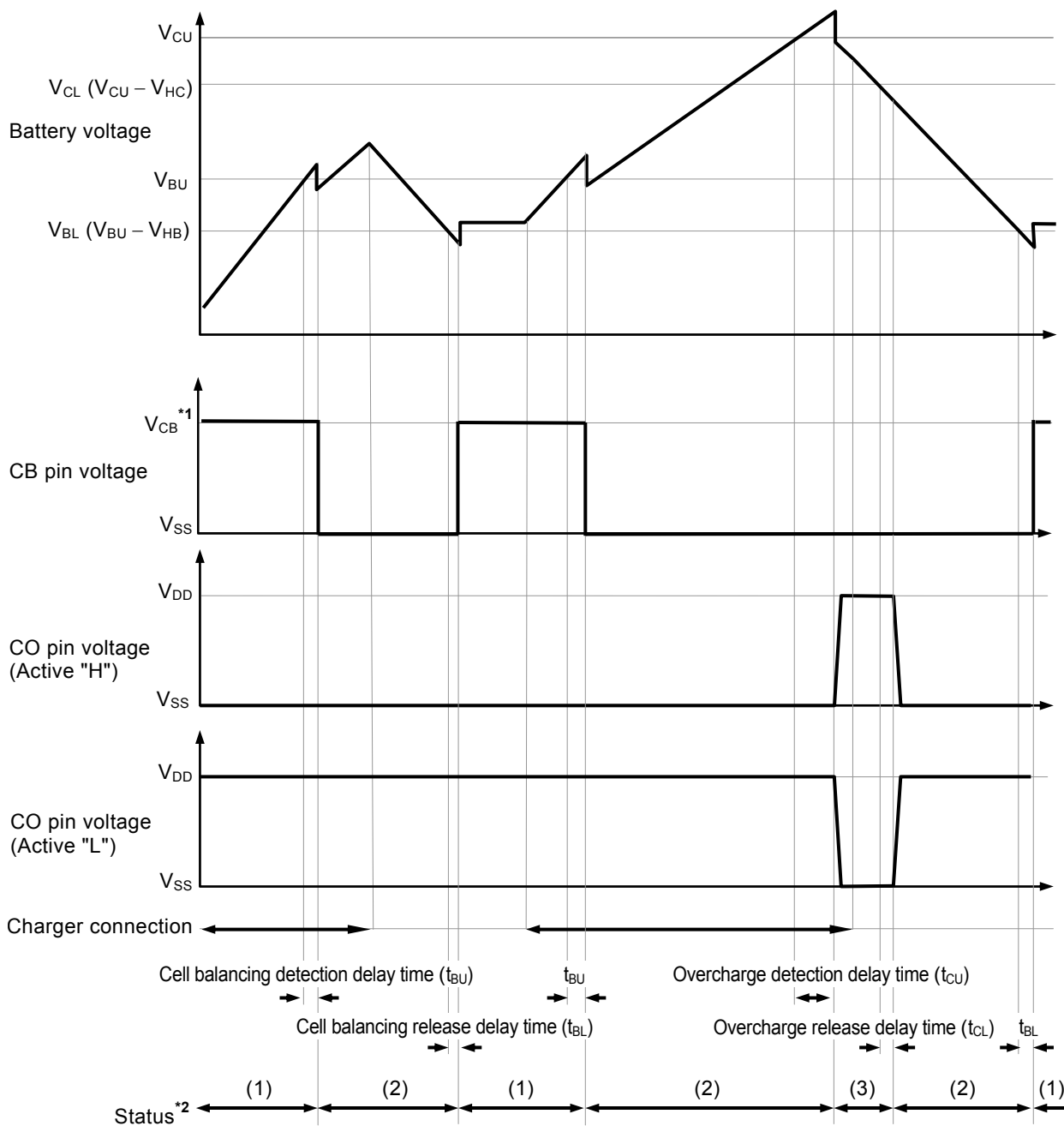
Table 14

DP Pin	Status
Open ($V_{DP} = V_{SS}$)	Normal operation mode
"H" ($V_{DP} \geq V_{DPH}$)	Test mode
"L" ($V_{DP} \leq V_{DPL}$)	Normal operation mode

In test mode, the cell balancing detection delay time (t_{BU}) and overcharge detection delay time (t_{CU}) are shortened to 1/64 of the delay time in the normal operation mode.

The DP pin is pulled down to V_{SS} by the internal resistor. When in a mode other than test mode, leave the DP pin open or short it with V_{SS} .

■ **Timing Chart**



*1. The CB pin is pulled up by the external resistor.

- *2. (1): Normal status
 (2): Cell balancing status
 (3): Overcharge status

Remark The charger is assumed to charge with a constant current.

Figure 6

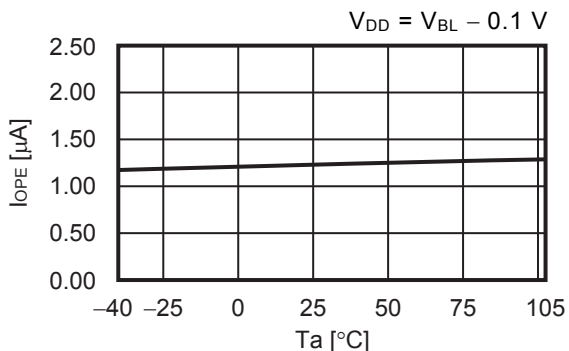
■ Precautions

- The application conditions for the input voltage, output voltage, and load current should not exceed the power dissipation.
- 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 and all disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

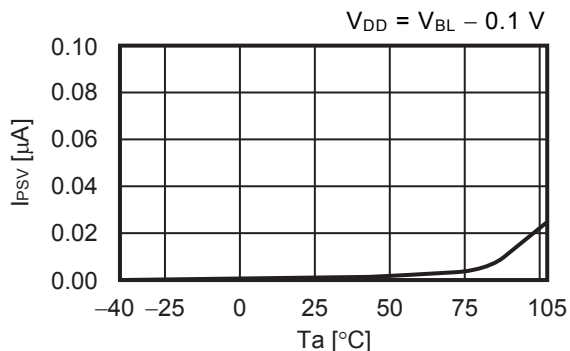
■ **Characteristics (Typical Data)**

1. Current consumption

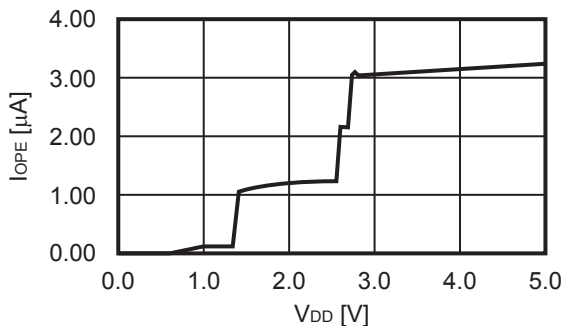
1.1 I_{OPE} vs. Ta



1.2 I_{PSV} vs. Ta

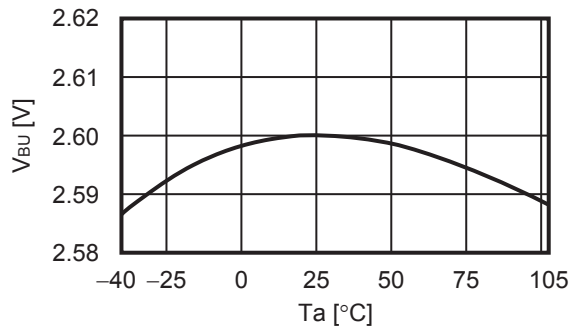


1.3 I_{OPE} vs. V_{DD}

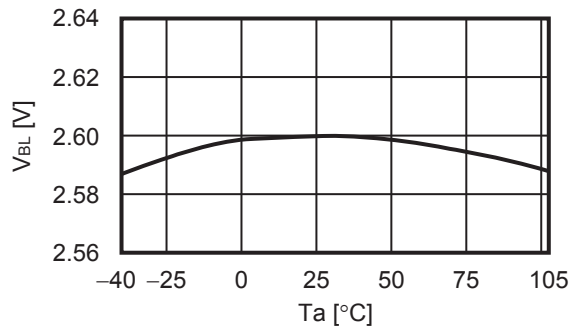


2. Cell balancing detection / release voltage, overcharge detection / release voltage and delay times

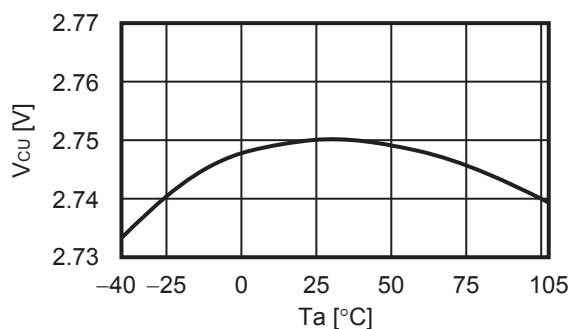
2.1 V_{BU} vs. Ta



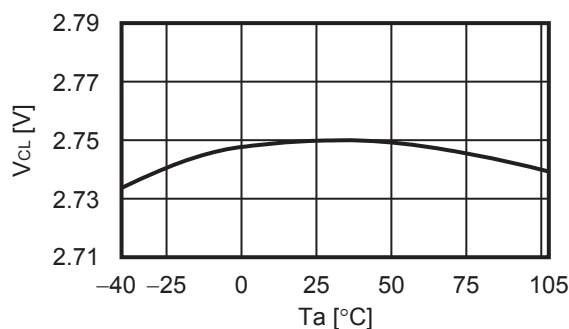
2.2 V_{BL} vs. Ta



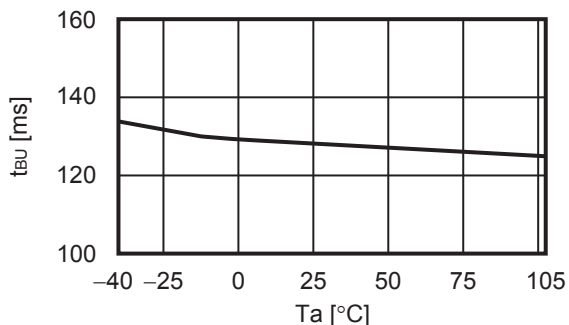
2.3 V_{CU} vs. Ta



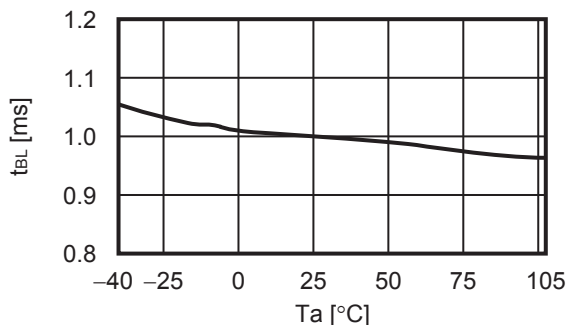
2.4 V_{CL} vs. Ta



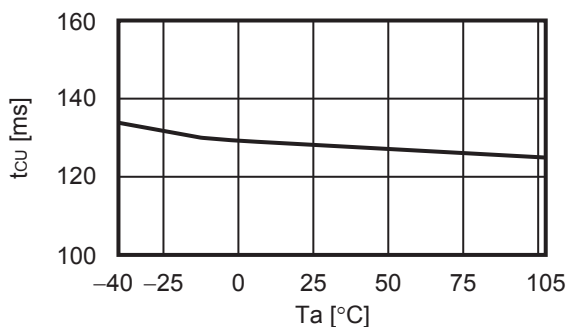
2.5 t_{BU} vs. T_a



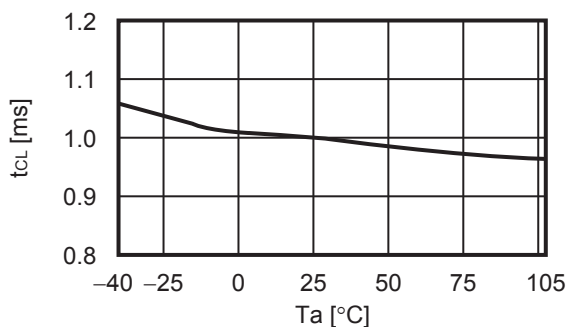
2.6 t_{BL} vs. T_a



2.7 t_{CU} vs. T_a

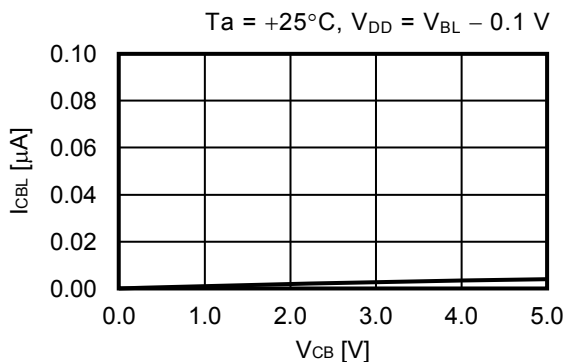


2.8 t_{CL} vs. T_a

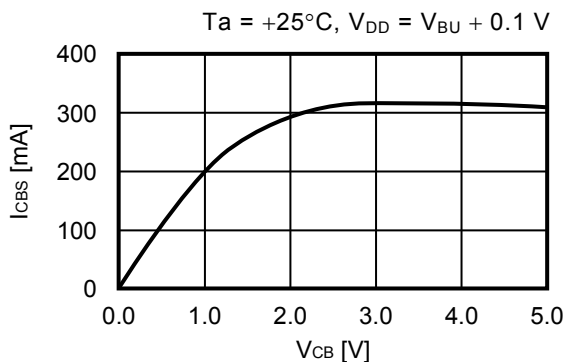


3. Output current

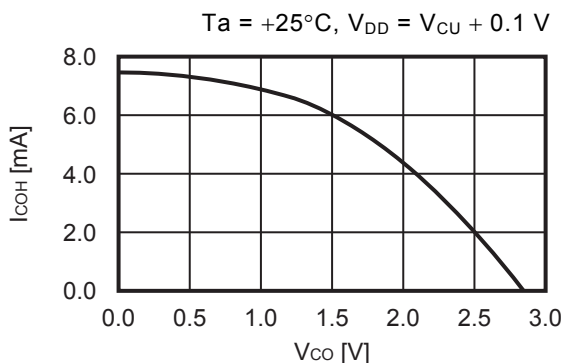
3.1 I_{CBL} vs. V_{CB}



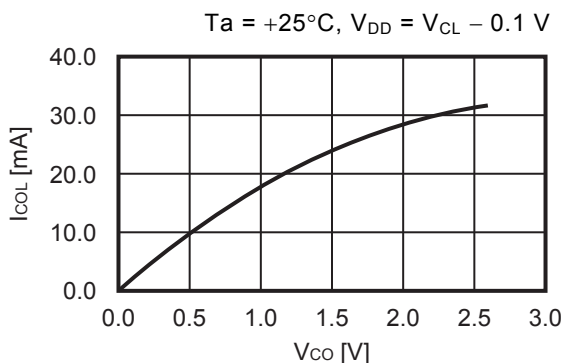
3.2 I_{CBS} vs. V_{CB}



3.3 I_{COH} vs. V_{CO}

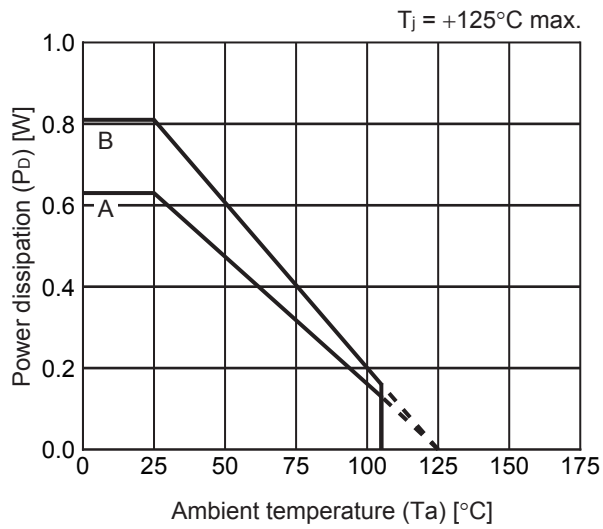


3.4 I_{COL} vs. V_{CO}



■ **Power Dissipation**

SOT-23-6



Board	Power Dissipation (P_D)
A	0.63 W
B	0.81 W
C	—
D	—
E	—

SOT-23-3/3S/5/6 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		-

No. SOT23x-A-Board-SD-2.0



No. MP006-A-P-SD-2.1

TITLE	SOT236-A-PKG Dimensions
No.	MP006-A-P-SD-2.1
ANGLE	
UNIT	mm
ABLIC Inc.	



No. MP006-A-C-SD-3.1

TITLE	SOT236-A-Carrier Tape
No.	MP006-A-C-SD-3.1
ANGLE	
UNIT	mm
ABLIC Inc.	



Enlarged drawing in the central part



No. MP006-A-R-SD-2.1

TITLE	SOT236-A-Reel		
No.	MP006-A-R-SD-2.1		
ANGLE		QTY	3,000
UNIT	mm		
ABLIC Inc.			

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