FUJITSU SEMICONDUCTOR
DATA SHEET

ASSP   For Power Supply Applications

Power Management 2-ch Switch IC

MB3842/MB3845

■ DESCRIPTION

The MB3842/3845 is a power management switch with built-in 2-channel low-on resistance (typ. 100mΩ) switch.
Output control is by means of a control signal, and the MB3842 is designed for high-active operation (output on when EN is Hi), while the MB3845 is designed for low-active operation (output on when $\overline{EN}$ is low.)
To provide adaptability to a variety of operations, the MB3842/3845 features low input voltage ($V_{IN} > 2.5V$)
operation and stable low-on resistance independent of input voltage. The switching current limit can be set from
100mA to 600mA by using external resistance, and when overcurrent conditions are detected the OC output goes
low to provide an external notification signal.
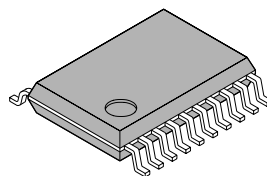V_{IN} is divided between the two channels, which operate independently of each other.
In addition, an off-state reverse current prevention function is provided to ensure accurate on/off switching action.

■ FEATURES

- Low on resistance switch (typ. 100mΩ)
- Low input voltage operation (2.5 V to 5.5 V)
- Switch current (max. 0.6 A)
- UVLO   :V_{IN} threshold   2.3V/2.1 V hysteresis 200 mV
- ENABLE   :EN threshold   EN 1.4V/1.6 V for MB3842, $\overline{EN}$ 1/2 V_{IN} for MB3845
                        :Power supply current at output off = 0μA   EN < 0.8V for MB3842, $\overline{EN}$ = V_{IN} for MB3845
- External setting for soft start time and switch current limit.
- Over-temperature detection (switch latched off), over-current detection (not latched)
- OC pin flag set following overcurrent detection, over-temperature detection, or UVLO detection.
- Reverse current prevention at OFF ($V_{IN} \geq 1.5$ V)
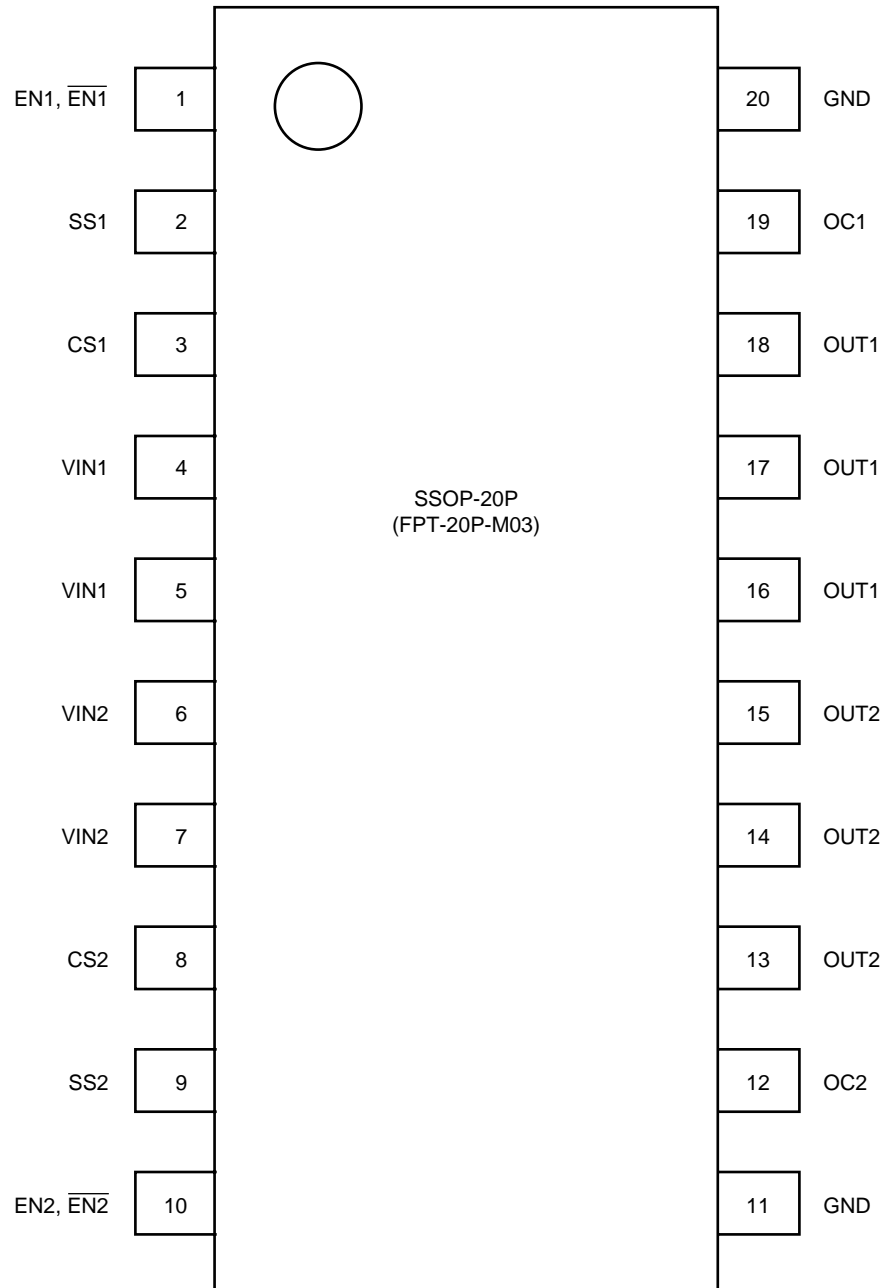- Either channel may be operated alone.

■ PACKAGE

20-pin plastic SSOP

(FPT-20P-M03)

MB3842/MB3845

■ PIN ASSIGNMENT

Left Pin	Pin #		Pin #	Right Pin
EN1, $\overline{EN1}$	1		20	GND
SS1	2		19	OC1
CS1	3		18	OUT1
VIN1	4		17	OUT1
VIN1	5		16	OUT1
VIN2	6		15	OUT2
VIN2	7		14	OUT2
CS2	8		13	OUT2
SS2	9		12	OC2
EN2, $\overline{EN2}$	10		11	GND

SSOP-20P
(FPT-20P-M03)

EN → Enable $\overline{EN}$ → $\overline{Enable}$ SS → Slow Start

CS → Current Set   OC → Over Current

The functions of pin 1 and pin 10 differ on the MB3842 and MB3845.
EN for MB3842/$\overline{EN}$ for MB3845

2
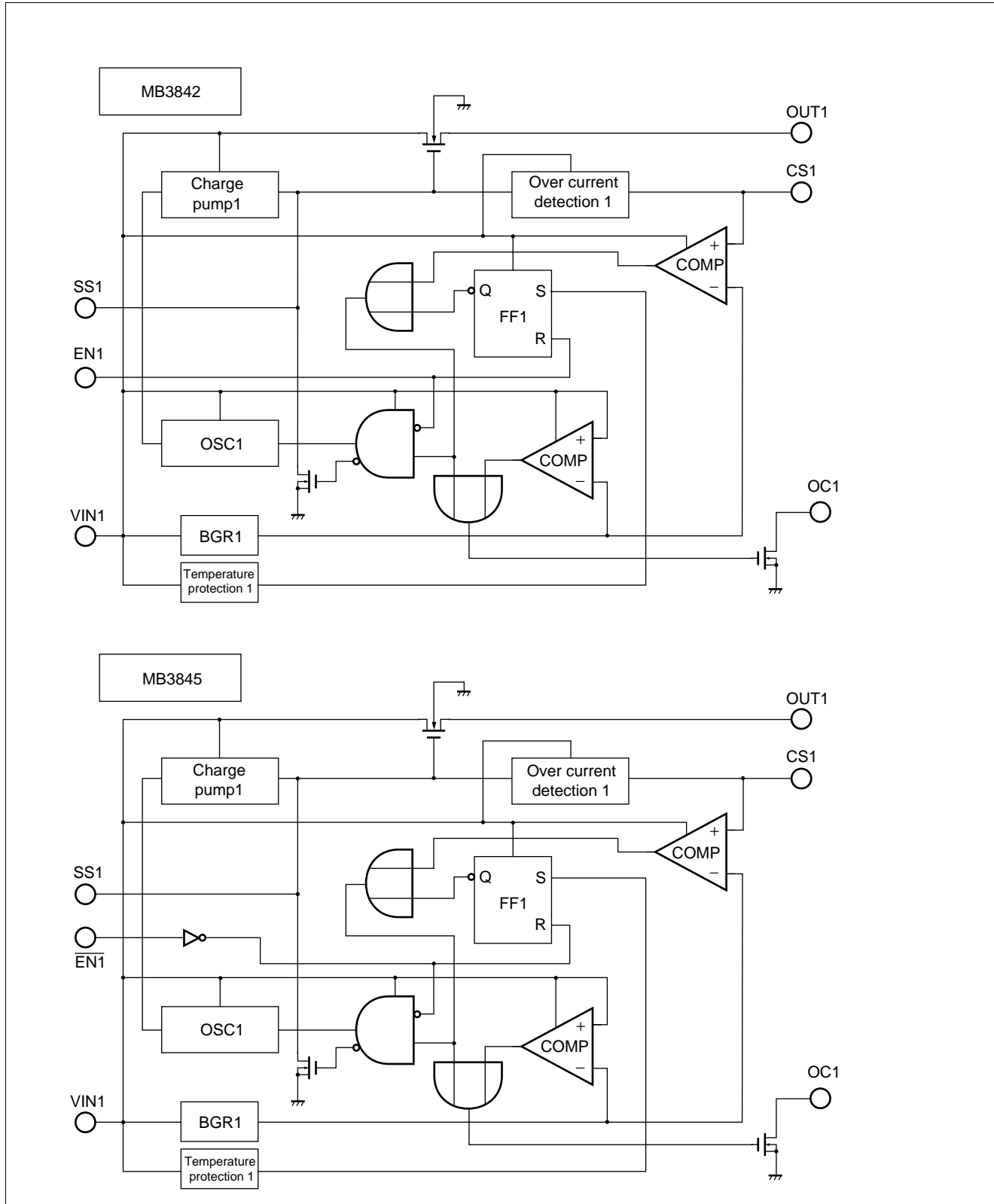
MB3842/MB3845

■ PIN DESCRIPTION

Pin no.	Symbol	Descriptions
1/10	EN (MB3842)	Control signal input pin. Set "H" to turn switch on, "L" to turn toff. At 0.8 V or less, the chip is in STBY state and current consumption is less than 1µA. "L" level is 1.4V (typ), "H" level is 1.6V (typ), with 200mV (typ) hysteresis.
	$\overline{EN}$ (MB3845)	Control signal input pin. Set "L" to turn switch on, "H" to turn off. At "H" level = V_{IN}, the chip is in STBY state and current consumption is less than 1µA. Normally used as CMOS inverter input, so that recommended use is "L" level at GND +0.5V or less, and "H" level is V_{IN} -0.5V or greater.
2/9	SS	Slow start setting pin. Used to adjust the switch on/off timing. Add external capacitance to delay operation. Leave open when not in use. In open mode voltages up to 12 V are present. Care should be taken in mounting to prevent leakage current generation because high impedance is required.
3/8	CS	Current limit setting pin. The limit current level is set by connecting this pin to external resistance.
4/5/6/7	VIN	Switch output pin. An UVLO (V_{IN} power monitor function) is provided so that when V_{IN} reaches 2.3V (typ.) or higher the OC pin voltage goes to "H" level. Also if the V_{IN} voltage drops to 2.1 V (typ.) or lower the OC output goes to "L" state. 200mV (typ) hysteresis is provided.
11/20	GND	Ground pin.
12/19	OC	External notification pin. When the switch is in on mode this pin normally outputs a "H" level signal, but changes to "L" level when an overcurrent, overtemperature, or UVLO condition is detected. This is an open drain connection, and should be pulled up to high potential using resistance.
13/14/15 16/17/18	OUT	Switching output pin.(N-ch MOSFET source)

MB3842/MB3845

■ BLOCK DIAGRAM (for 1 channel)

MB3842/MB3845

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating		Unit
			Max.	Min.	
Input voltage	V_{IN}	—	–0.3	7.0	V
ENABLE voltage	V_{EN}	—	–0.3	7.0	V
Switch current	I_{SW}	—	—	1.8	A
Power dissipation	P_D	Ta = +85°C	—	216	mW
Storage temperature	T_{STG}	—	–55	+125	°C

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

■ RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Input voltage	V_{IN}	—	2.5	5.0	5.5	V
ENABLE voltage	V_{EN}	$V_{EN} \leq V_{IN}$	0	—	5.5	V
Switch current	I_{SW}	V_{IN} = 2.5 V to 5.5 V	—	—	0.6	A
SS pin capacitance	C_{SS}*	—	—	—	10	nF
OC sink current	I_{OCS}	V_{IN} = 5.0 V, V_{OC} = 0.4 V	2.0	5.0	—	mA
Current limit resistance	R_{LIM}*	V_{IN} = 5.0 V (I_{SW} = 0.6 A)	1.4	2.0	2.6	kΩ
		V_{IN} = 5.0 V (I_{SW} = 0.1 A)	3.6	6.2	9.1	kΩ
Operating temperature	T_{OP}	—	–20	—	+85	°C

* : For C_{SS}, R_{LIM} settings, see "TYPICAL CHARACTERISTICS" and "FUNCTIONAL DESCRIPTION".

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representatives beforehand.

MB3842/MB3845

■ ELECTRICAL CHARACTERISTICS (per 1 ch)

• MB3842/MB3845 (V_{IN} = 5 V, Ta = +25°C)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Switch resistance	R_{ON}	I_{SW} =0.6A	—	100	150	mΩ
IN pin input current	I_{IN1}	I_{SW} = 0 A	—	350	550	μA
	I_{IN2}	I_{SW} = 0.6 A	—	1.0	1.5	mA
	I_{IN3}	$\overline{EN}$ < 0.8V for MB3842, $\overline{EN}$ = V_{IN} for MB3845	—	—	1.0	μA
UVLO threshold	V_{IUH}	V_{IN} at OC = L → H	2.1	2.3	2.5	V
	V_{IUL}	V_{IN} at OC = H → L	1.9	2.1	2.3	V
UVLO hysteresis width	V_{IUHY}	V_{IUHY} = V_{IUH} − V_{IUL}	100	200	300	mV
Switch current limit	I_{SWH}	R_{LIM} = 2.0 kΩ	0.42	0.6	0.78	A
	I_{SWL}	R_{LIM} = 6.2 kΩ	0.06	0.1	0.14	A
OC sink current	I_{OCS}	V_{OC} = 0.4 V at OC active	2.0	5.0	—	mA
	I_{OCL}	V_{OC} = 5.0 V at OC non-active	—	—	1.0	μA
Temperature protection (T_j)	T_{LIM}	—	+125	—	—	°C
OUT pin rise time	t_{ON}	SS pin: Open OUT pin: 100 kΩ pull down	—	100	200	μs
OUT pin fall time	t_{OFF}	SS pin: Open OUT pin: 100 kΩ pull down	—	50	120	μs

• MB3842 (V_{IN} = 5 V, Ta = +25°C)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
ENABLE pin input current	I_{ENH}	V_{EN} = 5 V, I_{SW} = 0 A	—	5	10	μA
	I_{ENL}	V_{EN} = 0 V, I_{SW} = 0 A	—	0.0	—	μA
ENABLE pin threshold voltage	V_{THEN}	—	1.45	1.60	1.75	V
	V_{TLEN}	—	1.25	1.40	1.55	V
ENABLE hysteresis width	V_{ENHY}	V_{ENHY} = V_{THEN} − V_{TLEN}	100	200	300	mV

• MB3845 (V_{IN} = 5 V, Ta = +25°C)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
$\overline{ENABLE}$ pin input current	I_{ENH}	V_{EN} = 5 V, I_{SW} = 0 A	—	0.0	—	μA
	I_{ENL}	V_{EN} = 0 V, I_{SW} = 0 A	—	0.0	—	μA
$\overline{ENABLE}$ pin input voltage	V_{ILEN}	—	0	—	0.8	V
	V_{IHEN}	—	3.0	—	5.0	V

■ DIAGRAM

• **Normal operation**

• **At V_{IN} fall**

Note: The OC pin should be pulled up using a separate power supply and resistance.
(This illustration shows pull-up with a separate 5V source.)

MB3842/MB3845

(Continued)

- **At overcurrent detection**

VIN ——— 5 V

EN ——— Hi

$\overline{EN}$ ——— Low

SW ON   OFF   ON   OFF

VOUT ——— 5 V

IOUT

OC ——— 5 V

≒ 0 V
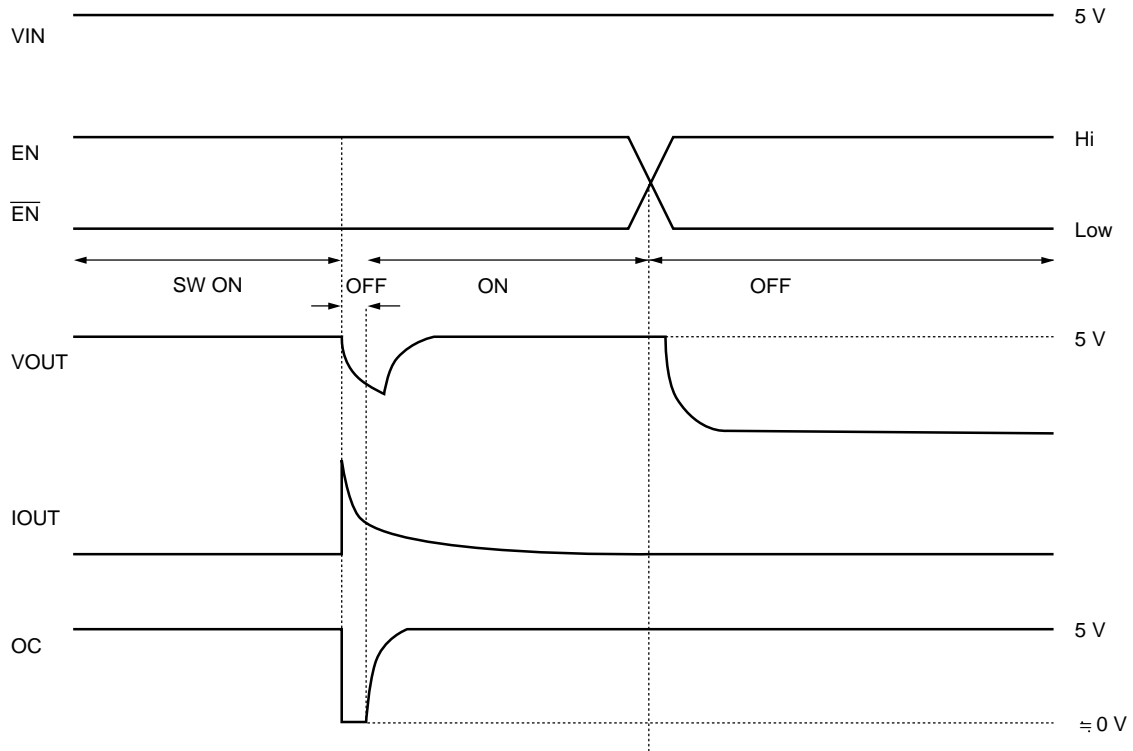
- **At over-temperature occurrence**
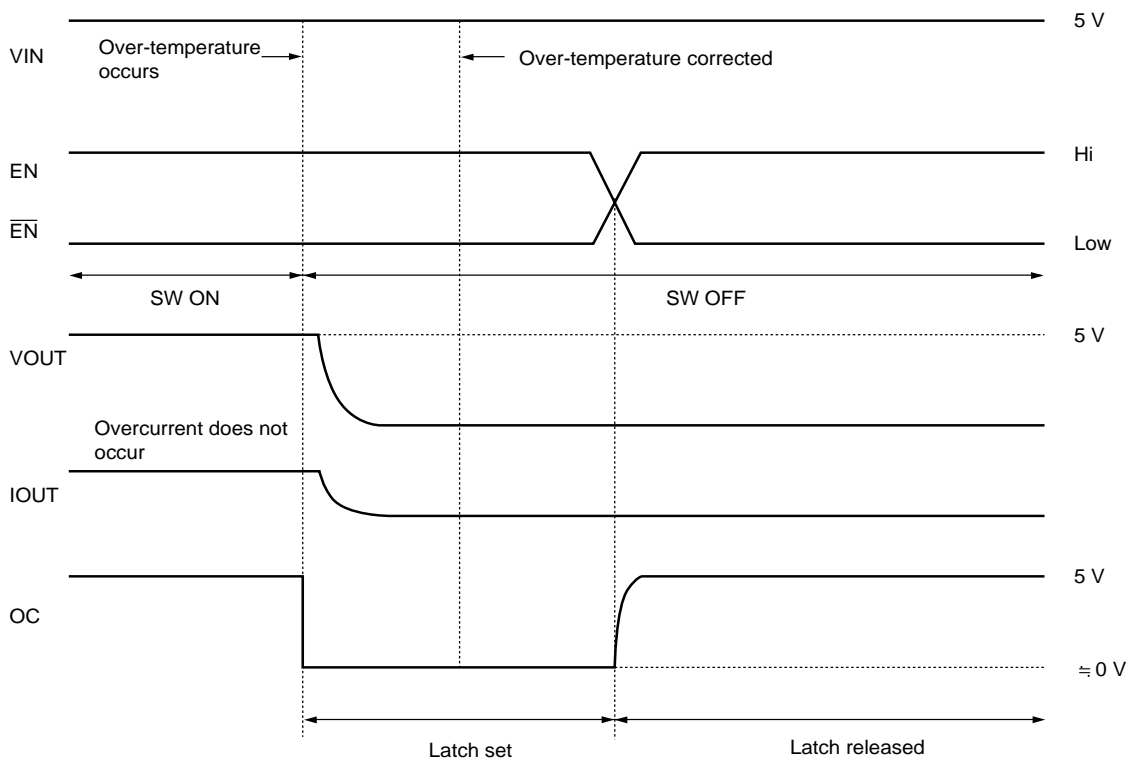
VIN ——— 5 V

Over-temperature occurs

Over-temperature corrected

EN ——— Hi

$\overline{EN}$ ——— Low

SW ON   SW OFF

VOUT ——— 5 V

Overcurrent does not occur

IOUT

OC ——— 5 V

≒ 0 V

Latch set   Latch released

Note: The OC pin should be pulled up using a separate power supply and resistance.
(This illustration shows pull-up with a separate 5V source.)

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■ TYPICAL CHARACTERISTICS

• R$_{LIM}$ vs. limit current characteristics

These are the limiting value characteristics for CS pin-to-GND external resistance and output current (OC flag).

R$_{LIM}$ (Ω)

Legend:
- V$_{IN}$ = 5.0 V
- V$_{IN}$ = 3.3 V
- V$_{IN}$ = 2.5 V
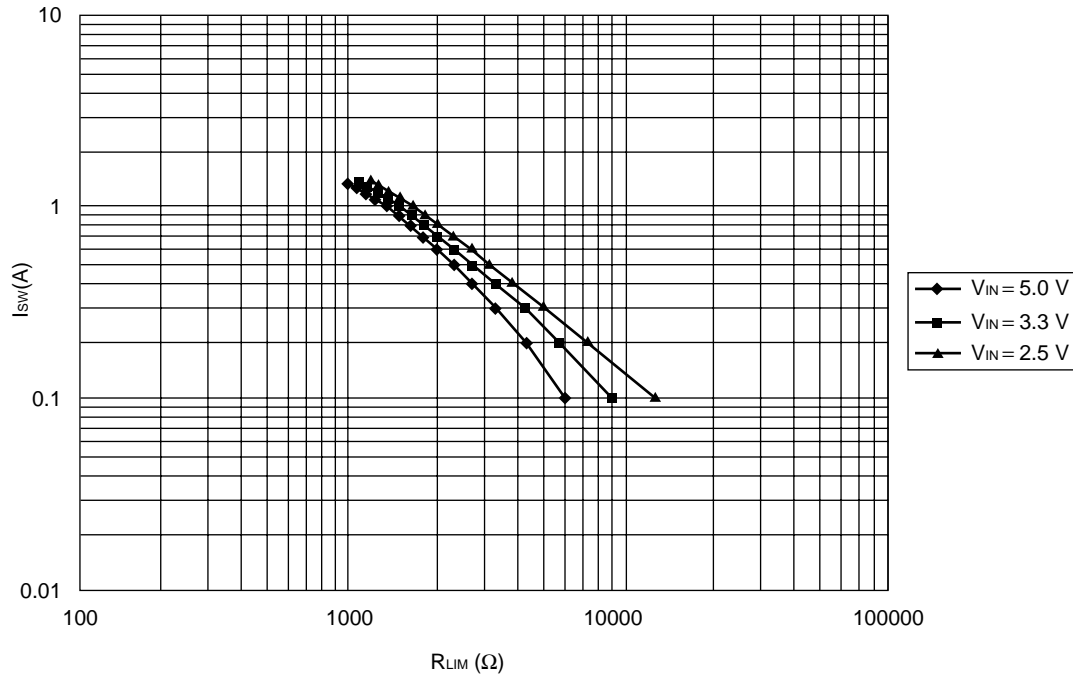
• C$_{SS}$ vs. T$_{ON}$ (SS) characteristics

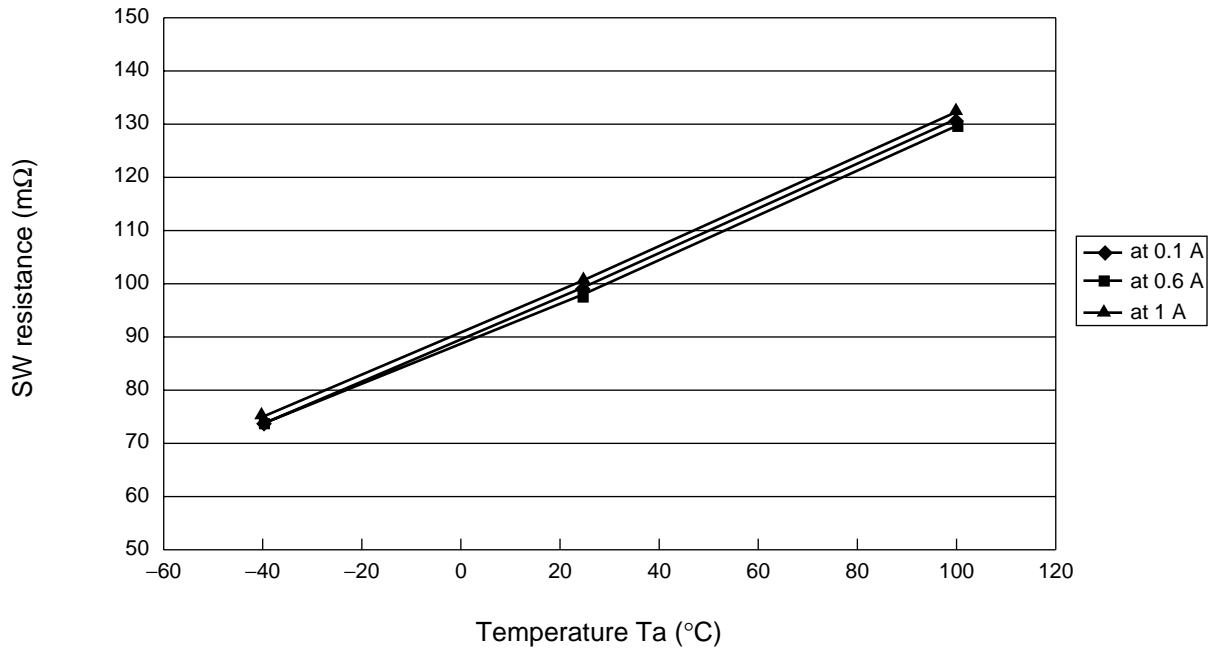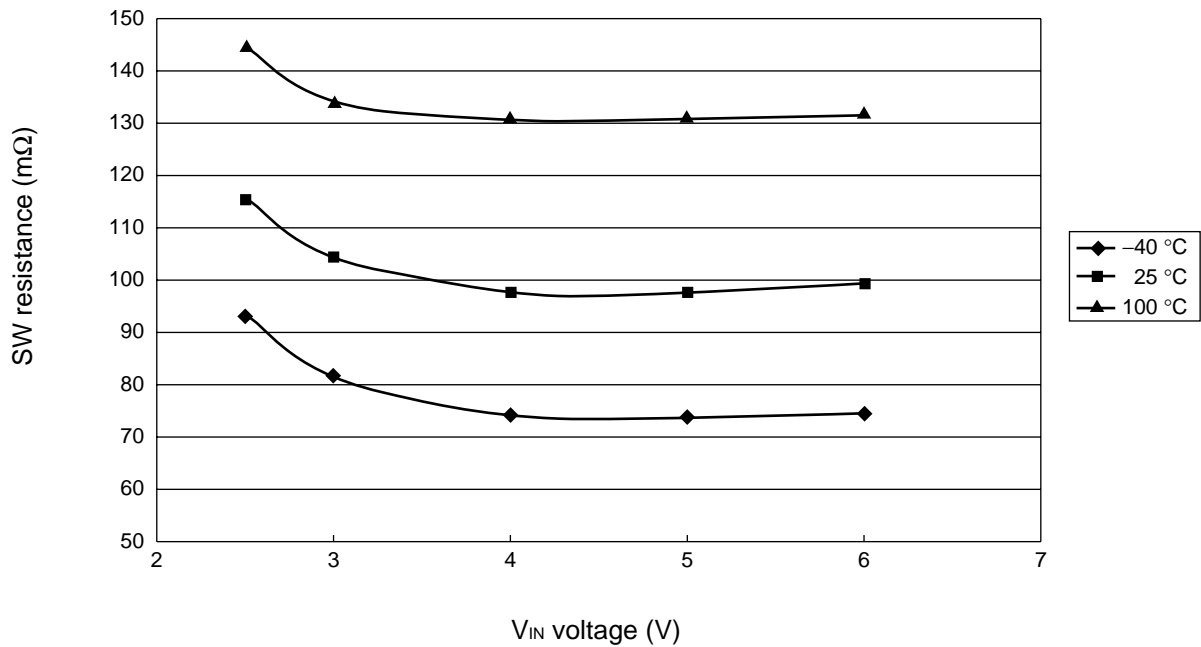There are the characteristics for SS pin-to-GND external capacitance and output ON time.

C$_{SS}$ (pF)

Legend:
- V$_{IN}$ = 5.0 V
- V$_{IN}$ = 3.3 V
- V$_{IN}$ = 2.5 V
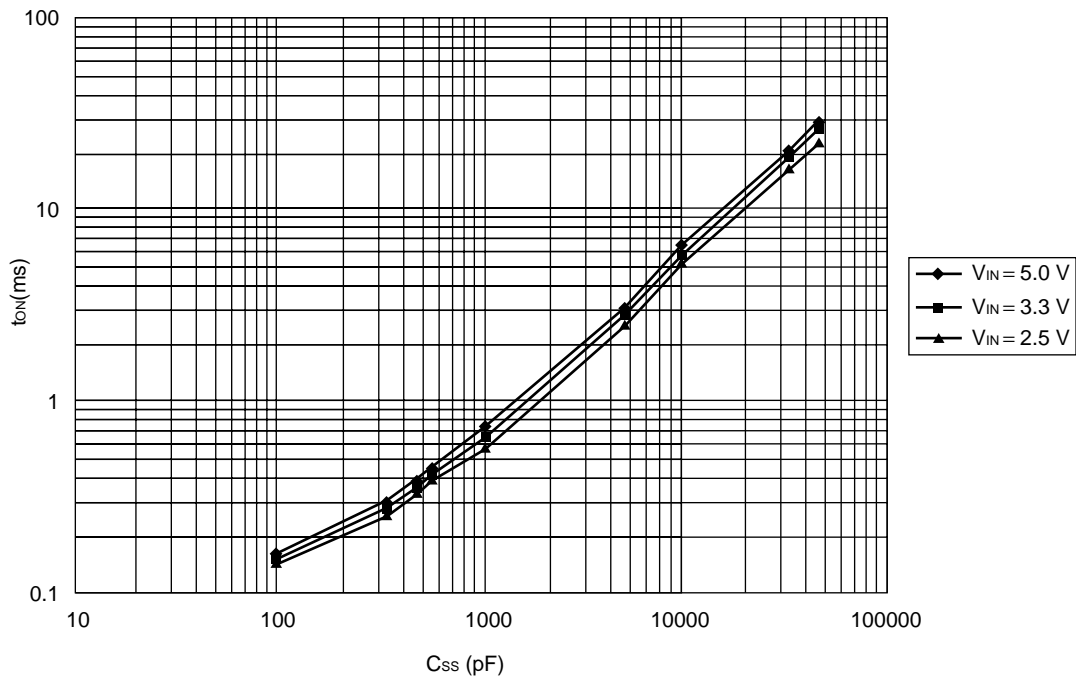
(Continued)

MB3842/MB3845

(Continued)

• **SW resistance vs. temperature characteristics**

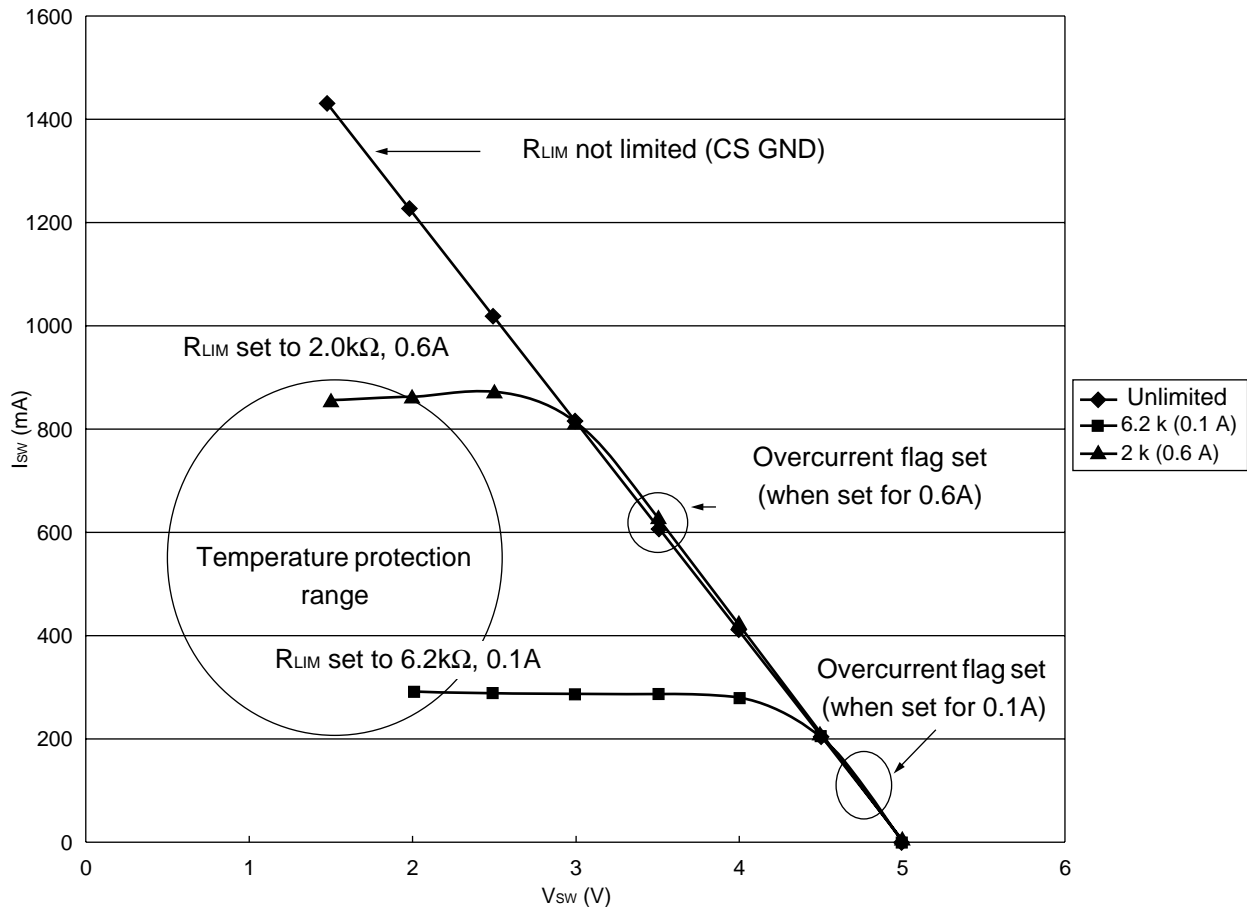• **Temperature-depended SW resistance vs. V$_{IN}$ (V) characteristics**

(Continued)

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(Continued)

• **Output power (I$_{SW}$) saturation characteristics**

Measurement circuit

5 V

VIN

EN, $\overline{\text{EN}}$ OC

V$_{IL}$/V$_{IH}$

SS

I$_{SW}$

CS   OUT   A

GND

2 Ω   100 kΩ

R$_{LIM}$

V$_{SW}$ 5 V

These are the output saturation current characteristics in overcurrent state. (when not controlled by the OC pin warning flag)
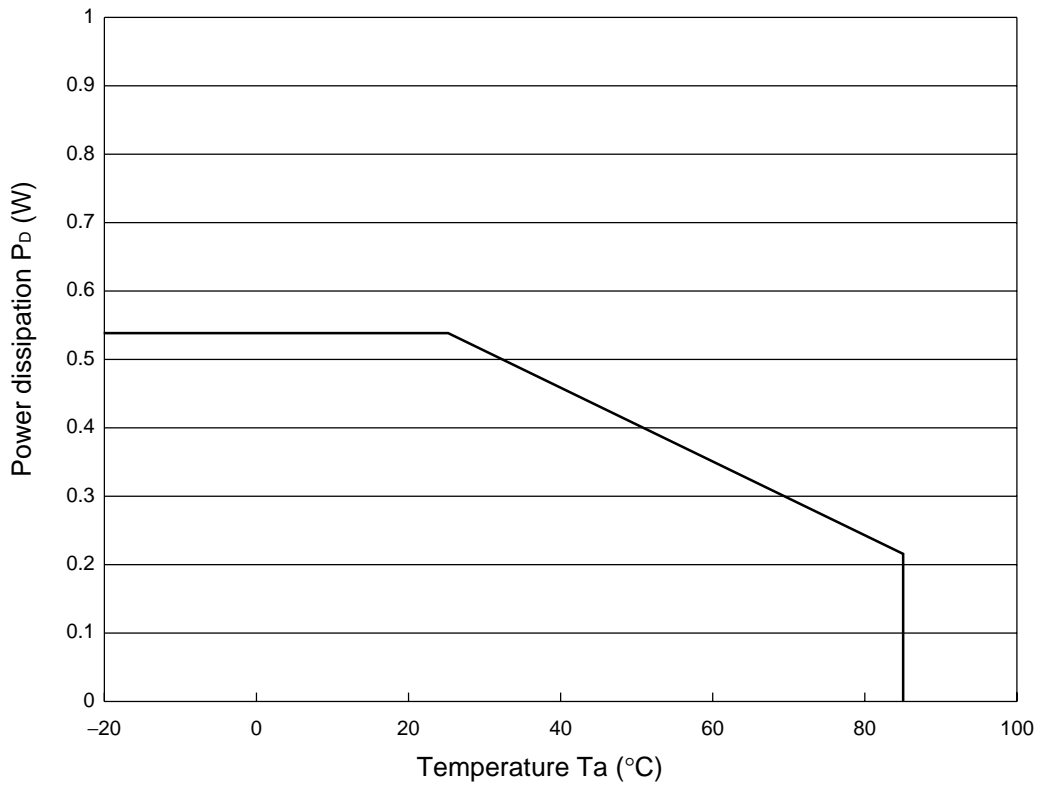

R$_{LIM}$ not limited (CS GND)

R$_{LIM}$ set to 2.0kΩ, 0.6A

Unlimited
6.2 k (0.1 A)
2 k (0.6 A)

Overcurrent flag set (when set for 0.6A)

Temperature protection range

R$_{LIM}$ set to 6.2kΩ, 0.1A

Overcurrent flag set (when set for 0.1A)

I$_{SW}$ (mA)

V$_{SW}$ (V)

(Continued)

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(Continued)

• **OC pin flag pull-up resistance (pull-up power 5V) dependant overcurrent operation**

1 V / 500 NS   1 kΩ

1 V / 500 NS   50 kΩ

GND ▶

▶

1 V / 500 NS   10 kΩ

1 V / 500 NS   100 kΩ

▶

▶
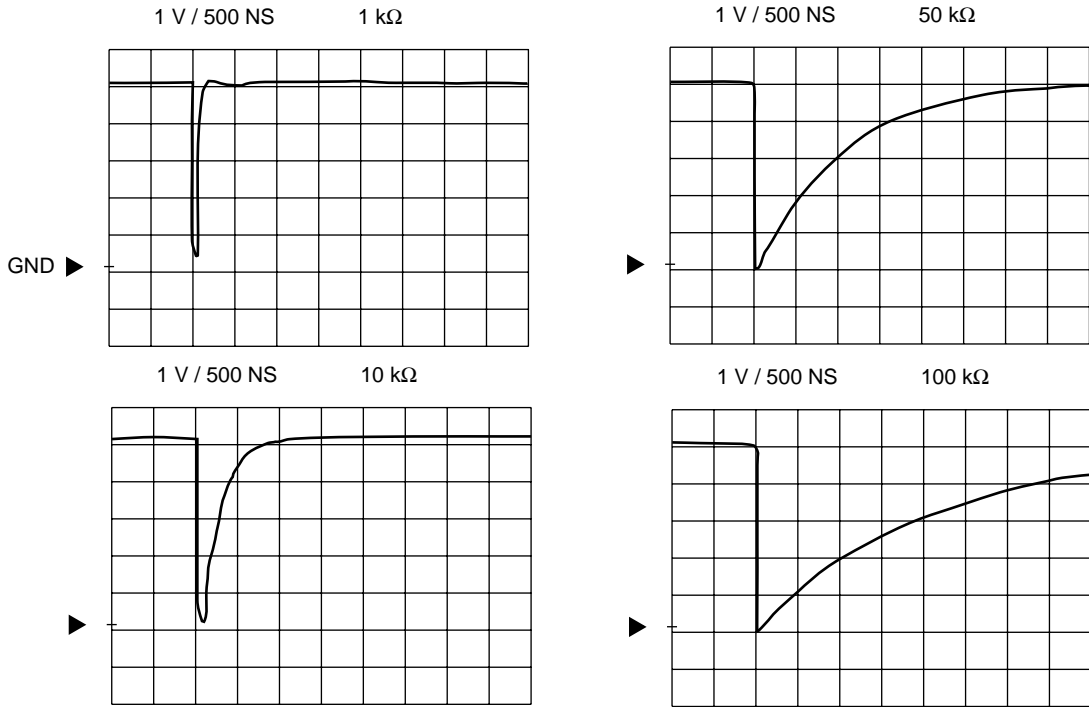
• **Power derating characteristics**

Power dissipation P_D (W) vs Temperature Ta (°C)

■ FUNCTIONAL DESCRIPTION

Current Limit Setting

By placing resistance between the CS and GND pins, the current limit can be set between 100mA and 600mA within ±30% accuracy (V_{IN} = 5 V, current limit at 600mA). Because the setting value is dependent on V_{IN} voltage, the user should select the optimum resistance value for the value of V_{IN} voltage . When the switching current exceeds the set value, the OC pin goes to "L" level as an external notification signal, but there is no latching function. To hold operation on "off" state, the input signal to the EN and $\overline{EN}$ pins should be used.
When a direct connection to GND is used, there is no current limitation.
When the connection is open, the switch is in a state of continuously held current limits.

Thermal Shutdown

The MB3842/MB3845 has a thermal shutdown function which turns the switch off and sets the latch to protect the device when junction temperature exceeds 125°C.
At the same time the OC output signal goes to "L" level to notify external systems.
The latch function can be reset by sending a low signal to the EN input of the MB3842, or a high signal to the $\overline{EN}$ input of the MB3845.

Slow Start

The on/off switching time can be delayed by applying capacitance between the SS and GND pins. Controlling the on time can soften surge current to the load side capacitance when power is turned on.
For details, see "Css vs. t_{ON} (SS) characteristics" on p. 9.

UVLO

A V_{IN} voltage monitoring function is provided, so that when V_{IN} voltage exceeds 2.3 V (typ) the OC pin voltage goes to "H" level. When V_{IN} voltage falls below 2.1V (typ), the OC output goes to "L" state.

Error Flag OC Pin

The OC pin produces a "L" signal in case of a UVLO, overcurrent, or over-temperature condition. In case of overcurrent, the output has a pulse waveform. See P12.
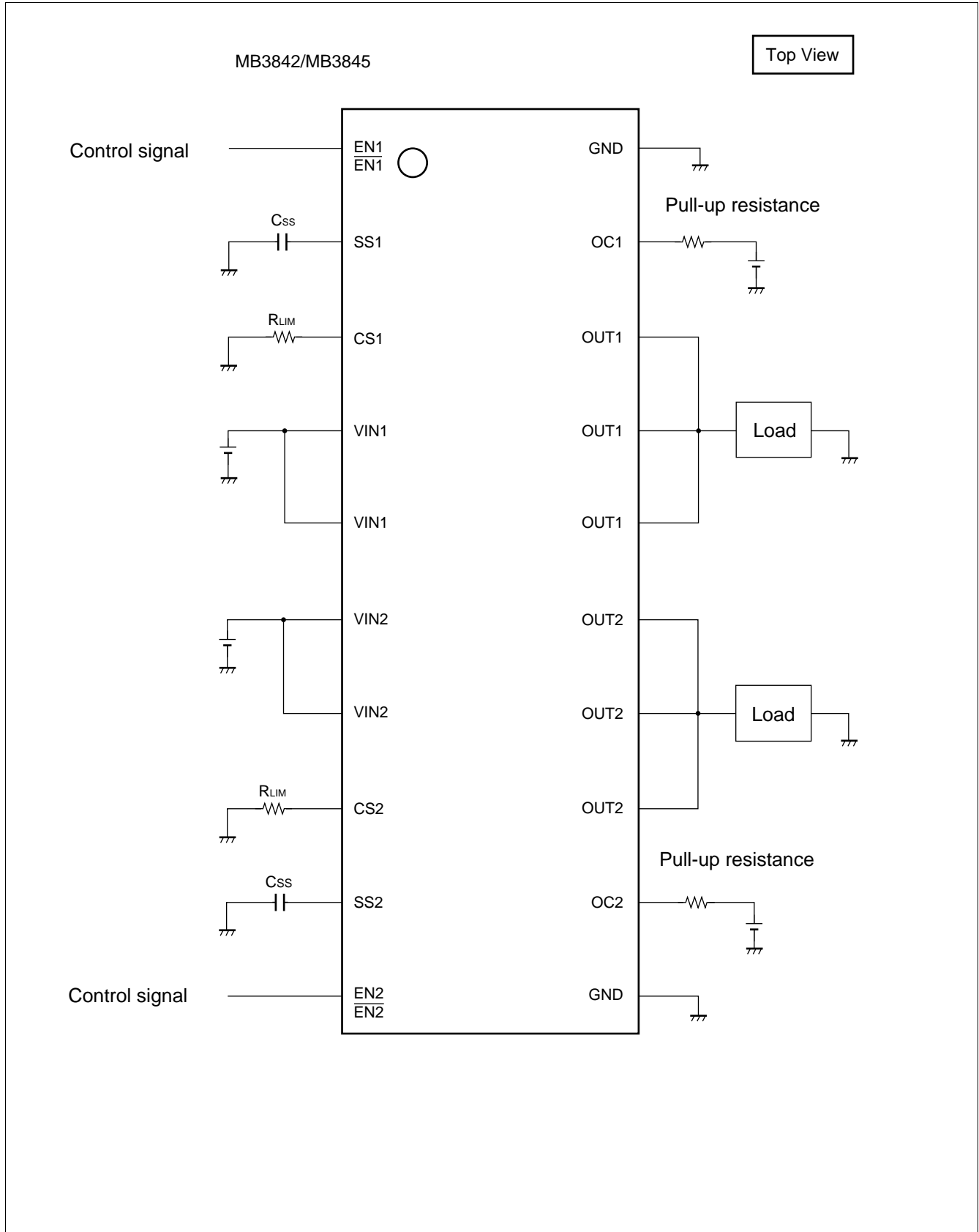
(note) Output current limit setting resistance values are shown on P9, and in the following table. (CS pin-to-GND)

Standard Values

V_{IN}/I_{SW}	0.1 A	0.2 A	0.3 A	0.4 A	0.5 A	0.6 A	0.7 A	0.8 A	0.9 A	1.0 A
V_{IN} 5.0V	6.2 kΩ	4.3 kΩ	3.3 kΩ	2.7 kΩ	2.2 kΩ	2.0 kΩ	1.8 kΩ	1.6 kΩ	1.4 kΩ	1.3 kΩ
V_{IN} 3.3V	9.1 kΩ	5.6 kΩ	4.3 kΩ	3.3 kΩ	2.7 kΩ	2.4 kΩ	2.0 kΩ	1.8 kΩ	1.6 kΩ	1.5 kΩ
V_{IN} 2.5V	13 kΩ	7.5 kΩ	5.1 kΩ	3.9 kΩ	3.0 kΩ	2.7 kΩ	2.2 kΩ	2.0 kΩ	1.8 kΩ	1.6 kΩ

MB3842/MB3845

■ TYPICAL APPLICATION

MB3842/MB3845

Top View

Control signal —— $\overline{EN1}$ / EN1

GND

Pull-up resistance

C_{SS} —— SS1

OC1

R_{LIM} —— CS1

OUT1

VIN1

OUT1

Load

VIN1

OUT1

VIN2

OUT2

VIN2

OUT2

Load

R_{LIM} —— CS2

OUT2

Pull-up resistance

C_{SS} —— SS2

OC2

Control signal —— $\overline{EN2}$ / EN2

GND

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■ APPLICATION EXAMPLE

(1) Dual-Port Self-Powered Hub Application (NON-GANG Mode Connection)
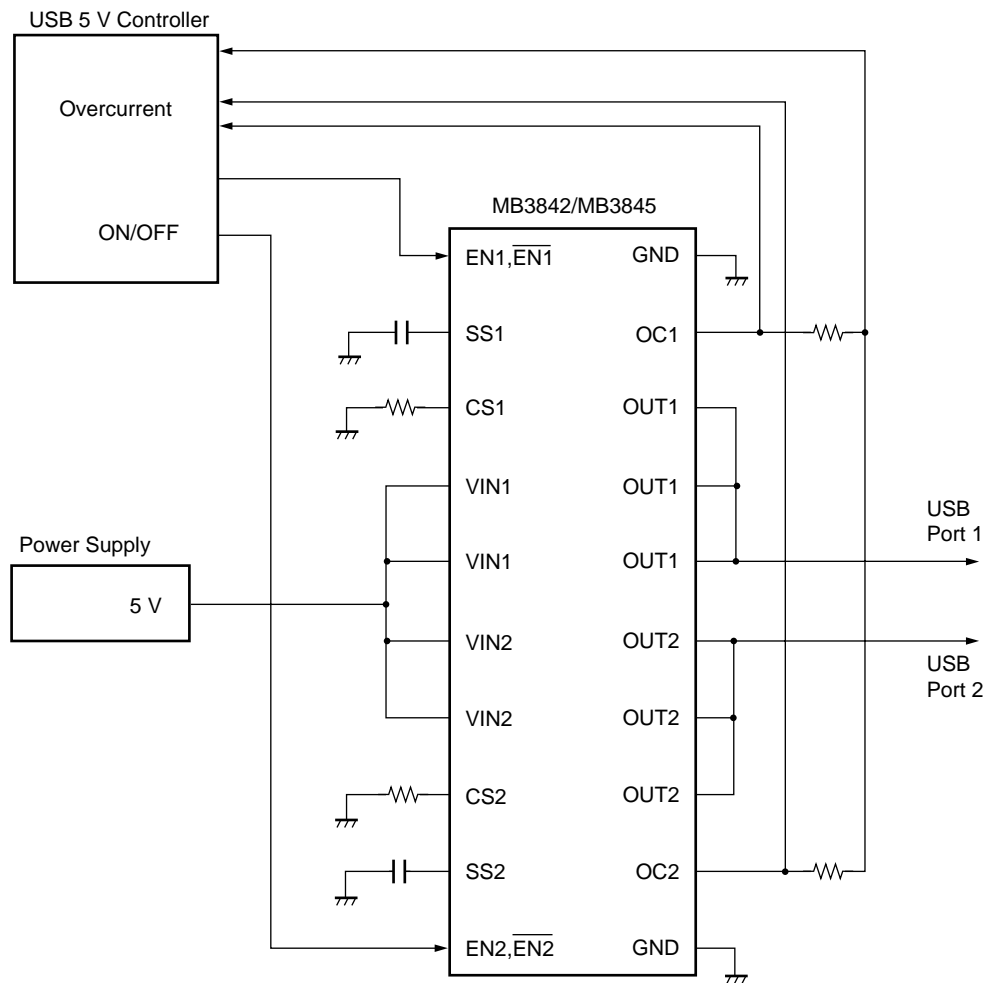
*The MB3842 can also be adapted for use with 3.3V controllers.

USB Port 500mA MAX Par Port
Smoothing capacitors should be placed between V_{IN} and GND, or between OUT and GND as required.

MB3842/MB3845

(2) Dual-Port Bus Powered Hub Application (GANG Mode Connection)

USB

Overcurrent

ON/OFF

MB3842/MB3845

EN1,$\overline{\text{EN1}}$ GND

SS1   OC1

CS1   OUT1

VIN1   OUT1

VIN1   OUT1

VIN2   OUT2

VIN2   OUT2

CS2   OUT2

SS2   OC2

EN2,$\overline{\text{EN2}}$ GND

USB Port1(×4)

400 mA MAX
(100 mA ×4)

USB Port2(×4)

400 mA MAX
(100 mA ×4)

5 V
Upstream Port
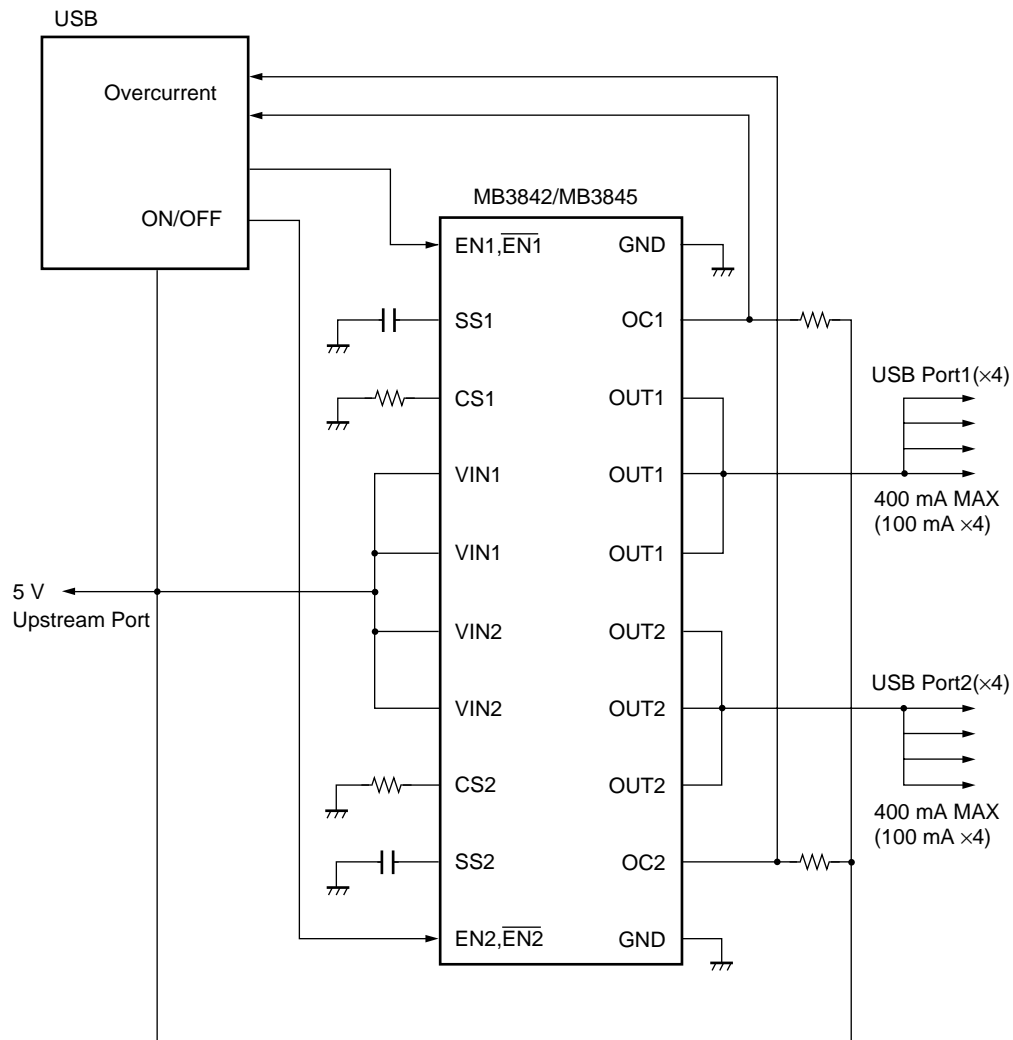
USB Port 100mA MAX Par Port
Smoothing capacitors should be placed between V_{IN} and GND, or between OUT and GND as required.

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MB3842/MB3845

■ **USAGE PRECAUTION**

1. **Never use settings exceeding maximum rated conditions.**

   Exceeding maximum rated conditions may cause permanent damage to the LSI.

   Also, it is recommended that recommended operating conditions be observed in normal use.
   Exceeding recommended operating conditions may adversely affect LSI reliability.

2. **Use this device within recommended operating conditions.**

   Recommended operating conditions are values within which normal LSI operation is warranted.

   Standard electrical characteristics are warranted within the range of recommended operating conditions and within the listed conditions for each parameter.

3. **Printed circuit board ground lines should be set up with consideration for common impedance.**

4. **Take appropriate static electricity measures.**
   • Containers for semiconductor materials should have anti-static protection or be made of conductive material.
   • After mounting, printed circuit boards should be stored and shipped in conductive bags or containers.
   • Work platforms, tools, and instruments should be properly grounded.
   • Working personnel should be grounded with resistance of 250 kΩ to 1 MΩ between body and ground.

5. **Do not apply negative voltages.**

   The use of negative voltages below –0.3 V may create parasitic transistors on LSI lines, which can cause abnormal operation.

6. **Reverse Current Prevention Function**

   Current cannot flow back to the V_{IN} pin with the switch off, even when the OUT pin voltage is higher than the V_{IN} pin (OUT $\geq$ V_{IN}), however when V_{IN} pin voltage is lower than 1.5 V circuit functions are lost, so that in this case there is danger of reverse current flow. For applications in which reverse flow is not acceptable, set V_{IN} $\geq$ 1.5 V.
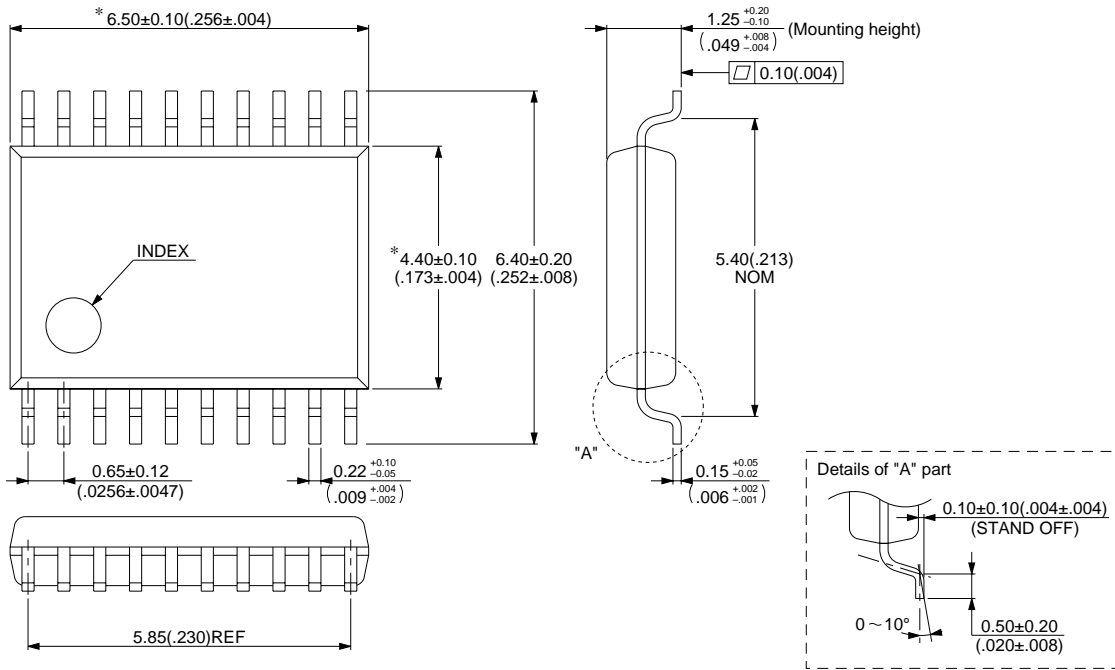
■ **ORDERING INFORMATION**

Part number	Package	Remarks
MB3842PFV MB3845PFV MB3845PFV-ER	20-pin Plastic SSOP (FPT-20P-M03)	

MB3842/MB3845

■ PACKAGE DIMENSION

20-pin plastic SSOP
(FPT-20P-M03)

*: These dimensions do not include resin protrusion.

* 6.50±0.10(.256±.004)

INDEX

* 4.40±0.10   6.40±0.20
(.173±.004) (.252±.008)

0.65±0.12
(.0256±.0047)

0.22 $^{+0.10}_{-0.05}$
$\left(.009 \, ^{+.004}_{-.002}\right)$

5.85(.230)REF

1.25 $^{+0.20}_{-0.10}$ (Mounting height)
$\left(.049 \, ^{+.008}_{-.004}\right)$

▱ 0.10(.004)

5.40(.213)
NOM

"A"

0.15 $^{+0.05}_{-0.02}$
$\left(.006 \, ^{+.002}_{-.001}\right)$

Details of "A" part

0.10±0.10(.004±.004)
(STAND OFF)

0 ~ 10°

0.50±0.20
(.020±.008)

Dimensions in mm (inches).

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FUJITSU LIMITED

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