

## 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.

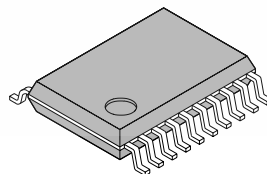
In addition, an off-state reverse current prevention function is provided to ensure accurate on/off switching action.

### 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

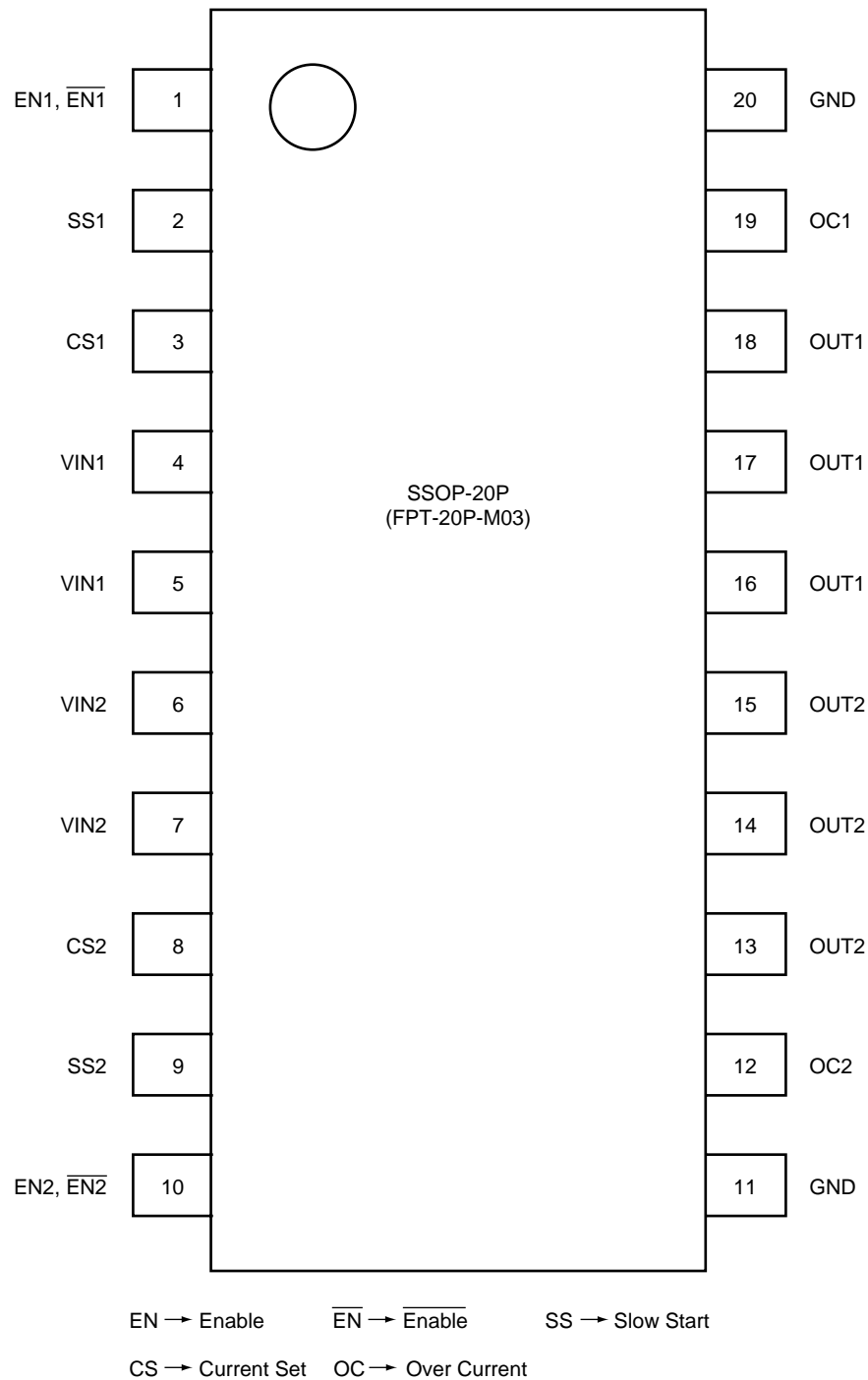
20-pin plastic SSOP



(FPT-20P-M03)

# MB3842/MB3845

## ■ PIN ASSIGNMENT



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

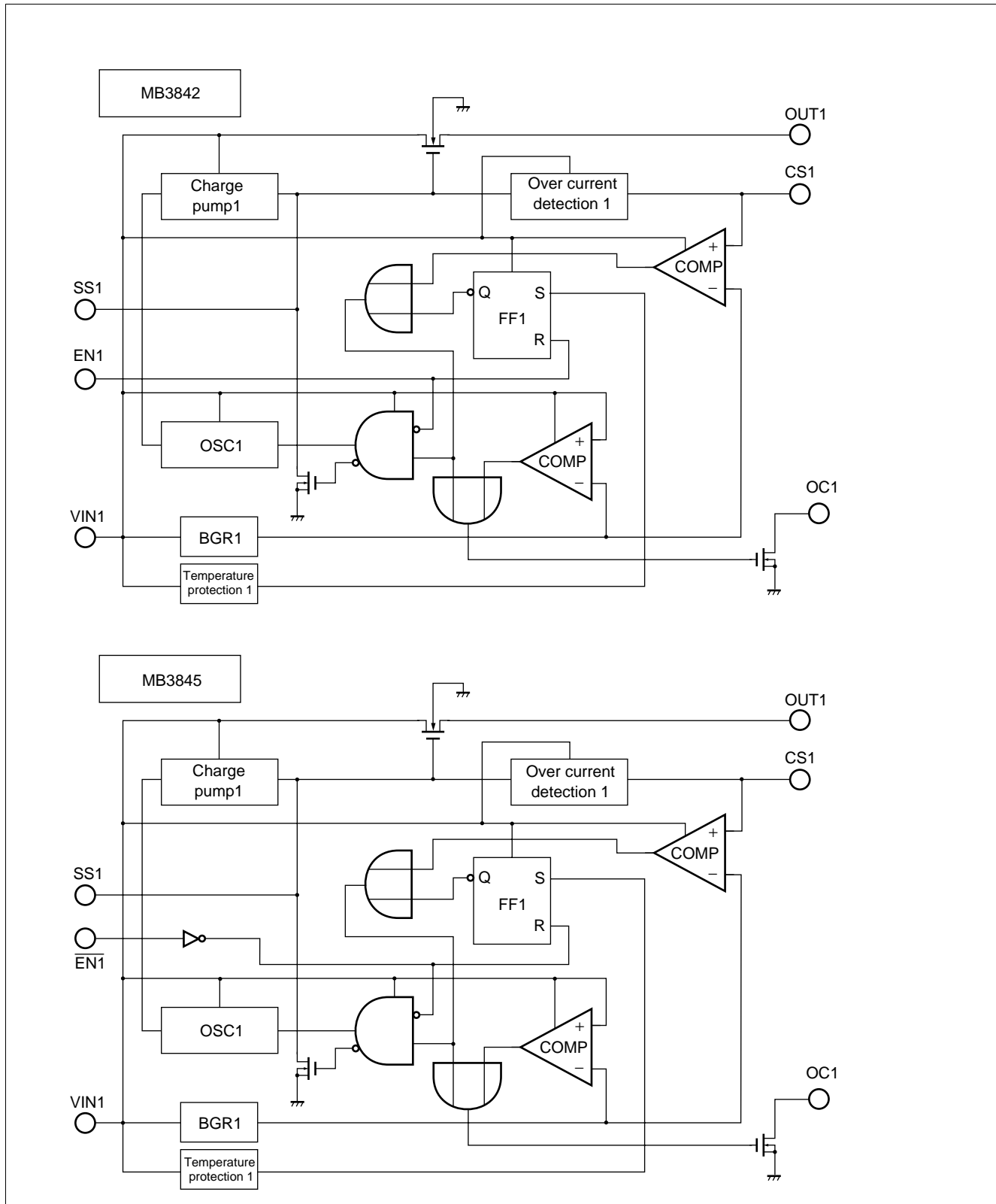
# MB3842/MB3845

## ■ 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 1 $\mu$ A. "L" level is 1.4V (typ), "H" level is 1.6V (typ), with 200mV (typ) hysteresis.
	$\overline{\text{EN}}$ (MB3845)	Control signal input pin. Set "L" to turn switch on, "H" to turn off. At "H" level = $V_{\text{IN}}$ , the chip is in STBY state and current consumption is less than 1 $\mu$ A. Normally used as CMOS inverter input, so that recommended use is "L" level at GND +0.5V or less, and "H" level is $V_{\text{IN}}$ -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 ( $V_{\text{IN}}$ power monitor function) is provided so that when $V_{\text{IN}}$ reaches 2.3V (typ.) or higher the OC pin voltage goes to "H" level. Also if the $V_{\text{IN}}$ 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)



## ■ 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	$P_D$	$T_a = +85^{\circ}\text{C}$	—	216	mW
Storage temperature	$T_{STG}$	—	−55	+125	$^{\circ}\text{C}$

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	$I_{SW}$	$V_{IN} = 2.5 \text{ V to } 5.5 \text{ V}$	—	—	0.6	A
SS pin capacitance	$C_{SS}^*$	—	—	—	10	nF
OC sink current	$I_{OCS}$	$V_{IN} = 5.0 \text{ V}, V_{OC} = 0.4 \text{ V}$	2.0	5.0	—	mA
Current limit resistance	$R_{LIM}^*$	$V_{IN} = 5.0 \text{ V} (I_{SW} = 0.6 \text{ A})$	1.4	2.0	2.6	$k\Omega$
		$V_{IN} = 5.0 \text{ V} (I_{SW} = 0.1 \text{ A})$	3.6	6.2	9.1	$k\Omega$
Operating temperature	$T_{OP}$	—	−20	—	+85	$^{\circ}\text{C}$

\* : 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

( $V_{IN} = 5\text{ V}$ ,  $T_a = +25^\circ\text{C}$ )

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

• MB3842

( $V_{IN} = 5\text{ V}$ ,  $T_a = +25^\circ\text{C}$ )

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

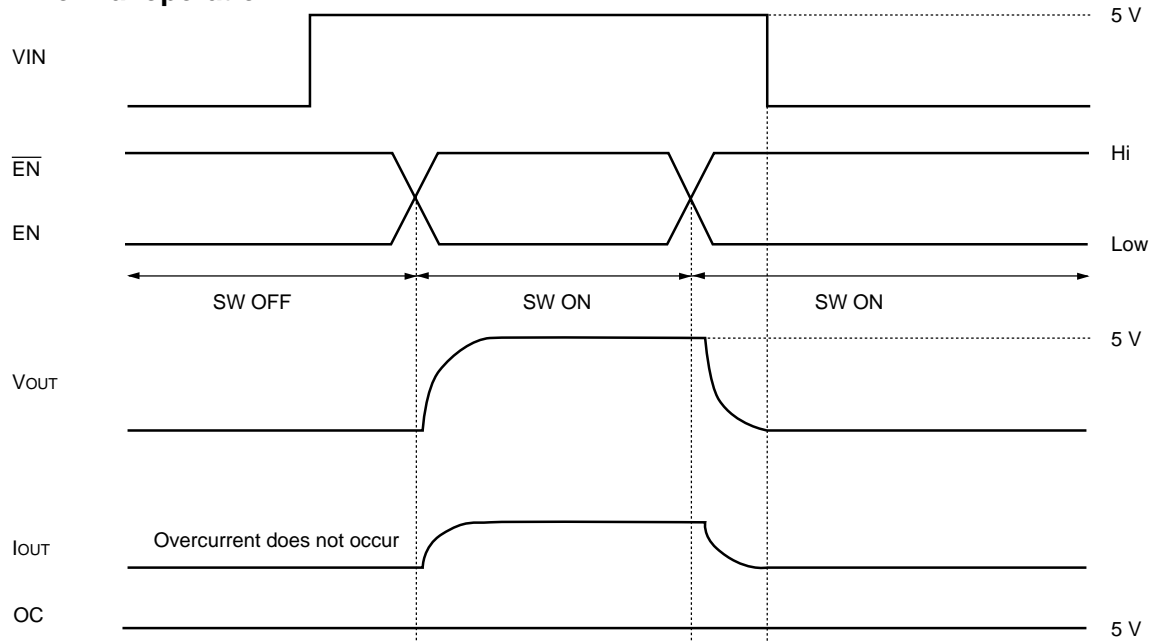
• MB3845

( $V_{IN} = 5\text{ V}$ ,  $T_a = +25^\circ\text{C}$ )

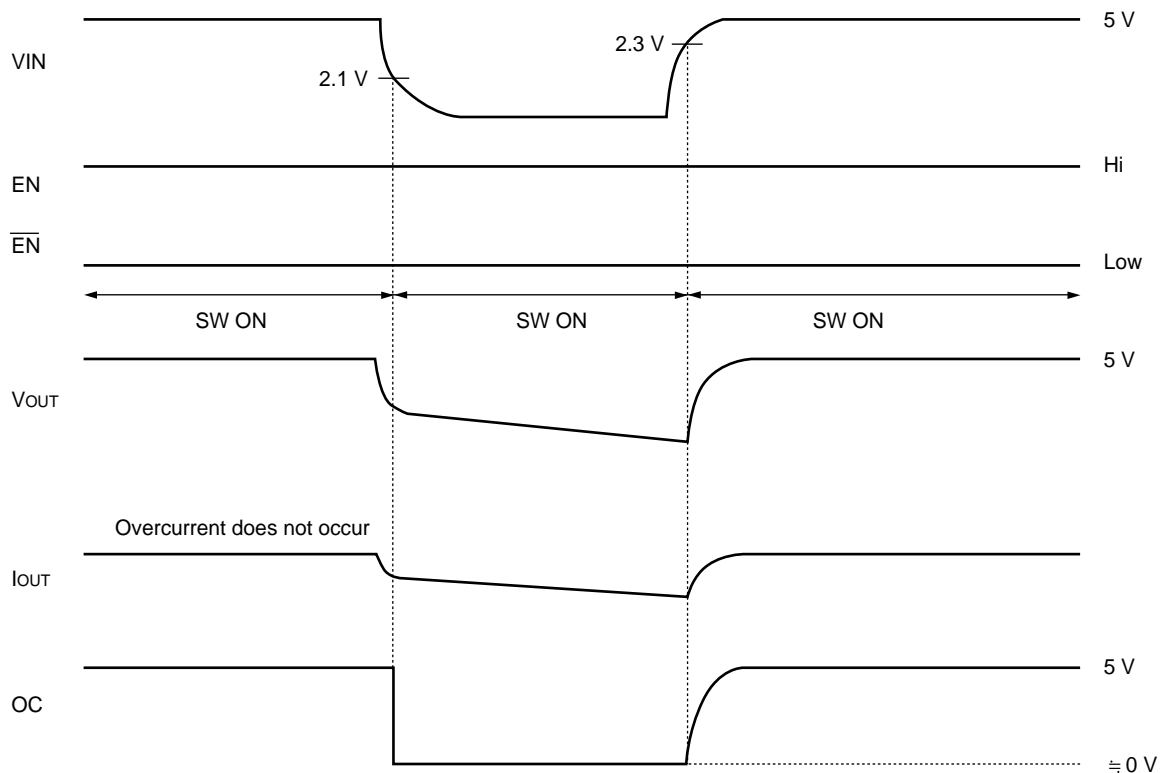
Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
$\overline{\text{ENABLE}}$ pin input current	$I_{ENH}$	$V_{EN} = 5\text{ V}$ , $I_{SW} = 0\text{ A}$	—	0.0	—	$\mu\text{A}$
	$I_{ENL}$	$V_{EN} = 0\text{ V}$ , $I_{SW} = 0\text{ A}$	—	0.0	—	$\mu\text{A}$
$\overline{\text{ENABLE}}$ pin input voltage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

## ■ DIAGRAM

### • Normal operation



### • At $V_{IN}$ fall



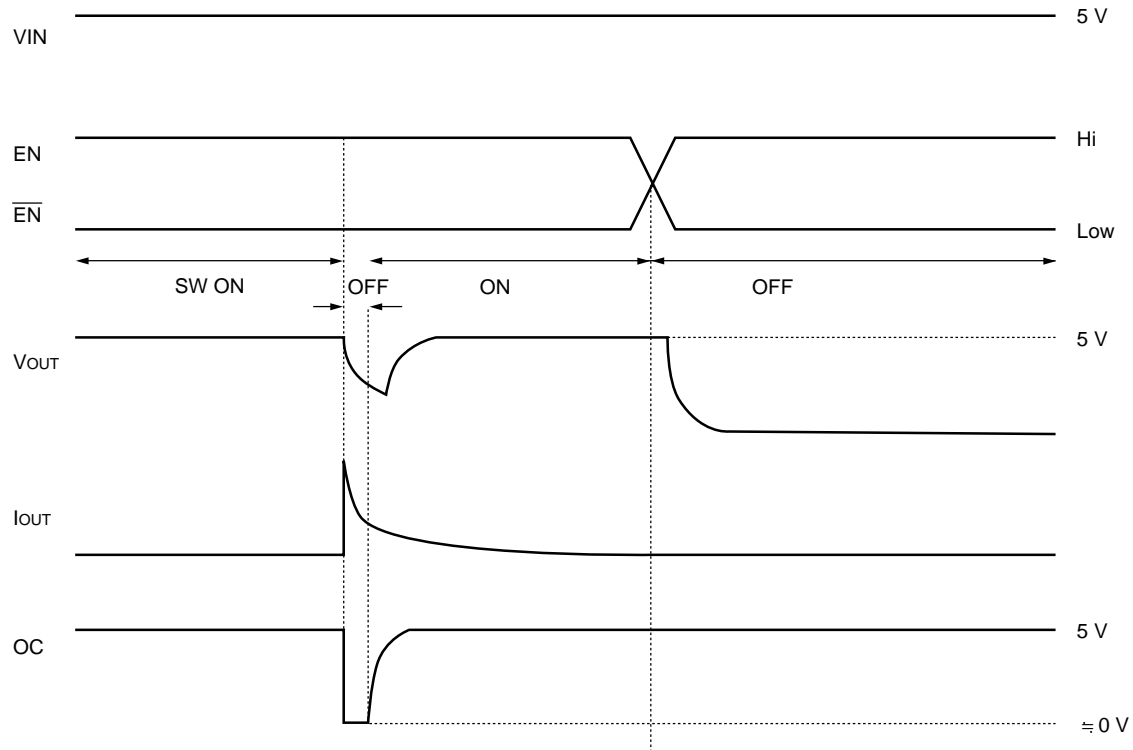
Note: The OC pin should be pulled up using a separate power supply and resistance.  
(This illustration shows pull-up with a separate 5V source.)

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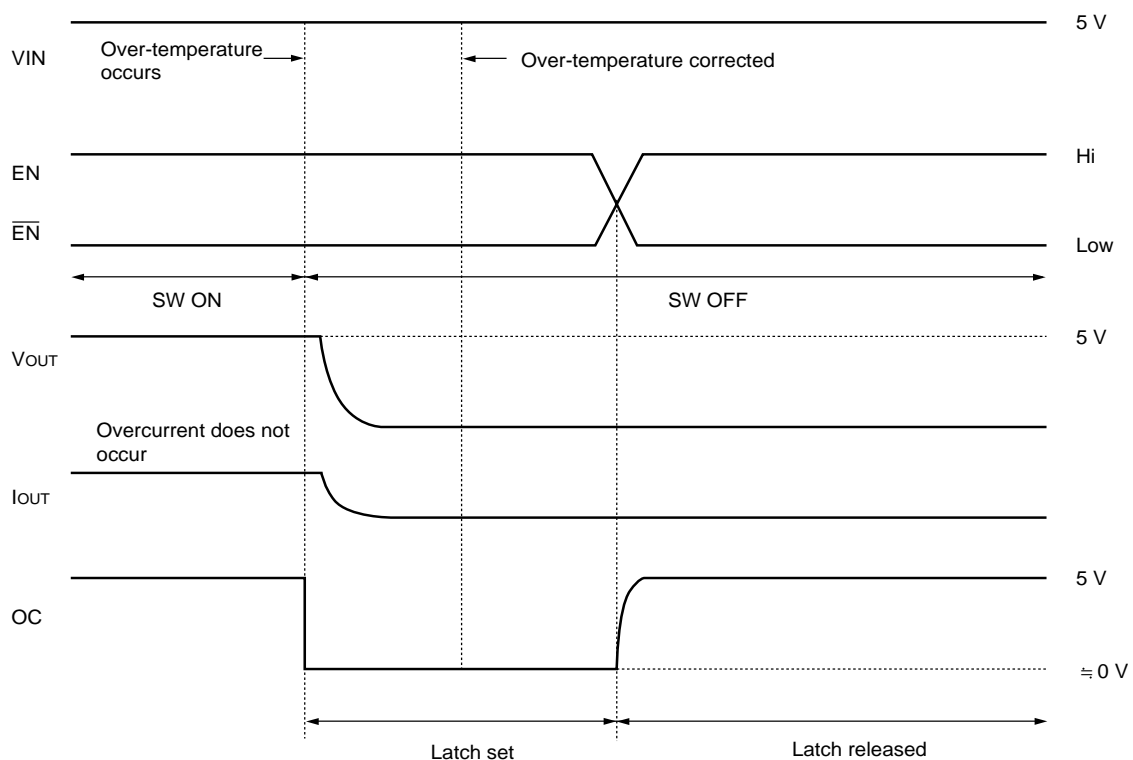
# MB3842/MB3845

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- At overcurrent detection



- At over-temperature occurrence



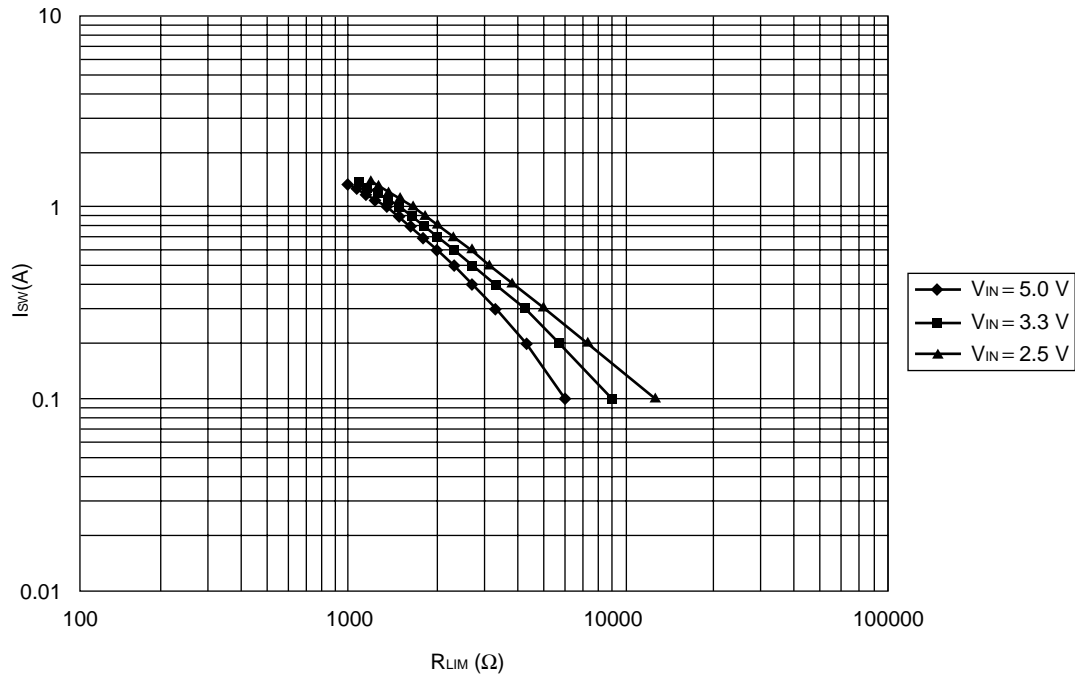
Note: The OC pin should be pulled up using a separate power supply and resistance.  
(This illustration shows pull-up with a separate 5V source.)



■ TYPICAL CHARACTERISTICS

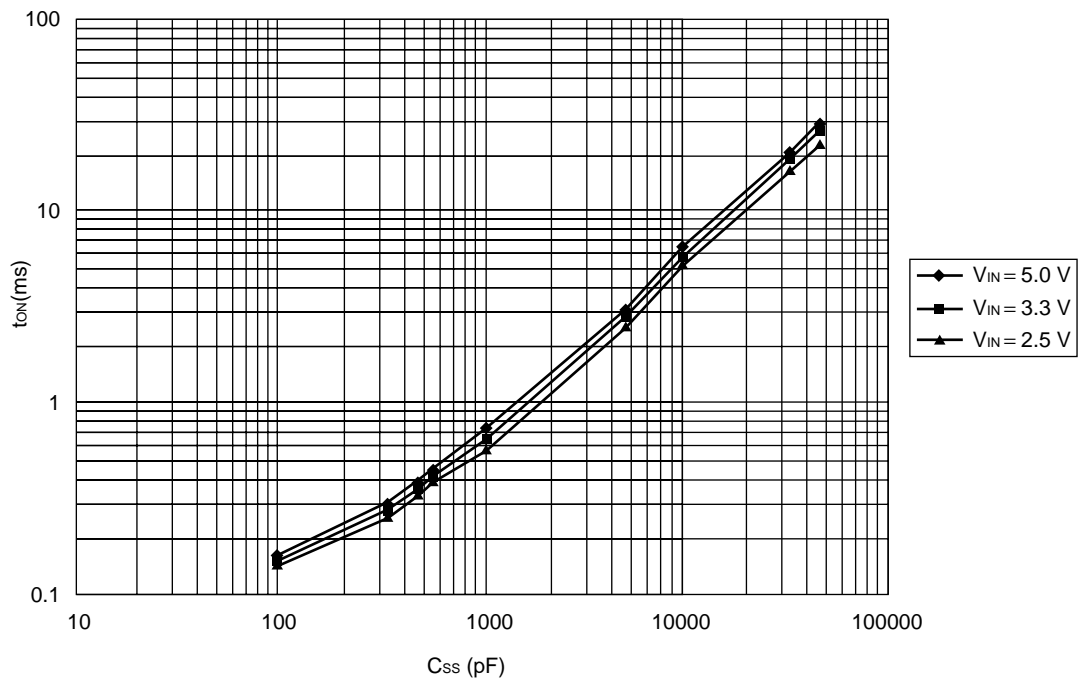
•  $R_{LIM}$  vs. limit current characteristics

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



•  $C_{SS}$  vs.  $T_{ON}$  (SS) characteristics

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

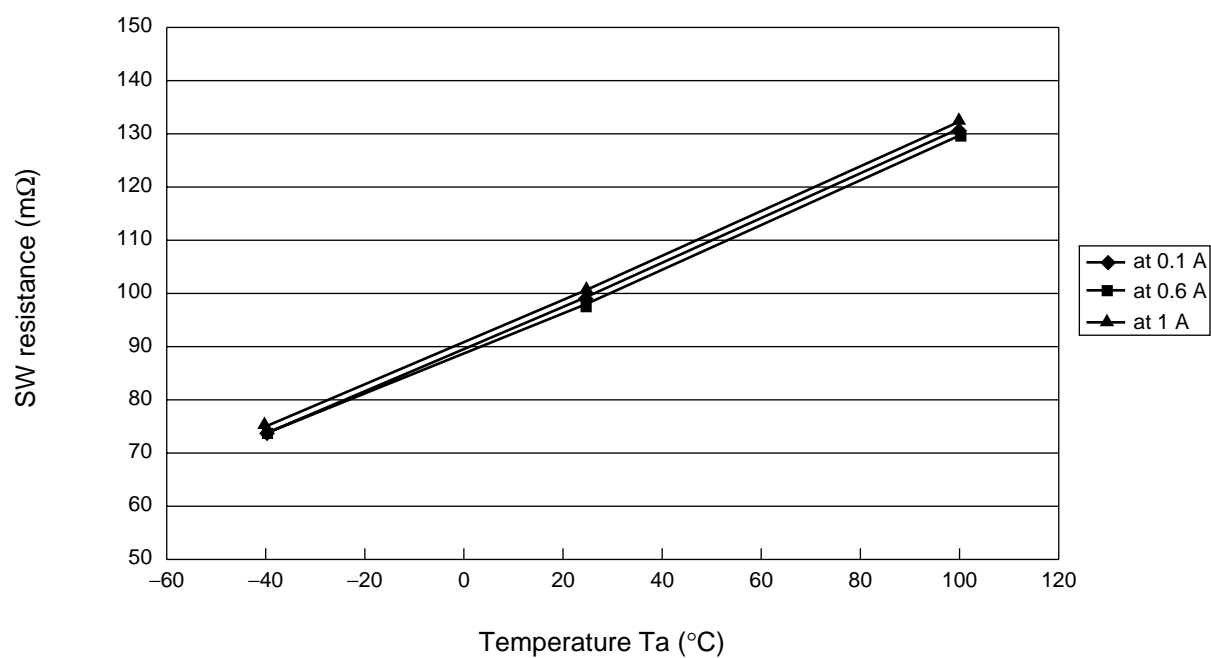


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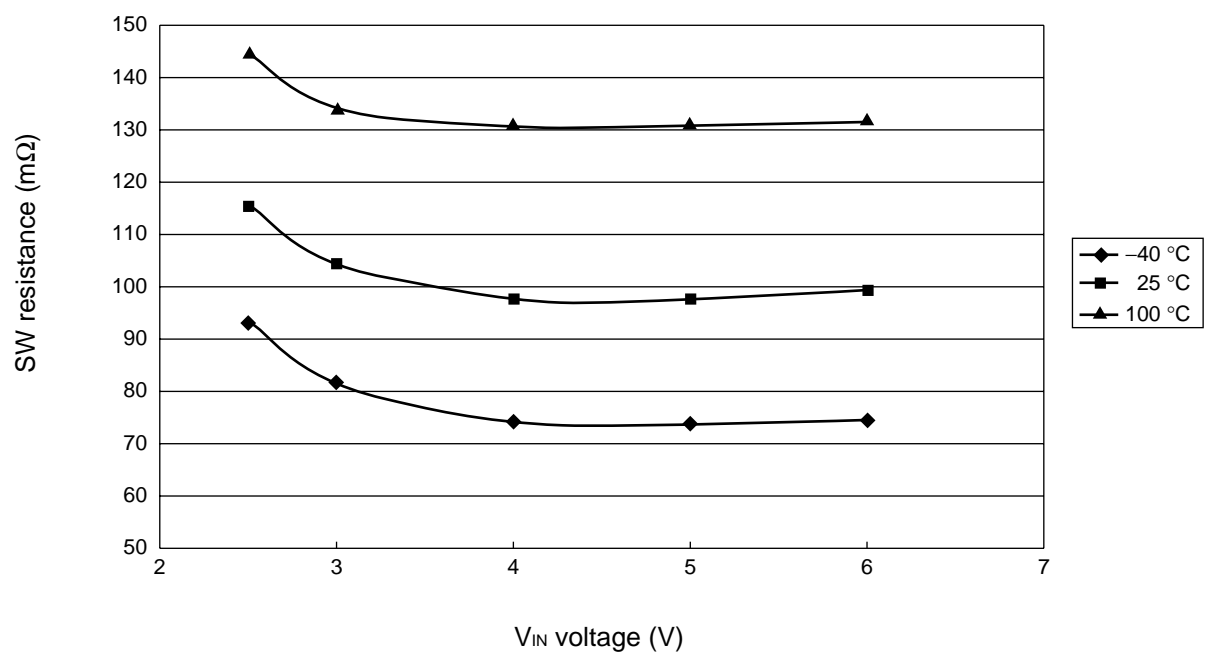
# MB3842/MB3845

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## • SW resistance vs. temperature characteristics



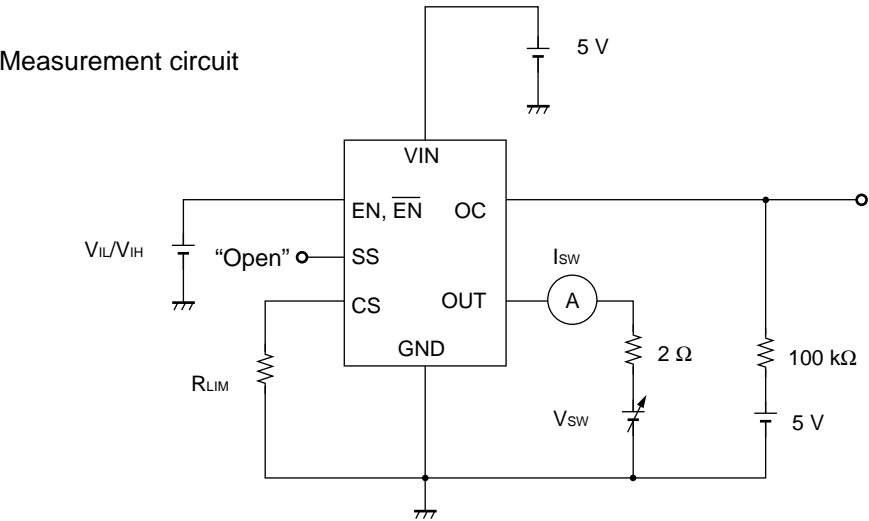
## • Temperature-dependent SW resistance vs. $V_{\text{IN}}$ (V) characteristics



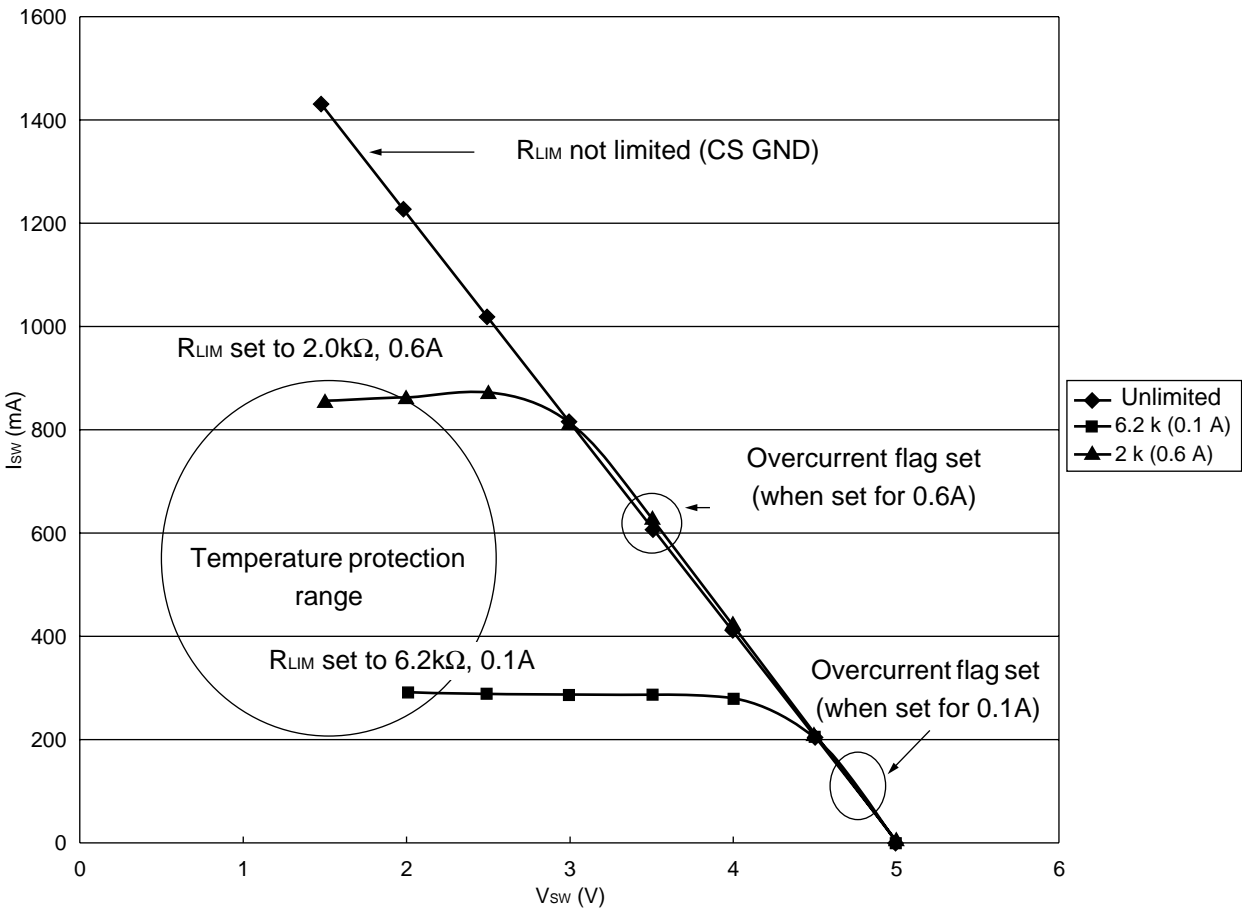
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• Output power ( $I_{sw}$ ) saturation characteristics



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

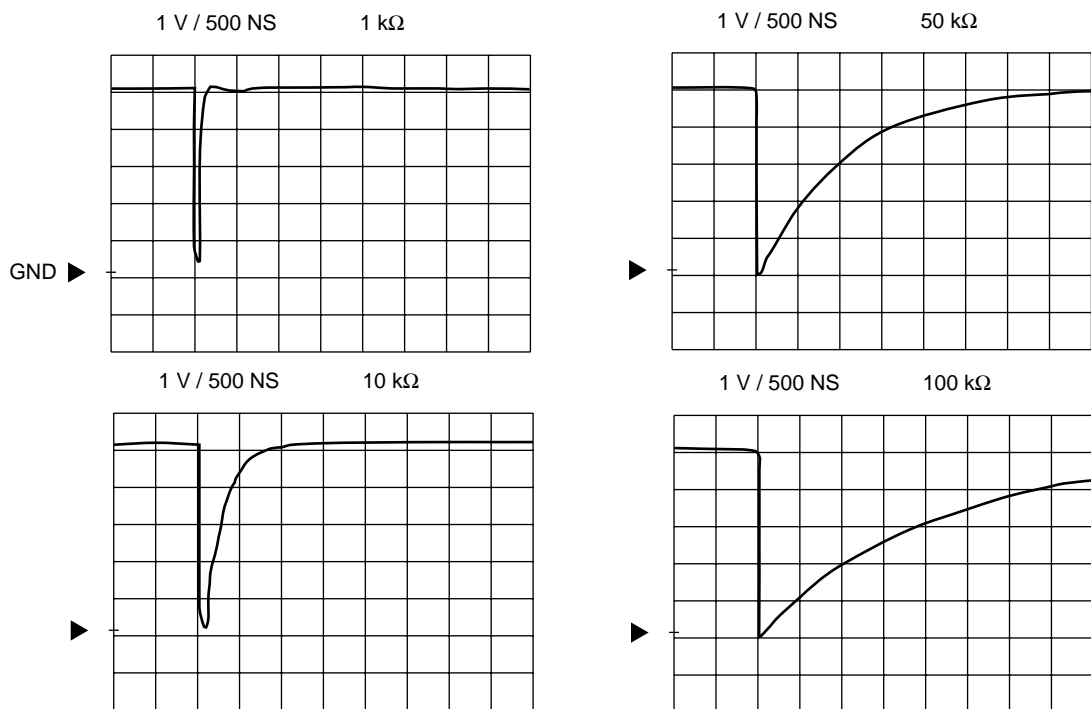


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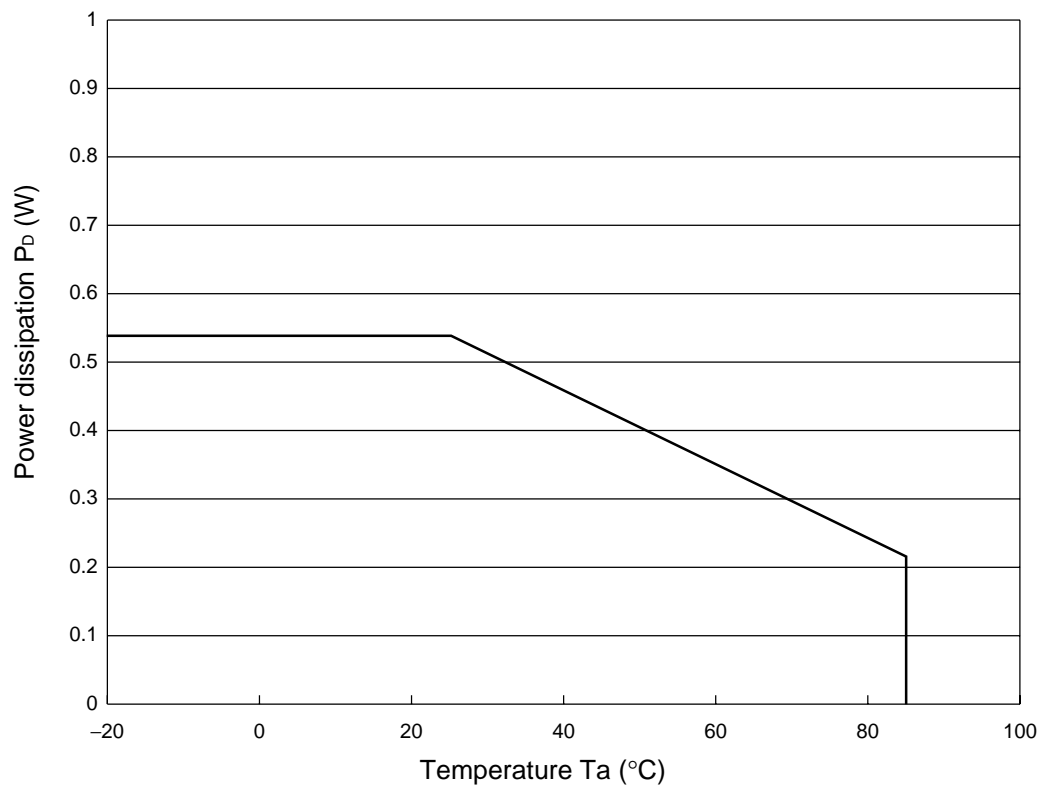
# MB3842/MB3845

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



- Power derating characteristics



# MB3842/MB3845

## ■ 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  $\pm 30\%$  accuracy ( $V_{IN} = 5\text{ V}$ , 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  $\overline{\text{EN}}$  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  $125^{\circ}\text{C}$ .

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  $\overline{\text{EN}}$  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 “C<sub>SS</sub> vs. t<sub>ON</sub> (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.

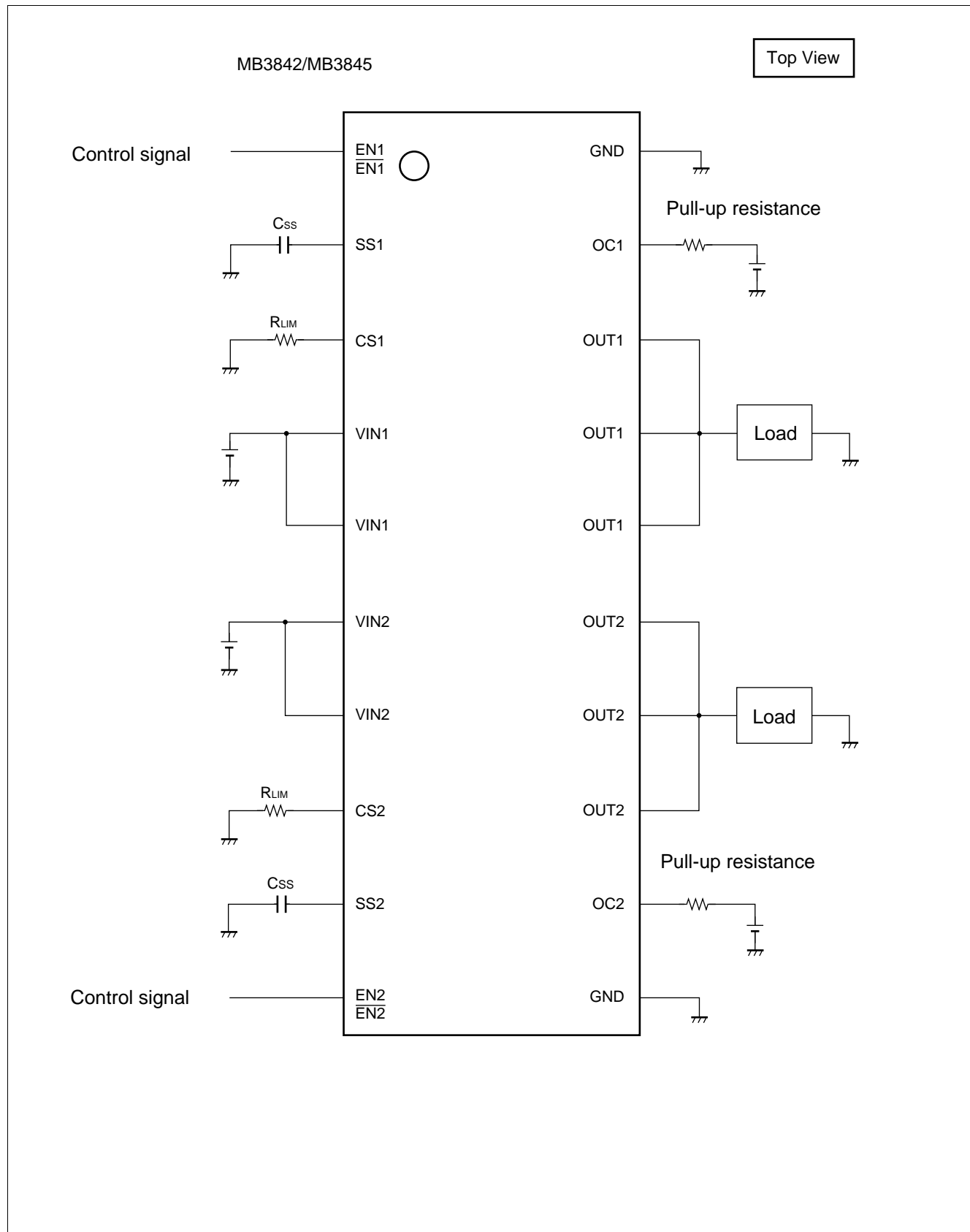
(note) Output current limit setting resistance values are shown on P9, and in the following table. (CS pin-to-GND)

### 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
$V_{IN} 5.0\text{V}$	6.2 k $\Omega$	4.3 k $\Omega$	3.3 k $\Omega$	2.7 k $\Omega$	2.2 k $\Omega$	2.0 k $\Omega$	1.8 k $\Omega$	1.6 k $\Omega$	1.4 k $\Omega$	1.3 k $\Omega$
$V_{IN} 3.3\text{V}$	9.1 k $\Omega$	5.6 k $\Omega$	4.3 k $\Omega$	3.3 k $\Omega$	2.7 k $\Omega$	2.4 k $\Omega$	2.0 k $\Omega$	1.8 k $\Omega$	1.6 k $\Omega$	1.5 k $\Omega$
$V_{IN} 2.5\text{V}$	13 k $\Omega$	7.5 k $\Omega$	5.1 k $\Omega$	3.9 k $\Omega$	3.0 k $\Omega$	2.7 k $\Omega$	2.2 k $\Omega$	2.0 k $\Omega$	1.8 k $\Omega$	1.6 k $\Omega$

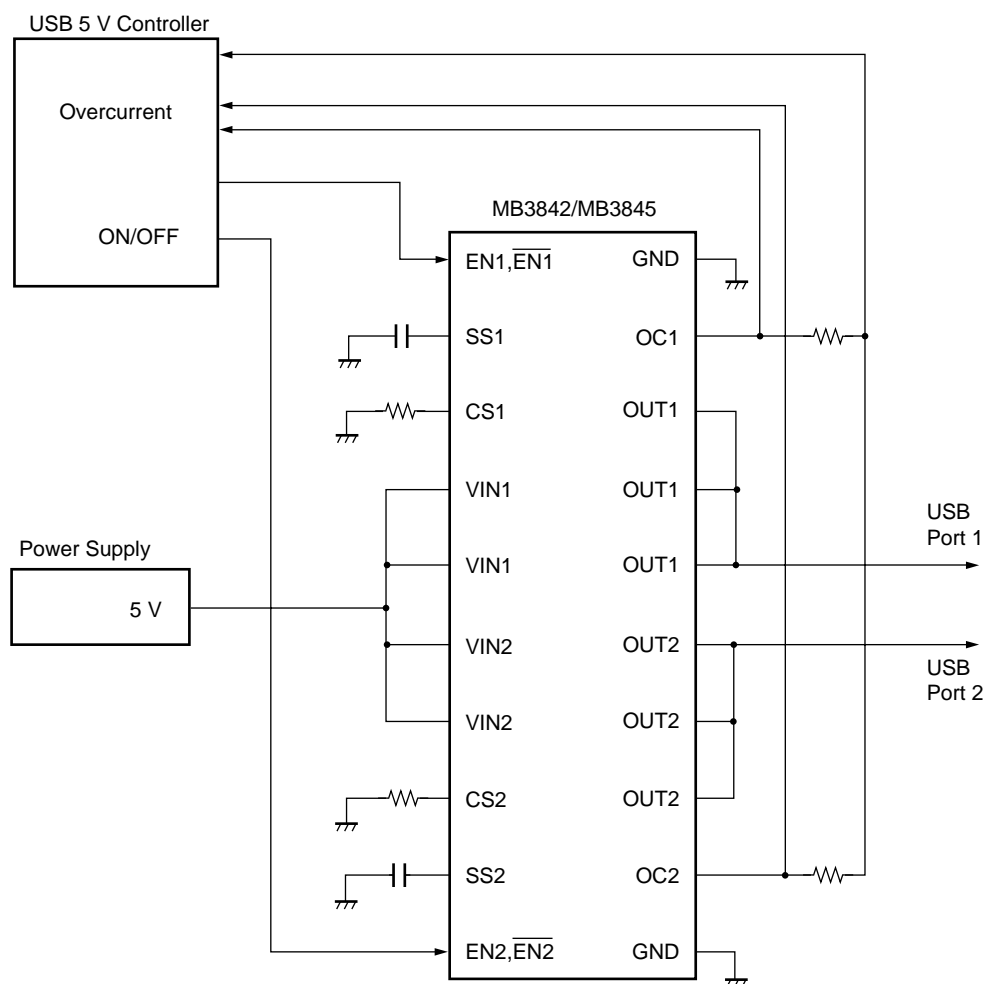
# MB3842/MB3845

## ■ TYPICAL APPLICATION



## ■ APPLICATION EXAMPLE

### (1) Dual-Port Self-Powered Hub Application (NON-GANG Mode Connection)



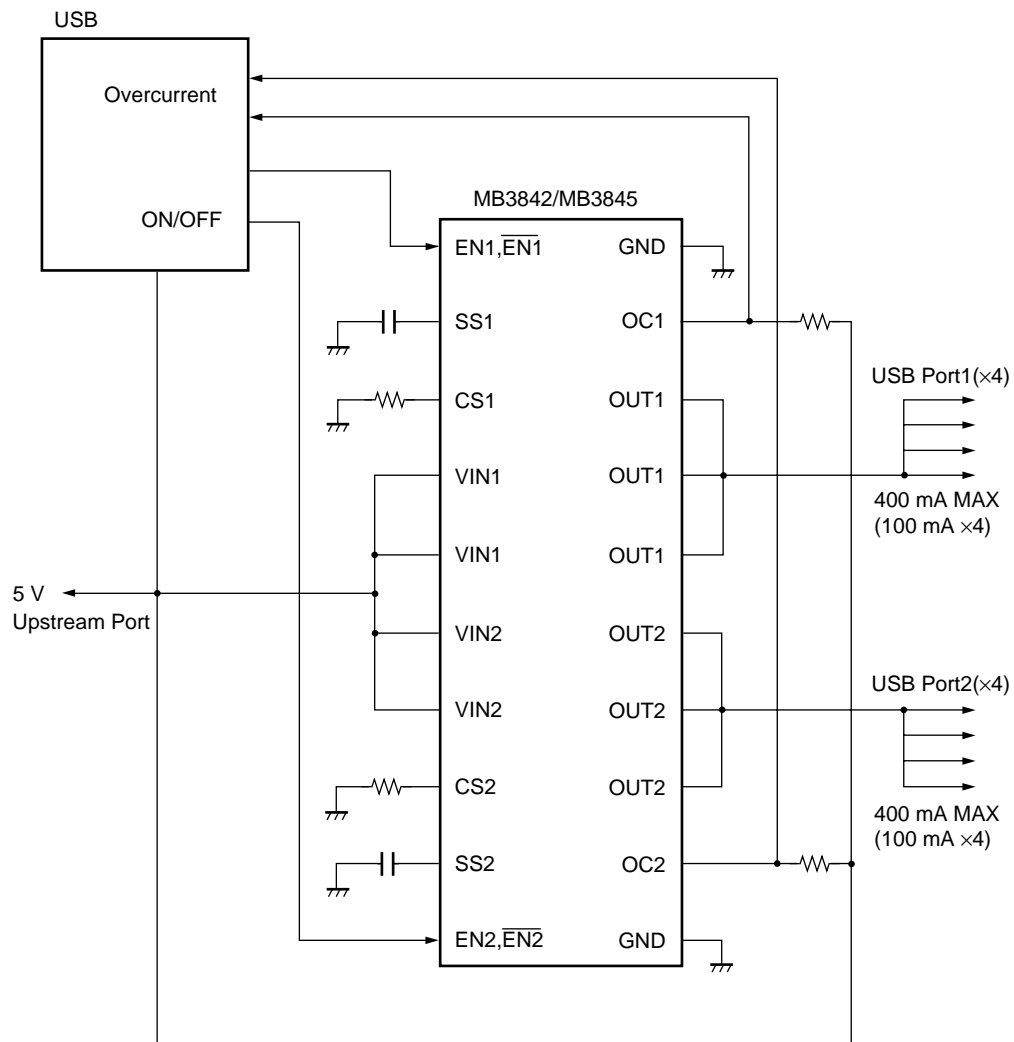
\*The MB3842 can also be adapted for use with 3.3V controllers.

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 Port 100mA MAX Par Port

Smoothing capacitors should be placed between  $V_{IN}$  and GND, or between OUT and GND as required.



## ■ 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 k $\Omega$  to 1 M $\Omega$  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

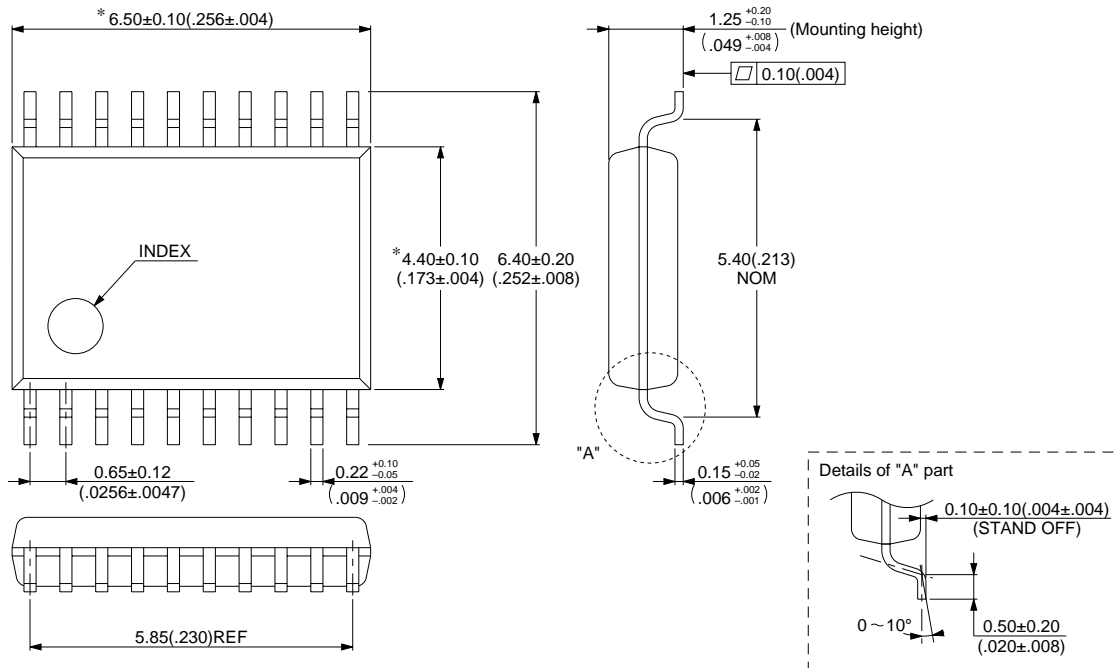
Part number	Package	Remarks
MB3842PFV MB3845PFV MB3845PFV-ER	20-pin Plastic SSOP (FPT-20P-M03)	

# MB3842/MB3845

## ■ PACKAGE DIMENSION

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

\*: These dimensions do not include resin protrusion.



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Dimensions in mm (inches).

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