FUJITSU SEMICONDUCTOR
DATA SHEET

ASSP   For Power Supply Applications (Lithium-ion Battery Chargers)

DC/DC Converter IC (High Precision with Constant-current Function)

MB3813A/MB3833A/MB3843

■ DESCRIPTION

The FUJITSU MB3813A/33A/43 is a pulse width modulation (PWM) DC/DC converter IC with independent output voltage and current setting capability.

The use of on-chip output setting resistance enables high precision output voltage control. Also, an output voltage switching feature for use with either graphite-electrode or coke-electrode lithium-ion batteries makes this IC ideal for internal battery chargers in notebook personal computers and similar applications.

| Cell count	Output voltage	Part number
3-cell	12.6 V/12.3 V	MB3813A
2-cell	8.4 V/8.2 V	MB3833A
1-cell	4.2 V/4.1 V	MB3843

■ FEATURES

- Output setting resistance is on-chip for high precision output voltage: $\pm 1.0\%$
- SEL pin enables output voltage selection
- High precision reference voltage source: $2.5 \text{ V} \pm 1.0\%$
- High frequency operating capability: max. 500 kHz
- On-chip current detector amplifier with wide in-phase input voltage range: 0 V to V_{CC}

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■ PACKAGE
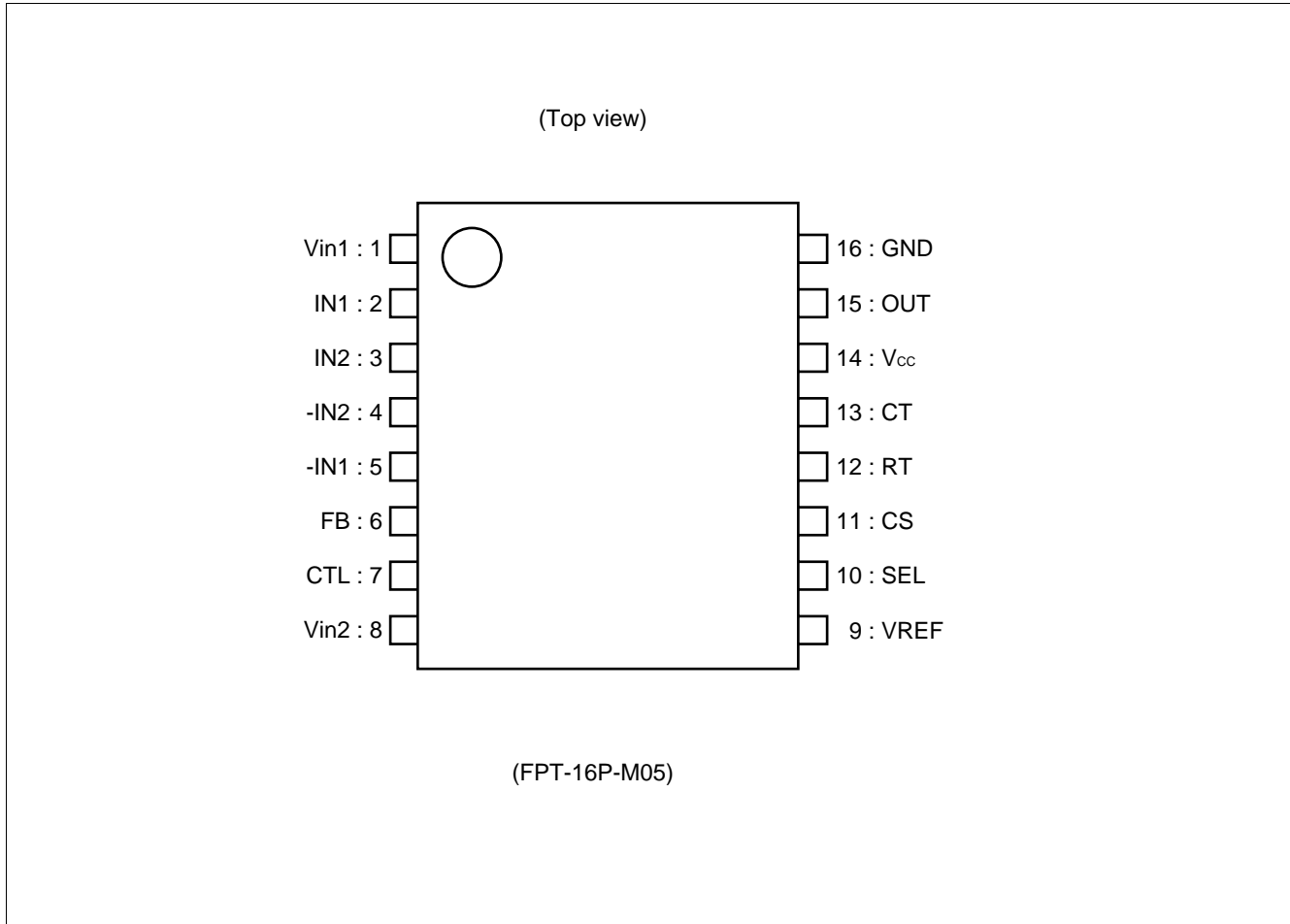
16-pin Plastic SSOP
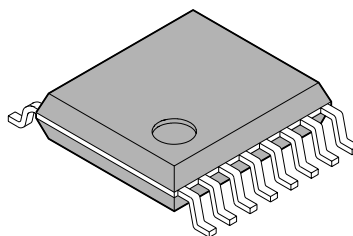
(FPT-16P-M05)

MB3813A/MB3833A/MB3843

(Continued)
- On-chip standby function
- On-chip input voltage detector circuit
- On-chip soft start control circuit
- On-chip output overshoot protection circuit for rapid load changes
- On-chip totem-pole output circuits for P-ch. MOS FET devices
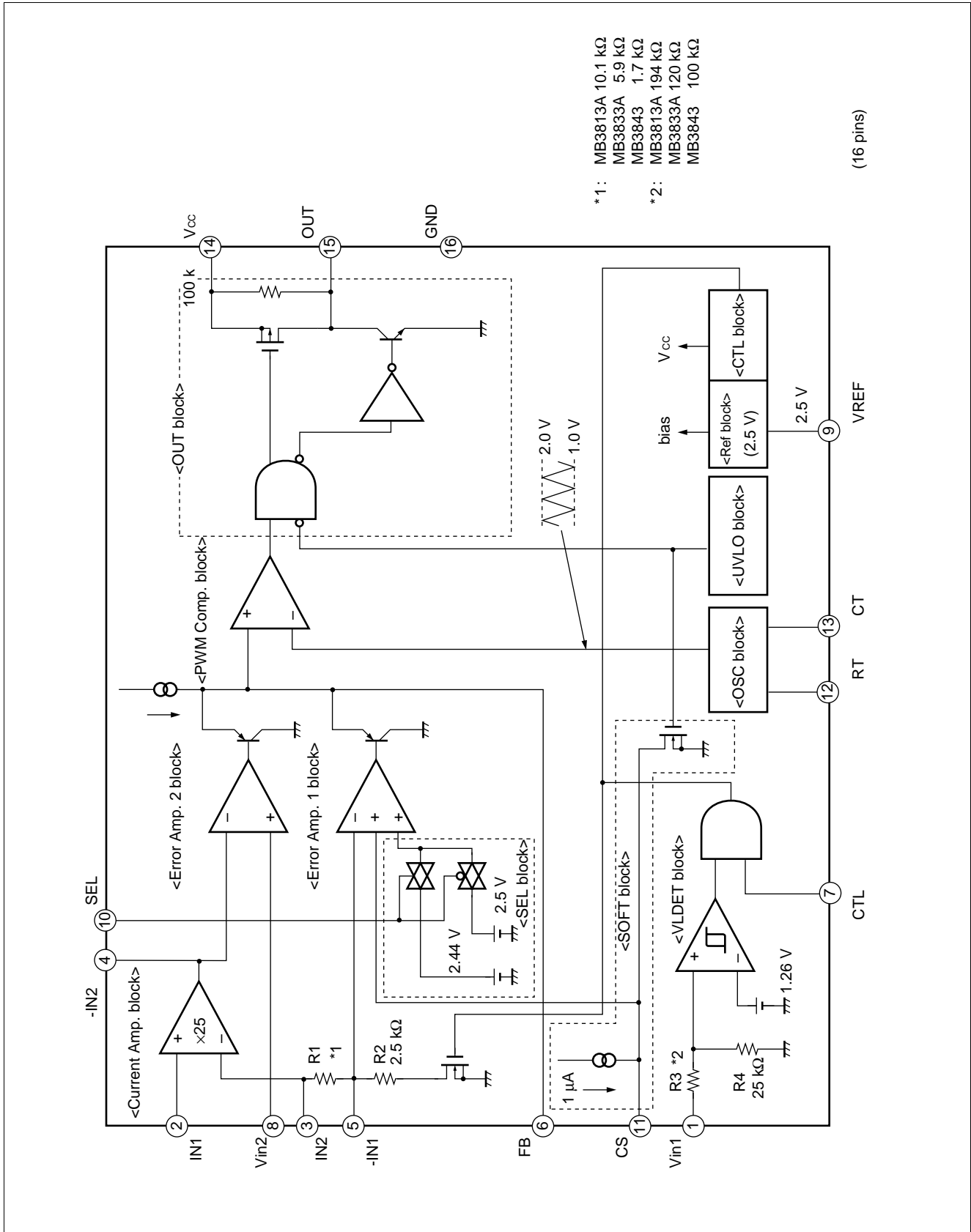
MB3813A/MB3833A/MB3843

■ **PIN ASSIGNMENT**

(Top view)

Vin1 : 1   16 : GND

IN1 : 2   15 : OUT

IN2 : 3   14 : V_{CC}

-IN2 : 4   13 : CT

-IN1 : 5   12 : RT

FB : 6   11 : CS

CTL : 7   10 : SEL

Vin2 : 8   9 : VREF

(FPT-16P-M05)

MB3813A/MB3833A/MB3843

■ PIN DESCRIPTION

Pin no.	Symbol	I/O	Descriptions
1	Vin1	I	Input voltage detector block (VLDET) input pin
2	IN1	I	Current detector amplifier (Current Amp.) input pin
3	IN2	I	Output voltage feedback input pin
4	-IN2	I	Error amplifier (Error Amp.2) inverted input pin
5	-IN1	I	Error amplifier (Error Amp.1) inverted input pin
6	FB	O	Error amplifier (Error Amp.1, 2 common) output pin
7	CTL	I	Power supply control pin An "L" level signal input to the CTL pin sets the IC in standby mode.
8	Vin2	I	DC/DC converter charging current setting input pin
9	VREF	O	Reference voltage output pin
10	SEL	I	Output voltage switching pin "L" level output voltage: MB3813A 12.6 V MB3833A 8.4 V MB3843 4.2 V "H" level output voltage: MB3813A 12.3 V MB3833A 8.2 V MB3843 4.1 V
11	CS	—	Soft start capacitor connection pin
12	RT	—	Triangular wave frequency setting resistor connection pin
13	CT	—	Triangular wave frequency setting capacitor connection pin
14	V_{CC}	—	Power supply pin
15	OUT	O	Totem-pole output pin
16	GND	—	Ground pin

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MB3813A/MB3833A/MB3843

■ BLOCK DIAGRAM

*1 : MB3813A 10.1 kΩ
      MB3833A   5.9 kΩ
      MB3843   1.7 kΩ
*2 : MB3813A 194 kΩ
      MB3833A 120 kΩ
      MB3843   100 kΩ

(16 pins)

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MB3813A/MB3833A/MB3843

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Value Min.	Value Max.	Unit
Power supply voltage	V_{CC}	—	—	20	V
Input voltage	V_{IN}	Vin1, IN1, IN2	—	20	V
Control input voltage	V_{CTL}	—	—	20	V
Select input voltage	V_{SEL}	—	—	20	V
Output current	I_O	—	—	50	mA
Peak output current	I_O	Duty ≤ 5% (t = f_{OSC} × Duty)	—	500	mA
Allowable dissipation	P_D	Ta ≤ +25°C	—	440*	mW
Storage temperature	Tstg	—	–55	+125	°C

* : When mounted on a 10 cm-square dual-sided epoxy base board

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 Min.	Value Typ.	Value Max.	Unit
Power supply voltage	V_{CC}	MB3813A	12	16	18	V
		MB3833A	8	16	18	V
		MB3843	7	16	18	V
Reference voltage output current	I_{OR}	—	–1	—	0	mA
Input voltage	V_{IN}	Vin1, IN1, IN2	0	—	18	V
	V_{IN}	Vin2	0	—	2.5	V
Control input voltage	V_{CTL}	—	0	—	18	V
Select input voltage	V_{SEL}	—	0	—	18	V
Peak output current	I_O	Duty ≤ 5% (t = f_{OSC} × Duty)	–300	—	300	mA
Oscillator frequency	f_{OSC}	—	10	200	500	kHz
Soft start capacitance	C_S	—	—	0.1	1.0	µF
Timing resistance	R_T	—	10	15	100	kΩ
Timing capacitance	C_T	—	100	330	10000	pF
Operating temperature	Ta		–30	25	85	°C

WARNING: Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. 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 representative beforehand.

MB3813A/MB3833A/MB3843

■ ELECTRICAL CHARACTERISTICS

$(V_{CC} = V_{in1} = +16 \text{ V}, V_{SEL} = 0 \text{ V}, Ta = +25°C)$

Parameter		Symbol	Pin no.	Condition	Value			Unit	Remarks
					Min.	Typ.	Max.		
Reference voltage block (Ref)	Output voltage	V_{REF}	9	—	2.475	2.500	2.525	V	
	Input stability	Line	9	$V_{CC} = 12$ V to 18 V	—	1.0	10.0	mV	MB3813A
		Line	9	$V_{CC} = 8$ V to 18 V	—	1.0	10.0	mV	MB3833A
		Line	9	$V_{CC} = 7$ V to 18 V	—	1.0	10.0	mV	MB3843
	Load stability	Load	9	VREF = −0 µA to −500 µA	—	3.0	10.0	mV	
Under voltage lockout circuit block (UVLO)	Threshold voltage	V_{TH}	9	VREF = "L" → "H"	1.8	2.0	2.2	V	
	Hysteresis voltage	V_H	9	—	—	0.2	0.35	V	
Input voltage detector block (VLDET)	Threshold voltage	V_{TH}	1	Vin1 = "L" → "H"	10.2	11.0	11.8	V	MB3813A
		V_{TH}	1		6.7	7.3	7.9	V	MB3833A
		V_{TH}	1		5.8	6.3	6.8	V	MB3843
	Hysteresis voltage	V_H	1	—	—	1.0	2.0	V	MB3813A
		V_H	1		—	0.7	1.4	V	MB3833A
		V_H	1		—	0.57	1.2	V	MB3843
	Input current	I_{IH}	1	Vin1 = 16 V	—	150	300	µA	MB3813A
		I_{IH}	1		—	270	540	µA	MB3833A
		I_{IH}	1		—	310	620	µA	MB3843
		I_{IL}	1	Vin1 = 0 V	−1.0	—	1.0	µA	
Soft start block (UVLO)	Charge current	I_{CS}	11	—	−1.4	−1.0	−0.6	µA	
Triangular wave oscillator block (OSC)	Oscillator frequency	f_{OSC}	15	CT = 330 pF, RT = 15 kΩ	180	200	220	kHz	
Error amplifier (Error Amp.1)	Threshold voltage	VT1	3	FB = 1.5 V, SEL = 0 V	12.474	12.60	12.726	V	MB3813A
		VT1	3		8.316	8.40	8.484	V	MB3833A
		VT1	3		4.158	4.20	4.242	V	MB3843
		VT1	3	FB = 1.5 V, Ta = −30°C to +85°C	12.41	12.60	12.79	V	MB3813A
		VT1	3		8.27	8.40	8.53	V	MB3833A
		VT1	3		4.13	4.20	4.26	V	MB3843

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MB3813A/MB3833A/MB3843

(V_{CC} = Vin1 = +16 V, V_{SEL} = 0 V, Ta = +25°C)

Parameter		Symbol	Pin no.	Condition	Min.	Typ.	Max.	Unit	Remarks
Error amplifier (Error Amp.1)	Threshold voltage	VT2	3	FB = 1.5 V, SEL = 5 V	12.177	12.30	12.423	V	MB3813A
		VT2	3		8.118	8.20	8.282	V	MB3833A
		VT2	3		4.059	4.10	4.141	V	MB3843
		VT2	3	FB = 1.5 V, Ta = −30°C to +85°C	12.11	12.30	12.49	V	MB3813A
		VT2	3		8.07	8.20	8.33	V	MB3833A
		VT2	3		4.04	4.10	4.16	V	MB3843
	Input stability	Line	3	V_{CC} = 13 V to 18 V, output 12.6 V	—	2.5	10.0	mV	MB3813A
		Line	3	V_{CC} = 9 V to 18 V, output 8.4 V	—	2.5	10.0	mV	MB3833A
		Line	3	V_{CC} = 7 V to 18 V, output 4.2 V	—	2.5	10.0	mV	MB3843
	Input current	IIN2	3	IN1 = 12.7 V, IN2 = 12.6 V	—	1.0	2.0	mA	MB3813A
		IIN2	3	IN1 = 8.5 V, IN2 = 8.4 V	—	1.0	2.0	mA	MB3833A
		IIN2	3	IN1 = 4.3 V, IN2 = 4.2 V	—	1.0	2.0	mA	MB3843
		IIN2	3	Vin1 = 0 V, IN2 = 12.6 V	−1.0	—	1.0	µA	MB3813A
		IIN2	3	Vin1 = 0 V, IN2 = 8.4 V	−1.0	—	1.0	µA	MB3833A
		IIN2	3	Vin1 = 0 V, IN2 = 4.2 V	−1.0	—	1.0	µA	MB3843
	Input resistance	R1	3	—	7.0	10.1	13.2	kΩ	MB3813A
		R1	3		4.1	5.9	7.7	kΩ	MB3833A
		R1	3		1.2	1.7	2.3	kΩ	MB3843
		R2	5	—	1.7	2.5	3.3	kΩ	
Error amplifier (Error Amp.2)	Input bias current	IB	8	Vin2	−400	−30	—	nA	
	Input offset voltage	V_{IO}	5	FB = 1.5 V	—	—	5	mV	
Error amplifiers (Error Amp.1,2 common)	Voltage gain	AV	—	DC	—	100*	—	dB	
	Frequency bandwidth	BW	—	AV = 0 dB	—	800*	—	kHz	
	Output voltage	V_{OH}	6	—	2.3	2.5	—	V	
		V_{OL}	6	—	—	0.8	0.9	V	
	Output source current	I_{SOURCE}	6	FB = 1.5 V	—	−120	−60	µA	
	Output sink current	I_{SINK}	6	FB = 1.5 V	0.6	2.0	—	mA	

* : Standard design value   *(Continued)*

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MB3813A/MB3833A/MB3843

$(V_{CC} = Vin1 = +16$ V, $V_{SEL} = 0$ V, Ta $= +25°C)$

Parameter		Symbol	Pin No.	Condition		Value			Unit	Remarks
						Min.	Typ.	Max.		
Current detector amplifier block (Current Amp.)	Threshold voltage	VT1	2	IN2 = 3 V to V$_{CC}$ VT1 = VTH – IN2	Vin2 = 2.5 V	90	100	110	mV	MB3813A
		VT1	2		Vin2 = 0.75 V	20	30	40	mV	MB3813A
		VT1	2	IN2 = 3 V to V$_{CC}$ VT1 = VTH – IN2	Vin2 = 2.5 V	90	100	110	mV	MB3833A
		VT1	2		Vin2 = 0.75 V	20	30	40	mV	MB3833A
		VT1	2	IN2 = 3 V to V$_{CC}$ VT1 = VTH – IN2	Vin2 = 2.5 V	90	100	110	mV	MB3843
		VT1	2		Vin2 = 0.75 V	20	30	40	mV	MB3843
		VT2	2	IN2 = 0 V VT2 = VTH – IN2	Vin2 = 2.5 V	50	100	150	mV	
		VT2	2		Vin2 = 0.75 V	5	30	55	mV	
	Input current	IIN1	2	IN1 = 12.7 V, IN2 = 12.6 V		—	17	34	µA	MB3813A
		IIN1	2	IN1 = 8.5 V, IN2 = 8.4 V		—	17	34	µA	MB3833A
		IIN1	2	IN1 = 4.3 V, IN2 = 4.2 V		—	17	34	µA	MB3843
	In-phase input voltage range	V$_{CM}$	2	—		0	—	V$_{CC}$	V	
	Voltage gain	A$_V$	2	IN1 = 12.7 V, IN2 = 12.6 V		21	25	29	V/V	MB3813A
		A$_V$	2	IN1 = 8.5 V, IN2 = 8.4 V		21	25	29	V/V	MB3833A
		A$_V$	2	IN1 = 4.3 V, IN2 = 4.2 V		21	25	29	V/V	MB3843
PWM comparator block (PWM)	Threshold voltage	VT0	15	Duty cycle = 0%		0.9	1.0	—	V	
		VT100	15	Duty cycle = 100%		—	2.0	2.1	V	
Output block (OUT)	ON resistance	R$_{ON}$	15	OUT = –30 mA		—	12	18	Ω	
	Output voltage	V$_{OL}$	15	OUT = 100 mA		—	1.0	1.4	V	
	Standby leak current	I$_{LO}$	15	V$_{CC}$ = 18 V, OUT = 18 V, CTL = 0 V		–1.0	—	1.0	µA	
Power supply control block (CTL)	Power supply operating mode	V$_{ON}$	7	CTL Voltage		2.0	—	18	V	
	Standby mode	V$_{OFF}$	7	CTL Voltage		0	—	0.8	V	
	Input current	I$_{IH}$	7	CTL = 5 V		—	100	200	µA	
		I$_{IL}$	7	CTL = 0 V		–1.0	—	1.0	µA	

(Continued)

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MB3813A/MB3833A/MB3843

(Continued)   (V_{CC} = Vin1 = +16 V, V_{SEL} = 0 V, Ta = +25°C)

Parameter		Symbol	Pin no.	Condition	Value			Unit	Remarks
					Min.	Typ.	Max.		
Output voltage selection block (SEL)	12.3 V output mode	V_{ON}	10	SEL voltage	2.0	—	18	V	MB3813A
	8.2 V output mode	V_{ON}	10		2.0	—	18	V	MB3833A
	4.1 V output mode	V_{ON}	10		2.0	—	18	V	MB3843
	12.6 V output mode	V_{OFF}	10	SEL voltage	0	—	0.8	V	MB3813A
	8.4 V output mode	V_{OFF}	10		0	—	0.8	V	MB3833A
	4.2 V output mode	V_{OFF}	10		0	—	0.8	V	MB3843
	Input current	I_{IH}	10	CTL = 5 V	−1.0	—	1.0	μA	
		I_{IL}	10	CTL = 0 V	−1.0	—	1.0	μA	
	Input current when power supply OFF	I_{IL}	10	V_{CC} = 0 V, SEL = 5 V	−1.0	—	1.0	μA	
General	Standby current	I_{CCS}	14	CTL = 0 V	—	260	390	μA	
	Power supply current	I_{CC}	14	at output voltage "H" level	—	3.4	5.4	mA	

MB3813A/MB3833A/MB3843

■ TYPICAL CHARACTERISTICS

Reference voltage vs. Power supply voltage characteristics

Vin1 = 20.5 V
CTL = Vcc
Ta = +25°C
I OR = 0 mA

Reference voltage VREF (V) vs. Power supply voltage Vcc (V)
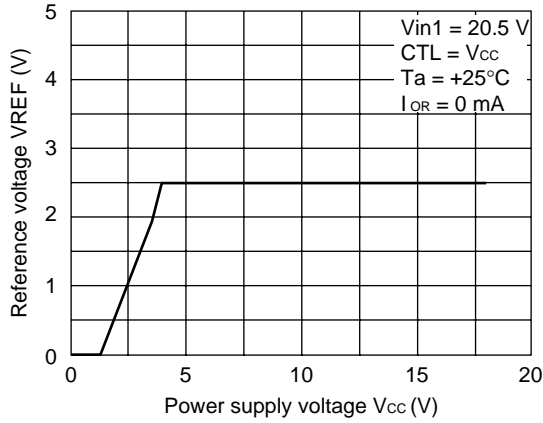
Reference voltage vs. VREF load current characteristics

Vin1 = Vcc
CTL = Vcc
Ta = +25°C
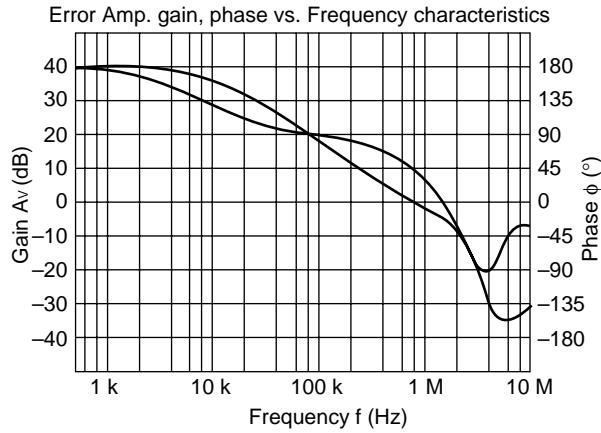
Reference voltage VREF (V) vs. VREF load characteristics I REF (mA)
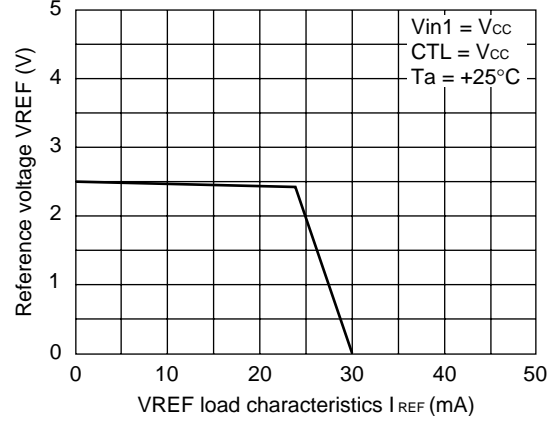
Reference voltage vs. Temperature characteristics

Vcc = Vin1 = 16 V
CTL = 5 V

Reference voltage ΔVREF (%) vs. Temperature Ta (°C)
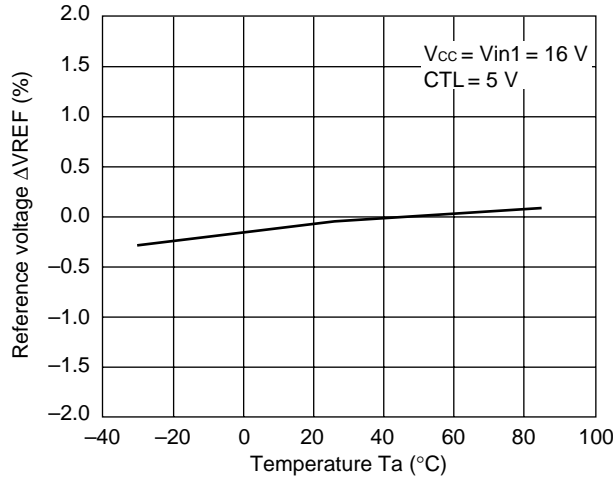
Reference voltage vs. Control voltage characteristics

Vcc = 16 V
Ta = +25°C
IOR = 0 mA

Reference voltage VREF (V) vs. Control voltage VCTL (V)
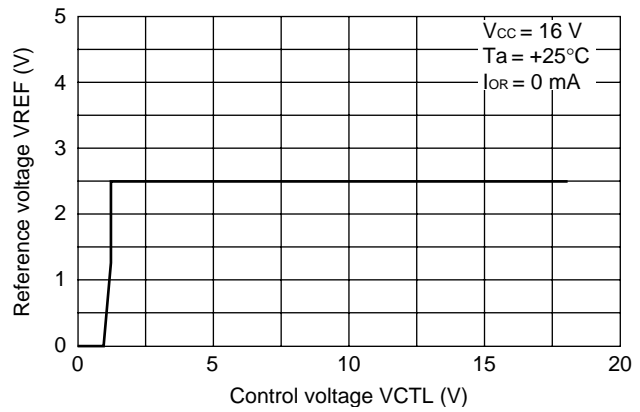
Control current vs. Control voltage characteristics

Vcc = 16 V
Ta = +25°C

Control current ICTL (µA) vs. Control current VCTL (V)

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Error amp. threshold voltage vs. Temperature characteristics

Gain plots and characteristics

$V_{CC} = V_{in1} = 16 \text{ V}$
$CTL = 5 \text{ V}$
$SEL = 0 \text{ V}$

Error Amp. threshold voltage ΔV_{T1} (%) vs Temperature Ta (°C)

Error amp. Threshold voltage vs. Temperature characteristics

$V_{CC} = V_{in1} = 16 \text{ V}$
$CTL = 5 \text{ V}$
$SEL = 5 \text{ V}$

Error Amp. Threshold voltage ΔV_{T2} (%) vs Temperature Ta (°C)

Error Amp. gain, phase vs. Frequency characteristics

Gain A_V (dB), Phase ϕ (°) vs Frequency f (Hz)

4 V
10 kΩ
240 kΩ
1 µF
2.4 kΩ
VREF
10 kΩ
2 V
Error Amp.

Triangular wave frequency vs. R_T resistance characteristics

$V_{CC} = V_{in1} = 16 \text{ V}$
$CTL = 5 \text{ V}$

CT = 100 pF
CT = 270 pF
CT = 330 pF
CT = 1500 pF

Triangular wave oscillator frequency f_{OSC} (Hz) vs RT resistance (Ω)

Triangular wave frequency vs. C_T capacitance characteristics

$V_{CC} = V_{in1} = 16 \text{ V}$
$CTL = 5 \text{ V}$

RT = 15 kΩ

Triangular wave oscillator frequency f_{OSC} (Hz) vs CT capacitance (F)

(Continued)

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(Continued)

Triangular wave frequency vs. Power supply voltage characteristics

Data shown for
MB3843
Vin1 = 16 V
CTL = 16 V

RT = 15 kΩ, CT = 330 pF

- Y-axis: Triangular wave oscillator frequency f_{OSC} (kHz), 150 to 250
- X-axis: Power supply voltage V_{CC} (V), 4 to 20
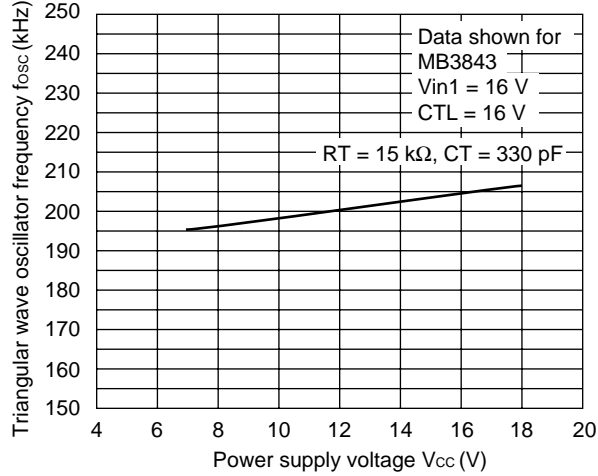
Triangular wave frequency vs. Temperature characteristics

V_{CC} = Vin1 = 16 V
CTL = 5 V

RT = 15 kΩ, CT = 330 pF

- Y-axis: Triangular wave oscillator frequency f_{OSC} (kHz), 150 to 250
- X-axis: Tenperature Ta (°C), −40 to 100
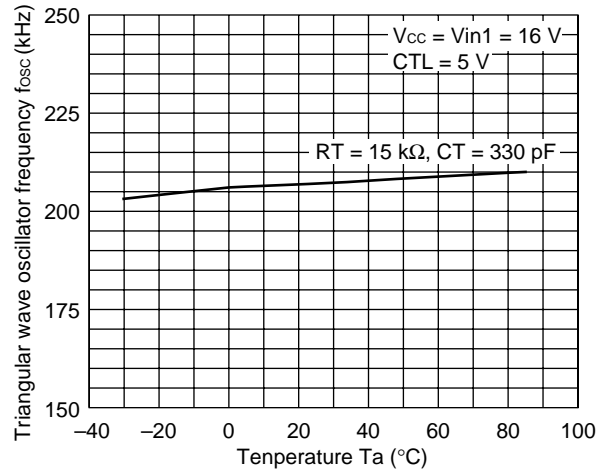
Triangular wave maximum amplitude voltage vs. Triangular wave frequency characteristics

V_{CC} = Vin1 = 16 V
CTL = 5 V

- Y-axis: Triangular wave maximum amplitude voltage (V), 0.5 to 2.5
- X-axis: Triangular wave frequency f_{OSC} (Hz), 1 k to 10 M
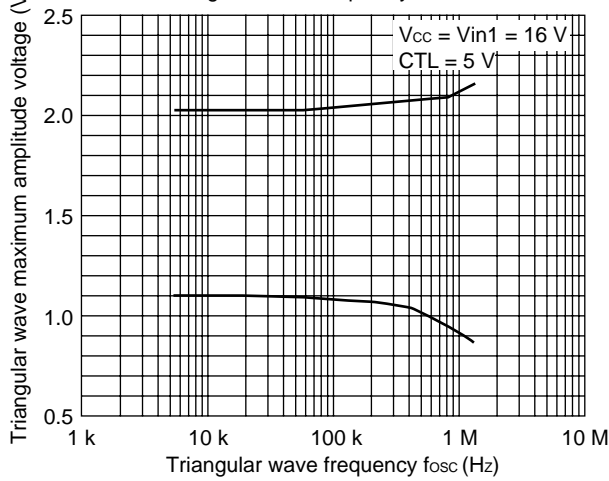
Power supply current vs. Power supply voltage characteristics

Vin1 = V_{CC}
Ta = +25°C

CTL = 5 V

MB3843   MB3833A   MB3813A

CTL = 0 V

- Y-axis: Power supply current I_{CC} (mA), 0 to 10
- X-axis: Power supply voltage V_{CC} (V), 0 to 20
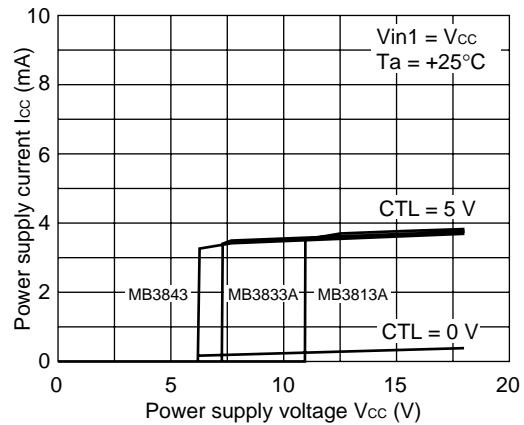
MB3813A/MB3833A/MB3843

■ FUNCTIONAL DESCRIPTION

1. Switching Regulator Block

(1) Reference voltage circuit (Ref)

The reference voltage circuit uses the voltage supply from the V_{CC} pin (pin 14) to generate a temperature compensated, stable voltage ($\cong 2.50$ V) for use as the reference voltage for the internal circuits of the IC chip.

It is also possible to supply a reference voltage output of up to 1 mA to external circuits through the VREF pin (pin 9).

(2) Triangular wave oscillator circuit (OSC)

By connecting the CT pin (pin 13) and RT pin (pin 12) respectively to a capacitance and resistance for timing, a triangular oscillator waveform can be generated.

The triangular wave is input to the PWM comparator circuits on the IC. At the same time, it can also be supplied to an external device from the CT terminal.

(3) Error amplifier circuit (Error Amp.1)

The error amplifier circuit is used to detect the output voltage from the switching regulator and produces the PWM control signal. No external resistance is required at the error amplifier inversion input pin, because the output voltage setting resistance is connected within the IC. The output voltage settings are defined as: MB3813A 12.6 V/12.3 V, MB3833A 8.4 V/8.2 V, MB3843 4.2 V/4.1 V, the optimum levels respectively for use with 3-cell, 2-cell and 1-cell lithium-ion batteries.

Also, by connecting feedback resistance and capacitance between the error amplifier FB pin (pin 6) and -IN pin (pin 5), it is possible to set the desired level of loop gain to provide stabilized phase compensation to the system.

The CS pin (pin 11) can be connected to a soft start capacitor to prevent current surges at startup. The soft start is detected by the error amplifier, which provides a constant soft start time independent of output load.

(4) Current detector amplifier circuit (Current Amp.)

The current detector amplifier provides $25 \times$ amplification of the voltage drop between the two ends of the output sensor resistor (RS) in the switching regulator, that occurs due to the flow of the charging current. This voltage drop is compared to the voltage at the Vin2 pin (pin 8) in the next stage error amplifier circuit (Error Amp.2), and used to control the charging current.

(5) Power supply control circuit (CTL)

An "L" level signal input to the CTL pin (pin 7) places the IC in standby mode. In standby mode, all circuits other than input detection circuits are switched off.

(6) PWM comparator circuit (PMW Comp.)

This is a voltage-pulse width conversion circuit that controls the output duty of the error amplifier circuits (Error Amp.1, 2) according to the output voltage.

During intervals when the triangular waveform is lower than the eror amplifier output voltage, an external output transistor is switched on.

(7) Output circuit (OUT)

The output circuit uses a totem-pole configuration and is capable of driving an external P-ch. MOS FET device.

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MB3813A/MB3833A/MB3843

2. Output Voltage Switching Function

The SEL pin (pin 10) is capable of output levels of 4.2 V or 4.1 V per battery cell.

- **Output voltage settings by model**

SEL pin voltage level	Model	Output voltage	Units
L	MB3813A	12.6	V
H		12.3	V
L	MB3833A	8.4	V
H		8.2	V
L	MB3843	4.2	V
H		4.1	V

3. Protection Functions

(1) Input voltage detector circuit (VIDET)

When the input voltage supply from the AC adapter or other source detected at the Vin1 pin (pin 1) falls below 11 V (MB3813A), or below 7.3 V (MB3833A), or below 6.3 V (MB3843), the internal reference voltage circuit switches off.

(2) Under voltage lockout circuit (UVLO)

Power surges at power-on, or momentary under-voltage situations can cause abnormal operation in a control IC, which may lead to damage or deterioration in systems. This circuit prevents abnormal peration during times of low voltage by using the supply voltage to detect the level of the internal reference voltage, and switching off the external output transistor to create a 100% rest interval. Once the supply voltage recovers to a level above the threshold voltage of the under voltage lockout circuit, operation is restored.

MB3813A/MB3833A/MB3843

■ METHOD OF SETTING THE CHARGING CURRENT

The charging current level (output limit current level) is set at the Vin2 pin (pin 8).

Charging current level (output limit current level) :

$$IL \text{ (MAX) [A]} = \frac{Vin2 \text{ (V)}}{25 \times RS \text{ (}\Omega\text{)}} \qquad RS: \text{output sensing resistance}$$

■ METHOD OF SETTING THE SOFT START TIME

- At startup, the capacitor (Cs) connected to the CS pin (pin 11) begins charging. The error amplifier compares the soft start setting voltage, which is proportional to the CS pin voltage, to the output feedback voltage and produces a soft start by varying the ON duty at the OUT pin (pin 15). The soft start time can be determined by the formula below.
- Because the CS pin voltage is input to the error amplifier, the soft start time setting is not dependent on the output current value.

Soft start time (time to output setting voltage VD) :

$$ts \text{ [sec]} = 2.5 \times CS \text{ [}\mu F\text{]}$$

■ ERROR AMP. BLOCK OVERSHOOT PROTECTION CIRCUIT

This built-in circuit responds to rapid fluctuations in charging current such as can occur when inserting or removing a chargeable battery, by clamping an inverted input signal (-IN1 or -IN2) from the error amps (Error Amp.1 or Error Amp.2) to suppress changes in output voltage.

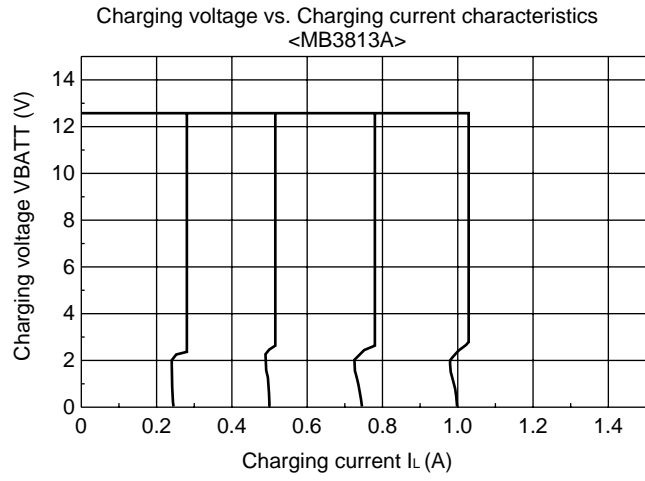## ■ CTL, SEL PIN EQUIVALENT CIRCUITS
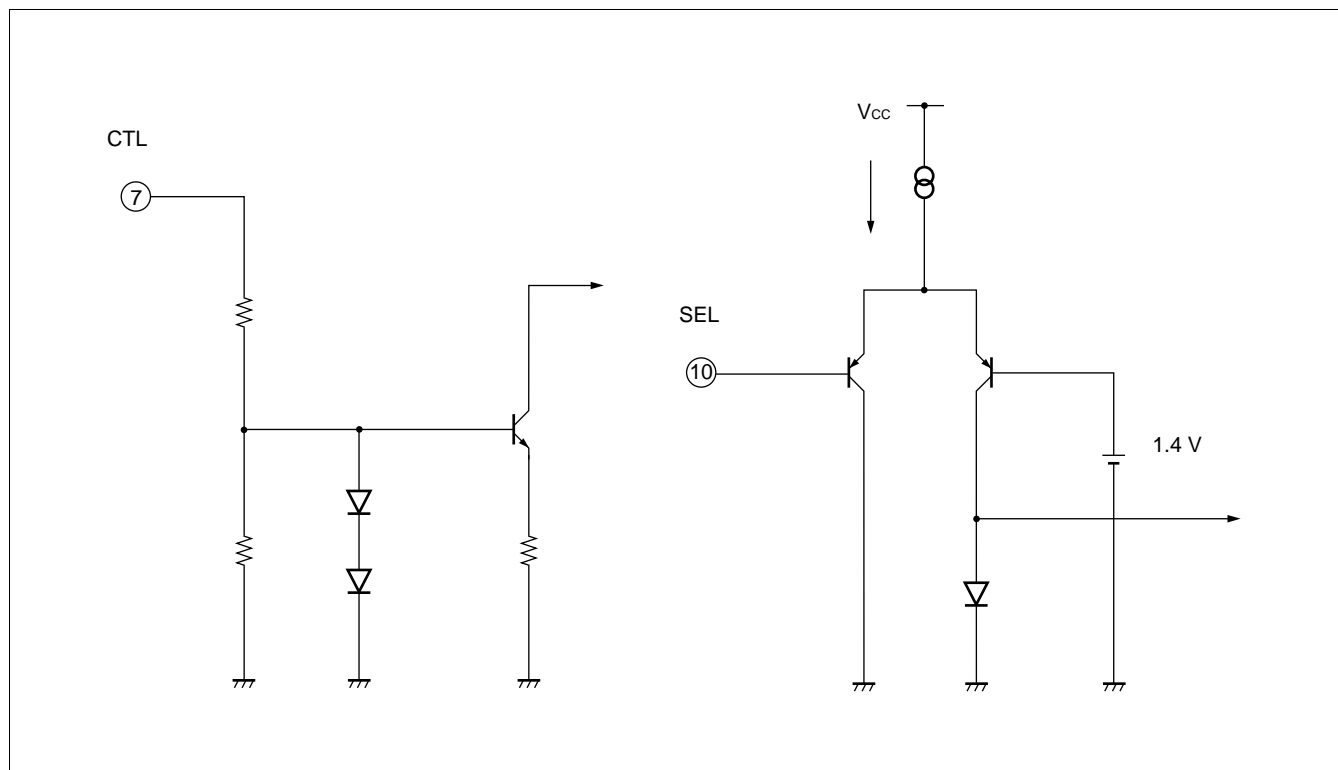
MB3813A/MB3833A/MB3843

■ APPLICATION EXAMPLE

VBATT

4.7 µF

220 µF

RS 0.1 Ω

33 µH

MTD20P03

MBRS 130LT3

47 µF 0.1 µF

Vcc 14

OUT 15

GND 16
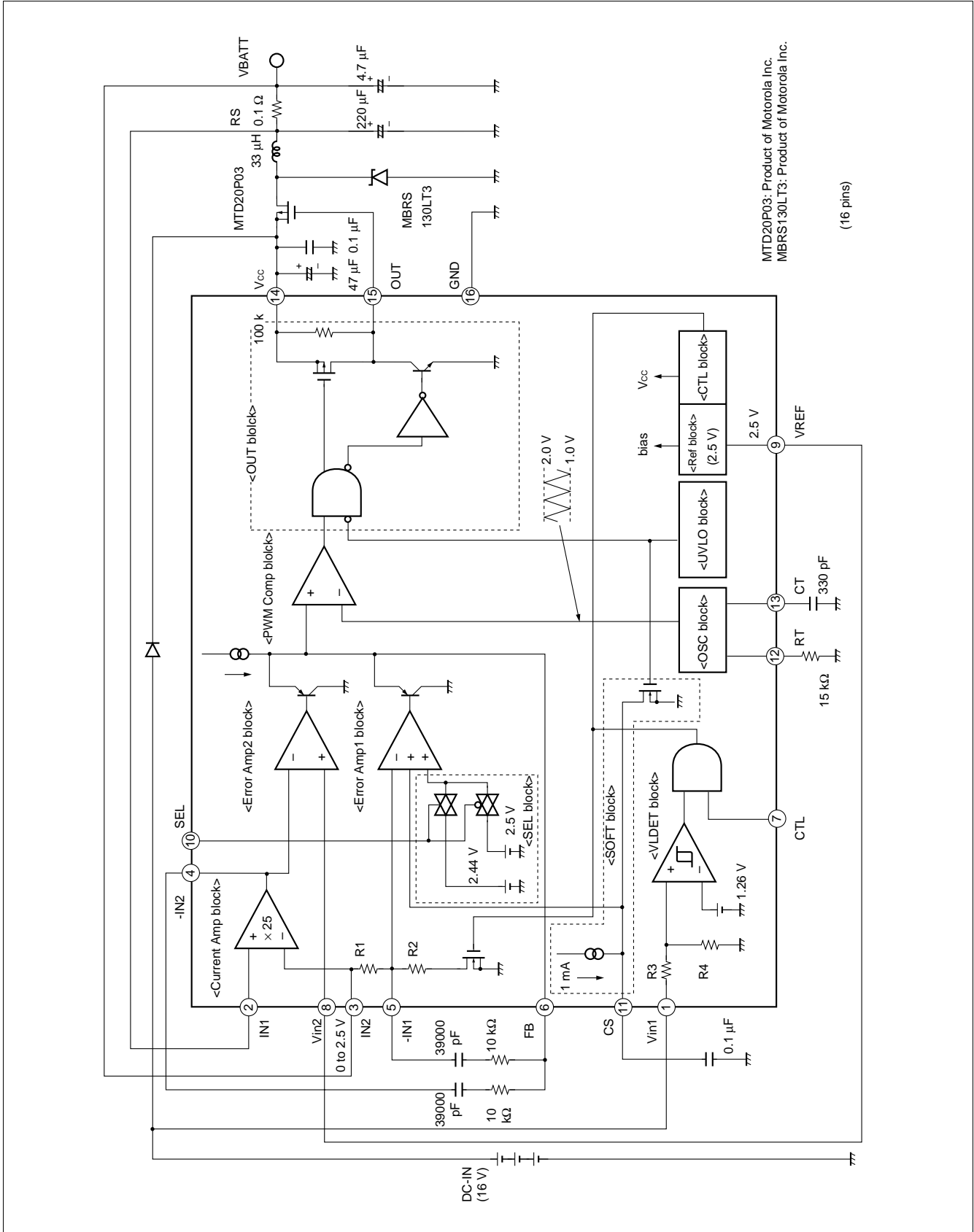
MTD20P03: Product of Motorola Inc.
MBRS130LT3: Product of Motorola Inc.

(16 pins)

100 k

<OUT blolck>

<PWM Comp blolck>

Vcc

bias

<CTL block>

<Ref block>
(2.5 V)

2.5 V

VREF 9

2.0 V
1.0 V

<UVLO block>

<OSC block>

CT 330 pF 13

RT 12

15 kΩ

<Error Amp2 block>

<Error Amp1 block>

<SEL block>

2.5 V

2.44 V

<SOFT block>

<VLDET block>

CTL 7

SEL 10

-IN2 4

<Current Amp block>

× 25

1 mA

1.26 V

R3

R4

R1

R2

39000 pF

10 kΩ

FB

IN1 2

Vin2 8

0 to 2.5 V

IN2 3

-IN1 5

CS 6

Vin1 11

1

0.1 µF

39000 pF

10 kΩ

DC-IN
(16 V)

MB3813A/MB3833A/MB3843

■ REFERENCE DATA

Charging voltage vs. Charging current characteristics
<MB3813A>

Charging voltage vs. Charging current characteristics
<MB3833A>

Charging voltage vs. Charging current characteristics
<MB3843>

(Continued)

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MB3813A/MB3833A/MB3843

(Continued)

Soft start operation waveforms

<MB3813A>

V_{CC} = Vin = 16 V
CTL = 5 V
CT = 330 pF
RT = 15 kΩ
Vin2 = 2.5 V
RL = 20 Ω
CS = 0.1 μF

<MB3833A>

V_{CC} = Vin = 16 V
CTL = 5 V
CT = 330 pF
RT = 15 kΩ
Vin2 = 2.5 V
RL = 20 Ω
CS = 0.1 μF

<MB3843>

V_{CC} = Vin = 16 V
CTL = 5 V
CT = 330 pF
RT = 15 kΩ
Vin2 = 2.5 V
RL = 20 Ω
CS = 0.1 μF

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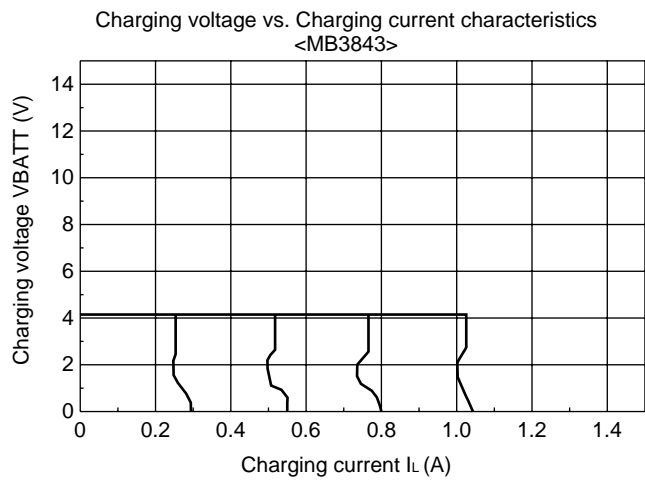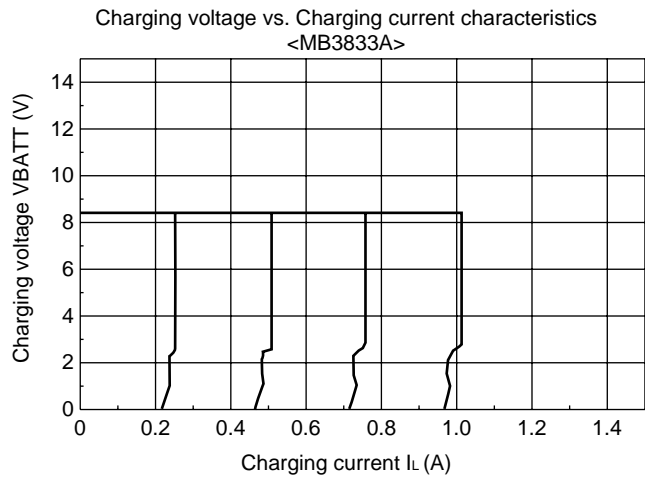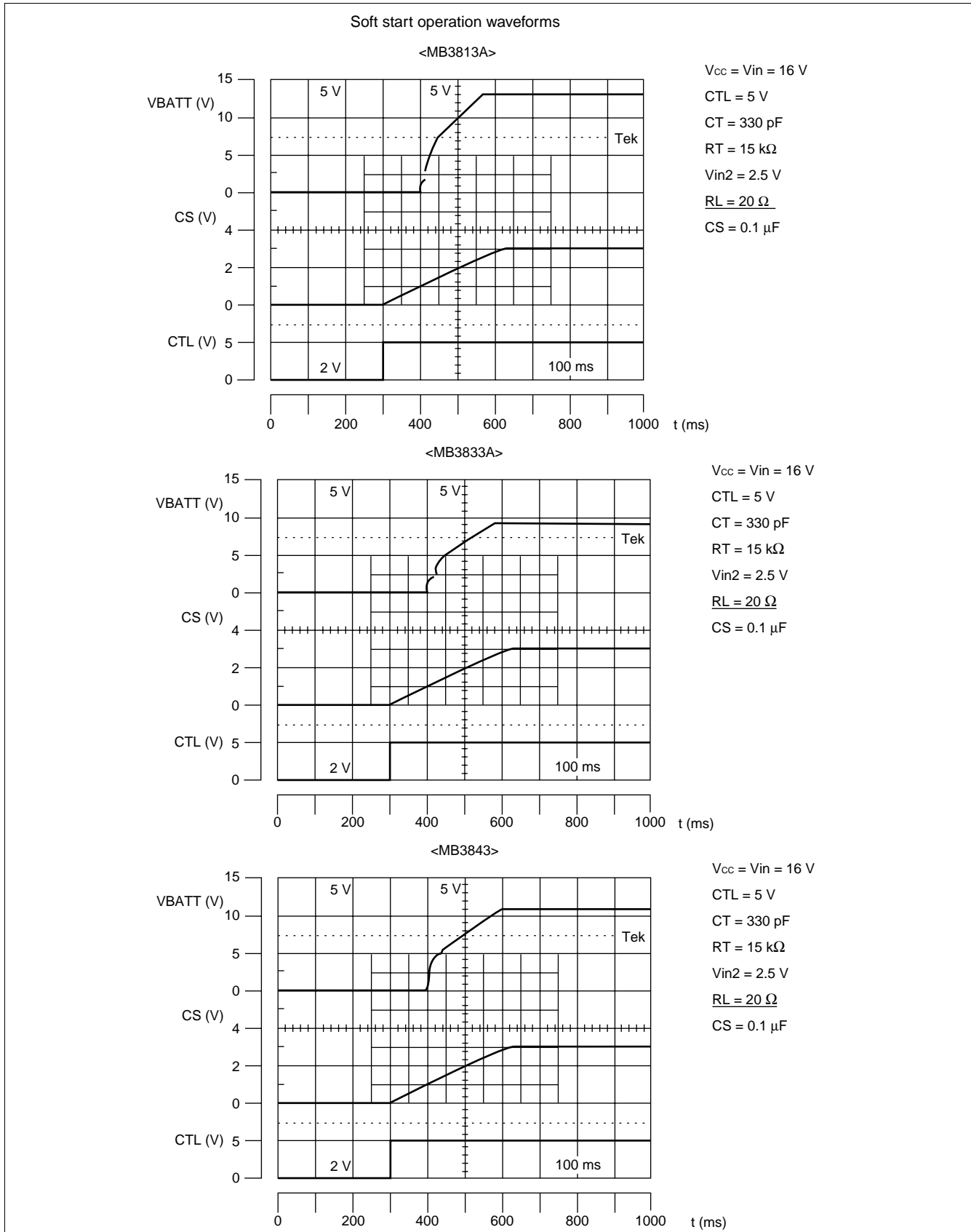
MB3813A/MB3833A/MB3843

■ USAGE PRECAUTION

1. **Device settings must not exceed absolute maximum ratings.**

   Usage under conditions exceeding absolute maximum ratings may permanently damage LSI devices.

   Note also that in normal operation usage within recommended operating conditions is preferred, and that the reliability of LSI devices may be adversely affected when used outside these conditions.

2. **Devices should be used within recommended operating conditions.**

   Recommended operating conditions are recommended values within which the LSI device is warranted to operate normally.

   Rated values of electrical characteristics are warranted within the range of recommended operating conditions and within the conditions listed in the condition column for each parameter.

3. **Printed circuit board ground lines should be designed in consideration of common impedance values.**

4. **Observe precautions against static electricity.**
   • Containers in which semiconductors are placed should either be protected against static electricity, or be of conductive material.
   • After devices are mounted, use conductive bags or conductive containers when storing or transporting printed circuit boards.
   • Working surfaces, tools and instruments should be properly rounded.
   • Workers should be grounded by a ground line with 250 kΩ to 1 MΩ resistance in series between the worker and ground.

■ ORDERING INFORMATION

Part number	Package	Remarks
MB3813APFV-G-BND MB3833APFV-G-BND MB3843PFV-G-BND	16-pin Plastic SSOP (FPT-16P-M05)	

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MB3813A/MB3833A/MB3843

■ PACKAGE DIMENSION

16-pin Plastic SSOP
(FPT-16P-M05)

* : These dimensions do not inclule resin protrusion.

* 5.00±0.10(.197±.004)

INDEX

* 4.40±0.10
(.173±.004)

6.40±0.20
(.252±.008)

0.65±0.12
(.0256±.0047)

0.22 +0.10 −0.05
(.009 +.004 −.002)

4.55(.179)REF

1.25 +0.20 −0.10 (Mounting height)
(.049 +.008 −.004)

☐ 0.10(.004)

5.40(.213)
NOM

"A"

0.15 +0.05 −0.02
(.006 +.002 −.001)

Details of "A" part

0.10±0.10(.004±.004)
(STAND OFF)

0 ～ 10°

0.50±0.20
(.020±.008)

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Dimensions in mm (inches)
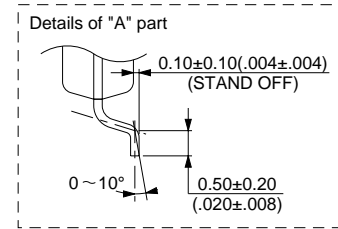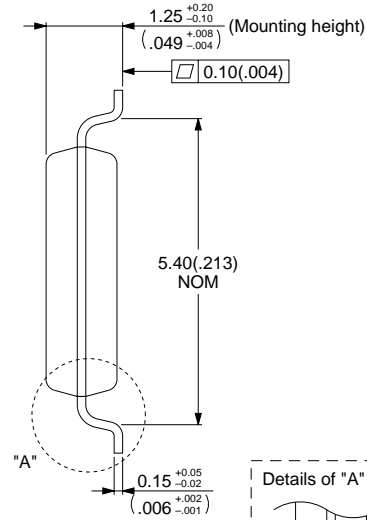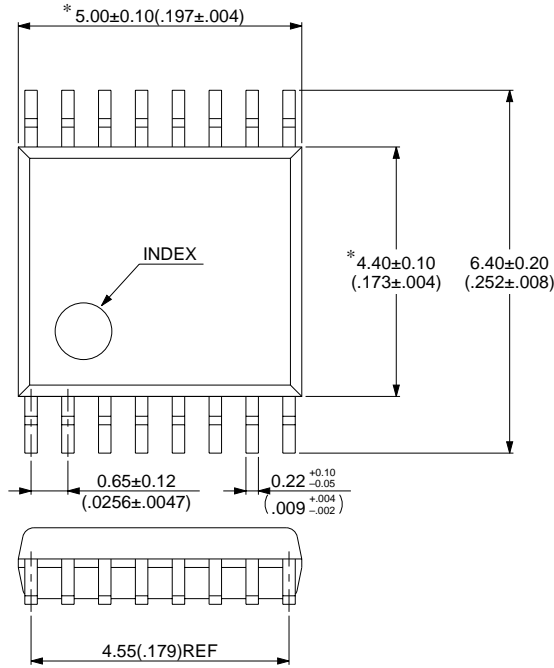
MB3813A/MB3833A/MB3843

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