ASSP   For Power Management Applications (Secondary battery)

DC/DC Converter IC for Charging

MB3832A

■ DESCRIPTION

The MB3832A is a pulse width modulation (PWM) DC/DC converter IC, incorporating a current detector amplifier and error amplifiers (2 circuits) to control the output voltage and current independently. It is suitable for down-conversion.
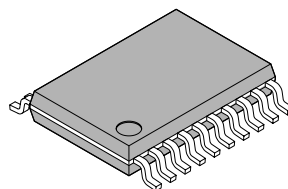
With an on-chip reference voltage generator, the MB3832A is best suited for use in applications such as lithium-ion battery (1-cell to 3-cell) chargers.

■ FEATURES

- High precision reference voltage source: 2.5 V ± 0.5% (+25°C)
                                                                            : 2.5 V ± 1.0% (−10°C to +85°C)
- High frequency operating capability: 500 kHz max.
- Wide operating supply voltage range: 3.6 V to 18 V
- On-chip current detector amplifier with wide in-phase input voltage range: 0 V to V_{CC}
- On-chip standby function
- On-chip triangular waveform oscillator capable of operating in external synchronization
- On-chip, timer-latch short-circuit protection circuit
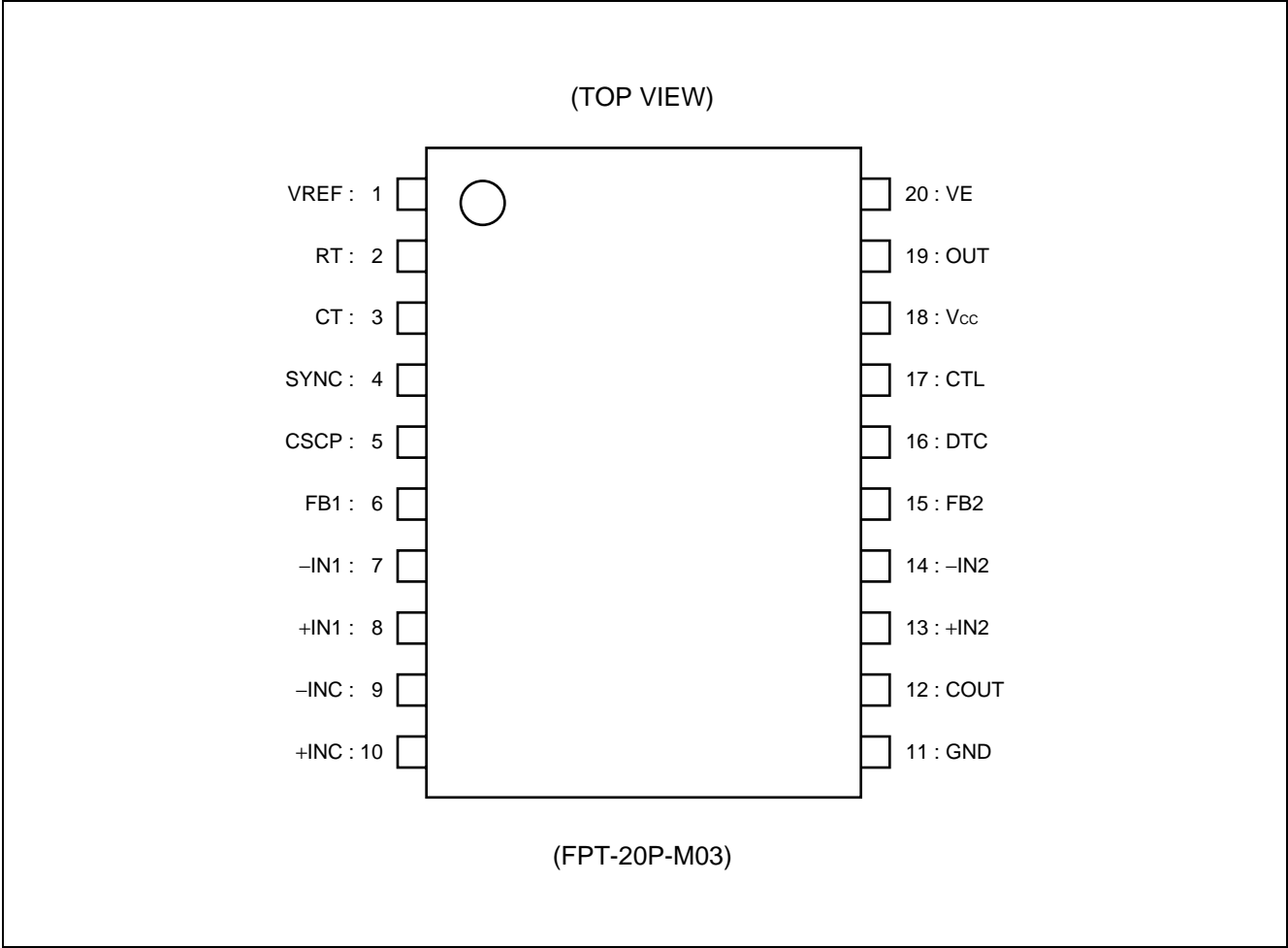- Internal totem-pole output stage supporting P-channel MOS FETs and PNP transistors

■ PACKAGE

20-pin plastic SSOP

(FPT-20P-M03)

■ PIN ASSIGNMENT

(TOP VIEW)

Left	Pin		Pin	Right
VREF :	1		20 :	VE
RT :	2		19 :	OUT
CT :	3		18 :	V_{CC}
SYNC :	4		17 :	CTL
CSCP :	5		16 :	DTC
FB1 :	6		15 :	FB2
−IN1 :	7		14 :	−IN2
+IN1 :	8		13 :	+IN2
−INC :	9		12 :	COUT
+INC :	10		11 :	GND

(FPT-20P-M03)

■ PIN DESCRIPTION

Pin no.	Pin name	I/O	Descriptions
1	VREF	O	Reference voltage output pin
2	RT	—	Connection pin for triangular wave frequency setting resistor
3	CT	—	Connection pin for triangular wave frequency setting capacitor
4	SYNC	I	External synchronous signal input pin
5	CSCP	—	Connection pin for time constant setting capacitor for timer-latch short-circuit protection circuit
6	FBI	O	Error amplifier 1 output pin
7	–IN1	I	Error amplifier 1 inverted input pin
8	+IN1	I	Error amplifier 1 non-inverted input pin
9	–INC	I	Current detector amplifier inverted input pin
10	+INC	I	Current detector amplifier non-inverted input pin
11	GND	—	Ground pin
12	COUT	O	Current detector amplifier output pin
13	+IN2	I	Error amplifier 2 non-inverted input pin
14	–IN2	I	Error amplifier 2 inverted input pin
15	FB2	O	Error amplifier 2 output pin
16	DTC	I	Connection pin for dead time/soft start time setting resistor/capacitor
17	CTL	I	Power supply control input pin "H" level: Active state "L" level: Standby state
18	V_{CC}	—	Power supply pin
19	OUT	O	Totem-pole output pin
20	VE	—	Connector pin for output sink current setting resistor

I: Input pin, O: Output pin

MB3832A

■ BLOCK DIAGRAM
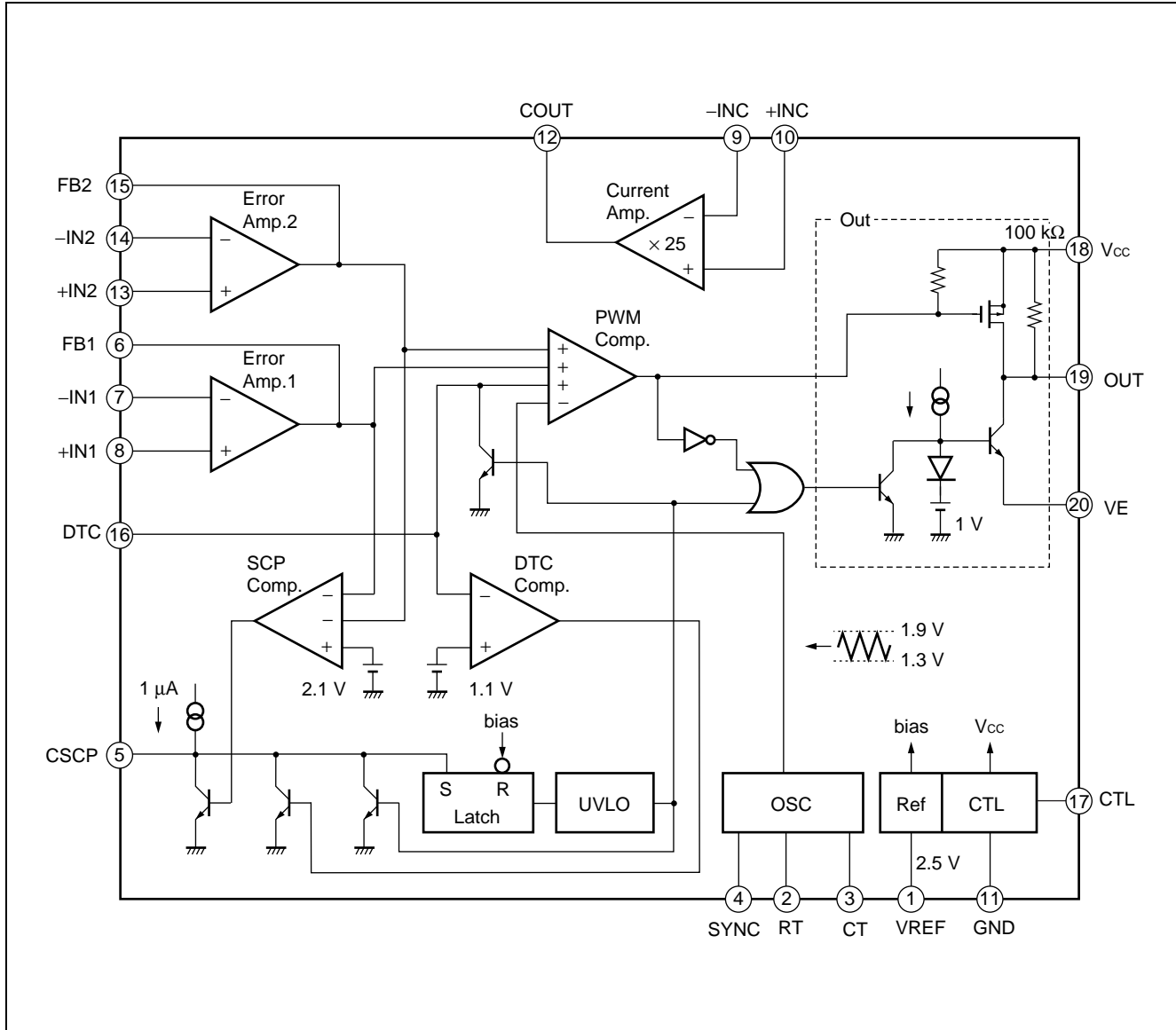
■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Rating		Unit
			Min.	Max.	
Power supply voltage	V_{CC}	—	—	20	V
Control input voltage	V_{CTL}	—	—	20	V
Output current	I_O	OUT pin, DC	—	50	mA
Peak output current	I_O	OUT pin, Duty $\leqq$ 5%	—	600	mA
Allowable dissipation	P_D	Ta $\leqq$ +25°C	—	540*	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			Unit
			Min.	Typ.	Max.	
Power supply voltage	V_{CC}	—	3.6	16	18	V
Reference voltage output current	I_{OR}	—	–1	—	0	mA
Input voltage	V_{IN}	+IN1, –IN1, +IN2, –IN2 pin	0	—	$V_{CC} - 0.9$	V
		+INC, –INC pin	0	—	V_{CC}	V
Control input voltage	V_{CTL}	CTL pin	0	—	18	V
SYNC input voltage	V_{SYNC}	SYNC pin	0	—	V_{CC}	V
Output current	I_O	OUT pin, DC	—	—	30	mA
Oscillatior frequency	f_{OSC}	—	10	200	500	kHz
Timing capacitance	C_T	—	100	390	2200	pF
Timing resistance	R_T	—	8.2	12	51	kΩ
Short detection capacitance	C_{SCP}	—	—	0.1	1.0	μF
Operating temperature	Ta	—	–30	+25	+85	°C

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.

■ ELECTRICAL CHARACTERISTICS

(V$_{CC}$ = 16 V, Ta = +25°C)

Parameter		Symbol	Pin no.	Condition	Value			Unit
					Min.	Typ.	Max.	
Reference voltage block (Ref)	Output voltage	V$_{REF}$	1	Ta = +25°C	2.4875	2.50	2.5125	V
				Ta = −10°C to +85°C	2.475	2.50	2.525	V
				Ta = +25°C to +85°C	2.480	2.50	2.520	V
	Input stability	Line	1	V$_{CC}$ = 3.6 V to 18 V	—	1	10	mV
	Load stability	Load	1	I$_{REF}$ = 0 mA to −1 mA	—	3	10	mV
	Short circuit output current	I$_{OS}$	1	V$_{REF}$ = 0 V	−36	−16	−7	mA
Under voltage lockout circuit block (UVLO)	Threshold voltage	V$_{TH}$	16	V$_{CC}$ pin	—	2.8	3.1	V
		V$_{TL}$	16	V$_{CC}$ pin	2.3	2.6	—	V
	Hysteresis width	V$_H$	16	V$_{CC}$ pin	80	200	—	mV
	Reset voltage	V$_{RST}$	19	V$_{CC}$ pin	1.7	2.1	—	V
Short detection block (SCP Comp, S-R Latch)	Detection voltage	V$_{TH}$	5	FB pin	2.0	2.1	2.2	V
	Threshold voltage	V$_{TH}$	5	CSCP pin	0.65	0.70	0.75	V
	Input standby voltage	V$_{STB}$	5	CSCP pin	—	50	100	mV
	Input latch voltage	V$_I$	5	CSCP pin	—	50	100	mV
	Input source current	I$_{CSCP}$	5	CSCP pin	−1.4	−1.0	−0.6	µA
Triangular wave oscillator block (OSC)	Oscillator frequency	f$_{OSC}$	19	C$_T$ = 330 pF, R$_T$ = 12 kΩ	190	200	210	kHz
	Frequency input stability	∆f/f	19	V$_{CC}$ = 3.6 V to 18 V	—	1	5	%
	SYNC input condition	V$_{IH}$	19	Input "H" level	2.0	—	—	V
		V$_{IL}$	19	Input "L" level	0	—	0.8	V
	Input current	I$_{SYNC}$	4	V$_{SYNC}$ = 5 V	—	50	100	µA
Error amplifier (Error Amp.1, 2)	Input offset voltage	V$_{IO}$	8, 7, 13, 14	V$_{FB}$ = 1.6 V	−3	—	3	mV
	Input bias current	I$_B$	8, 7, 13, 14	V$_{FB}$ = 1.6 V	−200	−50	—	nA
	Common mode input voltage range	V$_{CM}$	8, 7, 13, 14	—	0	—	V$_{CC}$ − 0.9	V
	Common mode rejection ratio	CMRR	6, 15	—	60	100	—	dB
	Voltage gain	A$_V$	6, 15	DC	60	100	—	dB
	Frequency bandwidth	BW	6, 15	A$_V$ = 0 dB	—	750*	—	kHz
	Maximum output voltage width	V$_{OM}$+	6, 15	—	2.5	2.7	—	V
		V$_{OM}$−	6, 15	—	—	0.8	1.0	V
	Output source current	I$_{OM}$−	6, 15	V$_{FB}$ = 1.6 V	—	−120	−60	µA
	Output sink current	I$_{OM}$+	6, 15	V$_{FB}$ = 1.6 V	0.6	2.0	—	mA

* : Standard design value

(Continued)

(V$_{CC}$ = 16 V, Ta = +25°C)

Parameter		Symbol	Pin no.	Condition	Value			Unit
					Min.	Typ.	Max.	
Current detector amplifier block (Current Amp.)	Input offset voltage	V$_{IO}$	10, 9	V$_{+INC}$, V$_{-INC}$ = 2.4 V to 12.6 V	–2	—	2	mV
	Input bias current	I$_{+INC}$	10	V$_{+INC}$ = 12.7 V, V$_{-INC}$ = 12.6 V	—	1	2	µA
		I$_{-INC}$	9	V$_{+INC}$ = 0.1 V, V$_{-INC}$ = 0 V	–2	–1	—	µA
	Output voltage	V$_{O1}$	12	V$_{+INC}$ = 12.7 V, V$_{-INC}$ = 12.6 V	2.25	2.5	2.75	V
		V$_{O2}$	12	V$_{+INC}$ = 12.8 V, V$_{-INC}$ = 12.6 V	4.5	5.0	5.5	V
		V$_{O3}$	12	V$_{+INC}$ = 0.1 V, V$_{-INC}$ = 0 V	2.25	2.5	2.75	V
		V$_{O4}$	12	V$_{+INC}$ = 0.2 V, V$_{-INC}$ = 0 V	4.5	5.0	5.5	V
	Common mode input voltage range	V$_{CM}$	10, 9	—	0	—	V$_{CC}$	V
	Common mode rejection ratio	CMRR	12	V$_{+INC}$, V$_{-INC}$ = 2.4 V to 12.6 V	60	90	—	dB
	Voltage gain	A$_V$	12	V$_{-INC}$ = 12.6 V	22.5	25	27.5	V/V
	Frequency bandwidth	BW	12	A$_V$ = 0 dB	—	500*	—	kHz
	Output resistance	R$_O$	12	f = 10 kHz	—	20*	—	Ω
	Maximum output voltage width	V$_{OM}$⁺	12	—	V$_{CC}$ – 2.0	V$_{CC}$ – 1.6	—	V
		V$_{OM}$⁻	12	—	—	50	200	mV
	Output source current	I$_{OM}$⁻	12	V$_{COUT}$ = 2.5 V	—	–7	–2	mA
	Output sink current	I$_{OM}$⁺	12	V$_{COUT}$ = 2.5 V	60	170	—	µA
PWM comparator block (PWM Comp.)	Threshold voltage	V$_{T0}$	19	Duty cycle = 0 %	1.2	1.3	—	V
		V$_{T100}$	19	Duty cycle = 100 %	—	1.9	2.0	V
	Input bias current	I$_{DTC}$	16	V$_{DTC}$ = 0.4 V	–1.0	–0.2	—	µA
	Latch mode input current	I$_{DTC}$	16	V$_{DTC}$ = 2.5 V	270	900	—	µA
	Input latch voltage	V$_{DTC}$	16	I$_{DTC}$ = 100 µA	—	0.15	0.3	V
	ON duty cycle	Dtr	19	V$_{DTC}$ = V$_{REF}$/1.56	43	48	53	%

* : Standard design value
(Continued)

MB3832A

(Continued)

$(V_{CC} = 16 \text{ V, Ta} = +25°C)$

Parameter		Symbol	Pin no.	Condition	Value			Unit
					Min.	Typ.	Max.	
Output block (OUT)	Output on resistance	R_{ON}	19	$I_O = -50$ mA	—	5	8	Ω
	Output sink current	I_O	19	$R_E = 33\ \Omega$	18	30	42	mA
	Output voltage	V_{OH}	19	$I_O = -300$ mA	12.5	14	—	V
		V_{OL}	19	$I_O = 300$ mA	—	1.2	1.8	V
	Control-off output resistance	R_{OUT1}	19	$V_{CTL} = 0$ V, $V_{REF} = 2.5$ V, $I_O = -50$ mA	—	5	8	Ω
		R_{OUT2}	19	$V_{CTL} = 0$ V, $V_{REF} = 0$ V, $I_O = -10\ \mu$A	70	100	130	kΩ
Control block (CTL)	CTL input condition	V_{ON}	1	IC is active state	2.0	—	18	V
		V_{OFF}	1	IC is standby state	0	—	0.8	V
	Input current	I_{IH}	17	$V_{CTL} = 5$ V	—	100	200	μA
		I_{IL}	17	$V_{CTL} = 0$ V	−1	0	—	μA
General	Standby current	I_{CCS}	18	$V_{CTL} = 0$ V	—	—	10	μA
	Power supply current	I_{CC}	18	Output "H"	—	4.6	7.0	mA

■ TYPICAL CHARACTERISTICS

Reference voltage vs. power supply voltage characteristics

CTL = V_{CC}
Ta = +25 °C
I_{REF} = 0 mA

Reference voltage V_{REF} (V) vs. Power supply voltage V_{CC} (V)

Reference voltage vs. V_{REF} load current characteristics

V_{CC} = 16 V
CTL = 5 V
Ta = +25 °C

Reference voltage V_{REF} (V) vs. V_{REF} load current I_{REF} (mA)

Reference voltage vs. temperature characteristics

V_{CC} = 16 V
CTL = 5 V

Reference voltage ΔV_{REF} (%) vs. Temperature Ta (°C)

Reference voltage vs. control voltage characteristics

V_{CC} = 16 V
Ta = +25 °C
I_{REF} = 0 mA

Reference voltage V_{REF} (V) vs. Control voltage V_{CTL} (V)

Control current vs. control voltage characteristics

V_{CC} = 16 V
Ta = +25 °C

Control current I_{CTL} (μA) vs. Control voltage V_{CTL} (V)

(Continued)

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MB3832A

Triangular wave oscillation frequency vs. R_T resistance characteristics

$V_{CC} = 16$ V
CTL $= 5$ V
$C_T = 100$ pF
$C_T = 390$ pF
$C_T = 2200$ pF

Triangular wave oscillation frequency f_{OSC} (Hz)

R_T resistance (Ω)
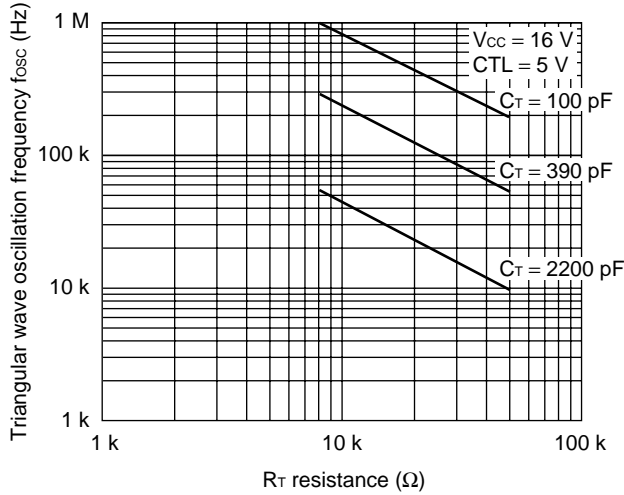
Triangular wave oscillation frequency vs. C_T capacitance characteristics

$V_{CC} = 16$ V
CTL $= 5$ V
$R_T = 12$ kΩ

Triangular wave oscillation frequency f_{OSC} (Hz)

C_T capacitance (F)
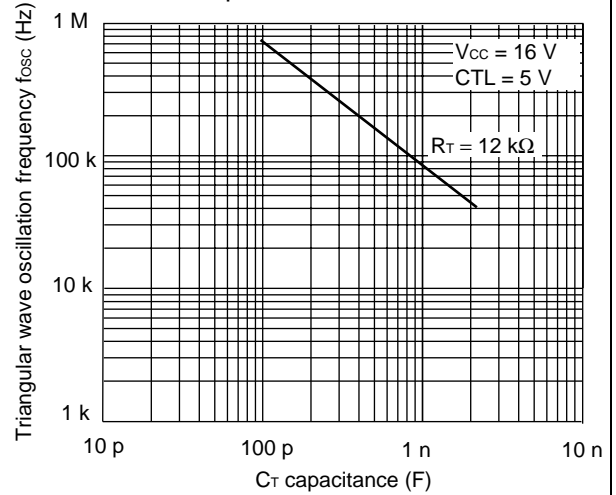
Triangular wave oscillation frequency regulation vs. power supply voltage characteristics

CTL $= V_{CC}$
$R_T = 12$ kΩ, $C_T = 390$ pF

Triangular wave oscillation frequency regulation Δf_{OSC} (%)

Power supply voltage V_{CC} (V)
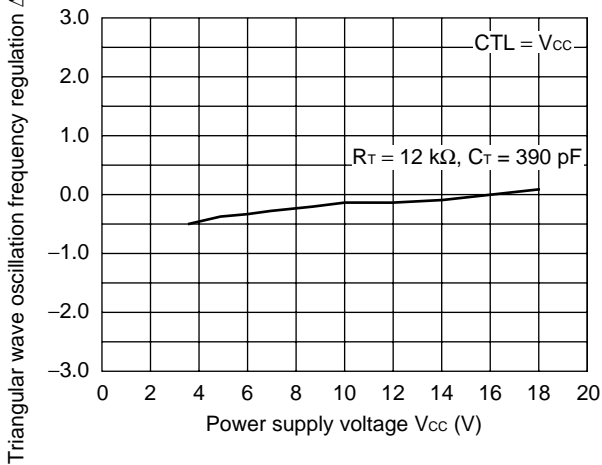
Triangular wave oscillation frequency vs. temperature characteristics

$V_{CC} = 16$ V
CTL $= 5$ V
$R_T = 12$ kΩ, $C_T = 390$ pF

Triangular wave oscillation frequency f_{OSC} (kHz)

Temperature Ta ($^\circ$C)
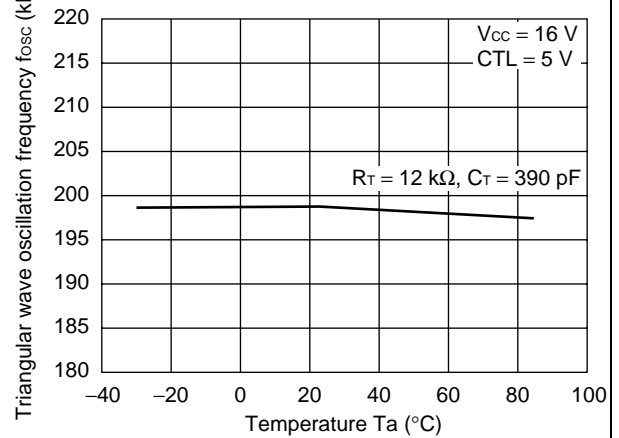
Triangular wave maximum/minimum voltages vs. triangular wave oscillation frequency characteristics

$V_{CC} = 16$ V
CTL $= 5$ V
Upper
Lower

Triangular wave upper and down voltage (V)

Triangular wave oscillation frequency f_{OSC} (Hz)

Error amp. gain, phase vs. frequency characteristics

gain Av (dB)

40 30 20 10 0 −10 −20 −30 −40

phase φ (deg.)

180 135 90 45 0 −45 −90 −135 −180

$V_{CC} = 16$ V
CTL = 5 V
$T_a = +25$ °C

Av

φ

Frequency f (Hz)

100 1 k 10 k 100 k 1 M 10 M

5 V

11 kΩ

240 kΩ

IN

1 μF

2.4 kΩ (14)

⑦

−

+

⑥
(15)

OUT

11 kΩ

⑧
(13)

2.5 V

Err Amp.1
(Err Amp.2)
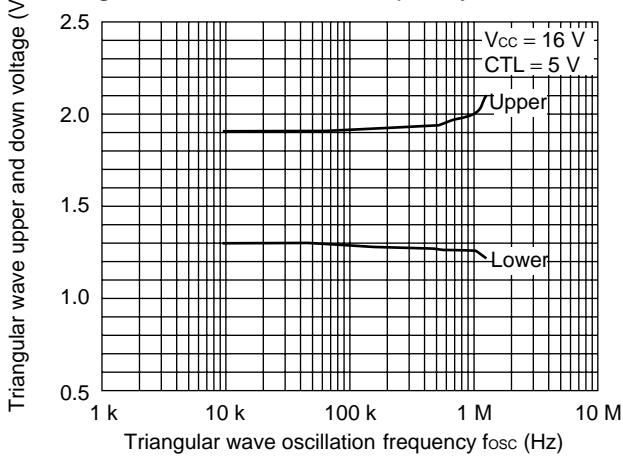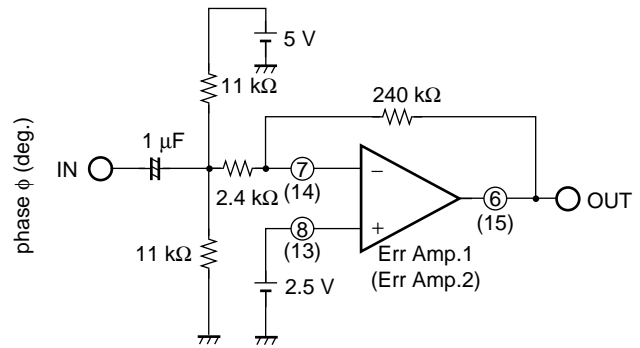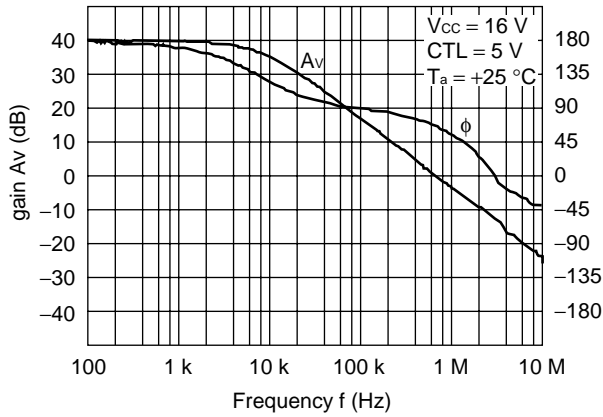
Current detector amp. gain, phase vs. frequency characteristics

Gain Av (dB)

50 40 30 20 10 0 −10 −20 −30 −40 −50

phase φ (deg.)

180 135 90 45 0 −45 −90 −135 −180

Av

φ

Frequency f (Hz)

100 1 k 10 k 100 k 1 M 10 M

Current Amp.

IN
0.1 V

12.6 V

⑩

⑨

+

−

× 2

+

−

× 12.5

⑫ OUT
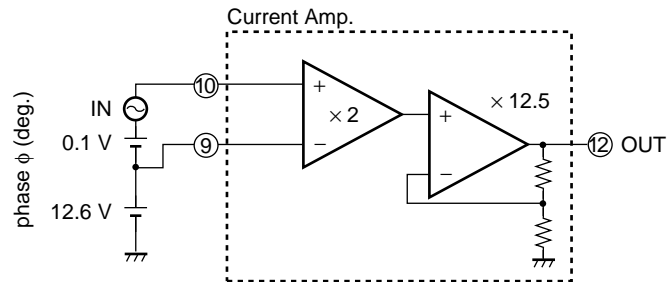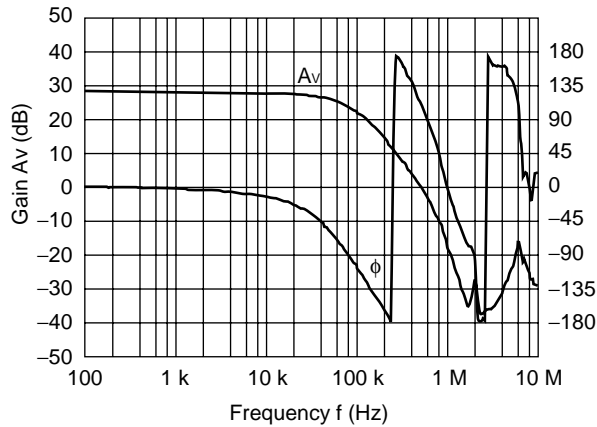
Current detector amp. output voltage vs. input voltage characteristics

Output voltage V_{COUT} (V)

3.0 2.8 2.6 2.4 2.2 2.0

$V_{CC} = 16$ V
$V_{+INC} = V_{−INC} + 0.1$ V
$T_a = +25$ °C

Inverting input voltage (V)

0 4 8 12 16

(Continued)

Allowable dissipation vs. ambient
temperature characteristics
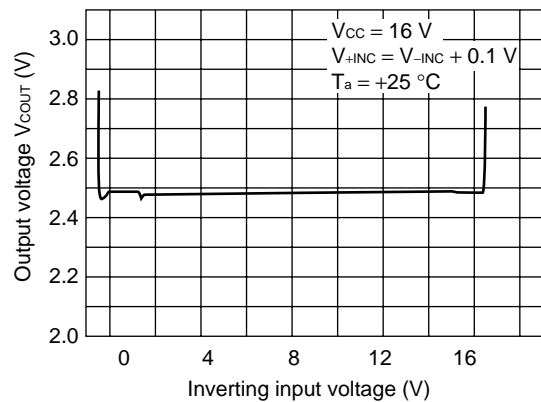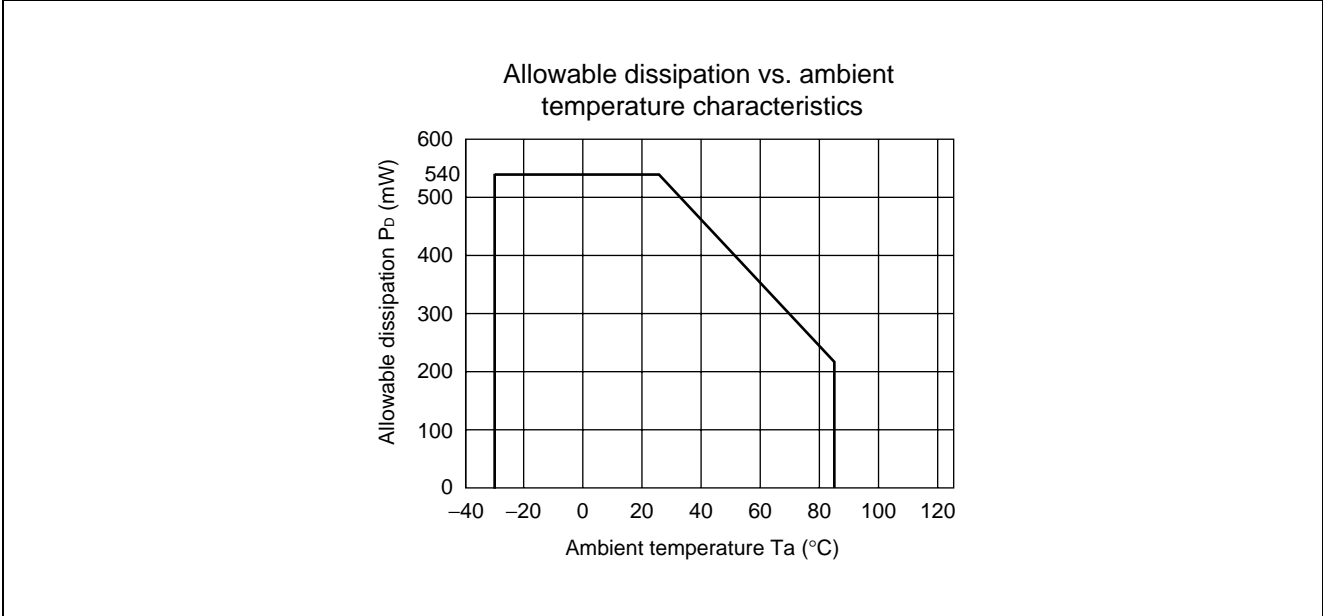
■ FUNCTIONAL DESCRIPTION

1. Switching Regulator Functions

(1) Reference voltage circuit (Ref)

The reference voltage generator uses the voltage supplied from the V_{CC} pin (pin 18) to generate a temperature-compensated, stable voltage (about 2.50 V) as the reference supply voltage for the IC's internal circuitry.

The reference voltage can be output, up to 1 mA, to an external device through the VREF pin (pin 1).

(2) Triangular wave oscillator (OSC)

The triangular wave oscillator generates a triangular waveform with a timing capacitor and a timing resistor respectively connected to the CT pin (pin 3) and RT pin (pin 2).

The triangular wave is input to the PWM comparator in the IC while it can also be supplied to an external device through the CT pin. In addition, the oscillator can be used for external synchronization, where it generates a triangular wave synchronous to the input signal from the SYNC pin (pin 4).

(3) Error amplifiers (Error Amp. 1, 2)

The error amplifiers detect the output voltage from the switching regulator and outputs the PWM control signal. It supports a wide range of in-phase inputs from 0 V to "V_{CC} – 0.9 V". An arbitrary loop gain can be set by connecting a feedback resistor and capacitor from the FB1 pin (pin 6) [FB2 pin (pin 15)] to the –IN1 pin (pin 7) [–IN2 pin (pin 14)] of the error amplifier, enabling stable phase compensation to the system.

(4) Current detector amplifier (Current Amp.)

The current detector amplifier provides 25 × 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. At the same time, the amplifier converts the voltage to the GND-reference voltage level and outputs it to the COUT pin (pin 12). It can also control the charging current in combination with the error amplifier circuit.

(5) Power control circuit (CTL)

The power control circuit can control turning on and off the power supply through the CTL pin (pin 17). (Supply current in standby mode: About 0 μA)

Depending on the voltage level of the PWM Comp. input pin, the OUT pin (pin 19) may become "L" level during discharging of the V_{REF} voltage after the CTL pin is turned off with a capacitor connected to the V_{REF} pin. The power control circuit contains a function for fixing the OUT output pin to the "H" level when CTL = "L" and VREF = "H", preventing inadvertent "L" level output after turning the CTL pin off.

(6) PWM comparator circuit (PWM Comp.)

The PWM comparator circuit is a voltage-pulse width converter for controlling the output duty of the error amplifiers (Error Amp. 1, 2) depending on their output voltage.

The PWM comparator circuit turns on the external output transistor during the interval in which the triangular wave voltage level is lower than the voltage level at both of the error amplifier output pins (FB1 pin (pin 6), FB2 pin (pin 15)) and the DTC pin (pin 16).

(7) Output circuit (Out)

The output circuit uses a totem-pole configuration, capable of driving an external P-channel MOS FET and PNP transistor. It can also control the output sink current with a resistor connected between the VE pin (pin 20) and the GND pin (pin 11).

2. Protection Functions

(1) Low input voltage malfunction preventive circuit (ULVO)

The transient state or a momentary decrease in supply voltage, which occurs when the power supply is turned on, may cause errors in the control IC, resulting in breakdown or degradation of the system. The low input voltage malfunction preventive circuit detects the internal reference voltage level according to the supply voltage

and turn off the external output transistor to make dead time 100%. The circuit restores voltage supply when the supply voltage reaches its threshold voltage.

(2)   Timer-latch short-circuit protection circuit (SCP Comp., SR Latch)

The latch circuit detects the output voltage levels of the error amplifiers. When the output voltage levels of the two error amplifiers reach about 2.1 V at the same time, the timer circuit is actuated to start charging the external capacitor connected to the CSCP pin (pin 5). If the error amplifier outputs are not restored to the normal voltage range before the capacitor voltage reaches about 0.7 V, the latch circuit is actuated to fix the output pins (OUT) at the "H" level. To reset the actuated protection circuit, turn the power supply on back.

■ METHOD OF SETTING FOR EXTERNAL SYNCHRONOUS OSCILLATION

For external synchronous oscillation, connect a timing capacitor (C_T), a timing resistor (R_T), and an external sync signal to the CT, RT, and SYNC pins, respectively.

In this case, select the C_T and R_T so that the oscillation frequency is 5% to 10% lower than the frequency of the external synchronous signal excluding the setting error of the oscillation frequency.

The duty cycle (T1/T) of the external sync signal must be set within a range from 10% to 90%.

\<Triangular wave oscillator (OSC) equivalent circuit\>

\<Free-run oscillation\>

\<External synchronous oscillation\>
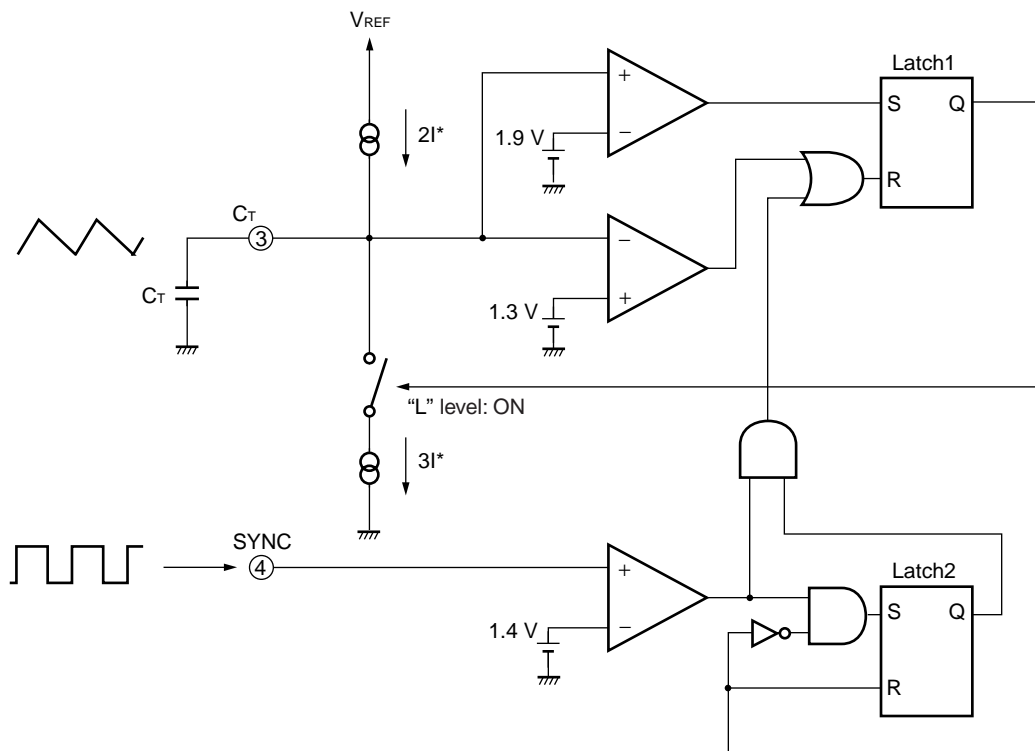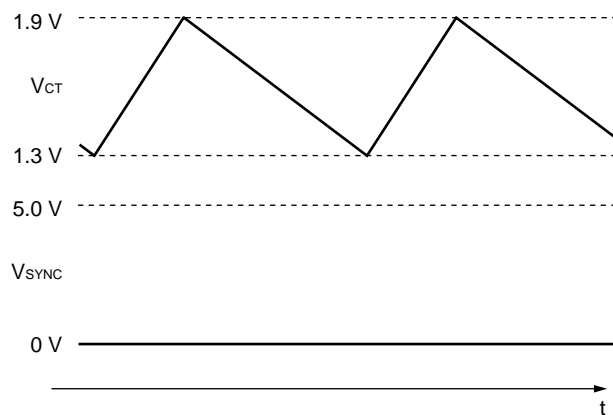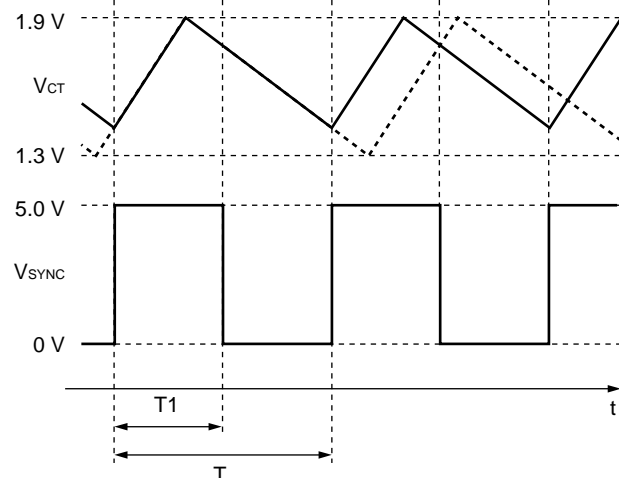
*: | = VRT/R$_T$, VRT (pin voltage at pin 2) = 1.0 V (typical)

■ TREATMENT OF UNUSED CSCP PIN

When the timer-latch short-circuit protection circuit is not used, connect the CSCP pin (pin 5) to the GND at the shortest distance.

Treatment of the CSCP pin when not used
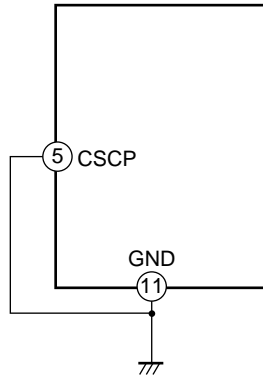
■ METHODS OF SETTING THE DEAD TIME AND SOFT START

1.   Dead Time

When the device is set for step-up inverted output based on the flyback method, the output transistor is fixed to a full-ON state (ON duty = 100%) when the power supply is turned on. To prevent this problem, you may determine the voltage at the DTC pin (pin 16) from the V_{REF} voltage so you can set the output transistor's dead time (maximum ON-duty period) as shown in Figure a below.

When the voltage at the DTC pin (pin 16) is higher than the triangular wave output voltage from the oscillator, the output transistor is turned off. The dead time calculation formula assuming that triangular wave amplitude ≒ 0.6 V and triangular wave minimum voltage ≒ 1.3 V is given below.

$$\text{Duty (ON)} ≒ \frac{V_{dt} - 1.3 \text{ V}}{0.6 \text{ V}} \times 100 \text{ [%]}, \quad V_{dt} = \frac{R_2}{R_1 + R_2} \times V_{REF}$$

When the DTC pin is not used, connect it directly to the VREF pin.

• **Figure a Setting the dead time**

• **Figure b Not setting the dead time**
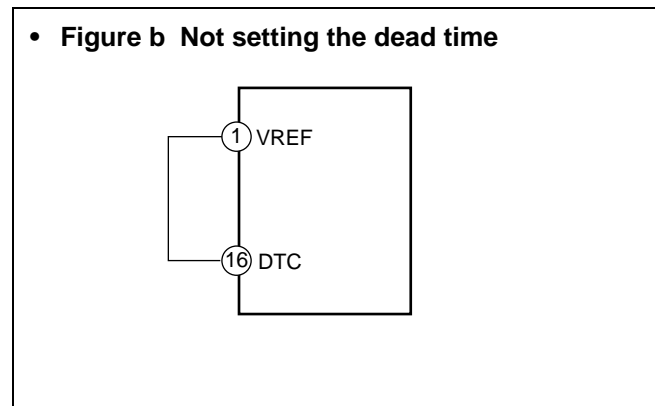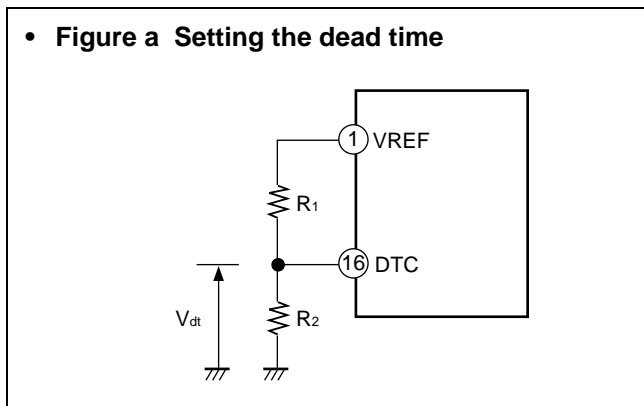
2.   Soft Start

To prevent surge currents when the IC is turned on, you can set a soft start using the DTC pin (pin 16). You can also set a soft start along with the dead time by making connections as shown in Figure d below.

• **Figure c Setting a soft start**

• **Figure d Setting the dead time and a soft start**

MB3832A
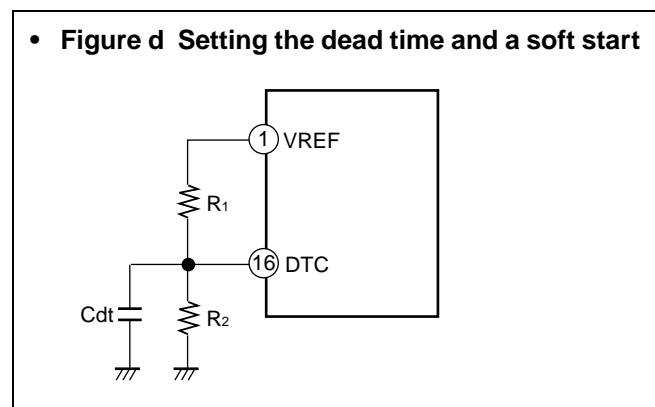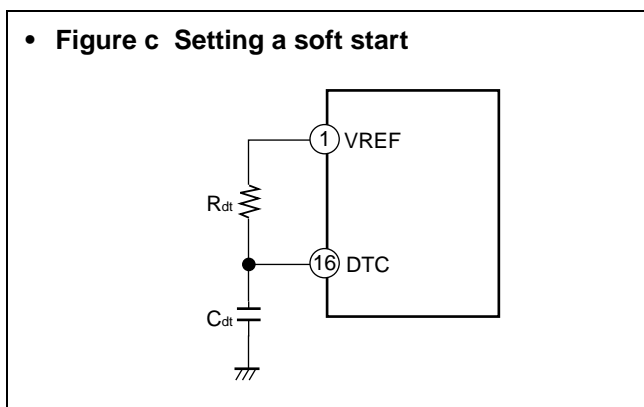
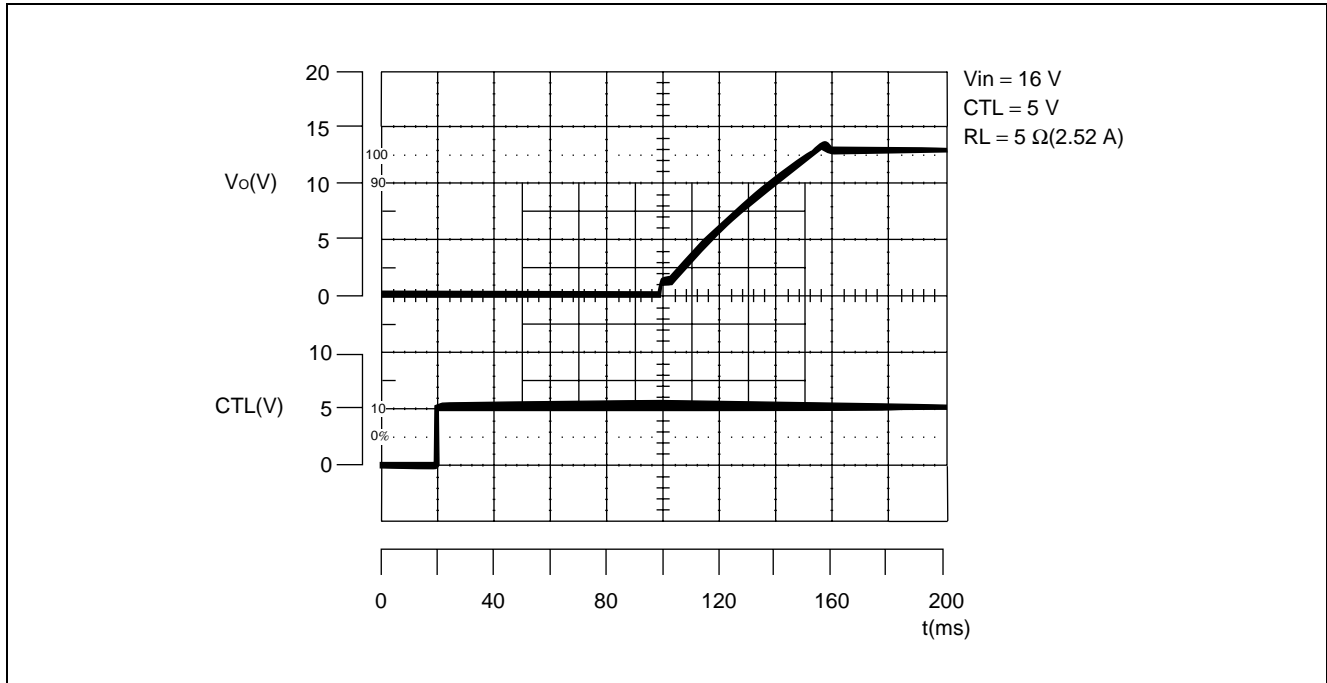## ■ EQUIVALE CIRCUIT (CTL, SYNC pin)

• **CTL pin**
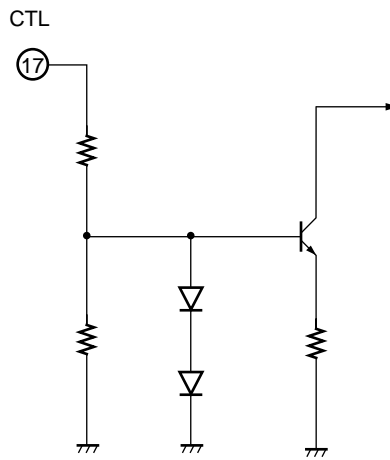
• **SYNC pin**
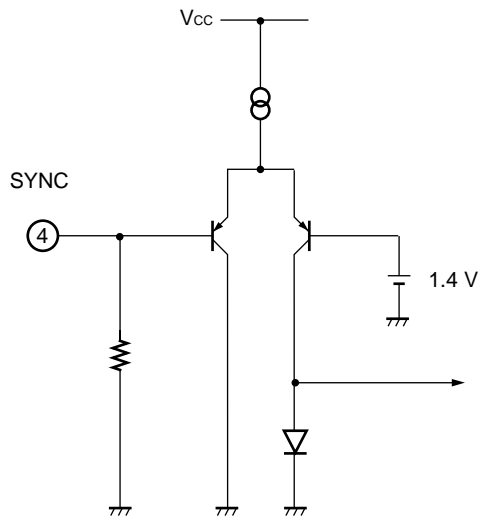
■ APPLICATION EXAMPLE (Step-down scheme)

MB3832A

■ REFERENCE DATA

Output voltage vs. output current characteristics

$V_{in} = 16$ V
$Ta = +25°C$

$V_{+IN2} = V_{REF}/3$
$(+IN2 \rightarrow c)$

$V_{+IN2} = V_{REF}*2/3$
$(+IN2 \rightarrow b)$

$V_{+IN2} = V_{REF}$
$(+IN2 \rightarrow a)$

Output voltage V_O (V)
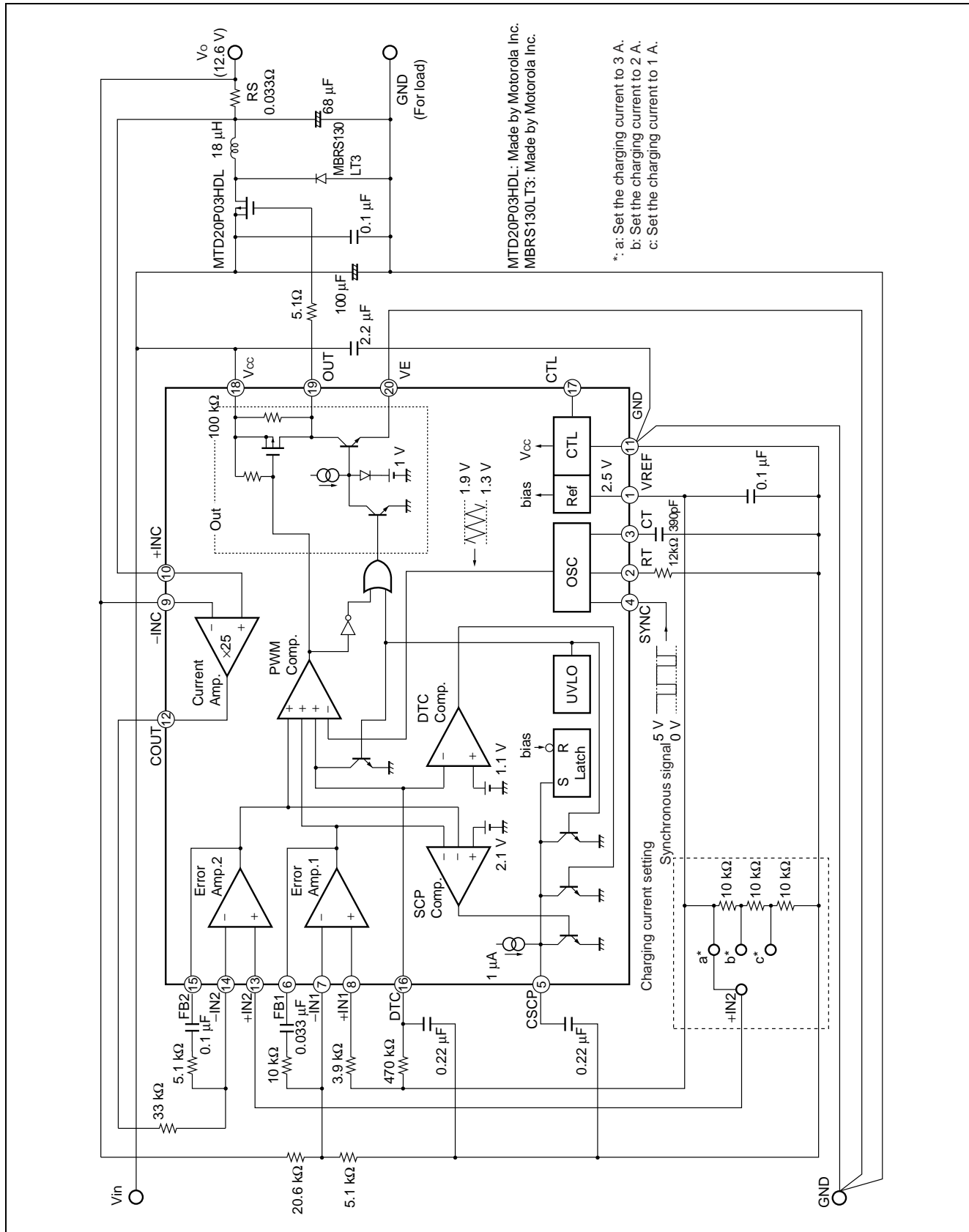
Output current I_O (A)
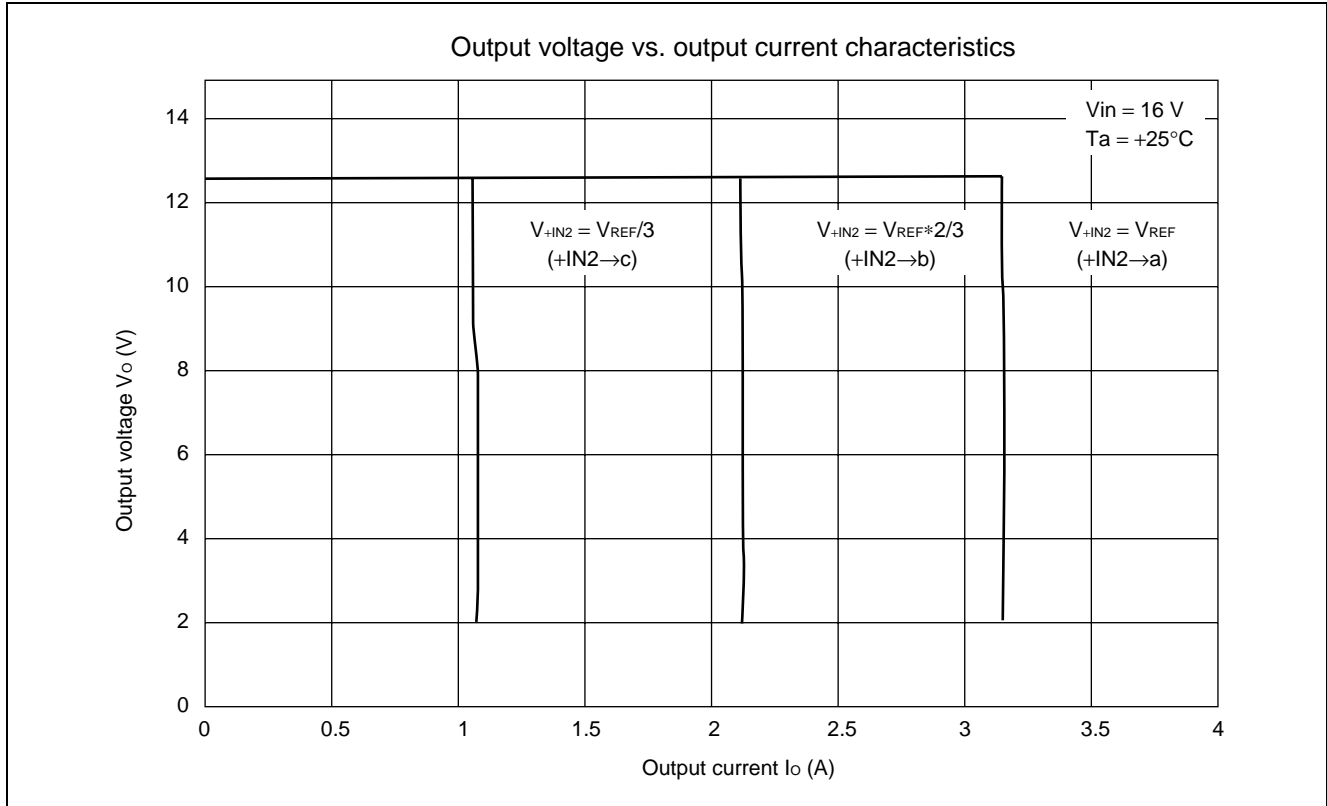
Soft start operation waveforms

V_O(V)

CTL(V)

$V_{in} = 16$ V
CTL = 5 V
$R_L = 5$ Ω(2.52 A)

t(ms)

■ **USAGE PRECAUTIONS**

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

2. **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.

■ **ORDERING INFORMATION**

Part number	Package	Remarks
MB3832APFV	20-pin Plastic SSOP (FPT-20P-M03)	

MB3832A

■ PACKAGE DIMENSION

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

*: These dimensions do not include resin protrusion.

* 6.50±0.10(.256±.004)

20   11

INDEX

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

LEAD No. 1   10

0.65(.026)

0.24±0.08   ⊕ 0.13(.005) Ⓜ
(.009±.003)

△ 0.10(.004)

0.17±0.03
(.007±.001)

"A"

Details of "A" part

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

0~8°

0.50±0.20
(.020±.008)

0.10±0.10 (Stand off)
(.004±.004)

0.25(.010)

0.45/0.75
(.018/.030)
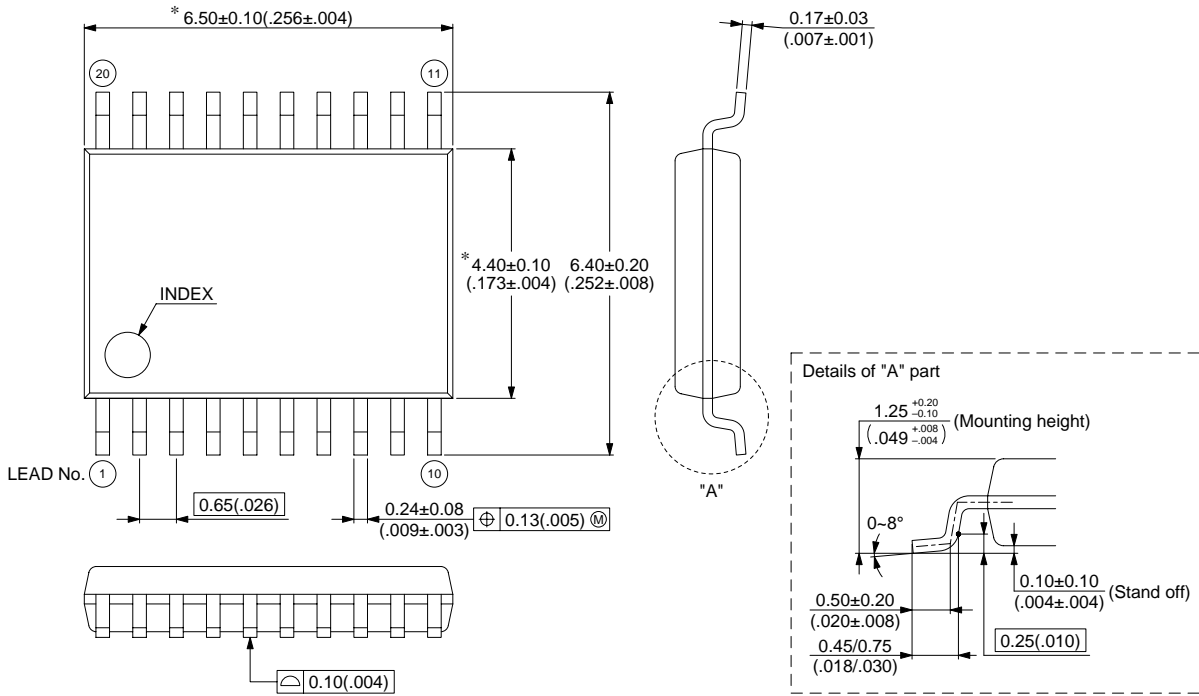
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Dimensions in mm (inches)

FUJITSU LIMITED

For further information please contact:

Japan

FUJITSU LIMITED
Corporate Global Business Support Division
Electronic Devices
KAWASAKI PLANT, 4-1-1, Kamikodanaka,
Nakahara-ku, Kawasaki-shi,
Kanagawa 211-8588, Japan
Tel: +81-44-754-3763
Fax: +81-44-754-3329

http://www.fujitsu.co.jp/

North and South America

FUJITSU MICROELECTRONICS, INC.
3545 North First Street,
San Jose, CA 95134-1804, U.S.A.
Tel: +1-408-922-9000
Fax: +1-408-922-9179

Customer Response Center
Mon. - Fri.: 7 am - 5 pm (PST)
Tel: +1-800-866-8608
Fax: +1-408-922-9179

http://www.fujitsumicro.com/

Europe

FUJITSU MICROELECTRONICS EUROPE GmbH
Am Siebenstein 6-10,
D-63303 Dreieich-Buchschlag,
Germany
Tel: +49-6103-690-0
Fax: +49-6103-690-122

http://www.fujitsu-fme.com/

Asia Pacific

FUJITSU MICROELECTRONICS ASIA PTE. LTD.
#05-08, 151 Lorong Chuan,
New Tech Park,
Singapore 556741
Tel: +65-281-0770
Fax: +65-281-0220

http://www.fmap.com.sg/

Korea

FUJITSU MICROELECTRONICS KOREA LTD.
1702 KOSMO TOWER, 1002 Daechi-Dong,
Kangnam-Gu,Seoul 135-280
Korea
Tel: +82-2-3484-7100
Fax: +82-2-3484-7111

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