

ASSP For Power Supply Applications

Switching Regulator Controller

MB3776A

■ DESCRIPTION

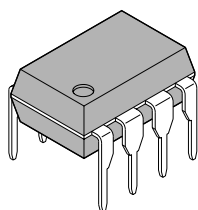
MB3776A is a PWM system switching regulator controller. Because of its low operating supply voltage and power-down, the MB3776A is ideal for use in DC/DC converters for battery-powered portable equipment.

■ FEATURES

- Wide supply voltage range: (2 V to 15 V)
- Wide oscillation frequency range, high-frequency oscillation: (10 kHz to 500 kHz)
- Push-pull output. Drive current set with external resistor
- Built-in idle period circuit
- Internally set error amplifier gain, few external components
- Built-in power-down function

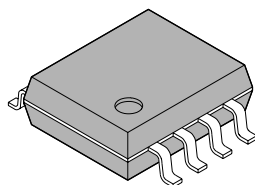
■ PACKAGES

8-pin Plastic DIP



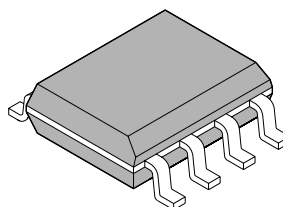
(DIP-8P-M01)

8-pin Plastic SOP



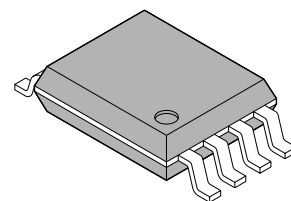
(FPT-8P-M01)

8-pin Plastic SOL



(FPT-8P-M02)

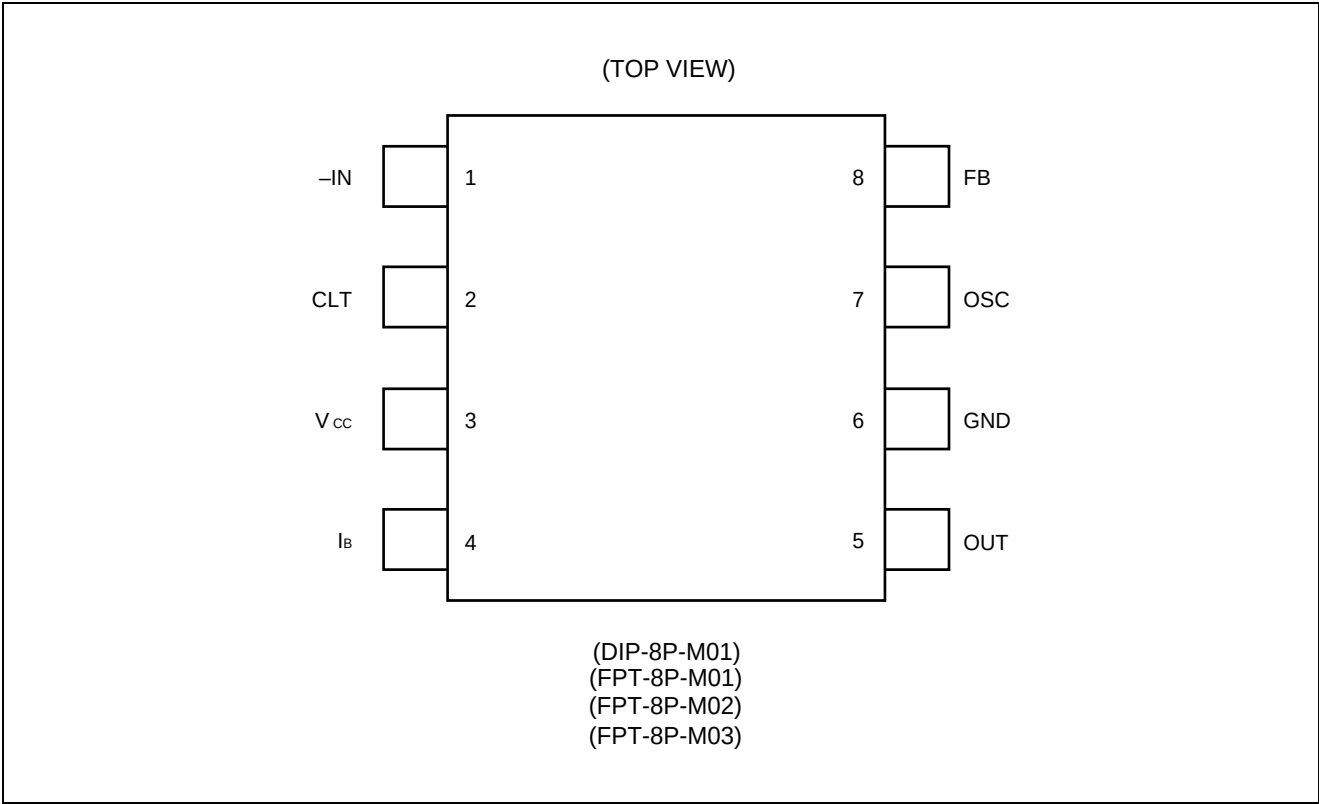
8-pin Plastic SSOP



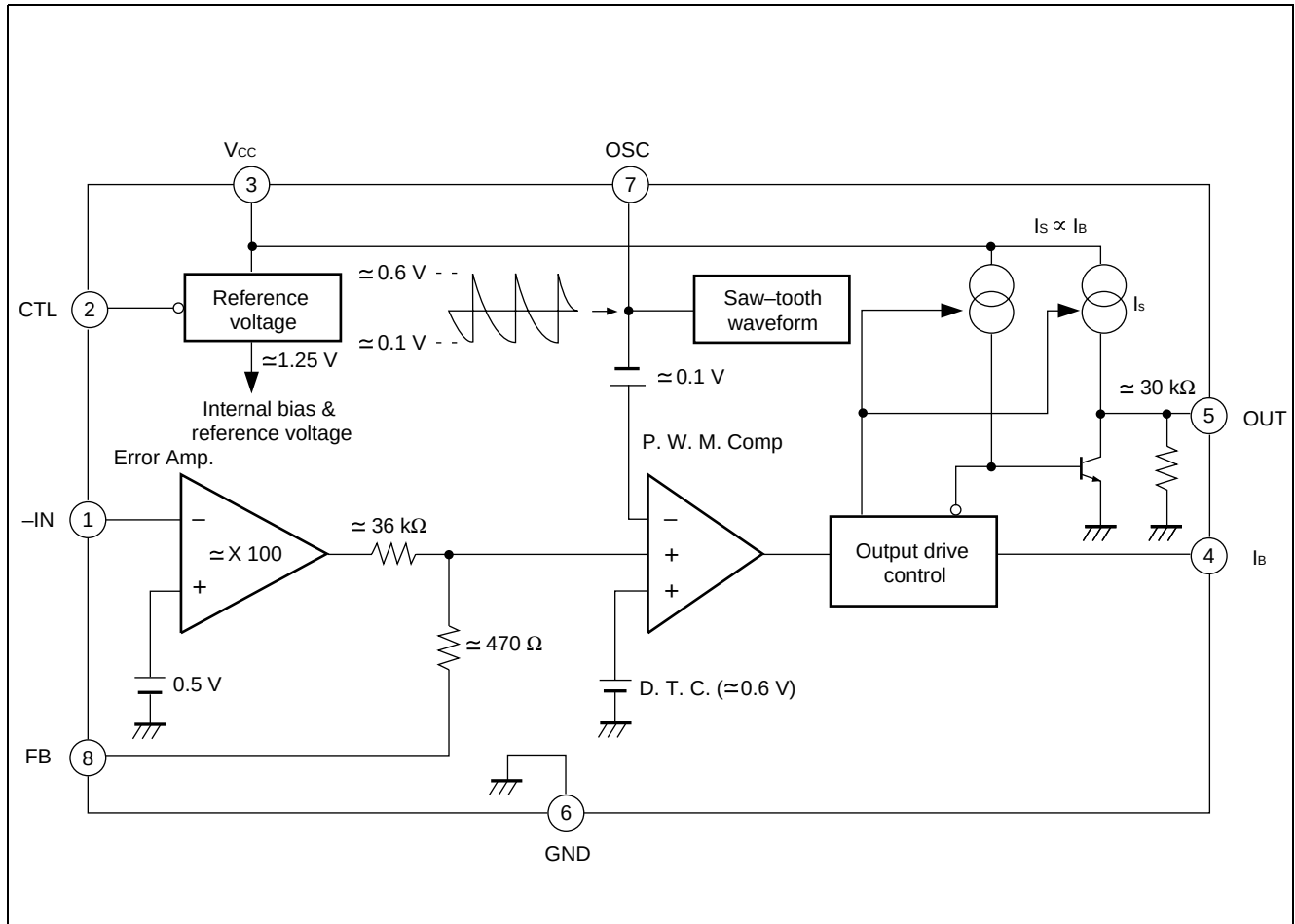
(FPT-8P-M03)

MB3776A

PIN ASSIGNMENT



■ BLOCK DIAGRAM



MB3776A

■ ABSOLUTE MAXIMUM RATINGS

(Ta = +25°C)

Parameter	Symbol	Condition		Rating		Unit
				Min.	Max.	
Power supply voltage	V _{CC}	—		—	16	V
Error amp. input voltage	V _I	—		−0.3	+10	V
Output source current	I _{SOURCE}	—		—	−50	mA
Output sink current	I _{SINK}	—		—	50	mA
Power dissipation	P _D	Ta ≤ +25°C (DIP)		—	550	mW
		Ta ≤ +25°C (SOP)	EIAJ	—	*570	mW
			JEDEC	—	*430	mW
		Ta < +25°C (SSOP)		—	*580	mW
Operating temperature	Top	—		−30	+75	°C
Storage temperature	Tstg	—		−55	+125	°C

* : The packages are mounted on the epoxy board (10 cm × 10 cm × 1.5 mm)

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	Value			Unit
		Min.	Typ.	Max.	
Power supply voltage	V _{CC}	2.0	—	15	V
Error amp. input voltage	V _I	−0.2	—	1.0	V
Output source current	I _{SOURCE}	−40	—	—	mA
Output sink current	I _{SINK}	—	—	40	mA
Phase compensation capacitor	C _P	—	0.1	—	μF
Timing capacitor	C _T	100	1000	10000	pF
Timing resistor	R _T	1.0	3.0	5.0	kΩ
Oscillator frequency	f _{OSC}	10	200	500	kHz
Operating temperature	T _{OP}	−30	25	75	°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.

■ ELECTRICAL CHARACTERISTICS

1. Reference Section and Error Amp. Section

(Ta = +25°C, Vcc = 3 V)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Input threshold voltage	V _T	V _{FB} = 450 mV	487	507	527	mV
V _T input stability	V _{TdV1}	V _{CC} = 2.0 V to 6.0 V	−5	—	5	mV
	V _{TdV2}	V _{CC} = 6.0 V to 15 V	−5	—	5	mV
V _T temp. stability	V _{TdT}	Ta = −30°C to +75°C	−3	—	3	%
Input bias current	I _B	V _{IN} = 0 V to 0.6 V	−1.0	−0.2	1.0	μA
Voltage gain	A _V	—	70	100	145	V/V
Frequency band width	BW	A _V = 0 dB	—	6	—	MHz

2. Saw-tooth Waveform Oscillator Section

(Ta = +25°C, Vcc = 3 V)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Oscillator frequency	f _{OSC}	R _T = 3.0 kΩ C _T = 1000 pF	160	200	240	kHz
Frequency input stability	f _{dV}	V _{CC} = 2.0 V to 15 V	—	±2	—	%
Frequency temp. stability	f _{dT}	Ta = −30°C to +75°C	—	±10	—	%

3. Under Lockout Protection

(Ta = +25°C, Vcc = 3 V)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Threshold voltage	V _{TH}	—	—	1.4	—	V

4. Dead-time Control Section

(Ta = +25°C, Vcc = 3 V)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Max. duty cycle	t _{DUTY}	C _T = 1000 pF R _T = 3.0kΩ V _{FB} = 0.9 V	60	70	85	%

5. Output Section

(Ta = +25°C, Vcc = 3 V)

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Output source current	ISOURCE	RB = 820 Ω, VO = 1 V	−40	−30	−20	mA
Output sink current	ISINK	RB = 820 Ω, VO = 0.3 V	30	60	—	mA
High-level output voltage	VOH	RB = 820 Ω, VO = 7 V IO = −15 mA	5.5	6.0	—	V
Output voltage	VOL	VCTL = VCC, IO = 3 μA	—	0.1	0.2	V

6. Control Section

(Ta = +25°C, Vcc = 3 V)

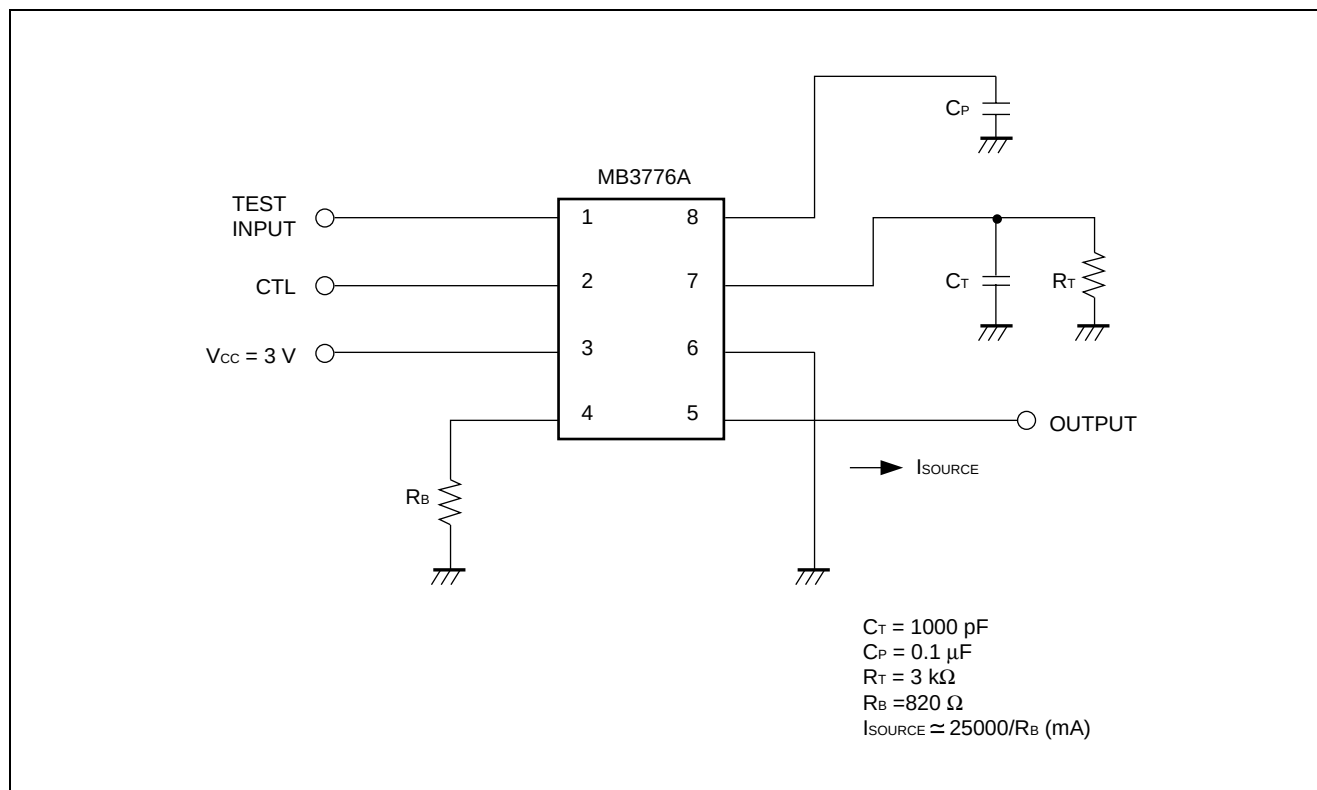
Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Input off condition	IOFF	—	−300	—	—	μA
Input on condition	ION	—	—	—	−700	μA
Control terminal current	ICTL	VCC = 7 V, VCTL = 0 V	−1.3	−1	—	mA

7. All Device

(Ta = +25°C, Vcc = 3 V)

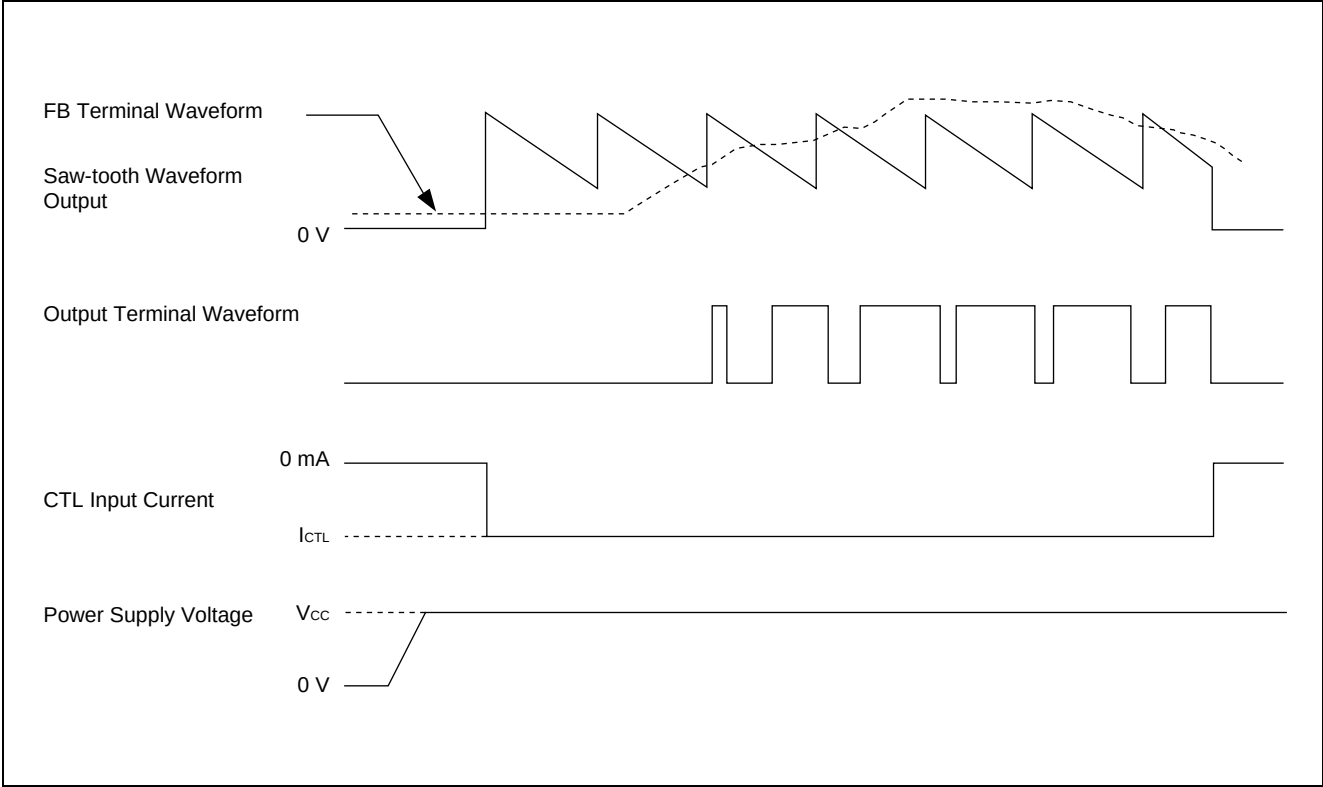
Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Stand by current	ICCS	VCTL = VCC or CTL terminal open	—	—	0.5	μA
Average supply current	ICC	ICTL = −700 μA RB = 820 Ω	—	4.5	8	mA

■ MEASUREMENT CIRCUIT



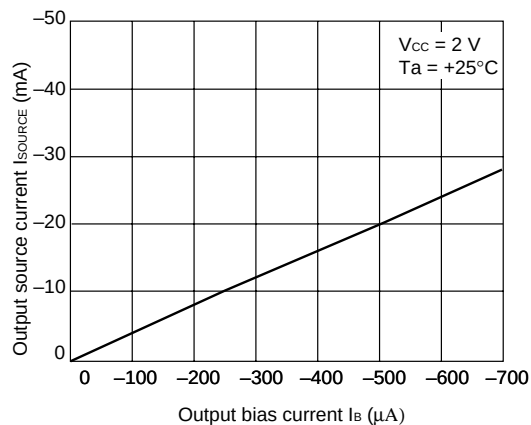
MB3776A

■ DIAGRAM

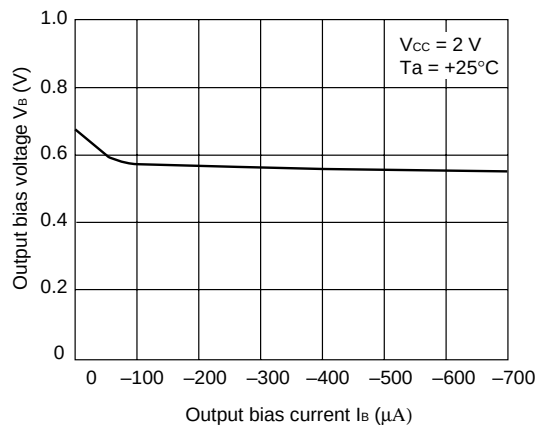


TYPICAL CHARACTERISTIC

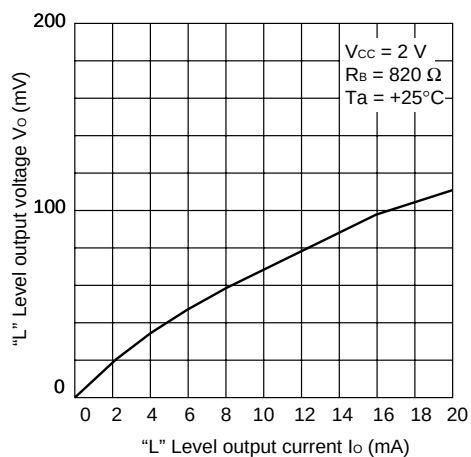
Output bias current vs. Output source current



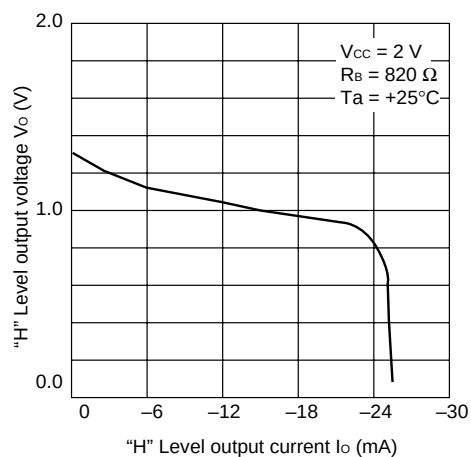
Output bias current vs. Output bias voltage



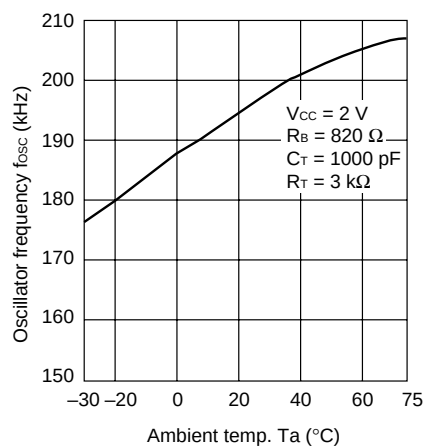
“L” Level output



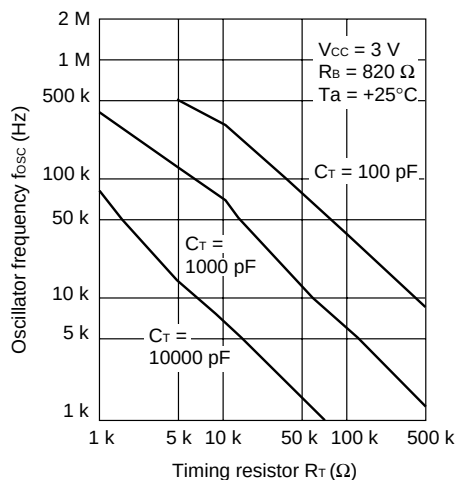
“H” Level output



Ambient temp. vs. Oscillator frequency



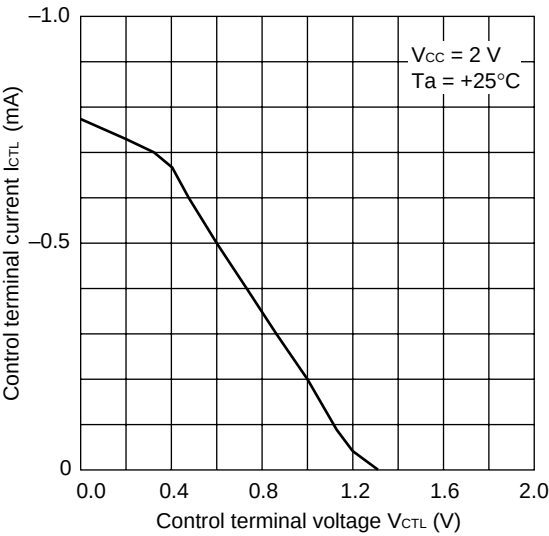
Timing resistor vs. Oscillator frequency



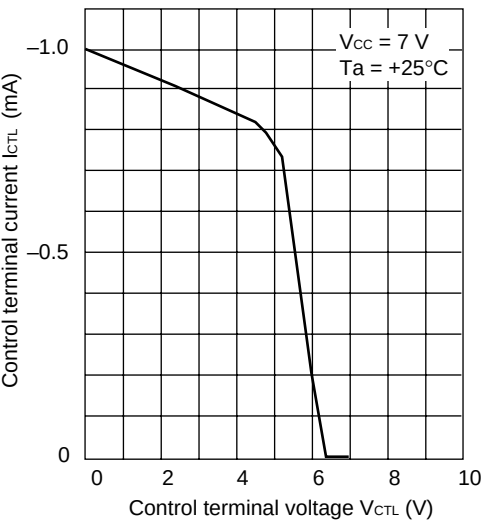
(Continued)

(Continued)

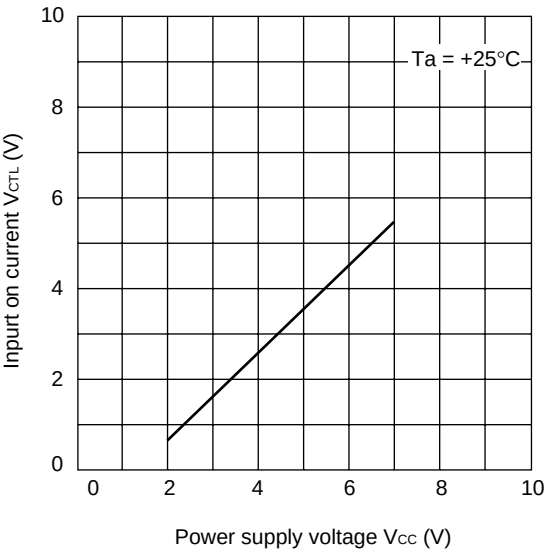
Control terminal voltage vs.
Control terminal current



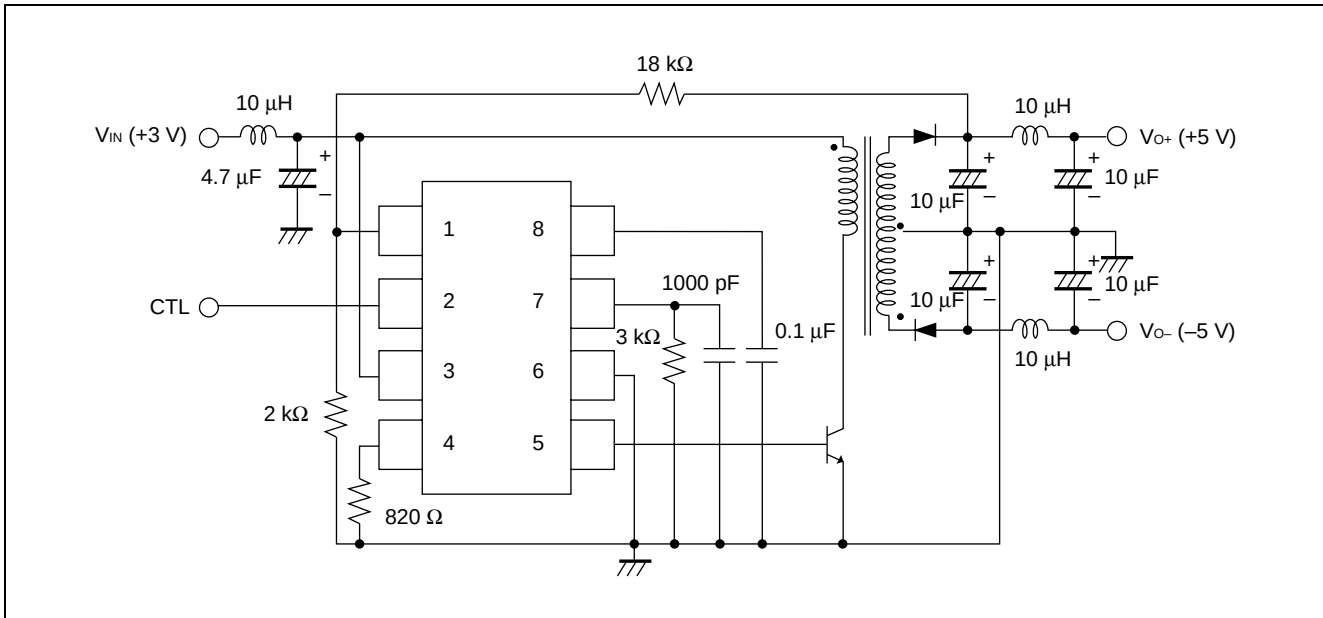
Control terminal voltage vs.
Control terminal current



Power supply voltage vs. Input on voltage

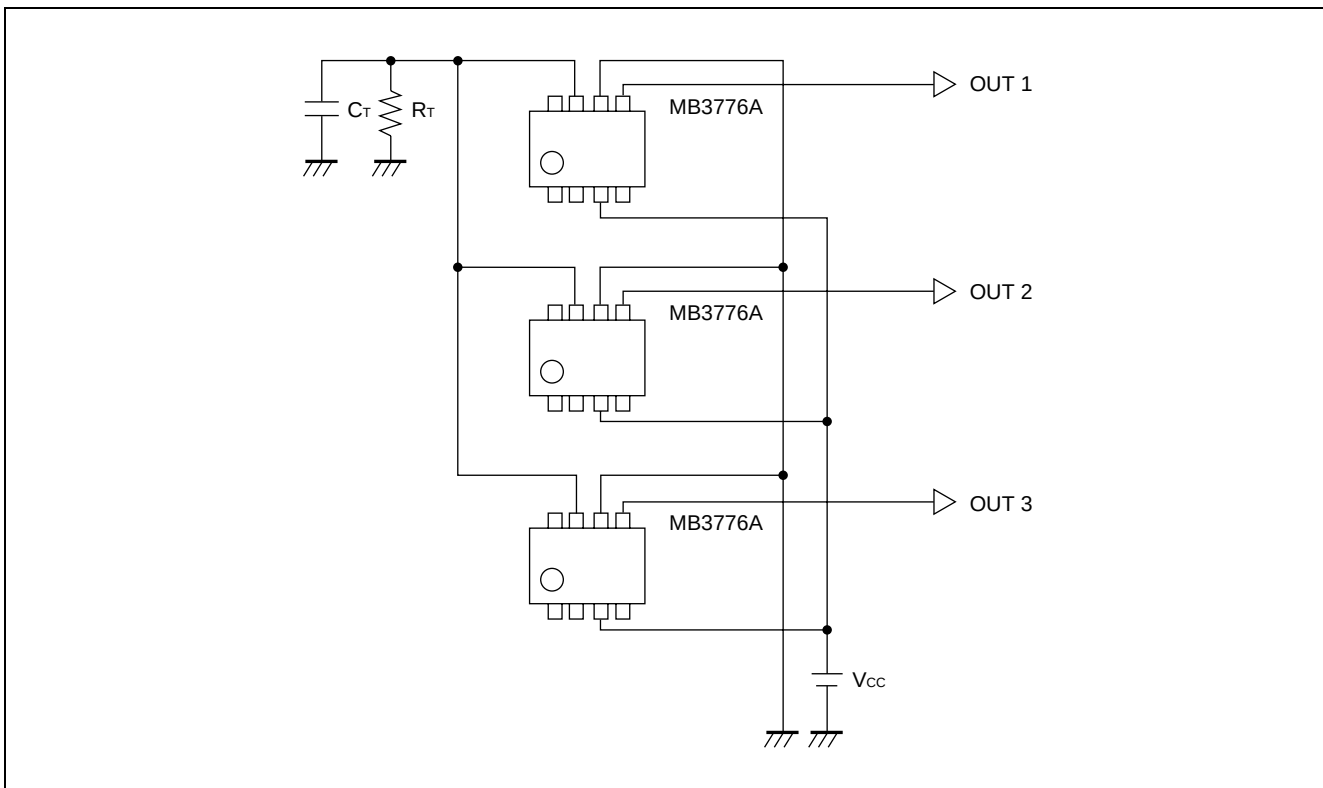


APPLICATION EXAMPLE



Synchronization

To synchronize MB3776A controllers, the OSC terminal of each IC is shared and the same specified capacitor and resistor used on a signal IC application is connected for self-excitation oscillation. The CTL terminal controls power on/off of each IC.



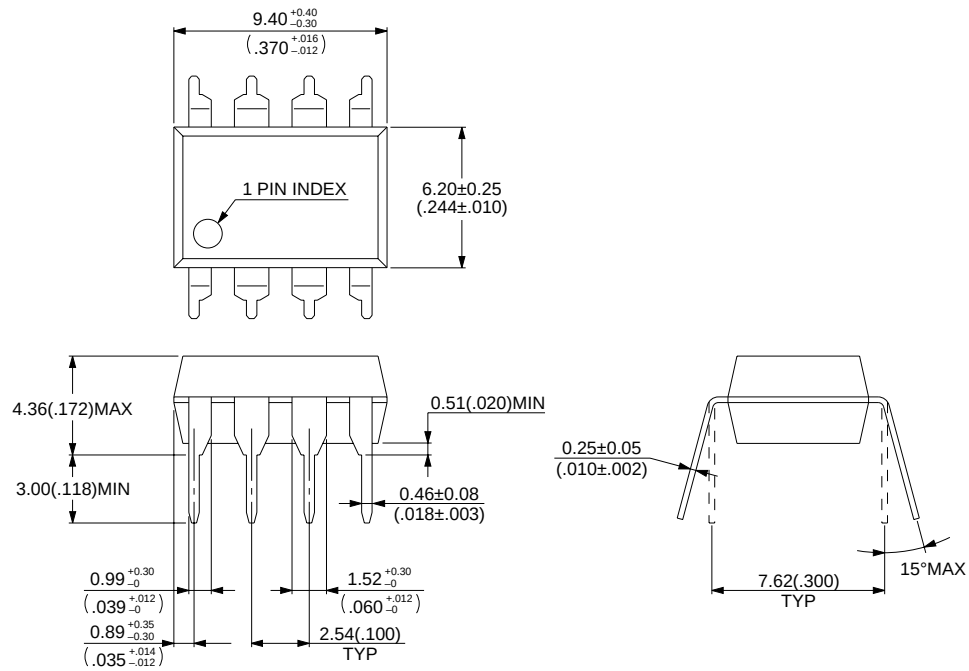
MB3776A

■ ORDERING INFORMATION

Part number	Package	Remarks
MB3776A-P	8-pin Plastic DIP (DIP-8P-M01)	
MB3776APF	8-pin Plastic SOP (FPT-8P-M01)	
MB3776APNF	8-pin Plastic SOL (FPT-8P-M02)	
MB3776APFV	8-pin Plastic SSOP (FPT-8P-M03)	

■ PACKAGE DIMENSIONS

8-pin Plastic DIP
(DIP-8P-M01)



© 1994 FUJITSU LIMITED D08006S-2C-3

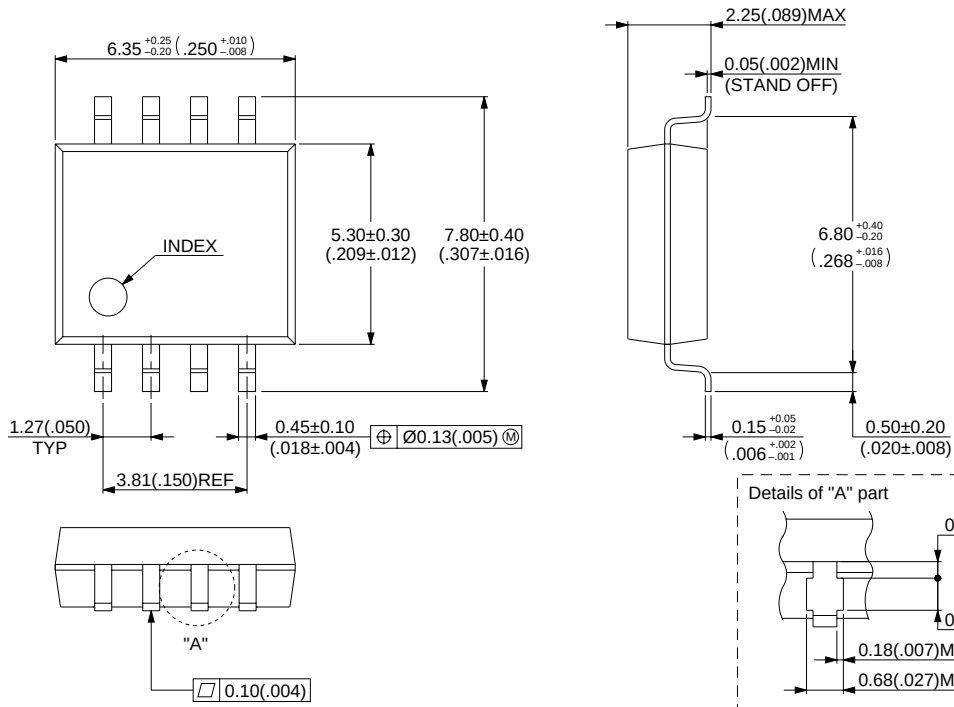
Dimensions in mm (inches).

(Continued)

MB3776A

(Continued)

8-pin Plastic SOP (FPT-8P-M01)



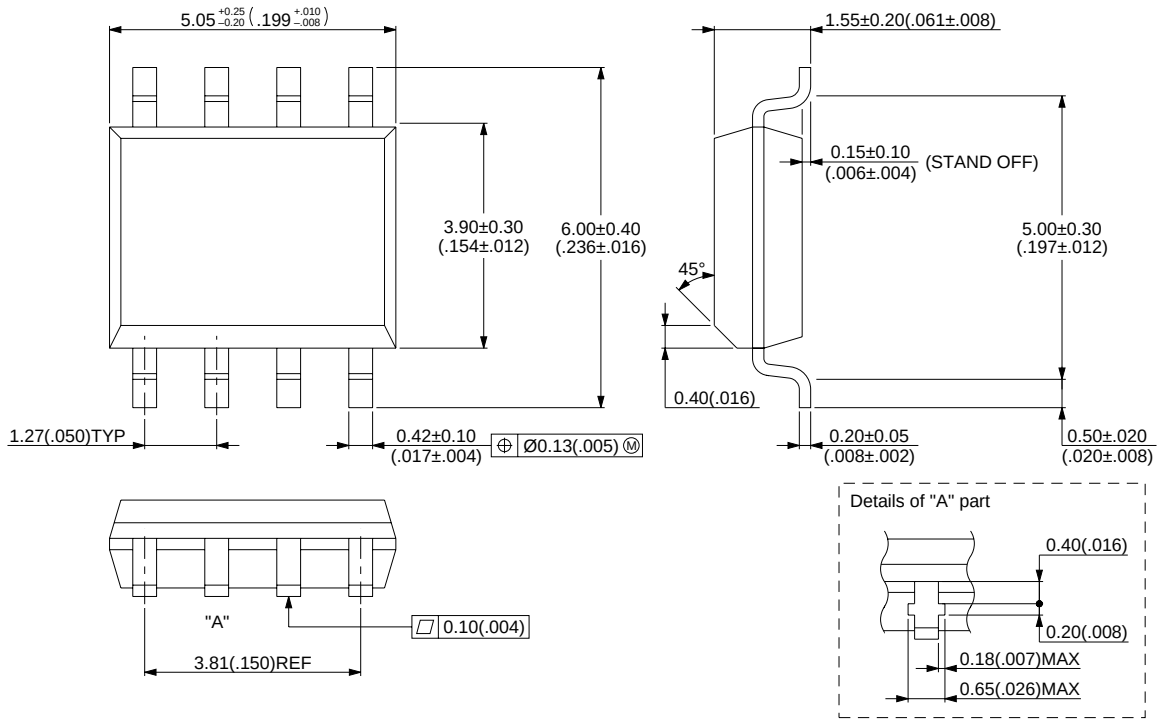
© 1994 FUJITSU LIMITED F08002S-4C-4

Dimensions in mm (inches).

(Continued)

(Continued)

8-pin Plastic SOL (FPT-8P-M02)



© 1994 FUJITSU LIMITED F08004S-2C-4

Dimensions in mm (inches).

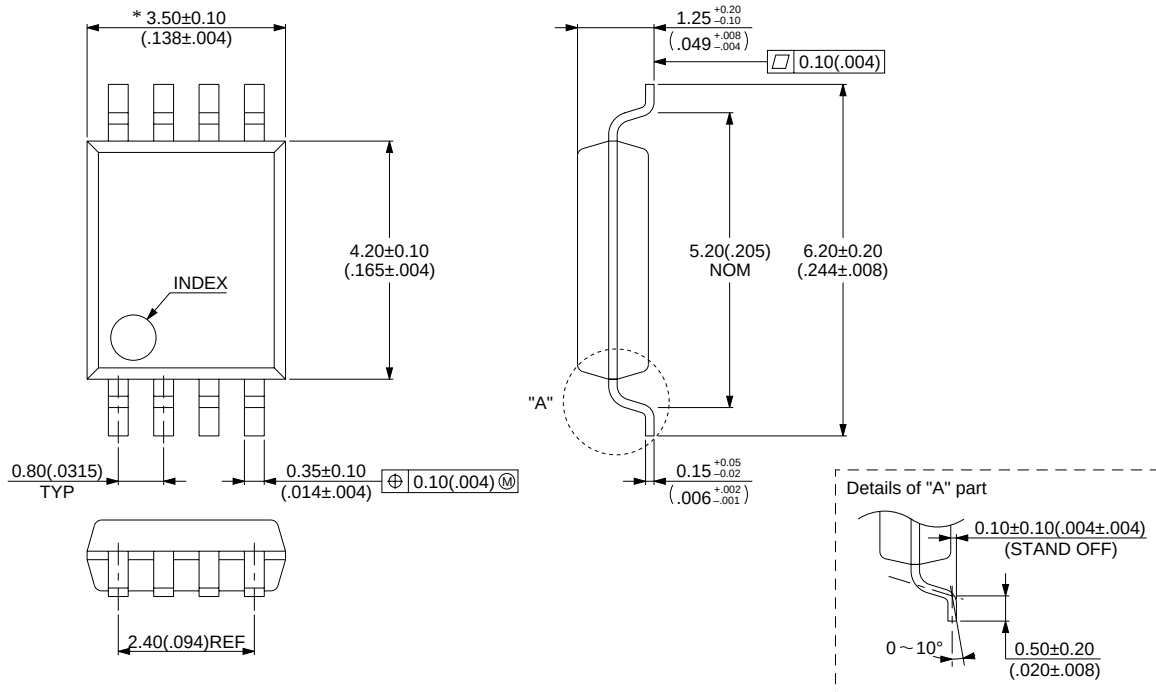
(Continued)

MB3776A

(Continued)

8-pin Plastic SSOP (FPT-8P-M03)

*: This dimension does not include resin protrusion.



© 1994 FUJITSU LIMITED F08005S-1C-2

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: (044) 754-3763
Fax: (044) 754-3329

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

North and South America

FUJITSU MICROELECTRONICS, INC.
Semiconductor Division
3545 North First Street
San Jose, CA 95134-1804, USA
Tel: (408) 922-9000
Fax: (408) 922-9179

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

<http://www.fujitsumicro.com/>

Europe

FUJITSU MIKROELEKTRONIK GmbH
Am Siebenstein 6-10
D-63303 Dreieich-Buchsschlag
Germany
Tel: (06103) 690-0
Fax: (06103) 690-122

<http://www.fujitsu-edc.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/>

F9802

© FUJITSU LIMITED Printed in Japan

All Rights Reserved.

The contents of this document are subject to change without notice. Customers are advised to consult with FUJITSU sales representatives before ordering.

The information and circuit diagrams in this document presented as examples of semiconductor device applications, and are not intended to be incorporated in devices for actual use. Also, FUJITSU is unable to assume responsibility for infringement of any patent rights or other rights of third parties arising from the use of this information or circuit diagrams.

FUJITSU semiconductor devices are intended for use in standard applications (computers, office automation and other office equipment, industrial, communications, and measurement equipment, personal or household devices, etc.).

CAUTION:

Customers considering the use of our products in special applications where failure or abnormal operation may directly affect human lives or cause physical injury or property damage, or where extremely high levels of reliability are demanded (such as aerospace systems, atomic energy controls, sea floor repeaters, vehicle operating controls, medical devices for life support, etc.) are requested to consult with FUJITSU sales representatives before such use. The company will not be responsible for damages arising from such use without prior approval.

Any semiconductor devices have inherently a certain rate of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.

If any products described in this document represent goods or technologies subject to certain restrictions on export under the Foreign Exchange and Foreign Trade Control Law of Japan, the prior authorization by Japanese government should be required for export of those products from Japan.