

## ASSP For Power Supply Applications

# Switching Regulator Controller

## MB3776A

### ■ DESCRIPTION

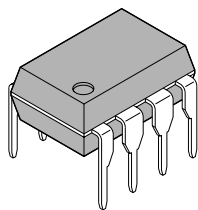
MB3776A is a PWM system switching regulator controller. Because of its low operating supply voltage and power-down, the MB3776A is ideal for use in DC/DC converters for battery-powered portable equipment.

### ■ 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

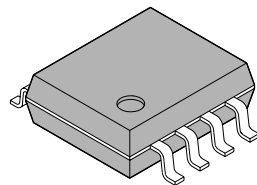
### ■ PACKAGES

8-pin Plastic DIP



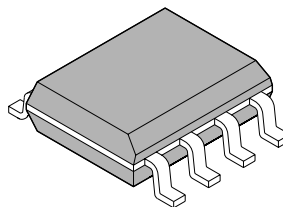
(DIP-8P-M01)

8-pin Plastic SOP



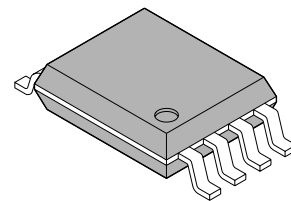
(FPT-8P-M01)

8-pin Plastic SOL



(FPT-8P-M02)

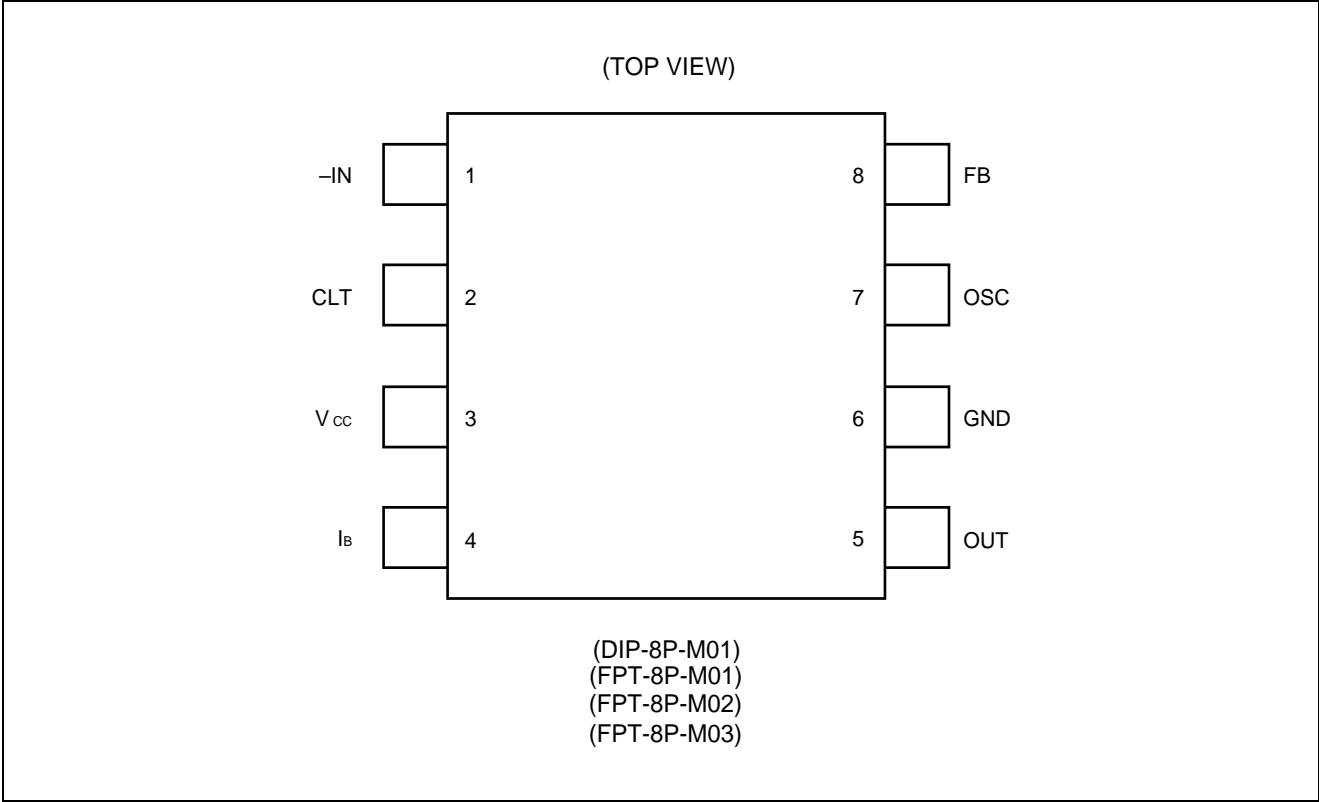
8-pin Plastic SSOP



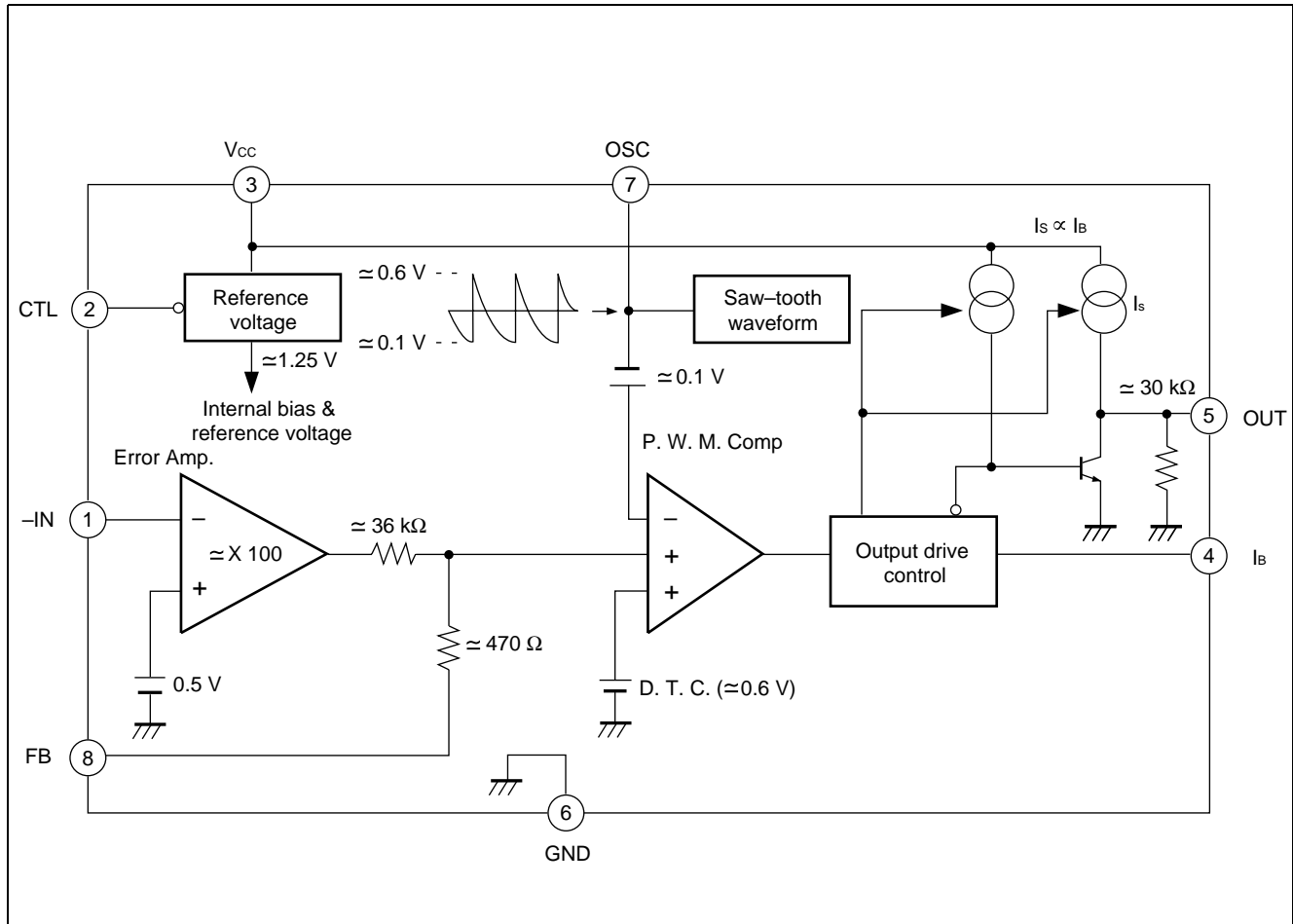
(FPT-8P-M03)

# MB3776A

## ■ PIN ASSIGNMENT



## ■ BLOCK DIAGRAM



# MB3776A

## ■ ABSOLUTE MAXIMUM RATINGS

(Ta = +25°C)

Parameter	Symbol	Condition	Rating		Unit	
			Min.	Max.		
Power supply voltage	V <sub>CC</sub>	—	—	16	V	
Error amp. input voltage	V <sub>I</sub>	—	-0.3	+10	V	
Output source current	I <sub>SOURCE</sub>	—	—	-50	mA	
Output sink current	I <sub>SINK</sub>	—	—	50	mA	
Power dissipation	P <sub>D</sub>	Ta ≤ +25°C (DIP)		—	550	mW
		Ta ≤ +25°C (SOP)	EIAJ	—	*570	mW
			JEDEC	—	*430	mW
		Ta < +25°C (SSOP)		—	*580	mW
Operating temperature	T <sub>OP</sub>	—	-30	+75	°C	
Storage temperature	T <sub>STG</sub>	—	-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 <sub>CC</sub>	2.0	—	15	V
Error amp. input voltage	V <sub>I</sub>	-0.2	—	1.0	V
Output source current	I <sub>SOURCE</sub>	-40	—	—	mA
Output sink current	I <sub>SINK</sub>	—	—	40	mA
Phase compensation capacitor	C <sub>P</sub>	—	0.1	—	μF
Timing capacitor	C <sub>T</sub>	100	1000	10000	pF
Timing resistor	R <sub>T</sub>	1.0	3.0	5.0	kΩ
Oscillator frequency	f <sub>OSC</sub>	10	200	500	kHz
Operating temperature	T <sub>OP</sub>	-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 <sub>T</sub>	V <sub>FB</sub> = 450 mV	487	507	527	mV
V <sub>T</sub> input stability	V <sub>TdV1</sub>	V <sub>CC</sub> = 2.0 V to 6.0 V	-5	—	5	mV
	V <sub>TdV2</sub>	V <sub>CC</sub> = 6.0 V to 15 V	-5	—	5	mV
V <sub>T</sub> temp. stability	V <sub>TdT</sub>	Ta = -30°C to +75°C	-3	—	3	%
Input bias current	I <sub>B</sub>	V <sub>IN</sub> = 0 V to 0.6 V	-1.0	-0.2	1.0	μA
Voltage gain	A <sub>V</sub>	—	70	100	145	V/V
Frequency band width	BW	A <sub>V</sub> = 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 <sub>osc</sub>	R <sub>T</sub> = 3.0 kΩ C <sub>T</sub> = 1000 pF	160	200	240	kHz
Frequency input stability	f <sub>dV</sub>	V <sub>CC</sub> = 2.0 V to 15 V	—	±2	—	%
Frequency temp. stability	f <sub>dT</sub>	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 <sub>TH</sub>	—	—	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 <sub>DUTY</sub>	C <sub>T</sub> = 1000 pF R <sub>T</sub> = 3.0kΩ V <sub>FB</sub> = 0.9 V	60	70	85	%

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## 5. Output Section

( $T_a = +25^\circ\text{C}$ ,  $V_{CC} = 3\text{ V}$ )

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Output source current	$I_{SOURCE}$	$R_B = 820\ \Omega$ , $V_O = 1\text{ V}$	-40	-30	-20	mA
Output sink current	$I_{SINK}$	$R_B = 820\ \Omega$ , $V_O = 0.3\text{ V}$	30	60	—	mA
High-level output voltage	$V_{OH}$	$R_B = 820\ \Omega$ , $V_O = 7\text{ V}$ $I_O = -15\text{ mA}$	5.5	6.0	—	V
Output voltage	$V_{OL}$	$V_{CTL} = V_{CC}$ , $I_O = 3\ \mu\text{A}$	—	0.1	0.2	V

## 6. Control Section

( $T_a = +25^\circ\text{C}$ ,  $V_{CC} = 3\text{ V}$ )

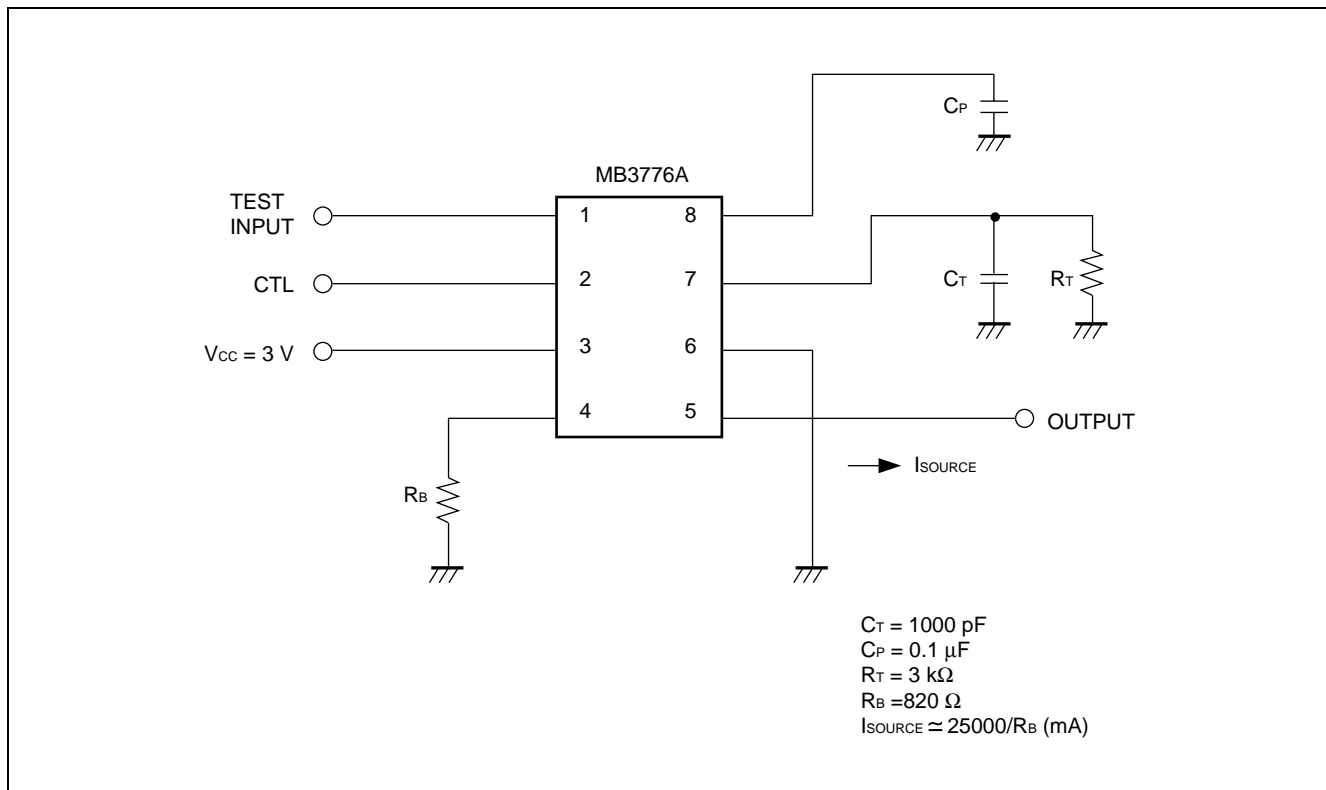
Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Input off condition	$I_{OFF}$	—	-300	—	—	$\mu\text{A}$
Input on condition	$I_{ON}$	—	—	—	-700	$\mu\text{A}$
Control terminal current	$I_{CTL}$	$V_{CC} = 7\text{ V}$ , $V_{CTL} = 0\text{ V}$	-1.3	-1	—	mA

## 7. All Device

( $T_a = +25^\circ\text{C}$ ,  $V_{CC} = 3\text{ V}$ )

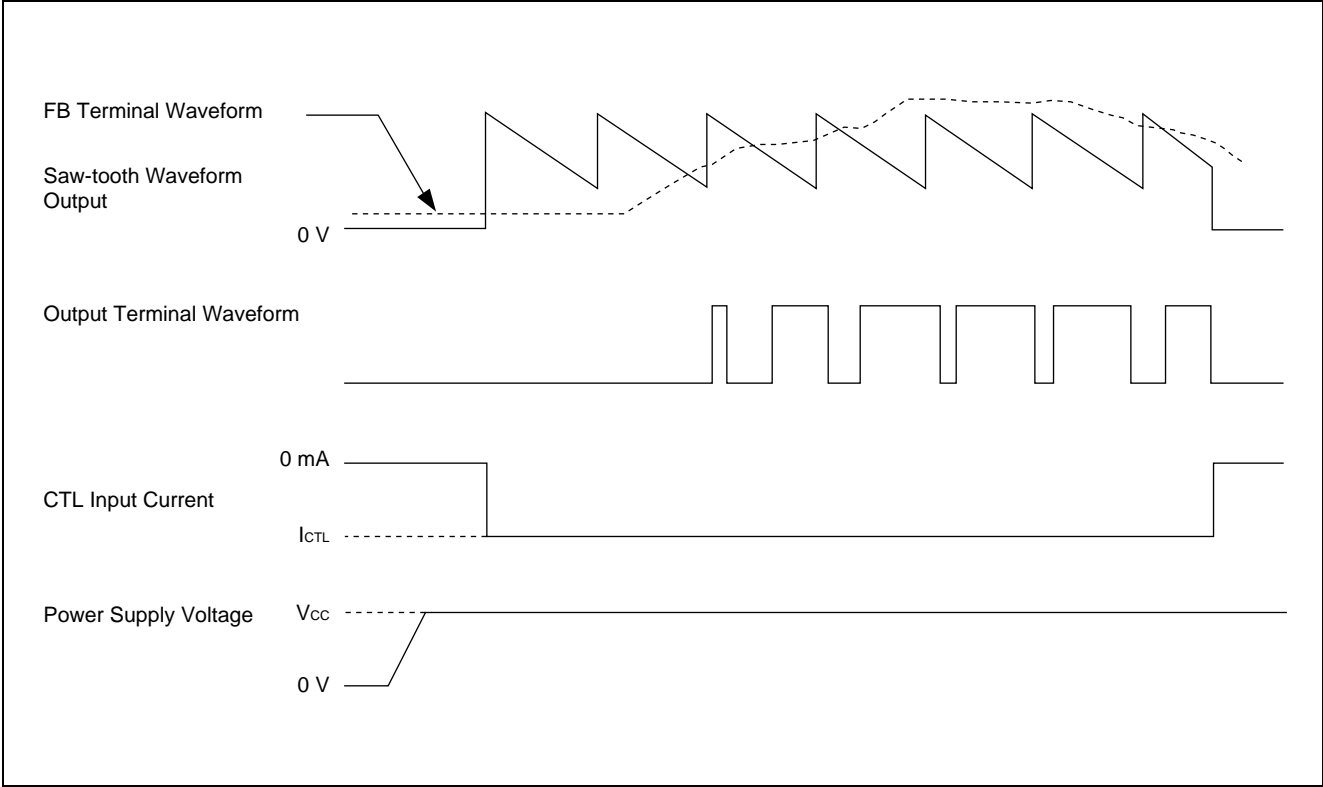
Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Stand by current	$I_{CCS}$	$V_{CTL} = V_{CC}$ or CTL terminal open	—	—	0.5	$\mu\text{A}$
Average supply current	$I_{CC}$	$I_{CTL} = -700\ \mu\text{A}$ $R_B = 820\ \Omega$	—	4.5	8	mA

## MEASUREMENT CIRCUIT



# MB3776A

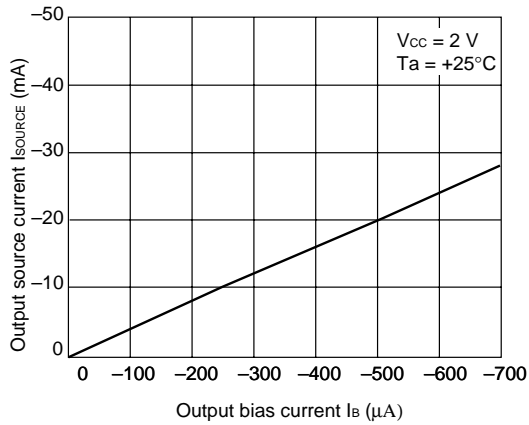
## ■ DIAGRAM



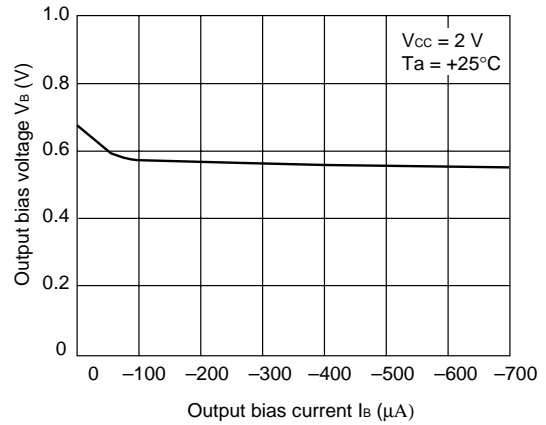


## TYPICAL CHARACTERISTIC

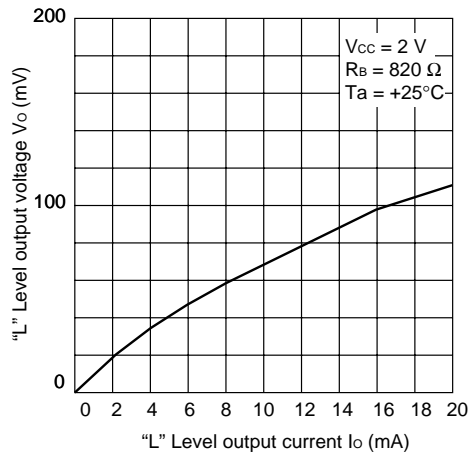
Output bias current vs. Output source current



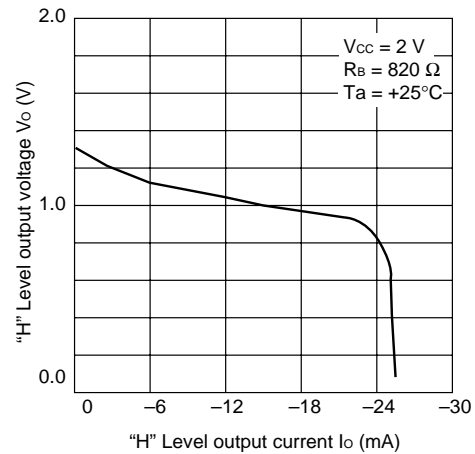
Output bias current vs. Output bias voltage



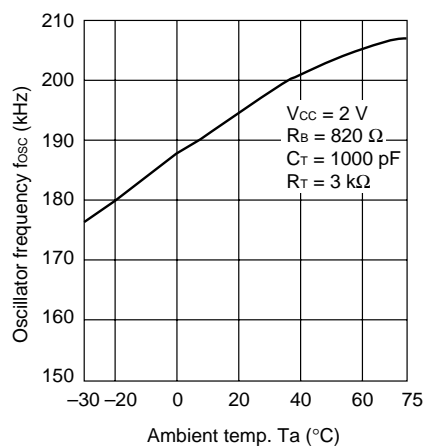
“L” Level output



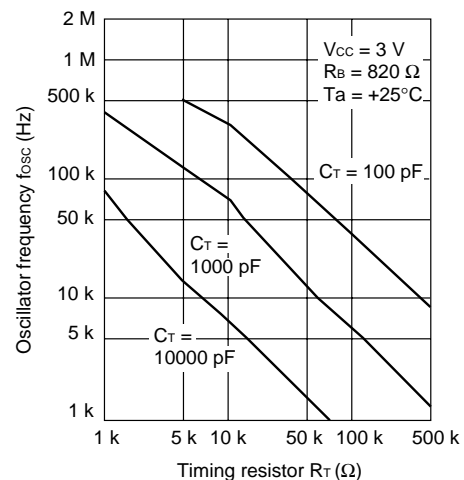
“H” Level output



Ambient temp. vs. Oscillator frequency



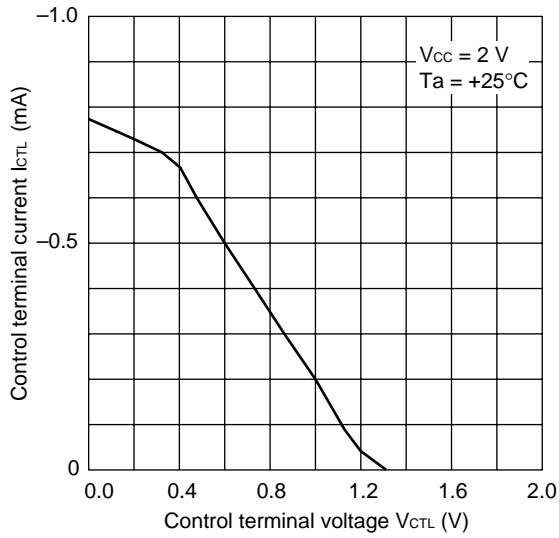
Timing resistor vs. Oscillator frequency



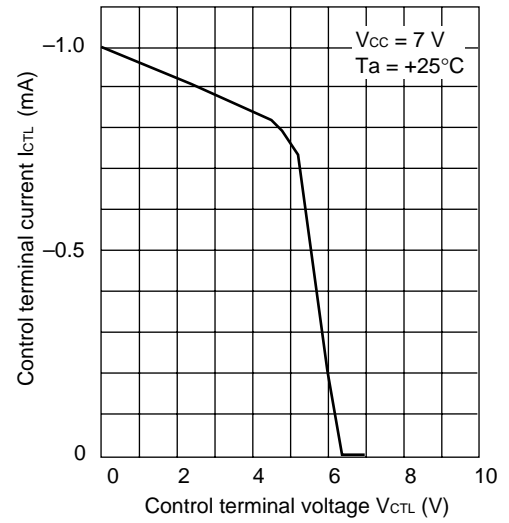
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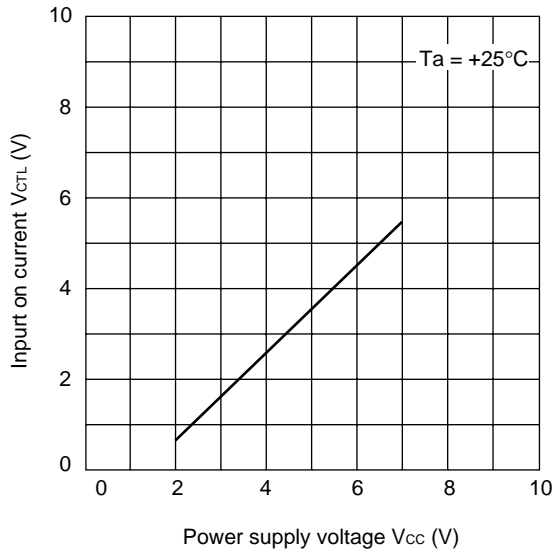
**Control terminal voltage vs. Control terminal current**



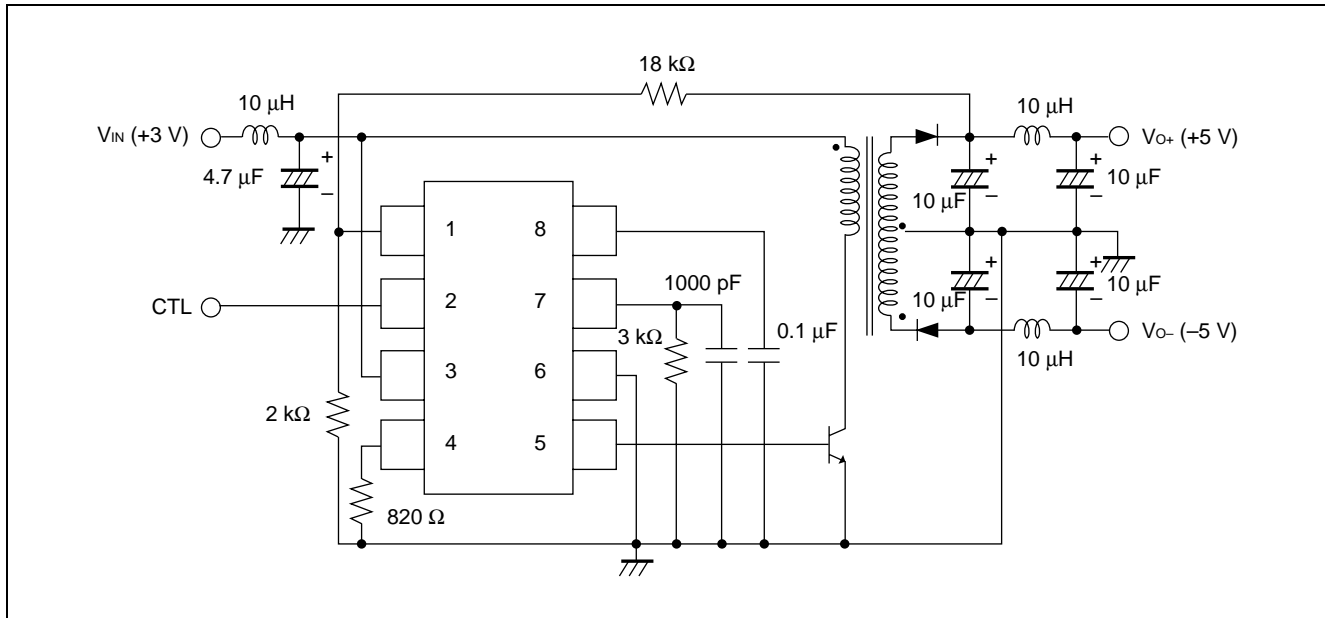
**Control terminal voltage vs. Control terminal current**



**Power supply voltage vs. Input on voltage**

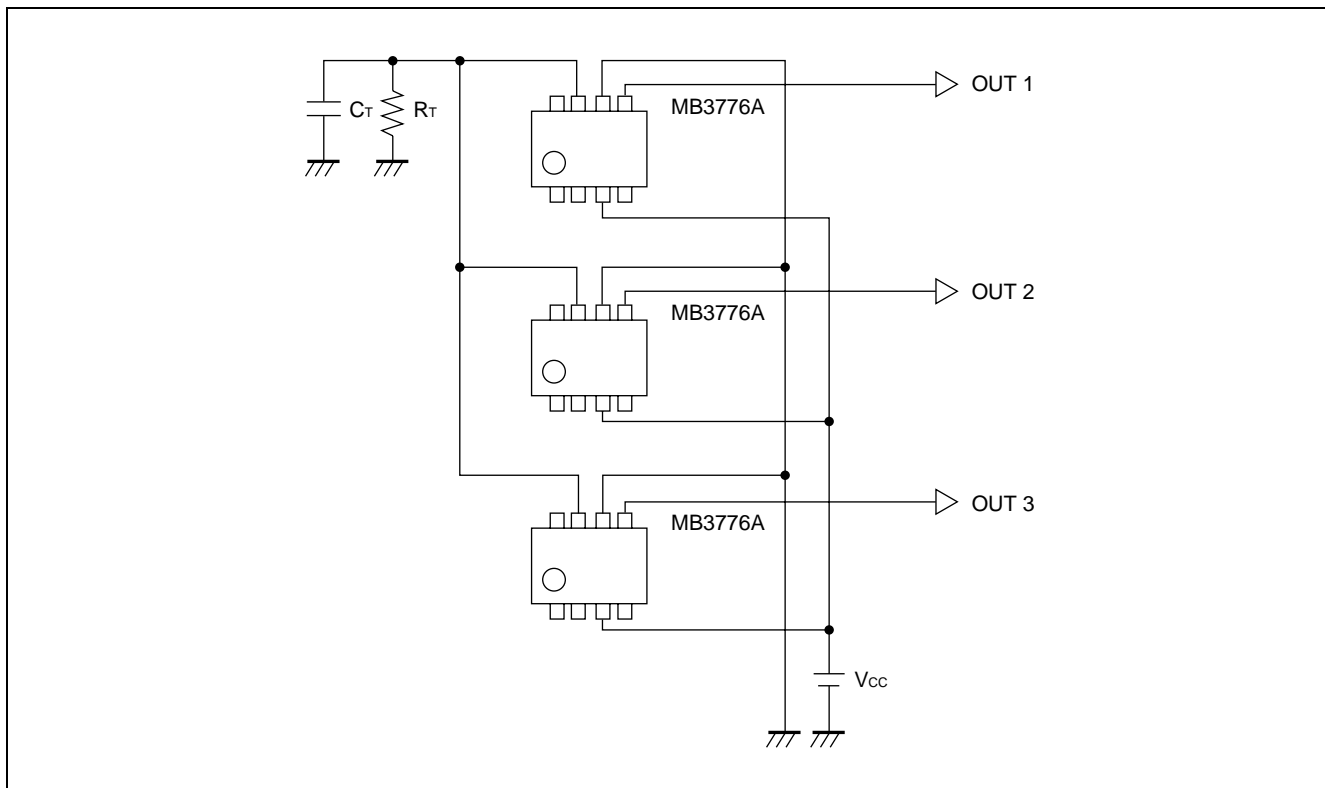


## APPLICATION EXAMPLE



## 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.



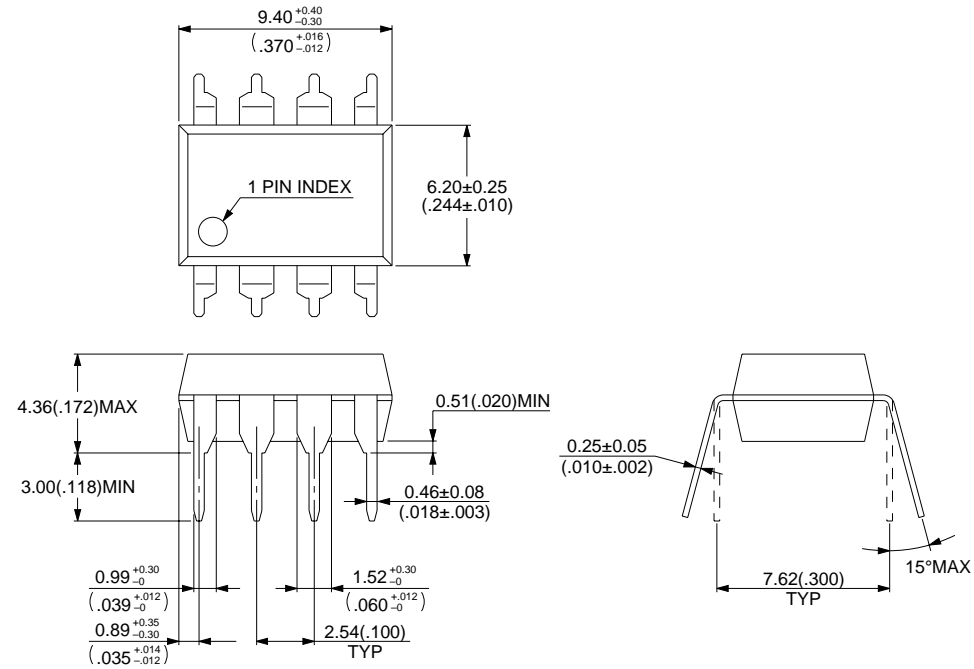
# MB3776A

## ■ 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)



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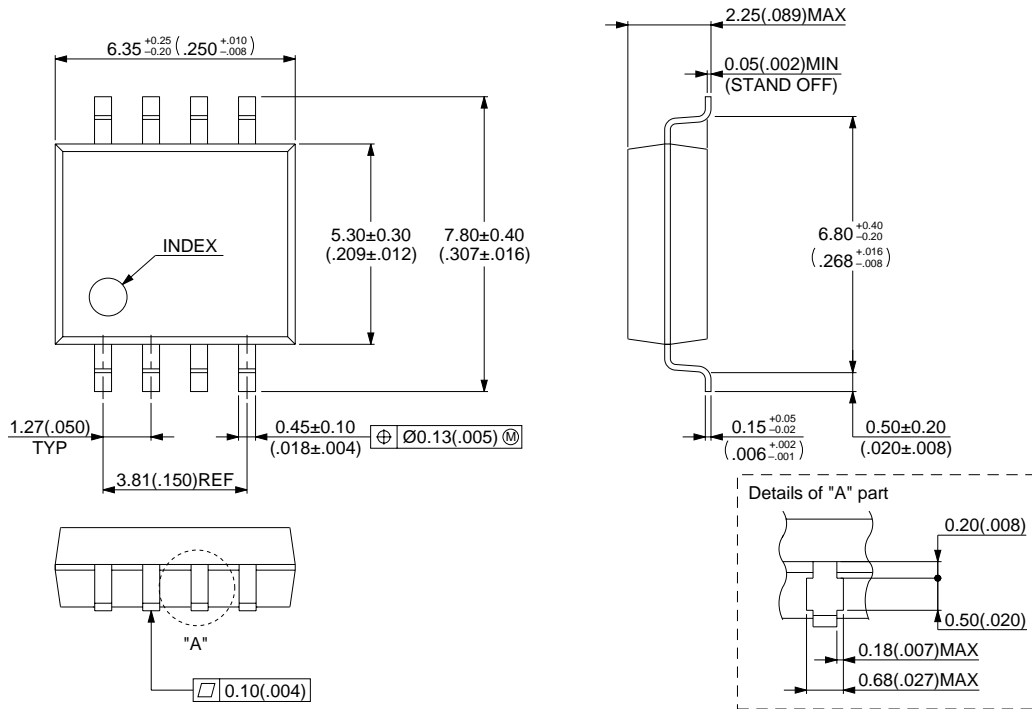
Dimensions in mm (inches).

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# MB3776A

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



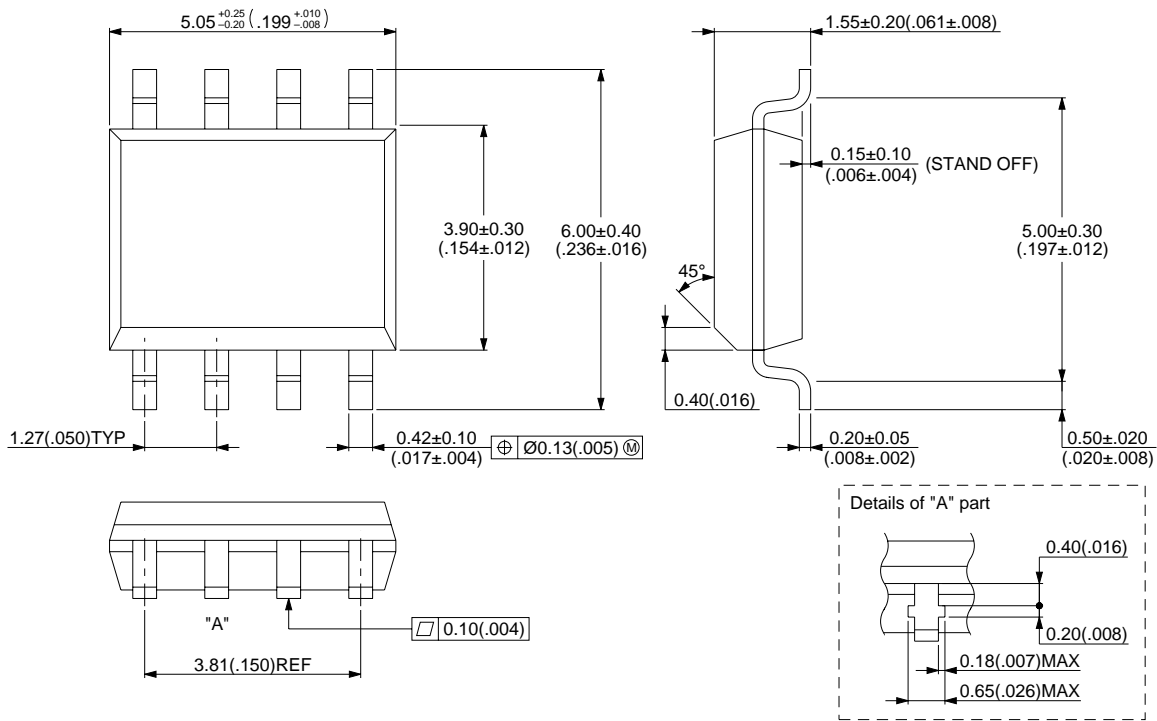
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Dimensions in mm (inches).

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



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Dimensions in mm (inches).

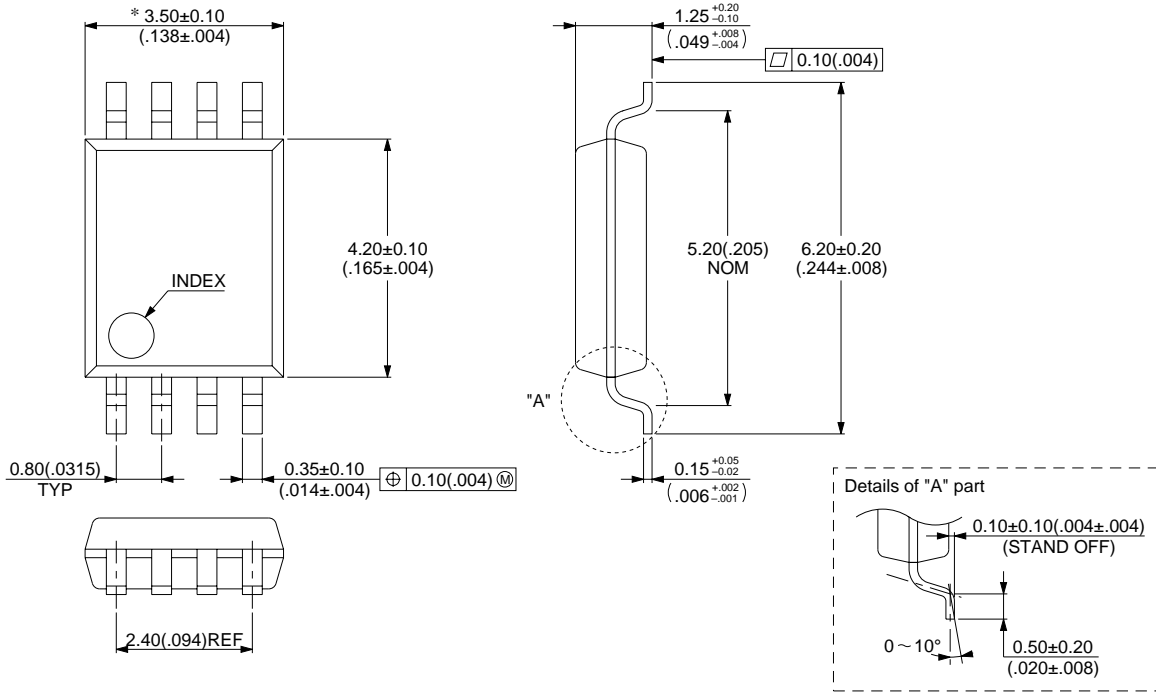
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# MB3776A

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

\* : This dimension does not include resin protrusion.



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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: (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/>

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