FUJITSU SEMICONDUCTOR
DATA SHEET

DS04-27201-4E

ASSP For Power Supply Applications

Switching Regulator Controller

MB3776A

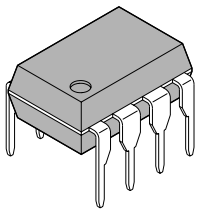
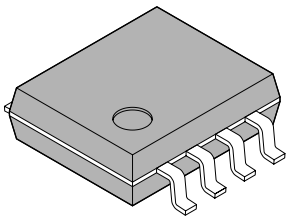
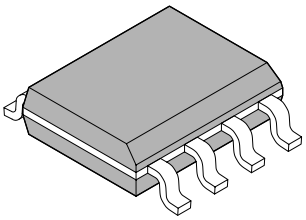
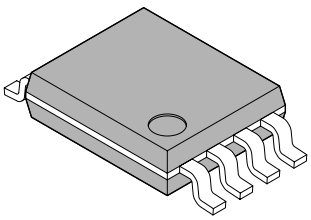
■ DESCRIPTION

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
- Bulit-in idle period circuit
- Internally set error amplifier gain, few external components
- Bulit-in power-down function

■ PACKAGES

8-pin Plastic DIP	8-pin Plastic SOP	8-pin Plastic SOP	8-pin Plastic SSOP
			
(DIP-8P-M01)	(FPT-8P-M01)	(FPT-8P-M02)	(FPT-8P-M03)

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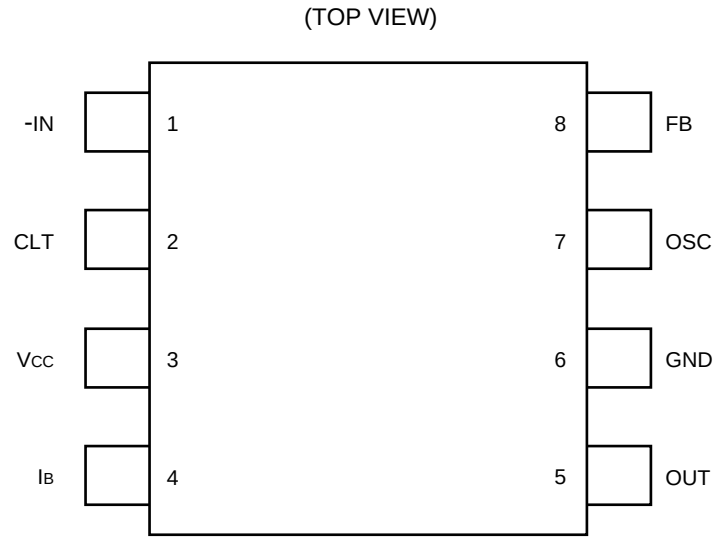
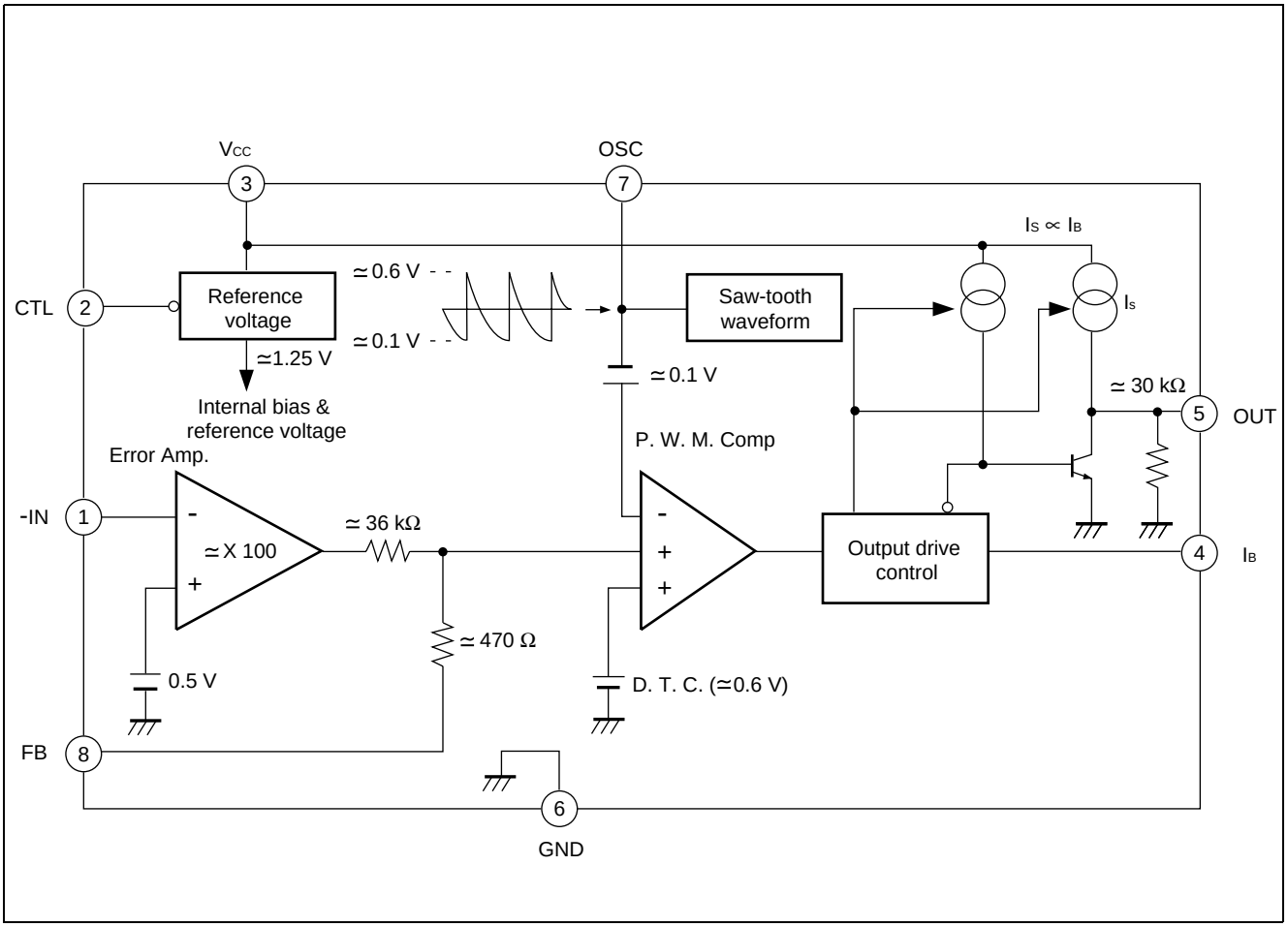
■ PIN ASSIGNMENT



(DIP-8P-M01)
(FPT-8P-M01)
(FPT-8P-M02)
(FPT-8P-M03)

■ BLOCK DIAGRAM



■ 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: 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

1. Reference Section and Error Amp. Section

(Ta = +25°C, V_{CC} = 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, V_{CC} = 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, V_{CC} = 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, V_{CC} = 3 V)

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Max duty cycle	t_{DUTY}	C_T = 1000 pF R_T = 3.0 kΩ V_{FB} = 0.9 V	60	70	85	%

5. Output Section

(Ta = +25°C, V_{CC} = 3 V)

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

6. Control Section

(Ta = +25°C, V_{CC} = 3 V)

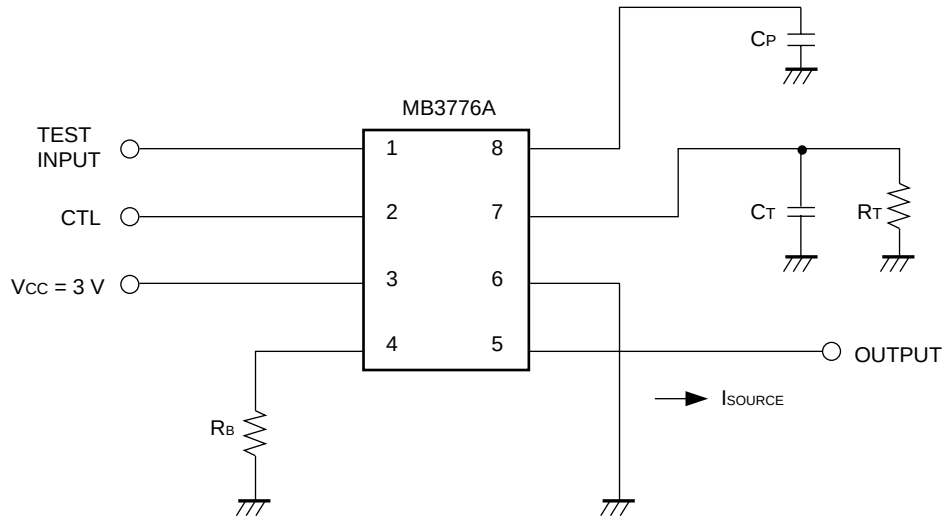
Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Input off condition	I_{OFF}	—	–300	—	—	µA
Input on condition	I_{ON}	—	—	—	–700	µA
Control terminal current	I_{CTL}	V_{CC} = 7 V, V_{CTL} = 0 V	–1.3	–1	—	mA

7. All Device

(Ta = +25°C, V_{CC} = 3 V)

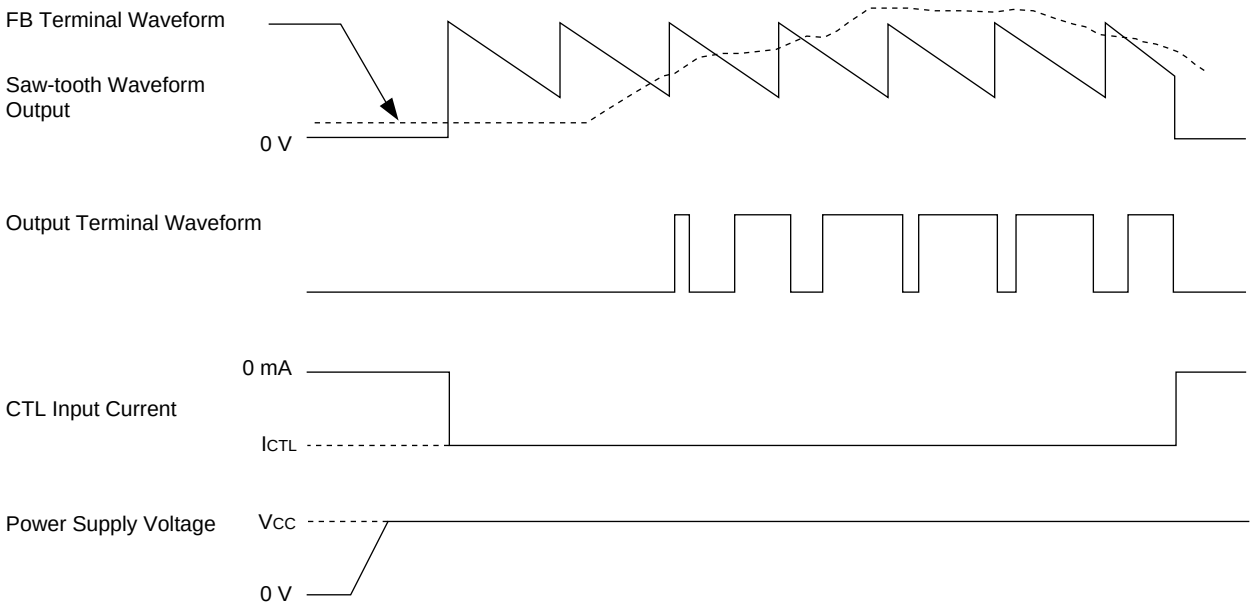
Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Stand by current	I_{CCS}	V_{CTL} = V_{CC} or CTL terminal open	—	—	0.5	µA
Average supply current	I_{CC}	I_{CTL} = –700 µA R_B = 820 Ω	—	4.5	8	mA

■ MEASURMENT CIRCUIT



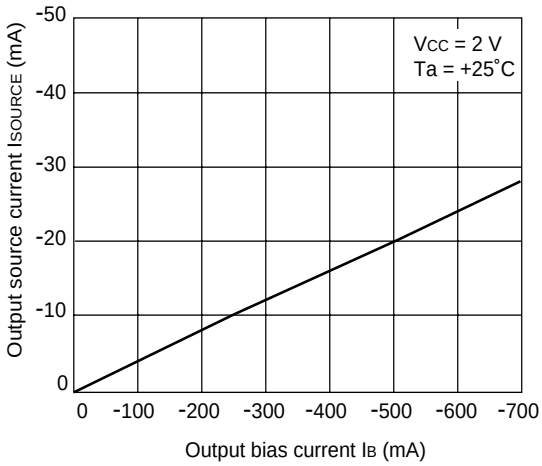
C_T = 1000 pF
C_P = 0.1 µF
R_T = 3 kΩ
R_B =820 Ω
$I_{SOURCE} \simeq 25000/R_B$ (mA)

■ DIAGRAM

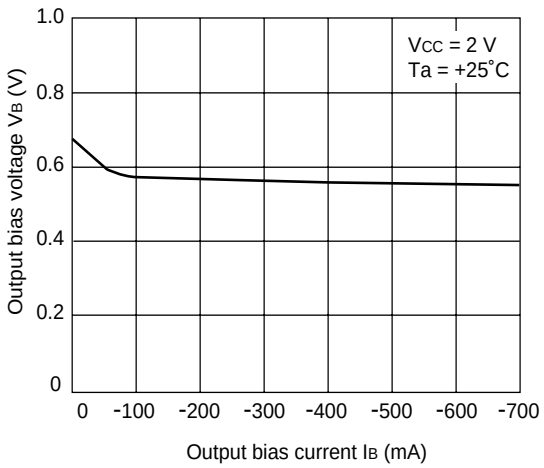


■ TYPICAL CHARACTERISTIC

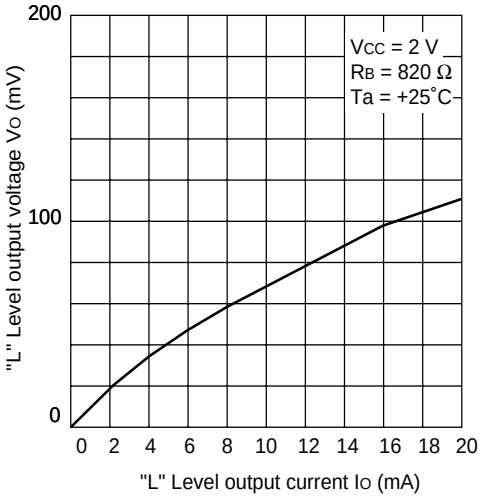
Output bias current vs. Output source current



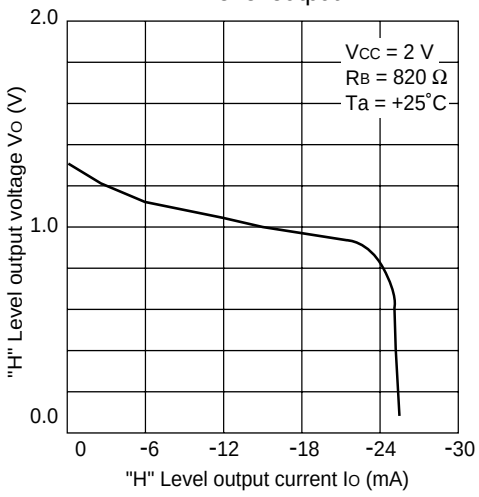
Output bias current vs. Output bias voltage



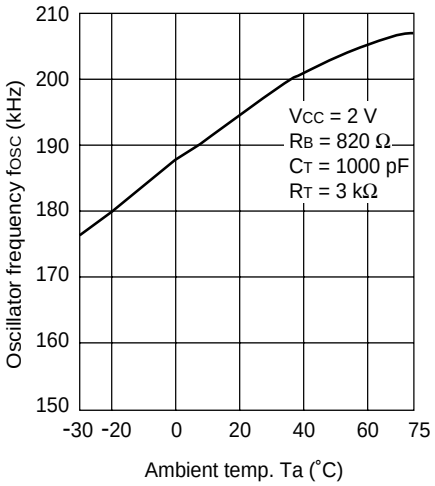
"L" Level output



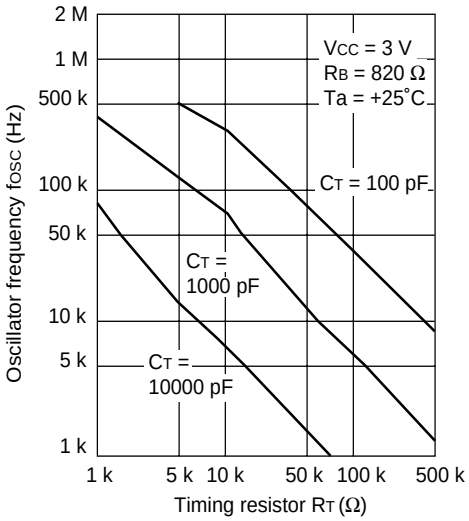
"H" Level output



Ambient temp. vs. Oscillator frequency



Timing resistor vs. Oscillator frequency



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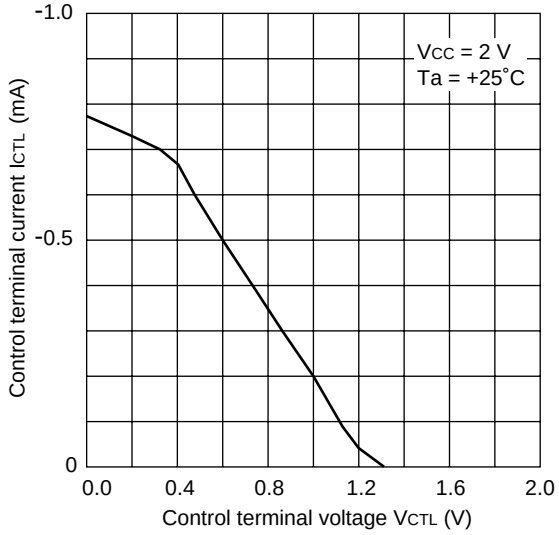
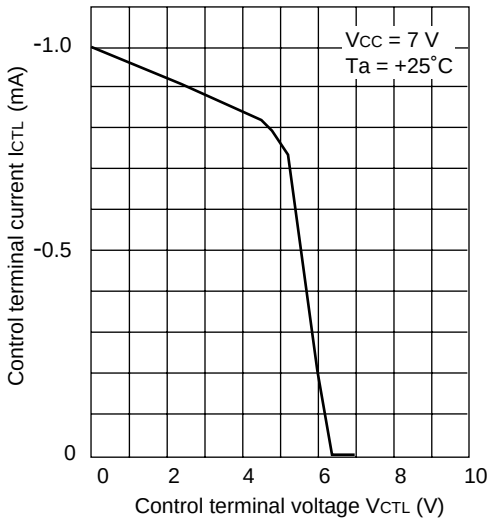
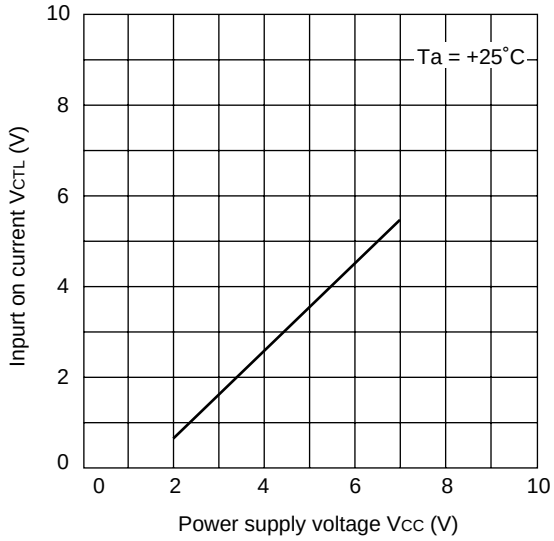
Control terminal voltage vs. Control terminal current



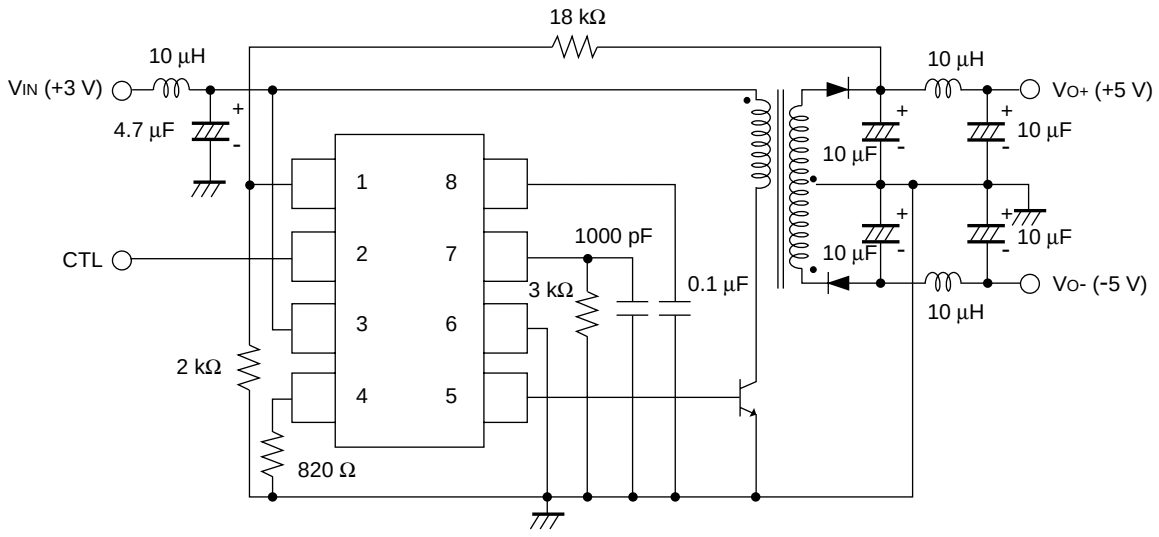
Control terminal voltage vs. Control terminal current



Power supply voltage vs. Input on voltage

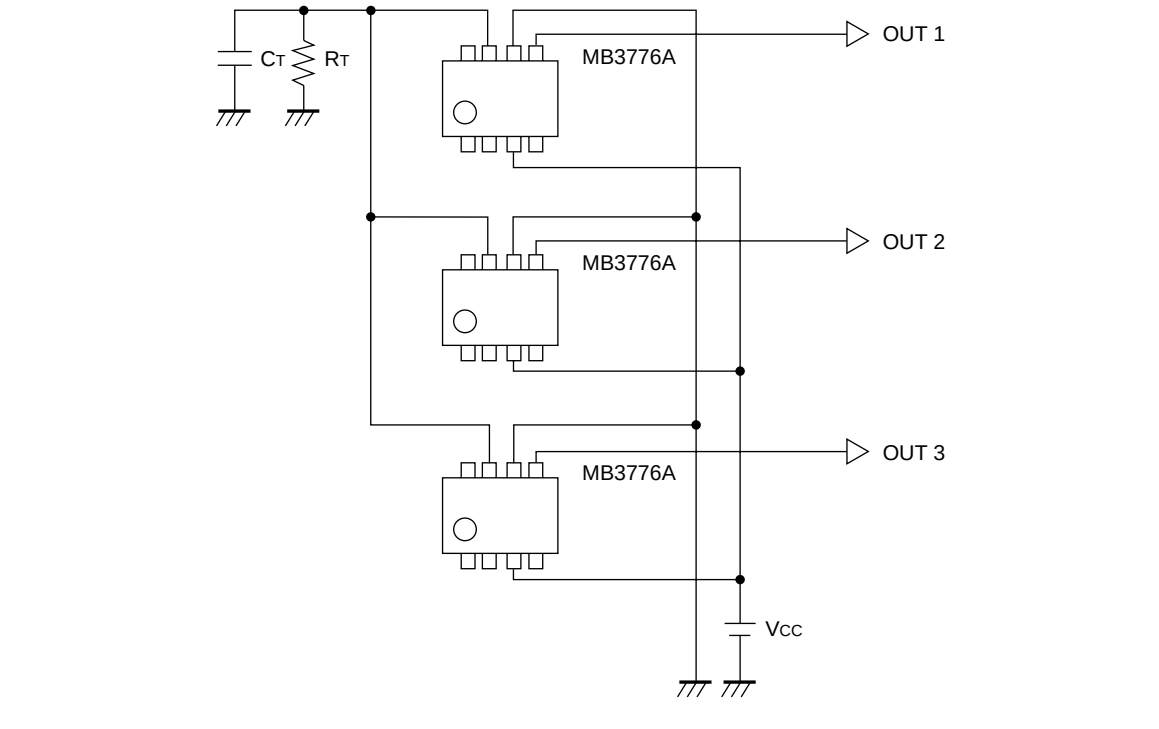


■ APPLICATION EXAMPLE



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.



■ NOTES ON USE

- Take account of common impedance when designing the earth line on a printed wiring board.

- Take measures against static electricity.
  - For semiconductors, use antistatic or conductive containers.
  - When storing or carrying a printed circuit board after chip mounting, put it in a conductive bag or container.
  - The work table, tools and measuring instruments must be grounded.
  - The worker must put on a grounding device containing 250 kΩ to 1 MΩ resistors in series.

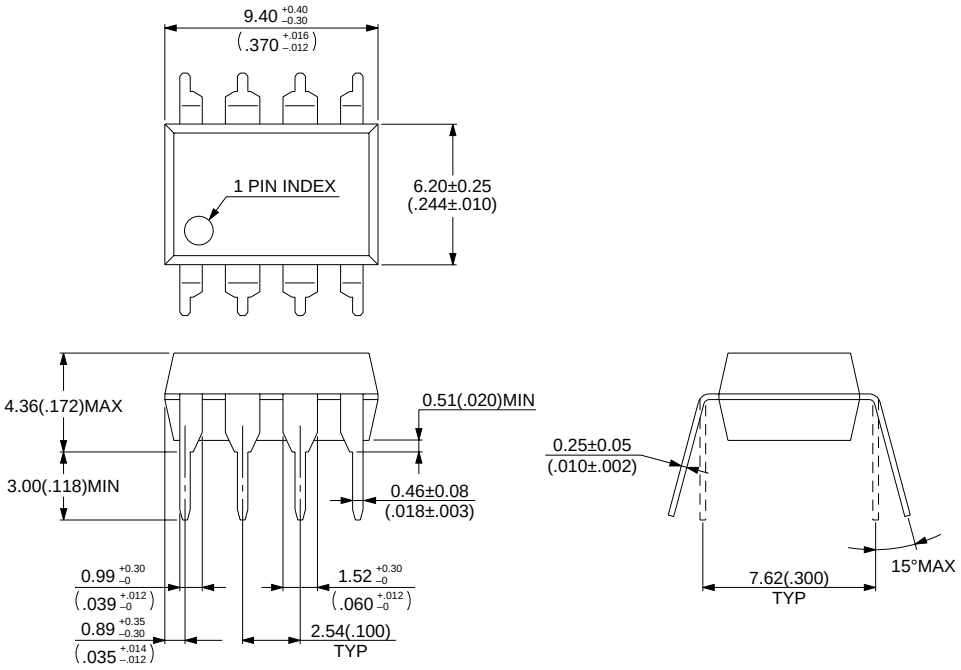
- Do not apply a negative voltage
  - Applying a negative voltage of –0.3 V or less to an LSI may generate a parasitic transistor, resulting in malfunction.

■ 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 SOP (FPT-8P-M02)	
MB3776APFV	8-pin Plastic SSOP (FPT-8P-M03)	

■ PACKAGE DIMENSIONS

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



Dimensions in mm (inches) .
Note : The values in parentheses are reference values.

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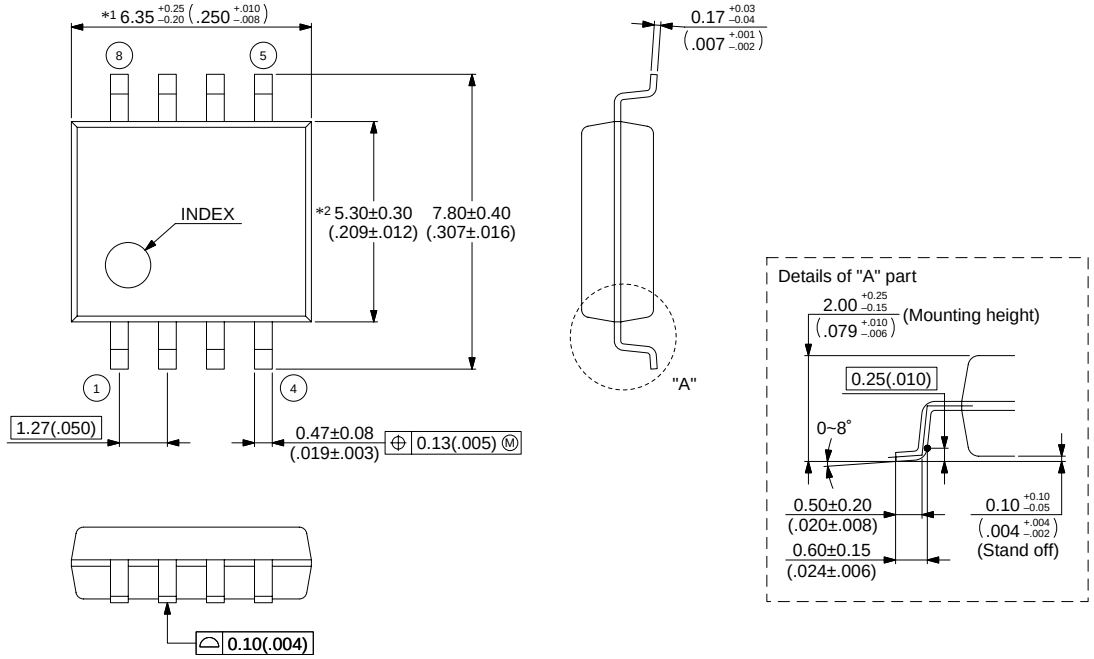
8-pin Plastic SOP
(FPT-8P-M01)

Note 1) *1 : These dimensions include resin protrusion.
Note 2) *2 : These dimensions do not include resin protrusion.
Note 3) Pins width and pins thickness include plating thickness.
Note 4) Pins width do not include tie bar cutting remainder.



Dimensions in mm (inches) .
Note : The values in parentheses are reference values.

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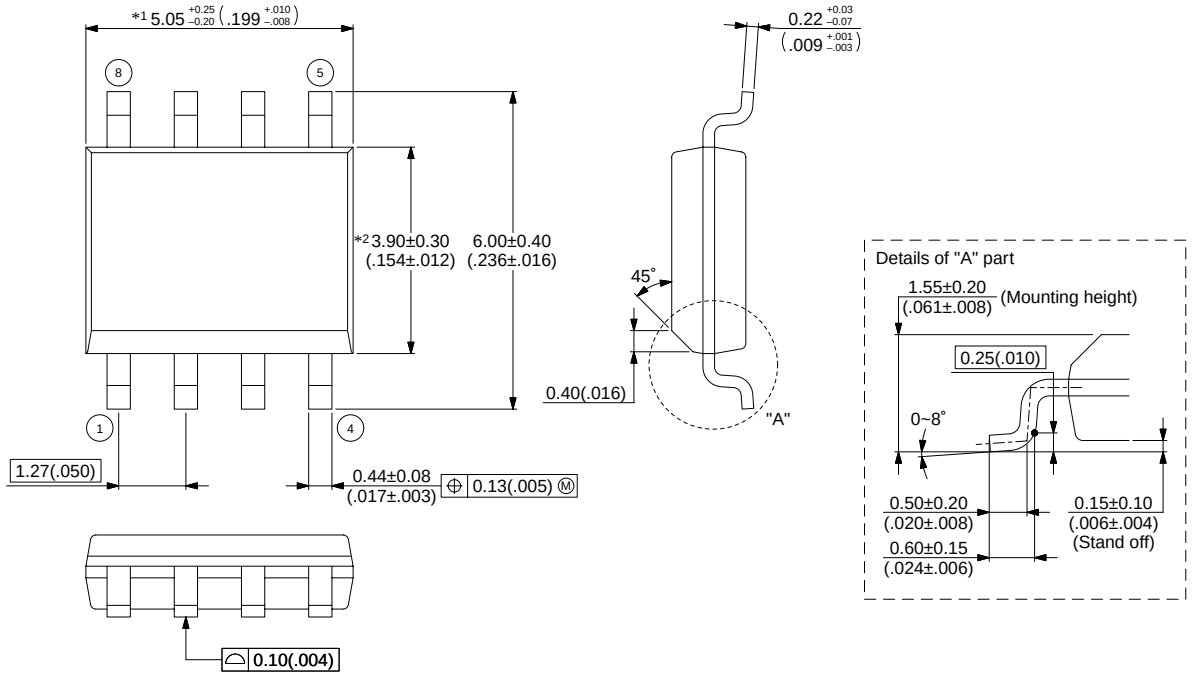
8-pin Plastic SOP
(FPT-8P-M02)

Note 1) *1 : These dimensions include resin protrusion.
Note 2) *2 : These dimensions do not include resin protrusion.
Note 3) Pins width and pins thickness include plating thickness.
Note 4) Pins width do not include tie bar cutting remainder.



Dimensions in mm (inches) .
Note : The values in parentheses are reference values.

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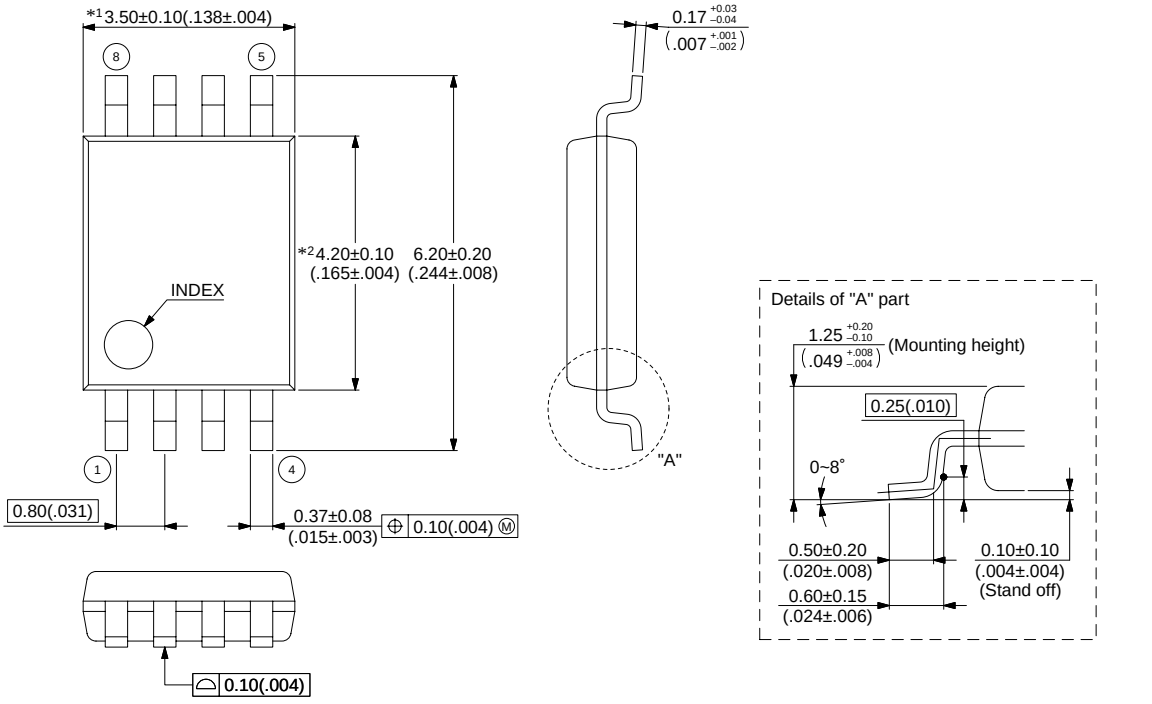
8-pin Plastic SSOP
(FPT-8P-M03)

Note 1) *1 : These dimensions include resin protrusion.
Note 2) *2 : These dimensions do not include resin protrusion.
Note 3) Pins width and pins thickness include plating thickness.
Note 4) Pins width do not include tie bar cutting remainder.



Dimensions in mm (inches) .
Note : The values in parentheses are reference values.

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