

# Pulse Width Modulation Circuit

## **MB3760**

Integrated Circuit

# DATASHEET

OEM – Fujitsu

Source: Fujitsu Databook 1983

**FUJITSU  
MICROELECTRONICS**

**MB3759  
MB3760**

**PULSE WIDTH MODULATION  
CONTROL CIRCUIT**

**DESCRIPTION**

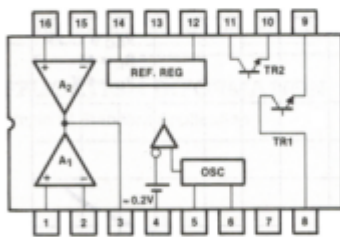
The MB3759 and MB3760 are complete pulse-width modulation control systems on a single monolithic chip. Both circuits provide an internal 5.00V reference, two or-connected amplifiers, externally timed (or synchronized) oscillator and control ramp generator. Both circuits provide for either push-pull or single-ended mode of operation with external control of dead-band. The MB3760 additionally provides steering control and an on-chip 39V zener diode.

The two NPN output transistors have uncommitted emitters and collectors that can be used to either sink or source up to 200mA each.

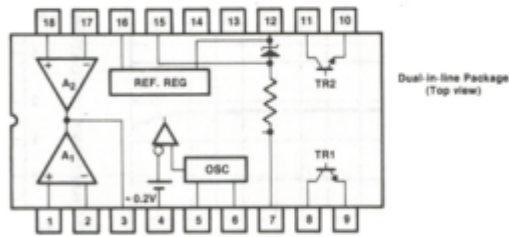
**FEATURES**

- Complete pulse-width-modulation system with power control circuit.
- Either push-pull or single-ended mode of operation
- On chip voltage reference
- Uncommitted output drivers
- Master or slave oscillator control
- Adjustable dead-band
- Dual error amplifiers
- Externally controlled output steering (MB3760 only)
- 39V Zener (MB3760 only)
- Compatible with TL494 & TL495

**MB3759**

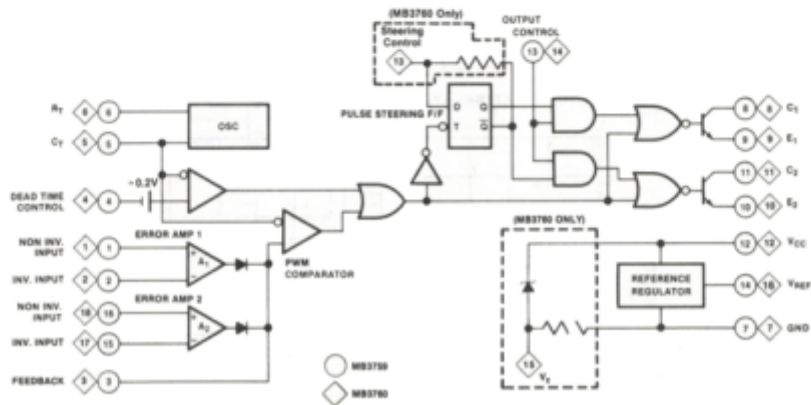


**MB3760**



Dual in-line Package (Top view)

**MB3759/MB3760 BLOCK DIAGRAM**



## MB3759/MB3760

## ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Value	Unit
Supply Voltage	$V_{CC}$	41	V
Collector Output Voltage	$V_{CE}$	41	V
Collector Output Current	$I_{CE}$	250	mA
Amplifier Input Voltage	$V_{IN}$	$V_{CC} + 0.3$	V
Continuous Total Dissipation	$P_D$	800 ( $T_A \leq 25^\circ\text{C}$ )	mW
		800 ( $T_A \leq 60^\circ\text{C}$ )	
Storage Temperatures	$T_{STG}$	-55 ~ +150	$^\circ\text{C}$
Operating Temperature	$T_{OP}$	-20 to +85	$^\circ\text{C}$

## RECOMMENDED OPERATING CONDITIONS

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage	$V_{CC}$	7	15	40	V
Collector Output Voltage	$V_{CE}$	—	—	32	V
Collector Output Current (each transistor)	$I_{CE}$	5	100	200	mA
Amplifier Input Voltage	$V_{IN}$	-0.3	—	$V_{CC} - 2$	V
Current into Feedback Terminal	$I_{f.b.}$	—	—	0.3	mA
Reference Section Output Current	$I_{REF}$	—	5	10	mA
Timing resistor	$R_T$	1.8	30	500	$\text{K}\Omega$
Timing capacitor	$C_T$	470	1000	$1 \times 10^6$	pF
Oscillator frequency	$f_{osc}$	1	40	300	kHz
Operating temperature	$T_{OP}$	-20	25	85	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

## Reference Section

Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage	$V_{REF}$	$I_O = 1 \text{ mA}$	4.75	5.0	5.25	V
Input regulation	$\Delta V_{R(LINE)}$	$V_{CC} = 7\text{V to } 40\text{V}$	—	2	25	mV
Output regulation	$\Delta V_{R(Load)}$	$I_{REF} = 1\text{mA to } 10\text{mA}$	—	-1	-15	mV
Output Voltage change with temperature	—	$T_A = -20 \text{ to } 85$	—	$\pm 200$	$\pm 750$	$\mu\text{V}/^\circ\text{C}$
Short circuit output current	$I_{REF(S.C.)}$	$V_{REF} = 0, T_A = 25^\circ\text{C}$	15	40	—	mA

## Oscillator Section

Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Frequency	$f_{osc}$	$R_T = 30 \text{ K}\Omega, C_T = 1000\text{pF}$	36	40	44	KHz
Standard deviation of frequency		$R_T = 30 \text{ K}\Omega, C_T = 1000\text{pf}$	—	$\pm 3$	—	%
Frequency change with voltage		$V_{CC} = 7\text{V to } 40\text{V}$	—	$\pm 0.1$	—	%
Frequency change with temperature		$T_A = -20 \text{ to } 85$	—	$\pm 0.01$	$\pm 0.03$	$\%/^\circ\text{C}$

**MB3759/MB3760****Dead Time Control Section**

Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Input bias current	$I_D$	$0 \leq V_I \leq 5.25V$	—	-2	-10	$\mu A$
Maximum duty cycle each output		$V_I = 0$	40	45	—	%
Input threshold voltage	zero duty cycle	$V_{DO}$	—	3.0	3.3	V
	Maximum duty cycle	$V_{DM}$	0	—	—	V

**Error-Amplifier Section**

Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Input offset voltage	$V_{IO}$	$V_{O(\text{pin } 3)} = 2.5V$	—	$\pm 2$	$\pm 10$	mV
Input offset current	$I_{IO}$	$V_{O(\text{pin } 3)} = 2.5V$	—	$\pm 25$	$\pm 250$	nA
Input bias current	$I_I$	$V_{O(\text{pin } 3)} = 2.5V$	—	-0.2	-1.0	$\mu A$
Common mode input voltage range	$V_{CM}$	$7V \leq V_{CC} \leq 40V$	-0.3 to $V_{CC} - 2$	—	—	V
Open-loop voltage amplification	$A_V$	$0.5V \leq V_O \leq 3.5V$	70	95	—	dB
Common-mode rejection ratio	$C_{MRR}$	$V_{CC} = 40V$	65	80	—	dB
Output current	sink	$-5V \leq V_{ID} \leq -15mV$	0.3	0.7	—	mA
	source	$15mV \leq V_{ID} \leq 5V$	-2	-10	—	mA

**Output Section**

Item	Symbol	Test Conditions	Min	Typ	Max	Unit	
Collector off-state current	$I_{CO}$	$V_{CE} = 40V, V_{CC} = 40V$	—	—	100	$\mu A$	
Emitter off-state current		$V_{CC} = V_C = 40V, V_E = 0$	—	—	-100	$\mu A$	
Collector Emitter Saturation Voltage	common emitter	$V_{SAT(C)}$	$V_E = 0, I_C = 200mA$	—	1.1	1.3	V
	emitter follower	$V_{SAT(E)}$	$V_C = 15V, I_E = -200mA$	—	1.5	2.5	V
Output control input current		$V_I = V_{REF}$	—	1.3	3.5	mA	

**PWM Comparator Section**

Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Input threshold voltage	$V_{TH}$	Zero duty cycle	—	4	4.5	V
Input sink current (Pin 3)		$V_{O(\text{pin } 3)} = 0.7V$	0.3	0.7	—	mA



**MB3759/MB3760**

**Total Device**

Item	Symbol	Test Conditions	Typ	Max	Unit
Standby supply current	$I_{CCQ}$	Voltage at Pin 6 = $V_{REF}$ , All Other inputs and outputs are open, $V_{CC} = 15V$	7	12	mA
Average supply current	$I_{CC}$	Voltage at Pin 4 = 2V, see test circuit	8		mA

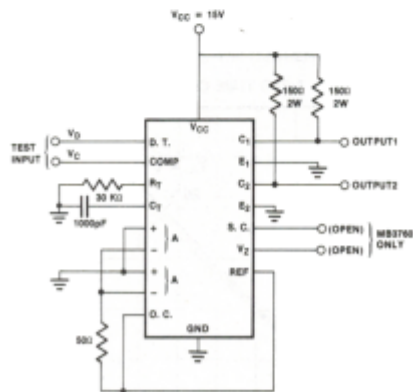
**MB3760 Only**

Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Steering control input current		$V_I = 0.4V$	—	—	-200	$\mu A$
		$V_I = 2.4V$	—	—	400	$\mu A$
Zener-diode breakdown voltage	$V_Z$	$V_{CC} = 41V, I_Z = 1mA$	—	39	—	V
Zener-diode sink current	$I_Z$	$V_{(pin 15)} = 1V$	—	0.3	—	mA

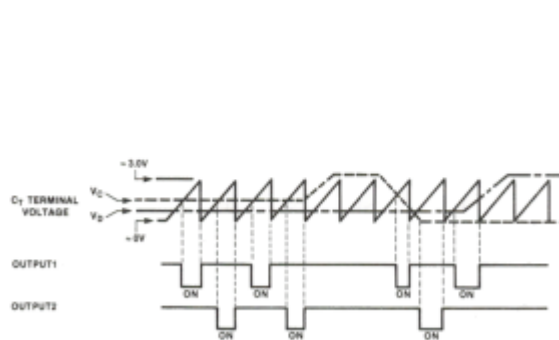
**SWITCHING CHARACTERISTICS**

Item	Symbol	Test Conditions	Min	Typ	Max	Unit
Output voltage rise time	Common Emitter Configuration	$R_L = 68\Omega$	—	100	200	ns
Output voltage rise time	Emitter Follower Configuration	$R_L = 68\Omega$	—	100	200	ns

**TEST CIRCUIT**



**VOLTAGE WAVEFORMS**



**MB3759/MB3760**

**OSCILLATOR FREQUENCY**

$$f_{osc} = \frac{1.2}{R_T \cdot C_T}$$

$R_T$  : K $\Omega$   
 $C_T$  :  $\mu$ F  
 $f_{osc}$  : KHz

**FUNCTION TABLE**

Output Control (Mode)	Input		Output Function
	Steering Control (MB3760 Only)		
GND	Open		Single-ended or parallel output
V <sub>REF</sub>	Open		Push-pull operation
V <sub>REF</sub>	V <sub>I</sub> < 0.4V		PWM Output at Output 1
V <sub>REF</sub>	V <sub>I</sub> > 2.4V		PWM Output at Output 2

**TYPICAL CHARACTERISTICS** (T<sub>A</sub> = 25°C unless otherwise specified)

