

MC34060A, MC33060A

Fixed Frequency, PWM, Voltage Mode Single Ended Controllers

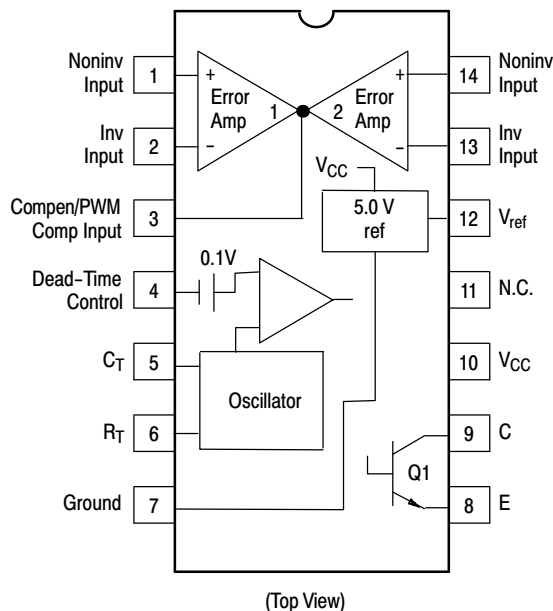
The MC34060A is a low cost fixed frequency, pulse width modulation control circuit designed primarily for single-ended SWITCHMODE™ power supply control.

The MC34060A is specified over the commercial operating temperature range of 0° to +70°C, and the MC33060A is specified over an automotive temperature range of -40° to +85°C.

Features

- Complete Pulse Width Modulation Control Circuitry
- On-Chip Oscillator with Master or Slave Operation
- On-Chip Error Amplifiers
- On-Chip 5.0 V Reference, 1.5% Accuracy
- Adjustable Dead-Time Control
- Uncommitted Output Transistor Rated to 200 mA Source or Sink
- Undervoltage Lockout
- These are Pb-Free and Halide-Free Devices

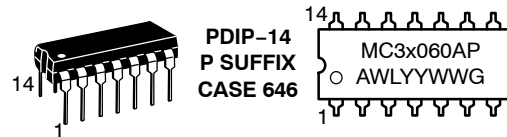
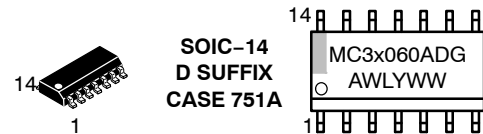
PIN CONNECTIONS



ON Semiconductor®

<http://onsemi.com>

MARKING DIAGRAMS



- x = 3 or 4
- A = Assembly Location
- WL = Wafer Lot
- Y, YY = Year
- WW = Work Week
- G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 14 of this data sheet.

MC34060A, MC33060A

MAXIMUM RATINGS (Full operating ambient temperature range applies, unless otherwise noted.)

Rating	Symbol	Value	Unit
Power Supply Voltage	V_{CC}	42	V
Collector Output Voltage	V_C	42	V
Collector Output Current (Note 3)	I_C	500	mA
Amplifier Input Voltage Range	V_{in}	-0.3 to +42	V
Power Dissipation @ $T_A \leq 45^\circ\text{C}$	P_D	1000	mW
Operating Junction Temperature	T_J	125	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-55 to +125	$^\circ\text{C}$
Operating Ambient Temperature Range For MC34060A For MC33060A	T_A	0 to +70 -40 to +85	$^\circ\text{C}$
ESD Capability Machine Model Human Body Model		200 2.0	V kV

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

- This device series contains ESD protection and exceeds the following tests:
Pins 1– 14: Human Body Model 2000 V per JEDEC Standard JESD22–A114E.
Machine Model Method 200 V per JEDEC Standard JESD22–A115–A.
- This device contains Latch–Up protection and exceeds ± 100 mA per JEDEC Standard JESD78.

THERMAL CHARACTERISTICS

Characteristics	Symbol	P Suffix Package	D Suffix Package	Unit
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	80	120	$^\circ\text{C}/\text{W}$
Derating Ambient Temperature	T_A	45	45	$^\circ\text{C}$

RECOMMENDED OPERATING CONDITIONS

Condition/Value	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V_{CC}	7.0	15	40	V
Collector Output Voltage	V_C	–	30	40	V
Collector Output Current	I_C	–	–	200	mA
Amplifier Input Voltage	V_{in}	-0.3	–	$V_{CC} - 2$	V
Current Into Feedback Terminal	I_{fb}	–	–	0.3	mA
Reference Output Current	I_{ref}	–	–	10	mA
Timing Resistor	R_T	1.8	47	500	$k\Omega$
Timing Capacitor	C_T	0.00047	0.001	10	μF
Oscillator Frequency	f_{osc}	1.0	25	200	kHz
PWM Input Voltage (Pins 3 and 4)	–	-0.3	–	5.3	V

- Maximum thermal limits must be observed.

MC34060A, MC33060A

ELECTRICAL CHARACTERISTICS ($V_{CC} = 15\text{ V}$, $C_T = 0.01\ \mu\text{F}$, $R_T = 12\ \text{k}\Omega$, unless otherwise noted. For typical values $T_A = 25^\circ\text{C}$, for min/max values T_A is the operating ambient temperature range that applies, unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
-----------------	--------	-----	-----	-----	------

REFERENCE SECTION

Reference Voltage ($I_O = 1.0\ \text{mA}$, $T_A = 25^\circ\text{C}$) $T_A = T_{\text{low}}$ to T_{high} – MC34060A – MC33060A	V_{ref}	4.925 4.9 4.85	5.0 – –	5.075 5.1 5.1	V
Line Regulation ($V_{CC} = 7.0\ \text{V}$ to $40\ \text{V}$, $I_O = 10\ \text{mA}$)	Reg_{line}	–	2.0	25	mV
Load Regulation ($I_O = 1.0\ \text{mA}$ to $10\ \text{mA}$)	Reg_{load}	–	2.0	15	mV
Short Circuit Output Current ($V_{\text{ref}} = 0\ \text{V}$)	I_{SC}	15	35	75	mA

OUTPUT SECTION

Collector Off-State Current ($V_{CC} = 40\ \text{V}$, $V_{CE} = 40\ \text{V}$)	$I_{C(\text{off})}$	–	2.0	100	μA
Emitter Off-State Current ($V_{CC} = 40\ \text{V}$, $V_{CE} = 40\ \text{V}$, $V_E = 0\ \text{V}$)	$I_{E(\text{off})}$	–	–	–100	μA
Collector-Emitter Saturation Voltage (Note 4) Common-Emitter ($V_E = 0\ \text{V}$, $I_C = 200\ \text{mA}$) Emitter-Follower ($V_C = 15\ \text{V}$, $I_E = -200\ \text{mA}$)	$V_{\text{sat}(C)}$ $V_{\text{sat}(E)}$	– –	1.1 1.5	1.5 2.5	V
Output Voltage Rise Time ($T_A = 25^\circ\text{C}$) Common-Emitter (See Figure 12) Emitter-Follower (See Figure 13)	t_r	– –	100 100	200 200	ns
Output Voltage Fall Time ($T_A = 25^\circ\text{C}$) Common-Emitter (See Figure 12) Emitter-Follower (See Figure 13)	t_r	– –	40 40	100 100	ns

ERROR AMPLIFIER SECTION

Input Offset Voltage ($V_{O[\text{Pin } 3]} = 2.5\ \text{V}$)	V_{IO}	–	2.0	10	mV
Input Offset Current ($V_{C[\text{Pin } 3]} = 2.5\ \text{V}$)	I_{IO}	–	5.0	250	nA
Input Bias Current ($V_{O[\text{Pin } 3]} = 2.5\ \text{V}$)	I_{IB}	–	–0.1	–2.0	μA
Input Common Mode Voltage Range ($V_{CC} = 40\ \text{V}$)	V_{ICR}	0 to $V_{CC} - 2.0$	–	–	V
Inverting Input Voltage Range	$V_{\text{IR(INV)}}$	–0.3 to $V_{CC} - 2.0$	–	–	V
Open-Loop Voltage Gain ($\Delta V_O = 3.0\ \text{V}$, $V_O = 0.5\ \text{V}$ to $3.5\ \text{V}$, $R_L = 2.0\ \text{k}\Omega$)	A_{VOL}	70	95	–	dB
Unity-Gain Crossover Frequency ($V_O = 0.5\ \text{V}$ to $3.5\ \text{V}$, $R_L = 2.0\ \text{k}\Omega$)	f_c	–	600	–	kHz
Phase Margin at Unity-Gain ($V_O = 0.5\ \text{V}$ to $3.5\ \text{V}$, $R_L = 2.0\ \text{k}\Omega$)	ϕ_m	–	65	–	deg.
Common Mode Rejection Ratio ($V_{CC} = 40\ \text{V}$, $V_{\text{in}} = 0\ \text{V}$ to $38\ \text{V}$)	CMRR	65	90	–	dB
Power Supply Rejection Ratio ($\Delta V_{CC} = 33\ \text{V}$, $V_O = 2.5\ \text{V}$, $R_L = 2.0\ \text{k}\Omega$)	PSRR	–	100	–	dB
Output Sink Current ($V_{O[\text{Pin } 3]} = 0.7\ \text{V}$)	I_{O-}	0.3	0.7	–	mA
Output Source Current ($V_{O[\text{Pin } 3]} = 3.5\ \text{V}$)	I_{O+}	–2.0	–4.0	–	mA

4. Low duty cycle techniques are used during test to maintain junction temperature as close to ambient temperatures as possible.

$T_{\text{low}} = -40^\circ\text{C}$ for MC33060A
= 0°C for MC34060A

$T_{\text{high}} = +85^\circ\text{C}$ for MC33060A
= $+70^\circ\text{C}$ for MC34060A

MC34060A, MC33060A

ELECTRICAL CHARACTERISTICS (continued) ($V_{CC} = 15\text{ V}$, $C_T = 0.01\ \mu\text{F}$, $R_T = 12\ \text{k}\Omega$, unless otherwise noted.)

For typical values $T_A = 25^\circ\text{C}$, for min/max values T_A is the operating ambient temperature range that applies, unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
-----------------	--------	-----	-----	-----	------

PWM COMPARATOR SECTION (Test circuit Figure 11)

Input Threshold Voltage (Zero Duty Cycle)	V_{TH}	–	3.5	4.5	V
Input Sink Current ($V_{[Pin\ 3]} = 0.7\ \text{V}$)	I_I	0.3	0.7	–	mA

DEAD-TIME CONTROL SECTION (Test circuit Figure 11)

Input Bias Current (Pin 4) ($V_{in} = 0\ \text{V}$ to $5.25\ \text{V}$)	$I_{B(DT)}$	–	–1.0	–10	μA
Maximum Output Duty Cycle ($V_{in} = 0\ \text{V}$, $C_T = 0.01\ \mu\text{F}$, $R_T = 12\ \text{k}\Omega$) ($V_{in} = 0\ \text{V}$, $C_T = 0.001\ \mu\text{F}$, $R_T = 47\ \text{k}\Omega$)	DC_{max}	90 –	96 92	100 –	%
Input Threshold Voltage (Pin 4) (Zero Duty Cycle) (Maximum Duty Cycle)	V_{TH}	– 0	2.8 –	3.3 –	V

OSCILLATOR SECTION

Frequency ($C_T = 0.01\ \mu\text{F}$, $R_T = 12\ \text{k}\Omega$, $T_A = 25^\circ\text{C}$) $T_A = T_{low}$ to T_{high} – MC34060A – MC33060A ($C_T = 0.001\ \mu\text{F}$, $R_T = 47\ \text{k}\Omega$)	f_{osc}	9.7 9.5 9.0 –	10.5 – – 25	11.3 11.5 11.5 –	kHz
Standard Deviation of Frequency* ($C_T = 0.001\ \mu\text{F}$, $R_T = 47\ \text{k}\Omega$)	$\sigma_{f_{osc}}$	–	1.5	–	%
Frequency Change with Voltage ($V_{CC} = 7.0\ \text{V}$ to $40\ \text{V}$)	$\Delta f_{osc}(\Delta V)$	–	0.5	2.0	%
Frequency Change with Temperature ($\Delta T_A = T_{low}$ to T_{high}) ($C_T = 0.01\ \mu\text{F}$, $R_T = 12\ \text{k}\Omega$)	$\Delta f_{osc}(\Delta T)$	– –	4.0 –	– –	%

UNDERVOLTAGE LOCKOUT SECTION

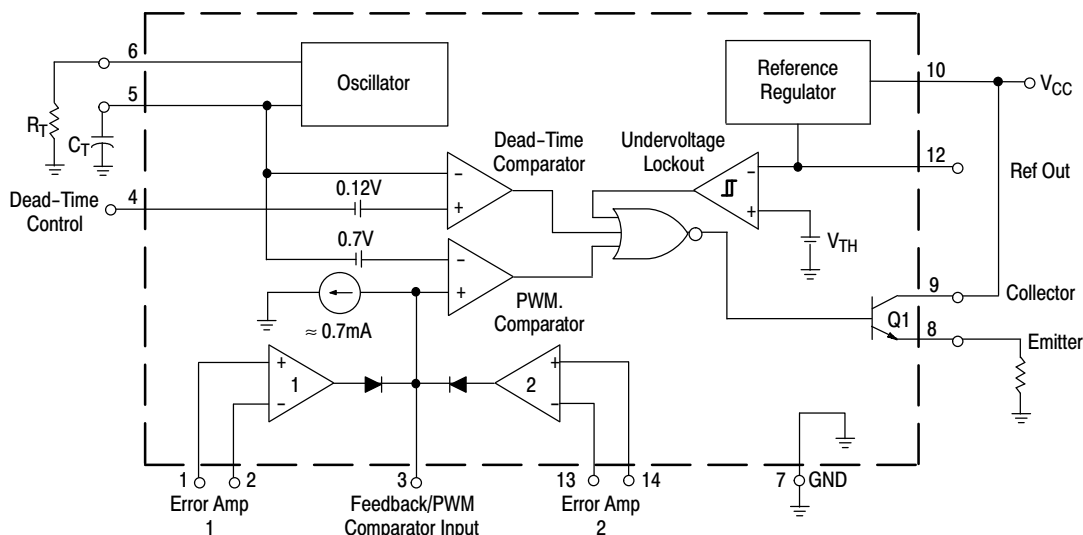
Turn-On Threshold (V_{CC} increasing, $I_{ref} = 1.0\ \text{mA}$)	V_{th}	4.0	4.7	5.5	V
Hysteresis	V_H	50	150	300	mV

TOTAL DEVICE

Standby Supply Current (Pin 6 at V_{ref} , all other inputs and outputs open) ($V_{CC} = 15\ \text{V}$) ($V_{CC} = 40\ \text{V}$)	I_{CC}	– –	5.5 7.0	10 15	mA
Average Supply Current ($V_{[Pin\ 4]} = 2.0\ \text{V}$, $C_T = 0.001\ \mu\text{F}$, $R_T = 47\ \text{k}\Omega$). See Figure 11.	I_S	–	7.0	–	mA

*Standard deviation is a measure of the statistical distribution about the mean as derived from the formula; $\sigma = \sqrt{\frac{\sum_{n=1}^N (x_n - \bar{x})^2}{N-1}}$

MC34060A, MC33060A



This device contains 46 active transistors.

Figure 1. Block Diagram

Description

The MC34060A is a fixed-frequency pulse width modulation control circuit, incorporating the primary building blocks required for the control of a switching power supply (see Figure 1). An internal-linear sawtooth oscillator is frequency-programmable by two external components, R_T and C_T . The approximate oscillator frequency is determined by:

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

For more information refer to Figure 3.

Output pulse width modulation is accomplished by comparison of the positive sawtooth waveform across capacitor C_T to either of two control signals. The output is enabled only during that portion of time when the sawtooth voltage is greater than the control signals. Therefore, an increase in control-signal amplitude causes a corresponding linear decrease of output pulse width. (Refer to the Timing Diagram shown in Figure 2.)

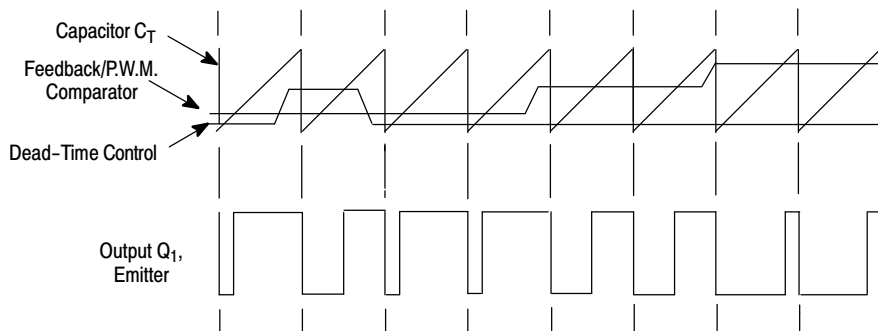


Figure 2. Timing Diagram

APPLICATIONS INFORMATION

The control signals are external inputs that can be fed into the dead-time control, the error amplifier inputs, or the feed-back input. The dead-time control comparator has an effective 120 mV input offset which limits the minimum output dead time to approximately the first 4% of the sawtooth-cycle time. This would result in a maximum duty cycle of 96%. Additional dead time may be imposed on the output by setting the dead time-control input to a fixed voltage, ranging between 0 V to 3.3 V.

The pulse width modulator comparator provides a means for the error amplifiers to adjust the output pulse width from the maximum percent on-time, established by the dead time control input, down to zero, as the voltage at the feedback

pin varies from 0.5 V to 3.5 V. Both error amplifiers have a common mode input range from -0.3 V to ($V_{CC} - 2.0$ V), and may be used to sense power supply output voltage and current. The error-amplifier outputs are active high and are ORed together at the noninverting input of the pulse-width modulator comparator. With this configuration, the amplifier that demands minimum output on time, dominates control of the loop.

The MC34060A has an internal 5.0 V reference capable of sourcing up to 10 mA of load currents for external bias circuits. The reference has an internal accuracy of $\pm 5\%$ with a typical thermal drift of less than 50 mV over an operating temperature range of 0° to +70°C.

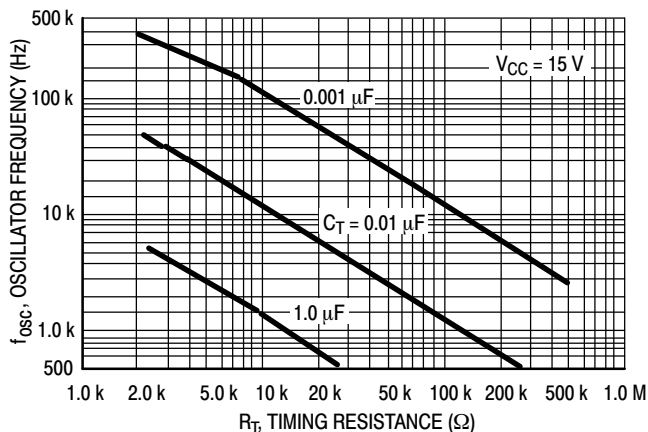


Figure 3. Oscillator Frequency versus Timing Resistance

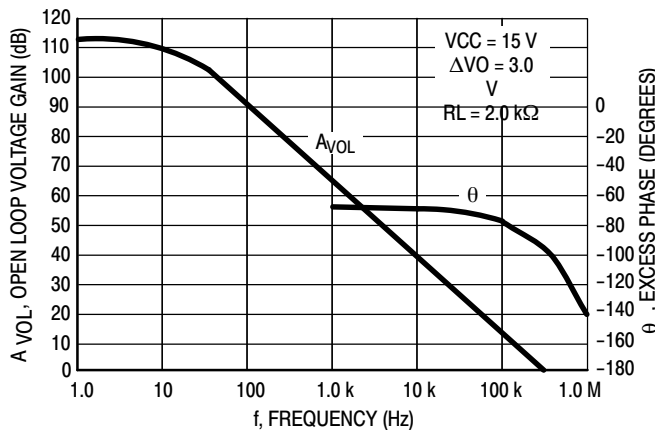


Figure 4. Open Loop Voltage Gain and Phase versus Frequency

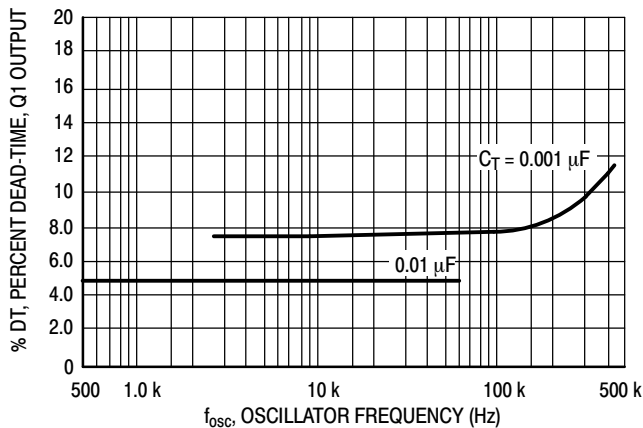


Figure 5. Percent Deadtime versus Oscillator Frequency

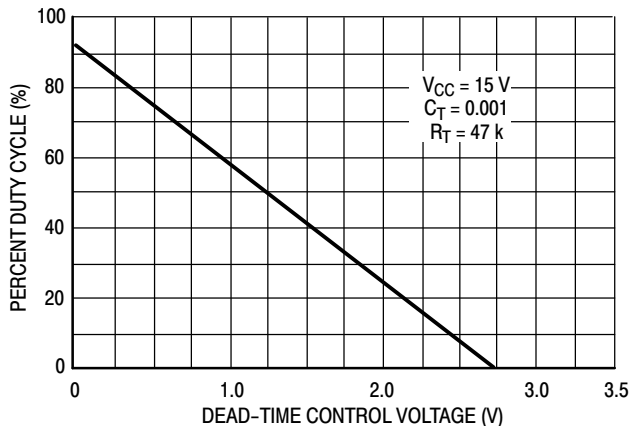


Figure 6. Percent Duty Cycle versus Dead-Time Control Voltage

MC34060A, MC33060A

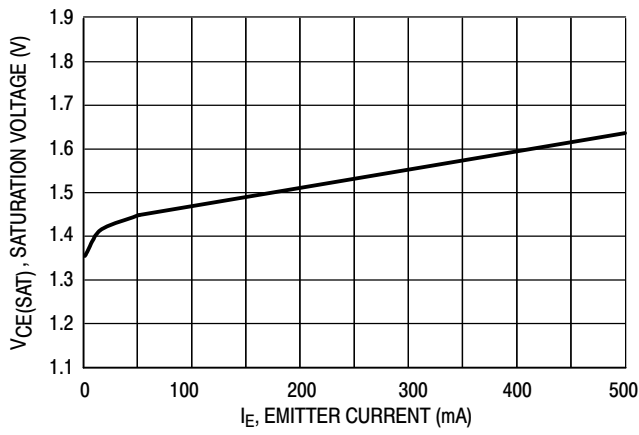


Figure 7. Emitter-Follower Configuration Output Saturation Voltage versus Emitter Current

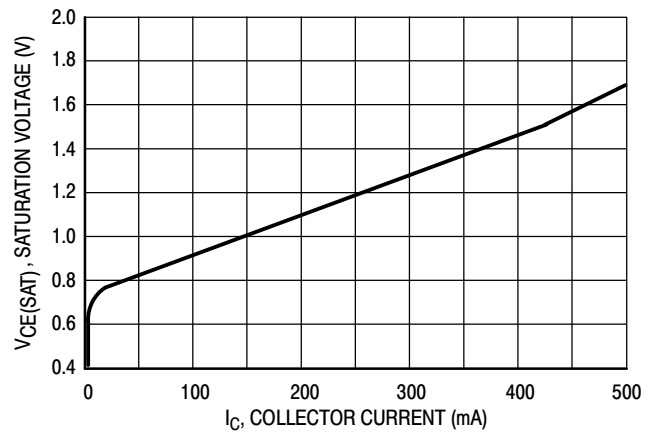


Figure 8. Common-Emitter Configuration Output Saturation Voltage versus Collector Current

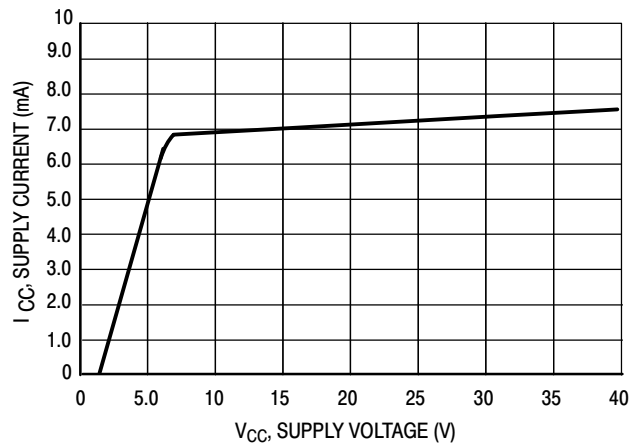


Figure 9. Standby Supply Current versus Supply Voltage

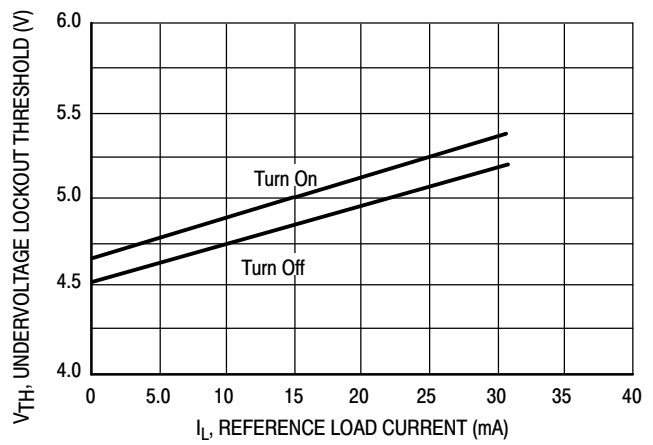


Figure 10. Undervoltage Lockout Thresholds versus Reference Load Current

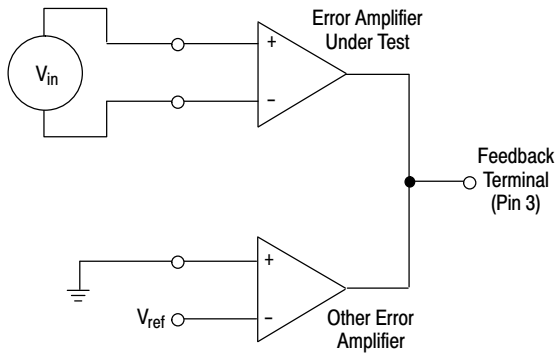


Figure 11. Error Amplifier Characteristics

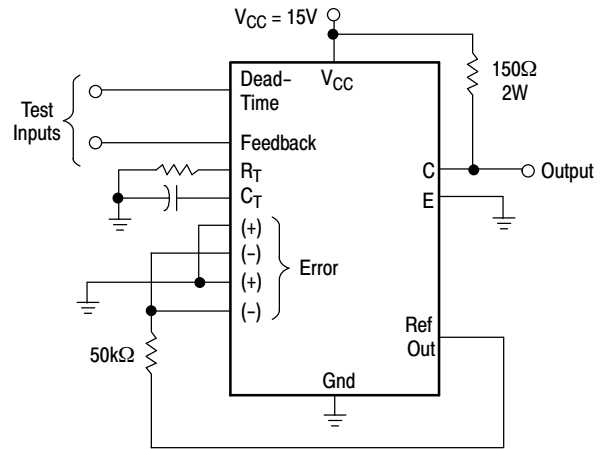


Figure 12. Deadtime and Feedback Control

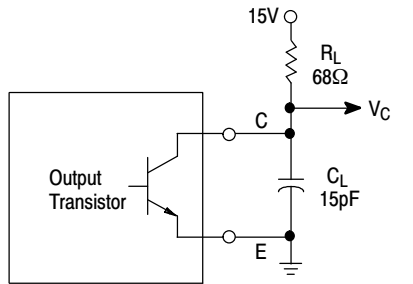


Figure 13. Common-Emitter Configuration and Waveform

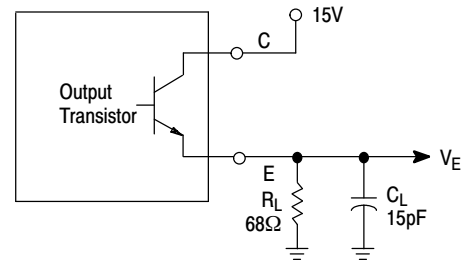


Figure 14. Emitter-Follower Configuration and Waveform

MC34060A, MC33060A

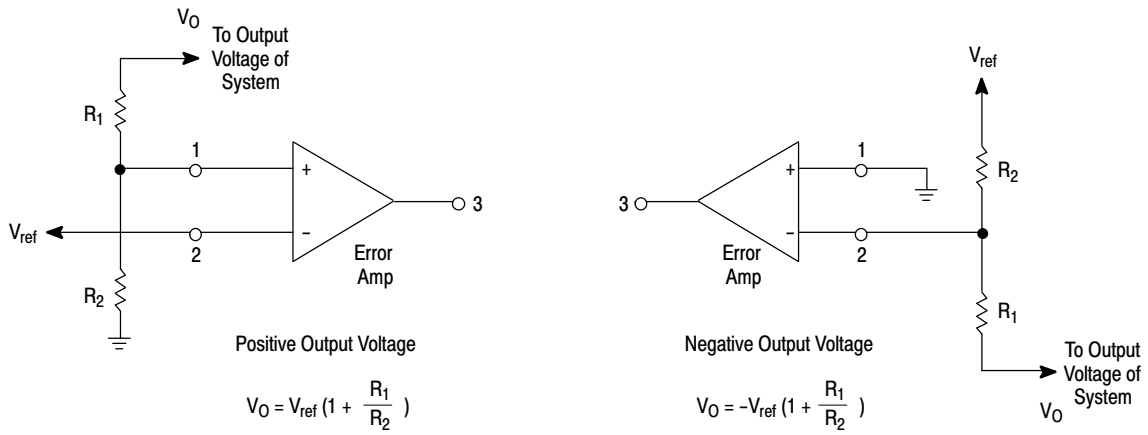


Figure 15. Error Amplifier Sensing Techniques

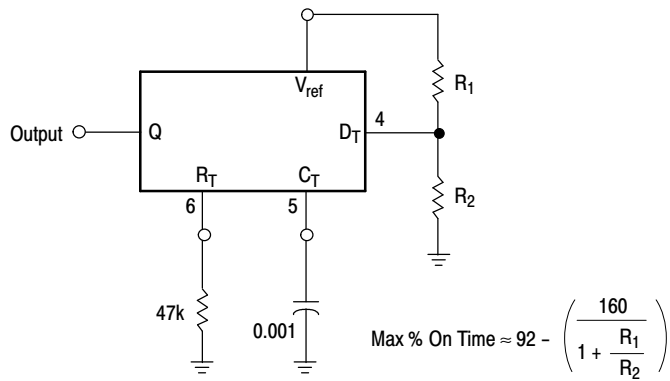


Figure 16. Deadtime Control Circuit

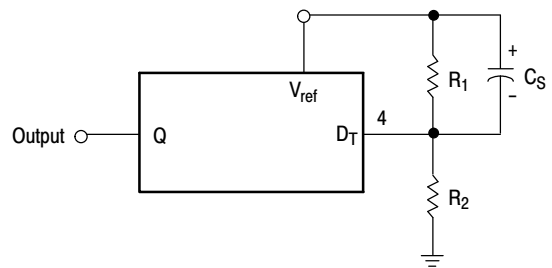


Figure 17. Soft-Start Circuit

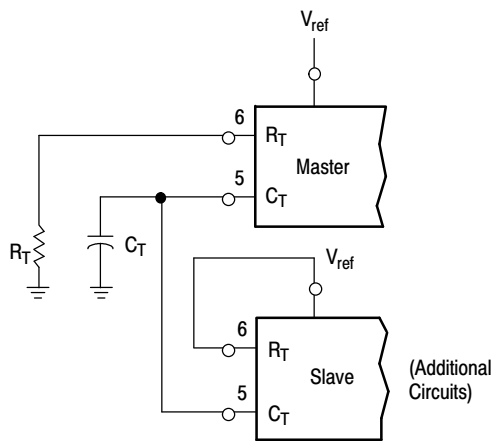
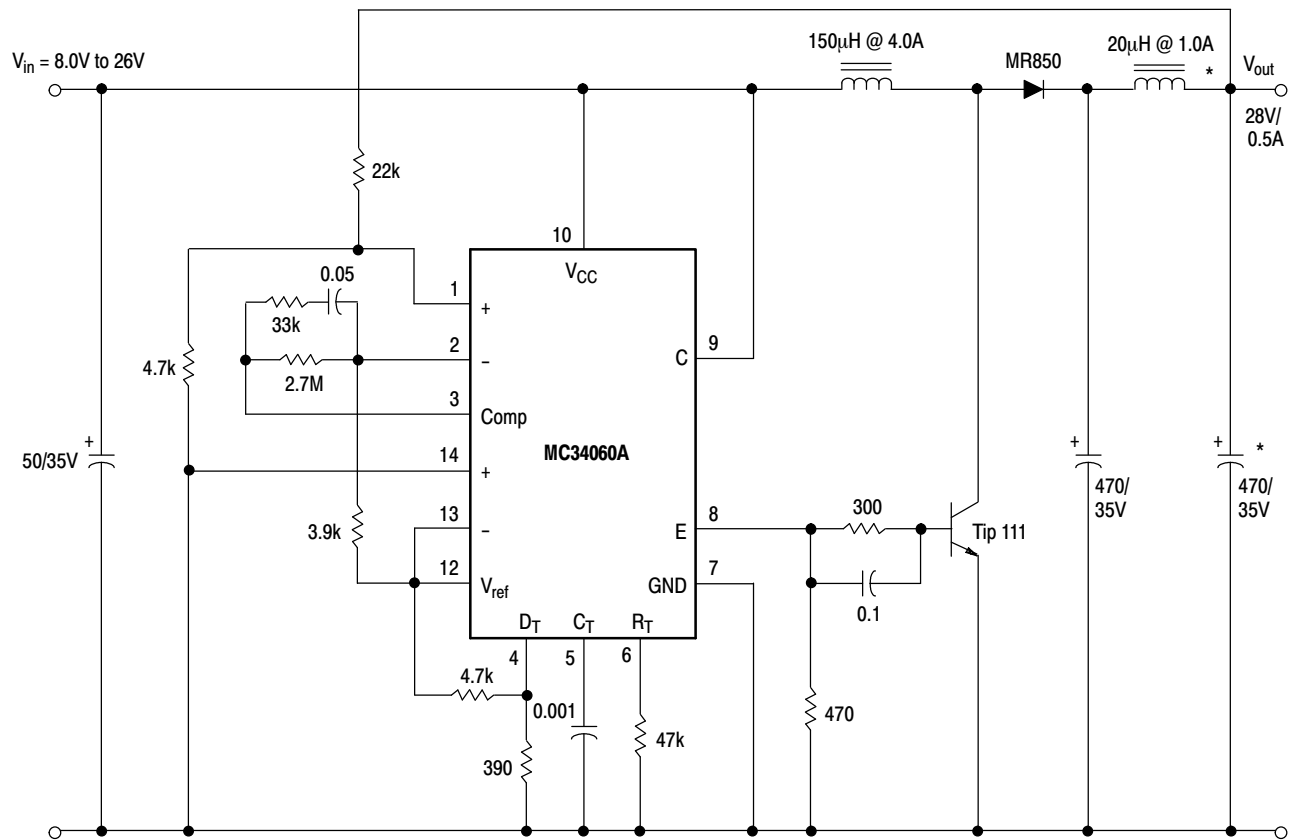


Figure 18. Slaving Two or More Control Circuits

MC34060A, MC33060A

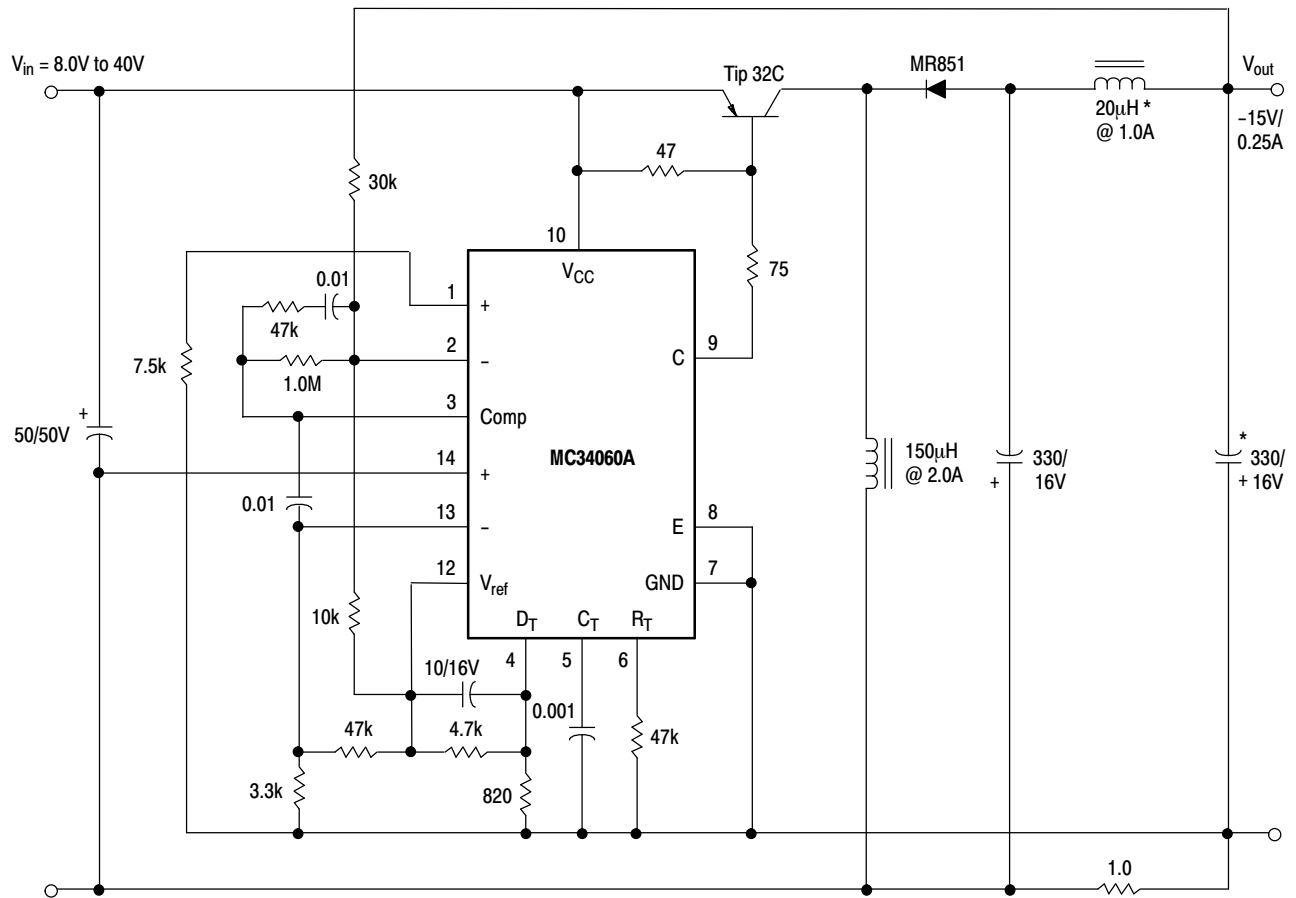


Test	Conditions	Results
Line Regulation	$V_{in} = 8.0 \text{ V to } 26 \text{ V}, I_O = 0.5 \text{ A}$	40 mV 0.14%
Load Regulation	$V_{in} = 12 \text{ V}, I_O = 1.0 \text{ mA to } 0.5 \text{ A}$	5.0 mV 0.18%
Output Ripple	$V_{in} = 12 \text{ V}, I_O = 0.5 \text{ A}$	24 mV p-p P.A.R.D.
Efficiency	$V_{in} = 12 \text{ V}, I_O = 0.5 \text{ A}$	75%

*Optional circuit to minimize output ripple

Figure 20. Step-Up Converter

MC34060A, MC33060A



Test	Conditions	Results
Line Regulation	$V_{in} = 8.0 \text{ V to } 40 \text{ V}$, $I_O = 250 \text{ mA}$	52 mV 0.35%
Load Regulation	$V_{in} = 12 \text{ V}$, $I_O = 1.0 \text{ to } 250 \text{ mA}$	47 mV 0.32%
Output Ripple	$V_{in} = 12 \text{ V}$, $I_O = 250 \text{ mA}$	10 mV p-p P.A.R.D.
Short Circuit Current	$V_{in} = 12 \text{ V}$, $R_L = 0.1 \Omega$	330 mA
Efficiency	$V_{in} = 12 \text{ V}$, $I_O = 250 \text{ mA}$	86%

*Optional circuit to minimize output ripple

Figure 21. Step-Up/Down Voltage Inverting Converter with Soft-Start and Current Limiting

MC34060A, MC33060A

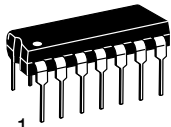
ORDERING INFORMATION

Device	Operating Temperature Range	Package	Shipping [†]
MC34060ADG	$T_A = 0^\circ \text{ to } +70^\circ\text{C}$	SOIC-14 (Pb-Free)	55 Units / Rail
MC34060ADR2G		SOIC-14 (Pb-Free)	2500 / Tape & Reel
MC34060APG		PDIP-14 (Pb-Free)	25 Units / Rail
MC33060ADG	$T_A = -40^\circ \text{ to } +85^\circ\text{C}$	SOIC-14 (Pb-Free)	55 Units / Rail
MC33060ADR2G		SOIC-14 (Pb-Free)	2500 / Tape & Reel
MC33060APG		PDIP-14 (Pb-Free)	25 Units / Rail

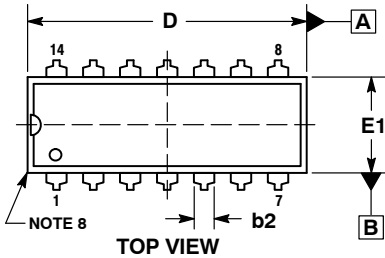
[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1

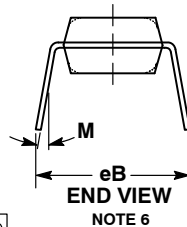
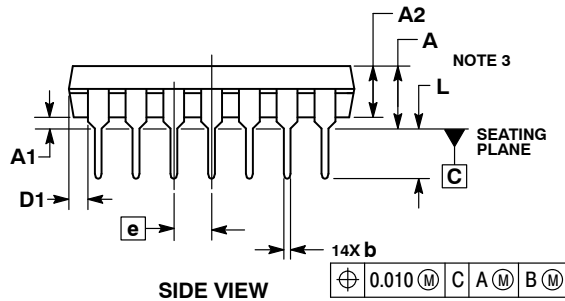
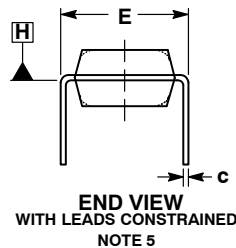


PDIP-14
CASE 646-06
ISSUE S

DATE 22 APR 2015

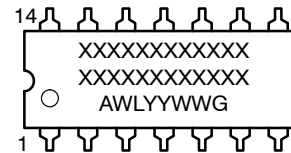
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSIONS A, A1 AND L ARE MEASURED WITH THE PACKAGE SEATED IN JEDEC SEATING PLANE GAUGE GS-3.
4. DIMENSIONS D, D1 AND E1 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS ARE NOT TO EXCEED 0.10 INCH.
5. DIMENSION E IS MEASURED AT A POINT 0.015 BELOW DATUM PLANE H WITH THE LEADS CONSTRAINED PERPENDICULAR TO DATUM C.
6. DIMENSION eB IS MEASURED AT THE LEAD TIPS WITH THE LEADS UNCONSTRAINED.
7. DATUM PLANE H IS COINCIDENT WITH THE BOTTOM OF THE LEADS, WHERE THE LEADS EXIT THE BODY.
8. PACKAGE CONTOUR IS OPTIONAL (ROUNDED OR SQUARE CORNERS).



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	----	0.210	----	5.33
A1	0.015	----	0.38	----
A2	0.115	0.195	2.92	4.95
b	0.014	0.022	0.35	0.56
b2	0.060 TYP		1.52 TYP	
C	0.008	0.014	0.20	0.36
D	0.735	0.775	18.67	19.69
D1	0.005	----	0.13	----
E	0.300	0.325	7.62	8.26
E1	0.240	0.280	6.10	7.11
e	0.100 BSC		2.54 BSC	
eB	----	0.430	----	10.92
L	0.115	0.150	2.92	3.81
M	----	10°	----	10°

GENERIC
MARKING DIAGRAM*



- XXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

STYLES ON PAGE 2

DOCUMENT NUMBER:	98ASB42428B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	PDIP-14	PAGE 1 OF 2

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

PDIP-14
CASE 646-06
ISSUE S

DATE 22 APR 2015

STYLE 1:
 PIN 1. COLLECTOR
 2. BASE
 3. EMITTER
 4. NO
CONNECTION
 5. EMITTER
 6. BASE
 7. COLLECTOR
 8. COLLECTOR
 9. BASE
 10. EMITTER
 11. NO
CONNECTION
 12. EMITTER
 13. BASE
 14. COLLECTOR

STYLE 2:
 CANCELLED

STYLE 3:
 CANCELLED

STYLE 4:
 PIN 1. DRAIN
 2. SOURCE
 3. GATE
 4. NO
CONNECTION
 5. GATE
 6. SOURCE
 7. DRAIN
 8. DRAIN
 9. SOURCE
 10. GATE
 11. NO
CONNECTION
 12. GATE
 13. SOURCE
 14. DRAIN

STYLE 5:
 PIN 1. GATE
 2. DRAIN
 3. SOURCE
 4. NO CONNECTION
 5. SOURCE
 6. DRAIN
 7. GATE
 8. GATE
 9. DRAIN
 10. SOURCE
 11. NO CONNECTION
 12. SOURCE
 13. DRAIN
 14. GATE

STYLE 6:
 PIN 1. COMMON CATHODE
 2. ANODE/CATHODE
 3. ANODE/CATHODE
 4. NO CONNECTION
 5. ANODE/CATHODE
 6. NO CONNECTION
 7. ANODE/CATHODE
 8. ANODE/CATHODE
 9. ANODE/CATHODE
 10. NO CONNECTION
 11. ANODE/CATHODE
 12. ANODE/CATHODE
 13. NO CONNECTION
 14. COMMON ANODE

STYLE 7:
 PIN 1. NO CONNECTION
 2. ANODE
 3. ANODE
 4. NO CONNECTION
 5. ANODE
 6. NO CONNECTION
 7. ANODE
 8. ANODE
 9. ANODE
 10. NO CONNECTION
 11. ANODE
 12. ANODE
 13. NO CONNECTION
 14. COMMON
 CATHODE

STYLE 8:
 PIN 1. NO CONNECTION
 2. CATHODE
 3. CATHODE
 4. NO CONNECTION
 5. CATHODE
 6. NO CONNECTION
 7. CATHODE
 8. CATHODE
 9. CATHODE
 10. NO CONNECTION
 11. CATHODE
 12. CATHODE
 13. NO CONNECTION
 14. COMMON ANODE


STYLE 9:
 PIN 1. COMMON CATHODE
 2. ANODE/CATHODE
 3. ANODE/CATHODE
 4. NO CONNECTION
 5. ANODE/CATHODE
 6. ANODE/CATHODE
 7. COMMON ANODE
 8. COMMON ANODE
 9. ANODE/CATHODE
 10. ANODE/CATHODE
 11. NO CONNECTION
 12. ANODE/CATHODE
 13. ANODE/CATHODE
 14. COMMON CATHODE

STYLE 10:
 PIN 1. COMMON
 CATHODE
 2. ANODE/CATHODE
 3. ANODE/CATHODE
 4. ANODE/CATHODE
 5. ANODE/CATHODE
 6. NO CONNECTION
 7. COMMON ANODE
 8. COMMON
 CATHODE
 9. ANODE/CATHODE
 10. ANODE/CATHODE
 11. ANODE/CATHODE
 12. ANODE/CATHODE
 13. NO CONNECTION
 14. COMMON ANODE

STYLE 11:
 PIN 1. CATHODE
 2. CATHODE
 3. CATHODE
 4. CATHODE
 5. CATHODE
 6. CATHODE
 7. CATHODE
 8. ANODE
 9. ANODE
 10. ANODE
 11. ANODE
 12. ANODE
 13. ANODE
 14. ANODE

STYLE 12:
 PIN 1. COMMON CATHODE
 2. COMMON ANODE
 3. ANODE/CATHODE
 4. ANODE/CATHODE
 5. ANODE/CATHODE
 6. COMMON ANODE
 7. COMMON CATHODE
 8. ANODE/CATHODE
 9. ANODE/CATHODE
 10. ANODE/CATHODE
 11. ANODE/CATHODE
 12. ANODE/CATHODE
 13. ANODE/CATHODE
 14. ANODE/CATHODE

DOCUMENT NUMBER:	98ASB42428B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	PDIP-14	PAGE 2 OF 2

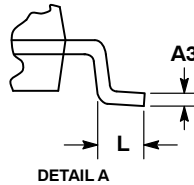
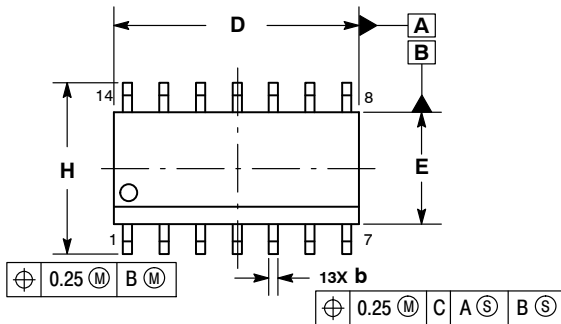
ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.



SCALE 1:1

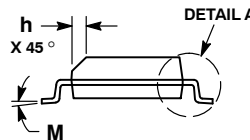
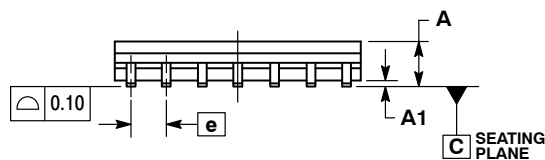
SOIC-14 NB
CASE 751A-03
ISSUE L

DATE 03 FEB 2016



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 2. CONTROLLING DIMENSION: MILLIMETERS.
 3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
 4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
 5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0°	7°	0°	7°



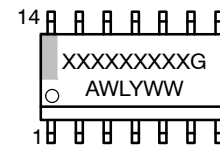
SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



- XXXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- Y = Year
- WW = Work Week
- G = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

DOCUMENT NUMBER:	98ASB42565B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOIC-14 NB	PAGE 1 OF 2

onsemi and onsemi are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

SOIC-14
CASE 751A-03
ISSUE L

DATE 03 FEB 2016

STYLE 1:
 PIN 1. COMMON CATHODE
 2. ANODE/CATHODE
 3. ANODE/CATHODE
 4. NO CONNECTION
 5. ANODE/CATHODE
 6. NO CONNECTION
 7. ANODE/CATHODE
 8. ANODE/CATHODE
 9. ANODE/CATHODE
 10. NO CONNECTION
 11. ANODE/CATHODE
 12. ANODE/CATHODE
 13. NO CONNECTION
 14. COMMON ANODE

STYLE 2:
 CANCELLED

STYLE 3:
 PIN 1. NO CONNECTION
 2. ANODE
 3. ANODE
 4. NO CONNECTION
 5. ANODE
 6. NO CONNECTION
 7. ANODE
 8. ANODE
 9. ANODE
 10. NO CONNECTION
 11. ANODE
 12. ANODE
 13. NO CONNECTION
 14. COMMON CATHODE

STYLE 4:
 PIN 1. NO CONNECTION
 2. CATHODE
 3. CATHODE
 4. NO CONNECTION
 5. CATHODE
 6. NO CONNECTION
 7. CATHODE
 8. CATHODE
 9. CATHODE
 10. NO CONNECTION
 11. CATHODE
 12. CATHODE
 13. NO CONNECTION
 14. COMMON ANODE

STYLE 5:
 PIN 1. COMMON CATHODE
 2. ANODE/CATHODE
 3. ANODE/CATHODE
 4. ANODE/CATHODE
 5. ANODE/CATHODE
 6. NO CONNECTION
 7. COMMON ANODE
 8. COMMON CATHODE
 9. ANODE/CATHODE
 10. ANODE/CATHODE
 11. ANODE/CATHODE
 12. ANODE/CATHODE
 13. NO CONNECTION
 14. COMMON ANODE

STYLE 6:
 PIN 1. CATHODE
 2. CATHODE
 3. CATHODE
 4. CATHODE
 5. CATHODE
 6. CATHODE
 7. CATHODE
 8. ANODE
 9. ANODE
 10. ANODE
 11. ANODE
 12. ANODE
 13. ANODE
 14. ANODE

STYLE 7:
 PIN 1. ANODE/CATHODE
 2. COMMON ANODE
 3. COMMON CATHODE
 4. ANODE/CATHODE
 5. ANODE/CATHODE
 6. ANODE/CATHODE
 7. ANODE/CATHODE
 8. ANODE/CATHODE
 9. ANODE/CATHODE
 10. ANODE/CATHODE
 11. COMMON CATHODE
 12. COMMON ANODE
 13. ANODE/CATHODE
 14. ANODE/CATHODE

STYLE 8:
 PIN 1. COMMON CATHODE
 2. ANODE/CATHODE
 3. ANODE/CATHODE
 4. NO CONNECTION
 5. ANODE/CATHODE
 6. ANODE/CATHODE
 7. COMMON ANODE
 8. COMMON ANODE
 9. ANODE/CATHODE
 10. ANODE/CATHODE
 11. NO CONNECTION
 12. ANODE/CATHODE
 13. ANODE/CATHODE
 14. COMMON CATHODE

DOCUMENT NUMBER:	98ASB42565B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOIC-14 NB	PAGE 2 OF 2

onsemi and **ONSEMI** are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales