

MC34060A, MC33060A

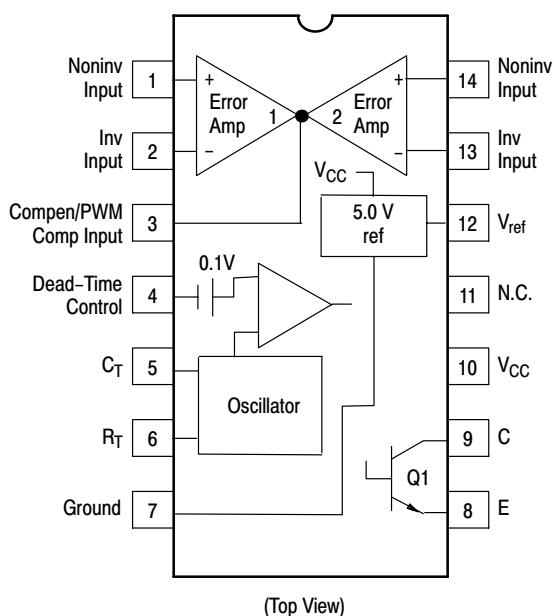
Fixed Frequency, PWM, Voltage Mode Single Ended Controllers

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.

- 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

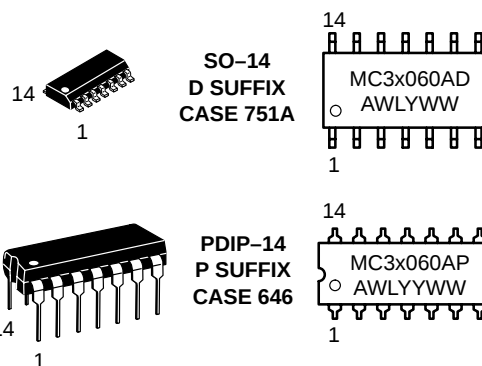
PIN CONNECTIONS



ON Semiconductor™

<http://onsemi.com>

MARKING DIAGRAMS



x = 3 or 4
A = Assembly Location
WL = Wafer Lot
YY, Y = Year
WW = Work Week

ORDERING INFORMATION

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

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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 1)	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	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristics	Symbol	P Suffix Package	D Suffix Package	Unit
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	80	120	$^\circ\text{C/W}$
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 Ω
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.

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ELECTRICAL CHARACTERISTICS ($V_{CC} = 15\text{ V}$, $C_T = 0.01\text{ }\mu\text{F}$, $R_T = 12\text{ k}\Omega$, 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
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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 V , $I_O = 10\text{ mA}$)	Reg_{line}	–	2.0	25	mV
Load Regulation ($I_O = 1.0\text{ mA}$ to 10 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 2) 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_f	– –	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	$V_{IR(\text{INV})}$	–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 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 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 V , $R_L = 2.0\text{ k}\Omega$)	ϕ_m	–	65	–	deg.
Common Mode Rejection Ratio ($V_{CC} = 40\text{ V}$, $V_{in} = 0\text{ V}$ to 38 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

2. 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

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ELECTRICAL CHARACTERISTICS (continued) ($V_{CC} = 15\text{ V}$, $C_T = 0.01\text{ }\mu\text{F}$, $R_T = 12\text{ k}\Omega$, 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
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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 V)	$I_{IB(DT)}$	–	–1.0	–10	μA
Maximum Output Duty Cycle ($V_{in} = 0\text{ V}$, $C_T = 0.01\text{ }\mu\text{F}$, $R_T = 12\text{ k}\Omega$) ($V_{in} = 0\text{ V}$, $C_T = 0.001\text{ }\mu\text{F}$, $R_T = 47\text{ k}\Omega$)	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 ($C_T = 0.01\text{ }\mu\text{F}$, $R_T = 12\text{ k}\Omega$, $T_A = 25^\circ\text{C}$) $T_A = T_{low}$ to T_{high} – MC34060A – MC33060A ($C_T = 0.001\text{ }\mu\text{F}$, $R_T = 47\text{ k}\Omega$)	f_{osc}	9.7 9.5 9.0 –	10.5 – – 25	11.3 11.5 11.5 –	kHz
Standard Deviation of Frequency* ($C_T = 0.001\text{ }\mu\text{F}$, $R_T = 47\text{ k}\Omega$)	σf_{osc}	–	1.5	–	%
Frequency Change with Voltage ($V_{CC} = 7.0\text{ V}$ to 40 V)	$\Delta f_{osc}(\Delta V)$	–	0.5	2.0	%
Frequency Change with Temperature ($\Delta T_A = T_{low}$ to T_{high}) ($C_T = 0.01\text{ }\mu\text{F}$, $R_T = 12\text{ k}\Omega$)	$\Delta f_{osc}(\Delta T)$	– –	4.0 –	– –	%

UNDERVOLTAGE LOCKOUT SECTION

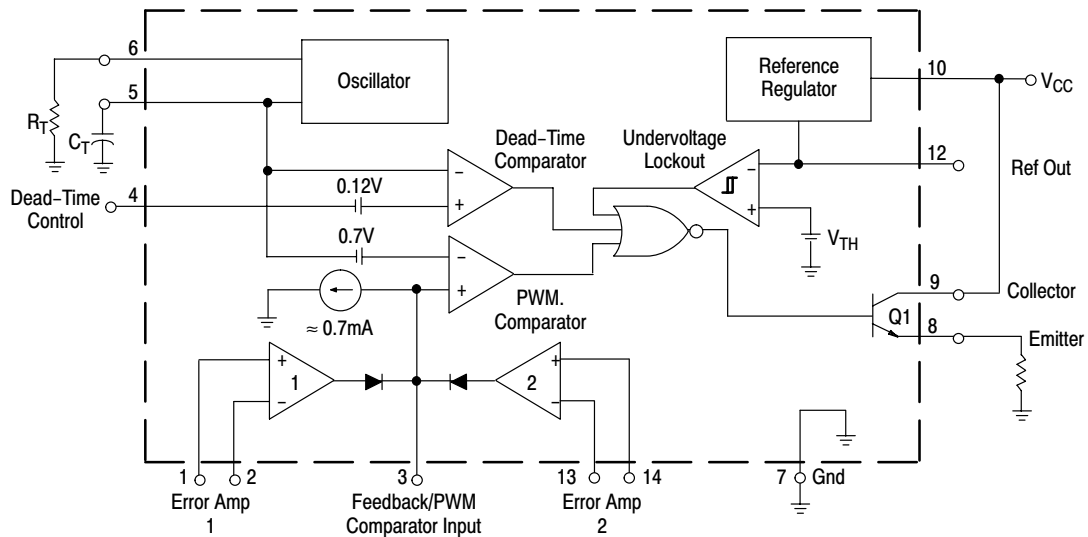
Turn-On Threshold (V_{CC} increasing, $I_{ref} = 1.0\text{ mA}$)	V_{th}	4.0	4.7	5.5	V
Hysteresis	V_H	50	150	300	mV

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 ($V_{Pin\ 4} = 2.0\text{ V}$, $C_T = 0.001\text{ }\mu\text{F}$, $R_T = 47\text{ k}\Omega$). 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; $\sigma = \sqrt{\frac{\sum_{n=1}^N (x_n - \bar{x})^2}{N-1}}$

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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.)

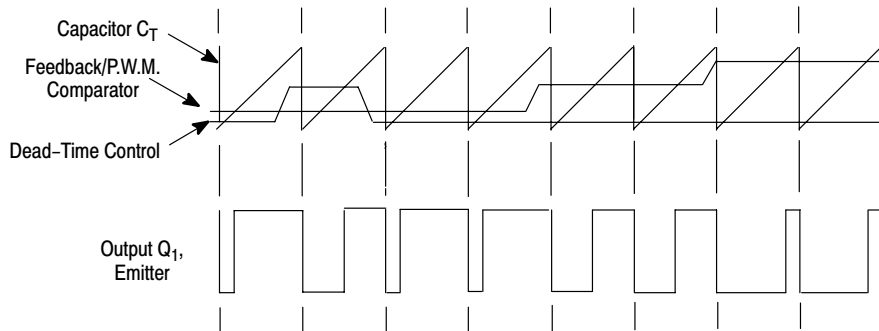


Figure 2. Timing Diagram

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 $(V_{CC} - 2.0\text{ V})$, 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 $+70^\circ\text{C}$.

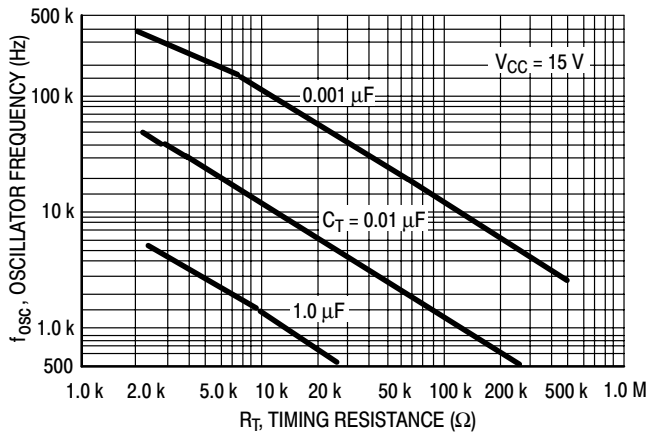


Figure 3. Oscillator Frequency versus Timing Resistance

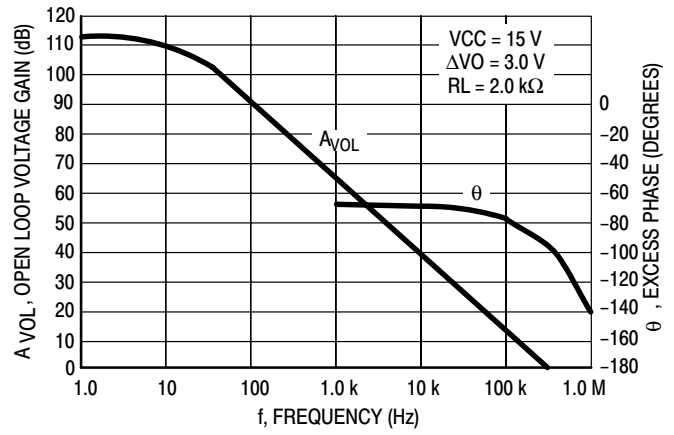


Figure 4. Open Loop Voltage Gain and Phase versus Frequency

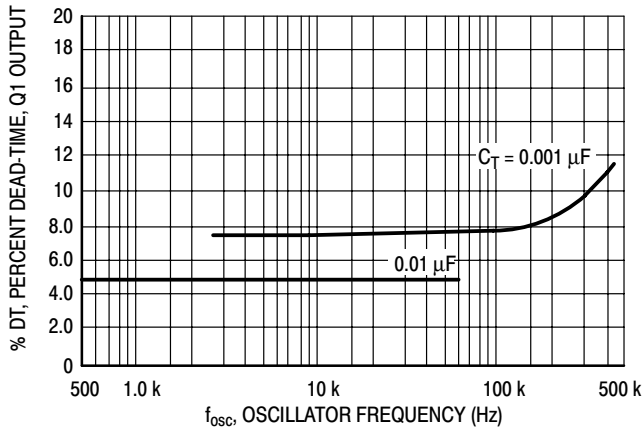


Figure 5. Percent Deadtime versus Oscillator Frequency

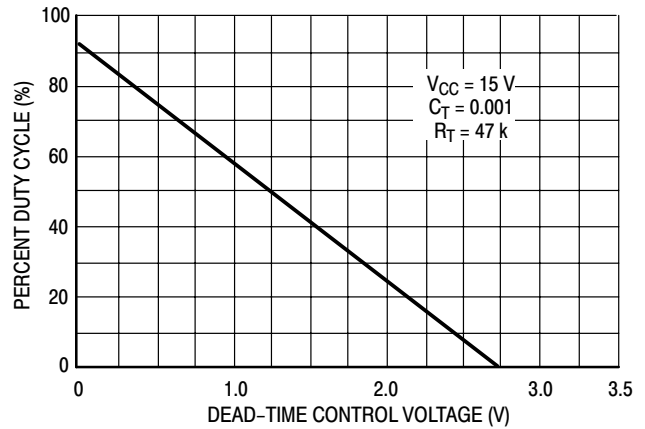


Figure 6. Percent Duty Cycle versus Dead-Time Control Voltage

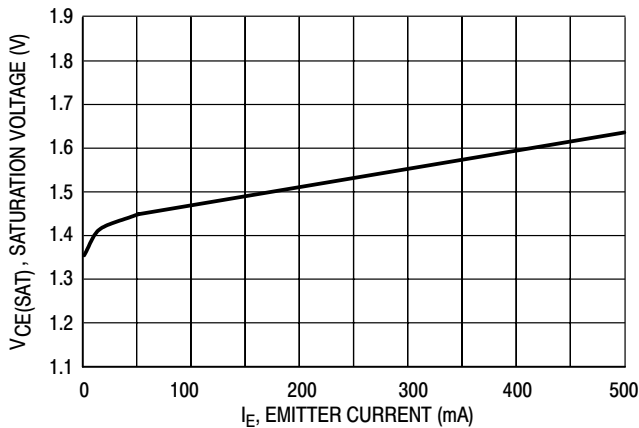


Figure 7. Emitter-Follower Configuration Output Saturation Voltage versus Emitter Current

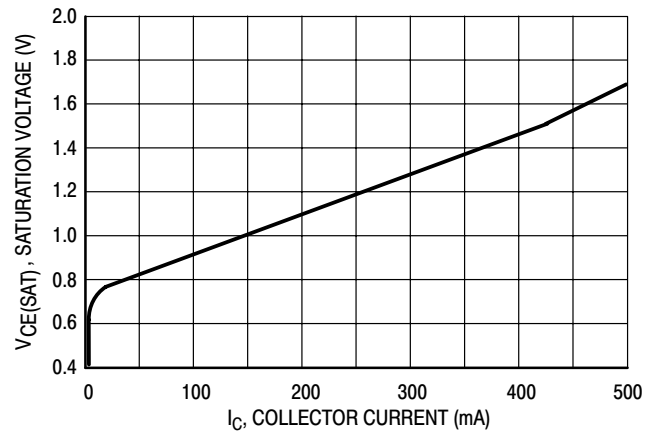


Figure 8. Common-Emitter Configuration Output Saturation Voltage versus Collector Current

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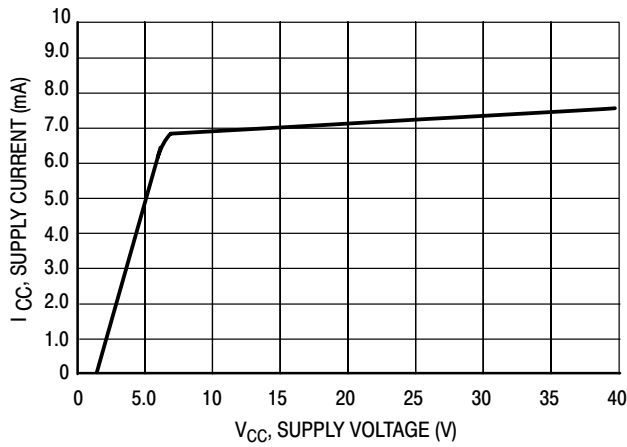


Figure 9. Standby Supply Current versus Supply Voltage

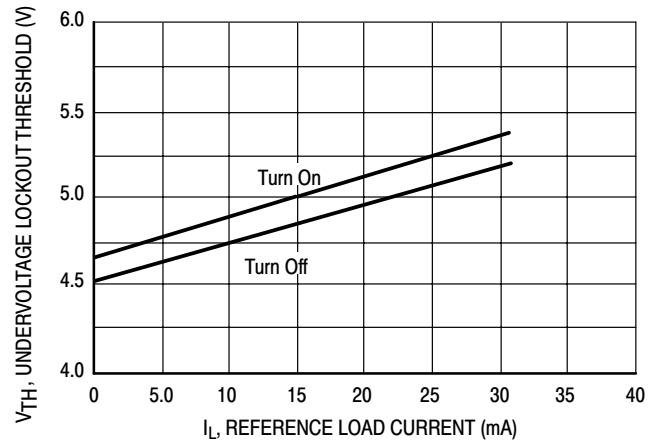


Figure 10. Undervoltage Lockout Thresholds versus Reference Load Current

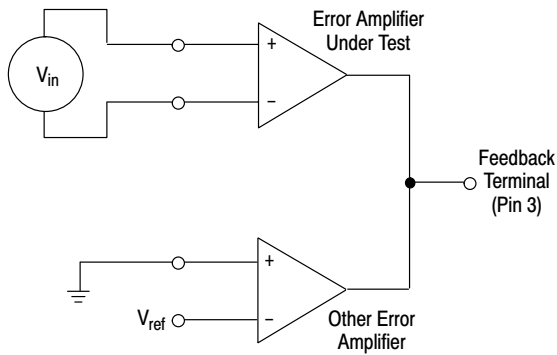


Figure 11. Error Amplifier Characteristics

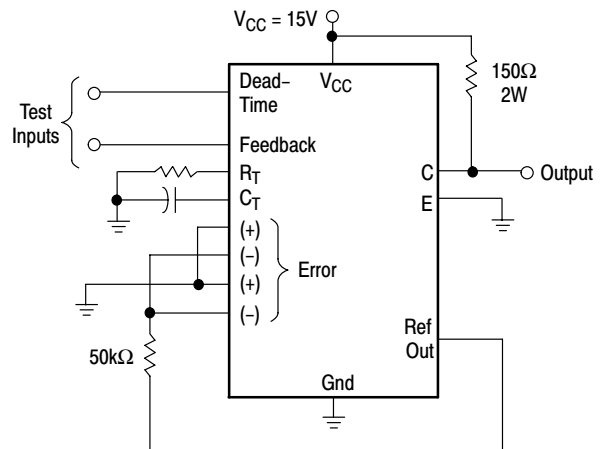


Figure 12. Deadtime and Feedback Control

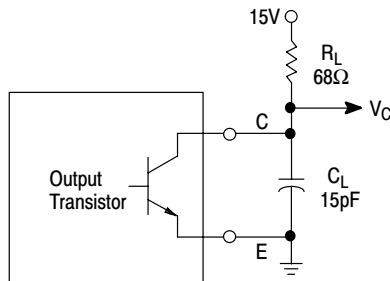


Figure 13. Common-Emitter Configuration and Waveform

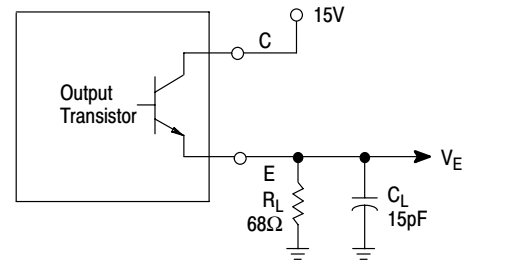


Figure 14. Emitter-Follower Configuration and Waveform

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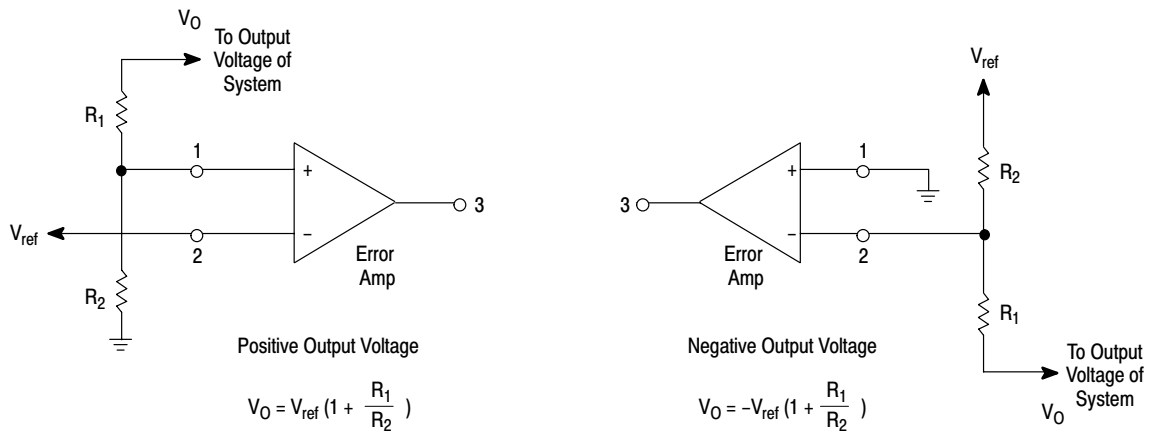


Figure 15. Error Amplifier Sensing Techniques

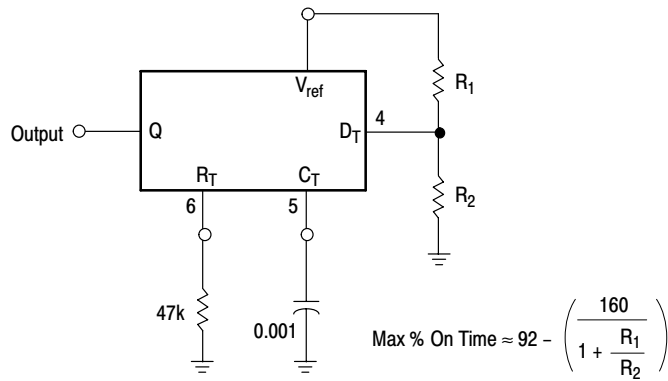


Figure 16. Deadtime Control Circuit

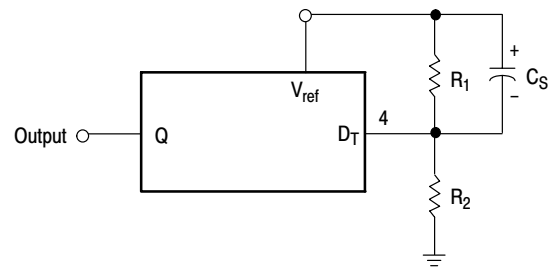


Figure 17. Soft-Start Circuit

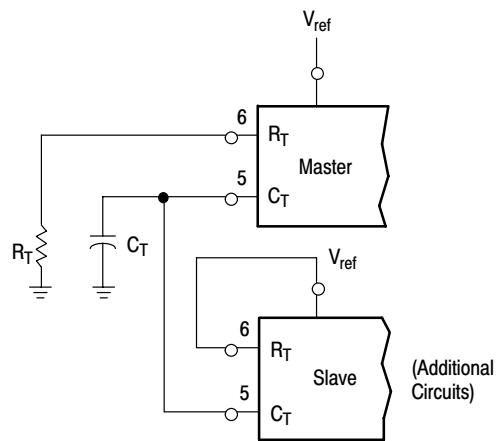
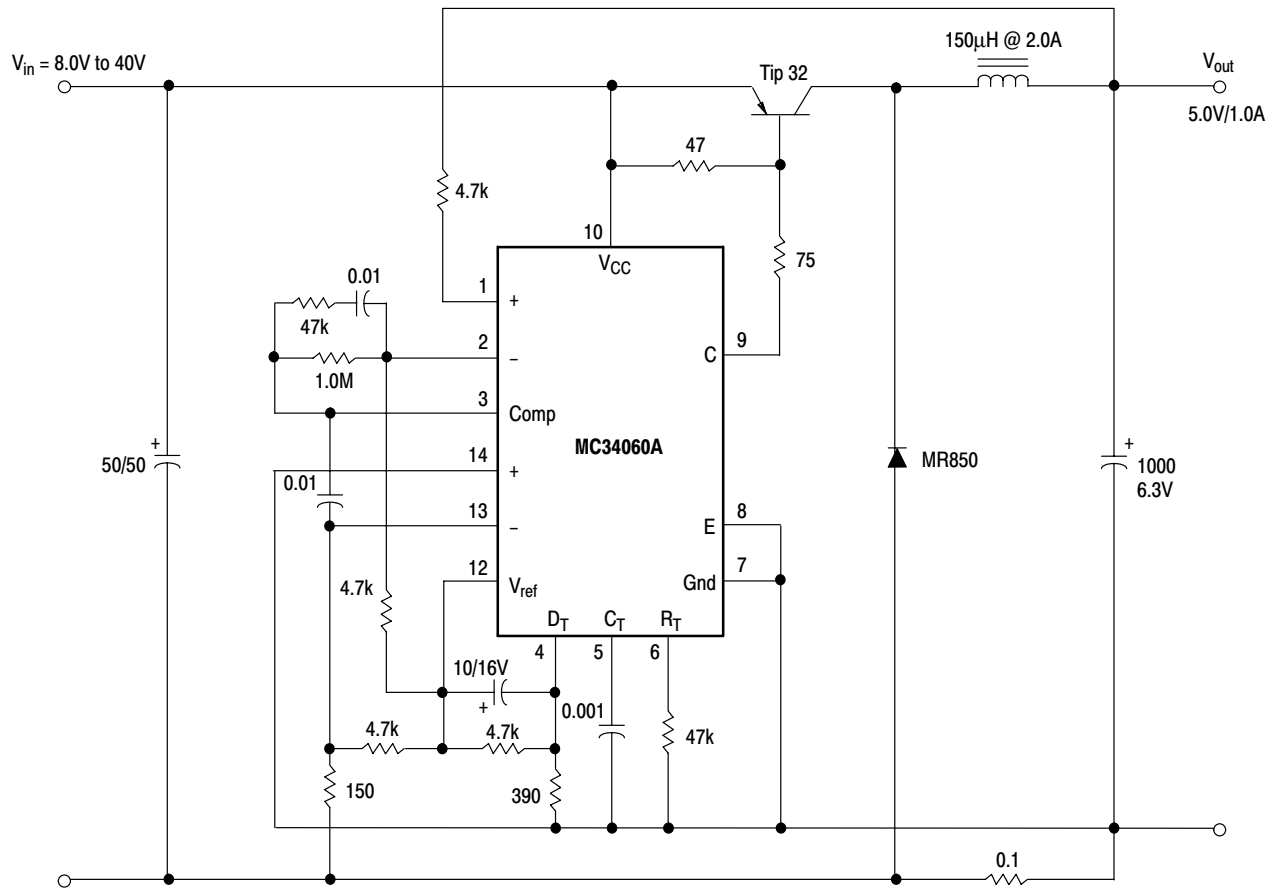


Figure 18. Slaving Two or More Control Circuits

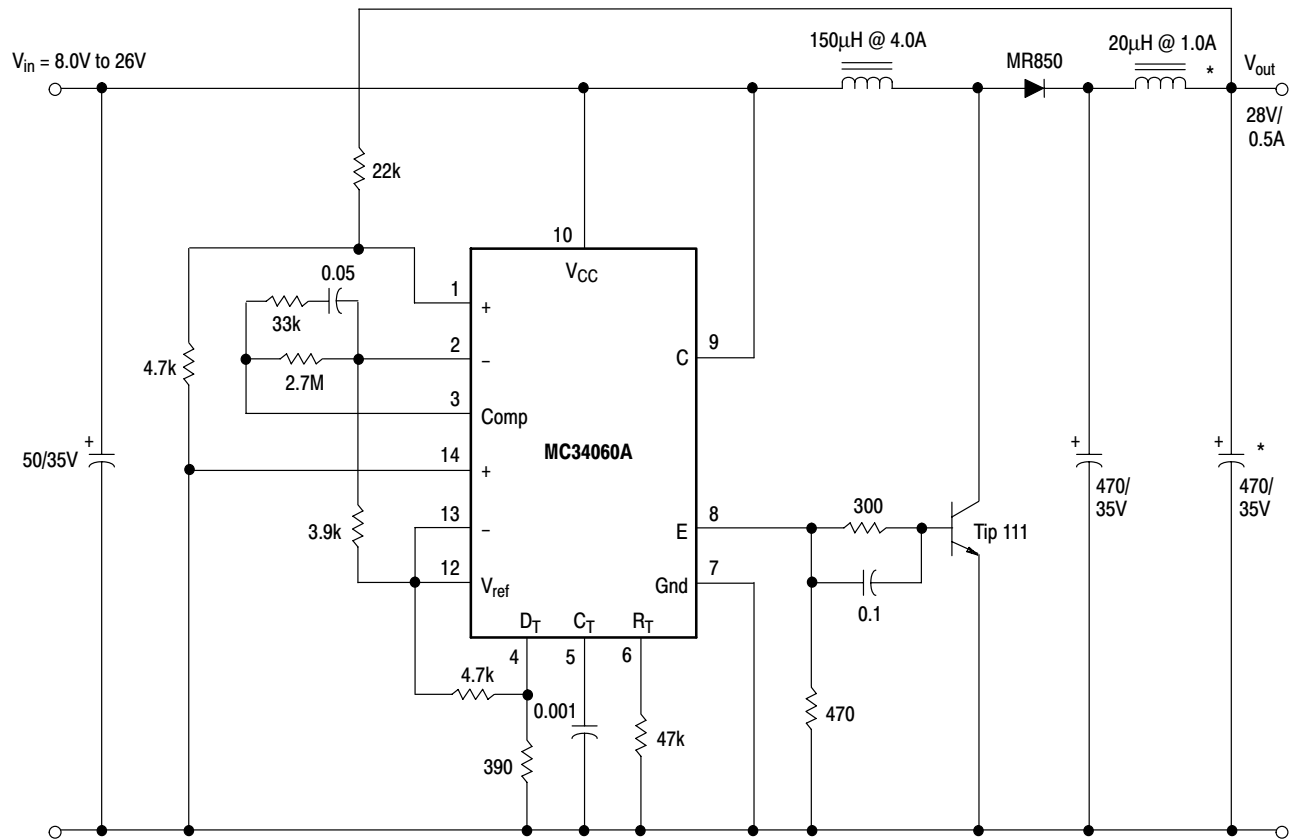
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Test	Conditions	Results
Line Regulation	$V_{in} = 8.0 \text{ V to } 40 \text{ V}$, $I_O = 1.0 \text{ A}$	25 mV 0.5%
Load Regulation	$V_{in} = 12 \text{ V}$, $I_O = 1.0 \text{ mA to } 1.0 \text{ A}$	3.0 mV 0.06%
Output Ripple	$V_{in} = 12 \text{ V}$, $I_O = 1.0 \text{ A}$	75 mV p-p P.A.R.D.
Short Circuit Current	$V_{in} = 12 \text{ V}$, $R_L = 0.1 \Omega$	1.6 A
Efficiency	$V_{in} = 12 \text{ V}$, $I_O = 1.0 \text{ A}$	73%

Figure 19. Step-Down Converter with Soft-Start and Output Current Limiting

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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%

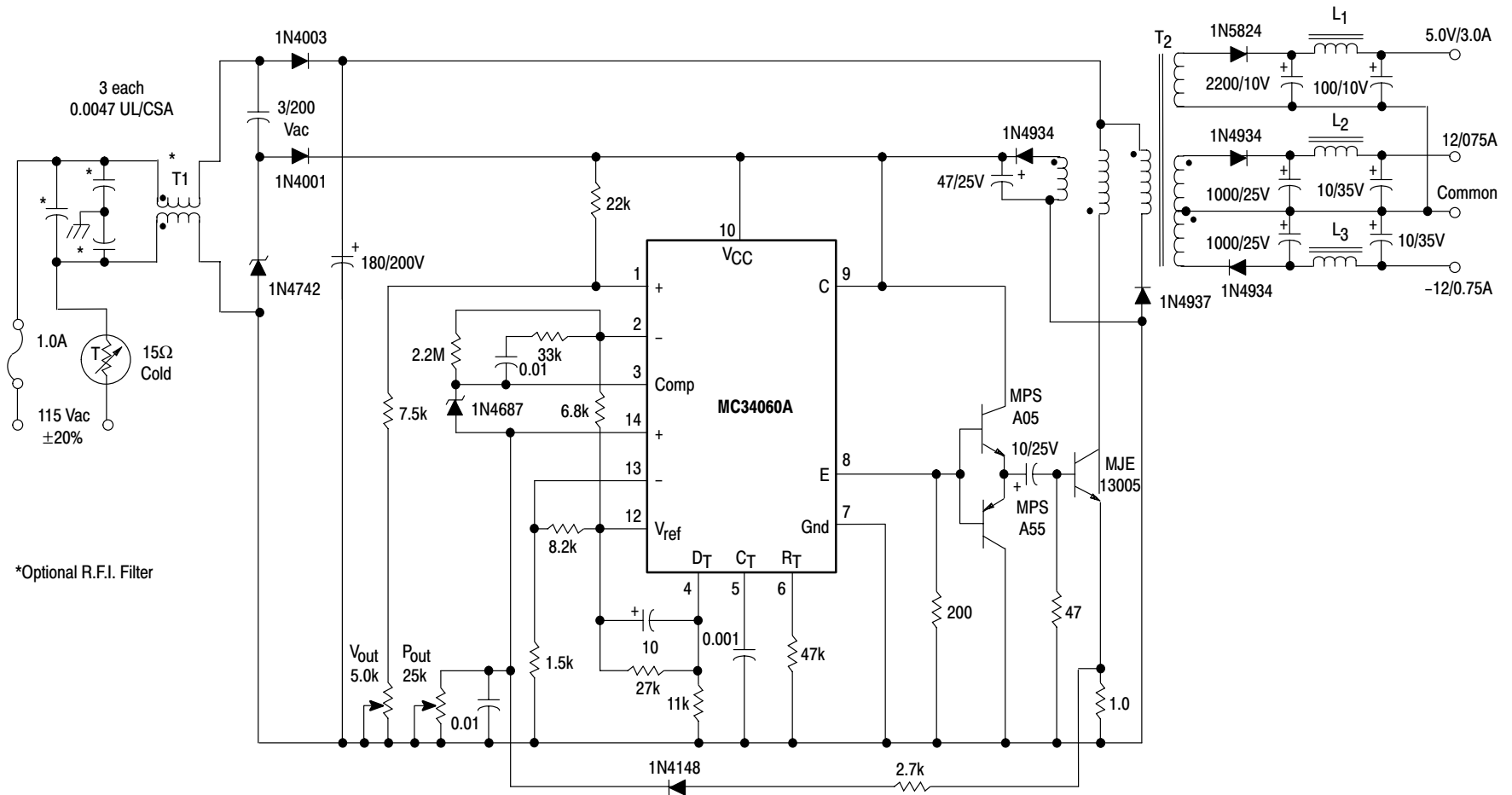
*Optional circuit to minimize output ripple

Figure 20. Step-Up Converter

The circuit diagram illustrates a precision current source implemented with the MC34060A integrated circuit. The input voltage V_{in} ranges from 8.0V to 40V. The output voltage V_{out} is -15V/0.25A, and the output current is 20μH* @ 1.0A. The circuit includes a 50/50V transformer, a 7.5k resistor, a 30k resistor, a 47k resistor, a 1.0M resistor, a 0.01 capacitor, a 10k resistor, a 10/16V capacitor, a 47k resistor, a 4.7k resistor, a 0.001 capacitor, a 47k resistor, a 3.3k resistor, a 820 resistor, a 1.0 resistor, a 150μH inductor @ 2.0A, a 330/16V capacitor, a 330/+16V capacitor, a Tip 32C transistor, and an MR851 diode. The MC34060A is configured with its V_{CC} pin (10) connected to the input voltage, its Gnd pin (7) connected to ground, and its E pin (8) connected to the output voltage. The internal nodes D_T, C_T, and R_T are connected to the output voltage. The internal nodes V_{ref} and Comp are connected to the output voltage. The internal nodes + and - are connected to the output voltage. The internal nodes 1, 2, 3, 14, 13, 12, 4, 5, and 6 are connected to the output voltage. The internal nodes 9 and 11 are connected to the output voltage. The internal nodes 15 and 16 are connected to the output voltage. The internal nodes 17 and 18 are connected to the output voltage. The internal nodes 19 and 20 are connected to the output voltage. The internal nodes 21 and 22 are connected to the output voltage. The internal nodes 23 and 24 are connected to the output voltage. The internal nodes 25 and 26 are connected to the output voltage. The internal nodes 27 and 28 are connected to the output voltage. The internal nodes 29 and 30 are connected to the output voltage. The internal nodes 31 and 32 are connected to the output voltage. The internal nodes 33 and 34 are connected to the output voltage. The internal nodes 35 and 36 are connected to the output voltage. The internal nodes 37 and 38 are connected to the output voltage. The internal nodes 39 and 40 are connected to the output voltage. The internal nodes 41 and 42 are connected to the output voltage. The internal nodes 43 and 44 are connected to the output voltage. The internal nodes 45 and 46 are connected to the output voltage. The internal nodes 47 and 48 are connected to the output voltage. The internal nodes 49 and 50 are connected to the output voltage. The internal nodes 51 and 52 are connected to the output voltage. The internal nodes 53 and 54 are connected to the output voltage. The internal nodes 55 and 56 are connected to the output voltage. The internal nodes 57 and 58 are connected to the output voltage. The internal nodes 59 and 60 are connected to the output voltage. The internal nodes 61 and 62 are connected to the output voltage. The internal nodes 63 and 64 are connected to the output voltage. The internal nodes 65 and 66 are connected to the output voltage. The internal nodes 67 and 68 are connected to the output voltage. The internal nodes 69 and 70 are connected to the output voltage. The internal nodes 71 and 72 are connected to the output voltage. The internal nodes 73 and 74 are connected to the output voltage. The internal nodes 75 and 76 are connected to the output voltage. The internal nodes 77 and 78 are connected to the output voltage. The internal nodes 79 and 80 are connected to the output voltage. The internal nodes 81 and 82 are connected to the output voltage. The internal nodes 83 and 84 are connected to the output voltage. The internal nodes 85 and 86 are connected to the output voltage. The internal nodes 87 and 88 are connected to the output voltage. The internal nodes 89 and 90 are connected to the output voltage. The internal nodes 91 and 92 are connected to the output voltage. The internal nodes 93 and 94 are connected to the output voltage. The internal nodes 95 and 96 are connected to the output voltage. The internal nodes 97 and 98 are connected to the output voltage. The internal nodes 99 and 100 are connected to the output voltage.

*Optional circuit to minimize output ripple

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Test	Conditions	Results
Line Regulation 5.0 V	$V_{in} = 95 \text{ Vac to } 135 \text{ Vac}$, $I_O = 3.0 \text{ A}$	20 mV 0.40%
Line Regulation ±12 V	$V_{in} = 95 \text{ Vac to } 135 \text{ Vac}$, $I_O = \pm 0.75 \text{ A}$	52 mV 0.26%
Load Regulation 5.0 V	$V_{in} = 115 \text{ Vac}$, $I_O = 1.0 \text{ A to } 4.0 \text{ A}$	476 mV 9.5%
Load Regulation ±12 V	$V_{in} = 115 \text{ Vac}$, $I_O = \pm 0.4 \text{ A to } \pm 0.9 \text{ A}$	300 mV 2.5%
Output Ripple 5.0 V	$V_{in} = 115 \text{ Vac}$, $I_O = 3.0 \text{ A}$	45 mV p-p P.A.R.D.
Output Ripple ±12 V	$V_{in} = 115 \text{ Vac}$, $I_O = \pm 0.75 \text{ A}$	75 mV p-p P.A.R.D.
Efficiency	$V_{in} = 115 \text{ Vac}$, $I_O 5.0 \text{ V} = 3.0 \text{ A}$ $I_O \pm 12 \text{ V} = \pm 0.75 \text{ A}$	74%

T1 – Coilcraft W2961
T2 – Core: Coilcraft 11–464–16,
0.025" gap in each leg.
Bobbin: Coilcraft 37–573
Windings:
Primary, 2 each, 75 turns #25 Awg Bifilar wound
Feedback: 15 turns #26 Awg
Secondary, 5.0 V, 6 turns @33 Awg Bifilar wound
Secondary, 2 each, 14 turns #24 Awg Bifilar wound
L1 – Coilcraft Z7156, 15 μH @ 5.0 A
L2, L3 – Coilcraft Z7157, 25 μH @ 1.0 A

Figure 22. 33 W Off-Line Flyback Converter with Soft-Start and Primary Power Limiting

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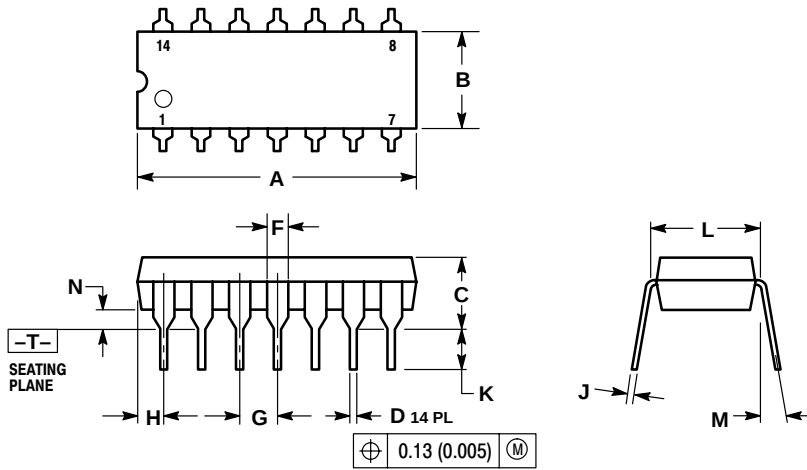
ORDERING INFORMATION

Device	Operating Temperature Range	Package	Shipping
MC34060AD	$T_A = 0^\circ \text{ to } +70^\circ\text{C}$	SO-14	55 Units/Rail
MC34060ADR2		SO-14	2500 Tape & Reel
MC34060AP		PDIP-14	25 Units/Rail
MC33060AD	$T_A = -40^\circ \text{ to } +85^\circ\text{C}$	SO-14	55 Units/Rail
MC33060ADR2		SO-14	2500 Tape & Reel
MC33060AP		PDIP-14	25 Units/Rail

MC34060A, MC33060A

PACKAGE DIMENSIONS

PDIP-14
P SUFFIX
CASE 646-06
ISSUE M

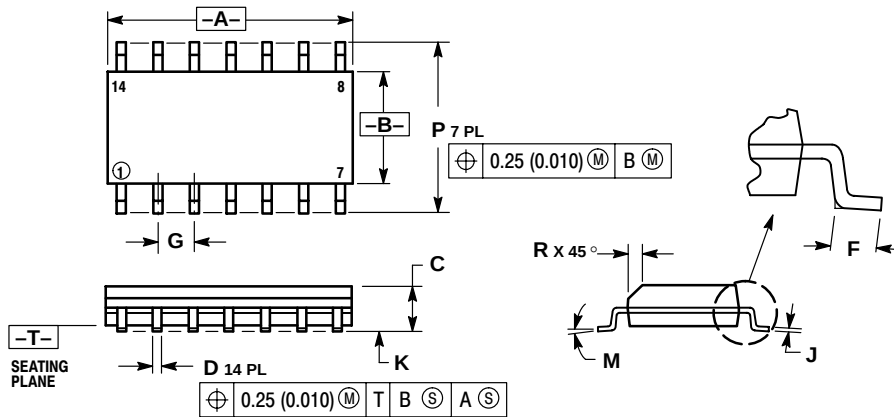


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	18.80
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.290	0.310	7.37	7.87
M	---	10°	---	10°
N	0.015	0.039	0.38	1.01

SO-14
D SUFFIX
CASE 751A-03
ISSUE F



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

MC34060A, MC33060A

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