

Power/Motor Control Circuits

In Brief . . .

With the expansion of electronics into more and more mechanical systems, there comes an increasing demand for simple but intelligent circuits that can blend these two technologies. In the past, the task of power/motor control was once accomplished with discrete devices. But today this task is being performed by bipolar IC technology due to cost, size, and reliability constraints. Motorola offers integrated circuits designed to anticipate the requirements for both simple and sophisticated control systems, while providing cost effective solutions to meet the needs of the applications.

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Power Controllers

An assortment of battery and ac line-operated control ICs for specific applications are shown. They are designed to enhance system performance and reduce complexity in a wide variety of control applications.

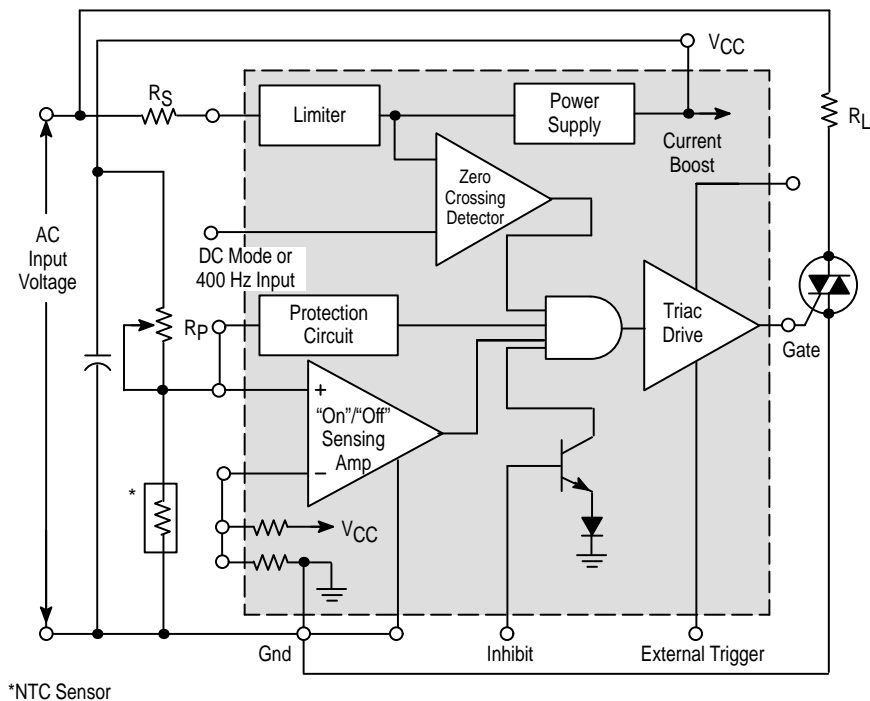
Zero Voltage Switch

CA3059

$T_A = -40^\circ$ to $+85^\circ\text{C}$, Case 646

This device is designed for thyristor control in a variety of ac power switching applications for ac input voltages of 24 V, 120 V, 208/230 V, and 227 V @ 50/60 Hz.

- **Limiter–Power Supply** – Allows operation directly from an ac line.
- **Differential “On”/“Off” Sensing Amplifier** – Tests for condition of external sensors or input command signals. Proportional control capability or hysteresis may be implemented.
- **Zero–Crossing Detector** – Synchronizes the output pulses to the zero voltage point of the ac cycle. Eliminates RFI when used with resistive loads.
- **Triac Drive** – Supplies high current pulses to the external power controlling thyristor.
- **Protection Circuit** – A built-in circuit may be actuated, if the sensor opens or shorts, to remove the drive circuit from the external triac.
- **Inhibit Capability** – Thyristor firing may be inhibited by the action of an internal diode gate.
- **High Power DC Comparator Operation** – Operation in this mode is accomplished by connecting Pin 7 to 12 (thus overriding the action of the zero-crossing detector).



Power Controllers (continued)

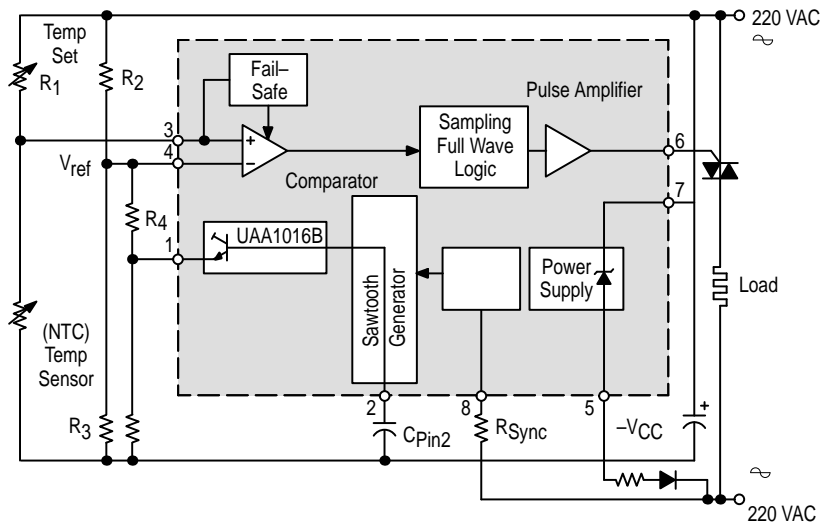
Zero Voltage Controller

UAA1016B

$T_A = -20^\circ$ to $+100^\circ\text{C}$, Case 626

The UAA1016B is designed to drive triacs with the Zero voltage technique which allows RFI free power regulation of resistive loads. It provides the following features:

- Proportional Temperature Control Over an Adjustable Band
- Adjustable Burst Frequency (to Comply with Standards)
- No DC Current Component Through the Main Line (to Comply with Standards)
- Negative Output Current Pulses (Triac Quadrants 2 and 3)
- Direct AC Line Operation
- Low External Components Count



Zero Voltage Controller

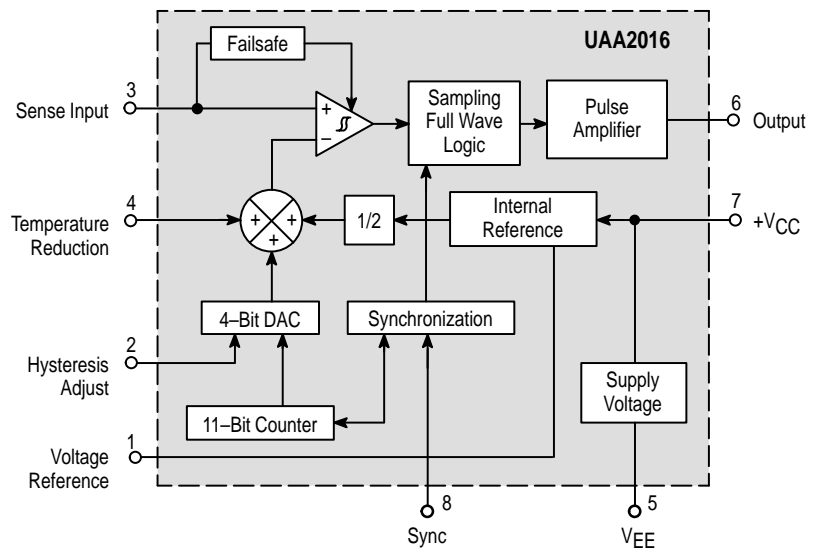
UAA2016P, D

$T_A = -20^\circ$ to $+85^\circ\text{C}$, Case 626, 751

The UAA2016 is designed to drive triacs with the Zero Voltage technique which allows RFI free power regulation of resistive loads. Operating directly on the ac power line, its main application is the precision regulation of electrical heating systems such as panel heaters or irons.

A built-in digital sawtooth waveform permits proportional temperature regulation action over a $\pm 1^\circ\text{C}$ band around the set point. For energy savings there is a programmable temperature reduction function, and for security, a sensor failsafe inhibits output pulses when the sensor connection is broken. Preset temperature (i.e., defrost) application is also possible. In applications where high hysteresis is needed, its value can be adjusted up to 5°C around the set point. All these features are implemented with a very low external component count.

- Zero Voltage Switch for Triacs, up to 2.0 kW (MAC212A8)
- Direct AC Line Operation
- Proportional Regulation of Temperature over a 1°C Band
- Programmable Temperature Reduction
- Preset Temperature (i.e., Defrost)
- Sensor Failsafe
- Adjustable Hysteresis
- Low External Component Count



Power Controllers (continued)

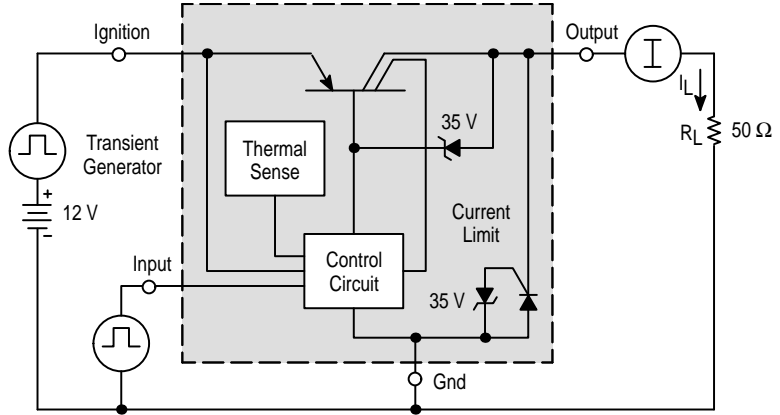
High-Side Driver Switch

MC3399T, DW

$T_J = -40^\circ$ to $+150^\circ\text{C}$, Case 314D, 751G

The MC3399T is a high side driver switch that is designed to drive loads from the positive side of the power supply. The output is controlled by a TTL compatible Enable pin. In the "on" state, the device exhibits very low saturation voltages for load currents in excess of 750 mA. The device also protects the load from positive or negative-going high voltage transients by becoming an open circuit and isolating the transient for its duration from the load.

The MC3399T is fabricated on a Power BiMOS process which combines the best features of Bipolar and MOS technologies. The mixed technology provides higher gain PNP output devices and results in Power Integrated Circuits with reduced quiescent current.



Motor Controllers

This section contains integrated circuits designed for cost effective control of specific motor families. Included are controllers for brushless, dc servo, stepper, and universal type motors.

Brushless DC Motor Controllers

Advances in magnetic materials technology and integrated circuits have contributed to the unprecedented rise in popularity of brushless dc motors. Analog control ICs are making the many features and advantages of brushless motors available at a much more economical price. Motorola offers a family of monolithic integrated brushless dc motor

controllers. These ICs provide a choice of control functions which allow many system features to be easily implemented at a fraction of the cost of discrete solutions. The following table summarizes and compares the features of Motorola's brushless motor controllers.

Table 1. Features Summary for Motorola Brushless DC Motor Controllers

Device	Operating Voltage Range (V)		Undervoltage Lockout	Internal Thermal Shutdown	Fwd/Rev Control	Sensor Electrical Phasing	Output Enable	Output Drivers		6.25 V Reference Output	Current Sense Comparator Input(s)	Error Amplifier	FAULT Output	Separate Drive VC	Brake Input	Suffix/Package
	V _{CC}	V _C						Totem Pole (Bottom)	Open Collector (Top)							
MC33033	10-30	-	✓	✓	✓	60°/300° and 120°/240°	✓	✓	✓	✓	Noninv. Only	✓	-	-	-	P/738, DW/751D
MC33035	10-40	10-30	✓	✓	✓		✓	✓	✓	✓	✓	Noninv. and Inv.	✓	✓	✓	✓

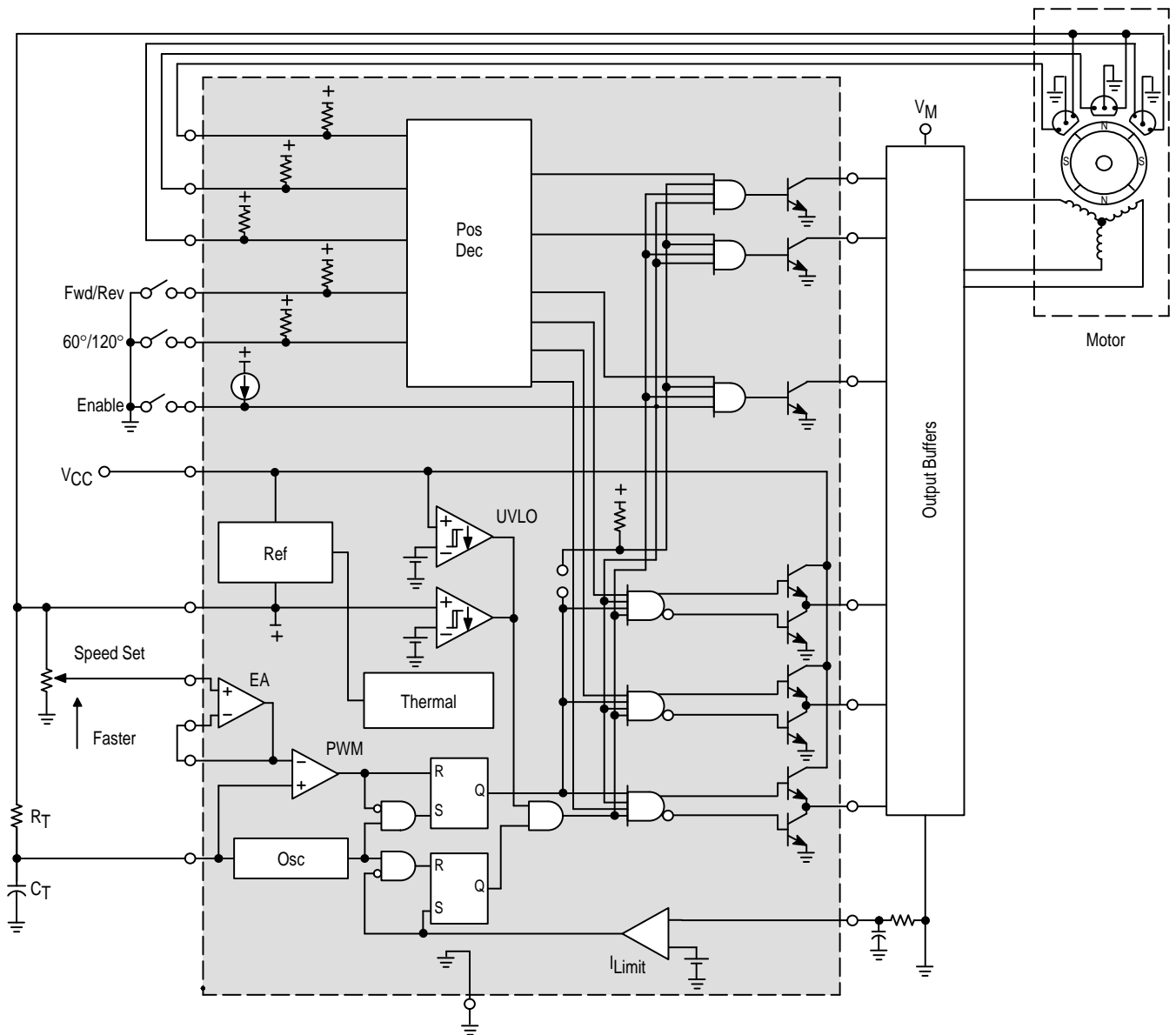
Motor Controllers (continued)

MC33033P, DW

$T_A = -40^\circ$ to $+85^\circ\text{C}$, Case 738, 751D

The MC33033 is a lower cost second generation brushless dc motor controller which has evolved from the full featured MC33035 controller. The MC33033 contains all of the active functions needed to implement a low cost open loop motor control system. This IC has all of the key control and protection functions of the two full featured devices with the following secondary features deleted: separate drive-circuit supply and ground pins, the brake input, and the fault output signal. Like its MC33035 predecessor, the MC33033 has a control pin which allows the user to select $60^\circ/300^\circ$ or $120^\circ/240^\circ$ sensor electrical phasings.

Because of its low cost, the MC33033 can efficiently be used to control brush dc motors as well as brushless. A brush dc motor can be driven using two of the three drive output phases provided in the MC33033, while the Hall sensor input pins are selectively tied to V_{Ref} or ground. Other features such as forward/reverse, output enable, speed control, current limiting, undervoltage lockout and internal thermal shutdown will still remain functional.



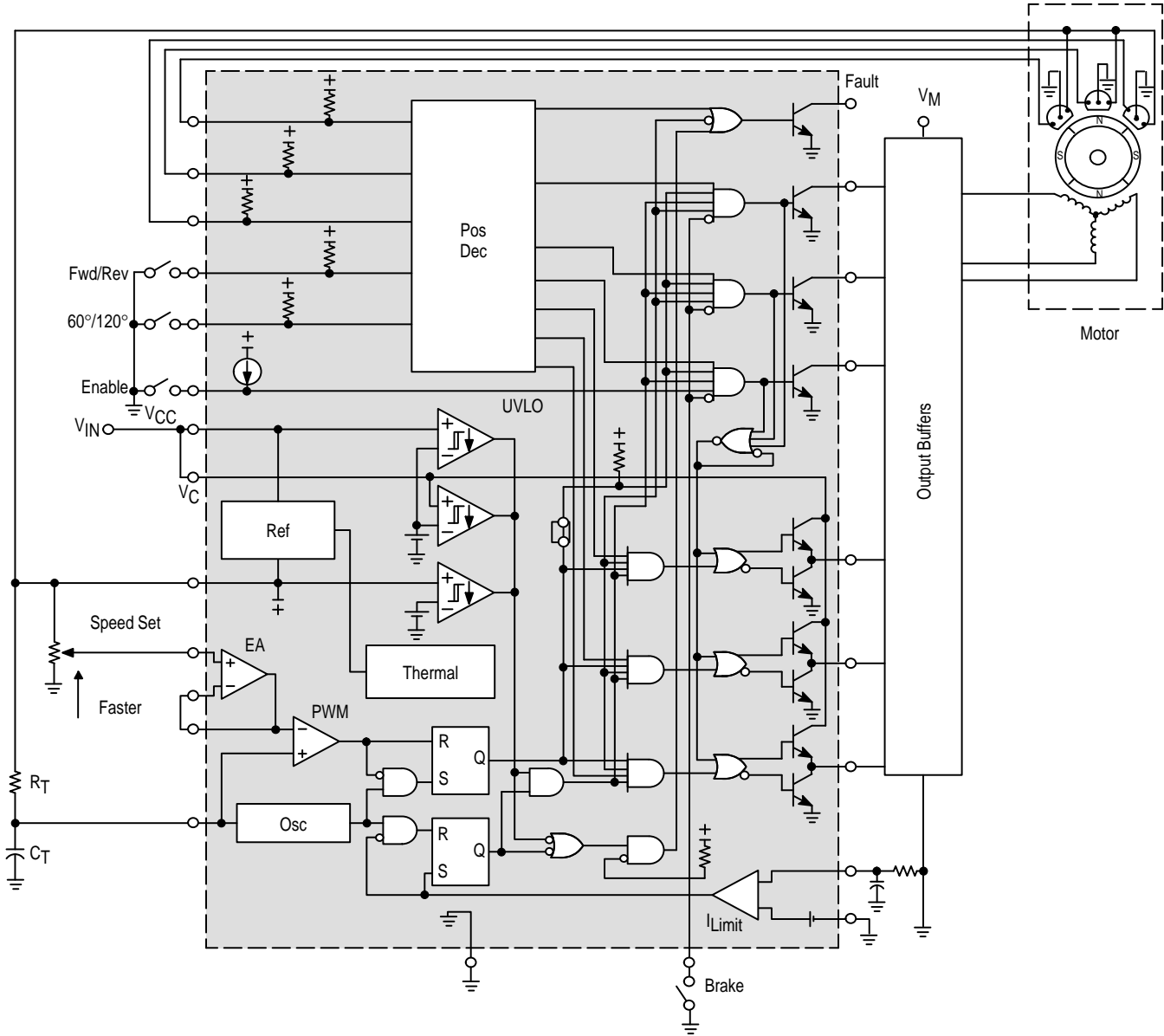
Motor Controllers (continued)

MC33035P, DW

$T_A = -40^\circ$ to $+85^\circ\text{C}$, Case 724, 751E

The MC33035 is a second generation high performance brushless dc motor controller which contains all of the active functions required to implement a full featured open loop motor control system. While being pin-compatible with an earlier device, the MC33035 offers additional features at a lower price. The two additional features provided by the MC33035 are a pin which allows the user to select $60^\circ/300^\circ$

or $120^\circ/240^\circ$ sensor electrical phasings, and access to both inverting and noninverting inputs of the current sense comparator. The earlier devices had two part numbers which were needed to support the different sensor phasings, and the inverting input to the current sense comparator was internally grounded. All of the control and protection features of the earlier device are also provided in the MC33035.



Motor Controllers (continued)

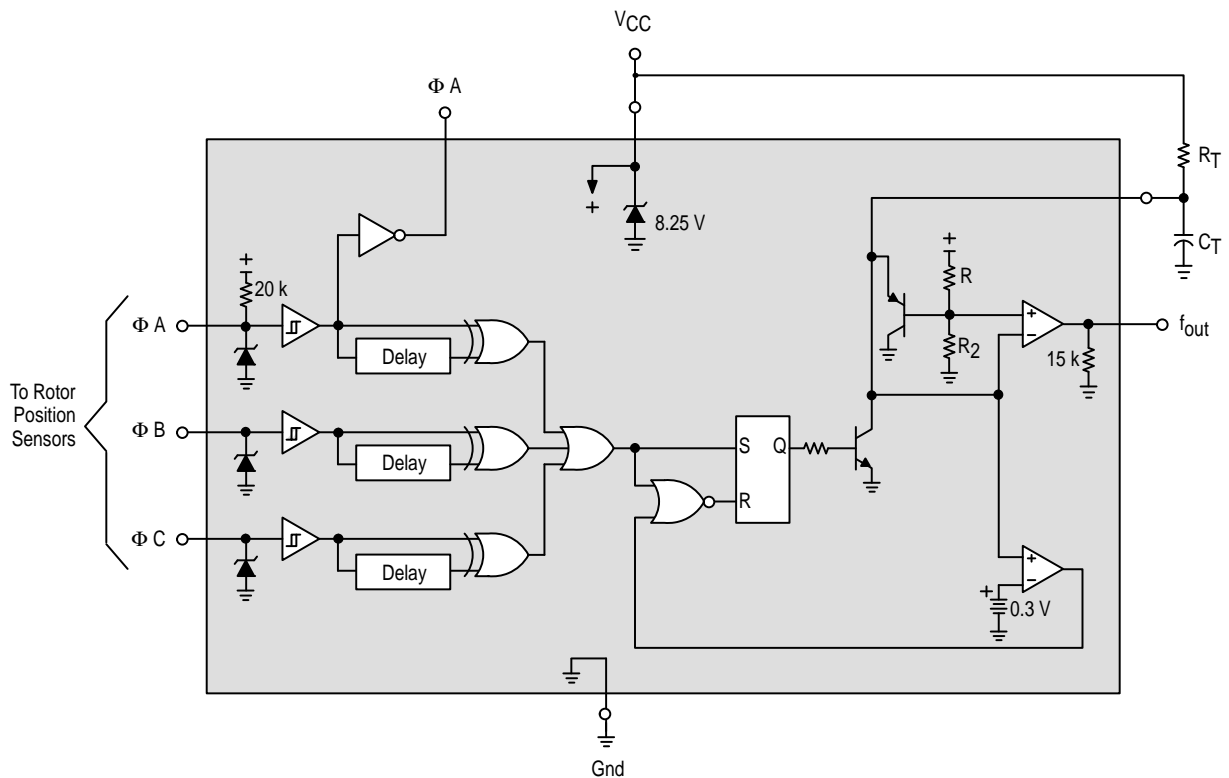
Closed Loop Brushless Motor Adapter

MC33039P, D

$T_A = -40^\circ$ to $+85^\circ\text{C}$, Case 626, 751

The MC33039 is a high performance close loop speed control adapter specifically designed for use in brushless dc motor control systems. Implementation will allow precise speed regulation without the need for a magnetic or optical tachometer. These devices contain three input buffers each with hysteresis for noise immunity, three digital edge

detectors, a programmable monostable, and an internal shunt regulator. Also included is an inverter output for use in systems that require conversion of sensor phasing. Although this device is primarily intended for use with the MC33033/35 brushless motor controllers, it can be used cost effectively in many other closed loop speed control applications.



Motor Controllers (continued)

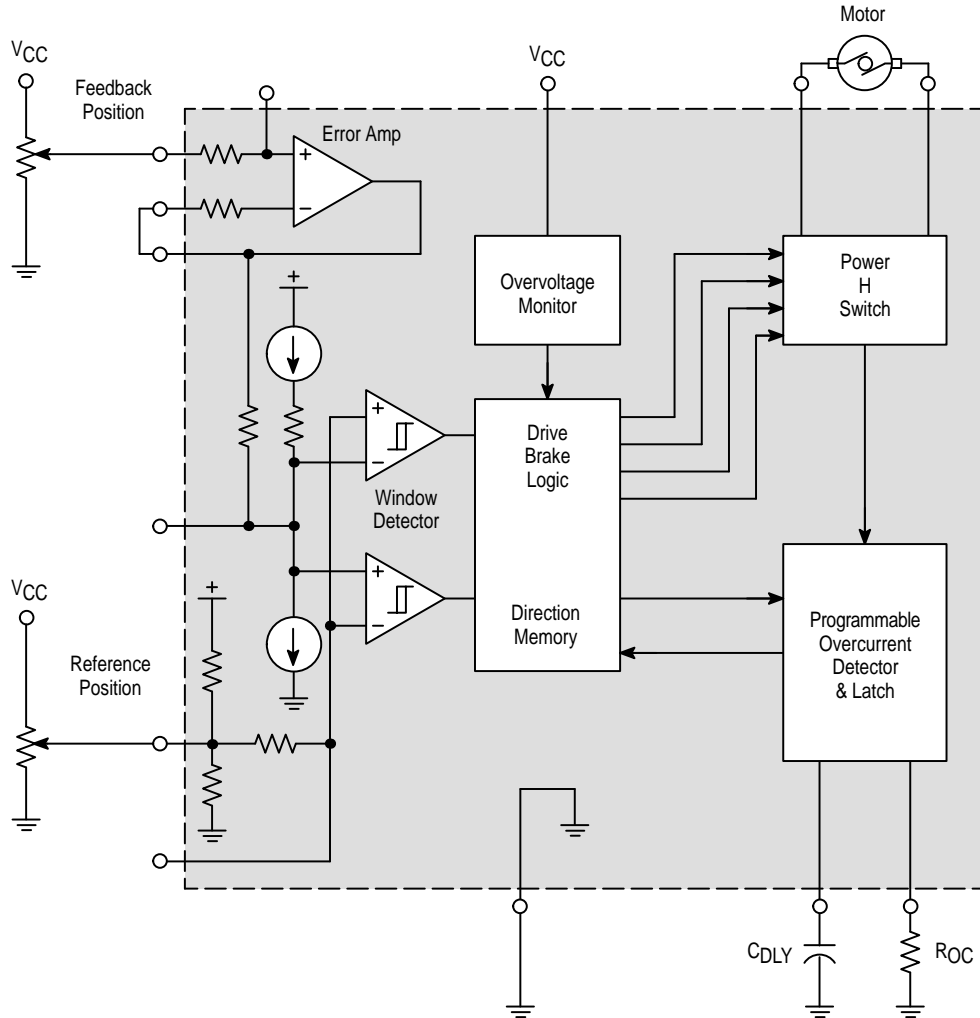
DC Servo Motor Controller/Driver

MC33030P, DW

$T_A = -40^\circ$ to $+85^\circ\text{C}$, Case 648C, 751G

A monolithic dc servo motor controller providing all active functions necessary for a complete closed loop system. This device consists of an on-chip op amp and window comparator with wide input common mode range, drive and brake logic with direction memory, a power H switch driver capable of

1.0 A, independently programmable over current monitor and shutdown delay, and over voltage monitor. This part is ideally suited for almost any servo positioning application that requires sensing of temperature, pressure, light, magnetic flux, or any other means that can be converted to a voltage.



Motor Controllers (continued)

Stepper Motor Driver

MC3479P, FN

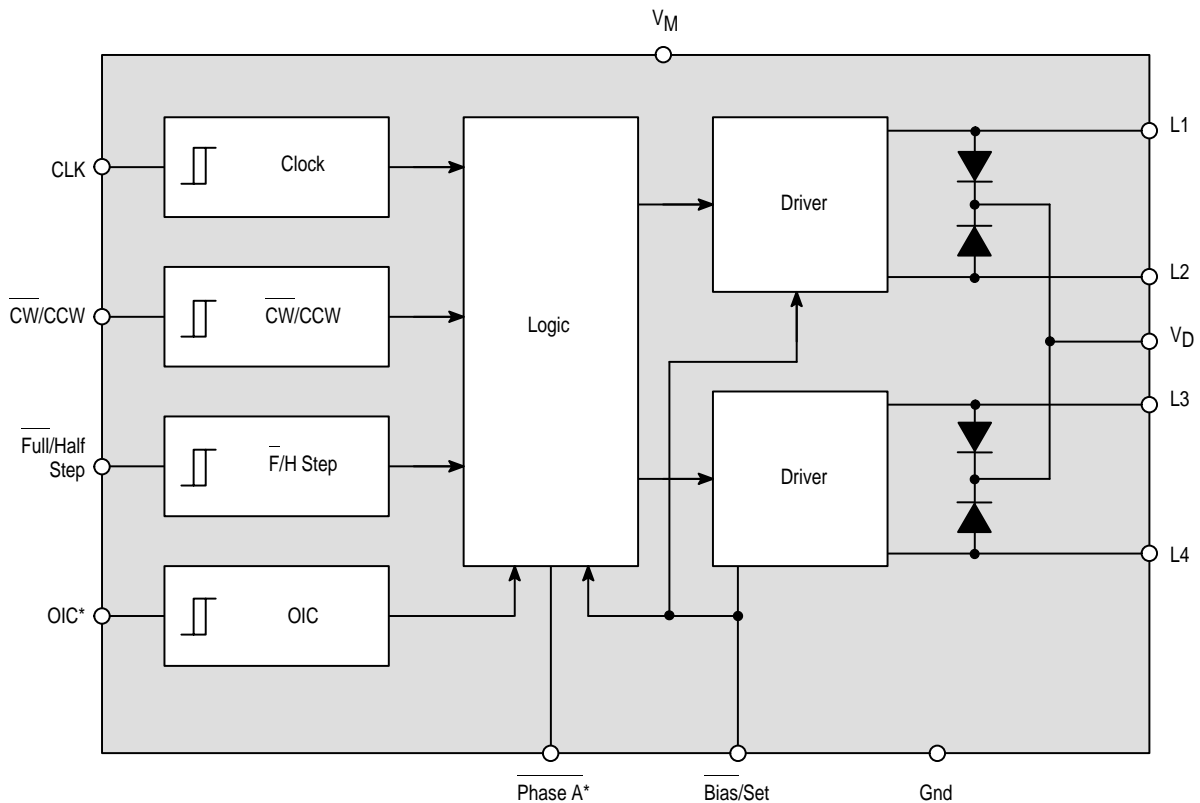
$T_A = 0^\circ$ to $+70^\circ\text{C}$, Case 648C, 775

SAA1042V

$T_A = -30^\circ$ to $+125^\circ\text{C}$, Case 648C

These Stepper Motor Drivers provide up to 500 mA of drive per coil for two phase 6.0 V to 24 V stepper motors. Control logic is provided to accept commands for clockwise, counter

clockwise and half or full step operation. The MC3479 has an added Output Impedance Control (OIC) and a Phase A drive state indicator (not available on SAA1042 devices).



* MC3479 Only

Motor Controllers (continued)

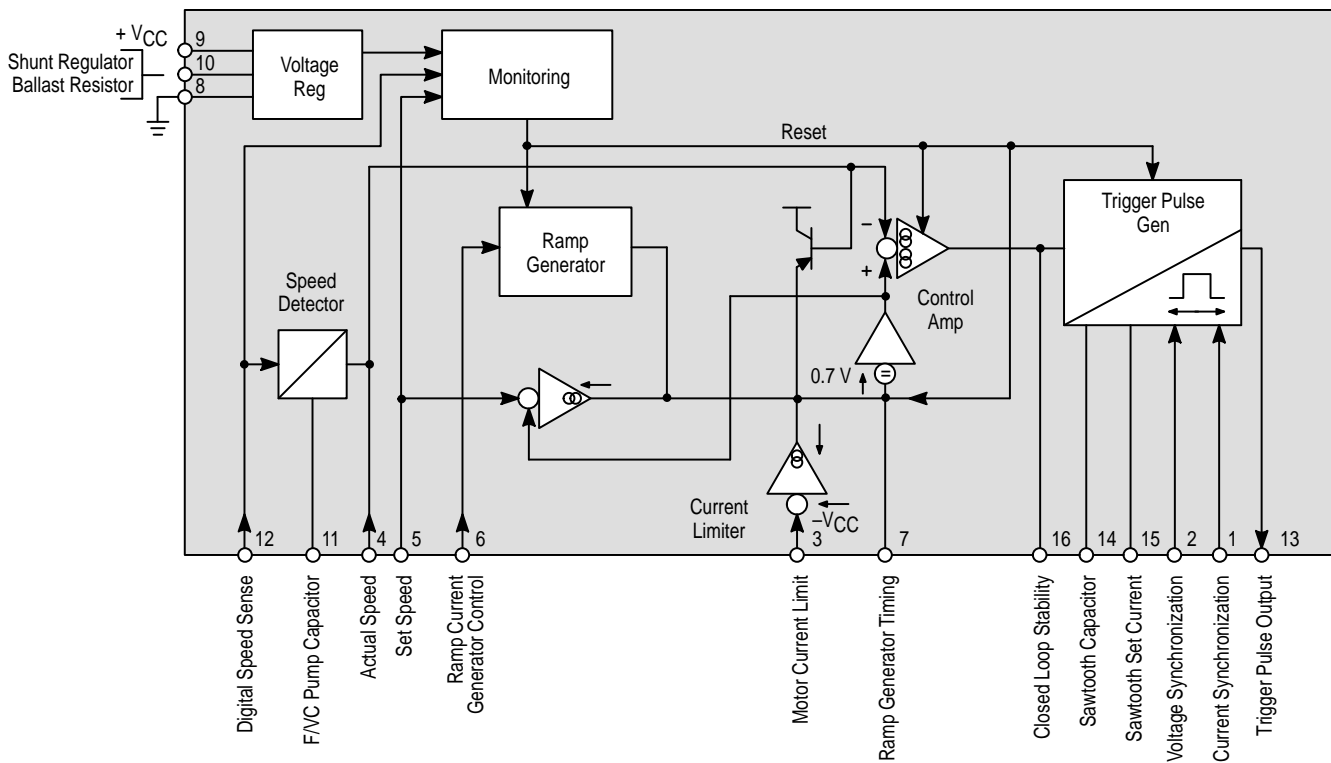
Universal Motor Speed Controller

TDA1085C, CD

$T_A = -10^\circ$ to $+120^\circ\text{C}$, Case 648, 751B

The TDA1085C is a phase angle triac controller having all the necessary functions for universal motor speed control in washing machines. It operates in closed loop configuration and provides two ramp possibilities.

- On-Chip Frequency to Voltage Converter
- On-Chip Ramps Generator
- Soft Start
- Load Current Limitation
- Tachogenerator Circuit Sensing
- Direct Supply from AC Line
- Security Functions Performed by Monitor



Power/Motor Control Circuits Package Overview

