

High- or Low-Side MOSFET Drivers

Features

- 2.75V to 30V Operation
- 100 μ A Maximum Supply Current (5V Supply)
- 15 μ A Typical Off-State Current
- Internal Charge Pump
- TTL-Compatible Input
- Withstands 60V Transient (Load Dump)
- Reverse Battery Protection to -20 V
- Inductive Spike Protection to -20 V
- Overvoltage Shutdown at 35V
- Internal 15V Gate Protection
- Minimum External Parts
- Operates in High-Side or Low-Side Configurations
- 1 μ A Control Input Pull-Off
- Inverting and Non-Inverting Versions

Applications

- Automotive Electrical Load Control
- Battery-Powered Computer Power Management
- Lamp Control
- Heater Control
- Motor Control
- Power Bus Switching

General Description

The MIC5014 and MIC5015 MOSFET drivers are designed for gate control of N-channel, enhancement-mode, power MOSFETs used as high-side or low-side switches. The MIC5014/5 can sustain an on-state output indefinitely.

The MIC5014/5 operate from a 2.75V to 30V supply. In high-side configurations, the driver can control MOSFETs that switch loads of up to 30V. In low-side configurations, with separate supplies, the maximum switched voltage is limited only by the MOSFET.

The MIC5014/5 have a TTL-compatible control input. The MIC5014 is non-inverting, while the MIC5015 is inverting.

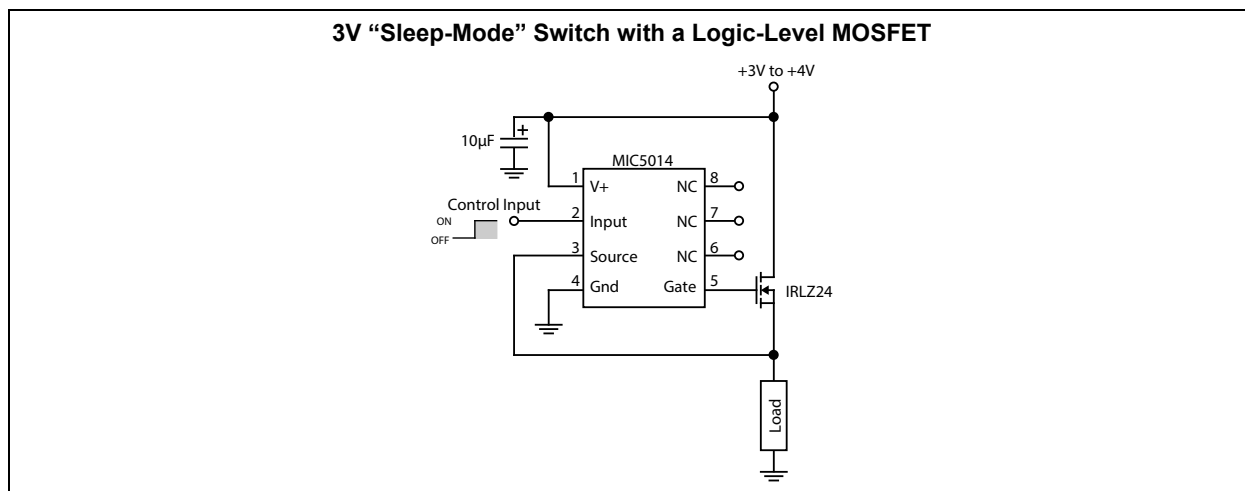
The MIC5014/5 feature an internal charge pump that can sustain a gate voltage greater than the available supply voltage. The driver is capable of turning on a logic-level MOSFET from a 2.75V supply or a standard MOSFET from a 5V supply. The gate-to-source output voltage is internally limited to approximately 15V.

The MIC5014/5 is protected against automotive load dump, reversed battery, and inductive load spikes of -20 V. The driver's overvoltage shutdown feature turns off the external MOSFET at approximately 35V to protect the load against power supply excursions.

The MIC5014 is an improved pin-for-pin compatible replacement in many MIC5011 applications.

The MIC5014/5 is available in plastic 8-pin DIP and 8-pin SOIC packages.

Typical Application Circuit



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage	–20V to +60V
Input Voltage	–20V to V^+
Source Voltage.....	–20V to V^+
Source Current.....	50 mA
Gate Voltage	–20V to +50V

Operating Ratings ‡

Supply Voltage (V^+).....	+2.75V to +30V
-------------------------------	----------------

† **Notice:** Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

‡ **Notice:** The device is not guaranteed to function outside its operating ratings. The MIC5014/5 are ESD sensitive.

ELECTRICAL CHARACTERISTICS

Electrical Characteristics: $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, unless noted. [Note 1](#)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions	
Supply Current		—	10	25	μA	$V^+ = 30\text{V}$	V_{IN} deasserted, Note 3
		—	5.0	10	mA		V_{IN} asserted, Note 3
		—	10	25	μA	$V^+ = 5\text{V}$	V_{IN} deasserted
		—	60	100			V_{IN} asserted
		—	10	25	μA	$V^+ = 3\text{V}$	V_{IN} deasserted
		—	25	35			V_{IN} asserted
Logic Input Voltage Threshold	V_{IN}	—	—	0.8	V	$3.0\text{V} \leq V^+ \leq 30\text{V}$ $T_A = 25^{\circ}\text{C}$	Digital low level
		2.0	—	—			Digital high level
Logic Input Current MIC5014 (Non-Inverting)		–2.0	0	—	μA	$3.0\text{V} \leq V^+ \leq 30\text{V}$	V_{IN} low
		—	1.0	2.0			V_{IN} high
Logic Input Current MIC5015 (Inverting)		–2.0	–1.0	—	μA	$3.0\text{V} \leq V^+ \leq 30\text{V}$	V_{IN} low
		—	–1.0	2.0			V_{IN} high
Input Capacitance	C_{IN}	—	5.0	—	pF	—	
Gate Enhancement $V_{\text{GATE}} - V_{\text{SUPPLY}}$		4.0	—	17	V	$3.0\text{V} \leq V^+ \leq 30\text{V}$	V_{IN} asserted
Zener Clamp $V_{\text{GATE}} - V_{\text{SOURCE}}$		13	15	17	V	$8.0\text{V} \leq V^+ \leq 30\text{V}$	V_{IN} asserted
Gate Turn-On Time, Note 2	t_{ON}	—	2.5	8.0	ms	$V^+ = 4.5\text{V}$ $C_L = 1000\text{ pF}$	V_{IN} switched on, measure time for V_{GATE} to reach $V^+ + 4\text{V}$
		—	90	140	μs	$V^+ = 12\text{V}$ $C_L = 1000\text{ pF}$	V_{IN} switched on, measure time for V_{GATE} to reach $V^+ + 4\text{V}$

MIC5014/5

ELECTRICAL CHARACTERISTICS (CONTINUED)

Electrical Characteristics: $T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, unless noted. [Note 1](#)

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions	
Gate Turn-Off Time, Note 2	t_{OFF}	—	6.0	30	μs	$V^+ = 4.5\text{V}$ $C_L = 1000\text{ pF}$	V_{IN} switched on, measure time for V_{GATE} to reach 1V
		—	6.0	30		$V^+ = 12\text{V}$ $C_L = 1000\text{ pF}$	V_{IN} switched on, measure time for V_{GATE} to reach 1V
Overvoltage Shutdown Threshold		35	37	41	V	—	

Note 1: Minimum and maximum Electrical Characteristics are 100% tested at $T_A = 25^{\circ}\text{C}$ and $T_A = 85^{\circ}\text{C}$, and 100% guaranteed over the entire operating temperature range. Typical values are characterized at 25°C and represent the most likely parametric norm.

2: Test conditions reflect worst case high-side driver performance. Low-side and bootstrapped topologies are significantly faster. See the [Application Information](#) section.

3: “Asserted” refers to a logic high on the MIC5014 and a logic low on the MIC5015.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Maximum Junction Temperature	$T_{\text{J(MAX)}}$	—	—	+150	$^{\circ}\text{C}$	—
Ambient Operating Temperature Range	T_A	−40	—	+85	$^{\circ}\text{C}$	—
Storage Temperature	T_S	−65	—	+150	$^{\circ}\text{C}$	—
Lead Temperature	T_{LEAD}	—	—	+260	$^{\circ}\text{C}$	Soldering, 10 sec.
Package Thermal Resistances						
Thermal Resistance, PDIP 8-Ld	θ_{JA}	—	160	—	$^{\circ}\text{C/W}$	—
Thermal Resistance, SOIC 8-Ld	θ_{JA}	—	170	—	$^{\circ}\text{C/W}$	—

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

All data measured using FET probe to minimize resistive loading.

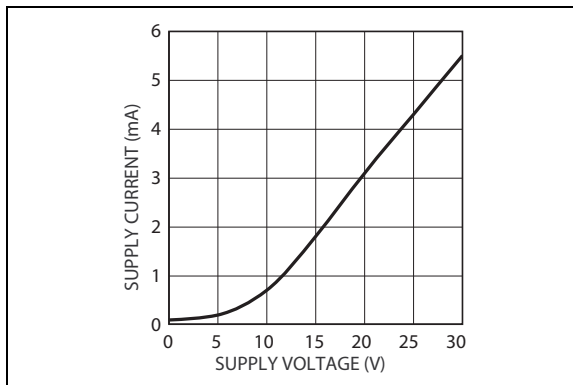


FIGURE 2-1: Supply Current (Output Asserted).

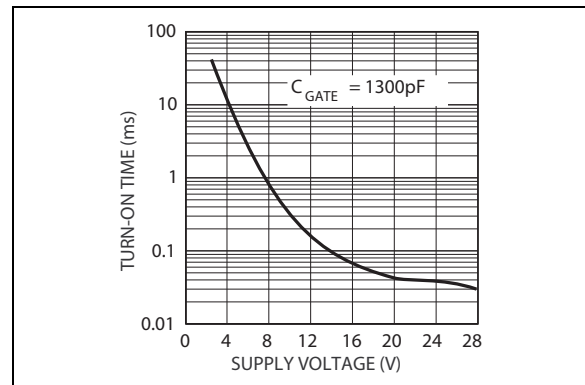


FIGURE 2-4: High-Side Turn-On Time Until Gate Supply Equals Supply + 4V.

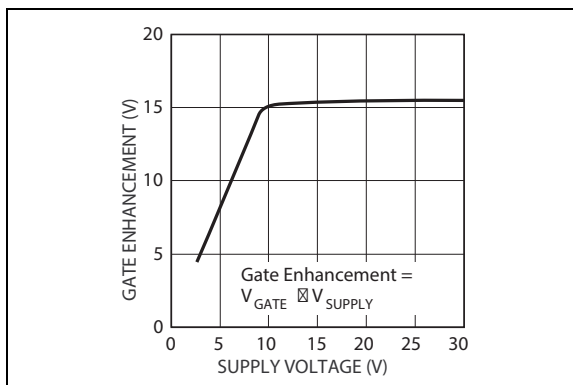


FIGURE 2-2: Gate Enhancement vs. Supply Voltage.

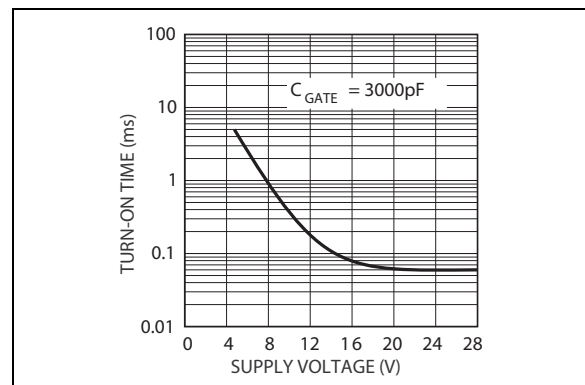


FIGURE 2-5: High-Side Turn-On Time Until Gate Supply Equals Supply + 4V.

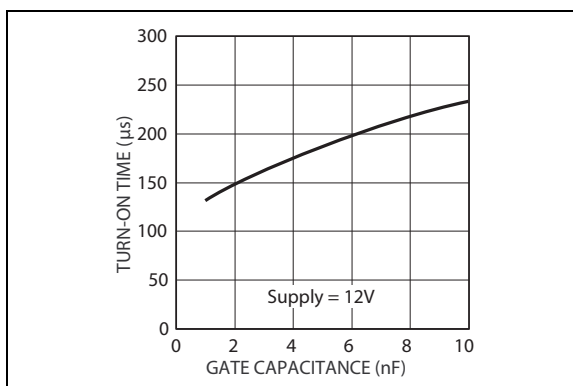


FIGURE 2-3: High-Side Turn-On Time vs. Gate Capacitance.

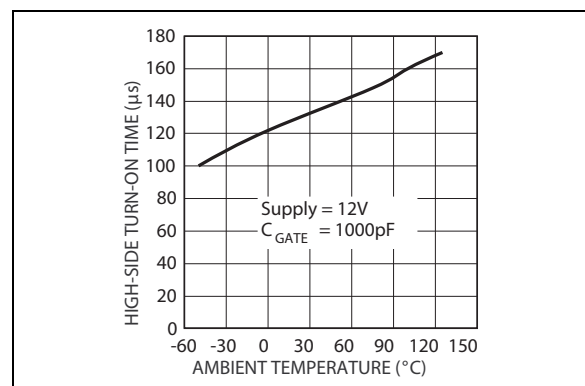


FIGURE 2-6: High-Side Turn-On Time vs. Temperature.

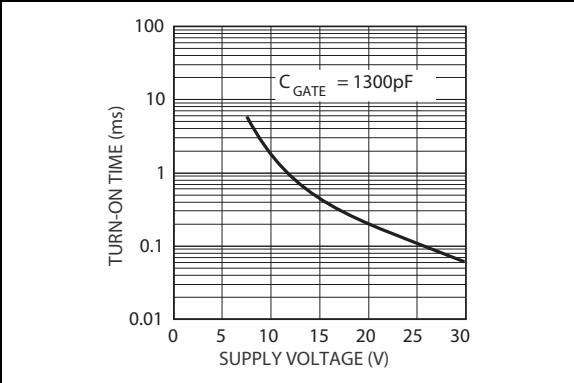


FIGURE 2-7: High-Side Turn-On Time Until Gate Supply Equals Supply + 10V.

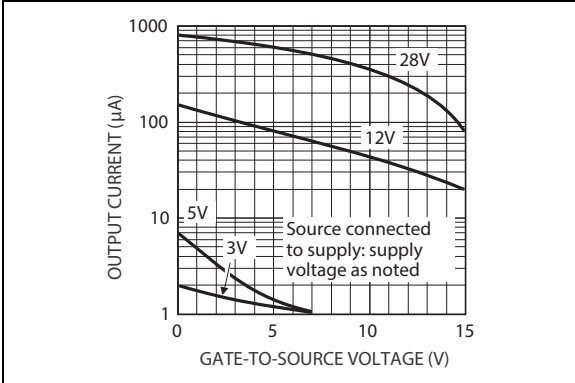


FIGURE 2-10: Charge-Pump Output Current.

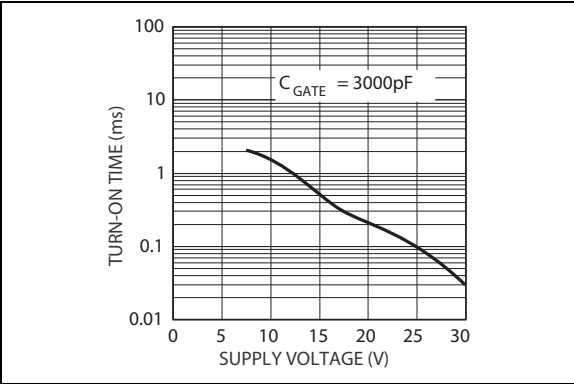


FIGURE 2-8: High-Side Turn-On Time Until Gate Supply Equals Supply + 10V.

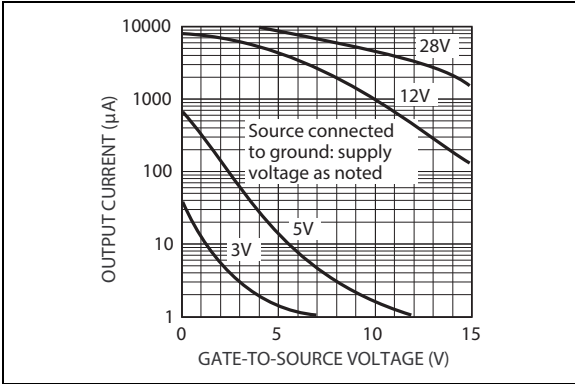


FIGURE 2-11: Charge-Pump Output Current.

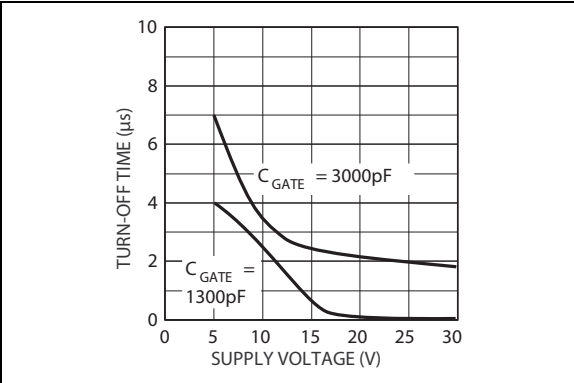


FIGURE 2-9: High-Side Turn-Off Time Until Gate Equals 1V.

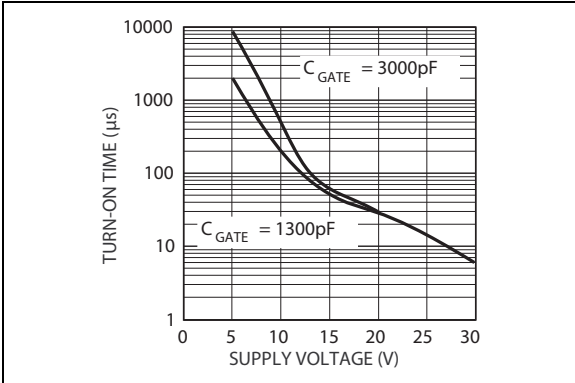


FIGURE 2-12: Low-Side Turn-On Time Until Gate Equals 4V.

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 3-1](#).

TABLE 3-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	V ⁺	Supply. Must be decoupled to isolate from large transients caused by the power MOSFET drain. 10 μ F is recommended close to Pins 1 and 4.
2	Input	Turns on power MOSFET when taken above (or below) threshold (1.0V typical). Pin 2 requires \sim 1 μ A to switch.
3	Source	Connects to source lead of power MOSFET and is the return for the gate clamp zener. Pin 3 can safely swing to -20 V when turning off inductive loads.
4	Ground	Ground.
5	Gate	Drives and clamps the gate of the power MOSFET.
6, 7, 8	NC	Not internally connected.

4.0 APPLICATION INFORMATION

4.1 Functional Description

The MIC5014 is functionally and pin-for-pin compatible with the MIC5011, except for the omission of the optional speedup capacitor pins, which are available on the MIC5011. The MIC5015 is an inverting configuration of the MIC5014.

The internal functions of these devices are controlled via a logic block (refer to the [Functional Block Diagram](#)) connected to the control input (Pin 2). When the input is off (low for the MIC5014, and high for the MIC5015), all functions are turned off, and the gate of the external power MOSFET is held low via two N-channel switches. This results in a very low standby current; 15 μ A typical, which is necessary to power an internal bandgap. When the input is driven to the "ON" state, the N-channel switches are turned off, the charge pump is turned on, and the P-channel switch between the charge pump and the gate turns on, allowing the gate of the power FET to be charged. The op amp and internal zener form an active regulator that shuts off the charge pump when the gate voltage is high enough. This is a feature not found on the MIC5011.

The charge pump incorporates a 100 kHz oscillator and on-chip pump capacitors capable of charging a 1,000 pF load in 90 μ s typical. In addition to providing active regulation, the internal 15V zener is included to prevent exceeding the V_{GS} rating of the power MOSFET at high supply voltages.

The MIC5014/5 devices have been improved for greater ruggedness and durability. All pins can withstand being pulled 20V below ground without sustaining damage, and the supply pin can withstand an overvoltage transient of 60V for 1 second. An overvoltage shutdown has also been included, which turns off the device when the supply exceeds 35V.

4.2 Construction Hints

High current pulse circuits demand equipment and assembly techniques that are more stringent than normal, low current lab practices. The following are the sources of pitfalls most often encountered during prototyping:

Supplies: Many bench power supplies have poor transient response. Circuits that are being pulse tested, or those that operate by pulse-width modulation will produce strange results when used with a supply that has poor ripple rejection, or a peaked transient response. Always monitor the power supply voltage that appears at the drain of a high-side driver (or the supply side of the load for a low-side driver) with an oscilloscope. It is not uncommon to find bench power supplies in the 1 kW class that overshoot or undershoot by as much as 50% when pulse loaded. Not only will the load current and voltage measurements be

affected, but it is possible to over stress various components, especially electrolytic capacitors, with possibly catastrophic results. A 10 μ F supply bypass capacitor at the chip is recommended.

Residual Resistances: Resistances in circuit connections may also cause confusing results. For example, a circuit may employ a 50 m Ω power MOSFET for low voltage drop, but unless careful construction techniques are used, one could easily add 50 m Ω to 100 m Ω resistance. Do not use a socket for the MOSFET. If the MOSFET is a TO-220 type package, make high current connections to the drain tab. Wiring losses have a profound effect on high-current circuits. A floating milliohmeter can identify connections that are contributing excess drop under load.

4.3 Low Voltage Testing

As the MIC5014/5 have relatively high output impedances, a normal oscilloscope probe will load the device. This is especially pronounced at low voltage operation. It is recommended that a FET probe or unity gain buffer be used for all testing.

4.4 Circuit Topologies

The MIC5014 and MIC5015 are well suited for use with standard power MOSFETs in both low- and high-side driver configurations. In addition, the lowered supply voltage requirements of these devices make them ideal for use with logic level FETs in high-side applications with a supply voltage of 3V to 4V. (If higher supply voltages [>4 V] are used with logic level FETs, an external zener clamp must be supplied to ensure that the maximum V_{GS} rating of the logic FET [10V] is not exceeded.) In addition, a standard IGBT can be driven using these devices.

Choice of one topology over another is usually based on speed vs. safety. The fastest topology is the low side driver, however, it is not usually considered as safe as high-side driving as it is easier to accidentally short a load to ground than to V_{CC} . The slowest, but safest topology is the high-side driver; with speed being inversely proportional to supply voltage. It is the preferred topology for most military and automotive applications. Speed can be improved considerably by bootstrapping from the supply.

All topologies implemented using these devices are well suited to driving inductive loads, as either the gate or the source pin can be pulled 20V below ground with no effect. External clamp diodes are unnecessary, except for the case in which a transient may exceed the overvoltage trip point.

High-Side Driver ([Typical Application Circuit](#)) The high-side topology shown here is an implementation of a "sleep-mode" switch for a laptop or notebook

computer which uses a logic level FET. A standard power FET can easily be substituted when supply voltages above 4V are required.

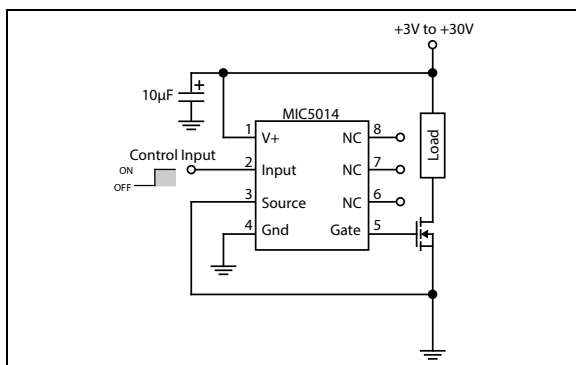


FIGURE 4-1: Low-Side Driver

Low-Side Driver (Figure 4-1) A key advantage of this topology, as previously mentioned, is speed. The MOSFET gate is driven to near supply immediately when the MIC5014/5 are turned on. Typical circuits reach full enhancement in 50 µs or less with a 15V supply.

Bootstrapped High-Side Driver (Figure 4-2) The turn-on time of a high-side driver can be improved to faster than 40 µs by bootstrapping the supply with the MOSFET source. The Schottky barrier diode prevents the supply pin from dropping more than 200 mV below the drain supply and improves turn-on time. Because the supply current in the “off” state is only a small leakage, the 100 nF bypass capacitor tends to remain charged for several seconds after the MIC5014/5 are turned off. Faster speeds can be obtained at the expense of supply voltage (the overvoltage shutdown will turn the part off when the bootstrapping action pulls the supply pin above 35V) by using a larger capacitor at the junction of the two 1N4001 diodes. In a PWM application (this circuit can be used for either pulse-width modulated or continuously energized loads), the chip supply is sustained at a higher potential than the system supply, which improves switching time.

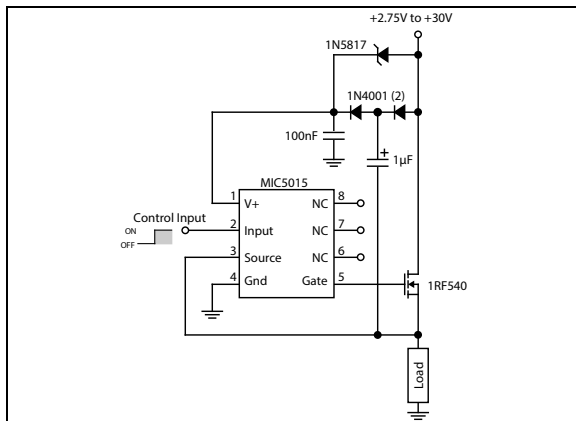


FIGURE 4-2: Bootstrapped High-Side Driver.

High-Side Driver With Current Sense (Figure 4-3)

Although no current sense function is included on the MIC5014/5 devices, a simple current sense function can be created via the addition of one more active component; an LM301A op amp used as a comparator. The positive rail of the op amp is tied to V^+ , and the negative rail is tied to ground. This op amp was chosen as it can withstand having input transients that swing below the negative rail, and has common mode range almost to the positive rail.

The inverting side of this comparator is tied to a voltage divider, which sets the voltage to $V^+ - V_{TRIP}$. The non-inverting side is tied to the node between the drain of the FET and the sense resistor. If the overcurrent trip point is not exceeded, this node will always be pulled above $V^+ - V_{TRIP}$, and the output of the comparator will be high, which feeds the control input of the MIC5014 (polarities should be reversed if the MIC5015 is used). Once the overcurrent trip point has been reached, the comparator will go low, which shuts off the MIC5014. When the short is removed, feedback to the input pin ensures that the MIC5014 will turn back on. This output can also be level shifted and sent to an I/O port of a microcontroller for intelligent control.

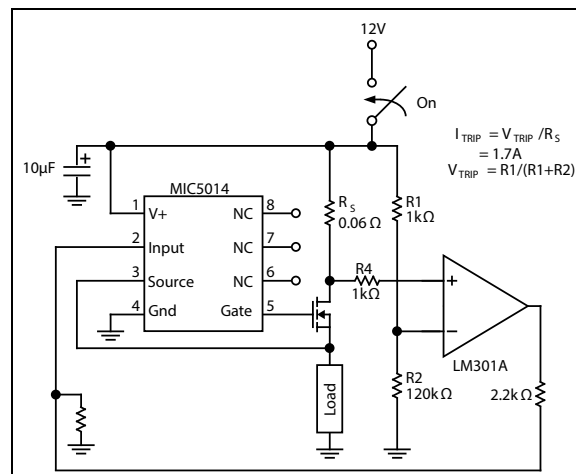


FIGURE 4-3: High-Side Driver with Overcurrent Shutdown.

Current Shunts (R_S) Low valued resistors are necessary for use at R_S . Resistors are available with values ranging from 1 mΩ to 50 mΩ, at 2W to 10W. If a precise overcurrent trip point is not necessary, then a non-precision resistor or even a measured PCB trace can serve as R_S . The major cause of drift in resistor values with such resistors is temperature coefficient; the designer should be aware that a linear, 500 ppm/°C change will contribute as much as 10% shift in the overcurrent trip point. If this is not acceptable, a power resistor designed for current shunt service (drifts less than 100 ppm/°C), or a Kelvin-sensed resistor may be used.

MIC5014/5

High-Side Driver With Delayed Current Sense (Figure 4-4) Delay of the overcurrent detection to accommodate high inrush loads such as incandescent or halogen lamps can be accomplished by adding an LM3905 timer as a one shot to provide an open collector pull-down for the comparator output such that the control input of the MIC5015 stays low for a preset amount of time without interference from the current sense circuitry. Note that an MIC5015 must be used in this application (Figure 4-4), as an inverting control input is necessary. The delay time is set by the RC time constant of the external components on Pins 3 and 4 of the timer; in this case, 6 ms was chosen.

An LM3905 timer was used instead of a 555 as it provides a clean transition, and is almost impossible to make oscillate. Good bypassing and noise immunity is essential in this circuit to prevent spurious op amp oscillations.

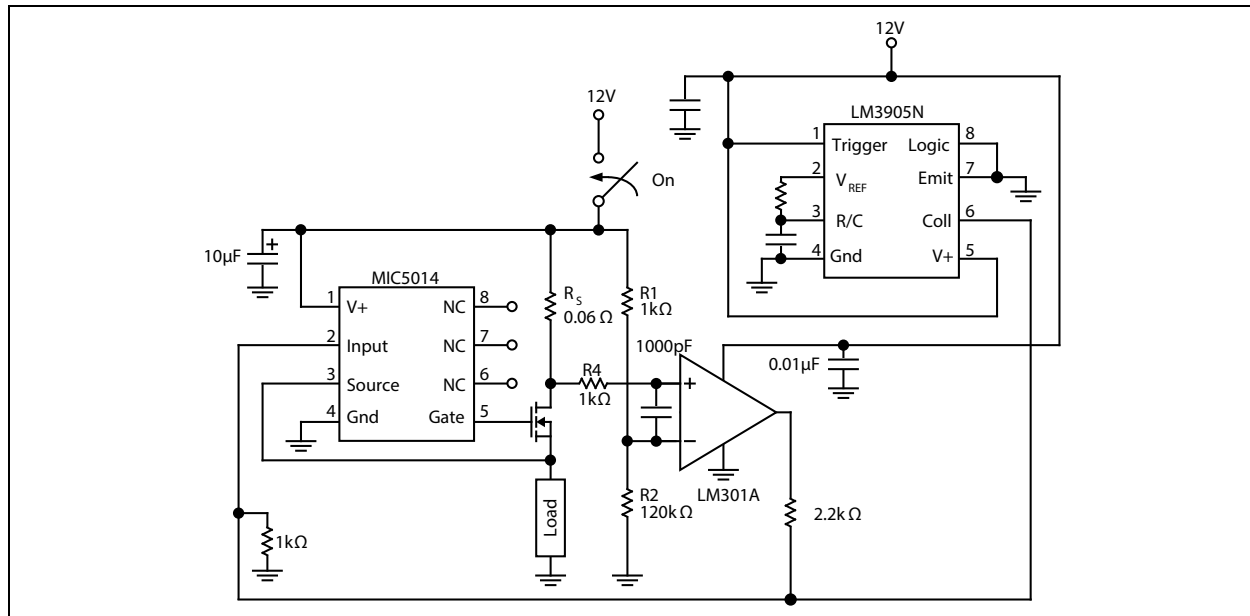


FIGURE 4-4: High-Side Driver with Delayed Overcurrent Shutdown.

4.5 Typical Applications

Variable Supply Low-Side Driver for Motor Speed Control (Figure 4-5) The internal regulation in the MIC5014/5 allows a steady gate enhancement to be supplied while the MIC5014/5 supply varies from 5V to 30V, without damaging the internal gate to source zener clamp. This allows the speed of the DC motor shown to be varied by varying the supply voltage.

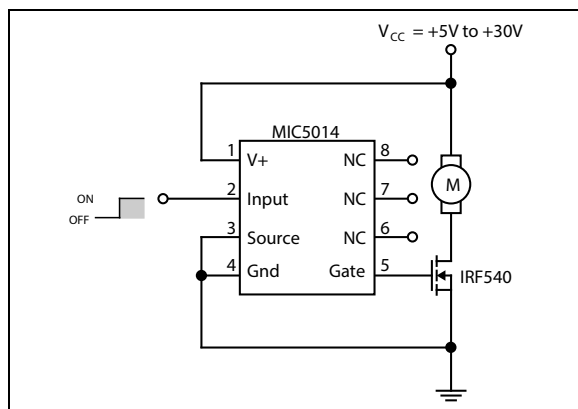


FIGURE 4-5: DC Motor Speed Control/Driver.

Solenoid Valve Driver (Figure 4-6) High power solenoid valves are used in many industrial applications requiring the timed dispensing of chemicals or gases. When the solenoid is activated, the valve opens (or closes), releasing (or stopping) fluid flow. A solenoid valve, like all inductive loads, has a considerable “kickback” voltage when turned off, as current cannot change instantaneously through an inductor. In most applications, it is acceptable to allow this voltage to momentarily turn the MOSFET back on as a way of dissipating the inductor’s current. However, if this occurs when driving a solenoid valve with a fast switching speed, chemicals, or gases may be inadvertently be dispensed at the wrong time with possibly disastrous consequences. Also, too large of a kickback voltage (as is found in larger solenoids) can damage the MIC5014 or the power FET by forcing the Source node below ground (the MIC5014 can be driven up to 20V below ground before this happens). A catch diode has been included in this design to provide an alternate route for the inductive kickback current to flow. The 5 kΩ resistor in series with this diode has been included to set the recovery time of the solenoid valve.

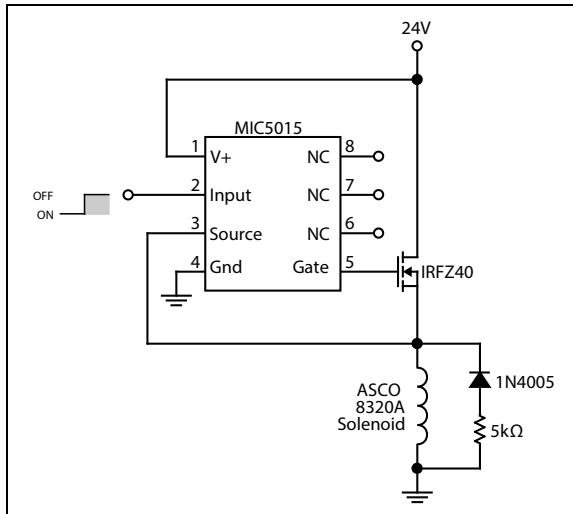


FIGURE 4-6: Solenoid Valve Driver.

Incandescent/Halogen Lamp Driver (Figure 4-7) The combination of an MIC5014/5 and a power FET makes an effective driver for a standard incandescent or halogen lamp load. Such loads often have high inrush currents, as the resistance of a cold filament is less than one-tenth as much as when it is hot. Power MOSFETs are well suited to this application as they have wider safe operating areas than do power bipolar transistors. It is important to check the SOA curve on the data sheet of the power FET to be used against the estimated or measured inrush current of the lamp in question prior to prototyping to prevent “explosive” results.

If overcurrent sense is to be used, first measure the duration of the inrush, then use the topology of Figure 4-4 with the RC of the timer chosen to accommodate the duration with suitable guardbanding.

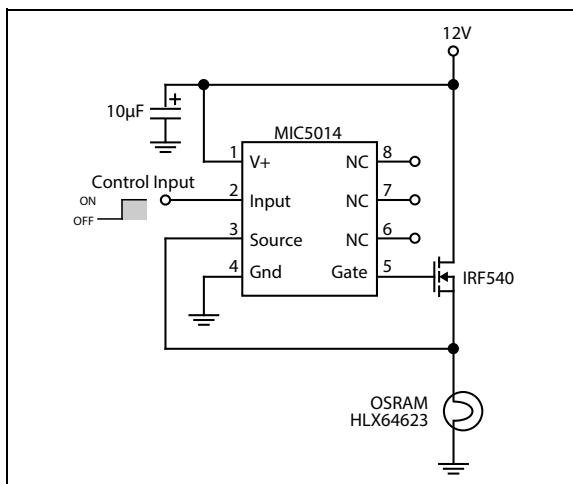


FIGURE 4-7: Halogen Lamp Driver.

Relay Driver (Figure 4-8) Some power relay applications require the use of a separate switch or drive control, such as in the case of microprocessor control of banks of relays where a logic level control signal is used, or for drive of relays with high power requirements. The combination of an MIC5014/5 and a power FET also provides an elegant solution to power relay drive.

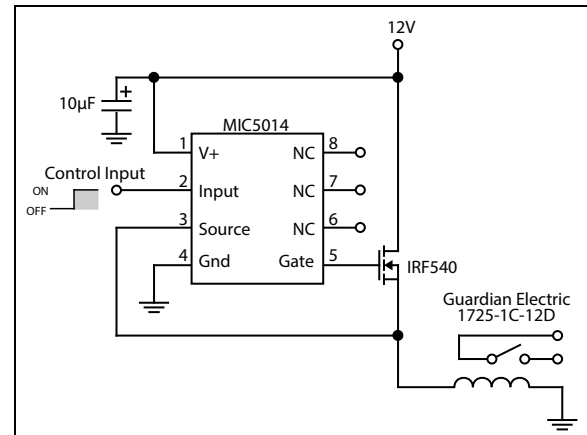


FIGURE 4-8: Relay Driver.

Motor Driver With Stall Shutdown (Figure 4-9) Tachometer feedback can be used to shut down a motor driver circuit when a stall condition occurs. The control switch is a 3-way type; the “START” position is momentary and forces the driver ON. When released, the switch returns to the “RUN” position, and the tachometer’s output is used to hold the MIC5014 input ON. If the motor slows down, the tachometer output is reduced, and the MIC5014 switches OFF. Resistor “R” sets the shutdown threshold.

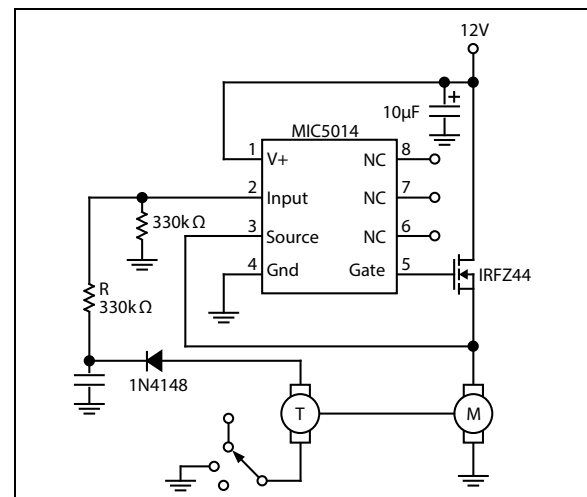


FIGURE 4-9: Motor Stall Shutdown.

MIC5014/5

Simple DC-DC Converter (Figure 4-10) The simplest application for the MIC5014 is as a basic one-chip DC-DC converter. As the output (Gate) pin has a relatively high impedance, the output voltage shown will vary significantly with applied load.

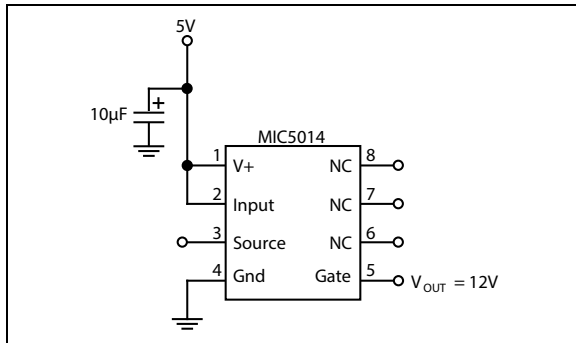


FIGURE 4-10: DC-DC Converter.

High-Side Driver With Load Protection (Figure 4-11) Although the MIC5014/5 devices are reverse battery protected, the load and power FET are not, in a typical high-side configuration. In the event of a reverse battery condition, the internal body diode of the power FET will be forward biased. This allows the reversed supply access to the load.

The addition of a Schottky diode between the supply and the FET eliminates this problem. The MBR2035CT was chosen as it can withstand 20A continuous and 150A peak, and should survive the rigors of an automotive environment. The two diodes are paralleled to reduce switch loss (forward voltage drop).

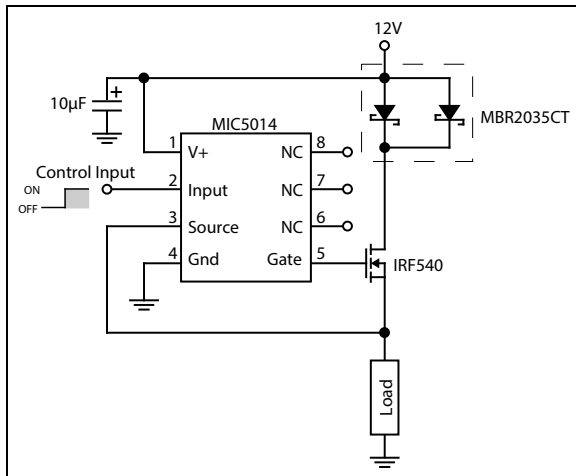


FIGURE 4-11: High-Side Driver with Load Protection.

Push-Pull Driver With No Cross-Conduction (Figure 4-12) As the turn-off time of the MIC5014/5 devices is much faster than the turn-on time, a simple push-pull driver with no cross conduction can be made using one MIC5014 and one MIC5015. The same control signal is applied to both inputs; the MIC5014 turns on with the positive signal, and the MIC5015 turns on when it swings low.

This scheme works with no additional components as the relative time difference between the rise and fall times of the MIC5014 is large. However, this does mean that there is considerable dead-time (time when neither driver is turned on). If this circuit is used to drive an inductive load, catch diodes must be used on each half to provide an alternate path for the kickback current that will flow during this dead-time.

This circuit is also a simple half H-bridge which can be driven with a PWM signal on the input for SMPS or motor drive applications in which high switching frequencies are not desired.

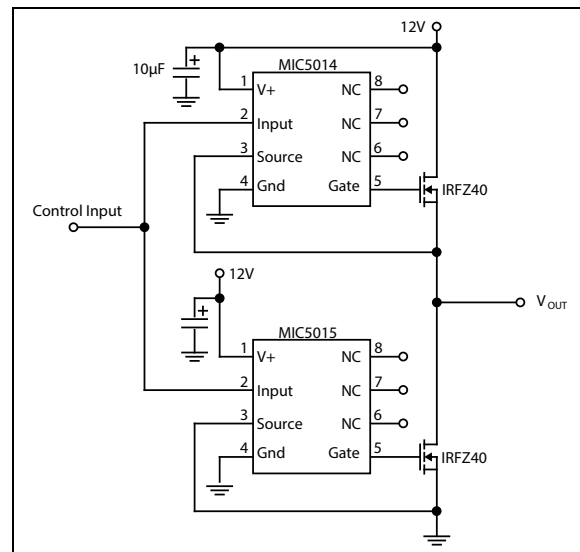
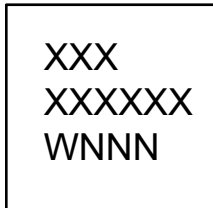


FIGURE 4-12: Push-Pull Driver.

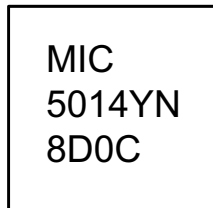
5.0 PACKAGING INFORMATION

5.1 Package Marking Information

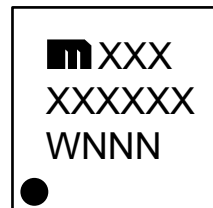
8-Lead PDIP*



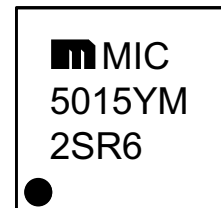
Example



8-Lead SOIC*



Example



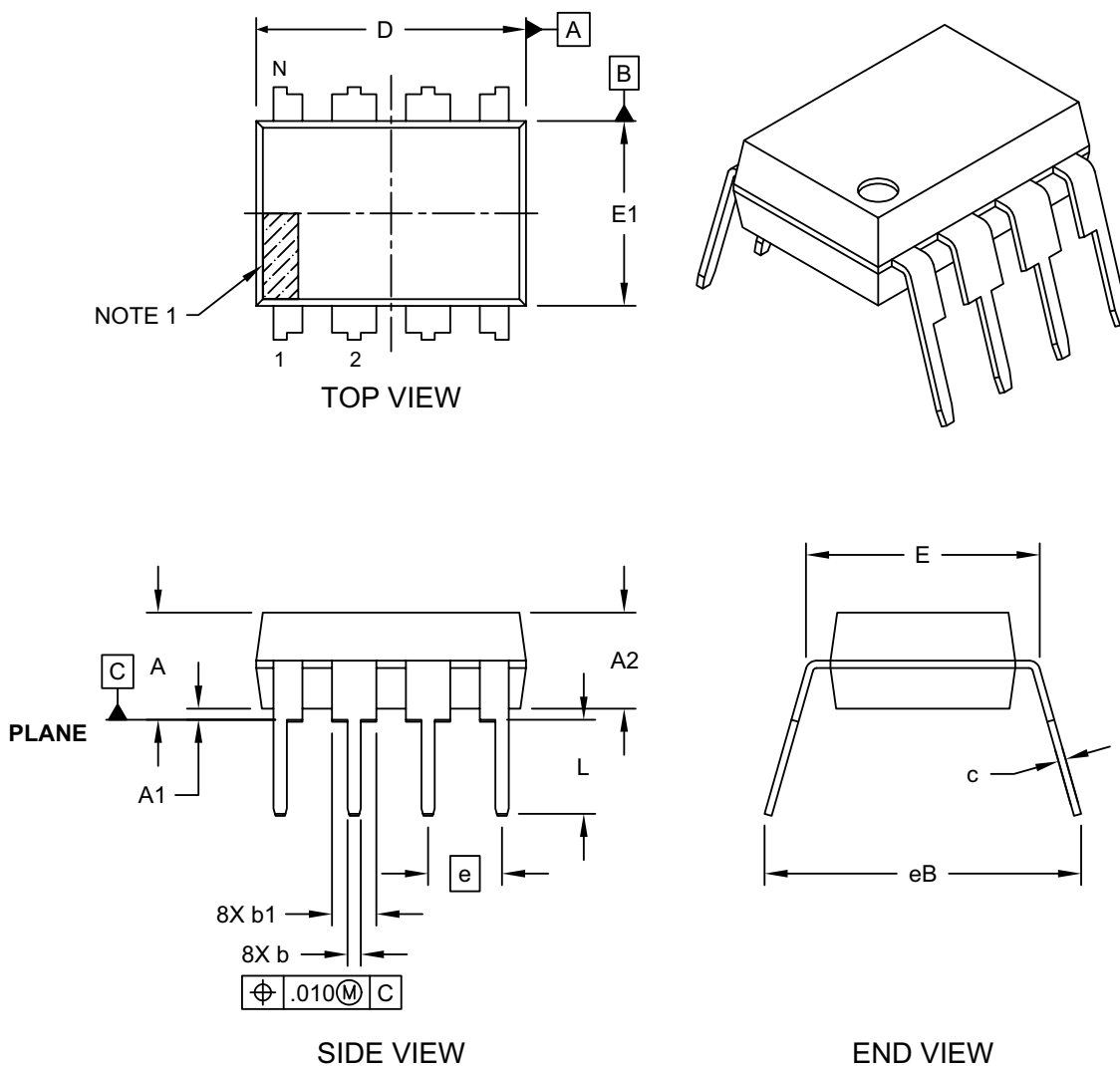
Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	•, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).
Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.		
Underbar (_) symbol may not be to scale.		

Note: If the full seven-character YYWWNNN code cannot fit on the package, the following truncated codes are used based on the available marking space:
 6 Characters = YYWWNNN; 5 Characters = WWNNN; 4 Characters = WNNN; 3 Characters = NNN;
 2 Characters = NN; 1 Character = N

MIC5014/5

8-Lead Plastic Dual In-Line (PA) - 300 mil Body [PDIP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

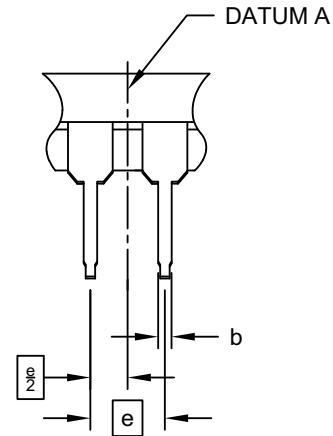
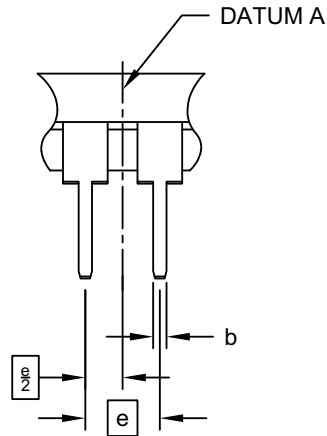


Microchip Technology Drawing No. C04-018-PA Rev F Sheet 1 of 2

8-Lead Plastic Dual In-Line (PA) - 300 mil Body [PDIP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

ALTERNATE LEAD DESIGN (NOTE 5)



Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	.100 BSC		
Top to Seating Plane	A	-	-	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	-	-
Shoulder to Shoulder Width	E	.290	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.348	.365	.400
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.040	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing	§ eB	-	-	.430

Notes:

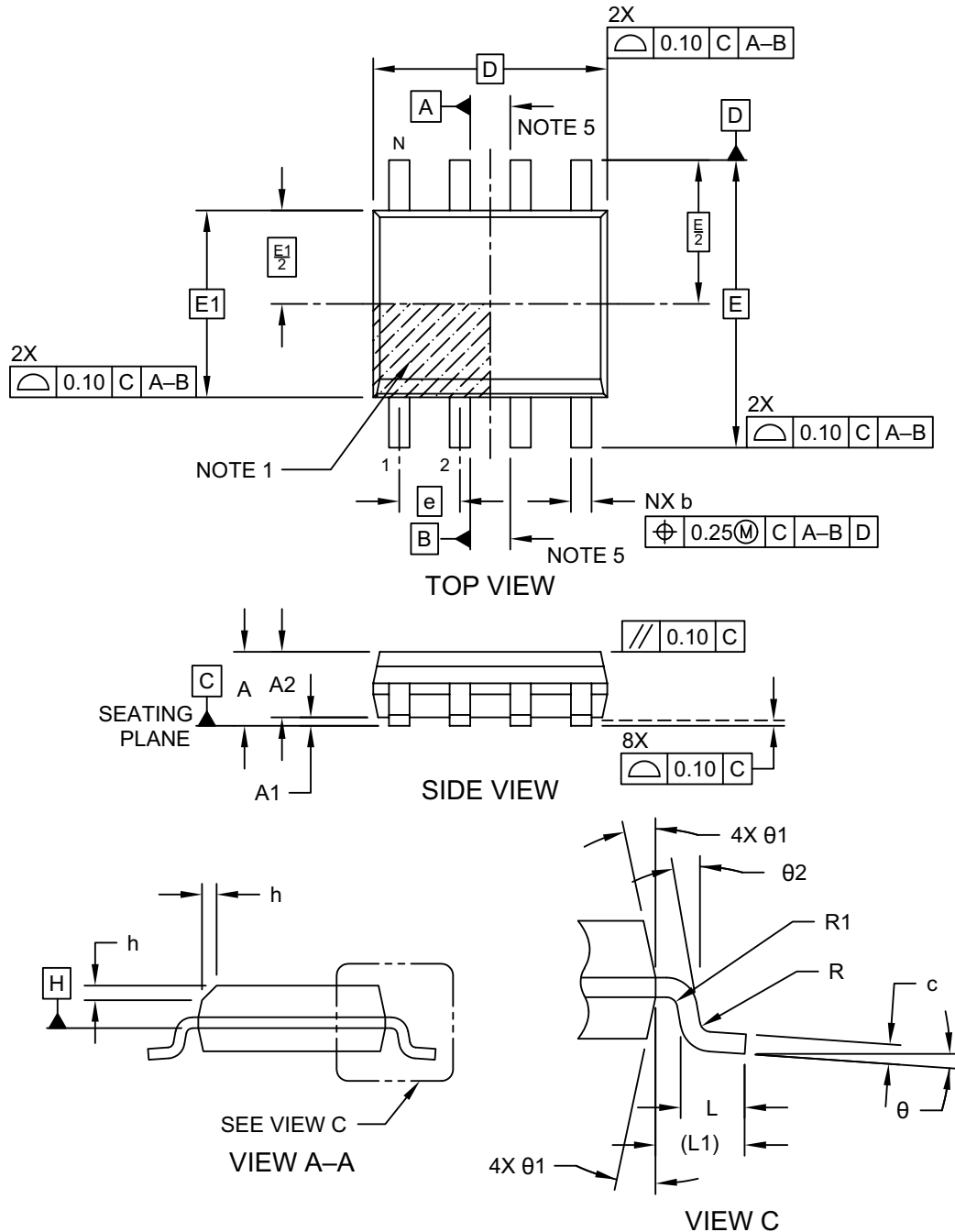
- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
- Dimensioning and tolerancing per ASME Y14.5M
BSC: Basic Dimension. Theoretically exact value shown without tolerances.
- Lead design above seating plane may vary, based on assembly vendor.

Microchip Technology Drawing No. C04-018-PA Rev F Sheet 2 of 2

MIC5014/5

8-Lead Plastic Small Outline (3BX) - Narrow, 3.90 mm (.150 In.) Body [SOIC] Atmel Legacy Global Package Code SWB

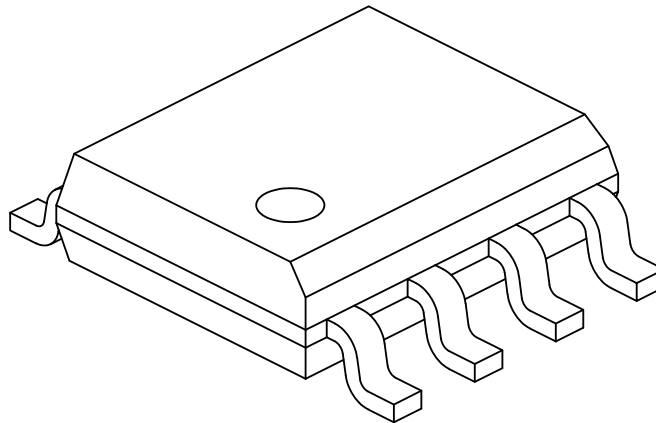
Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Microchip Technology Drawing No. C04-057-3BX Rev K Sheet 1 of 2

8-Lead Plastic Small Outline (3BX) - Narrow, 3.90 mm (.150 In.) Body [SOIC] Atmel Legacy Global Package Code SWB

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



Dimension Limits	Units	MILLIMETERS		
		MIN	NOM	MAX
Number of Pins	N	8		
Pitch	e	1.27 BSC		
Overall Height	A	—	—	1.75
Molded Package Thickness	A2	1.25	—	—
Standoff §	A1	0.10	—	0.25
Overall Width	E	6.00 BSC		
Molded Package Width	E1	3.90 BSC		
Overall Length	D	4.90 BSC		
Chamfer (Optional)	h	0.25	—	0.50
Foot Length	L	0.40	—	1.27
Footprint	L1	1.04 REF		
Lead Thickness	c	0.17	—	0.25
Lead Width	b	0.31	—	0.51
Lead Bend Radius	R	0.07	—	—
Lead Bend Radius	R1	0.07	—	—
Foot Angle	θ	0°	—	8°
Mold Draft Angle	θ1	5°	—	15°
Lead Angle	θ2	0°	—	—

Notes:

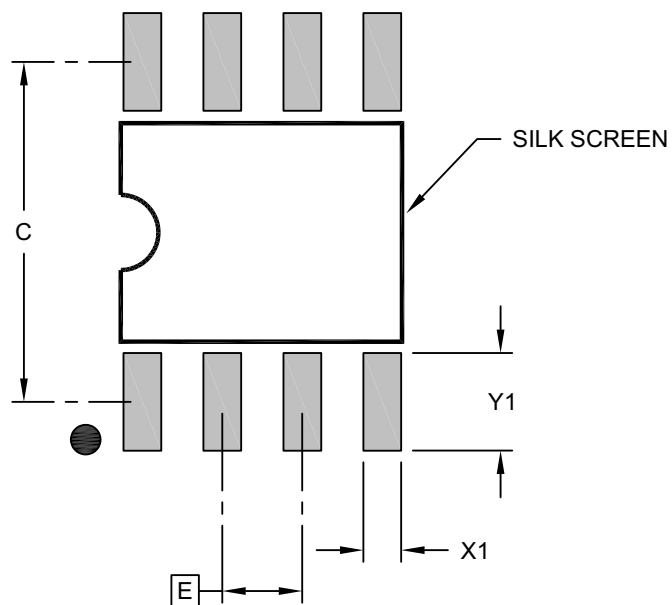
- Pin 1 visual index feature may vary, but must be located within the hatched area.
- § Significant Characteristic
- Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
- Dimensioning and tolerancing per ASME Y14.5M
 - BSC: Basic Dimension. Theoretically exact value shown without tolerances.
 - REF: Reference Dimension, usually without tolerance, for information purposes only.
- Datums A & B to be determined at Datum H.

Microchip Technology Drawing No. C04-057-3BX Rev K Sheet 2 of 2

MIC5014/5

8-Lead Plastic Small Outline (3BX) - Narrow, 3.90 mm (.150 In.) Body [SOIC]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	1.27 BSC		
Contact Pad Spacing	C		5.40	
Contact Pad Width (X8)	X1			0.60
Contact Pad Length (X8)	Y1			1.55

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-2057-3BX Rev K

APPENDIX A: REVISION HISTORY

Revision A (February 2023)

- Converted Micrel document MIC5014/5 to Microchip data sheet DS20006767A.
- Minor text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

<u>Part Number</u>	<u>X</u>	<u>X</u>	<u>[-XX]</u>	Examples:
Device	Temp. Range	Package	Media Type	
Device:	MIC5014:	High- or Low-Side Non-Inverting MOSFET Driver		a) MIC5014YN: MIC5014, -40°C to +85°C Temp. Range, 8-Lead PDIP, 50/Tube
	MIC5015:	High- or Low-Side Inverting MOSFET Driver		b) MIC5014YM-TR: MIC5014, -40°C to +85°C Temp. Range, 8-Lead SOIC, 2,500/Reel
Temperature Range:	Y	= -40°C to +85°C		c) MIC5015YM: MIC5015, -40°C to +85°C Temp. Range, 8-Lead SOIC, 95/Tube
Package:	M	= 8-Lead SOIC		d) MIC5015YN: MIC5015, -40°C to +85°C Temp. Range, 8-Lead PDIP, 50/Tube
	N	= 8-Lead PDIP		Note: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.
Media Type:	<blank>	= 50/Tube (PDIP option only)		
	<blank>	= 95/Tube (SOIC option only)		
	TR	= 2,500/Reel (SOIC option only)		

NOTES:

Note the following details of the code protection feature on Microchip products:

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
 - Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
 - Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
 - Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "unbreakable" Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.
-

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at <https://www.microchip.com/en-us/support/design-help/client-support-services>.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maxStylus, maxTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, Clockstudio, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, IntelliMOS, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, KoD, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, Trusted Time, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2023, Microchip Technology Incorporated and its subsidiaries.

All Rights Reserved.

ISBN: 978-1-6683-1948-2

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC
Tel: 919-844-7510

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto
Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

China - Shenzhen
Tel: 86-755-8864-2200

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Microchip:](#)

[MIC5014YM](#) [MIC5015YN](#) [MIC5015YM](#) [MIC5014YN](#) [MIC5015YM-TR](#) [MIC5014YM-TR](#)