

## 8-Bit Serial-Input Latched Source Driver

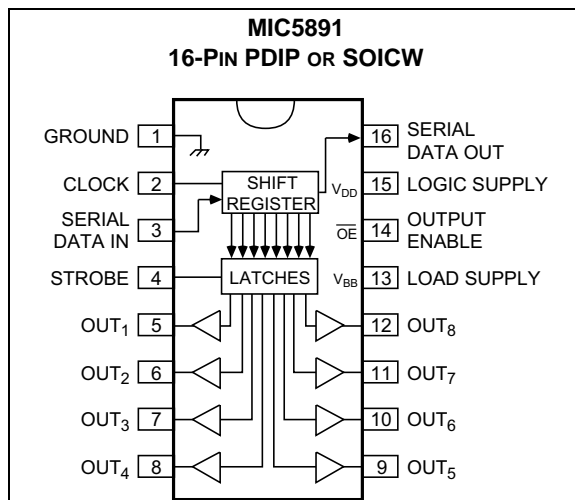
### Features

- High-Voltage, High-Current Outputs
- Output Transient Protection Diodes
- CMOS-, PMOS-, NMOS-, and TTL-Compatible Inputs
- 5 MHz Typical Data Input Rate
- Low-Power CMOS Latches

### Applications

- Alphanumeric and Bar Graph Displays
- LED and Incandescent Displays
- Relay and Solenoid Drivers
- Other High-Power Loads

### Package Type



### General Description

The MIC5891 latched driver is a high-voltage, high-current integrated circuit comprised of eight CMOS data latches, CMOS control circuitry for the common STROBE and OUTPUT ENABLE, and bipolar Darlington transistor drivers for each latch.

Bipolar/MOS construction provides extremely low power latches with maximum interface flexibility.

The MIC5891 will typically operate at 5 MHz with a 5V logic supply.

The CMOS inputs are compatible with standard CMOS, PMOS, and NMOS logic levels. TTL circuits may be used with appropriate pull-up resistors to ensure a proper logic-high input.

A CMOS serial data output allows additional drivers to be cascaded when more than 8 bits are required.

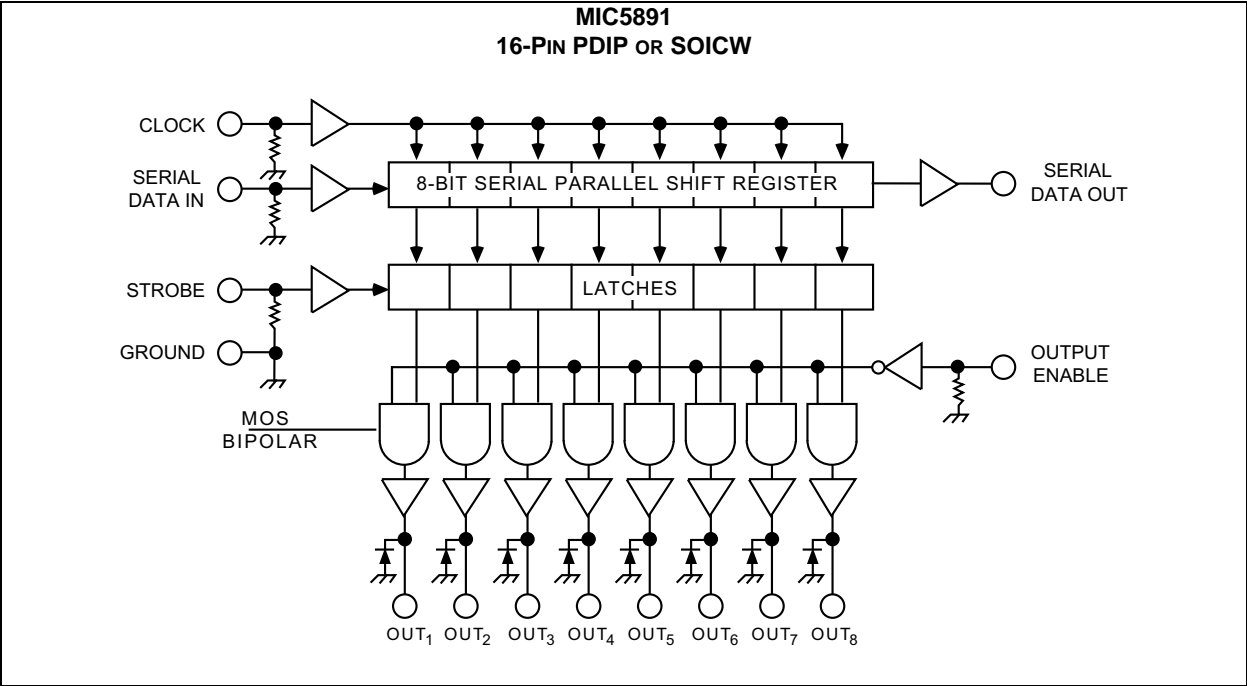
The MIC5891 has open-emitter outputs with suppression diodes for protection against inductive load transients. The output transistors are capable of sourcing 500 mA and will sustain at least 35V in the on-state.

Simultaneous operation of all drivers at maximum rated current requires a reduction in duty cycle due to package power limitations. Outputs may be paralleled for higher load current capability.

The MIC5891 is available in a 16-pin plastic DIP package (N) and 16-pin wide SOIC package (WM).

# MIC5891

## Functional Diagram



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings † (Note 1, Note 2, Note 3)

Output Voltage ( $V_{OUT}$ ) .....	+50V
Logic Supply Voltage Range ( $V_{DD}$ ) .....	+4.5V to +15V
Load Supply Voltage Range ( $V_{BB}$ ) .....	+5.0V to +50V
Input Voltage Range ( $V_{IN}$ ) .....	-0.3V to ( $V_{DD} + 0.3V$ )
Continuous Collector Current ( $I_C$ ) .....	500 mA
Package Power Dissipation .....	See Figure 2-1

† **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.

**Note 1:**  $T_A = +25^\circ\text{C}$ .

**2:** Derate at the rate of 20 mW/ $^\circ\text{C}$  above  $T_A = +25^\circ\text{C}$ .

**3:** Microchip CMOS devices have input-static protection, but are susceptible to damage when exposed to extremely high static electrical charges.

**TABLE 1-1: ALLOWABLE DUTY CYCLES**

Number of Outputs ON at $I_{OUT} = -200\text{ mA}$	Maximum Allowable Duty Cycles at a $T_A$ of:		
	+50°C	+60°C	+70°C
8	53%	47%	41%
7	60%	54%	48%
6	70%	64%	56%
5	83%	75%	67%
4	100%	94%	84%
3	100%	100%	100%
2	100%	100%	100%
1	100%	100%	100%

# MIC5891

**TABLE 1-2: ELECTRICAL CHARACTERISTICS**

Electrical Characteristics: $V_{BB} = 50V$ , $V_{DD} = 5V$ to $12V$ ; $T_A = 25^\circ C$ , unless noted. (Note 1).						
Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Output Leakage Current	$I_{CEX}$	—	—	-50	$\mu A$	$T_A = +25^\circ C$
		—	—	-100	$\mu A$	$T_A = +85^\circ C$
Output Saturation Voltage	$V_{CE(SAT)}$	—	—	2.3	V	$I_{OUT} = -100\text{ mA}$ , $T_A = +85^\circ C$
		—	—	2.4	V	$I_{OUT} = -225\text{ mA}$ , $T_A = +85^\circ C$
		—	—	2.5	V	$I_{OUT} = -350\text{ mA}$ , $T_A = +85^\circ C$
Output Sustaining Voltage	$V_{CE(SUS)}$	35	—	—	V	$I_{OUT} = -350\text{ mA}$ , $L = 2\text{ mH}$
Input Voltage	$V_{IN(1)}$ $V_{IN(0)}$	3.5	—	$V_{DD}+0.3$	V	$V_{DD} = 5.0V$
		10.5	—	$V_{DD}+0.3$	V	$V_{DD} = 12V$
		$V_{SS}-0.3$	—	0.8	V	$V_{DD} = 5.0V$ to $12V$
Input Current	$I_{IN(1)}$	—	—	120	$\mu A$	$V_{DD} = V_{IN} = 5.0V$
		—	—	240	$\mu A$	$V_{DD} = 12V$
Input Impedance	$Z_{IN}$	100	—	—	k $\Omega$	$V_{DD} = 5.0V$
		50	—	—	k $\Omega$	$V_{DD} = 12V$
Maximum Clock Frequency	$f_c$	3.3	—	—	MHz	—
Serial Data Output Resistance	$R_{OUT}$	—	—	20	k $\Omega$	$V_{DD} = 5.0V$
		—	—	6.0	k $\Omega$	$V_{DD} = 12V$
Turn-On Delay	$t_{PLH}$	—	—	2.0	$\mu s$	Output Enable to Output, $I_{OUT} = -350\text{ mA}$
Turn-Off Delay	$t_{PHL}$	—	—	10	$\mu s$	Output Enable to Output, $I_{OUT} = -350\text{ mA}$
Supply Current	$I_{BB}$	—	—	10	mA	All outputs on, all outputs open
		—	—	200	$\mu A$	All outputs off
	$I_{DD}$	—	—	100	$\mu A$	$V_{DD} = 5V$ , all outputs off, inputs = 0V
		—	—	200	$\mu A$	$V_{DD} = 12V$ , all outputs off, inputs = 0V
		—	—	1.0	mA	$V_{DD} = 5V$ , one output on, inputs = 0V
		—	—	3.0	mA	$V_{DD} = 12V$ , one output on, inputs = 0V
Diode Leakage Current	$I_H$	—	—	50	$\mu A$	$T_A = +25^\circ C$ ; Max. $V_{BB}$
		—	—	100	$\mu A$	$T_A = +85^\circ C$ ; Max. $V_{BB}$
Diode Forward Voltage	$V_F$	—	—	2.0	V	$I_F = 350\text{ mA}$ ; $V_{BB}$ open

**Note 1:** Specification for packaged product only.

**2:** Positive (negative) current is defined as going into (coming out of) the specified device pin.

**3:** Operation of these devices with standard TTL may require the use of appropriate pull-up resistors.

## TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
<b>Temperature Ranges</b>						
Operating Temperature Range	$T_A$	-40	—	+85	°C	Note 1
Storage Temperature Range	$T_S$	-65	—	+150	°C	—

**Note 1:** The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air (i.e.,  $T_A$ ,  $T_J$ ,  $\theta_{JA}$ ). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +125°C rating. Sustained junction temperatures above +125°C can impact the device reliability.

## Typical Circuits

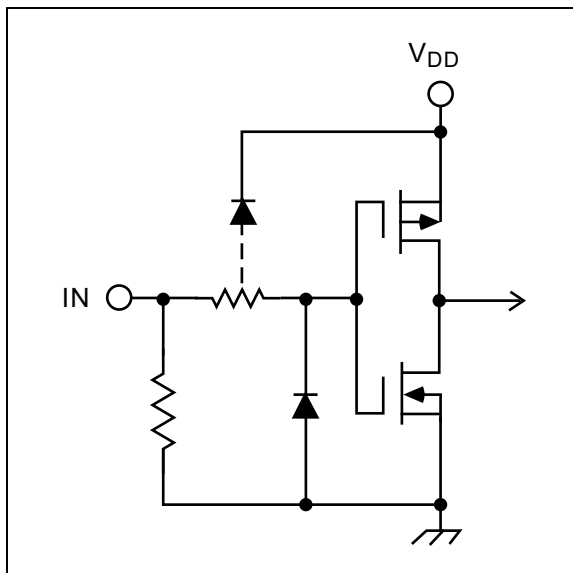


FIGURE 1-1: Typical Input Circuit

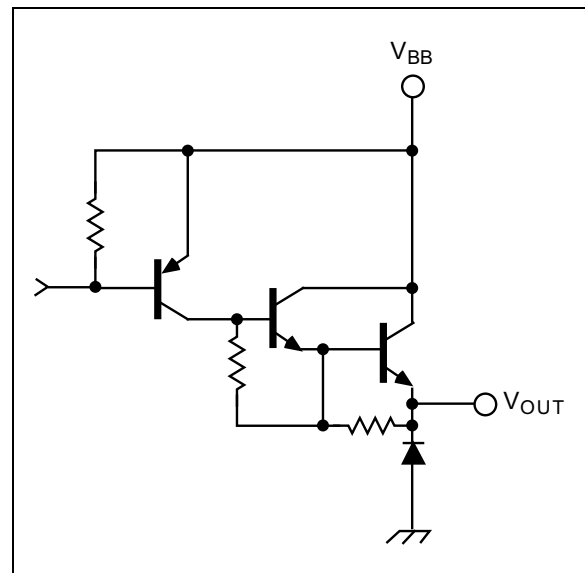
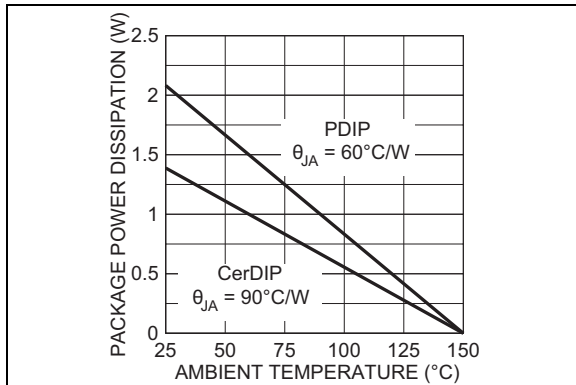


FIGURE 1-2: Typical Output Circuit.

# MIC5891

## 2.0 TYPICAL PERFORMANCE CURVES

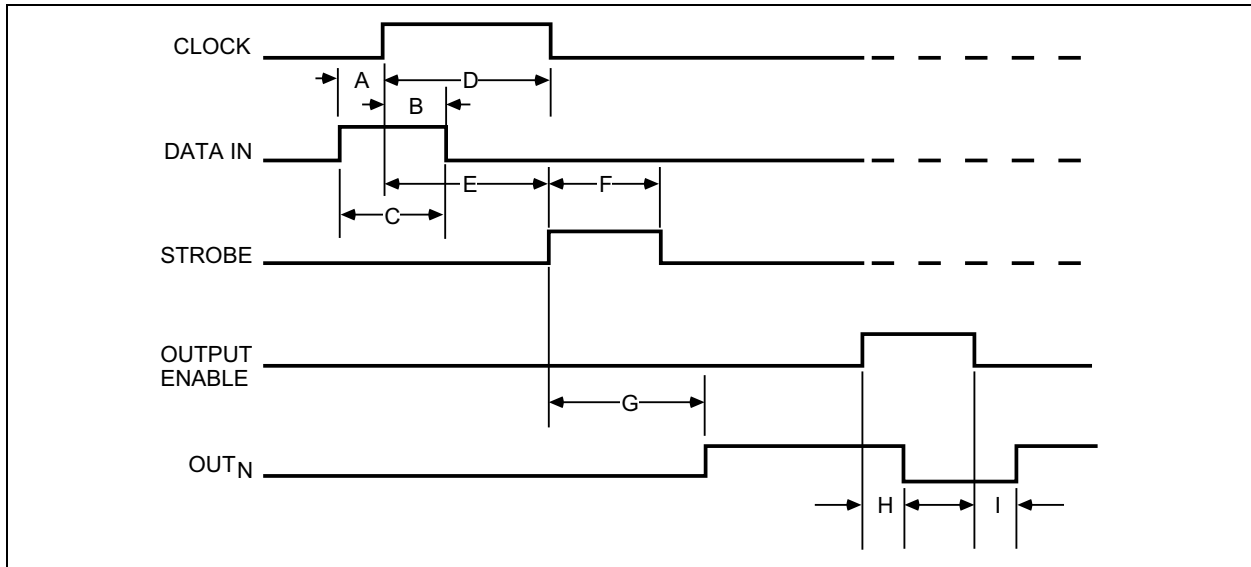
**Note:** The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be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



**FIGURE 2-1:** Allowable Package Power Dissipation vs. Temperature.

## 3.0 TIMING CONDITIONS

The descriptions of the timing conditions are listed below [Figure 3-1](#).



**FIGURE 3-1:** Timing Conditions.

**TABLE 3-1: TIMING CONDITIONS PARAMETERS**

V <sub>DD</sub> = 5.0V, Logic levels are V <sub>DD</sub> and ground.		
Reference	Parameter	Value
A	Minimum data active time before clock pulse (data set-up time)	75 ns
B	Minimum data active time after clock pulse (data hold time)	75 ns
C	Minimum data pulse width	150 ns
D	Minimum clock pulse width	150 ns
E	Minimum time between clock activation and strobe	300 ns
F	Minimum strobe pulse width	100 ns
G	Typical time between strobe activation and output transition	1.0 μs
H	Turn-off delay	See <a href="#">Electrical Characteristics</a>
I	Turn-on delay	See <a href="#">Electrical Characteristics</a>

**TABLE 3-2: TRUTH TABLE**

Serial Data Input	Clock Input	Shift Register Contents	Serial Data Output	Strobe Input	Latch Contents	Output Enable	Output Content
		I <sub>1</sub> I <sub>2</sub> I <sub>3</sub> ... I <sub>N-1</sub> I <sub>N</sub>			I <sub>1</sub> I <sub>2</sub> I <sub>3</sub> ... I <sub>N-1</sub> I <sub>N</sub>		I <sub>1</sub> I <sub>2</sub> I <sub>3</sub> ... I <sub>N-1</sub> I <sub>N</sub>
H		H R <sub>1</sub> R <sub>2</sub> ... R <sub>N-2</sub> R <sub>N-1</sub>	R <sub>N-1</sub>	—	—	—	—
L		L R <sub>1</sub> R <sub>2</sub> ... R <sub>N-2</sub> R <sub>N-1</sub>	R <sub>N-1</sub>				
X		R <sub>1</sub> R <sub>2</sub> R <sub>3</sub> ... R <sub>N-1</sub> R <sub>N</sub>	R <sub>N</sub>				
—	—	X X X ... X X	X	L	R <sub>1</sub> R <sub>2</sub> R <sub>3</sub> ... R <sub>N-1</sub> R <sub>N</sub>	L	P <sub>1</sub> P <sub>2</sub> P <sub>3</sub> ... P <sub>N-1</sub> P <sub>N</sub>
		P <sub>1</sub> P <sub>2</sub> P <sub>3</sub> ... P <sub>N-1</sub> P <sub>N</sub>	P <sub>N</sub>	H	P <sub>1</sub> P <sub>2</sub> P <sub>3</sub> ... P <sub>N-1</sub> P <sub>N</sub>		P <sub>1</sub> P <sub>2</sub> P <sub>3</sub> ... P <sub>N-1</sub> P <sub>N</sub>
		—	—	—	X X X ... X X		H

L = Low Logic Level, H = High Logic Level, X = Irrelevant, P = Present State, R = Previous State.

## 4.0 APPLICATION INFORMATION

Serial data present at the input is transferred into the shift register on the rising edge of the CLOCK input pulse. Additional CLOCK pulses shift data information towards the SERIAL DATA OUTPUT. The serial data must appear at the input prior to the rising edge of the CLOCK input waveform.

The 8 bits present in the shift register are transferred to the respective latches when the STROBE is high (serial-to-parallel conversion). The latches will continue to accept new data as long as the STROBE is held high. Most applications where the latching feature is not used (STROBE tied high) require the OUTPUT ENABLE input to be high during serial data entry.

Outputs are active (controlled by the latch state) when the OUTPUT ENABLE is low. All outputs are low (disabled) when the OUTPUT ENABLE is high. OUTPUT ENABLE does not affect the data in the shift register or latch.



## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

16-Pin PDIP\*



Example



16-Pin SOICW\*



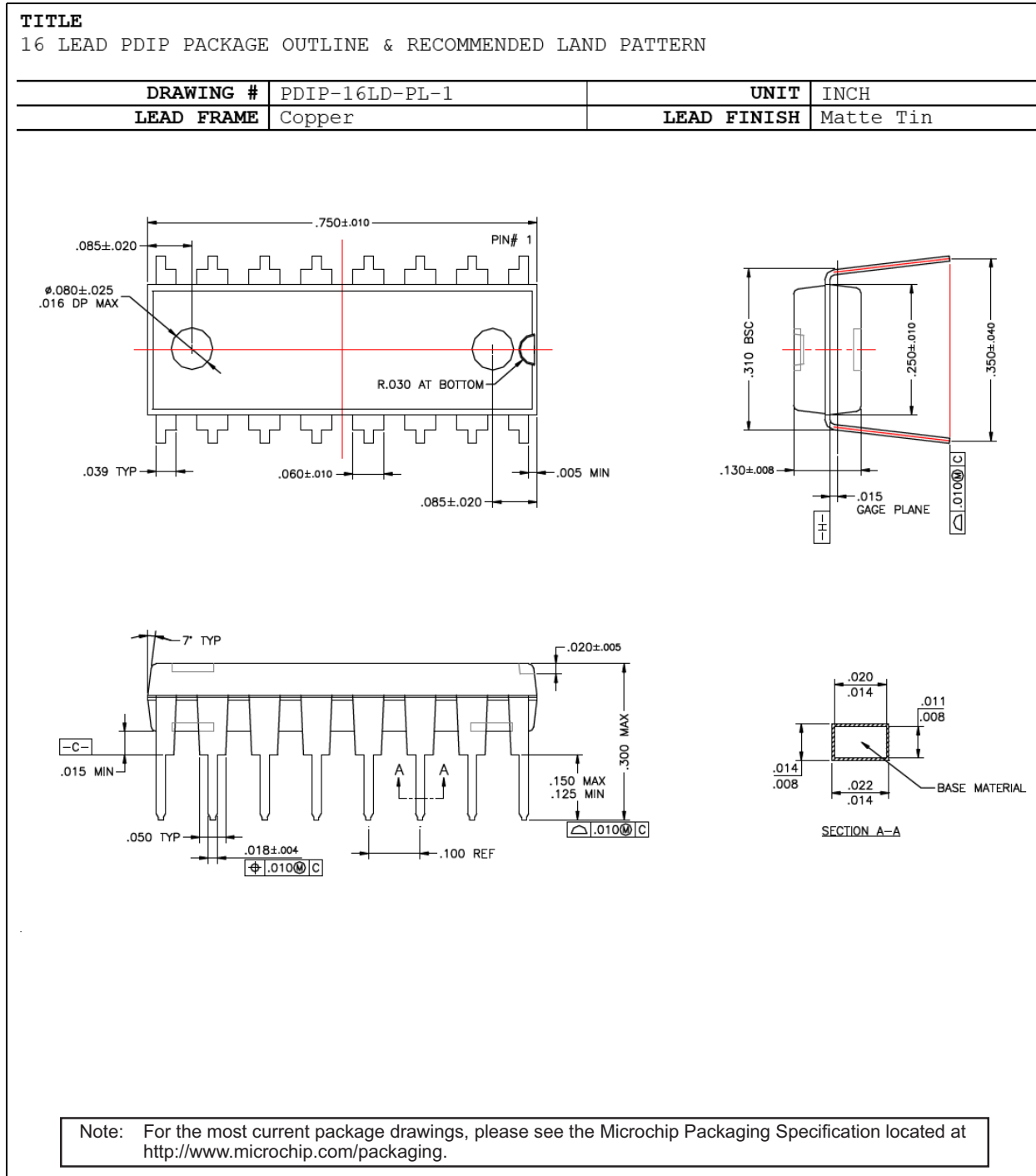
Example



<b>Legend:</b>	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).
<b>Note:</b>	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 ( ¯ ) and/or Overbar ( ¯ ) symbol may not be to scale.	

# MIC5891

## 16-Lead PDIP Package Outline and Recommended Land Pattern

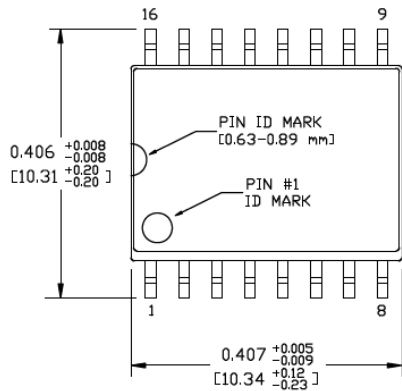


## 16-Lead SOICW Package Outline and Recommended Land Pattern

**TITLE**

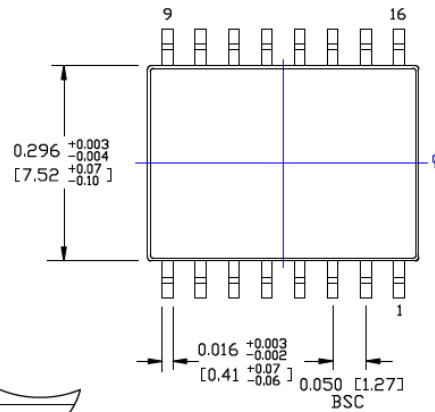
16 LEAD SOICW PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	SOICW-16LD-PL-1	UNIT	INCH [MM]
-----------	-----------------	------	-----------



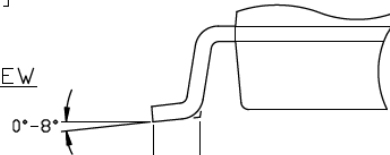
TOP VIEW

NOTE: 1, 2

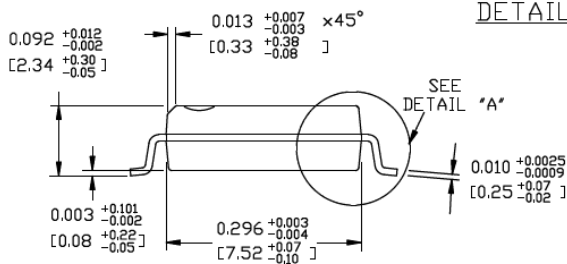


BOTTOM VIEW

NOTE: 1, 2

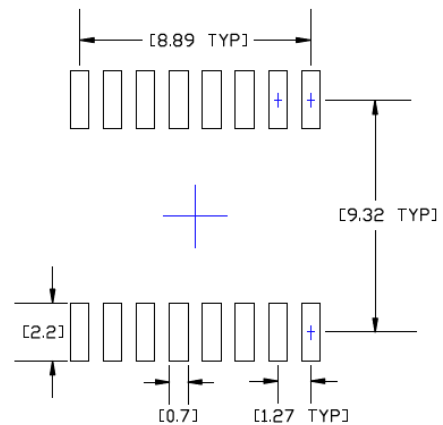


DETAIL "A"



END VIEW

NOTE: 1, 2, 3



RECOMMENDED LAND PATTERN

**NOTES:**

1. DIMENSIONS ARE IN INCHES[MM].
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.006[0.15] PER SIDE.

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

# MIC5891

---

NOTES:

## APPENDIX A: REVISION HISTORY

### Revision A (October 2016)

- Converted Micrel document MIC5891 to Microchip data sheet DS20005638A.
- Minor text changes throughout.
- Operating temperature range corrected in the [Temperature Specifications](#) section.
- Maximum Saturation Voltage values updated in [Table 1-2](#).
- First Input Current maximum value updated in [Table 1-2](#).

# MIC5891

---

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 NO.</u>		X	XX	-	XX
Device	Junction Temperature Range	Package	Media Type		
<b>Device:</b>	MIC5891:	8-Bit Serial-Input Latched Source Driver			
<b>Junction Temperature Range:</b>	Y =	-40°C to +85°C			
<b>Package:</b>	N =	16-Lead PDIP			
	WM =	16-Lead SOICW			
<b>Media Type:</b>	TR =	1,000/Reel for WM Package			
	(blank)=	25/Tube for N Package			
	(blank)=	47/Tube for WM Package			

<b>Examples:</b>	
a) MIC5891YN:	8-Bit Serial-Input Latched Source Driver, -40°C to +85°C Junction Temperature Range, 16-Lead PDIP, 25/Tube
a) MIC5891YWM:	8-Bit Serial-Input Latched Source Driver, -40°C to +85°C Junction Temperature Range, 16-Lead SOICW, 47/Tube
a) MIC5891YWM-TR:	8-Bit Serial-Input Latched Source Driver, -40°C to +85°C Junction Temperature Range, 16-Lead SOICW, 1,000/Reel

# MIC5891

---

NOTES:



---

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

---

Information contained in this publication regarding device applications and the like 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. 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 ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. 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.

*Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELoc® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*

**QUALITY MANAGEMENT SYSTEM  
CERTIFIED BY DNV  
= ISO/TS 16949 =**

### Trademarks

The Microchip name and logo, the Microchip logo, AnyRate, dsPIC, FlashFlex, flexPWR, Heldo, JukeBlox, KeeLoq, KeeLoq logo, Klear, LANCheck, LINK MD, MediaLB, MOST, MOST logo, MPLAB, OptoLyzer, PIC, PICSTART, PIC32 logo, RightTouch, SpyNIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, ETHERSYNCH, Hyper Speed Control, HyperLight Load, IntelliMOS, mTouch, Precision Edge, and QUIET-WIRE are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PureSilicon, RightTouch logo, REAL ICE, Ripple Blocker, Serial Quad I/O, SQL, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, 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.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademarks 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.

© 2016, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

ISBN: 978-1-5224-1034-8



# MICROCHIP

## 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](http://www.microchip.com/support)

Web Address:

[www.microchip.com](http://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

#### Cleveland

Independence, OH

Tel: 216-447-0464

Fax: 216-447-0643

#### 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

#### Los Angeles

Mission Viejo, CA

Tel: 949-462-9523

Fax: 949-462-9608

#### New York, NY

Tel: 631-435-6000

#### San Jose, CA

Tel: 408-735-9110

#### Canada - Toronto

Tel: 905-695-1980

Fax: 905-695-2078

### ASIA/PACIFIC

#### Asia Pacific Office

Suites 3707-14, 37th Floor  
Tower 6, The Gateway  
Harbour City, Kowloon

#### Hong Kong

Tel: 852-2943-5100

Fax: 852-2401-3431

#### Australia - Sydney

Tel: 61-2-9868-6733

Fax: 61-2-9868-6755

#### China - Beijing

Tel: 86-10-8569-7000

Fax: 86-10-8528-2104

#### China - Chengdu

Tel: 86-28-8665-5511

Fax: 86-28-8665-7889

#### China - Chongqing

Tel: 86-23-8980-9588

Fax: 86-23-8980-9500

#### China - Dongguan

Tel: 86-769-8702-9880

#### China - Guangzhou

Tel: 86-20-8755-8029

#### China - Hangzhou

Tel: 86-571-8792-8115

Fax: 86-571-8792-8116

#### China - Hong Kong SAR

Tel: 852-2943-5100

Fax: 852-2401-3431

#### China - Nanjing

Tel: 86-25-8473-2460

Fax: 86-25-8473-2470

#### China - Qingdao

Tel: 86-532-8502-7355

Fax: 86-532-8502-7205

#### China - Shanghai

Tel: 86-21-5407-5533

Fax: 86-21-5407-5066

#### China - Shenyang

Tel: 86-24-2334-2829

Fax: 86-24-2334-2393

#### China - Shenzhen

Tel: 86-755-8864-2200

Fax: 86-755-8203-1760

#### China - Wuhan

Tel: 86-27-5980-5300

Fax: 86-27-5980-5118

#### China - Xian

Tel: 86-29-8833-7252

Fax: 86-29-8833-7256

### ASIA/PACIFIC

#### China - Xiamen

Tel: 86-592-2388138

Fax: 86-592-2388130

#### China - Zhuhai

Tel: 86-756-3210040

Fax: 86-756-3210049

#### India - Bangalore

Tel: 91-80-3090-4444

Fax: 91-80-3090-4123

#### India - New Delhi

Tel: 91-11-4160-8631

Fax: 91-11-4160-8632

#### India - Pune

Tel: 91-20-3019-1500

#### Japan - Osaka

Tel: 81-6-6152-7160

Fax: 81-6-6152-9310

#### Japan - Tokyo

Tel: 81-3-6880-3770

Fax: 81-3-6880-3771

#### Korea - Daegu

Tel: 82-53-744-4301

Fax: 82-53-744-4302

#### Korea - Seoul

Tel: 82-2-554-7200

Fax: 82-2-558-5932 or

82-2-558-5934

#### Malaysia - Kuala Lumpur

Tel: 60-3-6201-9857

Fax: 60-3-6201-9859

#### Malaysia - Penang

Tel: 60-4-227-8870

Fax: 60-4-227-4068

#### Philippines - Manila

Tel: 63-2-634-9065

Fax: 63-2-634-9069

#### Singapore

Tel: 65-6334-8870

Fax: 65-6334-8850

#### Taiwan - Hsin Chu

Tel: 886-3-5778-366

Fax: 886-3-5770-955

#### Taiwan - Kaohsiung

Tel: 886-7-213-7828

#### Taiwan - Taipei

Tel: 886-2-2508-8600

Fax: 886-2-2508-0102

#### Thailand - Bangkok

Tel: 66-2-694-1351

Fax: 66-2-694-1350

### EUROPE

#### Austria - Wels

Tel: 43-7242-2244-39

Fax: 43-7242-2244-393

#### Denmark - Copenhagen

Tel: 45-4450-2828

Fax: 45-4485-2829

#### France - Paris

Tel: 33-1-69-53-63-20

Fax: 33-1-69-30-90-79

#### Germany - Dusseldorf

Tel: 49-2129-3766400

#### Germany - Karlsruhe

Tel: 49-721-625370

#### Germany - Munich

Tel: 49-89-627-144-0

Fax: 49-89-627-144-44

#### Italy - Milan

Tel: 39-0331-742611

Fax: 39-0331-466781

#### Italy - Venice

Tel: 39-049-7625286

#### Netherlands - Drunen

Tel: 31-416-690399

Fax: 31-416-690340

#### Poland - Warsaw

Tel: 48-22-3325737

#### Spain - Madrid

Tel: 34-91-708-08-90

Fax: 34-91-708-08-91

#### Sweden - Stockholm

Tel: 46-8-5090-4654

#### UK - Wokingham

Tel: 44-118-921-5800

Fax: 44-118-921-5820

06/23/16