

ECE 477 Digital Systems Senior Design Project

Module 2

Embedded System Hardware Interfacing

Outline

- **Level Translation**
- **Line Drivers and Receivers**
- **Switching D.C. Loads**
- **Optically Isolation**
- **Keypads (Switch Matrices)**
- **Switch De-bouncer**
- **Rotary Pulse Generators (RPG)**
- **PWM Applications/Interfaces**
- **Position Control and Stepper Motors**
- **Servos**
- **LCD Interface**
- **Digitally Controlled Potentiometer**
- **Temperature and Humidity**
- **Compass**
- **Accelerometer**
- **Hall Effect Sensor**
- **Pressure (Force) Sensor**
- **Ultrasonic Range Sensor**
- **IR Remote Control Decoding**
- **RF Serial Link**
- **AC Loads**

Level Translation

- Needed for interfacing CMOS families operating at different supply voltages

Logic-Level Translators - Maxim - Windows Internet Explorer

http://www.maximintegrated.com/products/interface/level-translators/logic-level.cfm

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Maxim > Products > Interface > Level Translators > Logic-Level Translators

Level Translators

- High-Speed Level Translators
- Logic-Level Translators

Product Information

- Latest Data Sheets
- Cross Reference

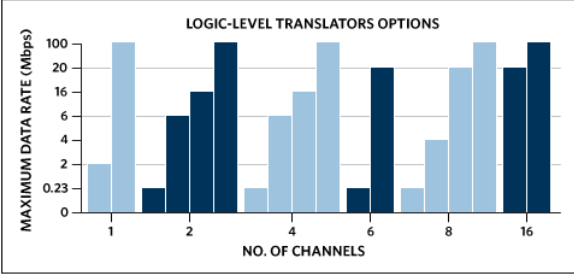
Design Resources

- Application Notes
- Interface Product Guide (PDF)
- Technical Support

Logic-Level Translators

Maxim offers bidirectional CMOS logic-level translators that provide the level-shifting necessary for data transfer in multivoltage systems. Our LLTs are bidirectional by design and do not require the use of a direction input. Two externally applied voltages, V_{CC} and V_L , set the logic levels of these devices.

[See Table of All Logic-Level Translators](#)



No. of Channels	Series 1 (Light Blue) Maximum Data Rate (Mbps)	Series 2 (Dark Blue) Maximum Data Rate (Mbps)
1	2	100
2	2	16
4	2	16
6	2	20
8	4	20
16	100	20

Also See: [High-Speed Level Translators](#)

Level Translation

Maxim - Parametric Search - Product Table - Windows Internet Explorer

http://para.maximintegrated.com/search.mvp?fam=bidirtranslators&hs=1

<

Line Drivers and Receivers

- Needed for driving (long) cables based on various standards (e.g., RS 232, RS 422, RS 485, etc.)

Maxim > Design Support > Technical Documents > Tutorials > Interface Circuits > APP 723

Keywords: RS-232, rs232, RS-422, rs422, RS-485, rs485, RS-232 port powered, RS-232 to RS-485 conversion, daisy chain, cable termination

Related Parts

TUTORIAL 723

Selecting and Using RS-232, RS-422, and RS-485 Serial Data Standards

Dec 29, 2000

Abstract: Three common serial data standards, RS-232, RS-422, and RS-485, are described by specification and electrical interface. Cable termination techniques, use of multiple loads, daisy-chaining of RS-232, conversion of RS-232 to RS-485, conversion of RS-485 to RS-232, and RS-232 port-powered RS-485 conversions are described.

Introduction

"The great thing about standards is there are so many to choose from." This statement was made at a recent conference on fiber optics, and it holds true for electrical-interface standards as well. As serial-data standards tend to evolve separately within particular industries, we thus have more standards than we should.

Perhaps the most successful serial-data standard for PC and telecom applications is the RS-232. Similarly, the RS-485 and RS-422 are among the most successful standards for industrial applications. These standards are not directly compatible. For control and instrumentation applications, however, it is often necessary to communicate between the standards. This article discusses the different standards (electrical physical-layer specifications), explains how to convert from one standard to another standard, and demonstrates how to combine different standards within the same application.

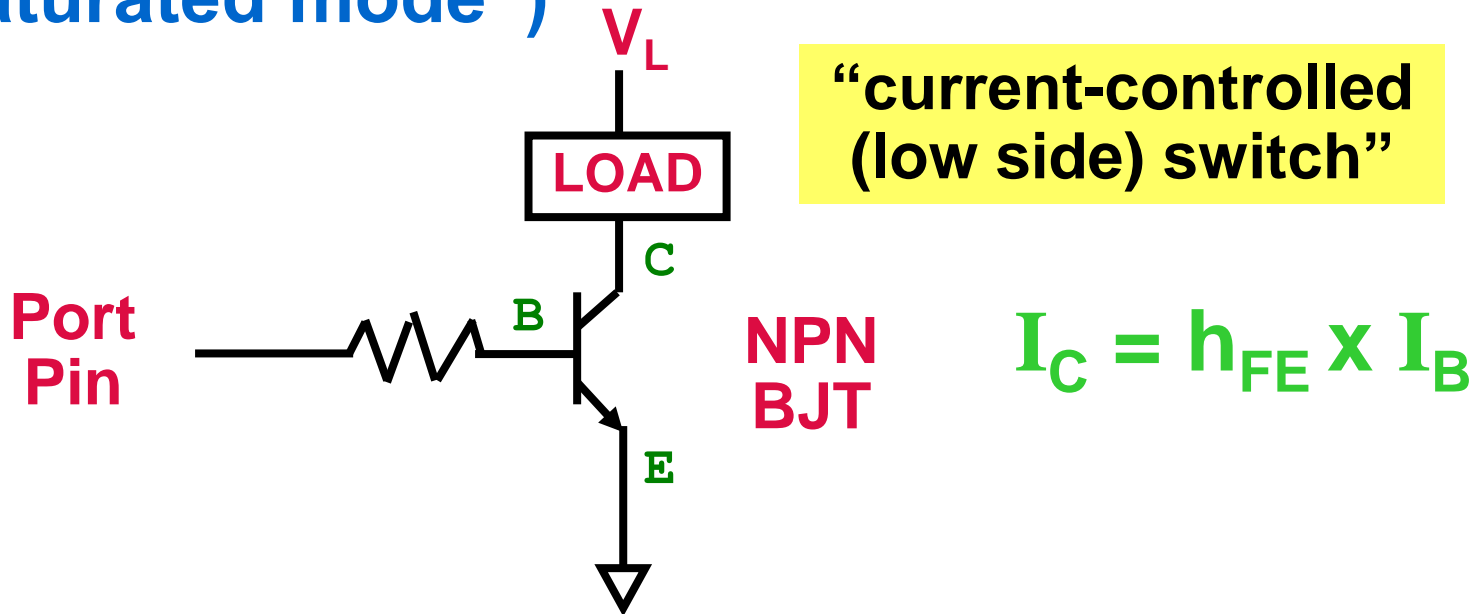
RS-232 Electrical Specifications and a Typical Connection

The RS-232 link was initially intended to support modem and printer applications on IBM PCs; however, it now enables a variety of peripherals to communicate with PCs. The RS-232 standard was defined as a single-ended standard for increasing serial-communication distances at low baud rates (<20kbps). Over the years the standard changed to accommodate faster drivers like the MAX3225E, which offers 1Mbps data-rate capability. For RS-232 compliance, a transceiver such as the MAX3225E must meet the electrical specifications listed in **Table 1**. A typical connection (**Figure 1**) shows the use of hardware handshaking to control the flow of data.

Parameter	Conditions	Min	Max	Units
Driver Output Voltage, Open Circuit			25	V
Driver Output Voltage, Loaded	3k Ω < RL < 7k Ω	± 5	± 15	V
Driver Output Resistance, Power Off	-2V < V < 2V		300	
Slew Rate		4	30	V/ μ s
Maximum Load Capacitance			2500	pF
Receiver Input Resistance		3	7	k Ω
Receiver Input Threshold:				

Switching D.C. Loads

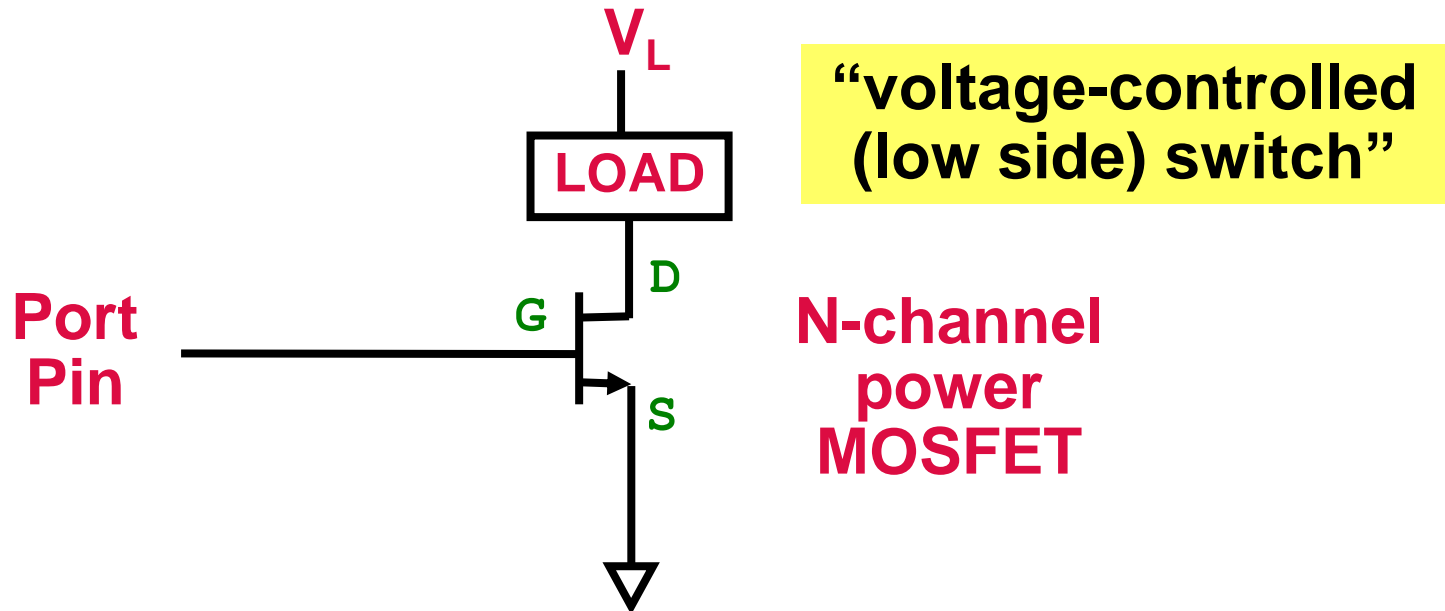
- Basic BJT-based switching circuit (“saturated mode”)



- Choose BJT based on following parameters
 - I_{Cmax} continuous
 - V_{CE} breakdown
 - h_{FE} (D.C. current gain), also called β

Switching D.C. Loads

- Basic MOSFET-based switching circuit



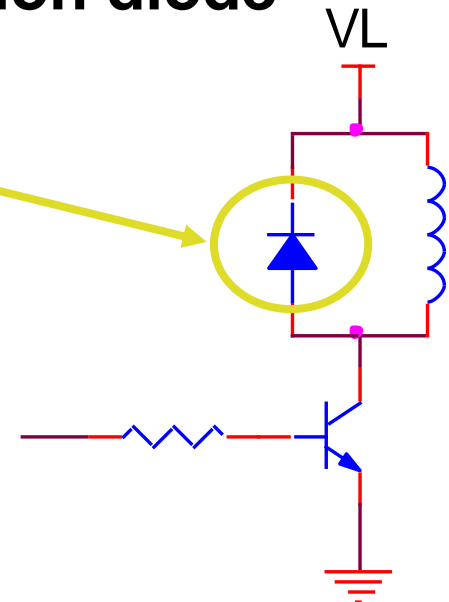
- Choose MOSFET based on following parameters

- I_{Dmax} continuous
- V_{DS} breakdown
- $r_{DS(on)}$ (drain-to-source "on" resistance)

Switching D.C. Loads

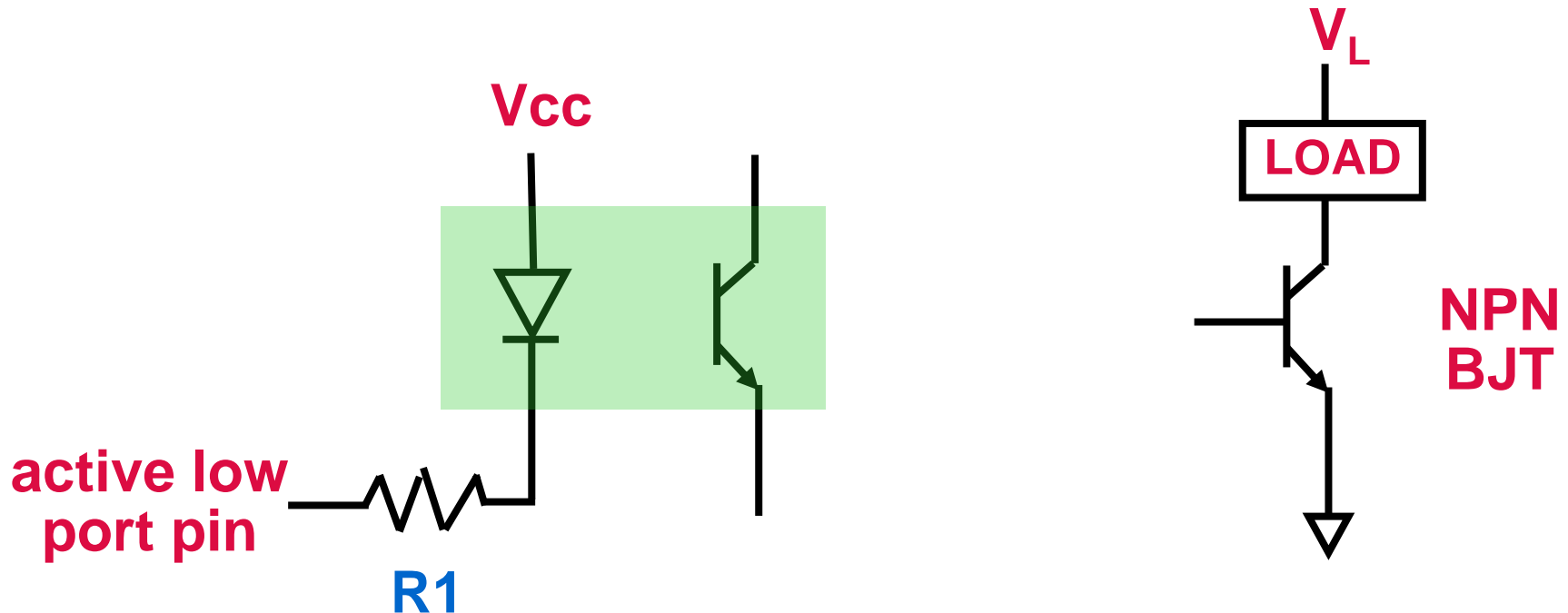
- Tradeoffs
 - BJTs: may require a significant amount of base current to drive into saturation (typically need Darlington for high h_{FE} at high I_C)
 - MOSFETs: require virtually no gate current to operate, less chance of thermal runaway than BJT
- Inductive loads require arc suppression diode

Energy stored in an inductive load must be dissipated, otherwise the “inductive kickback” can damage the switching device



Switching D.C. Loads

- Use optical isolation to protect microcontroller

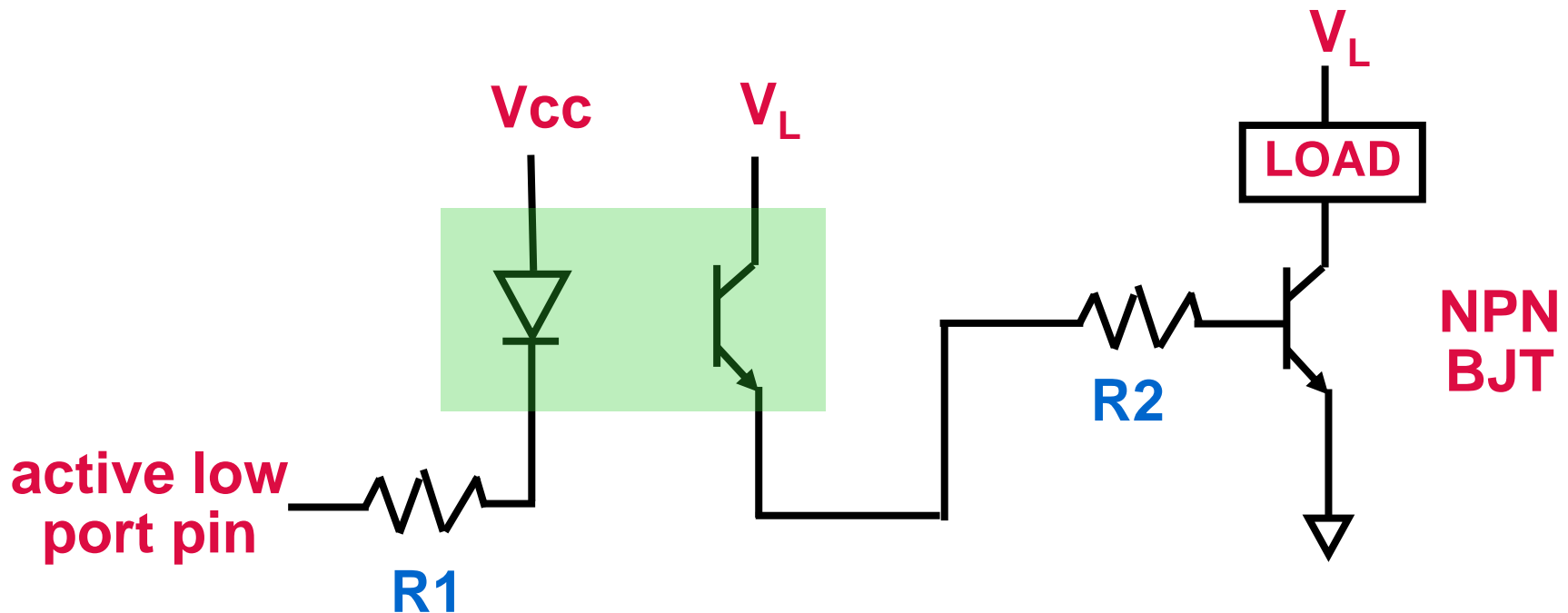


Assume $V_{CC} = 5\text{ V}$, $V_{LED} = 1.5\text{ V}$, and $V_{OL} @ 10\text{ mA} = 0.8\text{ V}$

$$\Rightarrow R1 = 2.7/0.01 = 270\Omega$$

Switching D.C. Loads

- Use optical isolation to protect microcontroller

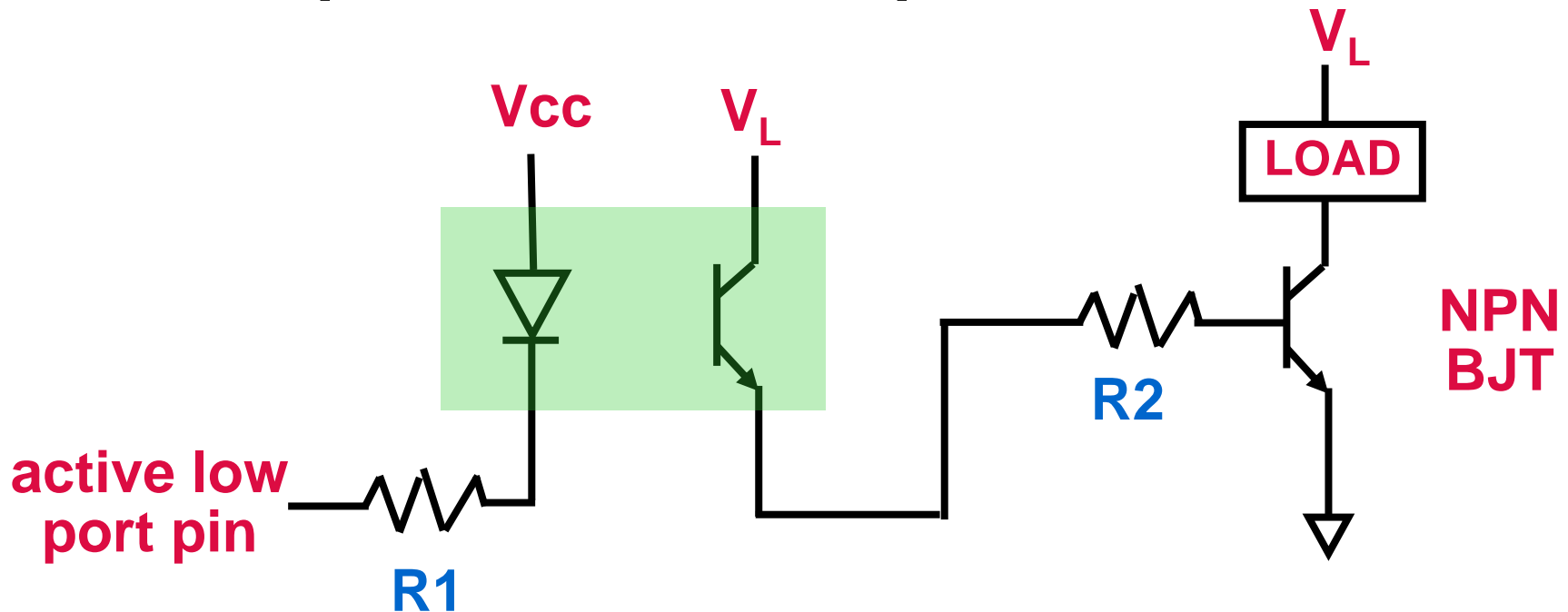


Assume $V_{CC} = 5\text{ V}$, $V_{LED} = 1.5\text{ V}$, and $V_{OL} @ 10\text{ mA} = 0.8\text{ V}$

$$\Rightarrow R1 = 2.7/0.01 = 270\Omega \quad P_{R1} = 0.027\text{ W}$$

Switching D.C. Loads

- Use optical isolation to protect microcontroller



Assume switching 1 amp load, and that h_{FE} of transistor is 100 \Rightarrow need 10 mA of base current to saturate transistor (assume V_{BEsat} of transistor is 0.7 V, and that V_{CEsat} of photo transistor is 0.3 V)

$$\Rightarrow R2 = (V_L - 1)/0.01 \text{ If } V_L=18V, R2=1700\text{ohms}, P_{R2}=0.17W$$

10-Port Constant-Current LED Drivers and I/O Expanders with PWM Intensity Control

General Description

The MAX6966/MAX6967 serial-interfaced peripherals provide microprocessors with 10 I/O ports rated to 7V.

Each port can be individually configured as either:

- A 20mA constant-current LED driver (static or pulse-width modulated (PWM)).
- A 10mA constant-current LED driver (static or PWM).
- An open-drain logic output.
- An overvoltage-protected Schmitt logic input.

Analog and switching LED intensity control is built in:

- Individual 8-bit PWM control per output.
- Individual 1-bit analog control (half/full) per output.
- Global 3-bit analog control applies to all LED outputs.

PWM timing of the 10 port outputs may be optionally staggered, consecutively phased in 45° increments. This spreads the PWM load currents over time in eight steps, helping to even out the power-supply current and reduce the RMS current.

The MAX6966/MAX6967 can be configured to awake from shutdown on receipt of a minimum 3ms pulse on the \overline{CS} input. This hardware-wakeup feature allows a power-management controller or similar ASIC to enable the MAX6966/MAX6967 with preconfigured LED intensity settings.

Shutdown can be programmed to wait up to 4s, fade down the sink currents to zero for a period of 1/16s to 4s, and then shut down. A similar ramp-up from shutdown can be programmed for 1/16s to 4s.

The MAX6966/MAX6967 support hot insertion. All port pins remain high impedance in power-down ($V+ = 0V$) with up to 8V asserted on them.

The DOUT/OSC pin can be configured as either the serial interface data output or optional PWM clock input. The MAX6966 powers up defaulting as DOUT output. The MAX6967 defaults as OSC input.

For a similar part without the constant-current controls, refer to the MAX7317 data sheet.

Applications

LCD Backlights	RGB LED Drivers
Keypad Backlights	Portable Equipment
LED Status Indication	Cellular Phones

Features

- ♦ High-Speed 26MHz SPI™/QSPI™/MICROWIRE™-Compatible Serial Interface
- ♦ 2.25V to 3.6V Operation
- ♦ I/O Ports Default to High-Z (LEDs Off) on Power-Up
- ♦ I/O Port Inputs Are Overvoltage Protected to 7V
- ♦ I/O Port Outputs Are 7V-Rated Open Drain
- ♦ I/O Port Outputs Are 10mA or 20mA Constant-Current Static/PWM LED Drivers, or Open-Drain Logic Outputs
- ♦ I/O Ports Support Hot Insertion
- ♦ Individual 8-Bit PWM Intensity Control for Each LED
- ♦ Any Output May Use or Not Use PWM Control
- ♦ Exit Shutdown (Warm Start) with Simple \overline{CS} Pulse
- ♦ Auto Ramp-Down into Shutdown
- ♦ Auto Ramp-Up Out from Shutdown
- ♦ 0.8μA (typ), 2μA (max) Shutdown Current
- ♦ Tiny 3mm x 3mm, 0.8mm High Thin QFN Package
- ♦ -40°C to +125°C Temperature Range

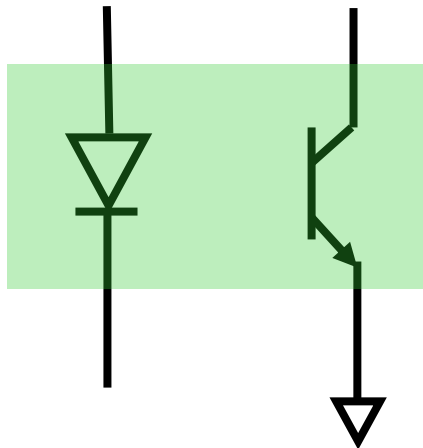
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK	PKG CODE
MAX6966ATE	-40°C to +125°C	16 Thin QFN 3mm x 3mm x 0.8mm	ACF	T1633-4
MAX6966AEE	-40°C to +125°C	16 QSOP	—	—
MAX6967ATE	-40°C to +125°C	16 Thin QFN 3mm x 3mm x 0.8mm	ACG	T1633-4
MAX6967AEE	-40°C to +125°C	16 QSOP	—	—

MAX6966/MAX6967

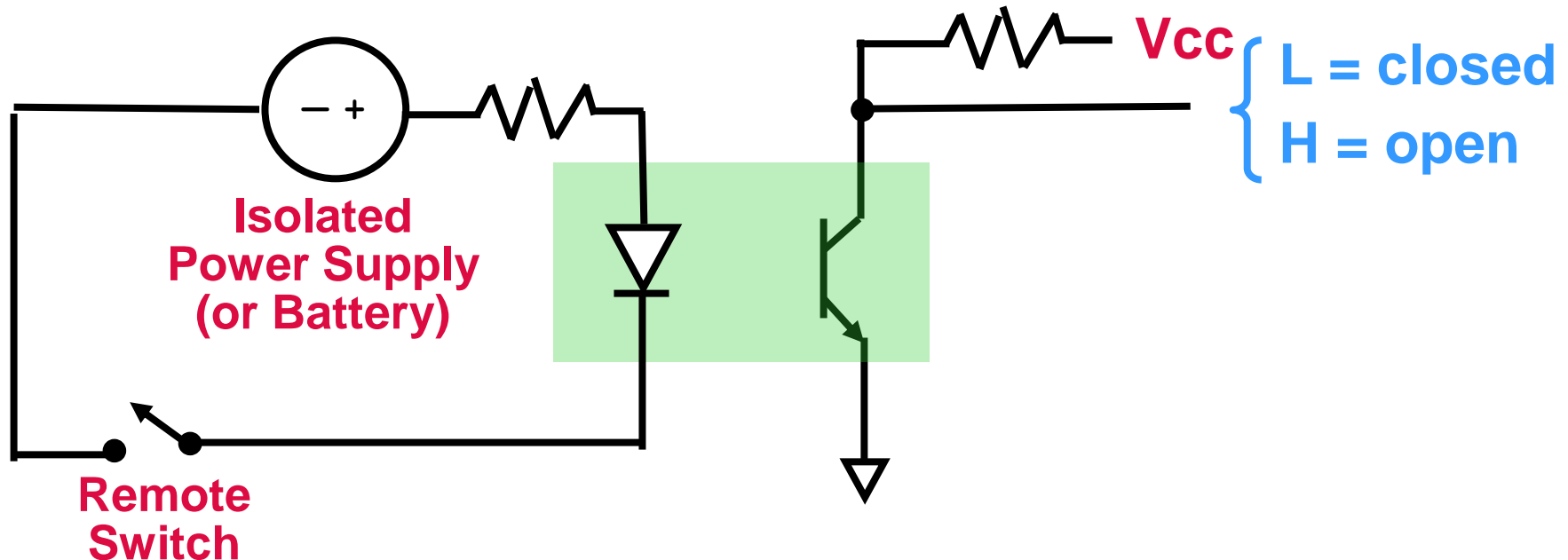
Optically-Isolated Inputs

- **Off-board (external, remotely located) switch/data inputs should be optically isolated**
 - helps reduce noise
 - helps prevent ESD-induced damage
 - prevents “strange” voltages from entering board
 - eliminates ground loops



Optically-Isolated Inputs

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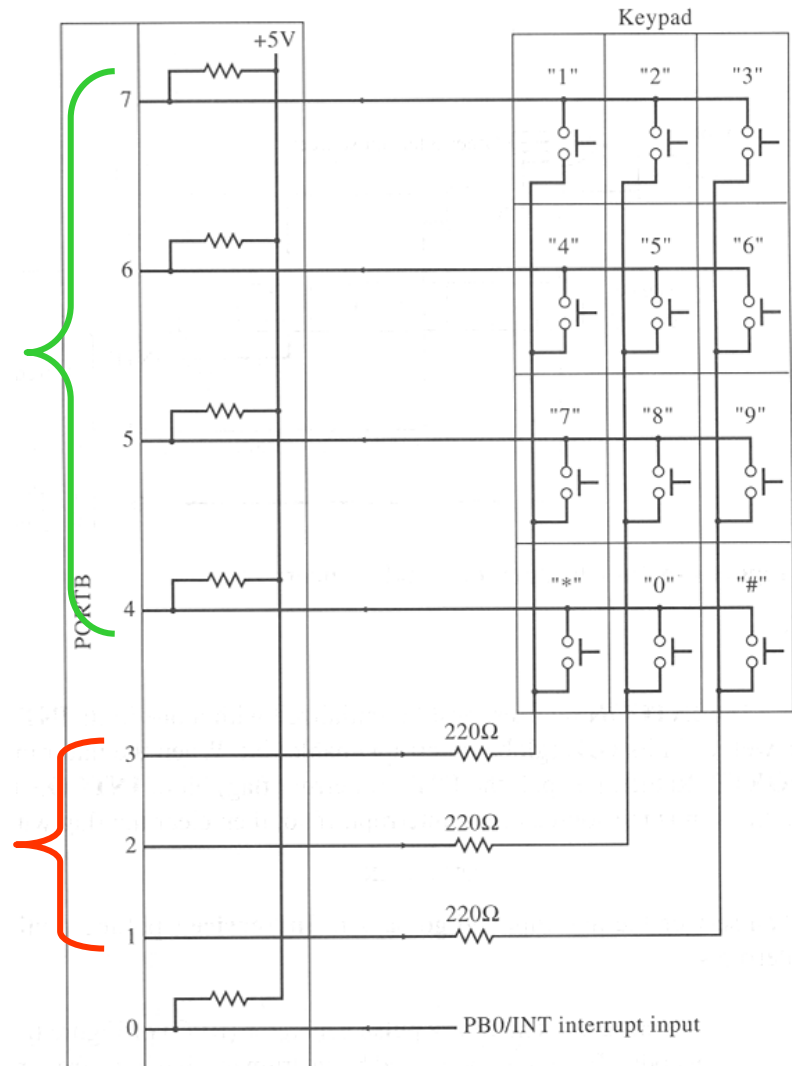


Scanned Keypad



row
return
lines

active low
column
scan lines

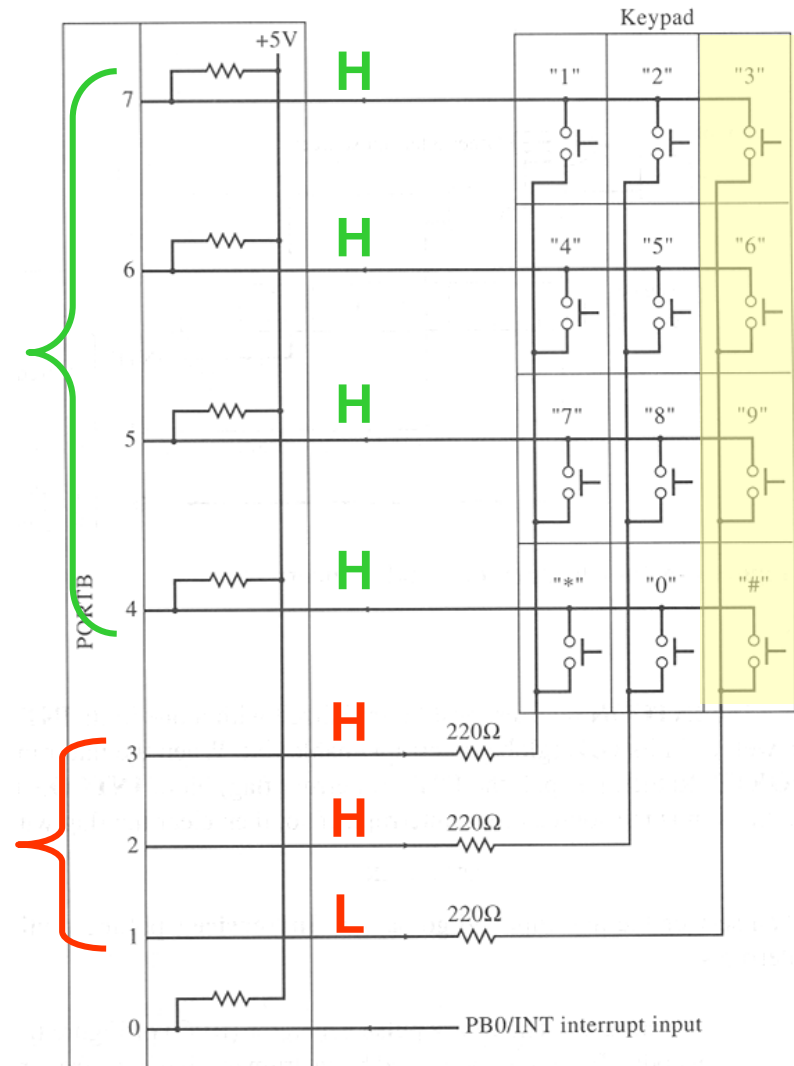


Scanned Keypad



row
return
lines

active low
column
scan lines

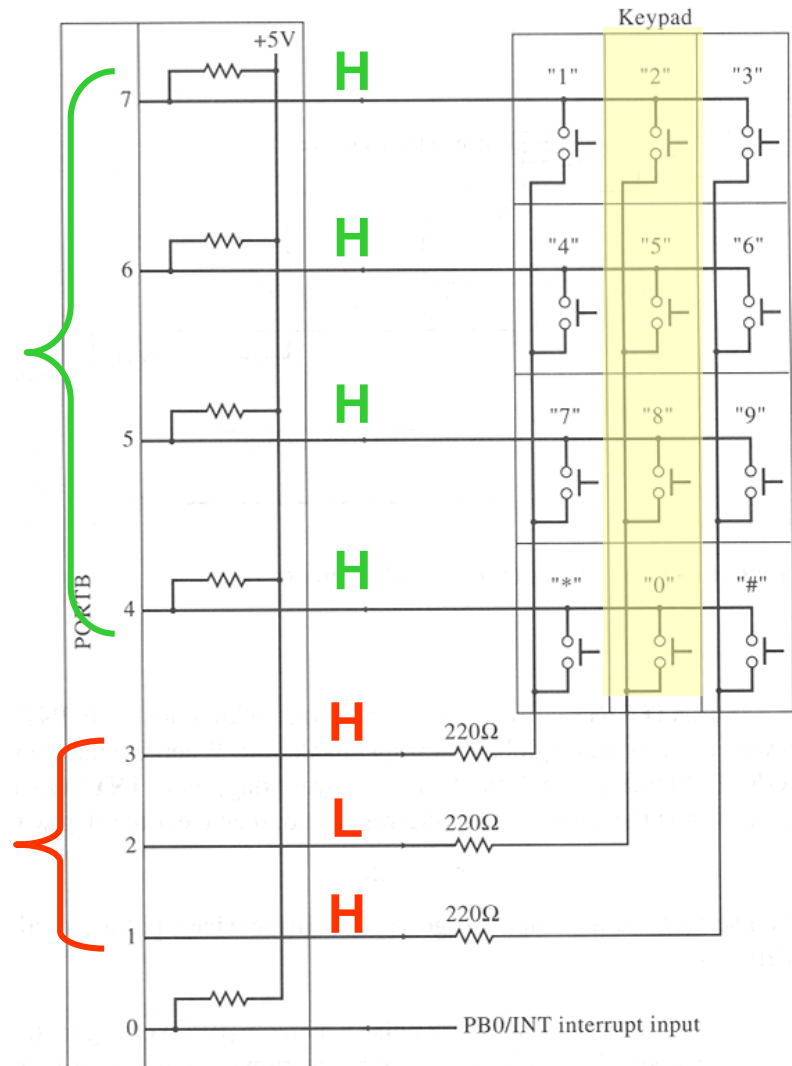


Scanned Keypad



row
return
lines

active low
column
scan lines

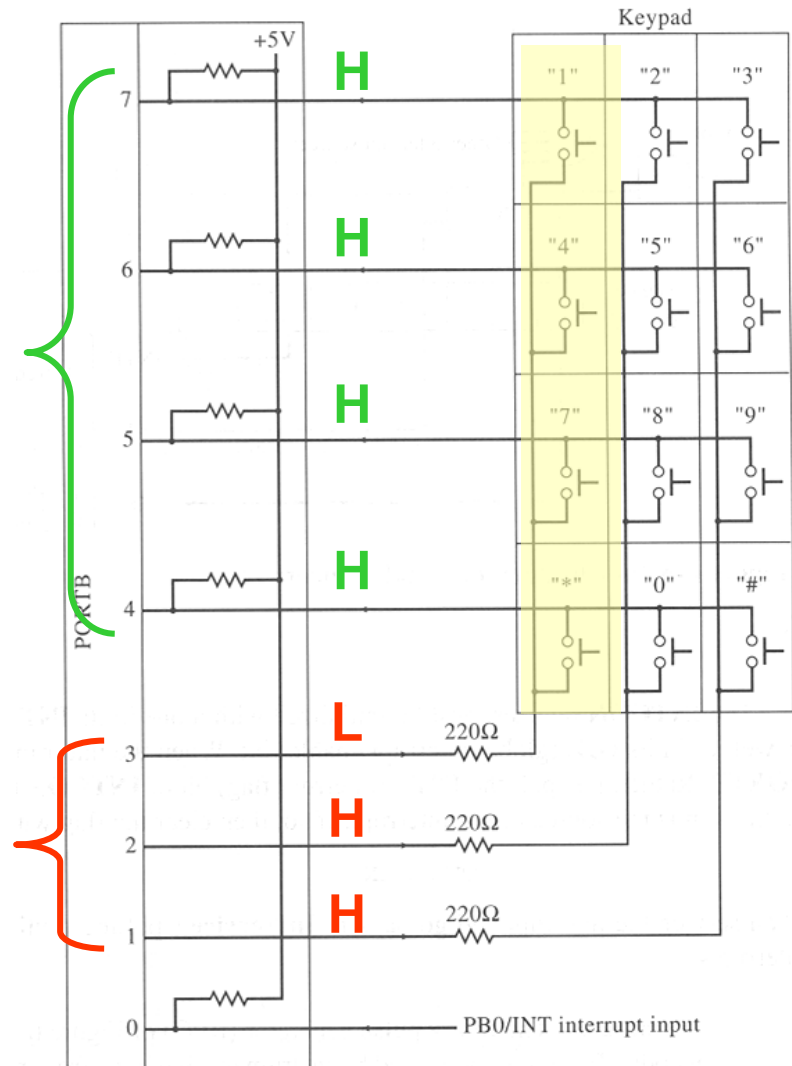


Scanned Keypad



row
return
lines

active low
column
scan lines

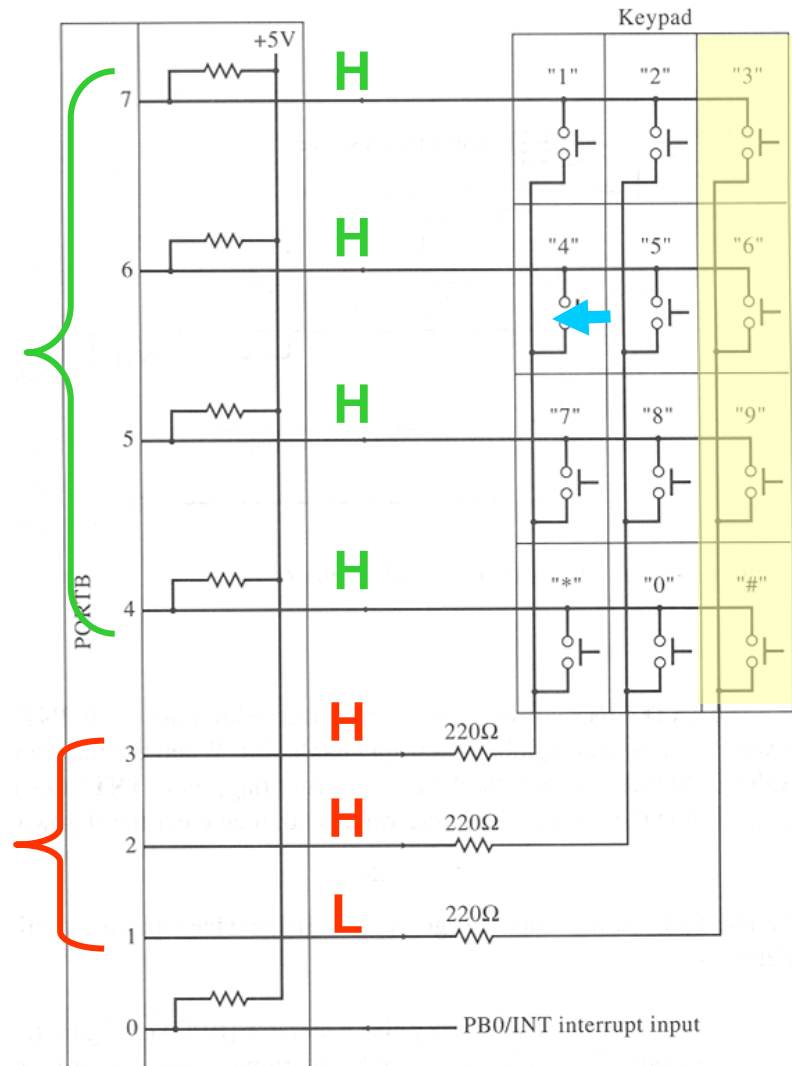


Scanned Keypad



row
return
lines

active low
column
scan lines

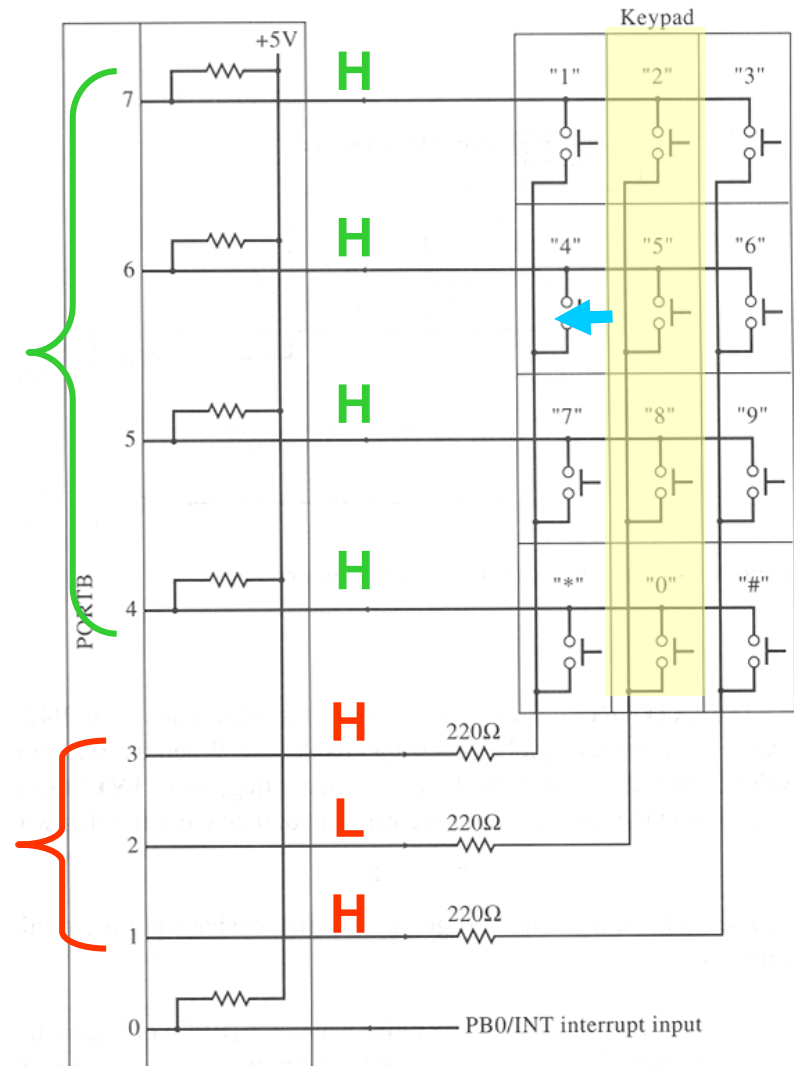


Scanned Keypad



row
return
lines

active low
column
scan lines

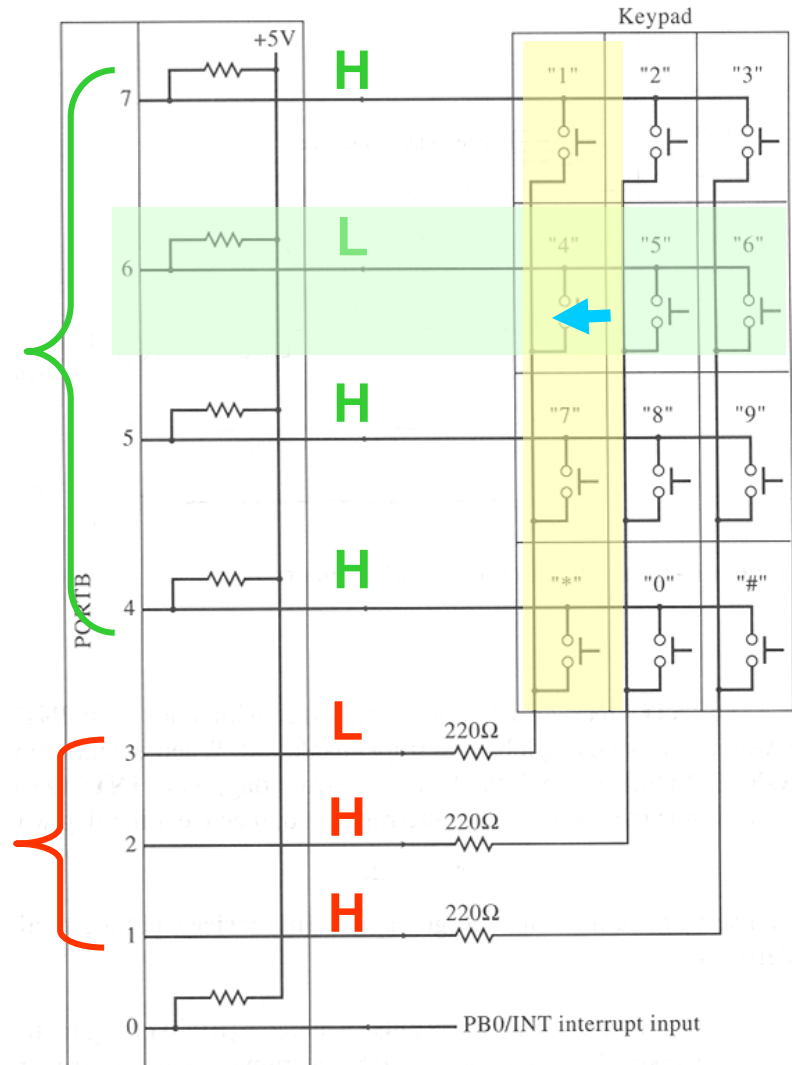


Scanned Keypad



row
return
lines

active low
column
scan lines



Keypad Encoder

FAIRCHILD
SEMICONDUCTOR™

October 1987
Revised January 1999

MM74C922 • MM74C923 16-Key Encoder • 20-Key Encoder

General Description

The MM74C922 and MM74C923 CMOS key encoders provide all the necessary logic to fully encode an array of SPST switches. The keyboard scan can be implemented by either an external clock or external capacitor. These encoders also have on-chip pull-up devices which permit switches with up to 50 k Ω on resistance to be used. No diodes in the switch array are needed to eliminate ghost switches. The internal debounce circuit needs only a single external capacitor and can be defeated by omitting the capacitor. A Data Available output goes to a high level when a valid keyboard entry has been made. The Data Available output returns to a low level when the entered key is released, even if another key is depressed. The Data Available will return high to indicate acceptance of the new key after a normal debounce period; this two-key roll-over is provided between any two switches.

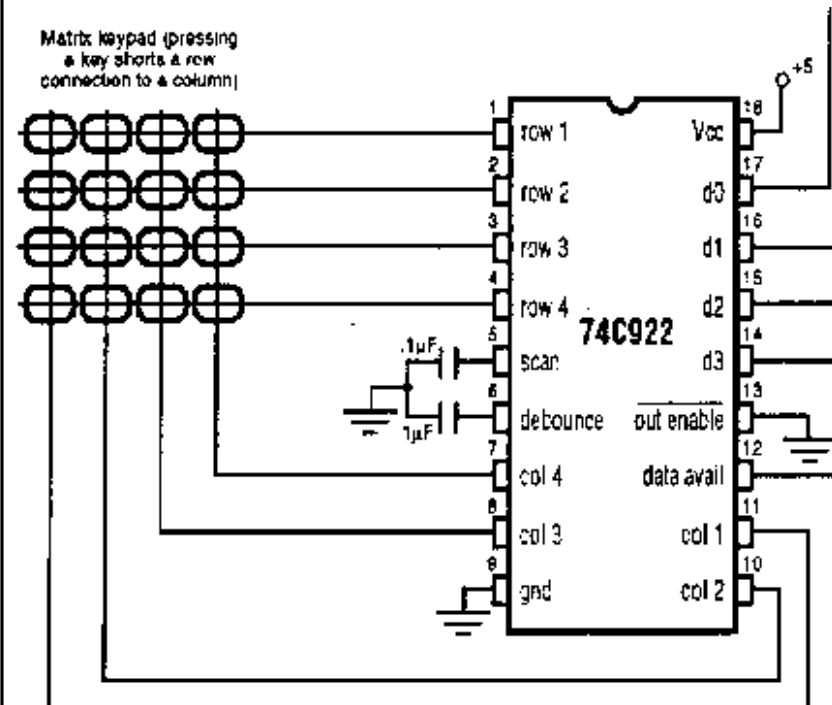
An internal register remembers the last key pressed even after the key is released. The 3-STATE outputs provide for easy expansion and bus operation and are LPTTL compatible.

Features

- 50 k Ω maximum switch on resistance
- On or off chip clock
- On-chip row pull-up devices
- 2 key roll-over
- Keybounce elimination with single capacitor
- Last key register at outputs
- 3-STATE output LPTTL compatible
- Wide supply range: 3V to 15V
- Low power consumption

Ordering Code:

Order Number	Package Number	Package Description
MM74C922N	N18A	18-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
MM74C922WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
MM74C923WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide

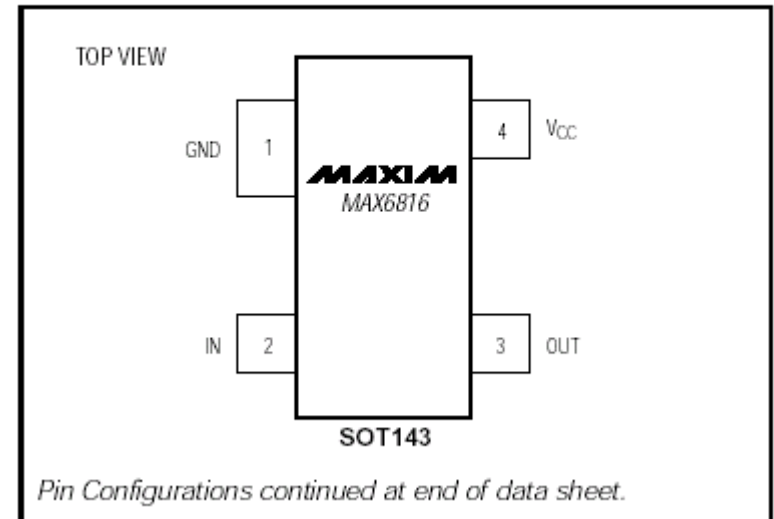


Switch Debouncer

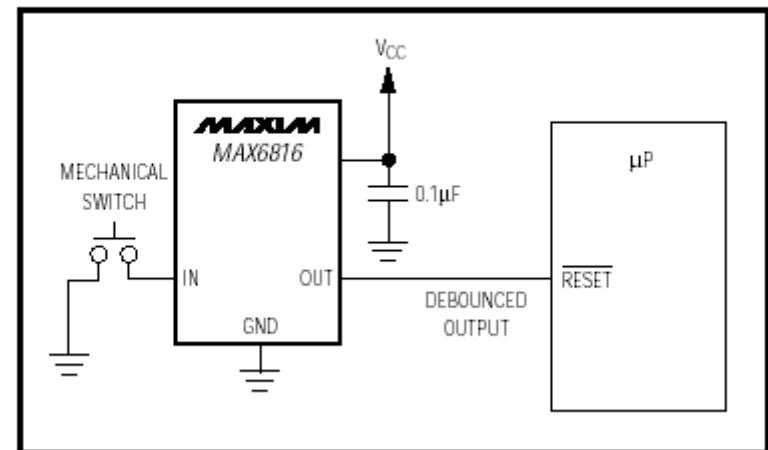
Features

- ◆ Robust Inputs can Exceed Power Supplies up to $\pm 25\text{V}$
- ◆ ESD Protection for Input Pins
 - $\pm 15\text{kV}$ —Human Body Model
 - $\pm 8\text{kV}$ —IEC 1000-4-2, Contact Discharge
 - $\pm 15\text{kV}$ —IEC 1000-4-2, Air-Gap Discharge
- ◆ Small SOT Packages (4 and 6 pins)
- ◆ Single-Supply Operation from $+2.7\text{V}$ to $+5.5\text{V}$
- ◆ Single (MAX6816), Dual (MAX6817), and Octal (MAX6818) Versions Available
- ◆ No External Components Required
- ◆ $6\mu\text{A}$ Supply Current
- ◆ Three-State Outputs for Directly Interfacing Switches to μP Data Bus (MAX6818)
- ◆ Switch Change-of-State Output Simplifies Polling and Interrupts (MAX6818)
- ◆ Pin-Compatible with 'LS573 (MAX6818)

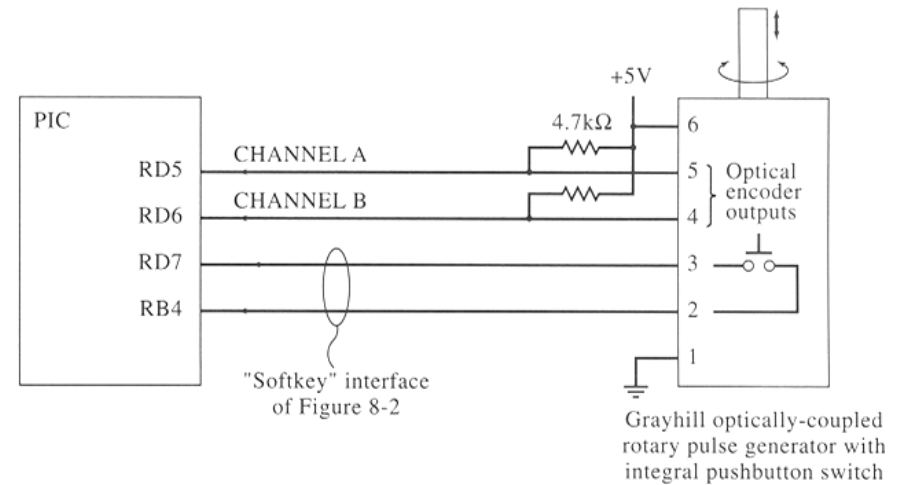
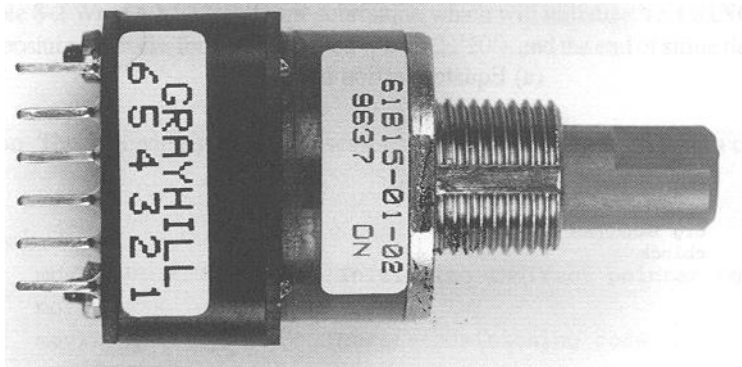
Pin Configurations



Typical Operating Circuit

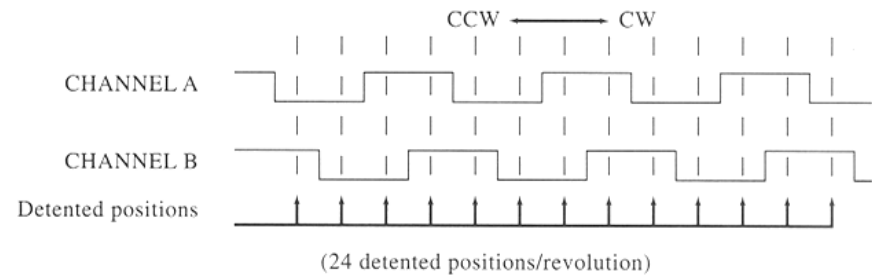


Rotary Pulse Generator (RPG)



(b) Circuit

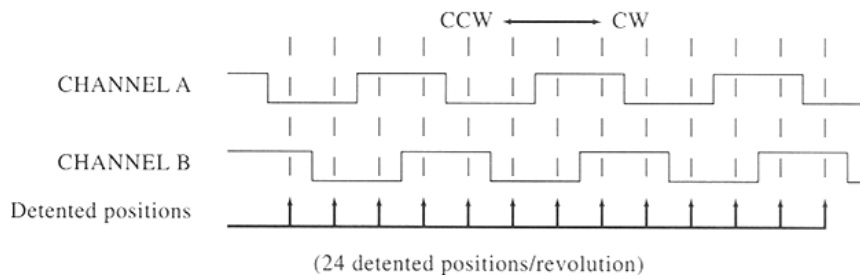
(Model 61B15-01-02)



(c) Encoder output

RPGs

- Determine direction of rotation by concatenating “previous” and “current” codes, and using as look-up table index



AB: 10 → 11 → 01 → 00 → 11 ... CCW rotation

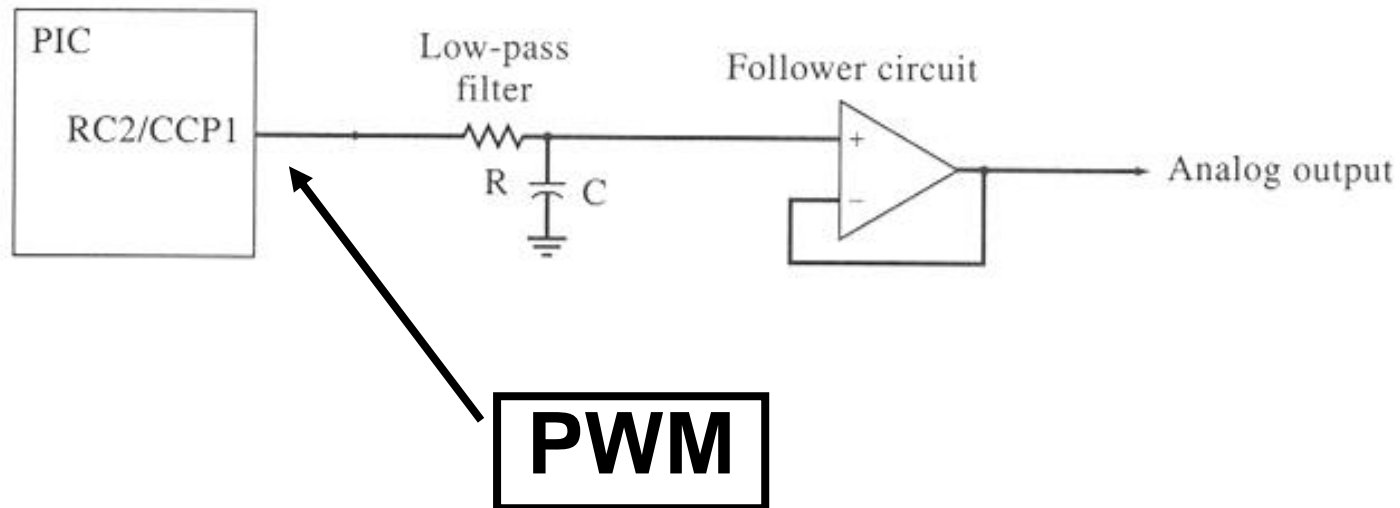
AB: 10 → 00 → 01 → 11 → 10 ... CW rotation

CODE	CONDITION
0	got interrupt, but no change in code read
1	clock-wise (single bit change)
2	counter clock wise (single bit change)
3	error (both bits change)

PREV	CURR	LOOK-UP CODE	COMMENTS
00	00	db 0	00 → 00, no change
00	01	db 1	00 → 01, CW
00	10	db 2	00 → 10, CCW
00	11	db 3	00 → 11, error
01	00	db 2	01 → 00, CCW
01	01	db 0	01 → 01, no change
01	10	db 3	01 → 10, error
01	11	db 1	01 → 11, CW
10	00	db 1	01 → 00, CW
10	01	db 3	10 → 01, error
10	10	db 0	10 → 10, no change
10	11	db 2	10 → 11, CCW
11	00	db 3	11 → 00, error
11	01	db 2	11 → 01, CCW
11	10	db 1	11 → 10, CW
11	11	db 0	11 → 11, no change

PWM Applications/Interfaces

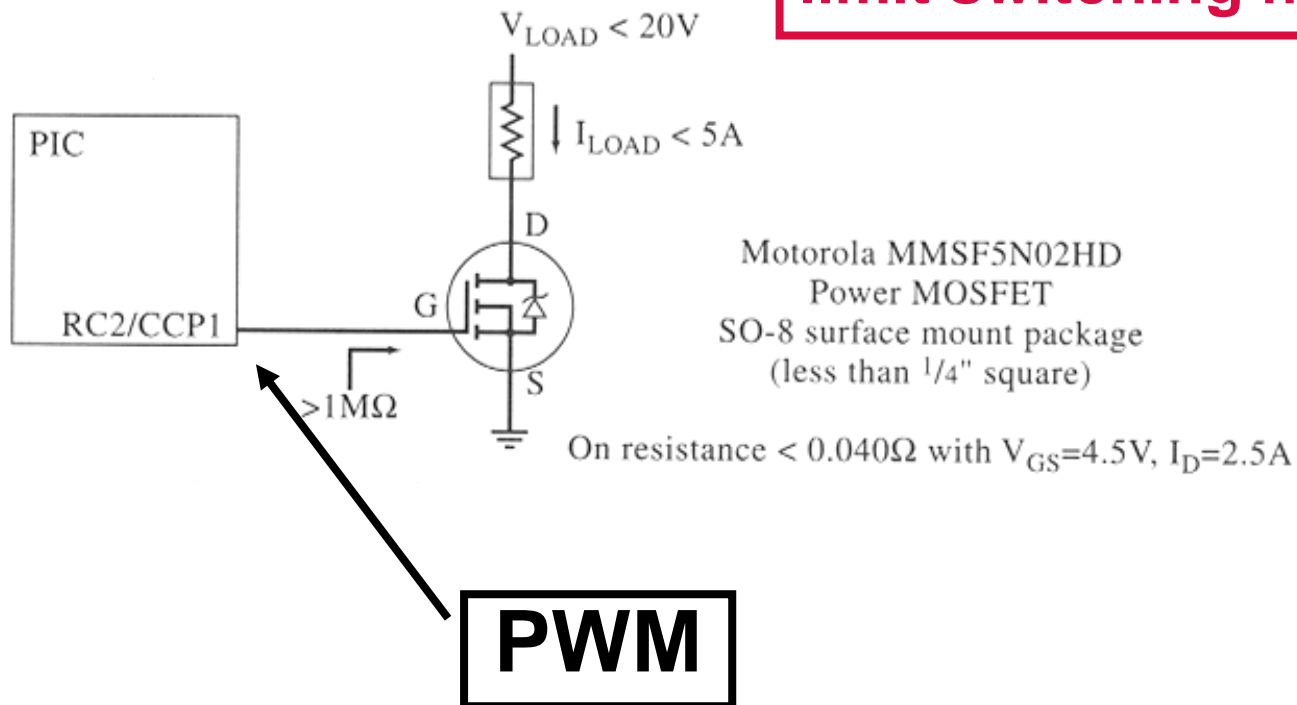
- **Simple D/A converter**



PWM Applications/Interfaces

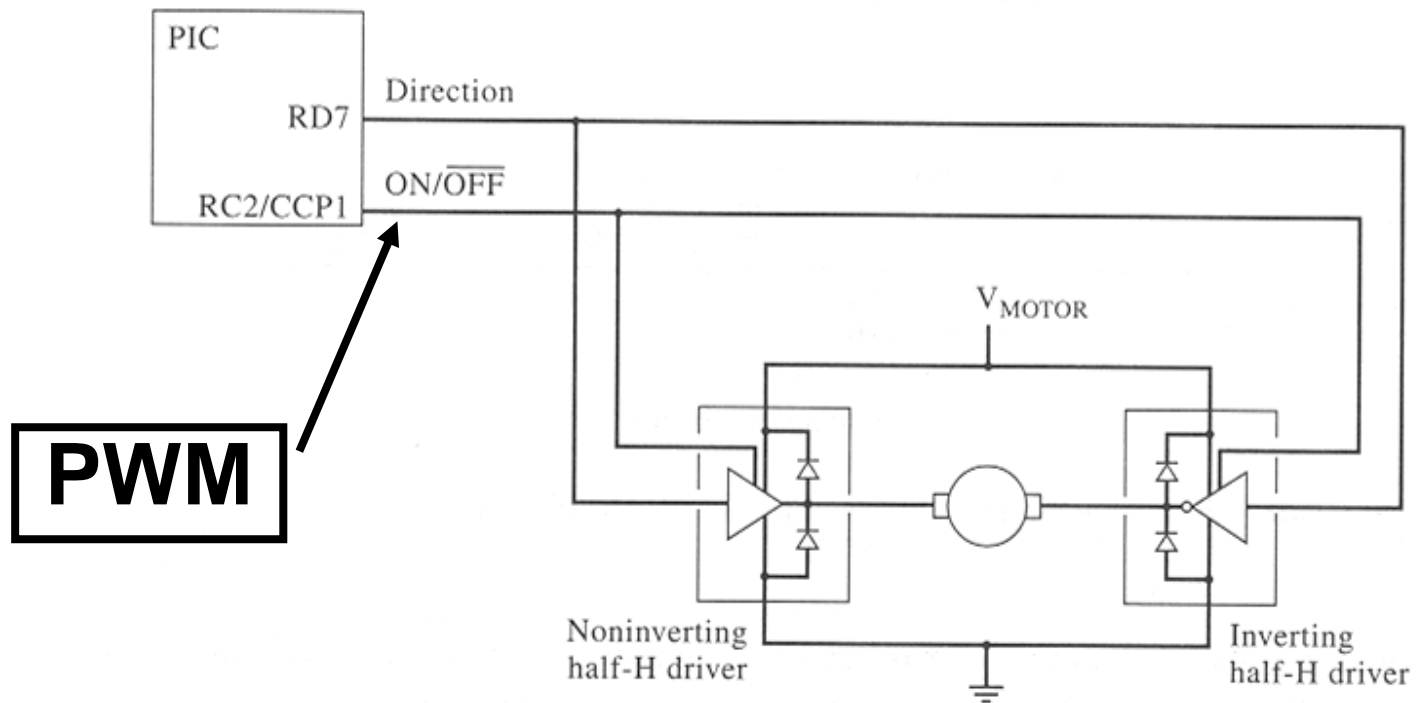
- Driving a switched load

Limitation: Capacitive load of MOSFET may limit switching frequency

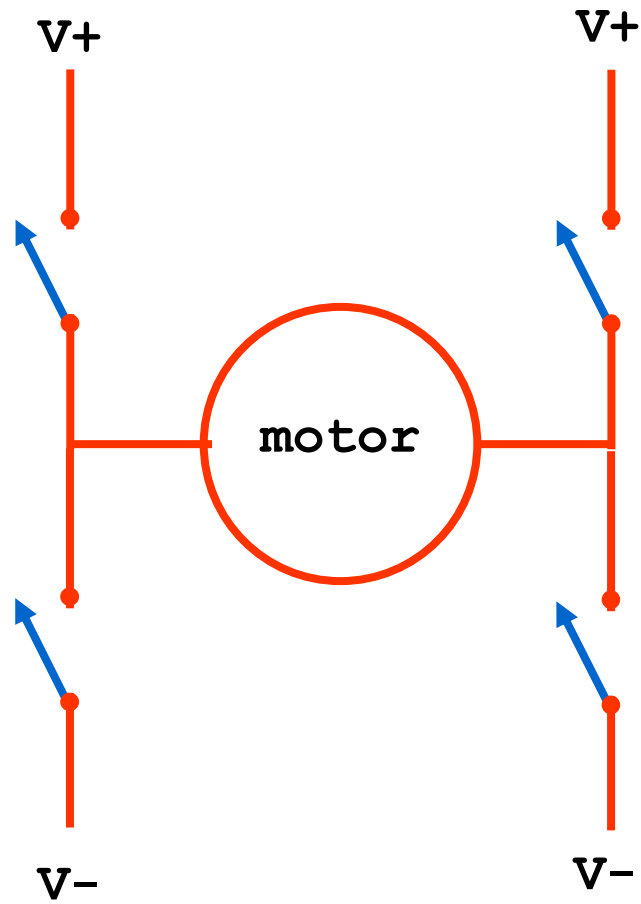


PWM Applications/Interfaces

- Motor speed and direction using H-bridge

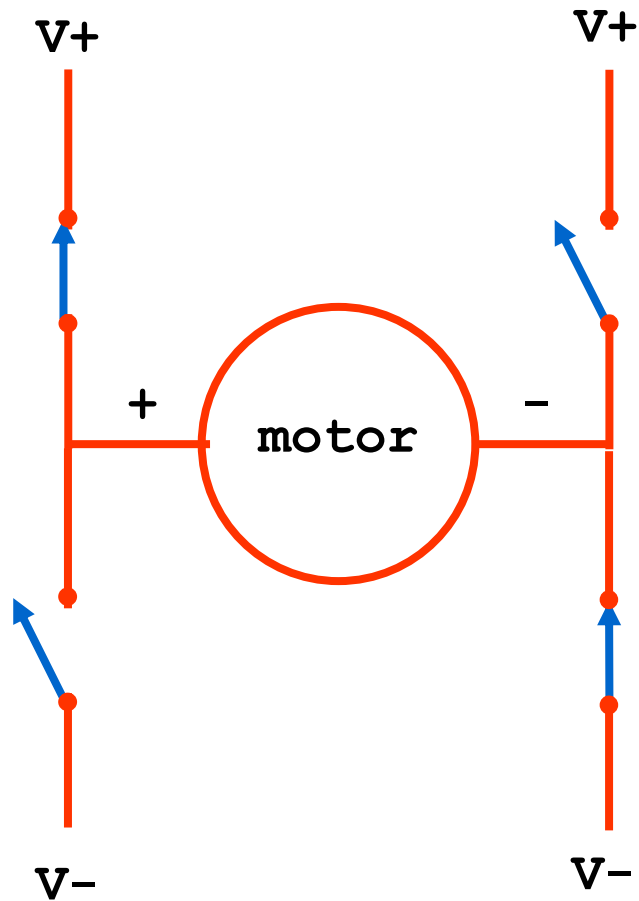


“H Bridge”



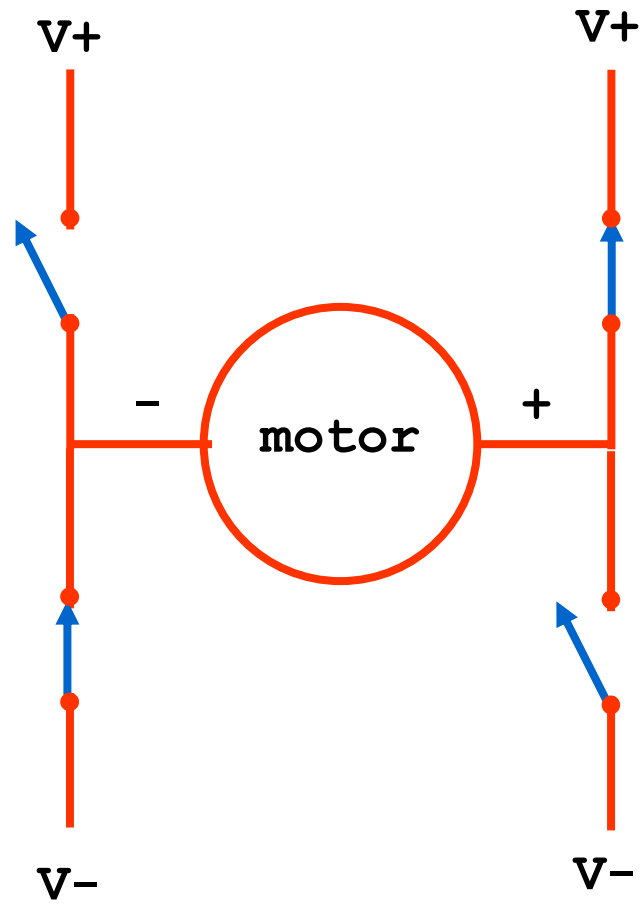
“coasting”

“H Bridge”



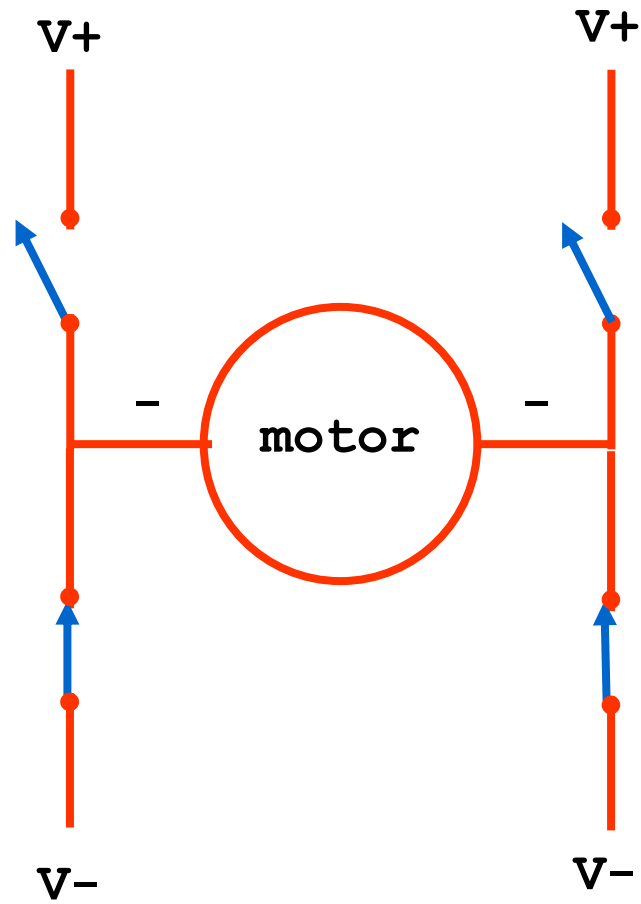
“forward”

“H Bridge”



“reverse”

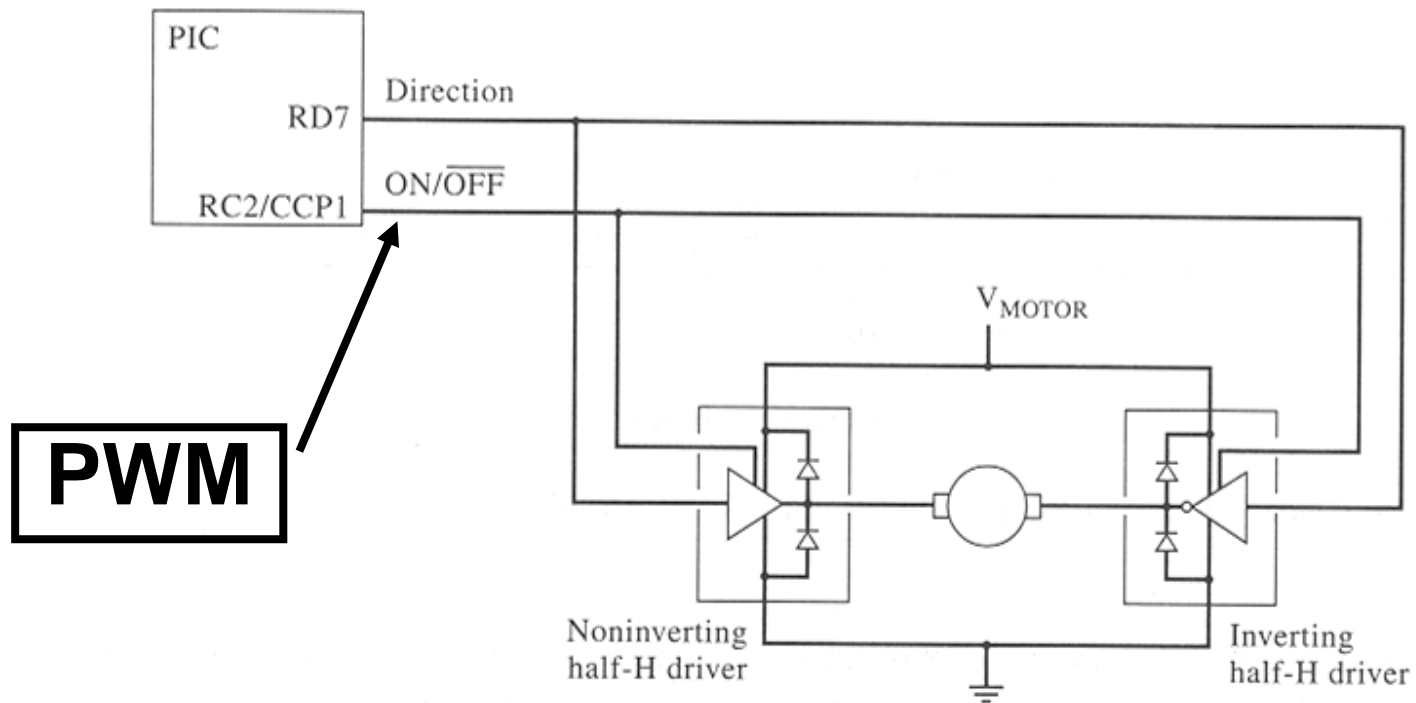
“H Bridge”



“braking”

PWM Applications/Interfaces

- Motor speed and direction using H-bridge



Notes about H-bridges

- H-bridge **MUST** be suitably sized for motor – measure **inrush current** of motor **BEFORE** buying H-bridge
- Often need “dead time” between phases of driving the H-bridge input to prevent shoot-through (turn-off delay)
- Use “snubber” diodes to protect H-bridge from inductive kickback from motor
- Carefully check all specifications of H-bridge, specifically turn-off time, max frequency, R_{DS} , max supply voltage, V_{IH-min} , V_{IL-max} , etc.

Position Control

- **Position control**

- required in many applications
- complications
 - inertia/mechanical loading
 - startup torque different than run torque (inrush)
 - gear backlash
- stepping actuators are a good solution for many positioning problems
 - Rotational and linear versions available
- why steppers are a good choice
 - high resolution without gearing
 - fast positioning (up to 1000 steps/sec)
 - position error (usually) does not accumulate
 - wide range of high and low torque (large/small) available
 - simple/efficient drive circuitry



Stepper Motor Interface

Half/full step = L

A	B	C	D
L	H	H	L
L	L	H	H
H	L	L	H
H	H	L	L
L	H	H	L

Direction = H

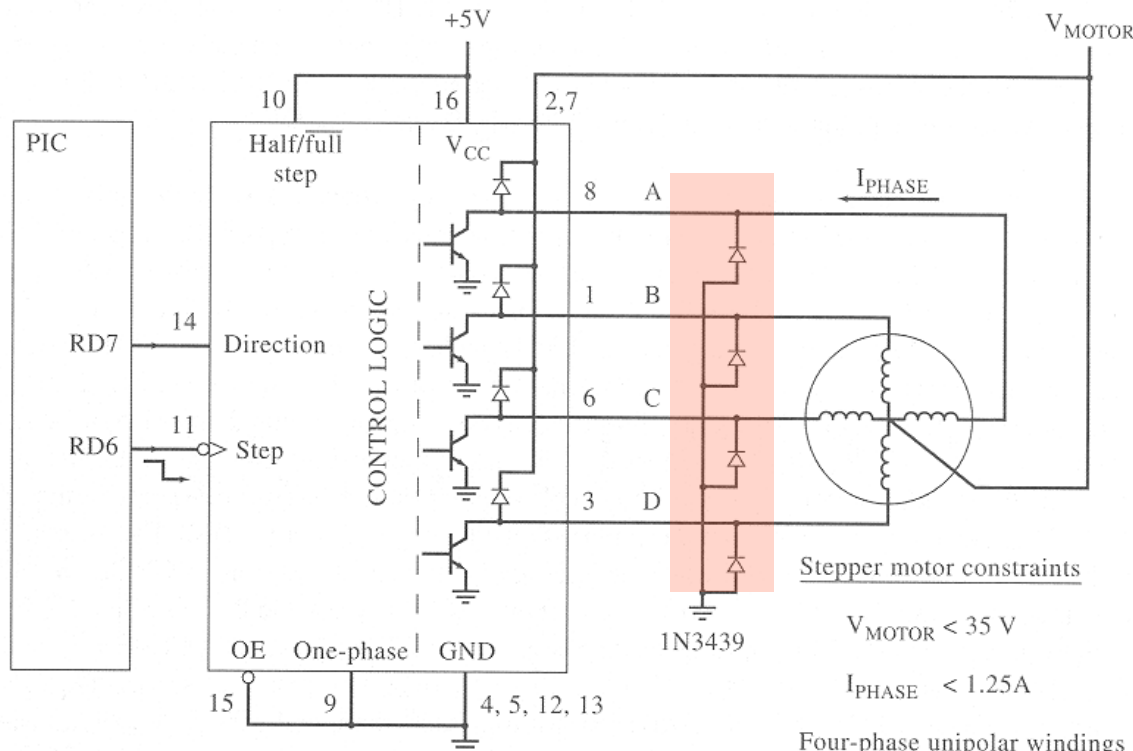
Direction = L

Half/full step = H

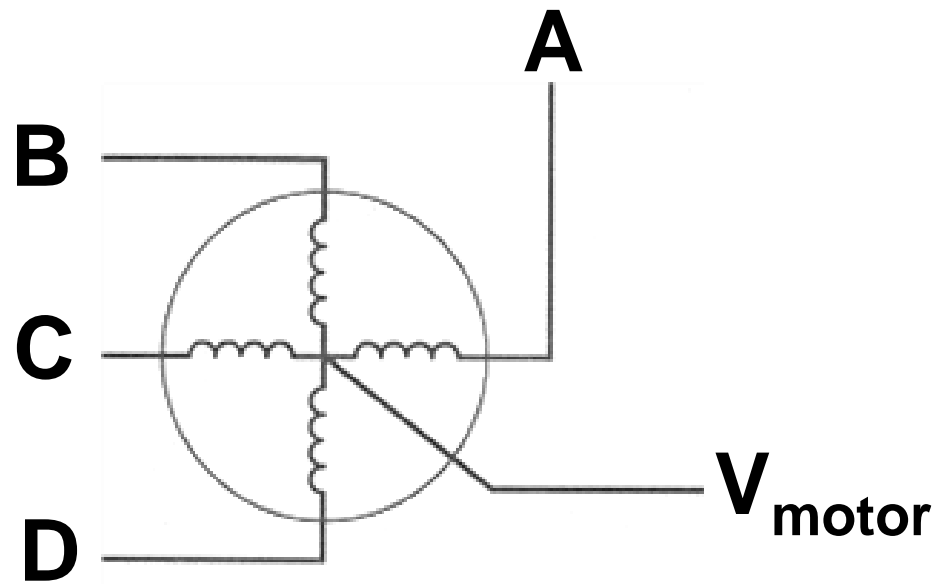
A	B	C	D
L	H	H	H
L	L	H	H
H	L	H	H
H	L	L	H
H	H	L	H
H	H	L	L
H	H	H	L
L	H	H	L
L	H	H	H

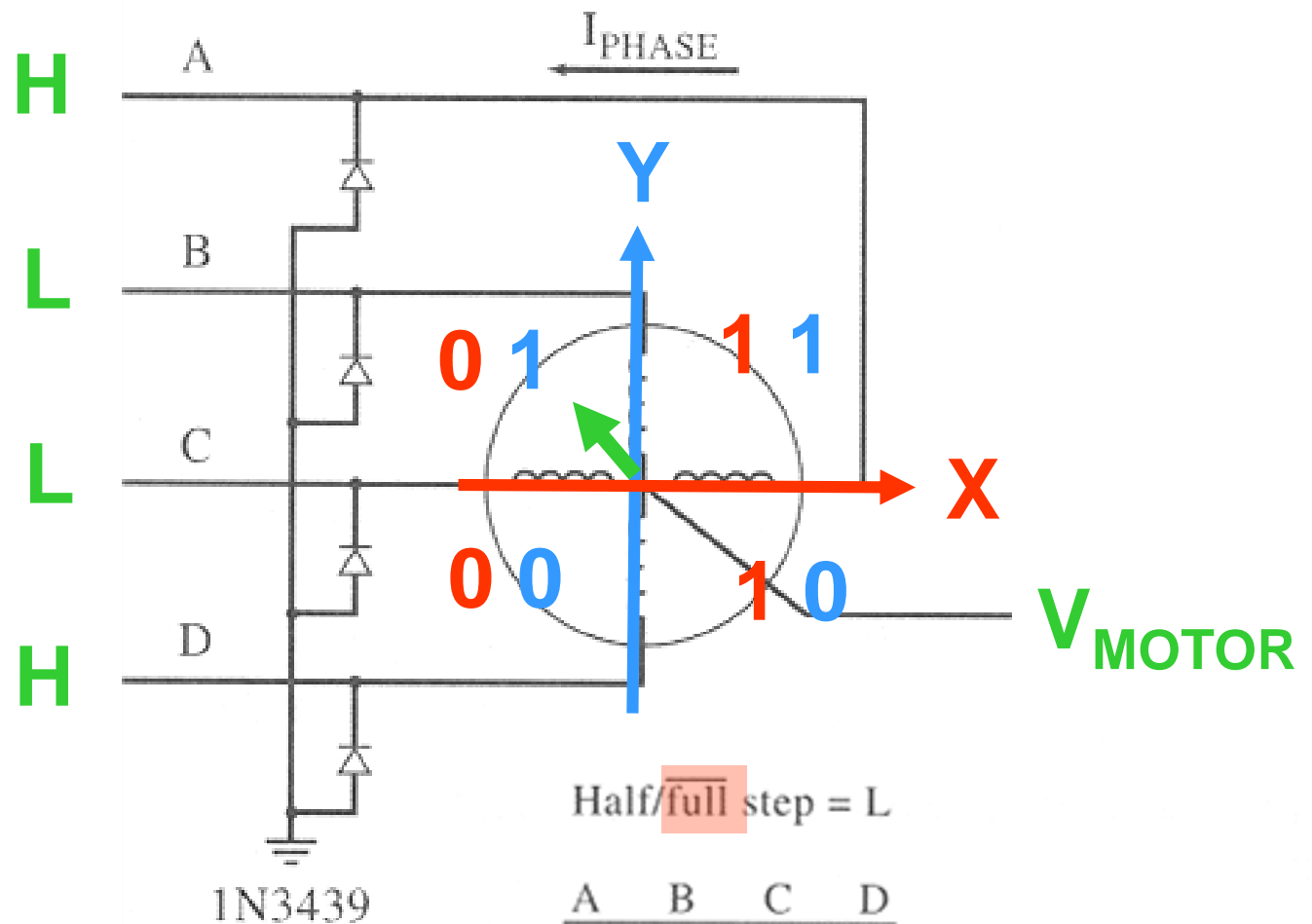
Direction = H

Direction = L



Allegro MicroSystems
Stepper Motor Translator/Driver
UCN5804B
(16-pin DIP)





Half/**full** step = L

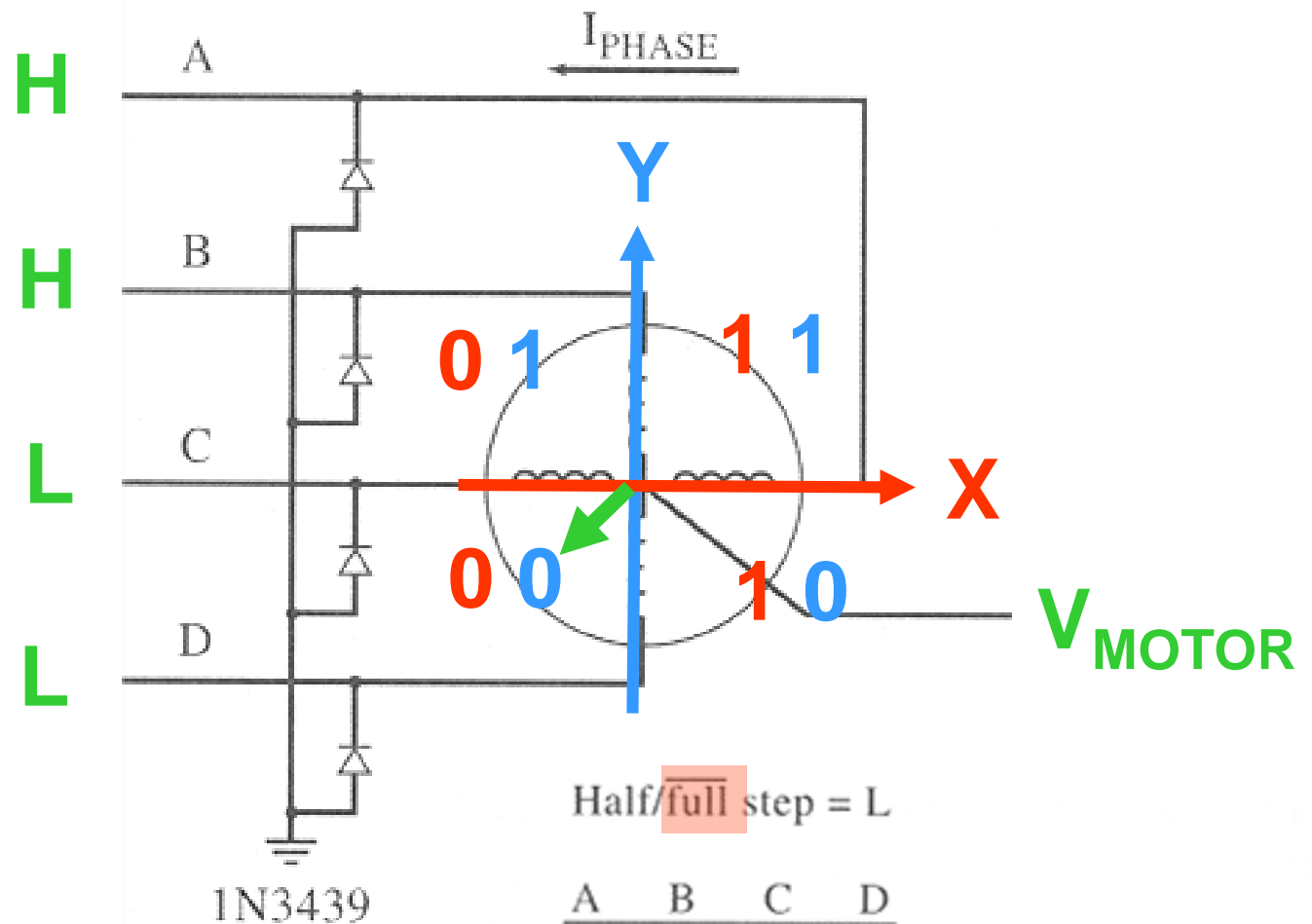
A	B	C	D
L	H	H	L
L	L	H	H
H	L	L	H
H	H	L	L
L	H	H	L

Direction = H



Direction = L

FULL STEP MODE



Half/**full** step = L

A	B	C	D
L	H	H	L
L	L	H	H
H	L	L	H
H	H	L	L
L	H	H	L

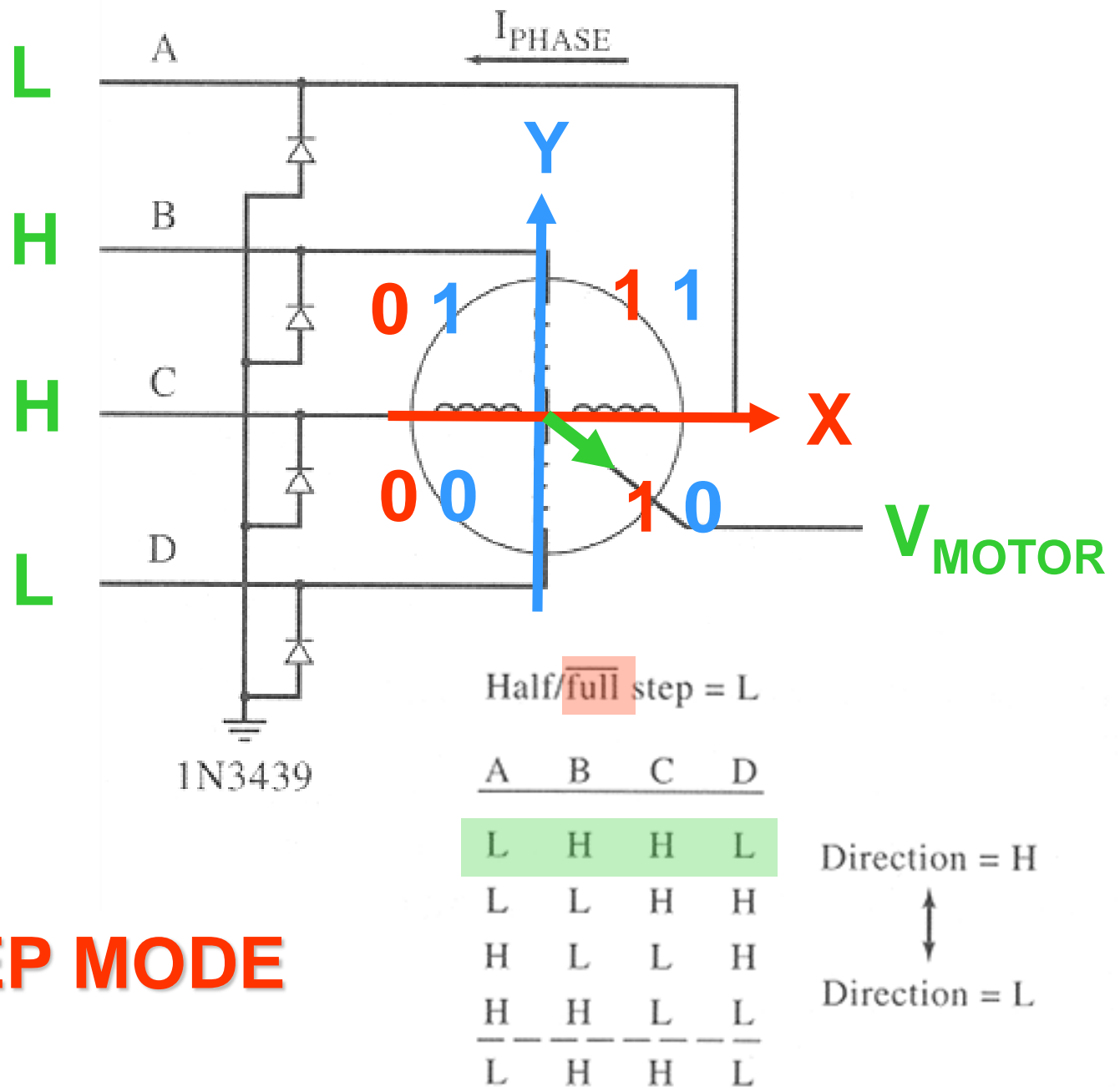
Direction = H

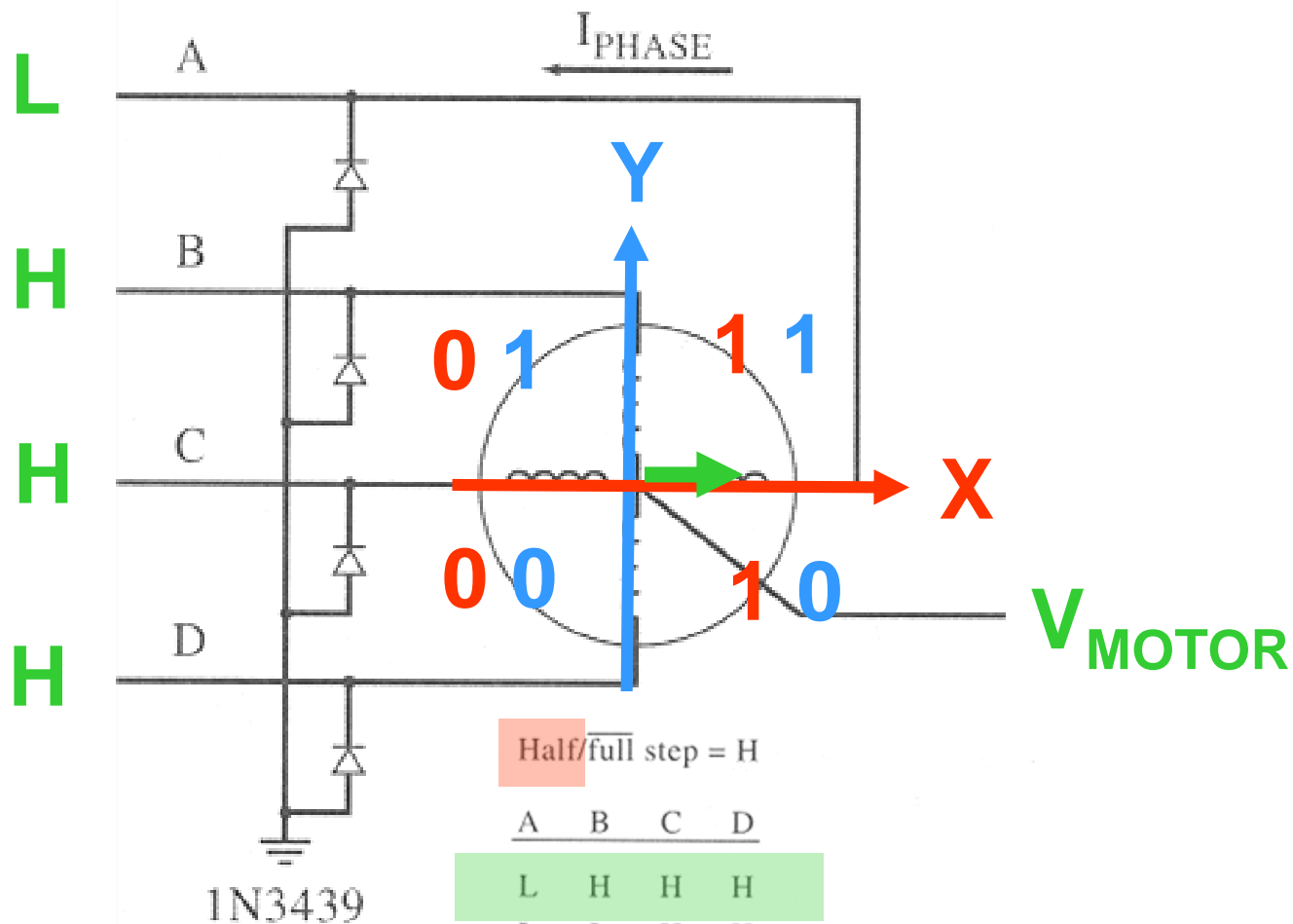


Direction = L

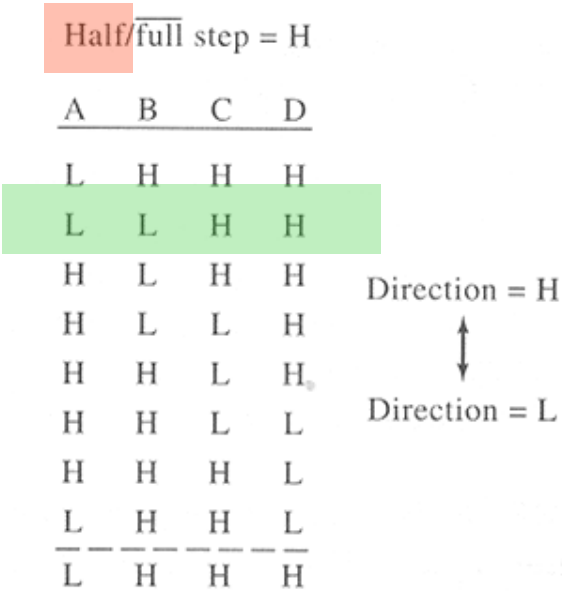
FULL STEP MODE

FULL STEP MODE

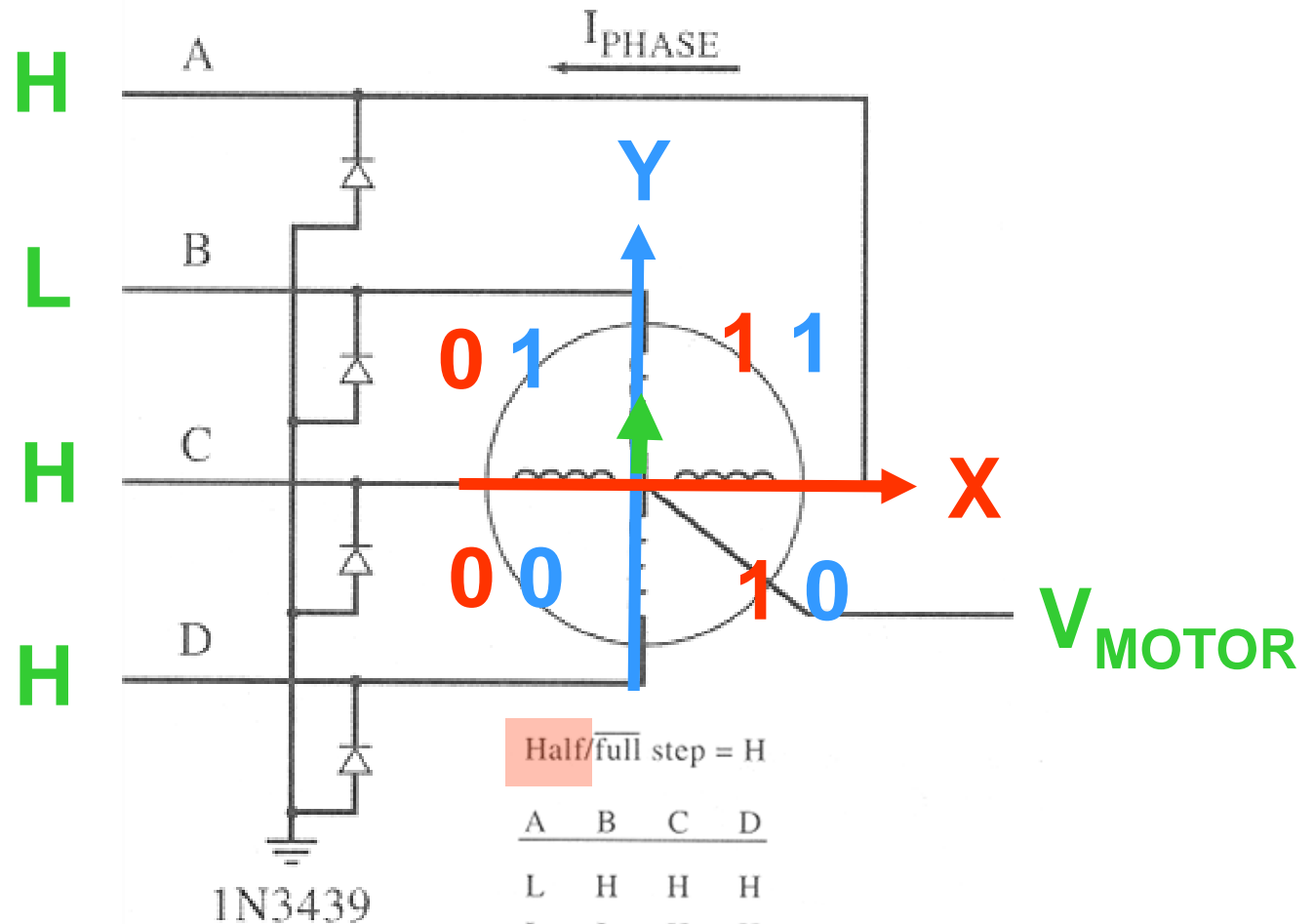




HALF STEP MODE



HALF STEP MODE



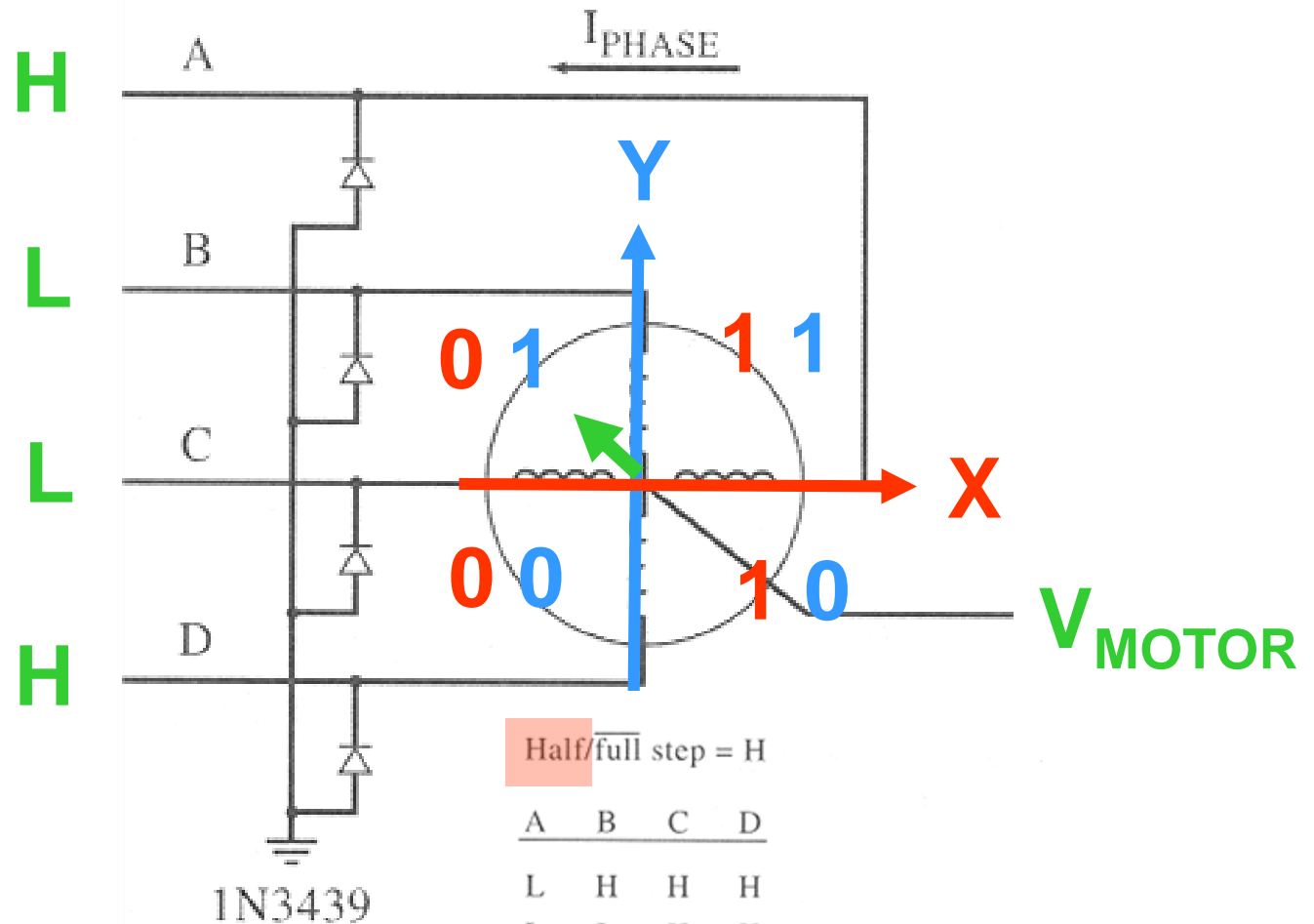
Half/full step = H

A	B	C	D
L	H	H	H
L	L	H	H
H	L	H	H
H	L	L	H
H	H	L	H
H	H	L	L
H	H	H	L
L	H	H	L
L	H	H	H

Direction = H

Direction = L

HALF STEP MODE



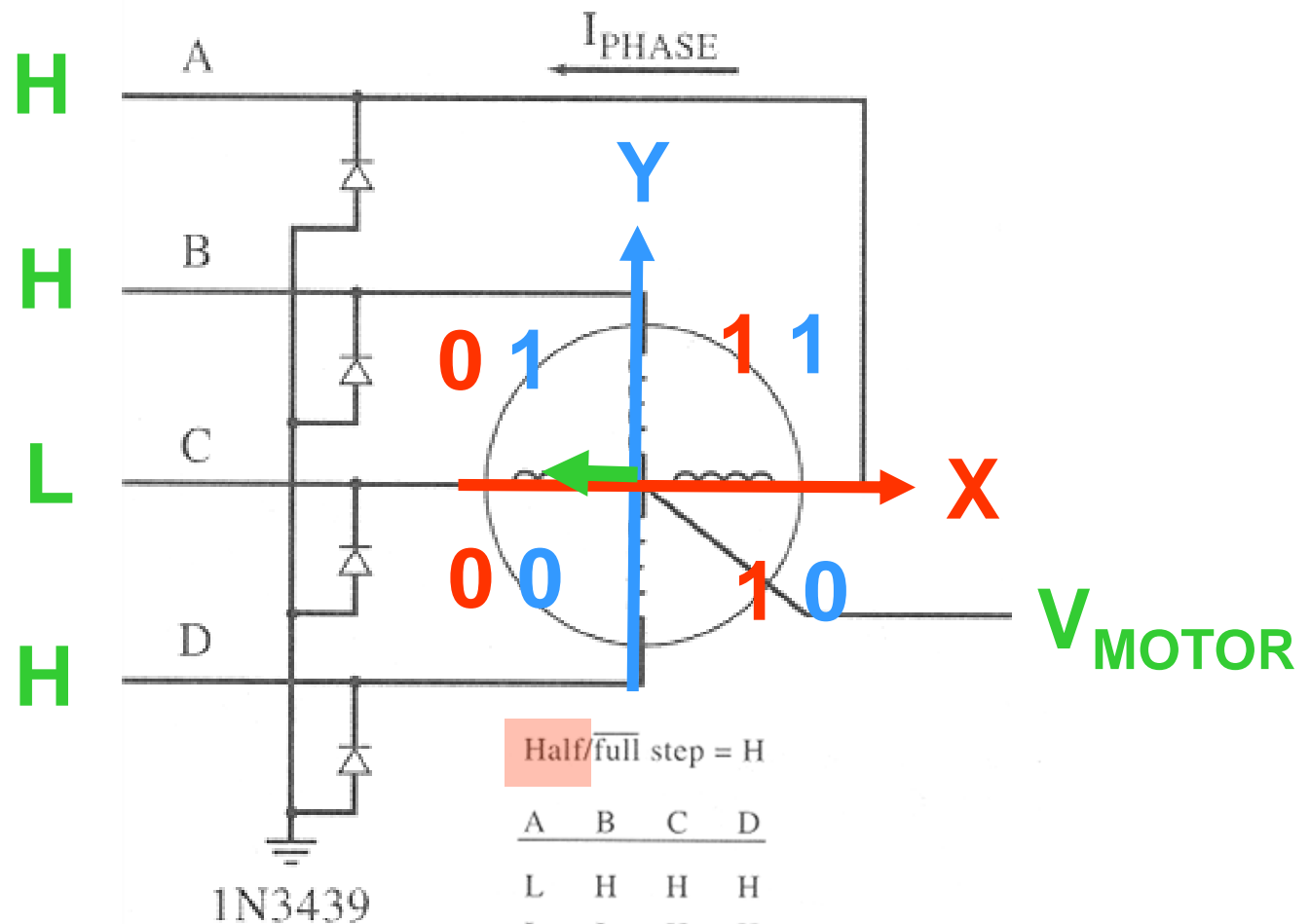
Half/full step = H

A	B	C	D
L	H	H	H
L	L	H	H
H	L	H	H
H	L	L	H
H	H	L	H
H	H	L	L
H	H	H	L
L	H	H	L
L	H	H	H

Direction = H

Direction = L

HALF STEP MODE



Half/full step = H

A	B	C	D
L	H	H	H
L	L	H	H
H	L	H	H
H	L	L	H
H	H	L	H
H	H	L	L
H	H	H	L
L	H	H	L
L	H	H	H

Direction = H



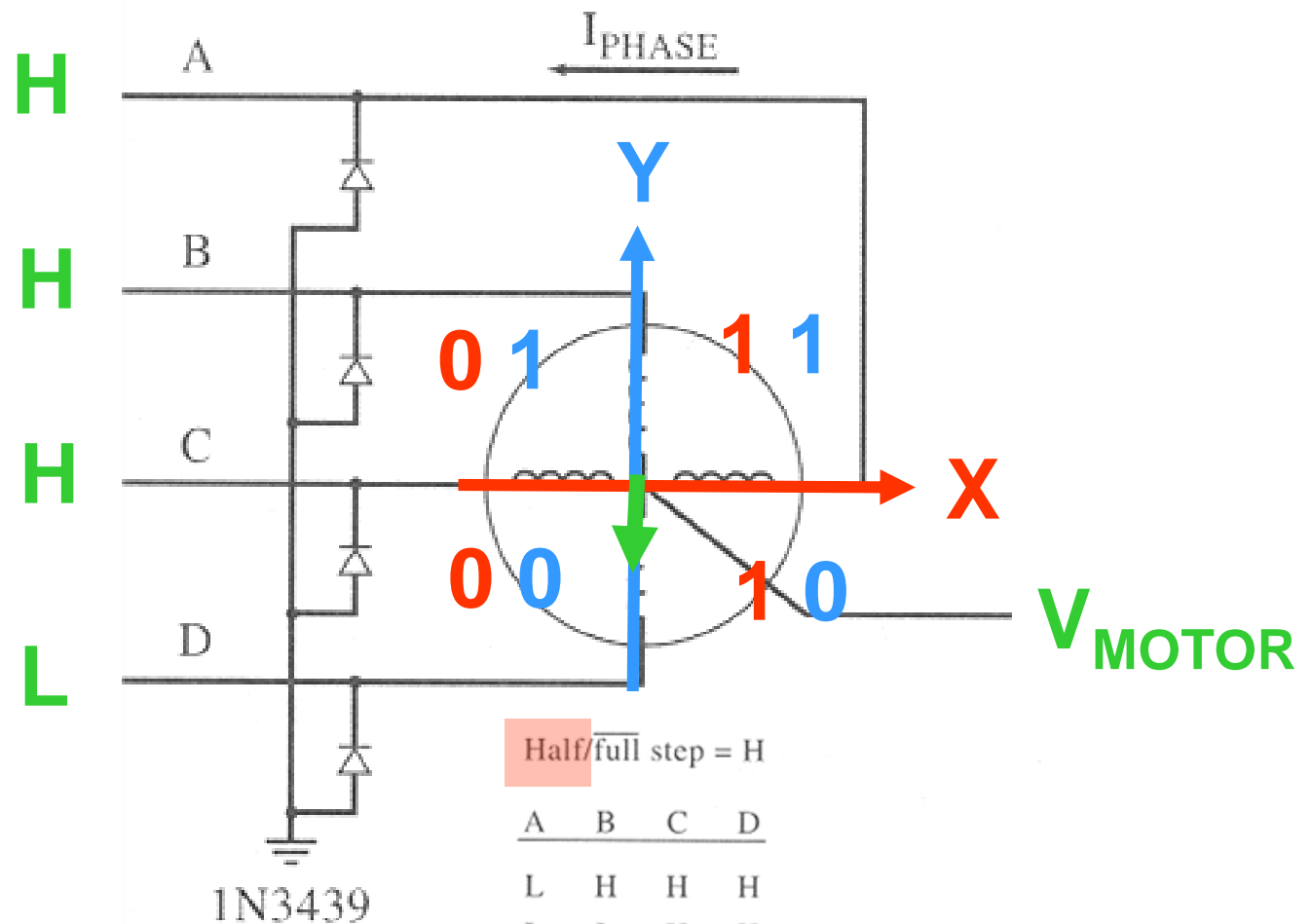
Direction = L

HALF STEP MODE



A	B	C	D
L	H	H	H
L	L	H	H
H	L	H	H
H	L	L	H
H	H	L	H
H	H	L	L
H	H	H	L
L	H	H	L
L	H	H	H

Direction = L



Half/full step = H

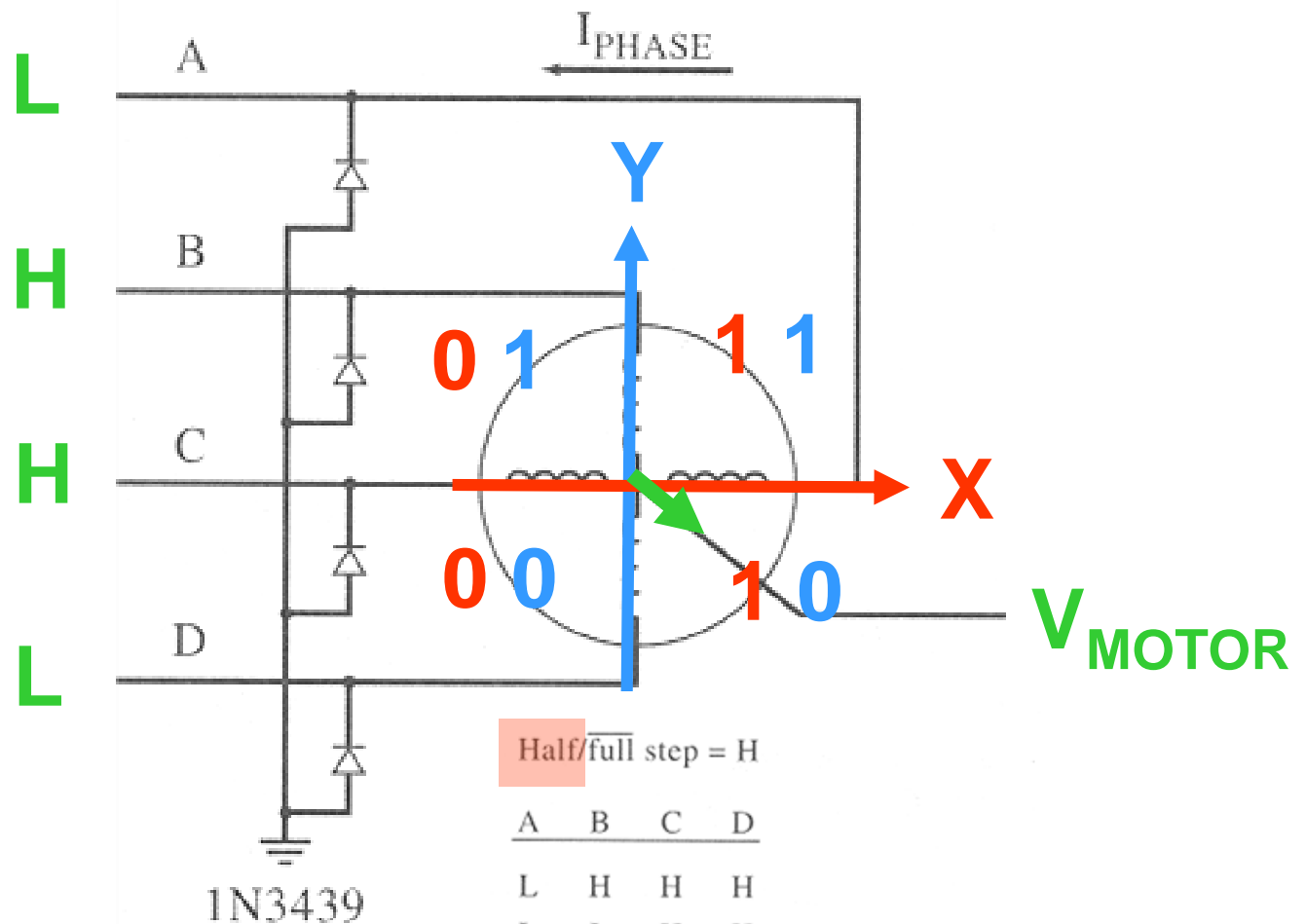
A	B	C	D
L	H	H	H
L	L	H	H
H	L	H	H
H	L	L	H
H	H	L	H
H	H	L	L
H	H	H	L
L	H	H	L
L	H	H	H

Direction = H



Direction = L

HALF STEP MODE



Half/full step = H

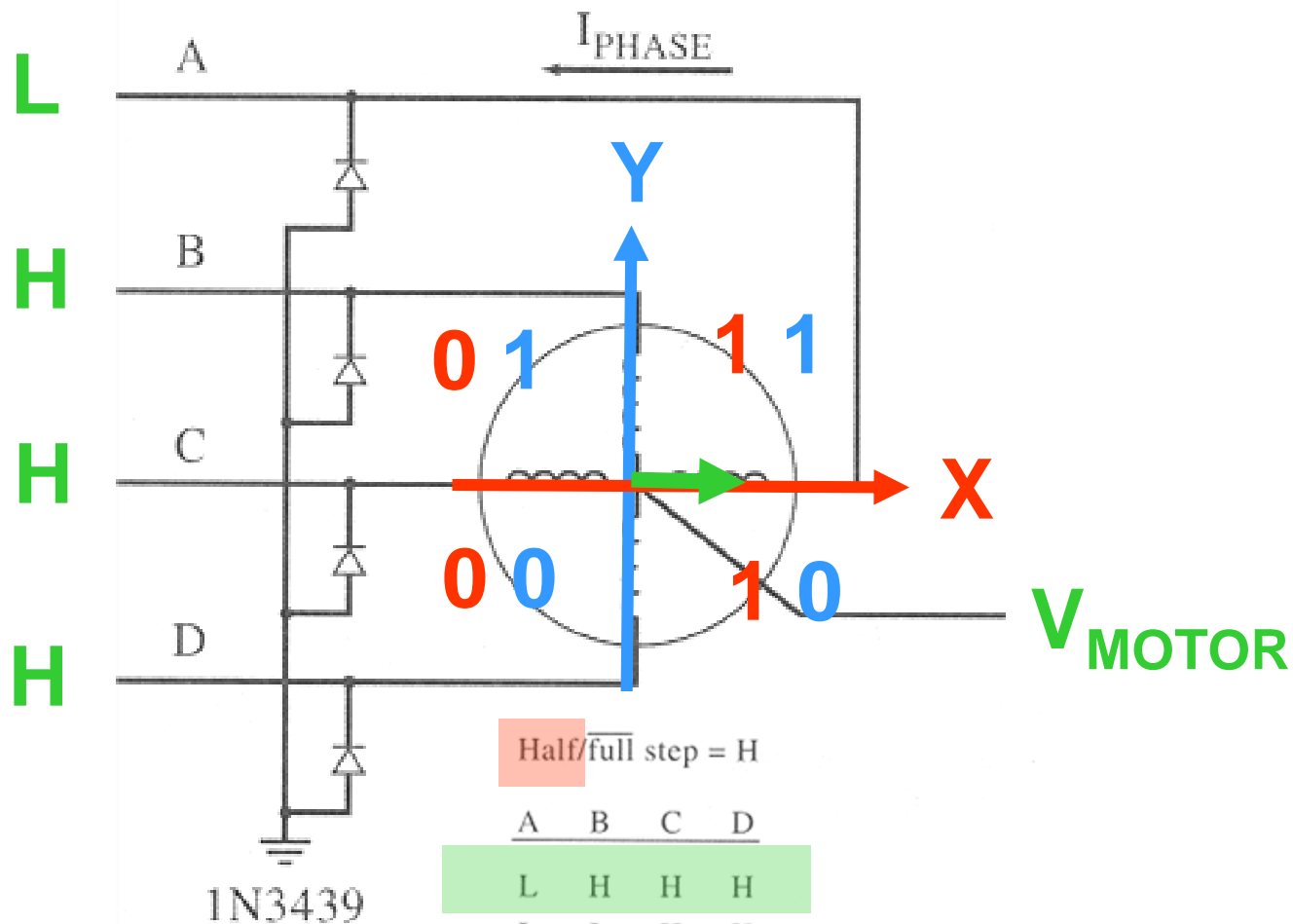
A	B	C	D
L	H	H	H
L	L	H	H
H	L	H	H
H	L	L	H
H	H	L	H
H	H	L	L
H	H	H	L
L	H	H	L
L	H	H	H

Direction = H



Direction = L

HALF STEP MODE



HALF STEP MODE

Hobbyist Servos



- **Position control**

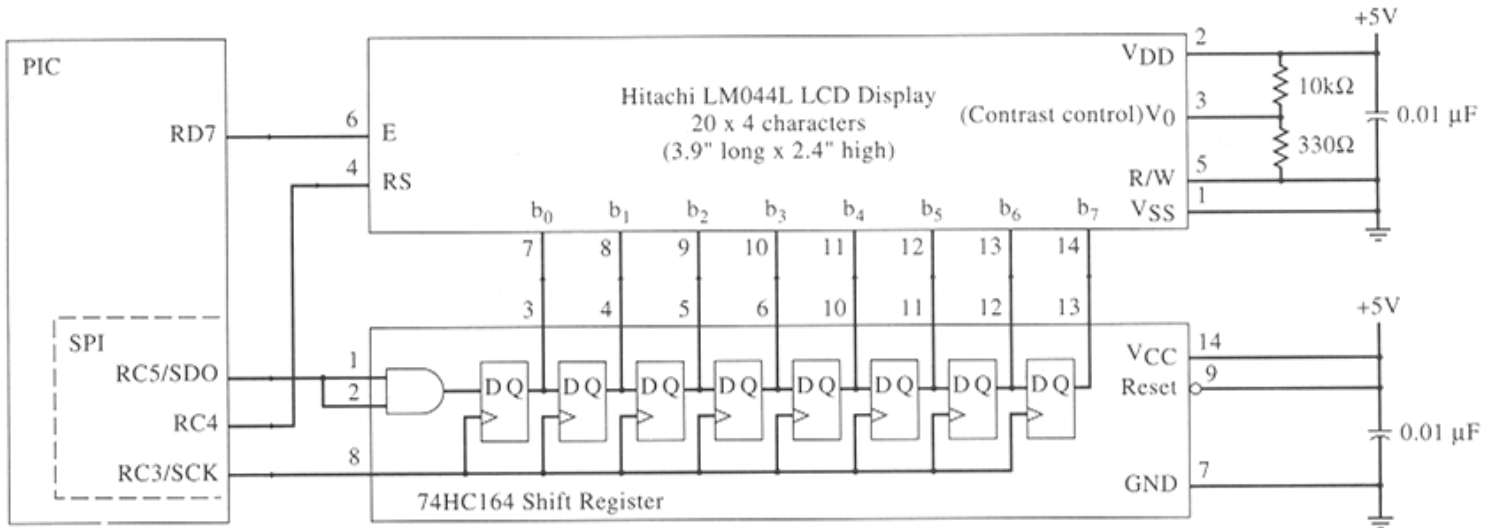
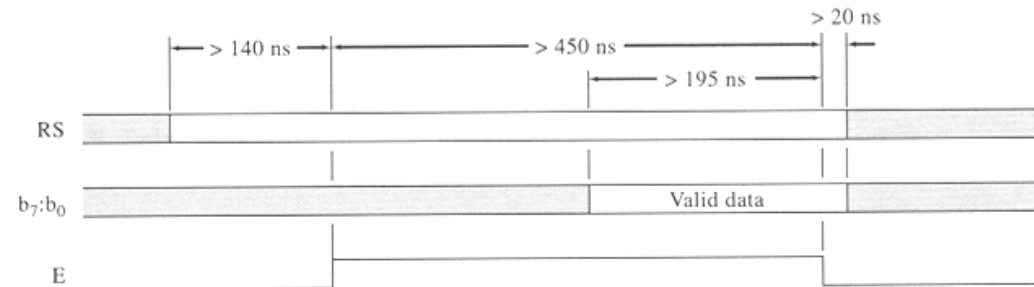
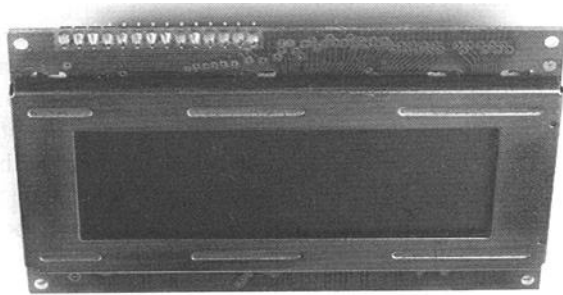
- Single-wire interface
- Can not rotate more than $\sim 270^\circ$
- why servos are a good choice
 - Low overhead for control – logic-level interface
 - Simple interface (PWM)

Pulse width (0.9-2.9 μ s)



- why servos may not be a good choice
 - Limited range of motion
 - Lower torque

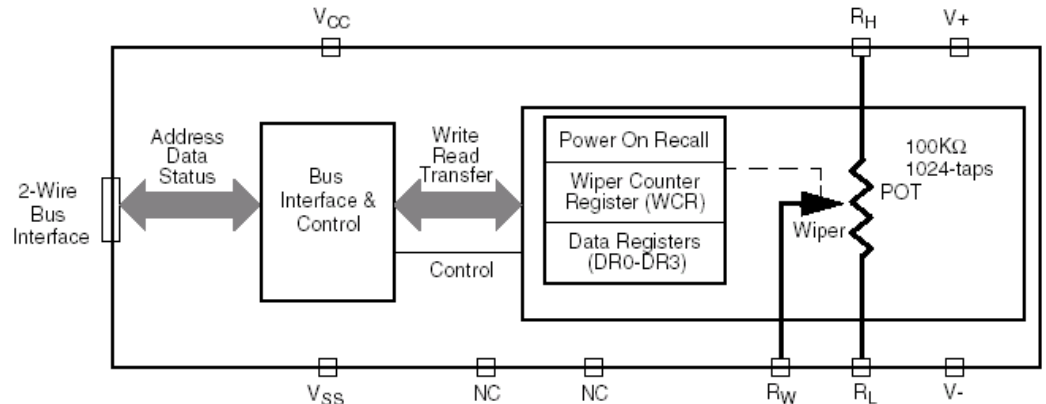
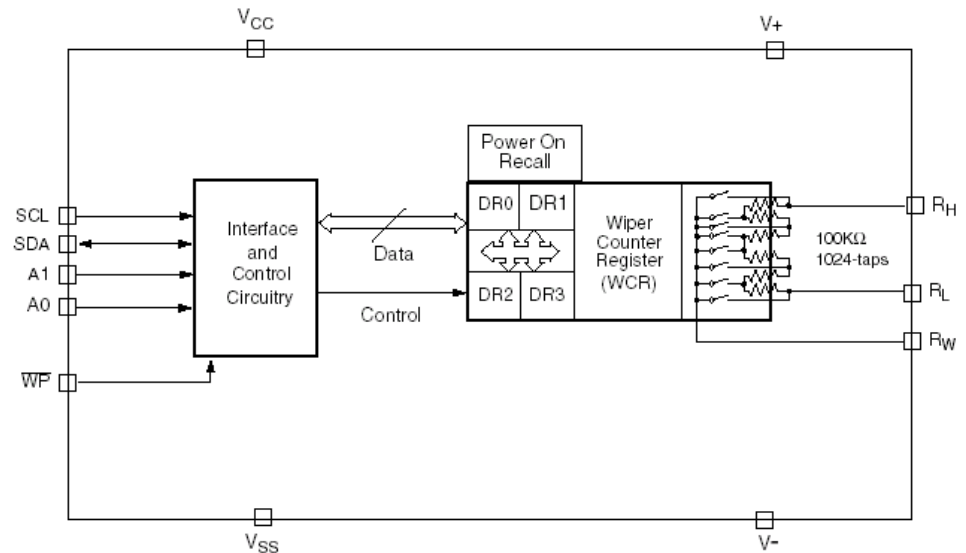
Basic LCD Interface



Digitally Controlled Potentiometer

FEATURES

- 1024 Resistor Taps – 10-Bit Resolution
- 2-Wire Serial Interface for write, read, and transfer operations of the potentiometer
- Wiper Resistance, 40Ω Typical @ 5V
- Four Non-Volatile Data Registers for Each Potentiometer
- Non-Volatile Storage of Multiple Wiper Positions
- Power On Recall. Loads Saved Wiper Position on Power Up.
- Standby Current < 3μA Max
- System V_{CC} : - 2.7V to 5.5V Operation
- Analog $V+/V-$: -5V to +5V
- 100KΩ End to End Resistance
- Endurance: 100,000 Data changes per bit per register
- 100 yr. Data Retention
- 14-Lead TSSOP, xx-Lead XBGA
- Low power CMOS



Digital Thermometer



www.maxim-ic.com

DS18S20 High-Precision 1-Wire Digital Thermometer

FEATURES

- Unique 1-Wire® interface requires only one port pin for communication
- Each device has a unique 64-bit serial code stored in an onboard ROM
- Multidrop capability simplifies distributed temperature sensing applications
- Requires no external components
- Can be powered from data line. Power supply range is 3.0V to 5.5V
- Measures temperatures from -55°C to $+125^{\circ}\text{C}$ (-67°F to $+257^{\circ}\text{F}$)
- $\pm 0.5^{\circ}\text{C}$ accuracy from -10°C to $+85^{\circ}\text{C}$
- 9-bit thermometer resolution
- Converts temperature in 750ms (max.)
- User-definable nonvolatile (NV) alarm settings
- Alarm search command identifies and addresses devices whose temperature is outside of programmed limits (temperature alarm condition)
- Applications include thermostatic controls, industrial systems, consumer products, thermometers, or any thermally sensitive system

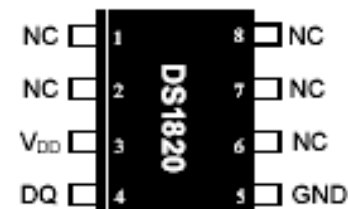
PIN ASSIGNMENT



(BOTTOM VIEW)

TO-92

(DS18S20)



8-Pin 150mil SO
(DS18S20Z)

PIN DESCRIPTION

GND - Ground
DQ - Data In/Out
V_{DD} - Power Supply Voltage
NC - No Connect

Humidity and Temperature Sensor

Humidity and Temperature Sensor - SHT15 - SparkFun Electronics - Windows Internet Explorer




http://www.sparkfun.com/products/8227

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PICAXE Microcontrollers

PSOC Microcontrollers

SMD ICs

Home | Components | SMD ICs | COM-08227

Product Info

RoHS✓

Humidity and Temperature Sensor - SHT15

sku: COM-08227

Description:

This is a compact and easy to use relative humidity sensor from Sensirion. The SHT15 digital humidity and temperature sensor is fully calibrated and offers high precision and excellent long-term stability at low cost. The digital CMOSens Technology integrates two sensors and readout circuitry on one single chip.

These sensors are really impressive! Very sensitive and straight forward to use.

Features:

- 2 factory calibrated sensors for relative humidity & temperature
- Digital 2-wire interface
- Precise dewpoint calculation possible
- Measurement range: 0-100% RH
- Absolute RH accuracy: +/- 2% RH (10...90% RH)
- Repeatability RH: +/- 0.1% RH
- Temp. accuracy: +/- 0.3°C @ 25°C
- Fast response time < 4 sec.
- Low power consumption (typ. 30 µW)
- Low cost
- High precision sensor at low cost
- Leading CMOSens Technology for superior long-term stability

Applications:

- Precise data logging

Pricing

108 in stock

\$28.95

\$26.06

\$23.16

price

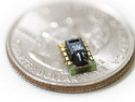
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100+



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Digital/Analog Compass

Dinsmore Sensors - Windows Internet Explorer

http://www.dinsmoresensors.com/

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Dinsmore Sensors

DINSMORE SENSORS

A Robson Company Product

**DIGITAL / ANALOG COMPASS
SENSORS**



The **1490** sensor, center, outputs eight digital compass positions (N-NE-E-SE-S-SW-W-NW)

The **1525** sensor, right, outputs a continuous analog sine/cosine signal capable of being decoded to any degree of accuracy

The **dime**, left, doesn't buy much of anything these days.

The Dinsmore Instrument Company invented the automobile compass and has been manufacturing precision magnetic instruments continuously since 1927. They have recently developed a series of new, miniature compass sensors which easily interface to computers and modern electronic technology. These sensors, due to their low cost, have an unlimited number of uses related to remote directional sensing.

Manufacturing and distribution of the Dinsmore Sensors is licensed to [The Robson Company, Inc.](#)

Select a sensor below for more details...

1490	Digital Sensor
1525	Analog Sensor
1655	Analog Sensor

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Digital Compass



www.parallax.com

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Hitachi HM55B Compass Module



This Compass Module made exclusively by Parallax is a dual-axis magnetic field sensor built around the Hitachi HM55B IC. Parallax has made this compass IC accessible by providing Hitachi's surface mount sensor chip with a 3 V onboard voltage regulator and resistor protection, all in a 0.3" wide 6-pin DIP module. The Hitachi HM55B Compass Module is compatible with all Parallax microcontrollers (including the BASIC Stamp microcontroller's 5 V supply and signal levels). Acquiring measurements from the module is made easy with a synchronous serial interface, and even easier with the BASIC Stamp 2 commands SHIFIN and SHIFOUT.

Features:

- Sensitive to microtesla (μT) variations in magnetic field strength.
- Simplifies direction by resolving magnetic field measurements into two components axes.
- 6-bit (64-direction) resolution after calibration
- Only 30 to 40 ms between start measurement and data-ready with simple synchronous serial interface.
- Built-in resistor protection for data pins eliminates bus conflict risks.
- Compact and breadboard-friendly 0.3 inch, 6-pin DIP package.
- Compatible with most microcontrollers including BASIC Stamp, Javelin Stamp, SX, and Propeller.

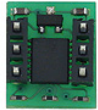
Application Ideas:

- Mobile and walking robot direction sensor
- Handheld electronic compass
- Weather-vane indicator for remote weather stations
- Audible compass for the vision impaired.
- Automotive electronic compass.

Key Specifications:

- Power: 5 VDC
- Communications: synchronous
- Dimensions: 0.4 x 0.5 x 0.45 in (10.2 x 12.7 x 11.4mm)
- Operating temp range: -4° to +185° F (-20° to +85° C)

Alternate viewing angle:



[Click through for a close-up.](#)

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Item code 29123

Availability Product is expected to ship on 2/28/2011


Stock **OUT OF STOCK** 0


Price **\$29.99**
Starting from: 5 pieces \$28.49
Starting from: 10 pieces \$26.99
Starting from: 20 pieces \$23.99

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	● COM-08951 RoHS✓ Compass with Tilt Compensation - HMC6343	\$143.95	1	Add to Cart	Add to Wish List
	▲ SEN-08960 RoHS✓ Compass Module with Tilt Compensation - OS4000-T	\$249.95	1	Add to Cart	Add to Wish List
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Accelerometer

Triple Axis Accelerometer - ADXL335 - SparkFun Electronics - Windows Internet Explorer

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Home | Components | SMD ICs | **COM-09265**

Product Info

RoHS✓

Triple Axis Accelerometer - ADXL335
sku: COM-09265

Description: The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ± 3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

The user selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application.

Breakout board listed below.

Features:

- 1.8V- 3.6V single-supply operation
- Integrated X, Y, and Z axis accelerometer on a single chip
- X and Y axis has a 0.5Hz to 1600Hz bandwidth
- Z axis has a 0.5Hz to 550Hz bandwidth
- Hermetically sealed for temp and humidity resistance
- 10,000 g shock tolerant
- LFCSP_LQ Package


Dimensions: 4 x 4 x 1.45mm

Documents:


Pricing

98 in stock

\$9.95	price
\$8.96	10-99
\$7.96	100+



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Hall Effect Sensor

Hall Effect Sensor - SparkFun Electronics - Windows Internet Explorer

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Hall Effect Sensor - SparkFun Electronics

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Home | Sensors | Magneto | COM-09312

Product Info

RoHS✓

Hall Effect Sensor

sku: COM-09312

Description:

The US1881 is an integrated Hall effect latched sensor. That's nice but what does it do? Holding a magnet near the sensor will cause the output pin to toggle. This makes for a robust presence sensor. A reed sensor also works nicely, but can be limited by the glass encapsulation and size. A hall effect sensor is much smaller, but can handle less current than a reed switch.

The device includes an on-chip Hall voltage generator for magnetic sensing, a comparator that amplifies the Hall voltage, and a Schmitt trigger to provide switching hysteresis for noise rejection, and open-collector output. An internal bandgap regulator is used to provide temperature compensated supply voltage for internal circuits and allows a wide operating supply range.

If a magnetic flux density larger than threshold Bop, DO is turned on (low). The output state is held until a magnetic flux density reversal falls below Brp causing DO to be turned off (high).

Features:

- 3-5V to 24V DC operation voltage
- Low current consumption
- Temperature compensation
- Wide operating voltage range
- Open-Collector pre-driver
- 50mA maximum sinking output current
- Reverse polarity protection
- Lead Free Package: TO-92

Pricing

1,953 in stock

\$0.95

\$0.86

\$0.76

price


10-99

100+


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Pressure (Force) Sensor



Flexiforce Pressure Sensor - 100lbs. - SparkFun Electronics - Windows Internet Explorer

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Home | Sensors | Flex / Force | SEN-08685

Product Info

RoHS✓

Flexiforce Pressure Sensor - 100lbs.

sku: SEN-08685

Description: This is a **piezoresistive** force sensor. The harder you press, the lower the sensor's resistance. Pressing hard, the resistance changes from infinite to ~300k. The sensor itself is thin and flexible, but the resistance does not change while being flexed. Resistance changes only when pressure is applied to the round area at the end of the sensor. Used as a presence sensor (someone standing), weight sensor, pressure sensor (impact testing), etc.

The overall length is about 8.5". Sensor comes with 0.1" spaced, reinforced, breadboard friendly connector.

This sensor comes in three flavors. This sensor ranges from 0 to 100lbs of pressure in the mega-ohm range.

Documents:

[Datasheet](#)

[User Manual](#)

[Flexiforce Homepage](#)

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5 comments

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by **Alx** | September 11, 2008 at 4:44 AM ★ 1

Pricing

256 in stock

\$19.95 price


\$17.96 10-99

\$15.96 100+


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Ultrasonic Range Finder



Ultrasonic Range Finder - XL-Maxsonar EZ4 - SparkFun Electronics - Windows Internet Explorer

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Product Info

RoHS✓

Ultrasonic Range Finder - XL-Maxsonar EZ4

sku: SEN-09495

Description: The XL series of MaxSonnars are a super high-performance version of the easy-to-use sonar range finder from **Maxbotix**. The XL series of this sensor features higher resolution, longer range, higher power output and better calibration when compared to the **LV** version.

We are extremely pleased with the size, quality, and ease of use of this little range finder. The sensor provides very accurate readings from 0 to 765cm (0 to 25.1ft) with 1cm resolution. This sensor can be powered with anywhere between 3.3 and 5VDC.

Range information can be gathered through one of three methods - analog, serial, or PWM - all of which are active at the same time. The analog output will produce a voltage proportional to the measured distance, with a sensitivity of (Vcc/1024)V/cm. The serial interface is simple and formatted to RS-232, with voltages ranging from 0 to Vcc and terminal settings of 9600-8-N-1. Finally, the PWM pin outputs a pulse-width representation of the range with a scale factor of 58us/cm.

The Maxsonar-XL series is offered in the EZ0, EZ1, EZ2, EZ3, and EZ4 versions, each with progressively narrower beam angles allowing the sensor to match the application. Please see beam width explanation below.

Features:

- 3.3V to 5V supply with very low average current draw
- High acoustic power output
- All interfaces are active simultaneously

Pricing

▲ 26 in stock

\$49.95

price

\$44.96

10-99

\$39.96

100+

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http://www.sparkfun.com/products/9495#

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Smart sensors

- Value-added sensors
 - Sense, process/distill, translate
- Abstraction layers
- A few selected sensors (may be relevant to a few projects this year)
 - Not recommendation/endorsement

IMU (Inertial measurement unit)

- Degrees of freedom (DOF)
 - Multiple measurements
 - 3-axis gyro
 - 3-axis accelerometer
 - 3-axis magnetometer
- Measurements accessible via standard interfaces
 - I2C, SPI etc.

Pixy

- Sensing visual (color-based objects)
- Pixy
- Not camera output
 - Object positions
 - Object id based on color signatures
 - Updated object positions every 20 ms (50Hz)
- Interfacing
 - SPI, I2C, UART, Analog X/Y
- Do not forget power demands

Photo Modules for PCM Remote Control Systems

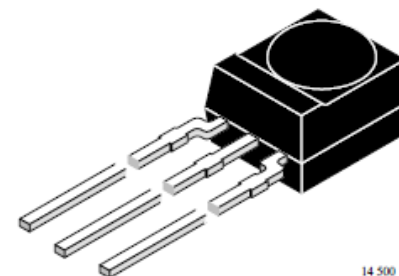
Available types for different carrier frequencies

Type	fo	Type	fo
TSOP1830	30 kHz	TSOP1833	33 kHz
TSOP1836	36 kHz	TSOP1837	36.7 kHz
TSOP1838	38 kHz	TSOP1840	40 kHz
TSOP1856	56 kHz		

Description

The TSOP18.. – series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter.

The demodulated output signal can directly be decoded by a microprocessor. The main benefit is the reliable function even in disturbed ambient and the protection against uncontrolled output pulses.



14 500

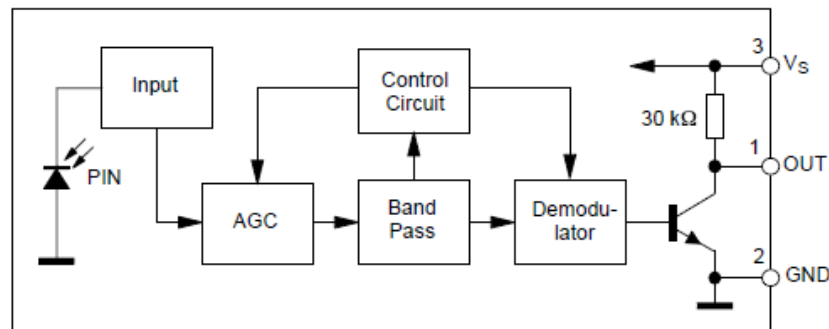
Features

- Photo detector and preamplifier in one package
- Internal filter for PCM frequency
- TTL and CMOS compatibility
- Output active low
- Improved shielding against electrical field disturbance
- Suitable burst length ≥ 6 cycles/burst

Special Features

- Small size package
- Enhanced immunity against all kinds of disturbance light
- No occurrence of disturbance pulses at the output
- Short settling time after power on ($< 200\mu\text{s}$)

Block Diagram



9612226

RF Link Transmitter - 434MHz - SparkFun Electronics - Windows Internet Explorer

http://www.sparkfun.com/products/8946

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Product Info

RoHS✓

RF Link Transmitter - 434MHz

sku: WRL-o8946

Description: This is only the 434MHz transmitter. This will work with the RF Links at 434MHz at either baud rate. Only one 434MHz transmitter will work within the same location.

This wireless data is the easiest to use, lowest cost RF link we have ever seen! Use these components to transmit position data, temperature data, even current program register values wirelessly to the receiver. These modules have up to **500 ft range** in open space. The transmitter operates from 2-12V. The higher the Voltage, the greater the range - see range test data in the documents section.

We have used these modules extensively and have been very impressed with their ease of use and direct interface to an MCU. The theory of operation is very simple. What the transmitter 'sees' on its data pin is what the receiver outputs on its data pin. If you can configure the UART module on a PIC, you have an instant wireless data connection. The typical range is 500ft for open area.

This is an ASK transmitter module with an output of up to 8mW depending on power supply voltage. The transmitter is based on SAW resonator and accepts digital inputs, can operate from 2 to 12 Volts-DC, and makes building RF enabled products very easy.

Features:

- 434 MHz Transmitter Operation
- 500 Ft. Range - Dependent on Transmitter Power Supply
- 2400 or 4800bps transfer rate

Pricing

● 1,483 in stock

\$3.95	price
\$3.56	10-99
\$3.16	100+

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Internet 100%

RF Link (Receiver)

RF Link 2400bps Receiver - 434MHz - SparkFun Electronics - Windows Internet Explorer



http://www.sparkfun.com/products/8949

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☐ Port-O-Rotary

☒ Programmers

☒ Prototyping

☒ Retired

☒ Robotics

☐ Sale

☒ Sensors

Home | Wireless | General | WRL-08949

Product Info

RoHS✓

RF Link 2400bps Receiver - 434MHz

sku: WRL-08949

Description: Sold as a receiver only. This receiver type is good for data rates up to 2400bps and will only work with the 434MHz transmitter. Multiple 434MHz receivers can listen to one 434MHz transmitter.

This wireless data is the easiest to use, lowest cost RF link we have ever seen! Use these components to transmit position data, temperature data, even current program register values wirelessly to the receiver. These modules have up to **500 ft range** in open space. The receiver is operated at 5V.

We have used these modules extensively and have been very impressed with their ease of use and direct interface to an MCU. The theory of operation is very simple. What the transmitter 'sees' on its data pin is what the receiver outputs on its data pin. If you can configure the UART module on a PIC, you have an instant wireless data connection. **Data rates** are limited to 2400bps.

The typical range is 500ft for open area.

This receiver has a sensitivity of 3uV. It operates from 4.5 to 5.5 volts-DC and has digital output. The typical sensitivity is -103dbm and the typical current consumption is 3.5mA for 5V operation voltage.

Features:

- 434 MHz Operation
- 500 Ft. Range - Dependent on Transmitter Power Supply

Pricing

721 in stock

\$4.95

price

\$4.46

10-99

\$3.96

100+

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Done

Internet

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X-10 Protocol Devices

- **Communication via existing A.C. wiring**
- **Computer interface available**
- **Modules for appliance control and lamp dimming**

RECEIVERS



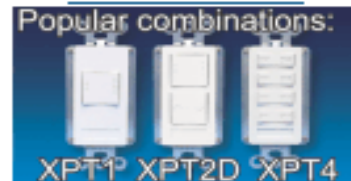
- **Plug-in** Lamp and Appliance Modules
- **Screw-in** Lamp Modules
- **Wire-in** Wall Switches & Modules
- Plug-in Universal Module & Sounder

CONTROLLERS



- **Plug-in** Timed, Telephone, Manual and Automatic Operation - Desk-top Controllers
- **Wired-in** Motion Floodlight Sensor
- **Wireless RF** Remotes & Mountable Wireless Controllers

IN-WALL TRANSMITTERS & KEYPADS



- **Hard Wired** & Wall Box Mounted Transmitters/Controllers
- **Numerous Keypad Options**

INTERFACES/CONTROLLERS



- **Computer Control**
- **Contact or Voltage** Interface
- **Data Interface** for OEM Alarms and Digital Logic Boards