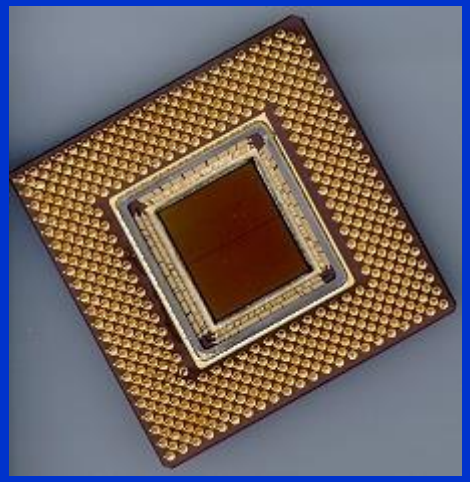

ECE 477 Digital Systems Senior Design Project

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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Logic-Level Translators - Maxim

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maxim integrated

Products Solutions Design Buy Support About Us My Maxim

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

Level Translators
- High-Speed Level Translators
- Logic-Level Translators

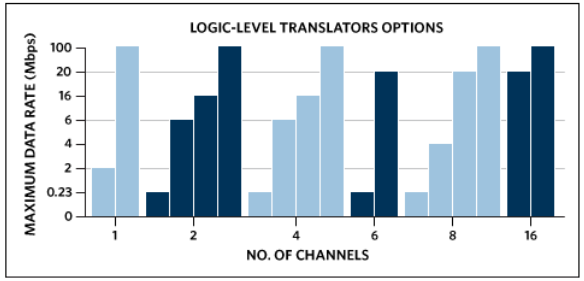
Product Information
- Latest Data Sheets
- Cross Reference

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

Logic-Level Translators

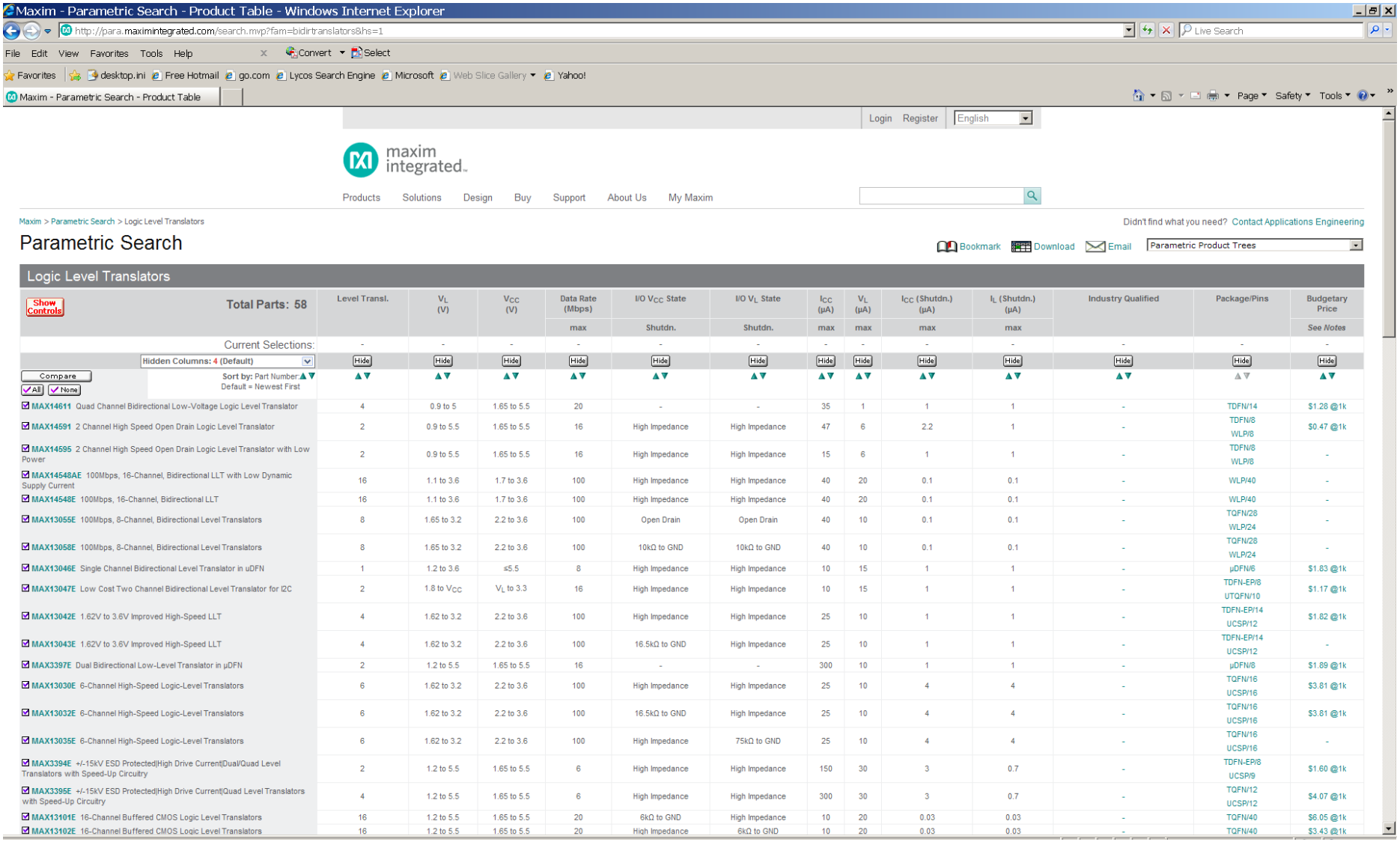
Maxim offers bidirectional CMOS logic-level translators that provide the level-shifting necessary for data transfer in multivoltage systems. Our LLTs are bidirectional by design and do not require the use of a direction input. Two externally applied voltages, V_{CC} and V_L, set the logic levels of these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

See Table of All Logic-Level Translators



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

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Maxim > Parametric Search > Logic Level Translators

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Logic Level Translators

Show Controls **Total Parts: 58**

Current Selections: -

Hidden Columns: 4 (Default)

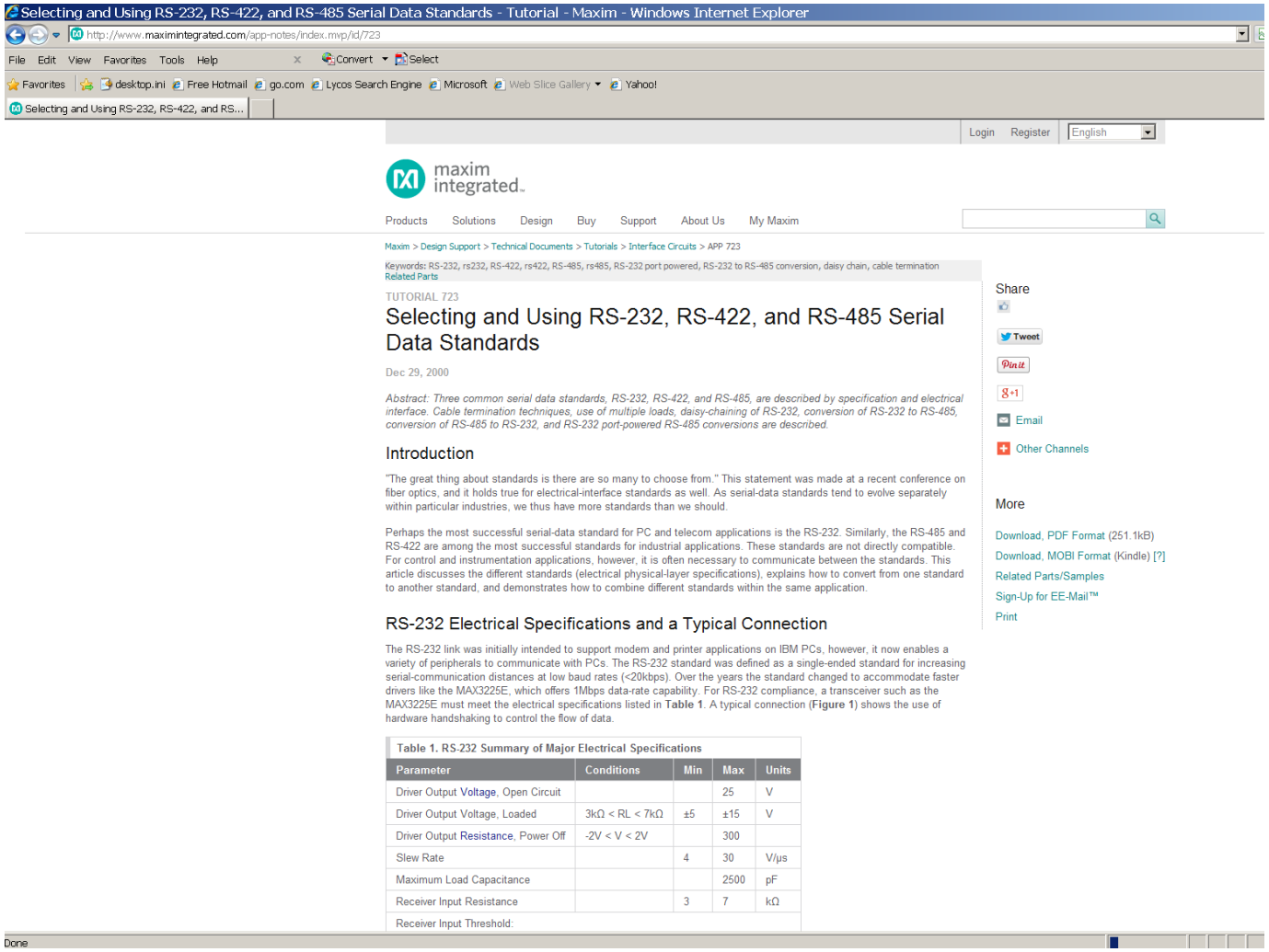
Compare All None

Sort by: Part Number Default = Newest First

	Level Transl.	V_L (V)	V_{CC} (V)	Data Rate (Mbps) max	I/O V_{CC} State Shutdn.	I/O V_L State Shutdn.	I_{CC} (µA) max	V_L (µA) max	I_{CC} (Shutdn.) (µA) max	I_L (Shutdn.) (µA) max	Industry Qualified	Package/Pins	Budgetary Price See Notes
MAX14611 Quad Channel Bidirectional Low-Voltage Logic Level Translator	4	0.9 to 5	1.65 to 5.5	20	-	-	35	1	1	1	-	TDFN/14	$1.28 @1k
MAX14591 2 Channel High Speed Open Drain Logic Level Translator	2	0.9 to 5.5	1.65 to 5.5	16	High Impedance	High Impedance	47	6	2.2	1	-	TDFN/8 WLP/8	$0.47 @1k
MAX14595 2 Channel High Speed Open Drain Logic Level Translator with Low Power	2	0.9 to 5.5	1.65 to 5.5	16	High Impedance	High Impedance	15	6	1	1	-	TDFN/8 WLP/8	-
MAX14548AE 100Mbps, 16-Channel, Bidirectional LLT with Low Dynamic Supply Current	16	1.1 to 3.6	1.7 to 3.6	100	High Impedance	High Impedance	40	20	0.1	0.1	-	WLP/40	-
MAX14548E 100Mbps, 16-Channel, Bidirectional LLT	16	1.1 to 3.6	1.7 to 3.6	100	High Impedance	High Impedance	40	20	0.1	0.1	-	WLP/40	-
MAX13055E 100Mbps, 8-Channel, Bidirectional Level Translators	8	1.65 to 3.2	2.2 to 3.6	100	Open Drain	Open Drain	40	10	0.1	0.1	-	TQFN/28 WLP/24	-
MAX13058E 100Mbps, 8-Channel, Bidirectional Level Translators	8	1.65 to 3.2	2.2 to 3.6	100	10kΩ to GND	10kΩ to GND	40	10	0.1	0.1	-	TQFN/28 WLP/24	-
MAX13046E Single Channel Bidirectional Level Translator in uDFN	1	1.2 to 3.6	≤5.5	8	High Impedance	High Impedance	10	15	1	1	-	µDFN/6	$1.83 @1k
MAX13047E Low Cost Two Channel Bidirectional Level Translator for I2C	2	1.8 to V_{CC}	V_L to 3.3	16	High Impedance	High Impedance	10	15	1	1	-	TDFN-EP/8 UTQFN/10	$1.17 @1k
MAX13042E 1.62V to 3.6V Improved High-Speed LLT	4	1.62 to 3.2	2.2 to 3.6	100	High Impedance	High Impedance	25	10	1	1	-	TDFN-EP/14 UCSP/12	$1.82 @1k
MAX13043E 1.62V to 3.6V Improved High-Speed LLT	4	1.62 to 3.2	2.2 to 3.6	100	16.5kΩ to GND	High Impedance	25	10	1	1	-	TDFN-EP/14 UCSP/12	-
MAX3397E Dual Bidirectional Low-Level Translator in µDFN	2	1.2 to 5.5	1.65 to 5.5	16	-	-	300	10	1	1	-	µDFN/8	$1.89 @1k
MAX13030E 6-Channel High-Speed Logic-Level Translators	6	1.62 to 3.2	2.2 to 3.6	100	High Impedance	High Impedance	25	10	4	4	-	TQFN/16 UCSP/16	$3.81 @1k
MAX13032E 6-Channel High-Speed Logic-Level Translators	6	1.62 to 3.2	2.2 to 3.6	100	16.5kΩ to GND	High Impedance	25	10	4	4	-	TQFN/16 UCSP/16	$3.81 @1k
MAX13035E 6-Channel High-Speed Logic-Level Translators	6	1.62 to 3.2	2.2 to 3.6	100	High Impedance	75kΩ to GND	25	10	4	4	-	TQFN/16 UCSP/16	-
MAX3394E +/-15kV ESD Protected|High Drive Current|Dual/Quad Level Translators with Speed-Up Circuitry	2	1.2 to 5.5	1.65 to 5.5	6	High Impedance	High Impedance	150	30	3	0.7	-	TDFN-EP/8 UCSP/9	$1.60 @1k
MAX3395E +/-15kV ESD Protected|High Drive Current|Quad Level Translators with Speed-Up Circuitry	4	1.2 to 5.5	1.65 to 5.5	6	High Impedance	High Impedance	300	30	3	0.7	-	TQFN/12 UCSP/12	$4.07 @1k
MAX13101E 16-Channel Buffered CMOS Logic Level Translators	16	1.2 to 5.5	1.65 to 5.5	20	6kΩ to GND	High Impedance	10	20	0.03	0.03	-	TQFN/40	$6.05 @1k
MAX13102E 16-Channel Buffered CMOS Logic Level Translators	16	1.2 to 5.5	1.65 to 5.5	20	High Impedance	6kΩ to GND	10	20	0.03	0.03	-	TQFN/40	$3.43 @1k

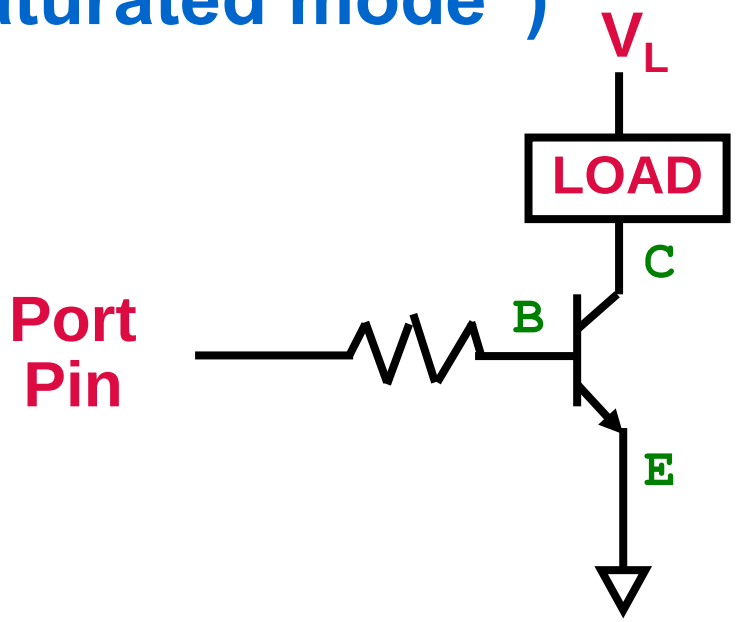
Line Drivers and Receivers

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



Switching D.C. Loads

- **Basic BJT-based switching circuit ("saturated mode")**



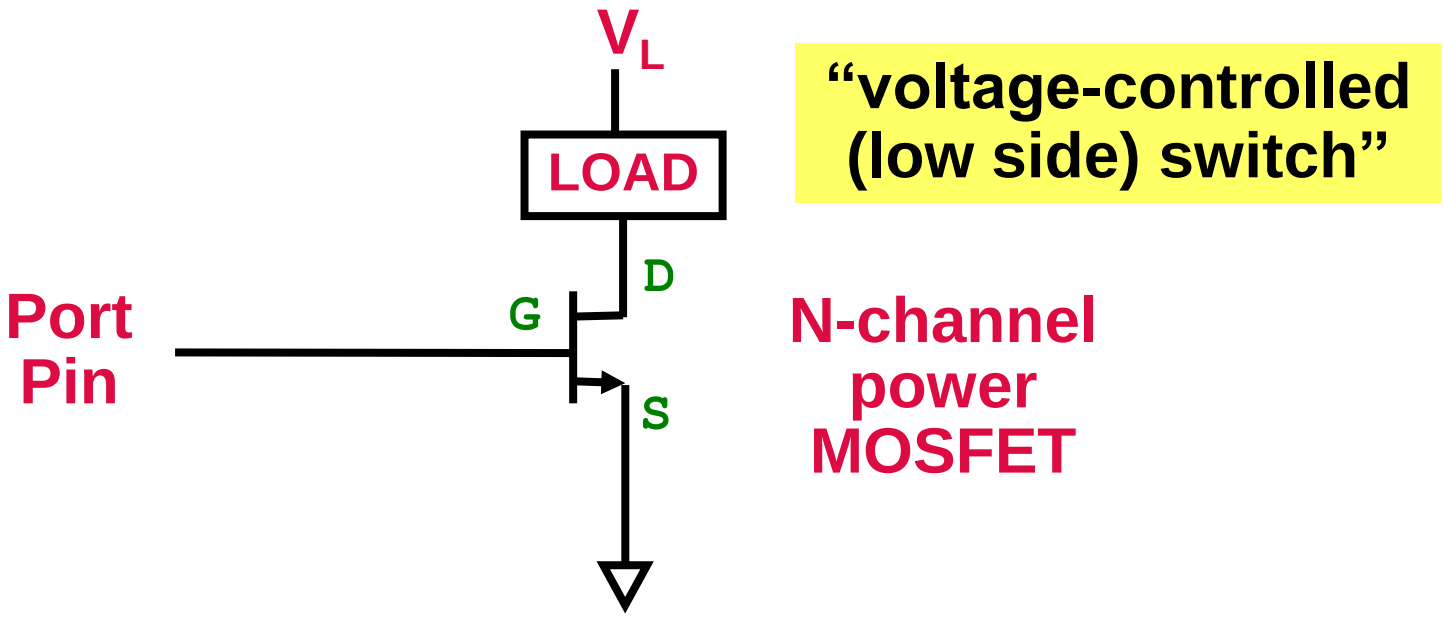
"current-controlled (low side) switch"

$I_C = h_{FE} \times I_B$

- **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**

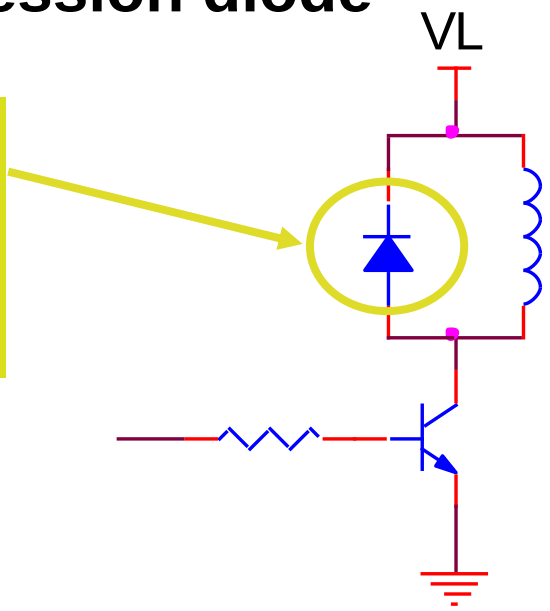


- **Choose MOSFET based on following parameters**
  - I_{Dmax} continuous
  - V_{DS} breakdown
  - $r_{DS\ (on)}$ (drain-to-source "on" resistance)

Switching D.C. Loads

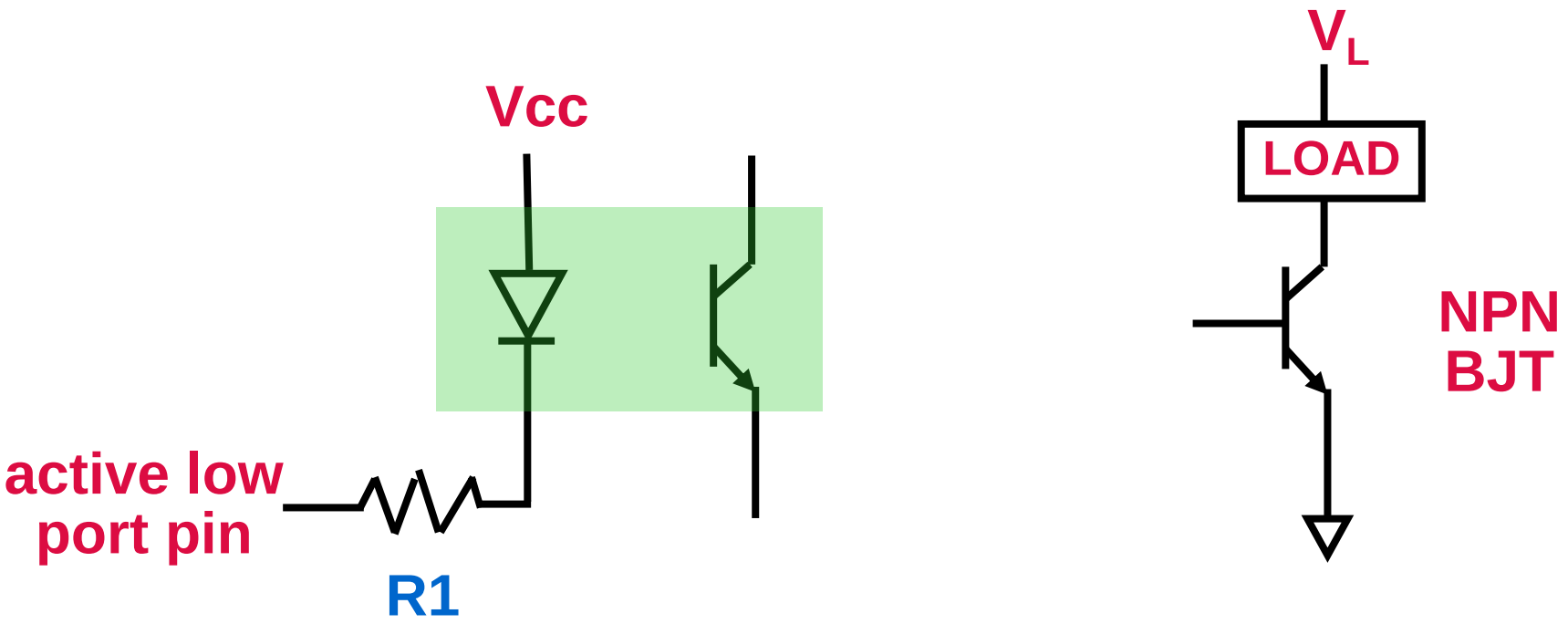
- **Tradeoffs**
  - **BJTs: may require a significant amount of base current to drive into saturation (typically need Darlington for high h_{FE} at high I_c)**
  - **MOSFETs: require virtually no gate current to operate, less chance of thermal runaway than BJT**
- **Inductive loads require arc suppression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

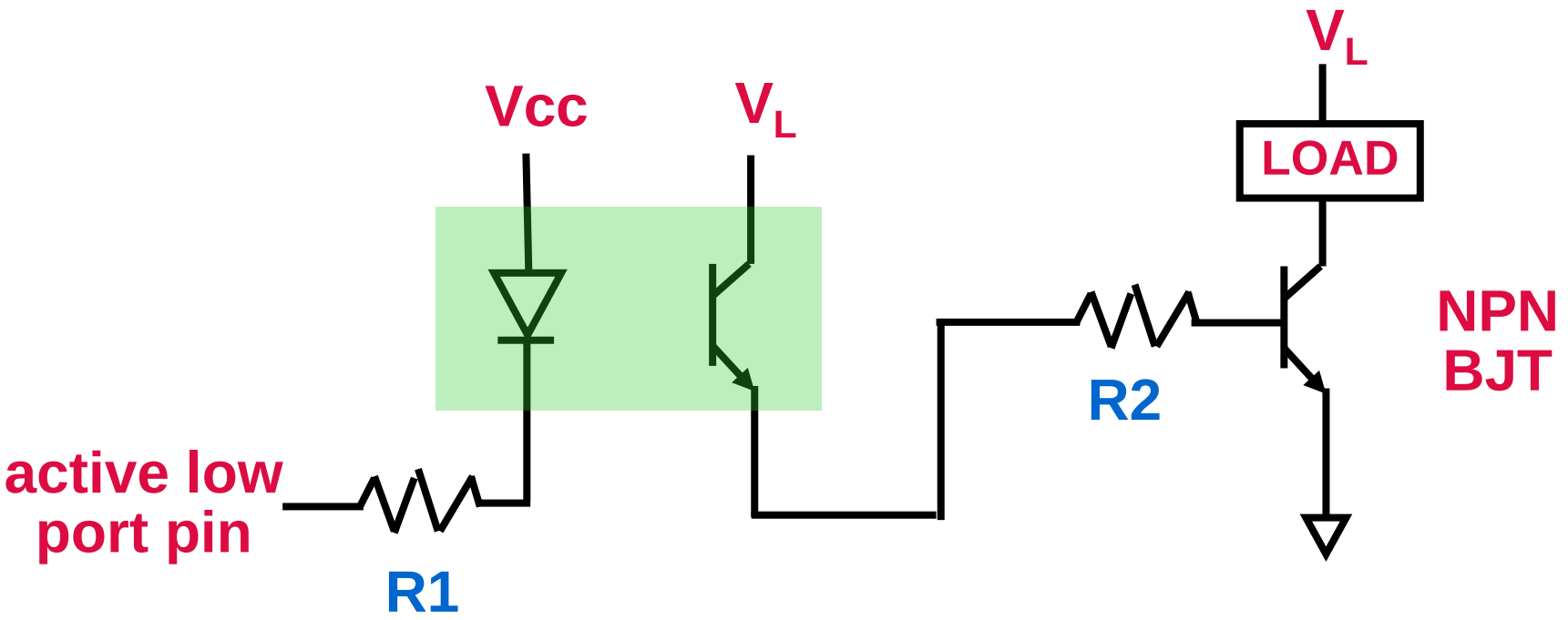


Assume Vcc = 5 V, V_{LED} = 1.5 V, and V_{OL} @ 10 mA = 0.8V

$\Rightarrow$ R1 = 2.7/0.01 = 270Ω

Switching D.C. Loads

- **Use optical isolation to protect microcontroller**

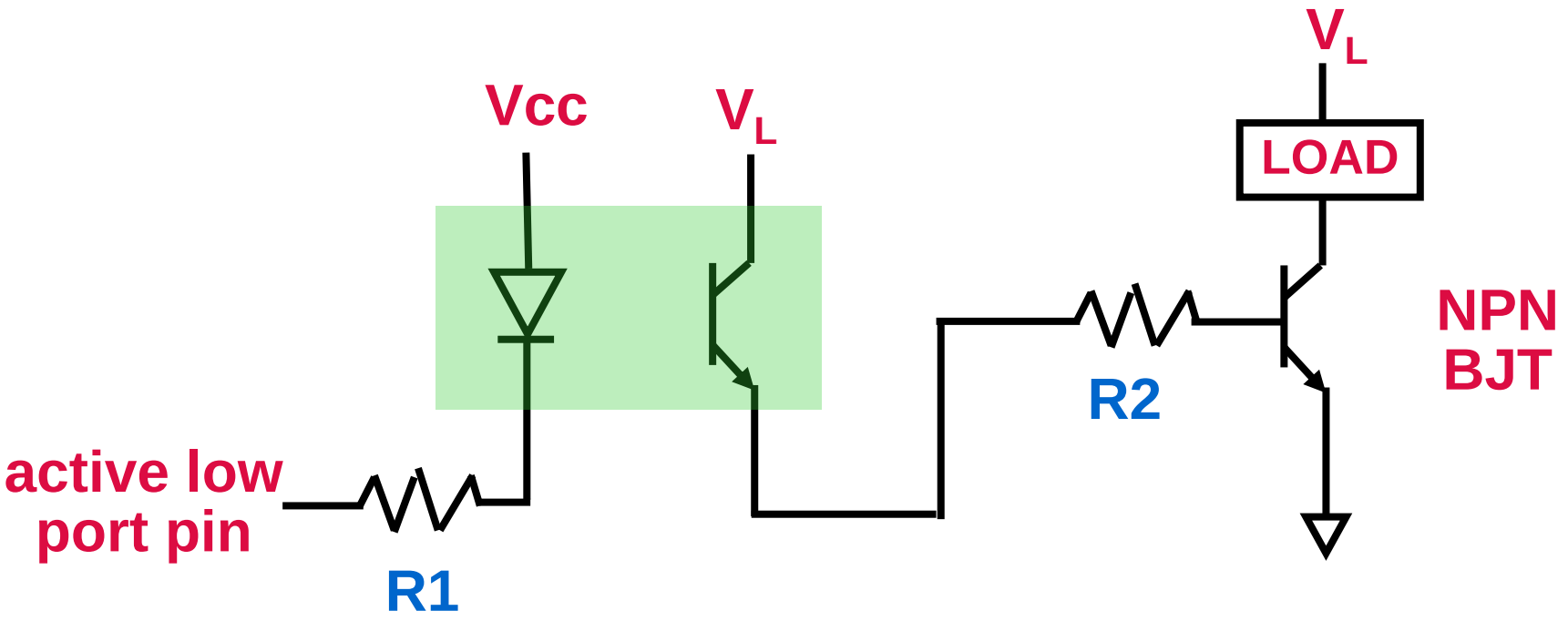


Assume Vcc = 5 V, V_{LED} = 1.5 V, and V_{OL} @ 10 mA = 0.8V

$\Rightarrow$ R1 = 2.7/0.01 = 270Ω P_{R1}=0.027W

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 If V_L=18V, R2=1700ohms, P_{R2}=0.17W

19-3487; Rev 2; 4/05

EVALUATION KIT AVAILABLE

MAXIM

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

Features

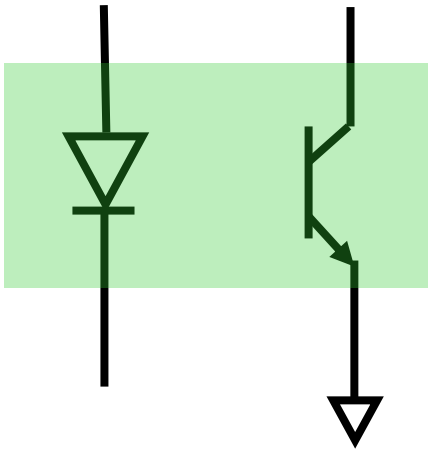
- **High-Speed 26MHz SPI-™/QSPI-™/MICROWIRE™-Compatible Serial Interface**
- **2.25V to 3.6V Operation**
- **I/O Ports Default to High-Z (LEDs Off) on Power-Up**
- **I/O Port Inputs Are Overvoltage Protected to 7V**
- **I/O Port Outputs Are 7V-Rated Open Drain**
- **I/O Port Outputs Are 10mA or 20mA 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	—	—

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**



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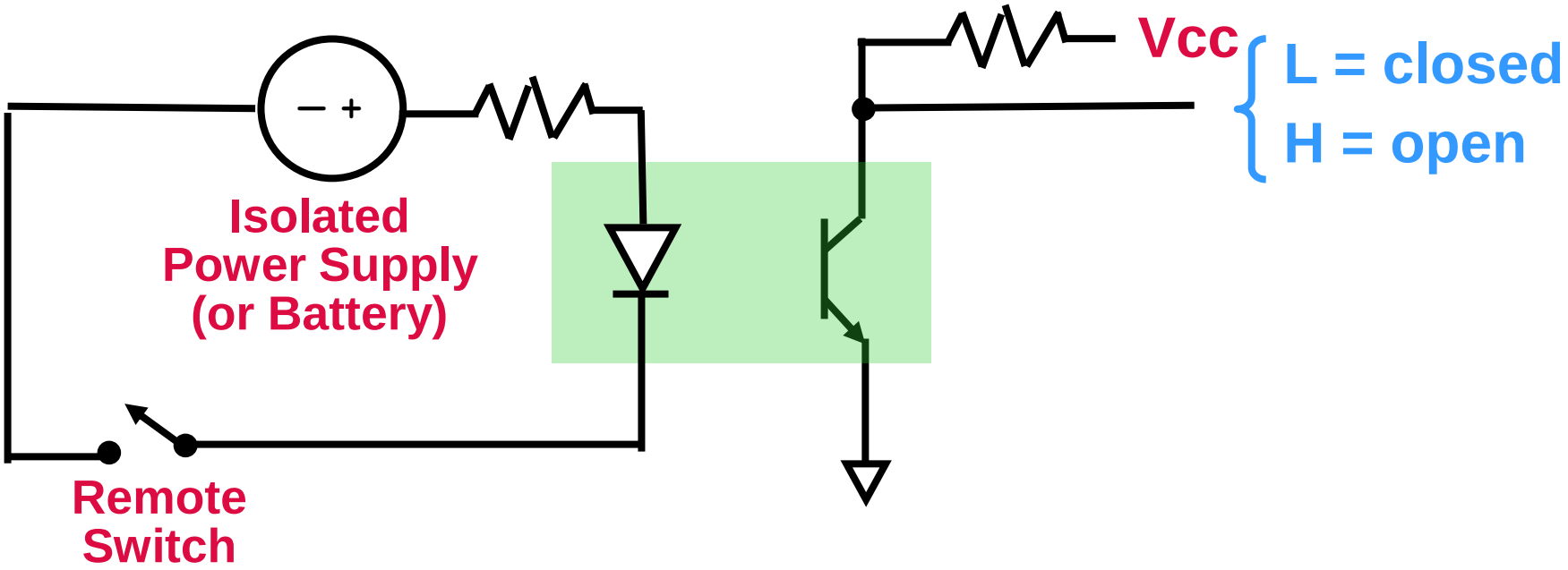
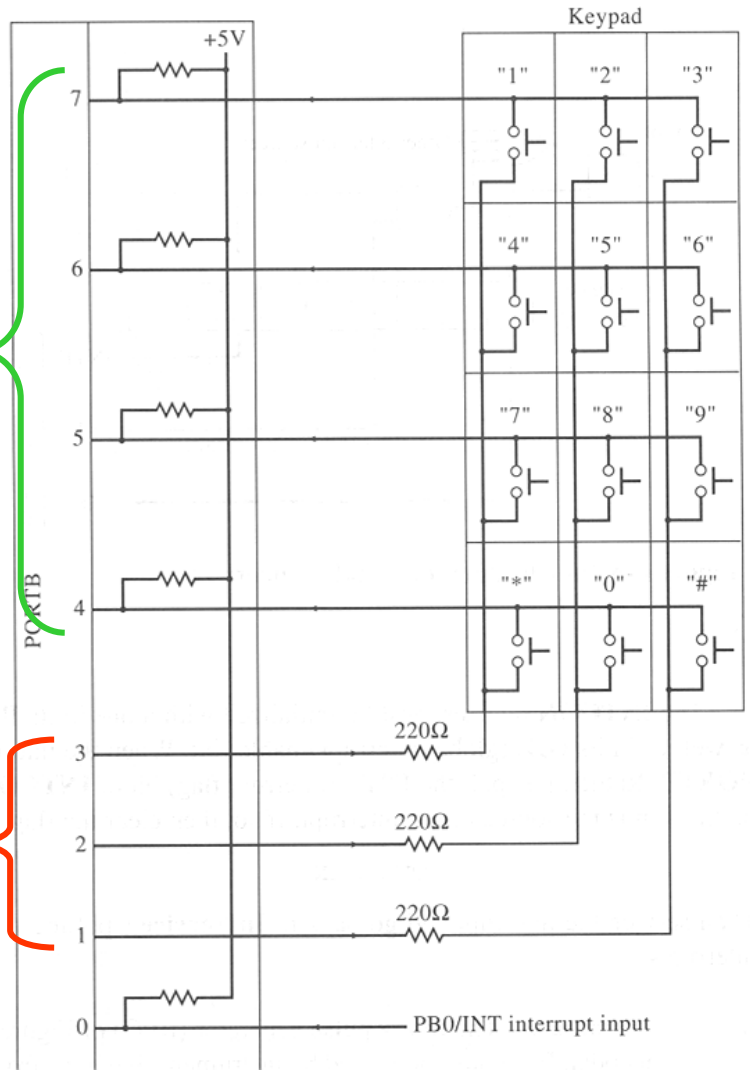


Scanned Keypad

row return lines

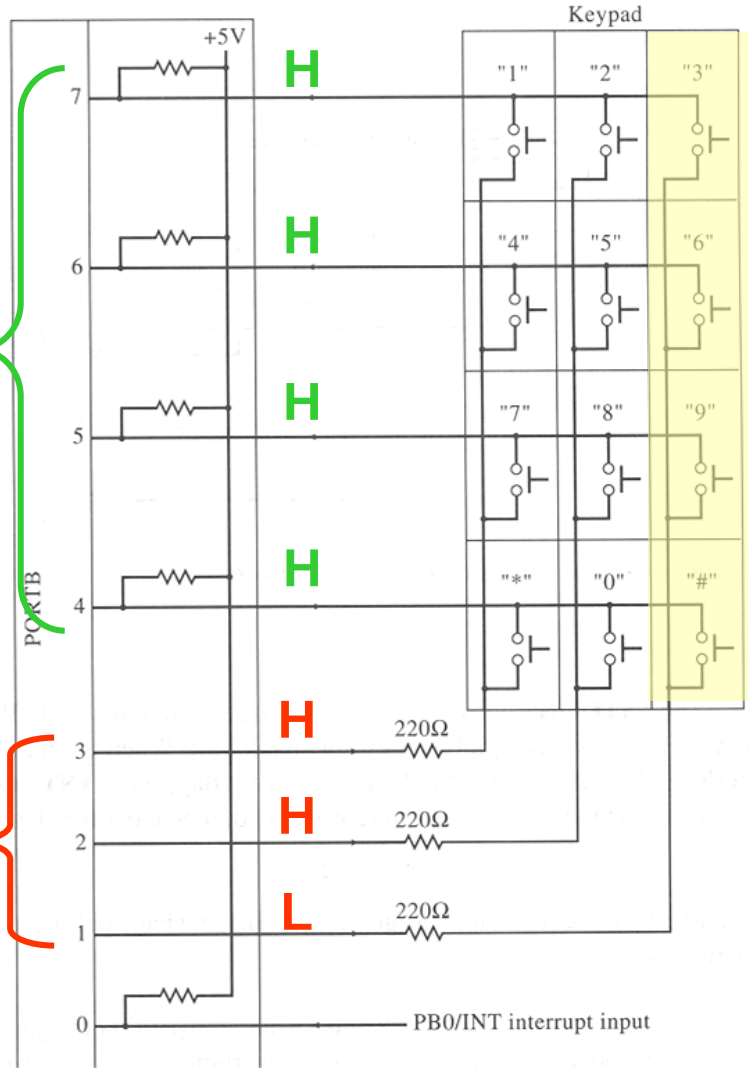
active low column scan lines



Scanned Keypad

row return lines

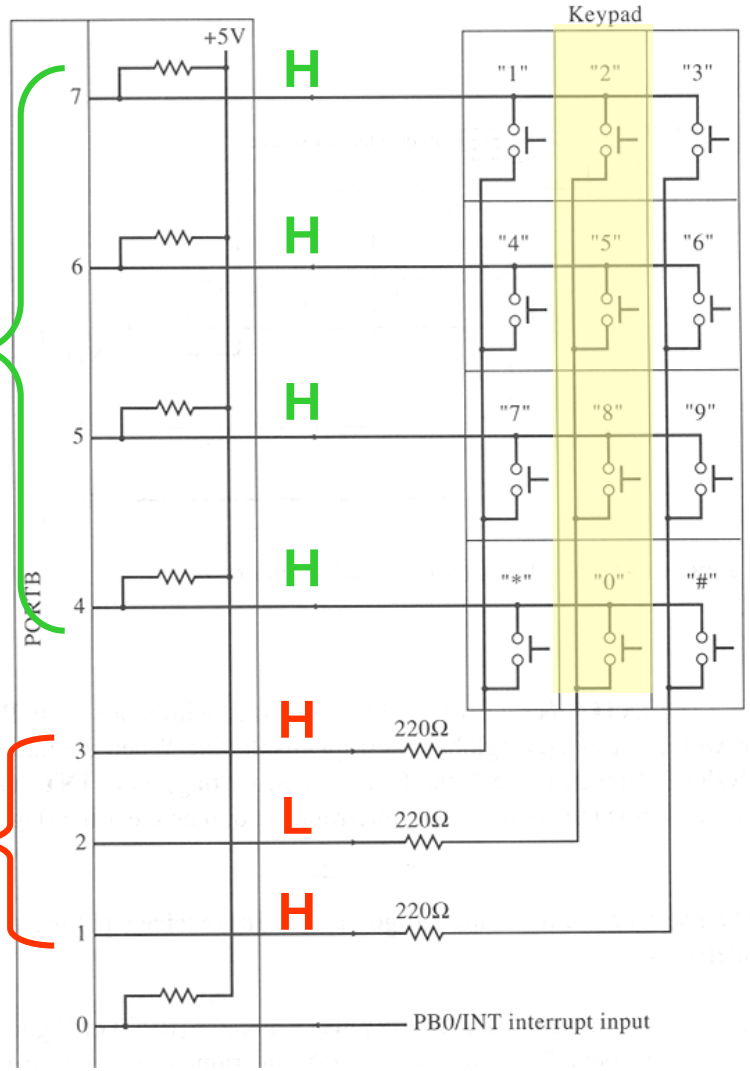
active low column scan lines



Scanned Keypad

row return lines

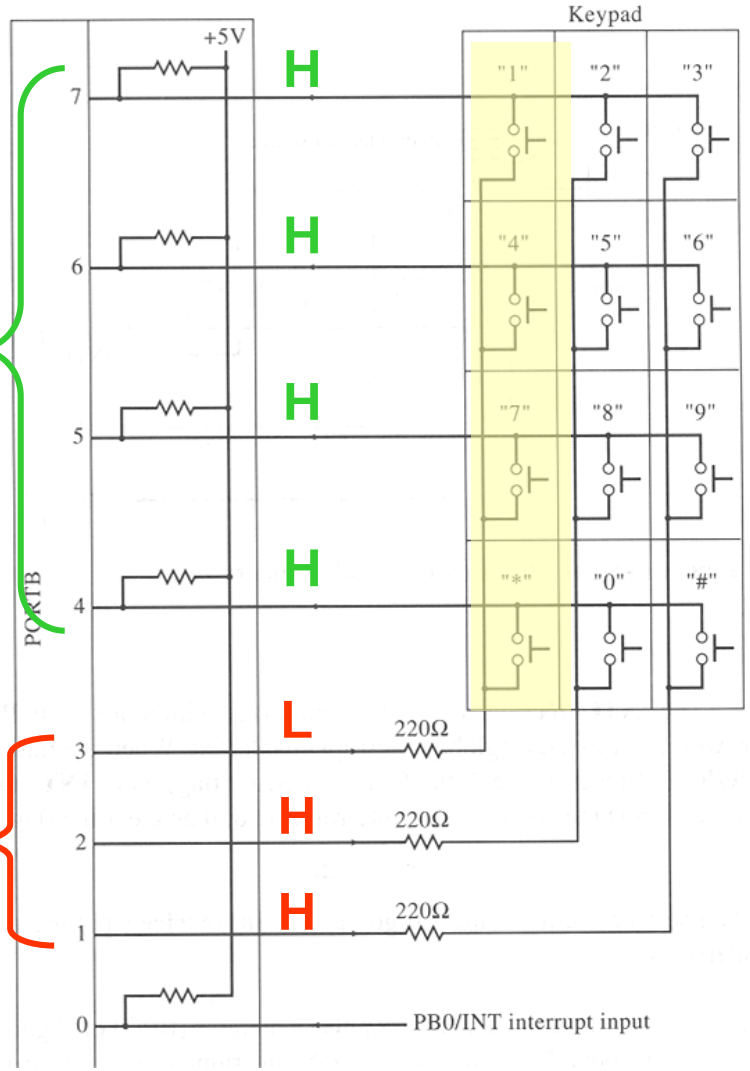
active low column scan lines



Scanned Keypad

row return lines

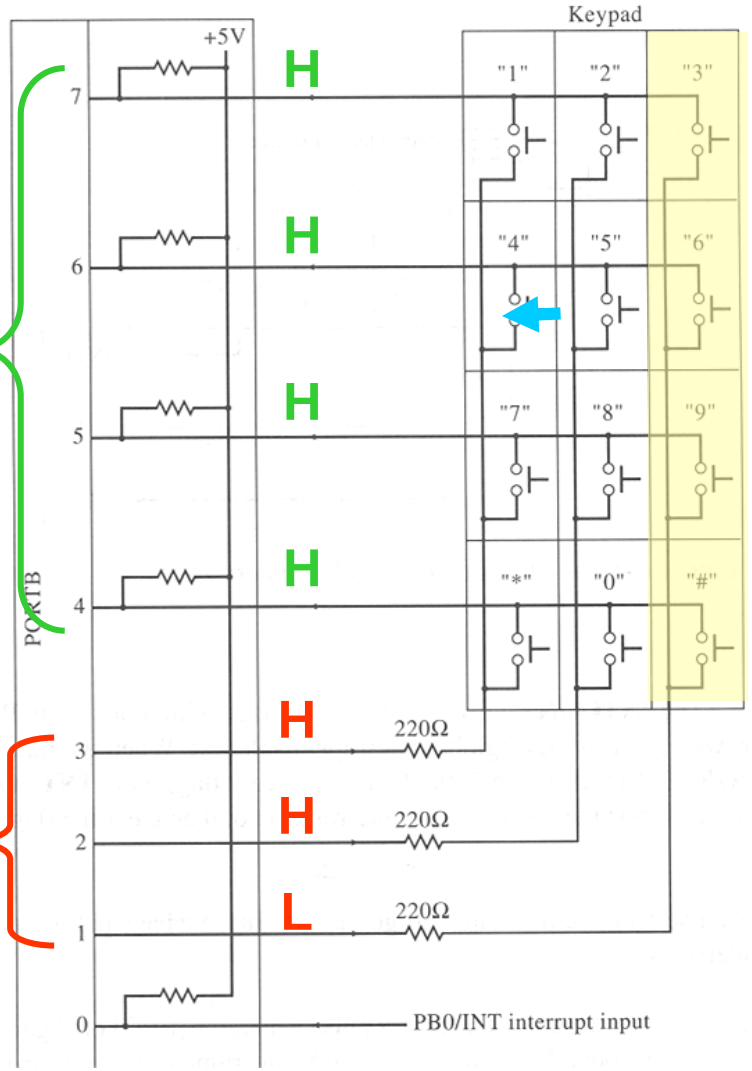
active low column scan lines



Scanned Keypad

row return lines

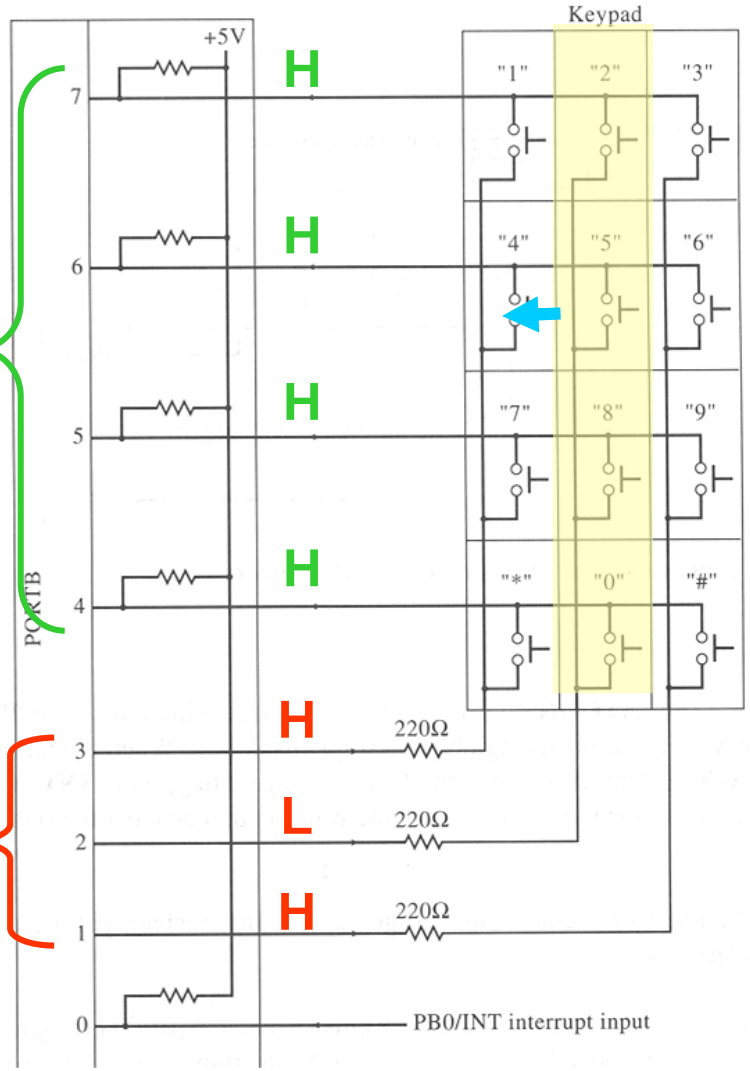
active low column scan lines



Scanned Keypad

row return lines

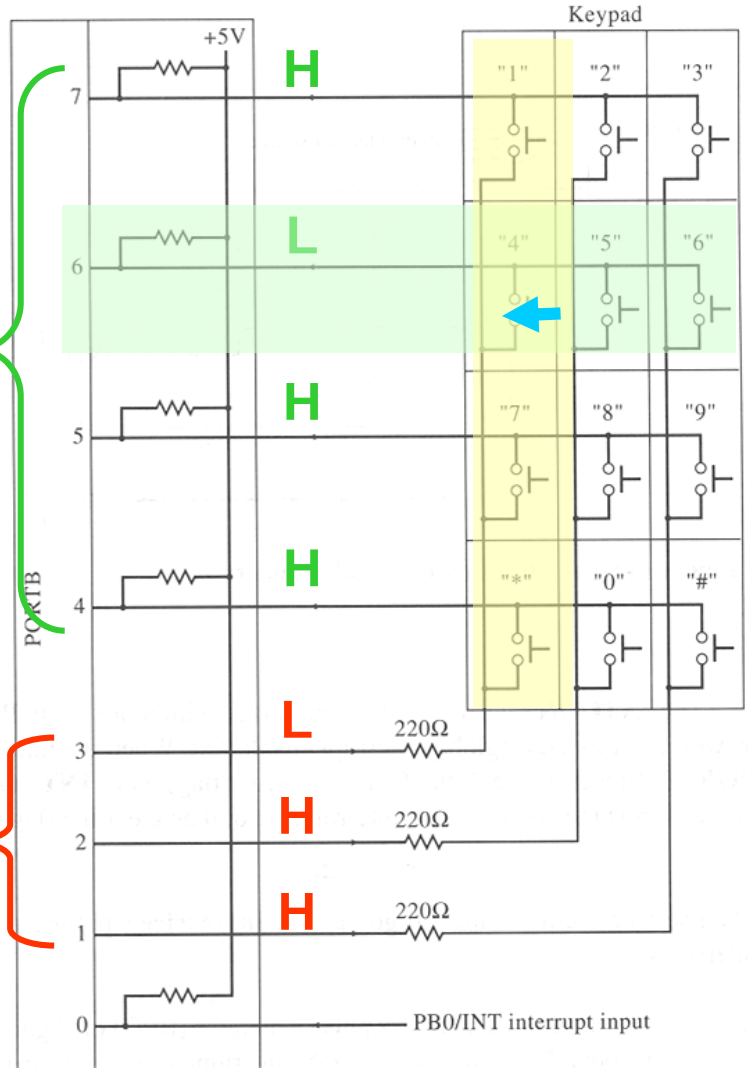
active low column scan lines



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 kΩ 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.

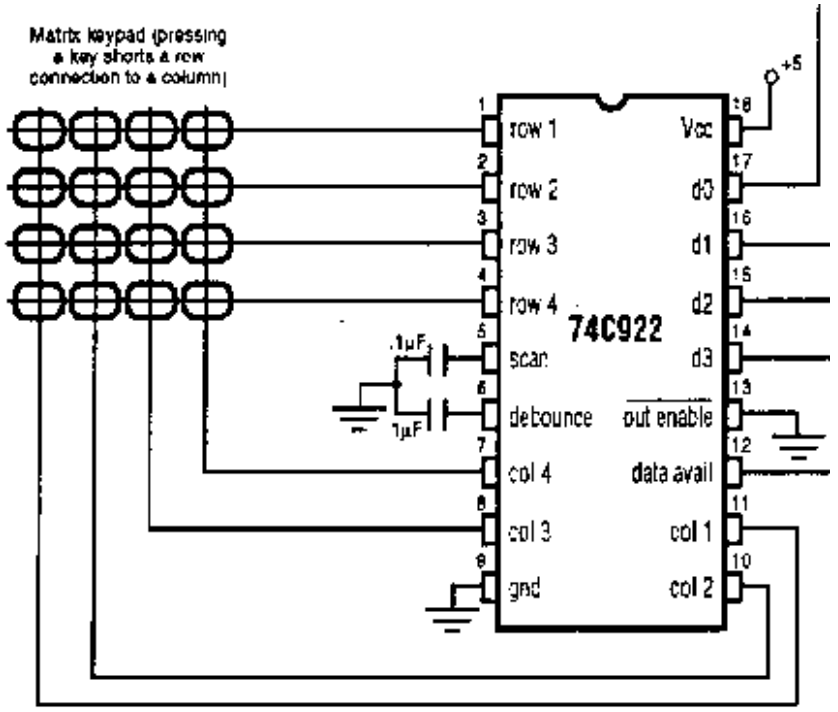
An internal register remembers the last key pressed even after the key is released. The 3-STATE outputs provide for easy expansion and bus operation and are LPTTL compatible.

Features

- 50 kΩ 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

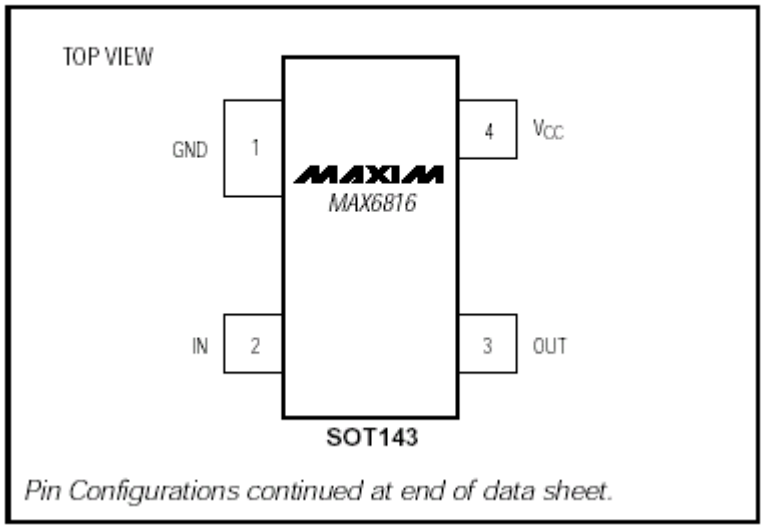


Switch Debouncer

Features

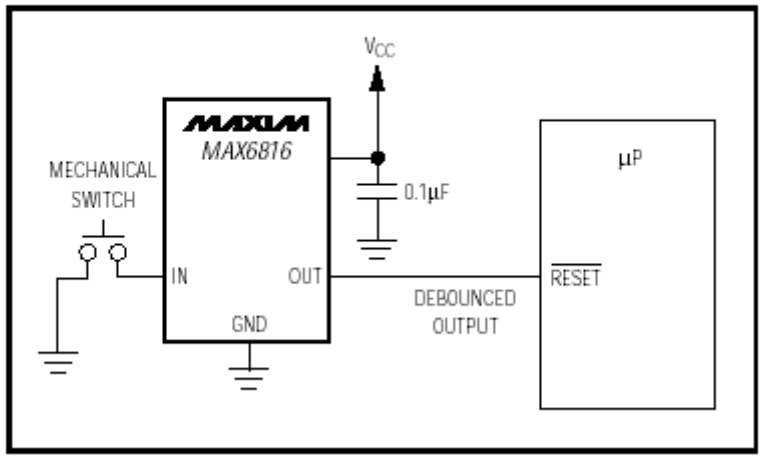
- Robust Inputs can Exceed Power Supplies up to ±25V
- ESD Protection for Input Pins
  - ±15kV—Human Body Model
  - ±8kV—IEC 1000-4-2, Contact Discharge
  - ±15kV—IEC 1000-4-2, Air-Gap Discharge
- Small SOT Packages (4 and 6 pins)
- Single-Supply Operation from +2.7V to +5.5V
- Single (MAX6816), Dual (MAX6817), and Octal (MAX6818) Versions Available
- No External Components Required
- 6µA 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

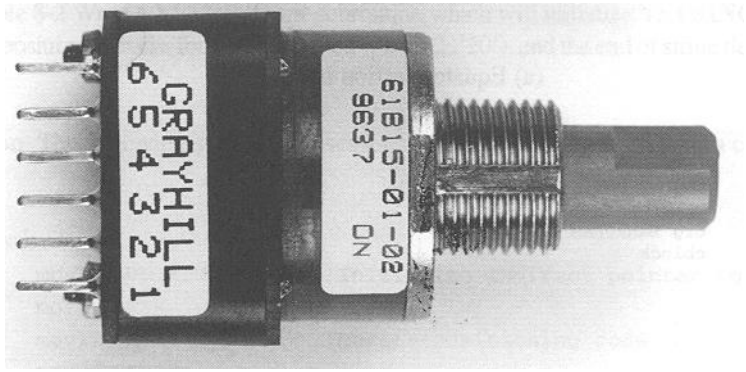


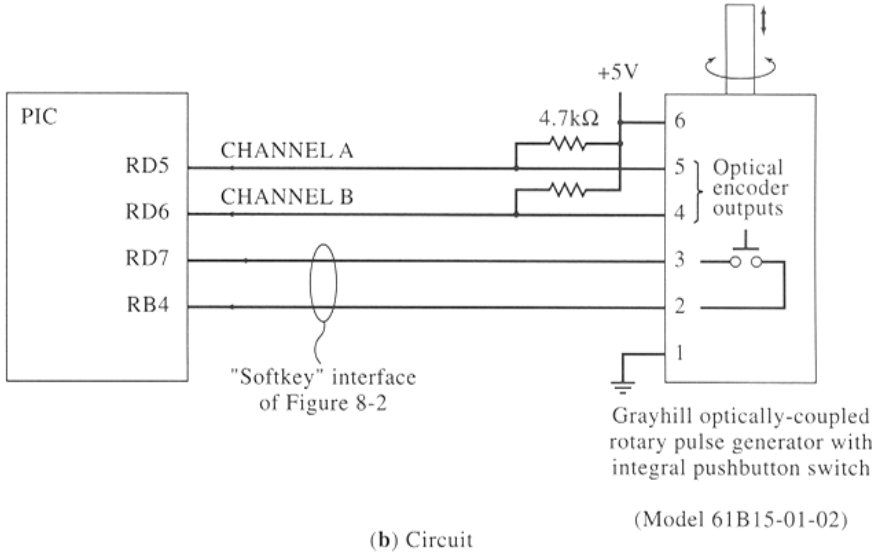
Pin Configurations continued at end of data sheet.

Typical Operating Circuit

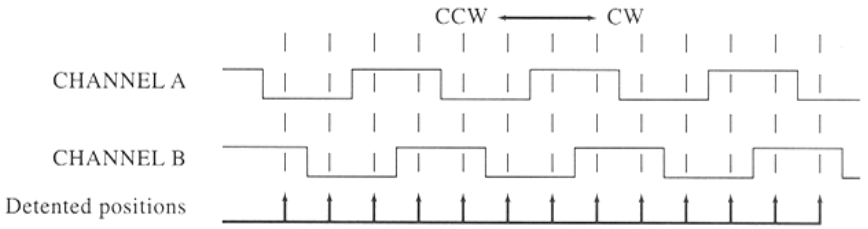


Rotary Pulse Generator (RPG)





(**b**) Circuit

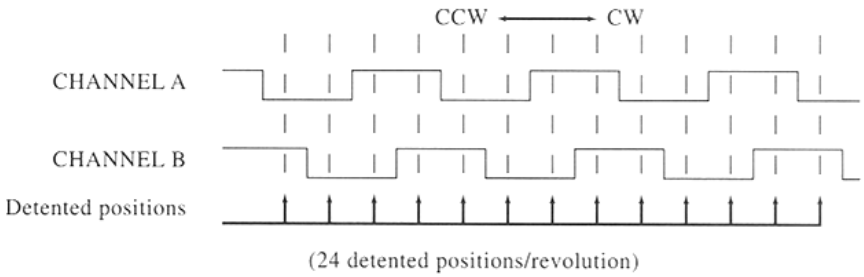


(24 detented positions/revolution)

(**c**) Encoder output

RPGs

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



(24 detented positions/revolution)

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

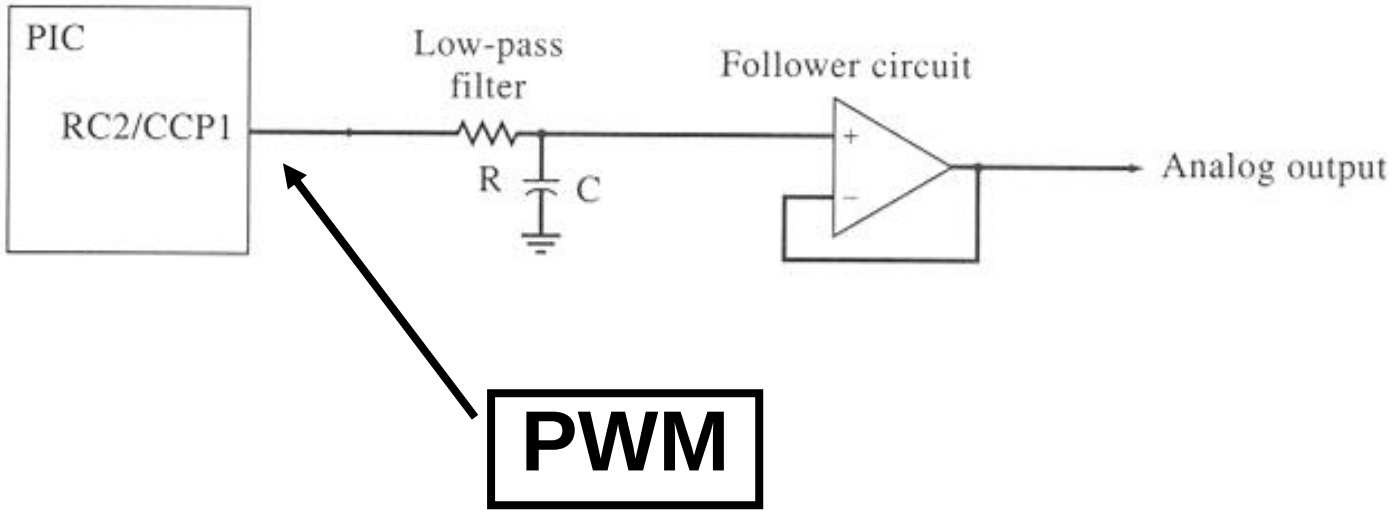
AB: 10 → 00 → 01 → 11 → 10 ... CW rotation

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

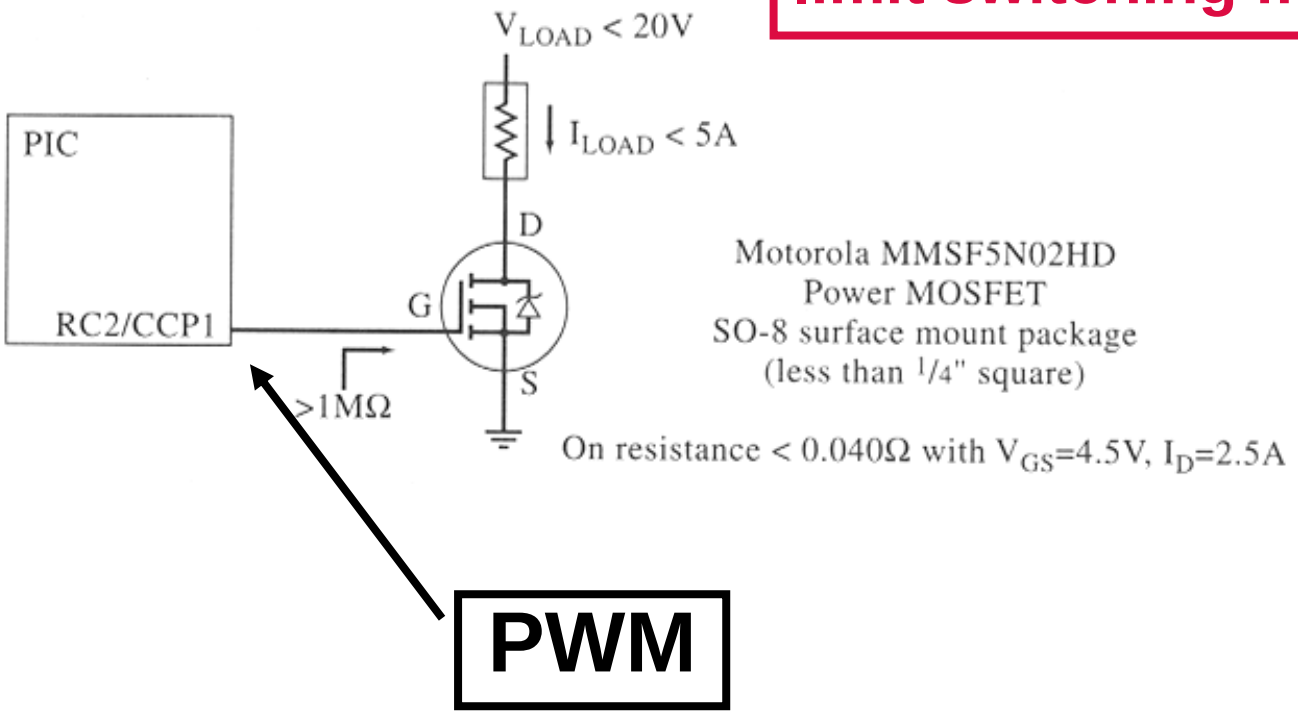
- **Simple D/A converter**



PWM Applications/Interfaces

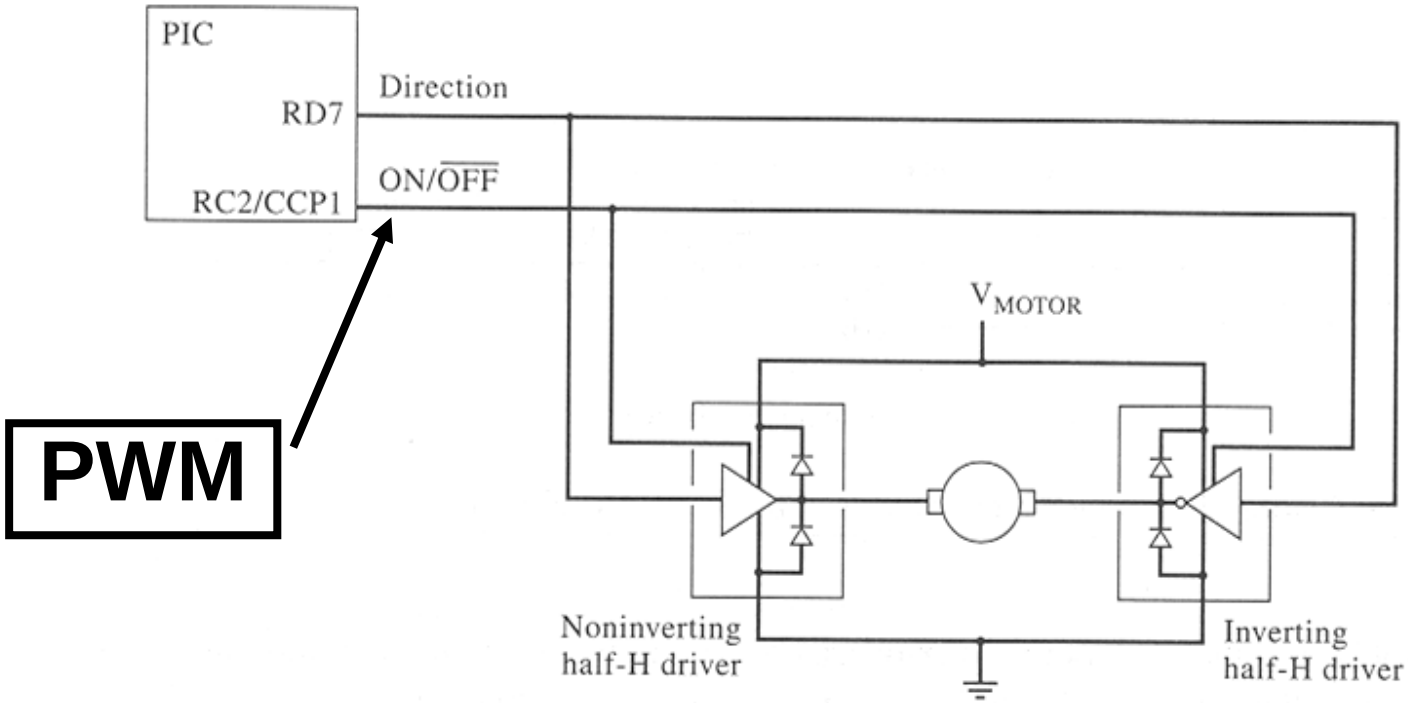
- **Driving a switched load**

Limitation: Capacitive load of MOSFET may limit switching frequency

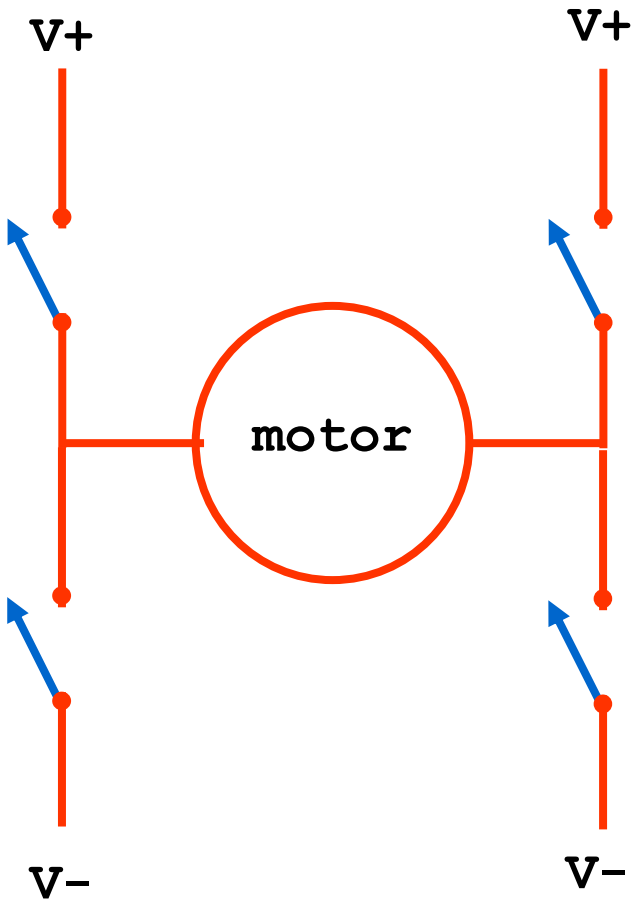


PWM Applications/Interfaces

- **Motor speed and direction using H-bridge**

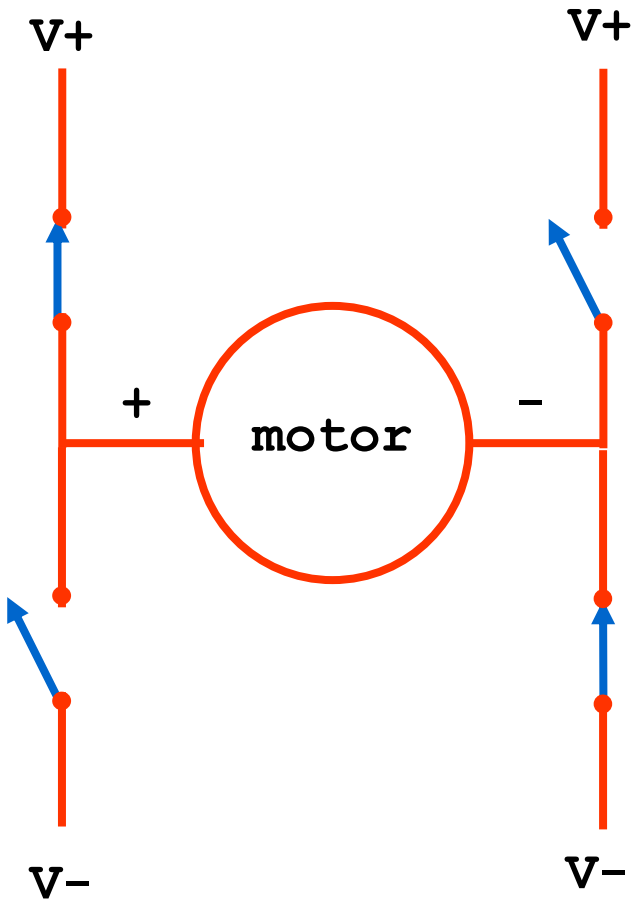


“H Bridge”



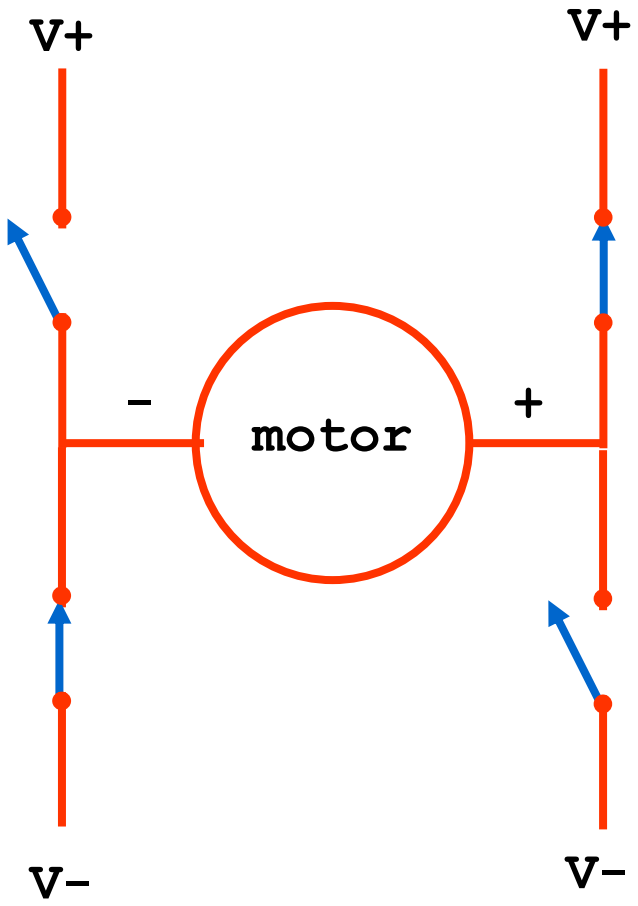
“coasting”

“H Bridge”



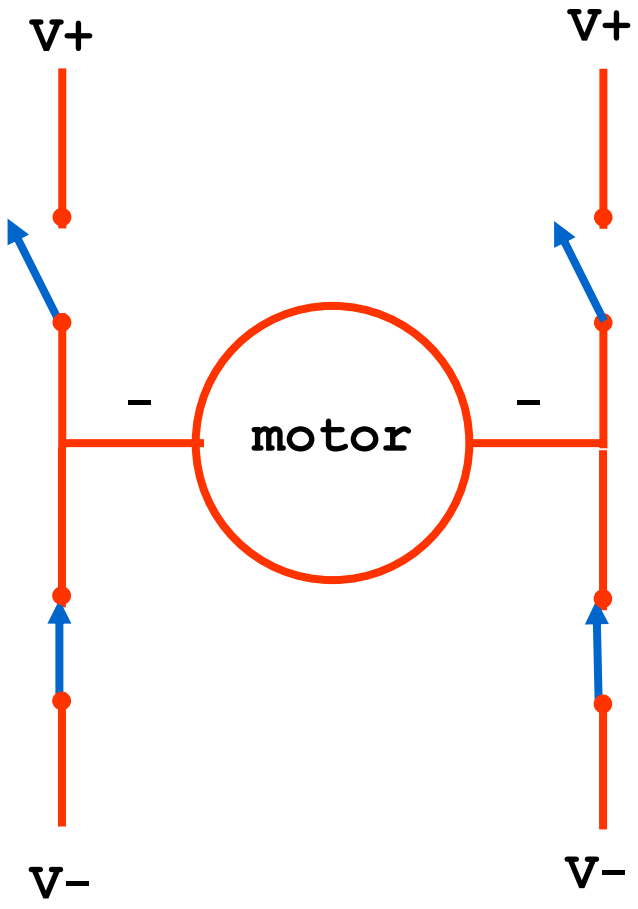
“forward”

“H Bridge”



“reverse”

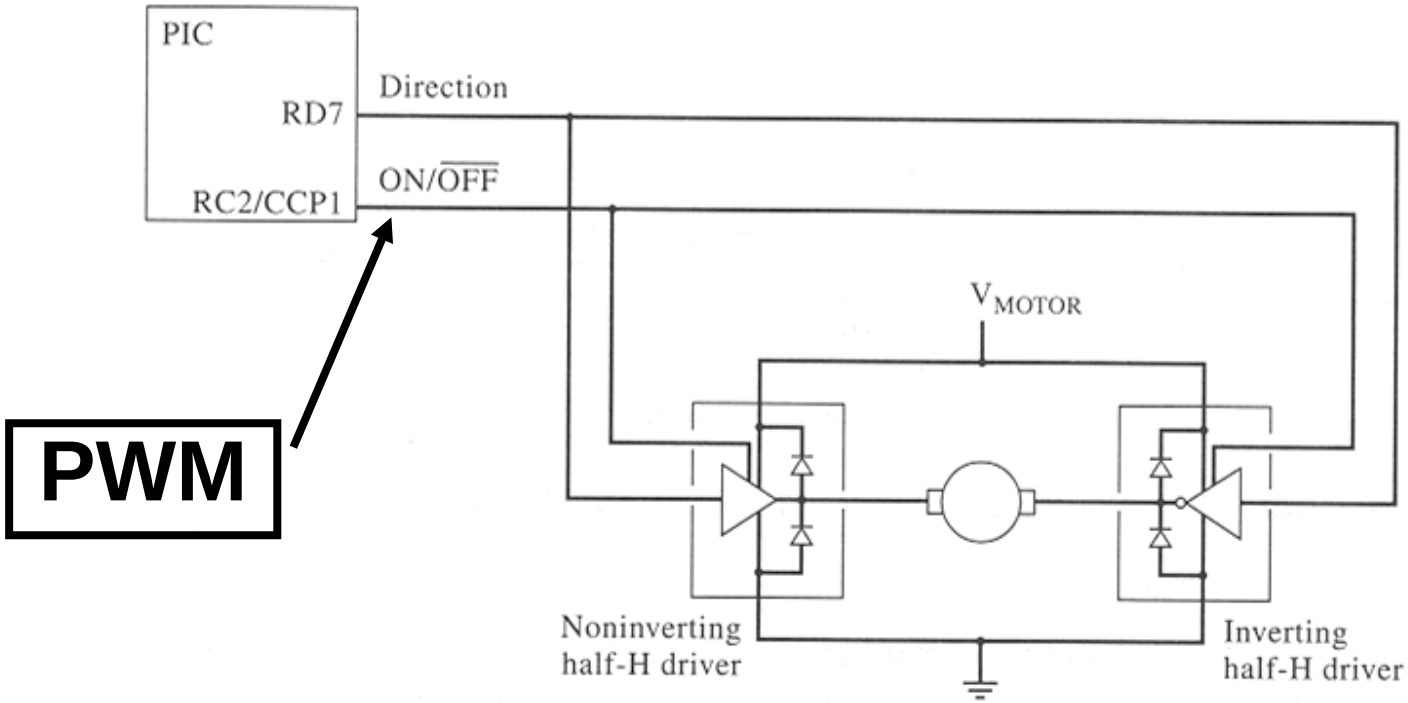
“H Bridge”



“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, $V_{IH\text{-}min}$, $V_{IL\text{-}max}$, 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/$\overline{\text{full}}$ step = L

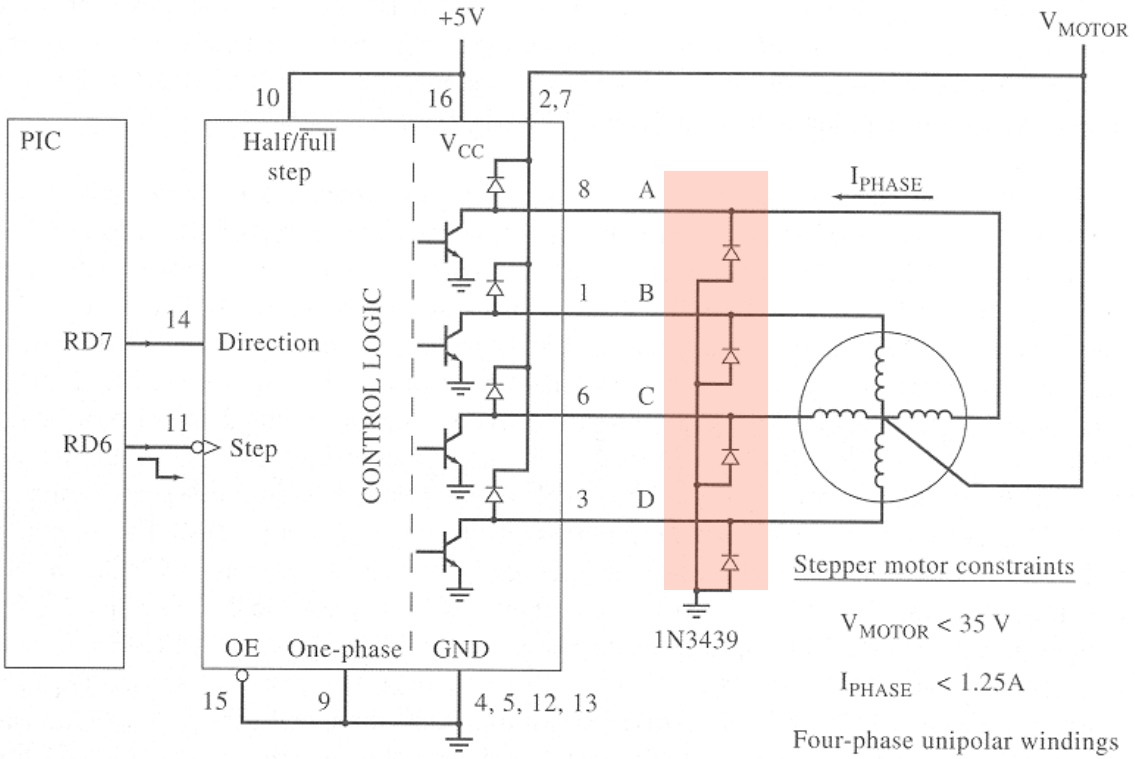
A	B	C	D
L	H	H	L
L	L	H	H
H	L	L	H
H	H	L	L
L	H	H	L

Direction = H ↕ Direction = L

Half/$\overline{\text{full}}$ 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



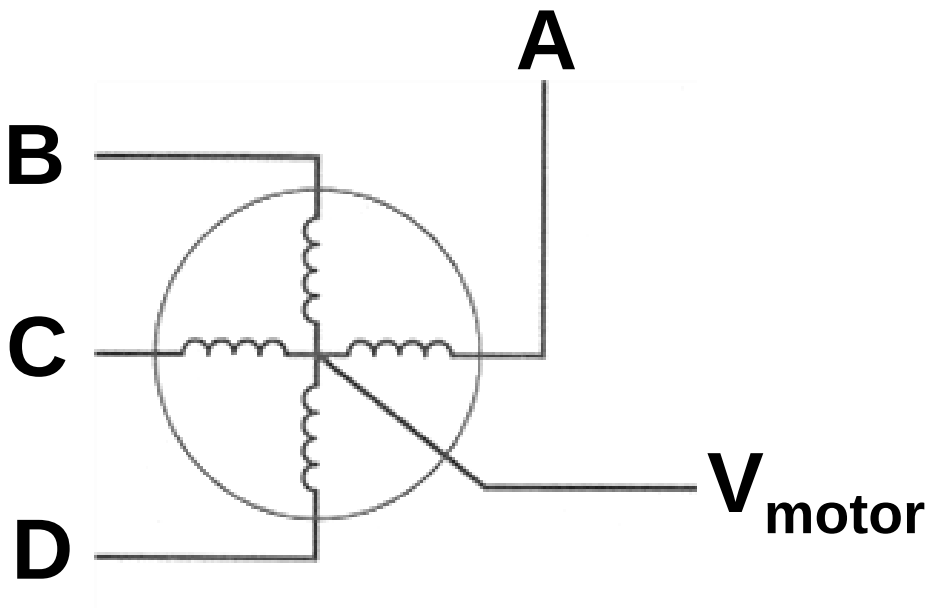
Allegro MicroSystems
Stepper Motor Translator/Driver
UCN5804B
(16-pin DIP)

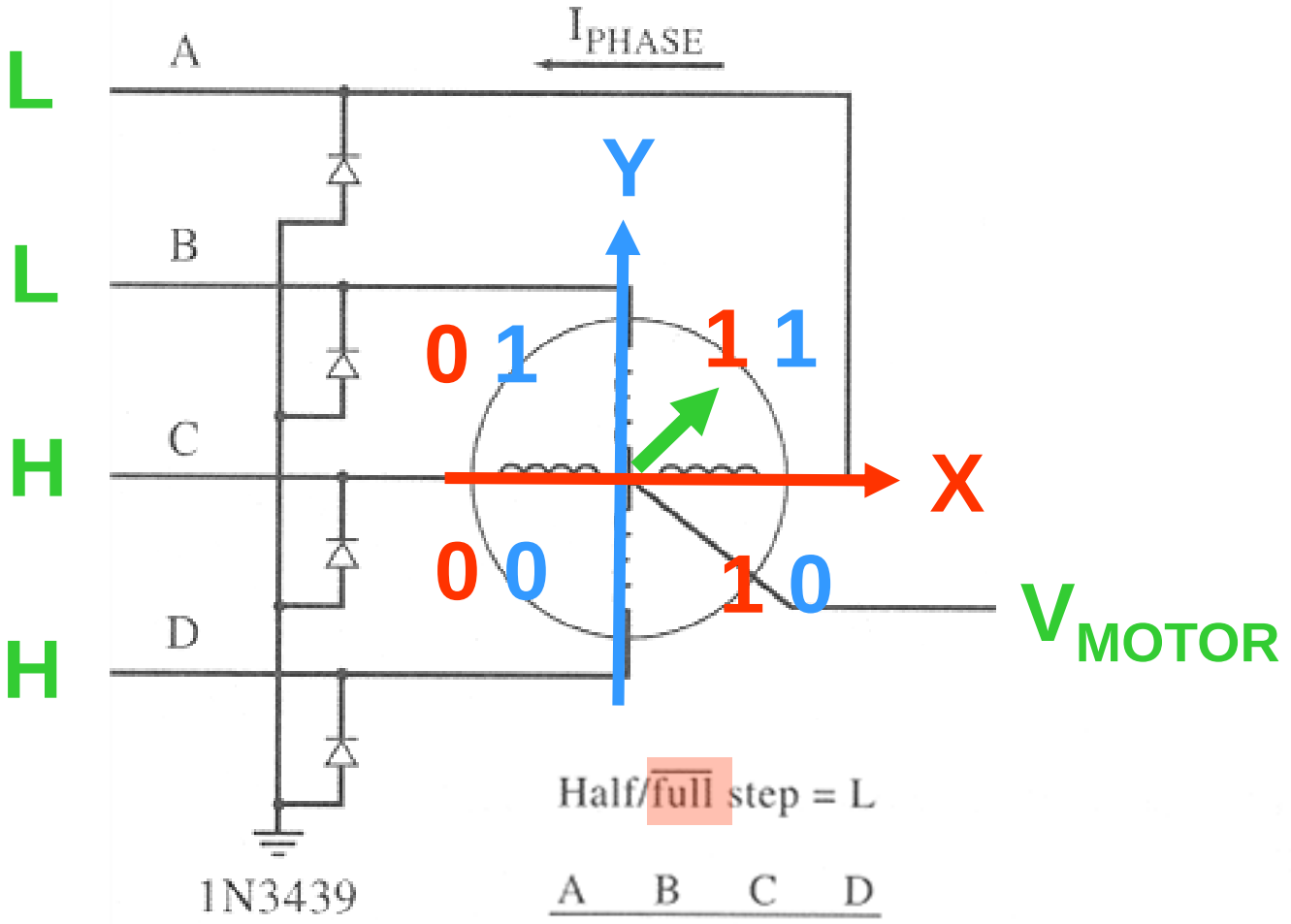
Stepper motor constraints

V_{MOTOR} < 35 V

I_{PHASE} < 1.25A

Four-phase unipolar windings


A
B
C
D
V motor



Half/full step = L

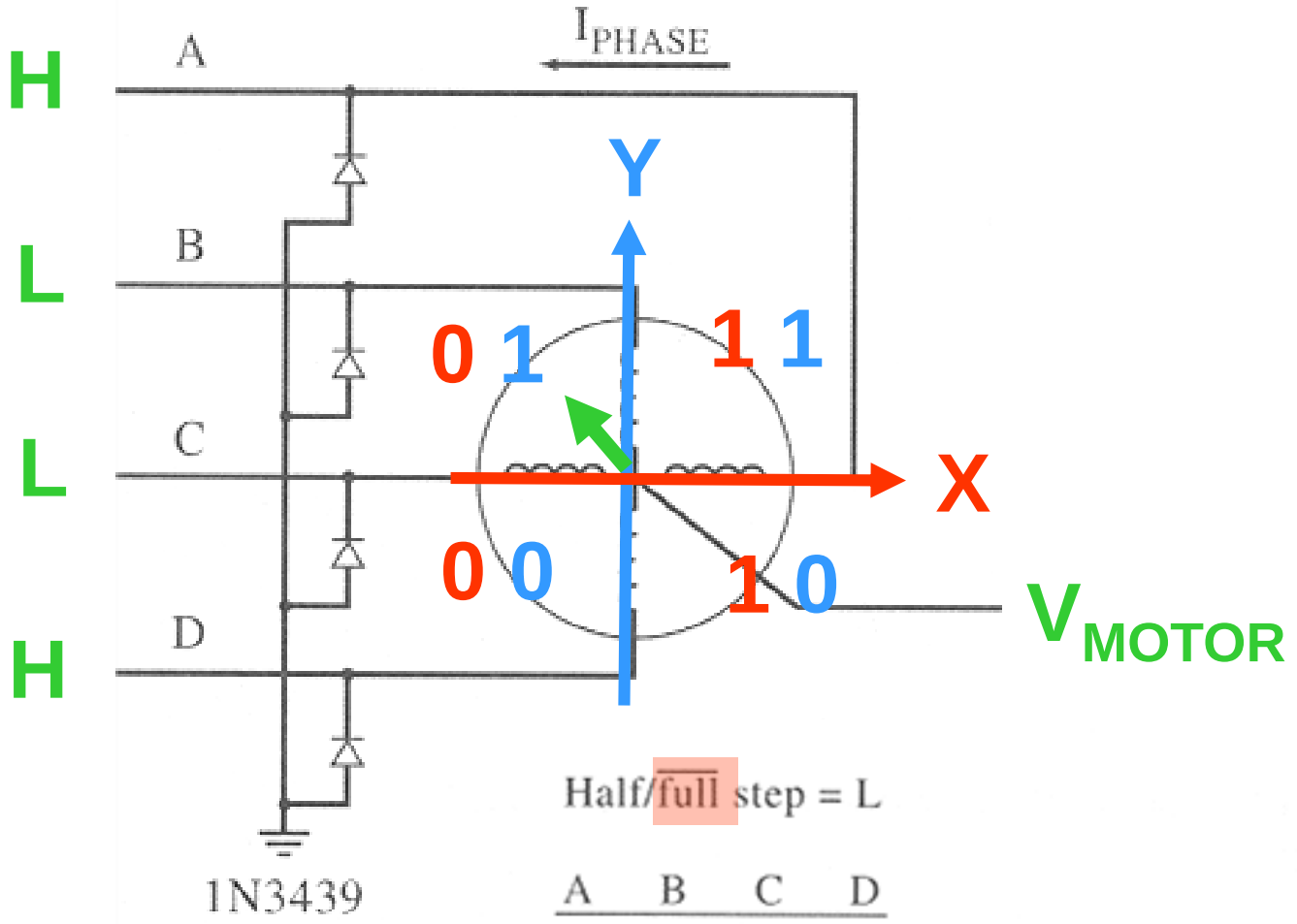
A	B	C	D
L	H	H	L
L	L	H	H
H	L	L	H
H	H	L	L
L	H	H	L

Direction = H

↕

Direction = L

FULL STEP MODE



Half/full step = L

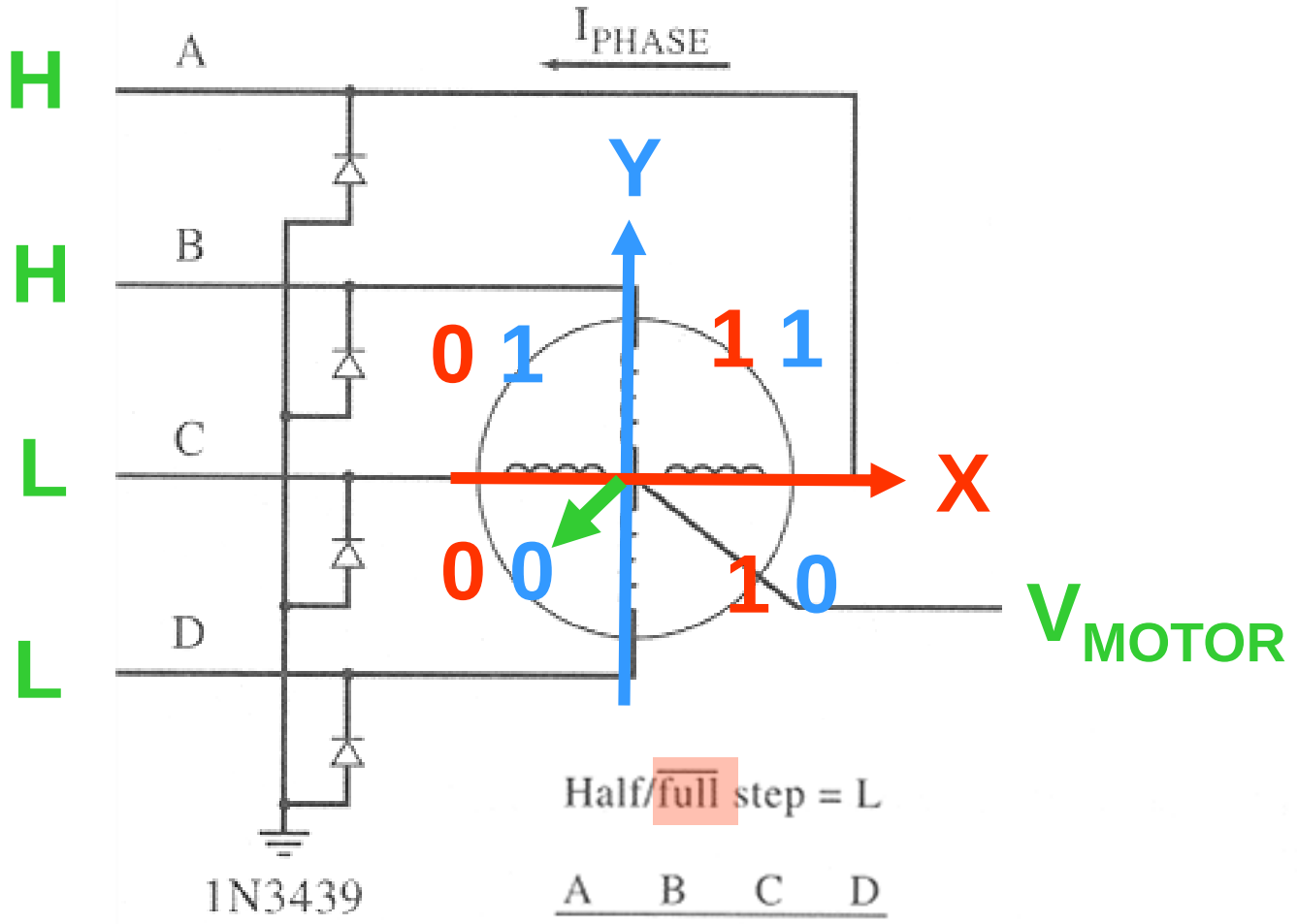
A	B	C	D
L	H	H	L
L	L	H	H
H	L	L	H
H	H	L	L
L	H	H	L

Direction = H

↕

Direction = L

FULL STEP MODE



Half/full step = L

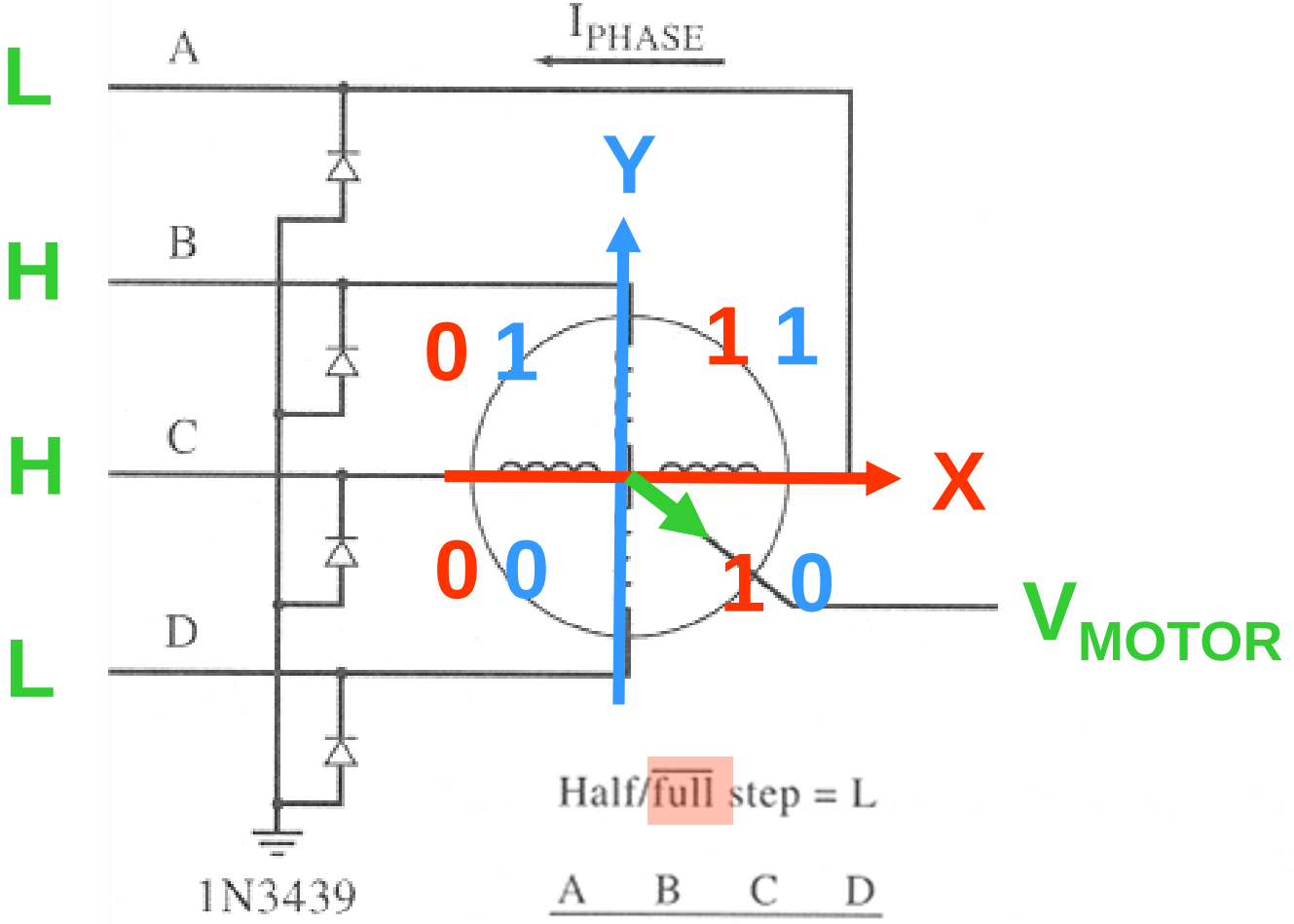
A	B	C	D
L	H	H	L
L	L	H	H
H	L	L	H
H	H	L	L
L	H	H	L

Direction = H

↕

Direction = L

FULL STEP MODE



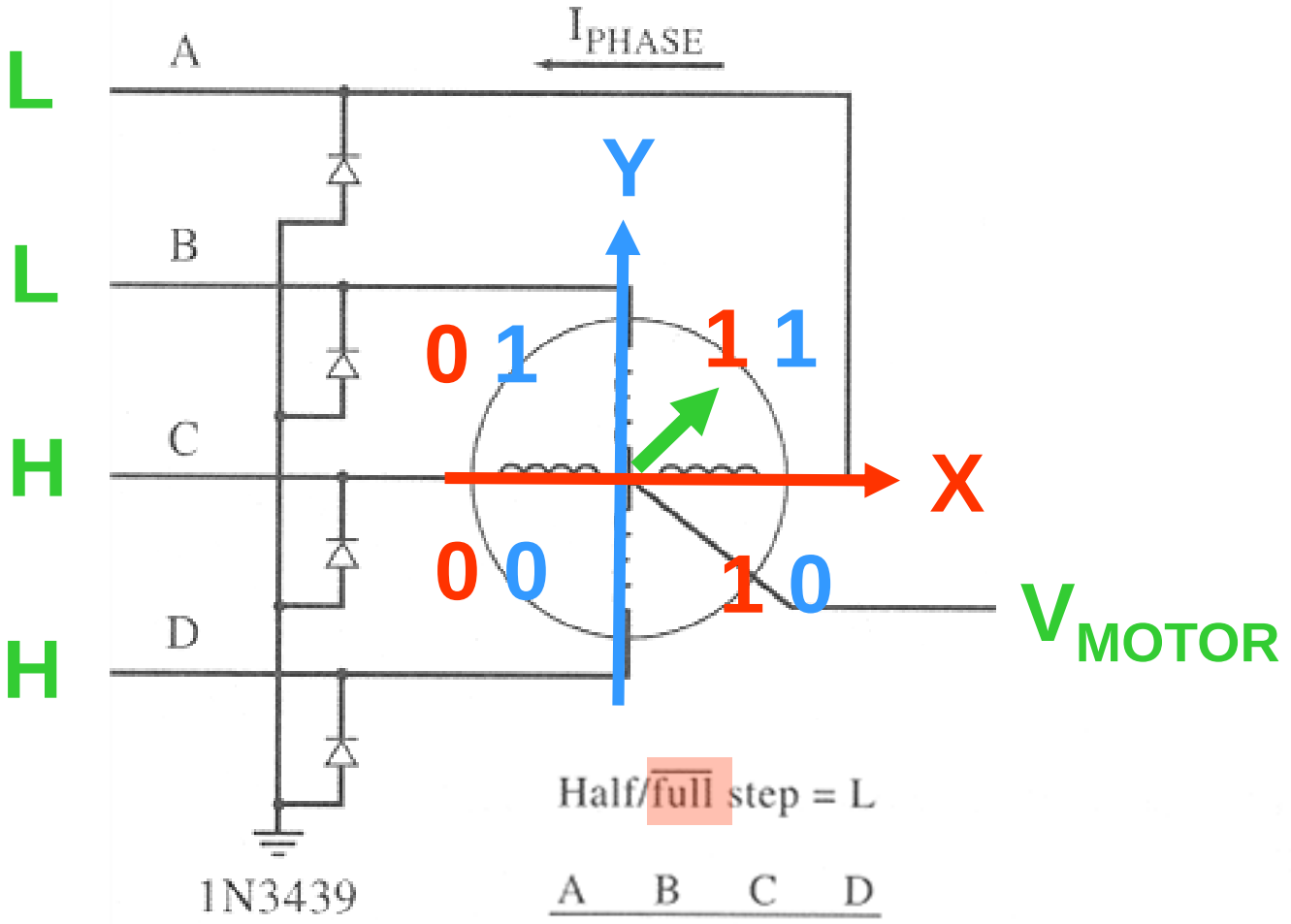
Half/full step = L

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



Half/full step = L

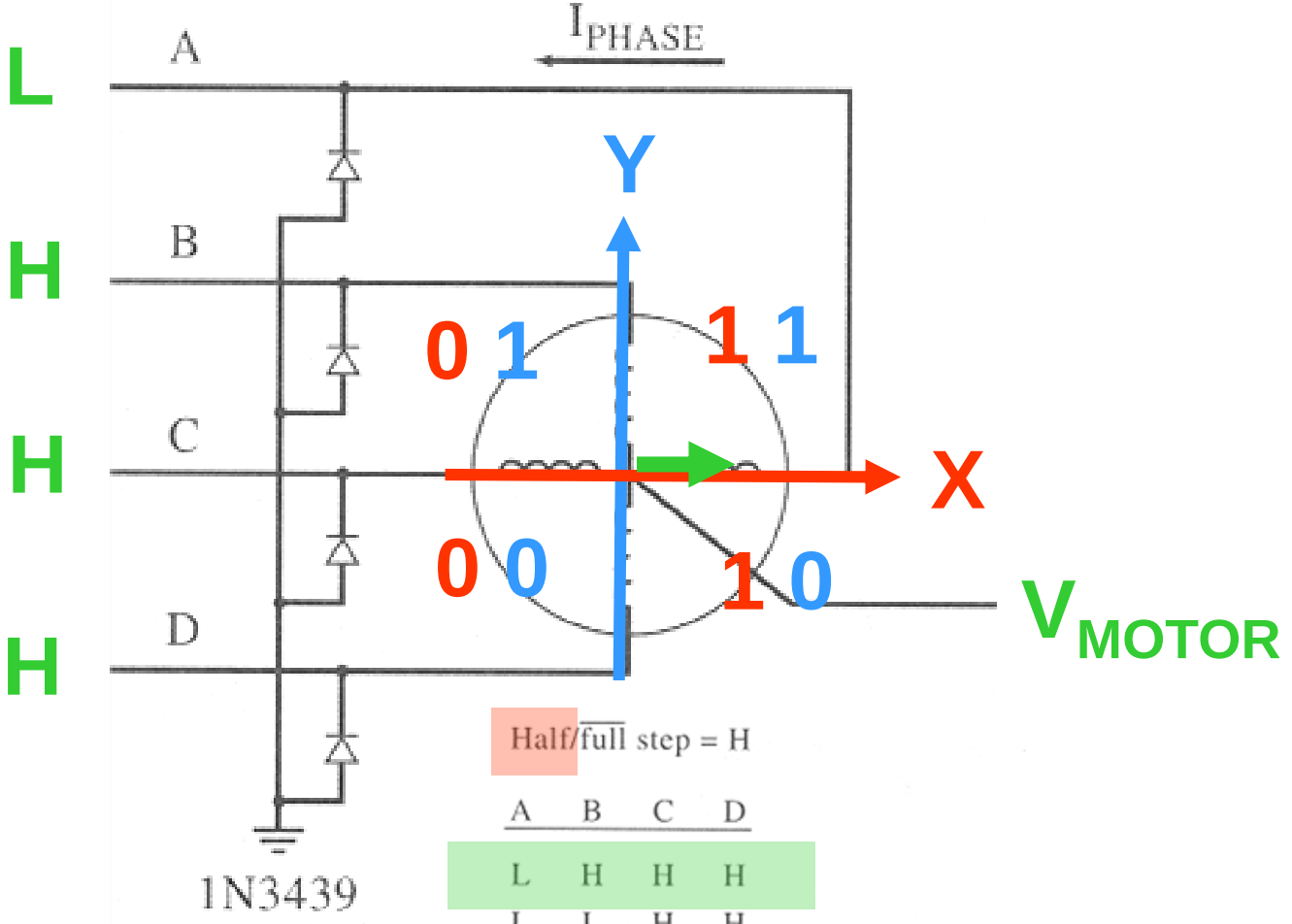
A	B	C	D
L	H	H	L
L	L	H	H
H	L	L	H
H	H	L	L
L	H	H	L

Direction = H

↕

Direction = L

FULL STEP MODE



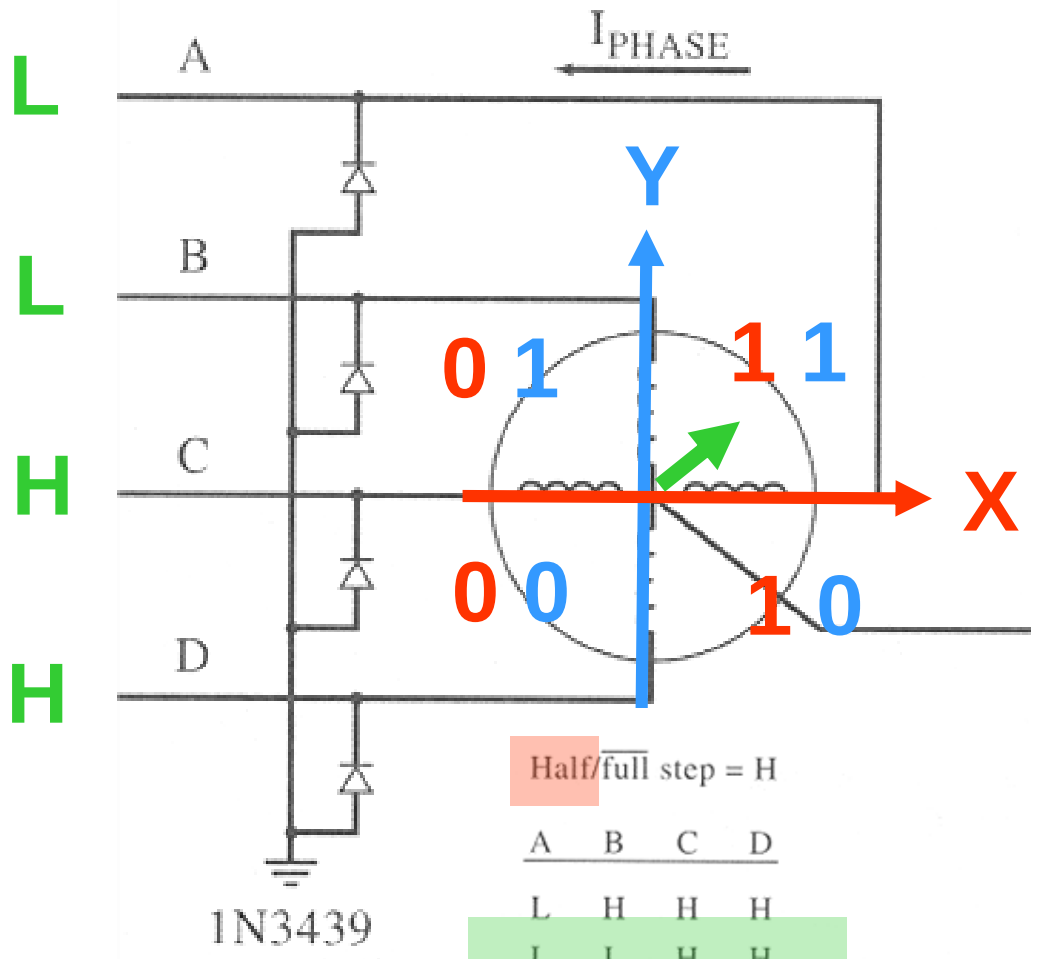
Half/$\overline{\text{full}}$ step = H

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



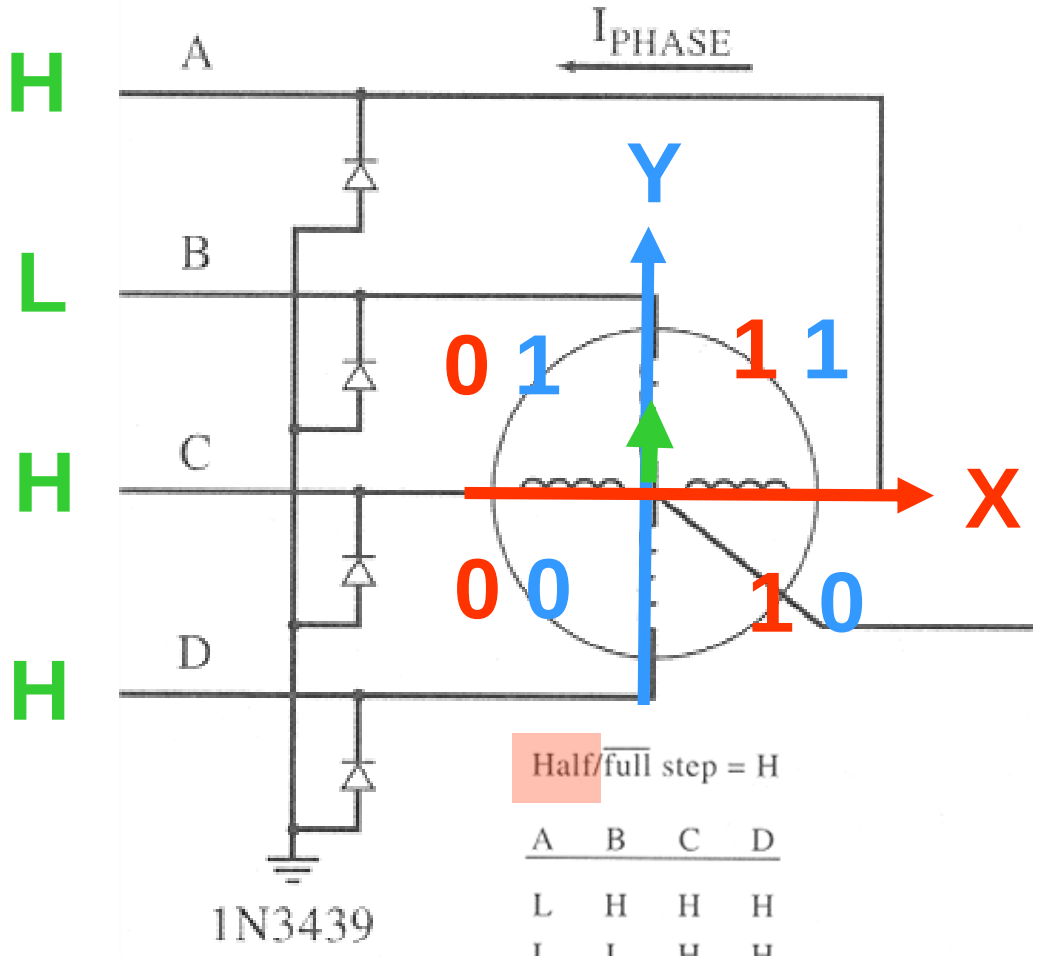
Half/$\overline{\text{full}}$ step = H

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



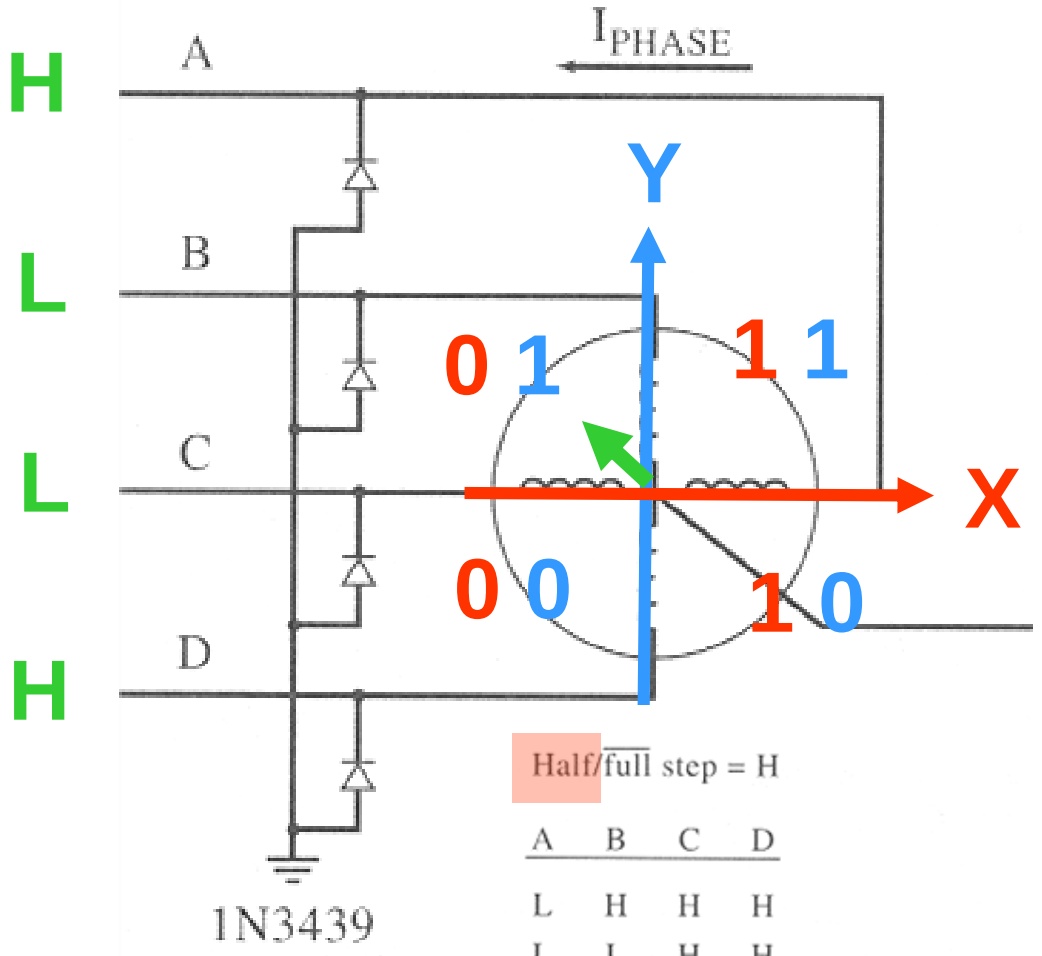
Half/$\overline{\text{full}}$ step = H

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



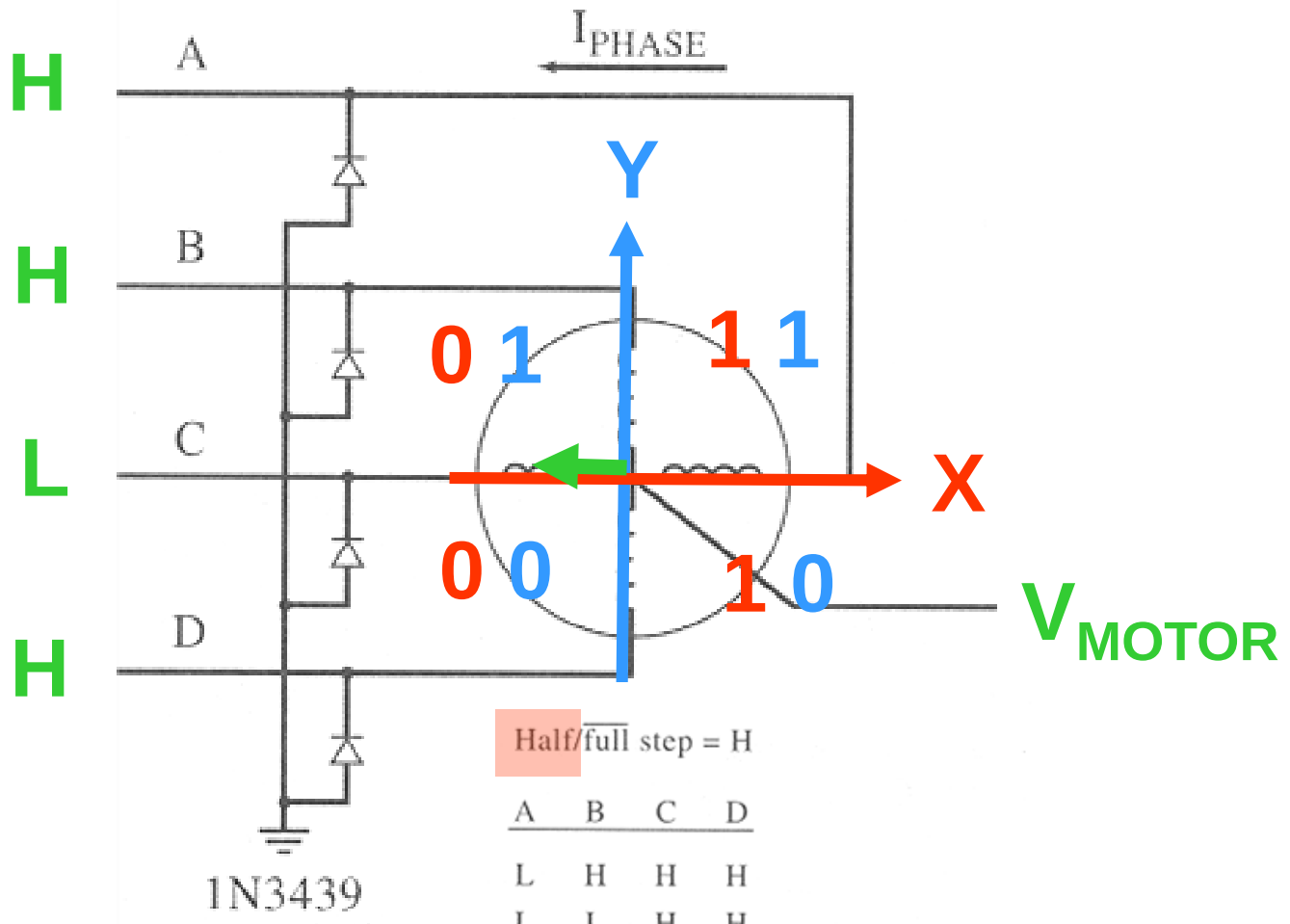
Half/$\overline{\text{full}}$ step = H

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



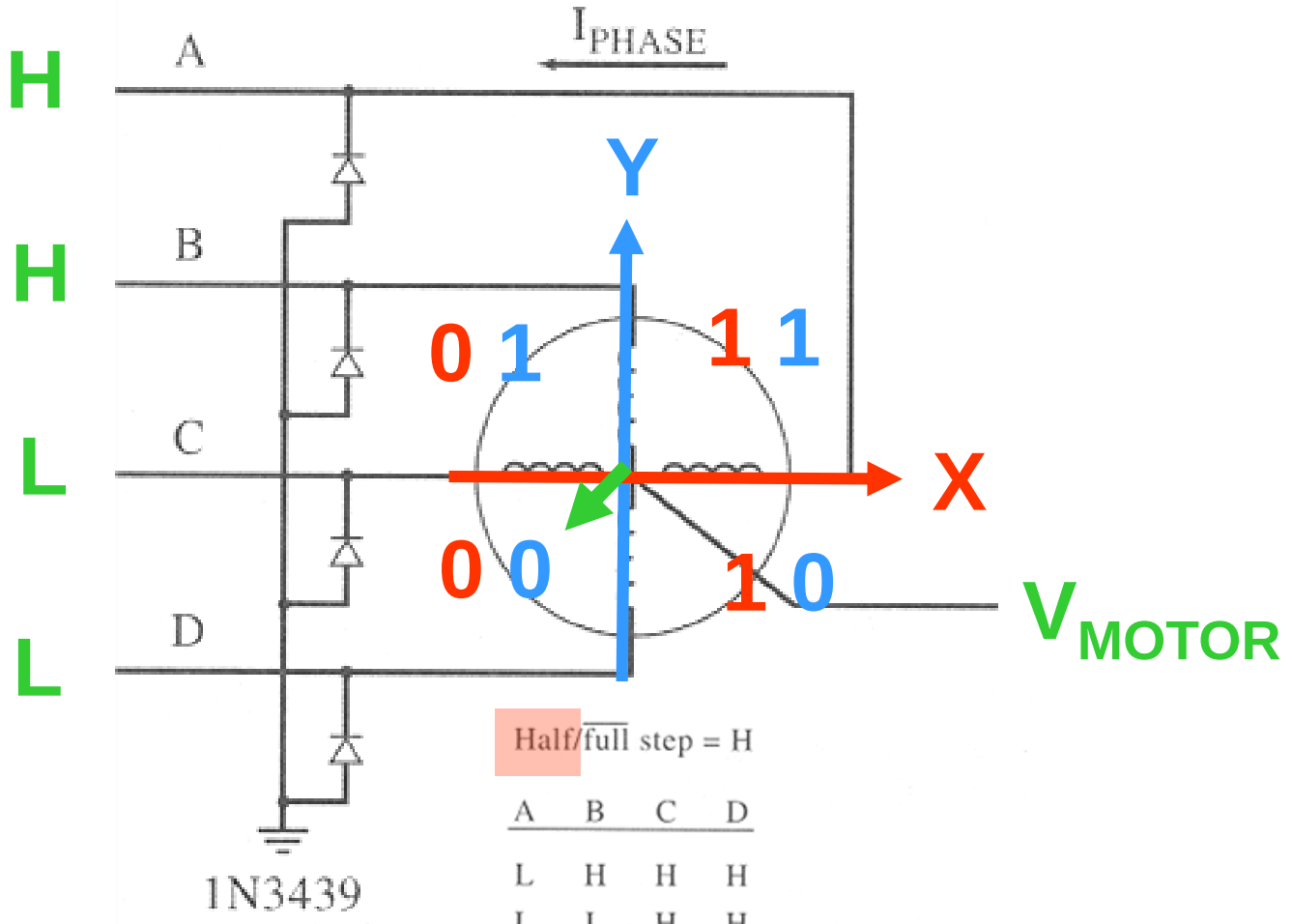
Half/$\overline{\text{full}}$ step = H

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

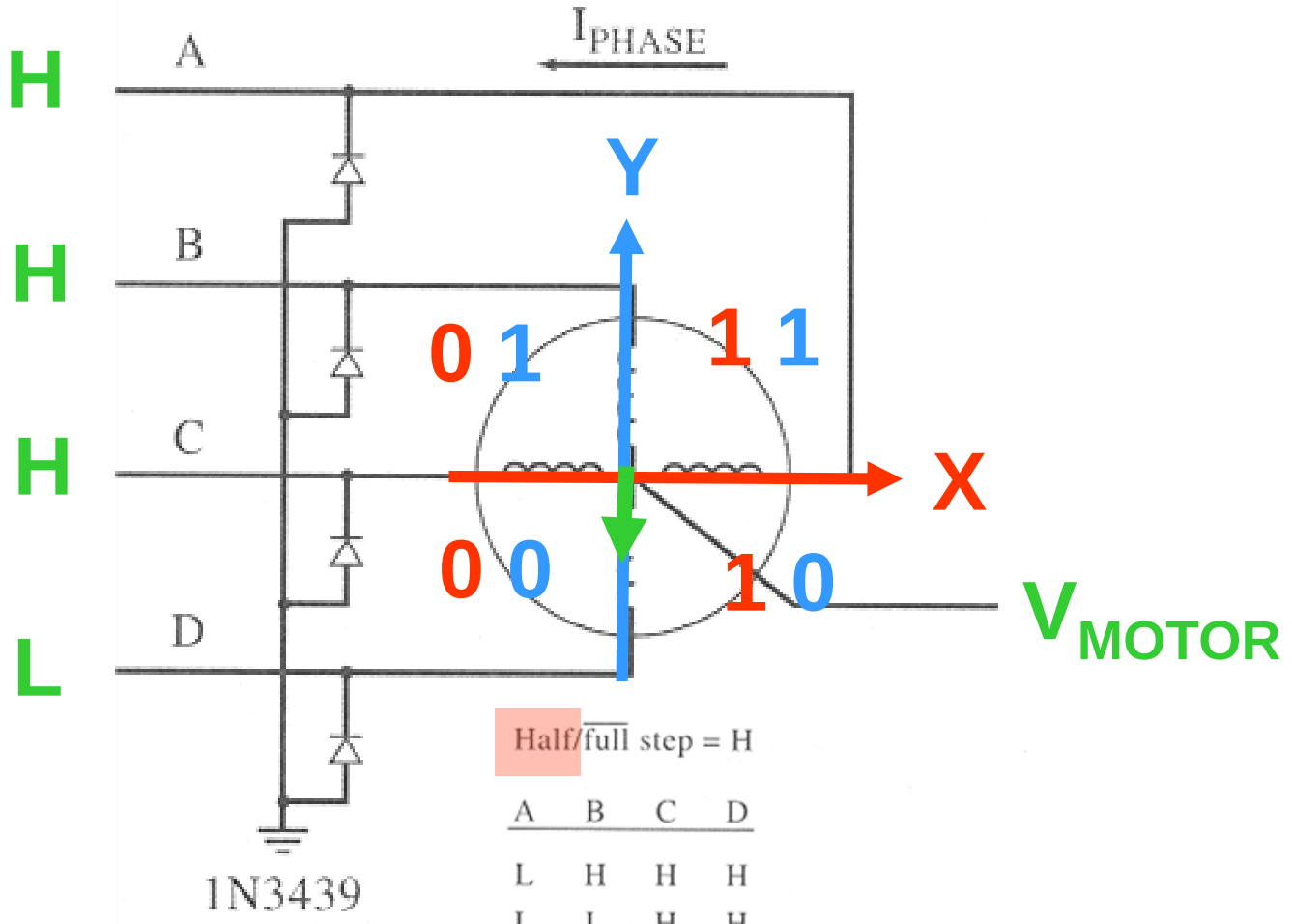
HALF STEP MODE



Half/$\overline{\text{full}}$ step = H

A	B	C	D	
L	H	H	H	
L	L	H	H	
H	L	H	H	Direction = H
H	L	L	H	
H	H	L	H	
H	H	L	L	Direction = L
H	H	H	L	
L	H	H	L	
L	H	H	H	

HALF STEP MODE



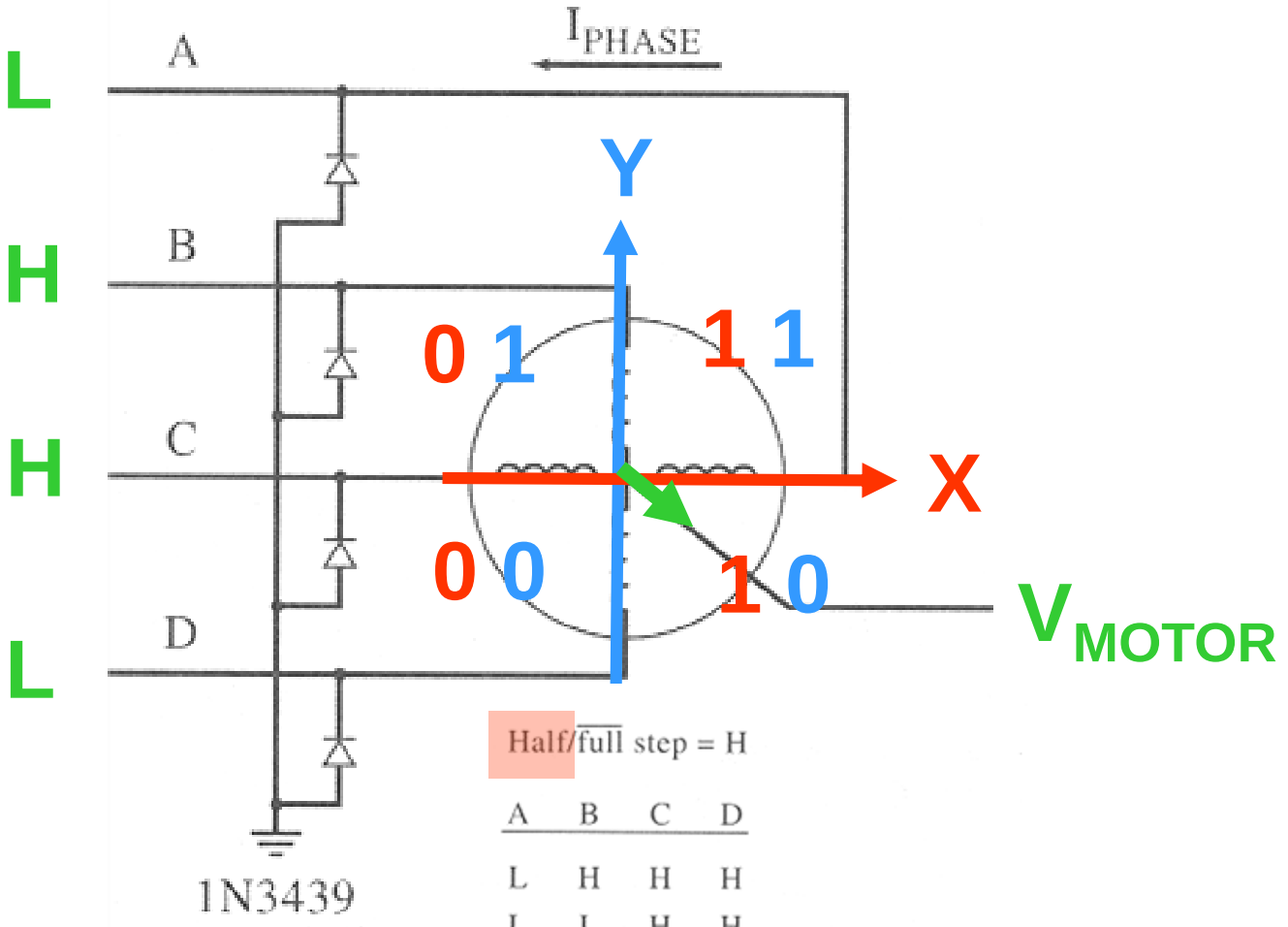
Half/$\overline{\text{full}}$ step = H

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



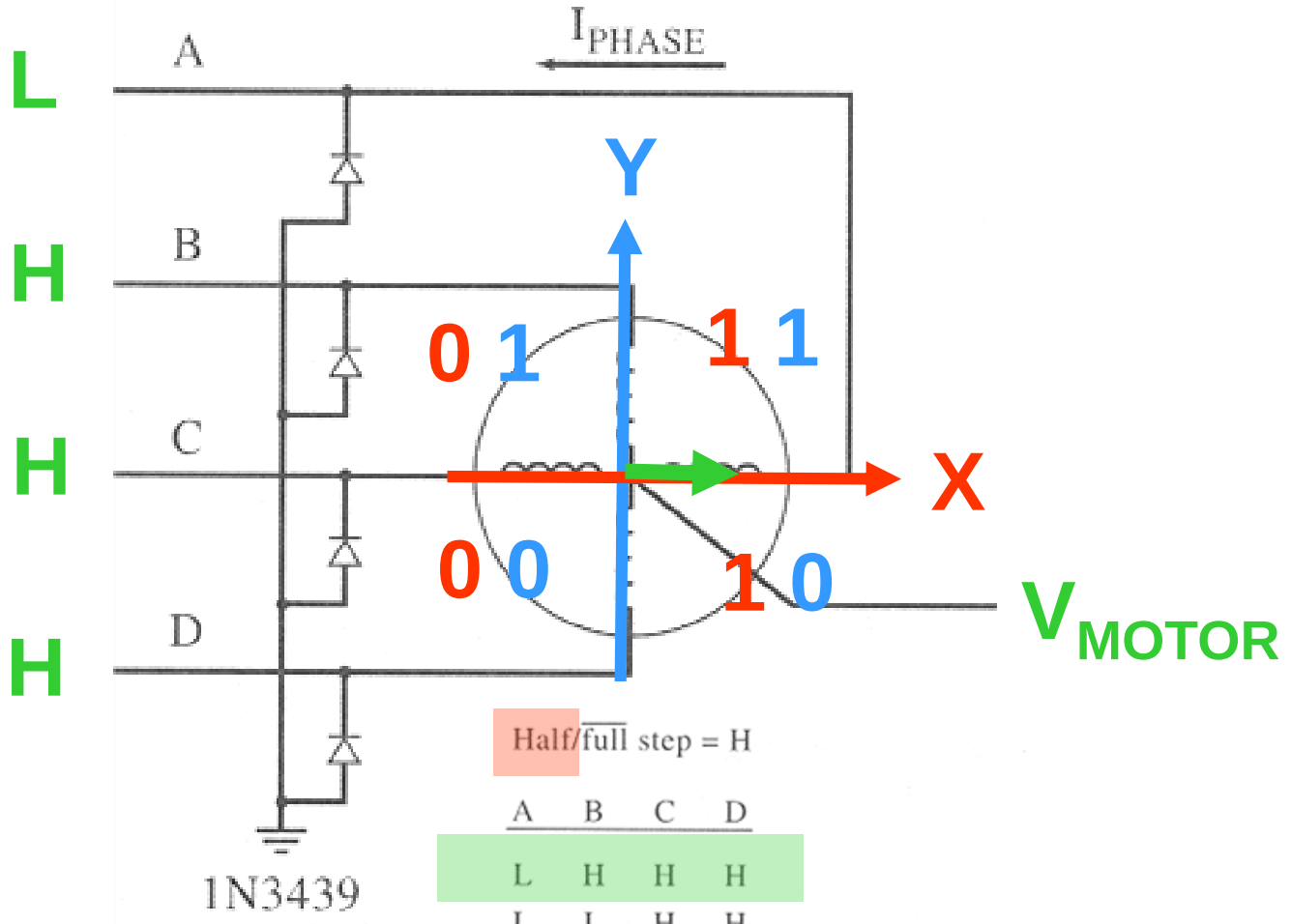
Half/$\overline{\text{full}}$ step = H

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/$\overline{\text{full}}$ 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

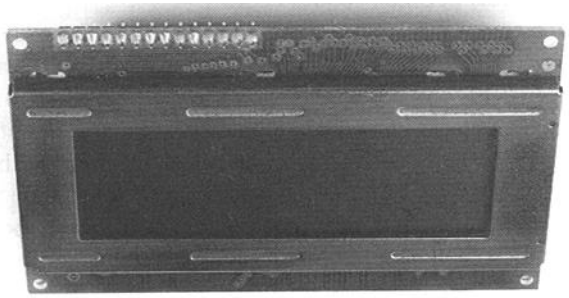
HALF STEP MODE

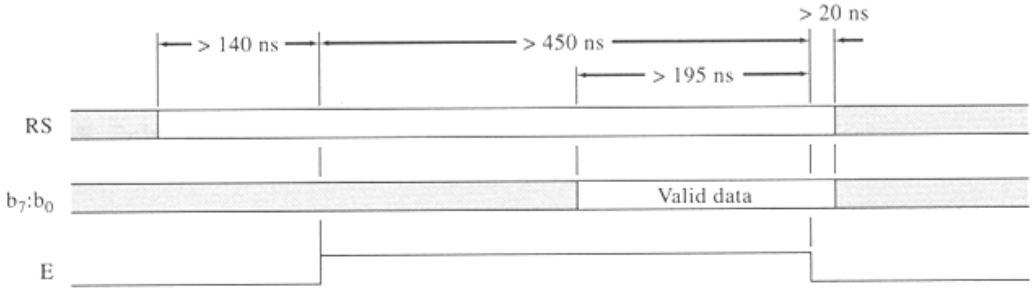
Hobbyist Servos

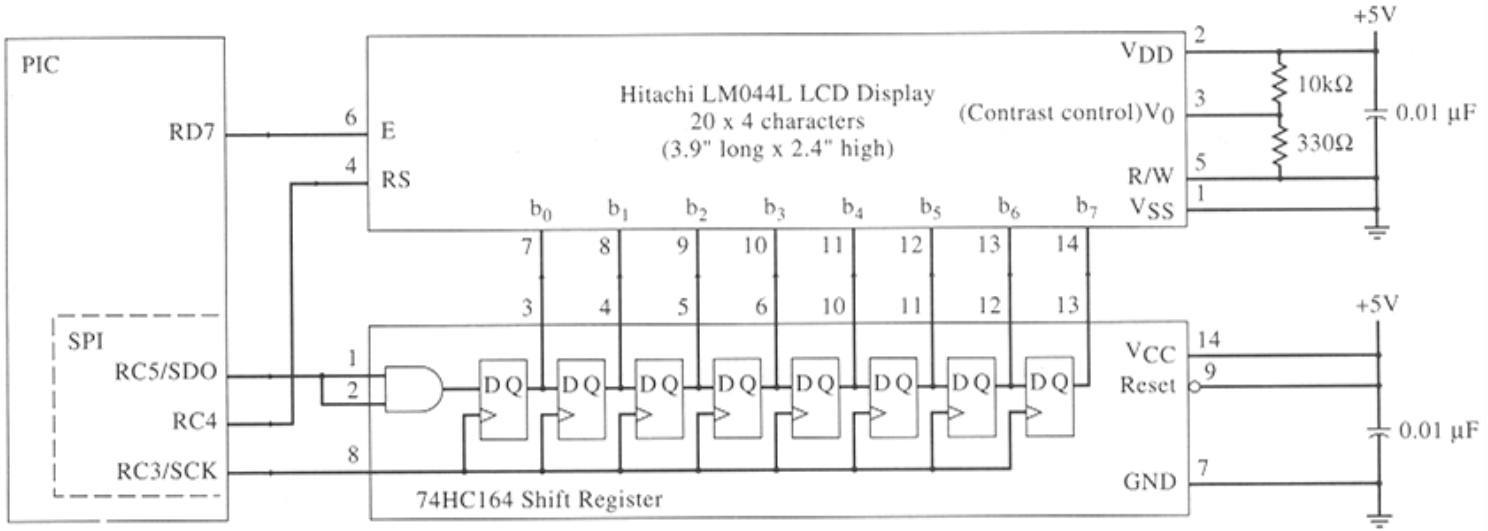
- **Position control**
  - **Single-wire interface**
  - **Can not rotate more than ~270°**
  - **why servos are a good choice**
    - **Low overhead for control – logic-level interface**
    - **Simple interface (PWM)**

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

Basic LCD Interface





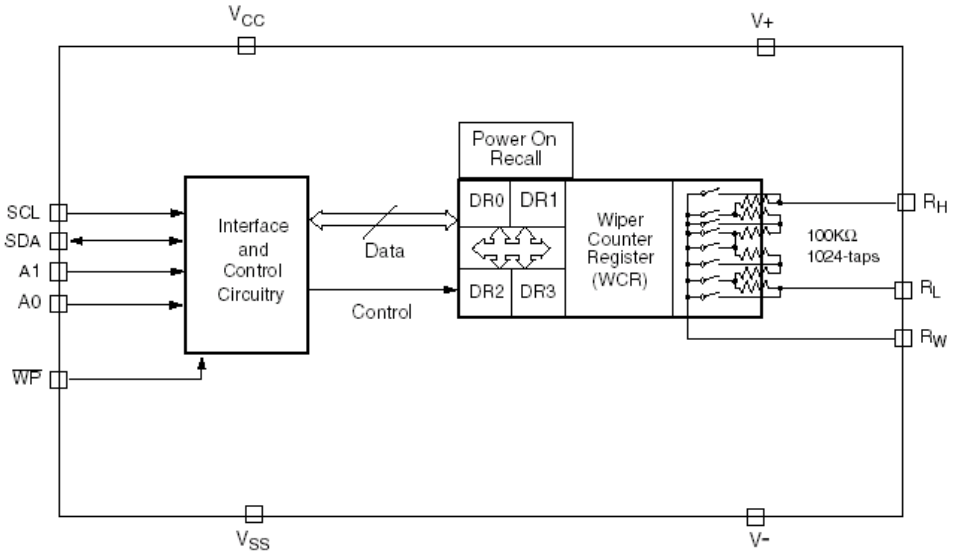


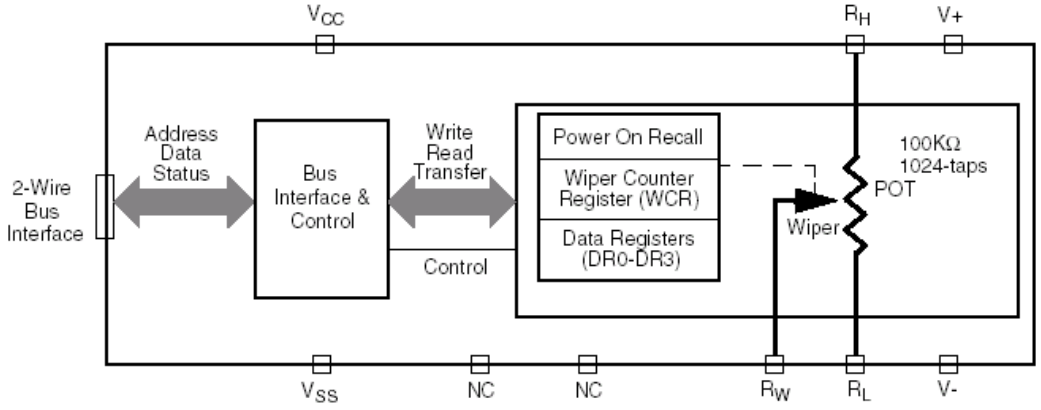
Digitally Controlled Potentiometer

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

XICOR





Digital Thermometer

DALLAS SEMICONDUCTOR MAXIM

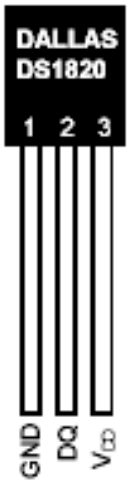
DS18S20
High-Precision
1-Wire Digital Thermometer

www.maxim-ic.com

FEATURES

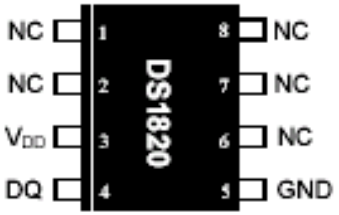
- Unique 1-Wire® interface requires only one port pin for communication
- Each device has a unique 64-bit serial code stored in an onboard ROM
- Multidrop capability simplifies distributed temperature sensing applications
- Requires no external components
- Can be powered from data line. Power supply range is 3.0V to 5.5V
- Measures temperatures from –55°C to +125°C (–67°F to +257°F)
- ±0.5°C accuracy from –10°C to +85°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)

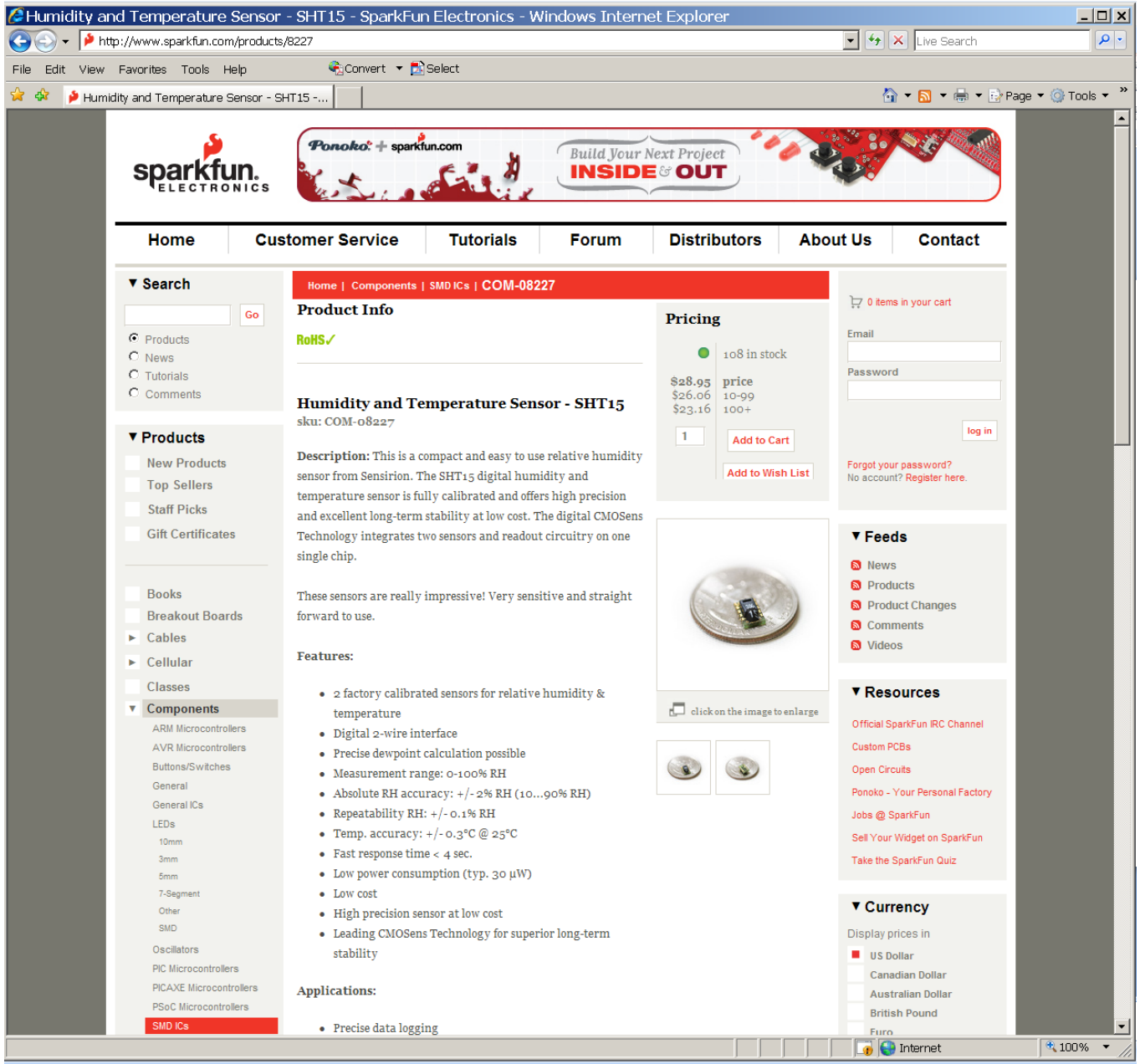


8-Pin 150mil SO
(DS18S20Z)

PIN DESCRIPTION

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

Humidity and Temperature Sensor



Digital/Analog Compass

Dinsmore Sensors - Windows Internet Explorer

http://www.dinsmoresensors.com/

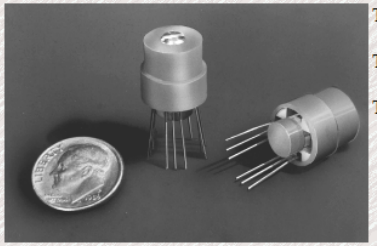
File Edit View Favorites Tools Help

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

ORDERING INFORMATION

Internet 100%

Digital Compass

www.parallax.com

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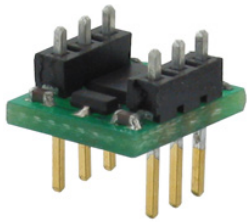
Hitachi HM55B Compass Module



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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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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 SHIFTIN and SHIFTOUT.

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.

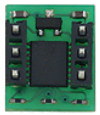
Application Ideas:

- Mobile and walking robot direction sensor
- Handheld electronic compass
- Weathervane 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)

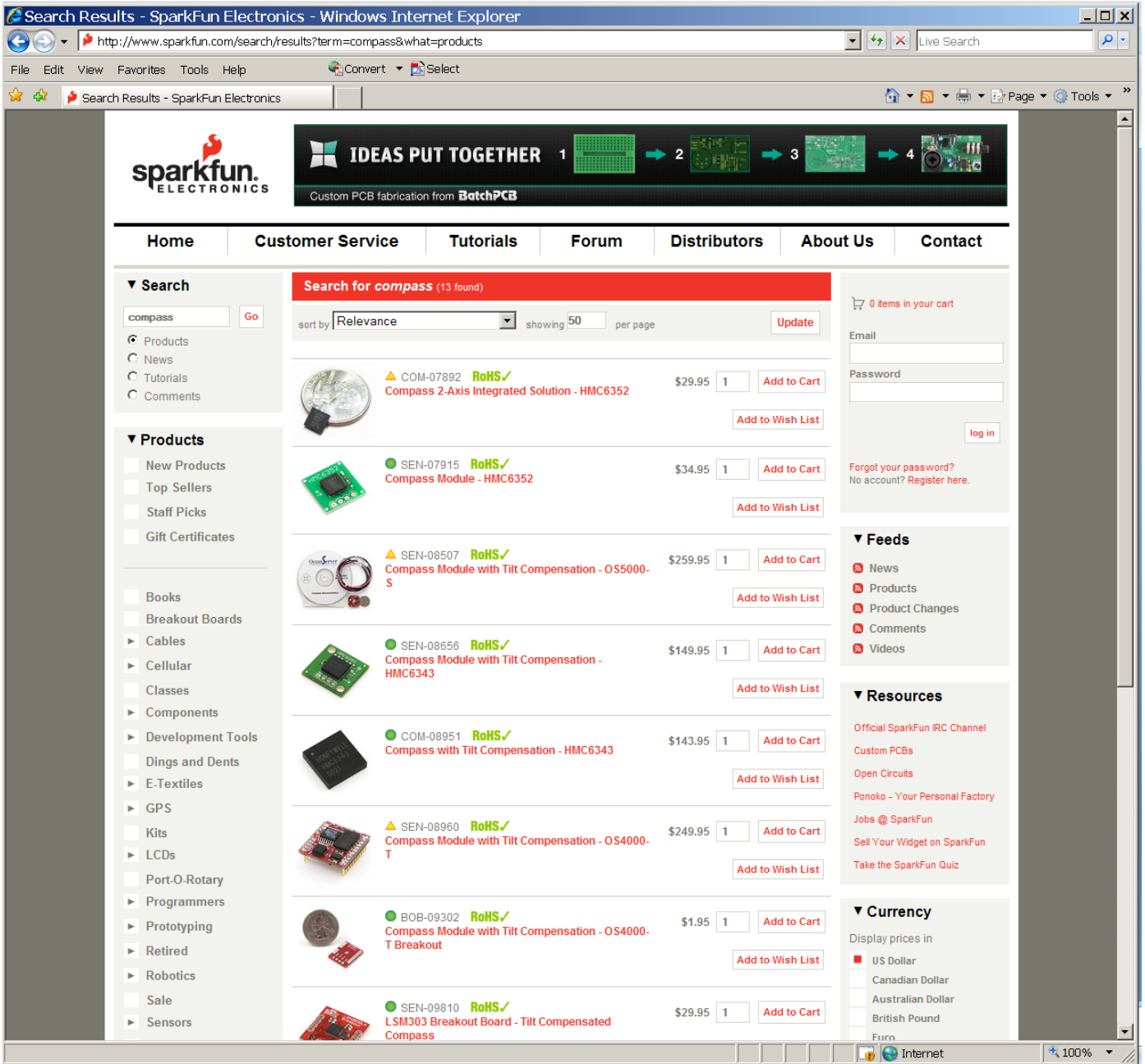
Alternate viewing angle:



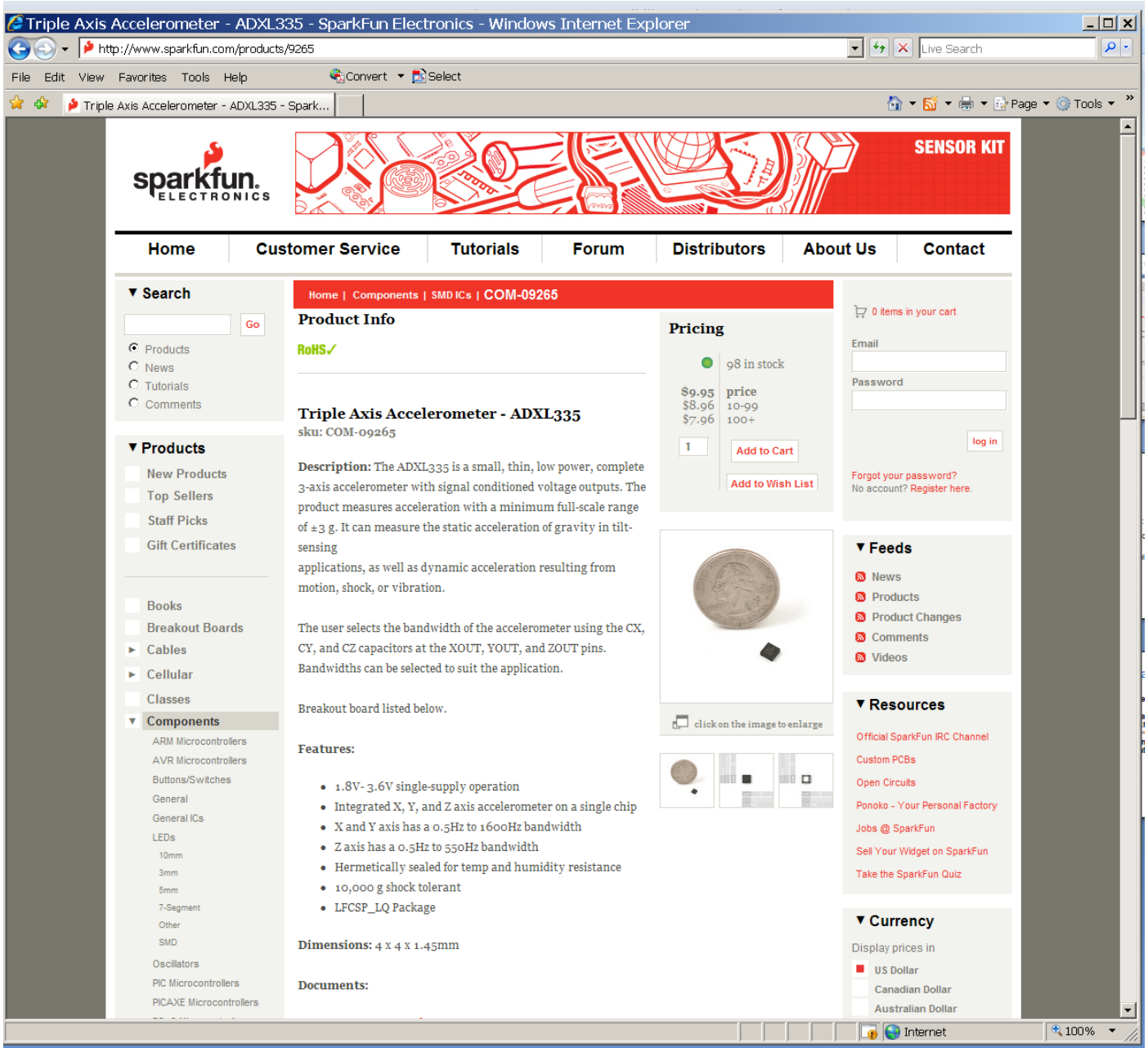
Click through for a close-up.

RoHS Compliant

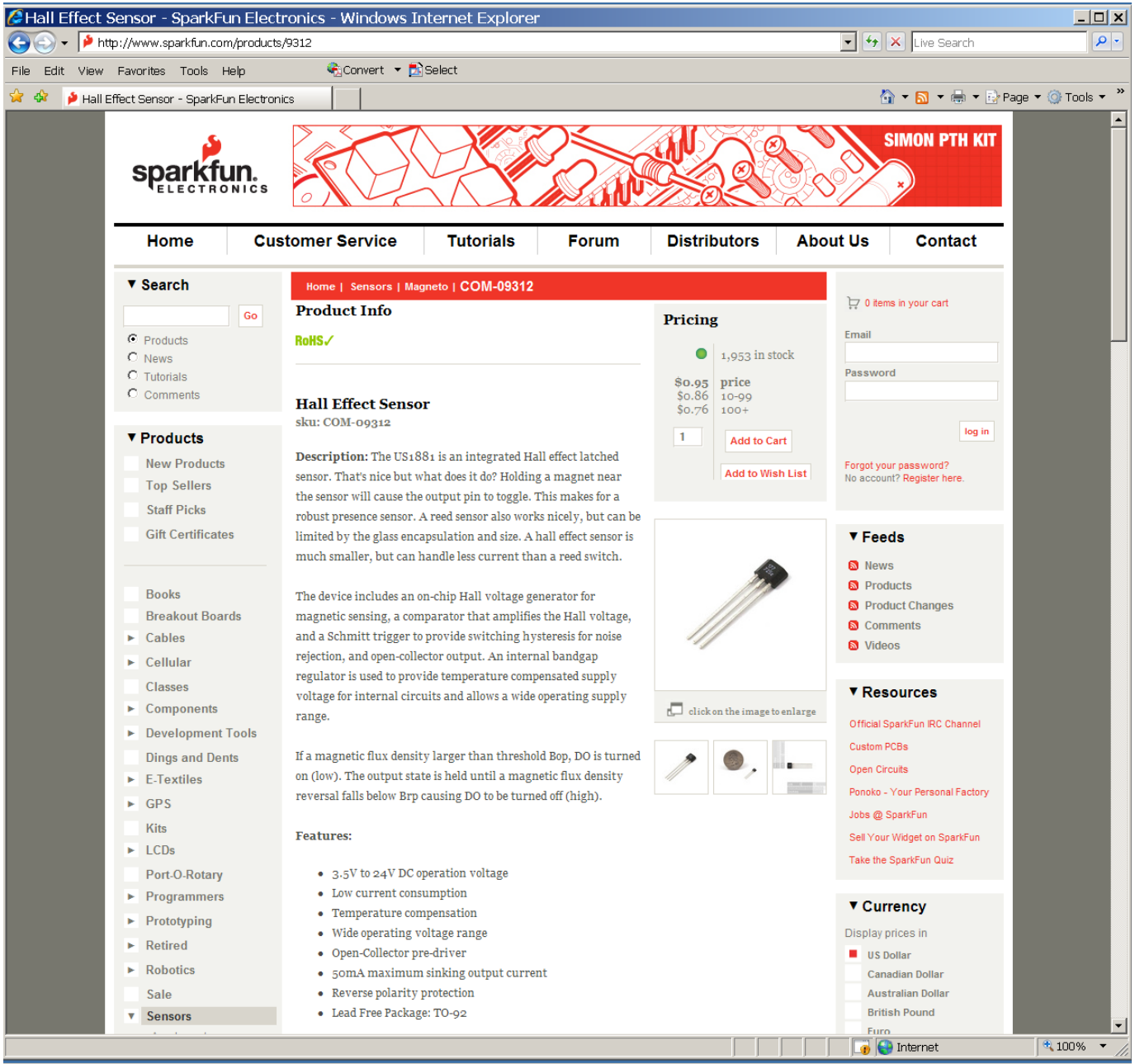
Digital Compass



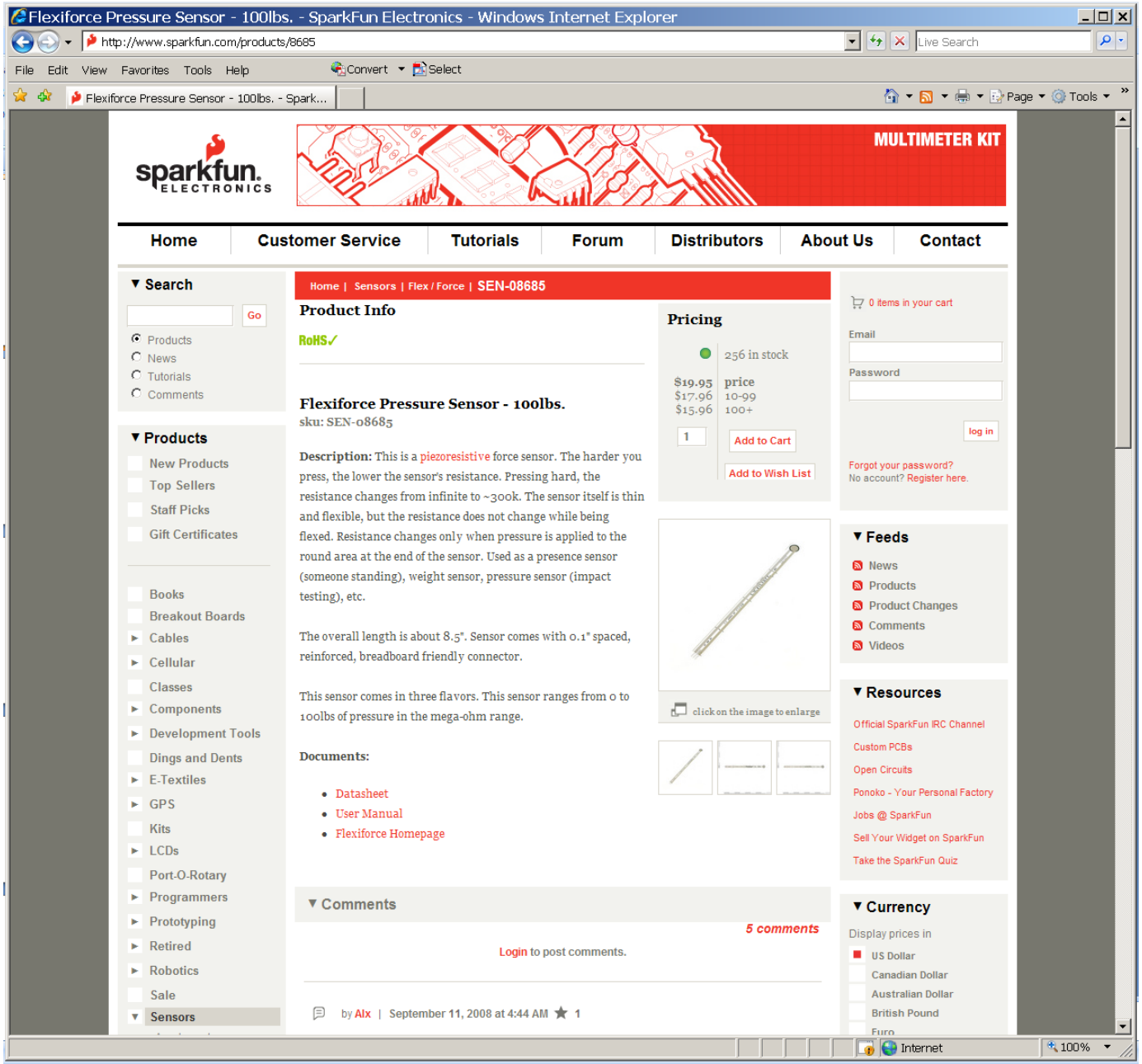
Accelerometer



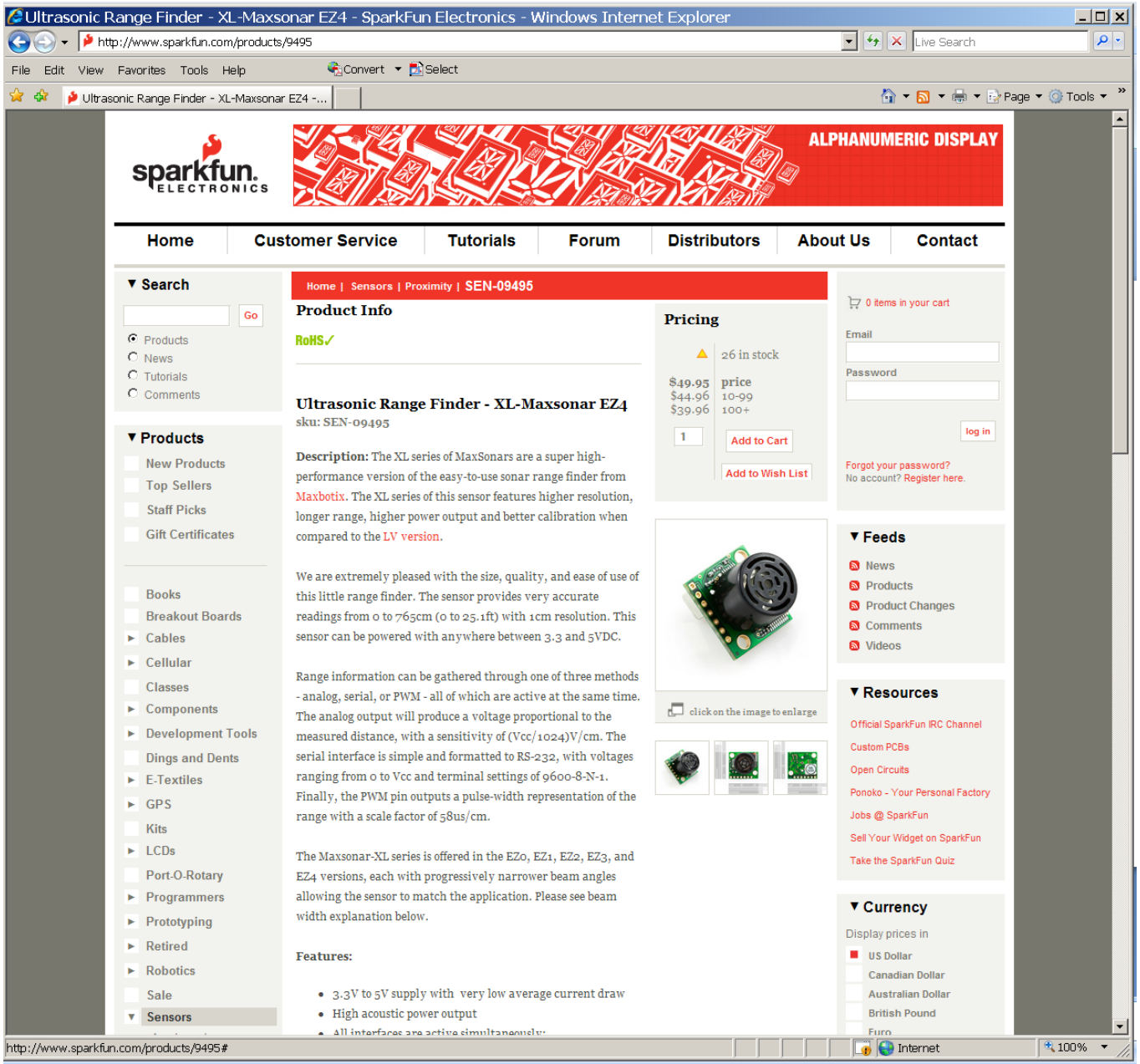
Hall Effect Sensor



Pressure (Force) Sensor



Ultrasonic Range Finder



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

IR Remote

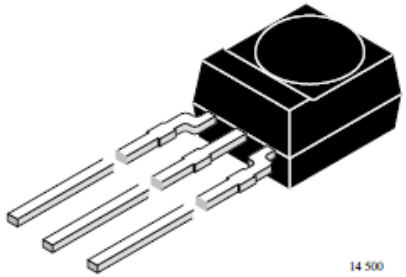
Photo Modules for PCM Remote Control Systems

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.



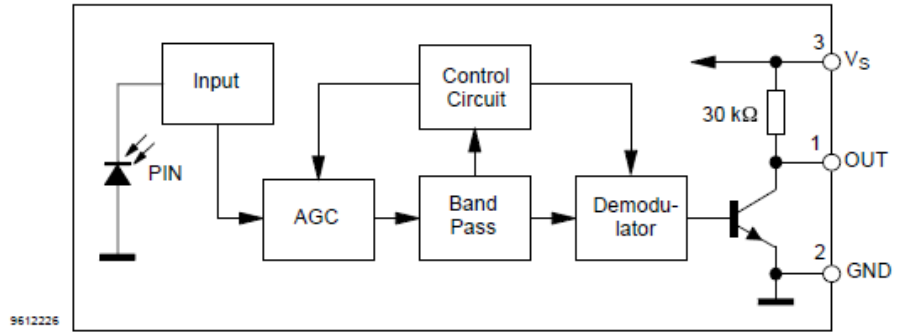
Features

- 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

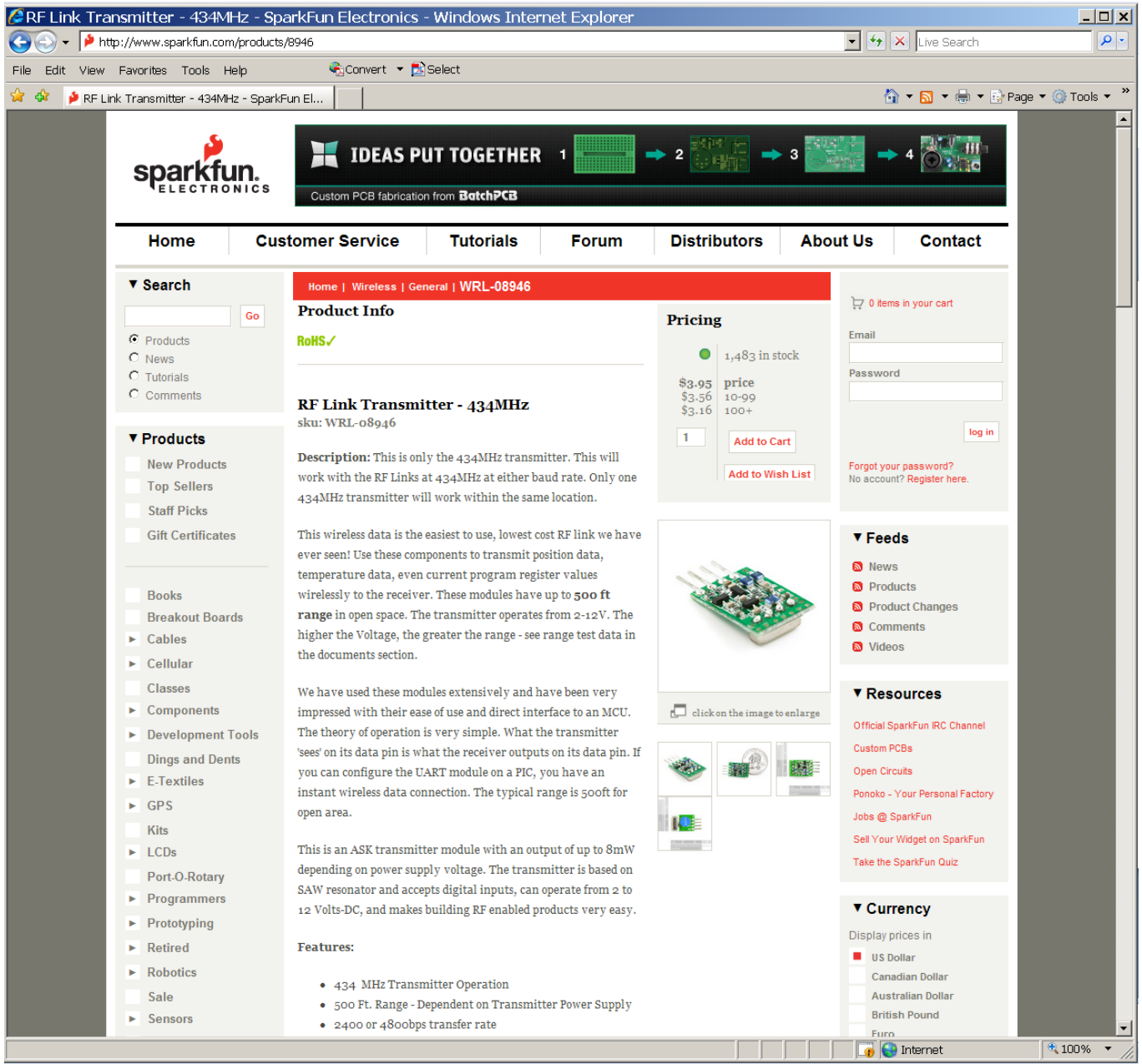
Special Features

- 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 (<200µs)

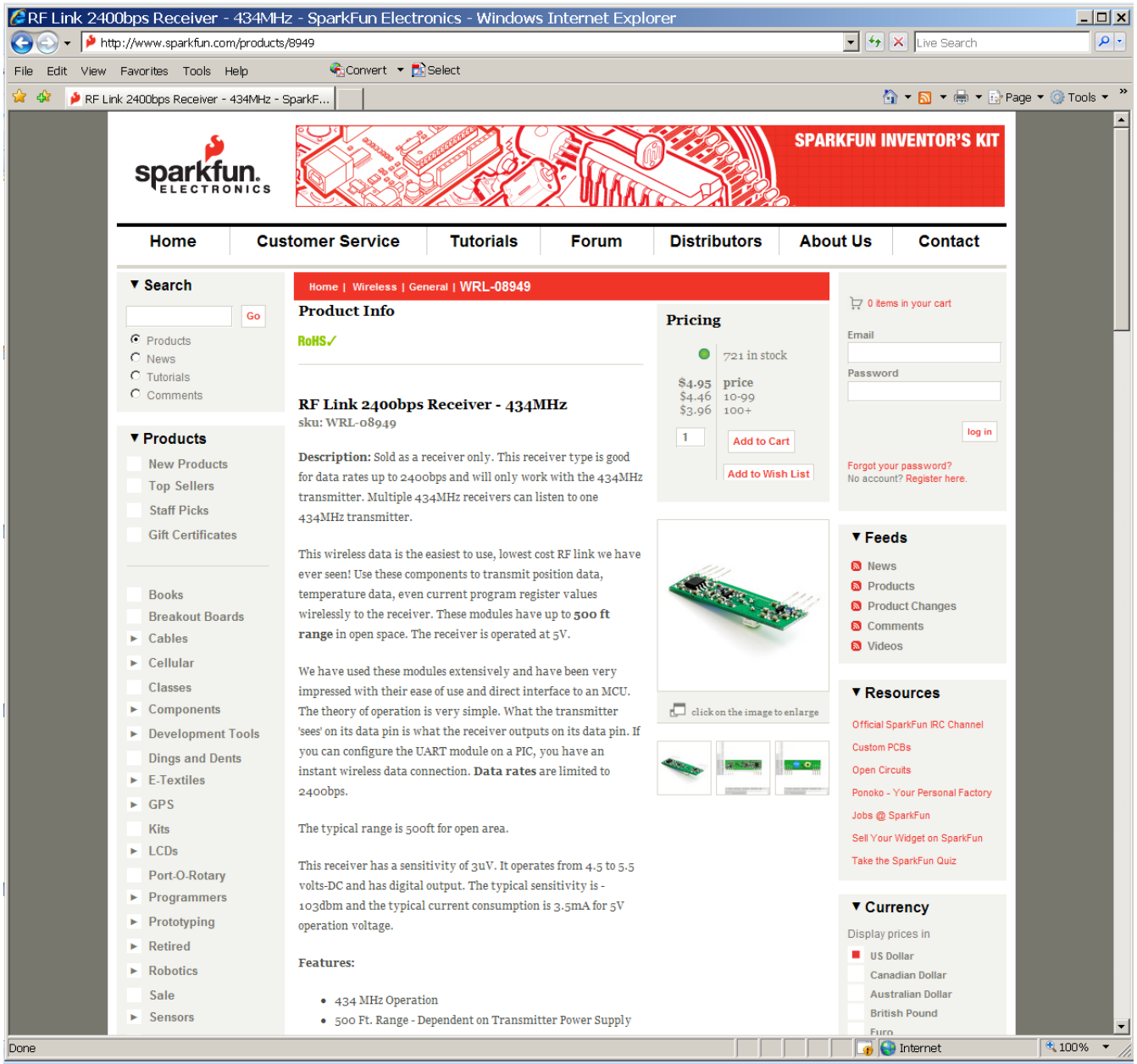
Block Diagram



RF Link (Transmitter)



RF Link (Receiver)



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