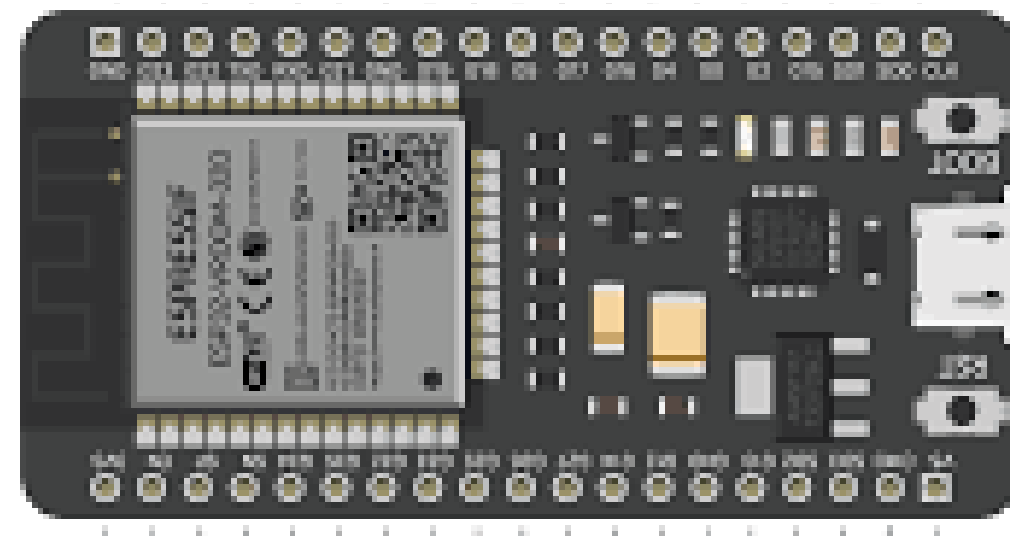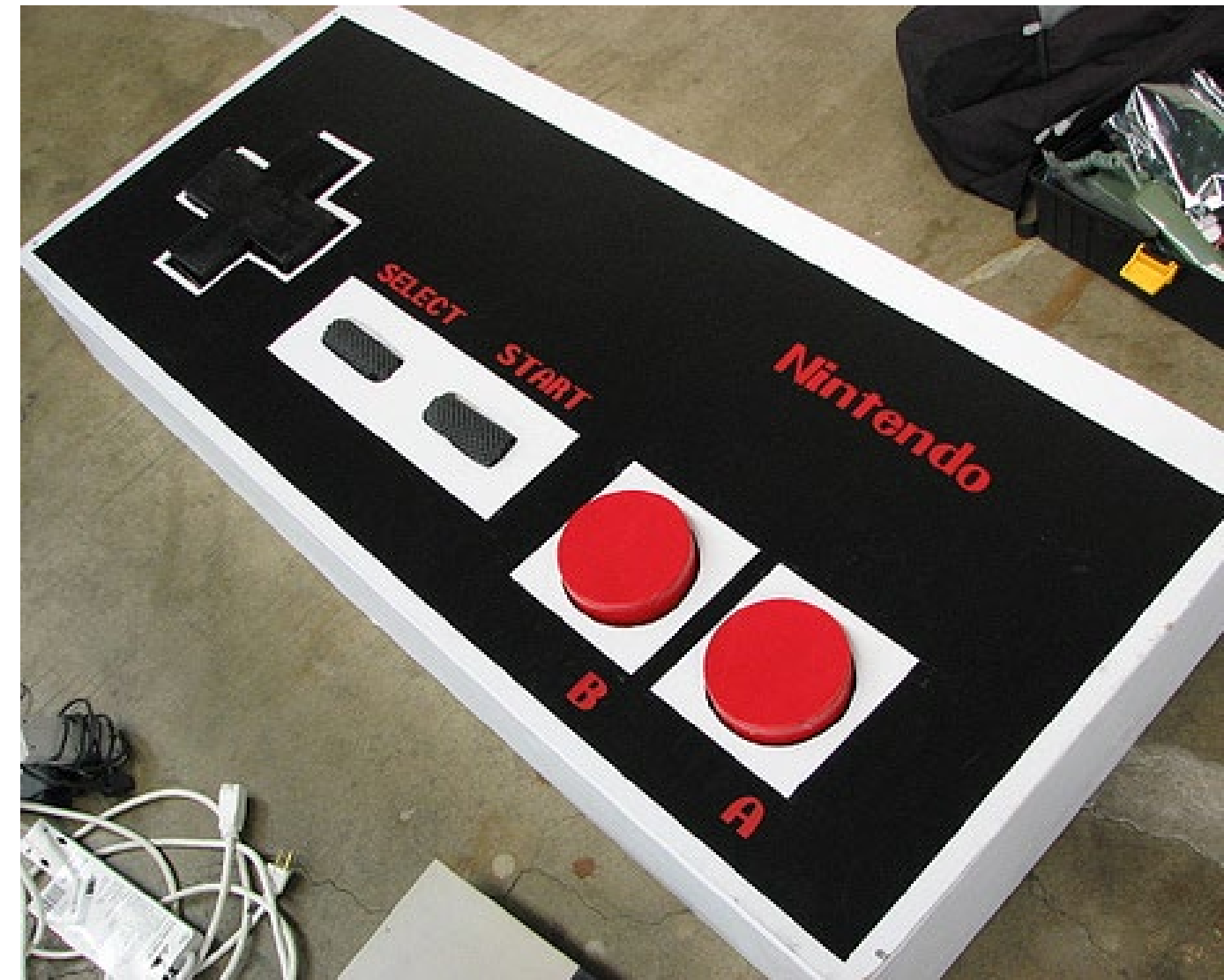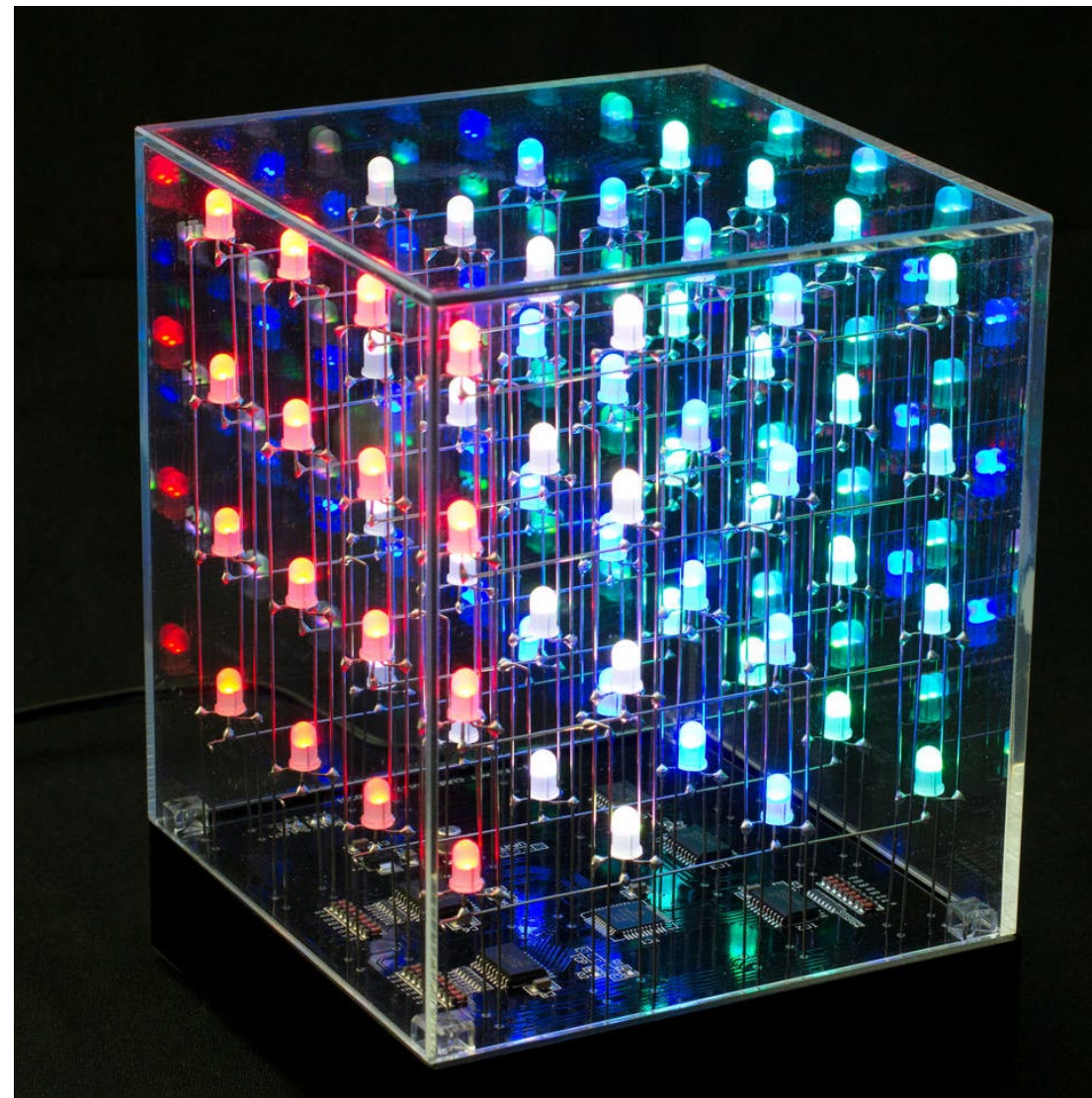# Shift Register

Huaishu Peng | UMD CS | Fall 2022

Shift Register - Why
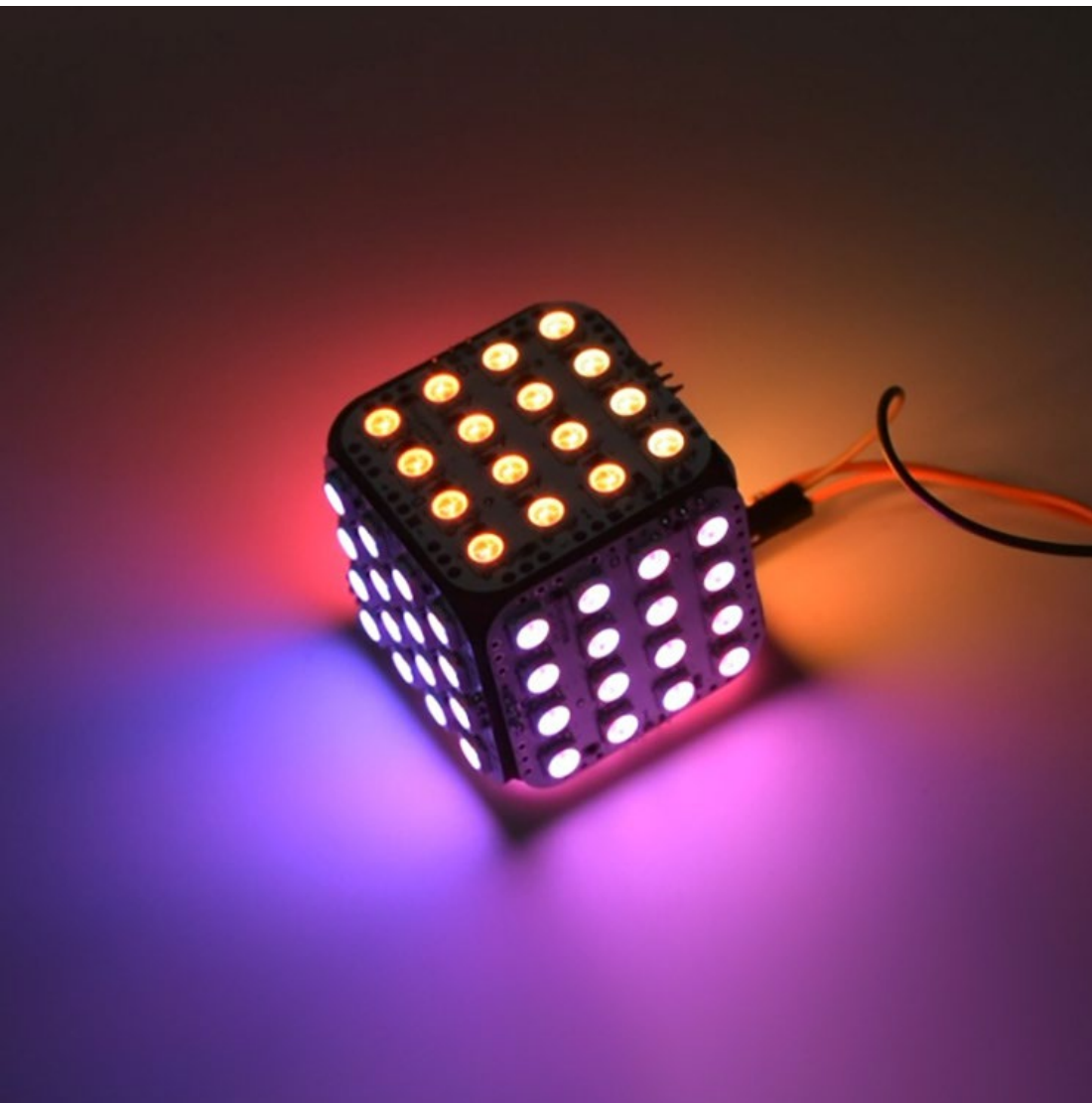
Shift Register - How

SIPO Vs PISO Shift Registers

Shift registers come in two basic types, either SIPO (Serial-In-Parallel-Out) or PISO (Parallel-In-Serial-Out). The popular SIPO chip is 74HC595, and the PISO chip is 74HC165.

The first type, SIPO, is useful for controlling a large number of outputs, like LEDs. While the latter type, PISO, is good for gathering a large number of inputs, like buttons

Shift Register - How – 74HC595

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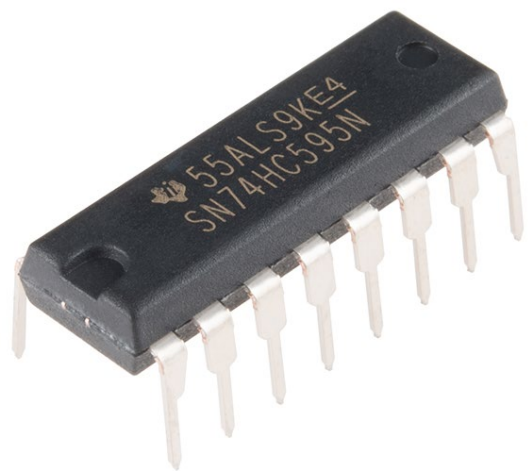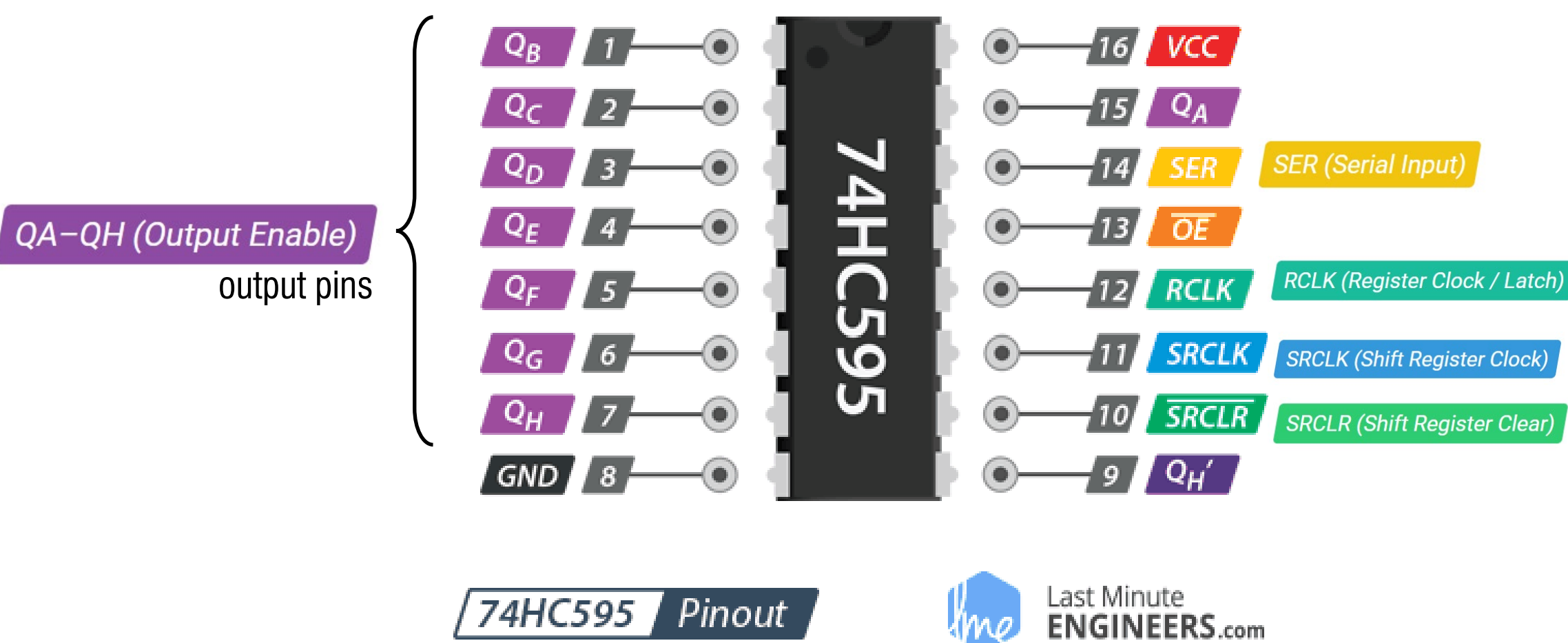
Shift Register - How – 74HC595

QA–QH (Output Enable)
output pins

QB	1
QC	2
QD	3
QE	4
QF	5
QG	6
QH	7
GND	8

74HC595

16	VCC
15	QA
14	SER	SER (Serial Input)
13	$\overline{OE}$
12	RCLK	RCLK (Register Clock / Latch)
11	SRCLK	SRCLK (Shift Register Clock)
10	$\overline{SRCLR}$	SRCLR (Shift Register Clear)
9	QH'

to feed data into the shift register a bit at a time

when driven HIGH, the contents of Shift Register
are copied into the Storage/Latch Register

the clock for the shift register

allows us to reset the entire Shift Register to 0

74HC595 Pinout

Last Minute
ENGINEERS.com

8bit
74HC595 { Shift Register
8bit
Storage Register

Shift Register - How – 74HC595

QA−QH (Output Enable)
output pins

Pin	Label	
1	Q_B	
2	Q_C	
3	Q_D	
4	Q_E	
5	Q_F	
6	Q_G	
7	Q_H	
8	GND	

74HC595

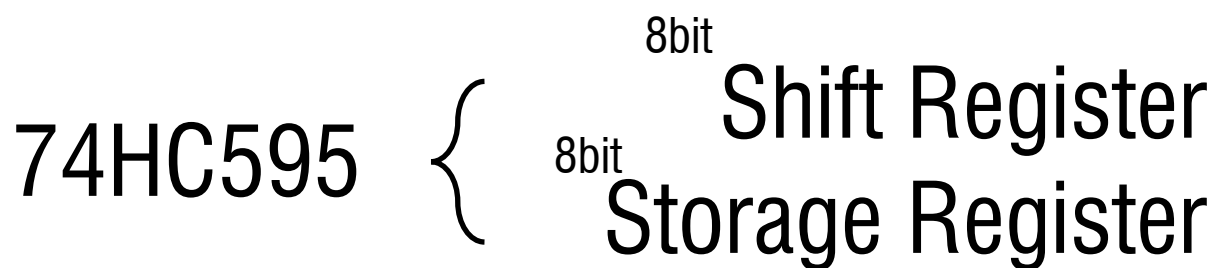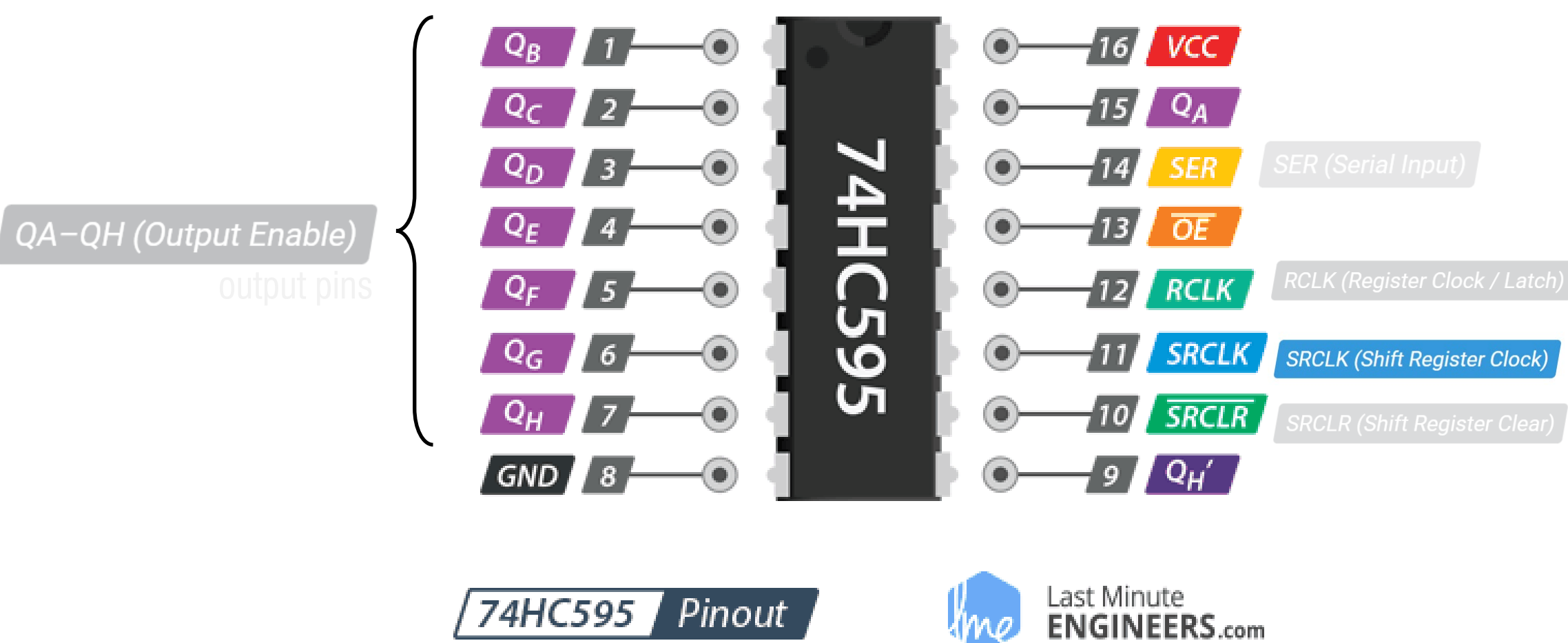| Pin	Label	
16	VCC	
15	Q_A	
14	SER	SER (Serial Input)
13	$\overline{OE}$	
12	RCLK	RCLK (Register Clock / Latch)
11	SRCLK	SRCLK (Shift Register Clock)
10	$\overline{SRCLR}$	SRCLR (Shift Register Clear)
9	Q_H'	

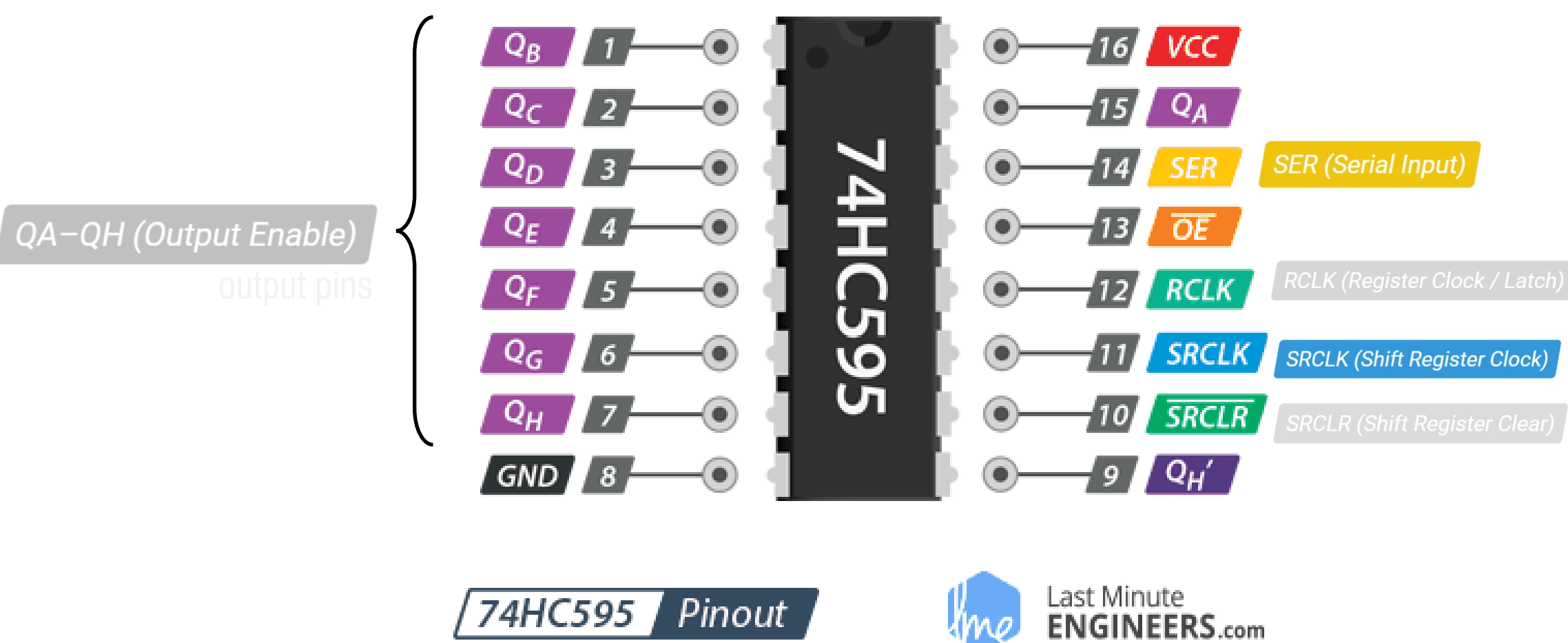to feed data into the shift register a bit at a time

when driven HIGH, the contents of Shift Register are copied into the Storage/Latch Register

the clock for the shift register

allows us to reset the entire Shift Register to 0

74HC595 Pinout

Last Minute ENGINEERS.com

74HC595
{
8bit
Shift Register   0b00000001
8bit
Storage Register

Shift Register - How – 74HC595

QA−QH (Output Enable)
output pins

74HC595 Pinout

Pin		Pin	
Q_B	1	16	VCC
Q_C	2	15	Q_A
Q_D	3	14	SER
Q_E	4	13	$\overline{OE}$
Q_F	5	12	RCLK
Q_G	6	11	SRCLK
Q_H	7	10	$\overline{SRCLR}$
GND	8	9	Q_H'

74HC595

SER (Serial Input) — to feed data into the shift register a bit at a time (0)

RCLK (Register Clock / Latch) — when driven HIGH, the contents of Shift Register are copied into the Storage/Latch Register

SRCLK (Shift Register Clock) — the clock for the shift register

SRCLR (Shift Register Clear) — allows us to reset the entire Shift Register to 0

Last Minute ENGINEERS.com

74HC595
- 8bit Shift Register   0b00000010
- 8bit Storage Register

Shift Register - How – 74HC595

QA–QH (Output Enable)
output pins

Pin	Name
1	Q_B
2	Q_C
3	Q_D
4	Q_E
5	Q_F
6	Q_G
7	Q_H
8	GND

74HC595

Pin	Name
16	VCC
15	Q_A
14	SER
13	$\overline{OE}$
12	RCLK
11	SRCLK
10	$\overline{SRCLR}$
9	Q_H'

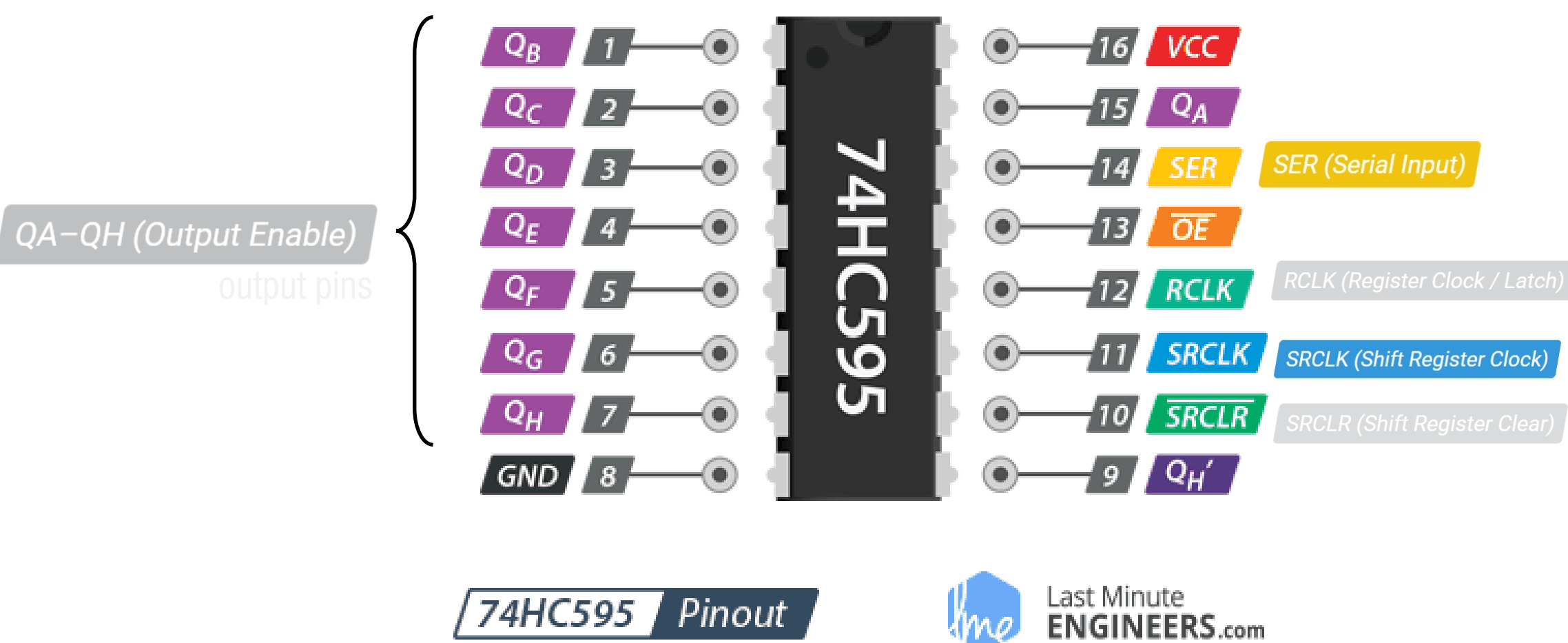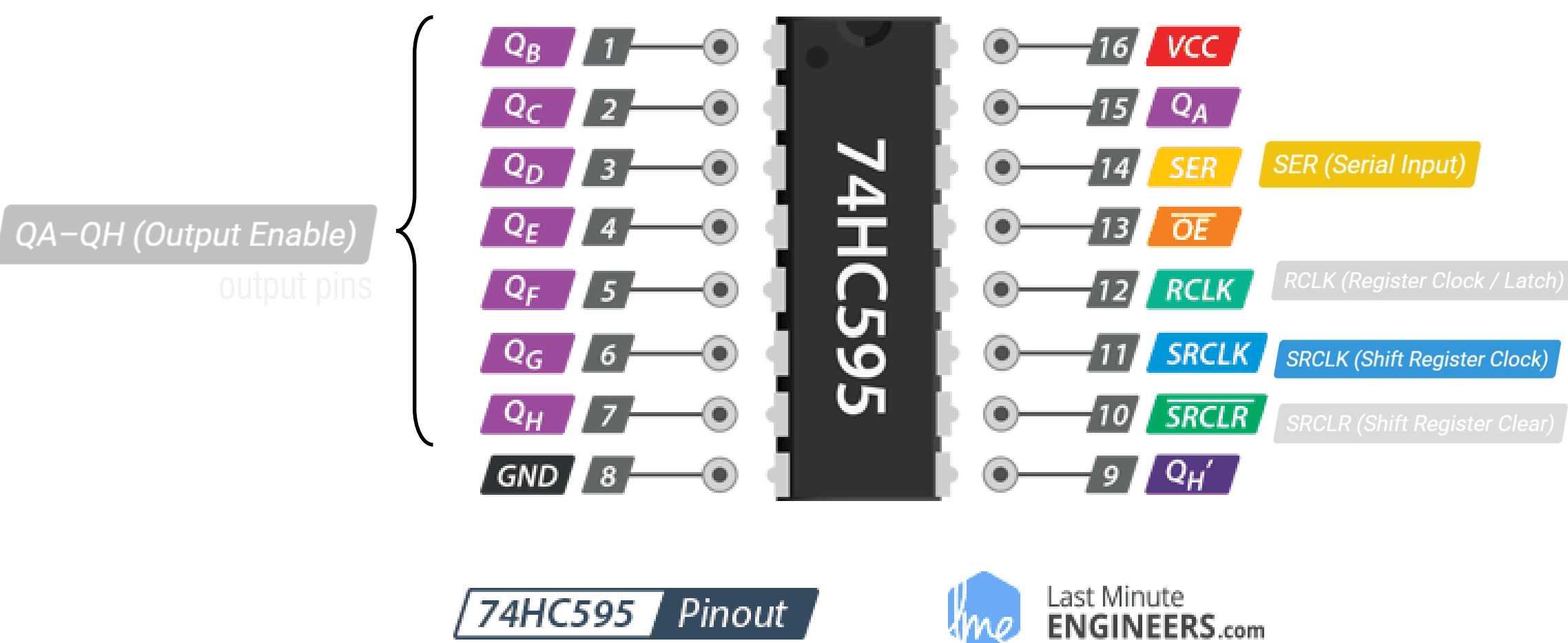SER (Serial Input) — to feed data into the shift register a bit at a time (0)

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SRCLR (Shift Register Clear) — allows us to reset the entire Shift Register to 0

74HC595 Pinout

Last Minute ENGINEERS.com

74HC595
{
8bit Shift Register   0b00000100
8bit Storage Register
}

Shift Register - How – 74HC595

QA−QH (Output Enable)
output pins

Pin	Label
1	Q_B
2	Q_C
3	Q_D
4	Q_E
5	Q_F
6	Q_G
7	Q_H
8	GND
16	VCC
15	Q_A
14	SER
13	$\overline{OE}$
12	RCLK
11	SRCLK
10	$\overline{SRCLR}$
9	Q_H'

SER (Serial Input) — to feed data into the shift register a bit at a time (0)
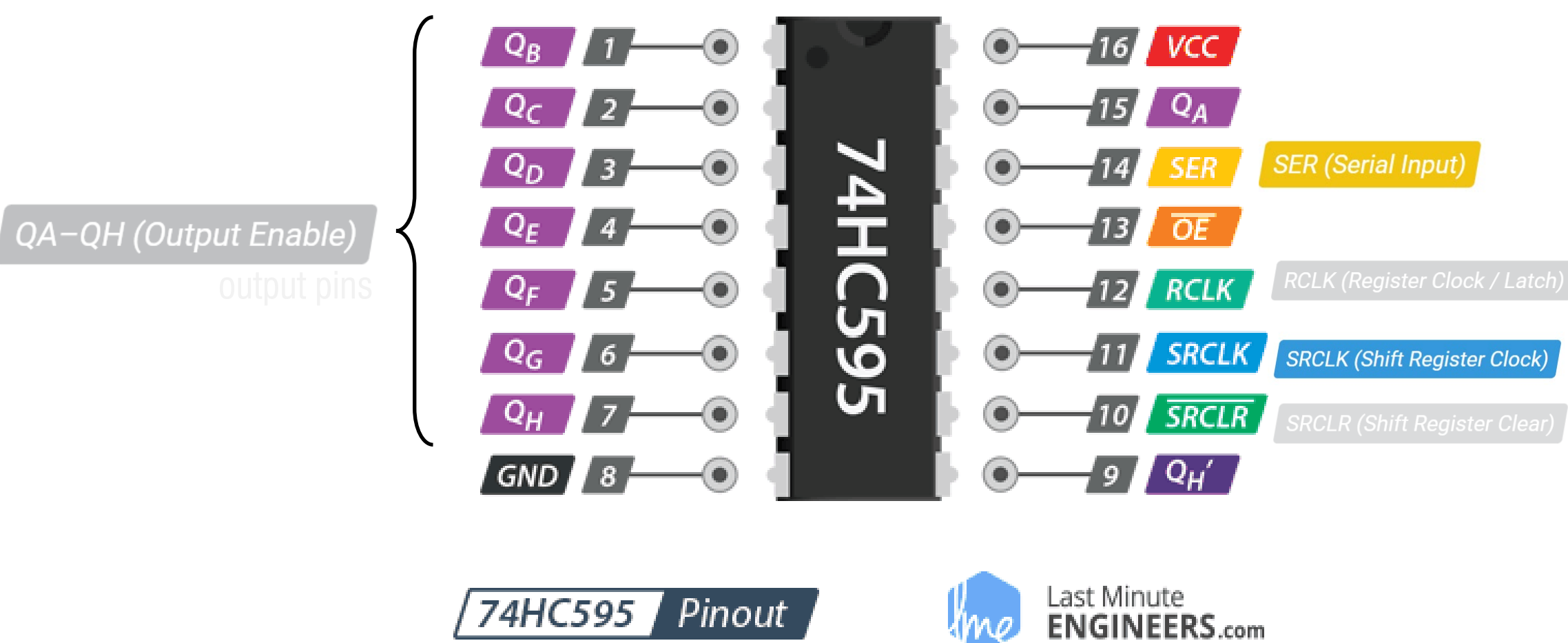
$\overline{OE}$

RCLK (Register Clock / Latch) — when driven HIGH, the contents of Shift Register are copied into the Storage/Latch Register

SRCLK (Shift Register Clock) — the clock for the shift register

$\overline{SRCLR}$ (Shift Register Clear) — allows us to reset the entire Shift Register to 0

74HC595 Pinout

Last Minute ENGINEERS.com

74HC595 {
  8bit Shift Register
  8bit Storage Register
}

0b00001000   Clock ticks 8 times

Shift Register - How – 74HC595

QA−QH (Output Enable)
output pins

1	Q_B
2	Q_C
3	Q_D
4	Q_E
5	Q_F
6	Q_G
7	Q_H
8	GND

16	VCC
15	Q_A
14	SER	SER (Serial Input)
13	$\overline{OE}$
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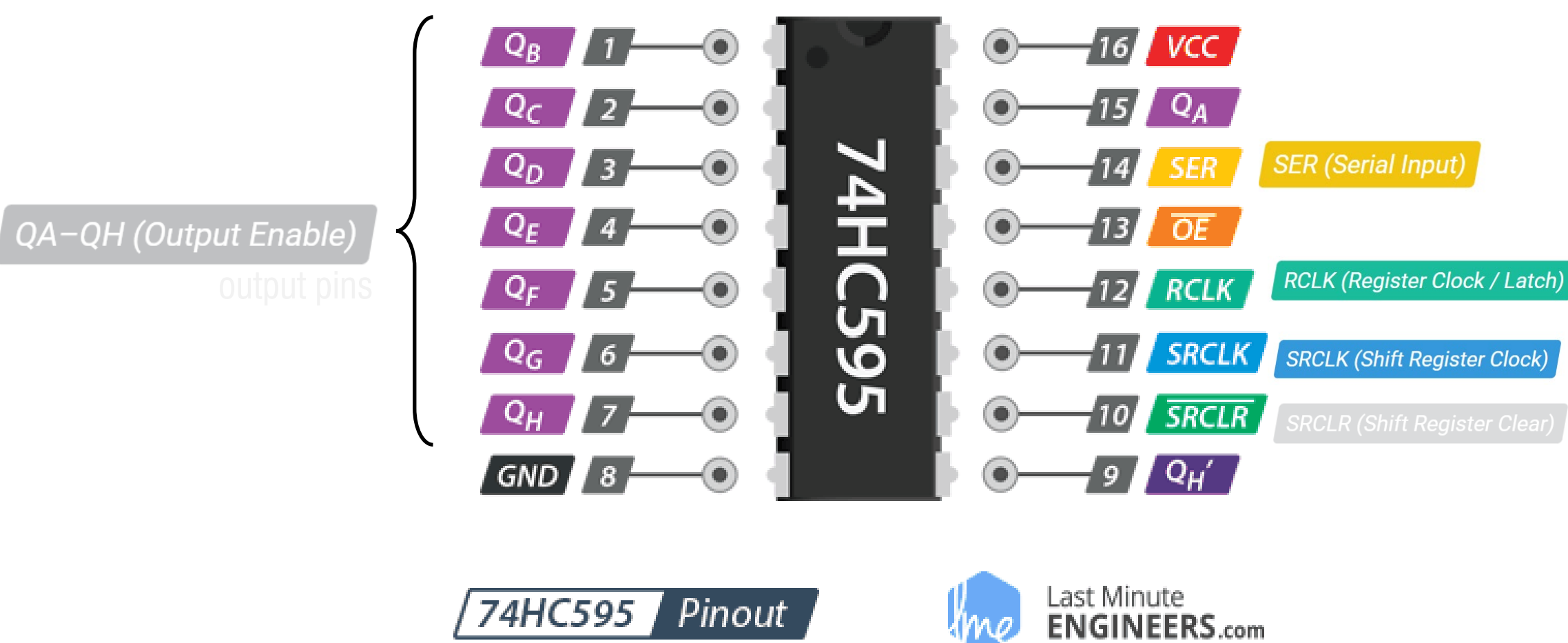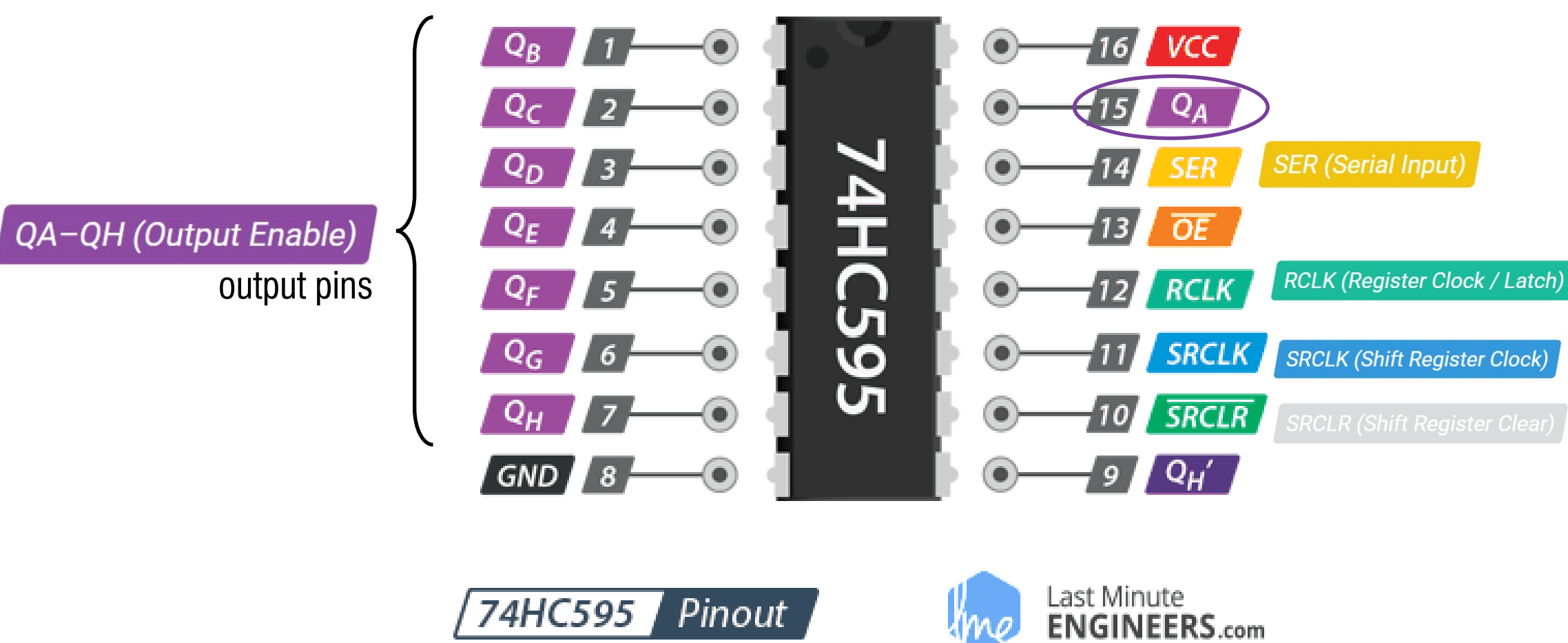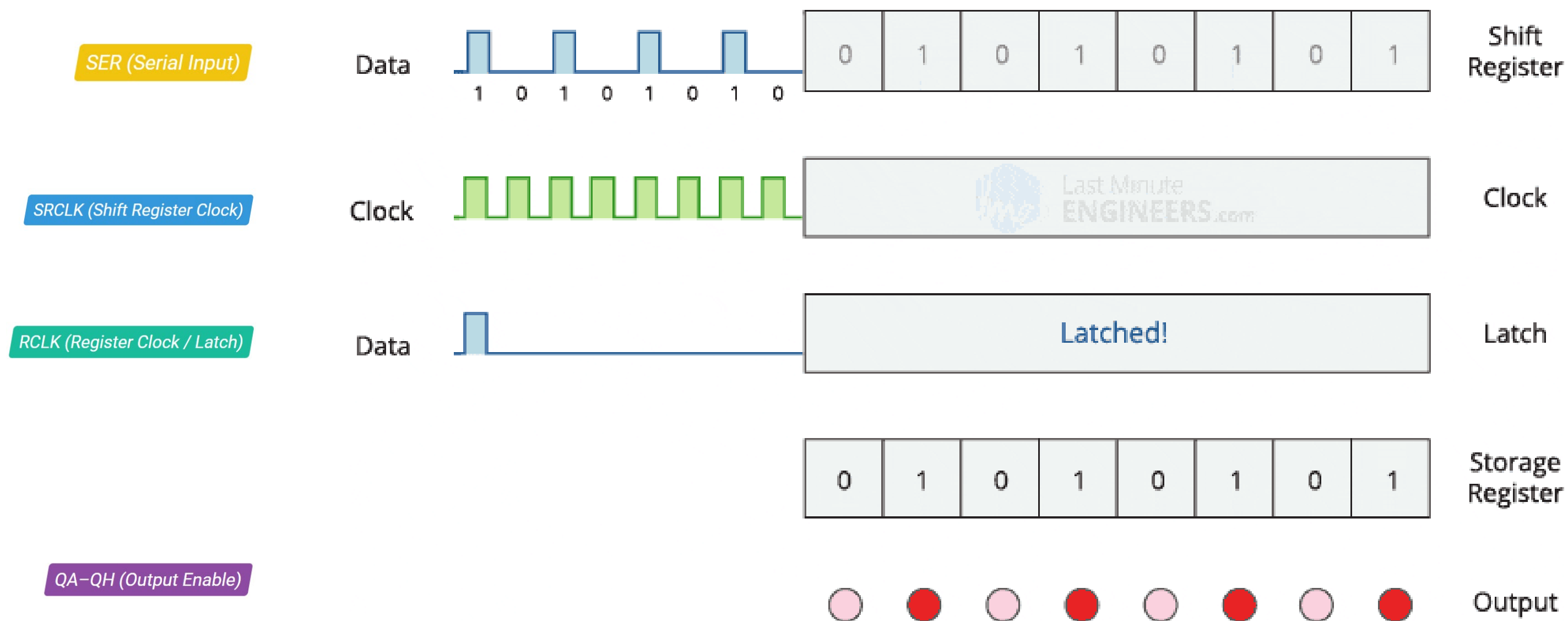to feed data into the shift register a bit at a time (0)

when driven HIGH, the contents of Shift Register
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74HC595 Pinout

Last Minute ENGINEERS.com

$$74HC595 \begin{cases} \text{8bit Shift Register} \quad \text{0b10000000} \\ \text{8bit Storage Register} \end{cases}$$

Shift Register - How – 74HC595

74HC595 Pinout

Last Minute ENGINEERS.com

QA–QH (Output Enable)
output pins

SER (Serial Input) — to feed data into the shift register a bit at a time

RCLK (Register Clock / Latch) — when driven HIGH, the contents of Shift Register are copied into the Storage/Latch Register

SRCLK (Shift Register Clock) — the clock for the shift register

SRCLR (Shift Register Clear) — allows us to reset the entire Shift Register to 0

74HC595 {
8bit Shift Register   0b10000000
8bit Storage Register   0b10000000

Shift Register - How – 74HC595

QA−QH (Output Enable)
output pins

Q_B 1
Q_C 2
Q_D 3
Q_E 4
Q_F 5
Q_G 6
Q_H 7
GND 8

74HC595

16 VCC
15 Q_A
14 SER — SER (Serial Input)
13 $\overline{OE}$
12 RCLK — RCLK (Register Clock / Latch)
11 SRCLK — SRCLK (Shift Register Clock)
10 $\overline{SRCLR}$ — SRCLR (Shift Register Clear)
9 Q_H'

to feed data into the shift register a bit at a time

when driven HIGH, the contents of Shift Register
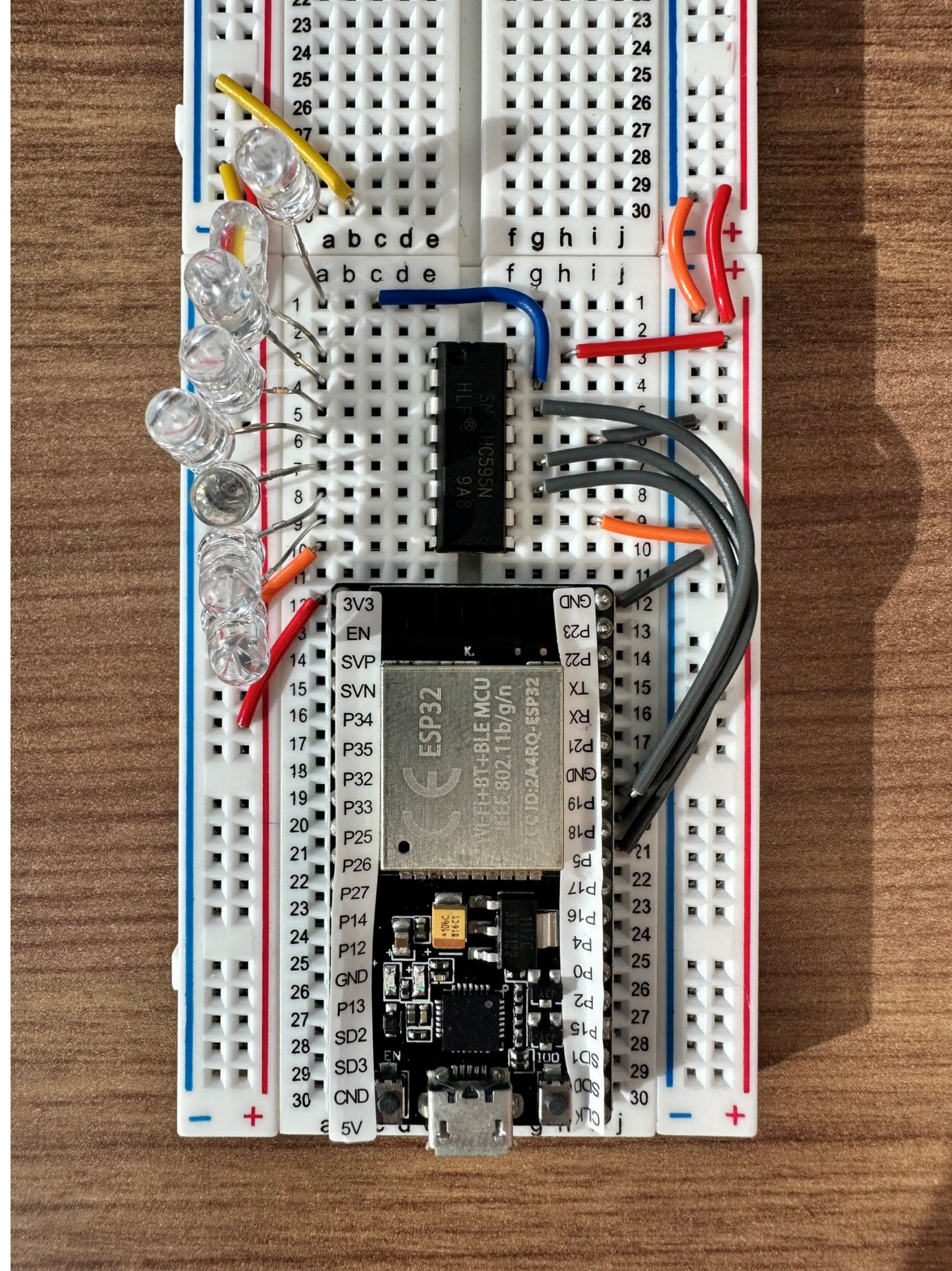are copied into the Storage/Latch Register

the clock for the shift register

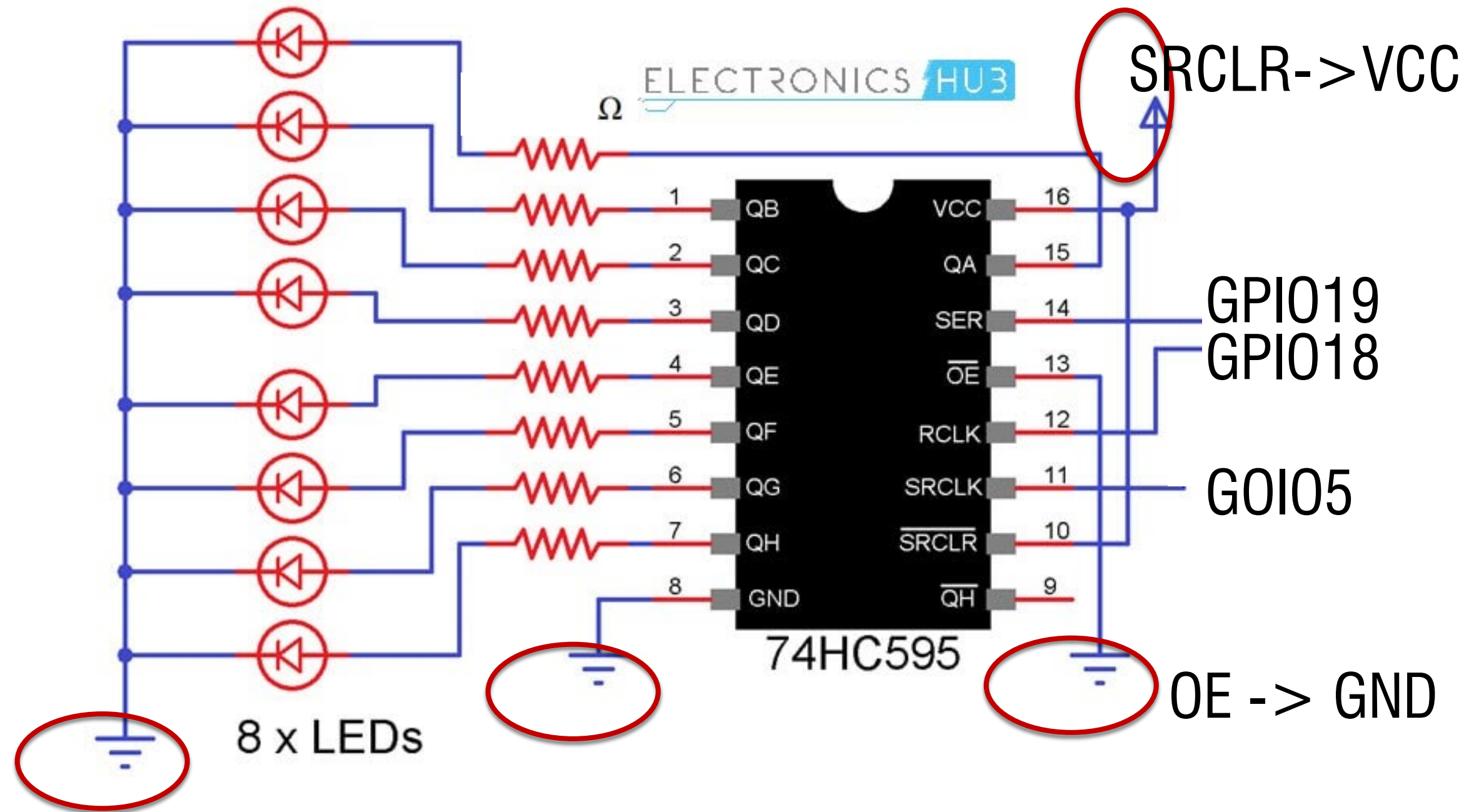allows us to reset the entire Shift Register to 0

74HC595 Pinout

Last Minute
ENGINEERS.com

74HC595 {
8bit Shift Register   0b10000000
8bit Storage Register 0b10000000

https://lastminuteengineers.com/74hc595-shift-register-arduino-tutorial/

Shift Register - How – 74HC595

74HC595 - Wiring

74HC595 - Wiring

SER->Data
RCLK->Latch
SSRCLK->Clock

SRCLR->VCC

GPIO19
GPIO18

GOIO5

OE -> GND

8 x LEDs
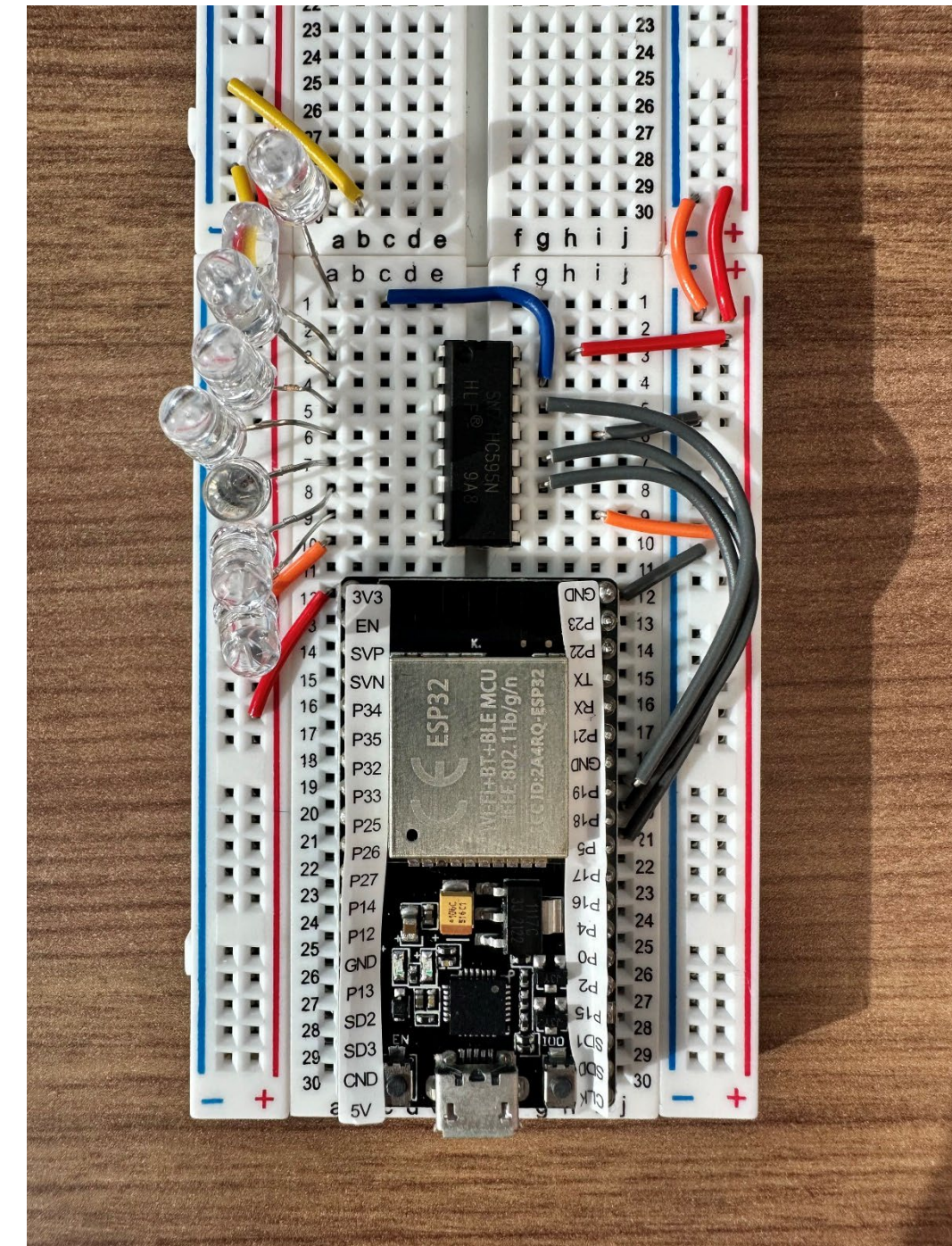
74HC595

74HC595 - Basic coding - light up one LED

```
int latchPin = 18;  // Latch pin of 74HC595
int clockPin = 5; // Clock pin of 74HC595
int dataPin = 19;  // Data pin of 74HC595

void setup()
{
  pinMode(latchPin, OUTPUT);
  pinMode(dataPin, OUTPUT);
  pinMode(clockPin, OUTPUT);
}

void loop()
{
  digitalWrite(dataPin, HIGH);
  digitalWrite(clockPin, HIGH);
  digitalWrite(clockPin, LOW);

  for(int i=0; i<7; i++)
  {
    digitalWrite(dataPin, LOW);
    digitalWrite(clockPin, HIGH);
    digitalWrite(clockPin, LOW);
  }

  digitalWrite(latchPin, HIGH);
  digitalWrite(latchPin, LOW);

  delay(4000);
}
```

0b10000000

} Push one bit of '1' into the shift register
Tick the clock pin

} Shift seven bit of '0' into the shift register

Tick the clock pin each time a new data is in

} Set the latch pin to push data to the storage register that sent to output

74HC595 - Controlling shift register with built-in functions

```
byte led_data = 0;                                    // Variable to hold the pattern of which LEDs are currently turned on or off

void setup()
{
  pinMode(latchPin, OUTPUT);
  pinMode(dataPin, OUTPUT);
  pinMode(clockPin, OUTPUT);
}

void loop()
{
  led_data = 0;
  updateShiftRegister();
  delay(500);

  for(int i=0; i<8; i++)
  {
    bitSet(led_data, i);                              // Set the bit that controls that LED in the variable 'led_data'
    updateShiftRegister();
    delay(500);
  }
}

void updateShiftRegister()
{
  digitalWrite(latchPin, LOW);
  shiftOut(dataPin, clockPin, LSBFIRST, led_data);    //Shifts out a byte of data one bit at a time
  digitalWrite(latchPin, HIGH);                       //putting the latch Pin HIGH
}
```

Assignment – Nov 23 EOD