

Table of contents

Basic Connections

Connecting a LED	1
Connecting two LED	2
Connecting a bi-colour LED	3
LEDs cluster	4
RGB LEDs	5
LEDs strip	6
Digitally-addressable LEDs	7
Charlieplexing	8
LEDs Array	9
Multiple LEDs cluster	10
The ULN2803	10
ULN2803 Port Schematic	10
Decoder/Demultiplexer	11
The 74HC238	11
Connecting multiple 74HC238	11
Shift Register	12
The 74HC595	12
Connecting multiple 74HC595	12
4 Digits 7 segments display with MAX7219	13
The MAX7219	13
Connecting 8x8 LED matrix	13
8x8 LED Matrix Schematic	13
Connecting multiple MAX7219	13
The TLC5940	14
TLC5940 Resistor Calculator	14



Basic Connections

Connecting LEDs to TLC5940 ports	14
Connecting a SERVOS to TLC5940 ports	14
Connecting power LEDs to TLC5940 ports	14
Connecting multiple TLC5940	14
7-segments display	15
Digits 7 segments display	16
Connecting a DC lamp	17
Connecting a high load DC lamp	18
Connecting a DC motor	19
Connecting a Solenoid	20
Connecting a Relay	21
Add a LED to show the relay status	21
Optoisolated Relay	22
Connecting a Mosfet	23
Connecting a magnetic Buzzer	24
Connecting a piezo Buzzer	24
Connecting a magnetic Buzzer with external power	25
Note frequency	25
Connecting a Servo	26
non Logic Mosfet	27
Connecting an IR Sensor	28
IR Sensors	28
Connecting an IR Emitter	29
Constant current IR	30
Connecting a LCD Hitachi 44780	31
LCD Hitachi 44780 pinout	31
Control LCD Backlight	31
LCD Hitachi 44780 via I2C	32
The PCF8574x	32
I2C Pull-up resistors	32
Nokia LCD	33
OLED LCD	34
Connecting a Push button	35



Basic Connections

Using Internal Pull-up resistors	35
Push button to 12V	36
Connecting a toggle Switch	37
toggle Switch using 1 analog input	37
Multiple push Buttons	38
Connecting an Encoder (internal pull-up)	39
How rotary Encoder works	39
Connecting an Encoder	40
How rotary Encoder is made	40
Simple Debounce	41
Switch Bounce	41
Debouncing	41
Encoder debouncing	42
The 74LS14 & 74LS4	42
Connecting a Keypad	43
Keypad	43
Membrane Keypad	44
Keypad with 1 analog Pin	44
Thumbwheel Switch	45
Connecting a rotary Switch	46
Connecting a PS2 Keyboard	47
Connecting a Potentiometer	48
Connecting a Photoresistor	49
Connecting a Phototransistor	50
Optocoupled DC IN	51
Optocoupled AC IN	52
Emulating Buttons	53
The 4066	53
Connecting a CT Sensor	54
LM35 Temperature Sensor	55
LM35 full Range Scale	56
TMP36 Temperature Sensor	57
MCP9600 Temperature Sensor	58



Basic Connections

DHT11 Sensor	59
DHT22 Sensor	60
Connecting a Thermistor	61
Connecting a RTD	62
DS18B20 Digital Temperature	63
DHTxx 2 wires connection	64
Connecting a MQ GAS Sensor	65
SHARP GP2Y0A21	66
DIY MicroSD card reader	67
SD Card pinout	67
Connecting a SD Card	68
SD Card Reader pinout	68
3 Wires computer Fan	69
4 Wires computer Fan	70
Bidirectional level Converter	71
Level Converter with voltage Divider	71
3.3V to 5V Interface	72
5V to 3.3V Interface	72
4050 level Shifter	73
74125 level Shifter	74
Voltage Divider	75
TTL/CMOS Converter	76
Protect an I/O Pin	77
Protect an I/O Pin with clamping diodes	77
Filter and protect an I/O Pin	78
Connecting two MPUs	78
Simple 5V power Supply	79
Simple 3.3V power Supply	80
LM317 Voltage Calculator	81
Simple rectifier	82
VGA Out	83
Composite Out	84
1 transistor Amplifier	85



Basic Connections

Audio Amplifier	86
Preamplifier	87
Connecting a Microphone	88
Connecting a Triac	89
Zero crossing detecting	90
Solid State Relay	91
RC Snubber Network	92
Electronic power switch	93
Reverse voltage protection	94
A simple RS485 node	95
Node termination jumpers	95
Midi IN	96
Midi OUT	96
Multiple Midi OUT	96
Midi Pinout	96
Midi daisy chain configuration	96
DMX Interface	97
DMX Pinout	97
RS232 Interface	98
The MAX232	98
RS232 Pinout	98
Connecting a RTC	99
Connecting an EEPROM	100
Shift Registers via SPI	101
The 74HC165	101
Connecting multiple 74HC165	101
Analog Mux/Demux	102
The 4051	102
Doubling the number of ports	102
Digital Potentiometer	103
Buffer OUT	104
HALL Sensor	105
Spectrum Analyzer	106



Basic Connections

Flex Sensor	107
Piezo Sensor	108
LM358 as ON/OFF Switch	109
Connecting a DAC	110
L293D	111
L293D Pinout	111
Drive a Bipolar Stepper	111
Step Sequence	111
Step Angle	111
MCP23017 I2C Expander	112
MCP23017 Pinout	112
Connecting an LED to MCP23017	112
Connecting a Pushbutton to MCP23017	112



Module Connections

ESP8266	C1
Bluetooth	C2

References

3 band Resistors	A1
3 band Resistors standard values	A1
4 band Resistors	A2
Ceramic Capacitors	A3
Polyester Capacitors	A4

Bifold

DIY Board	B1
UNO Pinout	B2
Stepper Motors	B3

Preface

Graphic Symbols
Conventions



