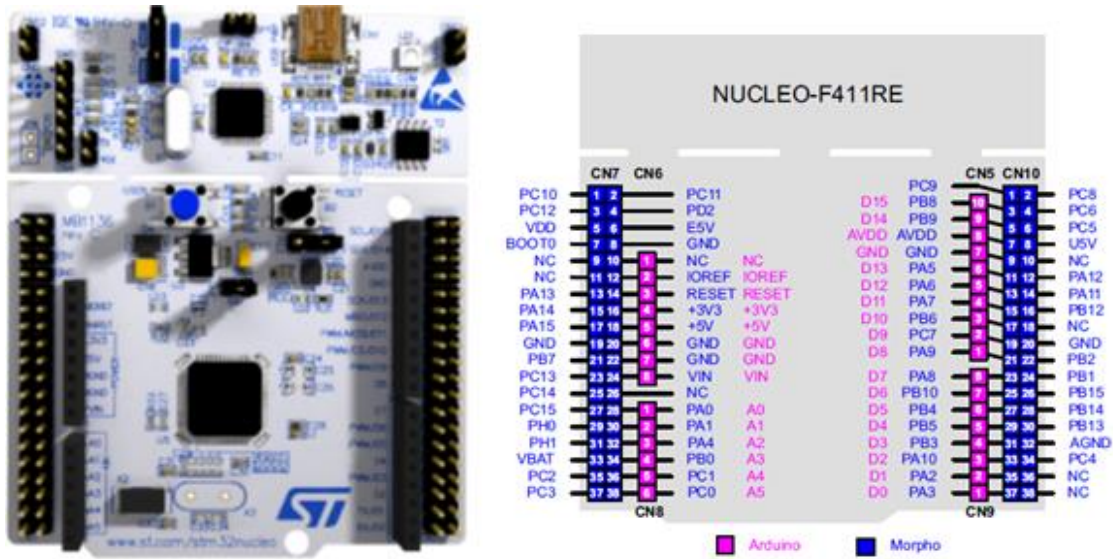


1. Nucleo-F411RE [10]



Specifications

1. Board connectors: External SMPS experimentation dedicated connector
2. Micro-AB or Mini-AB USB connector for the ST-LINK
3. MIPI® debug connector
4. System requirements: Windows® OS (7, 8 and 10), Linux® 64-bit, or macOS®
5. Price: 650 ₺

2. Raspberry Pi 4 Model B [11]



Specifications

1. Processor: Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
2. Connectivity:
 1. 2.4 GHz and 5.0 GHz IEEE 802.11b/g/n/ac wireless
 2. LAN
 3. Bluetooth 5.0, BLE
 4. Gigabit Ethernet
 5. 2 × USB 3.0 ports, 2 × USB 2.0 ports.
3. Video & sound:
 1. 2 × micro HDMI ports (up to 4Kp60 supported)
 2. 2-lane MIPI DSI display port
 3. 2-lane MIPI CSI camera port
 4. 4-pole stereo audio and composite video port
4. Multimedia:
 1. H.265 (4Kp60 decode);
 2. H.264 (1080p60 decode, 1080p30 encode);
 3. OpenGL ES, 3.0 graphics
5. SD card support: Micro SD card slot for loading operating system and data storage

6. Input power:
 1. 5V DC via USB-C connector (minimum 3A)
 2. 5V DC via GPIO header (minimum 3A)
 3. Power over Ethernet (PoE)-enabled (requires separate PoE HAT)
7. Environment: Operating temperature 0–50°C
8. Price: 2,595 ₺

3. Raspberry Pi Camera Module v1 [12]



Specifications

1. Sensor: Sony IMX219
2. Resolution: 8 Megapixels (3280 × 2464 pixels)
3. Video modes: 1080p30, 720p60 and 640 × 480p60/90
4. Focal length: 3.04 mm
5. Horizontal field of view: 62.2 degrees
6. Vertical field of view: 48.8 degrees
7. Focal ratio (F-Stop): 2.0
8. Weight: 3 g
9. Price: 989 ₺

4. SG90 Micro Servo [13]



Specifications

1. Operating Voltage: 5V
2. Torque: 2.5kg/cm
3. Operating speed is 0.1s/60°
4. Rotation: 0°-180°
5. Weight of motor: 9 g
6. Price: 90 ₺

5. DC Gear Box Motor 12V [14]



Specifications

1. Motor Diameter: 37 mm
2. Motor Shaft: 6mm
3. Torque: 3.95-13.5 kg cm
4. Price: 380 ₺

6. Infrared Sensor Switch (E18-D80NK-N) [15]



Specifications

1. Range: 6-80 cm
2. Operating Voltage: 5V
3. Price: 144 ₺

7. Ultrasonic sensors (HY-SRF05) [16]



Specifications

1. Operating Voltage: 5V
2. Sensor Angle: 15 Degree
3. Detection distance: 2-450 cm
4. Precision: 2 mm
5. Price: 70 ₺

8. Limit Switch (V-153-1C25) [17]



Specifications

1. 0.3A at 250VDC
2. Maximum Operating Force: 1.96 N
3. Price: 15 ₺

9 L298N Dual H-Bridge Motor Driver [18]



Specifications

1. Input Voltage: 3.2 – 40 VDC
2. Power Supply: 5 - 35 VDC
3. Peak current: 2 A
4. Operating current range: 0 – 36 mA
5. Control signal input voltage range:
 1. Low: $-0.3V \leq V_{in} \leq 1.5V$
 2. High: $2.3V \leq V_{in} \leq V_{ss}$.
6. Storage temperature: $-25\text{ }^{\circ}\text{C} \sim +130\text{ }^{\circ}\text{C}$
7. Price: 130 ₺

10. 5V Fan [19]



Specifications

1. Dimensions: 60x60x10mm
2. Rated Voltage: 5V
3. Rated Current: 0.25A
4. Speed: 2900RPM
5. Weight: 35g
6. Price: 120 ₺

11. 5mm LED [20]



12. LED Flexible Strip 5630 Series [21]



Specifications

1. Power Rating 75 W / 5 m
2. Light Angle: 120 Degree
3. Brightness: 55-62 lm

13. 0.25W 5% Carbon Filmed Resistor [22]



14. Belt set [23]



15. Shaft 8mm 50cm [24]

Specifications

1. diameter 8mm
2. stainless steel
3. length: 50cm
4. price 120 THB



16. MG996R servo motor [25]

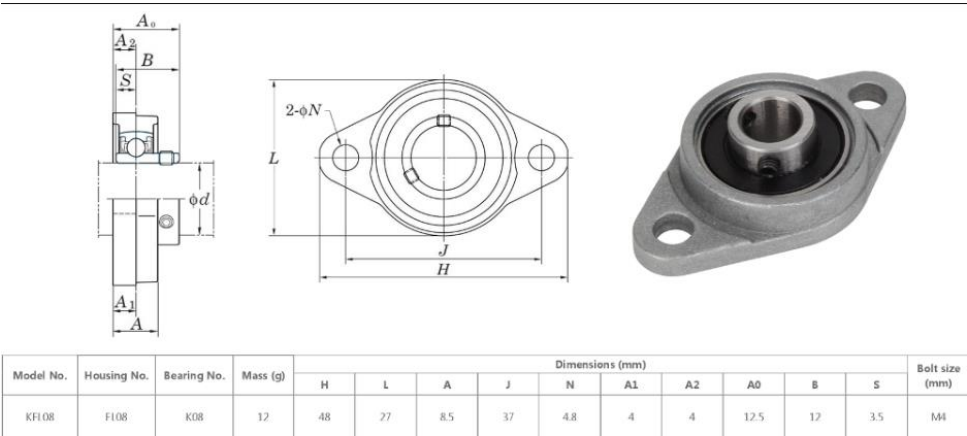
Wire Number	Wire Colour	Description
1	Brown	Ground wire connected to the ground of system
2	Red	Powers the motor typically +5V is used
3	Orange	PWM signal is given in through this wire to drive the motor

- Operating Voltage is +5V typically
- Current: 2.5A (6V)
- Stall Torque: 9.4 kg/cm (at 4.8V)
- Maximum Stall Torque: 11 kg/cm (6V)
- Operating speed is 0.17 s/60°
- Gear Type: Metal
- Rotation : 0°-180°
- Weight of motor : 55gm
- Package includes gear horns and screws

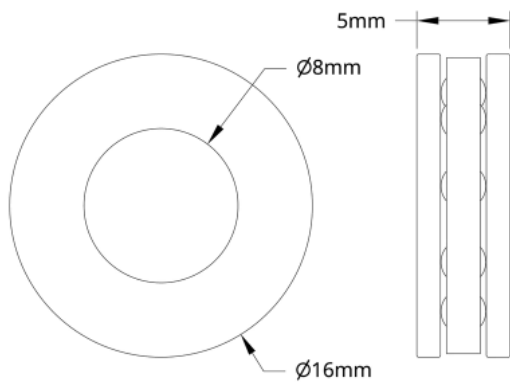


17. Bearing 8mm [26]

- **Bearing Model:** K08
- **Block Model:** FL08
- **Bore Diameter:** 8mm / 0.31"
- **Overall Size:** 47 x 27 x 11mm / 1.9" x 1.1" x 0.4" (L* W* T)
- **Mounting Hole Diameter:** 5mm / 0.2"
- **Holes Centre Distance:** 36mm / 1.4"
- **Material:** Zinc Alloy
- **Weight:** 29g



18. Thrust Ball Bearing 8mm [27]



Weight	3.4g
Material	Stainless Steel with Brass Bearing Race



19. 8mm Lock Collar [28]

1. Product Name: Openbuilds Lock Collar
2. Material: high quality stainless steel material
3. Size: 8 (ID) *14 (OD) *7 (Width)
4. Suit for 8mm T8 Lead Screw



20. Single channel 5v relay [29]

- 5V Single Channel Relay interface board, and needs 15-20mA Driver Current
- Also, equipped with high-current relay, AC250V 10A ; DC30V 10A
- Standard interface that you can control directly by microcontroller (Arduino , 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic)
- Indication LED's for Relay output status



21. 5v ac to dc adaptor [30]

Model NO.	MC-064	Power Source	Full-Bridge Type
Connection	Plug In	Brand	Muchy
Input Specification	100-240V 50-60Hz	Output Specification	5V3a
Power	15W	Weight	180g
Material	ABS+PC Fireproof Material	Plug	US EU UK AU Korea Brazil Indian Plug Available
OEM or ODM	Welcome	Working Humidity	20 ~ 90% Rh Non-Condensing
Temp. Coefficient	+0.05%/°C	Trademark	Muchy
Transport Package	PE Bag or White Box	Specification	83*43*31mm
Origin	China	HS Code	85044014



22. 12v ac to dc adaptor [31]

- Voltage Input: AC 100-240V
- Frequency Response: 50/60Hz
- Voltage Output: DC 12V
- Electric Current: Max. 2A
- Power: 24W
- Length of the cable: approx. 93 cm (36.6 inch)
- Internal diameter of the connector: 2.1 – 2.5 mm (0.1 inch)
- External diameter of the connector: 5.5 mm (0.21 inch)



23. Coupling 6mm to 8mm [32]

Type:Flexible Shaft Coupling

Material: Aluminium

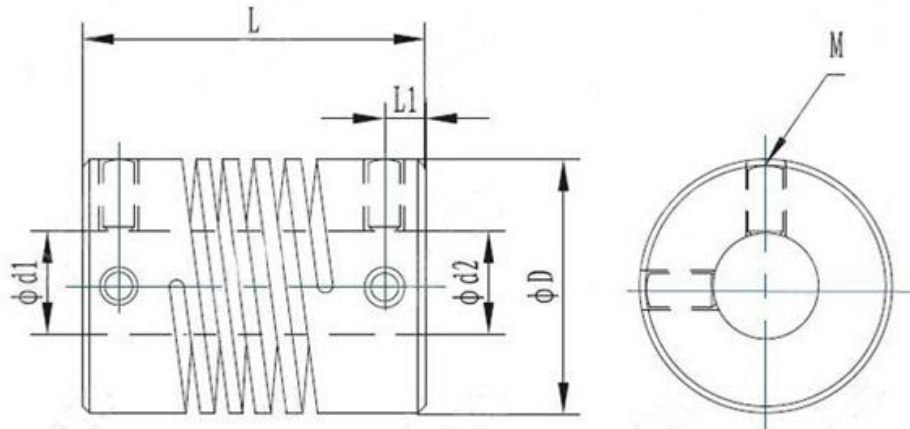
Size: 6mm x 8mm.

Outside Diameter:19mm

Length:25mm.

Color:Silver

Main dimensions: $d_1=6\text{mm}$, $d_2=8\text{mm}$, $D=19\text{mm}$, $L=25\text{mm}$



24. Flange 8mm [33]

- **Material:** Steel
- **Inner Hole Size:** about 8mm
- **Outer Diameter:** about 16mm, 32mm
- **Total Height:** about 13mm
- **Screw Size:** M4



25. 20x20 Aluminum profile [34]

Material	Aluminium
Thickness	12 - 16 mm
Anodised	Yes
Alloy Or Not	Is Alloy
Weight	0.4 Kgs
Color	Silver
Finish	Polished
Minimum Order Quantity	1 Meter



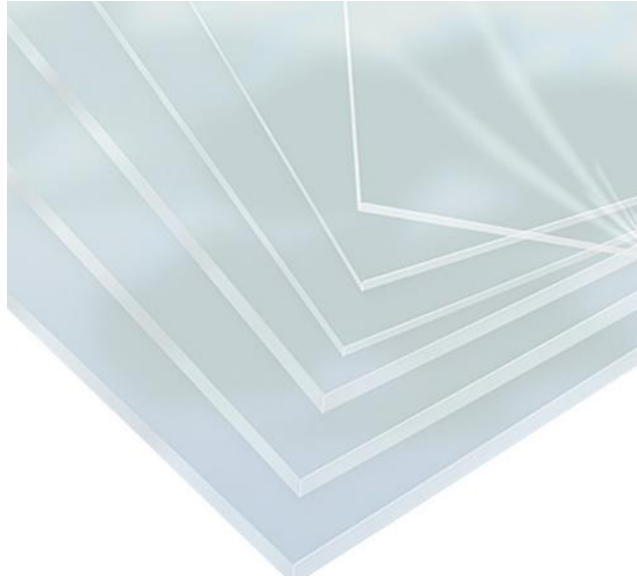
26. ARDUINO MEGA ADK REV3 [35]

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
USB Host Chip	MAX3421E
Length	101.52 mm
Width	53.3 mm
Weight	36 g



26. Others

Acrylic 5mm, 8mm



Wood



Future board 2mm



References

10. “NUCLEO-F411RE.” STMicroelectronics. Accessed December 4, 2019.
<https://www.st.com/en/evaluation-tools/nucleo-f411re.html>.
11. “Buy a Raspberry Pi 4 Model B – Raspberry Pi.” Buy a Raspberry Pi 4 Model B – Raspberry Pi. Accessed December 4, 2019. <https://www.raspberrypi.org/products/raspberry-pi-4-model-b/>.
12. “Camera Module.” Camera Module - Raspberry Pi Documentation. Accessed December 4, 2019. <https://www.raspberrypi.org/documentation/hardware/camera/>.
13. “Servo Motor SG-90 Basics, Pinout, Wire Description, Datasheet.” Basics, Pinout, Wire Description, Datasheet. Accessed December 4, 2019. <https://components101.com/servo-motor-basics-pinout-datasheet>.
14. “1x มอเตอร์เกียร์ดีซี 12V 10 Rpm ขนาด 37 มม. แกน 6 มม. Zhengke.” micontechlab. Accessed December 4, 2019. <http://www.micontechlab.com/product/1271/1x-มอเตอร์เกียร์ดีซี-12v-10-rpm-ขนาด-37-มม-แกน-6-มม-zhengke>.
15. ‘IR sensor’. Accessed December 4, 2019. <http://www.ett.co.th/productSensor/E18-D80NK/E18-D80NK.html>.
16. Dejan, Dejan Nedelkovski, Dejan Nedelkovski, Dejan Nedelkovski, Siddharth, Dejan Nedelkovski February, Dejan Nedelkovski, et al. “Ultrasonic Sensor HC-SR04 and Arduino Tutorial.” HowToMechatronics, August 4, 2018.
<https://howtomechatronics.com/tutorials/arduino/ultrasonic-sensor-hc-sr04/>.
17. GOH, Tomi. “Arduino Uno Limit Switch Interfacing and Programming.” Electronic Clinic, October 26, 2019. <https://www.electronicclinic.com/arduino-uno-limit-switch-tutorial/>.
18. Darko, Luis, Janos Szeman, Andras Tantos, Alex, Andras Tantos, Andras Tantos, et al. Modular Circuits. Accessed December 4, 2019.
<https://www.modularcircuits.com/blog/articles/h-bridge-secrets/h-bridges-the-basics/>.

19. "5 Volt Fans: Get the Right 5 Volt Cooling Fan at Coolerguys %Removesshopname%." Coolerguys. Accessed December 4, 2019. <https://www.coolerguys.com/collections/dc-5-volt-fans>.
20. "Make a Simple LED Circuit." Arduino Project Hub. Accessed December 4, 2019. <https://create.arduino.cc/projecthub/rowan07/make-a-simple-led-circuit-ce8308>.
21. "LemonBest - (Cool) 5630 5M White 300 SMD 12V LED Flexible Strip Light Waterproof." English. Accessed December 4, 2019. <https://www.lemonbest.com/lemonbest-cool-5630-5m-white-300-smd-12v-led-flexible-strip-light-waterproof>.
22. "Electronics & Robotics Parts Online Store." Udvabony.com, September 27, 2019. <https://udvabony.com/>.
23. "Replace a Timing Belt - Replacement Avoids Costly Repairs." Meineke, October 22, 2019. <https://www.meineke.com/blog/replace-timing-belt/>.
24. "8mm - Hard Chrome Plated Steel Shaft - 1025." 8mm - 50cm Hard Chrome Plated Stainless Steel Shaft - 1025 | RED CNC: Build Smart Machines. Accessed April 10, 2020. <https://www.redcnc.com/p-hard-chrome-plated-steel-shaft-15>.
25. "MG996R Servo Motor Datasheet, Wiring Diagram & Features." Datasheet, Wiring Diagram & Features. Accessed April 10, 2020. <https://components101.com/motors/mg996r-servo-motor-datasheet>.
26. "KFL08 Pillow Block Flange Bearing." Maker Store USA. Accessed April 10, 2020. <http://makerstore.cc/product/kfl08-pillow-block-flange-bearing/>.
27. "1613 Series Thrust Ball Bearing (8mm ID x 16mm OD, 5mm Thickness)." goBILDA. Accessed April 10, 2020. <https://www.gobilda.com/1613-series-thrust-ball-bearing-8mm-id-x-16mm-od-5mm-thickness/>.

28. "8mm Lock Collar T8 Lead Screw Lock Ring Lock Block For 3D Printer 3D Printer & Supplies from Electronics on Banggood.com." www.banggood.com. Accessed April 10, 2020. https://www.banggood.com/8mm-Lock-Collar-T8-Lead-Screw-Lock-Ring-Lock-Block-For-3D-Printer-p-1245112.html?cur_warehouse=CN.
29. "Single Channel 5V Relay." TD Egypt. Accessed April 10, 2020. <https://www.tdegypt.com/product/single-channel-5v-relay/>.
30. "5V 3A DC Adapter with UL ROHS CB SAA Certificate." Made. Accessed April 10, 2020. <https://maichi.en.made-in-china.com/product/KCIELONGSDVd/China-5V-3A-DC-Adapter-With-UL-ROHS-CB-SAA-Certificate.html>.
31. "12V Power Adapter: Makerlab Electronics." Makerlab Electronics - Bits and pieces of Hardware and Electronic Stuffs! Accessed April 10, 2020. <https://www.makerlab-electronics.com/product/12v-2a-power-adapter/>.
32. "6mm x 8mm Aluminum Flexible Shaft Coupling OD19mm x L25mm, Industrial & Scientific." www.banggood.com. Accessed April 10, 2020. https://www.banggood.com/6mm-x-8mm-Aluminum-Flexible-Shaft-Coupling-OD19mm-x-L25mm-CNC-Stepper-Motor-Coupler-Connector-p-994358.html?cur_warehouse=CN.
33. "8mm Flange Coupling Motor For CNC." Electronics.Com.BD. Accessed April 10, 2020. <https://www.electronics.com.bd/8mm-Flange-Coupling-Motor-For-CNC>.
34. "20x20 Aluminium Profile." indiamart.com. Accessed April 10, 2020. <https://www.indiamart.com/proddetail/20x20-aluminium-profile-16628862262.html>.
35. 'Arduino Mega ADK Rev3'. Accessed April 10, 2020. <https://store.arduino.cc/usa/arduino-mega-adk-rev3>.