LAMPIRAN

1. Link Google Drive Demo Alat

https://drive.google.com/drive/folders/17cDblMM8mrsVYz9_o1KXu4wUztiogx_W?usp=sharing

2. DataSheet

ESP8266EX Datasheet

Version 4.3

Espressif Systems IOT Team

http://bbs.espressif.com/

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Espressif Systems

Table of Contents

![Espressif Systems logo] **Espressif Systems**

1.   General Overview

1.1.   Introduction

Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.
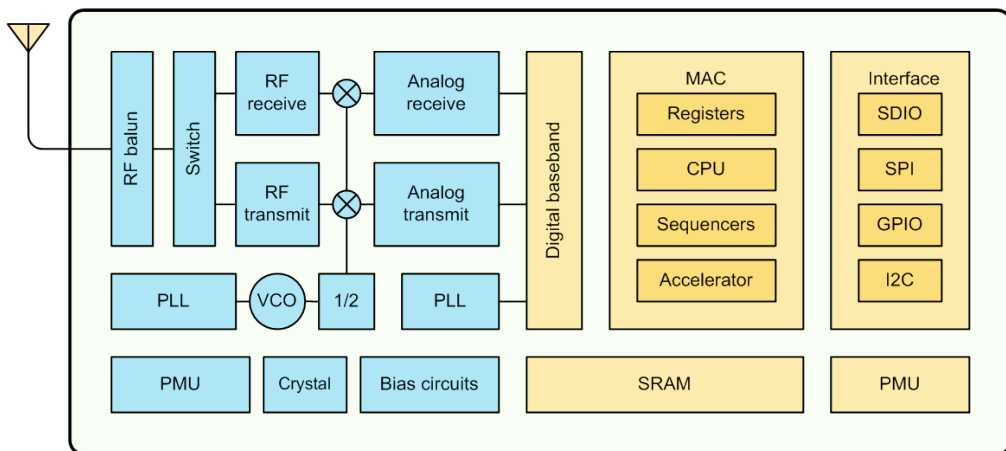
Figure 1   ESP8266EX Block Diagram

ESP8266EX offers a complete and self-contained WiFi networking solution; it can be used to host the application or to offload WiFi networking functions from another application processor.

When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications.

Alternately, serving as a WiFi adapter, wireless internet access can be added to any micro controller-based design with simple connectivity (SPI/SDIO or I2C/UART interface).

ESP8266EX is among the most integrated WiFi chip in the industry; it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules, it requires minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area.

ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor, with on-chip SRAM, besides the WiFi functionalities. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs; sample codes for such applications are provided in the software development kit (SDK).

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Espressif Systems' Smart Connectivity Platform (ESCP) demonstrates sophisticated system-level features include fast sleep/wake context switching for energy-efficient VoIP, adaptive radio biasing for low-power operation, advance signal processing, and spur cancellation and radio co-existence features for common cellular, Bluetooth, DDR, LVDS, LCD interference mitigation.

1.2.   Features

- 802.11 b/g/n

- Integrated low power 32-bit MCU

- Integrated 10-bit ADC

- Integrated TCP/IP protocol stack

- Integrated TR switch, balun, LNA, power amplifier and matching network

- Integrated PLL, regulators, and power management units

- Supports antenna diversity

- WiFi 2.4 GHz, support WPA/WPA2

- Support STA/AP/STA+AP operation modes

- Support Smart Link Function for both Android and iOS devices

- SDIO 2.0, (H) SPI, UART, I2C, I2S, IR Remote Control, PWM, GPIO

- STBC, 1x1 MIMO, 2x1 MIMO

- A-MPDU & A-MSDU aggregation & 0.4s guard interval

- Deep sleep power <10uA, Power down leakage current < 5uA

- Wake up and transmit packets in < 2ms

- Standby power consumption of < 1.0mW (DTIM3)

- +20 dBm output power in 802.11b mode

- Operating temperature range -40C ~ 125C

- FCC, CE, TELEC, WiFi Alliance, and SRRC certified

1.3.   Parameters

Table 1 Parameters

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Categories	Items	Values
WiFi Paramters	Certificates	FCC/CE/TELEC/SRRC
	WiFi Protocles	802.11 b/g/n
	Frequency Range	2.4G-2.5G (2400M-2483.5M)
	Tx Power	802.11 b: +20 dBm
		802.11 g: +17 dBm
		802.11 n: +14 dBm
	Rx Sensitivity	802.11 b: -91 dbm (11 Mbps)
		802.11 g: -75 dbm (54 Mbps)
		802.11 n: -72 dbm (MCS7)
	Types of Antenna	PCB Trace, External, IPEX Connector, Ceramic Chip
Hardware Paramaters	Peripheral Bus	UART/SDIO/SPI/I2C/I2S/IR Remote Control
		GPIO/PWM
	Operating Voltage	3.0~3.6V
	Operating Current	Average value: 80mA
	Operating Temperature Range	-40°~125°
	Ambient Temperature Range	Normal temperature
	Package Size	5x5mm
	External Interface	N/A
Software Parameters	WiFi mode	station/softAP/SoftAP+station
	Security	WPA/WPA2
	Encryption	WEP/TKIP/AES
	Firmware Upgrade	UART Download / OTA (via network)
	Ssoftware Development	Supports Cloud Server Development / SDK for custom firmware development
	Network Protocols	IPv4, TCP/UDP/HTTP/FTP

	User Configuration	AT Instruction Set, Cloud Server, Android/ iOS App

1.4.   Ultra Low Power Technology

ESP8266EX has been designed for mobile, wearable electronics and Internet of Things applications with the aim of achieving the lowest power consumption with a combination of several proprietary techniques. The power saving architecture operates mainly in 3 modes: active mode, sleep mode and deep sleep mode.

By using advance power management techniques and logic to power-down functions not required and to control switching between sleep and active modes, ESP8266EX consumes about than 60uA in deep sleep mode (with RTC clock still running) and less than 1.0mA (DTIM=3) or less than 0.5mA (DTIM=10) to stay connected to the access point.

When in sleep mode, only the calibrated real-time clock and watchdog remains active. The real-time clock can be programmed to wake up the ESP8266EX at any required interval.

The ESP8266EX can be programmed to wake up when a specified condition is detected. This minimal wake-up time feature of the ESP8266EX can be utilized by mobile device SOCs, allowing them to remain in the low-power standby mode until WiFi is needed.

In order to satisfy the power demand of mobile and wearable electronics, ESP8266EX can be programmed to reduce the output power of the PA to fit various application profiles, by trading off range for power consumption.

1.5.   Major Applications

Major fields of ESP8266EX applications to Internet-of-Things include:

•   Home Appliances

•   Home Automation

•   Smart Plug and lights

•   Mesh Network

•   Industrial Wireless Control

•   Baby Monitors

•   IP Cameras

•   Sensor Networks

•   Wearable Electronics

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- WiFi Location-aware Devices
- Security ID Tags
- WiFi Position System Beacons

2.   Hardware Overview

2.1.   Pin Definitions

The pin assignments for 32-pin QFN package is illustrated in Fig.2.
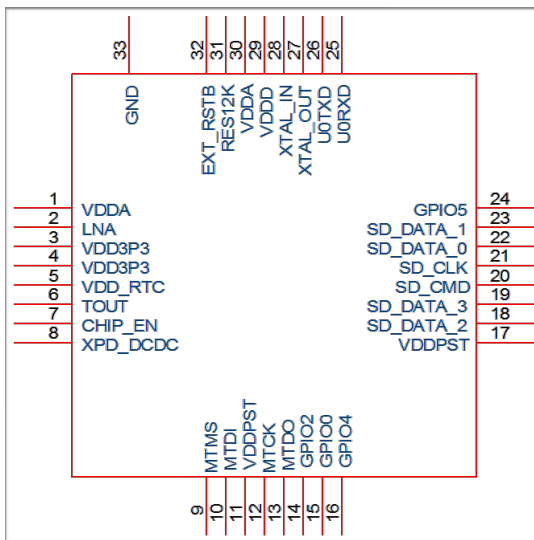
Figure 2   Pin Assignments

Table 2 below presents an overview on the general pin attributes and the functions of each pin.

Table 2 Pin Definitions

Pin	Name	Type	Function
1	VDDA	P	Analog Power 3.0 ~3.6V
2	LNA	I/O	RF Antenna Interface. Chip Output Impedance=50Ω No matching required but we recommend that the π-type matching network is retained.
3	VDD3P3	P	Amplifier Power 3.0~3.6V
4	VDD3P3	P	Amplifier Power 3.0~3.6V
5	VDD_RTC	P	NC (1.1V)

6	TOUT	I	ADC Pin (note: an internal pin of the chip) can be used to check the power voltage of VDD3P3 (Pin 3 and Pin4) or the input voltage of TOUT (Pin 6). These two functions cannot be used simultaneously.
7	CHIP_EN	I	Chip Enable. High: On, chip works properly; Low: Off, small current
8	XPD_DCDC	I/O	Deep-Sleep Wakeup；GPIO16
9	MTMS	I/O	GPIO14; HSPI_CLK
10	MTDI	I/O	GPIO12; HSPI_MISO
11	VDDPST	P	Digital/IO Power Supply (1.8V~3.3V)
12	MTCK	I/O	GPIO13; HSPI_MOSI; UART0_CTS
13	MTDO	I/O	GPIO15; HSPI_CS; UART0_RTS
14	GPIO2	I/O	UART Tx during flash programming; GPIO2
15	GPIO0	I/O	GPIO0; SPI_CS2
16	GPIO4	I/O	GPIO4
17	VDDPST	P	Digital/IO Power Supply (1.8V~3.3V)
18	SDIO_DATA_2	I/O	Connect to SD_D2 (Series R: 200Ω); SPIHD; HSPIHD; GPIO9
19	SDIO_DATA_3	I/O	Connect to SD_D3 (Series R: 200Ω); SPIWP; HSPIWP; GPIO10
20	SDIO_CMD	I/O	Connect to SD_CMD (Series R: 200Ω); SPI_CS0; GPIO11
21	SDIO_CLK	I/O	Connect to SD_CLK (Series R: 200Ω); SPI_CLK; GPIO6
22	SDIO_DATA_0	I/O	Connect to SD_D0 (Series R: 200Ω); SPI_MSIO; GPIO7
23	SDIO_DATA_1	I/O	Connect to SD_D1 (Series R: 200Ω); SPI_MOSI; GPIO8
24	GPIO5	I/O	GPIO5
25	U0RXD	I/O	UART Rx during flash programming; GPIO3
26	U0TXD	I/O	UART Tx during flash progamming; GPIO1; SPI_CS1
27	XTAL_OUT	I/O	Connect to crystal oscillator output, can be used to provide BT clock input
28	XTAL_IN	I/O	Connect to crystal oscillator input
29	VDDD	P	Analog Power 3.0V~3.6V
30	VDDA	P	Analog Power 3.0V~3.6V
31	RES12K	I	Serial connection with a 12 kΩ resistor and connect to the ground
32	EXT_RSTB	I	External reset signal (Low voltage level: Active)

Note: GPIO2, GPIO0, MTDO can be configurable as 3-bit SDIO mode.

2.2.   Electrical Characteristics

Table 3   ESP8266EX Electrical Characteristics

Parameters		Conditions	Min	Typical	Max	Unit
Storage Temperature Range			-40	Normal	125	°C
Maximum Soldering Temperature		IPC/JEDEC J-STD-020			260	°C
Working Voltage Value			3.0	3.3	3.6	V
I/O	V_{IL}/V_{IH}		$-0.3/0.75V_{IO}$		$0.25V_{IO}/3.6$	V
	V_{OL}/V_{OH}		$N/0.8V_{IO}$		$0.1V_{IO}/N$	
	I_{MAX}				12	mA
Electrostatic Discharge (HBM)		TAMB=25°C			2	KV
Electrostatic Discharge (CDM)		TAMB=25°C			0.5	KV

2.3.   Power Consumption

The following current consumption is based on 3.3V supply, and 25°C ambient, using internal regulators. Measurements are done at antenna port without SAW filter. All the transmitter's measurements are based on 90% duty cycle, continuous transmit mode.

Table 4   Description on Power Consumption

Parameters	Min	Typical	Max	Unit
Tx802.11b, CCK 11Mbps, P OUT=+17dBm		170		mA
Tx 802.11g, OFDM 54Mbps, P OUT =+15dBm		140		mA
Tx 802.11n, MCS7, P OUT =+13dBm		120		mA
Rx 802.11b, 1024 bytes packet length , -80dBm		50		mA
Rx 802.11g, 1024 bytes packet length, -70dBm		56		mA
Rx 802.11n, 1024 bytes packet length, -65dBm		56		mA
Modem-Sleep①		15		mA
Light-Sleep②		0.9		mA
Deep-Sleep③		10		uA
Power Off		0.5		uA

①: Modem-Sleep requires the CPU to be working, as in PWM or I2S applications. According to 802.11 standards (like U-APSD), it saves power to shut down the WiFi Modem circuit while maintaining a WiFi connection with no data transmission. E.g. in DTIM3, to maintain a sleep 300ms-wake 3ms cycle to receive AP's Beacon packages, the current is about 15mA

②: During Light-Sleep, the CPU may be suspended in applications like WiFi switch. Without data transmission, the WiFi Modem circuit can be turned off and CPU suspended to save power according to the 802.11 standard (U-APSD). E.g. in DTIM3, to maintain a sleep 300ms-wake 3ms cycle to receive AP's Beacon packages, the current is about 0.9mA.

③: Deep-Sleep does not require WiFi connection to be maintained. For application with long time lags between data transmission, e.g. a temperature sensor that checks the temperature every 100s, sleep 300s and waking up to connect to the AP (taking about 0.3~1s), the overall average current is less than 1mA.

2.4.   Receiver Sensitivity

The following are measured under room temperature conditions with 3.3V and 1.1V power supplies.

Table 5 Receiver Sensitivity

Parameters	Min	Typical	Max	Unit
Input frequency	2412		2484	MHz
Input impedance		50		Ω
Input reflection			-10	dB
Output power of PA for 72.2Mbps	15.5	16.5	17.5	dBm
Output power of PA for 11b mode	19.5	20.5	21.5	dBm
Sensitivity				
DSSS, 1Mbps		-98		dBm
CCK, 11Mbps		-91		dBm
6Mbps (1/2 BPSK)		-93		dBm
54Mbps (3/4 64-QAM)		-75		dBm
HT20, MCS7 (65Mbps, 72.2Mbps)		-72		dBm
Adjacent Channel Rejection				
OFDM, 6Mbps		37		dB
OFDM, 54Mbps		21		dB
HT20, MCS0		37		dB
HT20, MCS7		20		dB

2.5.   MCU

ESP8266EX is embedded with Tensilica L106 32-bit micro controller (MCU), which features extra low power consumption and 16-bit RSIC. The CPU clock speed is 80MHz. It can also reach a maximum value of 160MHz. Real Time Operation System (RTOS) is enabled. Currently, only 20% of MIPS has been occupied by the WiFi stack, the rest can all be used for user application programming and development. The following interfaces can be used to connect to the MCU embedded in ESP8266EX:

- Programmable RAM/ROM interfaces (iBus), which can be connected with memory controller, and can also be used to visit external flash;

- Data RAM interface (dBus), which can connected with memory controller;

- AHB interface, can be used to visit the register.

2.6.   Memory Organization

2.6.1.   Internal SRAM and ROM

ESP8266EX WiFi SoC is embedded with memory controller, including SRAM and ROM. MCU can visit the memory units through iBus, dBus, and AHB interfaces. All memory units can be visited upon request, while a memory arbiter will decide the running sequence according to the time when these requests are received by the processor.

According to our current version of SDK provided, SRAM space that is available to users is assigned as below:

- **RAM size < 36kB,** that is to say, when ESP8266EX is working under the station mode and is connected to the router, programmable space accessible to user in heap and data section is around 36kB.)

- There is no programmable ROM in the SoC, therefore, user program must be stored in an external SPI flash.

2.6.2.   External SPI Flash

An external SPI flash is used together with ESP8266EX to store user programs. Theoretically speaking, up to 16 Mbyte memory capacity can be supported.

Suggested SPI Flash memory capacity:

- OTA is disabled: the minimum flash memory that can be supported is 512 kByte;

- OTA is enabled: the minimum flash memory that can be supported is 1 Mbyte.

Several SPI modes can be supported, including Standard SPI, Dual SPI, DIO SPI, QIO SPI, and Quad SPI.

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Therefore, please choose the correct SPI mode when you are downloading into the flash, otherwise firmwares/programs that you downloaded may not work in the right way.

2.7.   AHB and AHB Blocks

The AHB blocks performs the function of an arbiter, controls the AHB interfaces from the MAC, SDIO (host) and CPU. Depending on the address, the AHB data requests can go into one of the two slaves:

APB block, or

flash controller (usually for standalone applications).

Data requests to the memory controller are usually high speed requests, and requests to the APB block are usually register access.

The APB block acts as a decoder. It is meant only for access to programmable registers within ESP8266's main blocks. Depending on the address, the APB request can go to the radio, SI/SPI, SDIO (host), GPIO, UART, real-time clock (RTC), MAC or digital baseband.

Ultrasonic Ranging Module HC - SR04

Product features:

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2,

Wire connecting direct as following:

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
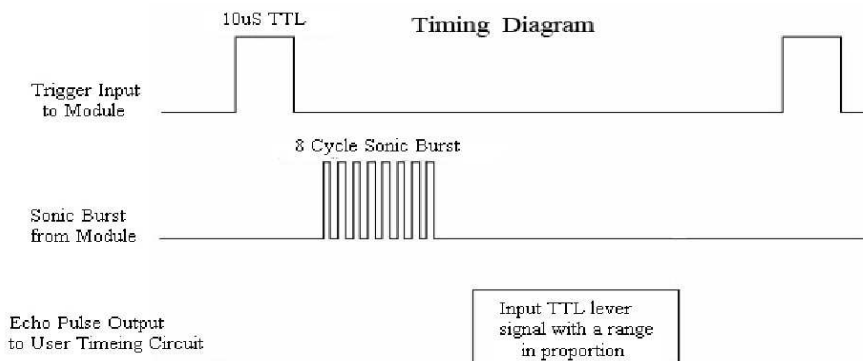- 0V Ground

Electric Parameter

Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
MeasuringAngle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

Vcc   Trig   Echo   GND

Timing diagram

The Timing diagram is shown below. You only need to supply a short 10uS
pulse to the trigger input to start the ranging, and then the module will send out
an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a
distance object that is pulse width and the range in proportion .You can
calculate the range through the time interval between sending trigger signal and
receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the
range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms
measurement cycle, in order to prevent trigger signal to the echo signal.

10uS TTL   Timing Diagram

Trigger Input
to Module

8 Cycle Sonic Burst

Sonic Burst
from Module

Echo Pulse Output
to User Timeing Circuit

Input TTL lever
signal with a range
in proportion

Attention:

● The module is not suggested to connect directly to electric, if connected electric, the GND terminal should be connected the module first, otherwise, it will affect the normal work of the module.

● When tested objects, the range of area is not less than 0.5 square meters and the plane requests as smooth as possible, otherwise ,it will affect the results of measuring.

www.Elecfreaks.com

SG90 9 g Micro Servo
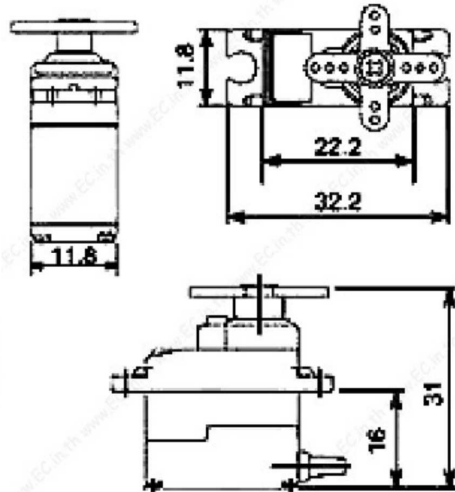
Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but *smaller*. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.

Specifications
• Weight: 9 g
• Dimension: 22.2 x 11.8 x 31 mm approx.
• Stall torque: 1.8 kgf·cm
• Operating speed: 0.1 s/60 degree
• Operating voltage: 4.8 V (~5V)
• Dead band width: 10 µs
• Temperature range: 0 ºC – 55 ºC
Position "0" (1.5 ms pulse) is middle, "90" (~2ms pulse) is all the way to the left. ms pulse) is all the way to the right, ""-90" (~1ms pulse) is all the way to the left.

TowerPro SG90 - Micro Servo

Basic Information

Modulation: Analog

Torque: **4.8V:** 25.0 oz-in (1.80 kg-cm)

Speed: **4.8V:** 0.10 sec/60°

Weight: 0.32 oz (9.0 g)

Dimensions:

Length: 0.91 in (23.1 mm)

Width: 0.48 in (12.2 mm)

Height:1.14 in (29.0 mm)

Motor Type: 3-pole
Gear Type: Plastic
Rotation/Support: Bushing

Additional Specifications

Rotational Range: 180°
Pulse Cycle: ca. 20 ms
Pulse Width: 500-2400 µs

T-Pro Mini Servo SG-90 9G Servo

The **TP SG90** is similar in size and weight to the Hitec HS-55, and is a good choice for most park flyers and helicopters. Hobbyists from around the world has used the SG90 on famous planes like GWS Slow Stick, E-Flite Airplanes, Great Planes, Thunder Tiger, Align, EDF jets and more. If you are looking for a servo that won't break your arm or leg, this is the perfect choice for you!

The **TP SG90** servo weighs 0.32 ounces (9.0 grams). Total weight with wire and connector is 0.37 ounces (10.6 grams).

The **TP SG90** has the universal "S" type connector that fits most receivers, including Futaba, JR, GWS, Cirrus, Blue Bird, Blue Arrow, Corona, Berg and Hitec.

The wire colors are **Red = Battery(+) Brown = Battery(-) Orange = Signal**

TP SG90 Specifications:

Dimensions (L x W x H) = 0.86 x 0.45 x 1.0 inch (22.0 x 11.5 x 27 mm)

Weight = 0.32 ounces (9 grams)

Weight with wire and connecter = 0.37 ounce (10.6 grams)

Stall Torque at 4.8 volts = 16.7 oz/in (1.2 kg/cm)

Operating Voltage = 4.0 to 7.2 volts

Operating Speed at 4.8 volts (no load) = 0.12 sec/ 60 degrees

Connector Wire Length = 9.75 inches (248 mm)

Universal "S" type connector fits most receivers

**9g Tower Pro Servo**

Tower Pro 9g servo
These Micro strong and made to last, great for planes. The servos include 3 servo arms.
Specs:

- DIMENSION: 26mm*13mm*24mm
- WEIGHT: 9G
- OPERATING SPEED: 0.12sec/60degree(4.8V);0.11sec/60degree(6V)
- STALL TORQUE: 1.2kg/cm or 17oz-in. (4.8V) 1.6kg/cm or 22oz-in.(6.0V)
- OPERATING VOLTAGE: 4.8V~6.0V
- FEATURE: 3 pole wire, all nylon gear, connector wire length: 15cm
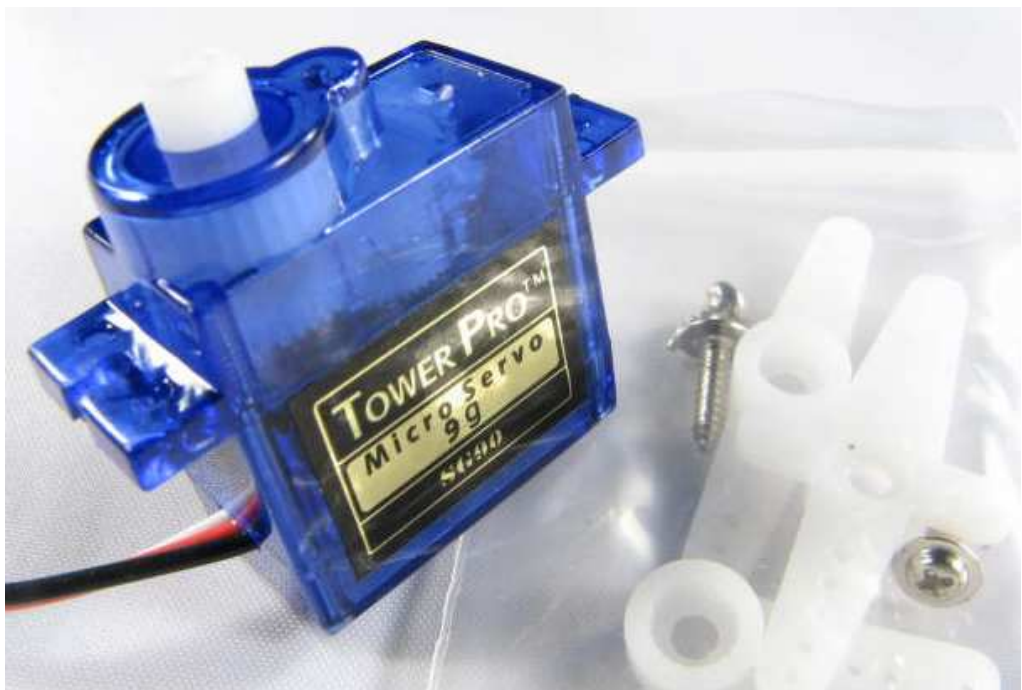
Usage Type :		
Voltage (V) :	4.8,6.0	
Speed@4.8V (sec/60 :	0.12	
Torque@4.8V (kg-cm) :	1.2	
Speed@6.0V (sec/60 :	0.11	
Torque@6.0V (kg-cm) :	1.6	
Weight (g) :	9	
Dimension B (mm) :	26	
Dimension C (mm) :	24	
Dimension D (mm) :	13	
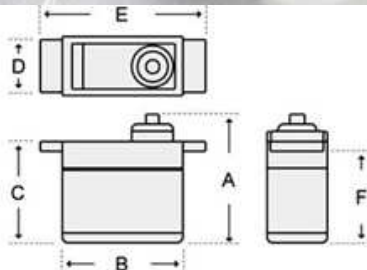
The TG9e boasts the same performance as other servo's 10x the price with a .10sec travel time and up to 1.5kg in torque and an ultra narrow dead bandwidth!

The TG9e performance is on par with the famous HXT900, however the TG9e isn't as resistant to crashes or over-loading.

Please always ensure your control surfaces are bind free.

Spec.

Dimension: 23x12.2x29mm

Torque: 1.5kg/cm (4.8V)

Operating speed: 0.10sec/60 degree 0.09sec/60 degree(6.0V)

Operating voltage: 4.8V
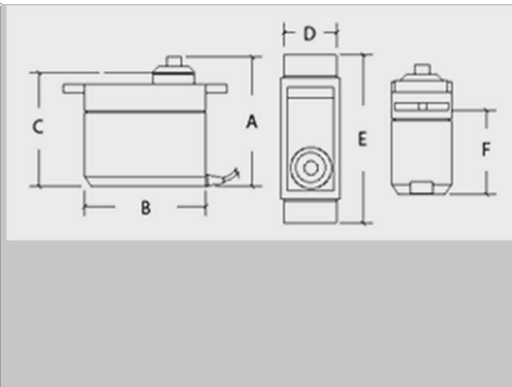
Temperature range: 0-55C

Dead band-width: 7us

Lead Length: 260mm

Important.
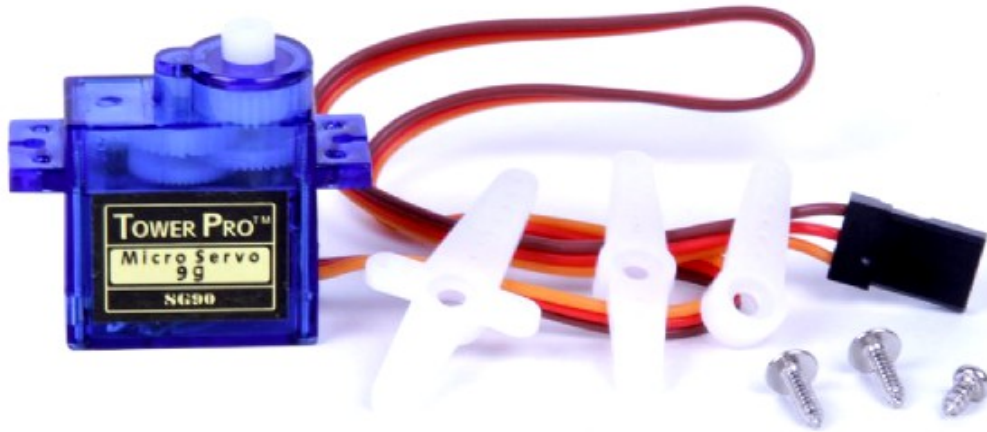**The TG9e does not have the same strength and longevity as the HXT900.**

Please ensure your control surfaces are bind-free and always check servos after a hard landing or crash!

|	
Weight (g)	9
Torque (kg)	1.5
Speed(Sec/60deg)	0.09
A(mm)	30
B(mm)	23
C(mm)	27
D(mm)	12
E(mm)	33
F(mm)	16

SERVO MOTOR SG90   DATA SHEET

Tiny and lightweight with high output power. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. You can use any servo code, hardware or library to control these servos. Good for beginners who want to make stuff move without building a motor controller with feedback & gear box, especially since it will fit in small places. It comes with a 3 horns (arms) and hardware.
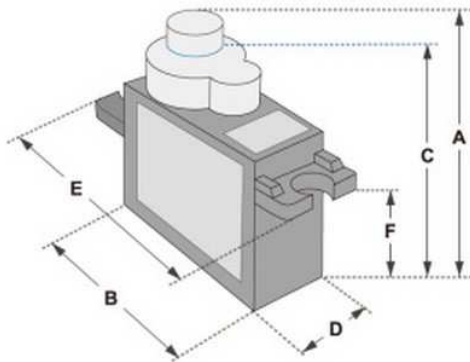
Dimensions & Specifications
A (mm) : 32
B (mm) : 23
C (mm) : 28.5
D (mm) : 12
E (mm) : 32
F (mm) : 19.5
Speed (sec) : 0.1
Torque (kg-cm) : 2.5
Weight (g) : 14.7
Voltage : 4.8 - 6

Position "0" (1.5 ms pulse) is middle, "90" (~2ms pulse) is middle, is all the way to the right, "-90" (~1ms pulse) is all the way to the left.

PWM=Orange (⎍)
Vcc = Red (+)
Ground=Brown (–)

1 - 2 ms
Duty Cycle

4.8 V (~5 V)
Power
and Signal

20 ms (50 Hz)
PWM Period