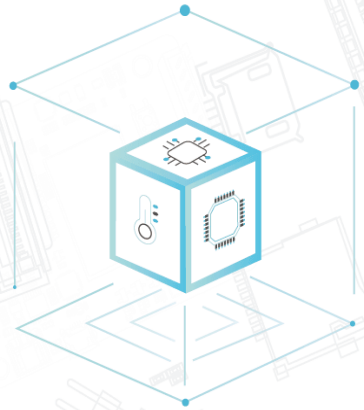
Basics of ESP8266 Microprocessor



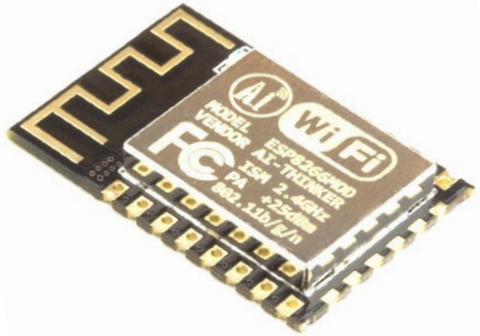
Yogesh M Iggalore

IC vs Module vs Development Kit

IC

ESP8266EX

Module

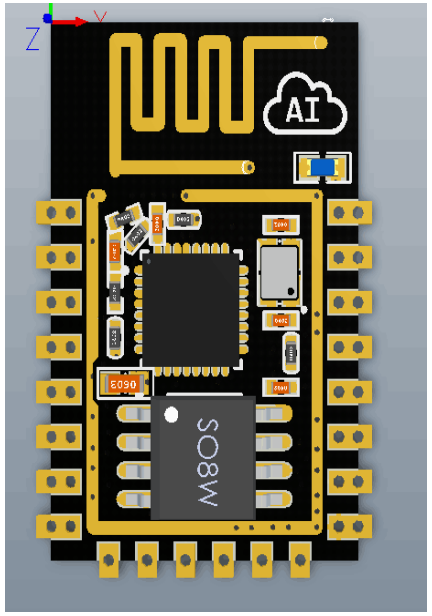


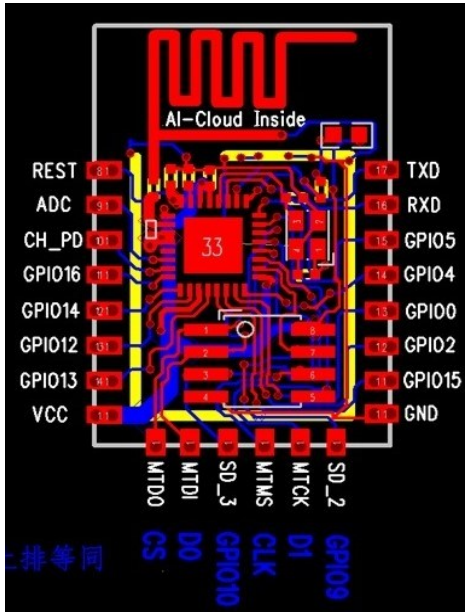
ESP8266-12E

Kit

NodeMCU

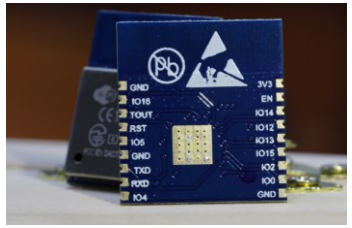
Inside ESP826612E

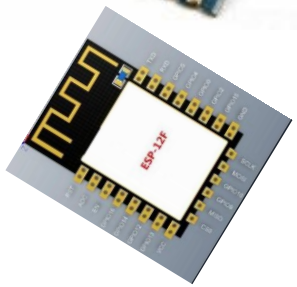


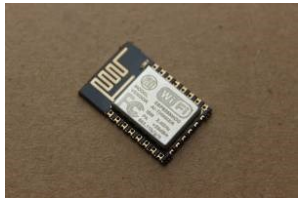


Component	Used
Processor	ESP8266EX
Flash	25Q80A
Crystal	26Mhz
Antenna	PCB trace
Certificate	FCC

ESP8266 Module family







ESP8266EX Features

- 802.11 b/g/n WiFi support
- Supports station/Access point and promiscuous mode
- Operating voltage 2.5V – 3.6V
- Operating current Average 80mA
- Operating temperature -40 – 125 degree C
- WPA/WPA2 WiFi security
- WEP/TKIP/AES encryption
- Adjustable WiFi transmitting power
- UART & OTA firmware support
- IPV4,TCP/UDP/HTTP network protocol support
- UART,I2C,I2S,SPI protocol support
- Single channel ADC support
- Support active, modern-sleep, light sleep and deep sleep mode

ESP8266EX Pins

Pins	Name	Type	Functions
1	VDDA	P	Analog power 2.5V – 3.6V
2	LNA	I/O	RF antenna interface,
3	VDDP3	P	Amplifier 2.5V – 3.6V
4	VDDP3	P	Amplifier 2.5V – 3.6V
5	VDD_RTC	P	NC (1.1V)
6	TOUT	I	ADC pin Voltage testing pin
7	CHIP_EN	I	Chip enable, High: On, chip works properly Low: Off, small current consumed
8	XPD_DCDC	I/O	GPIO16 Deep-sleep wake up pins
9	MTMS	I/O	GPIO14 HSPI_CLK
10	MTDI	I/O	GPIO12 HSPI_MISO
11	VDDPST	P	Digital/IO power supply (1.8V – 3.6V)

ESP8266EX Pins

Pins	Name	Type	Functions
12	MTCK	I/O	GPIO 13; HSPI_MOSI; UART0_CTS
13	MTDO	I/O	GPIO 15; HSPI_CS; UART0_RTS
14	GPIO2	I/O	GPIO 02; UART TX during flash programming
15	GPIO0	I/O	GPIO 00; SPI_CS2
16	GPIO4	I/O	GPIO 04; GPIO04
17	VDDPST	P	Digital/IO Power Supply (1.8 V ~ 3.6 V)
18	SDIO_DATA_2	I/O	GPIO 09; Connect to SD_D2 (Series R: 20 Ω); SPIHD; HSPIHD;
19	SDIO_DATA_3	I/O	GPIO 10; Connect to SD_D3 (Series R: 200 Ω); SPIWP; HSPIWP;
20	SDIO_CMD	I/O	GPIO 11; Connect to SD_CMD (Series R: 200 Ω); SPI_CS0;
21	SDIO_CLK	I/O	GPIO 06; Connect to SD_CLK (Series R: 200 Ω); SPI_CLK;
22	SDIO_DATA_0	I/O	GPIO 07; Connect to SD_D0 (Series R: 200 Ω); SPI_MISO;

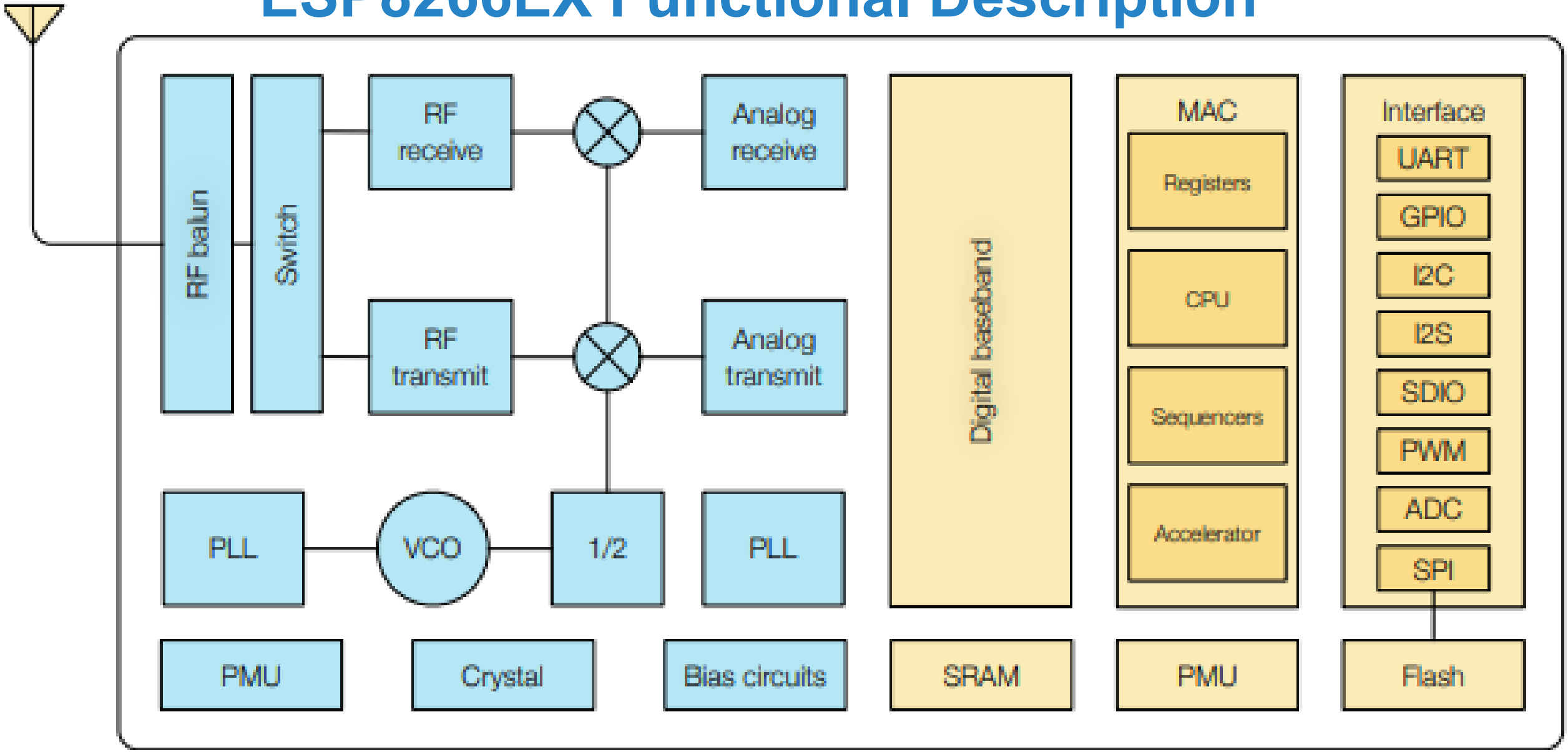
ESP8266EX Pins

Pins	Name	Type	Functions
23	SDIO_DATA_1	I/O	GPIO 08; Connect to SD_D1 (Series R: 200 Ω); SPI_MOSI;
24	GPIO05	I/O	GPIO 05
25	U0RXD	I/O	GPIO 03; UART Rx during flash programming; GPIO3
26	U0TXD	I/O	GPIO 01; UART Tx during flash programming; 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 2.5 V ~ 3.6 V
30	VDDA	P	Analog Power 2.5 V ~ 3.6 V
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)

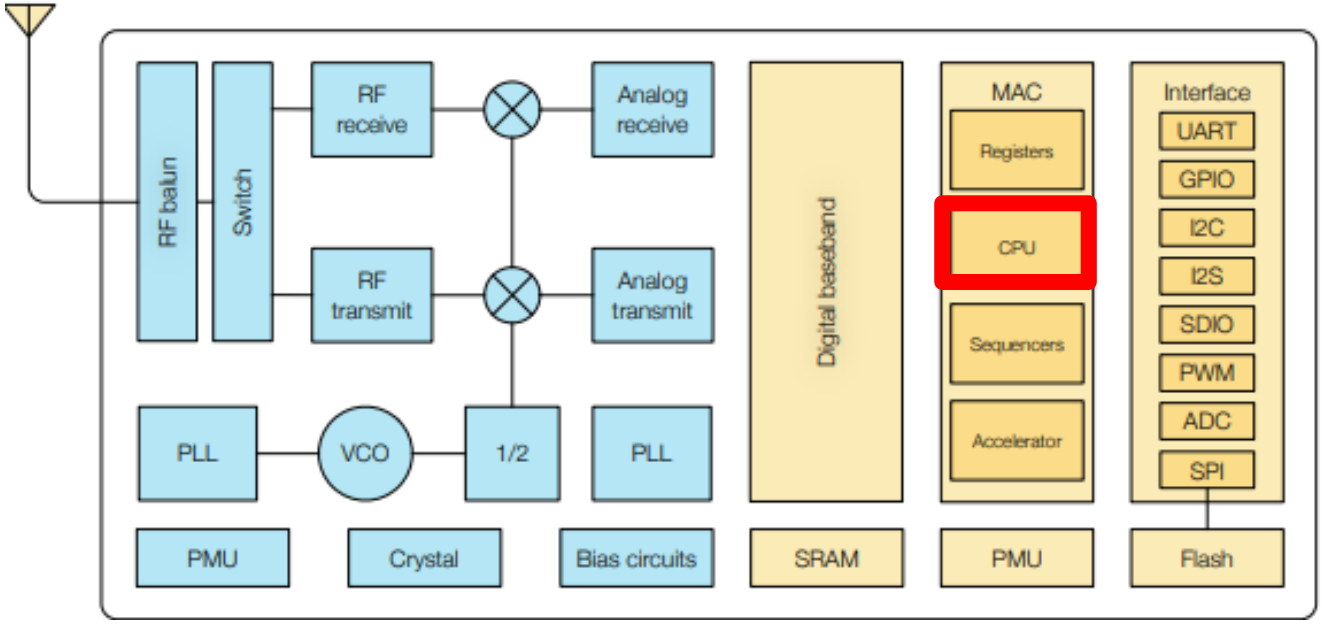
ESP8266EX Pins

Label	GPIO	Input	Output	Notes
D0	GPIO16	no interrupt	no PWM or I2C support	HIGH at boot used to wake up from deep sleep
D1	GPIO05	OK	OK	often used as SCL (I2C)
D2	GPIO04	OK	OK	often used as SDA (I2C)
D3	GPIO00	pulled up	OK	connected to FLASH button, boot fails if pulled LOW
D4	GPIO02	pulled up	OK	HIGH at boot connected to on-board LED, boot fails if pulled LOW
D5	GPIO14	OK	OK	SPI (SCLK)
D6	GPIO12	OK	OK	SPI (MISO)
D7	GPIO13	OK	OK	SPI (MOSI)
D8	GPIO15	pulled to GND	OK	SPI (CS) Boot fails if pulled HIGH
RX	GPIO03	OK	RX pin	HIGH at boot
TX	GPIO01	TX pin	OK	HIGH at boot debug output at boot, boot fails if pulled LOW
A0	ADC0	Analog input	X	Analog pin 1.8V

ESP8266EX Functional Description

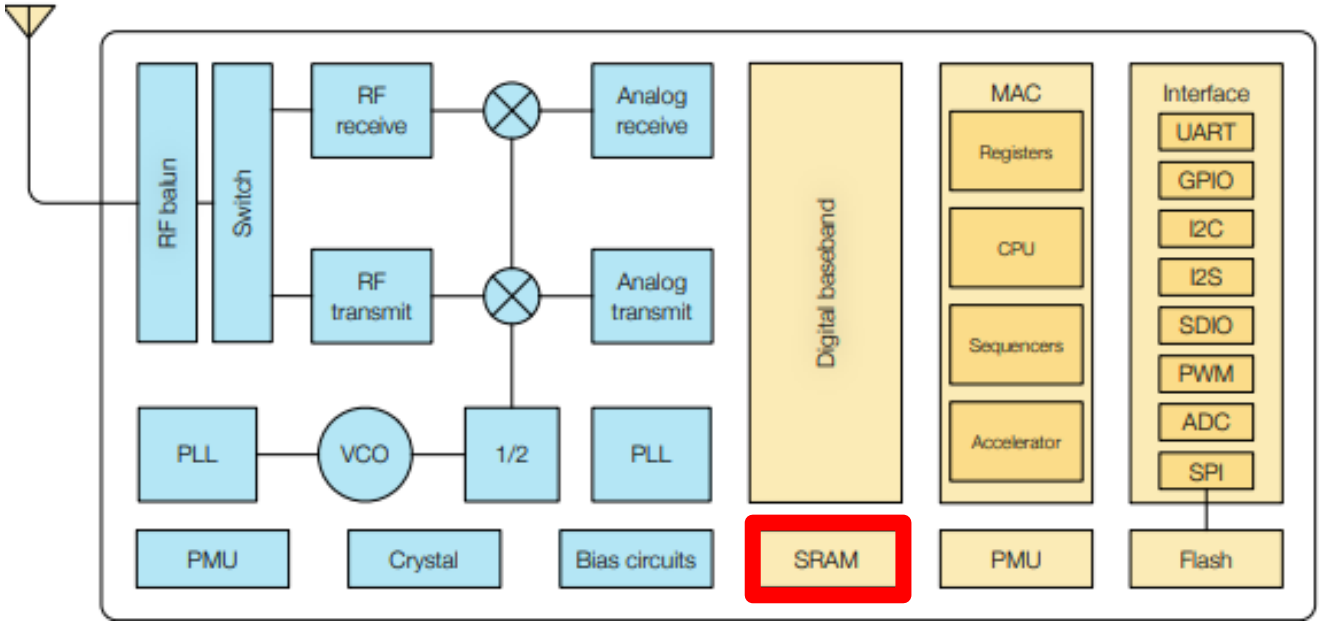


ESP8266EX Functional Description



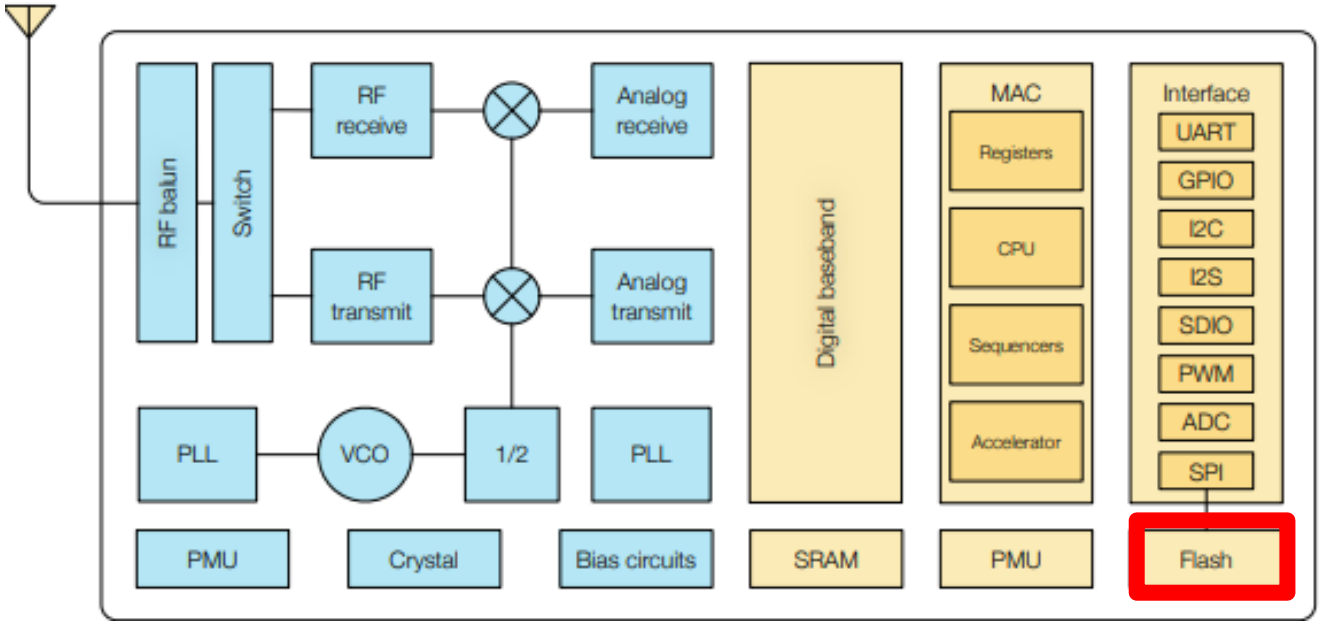
- Tensilica L106 32-bit RISC processor
- Maximum clock speed of 160 MHz
- Programmable RAM/ROM interfaces
- Data RAM interface,
- Advance Peripheral Bus(APB) interface

ESP8266EX Functional Description



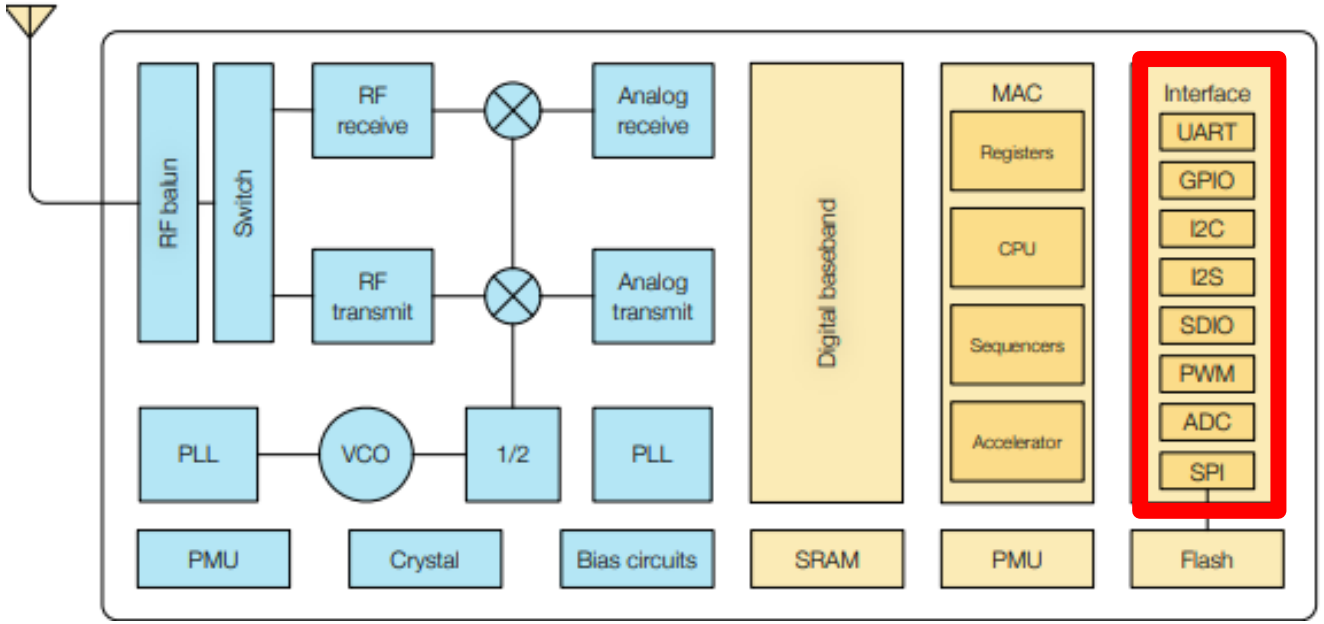
- 32 KiB instruction RAM
- 32 KiB instruction cache RAM
- 80 KiB user-data RAM
- 16 KiB ETS system-data RAM

ESP8266EX Functional Description



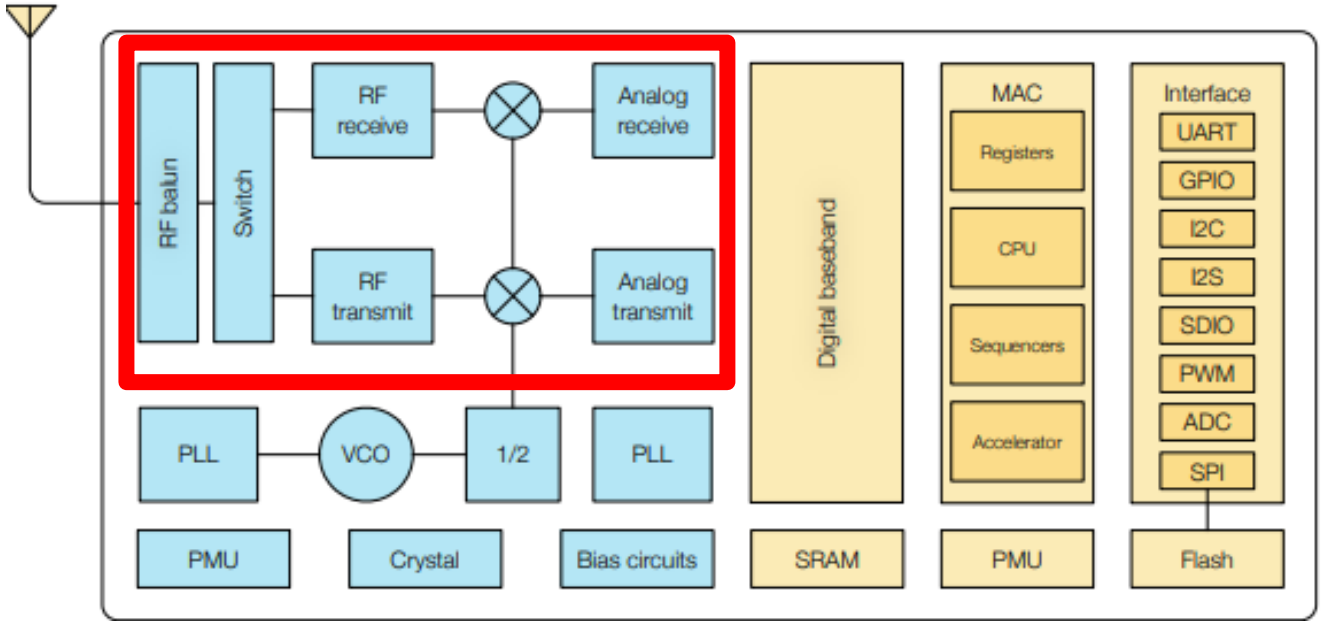
- Supports external Flash
- Communication SPI
- Max 16MB supported
- OTA disabled min 512kB
- OTA enabled min 1MB

ESP8266EX Functional Description



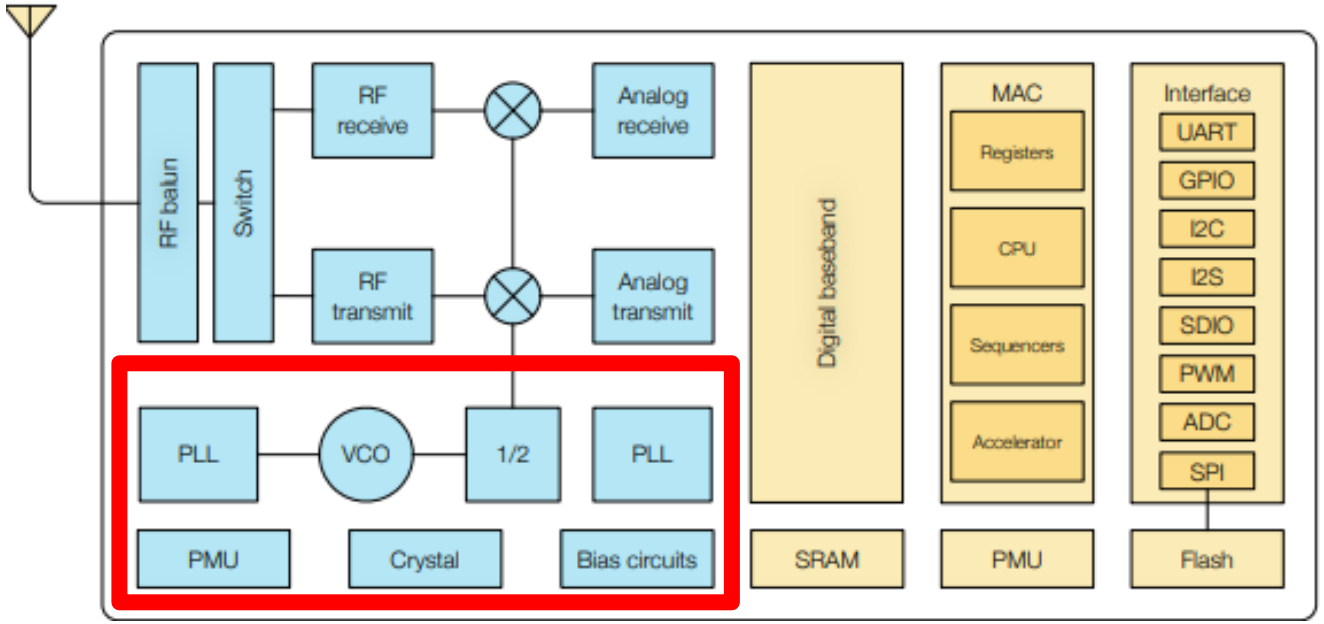
- GPIO (General Purpose Input and Output)
- UART (universal asynchronous receiver transmitter)
- I2C (Inter Integrated circuit)
- I2S (Inter IC sound)
- SDIO (Secure Digital Input Output)
- PWM (Pulse Width Modulation)
- ADC (Analog to Digital Conversion)
- SPI (Serial Peripheral Interface)

ESP8266EX Functional Description



- Receiver receives modulated RF signal and demodulates its signals.
- Transmitter transmits the modulated radio values
- RF balun converts between balanced and unbalanced signals
- Switch helps in switching between receiver and transmitter

ESP8266EX Functional Description



- PLL (Phase Lock Loop) control system generate output signal whose phase is related phase of input signal
- VCO (Voltage controlled Oscillator) oscillation frequency controlled by voltage input
- PMU (Power Management Unit) does power management
- External crystal 26MHz