

Differences between PicoA, PicoB, PicoC, PicoD, PicoM and PicoM305

The Pico is our new 10DOF IMU family available in six different configurations with one (PicoM) available with two different processors. Why so many you may ask? Well in order to meet the needs of different users and budgets we decided to support two different 8 bit processors and the ARM Cortex M0 and M4 processor family. This allows the family to meet the needs of cost sensitive applications while also addressing the needs of high performance applications.

All Picos have a USB interface, most are 10DOF capable, lithium battery support with charger, two different wireless options, two different display options and they are a lot smaller than the IMU8420 family. The one feature dropped was the uSD - too big to put on the board so that feature is available as an option. The PicoD is not a motion control device but rather an environmental sensor with digital humidity and temperature sensing. A key feature shared by all Picos is wireless integration. PicoA,B,M07 and M30 are all 10DOF IMUs. PicoC is a 7DOF device and PicoD is an environmental sensor.

The PicoM30 is our highest performance IMU and has all the features of the IMU8420 less the uSD and is capable of high performance sensor fusion using an Extended Kalman Filter made possible by the on chip hardware FPU. The EKF was a collaborative development between SOC Robotics and researchers at Simon Fraser University. The PicoM305 is a variation of the PicoM30 specifically designed to meet the needs of a finger tracking application. The PicoM305 is not available as a standalone device but only as part of the hand/finger tracking system.

Feature	PicoA	PicoB	PicoC	PicoD	PicoM07	PicoM30
Processor A	ATxmega32E5	ATmega328	ATxmega32E5	ATxmega32E5	STM32F072	STM32F303
Type	8 bit	8 bit	8 bit	8 bit	32 bit	32 bit
Clock Rate	32MHz	8MHz	32MHz	32MHz	48MHz	72MHz
Hardware FPU	No	No	No	No	Yes	Yes
AST Clock (14usec)	Yes	No	Yes	Yes	Yes	Yes
Flash	32K	32K	32K	32K	128K	256K
RAM	4K	2K	4K	4K	16K	48K
EEPROM	1K	1K	1K	1K	0K	0K
uSD	No	No	No	No	No	No
Accelerometer	3-axis	3-axis	3-axis	NA	3-axis	3-axis
Gyrocompass	3-axis	3-axis	No	NA	3-axis	3-axis
Magnetometer	3-axis	3-axis	3-axis	NA	3-axis	3-axis
Barometer	BMP180	BMP180	BMP180	BMP180	BMP180	BMP180
EKF	No	No	No	No	No	Yes
Motion Sensor	MPU-9150	MPU-9150	FXOS8700		MPU-9150	MPU-9150
Humidity/Temp/Light	No	No	No	Yes	No	No
LiPo + Charger	Yes	Yes	Yes	Yes	Yes	Yes
Wireless options	WiFi/RF24L01	WiFi/RF24L01	WiFi/RF24L01	WiFi/RF24L01	WiFi/RF24L01	WiFi/RF24L01
Measure Bat Volt	Yes	Yes	Yes	Yes	Yes	Yes
Display options	OLED/TFT	OLED/TFT	OLED/TFT	OLED/TFT	OLED/TFT	OLED/TFT
A/D	12-16 bit/8 Ch	10 bit/8 Ch	12-16 bit/8 Ch	12-16 bit/8 Ch	12 bit/12 Ch	12 bit/16 Ch
D/A	12 bit/2 Ch	No	12 bit/2 Ch	12 bit/2 Ch	12 bit/2 Ch	12 bit/2 Ch
Serial Ports	2	1	2	2	3	5
Hardware PWM	Yes	Yes	Yes	Yes	Yes	Yes
Processor B	PIC16F1454	PIC16F1454	PIC16F1454	PIC16F1454	NA	NA
IDE	AS 6.2	AS 6.2/Arduino	AS 6.2	AS 6.2	CooCox 1.7.5	CooCox 1.7.5

The application software running on each Pico is provided along with an IDE specific to each processor. Three IDE's are supported - Atmel AVR Studio 6.2, Arduino (for PicoB) and CooCox 1.7.5 for PicoM. By providing project code for each Pico users can tailor, modify and enhance the core Pico application for their own specific needs and either keep the changes confidential or return them to the community.

Source code is provided to communicate with the RF24L01 and ESP8266 and the OLED and Color TFT displays.

A new desktop GUI called SOCSense is in development and will be released shortly. The GUI is designed to handle multiple Picos in a wireless network system. The GUI talks directly to Picos attached via USB or indirectly via a Nano, NanoM or NanoMP.

Sensor Fusion Algorithms

There are two different sensor fusion algorithms available for the Picos and Nanos - Extended Kalman Filter (EKF) and Madgwick. Both calculate Quaternion's and output roll, pitch and yaw in real time. The EKF is only available on the high performance NanoM30 and PicoM30 devices (both use the STM32F303 processor with hardware FPU). The Madgwick filter is available on all Nanos and Picos. Due to the flash size requirements of the Madgwick algorithm some functions on Nanos and Picos with 32K of flash must be eliminated such as OLED display output. In terms of performance the EKF cycles in 1.5msec with sensor data acquisition in under 1 msec. The Madgwick algorithm cycles at 128Hz on the PicoB, 166Hz on the PicoA,M04,M07, and 600Hz on the PicoM.

Differences between Nano, NanoM and NanoMP

The Nano is a desktop focused 10DOF development board in a larger form factor than Picos and is intended to be the primary communications device for Pico wireless networks. Most of the processors pins are brought out to connectors to allow connection of other sensors or electronics circuits. Nanos are available with or without sensors.

Feature	Nano	NanoM07	NanoM30	NanoMP07	NanoMP30
Processor	ATxmega128A4U	STM32F072	STM32F303	STM32F072	STM32F303
Type	8 bit	32 bit	32 bit	32 bit	32 bit
Clock Rate	32MHz	8MHz	32MHz	32MHz	72MHz
Hardware FPU	No	No	No	No	Yes
AST Clock (14usec)	Yes	No	Yes	No	Yes
Flash	128K	128K	256K	128K	256K
RAM	8K	16K	40K	16K	40K
EEPROM	2K	-	-	-	-
uSD	No	No	No	No	No
Accelerometer	MPU-9150	MPU-9150	FXOS8700	NA	MPU-9150
Gyrocompass	MPU-9150	MPU-9150	No	NA	MPU-9150
Magnetometer	MPU-9150	MPU-9150	FXOS8700	NA	MPU-9150
Barometer	BMP180	BMP180	BMP180	BMP180	BMP180
LiPo + Charger	Yes	Yes	Yes	Yes	Yes
EKF	No	No	No	No	Yes
Wireless WiFi	Yes	Yes	Yes	Yes	Yes
Wireless RF24L01	Yes	Yes	Yes	Yes	Yes
A/D	12 bit/8 Ch	12 bit/8 Ch	12 bit/8 Ch	12 bit/8 Ch	12 bit/8 Ch
D/A	12 bit/2 Ch	12 bit/2 Ch	12 bit/2 Ch	12 bit/2 Ch	12 bit/2 Ch
Serial Ports	2	3	5	3	5
On chip Op Amp	No	No	Yes	No	Yes
IDE	AS 6.2	CooCox	CooCox	CooCox	CooCox

The NanoM and MP are also available with an STM32F042 processor for cost sensitive applications. The key difference between the three STM32 processors is summarized below.

Feature	NanoM04	NanoM07	NanoM30
Processor	STM32F042	STM32F072	STM32F303
Type	32 bit	32 bit	32 bit
Clock Rate	48MHz	48MHz	72MHz
Core Processor	ARM Cortex-M0	ARM Cortex-M0	ARM Cortex-M4
Hardware FPU	No	No	Yes
AST Clock	Yes	No	Yes
Flash	32K	128K	256K
RAM	6K	16K	40K
EEPROM	No	No	No
On chip Op Amp	No	No	Yes

Difference between Femtos

Femtos are standalone sensors with 9, 6 or 3 Degrees of Freedom or light processor. They are designed to add additional sensing options to Picos to address special applications such as the HandSense finger tracking system. A common feature of the Femtos is internal temperature sensing - important for calibrating the sensor.

Feature	FemtoA	FemtoB	FemtoC	FemtoD	FemtoE
Accelerometer	3-axis	3-axis	3-axis	-	-
Gyrocompass	3-axis	-	-	3-axis	-
Magnetometer	3-axis	3-axis	-	NA	-
Temperature	Yes	Yes	Yes	No	No
Light	-	-	-	-	RGB
Comm Protocol	I2C	I2C	I2C	I2C	I2C
Sensor	MPU-9150	FXOS8700	MMA8653	L3GD20	TCS3472
Type	9 DOF	6 DOF	3 DOF	3 DOF	NA