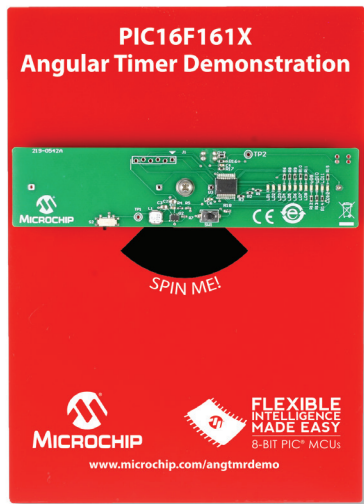


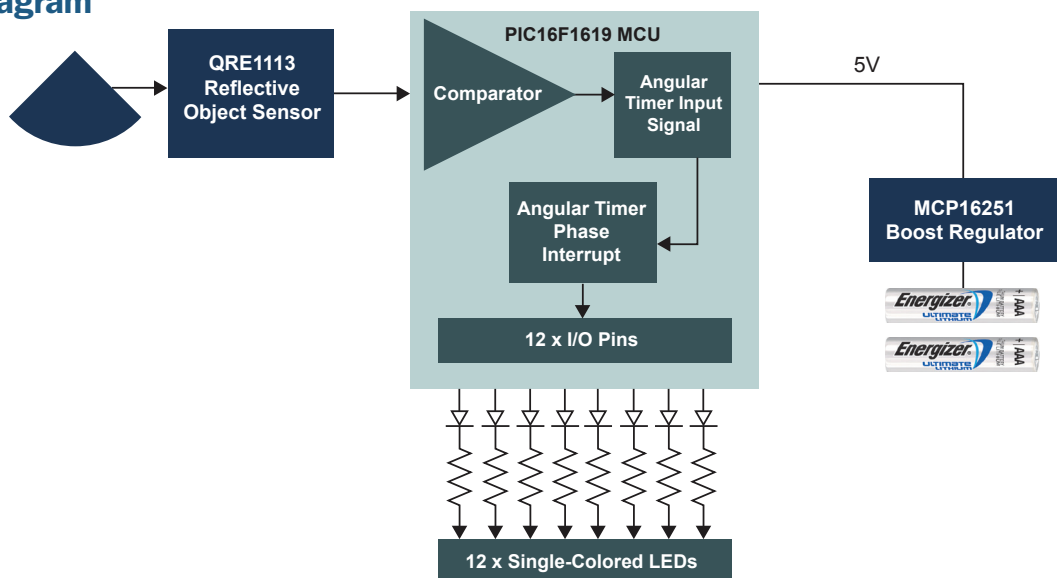
PIC16F161X Angular Timer Demonstration



Summary

The PIC16F161X Angular Timer Demonstration showcases the flexible intelligence of our newest family of PIC® MCUs. The manually-spun propeller displays an image in “mid-air”—an effect using the “Persistence of Vision” theory. The PIC MCU uses its on-board Angular Timer to maintain a precise and consistent location for the displayed image, making automatic adjustments as the propeller slows to a halt. The Angular Timer offers a latency-free way to identify any angle of rotation, as precise as 0.36° with 0.1° error, regardless of speed or acceleration. This hardware-based solution reduces power consumption, increases system performance and frees the CPU to perform the task of driving the LED array.

Block Diagram



About the Demonstration

The demonstration utilizes the powerful 20-pin PIC16F1619 MCU to enable all required functions. As the propeller spins, an analog Reflective Object Sensor (ROS) reacts to a “marker” printed on the demonstration’s acrylic base. The marker is used to indicate a complete rotation has occurred, and can be placed anywhere in the sensor’s path.

The ROS sensor’s analog output is converted using the PIC MCU’s comparator, and directly routed to the Angular Timer peripheral. The Angular Timer automatically calculates rotational speed, and can be configured to supply an interrupt signal to the CPU as the LED array reaches the 270° mark.

Once an interrupt signal has been received, the MCU drives the 12-LED array to display text in three different pushbutton-selectable modes:

- **Mode 1:** Static Text with Angular Timer – The spinning propeller displays a string of pre-determined text, while maintaining its position regardless of the rotational speed or acceleration.
- **Mode 2:** Static Text with Angular Timer Disabled – The spinning propeller displays a string of pre-determined text with the Angular Timer disabled. This mode displays the disadvantages and lack of accurate positioning at different speeds without the Angular Timer.
- **Mode 3:** RPM Counter – The current RPM is displayed as the propeller spins, once again being displayed at a fixed position regardless of speed or rotation.

The Angular Timer – An Overview

The Angular Timer peripheral is designed to convert periodic rotational or phase angle events into interrupt signals that correspond with their time of occurrence. This shifts the burden of conversion away from the CPU, which enables the microcontroller to perform the task more efficiently and with fewer lines of code.

The Angular Timer operates independently of the core, and can route signals via the Configurable Logic Cell (CLC) to other parts of the MCU for autonomous control over many closed-loop systems. The peripheral has been architected to perform in a number of applications, including:

- Capacitive discharge ignition systems
- Dishwashers
- Laundry machines
- Blenders
- Advanced LED lighting

Major Components

- PIC16F1619 microcontroller with Angular Timer peripheral
- MCP16251 boost regulator
- QRE1113 reflective object sensor
- Twelve surface-mount LEDs
- Two *Energizer*® L92 Ultimate Lithium batteries

Energizer® Ultimate Lithium Batteries

Microchip chooses *Energizer* Ultimate Lithium AAA (L92) batteries as the preferred power source for this demonstration. *Energizer* Ultimate Lithium enables a significantly longer runtime than Alkaline, maintains a flatter voltage discharge profile over the battery's life, offers a high-current pulsing capability, and has shelf life of up to 20 years. In addition, *Energizer* Ultimate Lithium batteries are leak-proof and certified intrinsically safe and perform in extreme temperatures—making them the default choice for today's deeply embedded applications. For more information, visit <http://data.energizer.com/PDFs/I92.pdf>.

PIC16F161X Products Featuring the Angular Timer

Device	Program Memory (Kbytes)	Data RAM (bytes)	I/O Pins	16-bit Timers	8-bit/8-bit with HLT	SMT	Angular Timer	Windowed Watchdog Timer	Comparators	10-bit ADC (ch)	Zero Cross Detect	CCP/10-bit PWM	CWG	CLC	CRC/Scan	Math Accelerator	Peripheral Pin Select (PPS)	EUSART	I ² C™/SPI	High-Current I/O (100 mA)
PIC16(L)F1614	7	512	12	3	1/3	2	1	✓	2	8	1	2/2	1	2	✓	1	✓	1	1	2
PIC16(L)F1615	14	1024	12	3	1/3	2	1	✓	2	8	1	2/2	1	4	✓	1	✓	1	1	2
PIC16(L)F1618	7	512	18	3	1/3	2	1	✓	2	12	1	2/2	1	2	✓	1	✓	1	1	2
PIC16(L)F1619	14	1024	18	3	1/3	2	1	✓	2	12	1	2/2	1	4	✓	1	✓	1	1	2



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