# FREESCALE DSP56800E FAMILY EVOLUTION BOARD

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## ABSTRACT

This paper deals with design and construction of low cost student's evolution board with Freescale DSP56800E family digital signal controller. Board has several general purpose I/O lines, A/D inputs and 6-chanel PWM output. It can take place in many power electronics and motor control experiments.

## 1. DSP56800E FAMILY

The Freescale's DSP56800E industry digital signal controller connects control and signal processing and efficiency as stand-alone microcontroller. Both MCU and DSP peripherals provide complete system-on-a-chip solutions for cost-sensitive applications requiring low to mid range MIPs performance.

56800E family main features:

- Many On-chip memories (Program Flash, Program RAM, Data Flash, Data RAM, Boot Flash)
- Up to 60 MIPS at 60 MHz execution frequency
- JTAG/EOnCE for unobtrusive, real-time debugging
- Four 36-bit accumulators
- 16- and 32-bit bidirectional barrel shifter
- Parallel instruction set with unique addressing modes
- Hardware DO and REP loops available
- MCU-style software stack support
- Controller-style addressing modes and instructions
- Single-cycle 16 x 16-bit parallel multiplier-accumulator (MAC)

Typical power electronics application is shown in fig. 1. 6-channel PWM module and 6-channel ADC (for measuring 3-phase voltage and current) are needed for controlling such application thus DSP56800E family digital signal controllers are suitable solution.

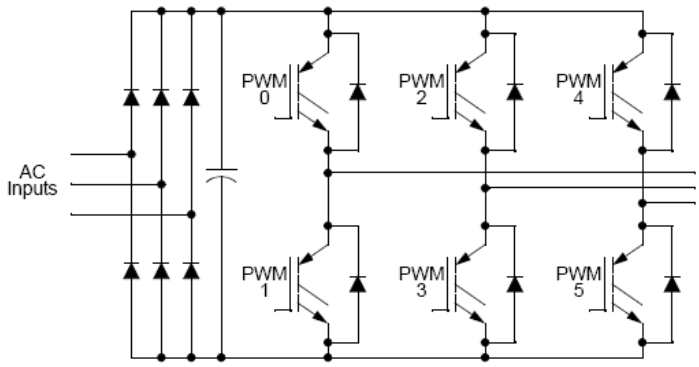


**Fig. 1:** Typical power electronics application

The 56800E core is based on Harvard-style architecture consisting of three units operating in parallel, allowing as many as six operations per instruction cycle. The MCU-style programming model and optimized instruction set allow straightforward generation of efficient, compact DSP and control code. The instruction set is also highly efficient for C compilers to enable rapid development of optimized applications.

## 2. MC56F8322 DIGITAL SIGNAL CONTROLLER

The MC56F8322 is a member of the DSP56800E family of hybrid controllers. It includes many peripherals that are especially useful for automotive control, industrial control, motion control, power management etc. It has 32KB of program Flash, 4KB of program RAM, 8KB of data Flash, 8KB of data RAM and 8KB of boot Flash.

Some peripherals of MC56F8322

- One PWM module with six PWM outputs with one fault input and dead time insertion
- Two 12-bit ADC with support of simultaneous conversions with dual 3-pin multiplexed inputs
- Two 16-bit quad timer modules
- Flex CAN (2.0B compliant)
- Two asynchronous serial communication interfaces
- Two serial peripherals interfaces
- Watchdog timer
- 21 general purpose I/O pins
- JTAG/Enhanced On-chip emulation (OnCE) for processor speed-independent real-time debugging

## 3. DSP56F8322-BASED EVOLUTION BOARD

Evolution board block diagram is in fig. 2. All necessary signals are wired to WAGO terminal strips.

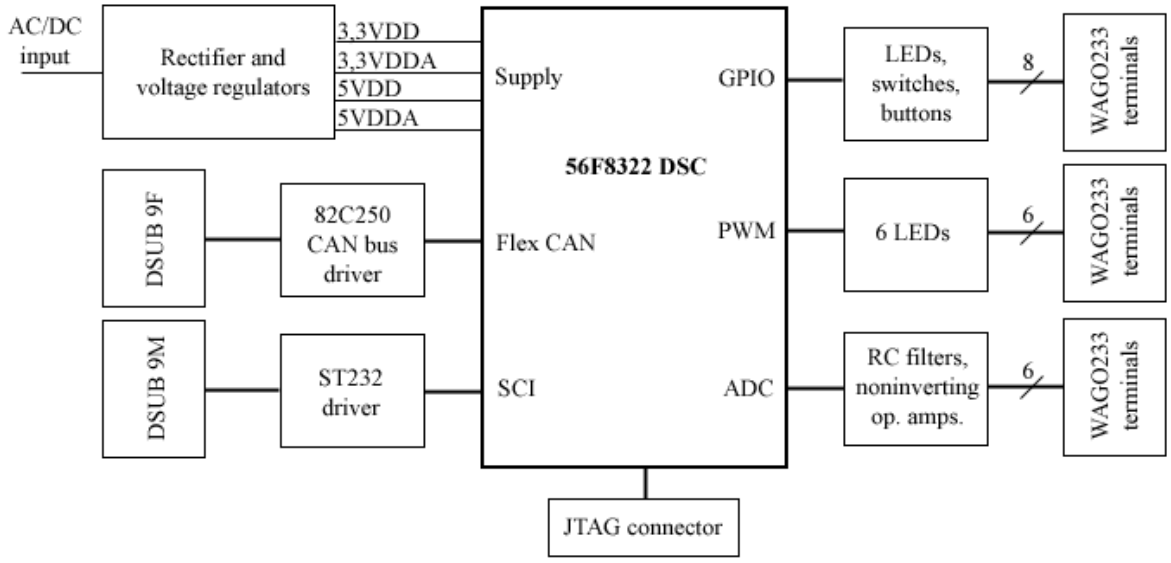


**Fig. 2:** Evolution board block diagram

### 3.1. GENERAL PURPOSE I/O LINES

Evolution board has 14 general purpose I/O lines (8 pins of port B and 6 pins of port A). Some of lines are parallely connected to push buttons and switches, 3 GPIO lines of port B are parallely connected to 3 LED drivers.

General purpose lines have alternate functions. They are shared with other peripherals of DSC - SPI0 and quadrature decoder on port B, PWM module and SPI1 on port A. All lines are wired to WAGO terminal so they can be easily connected to target experiment application.

There is one external interrupt request (IRQ) input wired to WAGO terminal which is parallely connected to push button.

### 3.2. 6-CHANNEL PWM MODULE

Evolution board has 6-channel PWM module for controlling applications as shown in fig 1. Every PWM output line is parallely connected to 6 LED drivers. These LEDs can be used as visual check of PWM functionality. DSP56800E family supports several operating modes of PWM module. All inputs can be heavily configured. They can work as independent outputs, complementary outputs with dead-time insertion or output state can be controlled by software.

There is also a fault protection input. Fault protection of PWM module can disable any combination of PWM pins. Fault input can is connected to voltage comparator and comparation level voltage can be adjusted by trimmer. Comparator can be bypassed by jumper.

### 3.3. 6-CHANNEL ANALOG TO DIGITAL CONVERTER

There are 6 analog inputs on board. They are filtered by RC input filter and then wired to non-inverting configurable operating amplifiers. There is a possibility to bypass operating amplifiers by jumper.

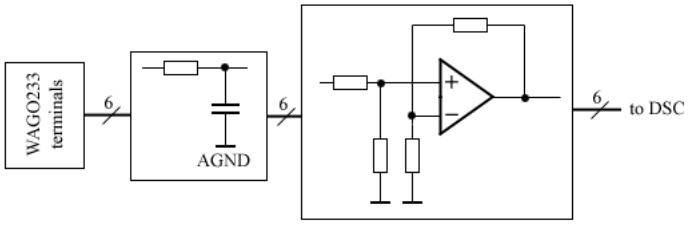


**Fig. 3:** A/D inputs

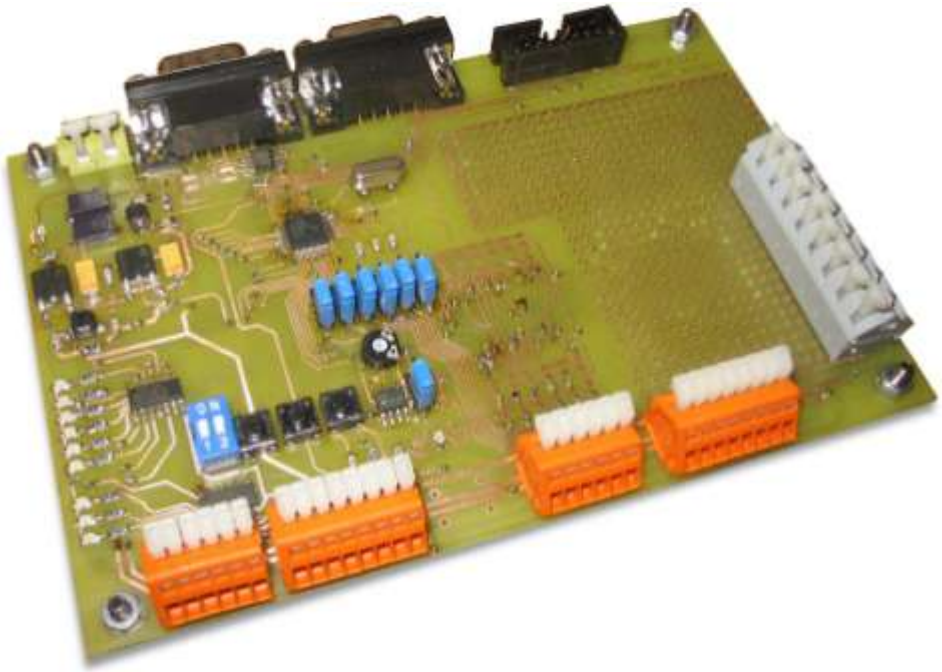

**Fig. 4:** Functional prototype

### 3.4. COMMUNICATION INTERFACES

Evolution board has CAN bus and RS232 DSUB9 connectors with standard pin-out. It allows communication with master system or control application.

## 4. CONCLUSION

The small and cost-effective student's digital signal controller evolution board was designed. The functional prototype was constructed and successfully tested. It is an effective microprocessor technique and power electronics control principles learning tool. It can be used in several laboratory experiments.

## REFERENCES


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