dSMC 101

Product Information

digital **S**mart **M**otion **C**ontroller, **dSMC®**

Description

The **dSMC®** is a programmable peripheral circuit, which includes all components needed for digital control of inverter systems for induction motors.

A versatile Host Port Interface connects the dSMC to a host processor (micro-controller, microcomputer or DSP).

An universal serial interface allows the connection of common A-D Converters to the dSMC - according to the special application.

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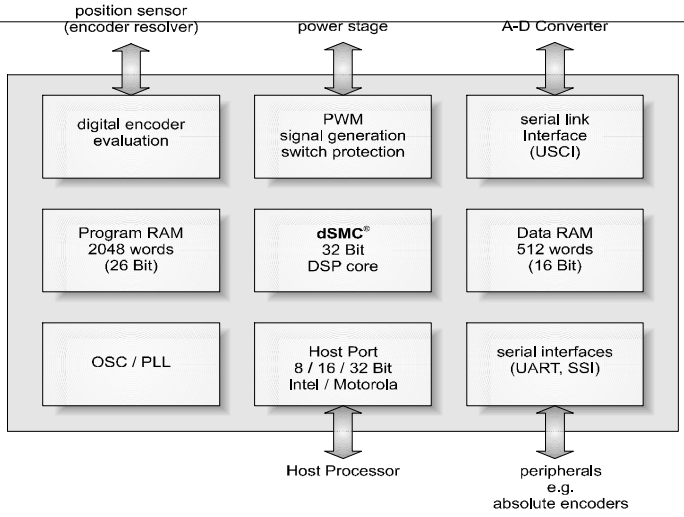
Characteristics

- 32 Bit Signal Processing Unit with 25 MIPS
- instruction set optimised for control applications
- integrated data (512 x16 Bit) and program (2048 x 26 Bit) memory
- universal Host Port Interface 8, 16, 32 Bit
- vector PWM with optimised output voltage
- static and modulated power switch outputs
- integrated dead time compensation
- synchronous serial interface for connection to absolute encoders (EnDAT™ protocol) or other peripherals
- three universal digital encoder interfaces
- generation of rectangular or sinusoidal primary excitation of resolvers
- one emulation output of a digital encoder
- universal serial link to A-D Converters or Data Acquisition Systems (SPI, Microwire or SSI compatible)
- asynchronous serial interface to absolute encoders with HIPERFACE® protocol



dSMC DSP core for control applications

The DSP core of the dSMC can perform fast calculations which are typically needed for motion control tasks. The structure of the DSP and its instruction set are optimised to perform digital closed loop control operations.

The dSMC incorporates a powerful arithmetic logical unit (ALU) which can calculate a 16 x 16 Bit multiply together with a 32 Bit accumulation in (max.) two cycles.

During these register operations data can be moved between registers of the processor and data memory or peripheral registers (parallel move operation). The data transfers can be 16 or 32 Bit wide.

The dSMC supports 16 or 32 Bit signed or unsigned integer variables. Add and substract operations can generate an overflow or can automatically be adjusted to the specified range. Furthermore single bits can be checked and modified.

The instruction set of the dSMC contains the following standard instructions:

- arithmetic operations (add, substract, multiply, multiply and accumulate, divide, square root)
- compare
- shift operations
- bit manipulations
- jumps

Especially digital control algorithms have their own characteristics. Therefore the dSMC owns a specialised instruction set which is ideally suited for these algorithms. These instructions include limit functions for control variables, instructions for evaluation of rotary encoder signals and calculation of switching times of the power switches.

Universal Host Port Interface

The Host Port Interface connects the dSMC to a host processor. The host can access the internal program, data and peripheral registers through the Host Port. The Host Port can be configured in the following main characteristics, allowing easy interfacing to all common microcontrollers and DSPs:

- 8 / 16 / 32 Bit data bus width
- Intel or Motorola style bus protocol
- multiplexed or non-multiplexed address and data lines
- Little or Big Endian data format

The host access is synchronised internally. A data transfer acknowledge signal indicates a successful transfer. Two interrupt outputs of the dSMC can be configured to signal various events to the host.

Program and data memory of the dSMC

The program and the data of the dSMC is stored in its integrated static memory. The memory is in fact dual-ported, so the host processor is able to access program, data and peripheral space of the dSMC without latencies. Access violations are resolved by the arbitration logic. An external ready signal signals the actual status to the host.

Interface to Position Sensors

Up to three position sensors can be directly connected to the dSMC. One position channel consists of an 16 Bit up-down counter, a time measurement unit (for lowest speeds) and a set of latched registers. These registers can be used for regular control tasks or for referencing to specific positions. A numeric controlled oscillator in addition with one of the three position channels can be configured to simulate encoder output signals. This can be used for chaining different drive control units.

In order to use a resolver as a position sensor an excitation is needed. The dSMC is able to generate rectangular or sinusoidal signals for resolver excitation.

Interface to Power Stage

The Power Stage Control converts the calculated on and off switching times to drive signals for the power switches of an inverter. It has 6 output signals to the switches and one chopper drive output. The power stage interface performs the following tasks:

- dead time generation
- compensation of switching dead times
- check on minimum switch on times
- safety lock out due to error conditions
- safety lock of one or all phases (half bridges)
- generation of static or modulated switching signals (used for isolation via transformers)

The following signals were computed:

- a VCO-Signal for measurement of the DC-link voltage
- feedback signals for turn-on and turn-off cross-points of the power switches
- overcurrent signals
- general error signal from the power stage
- control task synchronisation output to couple multiple dSMC or other processors

Interface to Analog Front Ends

A special A-D Front End for motor control applications is available from Burr-Brown. Its major components are three 12 Bit A-D Converters, input multiplexers, window comparators with D-A configurable voltage levels. The VECANA01 (ADS7833) is suitable to sense and supervise analog current and position sensor signals. The dSMC can be directly coupled to the VECANA01 through its serial high-speed interface. The conversion results are transferred to the dSMC without any DSP overhead and can be accessed through internal registers of the dSMC .

For some applications other A-D Converters may be more appropriate. All common A-D Converters with a serial interface like SPI™, QSPI™ or Microwire® can also be connected to the dSMC through the USCI (universal serial communication interface). One serial output channel can be used to configure the converters. Up to three serial inputs can read the conversion results. Conversion results can be read 16 Bit wide with max. half of system clock frequency (up to 12.5 MHz).

Synchronous Serial Interface (SSI)

The SSI can connect the dSMC to other peripherals. The transmission can be configured as master or slave with max. 16 Bit data words and programmable baud rate. A gray decoder can convert the incoming data. The sign Bit can be inverted, if an A-D Converter is connected to the SSI. The SSI is extended to connect to rotary encoders with an EnDAT™ compliant interface.

Asynchronous Serial Interface (ASCI)

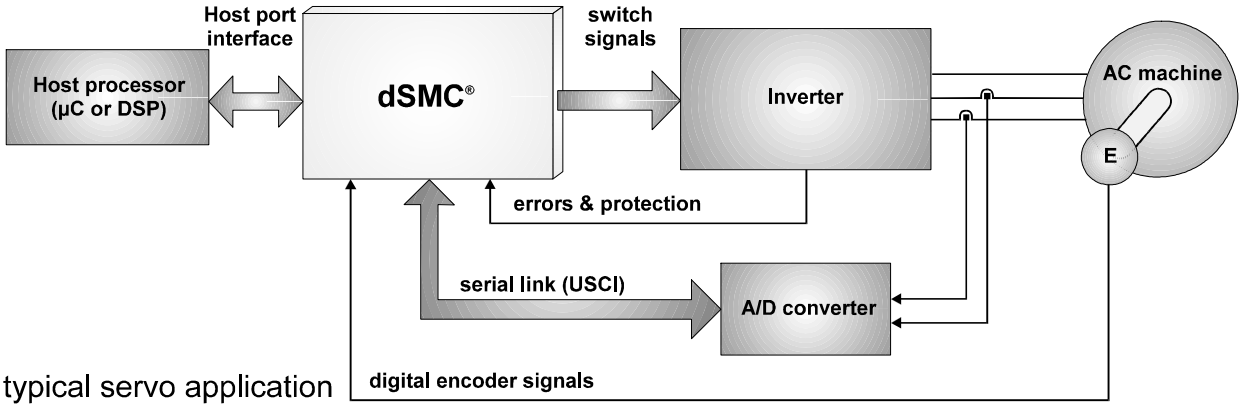
The ASCI is designed to interface to position encoders with a HIPERFACE® compliant interface. Because the communication is transmitted asynchronously by the ASCI can also be used as a general purpose UART.

Parallel I/O

Unused dedicated pins as well as pins from the General Purpose Ports (GPIO) can be used as general I/O pins.

Application Example

The figure shows an example of a minimal hardware suitable to perform field-oriented motor control of IM or PMSM. The Host Port Interface is configurable to connect the dSMC to powerful microcomputers as well as to microprocessors and DSPs. A minimal configuration will incorporate a dSMC , some low-cost A-D Converters and an 8 Bit Host micro-controller.



typical servo application

Mechanical and Electrical Data

package:		QFP 144
power supply	core:	3.3 V
	I/O:	3.3 V .. 5.5 V
internal clock:		25 MHz (max.) *1)
temperature range:		-40 °C .. + 85 °C

*1) internal PLL factor 5: 5 MHz external crystal = 25 MHz system clock

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