

TOSHIBA

**Easy Solutions for
Complex Inverter Designs**

Motor Control



TOSHIBA
TLCS-870

Target Applications

Inverter motor control applications are increasing at a tremendous speed. Their main advantages are

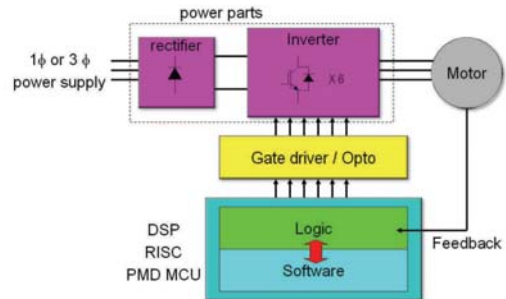
- better control
- energy saving
- longer lifetime.

Main areas of use are all kind of industrial applications, automotive and home appliances like washing machines or air-conditioning systems. Toshiba offers all active components needed for an inverter module including MCUs, Logic, MOSFETs, optocouplers and diodes.

Depending on the type of application and motor used, different solutions are possible.

For a pure motor control an unprogrammable logic solution is the easiest and most cost efficient solution. If the system also performs other functionality, a programmable MCU solution plus discrete driver and power parts is the better choice.

Block diagram of an inverter



Toshiba products for inverter

Solution Type	Unprogrammable		Programmable Solution			
	1 chip	2 chip	GP 8 bit MCU	PMD MCU 8bit	RISC 32bit	RISC MPU 64bit
Software			TMP86xH92			TX4925
PWM Logic		TB6539 TB6551 TB6556 TB6571		TMP88xx4x	TX19A70	FPGA / PLD
Driver	TPD4112		Optocouplers, TD62930P, RB9065			
Power Parts		TPD4113 TPD4104 TPD4105	MOSFET, IPM, MP6602			

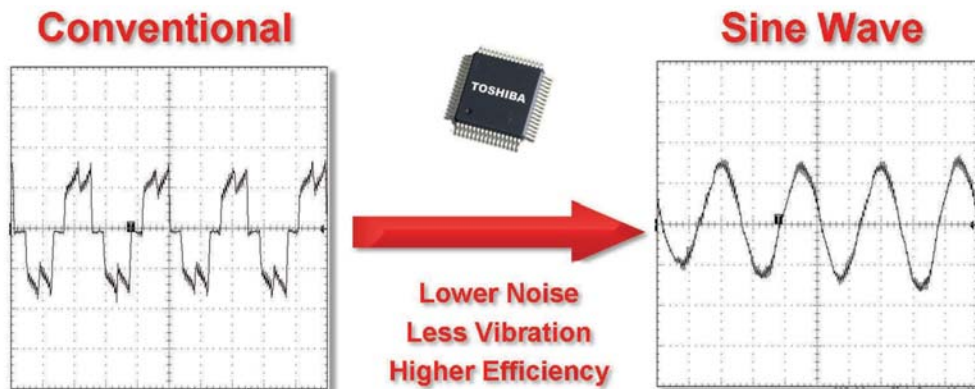
Depending on the type of motor Toshiba offers a variety of dedicated MCUs.

- Standard DC motor: a general purpose (GP) MCU
- Scalar controlled BLDC or AC induction motor: MCU with programmable motor drive (PMD) unit
- Vector controlled Motors: 32-bit RISC MCU with dedicated timer unit
- High end motion control applications, where several motors must be synchronised: 64-bit RISC ASSPs

Sine Wave Generation

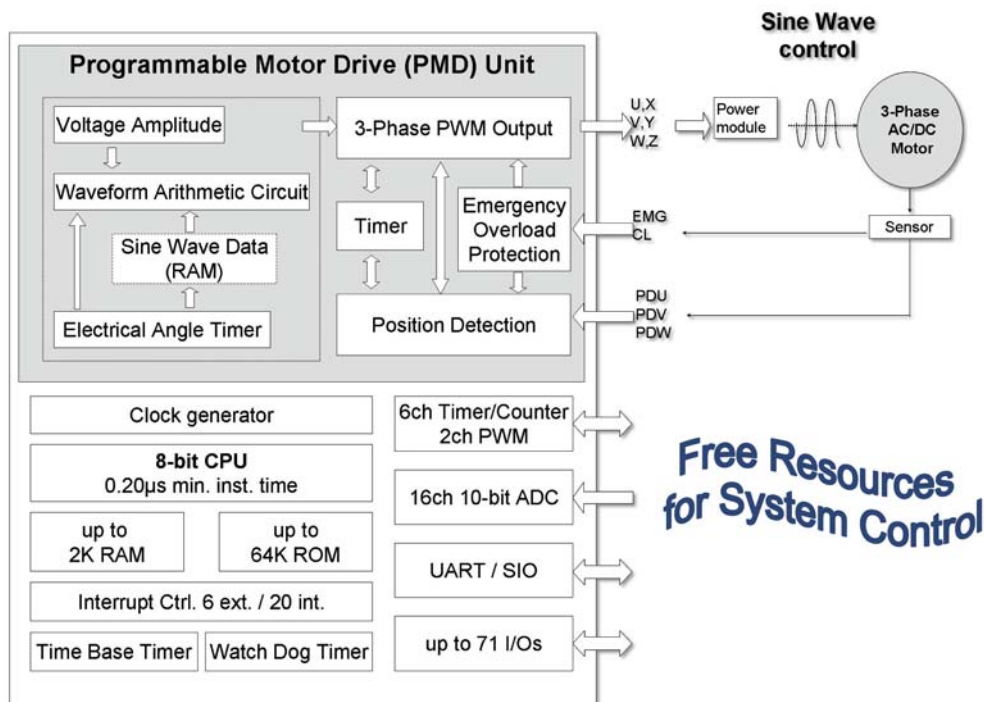
To realize a smooth motor operation it is important to induce a magnetic motor field that equals a true sine-wave. An operation with less audible and electrical noise and thus with less vibrations is possible using Toshiba's PMD MCUs.

The sine-wave data are stored inside an additional RAM area on-chip that is initialised after reset. The flexibility of having the sine-wave information stored in RAM leads to the fact that an easy manipulation of the waveform is possible, such as as the overlay of additional harmonics.



Benefits of PMD MCUs

- Easy development:** All necessary functions for the motor control are integrated in hardware. This leads to an even easier programming of complex closed loop motor control circuits featuring direct sine-wave control.
- Increased system functionality:** The complete motor control is solely managed by the control unit on chip with the advantage that no additional interrupt load is applied to the CPU core itself. Thus the 8-bit MCU is free for controlling the rest of the system, resulting in an overall performance of comparable 16-bit MCUs in use for motor control.
- Large motor frequency range:** Due to digital filtering within PMD unit control of motor speed in a dynamic range of 100—10000 rpm is possible, resulting in lower energy consumption.



Reference Design: A reference inverter module including PMD-MCU, MOSFET module and pre-driver from Toshiba is available.

Line-up of PMD MCUs

PMD MCU	PINS	ROM KB	ROM Type	SRAM Bytes	Hardware generated Sinus	Timer 16 bit	Timer 8 bit	Motor control PWM Pins	High speed PWM	ADC Channels 10 bit	UART	SIO
TMP88xH40	28	16	Mask+OTP	0.5K+128B	Yes	1	2	6		4	1	1
TMP88xH41	42/44	16	Mask+OTP Flash*	1K+128B	Yes	2	2	6		8	1	1
TMP88xS42	64	64	Mask+OTP	2K+128B	Yes	2	4	12	2	16	1	1
TMP88xS43	80	64	Mask+OTP	2K+128B	Yes	2	4	12	2	16	1	1
TMP88xW44	100	120	Mask+Flash	4K	Yes	2	4	12	2	16	2	1
TMP88xW45	80	120	Mask+Flash	4K	Yes	2	4	12	2	16	2	1

Application Examples

TB9065:

TB9065 is a 3-Phase full-wave pre-driver consisting of gate driver, charge pump, Automotive VReg, watchdog, comparators for hall sensors and LIN transceiver all on one chip.

Features:

- Over current, over temperature, over voltage protection
- Diagnostics
- Wake-up by LIN bus
- Low Standby Current: < 100µA
- Operating Voltage +7 to +18V
- Operating Temp.: -40 to +105°C
- Direct connection of Hall sensor supported; No Hall IC needed

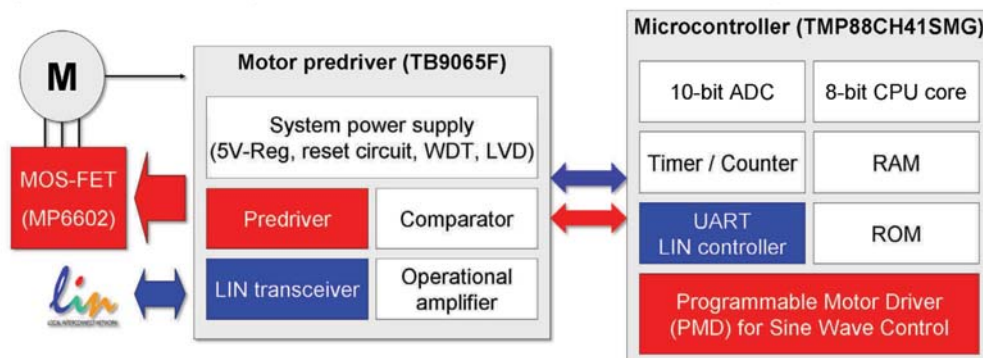
P6602:

MP6602 is a Power MOSFET module consisting of 6 Power MOSFET in one package for 3 phase operation.

Features:

- 6in1 power MOSFET module
- Trench UMOS III - Technology
- Low drain-source ON resistance: $R_{DS(ON)} = 22.4m\Omega$ (typ.)
- High forward transfer admittance: $|Y_{fs}| = 16 S$ (typ.)
- Low leakage current: $I_{DSS} = 100 \mu A$ (max) ($V_{DS} = 60 V$)
- Enhancement-mode: $V_{th} = 2.0$ to 4.0 ($V_{DS} = 10 V$, $I_D = 1mA$)
- The lower arm source terminal has been independent by each arm for the purpose of the current detection at the time of vector control.
- Thin package: 3.5mm(typ.)

Typical application (Automotive actuator with LIN connection):



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