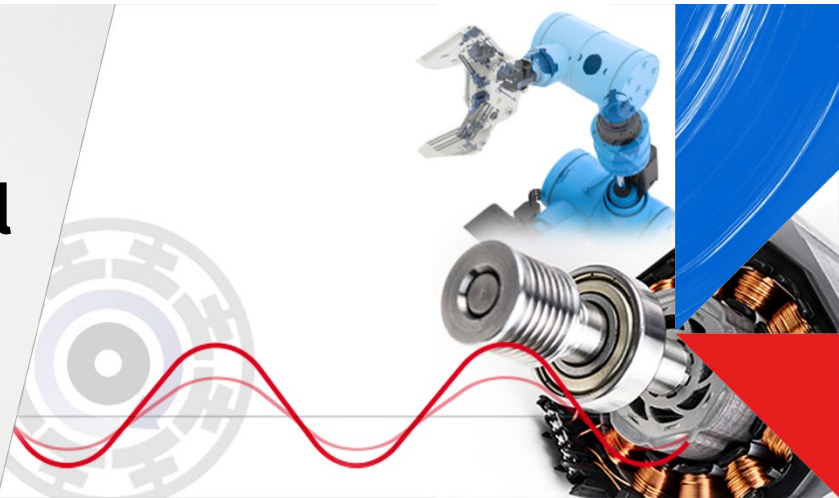# Servo Drive Reference Model for Multi-Channel Motor Control
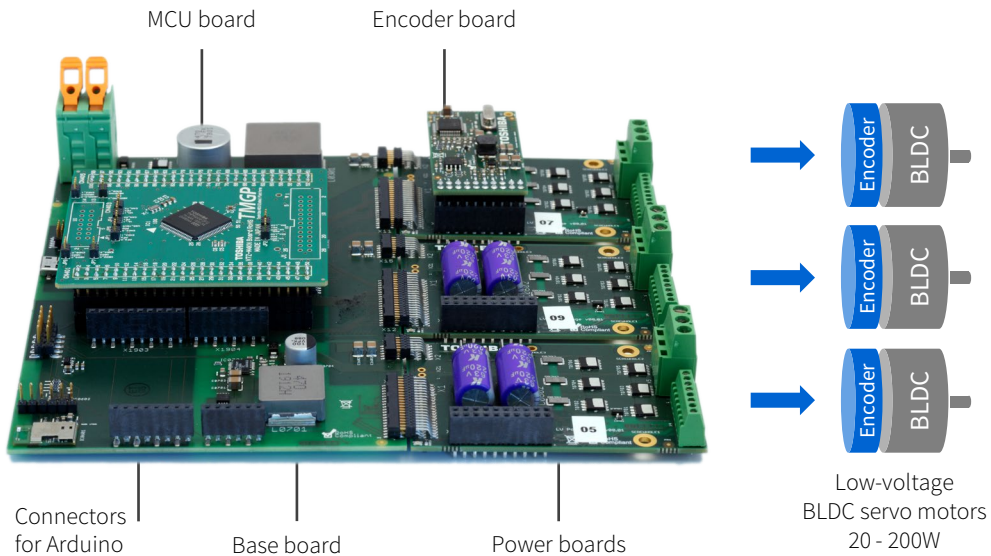
Modular and Versatile Platform

The Servo Drive Reference Model (RM) combines Toshiba's optimized motor control MCUs with Toshiba's low $R_{DS(ON)}$ Power MOSFETs providing high efficient control and drive solutions for brushless DC (BLDC) motors. The modular concept offers a high degree of flexibility for Field-Oriented Control (FOC) and closed-loop positioning of up to three BLDC servo motors by a single MCU resulting in reduced system cost. The RM gives a quick start for developers to realize advanced servo motor systems.

Applications

- BLDC servo motor
- Inverter / Driver
- Robots / Cobot / Scara
- Automated Guided Vehicle (AGV)
- Lawn mower
- 3D printer

MCU board   Encoder board

Connectors for Arduino   Base board   Power boards

Low-voltage BLDC servo motors 20 - 200W

Base Board

- 24/48V supply
- Connectors for 3 power stages
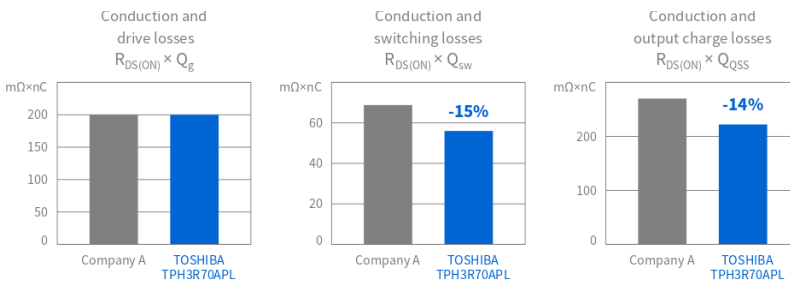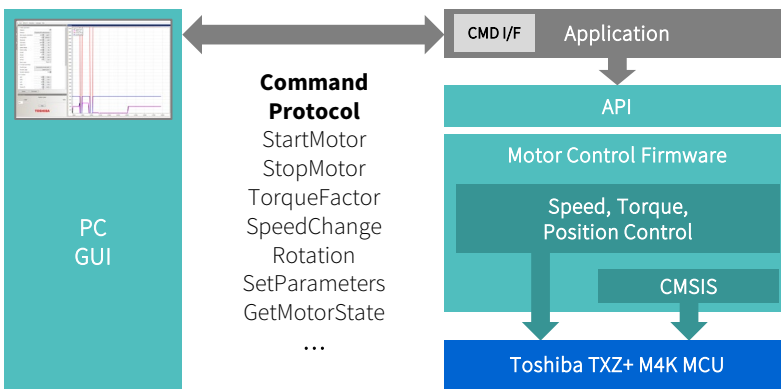- USB, BT5 and Arduino host interface
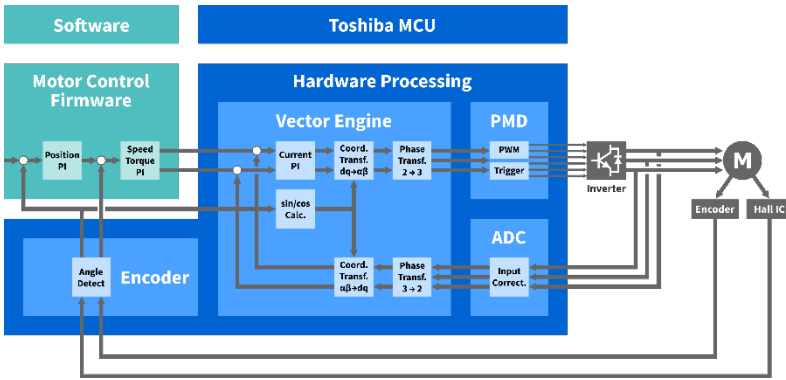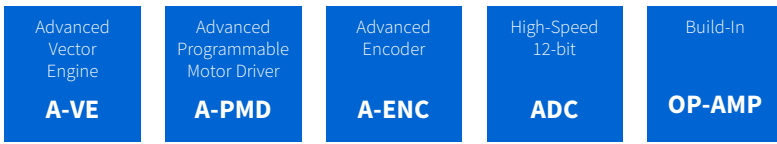
MCU Board

- Toshiba Arm® Cortex®-M4 with FPU (160 MHz)
- Vector Engine
- 3 channel Programmable Motor Driver (PMD)

Power Board

- 3-phase inverter
- 100V/150A MOSFETs
- 20-200W motor class
- Over current protection

Encoder Board

- Adopts resolver, encoder and hall sensors to the encoder block of the MCU

Advanced Vector Engine **A-VE**	Advanced Programmable Motor Driver **A-PMD**	Advanced Encoder **A-ENC**	High-Speed 12-bit **ADC**	Build-In **OP-AMP**

Vector control of up to 3 BLDC servo motors by a single MCU

Toshiba's Arm® Cortex®-M4F core-based microcontroller is dedicated to Field-Orientated motor control. The built-in Vector Engine (VE) takes care for the complex vector control calculations and feeds the Programmable Motor Drive (PMD) block to generate the PWM waveforms and perform other necessary functions such as dead-time control.

Command Protocol
StartMotor
StopMotor
TorqueFactor
SpeedChange
Rotation
SetParameters
GetMotorState
…

Motor control firmware

The firmware API provides a simple and straight forward interface to configure and control the motor. Beside speed, torque and position control there are functions for current measurement, over/under voltage protection or stall detection. All APIs can be accessed from remote via a command protocol.

200W power stage / 3-phase inverter

Conduction and drive losses $R_{DS(ON)} \times Q_g$

Conduction and switching losses $R_{DS(ON)} \times Q_{sw}$ **-15%**

Conduction and output charge losses $R_{DS(ON)} \times Q_{QSS}$ **-14%**

The 3-phase inverter design is based on the 100V / 150A TPW3R70APL low-voltage MOSFET from the latest U-MOS IX process technology which provides industry leading performance. With max. $R_{DS(ON)}$ of just 3.7mΩ, the drive, switching and output charge losses are reduced significantly enabling efficient driving of 48V BLDC motors up to 200W.

Part number	Description
TMPM4KNFYADFG	MCU, Arm®* Cortex®*-M4F, 160 MHz, 100-pin
TPW3R70APL	N-channel MOSFET, 100V/150A, DSOP adv.
TC7QPB9307FK	Level shifter
TCR3DM33	Low drop-out linear voltage regulator (LDO)
TLP2370	High-speed and low-power photocoupler
SSM3K16CTC	Small signal MOSFET
TC7SZ34FU / TC7SZ07FU	Single gate buffers
TC75W58FU	Comparator

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