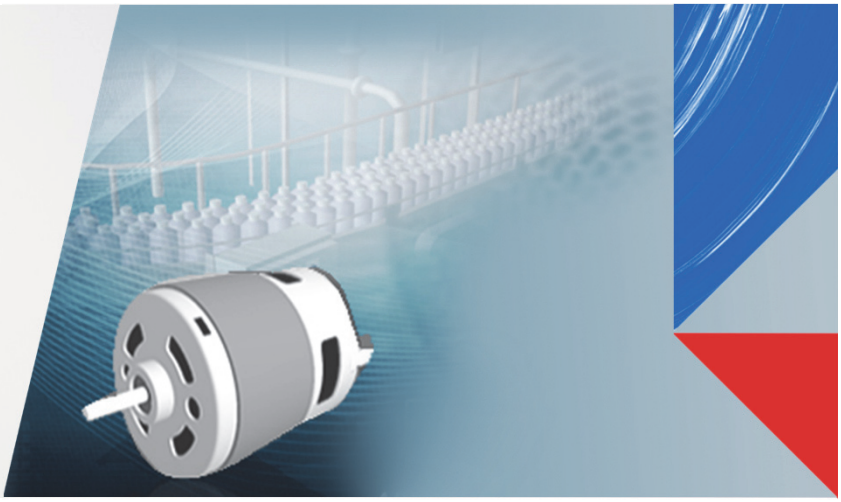
TOSHIBA

MICROCONTROLLER

Vector Engine



Toshiba's Original Motor Control Technology

Toshiba's vector engine is a co-processor exclusively for motor control and executes the typical calculations including transformation of the three-phase motor current to a two-phase and transformation/inverse transformation of the rotational coordinates. These functions help to reduce CPU utilization while user-specified functions like position estimation and speed control are still executed in software. Thus the vector engine keeps a high level of flexibility while providing high performance motor control processing engine, thereby accomplishing easy and low-cost vector control.

Applications

- Industrial motors
- Pumps
- E-bikes
- Washing machines
- Refrigerators
- Fans

Features

- Co-processor exclusive for motor control calculation
- Various scheduling schemes
- Predefined calculation tasks

Advantages

- Reduction of the CPU overhead. Since the motor control process time is reduced, a commanding share of the CPU held by the software is decreased by 72% when two motors are operating.
- The vector engine has Toshiba's original scheduling function which configures the tasks and their combinations.
- The impact of development environment and compiler options is reduced.

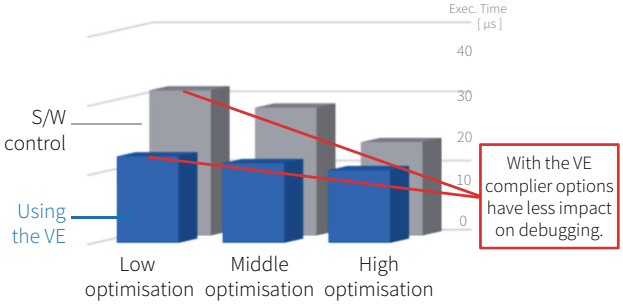
Benefits

- Total system performance is improved by releasing resources of the CPU to other tasks like Power Factor Correction (PFC), sensor processing or communication
- Quiet and low-vibration operation is possible with high speed PWM frequency
- Software development effort and debugging time is reduced
- High speed rotation of up to 100.000rpm and more

Reduction of development effort

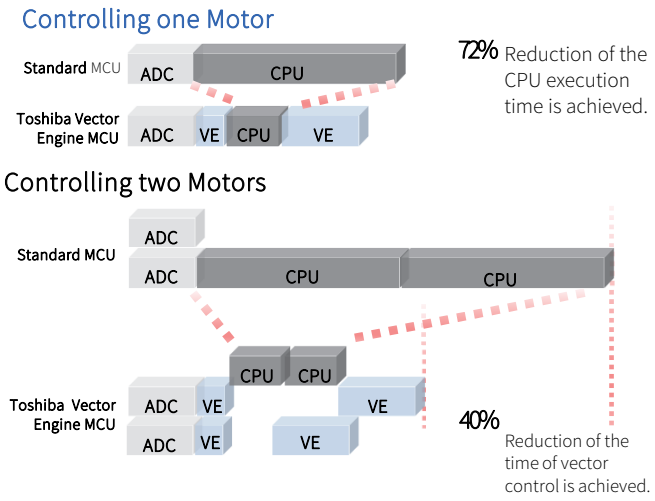
Since the vector control calculation is handled by the vector engine, the size of program code is reduced. Therefore the amount software to be complied is reduced. This makes the execution time independent from compiler performance and optimization options.

Execution Time vs Compiler Option



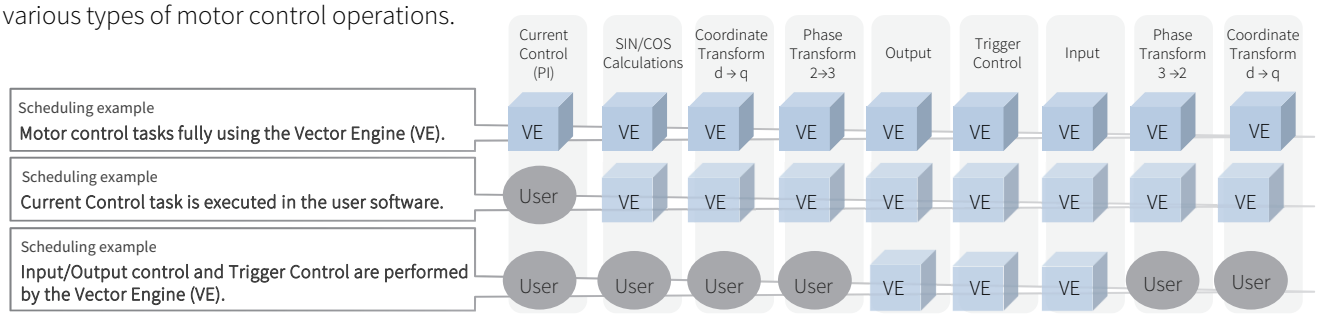
Reduced motor control processing time

Typical calculations for vector control are handled by the vector engine. Thus the CPU utilization of the software is decreased. This reduction improves overall system performance, because the CPU can release resources to other tasks like PFC, sensor processing or system communication. Especially when two motors are controlled, the vector engine notably reduces CPU processing time. In case of vector control of two motors by software, the clock speed of the CPU must be increased for the processing. This will lead to increased power consumption of the MCU which has an impact on the power supply, power dissipation, EMC and system cost. With Toshiba's vector engine the calculations for two channels are performed in parallel and the CPU clock doesn't need to be increased.



Flexible scheduling of vector engine tasks

Position estimation and speed control depend on system configuration and therefore these tasks are left to software processing. The vector engine handles the typical calculation including transformation from a three-phase motor current to a two-phase and the transformation of the rotational coordinates. The tasks of the vector engine are configured by a scheduler. This scheduler offers up to 16 combination types which gives the user a high level of flexibility and supports various types of motor control operations.



Product lineup

Part number	Flash [KB]	RAM [KB]	Data Flash [KB]	PMD* [ch]	Fsys [MHz]	Package	Features
TMPM372FWUG	128	6	-	1	80	LQFP64(10 x 10 mm)	Small scale pin package
TMPM373FWDUG	128	6	-	1	80	LQFP48(7 x 7 mm)	
TMPM374FWUG	128	6	-	1	80	LQFP44(10 x 10 mm)	
TMPM375FSDMG	64	4	-	1	40	SSOP30(5.6 x 10 mm)	
TMPM37AFSQG	64	4	-	1	40	VQFN32 (5 x 5 mm)	Pre-driver for 3-phase sine wave drive
TMPM475FYFG	256 - 512	18 - 34	-	2	120	LQFP100 (14 x 14 mm)	ARM® Cortex®-M4F core CAN-bus controller
TMPM4K0	64	18	-	1	80	LQFP32	New TXZ Family ARM® Cortex®-M4F core OpAmp integrated Advanced-VE+ 2.7V ~ 5.5V
TMPM4K1	64 – 256	18	-	1	80	LQFP44	
TMPM4K2	64 – 256	18	-	2	80	LQFP48	
TMPM4K4	64 – 256	18	-	2	80	LQFP64	
TMPM4KL	128 – 512	24	32	3	160	LQPF64	
TMPM4KM	128 – 512	24	32	3	160	LQPF80	
TMPM4KN	128 – 512	24	32	3	160	LQPF100	
TMPM4KP	128 – 512	24	32	3	160	LQPF128	Additionally with CAN controller
TMPM4KQ	128 – 512	24	32	3	160	LQPF144	

* PMD: Programmable Motor Driver