Microcontrollers

V850ES/IE2

32-Bit RISC Microcontroller

Description

The 32-bit V850ES/IE2™ RISC microcontroller for high-performance inverter control systems is equipped with a 3-phase, pulse-width modulator (PWM) inverter timer with dead-time function for motor control. On-chip software pull-up resistors, power-on-clear (POC) circuit, low-voltage indicator (LVI), as well as a high-speed 20 MHz CPU, multi-function timer, high-speed A/D converter, and high-speed serial interface result in enhanced system performance, smaller size, and lower cost. A 20 MHz full-function in-circuit emulator (ICE) with a dedicated debugging function is also available as an optional development tool.

Other microcontrollers in this product lineup include the V850ES/IK1™, V850E/IA3™ and V850E/IA4™, which operate at a frequency up to 32 and 64 MHz, and have timers and A/D converters that can handle a variety of system applications.

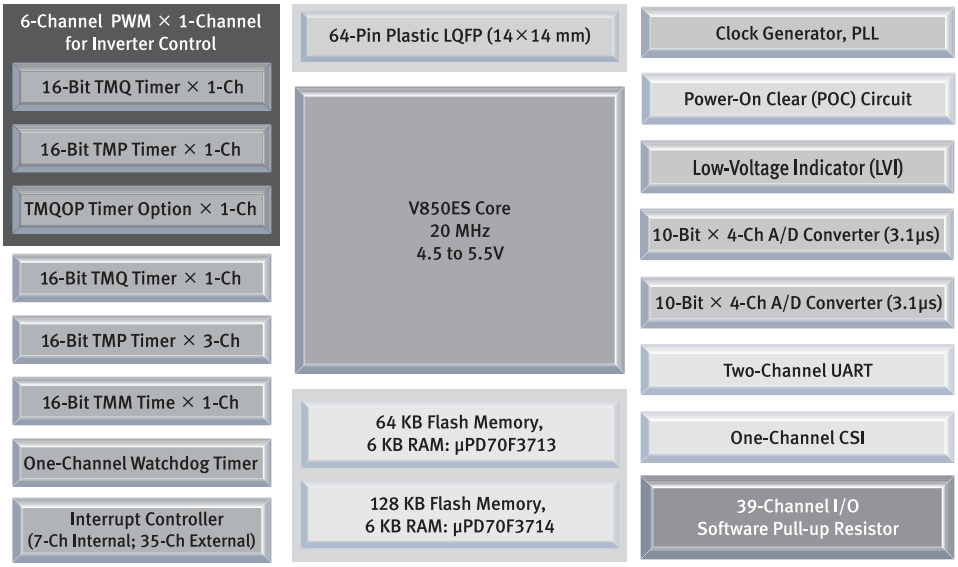
High Performance at 20 MHz/26 MIPS

The V850ES core processes 26 MIPS (Dhrystone benchmark 1.1) at 20 MHz, enhancing system functions and multifunctional control by software. The V850ES/IE2 microcontroller is capable of an interrupt response time of 200 ns (at 20 MHz) and is most suitable for high-speed, high-precision inverter control systems.

On-Chip Multifunction Inverter Timer

The inverter timer (TMQ+TMQOP) has four on-chip compare registers to support the 16-bit counter in generating a carrier frequency and three independent duty cycles. Data can be written to all four registers simultaneously, preventing mismatch of output waveforms. Data can be written to each compare register as required through a setting operation. An A/D converter trigger can be generated at any time via synchronous operation of the 16-bit TMP timer/event counter and TMQ timer for accurate motor current measurement.

Block Diagram



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High-Speed A/D Converters for Motor Shunt Current Measurement

The two 10-bit resolution A/D converter circuits can measure two power device currents simultaneously in 3.1 µs at 20 MHz. Conversion triggers can be selected from an external pin trigger, software setting, or the inverter timer. The latter can be set at any two points synchronized with the inverter timer.

POC Circuit, LVI and Software Pull-up Resistor

The POC circuit and LVI are equivalent to reset and low-voltage detection circuit. The V850ES/IE2 microcontroller also is equipped with software pull-up resistors selectable in 1-bit units for all ports configured as inputs (excluding the A/D converter and the output high-impedance pins). These built-in functions are useful for decreasing system size and lowering costs.

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System Safety Functions

Absolute safety is required for any system that controls motors through an inverter, since the system generates and controls high voltages using power devices. High-impedance operation of the inverter timer output pins can be selected from each function of an external input pin (T0Q10FF), software setting, watchdog timer overflow, and clock monitor. The clock monitor function monitors the stopping of main clock oscillation through the on-chip RC oscillation circuit.

Other On-Chip Functions

Function	Description
PLL	8x multiplication PLL function
UART	Maximum transfer rate of 1.25 Mbps; digital 2-point with sampling function to perform noise filtering at reception
CSI	Maximum transfer rate of 8 Mbps; 8-/16-bit transfer length selectable; continuous transfer possible

ROM, RAM and Packaging

Subseries	Device	Memory	RAM (KB)	Package
V850ES/IE2	μPD703713	64 KB mask ROM	6	64-pin LQFP
	μPD703714	128 KB mask ROM	6	64-pin LQFP
V850ES/IK1	μPD703327	64 KB mask ROM	4	64-pin LQFP
	μPD703329	128 KB mask ROM	6	64-pin LQFP
	μPD70F3329	128 KB flash memory	6	64-pin LQFP
V850E/IA3	μPD703183	128 KB mask ROM	6	80-pin LQFP
	μPD70F3184	256 KB flash memory	12	80-pin LQFP
V850E/IA4	μPD703185	128 KB mask ROM	6	100-pin LQFP/QFP
	μPD703186	256 KB mask ROM	12	100-pin LQFP/QFP
	μPD70F3186	256 KB flash memory	12	100-pin LQFP/QFP

Safe Low-Cost Development Environment

A full-function in-circuit emulator (ICE) that can perform debugging at 20 MHz is available as a hardware tool. For safe debugging, when program execution is halted by a breakpoint, the ICE can set the inverter timer output pins to high impedance mode.

Applications

This V850ES/IE2 is most suitable for various inverter control systems, such as outdoor air conditioning units, clothes dryers, fully automatic washing machines, refrigerators, IH cooking heaters, robots, AC servos, general-purpose inverters, UPS, motor-assisted bicycles, and various embedded devices that require a 5V interface.

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DOCUMENT NUMBER 51012