10 Key Features of Fujitsu Automotive MCUs
The automotive industry is using microcontrollers (MCUs) for an increasingly wide range of applications, from motor control to infotainment systems and auto body control. Selecting the “right” microcontroller is important to the system’s overall performance, power consumption, and capabilities. The MCUs must be robust enough to withstand the harsh automotive environment, and must be available for an extended period of time.

Fortunately, Fujitsu has a broad spectrum of microcontrollers that meet virtually any automotive-MCU need. Here are 10 important features that have helped make Fujitsu the microcontroller supplier of choice for leading automotive companies worldwide.

1. **Low voltage detection**

   One of the failure risks during MCU operation is when the power supply voltage or the internal MCU voltages drops below the required level at some critical point. Obviously, this can cause a malfunction, as the operation is not guaranteed outside the recommended voltage supply.

   Traditional systems used an external voltage-monitoring IC to check the voltage. However, Fujitsu has integrated that function into the MCU with an internal block that monitors both the internal MCU voltage and the external voltage supply levels. If the level falls below a preset threshold value, the MCU is reset automatically, as shown in Figure 1. The threshold level can be selected from a set of seven pre-assigned values. Such an approach eliminates an external component from the BOM, reducing costs.

2. **Watchdog timers**

   Another key feature is the watchdog timer that helps recover from failure situations such as a “runaway micro” or “processor in the weeds.” The module resets the MCU as soon as it detects that the MCU is unresponsive.

   Embedded systems have traditionally used an external IC to perform this function. However, Fujitsu has built two watchdog timers into its MCUs. One timer operates as an independent clock outside of the CPU operation system clock. This timer, which is based on a slower CR clock, is suitable for use as a hardware watchdog for the MCU, or for use by longer software loops to prevent runaway conditions. The other timer operates based on a faster peripheral clock. The Fujitsu watchdog timer modules also support the window function that resets the MCU when the timer is fed too quickly, which probably would be due to some erroneous condition.

   ![Figure 2 - Built-in Watchdog Timers](image)

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**MCUs for Hybrid Clusters**

The FCR4 family of microcontrollers has been especially designed to offer an innovative, scalable solution for hybrid clusters, which combine traditional meters and graphical displays. FCR4 devices offer a powerful architecture based on the ARM® Cortex™-R4 core and Fujitsu’s 2D “Iris” graphics engine. With their embedded Flash, the FCR4 MCUs and SOCs can serve as single-chip solutions or operate as companion chips for other devices to build high-performance systems.

These MCUs meet today’s highest automotive quality standards. The series supports the latest AUTOSAR specifications; and includes the safety, power-saving and security features (specifically SHE) automotive customers expect today.

![Figure 1 - Low Voltage Detection and Automatic Reset](image)

**Figure 1 - Low Voltage Detection and Automatic Reset**
3. Dedicated memory

Like the watchdog timers, EEPROMs have traditionally been external components to the MCUs. However, it is possible to make such memory storage an internal component by using dedicated ROMs. The built-in EEPROM can be further enhanced by increasing endurance and using error-correction mechanisms.

Fujitsu MCUs use a dual-operation Flash approach to implement EEPROM internally. One part of the Flash memory bank can be read while the other bank is being programmed, allowing the EEPROM function by a single Flash module. The Fujitsu MCUs have a high-endurance EEPROM implementation with a rating of 100,000 erase/program cycles. The MCUs also support ECC, and can retain data for 20 years. Commercial-grade software is available to control the EEPROM function.

4. Automotive grounding

Electrical connections in an automotive environment can be physically quite long because of the way the electronic control units (ECUs) are positioned. Automotive systems contain a number of ECUs and other equipment drawing relatively large current. As a result, the electrical ground level is not perfect and can "float" within a certain range, in addition to the parasitic noise generated by the ECUs themselves.

Designing the MCU according to such ground conditions can increase the robustness and safety levels against failures. Fujitsu MCUs are designed for standardized VIL according to automotive conditions. That helps prevent errors that could occur because of the "floating ground," improving the quality of the ECU.

5. Vbat level direct input

Some ECUs in automotive systems operate the IO signals around the battery-level voltage. For semiconductors designed based on CMOS technology, the IO signals are VCC-level maximum, usually in the 3 to 5 volts range. Hence, transceivers are needed for voltage-level translation.

Fujitsu MCUs have built-in voltage-protection diodes, which allow the high voltage signals to be connected directly through a current-limiting resistor. Such an approach reduces the number of components needed on the PCB, again lowering costs.
**6. Terminal function relocation**

Doing a PCB layout for an IC with a significant pin count, while maintaining the lowest possible layer count, is often challenging. The peripheral components on the PCB cannot always be ideally located according to the pin-out of the MCU.

The Fujitsu MCUs have the built-in flexibility to relocate their internal modules to a different set of pins, as shown in Figure 5. This is done by a software setting. This capability can increase flexibility during the PCB layout process.

**7. ADC-assist functions**

Analog to Digital Converters (ADCs), a fundamental building block of embedded systems, convert signals from the analog to digital domain, enabling access to information from the analog world.

It is possible to distinguish the MCU on the basis of the ADC block by adapting the block to specific applications. The enhancements can distinguish the whole MCU package.

The ADC module used in Fujitsu MCUs supports the range-comparator and pulse-detection functions in hardware. These are useful for applications such as stepper motor control in instrument clusters, power monitoring, and sensor applications. The ADC can process the input signals from the stepper motor coils to execute Zero Point Detection (ZPD). With the processing done in hardware, the CPU can use its MIPS elsewhere.

**8. LIN hardware-assist functions**

Local Interconnect Network (LIN) is an inexpensive, low-speed communication technology that is used extensively for body applications. Fujitsu has enhanced the MCU performance with LIN by implementing functions—such as automatic header transmission and detection, communication test function, variable break length generation, and checksum generation and verification—in hardware. That approach helps save the CPU’s MIPS for use elsewhere.
9. ZPD enhancements

For instrument cluster applications, the ECU uses Zero Point Detection to determine when a needle has reached the end point so that the stepper motor can be stopped. This function requires that the stepper motor controller (SMC) read and evaluate the voltage signal (also called “back EMF”) in the motor coil to make the detection.

The enhanced SMCs used in Fujitsu MCUs support voltage evaluation in hardware, so that no external components are needed to implement ZPD. Also, most of the back-EMF evaluation can be done using a hardware mechanism. (In that regard, the ADC range comparator and pulse-detection functions mentioned earlier are helpful.) Again, this approach requires minimal CPU use.

10. Position and revolution counter

Fujitsu MCUs also have the Quad Position and Revolution Counter (QPRC) functionality available in the form of a hardware block. This allows users to implement jog-dial functions for audio and navigation applications. The module can control the rotation extent and direction, and determine rotation speed. Theoretically, this can be done using the standard input capture unit in the MCUs. However, having a specialized hardware module for these tasks allows the CPU to conserve resources. The result is a better task allocation within the system, and a simplified software package.

Fujitsu: the Optimal Supplier

These 10 features are some of the reasons Fujitsu has been a leading global automotive-MCU vendor for many years. The company offers a wide range of MCUs for a broad spectrum of automotive applications, including body, power train, and driver information systems. Its latest product lineup for the automotive industry includes 16-bit and 32-bit MCUs, based on both industry-proven proprietary CPU and standard ARM® architectures.