

基于富士通MCU的电机驱动方案

富士通微电子（上海）有限公司

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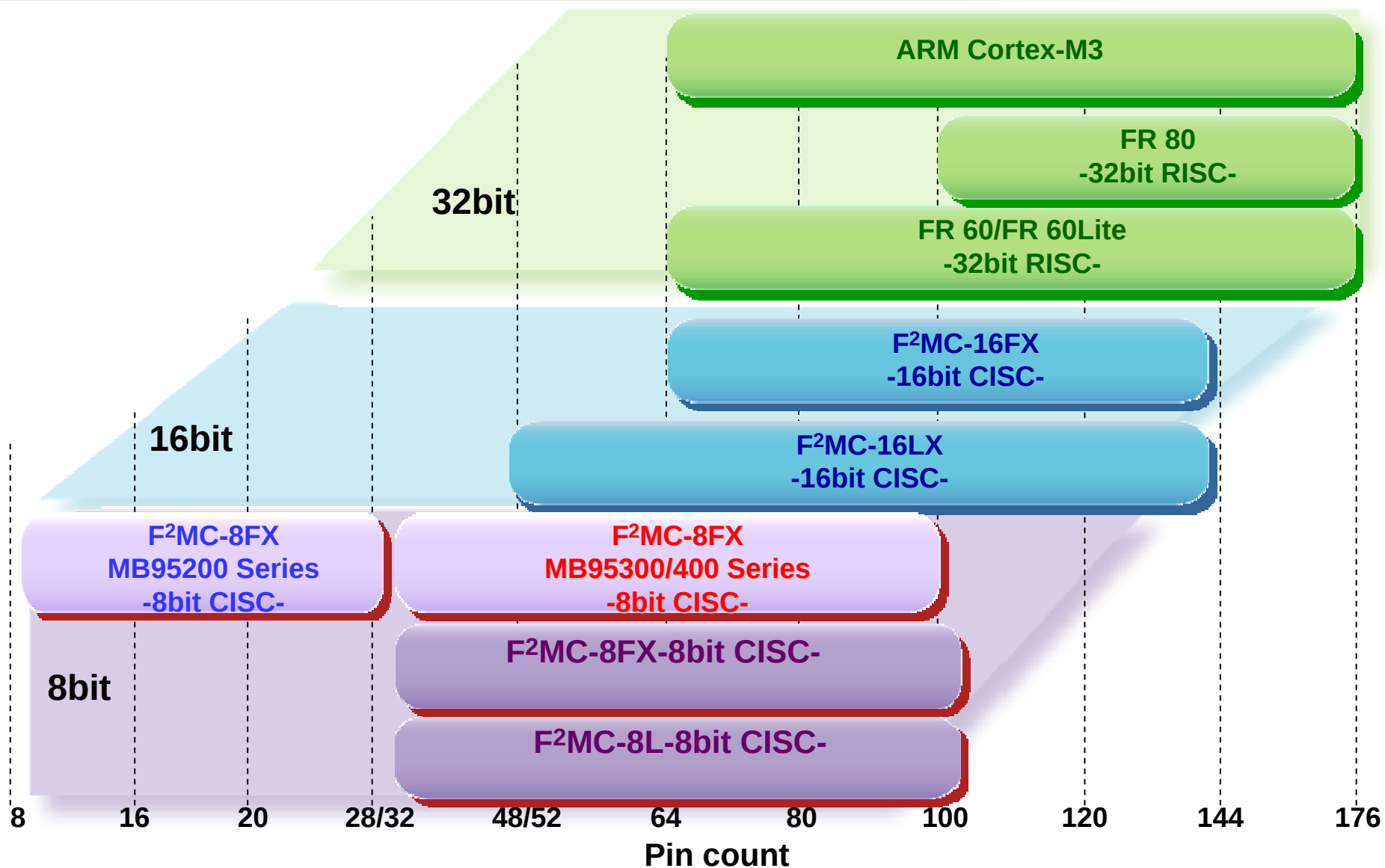
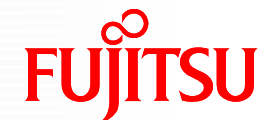
2010.5

与您携手 创意未来

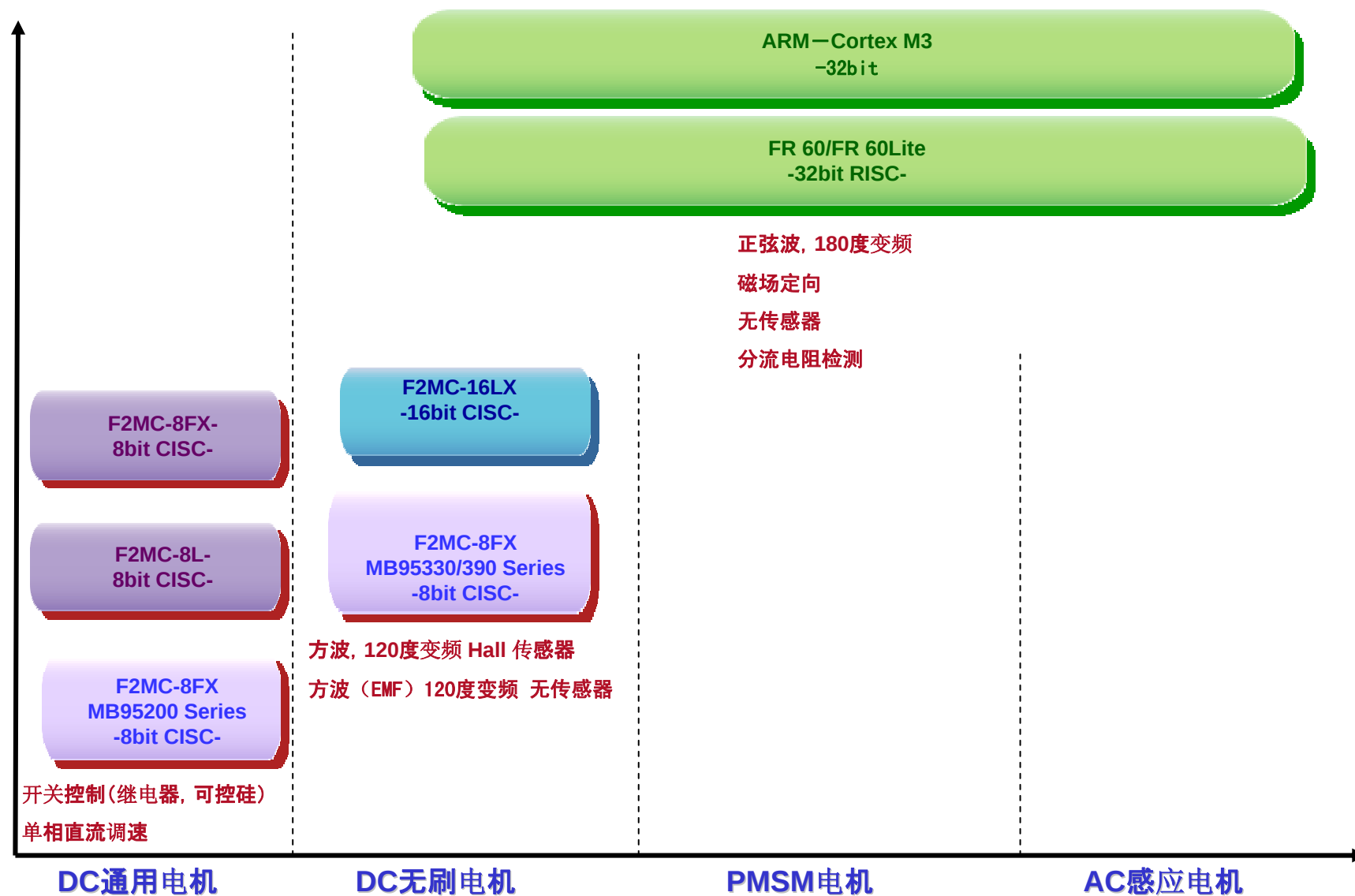
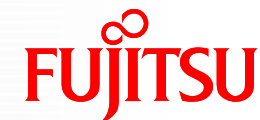
内容

- 富士通用于电机控制的MCU产品线
- 基于富士通MCU的电机解决方案
- 富士通MCU的开发工具
- 问与答

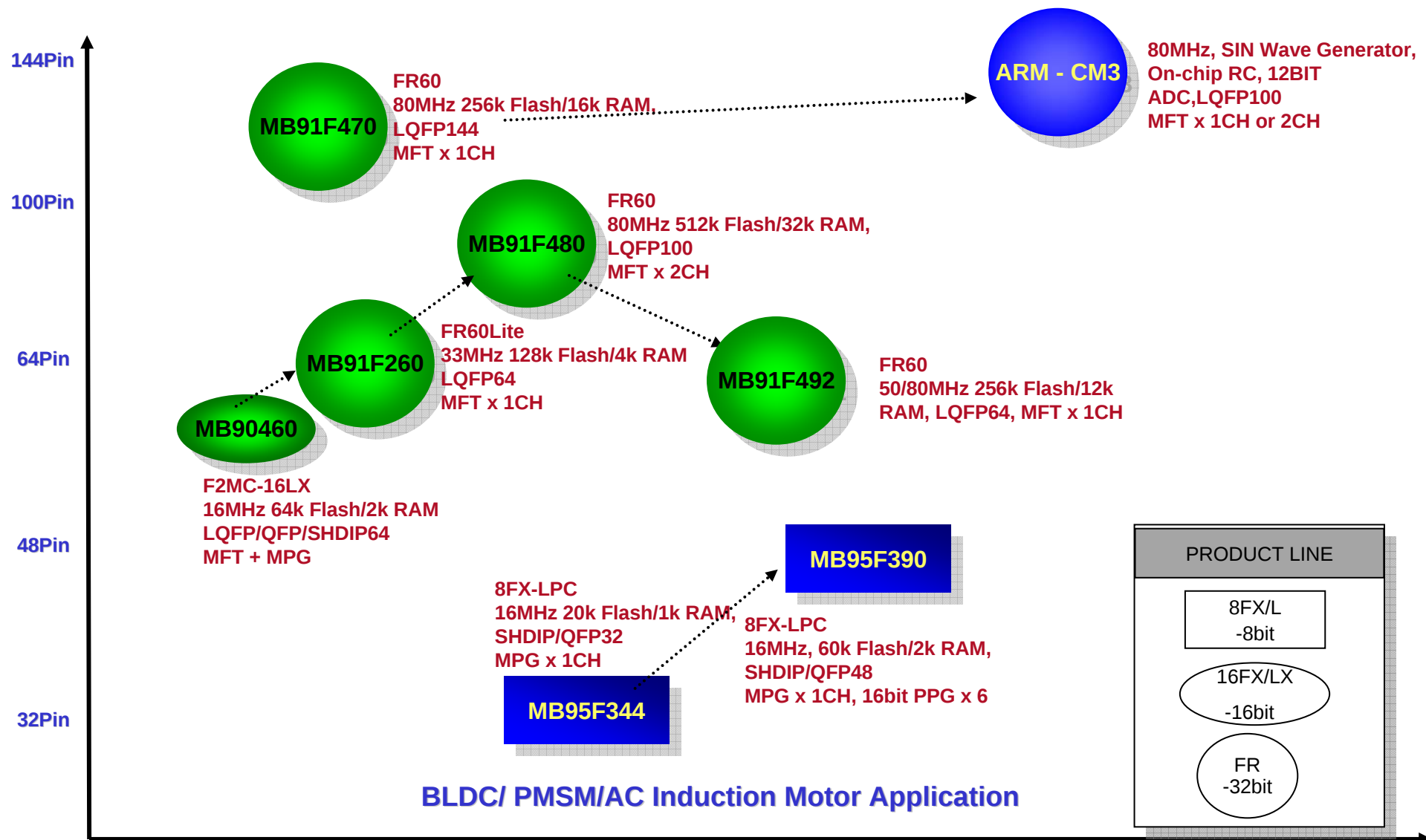
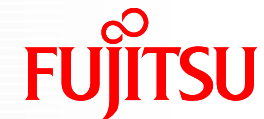
富士通MCU产品线路图



应用电机控制的富士通MCU产品系列



应用电机控制的富士通MCU推荐型号



应用于家电电机控制的产品



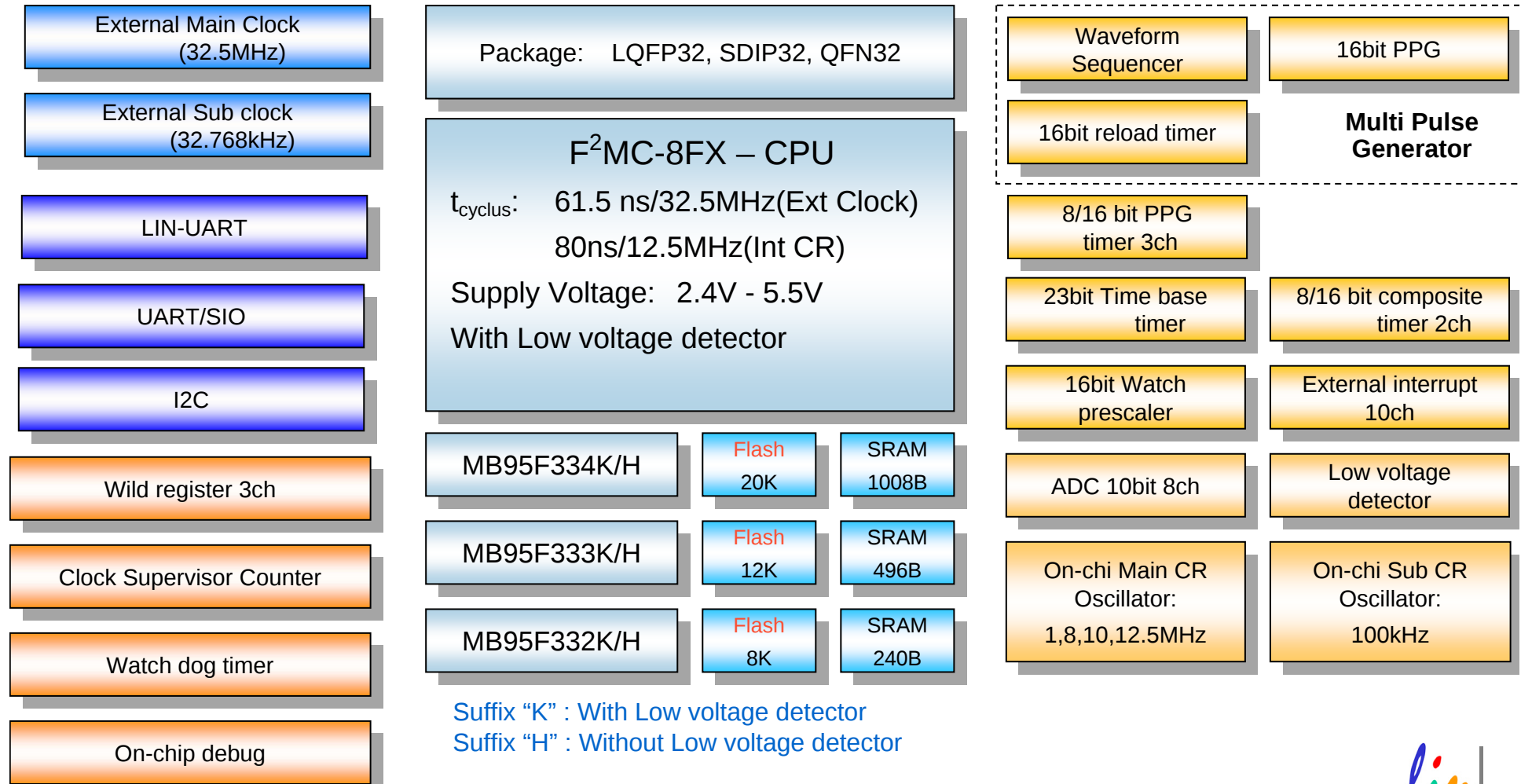
电机	控制方法		转子位置	电机电流采样	富士通MCU	应用
同步电机 直流无刷电机	180度正弦波控制	矢量控制	编码器	交流互感器采样	FR60, FR80	洗衣机
			电流估算	交流互感器或2-Shunt采样	FR60Lite, FR60	冰箱, 空调
			霍尔传感器	不检测	FR60Lite, FR60	洗衣机
	120度方波控制		反向电动势	不检测	16LX, MB95F300	冰箱, 空调
			霍尔传感器	不检测	16LX, MB95F300	洗衣机, 风扇
感应电机	三相	矢量控制	无	2-Shunt采样	FR60Lite, FR60, 16LX	洗衣机, 冰箱, 空调
		V/F控制	无	无		
	单相		无	无	8FX, 8L	
直流通用电机			无	无	8FX, 8L	风扇, 吸尘器, 电动工具

应用于工业电机变频控制的产品

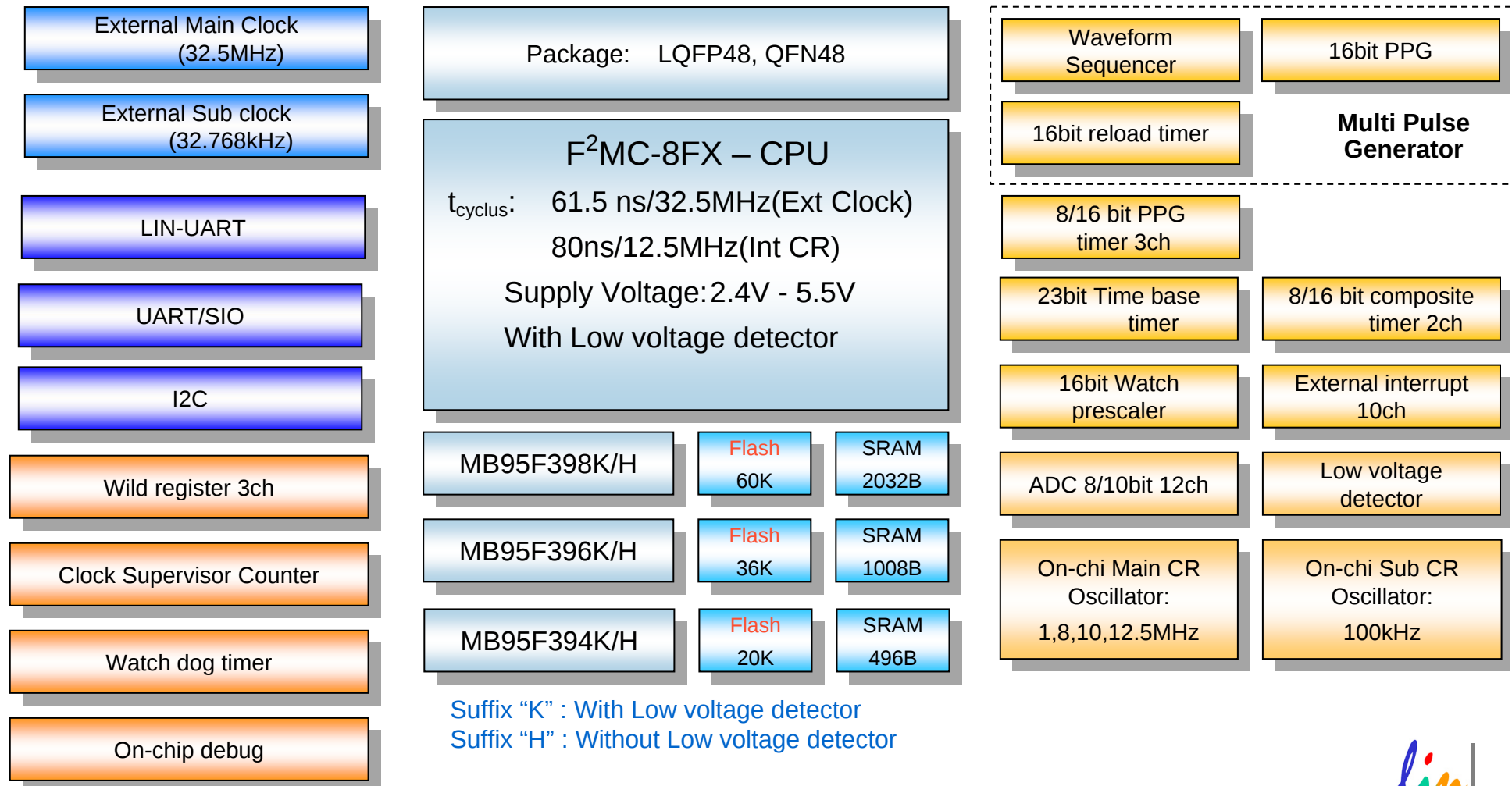


电机	控制方法(180度)	应用	富士通MCU
同步电机 (直流无刷电机)	矢量控制	交流伺服, 数控机床 (中端), 缝纫机	FR60, FR80
感应电机	无传感器 矢量控制	工业变频, PLC, 泵, UPS (中高端)	FR60, FR80
	简单矢量控制 V/F控制	工业变频, PLC, 泵, UPS (低端)	FR60Lite 16LX

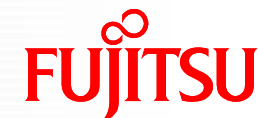
应用于电机的富士通8bit MCU-MB95F330



应用于电机的富士通8bit MCU-MB95F390

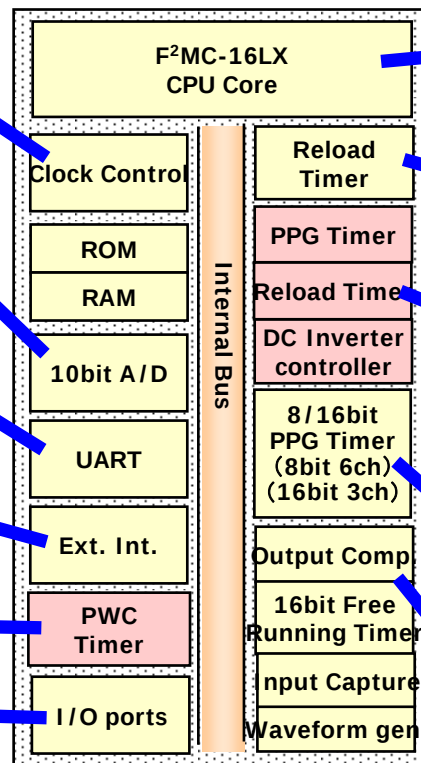


应用于电机的富士通16bit MCU-MB90F460



Features

- Single Clock**
 - Low Power operation clock management
 - PLL Operation mode/Stop mode/Sleep mode
 - PLL frequency multiplier<1/2,1,2,4>
 - Ext.OSC=4.192MHz can be operated for 16.768MHz
 - Low noise for the EMI
- 8/10bit resolution Analog input: 8ch**
 - Max Totally Error ± 3 LSB
 - Conversion time 6.17us at 16MHz
- Full Duplex Double buffer supported 2ch**
 - Synchronous/Asynchronous selectable
 - Each Channels have baud rate generator(1200-250kbp)
 - Each Channels selectable for the Sync/Async mode
- The input terminals 8ch**
 - Interrupt : Fall edge/Rise edge/Low level /High level selectable
- 16bit Plus width Counter 2ch** (MB90467 not built-in)
 - separate of each channels.(For the Operation)
 - Phase Detector
- COMS Input/Output terminals.(Max)** : 51pins
 - Include of the software Pull-Up support : 16Pins



Wide voltage and high speed
 Operation Vcc=3.0V to 5.5V
 Min clock 62.5ns>4.5V 83.3ns>3.0V
 - Program patch processing
 - Enhanced arithmetic instruction (signed multiply/dividend)

16bit Reload Timer 2ch
 -Multi Function supported
 Reload /One Shot /Event count supported
 -Measurement of the Plus width. (For Gate input mode)

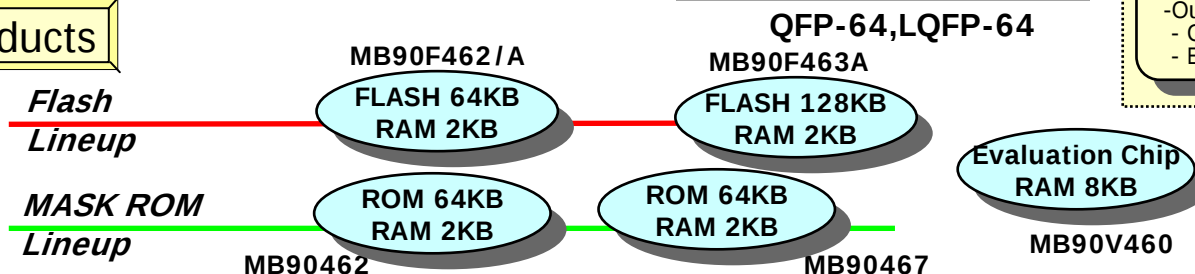
DC Inverter Controller Circuit (MB90467 not built-in)
 16bit PPG Timer $\times$ 1ch, 16bit Reload Timer $\times$ 1ch
 DC Inverter Control circuit
 - DC Inverter control waveform generator. (Rectangular Upper/Lower Arm Chopping controller)

Multifunction Timers

Separate of the 6 channels operation.(8Bit mode)
 -Flexible output plus.(Cycle or Duty ratio)
 -Separate of the 3 channels operation.(16bit mode)
 -8bitPPG+8bit pre scale operation supported.
 -Low and High plus width is set for register.

Optimized for the Real-time input/output.
 -Input Capture: 2ch
 - Clock cycle and Clock width measure:4ch
 - Resolution: 62.5ns(16MHz operation)
 -Output Compare: 6ch
 - Output of the event clock.
 - Event clock output: 62.5ns(16MHz operation)

Products



应用于电机的富士通32bit MCU-MB91F267



Features

Supports low power operation modes
 -PLL RUN, STOP, SLEEP.
PLL frequency multiplier<1/2,1,2,3,4,8>
 -4.192MHz oscillation,
 33.536MHz operation
 -Reduces EMI emission.

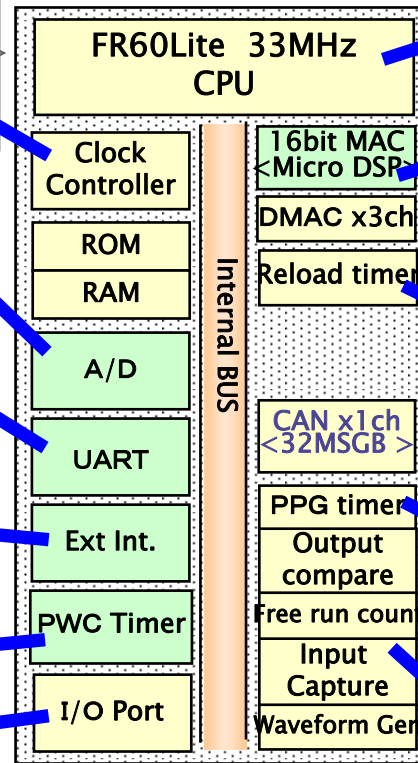
8/10bit resolution
 -2unit x4ch = 2unit 8ch
 -Total error +/- 3LSB
 -1.2us conversion time at 20MHz
 -Single shot/scan conversion.

Full-duplex double buffer x2ch
 -Clock synchronous / asynchronous.
 -Dedicated baud rate generator.
 <600~250Kbps>

9ch: 8 INT + 1 NMI
 Rise/fall edge, H/L level sensitive.

16bit x1ch <With phase detector>
 -Measures pules width.

CMOS Input/output : 37 pins
 Including software pull-up registers
 for 8 pins.



Package QFP-64

FUJITSU RISC MCU <FR60Lite>
 Vcc=4.0V~5.5V: Sigle power supply.
 Minimum clock cycle 30.3ns at 33MHz.

Multiply Accumulate Unit <μ DSP>
 -RAM: Instruction 128word,
 Data X:32 words/Y 32 words.
 -Single cycle MAC execution.
 -Truncated from 40 bits to 16bits.
 -Signals interrupt upon completion.

16bit x 2ch
 -Single shop operation.
 -Event count operation. (edge sensitive)
 -Gated count operation: possibility to measure pulse width (level sensitive)

Multi-function timer

8bit x8ch or 16bit x4ch
Arbitrary cycle and duty can be specified
 -16bit PPG mode.
 -8bit PPG mode.
 -8bit prescaler + 8bit PPG mode.

Real time Input and Output
 -Free running counter x 3ch. (Multi-Carrier)
 ICU/OCU are able to assigned
 -Input capture(ICU) x 4ch.
 -Output compare(OCU) x 6ch.
 -Waveform generator x 1ch.

Products

Flash Lineup

MB91F267A

FLASH 128KB
 RAM 4KB

MASK ROM Lineup

ROM 64KB
 RAM 2KB

MB91266A/NA

ROM 128KB
 RAM 4KB

MB91267A/NA

For evaluation
 RAM 20KB

MB91V265A

应用于电机的富士通32bit MCU-MB91F470



Features

Supports low power operation modes.
 -PLL RUN, STOP, SLEEP
PLL frequency multiplier<1/2,1,2,3,4>
 -20MHz oscillation, 80MHz operation.
 -Reduces EMI emission.

12bit resolution 1unit x 4ch
 -2.0us converted. 300KHz sampling
8/10bit resolution 1unit x 16ch
 -1.2us converted
 -Total error +/- 3LSB.
 -Single shot/scan conversion.

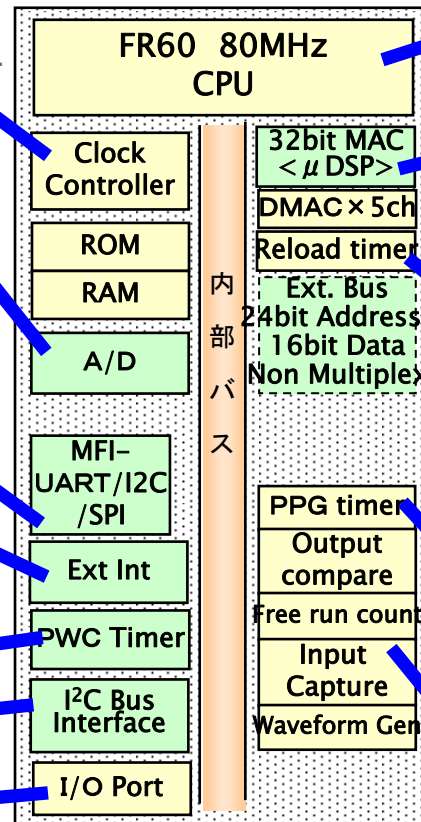
multi-function serial interface x6ch
 -UART/I2C/SPI selectable

17ch: 16 INT + 1 NMI
 Rise/fall edge, H/L level sensitive.

16bit x2ch <With phase detector x1ch>
 -Measures pules width.

100Kbps/400Kbps selectable x 1ch

CMOS Input/output : 85pins
 Including software pull-up registers for 16 pins.



Package QFP-144

FUJITSU RISC MCU <FR60>
 Vcc=4.0V~5.5V: Sigle power supply
 Minimum clock cycle 12.5ns at 80MHz
 -ROM correction feature.

Multiply Accumulate Unit <μ DSP>
 -RAM: Instruction 128word
 Data X:32 words/Y 32 words
 -Two cycle MAC execution
 -Truncated from 64 bits to 32bits
 -Signals interrupt upon completion

16bit x 2ch
 -Single shop operation.
 -Event count operation. (edge sensitive)
 -Gated count operation: possibility to measure pulse width. (level sensitive)

Multi-function timer

8bit x 16ch or 16bit x 8ch
 Arbitrary cycle and duty can be specified
 -16bit PPG mode.
 -8bit PPG mode.
 -8bit prescaler + 8bit PPG mode.

Real time Input and Output
 -Free running counter x 6ch. (Multi-Carrier)
 -Input capture x 8ch.
 -Output compare x 12ch.
 -Waveform generator x 2ch.

Products



应用于电机的富士通32bit MCU-MB91F492



Features

Supports low power operation modes.
 -PLL RUN, STOP, SLEEP
PLL frequency multiplier<1,2,3,4,5,8>
 -10MHz oscillation, 80MHz operation.
 -Reduces EMI emission.

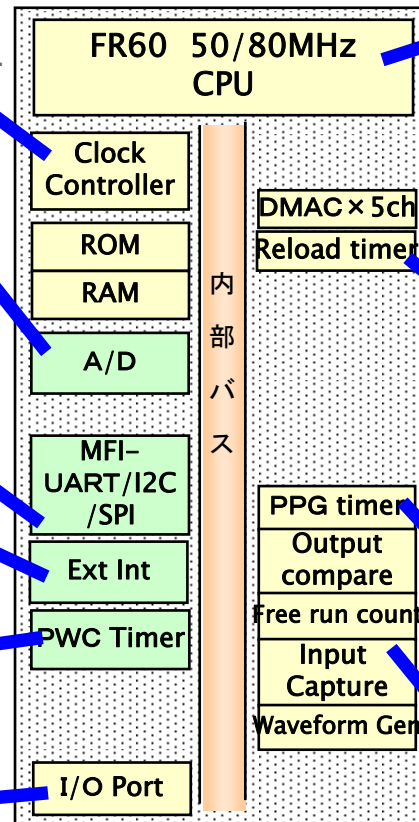
8/10bit resolution 1 unit x 4ch
8/10bit resolution 1 unit x 8ch
 -1.2us converted
 -Total error +/- 3LSB.
 -Single shot/scan conversion.

multi-function serial interface x3ch
 -UART/I2C/SPI selectable
 -I2C: 100Kbps/400Kbps selectable

8ch: 7 INT + 1 NMI
 Rise/fall edge, H/L level sensitive.

16bit x2ch <With phase detector x1ch>
 -Measures pulses width.

CMOS Input/output : 49pins
 Including software pull-up registers for 8 pins.



Package QFP-64

FUJITSU RISC MCU <FR60>
 Vcc=4.0V~5.5V: Single power supply
 Minimum clock cycle 12.5ns at 80MHz
 -ROM correction feature.

16bit x 2ch
 -Single shot operation.
 -Event count operation. (edge sensitive)
 -Gated count operation: possibility to measure pulse width. (level sensitive)

Multi-function timer

8bit x 8ch or 16bit x 4ch
 Arbitrary cycle and duty can be specified
 -16bit PPG mode.
 -8bit PPG mode.
 -8bit prescaler + 8bit PPG mode.

Real time Input and Output
 -Free running counter x 3ch. (Multi-Carrier)
 -Input capture x 4ch.
 -Output compare x 6ch.
 -Waveform generator x 1ch.

Products

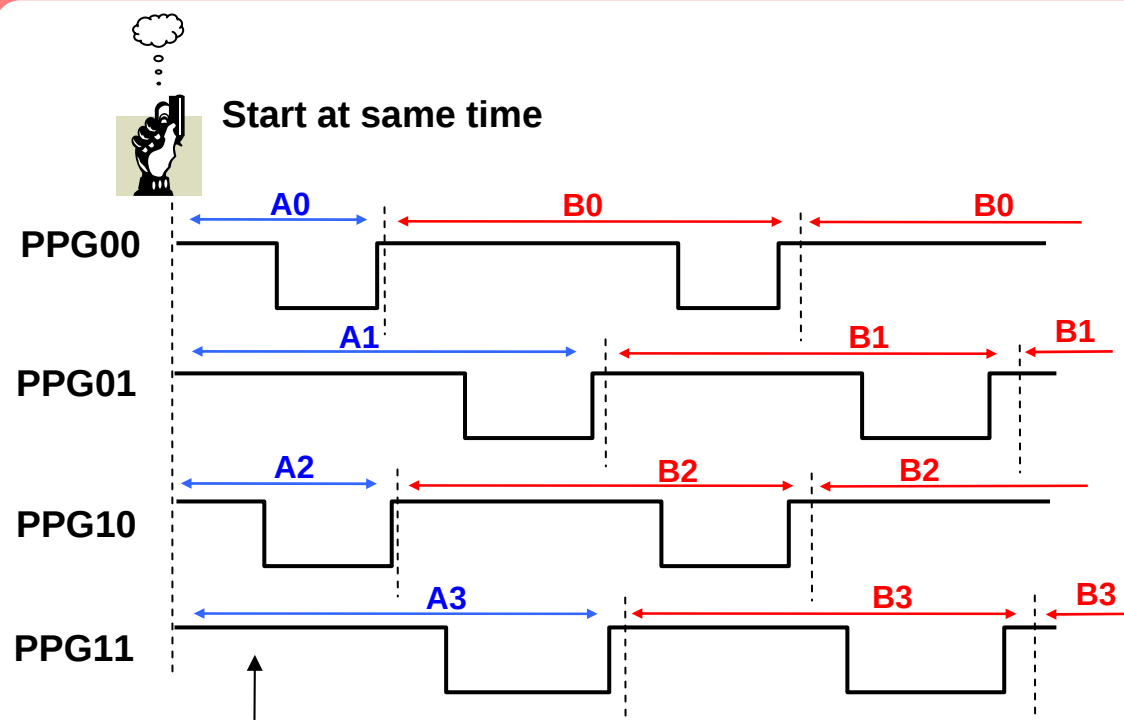
Flash Lineup

MB91F492
FLASH 256KB
RAM 12KB

For evaluation
 RAM 20KB
 MB91V470

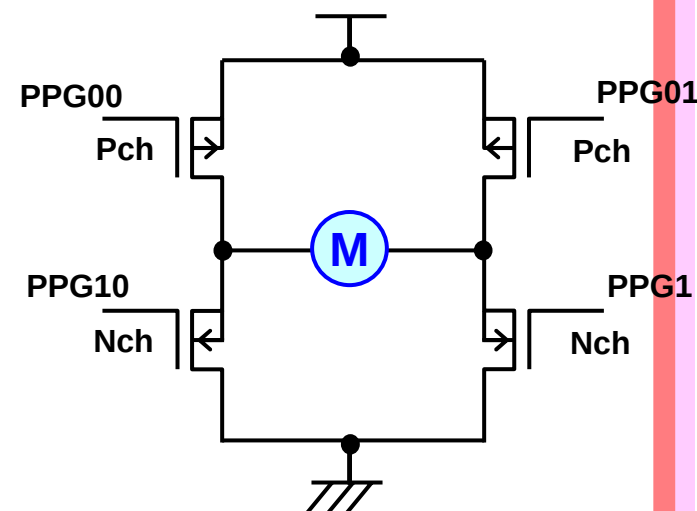
Let's start from keep place!

H bridge DC motor control is easy



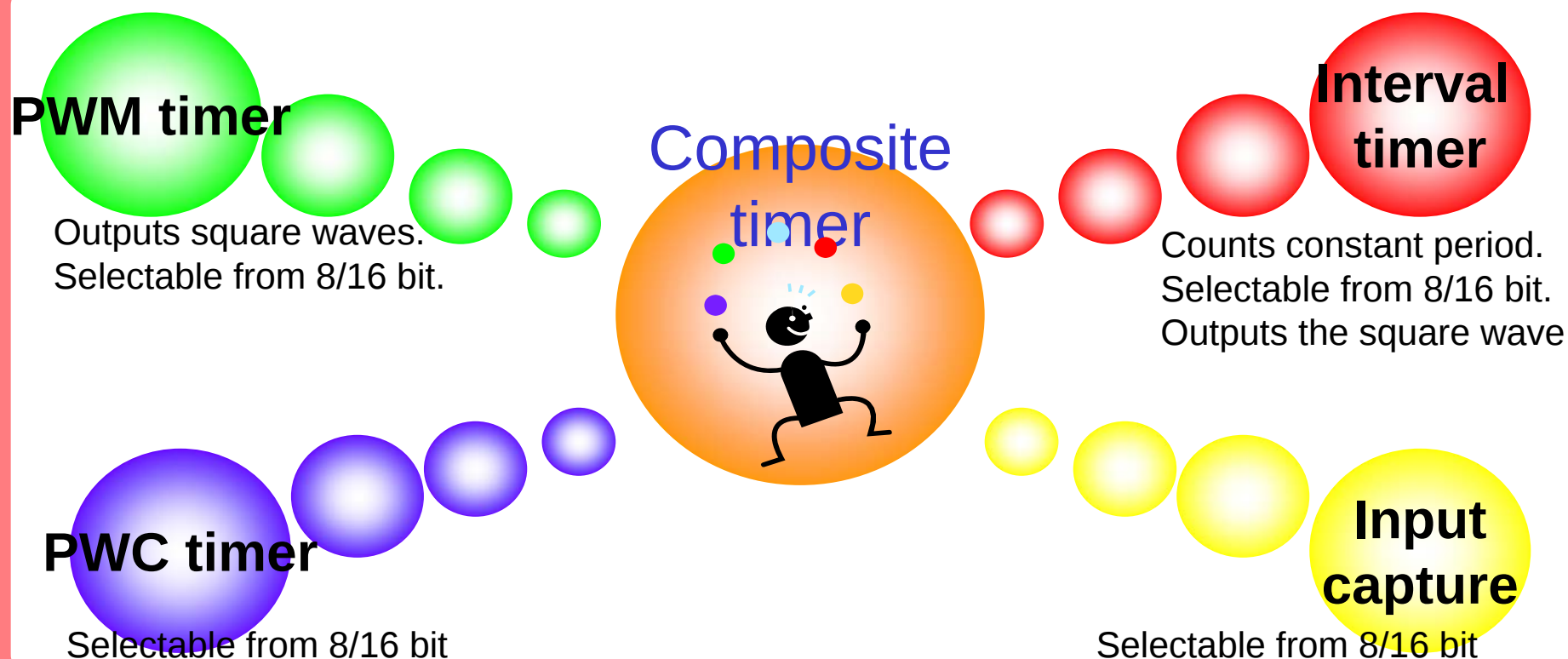
It's OK! If change the duty/cycle at one time after starting

*8/16bit PPG: only MCU that have 8bit mode timer x 4ch



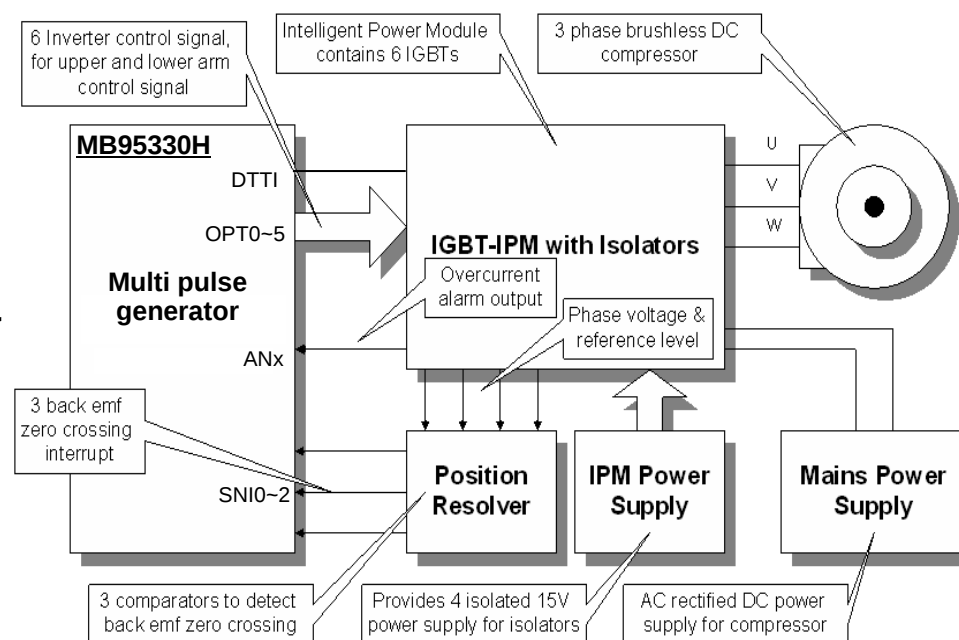
I need additional one channel timer!

Best answer is selectable timer 'complex timer'



Multi Pulse Generator Easy to control Inverter Motor!

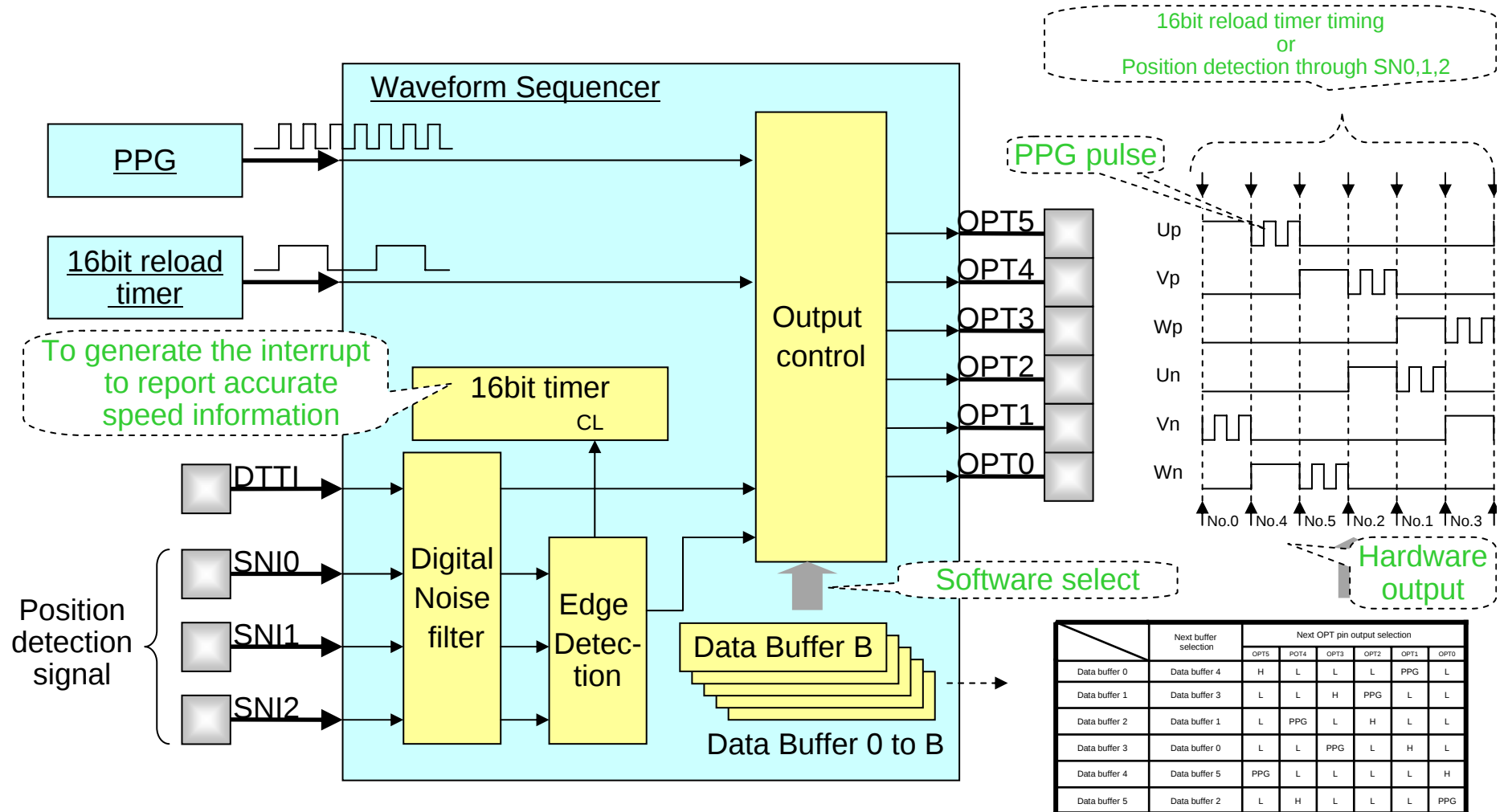
- Five operation modes suitable for the inverter control of 3 phase brushless DC motor with sensor or sensor-less, that is fan motor and compressor
- State sequencer will change output port value (state) upon a well defined condition is met
- Change state by hardware, good timing



应用于电机控制MCU外设特点－ MPG（2）

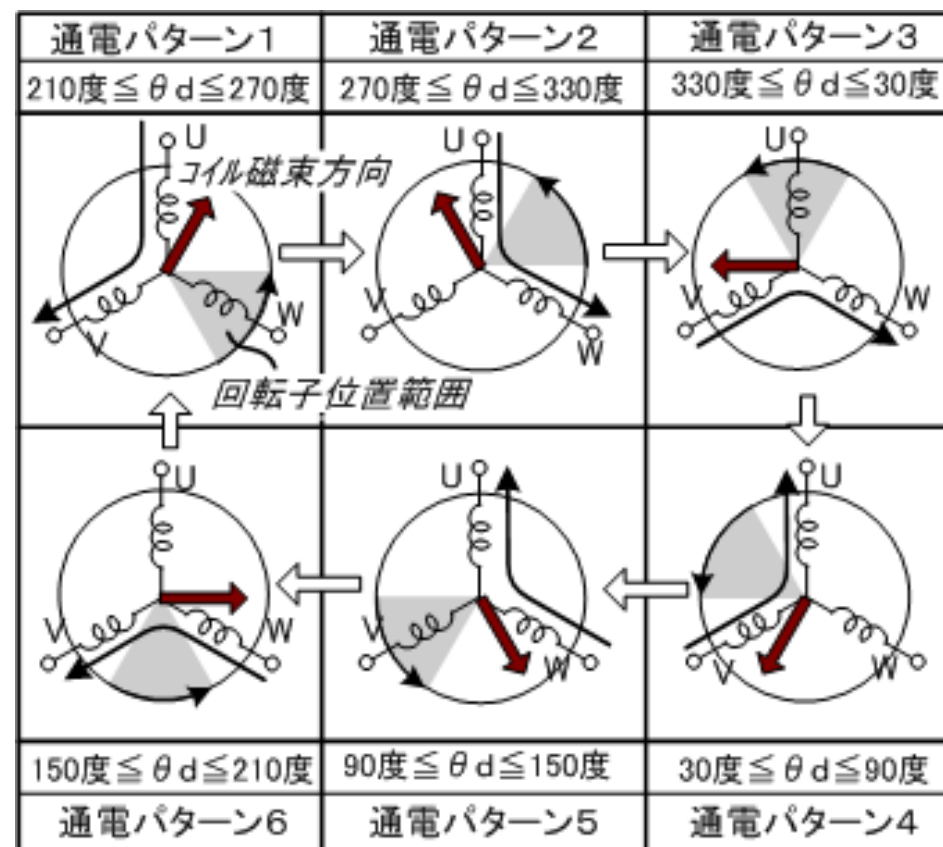
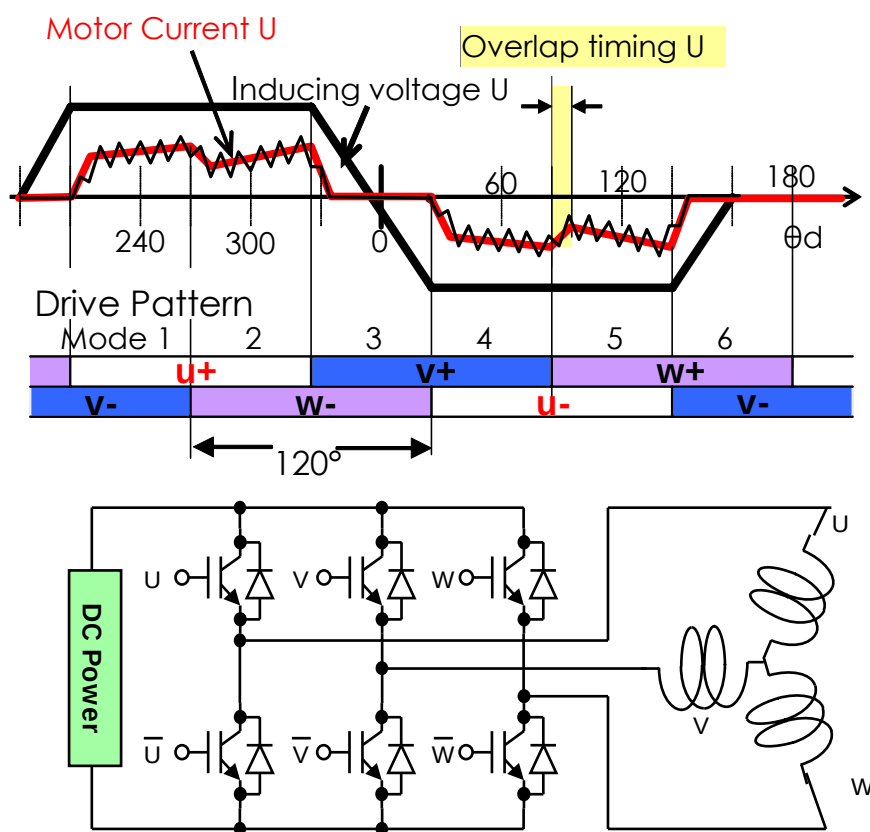


Function overview



应用于电机控制MCU外设特点－ MPG（3）

- Target Method of the 120 degree motor control with the rectangular waveform drive
 - How to detects rotor position
 - Measure of the motor driving current from IPM/IGBT



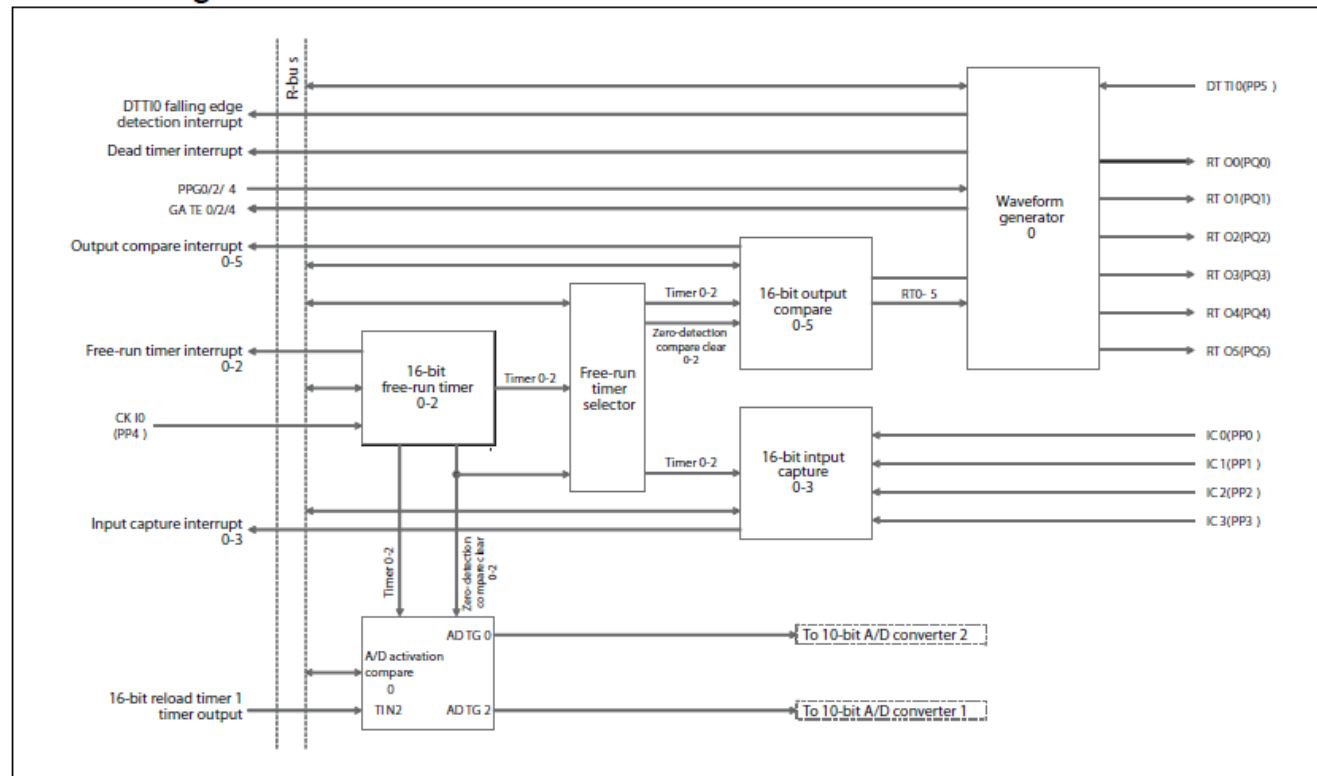
*コイル磁束方向: Coil flux of magnetic induction

应用于电机控制MCU外设特点— MFT

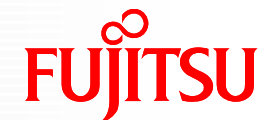


■ Multi-Function Timer

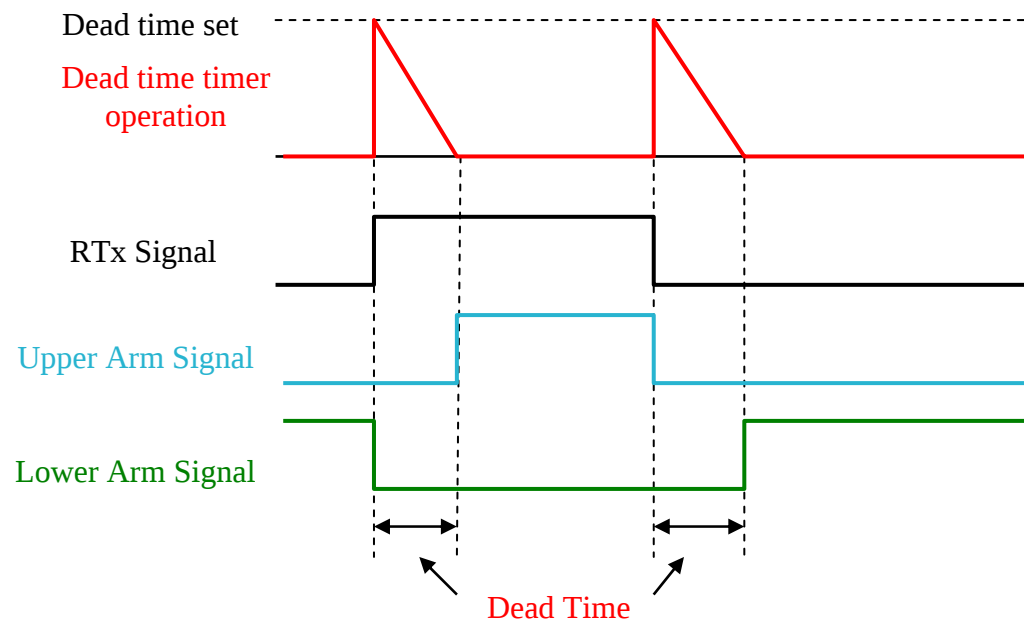
■ Block Diagram of the Multi-function Timer



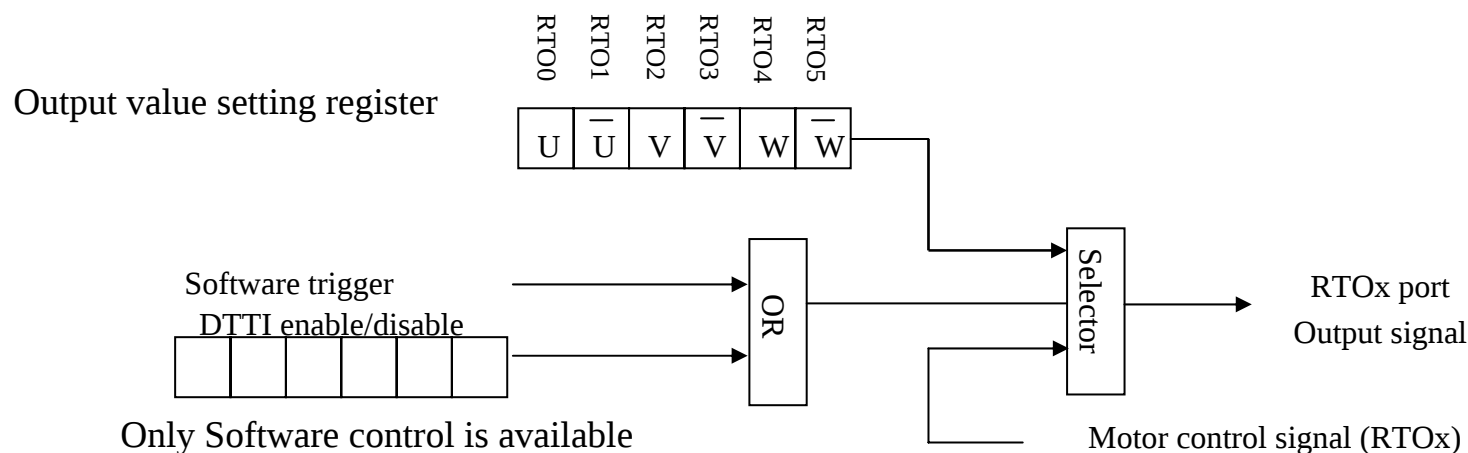
应用于电机控制MCU外设特点-The setting of dead time



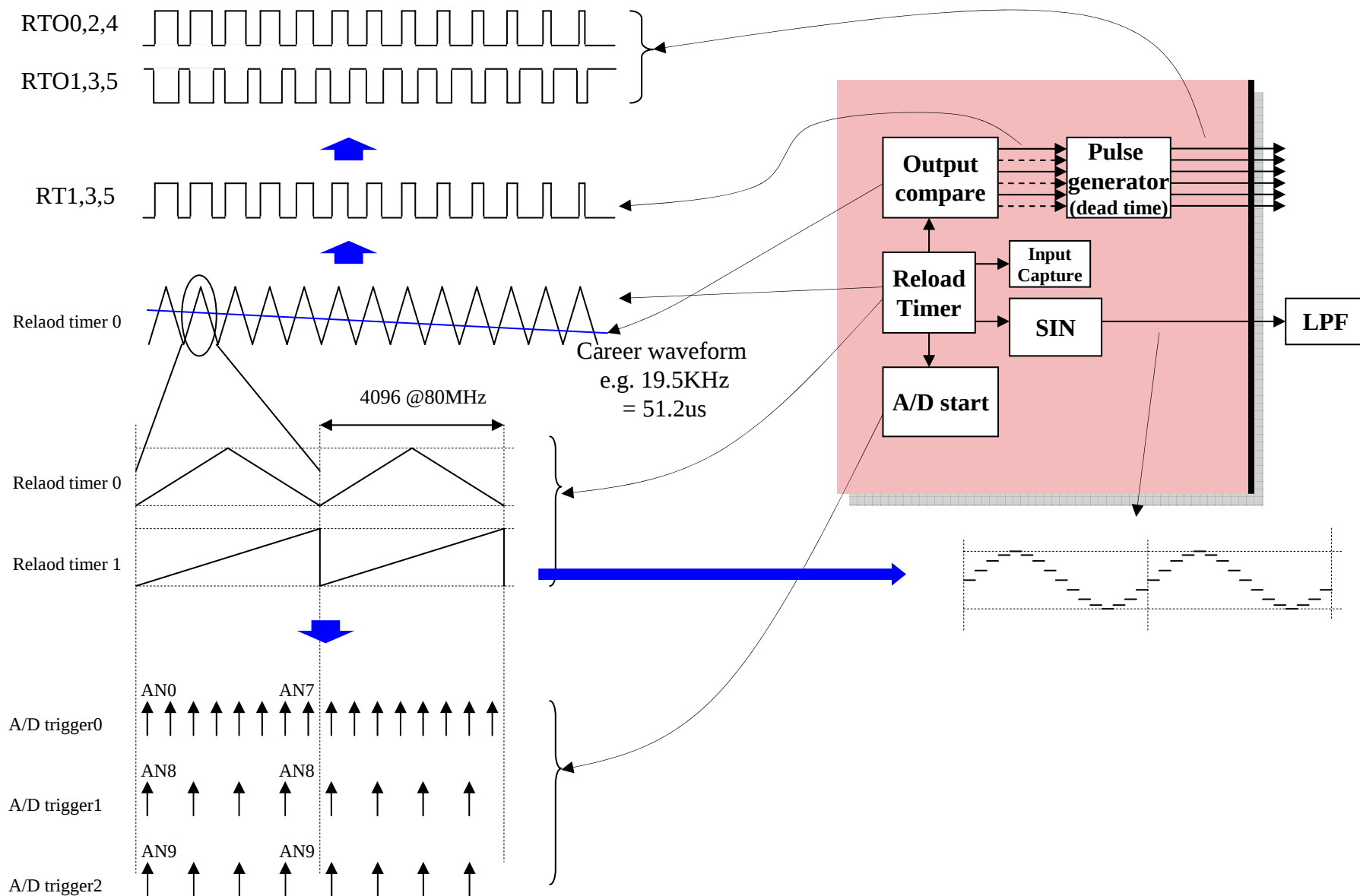
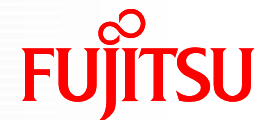
- It is able to generate 16bit x 3ch dead time.
- 1ch dead timer is also possible to set for 3phase dead time.
- It is able to set upper/lower dead time, individually.(3phase is same)
- Dead time is adding as following.(The base is rising/falling edge of RTx)
 - Upper arm:adding dead time from detecting rising edge.
 - Lower arm:adding dead time from detecting falling edge.



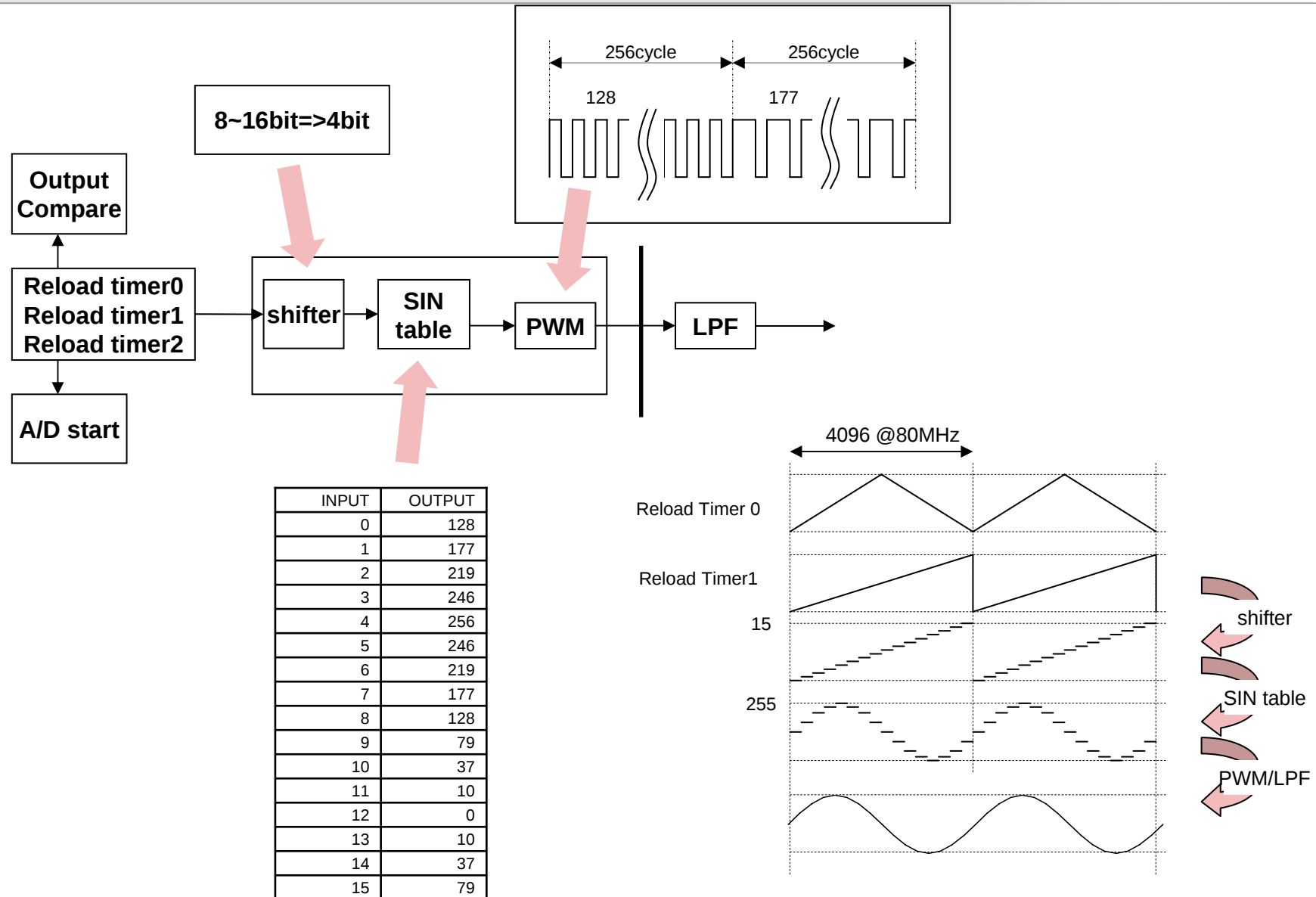
- DTTI; the function to control enable or disable of motor output at each port.
 - Hardware and software control of port output is available.
 - High/Low/High impedance is available as output level or status.



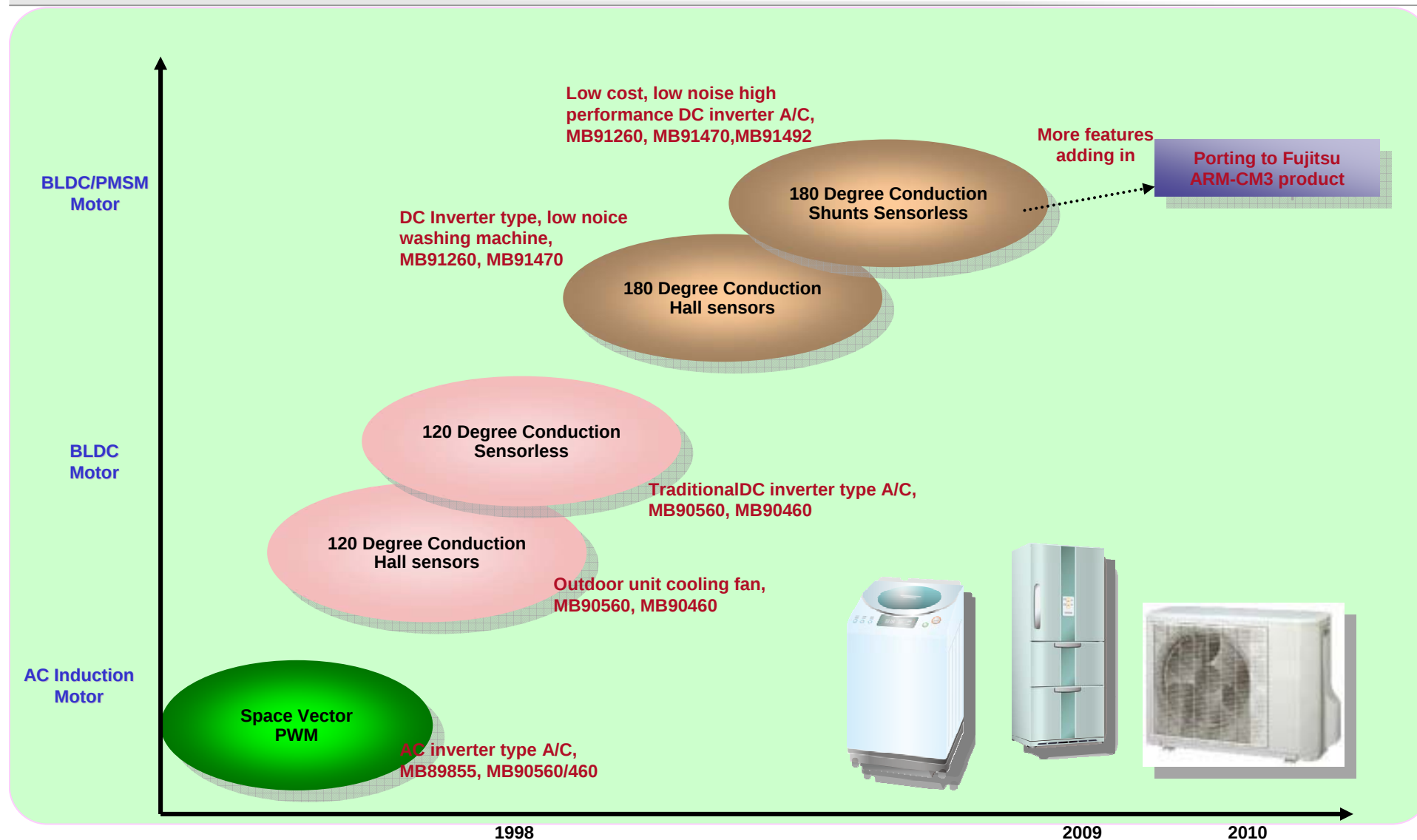
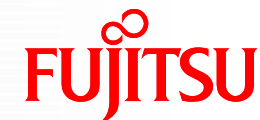
应用于电机控制MCU外设特点- Motor control macro



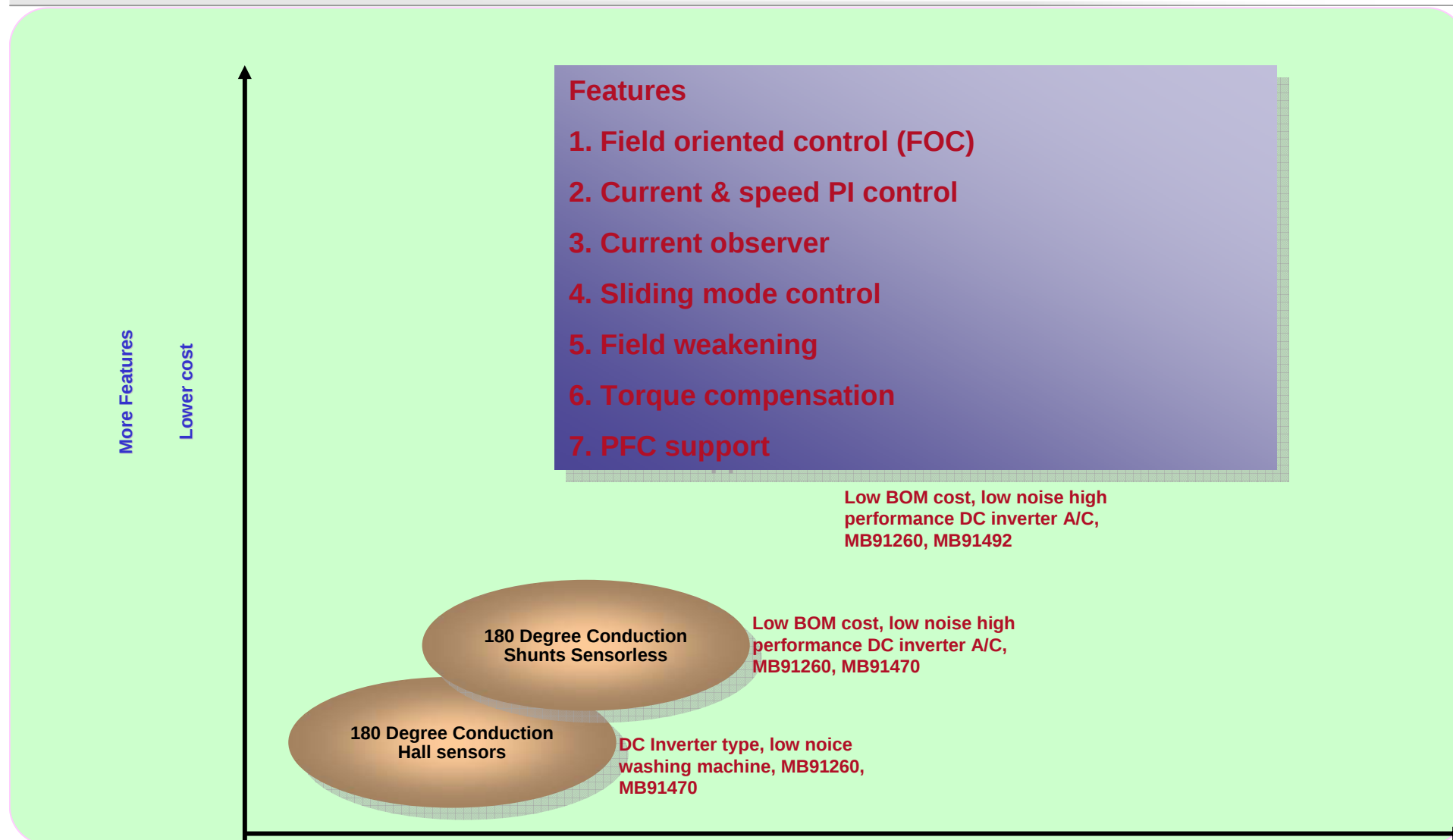
应用于电机控制MCU外设特点- SIN waveform generator



基于富士通MCU的电机变频控制方案



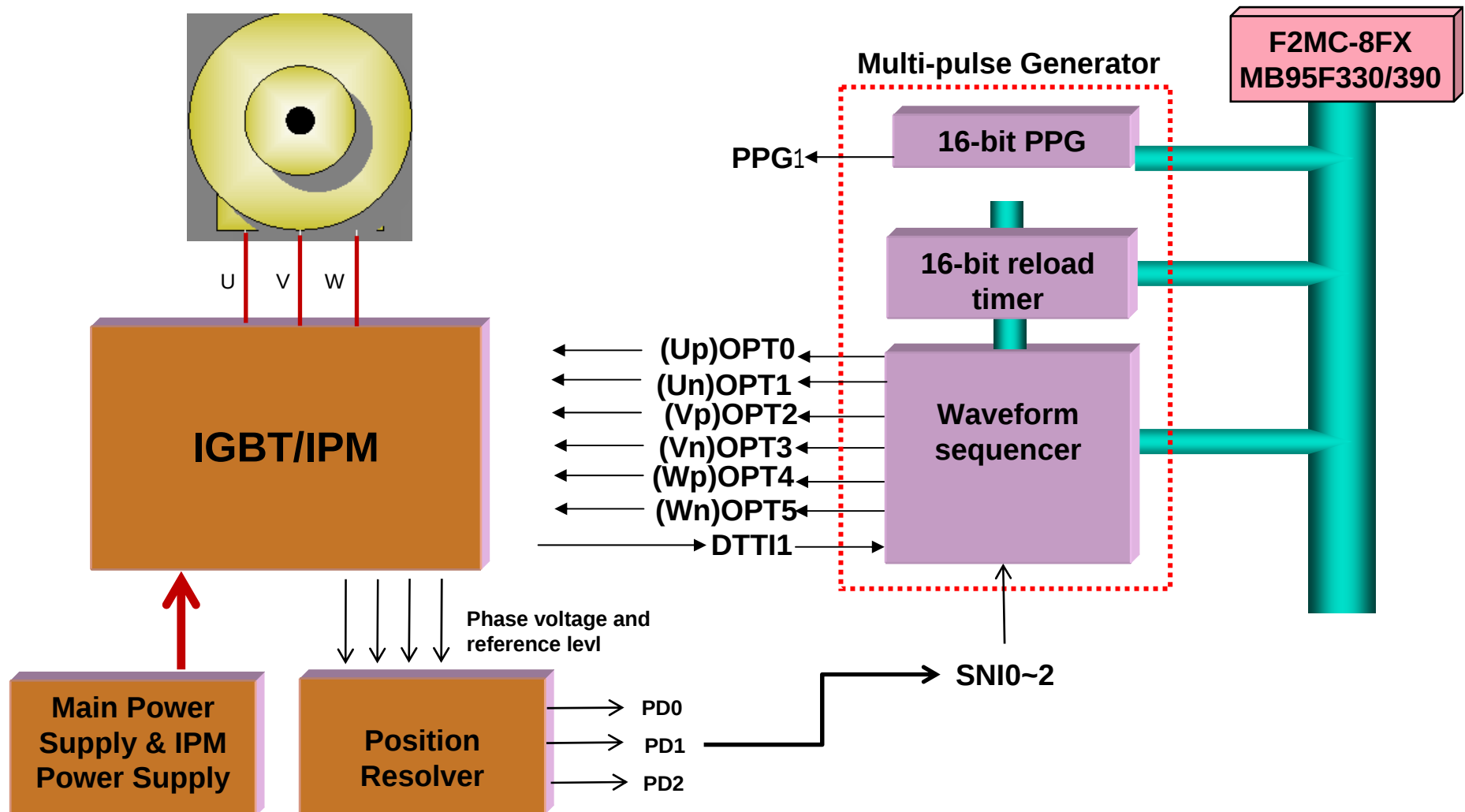
富士通电机变频控制方案特性



基于富士通8bit MCU的电机解决方案



- MB95F330/390 –BLDC motor control solution (120 degree DC Inverter)



基于富士通8bit MCU的电机评估板



■ Function

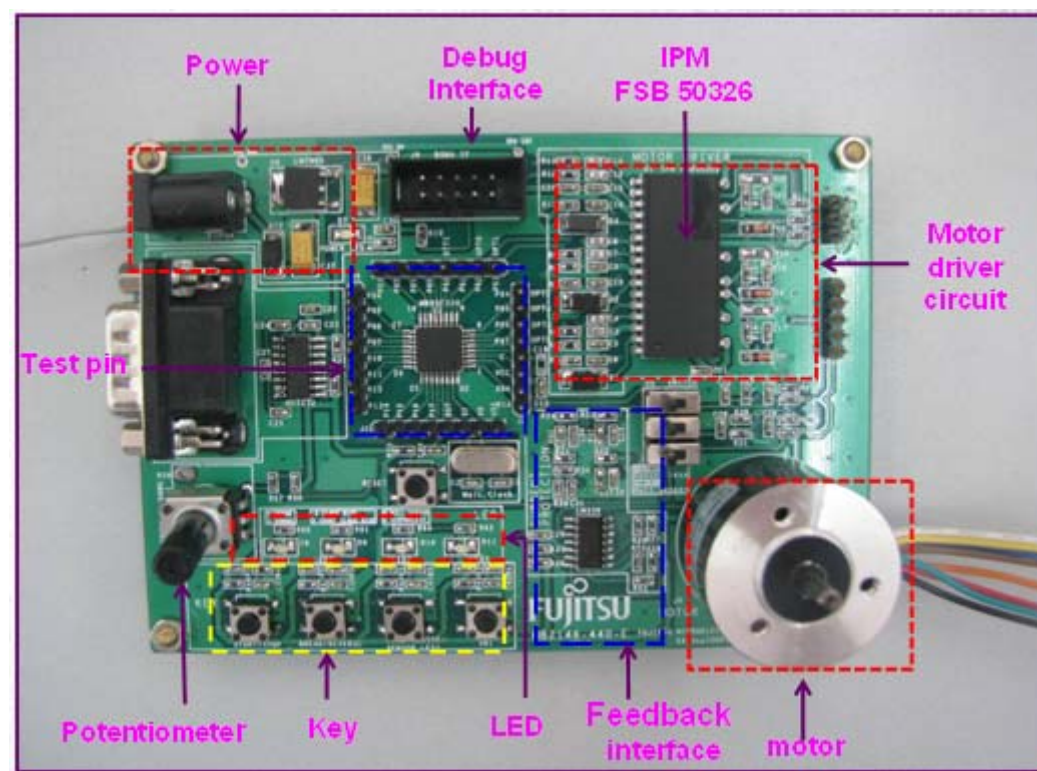
- Motor start/stop, Speed increase/decrease, Rotation reverse
- Hall sensor and Back EMF sensor less solution
- Over current protection.
- Test pins for all MCU pins

■ DC motor

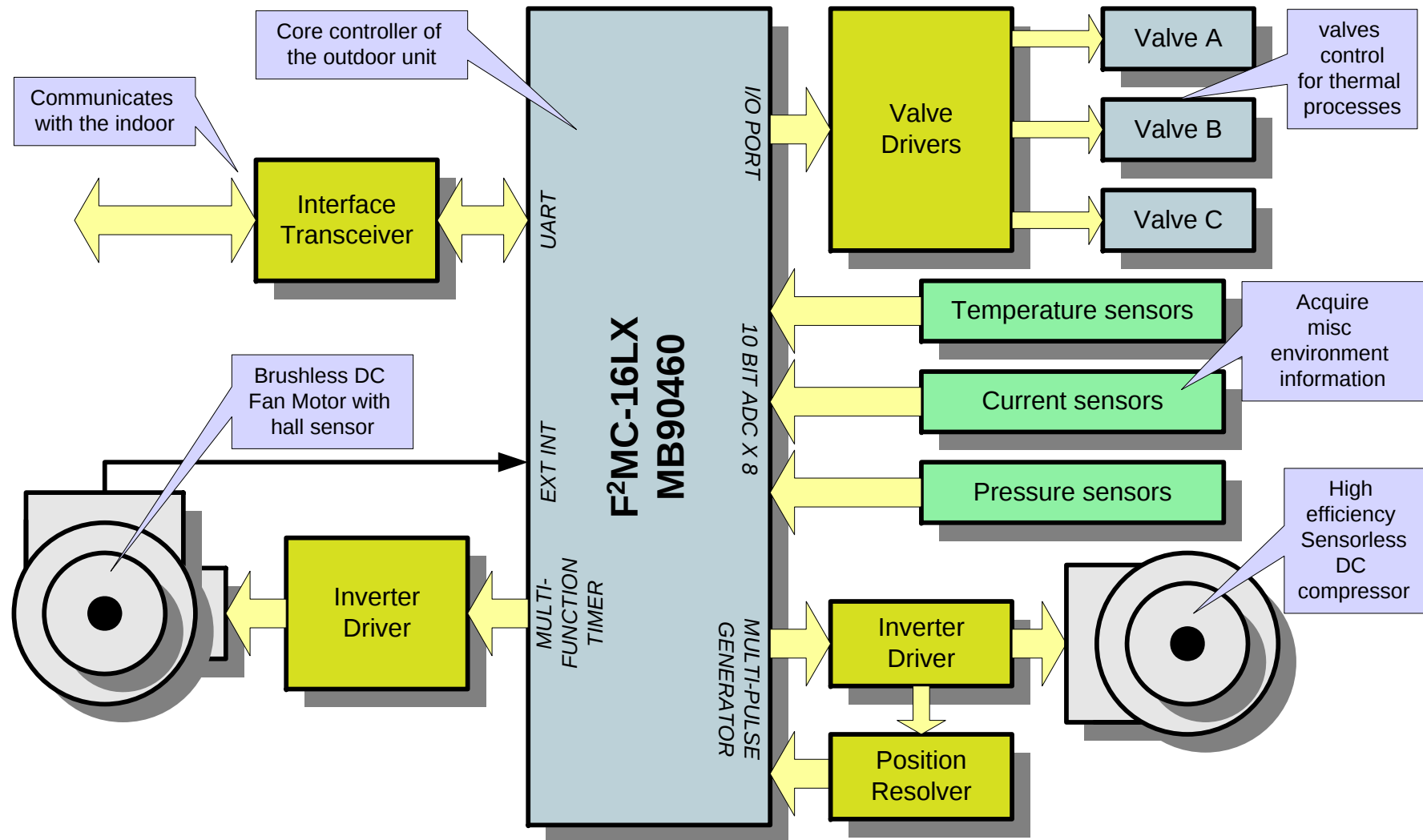
- Model : Fulling FL28BL26-15V-8006AF
- Number of phases : 3
- Number of poles : 4
- Supply voltage : 15VDC
- Minimum tested speed: 500rpm
- Maximum tested speed: 2000rpm

■ Software Algorithm

- Driving method : 120° conduction hall sensor or back EMF sensor less
- ROM:5 Kbytes
- RAM: 240 bytes

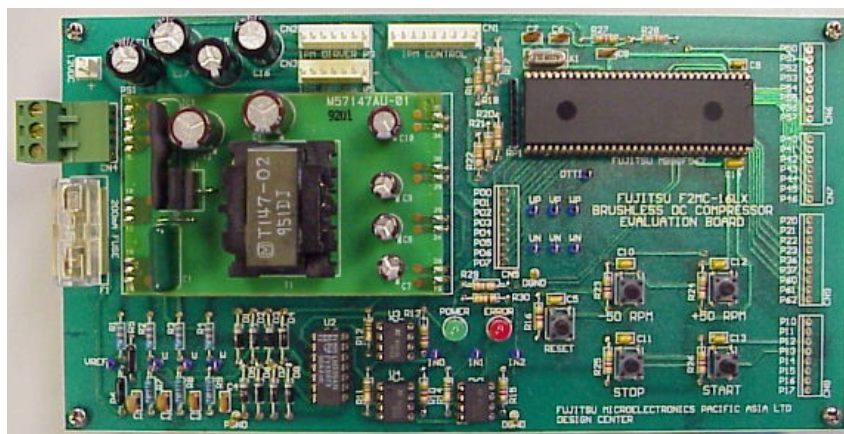


基于富士通16bit MCU的电机解决方案

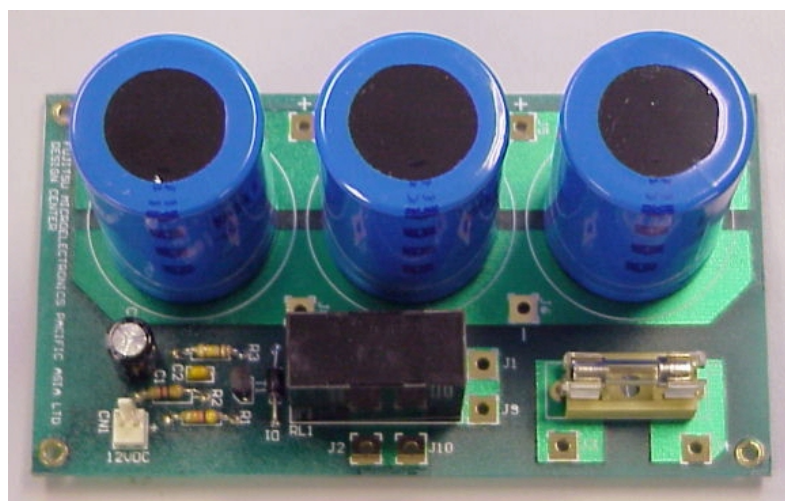


MB90F460 120度直流变频空调方案

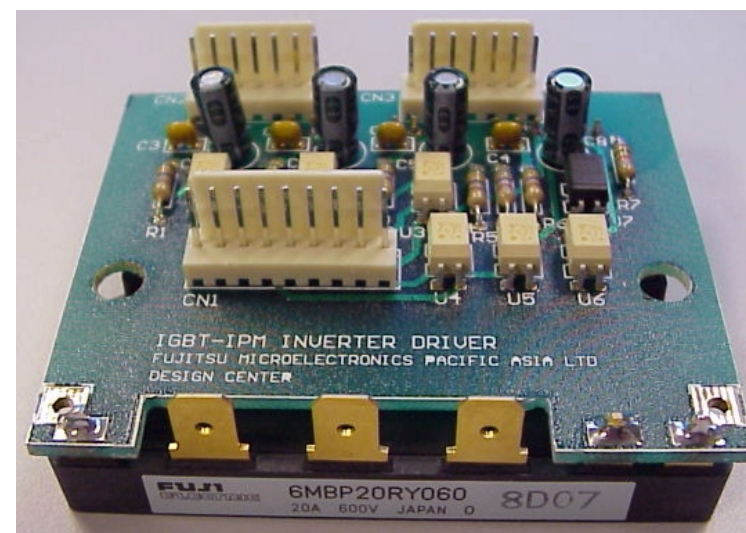
MB90F460 120度直流变频空调控制方案



MB90F460主控板

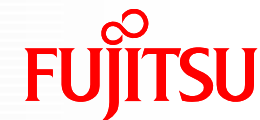


MB90F460电源板



MB90F460功率驱动板

Fujitsu 180度直流变频方案



■ Solution Features

■ Specification

- 3 phase PMSM (Permanent Magnet Synchronous Motor), BLDC (Brushless DC) compressor drive
- 180 degree conduction, 2 shunt resistors sensorless
- Field Oriented Control (FOC), PI control, current observer, sliding mode controller, space vector PWM, PFC, Torque compensation algorithm.

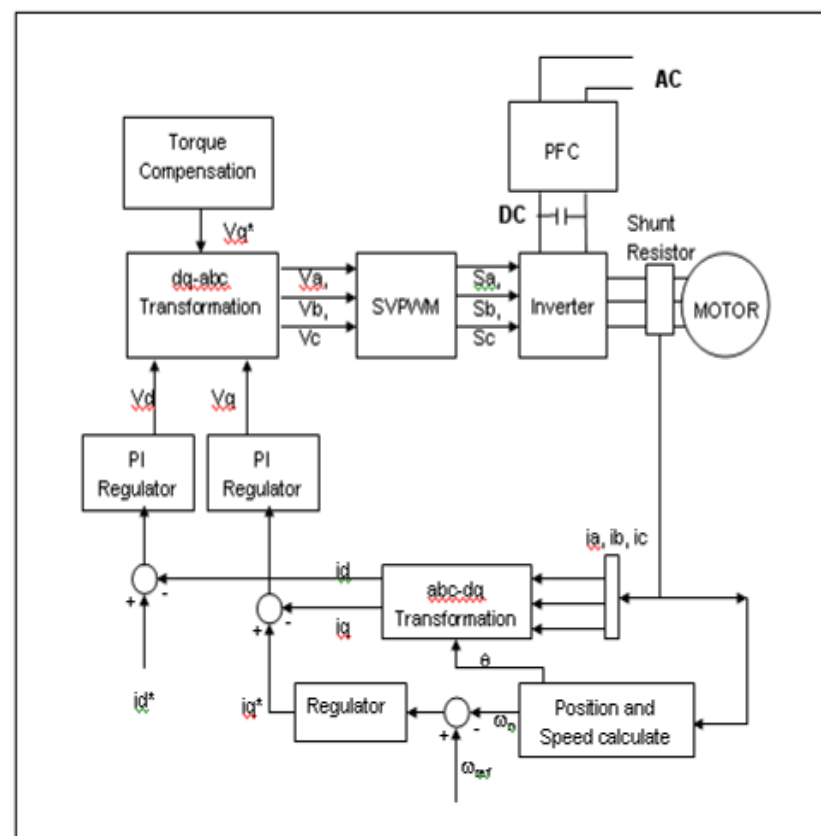
■ Supporting Devices

- Fujitsu 32 bit RISC MCU
 - MB91260, MB91470, MB91480 and MB91490

■ Performance

- Fast startup, minimize startup vibration
- Perfect sinusoidal current waveform
- 5kHz carrier frequency
- Electrical driving frequency : 10Hz – 400Hz
- Mechanical driving frequency from 15Hz upto 100Hz (Test limited by compressor)

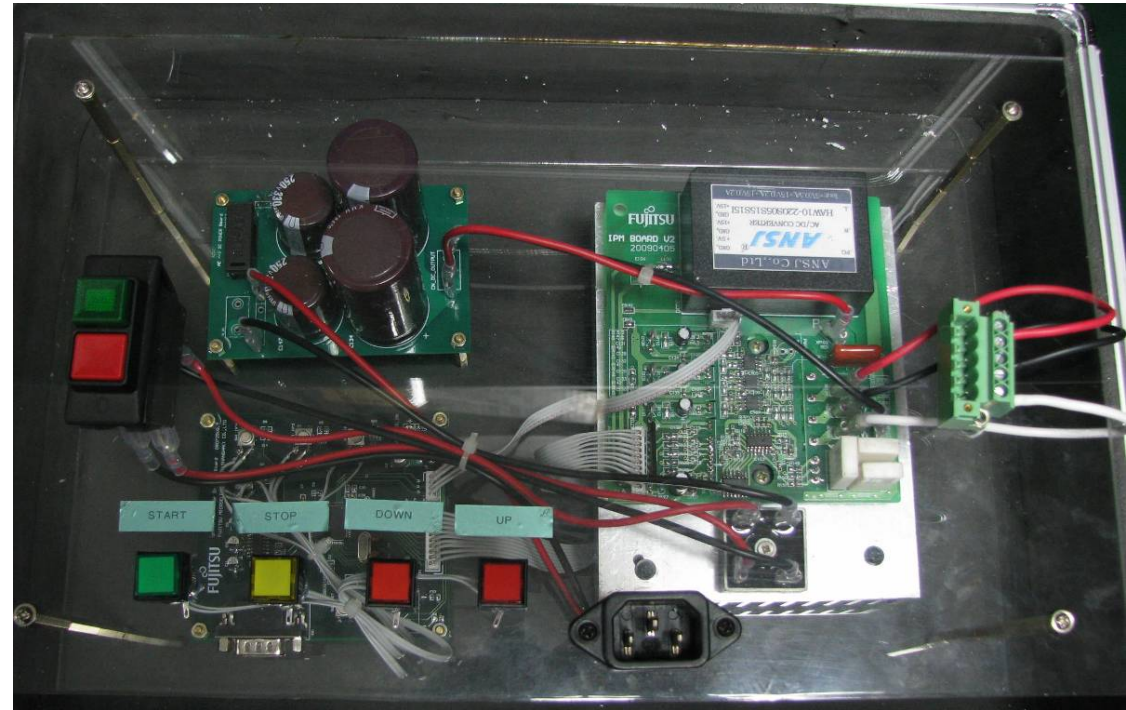
Overall Block Diagram



The diagram illustrates the system architecture, divided into three main sections by dashed lines:

- PFC Board:** Contains the **SPM Module** and the **Power supply**.
- IPM board:** Contains the **IPM (Inverter)** and the **Flat cable** connecting it to the MCU.
- Control board:** Contains the **MCU (MB91F267)** and the **KEY**.

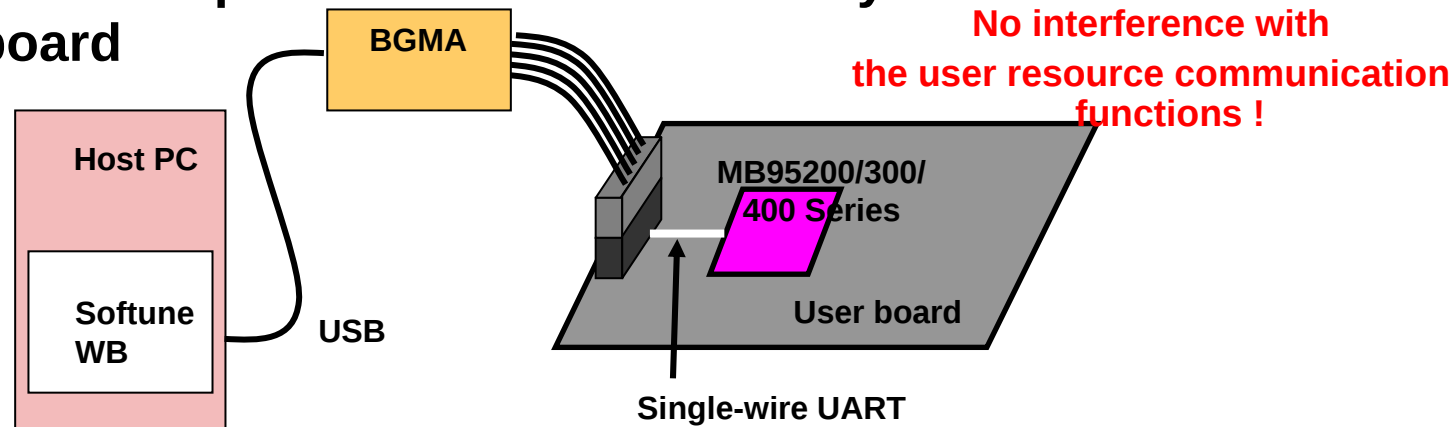
The **Compressor (DA108X1C-20FZ3)** is connected to the **IPM (Inverter)** via three arrows, indicating power flow. The **Power supply** provides power to the **IPM (Inverter)**. The **IPM (Inverter)** is connected to the **Flat cable**, which in turn connects to the **MCU (MB91F267)**. The **KEY** is connected to the **MCU (MB91F267)**.



富士通8bit MCU的开发工具



Debug system can be built with Fujitsu IDE SOFTUNE Workbench, BGM Adaptor and F2MC-8FX Family MB95200/300/400 Series user board



- BGM Adaptor
- Small size
 - 128mmX55mmX29mm
- USB interface to PC/SOFTUNE
 - Compliant with USB 1.1
- Single-wire UART interface to Commodity MCU
 - Total 5 pins needed to connect the target MCU board
 - Debug signal, Reset input, Reset output, VCC, GND

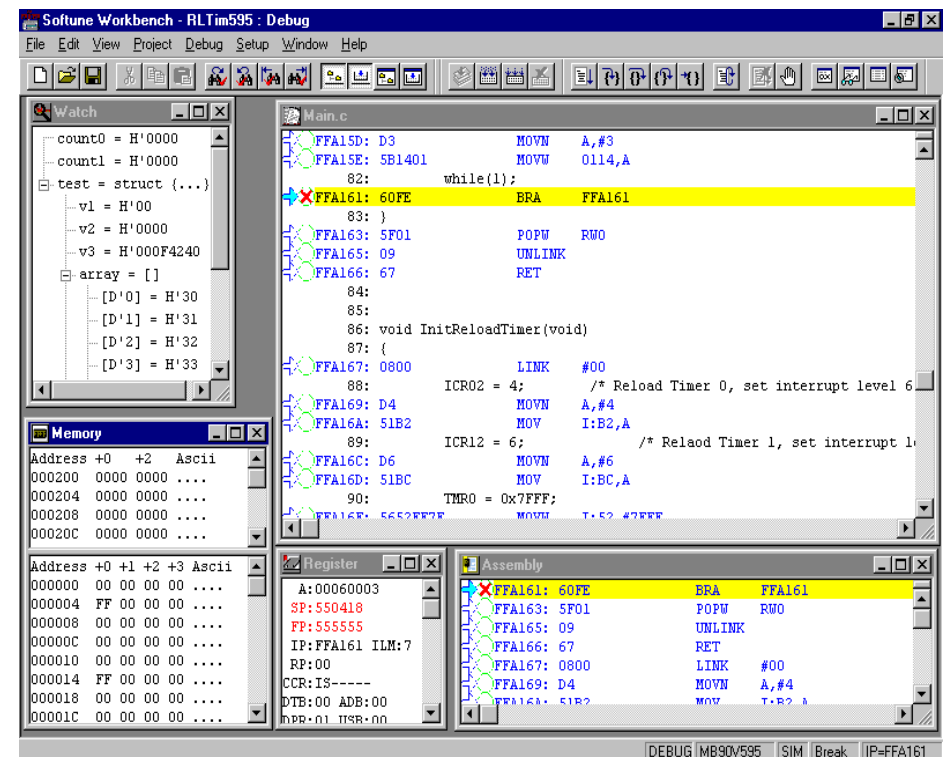
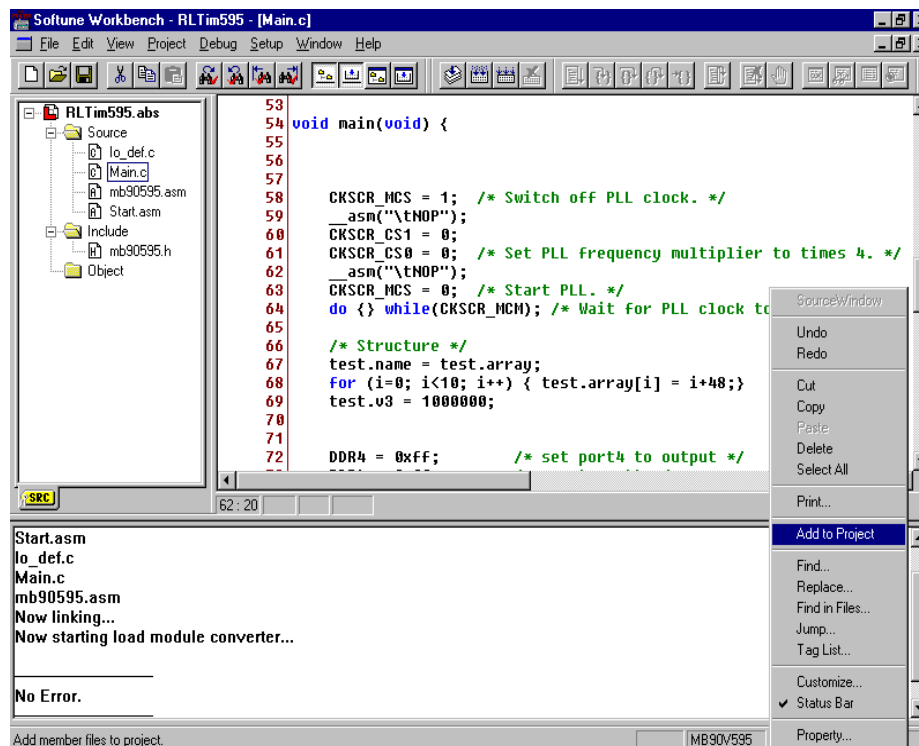


Development environment-IDE



SOFTUNE Workbench Development Environment

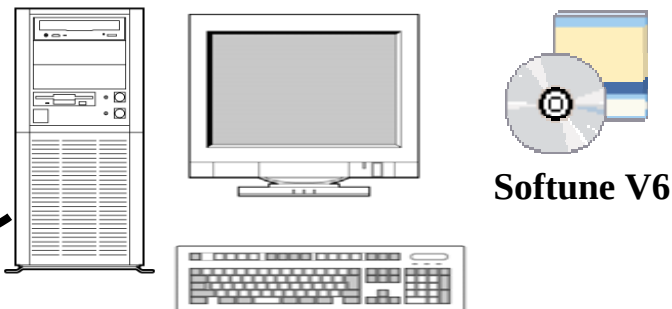
- Free internet download for experimental use
- C-Compiler, Assembler, Linker
- Simulator, Emulator, Monitor Debugger
- Example software



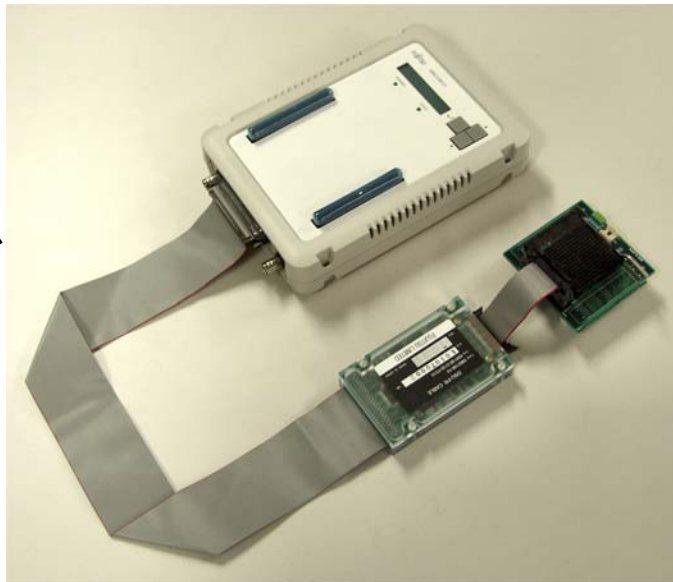
富士通32bit MCU的开发工具



Common Development tool of MB91490series

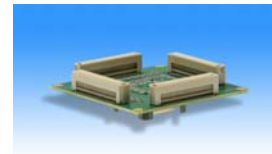


Softtune V6

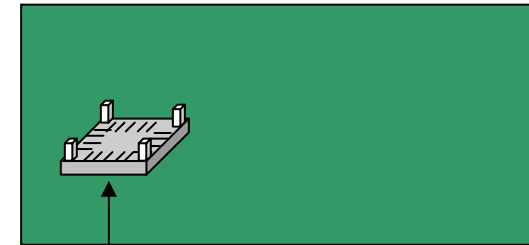


- ICE:MB2198-01-E
- DSU cable:MB2198-10-E
- Adapter board: MB2198-160
- Header board: MB2198-163(each product)

Header board



User target board



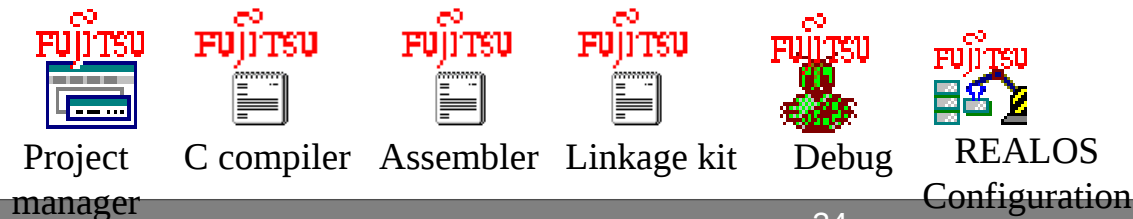
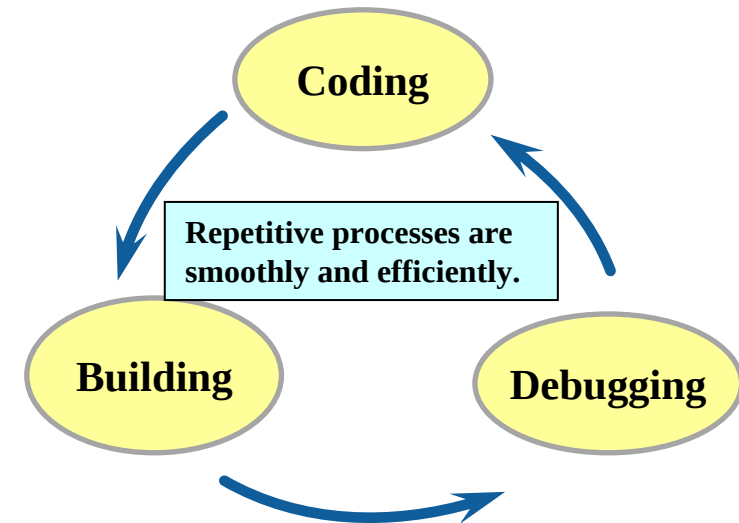
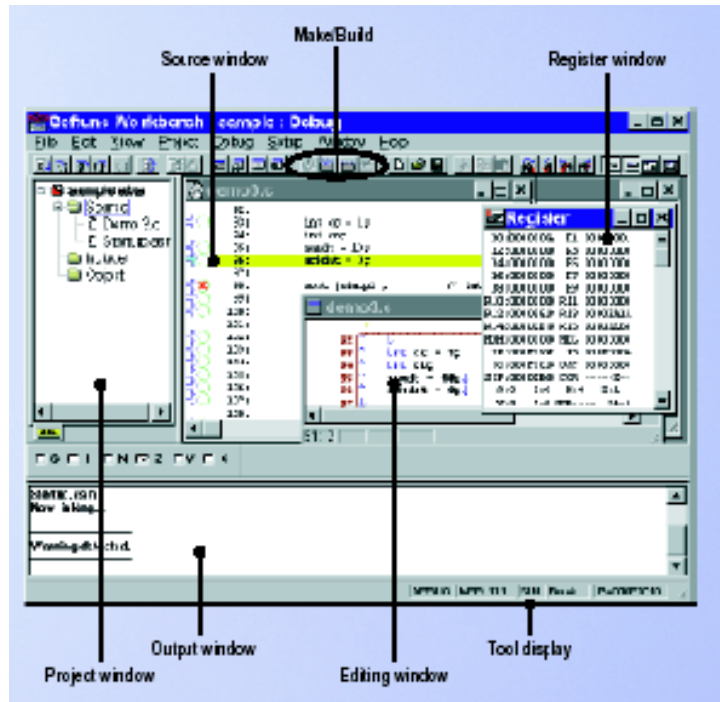
NQPACK

64pin~256pin
(each product)

集成开发环境：SOFTUNE Workbench



- Softune integrated each development tool to ensure ease of use.
- Coding / Building / Debugging processes are smoothly and efficiently.
- Common operation by 8/16/32bit MCU

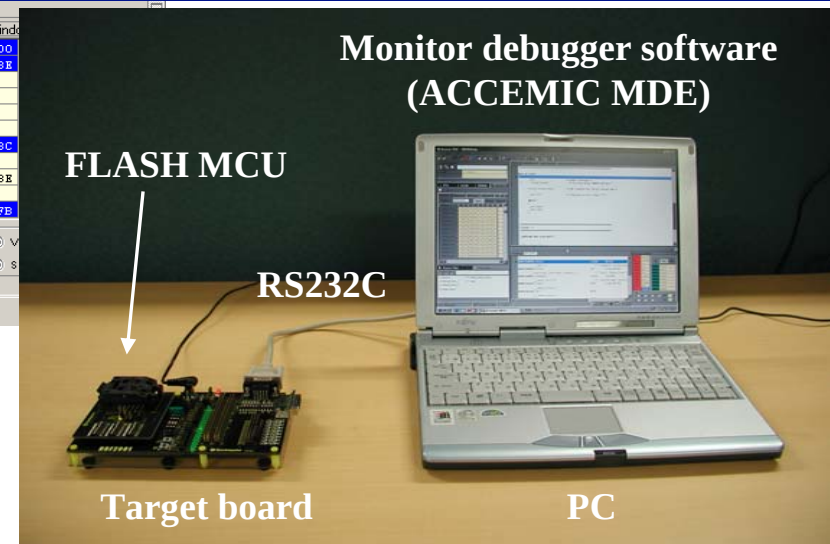


软件串口调试工具: ACCEMIC Monitor Debugger



The screenshot displays the ACCEMIC MDE (Monitor Debugger) software interface. The top window shows the source code for a program, including a `main` function and an interrupt service routine. The middle window shows the memory dump, and the bottom window shows the function list. On the right, a detailed hardware block diagram of the MB91364G / FPT-120-M21 microcontroller is shown, highlighting various peripherals like ports, timers, and converters.

<http://www.accemic.com>





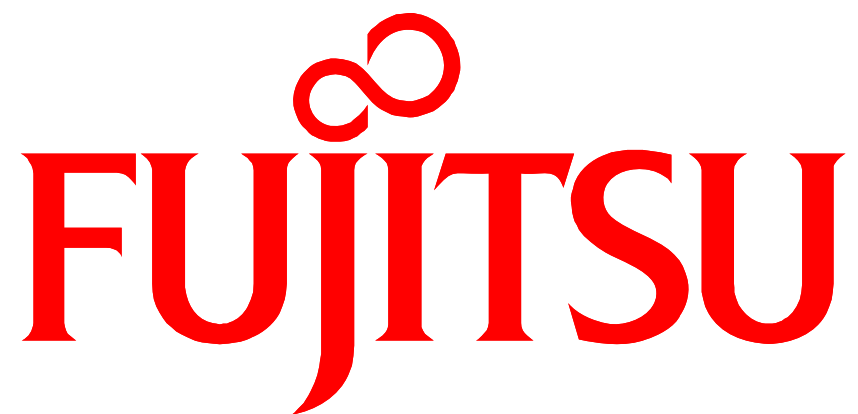
■ Web support

- Application note
- Discussion forum
- FAQ
- Hardware manual/datasheet
- Sample software
- IDE (Softune) free down load
- WEB sales by catalog distributors
- ROHS report, ESD/Latch up report, MSL report
- Sample request
- BBS

网页 : <http://www.fujitsu.com/cn/fmc/>

论坛: <http://fujitsu-mcubbs.com/index.html>

Q & A



富士通

与您携手 创意未来