User's Manual

e-RT3 OS-free CPU Module (F3RP70) Startup Manual

Applicable Modules:

Model	Name
F3RP70-2L	OS-free CPU Module

- Use of open source license software
  This product uses software with open license, such as GPL (GNU General Public License).

  - GPL clauses
    For the information on GPL, please refer to the information provided at the following URL.
    URL: http://www.gnu.org/copyleft/gpl.html

  - Warranty range and support responsibility
    Yokogawa Electric makes no warranties for the operation of the open source software itself in this product, in accordance with the clauses in GPL or other organizations.

- Information provided on Website
  Please refer to the website of eMbedded M@chine-Controller e-RT3 for the latest information on this product.

  URL: http://www.e-RT3.com/

  You need to sign up for the Yokogawa "Partner Portal," which is our exclusive partner website, to access the information.

  URL: https://partner.yokogawa.com/japan/itc/index.htm

Applicable Product

- ● **eMbedded M@chine Controller e-RT3**

  - Model: F3RP70-2L
  - Name: OS-free CPU Module

  The document number for this manual is given below.

  - Document No.: IM 34M06M52-25E

Applicable Product

Precautions

■ About This Manual

- This Manual should be passed on to the end user.

- This manual is an essential part of the product; keep it in a safe place for future reference.

- This product is designed to be used by a person with specialized knowledge.

- Before using the product, read this manual thoroughly to have a clear understanding of the product.

- This manual explains the functions of this product, but there is no guarantee that they will suit the particular purpose of the user.

- Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.

- The contents of this manual are subject to change without prior notice.

- Every effort has been made to ensure accuracy in the preparation of this manual. However, should any errors or omissions come to the attention of the user, please contact the nearest Yokogawa Electric representative or sales office.

■ Safety Symbols

- **"Handle with care."** This symbol on the product indicates that the operator must follow the instructions laid out in this user's manual to avoid the risk of personnel injuries, fatalities, or damage to the instrument.

- **Protective Conductor Terminal**

  This terminal is to prevent electric shock. Before using the instrument, connect to the Protective earth (Comply with the regulation of each country.), and route the line through the shortest path possible.

- **Functional Earth Terminal**

  This terminal is for stable operation. Before using the instrument, be sure to ground this terminal.

- **Alternating current.** Indicates alternating current.

- **Direct current.** Indicates direct current.

The following symbols are used only in the user's manual.

⚠ **WARNING**

- Draws attention to information essential to prevent electrical shock or other dangers that may result in injury or the loss of life.

⚠ **CAUTION**

- Draws attention to information essential to prevent hardware damage, software damage or system failure.

NOTE

- Draws attention to information essential to the understanding of operation and functions.

■ Safety Precautions when Using/Maintaining the Product

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety stated in this manual whenever handling the product. Take special note that if you handle the product in a manner other than prescribed in these instructions, the protection feature of the product may be damaged or impaired. In such cases, Yokogawa cannot guarantee the quality, performance, function and safety of the product.

- When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system as well as designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of processes and lines using the product and the system controlled by it, the user should implement it using devices and equipment, additional to this product.

- If component parts or consumable are to be replaced, be sure to use parts specified by the company.

- This product is not designed or manufactured to be used in critical applications which directly affect or threaten human lives and safety — such as nuclear power equipment, devices using radioactivity, railway facilities, aviation equipment, shipboard equipment, aviation facilities or medical equipment. If so used, it is the user's responsibility to include in the system additional equipment and devices that ensure personnel safety.

- Do not attempt to modify the product.

- To avoid electrical shock, turn off the power before wiring.

- This product is classified as Class A for use in industrial environments. If used in a residential environment, it may cause electromagnetic interference (EMI).

  In such situations, it is the user's responsibility to adopt the necessary measures against EMI.

■ Exemption from Responsibility

- Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa Electric) makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.

- Yokogawa Electric assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.

■ Software Supplied by the Company

- Yokogawa Electric makes no other warranties expressed or implied except as provided in its warranty clause for software supplied by the company.

- Use the software with one computer only. You must purchase another copy of the software for use with each additional computer.

- Copying the software for any purposes other than backup is strictly prohibited.

- Store the original media that contain the software in a safe place.

- Reverse engineering, such as decompiling of the software, is strictly prohibited.

- Under absolutely no circumstances may the software supplied by Yokogawa Electric be transferred, exchanged, or sublet or leased, in part or as a whole, for use by any third party without prior permission by Yokogawa Electric.

■ General Requirements for Using the FA-M3 / e-RT3 Controller

● Set the product in a location that fulfills the following requirements:

- INDOOR USE ONLY

- This product is an open equipment. The product must be installed in a metallic panel enclosure with an impact rating IK08 or more.

- Where the product will not be exposed to direct sunlight, and where the operating surrounding air temperature is from 0°C to 55°C (32°F to 131°F).

  There are modules that must be used in an environment where the operating surrounding air temperature is in a range smaller than 0°C to 55°C (32°F to 131°F). Refer to "Hardware Manual" (IM 34M06C11-01E) or the applicable user's manual. In case of attaching such a module, the entire system's operating surrounding air temperature is limited to the module's individual operating surrounding air temperature.

- Where the relative humidity is from 10 to 90%.

  In places where there is a chance of condensation, use a space heater or the like to constantly keep the product warm and prevent condensation.

- For use in Pollution Degree 2 Environment.

- Where there are no corrosive or flammable gases.

- Where the product will not be exposed to mechanical vibration or shock that exceed specifications.

- Where there is no chance the product may be exposed to radioactivity.

● Use the correct types of wire for external wiring:

- USE COPPER CONDUCTORS ONLY.

- Use conductors with temperature rating above 75°C.

● Securely tighten screws:

- Securely tighten module mounting screws and terminal screws to avoid problems such as faulty operation.

- Tighten terminal block screws with the correct tightening torque as given in this manual. Refer to the "Hardware Manual" (IM 34M06C11-01E) or the applicable user's manual for the appropriate tightening torque.

● Securely lock connecting cables:

- Securely lock the connectors of cables, and check them thoroughly before turning on the power.

● Interlock with emergency-stop circuitry using external relays:

- Equipment incorporating the FA-M3 / e-RT3 controller must be furnished with emergency-stop circuitry that uses external relays. This circuitry should be set up to interlock correctly with controller status (stop/run).

● Ground for low impedance:

- For safety reasons, connect the [FG] grounding terminal to a protective earth (Comply with the regulation of each country.). For compliance to CE Marking, use braided or other wires that can ensure low impedance even at high frequencies for grounding.

- **Configure and route cables with noise control considerations:**

  - Perform installation and wiring that segregates system parts that may likely become noise sources and system parts that are susceptible to noise. Segregation can be achieved by measures such as segregating by distance, installing a filter or segregating the grounding system.

- **Configure for CE Marking Conformance:**

  - For compliance to CE Marking, perform installation and cable routing according to the description on compliance to CE Marking in the "Hardware Manual" (IM 34M06C11-01E).

  - The list of CE conforming models is available in Appendix A2. of "Hardware Manual".

- **Keep spare parts on hand:**

  - We recommend that you stock up on maintenance parts, including spare modules, in advance.

  - Preventive maintenance (replacement of the module) is required for using the module beyond 10 years.

- **Discharge static electricity before touching the system:**

  - Because static charge can accumulate in dry conditions, first touch grounded metal to discharge any static electricity before touching the system.

- **Wipe off dirt with a soft cloth:**

  - Gently wipe off dirt on the product's surfaces with a soft cloth.

  - If you soak the cloth in water or a neutral detergent, tightly wring it out before wiping the product. Letting water enter the module interior can cause malfunctions.

  - Do not use volatile solvents such as benzine or paint thinner or chemicals for cleaning, as they may cause deformity, discoloration, or malfunctioning.

- **Avoid storing the FA-M3 /e-RT3 controller in places with high temperature or humidity:**

  - Since the CPU module has a built-in battery, avoid storage in places with high temperature or humidity.

  - Since the service life of the battery is drastically reduced by exposure to high temperatures, take special care (storage surrounding air temperature should be from -20°C to 75°C).

  - There is a built-in lithium battery in a Sequence CPU module which serves as backup power supply for programs, device information and configuration information.

    The service life of this battery is more than 10 years in standby mode at room temperature. Take note that the service life of the battery may be shortened when installed or stored at locations of extreme low or high temperatures. Therefore, we recommend that modules with built-in batteries be stored at room temperature.

- **Always turn off the power before installing or removing modules:**

  - Failing to turn off the power supply when installing or removing modules, may result in damage.

- **Do not touch components in the module:**

  - In some modules you can remove the right-side cover and install ROM packs or change switch settings. While doing this, do not touch any components on the printed-circuit board, otherwise components may be damaged and modules may fail to work.

- **Do not use unused terminals:**
  - Do not connect wires to unused terminals on a terminal block or in a connector. Doing so may adversely affect the functions of the module.

- **Use the following power source:**
  - Use only F3PU□□-□□ as the power supply module.
  - If using this product as a UL-approved product, for the external power supply, use a limited voltage / current circuit power source or a Class 2 power source.
  - If using this product as a CE-complied product, for the external power supply, use a SELV and limited-energy circuit separated by reinforced insulation or double insulation from hazardous voltage.

- **Refer to the user's manual before connecting wires:**
  - Refer to the "Hardware Manual" (IM 34M06C11-01E) or the applicable user's manual for the external wiring drawing.
  - Refer to "A3.6.5 Connecting Output Devices" in the "Hardware Manual" before connecting the wiring for the output signal.
  - Refer to "A3.5.4 Grounding Procedure" in the "Hardware Manual" for attaching the grounding wiring.

- **Authorized Representative:**
  - The Authorized Representative for this product in the EEA is:

    Yokogawa Europe B. V.

    Euroweg 2, 3825 HD Amersfoort, The Netherlands

■ General Requirements for Using the FA-M3 Slave Units (TAH Series)

● Connect YHLS cable to SHIELD terminal:

- Connect the DRAIN line of the YHLS cable to the SHIELD terminal of the YHLS master module securely. Failing to do so may affect the performance of the YHLS system.

● Do not touch components in the unit:

- Do not remove the back cover of the unit. Doing so may cause a failure.

■ Waste Electrical and Electronic Equipment

Waste Electrical and Electronic Equipment (WEEE), Directive
(This directive is only valid in the EU.)

This product complies with the WEEE Directive marking requirement.
The marking indicates that you must not discard this electrical/electronic
product in domestic household waste.

Product Category

With reference to the equipment types in the WEEE directive, this product is classified
as a "Monitoring and Control instruments".
When disposing of products in the EU, contact your local Yokogawa Europe B. V. office.
Do not dispose of this product in domestic household waste.

■ How to dispose the batteries

This is an explanation about the new EU Battery Directive. This directive is only valid in
the EU.
Batteries are included in some modules of this product. The procedure is different when
the user can remove or cannot remove.

① Batteries the user can remove

The battery of F3RP6□ and F3RP7□ can be removed by yourself.
When you remove the battery from F3RP6□ and F3RP7□ and dispose it, discard
them in accordance with domestic law concerning disposal. See the User's Manual
of F3RP6□ and F3RP7□ for the removal procedure. Take a right action on waste
batteries, because the collection system in the EU on waste batteries are
regulated. If you don't remove the battery from this product, please see ②.

② Batteries the user cannot remove

Dispose the battery together with this product.
When you dispose this product in the EU, contact your local Yokogawa Europe
B.V.office.
Do not dispose them as domestic household waste.

Battery category: Lithium battery

Note: With reference to Annex II of the new EU Battery Directive, the above symbol
indicates obligatory separate collection.

Introduction

■ Purpose of the Manual

This manual contains the information on how to use e-RT3 OS-free CPU module (model: F3RP70-2L).

F3RP70 is an open controller that is equipped with a boot loader only. It allows its users to construct a flexible system, including the operating system (OS).

This manual mainly describes the features provided by F3RP70 as well as how to construct and operate the system with F3RP70.

■ Overview of the Manual

This manual contains the description on the features provided by F3RP70 and how to use F3RP70.

It describes the features offered by the boot loader of F3RP70 and the information necessary to use the boot loader.

■ Other Instruction Manuals

● Common manuals

- e-RT3 CPU Module (F3RP7□) Hardware Manual (IM 34M06M52-01E)

- e-RT3 CPU Module (SFRD□2) BSP Common Function Manual (IM 34M06M52-02E)

Copyrights and Trademarks

■ Copyrights

The copyright of the programs and online manuals contained in the software medium of the Software Product shall remain in YOKOGAWA.

You are allowed to print the required pages of the online manuals for the purposes of using or operating the Product; however, reprinting or reproducing the entire document is strictly prohibited by the Copyright Law.

Except as stated above, no part of the online manuals may be reproduced, transferred, sold, or distributed to a third party in any manner (either in electronic or written form including, without limitation, in the forms of paper documents, electronic media, and transmission via the network). Nor it may be registered or recorded in the media such as films without permission.

■ Trademarks

The trade names and company names referred to in this manual are either trademarks or registered trademarks of their respective companies.

Blank Page

e-RT3 OS-free CPU Module (F3RP70)
Startup Manual

IM 34M06M52-25E   1st Edition

CONTENTS

1. F3RP70

1.1 Overview

This module is one of the models in the e-RT3 CPU modules. It incorporates a boot loader only and allows its users to construct a flexible system, including the operating system (OS).

After this module is turned on, the boot loader starts its operation, initializing hardware and e-RT3/FA-M3 modules. The boot loader of this module provides the features of starting the OS according to the setup parameters and self-diagnosing the module, based on the state of the MODE switch. For details on the boot loader, refer to "2. Boot loader".

■ Features

● Open controller

This product is a CPU module that has U-Boot only. The user can use various OS that are bootable from U-boot.

● Support for e-RT3/FA-M3 modules

The recognition and initialization operations of e-RT3/FA-M3 modules, such as sequence CPU modules and I/O modules, are performed when the boot loader is started.
Access to modules from the OS is possible by using or porting the kernel source code for Linux that is available on the e-RT3 website.

● Usability

Yokogawa provides bootable OS on this module for easy use. The OS images available on the e-RT3 website allow you to start development early.
For details on the OS provided, refer to the information on the website.

2. Boot loader

This chapter describes the boot loader that is pre-installed in this module. The bootloader with F3RP70-specific features added to the U-Boot 2019.04 base is embedded. It can start an operating system that supports U-Boot, such as Linux.
U-Boot is a boot loader that is widely used in embedded products, offering various features, including branching of the startup mode and specification of environment variables by means of commands.

Note

For details on the operations, environment variables, and commands of U-Boot, visit the following website:
URL: http://www.denx.de/wiki/U-Boot/WebHome

● Operation overview

The figure below shows an overview of the boot loader operations. The solid lines in the figure represent the operations performed by the boot loader.
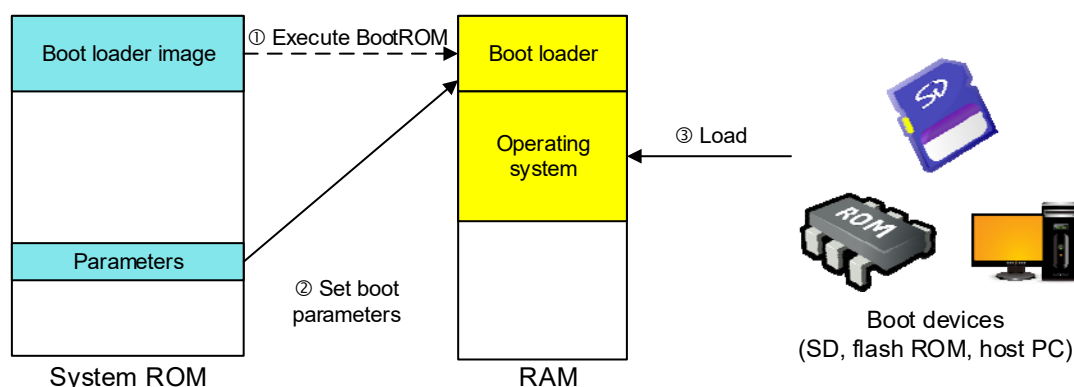

Figure 2.1   Overview of the boot loader operations

After the power is turned on, an instruction called BootROM is executed on the system ROM. BootROM loads the boot loader into RAM and runs it.
The boot loader initializes the necessary devices and memory, and then gets the boot parameters for starting the operating system. Then OS gets the information and files necessary to start according to the boot parameters, and runs the startup operation.

● Building an environment that allows the use of a serial console

To edit an environment variable, or check the boot log of the boot loader, you need to use a serial console from the development PC. You can use the serial console by

connecting between the development PC and this module via an RS-232C cable and starting terminal software (such as Tera Term) on the development PC. The following figure shows a connection diagram and the table lists the settings of the terminal software.
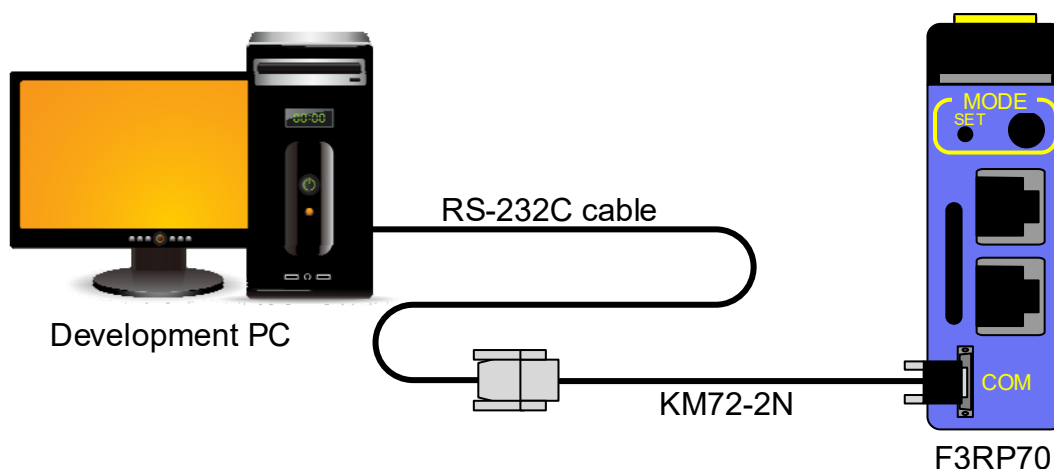

Figure 2.2   Serial connection

Table 2.1   Serial communication settings

Item	Setting value
Baud rate	115,200 bps
Data bit length	8 bits
Stop bit	1 bit
Parity bit	None
Flow control	None

Note

You need RS-232C conversion cable KM72-2N to connect the RS-232C cable to the COM port of this module. Use of the conversion cable converts the connector of the RS-232C cable into the 9-pin D-sub male connector. If you use a commercially available RS-232C cable, then use an interlink cross (reverse) cable with the 9-pin D-sub female connectors on both ends.

2.1 Startup modes

This section describes the startup mode of this module. The startup mode is a mechanism through which various features can be provided according to the state of the MODE switch at the front of this module.

The type of startup mode to be executed is the one assigned to the specified MODE switch number when the power is turned on or when this module restarts after being reset.
There are four types of startup modes. Of the 16 MODE switch numbers ranging from 0 to F, numbers other than 0, 1, 9, and B are reserved and therefore not available for use.

Table 2.2   Startup modes

SW	Startup mode	Description
0	User-Specified Startup	The module operates according to the startup parameters.
1	Command Mode	The module enters the command entry mode of the boot loader.
2 ~ 8	Reserved	
9	Parameter Initialization	The environment variables of the boot loader are initialized.
A	Reserved	
B	Self-Diagnosis	The hardware is self-diagnosed.
C ~ F	Reserved	

Note

Do not change the MODE switch until the action in each startup mode is finished. If you change the MODE switch during startup mode action, an action in a different startup mode may be performed.

2.1.1　User-Specified Startup (MODE switch: 0)

This mode is used to start the module according to the information specified by the user-specified environment variable "autoboot". By default, Command Mode is activated without any action. Configure the "autoboot" environment variable to suit the actions you use.

When the User-Specified Startup mode begins, the timer starts counting down from the value specified by the "bootdelay" setting value, waiting for the key input from the console. If the timer expires without any key input being made, this module is started in accordance with the "autoboot" setting values. If a key input is made, this module immediately enters Command Mode.

In this mode, you can import environment variables from the text file (uEnv.txt) in the SD memory card.

Note

Environment variables can be stored in system ROM using a U-boot command. For details on the environment variable operation commands, refer to "2.4 Bootloader commands".

● **How to use the environment variable setting file (uEnv.txt)**

"uEnv.txt" is a text file used to import the environment variables for the boot loader from the SD memory card.

When User-Specified Startup begins, "uEnv.txt" text file in the SD memory card inserted into the SD memory card slot are imported. The text file is searched for at SD slot 1 and then SD slot 2 in this order. The boot loader works according to the information in the text file that is found first.

The following coding rules apply:
- Each environment variable is specified in the format of:
  <variable name>=<value>.
- No space is allowed before and after the equal sign (=).
- Specify one variable per line. Use a backslash (\) to divide a long pair of a variable name and value into several lines.

Example (how to specify "board_name")
　Correct: board_name=f3rp7x
　Incorrect: board_name = f3rp7x ← A space is found before and after the equal
　　　　　　　　　　　　　　　　　sign (=).

Note

For details on the environment variables relating to startup, refer to "2.3 Environment variables".

2.1.2 Command Mode (MODE switch: 1)

This startup mode is used mainly to view or set up environment variables. This mode is also activated when there is a key input while the timer is counting down during User-Specified Startup.

Executable commands are the original commands available for the boot loader (U-Boot) and F3RP70-specific commands. If this module starts in Command Mode, the following boot prompt shows up on the console, waiting for command input:

f3rp7x>

To show the list of commands that can be executed with U-Boot, enter "?" or "help" on the console:

f3rp7x> ?

Note

For details on the F3RP70-specific commands and environment variable operation commands, refer to "2.4 Boot loader commands". If you want to know the details on U-Boot commands, visit the following website:
    URL: http://www.denx.de/wiki/U-Boot/WebHome

2.1.3 Parameter Initialization (MODE switch: 9)

This mode is used to initialize the environment variables for the boot loader. After the initialization is complete, the U-Boot Command Mode is activated.

Note

After the initialization is complete, environment variables stored in system ROM is removed.

2.1.4 Self-Diagnosis (MODE switch: B)

This startup mode is used to check hardware for any abnormalities. Diagnostic tests begin as soon as the startup mode is executed. When all the tests are complete, the U-Boot Command Mode is activated. The diagnostic test result is presented on the console output, or by the LED indicator at the front of the module. If any error is found, the ERR LED is turned on.

The following table lists test items provided by the self-diagnosis feature and the conditions under which the LED indicators light up.

Table 2.3   Test items and the conditions under which the LED indicators light up

Test name	Test description	ALM LED	ERR LED	Illumination condition
Battery	Battery voltage measurement test	--	ON	The LED is turned on if the self-diagnosis fails to measure the voltage value. The voltage value obtained is not evaluated.
CPU temperature	Measurement test of the temperature inside the case/CPU temperature	--	ON	The LED is turned on if a measured value is beyond the upper or lower limit.
Power supply voltage	Various power supply voltage tests inside the CPU module	--	ON	The LED is turned on if a measured value is beyond the upper or lower limit.
LED	Test all LEDs, except for the RDY LED, to see if they blink 10 times.	--	--	A visual check is required. Error if at least one LED does not blink.
FPGA	FPGA test	--	--	No LEDs are turned on. The module ID and revision are indicated.
RTC	Readout test of the specified RTC time	--	--	No LEDs are turned on. The RTC works normally if the specified time is indicated.

The following is a log when the F3RP70 module passed all the test items provided by the self-diagnosis feature:

===== Start Diagnostics =====

   - Battery check: 2859[mV]

   - Inside temperature check: 44[deg]

   - Temperature TJ check test pass

   - Power supply VCCPINT check test pass

   - Power supply VCCPAUX check test pass

   - Power supply VCCDDRO check test pass

   - Power supply VCCINT check test pass

   - Power supply VCCAUX check test pass

   - Power supply VCCBRAM check test pass

   - Power supply V0P75 check test pass

   - Power supply V1P2 check test pass

   - Power supply V3P3 check test pass

   - Power supply VCC5 check test pass

   - Power supply V3PSP check test pass

- **LED blink test is done**
- **FPGA Module ID check: 1**
- **FPGA Revision check: B08**
- **RTC read check: 2020-03-06 05:45:44**

===== Done =====

2.2 Starting the operating system

U-Boot loads the operating system (OS) and setting files from a boot device to start the OS.

Note

The OS to be started must support U-Boot. An example includes Linux. Necessary files and setting information vary depending on the OS. Refer to the manual of your operating system.

2.2.1 Boot devices

The boot devices used for this product refer to devices in which the OS is stored. This module can load an OS from various devices, such as an SD memory card, flash ROM, and network server, into RAM.
This subsection shows and describes some examples of commands for loading the OS from boot devices.

● SD memory card

You can load a file on a FAT- or ext4-formatted SD memory card into RAM by using the fatload, ext4load, or other commands.
The SD memory card is recognized as an mmc device, with SD slot 1 as mmc0 and slot 2 as mmc1.

The following shows an example of loading the "image.bin" file on ext4-formatted partition 2 in the SD memory card inserted into SD slot 1 into work memory 0x20000000.

```
f3rp7x> printenv workmem
workmem=0x2000000
f3rp7x> ext4load mmc 0:2 ${workmem} image.bin
16384 bytes read in 0 ms
f3rp7x>
```

Note

For details on the SD memory card available in this product, refer to "e-RT3 CPU Module (F3RP7☐) Hardware Manual" (IM 34M06M52-01E).

● Flash ROM

Flash ROM is accessible as memory. This module has a flash ROM area from 0x60000000 to 0x6FFFFFFF.

The user can use the above 256-MB area freely.

The following shows an example of loading 16384 bytes of data from the beginning of flash ROM into work memory 0x20000000:

```
f3rp7x> printenv workmem
workmem=0x2000000
f3rp7x> cp.b 0x60000000 ${workmem} 16384
16384 bytes read in 1 ms
f3rp7x>
```

You can also use memory copy to write data into the flash ROM.
Load a file from an SD memory card or network server into RAM, erase the area where data is written to, and run the memory copy.

The following shows an example of loading data from an SD memory card into the work memory and writing it to the flash ROM:

```
f3rp7x> printenv workmem
workmem=0x2000000
f3rp7x> fatload mmc 0:1 ${workmem} image.bin
16384 bytes read in 9 ms (1.7 MiB/s)
f3rp7x> erase 0x60000000 0x6001FFFF

. done
Erased 1 sectors
f3rp7x> cp.b ${workmem} 0x60000000 16384
Copy to Flash... 2....1....done
f3rp7x>
```

● **Network server**

You can load a file on an NFS server or tftp server into RAM by using the nfs, tftpboot, or other commands.

The following shows an example of loading the "/srv/nfsroot/image.bin" file available on the NFS server (192.168.3.1) into work memory 0x20000000:

```
f3rp7x> printenv workmem
workmem=0x2000000
f3rp7x> setenv ipaddr 192.168.3.72
f3rp7x>
f3rp7x> setenv serverip 192.168.3.1
f3rp7x>
```

```
f3rp7x> nfs ${workmem} /srv/nfsroot/image.bin
Using ethernet@e000b000 device
TFTP from server 192.168.3.1; our IP address is 192.168.3.72
Filename '/srv/nfsroot/image.bin'.
Load address: 0x2000000
Loading: ##
      2 MiB/s
done
Bytes transferred = 16384 (4000 hex)
f3rp7x>
```

The following shows an example of loading the "image.bin" file available on the tftp server (192.168.3.1) into work memory 0x20000000:

```
f3rp7x> printenv workmem
workmem=0x2000000
f3rp7x> setenv ipaddr 192.168.3.72
f3rp7x>
f3rp7x> setenv serverip 192.168.3.1
f3rp7x>
f3rp7x> tftpboot ${workmem} image.bin
Using ethernet@e000b000 device
TFTP from server 192.168.3.1; our IP address is 192.168.3.72
Filename 'image.bin'.
Load address: 0x2000000
Loading: ##
      2 MiB/s
done
Bytes transferred = 16384 (4000 hex)
f3rp7x>
```

Note

The access methods and commands listed above are just examples.
For details on the operations, environment variables, and commands of U-Boot, visit the following website:
    URL: http://www.denx.de/wiki/U-Boot/WebHome

2.2.2   Boot command

The OS is started after copied from the boot device to the memory.
To start the OS, use the bootm command.

The following shows an example of loading the Linux kernel into work memory 0x20000000 and the device tree into 0x2a000000 from an SD memory card:

```
f3rp7x> ext4load mmc 1:2 0x20000000 /boot/vmlinuz-xxx
4141456 bytes read in 199 ms (19.8 MiB/s)
f3rp7x> ext4load mmc 1:2 0x2a000000 /dtbs/xxx.dtb
14656 bytes read in 8 ms (1.7 MiB/s)
f3rp7x> bootm 0x200000 - 0x2a000000
## Booting kernel from Legacy Image at 02000000 ...
...
```

Note

The above commands are just an example of using the bootm command. Other environment variables must be configured to actually start the Linux OS.

2.3   Environment variables

This section describes F3RP70-specific environment variables used by the boot loader.

Note

An OS uses different types of environment variables. For details on the environment variables needed for startup, refer to the manual of your OS.

● **List of environment variables**

Table 2.4   List of environment variables

Item	Environment variable	Description	Initial value
User-Specified Startup	autoboot	Boot parameter for User-Specified Startup.	run $modeboot
	bootdelay	Countdown time to User-Specified Startup. Range: -2 to 10 (seconds) Note: If it is set to -1, Command Mode is activated. If it is set to -2, the countdown timer is disabled.	3
Shared Device*1	nonvolatile_er	Is used to choose whether you use the backup feature of a shared device*1. 0: Not used 1: Used	0

*1:   For details on the shared device, refer to "e-RT3 CPU Module (SFRD□2) BSP Common Function Manual" (IM 34M06M52-02E).

● **autoboot setting**

"autoboot" is the boot parameter for User-Specified Startup (MODE switch: 0) and is executed upon startup. By default, Command Mode is activated without any action. You can change the setting value arbitrarily by using the boot loader commands or the environment variable setting file (uEnv.txt).

Note

For details on "uEnv.txt", refer to "How to use the environment variable setting file (uEnv.txt)" in "2.1.1 User-Specified Startup (MODE switch: 0)".

● **nonvolatile_er setting**

This setting value is used to enable or disable the backup feature of shared devices. The shared devices are available by using or porting the kernel source code for Linux that is exposed on the e-RT3 website.

2.4 Boot loader commands

This section describes boot loader commands for this module. You can run the boot loader commands in Command Mode, which is a startup mode activated by MODE switch 1.
This module offers various commands. This section focuses only on F3RP70-specific commands and environment variable operation commands.

Note

For details on U-Boot commands, visit the following website:
URL: http://www.denx.de/wiki/U-Boot/WebHome

2.4.1 F3RP70-specific commands

This subsection describes F3RP70-specific commands.

● **f3_sw: Loads the MODE switch**

Syntax: f3_sw <env>
env: Sets the loaded value for the f3_mode environment variable.

This command loads the value of the MODE switch.
When the env option is specified, the loaded value is set for the f3_mode environment variable.

```
f3rp7x> f3_sw
MODE switch : 0x0
f3rp7x> printenv f3_mode
## Error: "f3_mode" not defined
f3rp7x>
f3rp7x> f3_sw env
f3rp7x> printenv f3_mode
f3_mode=0
f3rp7x>
```

● **f3_diag: Self-diagnosis**

Syntax: f3_diag [bat/temp/pwr/led/fpga/rtc/all]
bat: Self-diagnoses the battery.
temp: Self-diagnoses the CPU temperature.
pwr: Self-diagnoses the power supply voltage.
led: Self-diagnoses the LEDs.
fpga: Self-diagnoses the FPGA.
rtc: Self-diagnoses the RTC.

all: Self-diagnoses all the items indicated above.

Note

For details on the self-diagnosis, refer to "2.1.4 Self-Diagnosis (MODE switch: B)".

The following shows an example of running the commands:

```
f3rp7x> f3_diag
f3_diag - F3RP7X diagnostics

Usage:
f3_diag [bat/temp/pwr/led/fpga/rtc/all]
     bat    : Battery check
     temp   : Temperature check
     pwr    : Power Supply check
     led    : LED check
     fpga   : FPGA check
     rtc    : Real Time Clock check
     all    : Do all checks

f3rp7x>
f3rp7x> f3_diag bat

===== Start Diagnostics =====

   - Battery check: 2842[mV]

===== Done =====

f3rp7x>
f3rp7x> f3_diag temp

===== Start Diagnostics =====

   - Inside temperature check: 43[deg]
   - Temperature TJ check test pass

===== Done =====
```

```
f3rp7x>
f3rp7x> f3_diag pwr

===== Start Diagnostics =====

   - Power supply VCCPINT check test pass
   - Power supply VCCPAUX check test pass
   - Power supply VCCDDRO check test pass
   - Power supply VCCINT check test pass
   - Power supply VCCAUX check test pass
   - Power supply VCCBRAM check test pass
   - Power supply V0P75 check test pass
   - Power supply V1P2 check test pass
   - Power supply V3P3 check test pass
   - Power supply VCC5 check test pass
   - Power supply V3PSP check test pass

===== Done =====

f3rp7x>
f3rp7x> f3_diag led

===== Start Diagnostics =====

   - LED blink test is done

===== Done =====

f3rp7x>
f3rp7x> f3_diag fpga

===== Start Diagnostics =====

   - FPGA Module ID check: 1
   - FPGA Revision check: B08

===== Done =====

f3rp7x>
```

```
f3rp7x> f3_diag rtc

===== Start Diagnostics =====

   - RTC read check: 2020-03-06 06:05:15

===== Done =====

f3rp7x>
```

2.4.2　Environment variable operation commands

This subsection describes commands used to operate the boot loader environment variables.

● **printenv: Reference command**

Syntax:　printenv [*name*]
name:　　Name of the environment variable you want to view

This command shows the environment variable specified by [*name*]. It shows all the environment variables if [*name*] is not specified.

Example: board_name
f3rp7x> printenv board_name

board_name=f3rp7x

f3rp7x>

● **setenv: Setup command**

Syntax:　setenv [*name*] [*value*]
name:　　Name of the environment variable you set up
value:　　Setting value

This command sets the environment variable specified for *name* to *value*. If *value* is not specified, the applicable environment variable is removed.
Note that if an incorrect environment variable name is specified, it is added as a new variable.

Example: board_name
f3rp7x> setenv board_name f3rp70

f3rp7x> printenv board_name

board_name=f3rp70

f3rp7x>

● **saveenv: Save command**

Syntax:　saveenv

This command saves all the current environment variables to the system ROM.

Example:
f3rp7x> saveenv

Saving Environment to SPI Flash... Erasing SPI flash...Writing to SPI flash...done

OK

f3rp7x>

● **env default: Command to initialize an environment variable**

Syntax: env default [*name*]
name: Name of the environment variable you initialize

This command initializes the environment variable specified in *name*. It can initialize only variables that have been set up in the factory. Note that if a variable added by the user is specified, it is removed.
The setting is not applied to the system ROM when this command is run. To save the setting, run the saveenv command.

Note

To initialize all environment variables, execute the Parameter Initialization (MODE switch: 9) startup mode.

Example: board_name
f3rp7x> printenv board_name
board_name=f3rp70
f3rp7x> env default board_name
f3rp7x> printenv board_name
board_name=f3rp7x
f3rp7x>

3.   Troubleshooting

This chapter provides some troubleshooting information for this module.
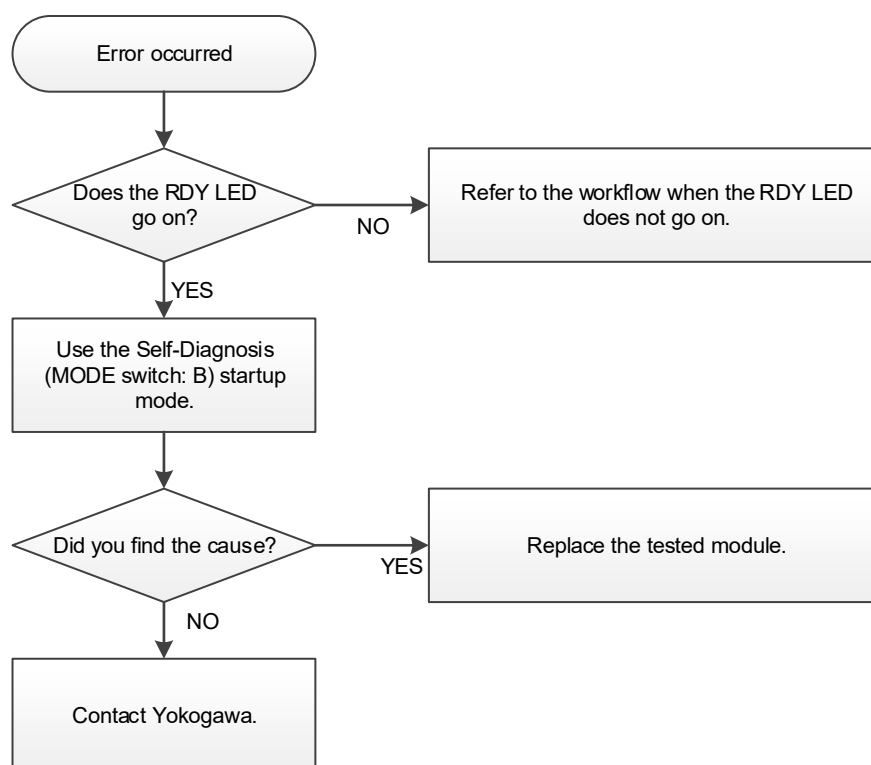

Figure 3.1   Troubleshooting for F3RP70

Note

For details on how to use the Self-Diagnosis (MODE switch: B) startup mode, refer to "2.1.4 Self-Diagnosis (MODE switch: B)".

3.1　When the RDY LED does not go on

The following figure shows the workflow when the RDY LED does not go on.

The RDY LED does not go on

Is the specified voltage applied to the power supply module? — NO → Check the module configuration.

YES

Is the module inserted into the slot correctly? — NO → Check the module configuration.

YES

Is the module configuration correct? — NO → Use the proper slot configuration of the module.

YES

Do the RDY LEDs go on in other modules? — NO → Replace the power supply module or base module.

YES

Is the RDY LED still off when the module is inserted into another slot? — NO → Replace the base module.

YES
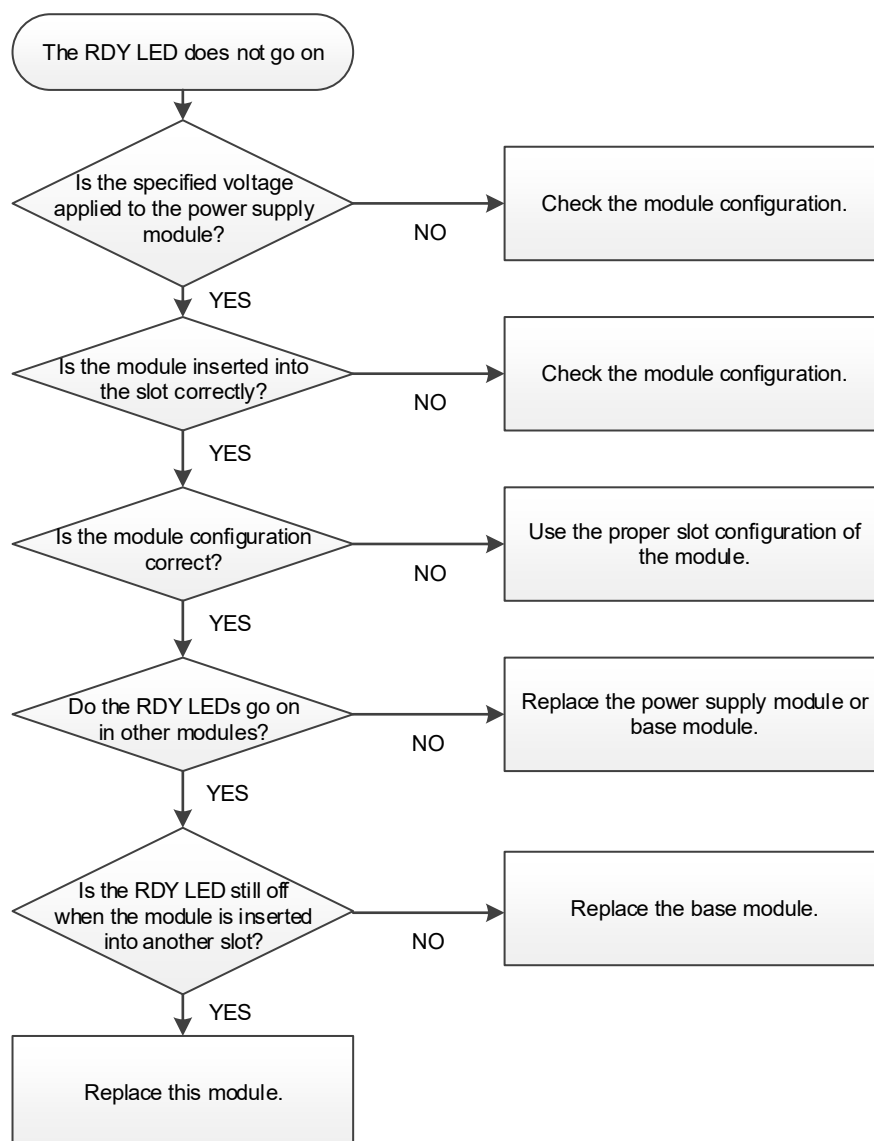
Replace this module.

Figure 3.2　Workflow when the RDY LED does not go on

Revision Information

Title   : e-RT3 OS-free CPU Module (F3RP70) Startup Manual
Document No. : IM 34M06M52-25E

Apr. 2020 / 1st Edition
   New Publication

Blank Page