USER GUIDE



Qseven-Q7AMX7

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QSEVEN-Q7AMX7 - USER GUIDE

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Revision History

Revision	Brief Description of Changes Date of Issue	
1.0	Initial version 20	

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Symbols

The following symbols may be used in this user guide

ADANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

▲WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

NOTICE

NOTICE indicates a property damage message.

ACAUTION

CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.



Electric Shock!

This symbol and title warn of hazards due to electrical shocks (> 60 V) when touching products or parts of products. Failure to observe the precautions indicated and/or prescribed by the law may endanger your life/health and/or result in damage to your material.



ESD Sensitive Device!

This symbol and title inform that the electronic boards and their components are sensitive to static electricity. Care must therefore be taken during all handling operations and inspections of this product in order to ensure product integrity at all times.



HOT Surface!

Do NOT touch! Allow to cool before servicing.



Laser!

This symbol inform of the risk of exposure to laser beam and light emitting devices (LEDs) from an electrical device. Eye protection per manufacturer notice shall review before servicing.



This symbol indicates general information about the product and the user guide.

 $This \ symbol \ also \ indicates \ detail \ information \ about \ the \ specific \ product \ configuration.$



This symbol precedes helpful hints and tips for daily use.

For Your Safety

Your new Kontron product was developed and tested carefully to provide all features necessary to ensure its compliance with electrical safety requirements. It was also designed for a long fault-free life. However, the life expectancy of your product can be drastically reduced by improper treatment during unpacking and installation. Therefore, in the interest of your own safety and of the correct operation of your new Kontron product, you are requested to conform with the following guidelines.

High Voltage Safety Instructions

As a precaution and in case of danger, the power connector must be easily accessible. The power connector is the product's main disconnect device.

ACAUTION

Warning

All operations on this product must be carried out by sufficiently skilled personnel only.

ACAUTION

Electric Shock!



Before installing a non hot-swappable Kontron product into a system always ensure that your mains power is switched off. This also applies to the installation of piggybacks. Serious electrical shock hazards can exist during all installation, repair, and maintenance operations on this product. Therefore, always unplug the power cable and any other cables which provide external voltages before performing any work on this product.

Earth ground connection to vehicle's chassis or a central grounding point shall remain connected. The earth ground cable shall be the last cable to be disconnected or the first cable to be connected when performing installation or removal procedures on this product.

Special Handling and Unpacking Instruction

NOTICE

ESD Sensitive Device!



Electronic boards and their components are sensitive to static electricity. Therefore, care must be taken during all handling operations and inspections of this product, in order to ensure product integrity at all times.

Do not handle this product out of its protective enclosure while it is not used for operational purposes unless it is otherwise protected.

Whenever possible, unpack or pack this product only at EOS/ESD safe work stations. Where a safe work station is not guaranteed, it is important for the user to be electrically discharged before touching the product with his/her hands or tools. This is most easily done by touching a metal part of your system housing.

It is particularly important to observe standard anti-static precautions when changing piggybacks, ROM devices, jumper settings etc. If the product contains batteries for RTC or memory backup, ensure that the product is not placed on conductive surfaces, including anti-static plastics or sponges. They can cause short circuits and damage the batteries or conductive circuits on the product.

Lithium Battery Precautions

If your product is equipped with a lithium battery, take the following precautions when replacing the battery.

ACAUTION

Danger of explosion if the battery is replaced incorrectly.

- Replace only with same or equivalent battery type recommended by the manufacturer.
- Dispose of used batteries according to the manufacturer's instructions.

General Instructions on Usage

In order to maintain Kontron's product warranty, this product must not be altered or modified in any way. Changes or modifications to the product, that are not explicitly approved by Kontron and described in this user guide or received from Kontron Support as a special handling instruction, will void your warranty.

This product should only be installed in or connected to systems that fulfill all necessary technical and specific environmental requirements. This also applies to the operational temperature range of the specific product version that must not be exceeded. If batteries are present, their temperature restrictions must be taken into account.

In performing all necessary installation and application operations, only follow the instructions supplied by the present user guide.

Keep all the original packaging material for future storage or warranty shipments. If it is necessary to store or ship the product then re-pack it in the same manner as it was delivered.

Special care is necessary when handling or unpacking the product. See Special Handling and Unpacking Instruction.

Quality and Environmental Management

Kontron aims to deliver reliable high-end products designed and built for quality, and aims to complying with environmental laws, regulations, and other environmentally oriented requirements. For more information regarding Kontron's quality and environmental responsibilities, visit http://www.kontron.com/about-kontron/corporate-responsibility/quality-management.

Disposal and Recycling

Kontron's products are manufactured to satisfy environmental protection requirements where possible. Many of the components used are capable of being recycled. Final disposal of this product after its service life must be accomplished in accordance with applicable country, state, or local laws or regulations.

WEEE Compliance

The Waste Electrical and Electronic Equipment (WEEE) Directive aims to:

- Reduce waste arising from electrical and electronic equipment (EEE)
- Make producers of EEE responsible for the environmental impact of their products, especially when the product be waste
- Encourage separate collection and subsequent treatment, reuse, recovery, recycling and sound environmental disposal of EEE
- Improve the environmental performance of all those involved during the lifecycle of EEE



Environmental protection is a high priority with Kontron.

Kontron follows the WEEE directive

You are encouraged to return our products for proper disposal.

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1/ Introduction

This user guide describes the Qseven® form factor module - Qseven-Q7AMX7. The Advanced RISC Machines (ARM) based module is equipped with a NXP i.MX7 processor. The single or dual core SoC takes advantage of the optimized power consumption and performance ratio.

The use of this user guide implies a basic knowledge of PC hardware and software. This user guide is focused on describing the special features and is not intended to be a standard PC textbook. New users are recommended to study the short installation procedure, before switching on the power.

All configuration and setup of the module is performed using the u-Boot CLI.

Latest revision of this user guide, datasheet, and BSPs (Board Support Packages) can be downloaded from Kontron Web Page.

2/ Product Description

The Qseven-Q7AMX7 is a Qseven® module, using the NXPs i.MX7 processor with either single or dual core ARM. The Qseven-Q7AMX7 is designed based on the latest Qseven 2.1 specification and is a highly integrated, embedded computer module.

2.1. Qseven® Computer-on-Module

The Qseven® standard was developed especially for new modules with ARM and SoC processors. Modules with this interface are characterized by the flat form factor. The Qseven® or MXM 2.0 connector comes with 230-pins and lowest construction height of 7.5 millimeters. The connector is also available in a shock and vibration resistant version for rough environmental conditions.

The standard integrates dedicated interfaces for the latest ARM and SoC processors and supports LVDS 24-bit. In addition, dedicated camera interfaces are available on module as an option. OEMs profit from minimized design effort and low Bill of Material (BoM) costs. Qseven® defines two different module sizes in order to offer a high level of flexibility regarding different mechanical requirements.

Figure 1: Qseven® Form Factor Module



The main Qseven-Q7AMX7 features are:

- Single/dual Cortex A7-Core based on NXP's processor i.MX7 solo with 800 MHz or i.MX7 dual with 1000 MHz
- Up to 2 GB DDR3L memory down
- 8 GB to 64 GB eMMC
- LVDS dual channel graphics
- MIPI CSI camera interface
- USB 2.0 On the Go (OTG)
- 5x USB 2.0 Host interface
- ► 1x SPI
- 3x General purpose I2C
- 1x Ethernet
- Dual and Dual only: 1x PCIe, optional 3x PCIe via bridge
- 8x GPIOs
- > 1x UART, 1x with 64 B FIFO
- 1x CAN Bus interface
- ► 1x SDIO
- 1x I2S
- APPROTECT (security chip) support

2.2. Qseven-Q7AMX7 Feature Set

The following table compares the Qseven-Q7AMX7 with the Qseven® 2.1 specification feature set.

Table 1: Qseven-Q7AMX7

Qseven® Feature Specification	Qseven® Specification Max.# possible	Qseven-Q7AMX7 Feature support	Description
LVDS Display support	Dual Channel	Dual Channel	Up to 1920x1080 display resolution
CSI Camera support	1	Yes	Dual lane
USB Interface	8 x USB 2.0 with 3 x USB 3.0 included	6x USB 2.0 with APPROTECT 5x	 - single core: 1x USB OTG port, 4x USB host ports (3x with WIBU key option/APPROTECT) - dual core: 1x USB OTG port, 5x USB host ports (4x with WIBU key option/APPROTECT)
PCle Interface	4	Yes	single core: 0 dual core: 1 or 3
GbE Interface	1	Yes	1
SDIO Interface	1	Yes	
SPI Interface	1	Yes	
I2S Interface	1	Yes	
I2C Interface	3	Yes	
CAN	1	Yes	
I/O Voltage (1.8 V) level support		No	
I/O Voltage (3.3 V) level support		Yes	

2.3. Product Variants

Table 2: Product Variants of Qseven-Q7AMX7

Module	Product Number	Description
Qseven-Q7AMX7 solo 1G/4S	81009-0104-08-1	Qseven 2.1 with Qualcom®/NXP single core i.MX7 processor, 1GB DDR3L memory down, 4GB eMMC SLC, extended consumer temperature
Qseven-Q7AMX7 dual 2G/85	81009-0208-10-2	Qseven 2.1 with Qualcom®/NXP single core i.MX7 processor, 2GB DDR3L memory down, 8GB eMMC SLC, extended consumer temperature
Qseven-Q7AMX7-dual-full 2G/32S	81009-0232-10-2-11	Qseven 2.1 with Qualcom®/NXP single core i.MX7 processor, 2GB DDR3L memory down, 32GB eMMC SLC, RTC and WiBu, extended consumer temperature

2.4. Accessories

Table 3: Accessories for the Qseven-Q7AMX7

Product Nam	е	Description
Qseven® Eval	. Carrier	Qseven® evaluation carrier board, based on Qseven® Design Specification Version 2.1.

3/ Installation Procedure

3.1. Packing Check List

The delivered package includes the following:

One Module

If this item is either damaged or missing, please contact your vendor and save all packing materials for future warranty shipments and storage.

Note: The above packing list is for standard single box packing only.

3.2. Requirements IEC60950-1

When designing chassis interface connectors, take care to fulfill the IEC60950-1 standard.

Users of the module must evaluate the end product to ensure compliance the requirements of the IEC60950-1 safety standard are met:

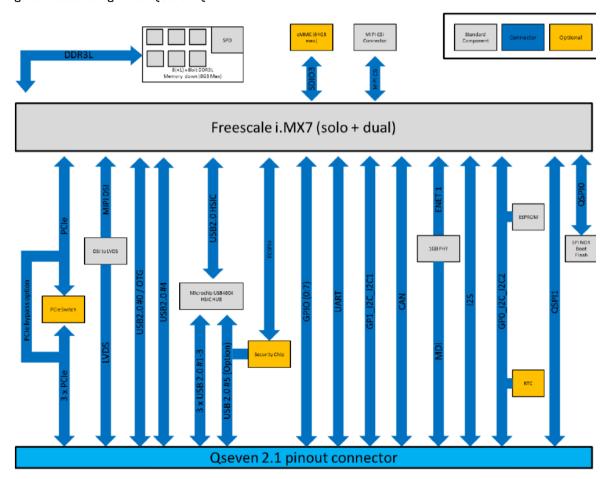
- The module must be installed in a suitable mechanical, electrical and fire enclosure.
- The module in its enclosure must be evaluated for temperature and airflow considerations.
- For interfaces having a power pin such as external power or fan, ensure that the connectors and wires are suitably rated. All connections from or to the product shall be with Safety Extra Low Voltage (SELV) circuits only.
- Wires have suitable rating to withstand the maximum available power.
- ▶ The enclosure of the peripheral device fulfills the fire protecting requirements of IEC60950-1.

4/ Product Specification

4.1. Block Diagram

The following figure displays the system block diagram applicable to the **Qseven-Q7AMX7** module.

Figure 2: Block Diagram of Qseven-Q7AMX7



4.2. Component Technical Data

The table below summarizes the module's features.

Table 4: Component Technical Data

Qseven-Q7AMX7	
Form factor	Qseven® 2.1 hardware with 70 mm x 70mm
Processor	Freescale/NXP/Qualcomm's i.MX7 28nm (solo and dual SKUs) with 19mm x 19mm BGA package in 0.75mm pitch (industrial version)
Memory	1600 MHz 32-bit DDR3L
	solo CPU: 1 GB 4x 2 Gbit 256 Mx8
	dual CPU: 2 GB 4x 4 Gbit 512 Mx8
Boot Flash	SPI NOR flash
u-Boot	Flash for u-Boot bootloader connected on SPIO. Two SPI package sizes are possible with two layout packages:
	SOIC-8 (up to 16 MB)
	WSON(6x8) (32 MB)
embedded	4 GB to 32 GB pseudo Single Level Cell (pSLC)
Multimedia Card (eMMC)	> 8 GB to 64 GB MLC Multi-level Cell (MLC)
EEPROM	Type: 24C32, 4 k x 8 (32k bit)
	Connected at I2C_INT bus at address 0x50 (7-bit)
Display	24-bit LVDS RGB (True Color) Resolution: 1920x1080 Pixel
On-board Controller	
Ethernet Controller	1x GBE PHY 88E1510PB2
ethernet controtter	A GBETTH GGETSTOLDZ
Watchdog Timer	CPU internal watchdog, configurable timeout counter with timeout periods from 0.5 to 128 seconds
USB HUB	USB HSIC 4 port Hub USB4604
PCI Switch	PCIe packet switch PI7C9X2G404SL
Display Bridge	MIPI DSI to LVDS Flatlink SN65DSI84ZQER
Real Time Clock (RTC)	High accuracy (+/-3%), low power, RV-8803
System	No dedicated System Management Controller on module System settings can be arranged
Management Controller	in U-Boot environment variables
Additional Features	
Storage	eMMC (See above for more information)
H/W Status Monitor	temperature monitoring sensor
Security	Security Chip (option), APPROTECT Key optional

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Power	Clock Control Module (CCM)
Management	General Power Controller (GPC)
	System Reset Controller (SRC)
Operating System	Linux Yocto
Support	
Interfaces via Qseve	n® I/O
I2C	3x I2C interfaces that are derived from the SoC:
	GP0_I2C General Purpose Use
	GP1_I2C General Purpose Use
	I2C_INT RTC, EEPROM, PCIE Switch, USB HSIC HUB, Camera Support
	GP2_I2C MIPI-DSI to LVDS Bridge & General Purpose
LAN, USB	1x Gb-Ethernet
	solo processor: 1x USB2.0 OTG and 1x USB2.0 High-Speed Inter-Chip (HSIC) 4-port USB Host hub
	dual processor: 1x USB2.0 OTG, 1x USB2.0 Host and 1x USB2.0 High-Speed Inter-Chip (HSIC) 4-port USB Host hub
PCIe	1x PCIe Standard configuration for dual core SKU,
	option for 3x PCle via bridge
Audio	1x Synchronous Audio Interface (SAI) configured as I2S
Display	MIPI-DSI to Dual-Channel LVDS bridge with TI SN65DSI84 (1000 Mbits/sec per DSI lane)
Camera	MIPI-CSI Camera Interface to Qseven® Camera Feature Connector
SD-Card	1x SDIO
UART	1x UART
Serial Peripheral Interface (SPI)	1x SPI
GPIO	8x General Purpose Inputs/Outputs (GPIO)
Other Connectivity	1x CAN
Power	
Consumption	Maximum Power consumption of the module is estimated to 10 W
Input Voltage	Wide range VCC (3.0 V to 5.25 V)

ACAUTION

Danger of explosion if the lithium battery is incorrectly replaced

- Replace only with the same or equivalent type recommended by the manufacturer
- Dispose of used batteries according to the manufacturer's instructions

4.2.1. Processor

The Qseven-Q7AMX7 uses a Freescale/NXP/Qualcomm's i.MX7 chip with 28 nm die. There are solo and dual SKUs with 19 mm \times 19 mm BGA package in 0.75 mm pitch available.

Table 5: Processor Support

Name	Speed	RAM.	Cache	TDP / Tj
Solo CPU: MCIMX7S5EVM08SC	0.8 GHz	1 GB	512 KB	2 W/-20°C to 85°C
Dual CPU: MCIMX7D5EVM10SC	1.0 GHz	2 GB	512 KB	4 W/-20°C to 85°C

4.2.2. System Memory

The memory system has one DDR3L. The DDR3LMemory Down supports the following memory features:

- > 32-bit data bus width (4 devices x8 bit)
- ► 1600 MHz (MT/s) clock (data rate)

Kontron offers the following memory modules:

Table 6: Memory Support

Product Number	Memory
81009-0104-08-1	1 GByte 2x 4 Gbit 256
[1061-9070 (solo)]	
81009-0208-10-2	2 GByte 4x 4 Gbit 512
[1061-9071 (dual)]	
81009-0232-10-2-11	2 GByte 4x 4 Gbit 512
[1061-9700 (dual full)]	

4.3. Environmental Condition and Standards & Approvals

The Qseven-Q7AMX7 module complies with the Standards and Directives mentioned in Table 7.

Table 7: Environmental Condition and Standards & Approvals

Environmentals	
Operating	Commercial grade: 0°C to +60°C Extended (E1): -20°C to 85°C Relative humidity: 93%, at +40°C, non-condensing (according to IEC 60068-2-78)
Storage	Commercial grade: -40°C to +85°C Extended (E1): -40°C to 85°C Relative humidity: 93%, at +40°C, non-condensing (according to IEC 60068-2-78)
Standards & Approvals	
Electromagnetic Compatibility (EMC) & Interference (EMI)	Emissions: Conducted in standard available chassis. Compliant to the requirements of EN55032:2012/AC:2013 class B / FCC part 15 class B Electromagnetic compatible – Emission standard for information technology equipment (ITE). External test in certified test laboratory and declaration of conformity written by Kontron Technology only. Immunity: Conducted in standard available chassis with Q7 carrier board. Compliant to the requirements of IEC/EN 61000-6-1:2007 Electromagnetic compatible – Generic immunity standard Part1: Residential, commercial and light industrial environment. Internal test and declaration of conformity only.
Safety	Component Recognition to IEC62368-1
Vibration/ Shock	According to: IEC/EN60068-2-64 IEC/EN60068-2-27
CE Marked	According to: Low voltage directive: 2006/95/EC
Theoretical MTBF	Not applicable
Restriction of Hazardous Substances (RoHS) II Compliance	The product will comply to the European Council Restriction of Hazardous Substances (RoHS) II Directive on the approximation of the laws of the member states relating to Directive 20011/65/EU or the last status thereof.

4.4. Module Views and I/O locations

Figure 3 : Top View – Qseven-Q7AMX7

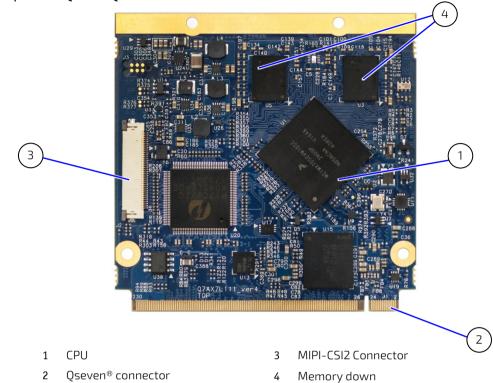
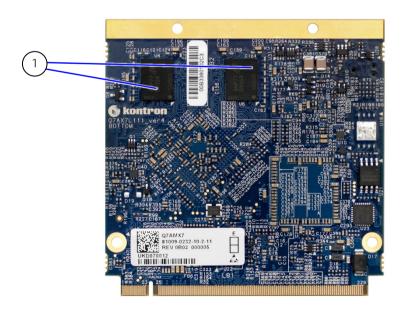


Figure 4 : Rear View – Qseven-Q7AMX7



1 Memory down

4.5. Mechanical Specification

4.5.1. Oseven-QAMX7 Mechanical Dimensions

Figure 5: Module Top Placement (measurements in mm)

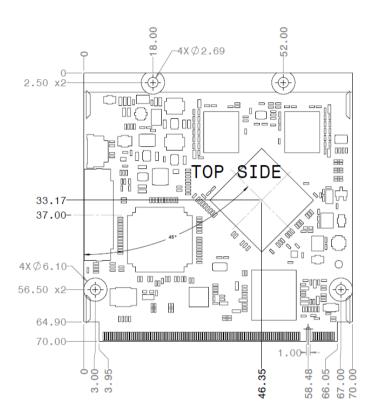
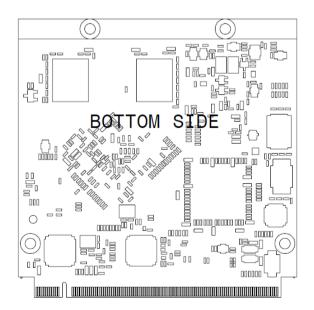
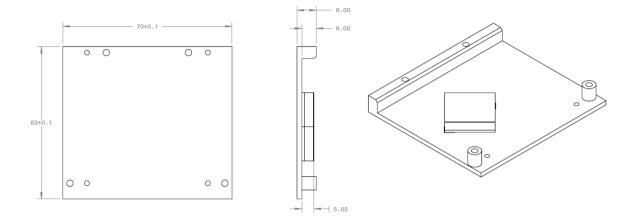


Figure 6: Module Bottom Placement (Mirrored) (measurements in mm)



4.5.2. Heat Spreader Mechanical Dimensions

Figure 7: Heat Spreader Part Number for 1062-0470



4.6. Thermal Management

A heatspreader plate assembly is available from Kontron for the Qseven-Q7AMX7. The heatspreader plate on top of this assembly is NOT a heat sink. It works as a QSEVEN-standard thermal interface to use with a heat sink or external cooling devices.

External cooling must be provided to maintain the heatspreader plate at proper operating temperatures. Under worstcase conditions, the cooling mechanism must maintain an ambient air and heatspreader plate temperature on any spot of the heatspreader's surface according the module specifications:

- ► 60°C for commercial grade modules
- > 75°C for extended temperature grade modules (E1)
- ▶ 85°C for industrial temperature grade modules (E2/XT)

The aluminum slugs and thermal pads or the heat-pipe on the underside of the heatspreader assembly implements thermal interfaces between the heatspreader plate and the major heat-generating components. About 80 % of the power dissipated within the module is conducted to the heatspreader plate and can be removed by the cooling solution. For documentation and CAD drawings of heatspreader and cooling solutions refer to: http://emdcustomersection.kontron.com.

5/ Features and Interfaces

5.1. Serial Peripheral Interface (SPI)

The Serial Peripheral Interface Bus (SPI bus) is a synchronous serial data link standard. Devices communicate in master/slave mode, where the master device initiates the data frame. Multiple slave devices are allowed with individual slave select (chip select) lines. SPI is sometimes called a four-wire serial bus, contrasting with three, two and one-wire serial buses.



No external BIOS/bootloader is available. Booting is only possible from the module SPI. The carrier SPI chip is accessible for read and write only.

5.2. SPI boot

The Qseven-Q7AMX7 only boots from the on-module SPI Flash (16 MB, 3.3 V serial external flash).

Table 8: SPI Boot Pin Configuration

Configuration	Function
Open	Boot on module

The following table lists the supported SPI Boot Flash types for the 8-SOIC package.

Table 9: Supported SPI Boot Flash Types for 8-SOIC Package

Size	Manufacturer	Part Number	Device ID
2MB	Winbond	W25Q16	0x90

5.3. Fast I2

Fast I2C supports transfer between components on the same board. The Qseven-Q7AMX7 features an embedded I2C controller connected to the LPC Bus.

The I2C controller supports:

- Multimaster transfers
- Clock stretching
- Collision detection
- Interruption on completion of an operation

5.4. UART

The UART implements a serial communication interface and supports the serial RX/TX ports defined in the Qseven® specification on pin-171 (UARTO_TX) and pin-177 (UARTO_RX) for UARTO. The UART controller is fully 16550A compatible.

UART features are:

- On-Chip bit rate (baud rate) generator
- With handshake lines
- Interrupt function to the host
- FIFO buffer for incoming and outgoing data

5.5. Dual Staged Watchdog Timer (WTD)

A watchdog timer (WDT) or (computer operating properly (COP) timer) is a computer hardware or software timer. If there is a fault condition in the main program, the watchdog triggers a system reset or other corrective actions. The intention is to bring the system back from the non-responsive state to normal operation.

Possible fault conditions are a hang, or neglecting to service the watchdog regularly. Such as writing a "service pulse" to it, also referred to as "kicking the dog", "petting the dog", "feeding the watchdog" or "triggering the watchdog".

The Qseven-Q7AMX7 offers a watchdog that works with two stages that can be programmed independently and used stage by stage.

0000ь	No action	The stage is off and will be skipped.
0001b	Reset	A reset restarts the module and starts a new POST and operating system.
0101b	Delay -> No action*	Might be necessary when an operating system must be started and the time for the first trigger pulse must be extended. Only available in the first stage.
1000b	WDT Only	This setting triggers the WDT pin on the Qseven® connector (pin-72) only.
1001b	Reset + WDT	
1010b	NMI + WDT	
1011b	SMI + WDT	
1100b	SCI + WDT	
1101b	DELAY + WDT -> No action*	

5.5.1. Watchdog Timer Signal

The Watchdog time-out event indicator (WDOUT, pin-72) on the Qseven® connector offers a signal that can be asserted when a watchdog timer has not been triggered within a set time. The WDT signal is configurable to any of the two stages. After reset, the signal is automatically deasserted. If deassertion is necessary during runtime, contact Kontron Support for further help.

5.5.2. Watchdog Trigger Signal

The watchdog trigger signal (WDTRIG#, pin-70) on the Qseven® connector restarts the Qseven® module's watchdog timer on the falling edge of a low active pulse.

5.6. Real Time Clock (RTC)

The RTC keeps track of the current time accurately. The RTC's low power consumption means that the RTC can be powered from an alternative source of power, enabling the RTC to continue to keep time while the primary source of power is off or unavailable. The Qseven-Q7AMX7's RTC battery voltage range is 2.4 V to 3.3 V.

5.7. Kontron Security Solution (Option)

Kontron Security Solution is a combined hardware and software solution that includes an embedded hardware security module and a software framework to protect applications.

The Qseven-Q7AMX7 can include an option integrated security module. The security module features are:

- Copy protection
- IP protection
- License model enforcement

If required, customers can customize the solution to meet specific needs. For more information, contact Kontron Support.

6/ Connectors

6.1.1. Connectors

Table 11: Connectors of Qseven-Q7AMX7

Connector	Function	Remark
FCI (Option)	MIPI-CSI2 Connector	1x36-pin connector
Qseven®	Central Interface	1x230-pin connector
JTAG	Debug connector	1x 6-pin header

6.2. Connector Pin Definitions

The following table defines terms used when describing the on-board connector's pinouts.

Table 12: Pin Definitions

Column Name	Description		
Pin	Shows the pin-numbers in the connector. The graphical layout of the connector definition tables is made similar to the physical connectors.		
Signal	The mnemonic name of the signal at the current pin. The notation "XX#" states that the signal "XX" is active low.		
Туре	į į		
Pull U/D	On-board pull-up or pull-down resistors on input pins or open-collector output pins.		
Note	Special remarks concerning the signal		
Designation	Type and number of item described		

6.3. Connector Pinouts

6.3.1. MIPI-CSI2 Connector

Figure 8 : MIPI-CSI2 Connector



Table 13: MIPI-CSI2 Connector

Pin	Signal
1	CAM_PWR 3.3V
2	CAM_PWR 3.3V
3	MIPI_CSI_D0+
4	MIPI_CSI_DO-
5	GND
6	MIPI_CSI_D1+
7	MIPI_CSI_D1-
8	GND
9	NC
10	NC
11	CAMO_RST#
12	NC
13	NC
14	GND
15	MIPI_CSI_CLK+
16	MIPI_CSI_CLK-
17	GND
18	I2C_CAMO_SCL
19	I2C_CAM0_SDA
20	CAMO_EN#
21	CAM_XCLK
22	NC
23	NC
24	NC
25	GND
26	NC
27	NC
28	GND
29	NC
30	NC
31	NC
32	NC
33	NC
34	GND
35	CAM0_GPIO
36	NC



6.3.2. JTAG Debug header

Figure 9 : 6-pin JTAG Debug Connector



Table 14: 6-pin JTAG Debug Connector

Pin	Signal
1	JTAG_TCK
2	JTAG_TMS
3	GND
4	JTAG_TDO
5	JTAG_TDI
6	JTAG_TRST#

6.3.3. Qseven® Connector

The Qseven® connector is a MXM 116-pin connector.

Table 15: Qseven® Connector Pin Assignment

Pin.No	Pin Name (Bottom side row)	Pin.No	Pin Name (Top side row)
1	GND	2	GND
3	GBE_MDI3-	4	GBE_MDI2-
5	GBE_MDI3+	6	GBE_MDI2+
7	GBE_LINK100#	8	GBE_LINK1000#
9	GBE_MDI1-	10	GBE_MDI0-
11	GBE_MDI1+	12	GBE_MDI0+
13	ICT10	14	GBE_Link_ACT#
15	ICT11	16	SUS_S5#
17	WAKE#	18	SUS_S3#
19	GP00	20	PWRBTN#
21	SLP_BTN#	22	LID_BTN#
23	GND	24	GND
KEY		KEY	
25	GND	26	PWGIN_Carrier
27	BATLOW#	28	RSTBTN#
29	NC	30	NC
31	NC	32	NC
33	NC	34	GND
35	NC	36	NC
37	NC	38	NC
39	GND	40	GND

Pin.No	Pin Name (Bottom side row)	Pin.No	Pin Name (Top side row)
41	BOOT_ALT#	42	SD1_CLK
43	SD1_CD#	44	NC (reserved)
45	SD1_CMD	46	SDIO_WP
47	SD1_RST#	48	SD1_DATA1
49	SD1_DAT0	50	SD1_DATA3
51	SD1_DAT2	52	NC (reserved)
53	NC (reserved)	54	NC (reserved)
55	NC (reserved)	56	USB_P1_OTG_EN
57	GND	58	GND
59	I2S_WS	60	GP1_I2C_CLK
61	I2S_RST#	62	GP1_I2C_DAT
63	I2S_CLK	64	SMB_ALERT#
65	I2S_SDI	66	GP0_I2C_CLK
67	125_SD0	68	GP0_I2C_DAT
69	THRM#	70	WDTRIG#
71	THRMTRIP#	72	WDOUT
73	GND	74	GND
75	NC	76	NC
77	NC	78	NC
79	NC	80	USB_4_5_OC#
81	USB_P5-	82	USB_P4-
83	USB_P5+	84	USB_P4+
85	USB_2_3_0C#	86	USB_0_1_0C#
87	USB_P3-	88	USB_P2-
89	USB_P3+	90	USB_P2+
91	USB_P1_VBUS_DET	92	USB_P1_OTG_ID
93	USB_P1_OTG-	94	USB_P0-
95	USB_P1_OTG+	96	USB_P0+
97	GND	98	GND
99	LVDS[0]_[0]+	100	LVDS[1]_[0]+
101	LVDS[0]_[0]-	102	LVDS[1]_[0]-
103	LVDS[0]_[1]+	104	LVDS[1]_[1]+
105	LVDS[0]_[1]+	106	LVDS[1]_[1]-
107	LVDS[0]_[2]+	108	LVDS[1]_[2]+
109	LVDS[0]_[2]+	110	LVDS[1]_[2]-
111	LVDS_PPEN	112	LVDS_BLEN
113	LVDS[0]_[3]+	114	LVDS[1]_[3]+
115	LVDS[0]_[3]-	116	LVDS[1]_[3]-
117	GND	118	GND
119	LVDS[0]_CLK+	120	LVDS[1]_CK+
121	LVDS[0]_CLK-	122	LVDS[1]_CK-
123	LVDS_BLT_CTRL	124	GP_1-Wire_Bus

Pin.No	Pin Name (Bottom side row)	Pin.No	Pin Name (Top side row)
125	GP2_I2C_DAT	126	NC
127	GP2_I2C_CLK	128	NC
129	CANO_TX	130	CANO_RX
131	NC	132	NC
133	NC	134	NC
135	GND	136	GND
137	NC	138	NC
139	NC	140	NC
141	GND	142	GND
143	NC	144	NC
145	NC	146	NC
147	GND	148	GND
149	NC	150	NC
151	NC	152	NC
153	NC	154	NC
155	CLK_100_PCIE_CLK_REF+	156	PCIE_WAKE#
167	CLK_100_PCIE_CLK_REF-	158	PCIE_RST#
159	GND	160	GND
161	NC	162	NC
163	NC	164	NC
165	GND	166	GND
167	PCIE2_TX+	168	PCIE2_RX+
169	PCIE2_TX-	170	PCIE2_RX-
171	UARTO_TX	172	UARTO_RTS#
173	PCIE1_TX+	174	PCIE1_RX+
175	PCIE1_TX-	176	PCIE1_RX-
177	UARTO_RX	178	UARTO_CTS#
179	PCIEO_TX+	180	PCIEO_RX+
181	PCIEO_TX-	182	PCIEO_RX-
183	GND	184	GND
185	GPI00	186	GPI01
187	GPIO2	188	GPIO3
189	GPIO4	190	GPI05
191	GPI06	192	GPI07
193	V_RTC	194	SPKR_ GP_PWM_OUT2
195	FAN_TACHOIN	196	FAN_PWMOUT
197	GND	198	GND
199	SPI_MOSI	200	SPI_CS0#
201	SPI_MISO	202	SPI_CS1#
203	SPI_SCK	204	NC
205	VCC_5V0_IN_SB	206	VCC_5V_SB
207	NC	208	NC

Pin.No	Pin Name (Bottom side row)	Pin.No	Pin Name (Top side row)
209	NC	210	NC
211	NC	212	NC
213	NC	214	NC
215	NC	216	NC
217	NC	218	NC
219	VCC_5V0_IN_S5	220	VCC_5V0_IN_S5
221	VCC_5V0_IN_S5	222	VCC_5V0_IN_S5
223	VCC_5V0_IN_S5	224	VCC_5V0_IN_S5
225	VCC_5V0_IN_S5	226	VCC_5V0_IN_S5
227	VCC_5V0_IN_S5	228	VCC_5V0_IN_S5
229	VCC_5V0_IN_S5	230	VCC_5V0_IN_S5

7/ Installation

7.1. Boot Mode

The following table shows possible boot sources on the carrier board defined in the QSEVEN 2.1 Specification and the module specification.

Table 16: Boot Options on the Module and Carrier board

Carrier Connection	Module Connection	Boot Type	Supported on Q7AMX7
BOOT_ALT#	CPU_BOOT_MODE1_3V3		
(on Carrier)	(Default: Internal Pull-down)		
GND	GND	Serial Downloader	Yes, force recovery
GND	Float	Reserved	No
Float	GND	Boot from fuses	Yes, default
Float	Float	Internal Boot	No



Due to the fact that boot from fuses is defined as default, U-Boot only supports boot from SPI Flash. i.MX7 internal boot from CPU ECSPI is only possible with 11 additional GPIOs.

7.2. Configurable Watchdog

No CPLD is available, therefore the SOC's Watchdog must be used. The WDOG features are:

- Configurable timeout counter with timeout periods from 0.5 seconds to 128 seconds that, after timeout expiration, result in the assertion of WDOG_RESET_B_DEB reset signal
- Time resolution of 0.5 seconds
- Configurable timeout counter that can be programmed to run or stop during low-power modes
- Programmable interrupt generation prior to timeout
- Duration between interrupt and timeout events can be programmed from 0 seconds to 127.5 seconds in steps of 0.5 seconds.

7.3. UART Interfaces

In the Qseven® 2.1 specification, RTS is defined as an output and CTS as an input. This is the same definition used by the standard PC serial port. However, in iMX7 implementations, RTS is an input and CTS is an output, this means that the pin functions corresponding to these names are swapped.



UART handshake lines are inverted when using the in the iMX7 implementation, RTS is an input and CTS is an output.

The Qseven-Q7AMX7, supports one UART connection between the CPU and Qseven® connector.

Table 17: UART Connections between CPU and Oseven® 2.1 Connector using Inverted iMX7 Implementation

CPU Interface	CPU Signal Name	Qseven® 2.1 Connector
UART0	UARTO_RXD	UART0_TX, Pin 171
	UARTO_TXD	UART0_RX, Pin177
	UARTO_RTS#	UARTO_RTS#, Pin172
	UARTO_CTS#	UARTO_CTS#, Pin 178



Note: The table above shows the UART signal inversion with the CPU UARTO_RXD signal connecting to the Qseven® 2.1 Connector's pin-171, UARTO_TX and the CPU UARTO_TXD signal connecting to the Qseven® 2.1 Connector's pin-177, UARTO_RX.

For information regarding the processor pin assignment, refer to relevant processor's datasheet.

7.4. Power Control

7.4.1. Power Supply

The Qseven-Q7AMX7 supports a power input from 3 V to 5.25 V. The supply voltage is applied through the module connector's VCC pins (VCC). Considered current rating of protective device is part of end-equipment.

7.4.2. Power Button

The power button (Pin-20) is available through the module connector described in the pinout list. To start the module via Power Button the PWRBTN# signal must be at least 50 ms (50 ms \leq t < 4 s, typical 400 ms) at low level (Power Button Event).



Pressing the power button for at least 4 seconds will turn off power to the module (Power Button Override).

7.4.3. Carrier Power In Signal (PWGIN_CARRIER)

The Qseven-Q7AMX7 provides an external input for a Carrier Board Power Bad signal (Pin-26). The implementation of this subsystem complies with the QSEVN Specification. PWGIN_CARRIER is pulled to buffer after Qseven® connector and must be high level to power on the module.

7.4.4. Reset Button Signal (RSTBTN#)

The reset button (Pin-28) is available through the module connector described in the pinout list. The module will stay in reset as long as RSTBTN# is grounded.



The following parameters should be delivered from the carrier board:

- Voltage Ripple maximum 100 mV peak to peak 0-20 MHz to 20 ms rise time from input voltage <10% to nominal VCC
- ► Max allowed inrush current: connector limit (15 W @ 3,0 V)

8/Bootloader Operation

8.1. Copyrights and Licensing of U-Boot

U-Boot is free Software. It is copyrighted by Wolfgang Denk and many others who contributed code. U-Boot can be redistributed and modified under the terms of version 2 of the GNU General Public (GPL V2) license as published by the Free Software Foundation.

Actual source code of mainline U-Boot and authors of the source can be obtained from the git repository at

git://git.denx.de/u-boot.git

QSEVEN-Q7AMX7 bootloader sources are derived work from a dedicated version of mainline U-Boot, e.g v2017.03. As bootloader evolves, the root of the derived work might change to a later version.

NOTICE

The source code of U-Boot will be delivered with the standard software package.

Additionally the software can be downloaded from the Kontron EMD Customer Section.

Contact Kontron Support for further assistance in obtaining the source code.

8.2. Bootloader Quickstart

The Qseven-Q7AMX7 module comes with U-Boot preinstalled on the QSPI flash device. Follow the steps below to gain access to the bootloader command line (CLI) on your host PC.

- Connect your host machine to the carrier port connected with the edge connector SER0 port of the module. On Kontron Qseven 2.1 Evaluation Carrier this port is named SER_0.
- Start a suitable terminal program on your host and attach it to the port connected with the module's serial interface. Configure the serial line using 115200 baud, 8 data bits, 1 stop bit, no parity.
- Connect power supply to the carrier and power up.
- When boot messages appear, press any key to stop automatic boot sequence.

After power on, bootloader boot messages will appear as shown below. There is a 3 second boot delay counter that tries to boot linux OS automatically, after expiration. Pressing any key stops the boot delay counter and enter the bootloader CLI:

```
U-Boot <Version> (<Date-code>)
      Freescale i.MX7D rev1.2 at 996MHz
CPU: Extended Commercial temperature grade (-20C to 105C) at 54C
Reset cause: POR
Board: Kontron QSeven AMX7 Module
I2C: ready
DRAM: 2 GiB
      FSL_SDHC: 0, FSL_SDHC: 1
SF: Detected w25q16dw with page size 256 Bytes, erase size 4 KiB, total 2 MiB
In:
      serial
Out.:
      serial
       serial
Err:
Net: FEC0, FEC1
Hit any key to stop autoboot: 0
```

8.3. Bootloader Commands

The bootloader CLI provides a set of powerful commands to control the module. The commands can be grouped into:

- Information Commands
- Memory Commands
- Flash Memory Commands
- **Execution Control Commands**
- Download Commands
- **Environment Control Commands**
- Flattened Device Tree Support Commands
- Storage Device Control Commands
- File System Support Commands
- Kontron Command Extensions



Typing "help" at the bootloader command line prompt shows a list of available commands Typing "help <command>" will show specific command help. Further help can be found under https://www.denx.de/wiki/view/DULG/UBoot.

On the Oseven-O7AMX7 bootloader, the powerful hush shell is enabled, that is similar to Bourne shell and provides features similar to a Linux shell:

- Control structures (if ... then ... else ... fi etc.)
- Command line completion
- Command line editing
- Command line history up to 20 entries
- Local environment variables

8.4. Kontron Bootloader Command Extensions

Kontron's implementation of U-Boot includes certain enhancements to provide module specific functions. They are not part of standard U-Boot as maintained by DENX. The following table provides a complete listing of all Kontron command extensions on the Oseven-O7AMX7.

Table 18: Bootloader Command Extensions

Command	Description
kboardinfo	Kontron Board Information - Displays a summary of board and configuration information
md5sum	Creates or checks the md5 message digest over a memory area
watchdog	Start and control i.MX7 CPU watchdog

8.4.1. kboardinfo - Kontron Board Information

The "kboardinfo" command shows a summary of board serialization data gathered from the system EEPROM.

=> kboardinfo Manufacturer: Kontron Europe GmbH QSEVEN-Q7AMX7 Product name: Material number: 51009-0208-10-2 Serial number: NZD070001 00:a0:a5:79:25:30 MAC0 (ethaddr): MAC1 (ethladdr): 00:a0:a5:79:25:31 Manufacturer Date: 11/15/2017 Revision: B00

10 Boot Counter:

CPU: Freescale i.MX7D rev1.2 at 996 MHz

==>

// 36 www.kontron.com

8.4.2. md5sum - MD5 Message Digest

The "md5sum" command is already part of standard U-Boot implementation. Additionally, Kontron provides the "-a" extension (ASCII) that enables users to check the MD5 checksum of a given memory area (e.g. a binary image copied into memory) against the checksum that has been copied into an ASCII file on an external Linux host. To achieve this, the ASCII string in the file representing the checksum is converted into a Hexadecimal value and compared against the calculated value.

Example:

Calculate th eMD5 checksum of a given binary using the md5sum command on Linux host and redirect output messages into a file:

```
# md5sum image.bin >image.md5
```

Copy both image file and checksum file to USB thumb device with EXT2/3/4 or FAT partition. Connect the USB device to the module carrier.

The following sequence shows how to load both the image file and image checksum file into the Qseven-Q7AMX7 memory and compare them. When success, the "md5sum -a" command will have no output messages as this extensions is meant to be used in automatic update scripts to check the binary images against their MD5 checksum.

```
usb start
load usb 0:1 88000000 <image.bin>
load usb 0:1 8a000000 <image.md5>
if md5sum -a 88000000 $ubootsz *88a00000; then
    echo 'CRC check passed'
else
    echo 'CRC check failed'
fi
```

8.4.3. Watchdog - CPU Watchdog Control

The "watchdog" command is used to control the i.MX7 CPU internal watchdog. After watchdog has been started using "watchdog start", the watchdog is kicked periodically by U-Boot to prevent expiration.



Watchdog timeout can be changed at any time. However, it is not possible to stop watchdog once it has been started.

```
=> help watchdog
watchdog - start/stop/kick IMX watchdog

Usage:
watchdog <timeout> - kick watchdog and set timeout (0 = disable kicking)
watchdog start <timeout> - start watchdog and set timeout
```

Example:

Start watchdog with 5 seconds timeout and stop kicking watchdog some time later. The module resets after the watchdog has expired.

```
=> watchdog 5
=> watchdog 0
```

8.5. Bootloader Environment

The bootloader environment is used to control bootloader and OS startup behavior. Environment variables can be used to control boot timing (e.g. bootdelay), interface properties (e.g. baudrate) or they define memory locations where OS images are stored before boot (e.g. loadaddr, fdt_addr). In addition, bootloader shell commands can be combined to environment scripts.

The redundant bootloader environment is permanently stored in the QSPI flash device at offset 0x0c0000 and 0x0c80000. During bootloader operation, the environment is held in RAM memory and can be modified and written back to persistent storage.

Bootloader commands to modify the environment are summed up under the "env" command group:

env default [-f] -a [forcibly] reset default environment

env default [-f] var [...] [forcibly] reset variable(s) to their default values

env delete [-f] var [...] [forcibly] delete variable(s)
 env edit name edit environment variable
 env exists name tests for existence of variable

env print [-a | name ...] print environment

env run var [...] run commands in an environment variable

env save save environment

env set [-f] name [arg ...]

However, the legacy commands for environment handling are still available:

- setenv",
- "editenv",
- "printenv"
- saveenv"

U-Boot standard environment variables are set up for the Qseven-Q7AMX7 module as shown below

Table 19: Standard Environment Variables

Variable	Value	Description
baudrate	115200	Serial line baudrate
bootcmd	Run mmcboot run sdboot run usbboot run netboot run bootfailed	Try booting (in this order) from eMMC, SD card, USB, network
bootdelay	3	Wait 3 seconds before executing bootcmd
ethprime	FEC0	Use Ethernet port FECO as default
loadaddr	0x80800000	Default memory location for OS boot

A typical user modification would be to set the variable "bootcmd" to change OS boot commands.

8.6. Kontron Bootloader Environment Extensions

To support Qseven-Q7AMX7 module properly, Kontron adds environment variables to the standard set of variables provided by mainline U-Boot. These variables are shown below:

Table 20: Bootloader Environment Extensions

Variable	Value	Description
core_variant	d	Set to "s" for i.MX7S module, "d" for i.MX7D module.
	S	
ethaddr	From EEPROM	Ethernet port FECO MAC address
fdt_addr	0x83000000	Memory location for device tree blob
panel	Default: ld101	Describes the panel type attached to the module. It is used to select the appropriate device tree file
pcie_a_prsnt	yes	Enable/disable PCIE_A PRSNT line to reduce power consumption
pcie_b_prsnt	yes	Enable/disable PCIE_B PRSNT line to reduce power consumption
pcie_c_prsnt	yes	Enable/disable PCIE_C PRSNT line to reduce power consumption
serial#	From EEPROM	Module serial number



Variables from the table above marked in bold are set automatically each time U-Boot starts. They will override different settings possibly stored in persistent environment.

8.7. Bootloader Mass Storage Support

U-Boot provides support to read and write from mass storage devices like:

- OSPI flash
- eMMC device
- SD card
- USB thumb device

8.7.1. QSPI flash

QSPI flash is accessed using the "sf" command:

Example: Load one sector (64K) from SPI flash

```
=> sf probe 0
=> sf read ${loadaddr} 0 10000
```

8.7.2. SD Card and eMMC Devices

eMMC and SD cards are accessed using the "mmc" command:

Example: Load 256 blocks from eMMC

```
=> mmc dev 1
=> mmc read ${loadaddr} 0 100
```

8.7.3. USB Storage Device

USB storage devices are accessed using "usb" command:

Example: Load bootloader update file from USB thumb device

```
=> usb start
=> usb dev 0
=> fatload usb 0:1 88000000 u-boot_Qseven-iMX7_spl.imx
```

8.8. Bootloader File System Support

U-Boot for the Qseven-Q7AMX7 provides support for FAT and EXT4 file systems. EXT4 support also includes EXT2 and EXT3 formatted file systems. There are file system specific commands available to list file system contents (ext2ls, fatls) and load a given file into module memory (ext2load, fatload). Additionally, U-Boot also provides generic commands ("ls" and "load"), that will detect the file system on the device and use appropriate file system functions automatically.

Example: Show /boot folder contents from SD card file system

```
=> ls mmc 0:1 /boot

./

../

41116 imx7d-q7amx7-ld101-m4.dtb

40569 imx7s-q7amx7-ld101.dtb

6447384 zimage

41072 imx7d-q7amx7-ld101.dtb
```

8.8.1. EXT4 File System Write Support

There is support available to write a given memory area into ext4 formatted file systems. However, the implementation is not bulletproof und should be used with care, as this could lead to file system corruption.



Writing to symbolic links in an ext4 filesystem does not work from u-boot! Do not create new files in ext4 filesystem as this could cause problems

8.9. Bootloader Network Support

The Oseven-O7AMX7 supports one Ethernet port "FECO".

Module specific MAC addresses are read from EEPROM during startup and environment variables are set automatically. If the EEPROM contents is missing or corrupted, a "random" MAC address will be set to "ethaddr"

If the current network interface is attached to a network providing a DHCP server, an IP address can be gathered using "bootp" ord "dhcp" commands.

After that, a file from a tftp server can be copied to memory using the "tftpboot" command:

Example:

```
=> bootp
=> tftpboot ${loadaddr} <filename</pre>
```

8.10. Bootloader Boot Source Support

To change the boot sequence that is automatically executed in the u-Boot environment, alter the variable "bootcmd". Before executing "bootcmd"ensure that the "bootdelay" variable has been set with the second to wait before running the boot process automatically.



The Qseven-Q7AMX7 supports mmc, sd, usb and tftp boot.

Table 21: Environment Variables for "boot_alt"

BOOT_ALT#	Boot Source
GND	Serial downloader
Float	Boot from fuses



The bootloader is always booted from the boot source defined by the fuse settings, which is normally the QSPI flash device.

8.11. Bootloader Boot Counter

The module EEPROM device contents implements a SMBIOS Running-time data block (type 161) as defined in the KEU EEPROM Specification Rev. 1.4. The running-time data block structure implements a 64-bit boot counter. U-Boot on the Qseven-Q7AMX7 module reads the current boot counter value and increments it on every boot cycle. Current boot counter is shown as part of the information shown by the "kboardinfo" command, see Chapter 8.4.1: kboardinfo - Kontron Board Information.

8.12. Bootloader Update

Bootloader update on Qseven-Q7AMX7 is using an update script containing all necessary checks and installation commands. It is provided by Kontron on an USB thumb device containing the scriptfile and update images.

As an alternative it is possible to perform bootloader update from the network. To achieve this, the update images above must have been copied to the TFTP server machine's server path.

If these prerequisites are met, the update can be performed from bootloader CLI using the predefined "update" script:

=> run update

Or, in case of a network update:

=> run net_uboot_update



It is recommended to use only the update script for bootloader update. This ensures that all necessary installation images are checksum controlled and copied to the appropriate location in QSPI flash.

Appendix A: List of Acronyms

Table 22: List of Acronyms

BSP	Board Support Package	
Carrier	Application specific circuit board that	
Board	accepts a Qseven® module	
СОР	Computer Operating Properly	
CNTG	Computer Network Transaction Group	
DDC	Display Data Control	
DDI	Digital Display Interface –	
DDIO	Digital Display Input/Output	
DIMM	Dual In-line Memory Module	
DP	DisplayPort	
	(digital display interface standard)	
DMA	Direct Memory Access	
DRAM	Dynamic Random Access Memory	
DVI	Digital Visual Interface	
EAPI	Embedded Application Programming Interface	
ECC	Error Checking and Correction	
EEPROM	Electrically Erasable Programmable Read-Only Memory	
eDP	Embedded Display Port	
EMC	Electromagnetic Compatibility (EMC)	
ESD	Electro Sensitive Device	
FAT	File Allocation Table	
FIFO	First In First Out	
FRU	Field Replaceable Unit	
Gb	Gigabit	
GBE	Gigabit Ethernet	
GPI	General Purpose Input	
GPI0	General Purpose Input Output	
GP0	General Purpose Output	
GPU	Graphics Processing Unit	
HBR2	High Bitrate 2	
HDA	High Definition Audio (HD Audio)	
HD/HDD	Hard Disk /Drive	
HPM	SGET Hardware Platform Management specification family	
HWM	Hardware Monitor	
IC	Integrated Circuit	
I2C	Inter integrated Circuit Communications	
IOL	IPMI-Over-LAN	
IOT	Internet of Things	

IPMI	Intelligent Platform Management Interface	
LAN	Local Area Network	
LPC	Low Pin-Count Interface:	
LSB	Least Significant Bit	
LVDS	Low Voltage Differential Signaling –	
MTBF	Mean Time Before Failure	
NA	Not Available	
NC	Not Connected	
NCSI2	Network Communications Services Interface	
PCI	Peripheral Component Interface	
PCle	PCI-Express	
PECI	Platform Environment Control Interface	
PEG	PCI Express Graphics	
SGET®	PCI Industrial Computer Manufacturers Group	
Pin-out Type	Qseven® definitions for signals on Qseven® Module connector pins.	
RoHS	Restriction of the use of certain Hazardous Substances	
RTC	Real Time Clock	
SAS	Serial Attached SCSI2 – high speed serial version of SCSI2	
SATA	Serial AT Attachment:	
SCSI2	Small Computer System Interface	
SEL	System Event Log	
ShMC	Shelf Management Controller	
SMB	System Management Bus	
SoC	System on a Chip	
SPI	Serial Peripheral Inteface	
SSH	Secure Shell	
TPM	Trusted Platform Module	
UART	Universal Asynchronous Receiver Transmitter	
USB	Universal Serial Bus	
VGA	Video Graphics Adapter	
VLP	Very Low Profile	
WDT	Watch Dog Timer	
WEEE	Waste Electrical and Electronic Equipement (directive)	



About Kontron

Kontron is a global leader in embedded computing technology (ECT). As a part of technology group S&T, Kontron offers a combined portfolio of secure hardware, middleware and services for Internet of Things (IoT) and Industry 4.0 applications. With its standard products and tailor-made solutions based on highly reliable state-of-the-art embedded technologies, Kontron provides secure and innovative applications for a variety of industries. As a result, customers benefit from accelerated time-to-market, reduced total cost of ownership, product longevity and the best fully integrated applications overall. For more information, please visit: www.kontron.com



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