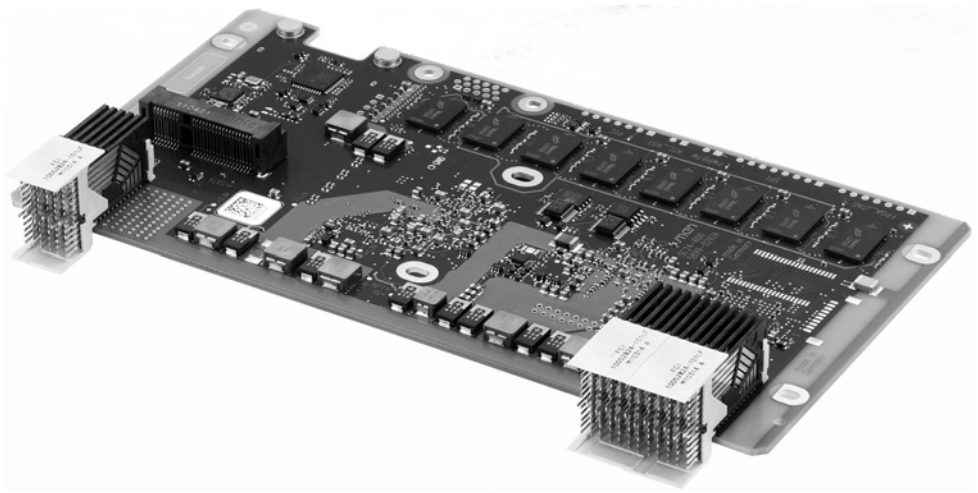
Embedded Solutions

SC24 – AMD G-Series SBC for Multi-Display Control



Configuration example

User Manual

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SC24 – AMD G-Series SBC for Multi-Display Control

The SC24 is a maintenance-free single-board computer designed to serve as the heart of MEN's box and display computer systems for use in commercial vehicles, mobile machines, railway applications, avionics and industrial automation.

It is powered by an AMD Embedded G-Series APU (Accelerated Processing Unit), the T52R, running at 1.5 GHz. The G-Series combines low-power CPUs and advanced GPUs, in this case an AMD Radeon™ HD 6310, into a single embedded device. The use of the Embedded G-Series makes for high scalability in CPU (single/dual core) and graphics performance (various Radeon™ GPUs or none at all).

The system is equipped with 1 GB of DDR3 SDRAM and offers SD card and mSATA slots. It is designed for fanless operation at temperatures from -40 to +85°C. For this it relies on conduction cooling, as realized in the BC1 Box PC, for example, where the entire housing serves as a heat sink for the internal electronics.

It supports up to two pairs of DisplayPort® interfaces (two independent images, each sent to one or two display panels) with a maximum resolution of 2560x1600 each. Two of the DisplayPort® interfaces offer individual AUX channels and hot plug detection while two others are duplicates of the former two with USB channels instead. As an option, the AUX channel of the first two DisplayPort® interfaces can be used for USB signals as well, e.g., to realize touch functionality. Other I/O includes up to 9 USB 2.0, 2 Gigabit Ethernet channels, 3 PCI Express®, up to 5 serial interfaces (4 UARTs also configurable as IBIS or GPS and 1 CAN), HD audio, 1 SATA and various GPIO, e.g., for status LEDs.

The SC24 is not meant to be used as a stand-alone board, as all I/O is collected on two pairs of AirMax VS® connectors - one for all graphics interfaces and one for all remaining I/O, allowing for flexible configuration on separate boards. By using the necessary interface boards like an AE51 or similar customer-specific solutions, the signals can be made available on standard connectors and various types of wide-range PSUs can be added. An I/O board can also offer the option of additional mass storage via the SC24's SATA interface and connections to other periphery, e.g., PCI Express® Mini cards via the PCIe® interface. Used in combination with the AE51 interface board and its integrated PSU, the unit is compliant with EN 50155 and prepared for e1 certification.

The combination of the various CPU/GPU options with easily customized interface boards makes for an extremely flexible system design that can quickly be tailored to a vast number of applications.

Technical Data

CPU

- AMD Embedded G-Series T52R
  - 1.5 GHz processor core frequency
  - Accelerated Processing Unit (APU), also includes GPU (see Graphics)

Controller Hub

- AMD A55E

Memory

- 64 KB L1 and 512 KB L2 cache
- 1 GB DDR3 SDRAM system memory
  - Soldered
  - 1333 MT/s (667 MHz)

Mass Storage

- One SD card slot
  - Via USB
- One mSATA slot
  - Transfer rate up to 3 Gbits/s

Graphics

- AMD Radeon™ HD 6310
  - Dual independent display support
  - 2x2 DisplayPort 1.1a interfaces
  - Maximum resolution: 2560x1600
  - Embedded in T52R APU
- 3D Graphics Acceleration
  - Full DirectX® 11 support, including full speed 32-bit floating point per component operations
  - Shader Model 5
  - OpenCL™ 1.1 support
  - OpenGL® 4.0 support
- Motion Video Acceleration
  - Dedicated hardware (UVD 3) for H.264, VC-1 and MPEG2 decoding
  - HD HQV and SD HQV support: noise removal, detail enhancement, color enhancement, cadence detection, sharpness, and advanced de-interlacing
  - Super up-conversion for SD to HD resolutions

Graphics interfaces via two 72-pin AirMax VS® graphics connectors

- 2x2 DisplayPort®
  - DisplayPort® A and B with AUX channel and hot plug detection
  - DisplayPort® C and D are duplicates of A and B
- 4 USB 2.0

Other I/O via two 72-pin AirMax VS® I/O connectors

- 5 USB 2.0
- 2 Ethernet 10/100/1000Base-T channels
- 1 SATA interface for HDD/SSD
  - SATA Revision 3.x support
  - Transfer rates up to 600 MB/s (6 Gbits/s)
- 4 UART or IBIS, GPS
- 1 CAN bus
- 3 PCI Express® x1
  - Three x1 links
  - PCIe® 2.x support
  - Data rate 500 MB/s in each direction (5 Gbits/s per lane)
- Various GPIO (e.g., for status LEDs)
- HD audio
  - HD audio codec
  - Audio stereo in
  - Audio stereo out
  - SPDIF out

Real-Time Clock

- Buffered by power source on connected interface board

Electrical Specifications

- Supply voltage: 12 VDC nom. ±10%
- Power consumption: Up to 25 W

Mechanical Specifications

- Dimensions: approx. 170 mm x 90 mm x 30 mm
- Weight: approx. 200 g

Environmental Specifications

- Temperature range (operation):
  - -40 to +85°C (screened) depending on cooling concept
  - Sufficient conduction cooling required
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300 m to +3,000 m
- Shock: 50 m/s², 30 ms
- Vibration (function): 1 m/s², 5 Hz – 150 Hz
- Vibration (lifetime): 7.9 m/s², 5 Hz – 150 Hz
- Conformal coating on request

MTBF

- tbd. h @ 40°C according to IEC/TR 62380 (RDF 2000)

Safety

- PCB manufactured with a flammability rating of 94V-0 by UL recognized manufacturers

EMC

- Conforming to EN 55022 (radio disturbance), IEC 61000-4-2 (ESD) and IEC 61000-4-4 (burst)
- Prepared for certification according to e1 requirements of the German Federal Motor Transport Authority when used in combination with an AE51 I/O board

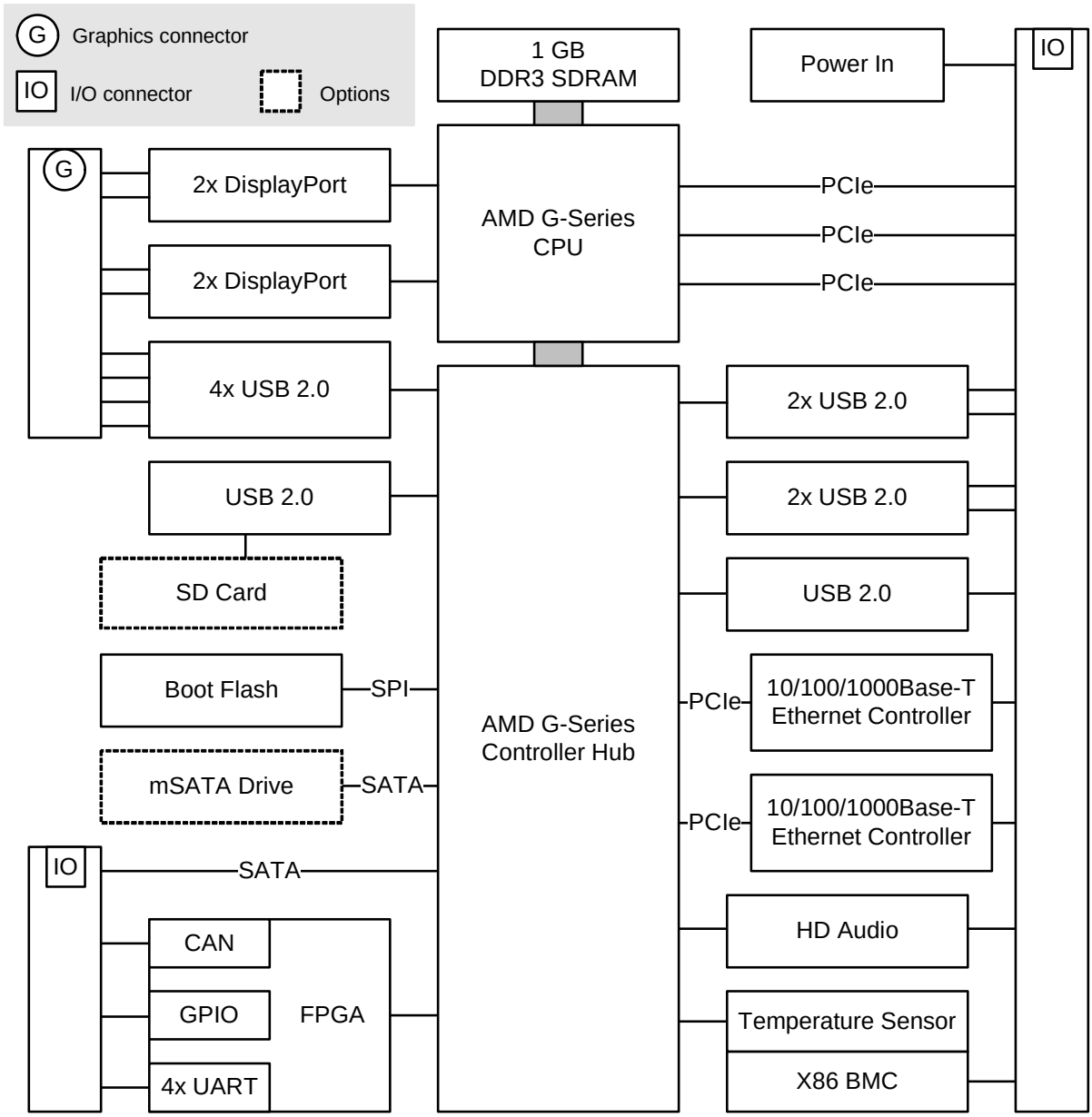
BIOS

- InsydeH2O™ UEFI Framework

Software Support

- Windows® 7
- Windows® Embedded Standard 7
- Windows® XP Embedded (on request)
- Linux
- For more information on supported operating system versions and drivers see online data sheet.

Block Diagram



Configuration Options

APU

- AMD T56N, 1.65 GHz Dual Core (L1 cache 64KB, L2 cache 512kB x2, 18W), DDR3-1333, AMD Radeon™ HD 6320
- AMD T52R, 1.5 GHz Single Core (L1 cache 64KB, L2 cache 512kB, 18W), DDR3-1333, AMD Radeon™ HD 6310
- AMD T48N, 1.4 GHz Dual Core (L1 cache 64KB, L2 cache 512kB x2, 18W), DDR3-1066, AMD Radeon™ HD 6310
- AMD T40N, 1.0 GHz Dual Core (L1 cache 64KB, L2 cache 512kB x2, 9W), LVDDR3-1066, AMD Radeon™ HD 6290
- AMD T44R, 1.2 GHz Single Core (L1 cache 64KB, L2 cache 512kB, 9W), LVDDR3-1066, AMD Radeon™ HD 6250
- AMD T40E, 1.0 GHz Dual Core (L1 cache 64KB, L2 cache 512kB x2, 6.4W), LVDDR3-1066, AMD Radeon™ HD 6250
- AMD T40R, 1.0 GHz Single Core (L1 cache 64KB, L2 cache 512kB, 5.5W), LVDDR3-1066, AMD Radeon™ HD 6250

Memory

- Up to 4 GB DDR3 SDRAM system memory

Graphics

- Maximum resolution depending on GPU
  - 2560x1600 (all DisplayPort® interfaces) with Radeon™ HD 6310 and 6320
  - 1920x1200 (all DisplayPort® interfaces) with Radeon™ HD 6250 and 6290

Software Support

- Windows® XP Embedded (on request)

As the product concept is very flexible, there are many other configuration possibilities. Please contact our sales team if you do not find your required function in the options. Please note that some of these options may only be available for large volumes.

For available standard configurations see online data sheet.

Product Safety

Electrostatic Discharge (ESD)

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Store the board only in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

About this Document

This user manual describes the hardware functions of the board, connection of peripheral devices and integration into a system. It also provides additional information for special applications and configurations of the board.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Issue	Comments	Date
E1	First issue	2012-01-18
E2	Added operating temperature restriction	2012-02-15

Conventions

This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics — Folder, file and function names are printed in *italics*.

bold — **Bold** type is used for emphasis.

`monospace` — A `monospaced` font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".

hyperlink — Hyperlinks are printed in blue color.

The globe will show you where hyperlinks lead directly to the Internet, so you can look for the latest information online.

IRQ# /IRQ — Signal names followed by "#" or preceded by a slash ("/") indicate that this signal is either active low or that it becomes active at a falling edge.

in/out — Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "coming from it".

Vertical lines on the outer margin signal technical changes to the previous issue of the document.

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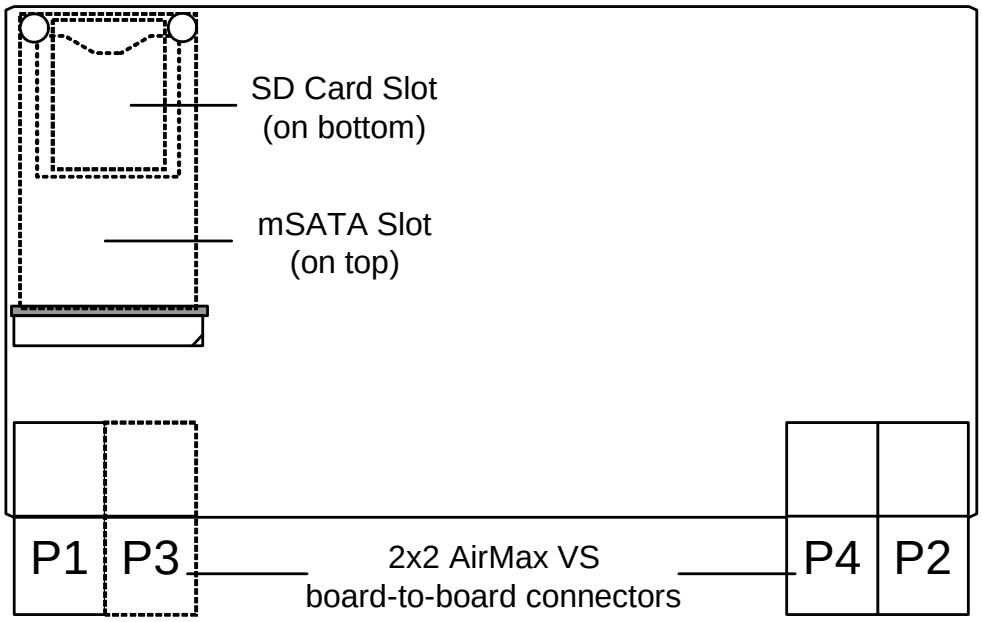
1 Getting Started

This chapter gives an overview of the board and some hints for first installation in a system.

1.1 Map of the Board

Figure 1. *Map of the board – top view*



1.2 First Operation

You can use the following check list when installing the board for the first time and with minimum configuration.

- ☑ Connect an interface board offering access to graphics and USB interfaces, e.g., the AE51, to the SC24.
- ☑ Connect a USB keyboard and mouse to the USB connector(s) of the interface board. If the board offers only one USB connection (as the AE51 does), use a USB hub.
- ☑ Connect a flat-panel display capable of displaying the resolution of 1024x786 to the first DisplayPort connector of the interface board.
- ☑ Power up the system.
- ☑ You can start up the BIOS setup menu by hitting the <DEL> key (see Chapter 5 BIOS on page 28).
- ☑ Now you can make configurations in BIOS (see Chapter 5 BIOS on page 28).
- ☑ Observe the installation instructions for the respective software.

1.3 Installing Operating System and Driver Software

The SC24 supports Windows 7, Windows Embedded Standard 7, Windows XP Embedded (on request) and Linux. By default, no operating system is installed.

For a detailed description on how to install operating system and driver software please refer to the respective documentation.

You can find any software available on MEN's website.

1.4 Booting from the 4GB SD Card with a Windows Embedded Standard 7 Image Customized for the SC24

MEN offers a 4GB SD card with a pre-installed Windows Embedded Standard 7 image (180-day trial version) customized for the SC24. For ordering details please consult MEN's website. The following paragraphs describe the first boot of a system with this OS image installed on the SD card.

During the first power up of the system, the resealing process of the Windows Embedded Standard 7 image will be started automatically, including a system reboot. This will take approximately 5 minutes. No action on behalf of the user is necessary at this time. The 180-day trial period starts the moment the resealing process has finished setting up the system.

Please note that the internal clock of the SC24 is used to determine how much of the trial period remains. It is buffered by a power source on the connected interface board, e.g., a Gold Cap or a battery.

The following events can cause the trial period to end prematurely:

- The BIOS time is modified.
- The Windows time is modified.
- A BIOS update has unforeseen side-effects.

Should any of this happen and render the trial version of Windows Embedded Standard 7 unusable prematurely, please contact MEN.

A complete log of the standard Windows Embedded Standard 7 image used on the customized SC24 SD card is available from MEN on request.

2 Interface to I/O Board

The SC24 is connected to an I/O board via a pair of AirMax VS connectors.

Connector type:

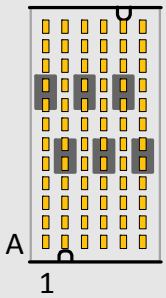
- 72-pin AirMax VS press-fit 2 wall signal header, 6 rows, right angle header (FCI 10052824-101LF)

Mating connector:

- 72-pin AirMax VS press-fit receptacle, 6 rows, right-angle (FCI 10114633-101LF)

The different functional groups are marked through different colors in the tables.

Table 1. *Pin assignment of the I/O board connector P1*



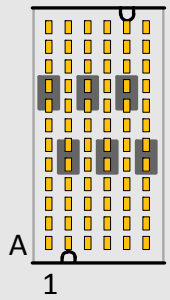
	1	2	3	4	5	6	
L	GND	EXT_ PWRGD	ETH2_ VREF	ETH1_ D4_N	ETH1_ LEDB	COM1_ CTS#	L
K	+12V	EXT_ PWRBTN#	ETH2_ D4_N	ETH1_ D4_P	ETH1_ LEDA	COM1_ RTS#	K
J	+12V	STATUS_LED	ETH2_ D4_P	GND	ETH2_ LEDB	GND	J
I	GND	WAKE#	GND	ETH1_ D3_N	ETH2_ LEDA	COM1_ TXD	I
H	+12V	SYS_ RST#	ETH2_ D3_N	ETH1_ D3_P	BIO[1]	COM1_ RXD	H
G	+12V	GND	ETH2_ D3_P	GND	BIO[0]	COM0_ DSR	G
F	GND	A_RST_ B#	GND	ETH1_ D2_N	GND	COM0_ CTS#	F
E	+12V	PS_ON#	ETH2_ D2_N	ETH1_ D2_P	USB_ HS1_N	COM0_ RTS#	E
D	+12V	GND	ETHB_ D2_P	GND	USB_ HS1_P	COM0_ DTR	D
C	GND	SDATA1	GND	ETH1_ D1_N	GND	COM0_ TXD	C
B	NU_VCC_ STBY_P1	SCLK1	ETH2_ D1_N	ETH1_ D1_P	USB_ HS0_N	COM0_ RXD	B
A	+12V	GND	ETH2_ D1_P	ETH1_ VREF	USB_ HS0_P	USB_ OC01#	A
	1	2	3	4	5	6	

Table 2. *Signal mnemonics of I/O board connector P1*

Signal	Direction	Function
+12V	in	+12V power supply
GND	-	Ground
NU_VCC_STBY_P1	in	Standby voltage
SCLK1	out	SMBus Clock

Signal	Direction	Function
SDATA1	in/out	SMBus Data
PS_ON#	in	Power supply on
A_RST_B#	in	Global board reset
SYS_RST#	in	Signal to reset the CPU
WAKE#	in	Wake up signal input
EXT_PWRBTN#	in	Power button
EXT_PWRGD	in	Power good from I/O board
ETH1_Dx_P	in/out	Ethernet 1 data x positive
ETH1_Dx_N	in/out	Ethernet 1 data x negative
ETH1_VREF	out	Ethernet 1 reference voltage
ETH1_LEDx	out	Ethernet 1 status LED x
ETH2_Dx_P	in/out	Ethernet 2 data x positive
ETH2_Dx_N	in/out	Ethernet 2 data x negative
ETH2_VREF	out	Ethernet 2 reference voltage
ETH2_LEDx	out	Ethernet 2 status LED x
USB_HSx_P	in/out	USB x positive
USB_HSx_N	in/out	USB x negative
USB_OC01#	in	USB overcurrent signal
STATUS_LED	out	Status LED
BIO[x]	in/out	Binary I/O x
COMx_RXD	in	Serial port x receive
COMx_TXD	out	Serial port x transmit
COMx_RTS#	out	Serial port x ready to send
COMx_CTS#	in	Serial port x clear to send
COM0_DTR	out	Serial port 0 data terminal ready
COM0_DSR	in	Serial port 0 data set ready

Table 3. *Pin assignment of the I/O board connector P2*



	1	2	3	4	5	6	
L	BAT_VCC	BIO[7]	USB_ OC23#	USB[3]_N	GND	AZ_ BITCLK	L
K	PCIE_ CLK2_EN#	BIO[6]	USB[2]_N	USB[3]_P	USB[8]_N	AZ_ SDIN0	K
J	PCIE_ CLK1_EN#	GND	USB[2]_P	GND	USB[8]_P	AZ_ RST#	J
I	PCIE_ CLK0_EN#	BIO[5]	GND	PCIE_ CLK1_N	GND	AZ_ SDOUT	I
H	COM3_ CTS#	BIO[4]	PCIE_ CLK0_N	PCIE_ CLK1_P	PCIE_ CLK2_N	AZ_ SYNC	H
G	COM3_ RTS#	GND	PCIE_ CLK0_P	GND	PCIE_ CLK2_P	GND	G
F	COM3_ TXD	BIO[3]	GND	PCIE_ RX_N[1]	GND	SATA_ RX1_N	F
E	COM3_ RXD	BIO[2]	PCIE_ RX_N[0]	PCIE_ RX_P[1]	PCIE_ RX_N[2]	SATA_ RX1_P	E
D	COM2_ CTS#	GND	PCIE_ RX_P[0]	GND	PCIE_ RX_P[2]	GND	D
C	COM2_ RTS#	CAN_TX	GND	PCIE_ TX_N[1]	GND	SATA_ TX1_N	C
B	COM2_ TXD	CAN_RX	PCIE_ TX_N[0]	PCIE_ TX_P[1]	PCIE_ TX_N[2]	SATA_ TX1_P	B
A	COM2_ RXD	GND	PCIE_ TX_P[0]	GND	PCIE_ TX_P[2]	GND	A
	1	2	3	4	5	6	

Table 4. *Signal mnemonics of I/O board connector P2*

Signal	Direction	Function
BAT_VCC	in	Supply for RTC
GND	-	Ground
COMx_RXD	in	Serial port x receive
COMx_TXD	out	Serial port x transmit
COMx_RTS#	out	Serial port x ready to send
COMx_CTS#	in	Serial port x clear to send
PCIE_CLKx_EN#	in	PCI Express clock enable
PCIE_TX_P[x]	out	PCI Express transmit positive
PCIE_TX_N[x]	out	PCI Express transmit negative
PCIE_RX_P[x]	in	PCI Express receive positive
PCIE_RX_N[x]	in	PCI Express receive negative
PCIE_CLKx_P	out	PCI Express clock positive
PCIE_CLKx_N	out	PCI Express clock negative
CAN_RX	in	CAN receive
CAN_TX	out	CAN transmit

Signal	Direction	Function
BIO[x]	in/out	Binary I/O x
USB[x]_P	in/out	USB x positive
USB[x]_N	in/out	USB x negative
USB_OC23#	in	USB overcurrent signal for USB 2 and 3
SATA_TX1_P	in	SATA transmit positive
SATA_TX1_N	in	SATA transmit negative
SATA_RX1_P	out	SATA receive positive
SATA_RX1_N	out	SATA receive negative
AZ_SYNC	out	HD audio synchronization
AZ_SDOUT	out	HD audio serial data out
AZ_RST#	out	HD audio reset low active
AZ_SDIN0	in	HD audio serial data in
AZ_BITCLK	out	HD audio bit clock

3 Interface to Graphics Board

The SC24 is connected to a graphics board via a pair of AirMax VS connectors.

Connector type:

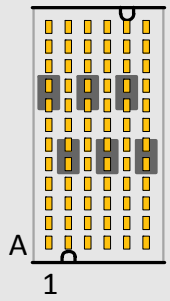
- 72-pin AirMax VS press-fit 2 wall signal header, 6 rows, right angle header (FCI 10052824-101LF)

Mating connector:

- 72-pin AirMax VS press-fit receptacle, 6 rows, right-angle (FCI 10114633-101LF)

The different functional groups are marked through different colors in the tables.

Table 5. *Pin assignment of the optional graphics board connector P3*

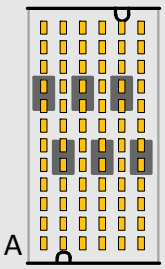


	1	2	3	4	5	6	
L	GND	Reserved	GND	Reserved	GND	USB[5]_N	L
K	+12V	Reserved	DPA_ D[3]_n	Reserved	DPD_ D[3]_n	USB[5]_P	K
J	+12V	GND	DPA_ D[3]_p	GND	DPD_ D[3]_p	USB_ OC45#	J
I	GND	DP_ VARY_BL	GND	Reserved	GND	USB[4]_N	I
H	+12V	DP_ DIGON	DPA_ D[2]_n	Reserved	DPD_ D[2]_n	USB[4]_P	H
G	+12V	DP_ BLON	DPA_ D[2]_p	GND	DPD_ D[2]_p	GND	G
F	GND	A_RST_ B#	GND	Reserved	GND	Reserved	F
E	+12V	DPA_ HPD	DPA_ D[1]_n	Reserved	DPD_ D[1]_n	Reserved	E
D	+12V	GND	DPA_ D[1]_p	GND	DPD_ D[1]_p	GND	D
C	GND	DPA AUX_n	GND	Reserved	GND	Reserved	C
B	NU_VCC_ STBY_P3	DPA AUX_p	DPA_ D[0]_n	Reserved	DPD_ D[0]_n	Reserved	B
A	+12V	GND	DPA_ D[0]_p	GND	DPD_ D[0]_p	GND	A
	1	2	3	4	5	6	

Table 6. *Signal mnemonics of optional graphics board connector P3*

Signal	Direction	Function
+12V	in	+12V power supply
NU_VCC_STBY_P3	in	Standby voltage
GND	-	Ground
A_RST_B#	in	Global board reset
DPA AUX_p	in/out	DisplayPort A auxiliary positive
DPA AUX_n	in/out	DisplayPort A auxiliary negative
DPA_HPD	in	DisplayPort A hot plug
DP_BLON	out	Display backlight on (for future use)
DP_DIGON	out	Display on (for future use)
DP_VARY_BL	out	Vary backlight brightness (for future use)
DPA_D[x]_p	out	DisplayPort A data x positive
DPA_D[x]_n	out	DisplayPort A data x negative
DPD_D[x]_p	out	DisplayPort D data x positive
DPD_D[x]_n	out	DisplayPort D data x negative
USB[x]_P	in/out	USB x positive
USB[x]_N	in/out	USB x negative
USB_OC45#	in	USB overcurrent signal for USB 4and 5

Table 7. *Pin assignment of the graphics board connector P4*



	1	2	3	4	5	6	
L	GND	Reserved	GND	Reserved	GND	USB[7]_N	L
K	+12V	Reserved	DPB_ D[3]_n	Reserved	DPC_ D[3]_n	USB[7]_P	K
J	+12V	GND	DPB_ D[3]_p	GND	DPC_ D[3]_p	USB_ OC67#	J
I	GND	DP_ VARY_BL	GND	Reserved	GND	USB[6]_N	I
H	+12V	DP_ DIGON	DPB_ D[2]_n	Reserved	DPC_ D[2]_n	USB[6]_P	H
G	+12V	DP_ BLON	DPB_ D[2]_p	GND	DPC_ D[2]_p	GND	G
F	GND	A_RST_ B#	GND	Reserved	GND	Reserved	F
E	+12V	DPB_ HPD	DPB_ D[1]_n	Reserved	DPC_ D[1]_n	Reserved	E
D	+12V	GND	DPB_ D[1]_p	GND	DPC_ D[1]_p	GND	D
C	GND	DPB AUX_n	GND	Reserved	GND	Reserved	C
B	NU_VCC_ STBY_P4	DPB AUX_p	DPB_ D[0]_n	Reserved	DPC_ D[0]_n	Reserved	B
A	+12V	GND	DPB_ D[0]_p	GND	DPC_ D[0]_p	GND	A
	1	2	3	4	5	6	

Table 8. *Signal mnemonics of graphics board connector P4*

Signal	Direction	Function
+12V	in	+12V power supply
NU_VCC_STBY_P4	in	Standby voltage
GND	-	Ground
A_RST_B#	in	Global board reset
DPB AUX_p	in/out	DisplayPort B auxiliary positive
DPB AUX_n	in/out	DisplayPort Bauxiliary negative
DPB_HPD	in	DisplayPort B hot plug
DP_BLON	out	Display backlight on (for future use)
DP_DIGON	out	Display on (for future use)
DP_VARY_BL	out	Vary backlight brightness (for future use)
DPB_D[x]_p	out	DisplayPort B data x positive
DPB_D[x]_n	out	DisplayPort B data x negative
DPC_D[x]_p	out	DisplayPort C data x positive
DPC_D[x]_n	out	DisplayPort C data x negative
USB[x]_P	in/out	USB x positive
USB[x]_N	in/out	USB x negative
USB_OC67#	in	USB overcurrent signal for USB 6 and 7

4 Functional Description

The following describes the individual functions of the board and their configuration on the board. There is no detailed description of the individual controller chips and the CPU. They can be obtained from the data sheets or data books of the semiconductor manufacturer concerned (Chapter 7.1 Literature and Web Resources on page 30).

Please note that the board BSPs for the different operating systems may not support all the functions of the SC24. For more information on hardware support please see the respective BSP data sheet on MEN's website.

4.1 Power Supply

The board is supplied with +12V (±10%) via the AirMax VS connectors P1/P3/P4.

The on-board power supply generates all the necessary internal voltages.

4.2 Real-Time Clock

The SC24 is equipped with a real-time clock integrated in the chipset. For data retention during power-off, the RTC can be supplied with backup power from the connected I/O board, e.g., via a battery or a Gold Cap.

4.3 Processor Core

The SC24 can be equipped with several AMD APUs (Accelerated Processing Units). The default APU is the T52R.

Table 9. *Processor core options on SC24*

Model	Clock Speed, No. of Cores	Cache	Max. TDP	DDR3 Speed	Graphics
AMD T56N	1.65 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	18 W	DDR3-1333	Radeon HD 6320
AMD T52R	1.5 GHz single core	L1 cache 64 KB, L2 cache 512 kB	18 W	DDR3-1333	Radeon HD 6310
AMD T48N	1.4 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	18 W	DDR3-1066	Radeon HD 6310
AMD T40N	1.0 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	9 W	LVDDR3-1066	Radeon HD 6310
AMD T44R	1.2 GHz single core	L1 cache 64 KB, L2 cache 512 kB	9 W	LVDDR3-1066	Radeon HD 6250
AMD T40E	1.0 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	6.4 W	LVDDR3-1066	Radeon HD 6250
AMD T40R	1.0 GHz single core	L1 cache 64 KB, L2 cache 512 kB	5.5 W	LVDDR3-1066	Radeon HD 6250

Note: T56N and T40N are models enabled by AMD Turbo Core technology, up to 10% clock speed increase is planned.

4.3.1 Thermal Considerations

The SC24 is designed for an operating temperature from -40 to +85°C. This temperature range can only be achieved with sufficient cooling. In order for the board to meet the thermal requirements, the surrounding system must provide the necessary means to dissipate heat.

4.4 Memory and Mass Storage

4.4.1 DRAM System Memory

The standard model of the SC24 is equipped with 1 GB of DDR3-SDRAM. Up to 4 GB are supported.

4.4.2 Boot Flash

The SC24 is equipped with a boot Flash containing its BIOS.

4.4.3 SD Card Slot

The SC24 provides one SD card slot.

Note: MEN offers a 4GB SD card with a pre-installed Windows® Embedded Standard 7 image (180-day trial version) customized for the SC24 (see Chapter 1.4 Booting from the 4GB SD Card with a Windows Embedded Standard 7 Image Customized for the SC24 on page 14). For ordering details please consult MEN's website.

4.4.3.1 Installing an SD Card

- ☑ Power down your system and disconnect the SC24 from power.
- ☑ Insert the SD card into the slot with the contacts facing the PCB.
- ☑ Make sure that it clicks into place properly.

☑ To eject the SD card, push it until it springs out, then simply pull it out.

4.4.4 mSATA Slot

The SC24 provides one mSATA slot.

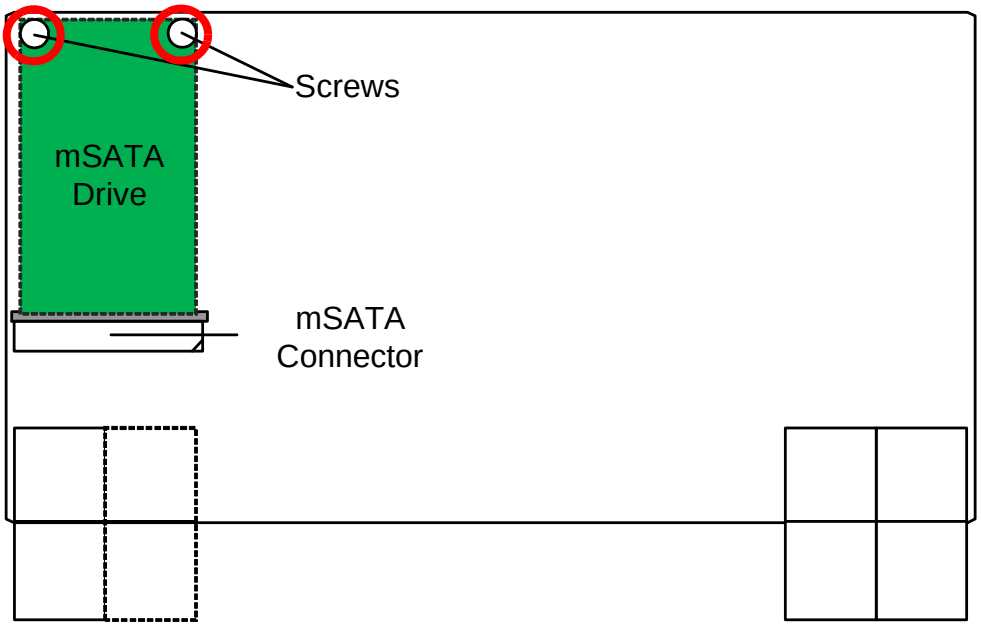
4.4.4.1 Installing an mSATA Drive

☑ Power down your system and disconnect the SC24 from power.

☑ Insert the mSATA drive carefully at a 30° angle.

☑ Make sure that all the contacts are aligned properly and the card is firmly connected to the mSATA connector. Fix the card using two M2.5x6 screws (highlighted in red).

Figure 2. *Installing an mSATA drive*



4.5 Graphics

4.5.1 Graphics Processing Unit

The standard model of the SC24 is equipped with an AMD APU (Accelerated Processing Unit) that also includes an AMD Radeon 6310 as a GPU (Graphics Processing Unit). For other GPU options please refer to Chapter 4.3 Processor Core on page 22.

4.5.2 DisplayPort Interfaces

Four DisplayPort interfaces are available via the P3 and P4 board-to-board connectors. The maximum supported resolution is 2560x1600 at 60 Hz.

Only DisplayPort interfaces A and B are fully featured DisplayPort interfaces and offer AUX channel support and hot plug detection. DisplayPort interfaces C and D are duplicates of the former two without AUX signals, with USB signals offered as an alternative. This makes it impossible for the SC24 to exchange device management and control data with the display panel connected to these duplicate interfaces, but in turn it enables features like an USB-driven touch interface via the I/O board's DisplayPort connectors. The P3 and P4 connectors offer two USB interfaces each, so USB instead of AUX can be realized for all four DisplayPort interfaces with a suitable I/O board (the AE51 offers this option).

4.5.3 Other Graphics Interfaces

Many third-party suppliers offer active adapters from DisplayPort to other graphics interfaces. The maximum resolution depends on the adapter used. Supported interfaces include:

- HDMI
- Single-link DVI
- Dual-link DVI
- VGA

Note: Passive adapters are not supported by the SC24!

4.6 USB Interface

The SC24 provides a total of nine USB 2.0 interfaces: Five at the P1 and P2 I/O board connectors and another two each at the P3 and P4 graphics board connectors.

4.7 Ethernet Interface

Each of the two controllers has its own EEPROM to store the MAC address etc.

The unique MAC address is set at the factory and should not be changed. Any attempt to change this address may create node or bus contention and thereby render the board inoperable. The naming of the interfaces may differ depending on the operating system. The MAC addresses on SC24 are:

- ETH1: `0x 00 C0 3A B1 Cx xx to 0x 00 C0 3A B1 FF FF`
- ETH2: `0x 00 C0 3A B2 xx xx to 0x 00 C0 3A B2 3F FF`

where "00 C0 3A" is the MEN vendor code and "B1" and "B2" are the MEN product codes. The last four digits depend on the interface and the serial number of the product. The serial number is added to the offset, for example for ETH1:

Serial number 0042 (`0x2A`): `0x C0 00 + 0x 00 2A = 0x C0 2A.`

See Chapter 7.2 Finding out the Product's Article Number, Revision and Serial Number on page 30.

4.7.1 Ethernet Status LEDs

The SC24 provides a total of four Ethernet status LEDs, two for each Ethernet channel. They signal the link and activity status (different LED behavior can be realized on demand).

Table 10. *Ethernet status LED*

LED	Description
ETH1_LEDA	Port 1 activity
ETH1_LEDB	Port 1 link
ETH2_LEDA	Port 2 activity
ETH2_LEDB	Port 2 link

4.8 CAN Bus and UART (COM) Interfaces

The SC24 provides five serial interfaces implemented in an FPGA: One CAN bus and four UARTs. The UART lines can also be used for IBIS or GPS interfaces by connecting the respective SA-Adapters on an I/O board.

The UART interfaces support the following handshake lines:

- COM0: DTR, RTS#, DSR, CTS#
- COM1..3: RTS#, CTS#

See MEN's website for a list of SA-Adapters which can be used on the standard I/O board AE51.

Please contact MEN's sales team for information about possible configurations and special board versions.

4.9 Binary I/O

The SC24 offers several binary I/O lines implemented in an FPGA. Typical uses include watchdog signals, LEDs or control of additional interfaces on an I/O board.

4.10 HD Audio

The SC24 supports a high definition audio interface on the board-to-board connector P2. However, the AMD A55E controller hub only includes the controller, i.e., if you want to use audio, an external codec needs to be implemented on I/O board. The standard I/O board AE51 comes with the Realtek ALC268 audio codec.

4.11 PCI Express

The SC24 provides 3 PCI Express x1 links with a supported data rate of up to 500 MB/s in each direction.

5 BIOS

A detailed description of the SC24's BIOS will be included in a future issue of this user manual.

6 Organization of the Board

6.1 SMBus Devices

Table 11. *SMBus devices*

SMBus	Address	Function
0	0x30 (write) 0x31 (read)	LSM303DLH accelerometer (located on AE51)
0	0x3C (write) 0x3D (read)	LSM303DLH magnetometer (located on AE51)
1	0xAC	STTS424E02 temperature sensor and production data EEPROM

7 Appendix

7.1 Literature and Web Resources

- SC24 data sheet with up-to-date information and documentation:
  www.men.de/products/08SC24-.html
- M-Module Standard:
  ANSI/VITA 12-1996, M-Module Specification;
  VMEbus International Trade Association
  www.vita.com

7.2 Finding out the Product's Article Number, Revision and Serial Number

MEN user documentation may describe several different models and/or design revisions of the SC24. You can find information on the article number, the design revision and the serial number on two labels attached to the board.

- **Article number:** Gives the product's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the design revision of the product.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 3. *Labels giving the product's article number, revision and serial number*