ELTEC

elektronik mainz

BAB-430/431/433/434

Universal Graphic Module and Display Adapters

Hardware Manual

Revision 1 A

Rev.	Changes	Date
1 A	First Edition valid for Hardware Revision 1.A	06.02.97, G.M.

WARNING !
This equipment generates and can radiate radio frequencies. If not installed in accordance with the instruction manual, it may cause interference to radio communications. The equipment has not been tested for compliance with the limits for class A computing devices, pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against such interference, but temporary usage is permitted as per regulations. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense is required to take whatever measures may be required to shield the interference.

DISCLAIMER!
The information in this document has been carefully checked and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. ELTEC reserves the right to make changes to any products to improve reliability, function or design. ELTEC does not assume any liability arising out of the application or use of any product or circuit described in this manual; neither does it convey any license under its patent rights nor the rights of others. ELTEC products are not authorized for use as components in life support devices or systems intended for surgical implant into the body or intended to support or sustain life. Buyer agrees to notify ELTEC of any such intended end use whereupon ELTEC shall determine availability and suitability of its product or products for the use intended.

ELTEC points out that there is no legal obligation to document internal relationships between any functional modules, realized in either hardware or software, of a delivered entity.

ELTEC Elektronik AG
Galileo-Galilei-Str. 11 Postfach 42 13 63
D-55129 Mainz D-55071 Mainz

Telephone +49 (61 31) 9 18-0
Telefax +49 (61 31) 9 18-1 99

Table of Contents

Page

Page

List of Tables

Page

Appendix:

List of Figures

Page

Scope of Delivery

Description:		Order No.:
BAB-430	Graphic module for BAB-40/60 for LCD/TFT-displays	**V-BAB.-A430**
BAB-431	800 x 600 graphic adapter for b/w or color display	**V-BAB.-A431**
BAB-433	Universal display adapter for 3.3 V or 5 V displays with TTL level	**V-BAB.-A433**
BAB-434	Universal display adapter for 5 V displays with CMOS level	**V-BAB.-A434**

The last letter of the order numbers refers to the hardware revision and is subject to changes. Please contact ELTEC for information about valid order numbers.

Example: *V-E16.-B105*

Revision number, subject to change!

Options

Description:	Order No.:
None	

Related Products

Description:		Order No.:
Documentation:	Hardware Manual for BAB-430/431/433/434	V-BAB.-A439
	Hardware Manual BAB-40/60	V-BAB.-A490
	Service Manual BAB-40/60	V-BAB.-A491
	Additional Documentation: 65548 Data Sheet Phoenix MultiKey/42 Technical Reference	
Hardware:	Basic Automation Board BAB-40	V-BAB.-A400
	Basic Automation Board BAB-60	V-BAB.-A600

Conventions

If not otherwise specified, addresses are written in hexadecimal notation and identified by a leading dollar sign ("$").

Signal names preceded by a slash ("/"), indicate that this signal is either active low or that this signal becomes active with the trailing edge.

b	bit
B	byte
KB	kilobyte (1024 bytes)
L	longword (4 bytes)
MB	megabyte (1 048 576 bytes)
MHz	1 000 000 Hertz
W	word (2 bytes)

Board-specific abbreviations:

BGB	BAB Graphic Bus
CFL	Cold Cathode Fluoresent Lamp
CRT	Cathode Ray Tube
DAC	Digital to Analog Converter
DRAM	Dynamic RAM
EMC	Electromagnetic Compliance
ESD	Electrostatic Discharge
GUI	Graphical User Interface
LCD	Liquid Crystal Display
MTBF	Mean Time Between Failure
NVRAM	Nonvolatile RAM
TFT	Thin Film Transistor (LCD)
VLB	VESA Local Bus

How to Use this Manual

Document Structure

This manual is divided into the following chapters:

Chapter 1 Specification contains a list of distinguishing features, a block diagram with a general description, a description of the main building blocks and the board parameters.

Chapter 2 Installation describes the requirements and the step-by-step installation. A table shows the default settings of jumpers and switches followed by a detailed description of adjustable functions.

Chapter 3 Programmer Reference shows the address map and describes the address ranges in detail. Special functions are also described in this chapter.

The **Appendix** contains references to additional literature, an index, and a glossary and necessary extracts of data sheets.

Document Conventions

Font Types:

Font	Use
Helvetica, 10 Pt	Signal names
Times, italic	*Notes, function names, commands*
`Courier, bold`	`Program code`

Indicates information that requires close attention.

Indicates critical information that is essential to read.

Indicates information that is imperative to read. Skipping this material, possibly causes damage to the system.

1 Specification

1.1 Main Features

BAB-430:

- Flatpanel resolution 800 x 600 and 640 x 480 pixels
- Video resolution 640 x 480, 800 x 600, or 1024 x 768 with 70 Hz frame rate
- 16 or 256 colors out of
  256K colors (video display or 18 bit TFT LCD display)
  4096 colors (dualscan color LCD display)
- 1 MB DRAM
- SVGA and flatpanel controlling (simultaneous display possible)
- Graphics controller 65548 from Chips & Technologies
- 32-bit wide data path to DRAM
- Bit Block Transfer engine to increase display memory throughput
- 8-bit DAC for variable contrast voltage 0.5 V to 3.0 V
- Keyboard interface for PS/2 compatible keyboards
- Adaptable to virtually all flatpanel displays via suitable display adapter

BAB-431:

- Adaption to Sharp LM80C20P or LM80C20PX dualscan color LCD display
- Adaption to Sharp LQ11DS01 TFT color LCD display
- Connector for TDK CXA-K10L-FS or Sharp AA605 inverter
- Brightness control via potentiometer

BAB-433:

- All features of BAB-431
- Connector with EUROCOM-128 compatible pinout for adaption to various flatpanel displays

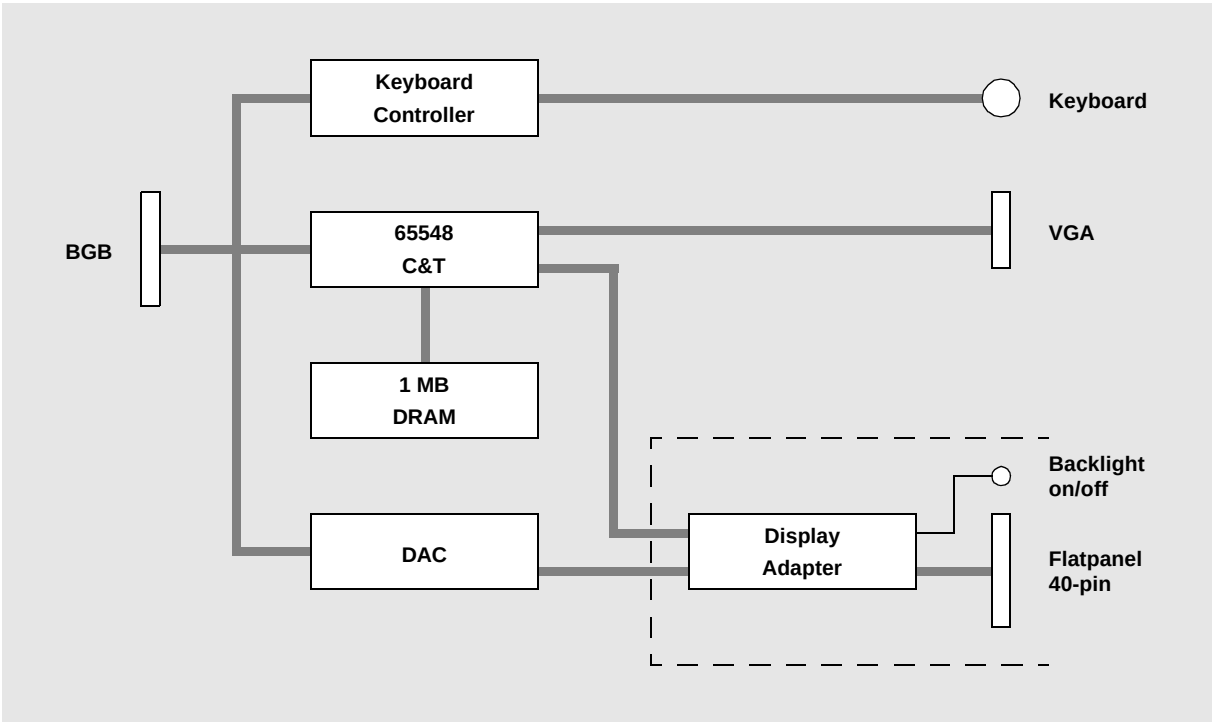
- DC/DC converter for variable contrast voltage -30 V to -20 V or +20 V to +30 V without additional power supply
- Contrast voltage adjustable via DAC on BAB-430
- Power switching for display and inverter
- Support for 3.3 V displays
- Support for 5 V displays with TTL level input (i.e. displays that accept 2.5 V as high)

BAB-434

- All features of BAB-433 but only support for 5 V displays that require CMOS level input (i.e. displays that want a high level input of more than 3.3 V)

1.2 General Description

Figure 1: Block Diagram



The BAB-430 is graphic module for the BAB-40/60 CPU boards. It features the connection of video monitors and flatpanel displays. The BAB-431/433/434 flatpanel display adapter has to be mounted on top of the BAB-430. The display adapter enables the flatpanel mode simultaneous to the video mode. So the BAB-40/60 is ideal suited for applications where the support of both display types video monitors and flatpanel displays is required. This is helpful especially for adjustment or service functions.

With the standard graphic interface BAB-430 installed the BAB-40/60 still needs only one VMEbus slot. Only if the display adapter BAB-431/433/434 is used the BAB-40/60 occupies two VMEbus slots.

1.3 Technical Details

The BAB Universal Graphic Module consists of the following building blocks:

- Keyboard Controller
- 65548 High Performance Flatpanel / CRT GUI Accelerator
- 1 MB DRAM
- DAC for Contrast Control
- Display Adapter

1.3.1 Keyboard Controller

The BAB-430 uses a standard 82C42 keyboard controller with Phoenix MultiKey/42 firmware to interface to a PS/2 compatible keyboard. After being properly initialized by the RMon firmware of the BAB-40/60 it is able to communicate with the keyboard via a 6-pin Mini-DIN connector. All keyboard signals are equipped with protection devices to improve ESD and EMC characteristics. The 82C42 is clocked with one quarter of BLCK (which is the bus clock of the BAB-40/60 board).

1.3.2 65548 High Performance Flatpanel / CRT GUI Accelerator

The BAB-430 uses the VLB mode of the 65548. The BGB signals are translated by a MACH210 device to the VLB signals. Since the 65548 uses Intel byte ordering in VLB mode the data bus bytes are connected in reversed order to the BGB. This results in correct ordering for accessing the framebuffer and the 8-bit wide registers of the 65548. For accessing the 32-bit registers of the 65548 the bytes in the longword must be swapped. The 65548 is able to generate timing signals for virtually all flatpanel displays and for CRT displays up to 80 MHz dotclock.

1.3.3 1 MB DRAM

1 MB of DRAM is used to hold the framebuffer for up to 1024 x 767 resolution with 8 bit/pixel. Due to the linear addressing feature of the 65548 the framebuffer appears to the CPU as a single plane as it is required by most graphic software. The DRAM is also used by the 65548 to temporary hold data that is required for dualscan displays. The 32-bit data path to the BGB offers a memory bandwidth of about 9 MB per second. To improve graphic performance the BitBLT engine of the 65548 can be used. Since the 65548 has direct access to the DRAM the BAB-430 offers then a better overall performance than the BAB-410 graphic module.

1.3.4 DAC for Contrast Control

The BAB-430 offers a 8-bit DAC that is intended for contrast control of dualscan displays. By writing $00 to $FF into the DAC the output voltage changes linear from 0 V to about 3.2 V. The DAC is write-only.

1.3.5 Display Adapter

Since there is a wide variety of display types with different interfaces some adaption is necessary between the 65548 and the display. For this purpose ELTEC currently offers three types of display adapter. First there is the BAB-431 which is intended for Sharp 800 x 600 dualscan or TFT displays. Second there is the BAB-433 which is suitable for nearly all displays with TTL interface (3.3 V or 5 V). Third there is the BAB-434 for 5 V displays that need CMOS level input. With the BAB-433/434 only an appropriate cable is necessary for most displays.

1.3.6 Connectors

1.3.6.1 Connectors on BAB-430

X201 is the VGA connector for CRT displays.

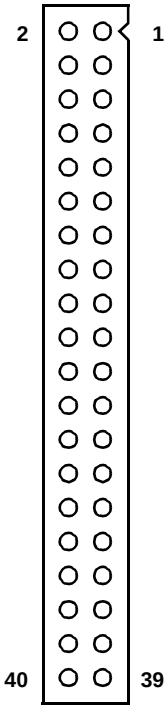
Table 1: VGA Connector X201

Pin	Name	Description
1	R	Red
2	G	Green
3	B	Blue
4	nc	
5	GND	Ground
6	GND	Ground
7	GND	Ground
8	GND	Ground
9	nc.	
10	GND	Ground
11	nc.	
12	nc.	
13	HSYNC	Horizontal Sync
13	VSYNC	Vertical Sync
15	nc	

X202 is used to connect to a flatpanel display via the appropriate display adapter (e.g. BAB-431/433/434).

Table 2: Flatpanel Connector X202 (and X101 on BAB-431/3/4)

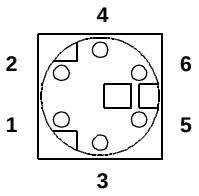
Pin	Name	Description
1	VCC	+5V to supply display adapter
2	VCC	+5V to supply display adapter
3	SHFCLK	Shift Clock
4	GND	Ground
5	M	Display M or DE signal
6	LP	Latch Pulse (flatpanel equivalent of HSYNC)
7	FLM	First Line Marker (flatpanel equivalent of VSYNC)
8	GND	Ground
9	VCONTR	Contrast Voltage 0V..3V
10	GND	Ground
11	ENBKL	Enable Backlight
12	ENAVDD	Enable Vdd
13	ENAVEE	Enable Vee
14	GND	Ground
15	P(0)	Flatpanel Data 0
16	P(1)	Flatpanel Data 1
17	P(2)	Flatpanel Data 2
18	P(3)	Flatpanel Data 3
19	P(4)	Flatpanel Data 4
20	P(5)	Flatpanel Data 5
21	P(6)	Flatpanel Data 6
22	P(7)	Flatpanel Data 7
23	P(8)	Flatpanel Data 8
24	P(9)	Flatpanel Data 9
25	P(10)	Flatpanel Data 10
26	P(11)	Flatpanel Data 11
27	P(12)	Flatpanel Data 12
28	P(13)	Flatpanel Data 13
29	P(14)	Flatpanel Data 14
30	P(15)	Flatpanel Data 15
31	P(16)	Flatpanel Data 16
32	P(17)	Flatpanel Data 17
33	P(18)	Flatpanel Data 18
34	P(19)	Flatpanel Data 19
35	P(20)	Flatpanel Data 20
36	P(21)	Flatpanel Data 21
37	P(22)	Flatpanel Data 22
38	P(23)	Flatpanel Data 23
39	GND	Ground
40	GND	Ground



X301 is a mini-DIN connector used to connect a PS/2 keyboard to the BAB-430.

Table 3: Keyboard Connector X301

Pin	Name	Description
1	KBDATA	Keyboard data
2	reserved	
3	GND	Ground
4	KBVCC	Keyboard supply voltage
5	KBCLK	Keyboard clock
6	reserved	



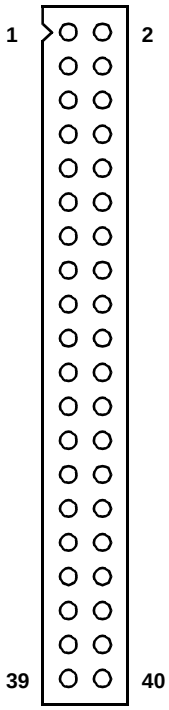
6-pin mini-DIN female connector

1.3.6.2 Connectors on BAB-431

X101 of the BAB-431 has the same layout as X202 of the BAB-430. X102 is intended to connect to a 800 x 600 dualscan color display (SHARP LM80C20PX).

Table 4: 800 x 600 Dualscan Color Display Connector X102

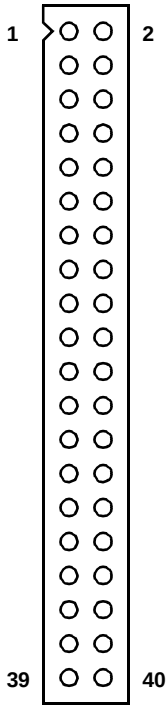
Pin	Name	Description
1	XCK	Data Input Clock
2	GND	Ground
3	GND	Ground
4	LP	Input Data Latch Signal
5	YD	Scan Startup Signal
6	GND	Ground
7	GND	Ground
8	VDD	Display Supply Voltage
9	DISP	Display Control Signal
10	GND	Ground
11	GND	Ground
12	GND	Ground
13	DL7	Lower Display Data 7
14	DL6	Lower Display Data 6
15	DL5	Lower Display Data 5
16	DL4	Lower Display Data 4
17	DL3	Lower Display Data 3
18	DL2	Lower Display Data 2
19	DL1	Lower Display Data 1
20	DL0	Lower Display Data 0
21	GND	Ground
22	GND	Ground
23	GND	Ground
24	DU0	Upper Display Data 0
25	DU1	Upper Display Data 1
26	DU2	Upper Display Data 2
27	DU3	Upper Display Data 3
28	DU4	Upper Display Data 4
29	DU5	Upper Display Data 5
30	DU6	Upper Display Data 6
31	DU7	Upper Display Data 7
32	GND	Ground
33	GND	Ground
34	GND	Ground
35	VDD	Display Supply Voltage
36	VDD	Display Supply Voltage
37	VCON	Contrast Adjust voltage
38	nc	
39	GND	Ground
40	GND	Ground



X103 is intended to connect to a 800 x 600 TFT color display (SHARP LQ11DS01).

Table 5: 800 x 600 TFT Color Display Connector X103

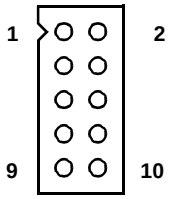
Pin	Name	Description
1	CK	Data Input Clock
2	GND	Ground
3	GND	Ground
4	HSYNC	Horizontal Synchronous Signal
5	VSYNC	Vertical Synchronous Signal
6	GND	Ground
7	R0	RED Data 0 (LSB)
8	R1	RED Data 1
9	R2	RED Data 2
10	R3	RED Data 3
11	R4	RED Data 4
12	R5	RED Data 5 (MSB)
13	GND	Ground
14	GND	Ground
15	GND	Ground
16	G0	GREEN Data 0 (LSB)
17	G1	GREEN Data 1
18	G2	GREEN Data 2
19	G3	GREEN Data 3
20	G4	GREEN Data 4
21	G5	GREEN Data 5 (MSB)
22	GND	Ground
23	GND	Ground
24	GND	Ground
25	B0	BLUE Data 0 (LSB)
26	B1	BLUE Data 1
27	B2	BLUE Data 2
28	B3	BLUE Data 3
29	B4	BLUE Data 4
30	B5	BLUE Data 5 (MSB)
31	GND	Ground
32	GND	Ground
33	GND	Ground
34	ENAB	Data Enable Signal
35	VDD	Display Supply Voltage
36	VDD	Display Supply Voltage
37	nc	
38	nc	
39	GND	Ground
40	GND	Ground



X104 is used to connect either a SHARP AA605 inverter to pin 1-5 or a TDK CXA-K10L-FS inverter to pin 6-10. P101 (100K) can be used to adjust the brightness of the CFL.

Table 6: Inverter Supply Connector X104

Pin	Name	Description
1	+12V	Inverter Power Supply
2	ENABKL	Enable Backlight
3	ADJ1	Brightness Control 1
4	ADJ2	Brightness Control 2
5	GND	Ground
6	+12V	Inverter Power Supply
7	GND	Ground
8	ENABKL	Enable Backlight
9	ADJ1	Brightness Control 1
10	ADJ2	Brightness Control 2



1.3.6.3 Connectors on BAB-433/434

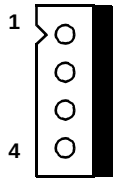
All connectors located on the BAB-431 are also on the BAB-433/434.

Additionally the BAB-433/434 also have the following connectors.

X105 is a 4-pin connector as it is often used for power supply of 3.5" floppy drives. It is intended for connection of inverters that have neither brightness control nor a shutdown.

Table 7: Inverter Supply Connector X105

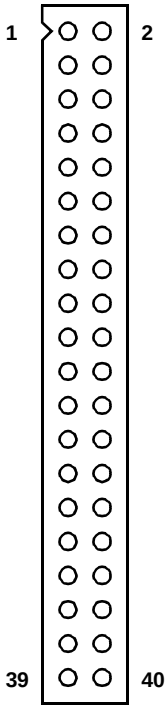
Pin	Name	Description
1	INV+	Inverter Power Supply (+5 V or +12 V)
2	GND	Ground
3	GND	Ground
4	INV+	Inverter Power Supply (+5 V or +12 V)



X201 is a universal display connector with EUROCOM-128 compatible pin layout.

Table 8: Universal Display Connector X201

Pin	Name	Description
1	P(23)	Data Bit 23
2	P(22)	Data Bit 22
3	P(15)	Data Bit 15
4	P(14)	Data Bit 14
5	n.c.	
6	GND	Ground
7	P(6)	Data Bit 6
8	n.c.	
9	TPVEE_I	Panel Vee In (used if external supply necessary)
10	SH	Shield (connected via 100 nF to ground)
11	TPVEE_O	Panel Vee Out
12	TPVDD	Panel Vdd
13	P(10)	Data Bit 10
14	TPVEE_O	Contrast Voltage
15	P(12)	Data Bit 12
16	P(11)	Data Bit 11
17	P(18)	Data Bit 18
18	P(13)	Data Bit 13
19	P(20)	Data Bit 20
20	P(19)	Data Bit 19
21	GND	Ground
22	P(21)	Data Bit 21
23	P(3)	Data Bit 3
24	P(2)	Data Bit 2
25	P(5)	Data Bit 5
26	P(4)	Data Bit 4
27	TPVDD	Panel Vdd
28	GND	Ground
29	SHFCLK	Shiftclock
30	ENBKL	Enable Backlight
31	LP	Latch Pulse
32	FLM	First Line Marker
33	P(7)	Data Bit 7
34	M	M or DE Signal
35	P(1)	Data Bit 1
36	P(0)	Data Bit 0
37	P(9)	Data Bit 9
38	P(8)	Data Bit 8
39	P(17)	Data Bit 17
40	P(16)	Data Bit 16



In the above table the names of the corresponding pins of the 65548 are used whenever possible. Also odd and even pins are swapped compared with the corresponding table of the EUROCOM-128 because the EUROCOM-128 uses bottom view of the display connector.

1.4 Definition of Board Parameters

1.4.1 CRT Display

- **Up to 1024 x 768 resolution with 4 or 8 bit per pixel**
- **Up to 80 MHz dotclock**
- **16 or 256 out of 256K colors**

1.4.2 Flatpanel Display

Table 9: BAB-430 Supported Display Types

Manufac-turer	Name	Type	Resolu-tion	Viewing Size (mm)	Duty Cycle	Display Adapter
ORION	OEM-6448	b&w	640 x 480	196.0 x 147.6	1/240	434
OPTEX	DMF-50260	b&w	640 x 480	196.0 x 148.0	1/240	434
OPTEX	DMF-50383	b&w	640 x 480	151.0 x 113.4	1/240	434
HITACHI	LMG5278XUFC-00T	b&w	640 x 480	196.0 x 150.0	1/242	434
HITACHI	LMG7550XUFC	b&w	640 x 480	213.3 x 160.0	1/244	434
HITACHI	LMG-9460XUCC	RGB	640 x 480	213.3 x 160.0	1/244	434
ORION	OEM- 6448C-2	RGB	640 x 480	196.0 x 147.0	1/240	434
ORION	OEM- 64C30-1	RGB	640 x 480	214.2 x 161.4	1/240	434
TOSHIBA	TLX-8062A-C3X	RGB	640 x 480	196.0 x 147.0	1/240	434
SHARP	LM80C20P	RGB	800 x 600	229.2 x 171.0	1/302	431/4
SHARP	LQ11DS01	TFT	800 x 600	229.2 x 171.0	-	431/3/4
SHARP	LM80C20PX	RGB	800 x 600	229.2 x 171.0	1/300 1/328	431/3/4

Please refer to the addendum of this manual for an updated or modified list of supported displays.

1.4.3 MTBF Values

• BAB-430:

- 38 056 h (computed after MTL HDBK-217E)
- 509 950 h (realistic value from industry standard experience)

• BAB-431:

- 637 294 h (computed after MTL HDBK-217E)
- 8 539 740 h (realistic value from industry standard experience)

• BAB-433/434:

- 307 708 h (computed after MTL HDBK-217E)
- 4 123 287 h (realistic value from industry standard experience)

1.4.4 Environmental Conditions

• Storage Temperature:

-35 °C to +85 °C

• Operating Temperature:

0 °C to +60 °C (non condensing)

• Maximum Operating Humidity:

85% relative

• Air temperature with forced air cooling of approx. 1 m/sec.

1.4.5 Power Requirements

• BAB-430:

+5 V ±5% 0.7 A max. (0.5 A typ.)

• BAB-431:

+5 V ±5% 0.2 A max. (0.1 A typ.)

• BAB-433/434:

+5 V ±5% 0.2 A max. (0.1 A typ.)

+12 V ±10% 0.2 A max. (0.05 A typ.)

2 Installation

2.1 Introduction

- Carefully remove the board from the shipping carton.
  - Save the original shipping container and packing material for storing or reshipping the board.

Avoid touching integrated circuits except in an electrostatic free environment. Electrostatic discharge can damage circuits or shorten their lifetime.

- Inspect the board for any shipping damage. If undamaged, the module can be prepared for system installation.
- Set all jumpers to the desired position, refer to Section 2.5 'Jumpers and Switches'.

When unplugging boards from the rack or otherwise handling boards, do always observe precautions for handling electrostatic devices.

Figure 2: Installation Diagram

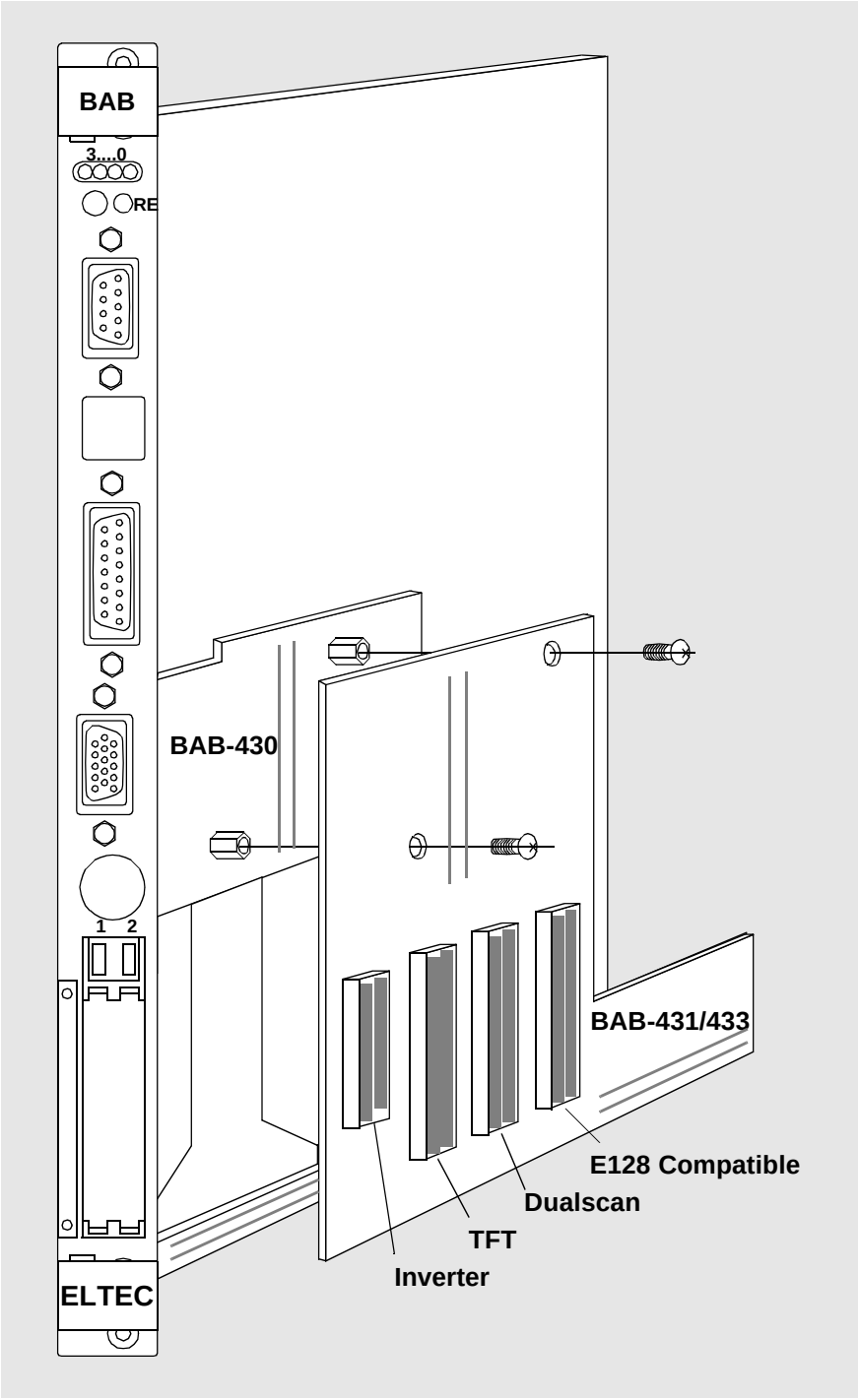


Figure 3: Location of Jumpers and Connectors (BAB-433/434)

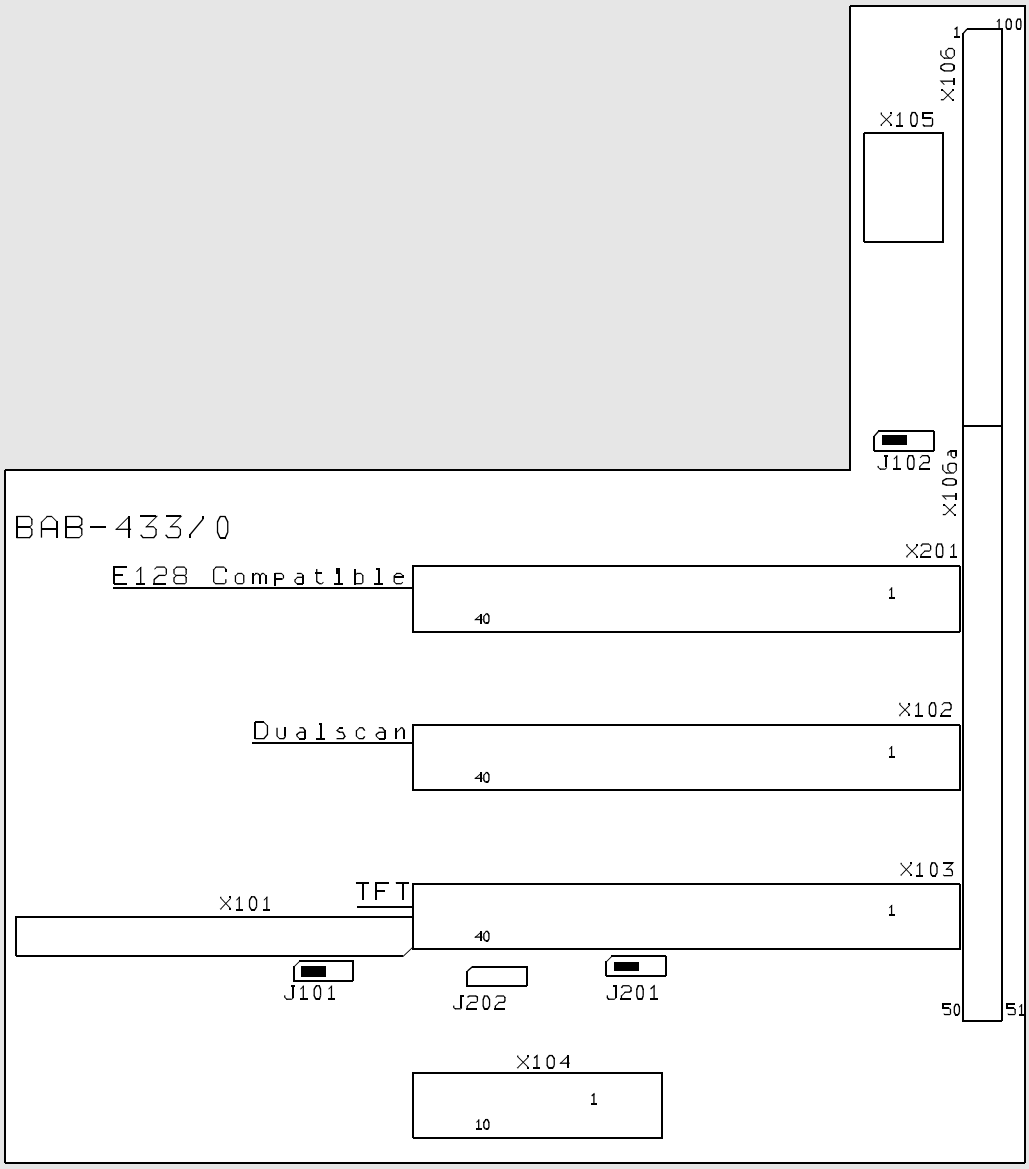
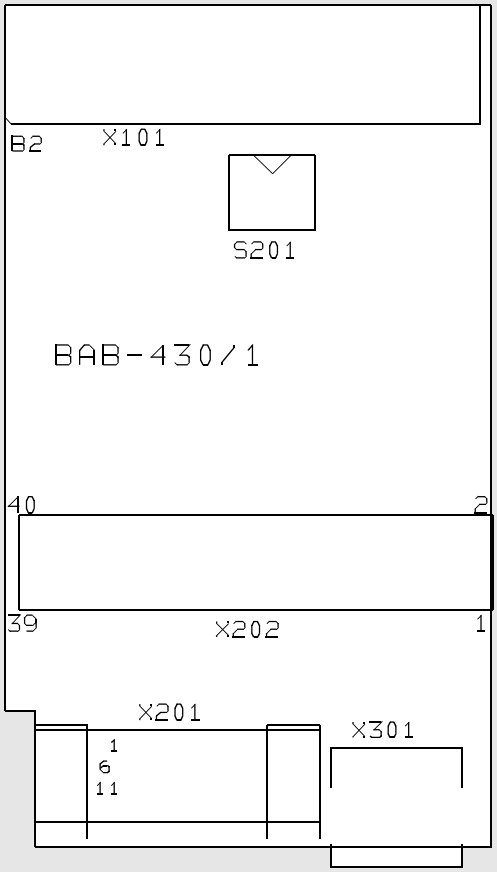


Figure 4: Location of Switch S201 and Connectors on BAB-430



2.2 Installation CRT Display

1. Set all switches S301 to off.
2. Set S902 on the BAB-40/60 to "0".
3. Remove bolts from X201 of BAB-430.
4. Plug the BAB-430 into BGB connector of the BAB-40/60.
5. Mount bolts for X201 of BAB-430.
6. Plug BAB-40/60 into the rack.
7. Connect CRT monitor and PS/2 keyboard.
8. Switch power on.
9. Configure the setup menu of the RMon.
10. Save setup and set S902 of the BAB-40/60 to "1".

2.3 Installation Flatpanel Display

1. Set up switches S301 and on the BAB-430 for desired display.
2. Set up jumpers J101-102 and J201-202 on BAB-433.
3. Set S902 on the BAB-40/60 to "0".
4. Remove bolts from X201 of BAB-430.
5. Remove bolts M2.5x6 from display adapter.
6. Mount bolts M2.5x6 on soldering side of the BAB-430 with two screws M2.5x4.
7. Plug the BAB-430 into BGB connector of the BAB-40/60.
8. Mount bolts for X201 of BAB-430.
9. Plug display adapter into X202 of the BAB-430 and the BEB of the BAB-40/60.
10. Mount screws M2.5x4 so that the BAB-430 and the display adapter are fixed together.
11. Connect flatpanel, inverter, and PS/2 keyboard.
12. Make sure that the connections to the flatpanel and to the inverter are correct.
13. Plug BAB-40/60 into the rack.
14. Switch power on.
15. Configure the setup menu of the RMon.
16. Save setup and set S902 of the BAB-40/60 to "1".
17. Adjust brightness with P101 on BAB-431/433. Note that the maximum allowable value of P101 depends on the type of the inverter and display.

Operating the flatpanel display with the wrong configuration may damage the display.

2.4 Interface Cable

When ordinary flat cable is used the distance between the BAB-431/433/434 and the display should not exceed 0.6 m. Especially with TFT displays cable length is critical. With cable where every signal is shielded and terminated at the display side cable length may be extended up to some meters.

A SHARP LM80C20PX or LQ11DS01 display can be directly connected to X102 respectively X103 of the BAB-431/433/434 because these connectors have a layout that matches the one of the display. All others should be connected to X201 of the BAB-433 according to Table 10: 'Interface Cable Connections'.

Table 10: Interface Cable Connections

X201		HITACHI LMG9460XUCC		TOSHIBA TLX-8062S-C3; ORION OEM-6448C-2, OEM-64C30-1		HITACHI LMG5278XUFC-00T, LMG7550XUFC; ORION OEM-6448	
Pin	**Name**	**Pin**	**Name**	**Conn./Pin**	**Name**	**Pin**	**Name**
1	P(23)						
2	P(22)						
3	P(15)	11	LD0	CN2/2	LD0		
4	P(14)	13	LD1	CN2/3	LD1		
5	n.c.						
6	GND	27, 30	VSS	CN2/1	GND		
7	P(6)	3	LDS	CN2/7	LD5	13	LD1
8	n.c.						
9	TPVEE_I						
10	SH						
11	TPVEE_O	12	VCON	CN1/7	VEE	7	VEE
12	TPVDD	14	VDD	CN1/5	VDD	5	VDD
13	P(10)	26	UD11	CN1/9	UD1		
14	TPVEE_O						
15	P(12)	19	LD3	CN2/5	LD3		
16	P(11)	28	UD0	CN1/8	UD0		
17	P(18)						
18	P(13)	17	LD2	CN2/4	LD2		
19	P(20)						
20	P(19)						
21	GND	15, 21	VSS	CN1/6	GND	6	GND
22	P(21)						
23	P(3)	23	UD4	CN1/12	UD4	8	UD0
24	P(2)	25	UD5	CN1/13	UD5	9	UD1
25	P(5)	5	LD6	CN2/8	LD6	14	LD2
26	P(4)	7	LD7	CN2/9	LD7	15	LD3
27	TPVDD	16, 18	VDD,DOFF	CN1/4	DISP	4	DISP
28	GND	2, 8, 9	VSS	CN2/10	GND		
29	SHFCLK	10	CL2	CN1/3	SCP	3	SCP
30	ENBKL						
31	LP	6	CL1	CN1/2	LP	2	LP
32	FLM	4	FLM	CN1/1	FP	1	FP
33	P(7)	1	LD4	CN2/6	LD4	12	LD0
34	M						
35	P(1)	29	UD6	CN1/14	UD6	10	UD2
36	P(0)	31	UD7	CN1/15	UD7	11	UD3
37	P(9)	24	UD2	CN1/10	UD2		
38	P(8)	22	UD3	CN1/11	UD3		
39	P(17)						
40	P(16)						

2.5 Jumpers and Switches

2.5.1 Jumpers (BAB-433 only)

J101 is used to select whether the flatpanel display operates with 5 V or 3.3 V supply.

Table 11: Display Voltage Select J101

Jumper J101	Function
1 - 2	**5 V Display Supply Voltage**
2 - 3	3.3 V Display Supply Voltage

2.5.2 Jumpers (BAB-433/434)

J102 is used to select whether the inverter connected to X105 operates with 5 V or 12 V.

Table 12: Inverter Voltage Select J102

Jumper J102	Function
1 - 2	**12 V Inverter Supply Voltage**
2 - 3	5 V Inverter Supply Voltage

J201 is used to select whether a dualscan flatpanel display operates with positive or negative contrast voltage.

Table 13: Contrast Voltage Polarity Select J201

Jumper J201	Function
1 - 2	**Contrast Voltage +20 V to +30 V**
2 - 3	Contrast Voltage -30 V to -20 V

J202 is used to select the source of the contrast voltage for a dualscan flatpanel display.

Table 14: Contrast Voltage Source Select J202

Jumper J202	Function
open	**Contrast Voltage supplied externally at TPVEE_I**
1-2	Contrast Voltage supplied by internal DC/DC converter
2-3	Contrast Voltage directly from DAC

2.5.3 Display Type Switch

S201 is used to select which type of display is connected to the BAB-431/433/434.

Table 15: Display Type Select Switch S201

No.	4	3	2	1	Description
0	off	off	off	off	CRT
1	off	off	off	on	800 x 600 Dualscan Color (SHARP LM80C20P, LM80C20PX)
2	off	off	on	off	800 x 600 TFT Color (SHARP LQ11DS01)
3	off	off	on	on	648 x 480 Dualscan b&w (ORION OEM-6448, HITACHI LMG7550XUFC)
4	off	on	off	off	640 x 480 Dualscan Color (ORION OEM-6448C-2, TOSHIBA TLX-8062S-C3X, HITACHI LMG9460XUCC)
15	on	on	on	on	user defined
	all others				reserved

2.5.4 Recommended Setup

Table 16: Recommended Setup for Various Displays

Display	J201	J202	S201	RMon Screen Resolution
SHARP LM80C20P SHARP LM80C20PX	-	-	1	800 x 600 36kHz 58Hz
SHARP LQ11DS01	-	-	2	800 x 600 36kHz 58Hz
HITACHI LMG5278XUFC-00T HITACHI LMG7550XUFC ORION OEM-6448	2-3	1-2	3	640 x 480 31kHz 60Hz
HITACHI LMG9460XUCC	-	2-3	4	640 x 480 31kHz 60Hz
ORION OEM-6448C-2 ORION OEM-64C30-1 TOSHIBA TLX-8062S-C3X TOSHIBA TLX-8102S-C3X	1-2	1-2	4	640 x 480 31kHz 60Hz

- Means don't care.

3 Programmers Reference

3.1 Address Map

Table 17: BAB-430 Address Map

Address	Name	Description	Access **
$0410.0000-$041F.FFFF*		1 MByte Frame Buffer	B/W/L r/w
$FEC6.0060	KBDATA	Keyboard Data	B r/w
$FEC6.0064	KBCSR	Keyboard Control/Status	B r/w
$FEC6.03B4-$FEC6.03C2*		F65548 Registers	B r/w
$FEC6.03C3	VSEnable	Video Subsystem Enable	B r/w
$FEC6.03C4-$FEC6.03DA*		F65548 Registers	B r/w
$FEC6.XXA0*		F65548 32 Bit Register	L r/w
$FEC6.2000	LSVER	Least Significant Version	B r
$FEC6.2004	MSVER	Most Significant Version	B r
$FEC6.2044	DACBRI	LCD Brightness Control	B w
$FEC6.2060	KBINT	Keyboard Interrupt Enable	B r/w

* Only available if the video controller 65548 is properly initialized.

** r/w read/write
B byte
W word
L longword

3.2 Version Registers

The version registers LSVER and MSVER can be used to identify the BAB-430 graphic module.

Table 18: Version Registers LSVER and MSVER (read only)

D7							D0	
-	-	-	-	-	-	VD1	VD0	LSVER at $FEC6.2000
-	-	-	-	-	-	VD3	VD4	MSVER at $FEC6.2004

VD3	VD2	VD1	VD0	Version
0	0	0	0	BAB-410
0	0	0	1	BAB-411
0	0	1	0	BAB-412
0	0	1	1	BAB-420
0	1	0	0	BAB-421
0	1	0	1	BAB-430
Rest				Reserved

3.3 Contrast DAC

There is a 8-bit DAC to control contrast of dualscan LCD displays by writing to $FEC6.2044. The content of the DAC is undefined at reset. The DAC is write only. The RMon initializes the DAC to $80 after reset.

Software that allows to change the contrast voltage must ensure that the maximum ratings of the display are not exceeded. Alternatively R202-204 on the BAB-433 may be changed to achieve a different range for the contrast voltage (see Appendix A.4 "Calculating of Contrast Voltage Range").

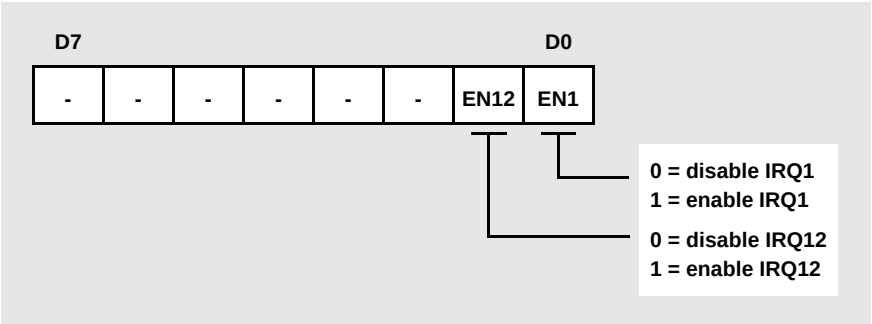
3.4 Keyboard Interrupt Enable

The keyboard controller 82C42 has two interrupt outputs named IRQ1 (pin 11) and IRQ12 (pin 13). Interrupts from these two outputs can be enabled separately via the keyboard interrupt register KBINT at $FEC6.2060. The interrupts are disabled after reset.

To signal service requests the keyboard controller interrupt signal is connected to the VIC's LIRQ1 input of the BAB-40/60. The VIC has to be programmed to low level-sensitive and has to supply the interrupt vector.

The keyboard controller shares the LICR1 input of the VIC with the NCR53C710 SCSI controller of the BAB-40/60.

Table 19: Keyboard Interrupt Register KBINT at $FEC6.2060



3.5 Video Controller

The only register of the video controller that is reachable after reset is the VSEnable register at $FEC6.03C3. The other registers are enabled by writing $01 to the VSEnable register.

Due to Intel byte ordering the bytes in the 32-bit registers of the 65548 are swapped.

Appendix

A.1 BAB-430

Table A.1: Parts List BAB.-A430.0

Part No.	Count	Part Type	Case	Socket	Comment
C100..112	13	C,C,100NF-0805	C0805B		
C115..116	2	C,C,22PF-2R	C1206B		
Q101	1	XTAL,14.318-MINI	XTAL		
R101	1	R,150-SMD	R1206B		
R102	1	R,1K-SMD	R1206B		
R103	1	R,470-SMD	R1206B		
R104	1	R,1M-SMD	R1206B		
R105	1	R,1K-SMD	R1206B		
U101	1	MACH210-15-PLCC	44PLCC		BAB_*14.XY
U102	1	AD557	16DIP3		
X101	1	X,BU-5X20	5X20BU		
C201..202	2	C,C,100NF-2R	C0805B		
C203	1	C,T,47/10-SMD	TACD		
C204	1	C,C,100NF-2R	C0805B		
C205	1	C,T,47/10-SMD	TACD		
C206	1	C,C,100NF-2R	C0805B		
C207	1	C,T,22/16-1R	TA1R		
C208	1	C,C,100NF-2R	C0805B		
C209	1	C,C,10NF-2R	C1206B		
C210..214	5	C,C,22PF-2R	C1206B		
D201..206	6	DIO,LL101A	MM		
L201..203	3	R,22-SMD	L1210		
L204	1	L,3.3UH-SMD	L1812		
R201	1	R,1K-SMD	R1206B		
R202	1	R,22-0805	R0805B		
R203	1	R,4K7-SMD	R1206B		
R204..206	3	R,150-SMD	R1206		

Table A.1: Parts List BAB.-A430.0 (Continued)

Part No.	Count	Part Type	Case	Socket	Comment
R207..208	2	R,22-0805	R0805B		
R209	1	R,270-SMD-1%	R1206B		
R210	1	PTC425	PTC425		
R211..212	2	R,10-SMD	R1206B		
RN201..202	2	RN,4X33-743	8R743B		
RN203	1	RN,4X4K7-743	8R743B		
S201	1	S,4-POS-MDIL-SMD	8SOMSWB		
U201	1	65548VLB	208PQV		
U202..203	2	TC514260B-TSOP	TSOP44-P-400-BOT		
U204	1	74ABT125-SO	14SO3		
X201	1	X,15/3-DF-G	15X3FG		
X202	1	X,AMP2X20	40AMP1		
C301..304	4	C,C,100NF-2R	C0805B		
R301..303	3	R,0-SMD	R0805B		
R311	1	R,10K-SMD	R1206B		
RC301..304	4	VC-1.10NF-0805	C0805B		
RN301..302	2	RN,8X4K7-745	10R745B		
RN303	1	RN,4X47-743	8R743B		
U301	1	S82C42PC-QFP	44QFPB		
U302	1	74F38-SO	14SO3		
X301	1	X,MINI-DIN-6-GND	6XMDG		

A.2 BAB-433/434

Table A.2: Parts List BAB.-A433.0/434.0

Part No.	Count	Part Type	Case	Socket	Comment
C101..106	6	C,C,100NF-2R	C1206		
C110..139	30	C,C,22PF-2R	C1206		
J101..102	2	J,1X3	1X3J		J101 not used on BAB-434
P101	1	R,100K-TRIM	TRIM,100K-ST		
R101..102	2	PTC425	PTC425		
R103..106	4	R,10K-SMD	R1206		
RN101..108	8	RN,4X22-743	8R743		
T101	1	SI-9430DY	SO,8-PIN		
T102	1	TRA,BC847B	TO236		
T103	1	SI-9430DY	SO,8-PIN		
T104	1	TRA,BC847B	TO236		
U101..102	2	74LVT16245-SO-EX	48SO4		74ABT16245 on BAB-434
U103	1	LT1086-3.3CT	TO-220,3-PIN-K		not used on BAB-434
X101	1	X,STIFTL-2X20	2X20STBOT		
X102..103	2	X,PFLEST-40	40PLST		
X104	1	X,PFLEST-10	10PLST		
X105	1	X,4-PIN-AMP	4XFL3		
X106	1	X,STIFTL-2X50	2X50ST		
PC201	1	C,T,10/25-SMD	TACD		
C202	1	C,C,100NF-2R	C1206		
C203..205	3	C,T,10/35-SMD	TACD		
C206	1	C,C,100NF-2R	C1206		
D201..203	3	DIO,BYS21-45	DA398a		
F201	1	F,PICO	2RES4		
J201..202	2	J,1X3	1X3J		
L201	1	L,47UH	2L5		
R202	1	R,20K-MF	2RES4		
R203	1	R,1K-MF	2RES4		
R204	1	R,6K81-MF	2RES4		
R206	1	R,150-SMD	R1206		

Table A.2: Parts List BAB.-A433.0/434.0 (Continued)

Part No.	Count	Part Type	Case	Socket	Comment
R210	1	R,1K5	2RES4		
U201	1	LT1172CN8	8DIP3		
U202	1	TLP595G	6DIP3		
X201	1	X,PFLEST-40	40PLST		

A.3 Adaption of the BAB-430/433/434 to new Displays

Adaption of a new display requires the following:

- BAB-430 and BAB-433/434
- 65548 data sheet
- Display data sheet
- Suitable cable for display
- CRT monitor and keyboard
- OS-9 with console driver (useful)
- EPROM programmer

For initialization of a particular display RMon uses a table that is located at offset $1A00 + (n-1)*$50 in the RMon firmware EPROM. Where n is the position of S201 on the BAB-430. This table contains the numbers and values for all extension registers of the 65548 that are different from CRT setup. Essentially these tables are those of the "Programming" chapter of the 65548 data sheet terminated by two bytes $00 to identify the end of the table. RMon always uses the table selected by S201 for initialization while the OS-9 console driver uses a copy of the table that is located in the RAM at $0000.0D00. This gives the chance to modify and test the setup of the extension registers for a new display via the following procedure:

1. Set S201 of the BAB-430 to the position that matches the requirements of the new display best.
2. Don't connect the new display.
3. Configure screen resolution and booting of OS-9 in the RMon setup and set S902 on the BAB-40/60 to "1".
4. Modify the table at $0000.0D00 in the RAM with the RMon debugging commands via keyboard and CRT (if you are lucky you can directly use one of the tables of the 65548 data sheet).
5. Write the modified table with the RMon command "we" to the NVRAM.
6. Switch power off and install new display.
7. Switch power on.

8. Read the NVRAM with the "re" command.
9. Boot OS-9 and inspect display.
10. Perform a reset and repeat steps 8, 4, 5, 9, and 10 until satisfied with the display.
11. Read RMon firmware EPROM with the EPROM programmer.
12. Modify the table at the desired offset ($1E60 is recommended for user-defined displays, which belongs to position 15 of S201 on the Bab-430) with the values you found in steps 4 to 10.
13. Program new EPROM and mount it on the BAB-40/60.
14. Set S201 on the BAB-430 to the chosen number.
15. Switch power on.

Now RMon should work with the new display.

With the above procedure the display may be operated with a wrong setup for a short time. Normally this does not harm the display.

If you don't have OS-9 you have to program a new EPROM for every try. In this case you have to leave steps 1 to 10.

A.4 Calculating of Contrast Voltage Range

The following C program calculates the neccessary values of R202 and R204 of the contrast voltage DC/DC converter on the BAB-433 from the desired output voltages.

```
#include <stdio.h>

main(argc,argv)
int argc;
char **argv;
{
    double r1, r2, rr, ur, ue1, ue2, ua1, ua2;

    if(argc!=7) {
        printf("\nSyntax:    lt1171 Ur Rr Ue1 Ue2 Ua1 Ua2\n");
        printf("           Ur = LT1171/LT1172 reference voltage (1.244V nominal)\n");
        printf("           Rr = reference resistor (R204)\n");
        printf("           Ue1= minimum DAC output voltage (usually 0 V)\n");
        printf("           Ue2= maximum DAC output voltage (usually 3.2V)\n");
        printf("           Ua1= maximum output voltage (must be less than 35V)\n");
        printf("           Ua2= minimum output voltage (must be more than 12V)\n");
    } else {
        if(sscanf(argv[1],"%lf",&ur)==0) {
            printf("\nIllegal parameter %s\n",argv[1]);
            exit(0);
        }
        if(sscanf(argv[2],"%lf",&rr)==0) {
            printf("\nIllegal parameter %s\n",argv[2]);
            exit(0);
        }
        if(sscanf(argv[3],"%lf",&ue1)==0) {
            printf("\nIllegal parameter %s\n",argv[3]);
            exit(0);
        }
        if(sscanf(argv[4],"%lf",&ue2)==0) {
            printf("\nIllegal parameter %s\n",argv[4]);
            exit(0);
        }
        if(sscanf(argv[5],"%lf",&ua1)==0) {
            printf("\nIllegal parameter %s\n",argv[5]);
            exit(0);
        }
        if(sscanf(argv[6],"%lf",&ua2)==0) {
            printf("\nIllegal parameter %s\n",argv[6]);
            exit(0);
        }

        r1 = rr * (ue2*ua1 - ua1*ur - ue2*ur - ua2*ue1 + ua2*ur + ue1*ur)
             / (ur*(ua1 - ua2));
        r2 = rr*r1*(ua1 - ur) / (ur*r1 - ue1*rr + ur*rr);
        printf(" R202 = %lf   R204 = %lf\n", r1, r2);
    }
}
```

Example:

```
> lt1171 1.244 10 0 3.2 30 20
 R202 = 63.970418   R204 = 199.907556
```

A.5 Index