INTERCONNECTION BACKPLANES FOR G-64 AND G-96 EUROBOARDS

Among the numerous buses existing for microprocessor based systems, the G-64 standard offering a simple and powerful solution, has proven to the best solution available for industrial applications with all 8 or 16 bit processors. Since its introduction in 1979, the G-64 concept has become a “de facto” standard in most industrial applications.

The DIN 42612 type connector (2.54mm pitch) allows the use of printed circuit boards without gold connectors or other special treatment and provides an excellent electrical connection. Furthermore the shape of the connector is also compatible with flat cable connectors. The G-64 bus uses only the rows A and B of the connector (i.e. 64 pins) which are sufficient for all 8 or 16 bit microprocessor environments. There are several versions of the GESBUS depending upon size:

- GESBUS-4D with 4 slots for smaller applications
- GESBUS-8D with 8 slots mounts in a 19” rack enabling the use of 8 Euroboards and one 8” disk drive
- GESBUS-12D with 12 slots enables the mounting of 12 Euroboards and one or two 5 ¼” floppy disk drive in various standard “EURONORM” racks (3U)
- GESBUS-16D with 16 slots
- GESBUS-20D with 20 slots

In November 1984, to keep ahead in the fast technological progress, Gespac introduced the G-96 Bus, which uses rows A, B and C of the DIN 42612 connector (96 pins). This expansion of the standard G-64 Bus was designed to support the following criterion:

- Full compatibility with the G-64 Bus.
- To meet 16/32 bit microprocessor requirements.
- Larger addressing capability (32 Mbytes).
- Multiprocessor with decentralized arbitration.
- Fully terminated multilayer motherboard for high-speed transfer.
- Possibility to mix G-96 and G-64 modules on the same motherboard.

There are several versions of the G96 Bus:

- GESBUS-4M with 4 slots.
- GESBUS-6M with 6 slots.
- GESBUS-8M with 8 slots.
- GESBUS-12M with 12 slots.
- GESBUS-16M with 16 slots.
- GESBUS-20M with 20 slots.
- GESBUS-4A with 4 slots.
- GESBUS-6A with 6 slots.
- GESBUS-8A with 8 slots.
- GESBUS-12A with 12 slots.
- GESBUS-16A with 16 slots.
- GESBUS-20A with 20 slots.

The differences between the G-64 and G-96 Buses mainly affect only processor and memory modules. Generally, the G-64 interface and controller modules can be used either with G-96 and G-64.

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1. INTRODUCTION

1.1 BUS DEFINITION (BACKPLANE)

The backplane is a printed circuit with connectors (press-fit technology) wired together by a set of buses lines. The backplane also includes Plat FASTON terminals for the power supply prepositioned holes for fixing guides and prepositioned holes for mechanical mounting in different rack types. Optionally, backplanes can be supplied with jumper positions used to short-circuit the daisy chain on unoccupied slots between 2 modules (available on G-96 Backplanes only). Different backplane lengths are use for 4 to 20 connectors numbered 1, 2, 3, …….20 from right to left when looking at the backplane from the board side.

1.2 BUS IDENTIFICATION

The different bus types are described in the table 1.1.

FEATURES	GESBUS																
	4D	8D	12D	16D	20D	4M	6M	8M	12M	16M	20M	4A	6A	8A	12A	16A	20A
DIN 42612 FORM C 64-pin connector on Row A and B G-64	●																
DIN 42612 FORM C 96-pin connector on Row A, B and C G-96						●	●	●	●	●	●	●	●	●	●	●	●
4 slots	●					●						●					
6 slots							●						●				
8 slots		●						●						●			
12 slots			●						●						●		
16 slots				●						●						●	
20 slots					●						●						●
Double side PCB	●	●	●	●	●												
Multilayer terminated PCB						●	●	●	●	●	●	●	●	●	●	●	●
Power connection with FASTON	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Jumpers for daisy chain						●	●	●	●	●	●	●	●	●	●	●	●
Passive terminations						●	●	●	●	●	●	●	●	●	●	●	●
Active terminations												●	●	●	●	●	●
Protective earth terminal												●	●	●	●	●	●

Note: For new design you should use only the GESBUS-A family and no longer the other family.

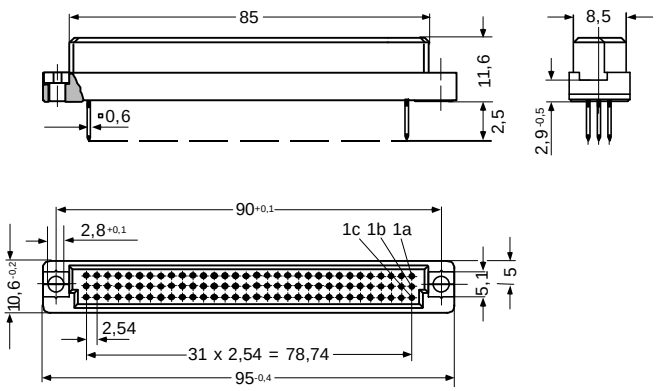
Table 1.1 Bus identification.

2. MECHANICAL SPECIFICATIONS

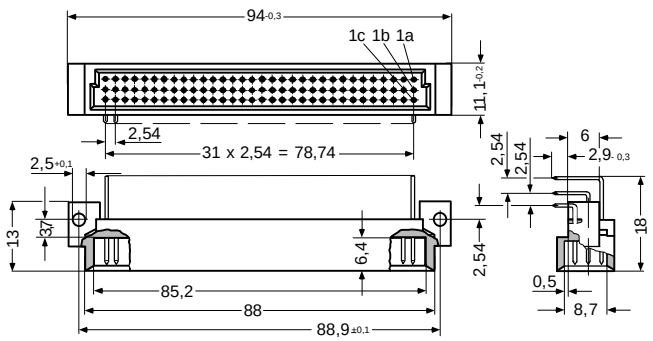
2.1 G-64 CONNECTOR (TYPE D)

The backplane of the G-64 Bus uses a standard DIN 41612-B female type connector with the row C not equipped. G-64 module uses the corresponding male connector. This connector ensures compatibility between G-64 and G-96.

Physical dimensions for implementation are shown in figures 2.1a and 2.1b.



Note: Row C is not equipped.
Figure 2.1a Backplane connector for G-64 standard.



Note: Row C is not equipped.
Figure 2.1b Module connector for G-64 standard.

2.2 G-96 CONNECTOR (TYPE M)

The backplane of the G-96 Bus uses a standard DIN 41612-C female type connector. G-96 modules use the corresponding male connector.

Physical dimensions for implementation are shown in figures 2.2a and 2.2b.

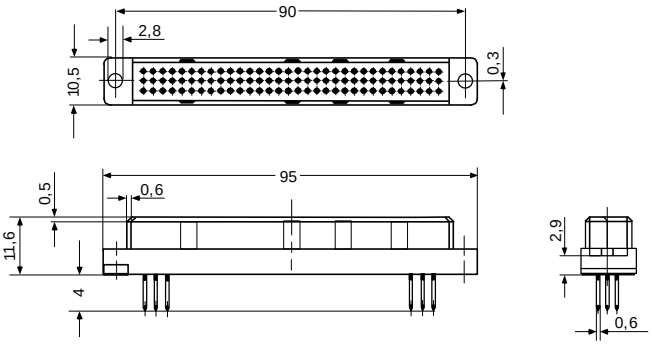


Figure 2.2a Backplane connector for G-96 standard.

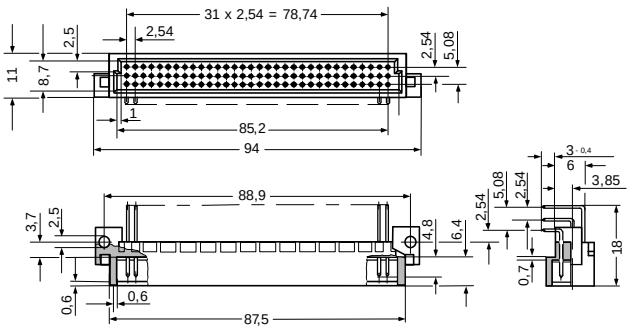


Figure 2.2b Module connector for G-96 standard.

2.3 GESBUS-4D/8D/12D/16D/20D

Mechanical characteristics of the GESBUS-4D/8D/12D/16D/20D are illustrated in figure 2.3.

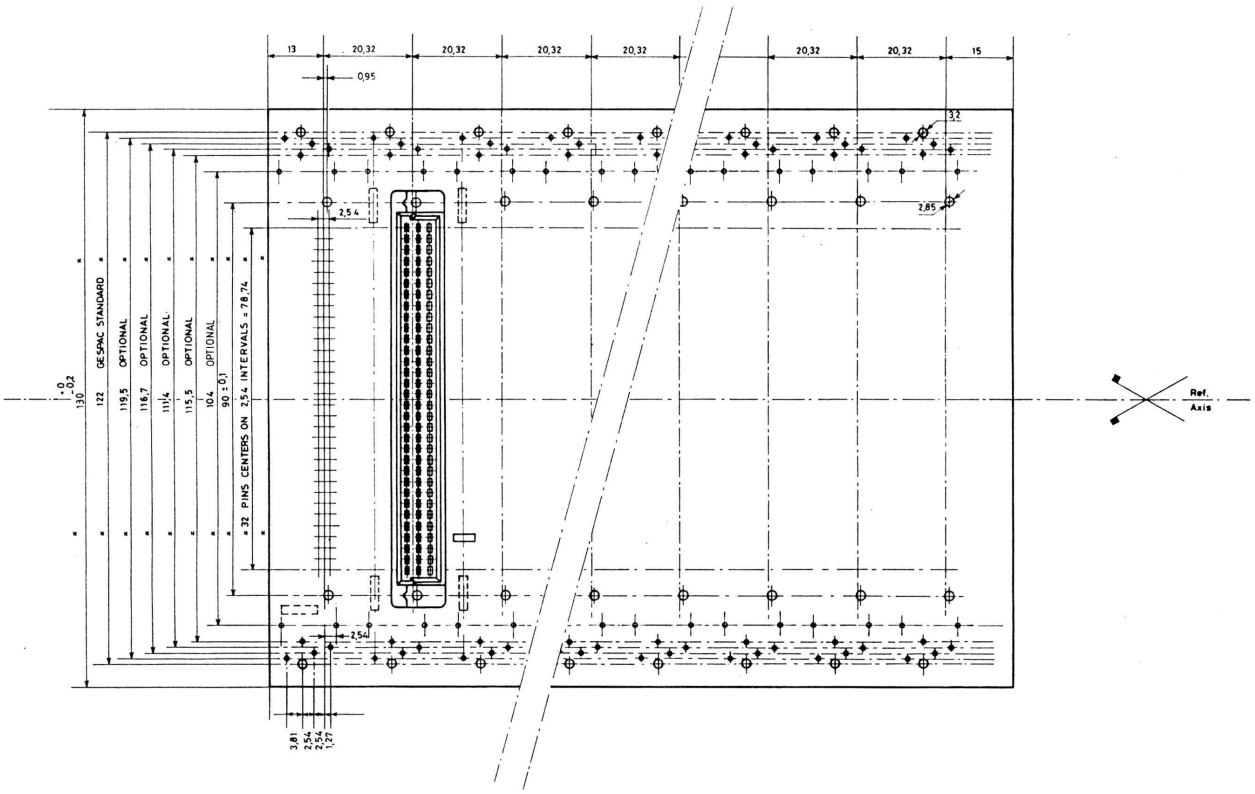


Figure 2.3 GESBUS-4D to 20D mechanical characteristics.

2.4 GESBUS-4M/6M/8M/12M/16M/20M

Mechanical characteristics of GESBUS-4M/6M/8M/12M/16M/20M are illustrated in figure 2.4.

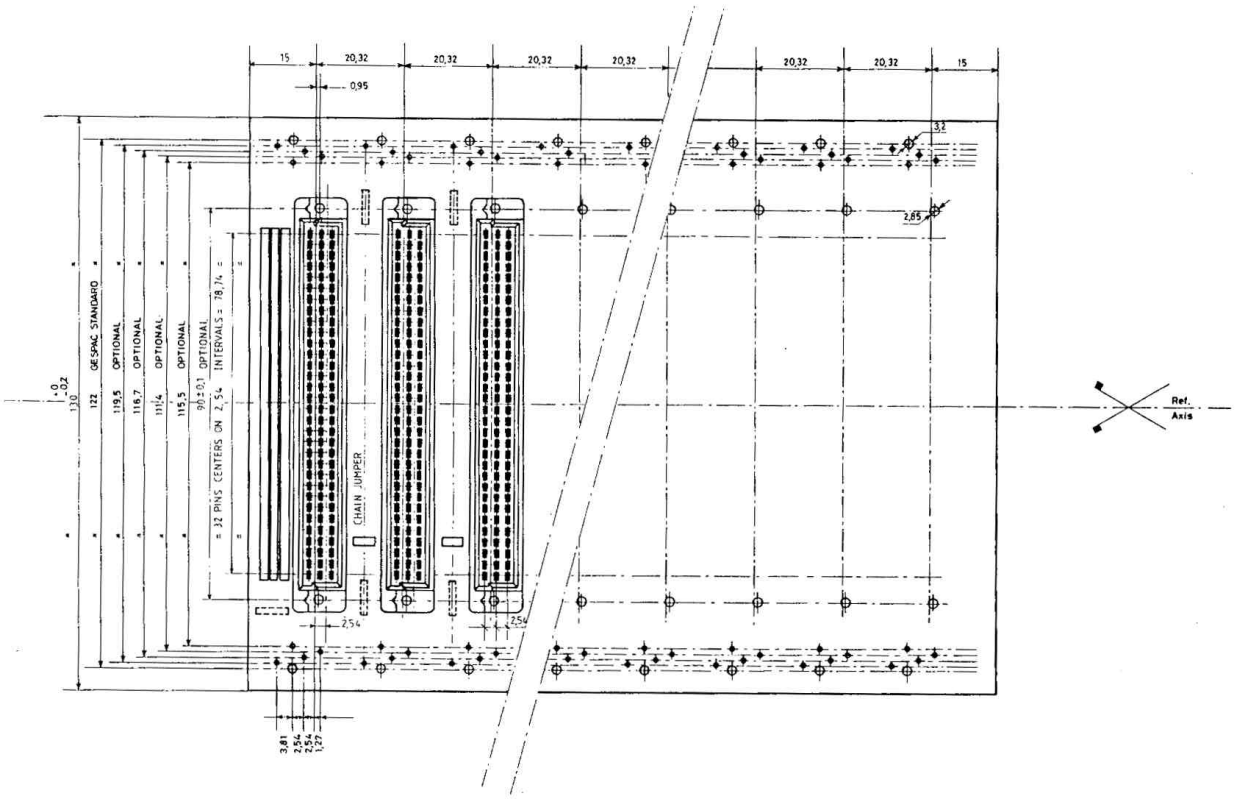


Figure 2.4 GESBUS-4M to 20M mechanical characteristics.

2.5 GESBUS-4A/6A/8A/12A/16A/20A DIMENSIONS

Mechanical characteristics of GESBUS-4A/6A/8A/12A/16A/20A are illustrated in figure 2.5.

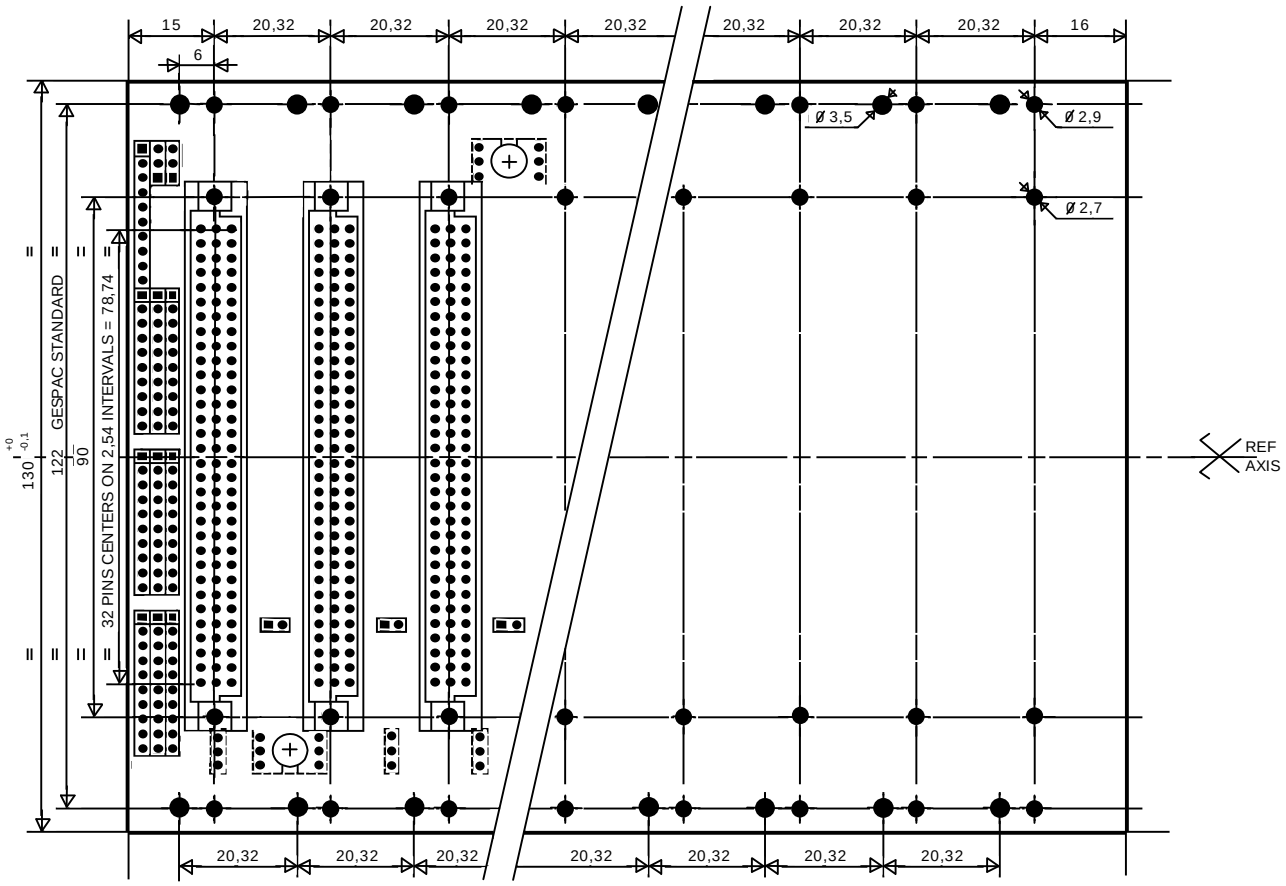


Figure 2.5 GESBUS-4A to 20A mechanical characteristics.

3. ELECTRICAL SPECIFICATIONS

3.1 INTRODUCTION

This section defines the electrical characteristics of the signals and the board materials for the G-64 and G-96 Buses. The following items are discussed below the power supply, the backplane, the bus termination and the connectors.

3.2 POWER SUPPLY

The G-64 and G-96 Buses must be supplied by three voltages, +5Vdc, +12Vdc and -12Vdc. The +5Vdc standby is used for battery backup applications like CMOS RAM, calendar and time-of-day devices.

Supply voltage (Vdc)	Tolerance % max.* (%)	Ripple noise at full load (mVpp)	maximum current per slot (board)** (A)		Minimum temperat. Range (convert. Cooling)
			G-64 Bus	G-96 Bus	
+5	+5/-3	50	3(2pins)	4,5(3pins)	0/55°C
+12	+5/-3	50	1(1pin)	1(1pin)	0/55°C
-12	+5/-3	50	1(1pin)	1(1pin)	0/55°C
+5batt	+0/-40	50	1(1pin)	1(1pin)	0/55°C
GND	Reference	-	5(4pins)	8(8pins)	-

Note: * The tolerance must be respected throughout the backplane length.
** The total maximum current for a backplane should not exceed the limits specified in table (see 3.3.4).

Table 3.1 Power supply specification.

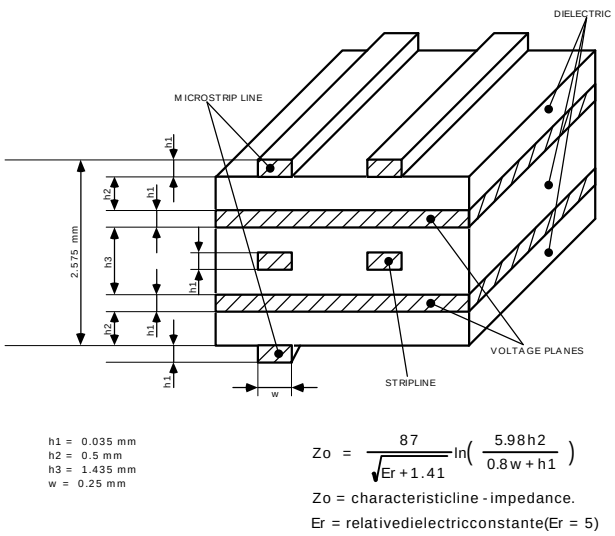


Figure 3.1 GESBUS-M multilayer backplane structure.

3.3 BACKPLANE

3.3.1 INTRODUCTION

Three types of backplane are considered here, one which is a 2-layer non-terminated, one which is a 4-layer terminated by resistor networks and one which is a 5-layer also terminated by resistor networks.

3.3.2 BACKPLANE WITHOUT TERMINATIONS

Applications, which operate at a transfer rate up to 1 MHz, can use a 2-side printed circuit backplane. The backplane is not terminated and can support also low power (CMOS) applications.

3.3.3 BACKPLANE WITH TERMINATIONS

For systems operating at a transfer rate faster than 1 MHz, a multilayer printed circuit is used for the backplane. Generally, the asynchronous systems operate at transfer rates faster than 1 MHz and will require a terminated backplane.

The modules operating on this type of backplane are equipped with 48 mA driver devices, which will drive up to 20 modules and the TERMINATION on the bus.

3.3.4 BACKPLANE SPECIFICATIONS

The specifications for the backplanes with and without terminations are shown in 3.2. There are several techniques to build multilayer backplanes. However, the signal characteristic impedance should not be much lower than 100 Ohms, thus the GESBUS-M and the GESBUS-A use a structure as illustrated in figures 3.1 and 3.2.

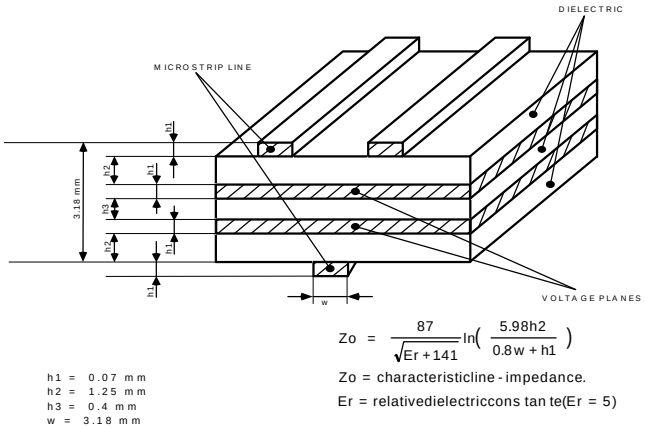


Figure 3.2 GESBUS-A multilayer backplane structure.

Backplane	2 sides without terminations	Multilayer terminated
Resistance from source to any connector: +5V	20mΩ max.	10mΩ max.
Resistance from source to any connector: ±12V	100mΩ max.	50mΩ max.
Resistance from source to any connector: other signals	1Ω max.	1Ω max.
Current total: +5V	20A max.	35A max.
Current total: ±12V	4A max.	4A max.
Capacitive load per card slot	20pF max.	20pF max.
Spur length (bus to driver or receiver)	50mm max.	50mm max.
Card connector number	20 max.	20 max.
Total bus length	500mm max.	500mm max.

Note: * For a current higher than 6A, it is recommended to apply the power at both ends of a 2 sided backplane.

Table 3.2 Backplane electrical characteristics.

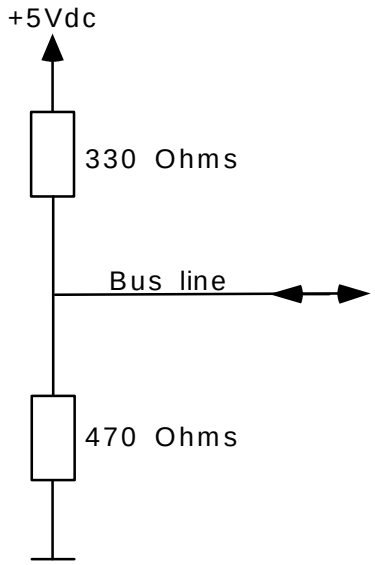
3.4 BUS TERMINATIONS

A Thevenin network termination is used on each end of the multilayer buses for all signals except the daisy chain. The resistor network values are chosen in order that the drivers can drive up to 20 modules and the bus terminations.

3.4.1 PASSIVE TERMINATIONS

A 330/470 Ohms network is use to terminate the bus signals at both ends of the multilayer backplane. The buffer devices must be of type 48mA to drive up to 20 modules and the terminations on the bus. An alternative is proposed to terminate the 2 side's buses with a network module (GESTER-1) which allows 48mA as well as 24mA buffer device to drive the modules and termination. The network, which is proposed, is of 608/1000 Ohms at one end of the bus. Typical consumption of an unpopulated backplane with passive terminations is 1.125A (@+5Vdc).

The passive termination used is illustrated in the figure 3.3.



Note: The termination should be located directly on the backplane at each bus line extremity. It is important to decouple correctly the power supply very close to the termination networks.

Figure 3.3 Passive bus termination.

3.4.2 ACTIVE TERMINATIONS

A Thevenin generator is used to terminate the bus signals at both end of the backplane. Typical consumption of an unpopulated backplane with active terminations is 60mA (@+5Vdc).

The active termination is illustrated in the following figure.

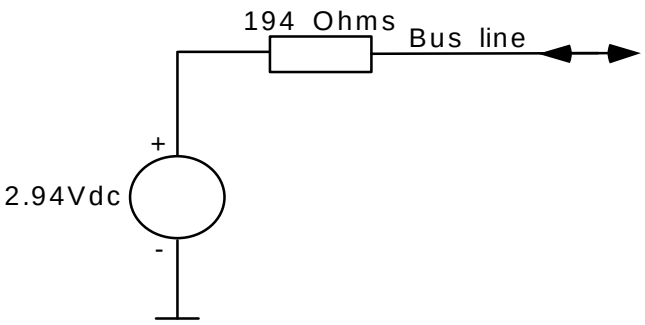


Figure 3.4 Active terminations.

3.4.3 JUMPERS SELECTION ON GESBUS-A

On the GESBUS-A family, users have the choice between passive terminations or active terminations. A 3-pin jumper makes this selection for each slot. This selection is shown on figures 3.5 and 3.6.

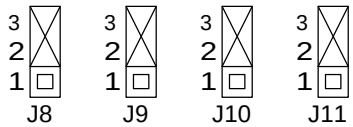


Figure 3.5 Passive termination.

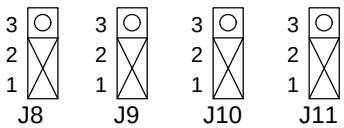


Figure 3.6 Active termination.

Note: This jumpers numeration is valid for the GESBUS-8A only. The following table gives you the equivalence for the other GESBUS-A family buses.

GESBUS 8A	GESBUS 4A	GESBUS 6A	GESBUS 12A	GESBUS 16A	GESBUS 20A
J8	J4	J6	J12	J16	J20
J9	J5	J7	J13	J17	J21
J10	J6	J8	J14	J18	J22
J11	J7	J9	J15	J19	J23

Table 3.3 Jumpers correspondence.

3.5 PROTECTIVE EARTH TERMINAL

A new terminal is available on the GESBUS-A type, the “Protective Earth”. The Protective Earth must be connected to the chassis. Capacitors are located on the backplane between each supply terminals and the Protective Earth to respect EMC.

Protective Earth conductor insulation shall be green with a yellow stripe.

3.6 G-64 AND G-96 BUS CONNECTORS

The G-64 and G-96 Buses use DIN 42612 connectors which are characterized by the IEC DIN 42610 specification. The parameters in table 3.4 are extracted from IEC 603-2 specification class 2.

Current per contact	2A (20°C)
Resistance per contact	0.02 Ohm
Insertion time	400
Test voltage	100Veff/50Hz
Temperature range	-55 to +125°C
Isolation resistance	10MOhms

Table 3.4 Electrical specifications for backplane and board connectors.

3.7 SIGNAL ELECTRICAL CHARACTERISTICS

The signal requirements on G-64 and G-96 Buses are illustrated on figure 3.7.

Signal States are:

Low level, High level.
Transition lows too high level (rising edge).
Transition high to level (falling edge).

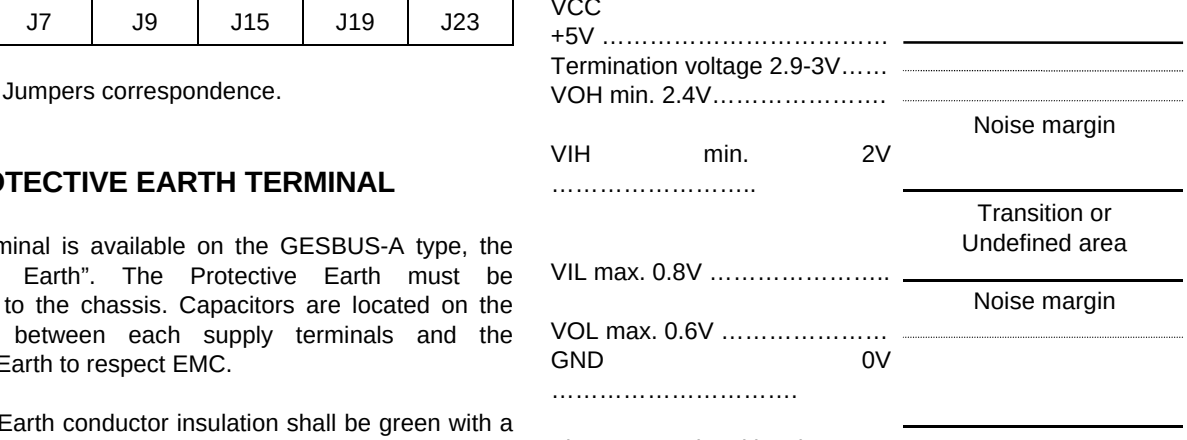


Figure 3.7 Signal levels.

4. PREPARATION FOR USE

4.1 GESBUS-4D/8D/12D/16D/20D

The GESBUS-4D to 20D are ready for use.

The regulator for -5V does not exist anymore on these backplanes and the user should provide this voltage if it is required (only for old boards with 2708 EPROM or 4116 DRAM devices).

The power supply voltages are identified on the PCB serigraphy. Connections are made by flat Faston terminals located on the PCB soldier side at the bottom.

A resistor R (1K to 4K7) can be mounted to provide a high level on Chain out of connector 1. This is normally not required since this signal is usually provided directly on GESPAC boards.

The figure 4.1 shows the GESBUS-4D implementation as an example.

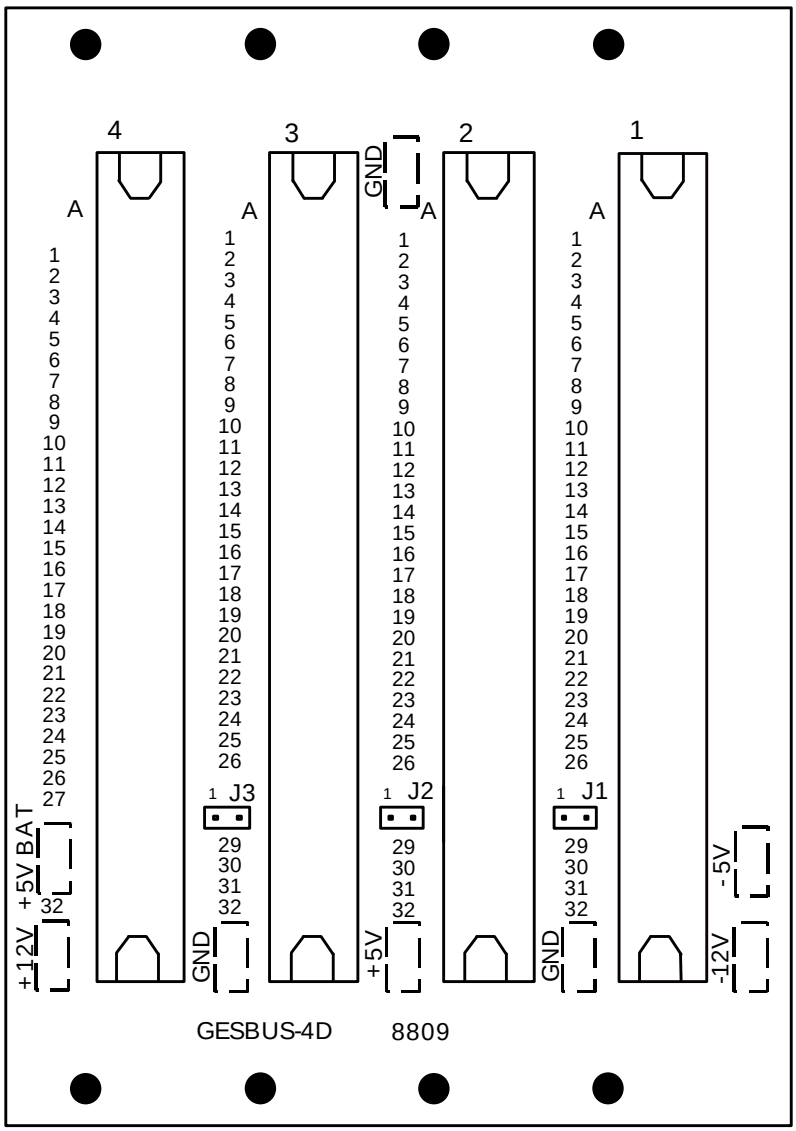


Figure 4.1 GESBUS-4D implementation

4.2 GESBUS-4M/6M/8M/12M/16M/20M

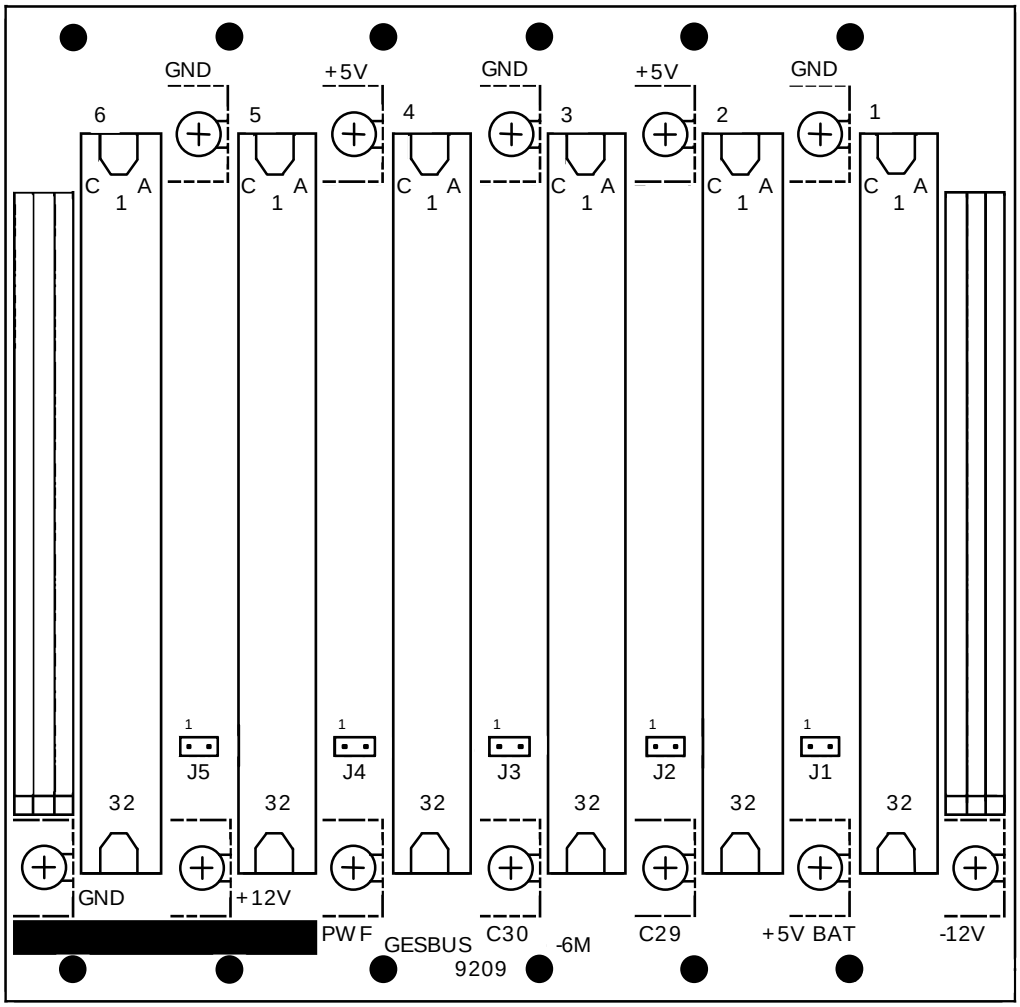
The multilayer terminated GESBUS-4M to 20M are ready for use.

The jumpers on J1, J2… Jn allows, when installed, to propagate the daisy chain from one connector to the next on the left side (chain out to chain in).

The power supply voltages are identified on the PCB serigraphy. Connections are made by either a flat Faston or screw terminals located on the PCB soldier side at the bottom.

It is recommended to provide more than a single connection for the GND and the +5V and to place these power connections at the bus extremities when using 2 wires per voltage.

The figure 4.2 shows the GESBUS-6M implementation as an example.



Note: For the other backplanes, refer to the PCB serigraphy to identify the power supply locations.

Figure 4.2 GESBUS-6M implementation

4.3 GESBUS-4A/6A/8A/12A/16A/20A

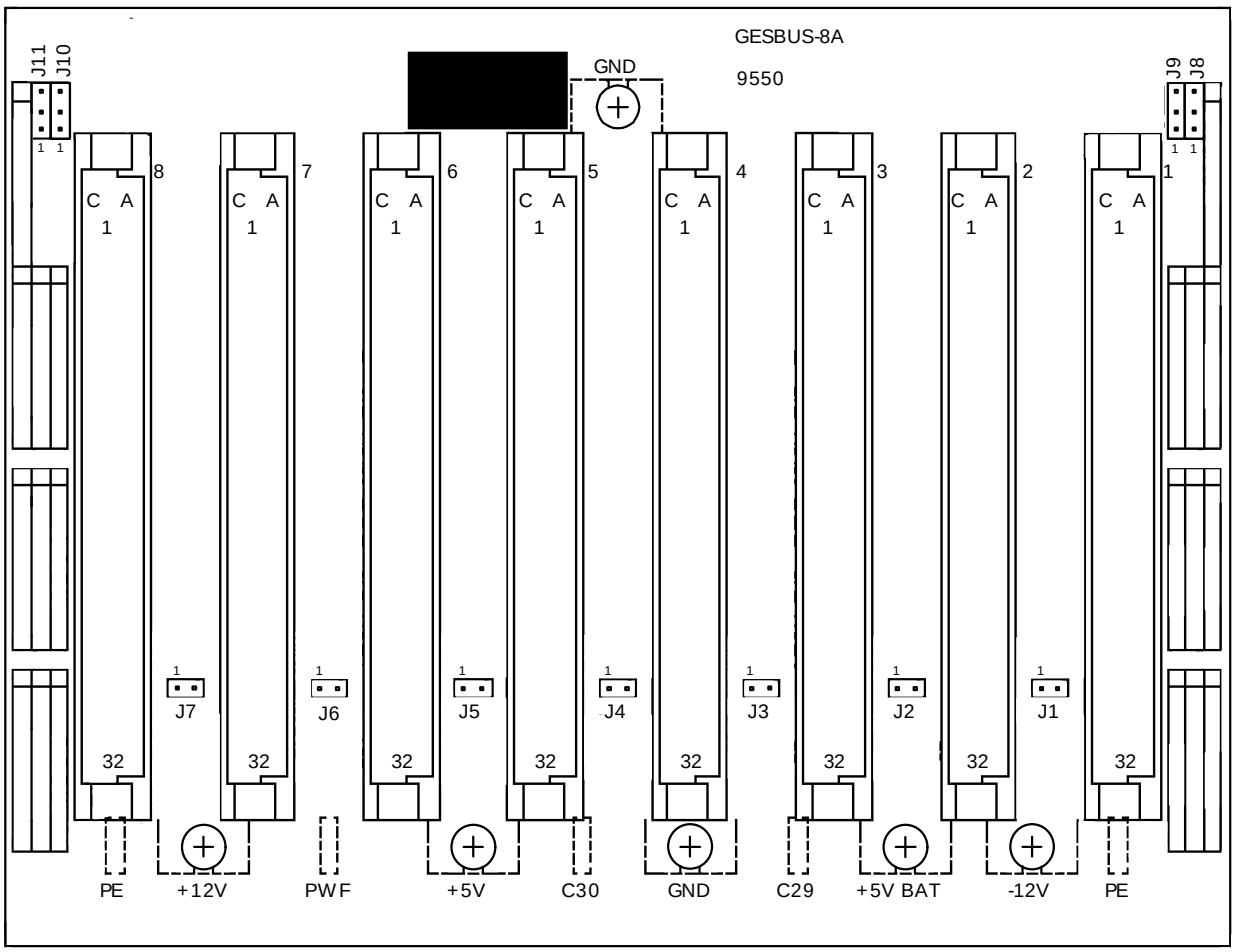
The multilayer terminated GESBUS-4A to 20A are ready for use.

The jumpers J1, J2… Jn allows, when installed, to propagate the daisy chain from one connector to the next on the left side (chain out to chain in).

The power supply voltages are identified on the PCB serigraphy. Either a flat Faston or screw terminals located makes connections on the PCB soldier at the bottom.

It is recommended to provide more than a single connection for the GND and the +5V and to place these power connections at the bus extremities when using 2 wires per voltage.

The figure 4.3 shows the GESBUS-8A implementation as an example.

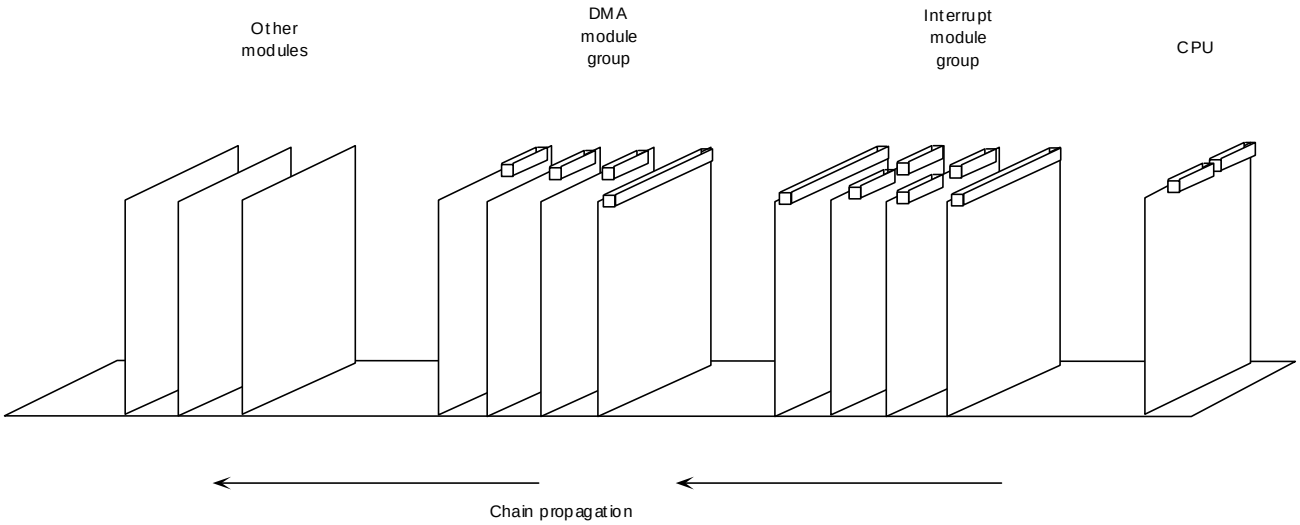


Note: For the other backplanes, refer to the PCB serigraphy to identify the power supply locations.

Figures 4.3 GESBUS-8A implementation.

4.4 MODULE INSTALLATION

There is no specific position to install G-64 or G-96 modules on the backplane except when using the daisy chain, which is required to set up priority between several vectored interrupt sources or DMA modules. All modules using this feature are plugged into adjacent connectors to form a group with a continuous daisy chain. At least the first module in the chain is supplied with a pull-up resistor to start the chain. The module arrangement is shown in figure 4.4.

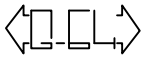


Note: - The CPU has a pull-up resistor on the chain out signal that can be used to start the chain in a group.
- The 2 group locations can be exchanged.
- A module which does not use the chain can be plugged in a group if its chain in and chain out pins are short circuited.
- An empty connector in a group must have the chain in and chain out signals short-circuited. The GESBUS-4M to 20M and GESBUS-4A to 20A are provided with jumpers allowing to propagate the chain between any pair of bus connectors.

Figure 4.4 Module arrangement for daisy chain use

5. G-64 AND G-96 BUS SIGNAL IDENTIFICATION

The signal names are identified in the table 5.1. For their definition and characteristics refer to the G-64/G-96 Specifications manual.



ROW C	ROW B	ROW A		Definition
GND	GND	GND	1	Power
A16	A8	A0	2	
A17	A9	A1	3	
A18	A10	A2	4	Address
A19	A11	A3	5	line
A20	A12	A4	6	A0 to
A21	A13	A5	7	A23
A22	A14	A6	8	
A23	A15	A7	9	
$\overline{\text{BWD}}$	$\overline{\text{BRQ}}$	$\overline{\text{BGRT}}$	10	
$\overline{\text{LWORD}}$	$\overline{\text{DS1}}$	$\overline{\text{DS0}}$	11	
$\overline{\text{BARB}}$	$\overline{\text{BBUSY}}$	$\overline{\text{HALT}}$	12	Control
GND	Enable	SYCLK	13	lines
Reserved	$\overline{\text{RES}}$	$\overline{\text{VPA}}$	14	and
Reserved	$\overline{\text{NMI}}$	$\overline{\text{DTACK}}$	15	interrupt
$\overline{\text{IRQ3}}$	$\overline{\text{IRQ1}}$	$\overline{\text{VMA}}$	16	lines
$\overline{\text{IRQ5}}$	$\overline{\text{IRQ2}}$	R / $\overline{\text{W}}$	17	
$\overline{\text{VED}}$	$\overline{\text{IACk}}$	$\overline{\text{IRQ4}}$	18	
GND	$\overline{\text{D12}}$	$\overline{\text{D8}}$	19	
$\overline{\text{P5}}$	$\overline{\text{D13}}$	$\overline{\text{D9}}$	20	
$\overline{\text{P4}}$	$\overline{\text{D14}}$	$\overline{\text{D10}}$	21	Data lines
$\overline{\text{P3}}$	$\overline{\text{D15}}$	$\overline{\text{D11}}$	22	D0 to
$\overline{\text{P2}}$	$\overline{\text{D4}}$	$\overline{\text{D0}}$	23	D16 and
$\overline{\text{P1}}$	$\overline{\text{D5}}$	$\overline{\text{D1}}$	24	Arbitration
$\overline{\text{P0}}$	$\overline{\text{D6}}$	$\overline{\text{D2}}$	25	lines
$\overline{\text{LOCK}}$	$\overline{\text{D7}}$	$\overline{\text{D3}}$	26	
$\overline{\text{SYSFAIL}}$	$\overline{\text{BERR}}$	$\overline{\text{Page}}$	27	
Reserved	Chain In	Chain Out	28	Miscellan.
Reserved	+5Vbat.	$\overline{\text{PWF}}$	29	
Reserved	-12 V	+12 V	30	
+5 V	+5 V	+5 V	31	Power
GND	GND	GND/AGND	32	

Note: Overlined terms are active or true when the voltage is low, other terms when voltage is high.

Table 5.1 G-64/G-96 Bus signal identification
Six G-64 functions have changed in the G-96 concept.

These functions are shown in the table 5.2.

Pin	old G-64	G-96
16b	$\overline{\text{IRQ}}$	$\overline{\text{IRQ1}}$
17b	$\overline{\text{FIRQ}}$	$\overline{\text{IRQ2}}$
18b	IACK	$\overline{\text{IACK}}$
10a	BGRT	$\overline{\text{BGRT}}$
18a	Halt Ack	$\overline{\text{IRQ4}}$
29a	-5V	$\overline{\text{PWF}}$ (Power Fail)

Table 5.2 New functions

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