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VMEbus systems

The past 20 years the VMEbus has reached a dominant position for industrial busses with a number of suppliers.

Despite numerous new bus systems based on the rapid changes in chip technology, VMEbus systems offer significant advantages such as their robustness, reliability and increased availability of processor, memory and I/O cards.

Additional advantages appear under real-time conditions, where unforeseen events have to be managed. This is realised with the program interrupt concept and variable control that closely monitors the bus system.

With the increase in processing speeds and data transmission rates, 3 row DIN 41612 connectors have reached their limit, so the VME standard needs to be enhanced further.

When VME architecture was increased from 8-bit to 64-bit and data transmission rates up to 160 Mbyte/s (VME 64x), HARTING introduced har-bus 64 with 160 pins. This Eurocard connector is 100% backwards compatible to existing 3 row connectors with 96 contacts, therefore old can plug into new.

To offer the best design possible from the start, HARTING developed spice models that were later certified via signal integrity measurements of the connector.
Backward compatibility

The design of harbus 64 female connectors allows mating of any combinations of the 5 or 3 row versions without mechanical interference, thus making it possible for users to upgrade and maintain existing systems at lower costs. It is also possible to mate 5 row male connectors with 3 row female connectors.

The feature of backward compatibility allows a gradual upgrade of existing Eurocard based systems without the additional cost of a complete system redesign. It is not necessary to replace conventional 96 pin based boards as they remain pluggable into the 160 pin based systems.

Not only VMEbus, but also existing proprietary bus systems for which 3 row 96 pin connectors are no longer performance sufficient, harbus 64 provides the opportunity to adapt the system economically without a complete redesign to a new bus architecture.

harbus®64 – five rows – 160 poles

Two additional rows of contacts in the harbus 64 connector offer new system features:

- Additional contacts for I/O and system upgrade
- New voltage supplies for 3.3 V and 48 V system components
- Identifying locations of system components and the bus length. “Plug & Play”
- Improved signal/ground ratio for reliable signal data transfer at rates up to 320 MByte/s (VMEbus) resp. 1.25 Gb/s (Gigabit Ethernet) or 3.125 Gb/s (serial point-to-point)
- Live Insertion for replacing processor or memory cards without closing down the system
- User defined pins for test and maintenance bus lines
The advantages of harbus®64 in detail

User-defined pins in the outer rows can be used for application specific functions such as additional I/O. Configured as a shield to provide larger ground return paths, they assure for higher data transfer rates:

- Up to 320 MByte/s for asynchronous signals (VMEbus)
- Up to 1.25 GB/s for Gigabit Ethernet
- Up to 3.125 GB/s for differential signals (serial, point-to-point)

Proprietary bus systems can utilise the new contact rows to optimise signal-to-ground ratios and improve system speed.

Four preleading contacts (1.5 mm) serve to pre-load the transmit and receive logic so that the bus will not experience glitches during live insertion of new cards into the backplane.

Backplane connector terminations are designed in solderless press-in technology. The connector can be installed without any special tooling using economical flat dies for high speed insertion.
The insulator, made of LCP, has an inherent flammability rating of UL 94-V0 and therefore provides an environment friendly connector. In addition, the heat deformation stability of LCP makes the connector surface-mount compatible (see chapter 00).

Partially gold plated terminations with precisely formed tips serve as contact area for rear transition boards.
As a typical multiprocessor bus, VME has to distribute processor information continuously according to the right priorities.

This is done through the well known daisy-chain lines.

The VME protocol requests 5 daisy-chains on position 1 of every backplane.

These lines are defined to go through every daughter card.

Therefore, in case of unloaded card slots the signal have to be bridged across the connector.

**Bridging variants:**

1. The empty card slots may be assembled with dummy cards, that bridge the daisy-chain lines.

2. Bridging can be achieved by inserting 5 jumpers on the backplane manually.

3. Bridging by using IC’s with internal integration OR the function may accept automatic daisy-chaining.

4. The 5-row harbus® 64 connector with switches allows an automatic switching. In the case of an unmated daughter card the connector bridges the signals at positions a21-22, b4-5, b6-7, b8-9 and b10-11. The switch elements open automatically when the daughter card is mated, so that the daughter card accepts the ongoing signal daisy-chain.
Advantages:
- Passive backplane; no active components assembled
- No additional space required, due to integrated switching function inside the connector
- No jumpers on the backplane
- User friendly regarding maintenance and repairing
- Automatically daisy-chaining through mating/unmating the daughter card
- High MTBF value
- No additional, manual bridging necessary
- Less assembly cost, no special tooling required
## Technical characteristics according to IEC 61076-4-113

### Number of contacts
- **160**

### Contact spacing (mm)
- **2.54**

### Working current
- **1 A at 70 °C and all contacts are loaded**
  - See current carrying capacity chart

### Current carrying capacity chart

The current carrying capacity is limited by maximum temperature of materials for inserts and contacts including terminals. The current capacity curve is valid for continuous, non interrupted current loaded contacts of connectors when simultaneous power on all contacts is given, without exceeding the maximum temperature.

Control and test procedures according to DIN IEC 60 512

With selective loading higher currents can be transmitted. The requirements according to VITA 1.7 are fulfilled.

### Clearances and creepage distances

<table>
<thead>
<tr>
<th>Distance in mm</th>
<th>minimal clearance and creepage distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>rows a, b, c</td>
<td>1.2</td>
</tr>
<tr>
<td>rows z, d</td>
<td>1.2</td>
</tr>
<tr>
<td>female angled</td>
<td>0.6</td>
</tr>
<tr>
<td>between two rows</td>
<td>clearance 1.2</td>
</tr>
<tr>
<td></td>
<td>creepage 1.2</td>
</tr>
<tr>
<td></td>
<td>between two contacts</td>
</tr>
<tr>
<td>(in a row)</td>
<td>creepage 1.2</td>
</tr>
</tbody>
</table>

### Working current

- **Ambient temperature**

#### Test voltage

- **U<sub>r.m.s.</sub>**
  - 1 kV

### Contact resistance

- **rows a, b, c**
  - ≤ 20 mΩ
- **rows z, d**
  - ≤ 30 mΩ

### Insulation resistance

- ≥ 10¹⁰ Ω acc. to IEC 60 512-2

### Temperature range

- **for press-in termination**
  - – 55 °C ... + 125 °C
  - – 40 °C ... + 105 °C

### During reflow soldering

- **max. + 240 °C for 20 s**
  - for THR connectors

---

### Electrical termination

- **Solder pins for pcb termination Ø 1.0 ± 0.1 mm**
  - according to IEC 60 326-3
- **Crimp terminal**
  - 0.09 - 0.50 mm²
  - Compliant press-in terminations

### pcb thickness

- ≥ 1.6 mm

### Recommended pcb holes

- See recommendation page 00.25 in acc. to EN 60 352-5

### Insertion and withdrawal force

- ≤ 160 N

### Materials

- **Mouldings**
  - Liquid Cristal Polymer (LCP), for male connectors, straight female connectors, UL 94-V0
  - Thermoplastic resin glass-fibre filled, UL 94-V0
  - Copper alloy

- **Contacts**

### Contact surface

- **Contact zone**
  - Plated acc. to performance level<sup>1)</sup>

---

<sup>1)</sup> Explanation performance levels see chapter 00
Number of contacts

160

Male connectors, angled, THR compatible

<table>
<thead>
<tr>
<th>Identification</th>
<th>No. of contacts</th>
<th>Contact arrangement</th>
<th>Part number</th>
<th>Performance levels according to IEC 61 076-4-113</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male connector*</td>
<td></td>
<td></td>
<td></td>
<td>Explanation chapter 00</td>
</tr>
<tr>
<td>without retention clip</td>
<td>160</td>
<td>z, a, b, c, d</td>
<td>02 01 160 2101</td>
<td>02 01 160 1101 02 01 160 11052)</td>
</tr>
<tr>
<td>with retention clip</td>
<td>160</td>
<td>z, a, b, c, d</td>
<td>02 01 160 2102</td>
<td>02 01 160 1102 02 01 160 11062)</td>
</tr>
</tbody>
</table>

Dimensions

Board drillings
Mounting side

Cross section of solder terminations
Row z: A = 0.21 - 0.25 mm²
Rows a, b, c: A = 0.25 - 0.33 mm²
Row d: A = 0.29 - 0.32 mm²

* Pre-leading contacts at positions d1, d2, d31 and d32
1) Recommendation for variants with clip: Drillings can be enlarged up to 3.1 mm ø to reduce standard mounting force (see chapter 00)
2) Special variant with min. 1.27 µm (50 µinch) Au and SnPb on termination
Female connectors

Identification | No. of contacts | Contact arrangement | Part number | Performance levels according to IEC 61076-4-113
--- | --- | --- | --- | ---
Female connectors, straight² with press-in terminations | 160 | z, a, b, c, d | 02 02 160 1601 | 02 02 160 1201
with fixing flange 3.7 mm | 160 | z, a, b, c, d | 02 02 160 2201 | 02 02 160 2301
with fixing flange 4.5/5 mm 17 mm* | 160 | z, a, b, c, d | 02 02 160 2202 | 02 02 160 2302
without fixing flange 5 mm | 160 | z, a, b, c, d | 02 02 160 2202 | 02 02 160 2302
with solder pins 17 mm* | 160 | z, a, b, c, d | 02 02 160 2804

Dimensions

Part number | Dimension “X” for row
--- | ---
02 02 160 1601 | 3.7 a 3.7 b 3.7 c 3.7 d
02 02 160 2201 / 02 02 160 1201 | 5.0 a 4.5 b 4.5 c 4.5 d
02 02 160 2301 / 02 02 160 1301 | 17.0 a 17.0 b 17.0 c 17.0 d
02 02 160 2202 / 02 02 160 1202 | 5.0 a 5.0 b 5.0 c 5.0 d
02 02 160 2302 / 02 02 160 1302 | 17.0 a 17.0 b 17.0 c 17.0 d
02 02 160 2804 | 2.9 a 2.9 b 2.9 c 2.9 d

Board drillings
Mounting side

Dimensions in mm

*Press-in technology and refer to recommended configuration of pcb holes, see page 00.25
*selectively gold-plated
Number of contacts

160

Female connectors

<table>
<thead>
<tr>
<th>Identification</th>
<th>No. of contacts</th>
<th>Contact arrangement</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female connectors, straight with switches(^2)</td>
<td>160</td>
<td>z, a, b, c, d</td>
<td>02 03 160 2201</td>
</tr>
<tr>
<td>with press-in terminations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with flange 4.5/5 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dimensions

<table>
<thead>
<tr>
<th>Board drillings Mounting side</th>
</tr>
</thead>
<tbody>
<tr>
<td>All holes</td>
</tr>
<tr>
<td>row</td>
</tr>
<tr>
<td>All holes</td>
</tr>
</tbody>
</table>

Dimensions in mm

Tooling see chapter 30

1) Press-in technology see page 00.25
2) Switching elements at positions a21-22, b4-5, b6-7, b8-9 and b10-11
Female connectors

<table>
<thead>
<tr>
<th>Identification</th>
<th>No. of contacts</th>
<th>Contact arrangement</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female connectors, angled with solder pins</td>
<td>160</td>
<td>z, a, b, c, d</td>
<td>02 04 160 1101</td>
</tr>
<tr>
<td>for rear access</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for har-bus® 64 male connector</td>
<td>160</td>
<td>z, a, b, c, d</td>
<td>02 07 160 1101</td>
</tr>
</tbody>
</table>

Dimensions 02 04 160 1101

Dimensions 02 07 160 1101

Board drillings
Mounting side

Dimensions in mm
Female connectors

<table>
<thead>
<tr>
<th>Identification</th>
<th>No. of contacts</th>
<th>Contact-arrangement</th>
<th>Suitable for</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female connector for crimp contacts</td>
<td>160</td>
<td>3231 2 1</td>
<td>har-bus® 64 shroud</td>
<td>02 05 000 0004</td>
</tr>
<tr>
<td></td>
<td>160</td>
<td>3231 1 2 3132</td>
<td>Male connector type R with 5 rows</td>
<td>02 05 000 0005</td>
</tr>
<tr>
<td></td>
<td>160</td>
<td>3231 2 1</td>
<td>Male connector type C with 5 rows</td>
<td>02 05 000 0003</td>
</tr>
</tbody>
</table>

Dimensions

<table>
<thead>
<tr>
<th>Identification</th>
<th>Part number</th>
<th>Performance levels according to IEC 61076-4-113. Explanation chapter 00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female crimp contacts har-bus® 64</td>
<td>02 05 000 2511</td>
<td>2</td>
</tr>
<tr>
<td>Bandoliered contacts (approx. 5,000 pieces)</td>
<td>02 05 000 2512</td>
<td>1</td>
</tr>
<tr>
<td>Bandoliered contacts (approx. 500 pieces)</td>
<td>02 05 000 2513</td>
<td>1</td>
</tr>
<tr>
<td>Individual contacts(^1)</td>
<td>02 05 000 1511</td>
<td>1</td>
</tr>
<tr>
<td>02 05 000 1512</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>02 05 000 1513</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Wire gauge mm\(^2\) | Insulation ø mm
0.09 - 0.5 | 28 - 20 | 0.7 - 1.5
3.5 + 0.5 mm of insulation is stripped
For the fabrication in line with the specification please use exclusively crimp tools approved by HARTING (see DIN EN 60 352-2)
Insertion, removal and crimping tools see chapter 30

\(^1\) Packaging unit 1,000 pieces
**Number of contacts**

160

**Pin shrouds**

<table>
<thead>
<tr>
<th>Identification</th>
<th>pcb-thickness ± 0.3</th>
<th>Dimension X - 0.1</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin shrouds¹)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1.6</td>
<td>7.8</td>
<td>02 44 000 0012</td>
</tr>
<tr>
<td>2</td>
<td>2.2</td>
<td>7.2</td>
<td>02 44 000 0011</td>
</tr>
<tr>
<td>2.8</td>
<td>6.6</td>
<td></td>
<td>02 44 000 0007</td>
</tr>
<tr>
<td>3.4</td>
<td>6.0</td>
<td></td>
<td>02 44 000 0001</td>
</tr>
<tr>
<td>4.0</td>
<td>5.4</td>
<td></td>
<td>02 44 000 0002</td>
</tr>
<tr>
<td>4.6</td>
<td>4.8</td>
<td></td>
<td>02 44 000 0003</td>
</tr>
<tr>
<td>5.2</td>
<td>4.2</td>
<td></td>
<td>02 44 000 0004</td>
</tr>
<tr>
<td>5.8</td>
<td>3.6</td>
<td></td>
<td>02 44 000 0005</td>
</tr>
<tr>
<td>6.4</td>
<td>3.0</td>
<td></td>
<td>02 44 000 0006</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fixing brackets for shell housing C²)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>02 44 000 0009</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shroud insert for 3 row female connectors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>02 44 000 0008</td>
</tr>
</tbody>
</table>

**Dimensions**

![Dimension diagram](image)

1) Insert block (02 09 000 0012) for assembly see chapter 30
2) order 2 pieces per connector
Application 1*

- Female connector: 02 02 160 2301
- Backplane
- Pin shroud: 02 44 000 0007
- Fixing brackets: 02 44 000 0009
- Shell housing C: 09 05 048 0501
- Female connector with crimp contacts: 02 05 000 0004
- Locking lever left: 09 02 000 9902
- Locking lever right: 09 02 000 9903

Application 2*

- Female connector: 02 02 160 2301
- Backplane
- Pin shroud: 02 44 000 0007
- Locking lever: 09 03 000 9913
- Female connector for crimp contacts: 02 05 000 0004

Application 3

- Female connector: 02 02 160 2301
- Backplane
- Pin shroud: 02 44 000 0007
- Shroud insert: 02 44 000 0008
- Female connector: 09 73 296 6801

* Only for applications without rear P0-connector
Application 4

Female connector 02 02 160 2301

Backplane

Pin shroud 02 44 000 0007

Screw M 2.5 x 30

Female connector for crimp contacts 02 05 000 0004