May 29, 2003

# Definition of Feed-through and Splitting Boards

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**Abstract**

The note decribes the different wire support boards: the feed-though boards at the active end and the wire-splitting in the middle region.

# 1 Feed-through boards

## Description and functionality:

The feed-through board provides the electrical connection between the signal wires (anodes) inside the gas-tight module and the front-end electronics at the out-side. The board carries the pads to which the anode wires are soldered. As the wire position is guaranteed by the end-pieces the absolut pad postion is less important and do not have to be particularly precise.
The feed-though board also serves as common ground reference: The cathode of the straws and the inner alu skin of the panels are explicitly connected to the board. To ensure good contact of the subsequent readout components (HV boards) the feed-through board provides a large contact surface to these boards.
The printed-circuit board (PCB) consists of 3 layers:

- The upper layer with the solder pads for the anode wires inside the gas-volume and ground connection to close the box electrically.
- The middle layer with the signal traces.
- the bottom layer with contacts for the signal connector, large ground contacts to connect the straw ground using the tongues, and a spring-like contact over the full width of the board to provide safe ground connection to the HV boards.

## Electrical specification:

<u>Insulation</u>
Since the anode wires are at HV the distances between "open" (means not burried inside the PCB) signal contacts and any open ground contact should be HV safe. A a rule of thumb in the counting gas a minimal distance of 5mm between signal and any ground contact is required. The same minimum distance is also required outside the gas volume. The thickness of the PCB should be choosen to gurantee good insulation between ground and HV plans.

<u>Signal transmission</u>
The cross talk generated by the feed-through board should be smaller than the chamber cross-talk. To reduce cross-talk and to improve the the signal transmission the signal lines in the middle layer should be imbeded as much as possible inbetween ground planes.

Table 1: Summary of electrical requirements and properties

| Quantity | Value |
|---|---|
| Distance signal–GND<br>inside counting gas<br>in air | <br>5mm<br>5mm |
| Impedance | 150$\Omega$ |
| Cross talk | ?? |

## Geometry and layout

The design of the Feed-through board is shown in Fig. 1. Main features are:

- a step at the side of the straw-tubes to hold the endpiece
- an additional "FR4" plate glued such that a second step appears
- a rail of springs to provide a large area ground contact for the HV board
- a connector to connect the signals to the HV board
- a large contact pad to connect the cathod of each straw-tube explicitly to ground: this is done by connecting a specially cut tongue of the straw to the ground pad.
- an additional pre-mounted flap which is soldered to a copper strip at the sandwhich panel: in this way also the inner alu skins are connected to a common ground point, namely the ground plane of the feed-through board.

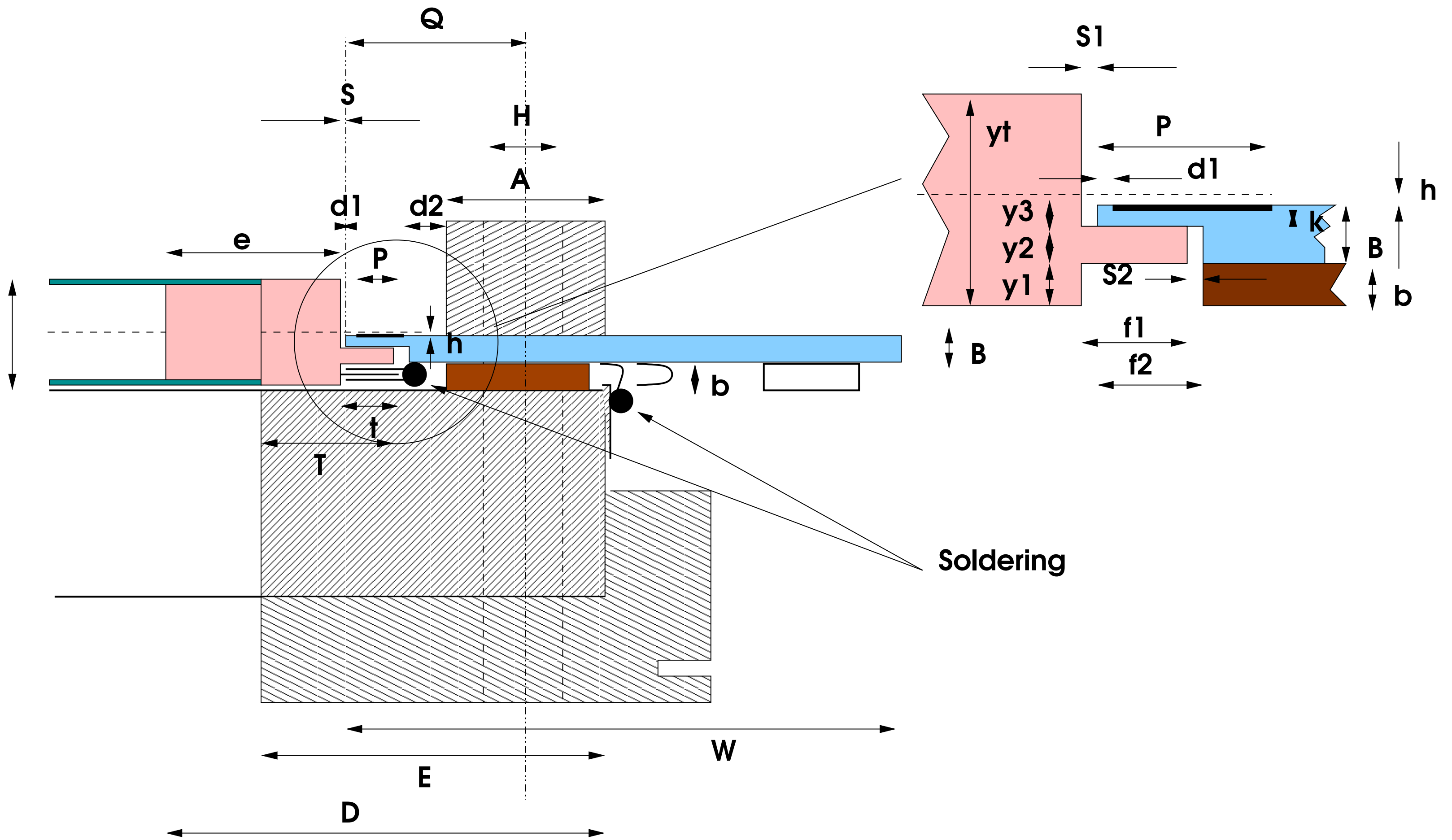


Figure 1: Feed-through board and its surrounding

Table 2: List of geometrical parameters as defined in Fig. 1:

| Quantity | | Value | Comments |
|---|---|---|---|
| W | (width of PCB) | 70mm | |
| P | (pad) | 6mm | 1 |
| d1 | (distance) | 1mm | |
| d2 | (distance) | 5mm | |
| S1 | (slit) | 0.5mm | 2 |
| f1 | (flap width) | 4 mm | |
| f2 | (step width) | 4 mm | |
| B | (PCB thickness) | 1.5mm | 3 |
| b | (strip thickn.) | 0.95 | 3 |
| y1 | (endpiece) | 0.95mm | 3 |
| y2 | (endpiece) | 0.75mm | 3 |
| y3 | (endpiece) | 0.875mm | 3 |
| yt | (endpiece) | 5.3mm | |
| h | (pad to wire) | 0.05mm | |
| k | (PCB nose) | 0.75mm | |
| e | (end piece) | 11mm | |
| E | (insert) | 58mm | 5 |
| A | (alu bar) | 25mm | f(H) 4 |
| H | (pin hole) | 6mm | 4 |
| | (slotted hole) | 6x8mm | 4 |
| Q | (hole to PCB edge) | 25mm | |
| D | (dead length) | 52mm | f(e,d1,P,d2,A) |

Comments:

1. Solder pads and soldering procedure: A solder pad length of 5mm was used in HERA-B value. After soldering the wire is cut at the edge of the pad, but just inside the solder dot.

2. Slit between Feed-through PCB and endpiece: during a test mounting in Heidelberg it turned out that glue was sug into the endpiece. Noches at the endpiece define a slit sufficiently large to prevent the glue from creeping into the end-piece.

3. from the PHILIPS design

4. The alu bar has a dowel pin hole for the module support. The dowel pin holes are different for upper (round) and lower (long holes) module side.

5. The alu inserts are defined in the panel specification document.

## 1.1 Ground connection

Connetion between the inner and outer cathod layer: there is no electrical contact between inner and outer cathod foil. Thus to ensure a reliable ground connection of the inner carbon doped Kapton foil a long tongue (kapton) at the end of the straw which is soldered, using a ultra-sonic soldering, between a flap. The flap with the tongue in the inside is soldered to the gorund plane of the feed-through board.
The explicit connection of the alu skin of the panels to the ground reference of the feed-through board is more difficult. A a copper strip is glued on the panel front wall. Solder dots provide the electrical contact to the alu skin. An additional flap, pre-mounted on the feed-trhough PCB, is soldered to this copper strip.

# 2 Wire splitting board

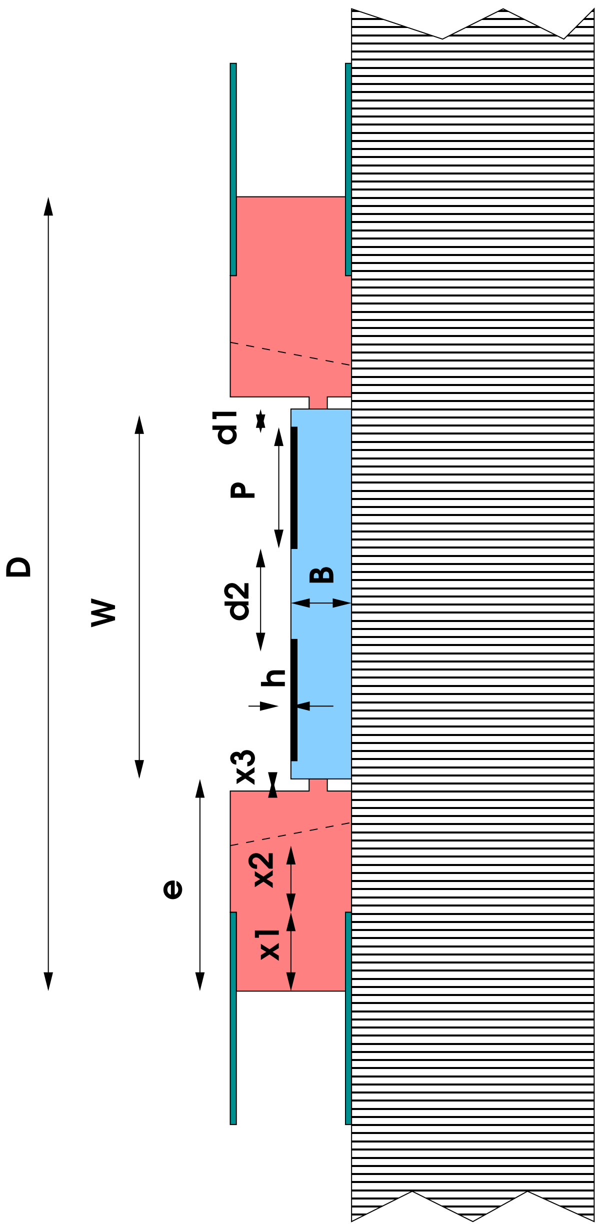


Figure 2: Wire splitting board and its surrounding

## Geometry and layout

The wire splitting board sits in the middle of the module and provides two insulated solder pads for the anode wires of the 2 straw halves. As the board represents a dead area in the middle of the acceptance the width is minimized. The dimesions of the wire-splitting boards follow from the sizes of the end-pieces and the specs of the feed-through boards.

Table 3: List of geometrical parameters as defined in Fig. 2:

| Quantity | | Value | Comments |
|---|---|---|---|
| W | (PCB width) | 17mm | f(d1,d2,P) |
| P | (pad) | 5mm | see above |
| d1 | (distance) | 1mm | see above |
| d2 | (pad dist) | 5mm | see above |
| B | (PCB thickness) | 2.48mm | see above |
| h | (pad to wire) | 0.05mm | see above |
| e | (end piece) | 9.5mm | |
| x1 | (end piece) | 3mm | |
| x2 | (end piece) | 3mm | |
| x3 | (nose at endp) | 0.5mm | 1 |
| D | (dead length) | 36mm | f(e,W,) 2 |

1. The nose is part of the current PHILIPPS design.

2. the total width of the dead area is now about 35mm.

## Staggering of the splitting boards of the 2 module layers

Table 4: List of geometrical parameters as defined in Fig. 3:

| Quantity | Value | Comments |
|---|---|---|
| st1 (staggering) | +17.5mm | |
| st2 (staggering) | -17.5mm | |
| ST (staggering) | 71mm | |

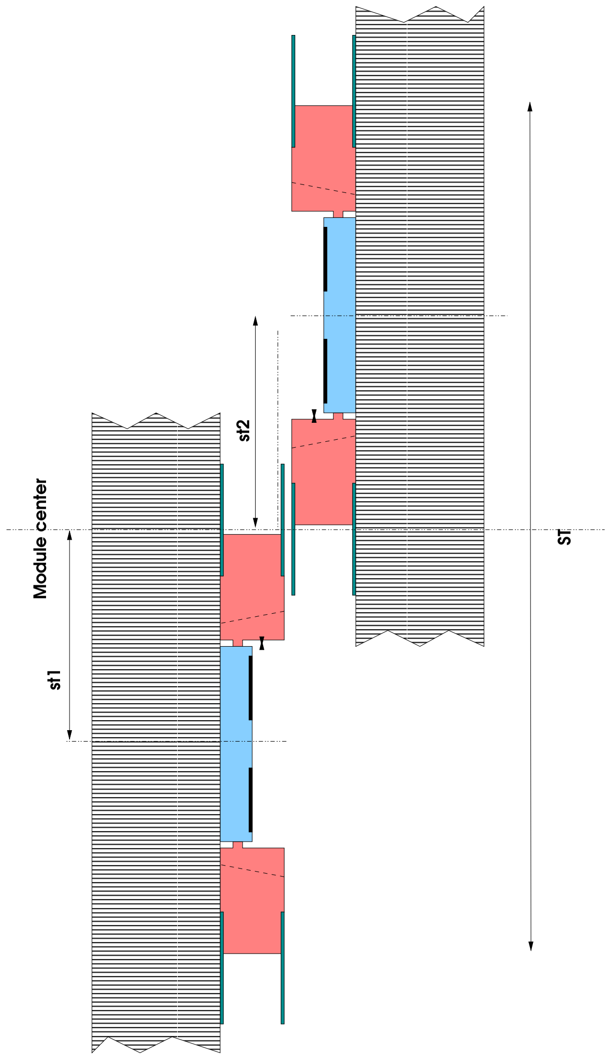


Figure 3: Staggering of the wire splitting boards

# 3 Solder board for short modules

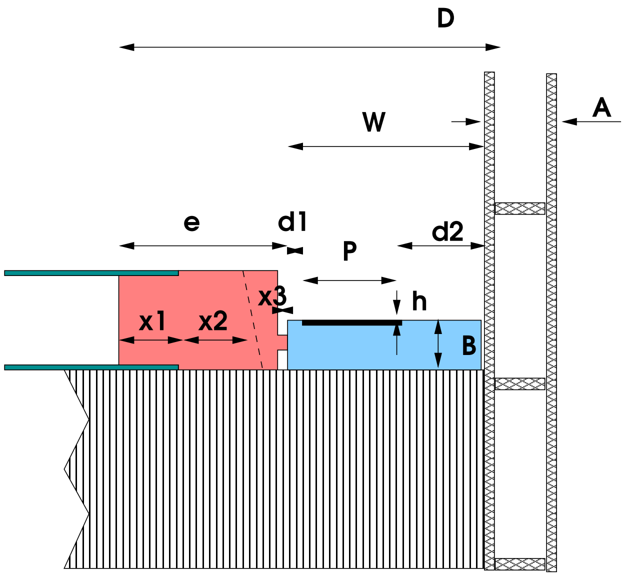


Figure 4: Wire splitting board and its surrounding

Table 5: List of geometrical parameters as defined in Fig. 4:

| Quantity | | Value | Comments |
|---|---|---|---|
| W | (PCB width) | 11mm | f(d1,d2,P) |
| P | (pad) | 5mm | see above |
| d1 | (distance) | 1mm | see above |
| d2 | (pad dist) | 5mm | see above |
| B | (PCB thickness) | 2.5 | see above |
| h | (pad to wire) | 0.1mm | see above |
| e | (end piece) | 9.5mm | |
| x1 | (end piece) | 3mm | |
| x2 | (end piece) | 3mm | |
| x3 | (nose at endp) | 0.5mm | |
| A | (hollow profile) | 9.5mm | |
| D | (dead length) | 29.5mm | |