*Operating Manual*

# Digital Load Cells
# FIT® and PW18i

## Part 1,
## Hardware and Functions

**Operating manual Digital Load Cells FIT® and PW18i**

**Part 1: Hardware and Functions**

**Description of the hardware and the functions of the Digital Load Cells FIT® and PW18i**

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Part 2: Command set

Description of the command set for the serial communication of the Digital Load Cells FIT® and PW18i

Part 3: Dosing functions

Description of the command set for the dosing functions of the Digital Load Cells FIT® and PW18i

## Important notes

This instrument must not be modified from the design or safety engineering point of view except with our express agreement. Any modification shall exclude all liability on our part for any damage resulting therefrom.

In particular, any repair is prohibited. Repairs may be carried out only by HBM.

The complete factory settings are stored nonvolatilely and protected against overwriting. The factory settings can be restored by means of the command **TDD0** at any time, if necessary.

You will find further notes in the 'Individual descriptions of the commands' chapter, operating manual part 2.

The production number set in the factory should not be changed.

## Safety instruction

- FIT and PW18i load cells must be used exclusively for weighing tasks and control and adjustment tasks directly connected thereto.
- In the normal case the product causes no dangers, provided the notes and instructions for configuring, installation, operation as intended and maintanance are complied with.
- The safety and accident prevention regulations applicable corresponding to the application must be observed without fail.
- Installation and commissioning may be performed exclusively by qualified personnel.
- When connecting the cables take measures against electrostatic discharges which can damage the electronic unit.
- An extra low voltage (6...30V) with safe isolation from the mains is required for the power supply of the unit.
- When connecting additional devices, the safety regulations according to EN61010[1)] must be complied with.
- Shielded cables are required for all connections. The shield must be connected flatly with ground at both ends.

1) "Safety regulations for electrical measuring, control and laboratory equipment"

# 1 Application

The load cells FIT® and PW 18i belong to the family of digital load cells and measuring chains which generate measuring signals based on the strain gauge technology, condition and output these signals digitally and network them with bus capability.

FIT® load cells are completely encapsulated in a stainless steel housing and suitable to work in aggressive environments. PW 18i load cells with plugs are cost-effective and space-saving.

The integrated signal processing was developed especially for the requirements of dynamic weighing and dosing processes. It includes a fast output of up to 600 measurements per second, fast recovering digital filters and a trigger function for checkweigher applications.

Depending on the version limit switches (L-version) or a complete dosing control (D-version) are available.

The conditioned weighing values can be transmitted by a RS 232 or by a RS 485 interface. A bus capability of up to 90 bus members is provided with the RS 485 interface.

The PC-software AED PANEL 32 is available for the easy adjustment of all parameters, for the display of dynamic weighing signals and for the comprehensive analysis of the dynamic system.

This instruction manual is valid for the following versions of the Digital Load Cells FIT® and PW18i:

| | | |
|---|---|---|
| FIT/H1SR2 | FIT/H4SR2 | PW18ISR2 |
| FIT/H1LR2 | FIT/H4LR2 | PW18ILR2 |
| FIT/H1DR2 | FIT/H4DR2 | PW18IDR2 |
| FIT/H1SR5 | FIT/H4SR5 | PW18ISR5 |
| FIT/H1LR5 | FIT/H4LR5 | PW18ILR5 |
| FIT/H1DR5 | FIT/H4DR5 | PW18IDR5 |

**The Digital Load Cells FIT® and PW18i are abbreviated with " FIT " in the following text.**

## 2 Characteristic features

- High overload limits
- High torsion / bending stiffness
- High resonance frequencies
- Internal and external trigger functions
- 2 limit switches with hysteresis (L/D-version)
- Dosing control functions (D-version)
- Fast digital filtering and scaling of the measuring signal
- Serial interfaces (UART) RS 232 or RS 485-4-wire
- All settings via the serial interface
- Storage of the parameters protected against power failure
- Indestructably stored factory settings
- Choice of the measuring rate up to 600 measurements per second
- Automatic zero tracking (±2%)
- Automatic initial zero setting (±2%...±20%)
- Trigger function (internal level trigger, external trigger)
- Operating voltage 6V...30V DC
- Galvanic isolated power supply
- Galvanic isolated control inputs and outputs (L/D-version)

**FIT:**

- Integrated vertical overload stops
- Corrosion resistant , laser welded
- Protection class IP 66

**PW 18i:**

- Electrical connections via plugs
- Protection class IP 67

# 3 Housings, versions, interfaces

## 3.1 Housings

Digital load cells FIT® are encapsulated in a laser welded stainless steel housing (Fig. 1) and are supplied with fixed mounted connecting cables. The type designation is

**FIT/H1XYY/ZZK**

The stainless steel housing permits the application in corrosive environments (protection class IP 66).

Alternatively the digital load cells are available without stainless steel housing but with full FIT functionality (Fig. 2). The type designation is

**PW18iXYY/ZZK**

This type is characterized by an aluminium load cell body with integrated electronics and plug connections. It is space-saving and cost-effective and applicable in environments where a high corrosion resistance is not necessary.

FIT®- and PW18i-load cells are produced in the rated capacities of 5 kg to 75 kg. The dummy characters 'ZZ' in the type designation characterize the rated capacity in kg.

Fig. 1: FIT-load cell

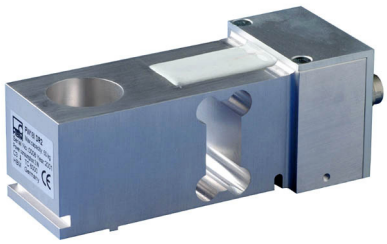


Fig. 2: PW18i-load cell

## 3.2 Versions

FIT®- and PW18i-load cells are supplied in three versions:

a) Standard version (S)

b) Version with limit switches (L)

c) Version with dosing function (D)

In the standard version (S) with only one cable / one plug all functions necessary for dynamic weighing are already available including the trigger function.

In the version with limit switches (L) two digital outputs can be activated depending on the exceeding of limit values. Additionally two digital inputs can be used for external control or taring and triggering.

In the version with dosing function (D) two digital inputs and four digital outputs are able to control a dosing or filling system stand alone.

The dummy character 'X' in the type designation characterizes the version of the load cell.

## 3.3 Interfaces

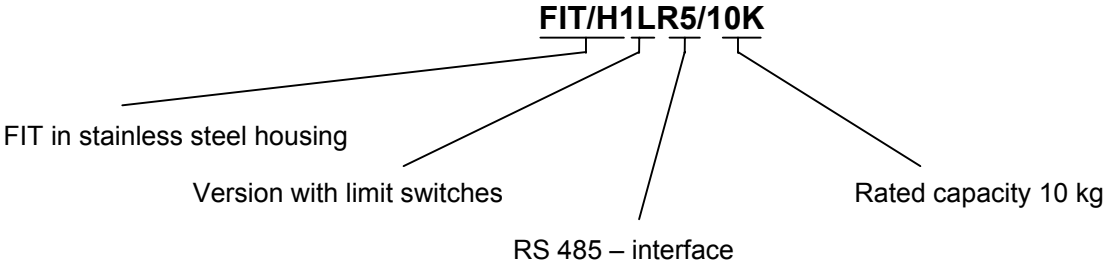
All housings and versions are avaliable with the serial interface RS 232 (R2) or RS 485-4wire (R5).

The dummy character 'YY' in the type designation characterizes the interface.

You will find details of the interface connections in section 6 of this part of the instruction manual.

## 3.4 Labelling

Example for the type designation on the type plate:



# 4 Mechanical constructions

## 4.1 FIT/H1...

In the housing version FIT/H1... the load cell is completely protected by a laser-welded stainless steel housing (Fig. 3). The sealing between the loading part (1) and the housing is realized by a silicone diaphragm. Ventilation channels underneath the loading part (1) provide the pressure balance between the interior and the outside. The FIT load cells are specified for IP 66.

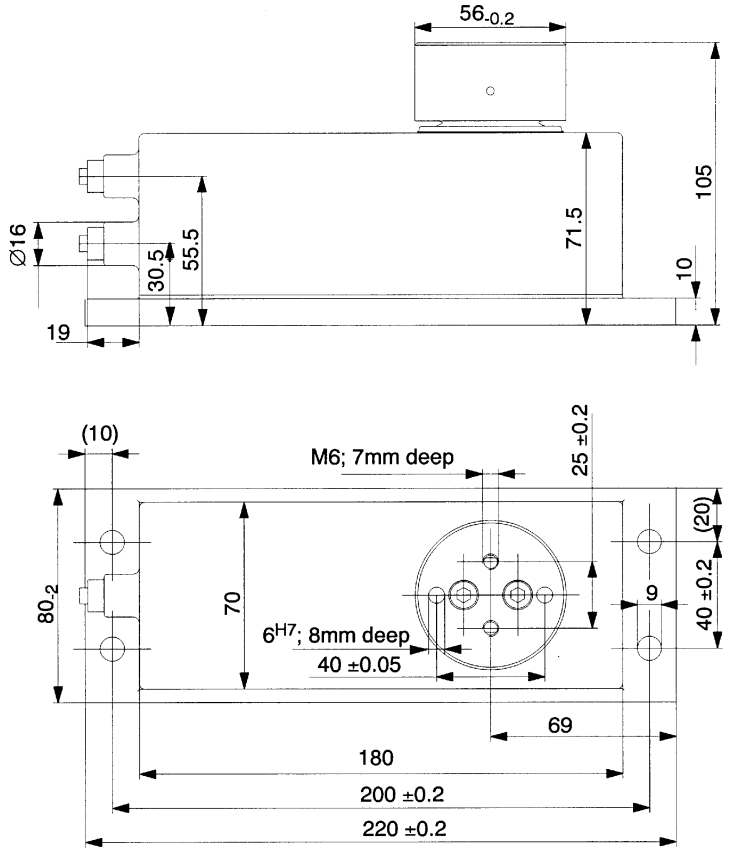



Fig. 3: Dimensions of FIT

**Mounting recommendations (Fig. 4):**

The load cell is fixed by 4 screws M8. A strength class 10.9 and a tightening torque of 25 Nm is recommended.

The flatness of the mounting area must be better than 0.1 mm to avoid bracing of the base plate. Bracing of the base plate can affect the function of the overload stop and can cause measuring errors.

For the mounting of the weighing platform you find 2 reamed boreholes (∅ 6H7, depth 8 mm) and 2 threaded holes M6 (depth 7 mm). A strength class 10.9 and a tightening torque of 14 Nm are recommended.

The loading part (1) of the load cell should be mounted in the centre of the weighing platform to avoid moments and eccentric loading errors.

Take care when more than one FIT is installed in a system with RS485-Bus:

The Production number (stated on the data plate) is required for setting up the communication via RS485. If the data plate is hidden after installing, note the number and keep it for later use.

Alternatively, each FIT may be switched to a unique address **before** wiring the RS485-lines. For this, the FIT has to be connected separately to a PC. For address setting use the ADR command, described in Part 2 of this manual.

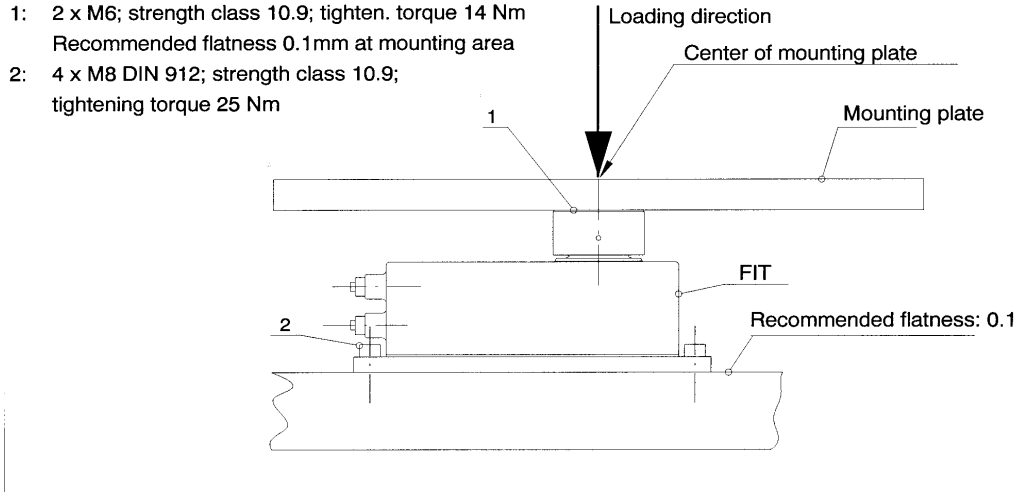



Fig. 4: Mounting of FIT

**Please note the following precautions at mounting and operation:**

- The fixing screws of the loading part must not be unscrewed in any case.
- The loading part (1) protects the silicone diaphragm from mechanical damage.The gap between the loading part (1) and the housing must not be cleaned with sharp tools or with a high pressure cleaner.
- Under unfavourable circumstances water can enter the interior of the load cell through the ventilation holes. Therefore the loading part (1) and the gap to the housing should not be completely covered by water.
- The depth of the M6-threaded holes is 7 mm. Please note this dimension for selecting the fixing screws.
- FIT load cells are provided with an effective overload stop in tension and compression direction. Please note the maximum values for eccentric loading and take into account overload forces caused by shock.
- Avoid by-pass forces in the mounting.

## 4.2 PW 18i

The digital load cell PW 18i is characterized by a compact aluminium body and connection plugs. The electronics are integrated in the load cell (Fig. 5). The load cell is space-saving and cost-effective and is recommended if a high corrosion resistance is not necessary. It is specified for IP 67.

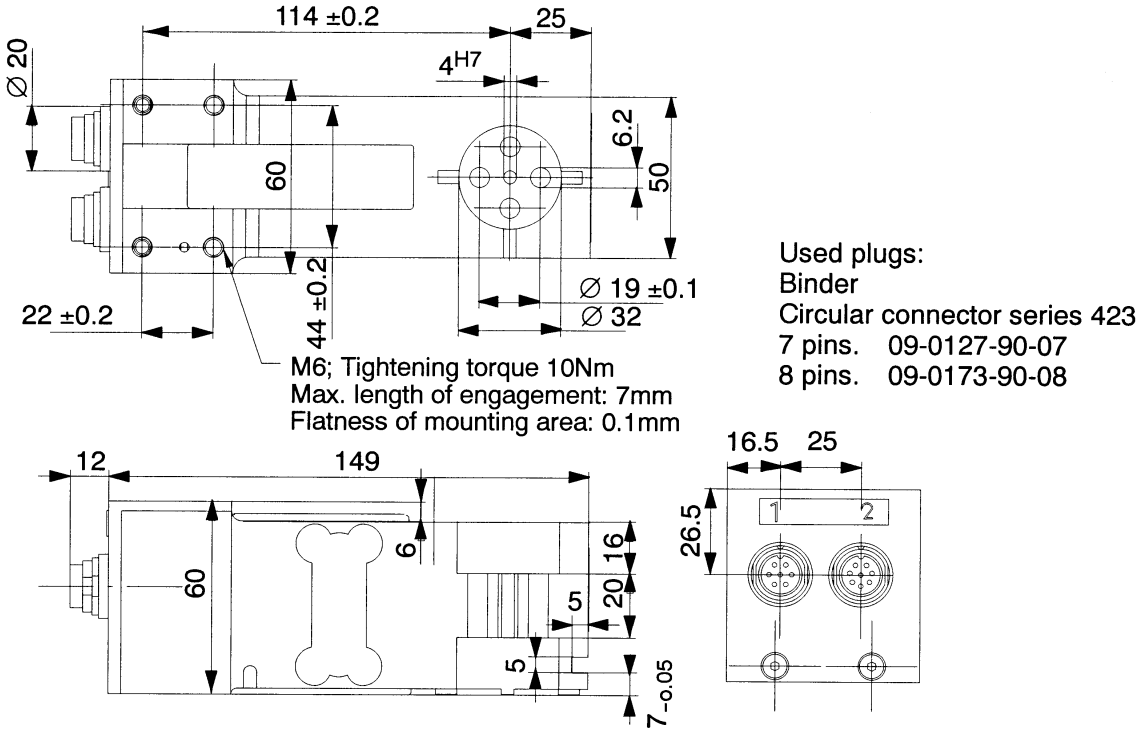



Fig. 5: Dimensions PW 18i

**Mounting recommendations:**

The load cell PW 18i should be mounted on a clean surface with a flatness of < 0.1 mm This flatness is important for a correct functioning of an overload stop in the compression direction.

Additionally an overload stop can be realized in the tension direction by mounting an overload stop in the slot on the face side of the load cell (customer made construction). The gap between the overload stop and the slot must be 0.1 mm.

The loading part has to be designed and produced by the customer.It should be mounted by 4 screws M6, strenght class 10.9, tightening torque 14 Nm. The flatness of the connection area should be <0.1 mm.

The loading part can be mounted on top or underneath. This way an alternative load introduction through the base plate is possible. The loading part should touch the load cell on the connection area only.

The PW 18i is mounted on the base plate by 4 screws M6, strength class 10.9, tightening torque 14 Nm. Please note the maximum depth of thread is 7 mm. Screws with a length of thread of more than 7 mm can damage the load cell. For centering a reamed borehole ∅ 4 H7 is provided.

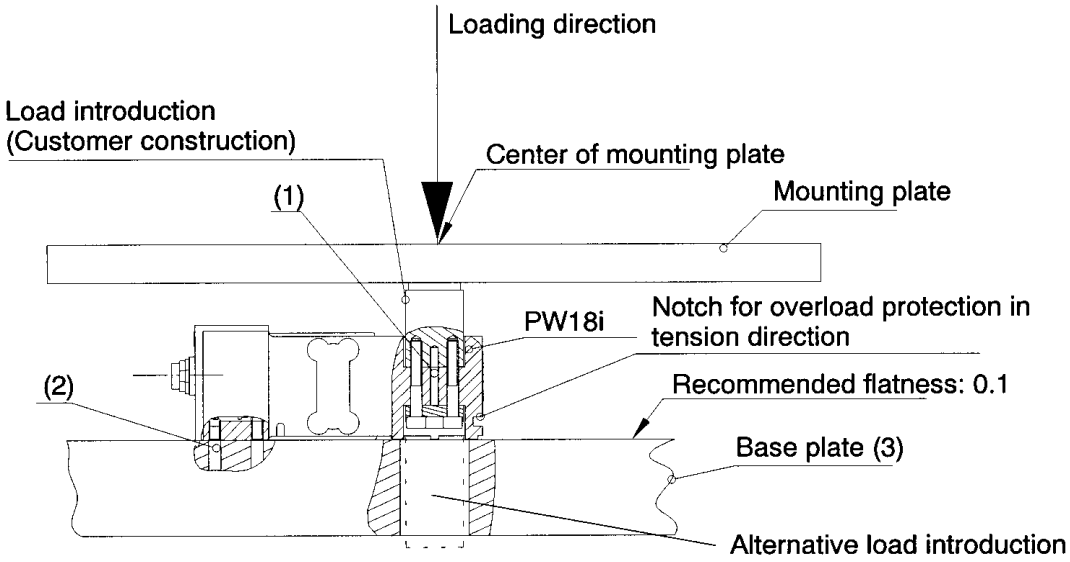
The loading part should be mounted in the centre of the weighing platform to avoid moments and eccentric loading errors.

The plugs 1 (7 pins) and plug 2 (8 pins) are different and cannot be mistaken for. Matching cables are available by HBM (see data sheet).

Take care when more than one FIT is installed in a system with RS485-Bus:

The Production number (stated on the data plate) is required for setting up the communication via RS485. If the data plate is hidden after installing, note the number and keep it for later use.

Alternatively, each FIT may be switched to a unique address **before** wiring the RS485-lines. For this, the FIT has to be connected separately to a PC. For address setting use the ADR command, described in Part 2 of this manual.




1: Attachment PW18i at load introduction: 4 x M6;
strength class10.9; tightening torque 14 Nm.
Recommanded flatness 0.1 mm of mounted area
2: Attachment PW18i with base plate: 4 x M6 DIN 912; strength class 10.9:
tightening torque 10Nm; max. length of engagement 7mm
3: If the load cell is mounted on a base plate with a flatness of <0.1mm, the safe load
limit in loading direction increases to 1000%.

Fig.: 6 Mounting of PW18i

Please note the following precautions at mounting and operation:

- In any case the length of the fixing screws must be selected such way that the maximum length of thread of 7 mm is not exceeded, otherwise the load cell can be damaged.
- The gap between the base plate and the load cell only works as an overload protection if it is clean. Material pollution of this gap causes by-pass forces and measuring errors. If pollution cannot be avoided it is better to realize the overload stops in another way (e.g. point shaped with set screws).
- When using overload stops please note the maximum values for eccentric loading and take into account overload forces caused by shock.
- Avoid by-pass forces in the mounting.

# 5 Electrical construction

The digital load cell FIT consists essentially of the following function groups:

- Single-point load cell
- Amplifier
- Analog-digital converter (A/D)
- Evaluation unit (µP)
- Power failure-protected parameter memory (EEPROM)
- Serial interface
- Galvanic isolated power supply
- Galvanic isolated control inputs and outputs (L/D-version)

## 5.1 Function

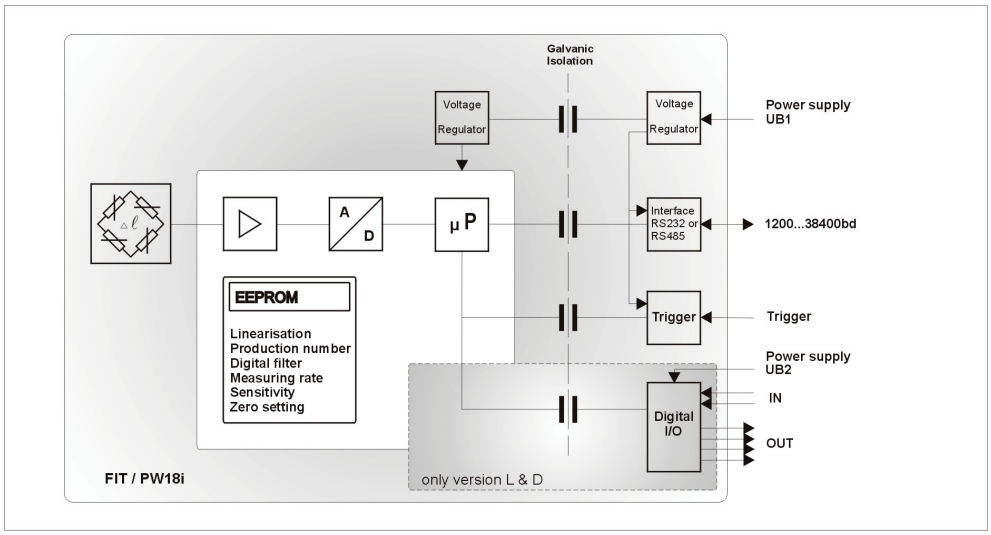



Fig. 7:Basic device block circuit diagram

The analog transducer signal is initially amplified, filtered and converted into a digital value in the analog-digital converter. The digitized measuring signal is processed in the microprocessor and forwarded through the serial interface. All parameters can be stored power failure-protected in the EEPROM.

The FIT is adjusted in the factory at zero load and nominal load. The electronics determine from these measured values a factory characteristic and map the subsequent measured values using this characteristic. According to output format (**COF**) the following measured values are delivered:

| Output format | Input signal | Measured values at NOV = 0 | Measured values at NOV > 0 |
|---|---|---|---|
| Binary 2 characters (integer) | 0 ... Nominal load | 0 ... 20 000 Digit | 0 ... NOV |
| Binary 4 characters (long integer) | 0 ... Nominal load | 0 ... 5 120 000 Digit | 0 ... NOV |
| ASCII | 0 ... Nominal load | 0 ... 1 000 000 Digit * | 0 ... NOV |

* condition on delivery

You have the possibility of adapting the characteristic to your requirements (scale characteristic) correspondingly with the parameter pair **LDW** and **LWT** and to standardize the measured values to the required scaling value (e.g. 3000d) using the command **NOV**. You will find detailed information in the 'Individual descriptions of the commands' chapter, instruction manual part 2.

## 5.2 Signal processing

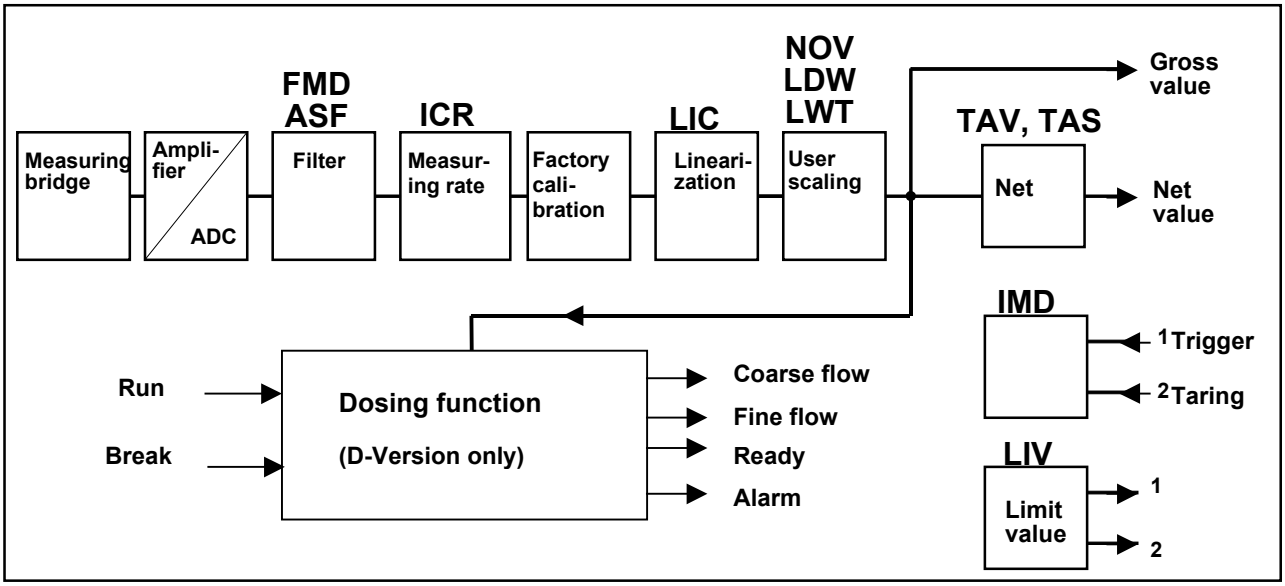



Fig. 8: Signal flow chart

After amplification and AD conversion the signal is filtered by adjustable digital filters.

The cutoff frequency of the digital filter is set with the commands **ASF,FMD**. The output rate (measured values per second) can be changed with the command **ICR**.

The user can set his own characteristic (commands **LDW, LWT, NOV**) without changing the factory calibration. Furthermore a gross/net switch-over is available (command **TAS**). An automatic power-on zero can be activated with the command **ZSE**. An automatic zero tracking function (**ZTR**) also exists.

The command (**LIC**) is available for linearizing the scale characteristic (with a 3rd order polynomial). The polynomial parameters can be determined using a HBM PC program AED_PANEL 32.

The current measured value is read out using the command **MSV?**. The format of the measured value (ASCII or binary) is set using the command COF. Automatic measured value output can also be selected using the command **COF**.

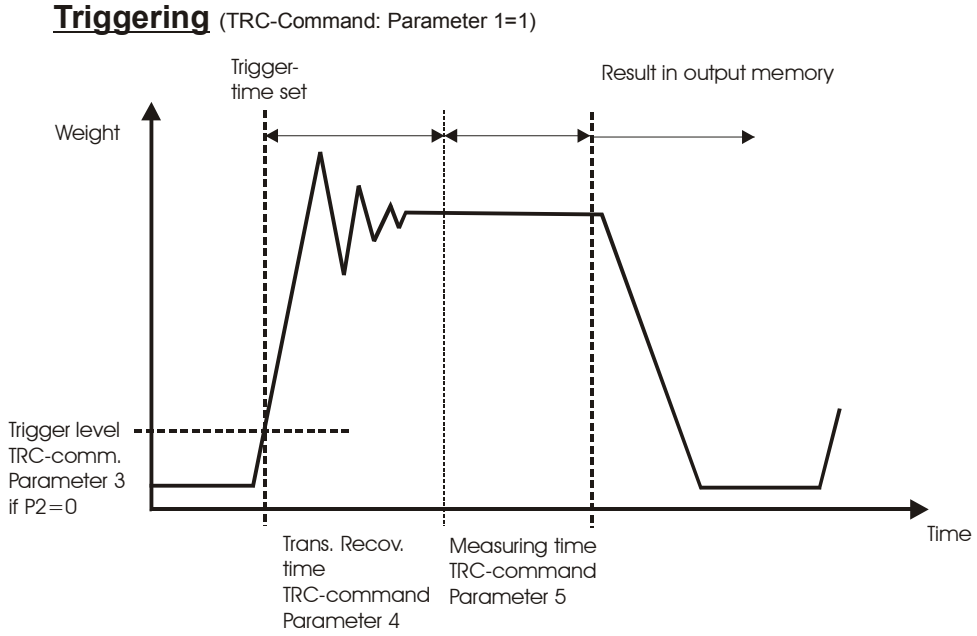
Two types of digital filter, which are switched over using the command **FMD**, are implemented in the FIT. In FMD0 filters even below 1Hz cutoff frequency are available. In the filter mode FMD1 fast recovering filters with high damping in the cut-off range are activated. You will find detailed information in the chapter 'Individual descriptions of the commands', instruction manual part 2.

## 5.3 Trigger function:

The FIT contains two **trigger functions** for supporting measurements in packaging machines and checkweighers**:**

- Internal triggering by an adjustable level (gross or net measured value)
- Triggering by an external trigger input

This special measuring mode is switched on using the command **TRC**. The determined measured value is read out using the command **MAV?**. The filter mode **FMD1** (fast recovering filter) should be set for this measuring mode. The measuring rate depends upon the selected filter, the set cut-off time and the measuring time. The cut-off time should also fit with the transient response time of the filter used (ASF).



**Level triggering:**

This measuring mode is suitable for weighing processes in which the scale is unloaded between the weighings.

At first the scale is unloaded. The weighed material is placed on the scale, the trigger level is exceeded, the cut-off time measurement is started. After the end of this transient recovery time the weight is determined, after the end of this measuring time the weight value is filed in the memory. The weighing process cannot be started again until the weight value is below the trigger level (unload the scale). In this measuring mode the weight determination does not have to be monitored by an external computer with high speed. The output memory contains an ‘overflow’ value ‘ (ASCII: -1638400; 2 byte binary: -32767) until a new measured value has been formed. After reading out the measured value memory using the command MAV?, this memory is set back to ‘overflow’.

Cut-off time, measuring time and trigger level can be set freely using the command TRC. The trigger level lies on the user characteristic (NOV). The times depend upon the selected filter ASF,FMD, the measuring rate ICR and the parameters of the command TRC. They are documented in the description of the command TRC (part 2 of the instruction manual).

**External trigger signal:**

- To use an external trigger signal the external input must be set to the trigger function with the command IMD1.

This trigger input activates the measuring process with the high-to-low transition. This means, when an active high signal is used, the timing starts by the end of the pulse. See section 6.4.1

The trigger edge starts the cut-off time measurement. After the end of this transient recovery time the weight is determined over the measuring time and the averaged weight value is filed in the memory. The output memory contains an ‘overflow’ value (ASCII: -1638400; 2 byte binary: -32767) until a new measured value has been formed. After reading the measured value memory using the command MAV?, this memory is set back to ‘overflow’.

Cut-off time and measuring time can be set freely using the command TRC. The times depend upon the selected filter ASF,FMD, the measuring rate ICR and the parameters of the command TRC. They are documented in the description of the command TRC (part 2 of the instruction manual).

A renewed trigger edge starts the measuring process anew. Unloading the scale is not necessary here.

During a measurement (waiting time + measuring time) a trigger signal is ineffective (no retriggering).

In the standard version (S) the trigger input is available in cable 1 / plug 1 only.

FIT versions with limit switches (L) or dosing (D) provide an “In 1”-line in cable 2 / plug 2. This may also be used for trigger function. See section 5.4.1. The low- and high-level of the two trigger inputs are different (see technical data in section 7).

## 5.4 Digital inputs / outputs

### 5.4.1 Inputs

- All versions of the FIT (S, L, D) provide one digital input in cable 1.
- FIT L- or D- versions provide two inputs with galvanic isolation in cable 2.

The operating mode for the inputs is selected by means of the **IMD** command:

**IMD0** The input level has no influence on the signal processing but can be enquired using the command **POR?**. Thus, the logic state of auxiliary equipment can be detected by the control software without installing separate lines and I/O-modules.

**IMD1** The inputs are assigned to functions for measurement automation (e.g. checkweigher).

| input | IMD0; | IMD1; | IMD2; |
|---|---|---|---|
| **"Trigger"-line** (cable 1) | polling by **POR?** | external trigger input | same as **IN1** (see following chapter) |
| **IN1** | polling by **POR?** | external trigger input | see following chapter |
| **IN2** | polling by **POR?** | taring, switch to net value output | see following chapter |

block diagram:

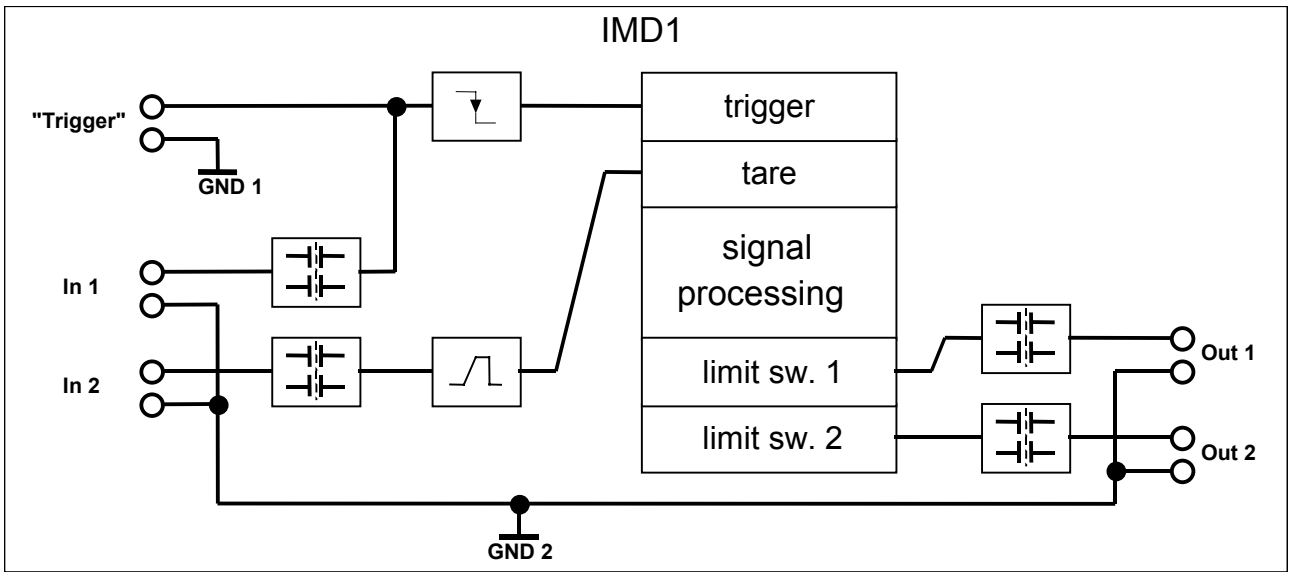



Fig. 6.4.1 : Signal diagram for inputs / outputs (with IMD = 1 and limit switches enabled)

Legend:

**galvanic isolation (signal processing ⇔ cable 2)**

**falling edge detection (for trigger function only)**

**debouncing 20 ms**

Please consider the following notes:

- The „trigger“ – line (cable 1) and input „in1“ (cable 2) are associated with the same function internally. Thus, the „break dosing“ function or a logical „1“ for the POR inquiry may be obtained by a high level on one of these (or both) inputs.
- Note that the *trigger function* is activated by a high to low transition which occurs on one of these lines, while the other line is **kept in a low** state.
- No input function is active ex works. To use the external trigger function, the respective settings have to be done with the **IMD** / **TRC** command. This also applies to the cable 1 input.
- For the „trigger“ and „In1“ line, there are differences concerning the electrical data only (galvanic isolation, reference ground, threshold). See section 6.4.1 or data sheet for details. For signal processing, the usage of a certain input is not essential.

### 5.4.2 Outputs (L- or D- version only)

The two outputs of the FIT can be used as limit value outputs (LIV command) or as digital outputs which can be set using the **POR** command.

**Limit switch function**

The state of the output is determined by the limit switch function. As a prerequisite, the limit output as a hardware signal has to be activated by the **LIV** command (see manual part 2).

**Switching the outputs by POR command**

An output not used for limit value function can be switched on or off by the **POR** command. Thus, the controlling software can initiate functions of auxiliary equipment without installing separate lines and I/O-modules.

**Remarks:**

- the output function is selected independly for each output by the appropriate LIV-command (see manual part 2).
- These functions cannot be used with **IMD** set to 2 (dosing function, D-version only).

**Function of outputs OUT 1 and OUT 2 (with IMD = 0 or IMD = 1)**

| | **limit value1 (LIV) not used** | **limit value1 indicated in msv-status* only** | **limit value1 in msv-status* and output** |
|---|---|---|---|
| **OUT1** | switched by **POR** command | switched by **POR** command | limit switch, determined by **LIV setting** |

| | **limit value2 (LIV) not used** | **limit value2 indicated in msv-status* only** | **limit value2 in msv-status* and output** |
|---|---|---|---|
| **OUT2** | switched by **POR command** | switched by **POR command** | limit switch, determined by **LIV setting** |

* The measurement value status byte is part of the measured value in some output formats (see command COF)

### 5.4.3 Dosing function (D-version only)

All functions described above are also available with FIT D-version. **IMD** must then be set to 0 or 1.

**Setting IMD = 2 activates the dosing function which specifies special functions for all inputs and outputs. In this mode, any settings concerning limit switches or POR commands have no effect. There are several commands for timing and optimization parameters of the dosing process. These are described in part 3 of this instruction manual.**

Two further outputs OUT 3 and OUT 4 are implemented especially for dosing. They have different functions depending on **EPT** and **OMD** setting .

| function | **IMD0;** | **IMD1;** | **IMD2;** (D-version only) |
|---|---|---|---|
| **IN1** | polling by **POR?** | external trigger input | dosing stop (BRK) |
| **IN2** | polling by **POR?** | taring, switch to Net value output | dosing start (RUN) |
| **OUT1** | used for limit switch output if enabled (**LIV** command) | | coarse flow |
| | otherwise: switched by **POR** command | | |
| **OUT2** | used for limit switch output if enabled (**LIV** command) | | fine flow |
| | otherwise: switched by **POR** command | | |

| | | **IMD0; / IMD1;** | **IMD2;** |
|---|---|---|---|
| **OUT3** | with EPT = 0 *) | -- | ready signal |
| | with EPT > 0 *) | -- | emptying control |
| **OUT4** | with OMD = 0 **) | -- | result > upper tolerance limit |
| | with OMD = 1 **) | -- | result out of tolerance (+ / -) |
| | with OMD = 2 **) | -- | alarm (e.g. bag rupture) |

**Remarks:**

*) **EPT** = emptying time, see manual part 3

**emptying control:** signal becomes active when the filling result has been evaluated and is reset on expiry of the emptying time.

**ready signal:** output is set when the filling result has been evaluated and remaines high until a new start command occurs.

****)OMD** = output mode, see manual part 3

# 6 Electrical connections

## 6.1 Wiring diagrams FIT / PW18i

The terminal assignment for different FIT loadcells is described by the following charts. The FIT® with stainless steel housing provides one or two fixed cables. Matching cables for the PW18 i connectors can be ordered separately with various overall length. They may also be taylored by the user. The charts are applicable for wiring with these cables, too (take care for colour assignment when using your own cable).

**Remarks:**

- The housing is connected to the shield of both cables (S-version: one cable only). To satisfy EMC requirements (EMC = electromagnetic compatibility), join the cable shield to the unit ground of external devices, respective the earth potential. Ensure that the shield is connected directly with low resistance (shield must be applied over a large area to ground, e.g. with EMC-compiant PG glands).

- Use only shielded, low-capacitance cables for connection to supply, interface and auxiliary devices (measuring cables from HBM fulfil these conditions).

- Electrical and magnetic fields frequently cause coupling of interference voltages into the measuring circuit. Do not run the measuring cables parallel to power current and control cables. If this is not possible, protect the measuring cable (e.g. by steel conduits). Avoid stray fields of transformers, motors and contactors.

**Caution:**

The FIT is designed for a supply voltage up to 30 V. Unintentional connection from supply voltage to any interface line may cause permanent damage.

**Check the wiring carefully before switching on the first time.**
(colour assignments in this manual apply to FIT® or HBM-cable KAB147-x, KAB148-x).

**Be sure not to mistake cable 1 and cable 2.**

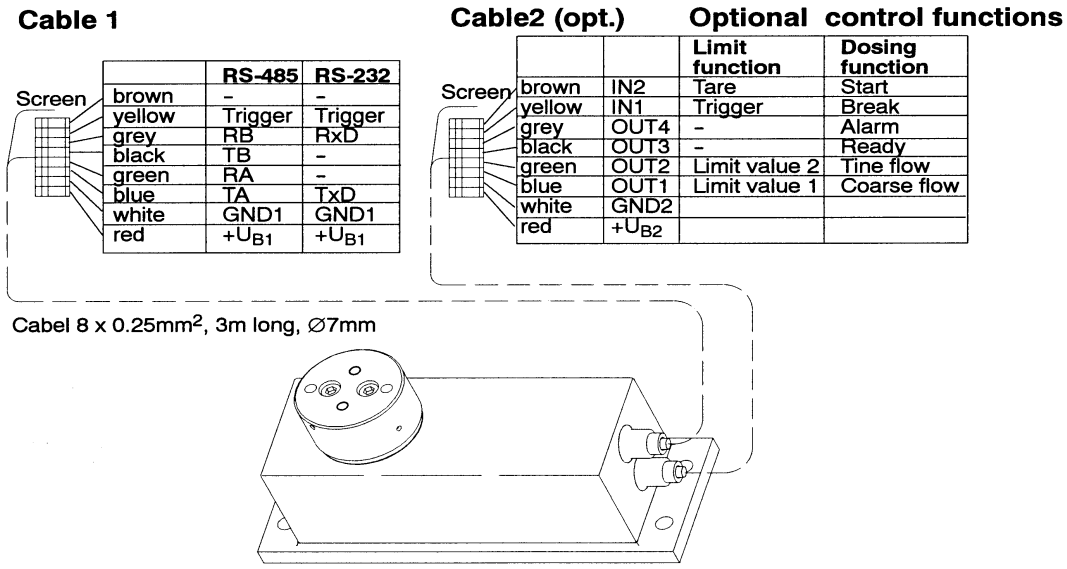



Fig. 7: Terminal assignment FIT

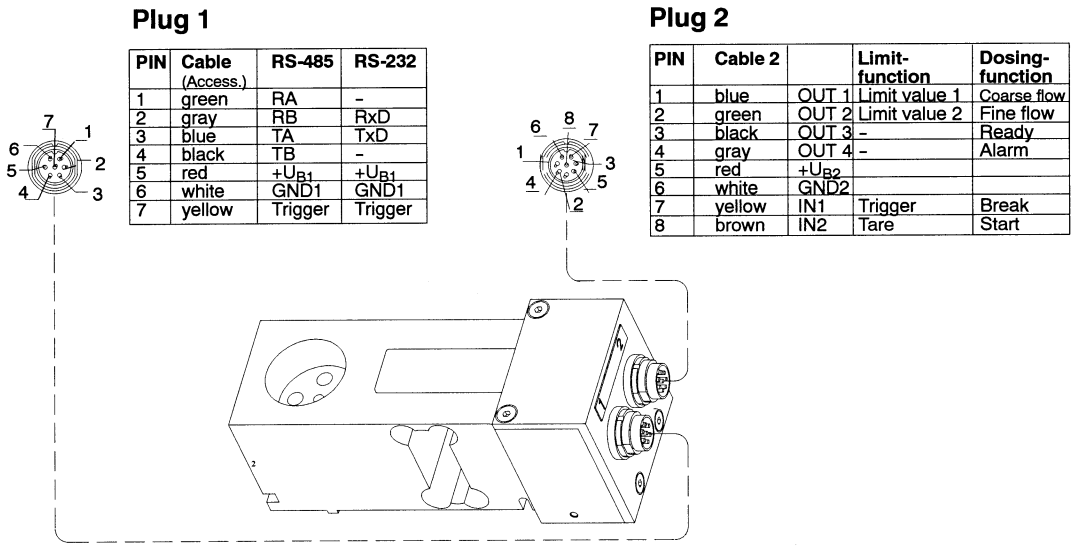



Fig. 8: Terminal assignment PW18i

## 6.2 Power supply

A regulated DC-voltage in the range +6...+30 V is required for measurement and serial communication. The supply lines are Ub1 and GND1, located in cable 1.

**Requirements for power supply:**

- The supply voltage must be filtered sufficiently (residual ripple < 1V rms; Ub1(t) > 6V).
- The high efficiency supply circuit of the FIT load cell has a power consumption of 2 W. Therefore the required current depends on the supply voltage:

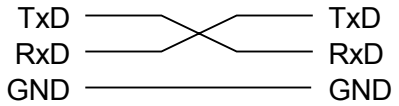
$$\frac{2W}{\text{supply voltage}[V]} = \text{supply current}[A]$$

- When switching on the power, the starting current of each FIT is about 0.3 A. This must be provided by the supply. To ensure a proper start up, limitation must not react before reaching this value. Observe this especially when providing the power for several FIT by one supply. However, the continuous load can be calculated with the formula above.
- Connection to wide area power distributions is not permitted, as these frequently conduct transient voltage and noise which interferes to the measuring electronic. Better provide a local supply, this may also feed more than one FIT.
- The supply voltage (Ub1, GND1) is galvanically isolated to the cable shield potential. It is not required to connect GND1 and the case, but the potential difference must not exceed 10 V.
- The supply ground line (GND1) serves as reference potential for all serial interface lines and the „trigger"-input of cable 1.
- For applications with several transducers the supply lines can be combined with the RS485 bus signal lines in one 6-wire cable (e.g. with HBM junction box VKK1-4 or VKK2-6). Be sure to use sufficient wire gauge, as some sections are loaded with the cumulative supply current of all transducers.

## 6.3 Serial interface

The FIT is available with a RS232- or RS485 serial interface. The baud rate can be selected between 1200 and 38400 baud in both interface versions. The FIT power ground (GND1 , located in cable 1) serves as reference potential for all interface lines.

The RS232 interface is suitable for peer-to-peer connection (**one** FIT-transducer connected to one counterpart). Only the **RxD** ( **R**eceive **D**ata ), **TxD** ( **T**ransmit **D**ata ) and GND1 lines are used.




For the communication with an external device its TxD line must be connected with RxD of the FIT and vice versa.

**Fig. 6.3.1 : Simplified diagram for an RS232 connection**

FIT-loadcells with RS485 interface are suited to build a measurement bus arrangement. Fig. 6.3.2 shows the principle of bus cabling. All FIT (RS485 version) are connected in parallel to the transmission line, but the transmit and receive lines must be interchanged at the control computer connection (bus line Ra to bus coupler Ta etc.). The HBM interface converter SC232/422A can be used for the PC-side conversion of RS232 (COM interface) to RS485. For EMC reasons, shielded cables must be used for the bus lines.

Since all FIT are connected to the same line, a software protocol determines which component has to respond. A communication address (00 ... 89) is allocated to each FIT.
**To establish the bus communication the first time, it is necessary to know the production numbers of all connected FIT-loadcells. We recommend to make a note before installing.**
The procedure is described in manual part 2.

Since the RS-485 is a differential bus interface, the levels are also stated as differential voltage between the lines (and not ground-related).
The following applies as quiescent level on the RS-485 master line:

TB - TA > 0.35 V
RB - RA > 0.35 V

A correct termination of the line impedance is important to avoid faults on the bus. For this purpose the FIT has integrated terminating resistors (500 ohms) which can be activated by software (STR command, see manual part 2). The terminating resistors must be activated at the ends of the bus line, as a rule therefore in the last FIT and in the bus coupler of the control computer. They must be switched off in the other units, since otherwise the bus drivers are overloaded. The HBM interface converter also contains the bus terminating resistors.

The maximum common mode range (raising both lines by the same potential) is +/- 7V. Common mode signals arise if the reference grounds of the connected units have different potential, e.g. due to large currents in the supply cable. If required, the potential equalization between the bus subscribers should be ensured through a separate ground wire. The cable shield may not be used for this equipotential equalization.

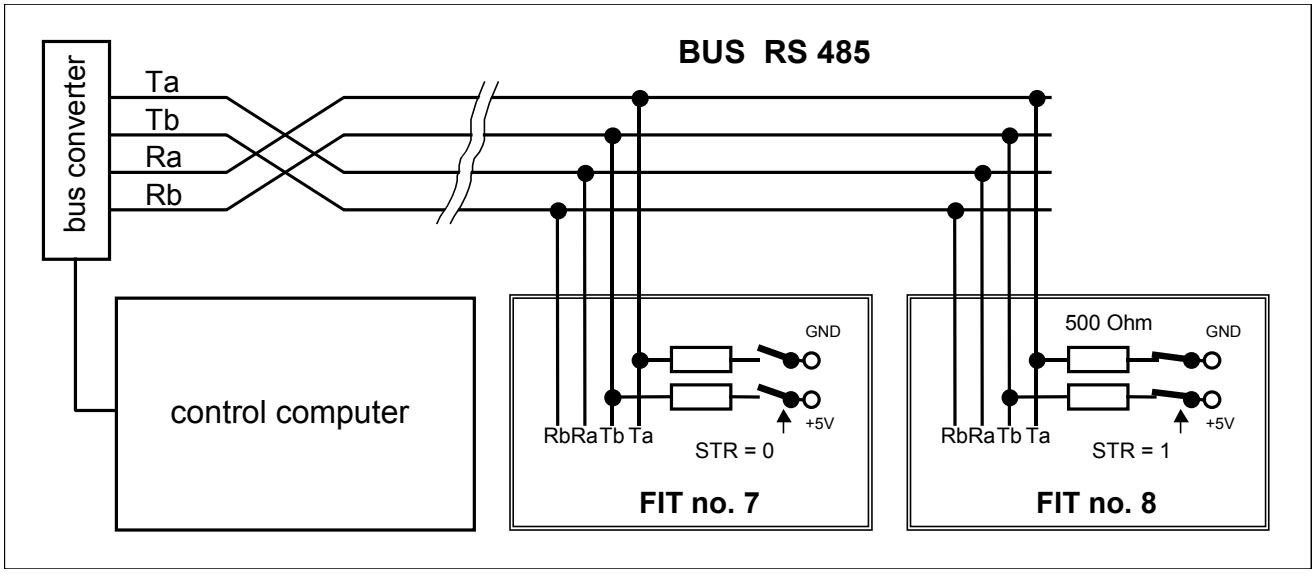



Fig. 6.3.2 : Connecting several FIT to one control unit by RS-485 bus line (FIT numbers shown as an example)

Fig. 6.3.3. describes all required connections (cable 1) for FIT RS-232-version connected to a PC. Colour assignments apply to FIT® or HBM-cable KAB147-x, KAB148-x.

Connection with RS485-version takes place in the same way, using line Ra,Rb,Ta,Tb, GND1, Ub1.

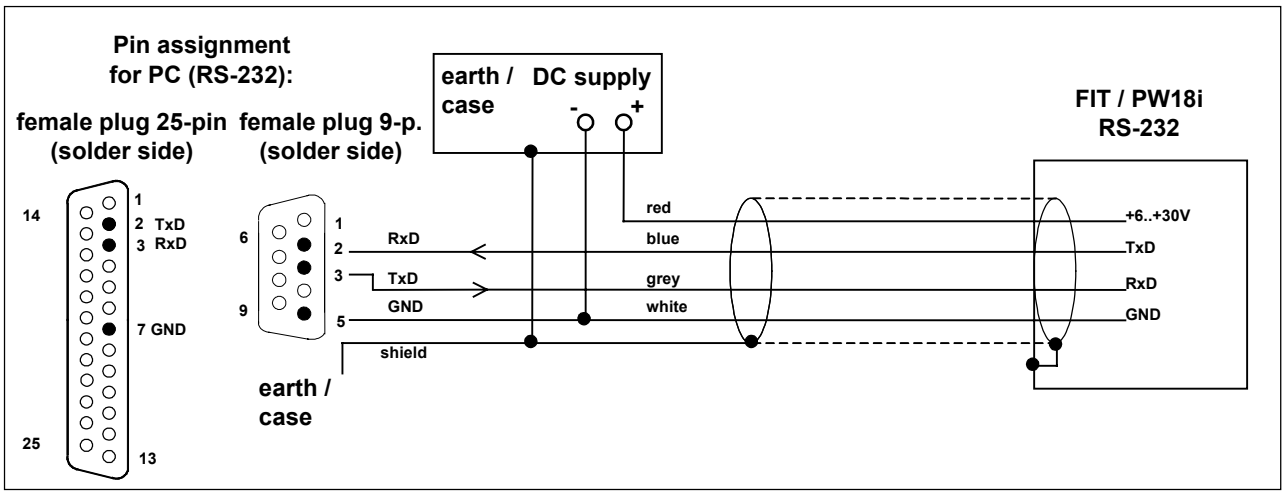



Fig. 6.3.3 : Connection to supply and interface, FIT RS232-version

## 6.4 Inputs, outputs

### 6.4.1 Electrical data

To actuate an input function, switch an auxiliary voltage to the corresponding input line.

**Cable 1 input** works with HCMOS-compatible level but can accept up to 12 V without damage. Signal is related to ground potential GND 1.

**Cable 2 inputs** are PLC-compatible and are galvanically isolated against the signal processing electronic. Signals are related to ground potential GND 2.

See section 5.4.1 for functional description.

**Timing**

The logic states and their associated electrical input values are shown in the following tables. Avoid any levels between this ranges as they result in undefinite conditions.

All functions except the external trigger are debounced internally. An active level which is applied for at least 20 ms at an input initiates the corresponding function. This prevents an unintentional initiazion caused by transients or multiple signal edges, which frequently occur when using mechanical switches.

The trigger function detects a falling edge of the signal and is not debounced. This ensures immediate processing with constant response time. On the other hand, even short pulses start a new measurement. Therefore a proper signal without noise coupling is essential. See instructions for cabeling and EMC in this manual, section 6.1.

| **Function** | **Ext.trigger** | **TAR, BREAK, RUN** |
|---|---|---|
| **Quiescent level** | stable high or low *) | Low |
| **Function initiated by..** | High-to-low-transition | High level, with debouncing |

*) applies only to the input currently used as Trigger line. The other input (cable 1 or cable 2, respectively) must be kept in a low state. See section 5.4.1.

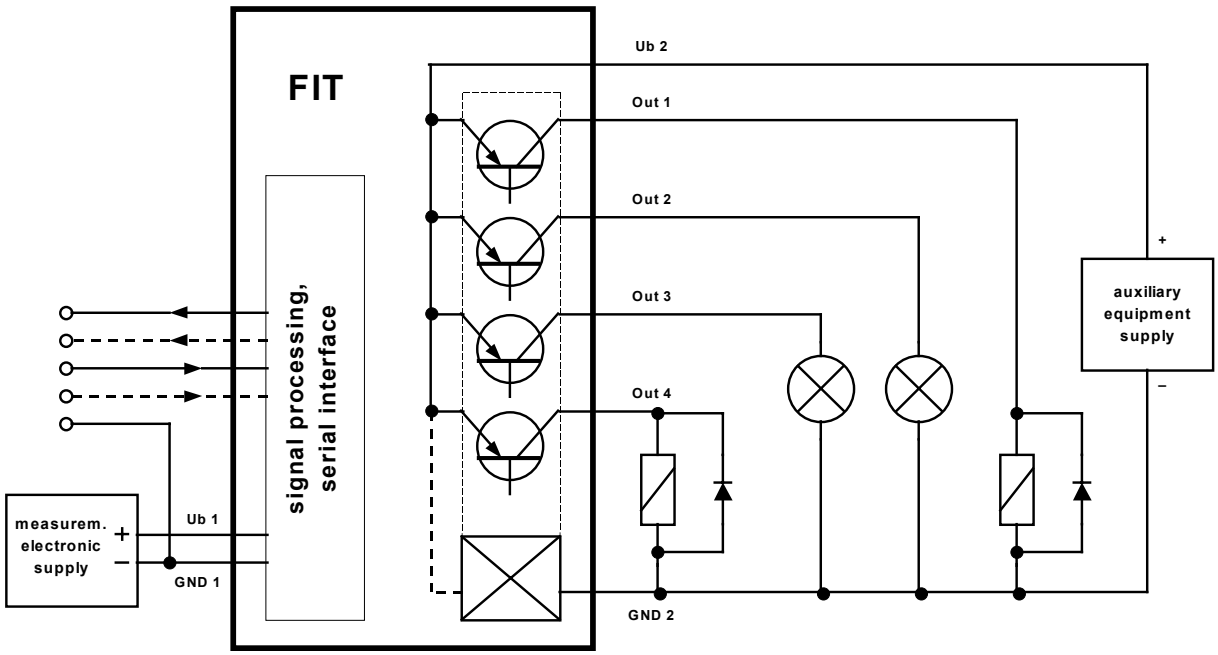
Debounce feature depends on selected function (**IMD** command) but not the used input (cable 1 / cable 2).

**Observe the different electrical data for cable 1 and cable 2 inputs:**

| | **„trigger"- input (cable 1)** | **Input IN1, IN2** |
|---|---|---|
| **Reference potential** | GND 1 | GND 2 |
| **Low-level** | 0...1 V | 0...6 V |
| **High-level** | 3...12 V | 10...30 V |
| **Input impedance** | 10kΩ | > 3 kΩ |

## 6.4.2 Output properties and application

The output stage of all FIT-outputs is a semiconductor high-side-switch (PLC-compatible). This circuit is galvanically isolated against the signal processing electronic, it requires an external supply by means of Ub2 line. An active output provides a high level on the respective output line. Its absolute value depends on supply voltage Ub2. Connect the load to output line and GND2 ( = ground of auxiliary equipment supply).




The outputs are not restricted to a special kind of load (lights, relais).

**Fig. 6.5.1 Application example for output lines**

**Remarks:**

- The connection to GND 2 is always required when using any output.
- The supply voltage (Ub2, GND2) is galvanically isolated to the signal processing supply GND1. It is not required to connect GND1 and GND2, but the potential difference must not exceed 30 V.
- All outputs have the same properties and can drive ohmic or inductive loads (relais, valves) up to the rated driver current. Loads in Fig. 6.5.1 are drawn exemplaryly.
- With inductive loads, it is necessary to connect a freewheeling diode in parallel.

| | **Output line Out1, Out2, (Out3, Out4)** | **Logic state** |
|---|---|---|
| **Reference potential** | GND 2 | |
| **Low-level** | 0V or determined by application<br>(as output is in high impedance state) | inactive * |
| **High-level** | ca. Ub2 – 1V | active * |
| **Current** | max. 500 mA per output, 1A total | |

* When used as a limit switch, an active level can be assigned to measured values above or below the limit value. See LIV command description, manual part 2.

# 7 Technical data

| **FIT Load Cell Standard version** - with RS 485- 4-wire **FIT/H1SR5** - with RS 232 **FIT/H1SR2**<br>**FIT Load Cell with limit switches** - with RS 485- 4-wire **FIT/H1LR5** - with RS 232 **FIT/H1LR2**<br>**FIT Load Cell with dosing function** - with RS 485- 4-wire **FIT/H1DR5** - with RS 232 **FIT/H1DR2** | | | | | | |
|---|---|---|---|---|---|---|
| Accuracy class according to OIML R60 | | **C3** | | | | |
| Max. capacity ($E_{max}$) | kg | 5 | 10 | 20 | 50 | 75 |
| Min. load cell verification interval ($v_{min}$) | g | 0.5 | 1 | 2 | 5 | 7.5 |
| Min. application range (3000d) | kg | 1.5 | 3 | 6 | 15 | 22.5 |
| Max. platform size (Length x Width) | mm | 400 x 400 | | | 600 x 500 | |
| Max. number of load cell verification intervals ($n_{LC}$) | | 3000 | | | | |
| Apportionment factor ($p_{LC}$) | | 1 | | | | |
| Temperature effect on sensitivity(0°C...+40°C)[1)2)] | %/10K | ±0.0250 | | | | |
| Temperature effect on zero signal[2)] | %/10K | ±0.0200 | | | | |
| Hysteresis error [1)2)] | % | ±0.0166 | | | | |
| Nonlinearity[1)2)] | % | ±0.0166 | | | | |
| Creep (30 min.) | % | ±0.0166 | | | | |
| Eccentric loading error acc. to OIML R76 | % | ±0.0233 | | | | |
| Service load (max. 120 mm eccentricity) | % of $E_{max}$ | 150 | | | | |
| Safe load limit (max. 20 mm eccentricity) | % of $E_{max}$ | 1000 | | | | |
| Permiss. dynamic load (max. 50 mm eccentricity) | % of $E_{max}$ | 70 | | | | |
| Deflection at max. capacity | mm | < 0.15 | | | | |
| Power supply: | | | | | | |
| Supply voltage UB1 (DC) | V | + 6 ... +30 | | | | |
| Power consumption | W | ≤ 2 | | | | |
| Switch-on current | A | 0.3 | | | | |
| Resolution of meas. signal (1Hz Filter) | Bit | 20 | | | | |
| Measuring rate | 1/s | 4 ... 600 | | | | |
| Adjustable cut-off frequency of the digital filters: | | | | | | |
| Filtermode 0 | Hz | 40 ... 0.25 | | | | |
| Filterm. 1 (response time 62 ... 365 ms) | Hz | 18 ... 2.5 | | | | |
| Baud rate | Baud | 1200; 2400; 4800; 9600; 19200; 38400 | | | | |
| Max. number of bus members | | 90 | | | | |
| Asynchronous serial interface (cable 1) | | | | | | |
| RS-485, 4 wire, max. cable length | m | 500 | | | | |
| RS-232, max. cable length | m | 15 | | | | |
| Trigger input (cable 1) | | | | | | |
| Max. input voltage | V | 0 ... +12 | | | | |
| Low-level | V | 0 ... 1 | | | | |
| High-level | V | 3 ... 12 | | | | |
| Input resistance | kΩ | 10 | | | | |
| Control inputs (optional, cable 2) | | isolated, reference potential GND2 | | | | |
| Max. input voltage | V | 0 ... +30 | | | | |
| Low-level | V | 0 ... 6 | | | | |
| High-level | V | 10 ... 30 | | | | |
| Input resistance | kΩ | > 3 | | | | |
| Control outputs (optional, cable 2) | | isolated, reference potential GND2 | | | | |
| External supply voltage UB2 | V | +11 ... +30 | | | | |
| Max. current of one output | A | < 0.5 | | | | |
| Accumulated current of all outputs | A | < 1.0 | | | | |
| High-level | V | < (UB2 -1V) | | | | |
| Nominal temperature range | °C [°F] | -10 ... +40 [+14...104] | | | | |
| Service temperature range | °C [°F] | -10 ... +50 [+14...122] | | | | |
| Storage temperature range | °C [°F] | -25 ... +75 [-13...167] | | | | |
| EMC - requirements | | EN 45501, OIML R76<br>EN 61326-1/Tab. 4, equipment of class B<br>EN 61326/A1, Tab. A1, equipment in industrial areas | | | | |
| Protection class according to EN 60529 | | IP 66 | | | | |
| Cable length | m | 3 | | | | |
| Connector | | Pancon, 8 pin, female | | | | |
| Material: Housing | | Stainless steel | | | | |
| Diaphragm | | Silicone R830 | | | | |
| Weight, approx. | kg | 3 | | | | |

1) The values can be exceeded in individual cases. The resulting errors of $TK_C$, nonlinearity and hysteresis don't exceed the maximum permissible errors of OIML R 60 with $p_{LC} = 1$.

2) All relative errors are related to the output signal at max. capacity.

D.FIT/S/L/D.0e - 304.00-1014.4 - Version a - 21.02.02

| **PW18i Load Cell Standard version** | **- with RS 485- 4-wire** | **PW18iSR5** | | **- with RS 232** | | **PW18iSR2** |
|---|---|---|---|---|---|---|
| **PW18i Load Cell with limit switches** | **- with RS 485- 4-wire** | **PW18iLR5** | | **- with RS 232** | | **PW18iLR2** |
| **PW18i Load Cell with dosing function** | **- with RS 485- 4-wire** | **PW18iDR5** | | **- with RS 232** | | **PW18iDR2** |
| Accuracy class according to OIML R60 | | **C3** | | | | |
| Max. capacity ($E_{max}$) | kg | 5 | 10 | 20 | 50 | 75 |
| Min. load cell verification interval ($v_{min}$) | g | 0.5 | 1 | 2 | 5 | 7.5 |
| Min. application range (3000d) | kg | 1.5 | 3 | 6 | 15 | 22.5 |
| Max. platform size (Length x Width) | mm | 400 x 400 | | | 600 x 500 | |
| Max. number of load cell verification intervals ($n_{LC}$) | | 3000 | | | | |
| Apportionment factor ($p_{LC}$) | | 1 | | | | |
| Temperature effect on sensitivity [1) 2)] (0°C...+40°C) | %/10K | ±0.0250 | | | | |
| Temperature effect on zero signal [2)] | %/10K | ±0.0200 | | | | |
| Hysteresis error [1) 2)] | % | ±0.0166 | | | | |
| Nonlinearity [1) 2)] | % | ±0.0166 | | | | |
| Creep (30 min.) | % | ±0.0166 | | | | |
| Eccentric loading error acc. to OIML R76 | % | ±0.0233 | | | | |
| Safe load limit (max. 20 mm eccentricity) | % of $E_{max}$ | 300 | | | | |
| Permiss. dynamic load (max. 50 mm eccentricity) | % of $E_{max}$ | 70 | | | | |
| Deflection at max. capacity | mm | < 0.15 | | | | |
| Power supply: | | | | | | |
| Supply voltage UB1 (DC) | V | + 6 ... +30 | | | | |
| Power consumption | W | ≤ 2 | | | | |
| Switch-on current | A | 0.3 | | | | |
| Resolution of meas. signal (1Hz Filter) | Bit | 20 | | | | |
| Measuring rate | 1/s | 4 ... 600 | | | | |
| Adjustable cut-off frequency of the digital filters: | | | | | | |
| Filtermode 0 | Hz | 40 ... 0.25 | | | | |
| Filterm. 1 (response time 62 ... 365 ms) | Hz | 18 ... 2.5 | | | | |
| Baud rate | Baud | 1200; 2400; 4800; 9600; 19200; 38400 | | | | |
| Max. number of bus members | | 90 | | | | |
| Asynchronous serial interface (plug 1) | | | | | | |
| RS-485, 4 wire, max. cable length | m | 500 | | | | |
| RS-232, max. cable length | m | 15 | | | | |
| Trigger input (plug 1) | | | | | | |
| Max. input voltage | V | 0 ... +12 | | | | |
| Low-level | V | 0 ... 1 | | | | |
| High-level | V | 3 ... 12 | | | | |
| Input resistance | kΩ | 10 | | | | |
| Control inputs (optional, plug 2) | | isolated, reference potential GND2 | | | | |
| Max. input voltage | V | 0 ... +30 | | | | |
| Low-level | V | 0 ... 6 | | | | |
| High-level | V | 10 ... 30 | | | | |
| Input resistance | kΩ | > 3 | | | | |
| Control outputs (optional, plug 2) | | isolated, reference potential GND2 | | | | |
| External supply voltage UB2 | V | +11 ... +30 | | | | |
| Max. current of one output | A | < 0.5 | | | | |
| Accumulated current of all outputs | A | < 1.0 | | | | |
| High-level | V | > (UB2-1V) | | | | |
| Nominal temperature range | °C [°F] | -10 ... +40 [+14...104] | | | | |
| Service temperature range | °C [°F] | -10 ... +50 [+14...122] | | | | |
| Storage temperature range | °C [°F] | -25 ... +75 [-13...167] | | | | |
| EMC - requirements | | EN 45501, OIML R76<br>EN 61326-1/Tab. 4, equipment of class B<br>EN 61326/A1, Tab. A1, equipment in industrial areas | | | | |
| Protection class according to EN 60529 | | IP 67 | | | | |
| Connectors | | BINDER circular connectors series 423<br>7 pins 09-0127-90-07<br>8 pins 09-0173-90-08 | | | | |
| Material | | Aluminum | | | | |
| Weight, approx.. | kg | 0.8 | | | | |

1) The values can be exceeded in individual cases. The resulting errors of $TK_C$, nonlinearity and hysteresis don't exceed the maximum permissible errors of OIML R 60 with $p_{LC} = 1$.

2) All relative errors are related to the output signal at max. capacity.

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