DL16 V3.0, DL16CAN V3.0

General

The data loggers *DL16* (Version 3.0) and *DL16CAN* (Version 3.0) have the ability to acquire signals from their voltage inputs, digital inputs (i.e. frequency signals), serial input (i.e. GPS-receiver) and logical signal input, and to save these signals onto an integrated 8-MB-SRAM-card with a sample frequency of up to 4 kHz (with limited capabilities up to 10 kHz). Additionally the *DL16CAN* can also acquire signals from a *CAN* (Controller Area Network).
Before using the data logger, it must first be set up. This is done by defining a parameter set with the PC program *TEMES* (Windows 95/NT4 or better), and then by transferring this parameter set either via a serial connection (COM1) or via a parallel port (LPT1) over an optionally available parallel adapter. *TEMES* also provides means to calibrate a voltage signal either at one known point (offset adjustment) or at two known points (two-point calibration). After everything is set up, the data logger can do its job without necessarily being connected to the PC. After the measurement, the data logger can again be connected to the PC, and the stored data can be written to a PC file for further processing.
Beneath its recording task the data logger can also be used as online signal source for *TEMES*. Furthermore, it can display up to eight signals on its display, transmit signals over the *CAN* (requires DL16CAN), put out logical signals and put out up to two voltage signals.

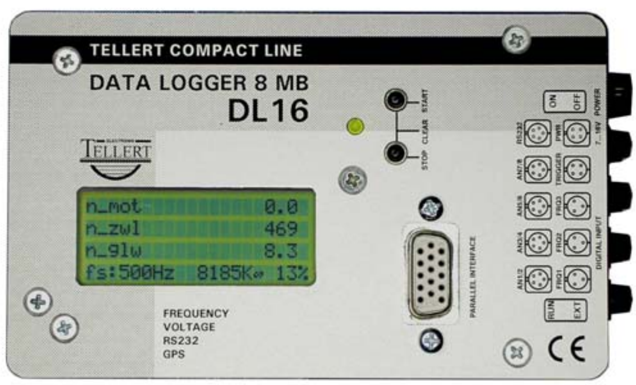

Figure 1: Data Logger DL16.

Sample Rate

The input signals can be recorded at two different sample rates. The first sample rate is the basic sample rate and the second sample rate is an integer multiple of the basic sample rate. The basic sample rate is either 100 µs (limited to three voltage input signals) or lies within the range of 250 µs to 15 s (in steps of 250 µs). The slower second sample rate is 1 to 256 times larger and may also not be larger than 15 s (to prevent an overflow of the internal average value registers). Note, that the recording speed should not be faster than 100 KB/s. Hence, up to 12 signals can be recorded with the fastest non-limited sample rate of 250 µs.
The data logger has a further cycle which runs at a default rate of 10 ms. This cycle is used for *CAN* signals, *LIN* signals, calculated signals and voltage output. If the operations are not too complex, the cycle rate can be reduced down to 2 ms (CPU load should not exceed 80 %).
Finally there is a cycle with lowest priority which runs at a fixed rate of 10 ms. This cycle is used for logical input and output signals, display refresh and real time clock refresh.

Recording Memory

As soon as the recording has been started, the data logger copies the acquired input signals to its 8-MB-SRAM-card. This is done as long as the measurement has not been forced to stop, and as long there is available space on the SRAM-card. Alternatively, the memory card can be used as ring memory, which causes the data logger to overwrite the oldest measurement values with the most recent ones.
The SRAM-card holds more than only the measurement data. It also keeps the entire content of the *TEMES* parameter file including its name and a time stamp (date and time) from when the data logger has been set up.
The transfer speed to save measurement data to a PC file depends on the transfer method and can be looked up from the following table (using a standard 200 MHz-PC with Windows 95):

Transfer method	Transfer speed
Serial (57.600 bps)	5 KB/s (27 min 18 s for 8 MB)
Serial (115.200 bps)	10 KB/s (13 min 39 s for 8 MB)
Parallel (requires parallel adapter *PAD*)	42 KB/s (3 min 15 s for 8 MB)

If the desired size of the recording memory is set to a fraction of the SRAM-card size, the SRAM-card is divided into segments of the desired size. Each segment can hold a single measurement. After an occurring stop event, the measurement of the current segment is terminated and the next available segment is selected. Before saving the measurements to a PC file, the user can decide whether to save all segments into one PC file (inclusive an additional signal which indicates the segment number), or to save each segment to a separate file.

Voltage Signal Input

The data logger can acquire up to eight voltage signals with a resolution of 10 bits. These signals must lie within the voltage range from 0 V to 5.12 V where 0 V correspond to bit value 0, and where 5.12 V correspond to bit value 1023. These raw signal values are always acquired with a sample rate of 250 µs (or 100 µs if the basic sample rate is less than 250 µs), and an average value over a period of the recording sample rate with a resolution of 16 bits is used to represent the value of the voltage signal (5.12 V correspond to bit value 65472). The internal impedance of each voltage input is greater than 10 MΩ.
Voltage input signals can optionally be linearized via a table look-up during the calculation cycle. For this purpose user defined characteristic curves with up to 33 sampling points are used. Look-up values for input values, which lie between two sampling points, are obtained by linear interpolation.

Digital Signal Input

The data logger has three inputs for digital signals, which may be of following type:
Frequency Signal: The input voltage level (TTL, CMOS) may lie within the range from 0 V to 20 V. The resolution of each single measurement period is 108 ns. The frequencies to be measured may lie in the range from 0.1 Hz to 30 kHz. Note that the sum over all three input frequencies must not be greater than 30 kHz.
The digital signal can be triggered either with the raising or with the falling edge of the input signal, and is represented by the average value over a period of the sample rate.
Each digital input connector has a pin to supply a preamplifier (over a 200 Ω protective resistor) with the operating voltage of the data logger.
Switch State: Depending on the voltage level of the digital input, the digital signal is taken either as bit value 0 or as bit value 1. This signal type can be used for markers or to reset counter readings (see *calculated signals*).

Serial Ports

The data logger has two serial ports. The first serial port is used for the communication between data logger and host PC. The second serial port is used for one of the following signal sources (or sinks):
NMEA-protocol: If the baud rate is set to either 4800 baud or 38400 baud, the data logger expects *NMEA* sentences from a GPS-receiver, and extracts 5 input signals (*speed*, *longitude*, *latitude*, *height* and *time)* from the sentences *GGA*, *RMC*, and *VTG*.
F6-protocol: If the baud rate is set to 9600 baud or higher (except 38400 baud), the data logger polls up to five 16-bit-signals from a device which supports the F6-protocol (i.e. *SICO1*, *SICO2*, *DL16*, *DL16CAN*, *FU16uP*).
LIN-subbus: The data logger receives/transmits up to 8 messages from/to a LIN-subbus (see below).

Logical Signal Input

The data logger has three 16-bit input signals, which can be (in groups of 8 bits) fed into the logger over an I²C-bus during the calculation cycle. For each of the three 16-bit signals a bus address for the lower significant byte, and a bus address for the higher significant byte can be specified. External devices (which are connected to the logger) have bus addresses from 1 to 7.
To get further information about the current state of the data logger the following bus addresses can be used:

Bus Address 256 (Internal State):

bit 0	Start button pressed (= 1)
bit 1	Stop button pressed (= 1)
bit 2	External start (Logic level 0 = 1)
bit 3	External stop (Logic level 0 = 1)
bit 4	Peak, if start button is pressed
bit 5	Peak, if stop button is pressed
bit 6	Peak, if *external start* changes to logic level 0
bit 7	Peak, if *external stop* changes to logic level 0

Bus Address 257 (Status Flags):

bit 0	Multiple segment mode (= 1)
bit 1	Recording mode active (= 1)
bit 2	Write access permitted (= 1). This bit is reset to zero as soon the memory is completely filled with measurement data (in non-ring memory mode).
bit 3	Ring memory mode (= 1)
bit 4	Clear buttons disabled (= 1)
bit 5	Buttons disabled (= 1)
bit 6	External start/stop events disabled (= 1)
bit 7	External record control signal disabled (= 1)

Bus Address 258 (Segment Number): Current segment number normalized to 255 for the last segment.

Bus Address 259 (Memory Usage): Amount of used memory normalized to 255 for max. available memory.

Logical Signal Output

The data logger cannot only acquire signals via the I²C-bus, it can also put out up to three 16-bit signals (in groups of 8 bits). For each of the 16-bit signals a bus address for the lower significant byte, and a bus address for the higher significant byte can be specified. Bus addresses of external devices lie within the range from 1 to 7.

Voltage Signal Output

The data logger has two 8-bit-D/A-converters. They are used to put out two voltage signals during the calculation cycle. The output voltage lies within the range from 0 V to 5.12 V. Each output has an internal impedance of 10 kΩ.

Multiple Purpose Channels

Standard Multiple Purpose Channels: Beneath the hardware signal sources like voltage input, digital input and serial input, the data logger has 52 *standard multiple purpose channels*. Each of these channels is used to represent the value of either a CAN-signal or the result of a calculation.
Virtual Multiple Purpose Channels: Beneath the standard multiple purpose channels, the data logger has further 44 *virtual multiple purpose channels*. These channels can be used like the standard ones with the restriction that there is only limited support to transfer their values online to the PC.
The assignment of multiple purpose channels is done automatically by *TEMES*.

CAN

The data logger *DL16CAN* can be connected to a *CAN* (Controller Area Network). It has the ability to receive or transmit up to 14 *CAN messages* (with either 11-bit or 29-bit message identifiers). The messages (to be received or to be transmitted) are refreshed during the calculation cycle.
Input signals are embedded within a received message. To extract them, following properties are supported: *start bit* within a message, *bit length* (max. 16 bits), *data type* (*unsigned* or *signed*) and *byte order* (*Intel* or *Motorola*).
Multiplex signals are only supported for message reception (and not for transmission).
The data logger hardware (physical layer) is compatible to a *high speed CAN* (usually run at 125 kBit/s, 500 kBit/s or 1 MBit/s). An optional adapter is required to integrate the data logger in a *low speed CAN* (usually run at 83.3 kBit/s, 100 kBit/s or 125 kBit/s).
Note, that each of the two ends of a *high speed CAN* must be terminated (typically with a 120 Ω resistor between *CAN_H*-wire and *CAN_L*-wire).

LIN

The data logger *DL16CAN* can be connected over an optional available adapter to a *LIN-subbus* (*Local Interconnect Network*). It can be configured to work either as a *master control unit* or as a *slave control unit*. The data logger has the ability to receive or to transmit up to 8 *LIN messages*. The messages (to be received or to be transmitted) are refreshed during the calculation cycle.
Input signals are embedded within a received message. To extract them, following properties are supported: *start bit* within a message, *bit length* (max. 16 bits), *data type* (*unsigned* or *signed*) and *byte order* (*Intel* or *Motorola*).
Multiplex signals are only supported for message reception (and not for transmission).
However, the DL16CAN ignores bus-sleep-requests and wake-up-signals.
As master control unit, the data logger supports one schedule table with up to 16 *identifier-frame_time*-entries (where *frame_time* must be an integer multiple of the calculation cycle time).
The LIN baud rate must lie within the range from 2.4 to 20 Kbaud. If the DL16CAN is used as a master control unit, the baud rate should be 576000/*i* baud with integer *i* from 29 to 240 (to comply with the smaller baud rate deviation allowed for master control units). Hence, the recommended baud rates 2400, 9600 and 19200 baud are supported even if the data logger is used as master control unit.

Calculated Signals

The data logger supports operations with signal values. For this purpose the signal values are treated as unsigned 16-bit integer values with little-endian (= Intel) byte order. Following operations are already built in the firmware: definition of constants; basic arithmetic (sum, difference, product, ratio); bit manipulations (AND, OR, XOR, mirror bits, byte order change from Intel to Motorola and vice versa); comparisons (=, <, ≤); condition (use signal s_1 if condition is true, otherwise use signal s_2); delay (e.g. for derivation or signal filtering); counter operations (e.g. for 32-bit-counters or for integration).
More complex operations can be obtained by using the result of a single operation as an operand for following operations.

Recording Control

Basically there are three different types to control the recording. All of them have in common that the data logger may only be turned off if it is not currently recording data (indicated by a red LED).
Dynamically via start/stop events: The recording is only controlled by the buttons, by external trigger events (alternating edges) and by internal trigger

events. The stop of the recording, which is caused by a stop event, can be delayed by a user-defined period (max. 655 seconds). Pressing the stop button always stops the current measurement instantly.
External recording control: The external control signal defines with its voltage level whether to record (low level) or to pause (high level). No trigger events or buttons are taken into account. Only if the memory is divided into several segments (see DL16 V2.6), a single measurement can be stopped by stop events (requires DL16 V2.7). These stop events (inclusive those caused by the stop button) can be delayed by a user defined period (max. 655 seconds).
External recording with inverted logic (DL16 V2.7): Almost the same as the *external recording control*, but using high level to record and low level to pause.

Trigger Conditions

The data logger supports up to four trigger conditions. If one condition is fulfilled, it generates either a start or a stop event. The condition is always a comparison of an input signal with a constant threshold value.

Start/Stop Button

The start button can be used to start the recording, and the stop button can be used to stop a recording. If start and stop button are pressed together for at least two seconds, the entire measurement is discarded.
To prevent an accidentally stop or erasure of the measurement, the buttons can be disabled via the parameter set.

RUN/EXT-Slider

If the *RUN/EXT-slider* is in position *RUN*, the external start trigger is connected over a 1 kΩ resistor to ground, therefore an external positive signal (with low impedance) has always a higher priority than the slider position. If the *RUN/EXT-slider* is in position *EXT*, the external start trigger signal is not connected to ground.
If no external start trigger signal is connected to the data logger, the slider position *EXT* has the same effect as a high level at the external start trigger input (connected over a 100 kΩ pull-up resistor to +5V), and the slider position *RUN* has the same effect as a low level at the start trigger input.

LED

The LED (light-emitting diode) indicates the current status of the data logger. The following states are distinguished:
LED is off: The data logger has no supply voltage. Therefore, the data logger is not working, but the data on the SRAM-card is kept (powered by an integrated lithium battery).
Permanent green light: The data logger is working but no data is currently recorded. Furthermore, there is still recording memory available.
Permanent red light: The data logger is working and is currently recording data. There is still unused memory available.
Flashing green light: The data logger is working but no data is currently recorded. However, even the memory is completely filled with measurement data, the logger is still able to record further data, since the memory is run in ring memory mode.
Flashing red light: The data logger is working and currently recording data; even the memory is complete full with measurement data (ring memory mode).
Flashing red/green light: The data logger stopped the recording because the recording memory is full and the memory is not run in ring memory mode.
Fast flashing red/green light: The recording memory has been erased by pressing the start and stop button for two seconds.

Display

The LCD (liquid-crystal display) has four lines with 20 alphanumeric characters per line. The LCD is considered as a 4×2 matrix with 8 cells and 10 characters per cell. Each cell shows one of the following display items: static text; signal value (either as fixed point value, hexadecimal value or binary value), status information (like CPU load or sample rate), or date and time.
A user-defined text can be displayed during the start-up of the data logger (two lines). This can be used to display the name of the parameter set or the device number.

Real Time Clock

The data logger has a built-in real time clock which is synchronized with the host PC during the logger setup procedure. A 32-bit time stamp is derived from current date and time with a resolution of 1 s. This time stamp is monotonically increasing from year 2000 until the end of year 2063. It has the following bit layout:

Bit Range	Value
31…26	(Year − 2000) modulo 64
25…22	Month (1…12)
21…17	Day (1…31)
16…12	Hours (0…23)
11…6	Minutes (0…59)
5…0	Seconds (0…59)

If, however, the real time clock is not available, the time stamp is set to zero. Internally, the real time clock represents the year with a 2-bit-value. This implies that the year value is only valid for the next three years after clock synchronization with the PC. Note, that the real time clock is not automatically adjusted for daylight saving changes.

The data logger maintains a list of time stamps for start and stop events. This list has a predefined size and supports 1000 events by default.

Multiplexer Support

In order to control multiplexed input signal sources, the data logger can broadcast the next control byte to connected multiplexers over its logic I/O port just after storing its signal values during the fast or slow recording cycle. This synchronization minimizes signal crosstalk between two neighboring channel time slices since the command to switch to the next channel is sent as soon as possible. The list of control bytes contains 16 items, where the 4 least significant bits of a control byte represent the channel number, and where the 4 most significant bits of a control byte can be used for the corresponding operation range.
Signal crosstalk can be further reduced or even entirely avoided by defining a duration during which the data logger ignores the voltage input signal while the multiplexer shifts to the next channel. This duration should include the max. duration for broadcasting the control byte (2.5 ms), possible switch times (e.g. 3.5 ms for thermocouple amplifier *TH16MI*) and transient times for the multiplexer. This yields a recommended suppression duration of 20 ms for thermocouple amplifier *TH16MI.*
Optionally, the channel number (0...15) can be copied to the four least significant bits of the input signal. This allows to record only the multiplexed signal and to assign its signal values to the corresponding channels afterwards.

Sample Buffer

There are two supported ways to obtain the current signal values with a PC. The first method is asking for the current value of each signal by polling. The second (more sophistic) method is to define the signals of interest in advance. These signals are then permanently sampled by the data logger with the user defined basic sample rate and buffered in a 1500-bytes queue (= sample buffer). The PC can then read from this queue to obtain not only the signal values but also a precise time stamp for each signal value.

Technical Data

Power supply:	6.5 V to 18 V DC
Current consumption:	*DL16*: about 50 mA *DL16CAN*: about 80 mA
Sample rate:	100 µs or from 250 µs to 15 s in steps of 250 µs
Memory size:	8 MB
Recording speed:	max. 100 KBytes/s
Number of recordable signals	max. 66
RS232-port:	4800 bps to 115.200 bps
CAN-Bit rate:	Up to 1 MBit/s; (1 MBit/s) / *k*, where *k* is an integer from 1 to 64
Box size without plugs, sockets, buttons and sliders:	115 × 70 × 24 mm

PC Software

The data logger can be set up with the PC software TEMES. TEMES requires a PC with Windows 95/98/ME/NT4.0/2000/XP. The current version can be downloaded from the internet (http://www.tellert.de).

Further functions of TEMES are:

- **Online-Calibration:** The voltage input signals can be calibrated either at one known point (offset adjustment) or at two known points (two-point calibration).
- **Online-View:** The online-view displays a curve chart of the current signal values in the upper part of its window. The lower part of the window is used to display these values as numbers in physical units. However, TEMES cannot be used to monitor signals during a running measurement, since the creation of the online-chart window initializes the data logger with the currently active parameter set.
- **Saving Measurements:** The measurements, which are captured by the logger, can be stored to a PC file. After storing the data, the measurement can directly be displayed in a curve chart.
- **Exporting Measurements:** A measurement (or each of its sample blocks) can be exported to *ASCII*, *DIADEM*, *TurboLab* or *x-y Recorder* format. TEMES provides a documented DLL interface for accessing TEMES measurement files. This allows programmers to read TEMES measurement files without knowing the internal file structure.

Following TEMES functions require an optional available single-PC license:

- **Online-Recording:** The current signal values which are displayed in the online-view can be saved to a PC file (data acquisition without the internal SRAM-card)
- **Import of ASCII files:** Measurements can be imported from ASCII files.

Additional Properties

The data logger has further properties, which are not already supported by the recent program version of TEMES.
User defined functions: It is possible to integrate self-written assembler routines within the sample-rate-loop or the calculation cycle of the data logger. User defined functions can be provisionally implemented with TEMES V1.0 by embedding the hex dump of the corresponding binary file within the device comment of a TEMES parameter set.
Assignment of regions: The DL16 has an operation, which divides the 16-bit-number-space into ranges. The result of this operation is the range number, which belongs to the input signal.
Variable text output: The DL16 has the ability to select one item of a string list (by using the signal value as list index) and to display that string.

Scope of supply

The delivery of a data logger DL16 includes:
- DL16 box
- 4-pin-cable for power supply (12 V DC) and CAN with open wire ends
- PC-connection cable with 9-pin SUB-D-socket
- PC-software (TEMES)
(requires Windows 95/98/ME/NT4.0/2000/XP)

Optional Accessories

General accessories:
- Power transformer (Euro plug; 100-230 V AC; 50-60 Hz)
- Parallel adapter *PAD* for fast data transfer via PC's parallel port
- Accu-pack (with rechargeable Ni-MH battery cells) *AC230*, *AC230/12* and *AC230/24*
- Low speed CAN adapter *LCC719* (to connect the DL16CAN to a low speed CAN)
- LIN-subbus adapter *LIN719*

Accessories for digital input:
- Hall effect sensor *HS-M10X1* (to detect passing magnets)
- Hall effect sensor *FPS* (to measure the frequency of steal teeth wheels, even at lowest frequencies; requires preamplifier *FP1*)
- Preamplifier *FP1* for hall effect sensor *FPS*
- Preamplifier *PP3* for AC-coupled signals (for magnetic sensors)

Accessories for voltage input:
- Passive voltage transformer *BNC-PI2* or *RVT2*
- Galvanically isolated preamplifier *INA1*
- Acceleration sensor *DAC50*
- NTC temperature sensor *NTC10K* (operating point 25 °C) and *NTC2K* (operating point 66 °C) for temperatures from −40 °C to 150 °C
- Thermal sensor amplifier *TH2*
- DC-bridge amplifier *DCBA2*/*DCBA8*
- Barometric height meter *HM2*
- Signal multiplexer *MPX16* (e.g. for NTC-temperature sensors or humidity sensors)
- Galvanically isolated thermal sensor amplifier *TH16MI* (16 channels, multiplexed)
- Thermal sensor amplifier *TH16M* (16 channels, multiplexed)

Accessories for logical signals:
- Switch/button *SW1* for DL16 trigger input
- Input for eight logical signals *LI8*
- Output for eight logical signals *LO8*

Version History

Data Logger *DL16 V2.2*: First release of the *data logger DL16 Version 2* series.

Data Logger *DL16 V2.5*: Support for 10 kHz sample frequency.

Data Logger *DL16 V2.6*: Expanded with two voltage outputs and support for multiple recording segments.

Data Logger *DL16 V2.7*: Expanded with an I²C-bus connector for logical signals (input/output). Stop events can now be delayed by a user-defined period.

Data Logger *DL16 V2.8*: Expanded with LIN-subbus-support and user definable calculation cycle time.

Data Logger *DL16 V2.9*: Expanded with a real time clock. Support for NMEA sentence *VTG*. Fields of NMEA sentences may now contain an arbitrary number of digits. Support for high-speed NMEA baud rate (38400 baud). Better synchronization of multiplexed input signals. Reduced number of standard multiple purpose channels from 56 to 52 (due to real time clock)

Data Logger *DL16 V3.0*: Better crosstalk suppression for multiplexed voltage input signals by suspending the input signal sampling during channel shifting for a user-defined duration. Multiplexed signals can now optionally be overlaid with the corresponding channel number. Reduced number of supported voltage input signals at a sampling rate of 100 µs from four to three.

Pin Assignment

The sockets and plugs of the DL16 are manufactured by *Binder* and parts of *Binder Series 719*. The socket pins (in front view) are numbered clockwise starting with the first pin after 12 o'clock position.

The plug pins are numbered correspondingly anti-clockwise. The first pin is respectively labeled at the solder side (back view).

POWER/CAN: This plug supplies the data logger with voltage and connects the logger to a CAN.

Pin	Assignment [Cable Color]
1	Supplying voltage (7 V to 20 V DC inverse-polarity protected) [red]
2	Ground [brown]
3	CAN_L [black] (*DL16CAN* only)
4	CAN_H [orange] (*DL16CAN* only)

RS1/2: This plug provides two serial ports. Note, that the data logger is either shipped with option *GPS* (standard) or option *RS232* (on request).

Pin	Assign-ment	SUB-D-Plug of host PCs [Comment]
1	TX1	Pin 2
2	Ground	Pin 5
3	RX1	Pin 3
4	U_B – 1 V	Option *GPS*
	TX2	Option *RS232* [Serial data output]
5	RX2	[Serial data input, i.e. GPS]
		Pins 7 and 8 are bridged
		Pins 1, 4, 6 and 9 are bridged

TRIGGER: This socket provides inputs to create start and stop events (recording control).

Pin	Assignment
1	Supplying voltage – 1 V
2	Ground
3	*External recording control* or *start trigger* (connected over a 100 kΩ resistor to 5 V); Start event at low level (< 2 V);
4	*Stop trigger* (connected over a 100 kΩ resistor to 5 V); Stop event at low level (< 2 V);

AN1/2: This socket provides inputs for the *voltage input signals* 1 and 2.

Pin	Assignment
1	Supplying voltage – 1 V
2	Ground
3	Analog input 1
4	Analog input 2
5	5.12 V Reference voltage (max. 20 mA for AN1-AN8)

AN3/4: This socket provides inputs for the *voltage input signals* 3 and 4.

Pin	Assignment
1	Supplying voltage – 1 V
2	Ground
3	Analog input 3
4	Analog input 4
5	5.12 V Reference voltage (max. 20 mA for AN1-AN8)

AN5/6: This socket provides inputs for the *voltage input signals* 5 and 6.

Pin	Assignment
1	Supplying voltage – 1 V
2	Ground
3	Analog input 5
4	Analog input 6
5	5.12 V Reference voltage (max. 20 mA for AN1-AN8)

AN7/8: This socket provides inputs for the *voltage input signals* 7 and 9.

Pin	Assignment
1	Supplying voltage – 1 V
2	Ground
3	Analog input 7
4	Analog input 8
5	5.12 V Reference voltage (max. 20 mA for AN1-AN8)

FRQ1: This socket provides an input for the first digital (frequency) signal.

Pin	Assignment
1	Supplying Voltage – 1 V (R_i = 220 Ω)
2	Ground
3	Digital input 1 (connected over 100 kΩ to 5 V)
4	

FRQ2: This socket provides an input for the second digital (frequency) signal.

Pin	Assignment
1	Supplying Voltage – 1 V (R_i = 220 Ω)
2	Ground
3	Digital input 2 (connected over 100 kΩ to 5 V)
4	

FRQ3: This socket provides an input for the third digital (frequency) signal.

Pin	Assignment
1	Supplying Voltage – 1 V (R_i = 220 Ω)
2	Ground
3	Digital input 3 (connected over 100 kΩ to 5 V)
4	

AOUT: This socket provides outputs for two voltage signals.

Pin	Assignment
1	Analog output 1 (0 V to 5.12 V; R_i = 10 kΩ)
2	Analog output 2 (0 V to 5.12 V; R_i = 10 kΩ)
3	TX2
4	Supplying voltage – 1 V
5	Ground

LOGIC I/O: This socket provides access to an I²C-bus for logical input and output signals.

Pin	Assignment
1	Supplying voltage – 1 V
2	Ground
3	SDA (serial data line)
4	SCL (serial clock line)