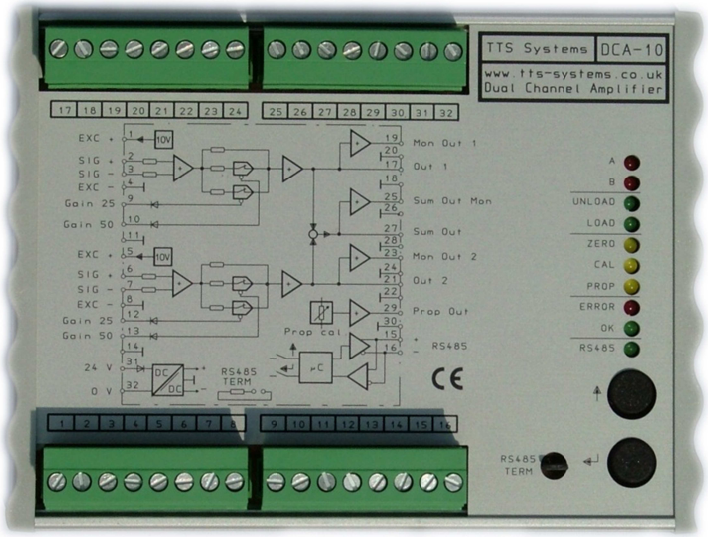
DCA - 10 / DCA - 20

Two Channel Load Cell Amplifier



Reference Manual

TTS Systems

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DCA – 10 / DCA – 20 Amplifier

Table of Contents

IMPORTANT SAFETY INFORMATION

To conform with the Health and Safety at Work Act (1974) this product should be installed, used and maintained by competent persons in accordance with normal safety procedures, the information contained herein and any other relevant norms or standards.

DCA-10 and DCA-20 Two Channel Amplifier for Strain Gauges

The modules DCA-10 and DCA-20 have been developed to allow connection to strain gauges that are configured as a full bridge resistive network. The modules are typically used with load cells / transducers in web tension applications.

Calibration of the tare and span is performed by microprocessors. The unit has several analogue output signals producing 0...10V for both indication and control functions. The excitation voltage for the measuring elements is also provided and is fixed at 10V. The input range per load cell to the amplifier is between 2mV to 25mV.

Two load cells can be connected to each amplifier separately to provide independent individual outputs or when used as a pair they provide an average value. The power supply to the unit is 24V DC.

The amplifiers are modular units and can be mounted onto a DIN rail, type TS35.

Special features:

- Automatic zeroing
- Automatic calibration to rating
- Proportional calibration by applying a fraction of the full scale load
- Three measuring ranges to increase the range of low forces without the need for re-calibration
- Dampened outputs for connection to measuring devices
- Optional operation via keys or RS 485 serial link

The following modes of operation are possible:

- Two load cells on one sensing roll to give a separate signal for channel A and channel B plus the average A+B signal.
- Separate independent load cells on individual rolls to give isolated signals for both channel A and channel B (do not use A+B outputs in this mode)

Mode of Operation

There are two modes for commissioning the module.

- Mode 1 – On board keypad
- Mode 2 – RS 485 via PC [TTS Systems can supply a USB to RS485 converter interface]

By default the module is supplied in keypad mode.

Selection of Modes

The module is supplied in keypad mode as a default. If you wish to use the RS 485 mode the following procedure is required.

- Switch off power to the module
- Pressing the “UP“ and “ENTER“keys simultaneously on power up will place the module in the RS 485 serial link mode.
- The LED RS485 would illuminate to confirm the module is in communication mode.
- The remaining LED’s will display the bus address in binary format.
- The required address can now be selected by using the keypad “UP“ and “ENTER“ keys. The “ENTER“ key has the function as “DOWN“.
- To save the address you have to keep pressed the last used key and at the same time press the second key.

To revert back to keypad mode the bus address 0 has to be entered.

Attention!

If an address other than zero (0) is selected it is not possible to carry out the calibration via the keypad.
The LED OK being permanently lit shows this is in the operational mode.

Calibration of the module using the keypad

Adjustment for zeroing the dead weight and calibration to the required load is carried out by using the two keys located on the front of the housing. The procedure involves selection of the calibration channel(s) then either the zero offset [Zero], calibration [Cal] or proportional calibration [Prop].

Once confirmation of the selected function is made the module will indicate whether to unload or load the sensing roller before carrying out the required function.

Principle of Operation

For correct operation the amplifier output must be zeroed and calibrated to remove the dead weight (zero or tare). During this operation the microprocessor will negate the effects of the deadweight to provide a zero reference value. On completion the amplifier will indicate 0V when no web is present.

The next stage is to place a load onto the sensing roller according to the MAXIMUM tension required.

The amplifier will adjust automatically to give an output voltage on the appropriate channel(s) that will be equal to 10V at full scale. Please note that the sensing roller load must follow the production web path.

If full loading is not possible then the proportional mode must be selected and a reference voltage scaled proportionally to this load is created before calibration can proceed. The appropriate output channel(s) will then assume this voltage whereby the full-scale output will be equal to 10V.

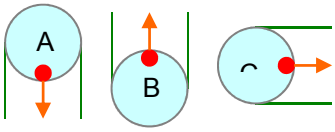
Changing the measuring range without new calibration or load cells

If different materials with different tensions are used the measuring range of the amplifier can be increased without the need to re-calibrate and making use of the same load cell rating. The switching between the ranges is carried out by the active low digital inputs. With this method it is possible to adjust the signal output to provide 0…10V proportional to 25%, 50% or 75% of the actual calibrated load.

Connecting the Transducers

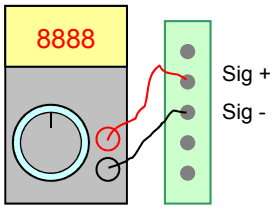
When interfacing the transducers the following points should be taken into account.

- The convention adopted here is that when using with TTS transducers these should be orientated such that the red spot is positioned away from the web angle bisector as shown in the following diagrams.



If the wiring is incorrect the amplifier may fail to calibrate successfully to give the 0…10V output.

It is a straightforward procedure to establish that the amplifier is correctly wired.



1. Connect a meter to load cell signal terminals. Check channels A and B. Meter positive should be on Sig + and meter negative on Sig – of the transducer.
2. Note the no load voltage and observe the polarity.
3. Load the sensing roll and note the output voltage again and observe the polarity.
4. Calculate the difference between the No load and Loaded voltage (in millivolts).
5. If the load cell is correctly wired when increasing the load the resultant signal should be positive going i.e. if the off set voltage is minus 7 millivolts on the no load condition and the resultant voltage with load is minus 3 millivolts this would indicate that the transducer and the wiring are correctly orientated.

Commissioning the DCA-10 and DCA-20

Calibration by keypad

1. Selection of the channel(s) to be calibrated

By repeated usage of the key “UP” the channel to be calibrated is selected

The following channels can be calibrated:

- Standard condition — LED is lit
- Channel A and channel B together — LED A and B are lit
- Channel A — LED A is lit
- Channel B — LED B is lit

After selection of the required channel the “ENTER“ key has to be pressed for confirmation.

2. Selection of the function to perform

By repeatedly pressing the “UP“ key the desired function is selected.

The following functions are possible:

- Zero tare — LED ZERO is lit
- Calibration — LED CAL is lit
- Proportional Calibration — LED CAL and LED PROP are lit
- Return to the selection of the channel (non of the above LED’s are lit)

On arriving at the required function the “ENTER“ key has to be pressed to confirm the selection

3. Calibration

a) Zero adjustment

Following the selection of the channel(s) to be calibrated as described above and by placing the module into zero mode the LED ZERO should be lit. The LED UNLOAD should also be lit and automatic zeroing can then be performed.

- Remove all material on the sensing roll and confirm this by pressing “ENTER“.
- The LED UNLOAD goes off and the automatic zeroing is performed. Do not put any weights on the roll during this process.
- After the process is finished the LED “OK“ should light up for approximately 2 seconds. All other LED’s should be off.
- If the zeroing function was not successful (as range was exceeded), the LED ERROR will light to show this. Correct error and start procedure again.

The device is ready for the next adjustment or for operation

b) Span Adjustment (Calibration)

Following the selection of the channel(s) to be calibrated as described above and by placing the module into calibration mode the LED CAL should be lit. The LED LOAD should also be lit and automatic calibration can then be performed. This point will automatically be selected if you have carried out a zero function.

- Place a load on the sensing roller as described in the load cell manual. Confirm this by pressing “ENTER“.
- The LED LOAD goes off and the automatic calibration process is performed. Do not touch the sensing roll during this process.
- After the process is finished the LED “OK“ should light up for approximately 2 seconds. All other LED’s should be off.
- If the calibration function was not successful (as range was exceeded or there was insufficient load) the LED ERROR will light to show this. Correct error and start procedure again.

The device is ready for the next adjustment or for operation

c) Proportional calibration

If you do not have a full load to apply to the sensing roll then you will need to select proportional calibration mode.

Following the selection of the channel(s) to be calibrated as described above and by placing the module into proportional calibration mode the LED CAL and the LED PROP should be lit.

- THE LED CAL will blink. You can now adjust the required tension for the load as a percentage value given in Volts (in 40mV steps) with the keys “UP” and “ENTER” measured across the PROP OUT terminals. At this point the “ENTER” key will function as “DOWN”.
- Once this is done you can leave the adjustment mode by pressing down the last used key and at the same time the second key.
- Place the proportional load on the sensing roller as described in the load cell manual. Confirm this by pressing, “ENTER”.
- The LED LOAD and LED PROP go off and the automatic calibration process is performed. Do not touch the sensing roll during this process.
- After the process is finished the LED OK should light up for approximately 2 seconds. All other LED’s should be off.
- If the calibration function was not successful (as range was exceeded or there was insufficient load) the LED ERROR will light to show this. Correct error and start procedure again.

The device is ready for the next adjustment or for operation

Example:

If the required TOTAL load is 100kg but the available load is only 25kg then 2.5V has to be created across the PROP CAL output terminals i.e. 25% of 10V is 2.5V 5.0V is equal to 50%, 7.5V is equal to 75% etc.

Formulae is given as $$\frac{\textbf{Proportional Load} \times \textbf{10 in Volts}}{\textbf{Full Sale Load}}$$

Using the Ranging Facility

The digital input (terminals 13,14 or 15, 16 DCA - 20) or (terminals 9,10 or 12,13 DCA - 10) have to be connected to GND.

This can be tested by varying the load on the sensing roll in accordance to the range selected to indicate that the appropriate output terminals still give 0…10V at the new load with 25%, 50% or 75% of the calibrated value.

Calibration via the RS485 serial point

The communication with the amplifier is done via the RS 485 serial link with the following described protocols.

Parameter of the serial link:
9600 Baud, 8 data bits, No Parity, 1 stop bit (9600 8-N-1)

The module DCA - 10 / DCA - 20 is to receive data.

Addressing the module :

Starting sign	Module address	Module address	Number of data bytes	Type of data	Data byte 1	Data byte 2	Data byte n	End of sign	Block Check
STX	ADR	ADR	LEN	TYP	DAT	DAT	DAT	ETX	BCC

- When the module DCA-10 / DCA-20 recognises an incorrect build up of the data frame or an incorrect BCC it will answer with the sign **NAK**.
- If the data frame has been received correctly, the DCA-10 / DCA-20 will show the sign **ACK** and will wait for the sign **ENQ** in order to confirm with the sign **EOT** if the receipt is correct.
- This finishes the communication and the amplifier carries out the required function.

Example of a data frame:

To zero channel A and B at module address 04h:

Starting sign	Module address	Module Address	Number of data bytes	Type of data	Data byte 1	Data byte 2	Data byte 3	End of sign	Block Check
STX (02h)	ADR (04h)	ADR (04h)	LEN (03h)	TYP (00h)	DAT (01h)	DAT (01h)	DAT (01h)	ETX (03h)	BCC (01h)

The sent data bytes will carry out the following functions:

Data byte	Function	Possible selection
Data byte 1	Selects the calibration via RS 485	Always High
Data byte 2	Selects the channel to be calibrated	0 = no selection 1 = channel A and B 2 = only channel A 3 = only channel B
Data byte 3	Selects the range to be calibrated	0 = no selection 1 = zero point (TARE) 2 = amplification 3 = proportional calibration
Data byte 4	Low byte percentage value	00 hex – 99 hex
Data byte 5	High byte percentage value	00 hex – 99 hex

***** The information for the 4th and 5th data byte is only required for the proportional calibration.

Example:

If you want to calibrate 25,00% of the required load the following data has to be sent:

Low byte = 00 High byte = 25

Notes

- The master always sends the module address twice, so that an interruption in the supply will not be responsible for addressing the wrong module.
- The calculation of the BCC- bytes on all the transmitted data except STX and BCC are linked by an EXCLUSIVE OR.
- No more than 10 byte data can be transferred as one block.
- If address 0 is sent then all modules that are connected to the bus are addressed

The module DCA - 10 / DCA - 20 is to return data

Request to the module :

Starting sign	Module address	Module address	Number of data bytes	Type of data	Request to send
STX	ADR	ADR	LEN	TYP	ENQ

Enter 0 in LEN.

Example of a data frame :

To receive a measured value on channel A at address 04h:

Starting sign	Module address	Module address	Number of data bytes	Type of data	Request to send
STX (02h)	ADR (04h)	ADR (04h)	LEN (00h)	TYP (01h)	ENQ (05h)

The module replies with the following data :

Start sign	Module address	Number of data bytes	Type of data	Data byte 1	Data byte 2	Data byte n	End sign	Block Check
STX	ADR	LEN	TYP	DAT	DAT	DAT	ETX	BCC

Note :

- If the receiving device sees the wrong construction of a data frame or a wrong BCC, it will answer with the sign **NAK.** The DCA-10 / DCA-20 is requested to send a new data frame. This has to be repeated 3 times at most.
- If the data frame was received correctly the receiving device will send the message **ACK** and waits for the sign **EOT** from the module DCA-10 or DCA-20.
- The communication is now finished.

The request for sending will enable the following function:

Type Byte	**Function**	**Possible Selection**
Type	Selects the data to be sent	0 = send all analogue values 1 = send value of channel A 2 = send value of channel B 3 = send status report

The status message can have the following meaning:

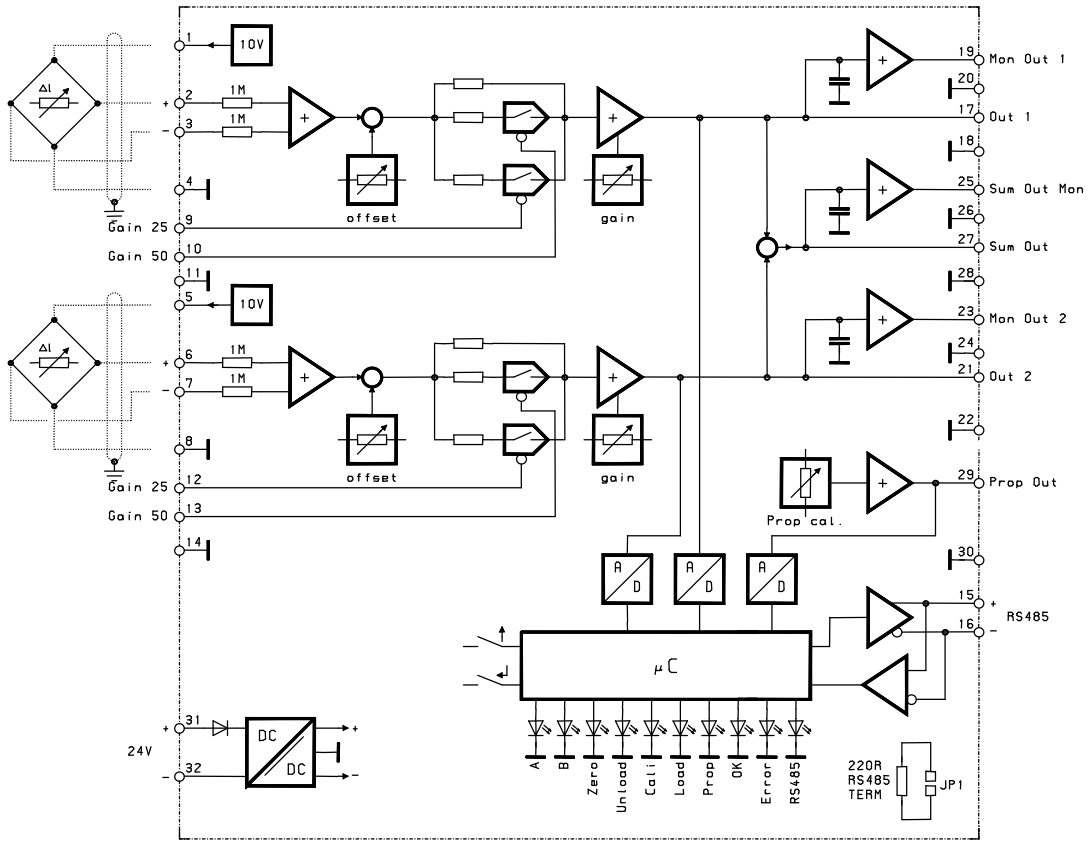
Data byte = 0 calibration successful or Data byte = 1 calibration unsuccessful

If you request the analogue values the values received will always consist of two data bytes. The first representing the low-byte and the second the high-byte of the measured tension. Together these bytes form a 12Bit value, which has to be scaled to a maximum tension of 10V.

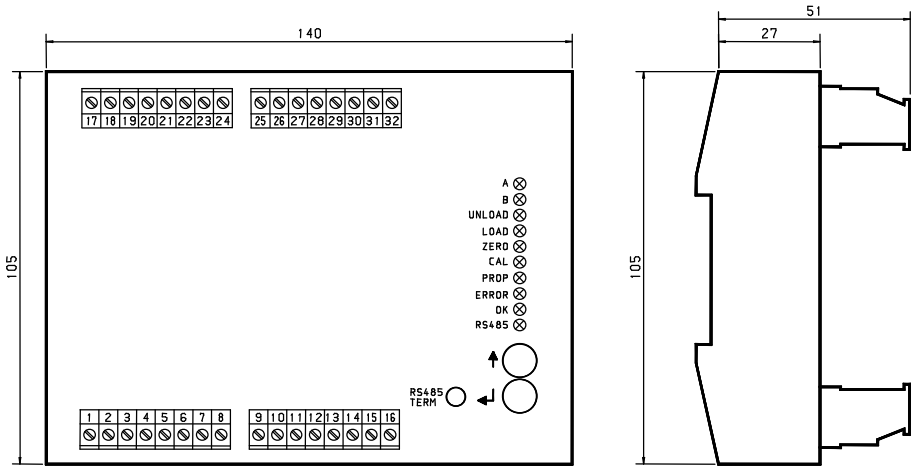
Meaning of symbols :

STX	=	starting sign	= 02 hex
ADR	=	adjusted address on DCA-20	= 00 hex – FF hex
LEN	=	number of data bytes to be transferred	= 00 hex – FF hex
TYP	=	not used, hence always	= 00 hex
DAT	=	usable data	= 00 hex – FF hex
ETX	=	end sign	= 03 hex
BCC	=	block check	= 00 hex – FF hex
NAK	=	negative receipt	= 15 hex
ACK	=	positive receipt	= 06 hex
ENQ	=	request to send	= 05 hex
EOT	=	end of transfer	= 04 hex

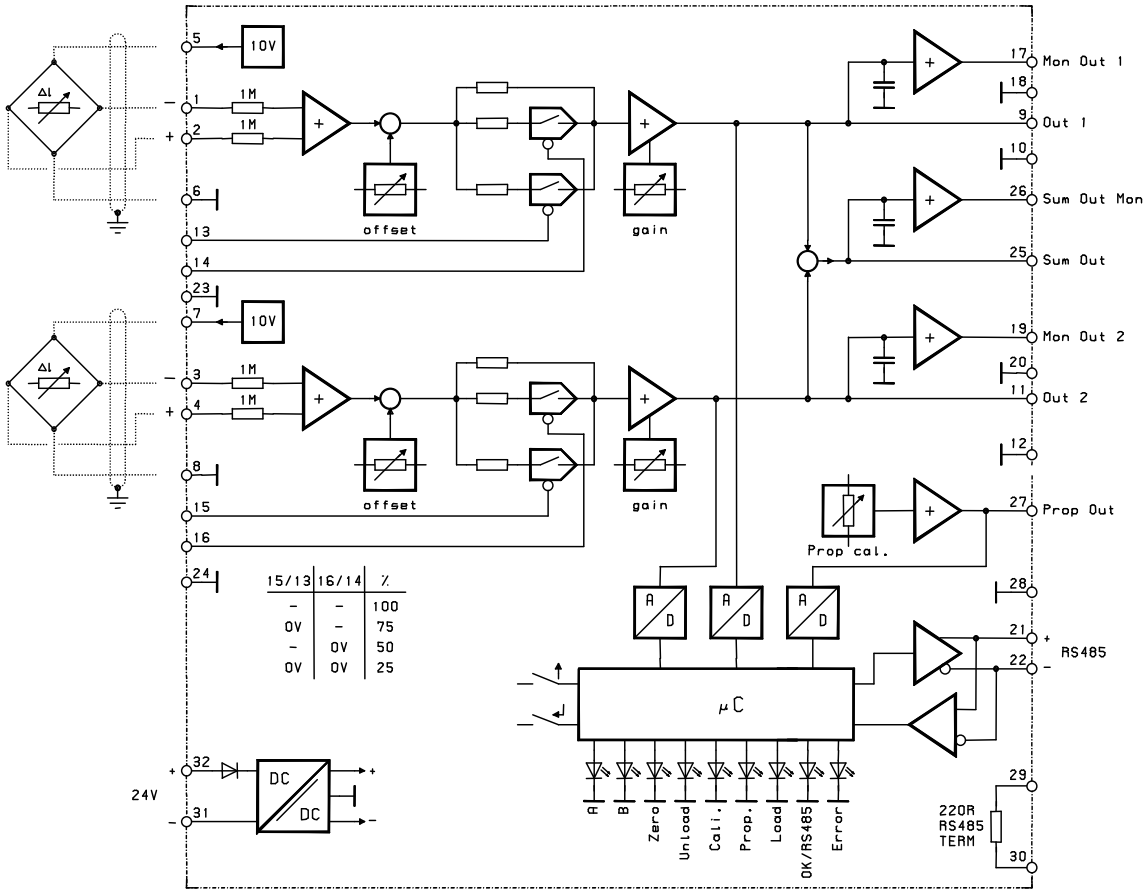
Connection Diagram DCA - 10:



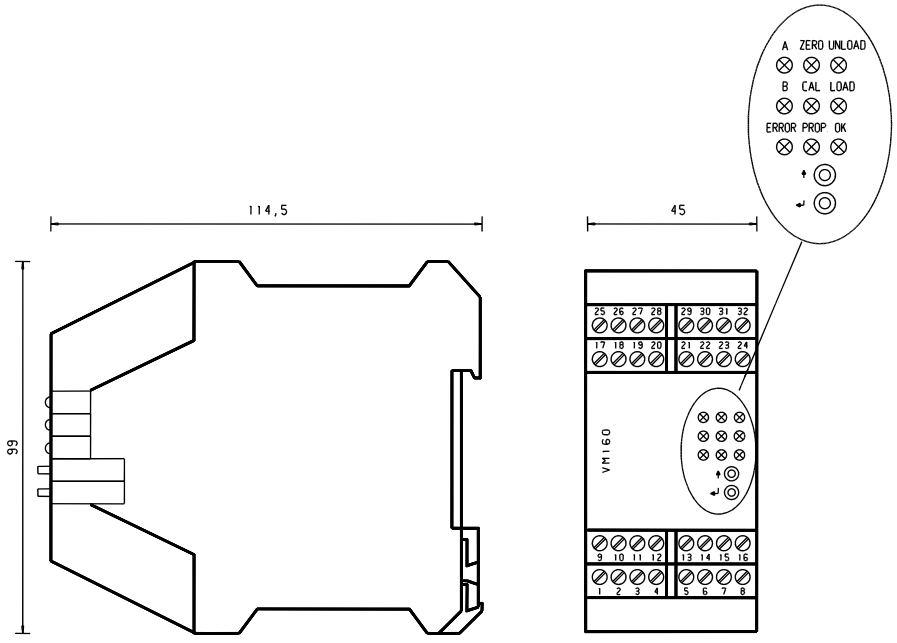
General Arrangement Diagram DCA - 10:



Connection Diagram DCA - 20:



General Arrangement Diagram DCA - 20:



Technical Data DCA - 10 / DCA - 20

Supply voltage	: 24 Vdc ±10% / ripple ≤ 5%
Consumption	: max. 2,5 W
Suitable bridge	: full Wheatstone bridge only
Bridge resistance	: 350 Ω
Tension for bridge supply	: 10 V / max. 30 mA
Zero adjustment (TARE)	: automatic
Possible offset range	: 12,5 mV is equal to max. 50 % of sensor signal at 25mV end range
Adjustment for amplification	: automatic
Possible input range	: 2 mV to 25 mV
Overload capability of inputs	: 0 ... +/- 50 mV
Input resistance	: 1 MΩ
Range switching	: 25%,50%,75%,100% by switching : inputs 9,10 und 12,13 (DCA - 10) : inputs 13,14 and 15,16 (DCA - 20)
Signal outputs	: 0 ... +10 V / max. 5 mA
Max. frequency	: 5kHz
Monitor output	: 0...+10 V / max. 5 mA
Max. frequency	: 0,3 Hz
Linearity error	: 0,005%
Temperature drift	: 0,002%/K
Zero point error	: +/- 5 mV
Amplification error	: +/- 5 mV
RS485 serial link	: 9600 Baud, 8 Data bits, 1 Stop bit, No Parity
Ambient temperature	: 0 ... 50°C
Connections	: screw type terminals 2,5 mm²
Material of housing	: green insulating material
Mounting of housing	: snap on fixing arrangement for TS35
Housing measurements	: see diagram
Weight	: 250g (DCA - 10) : 225 g (DCA - 20)

ISS	Modification	Date	Change	Checked
1.1 ENG	Changed description of calibration when using gain 25, 50 or 75% on page 5	06-06-05	GL	SN
1.2 ENG	Upgraded power specification from 1.5 to 2.5W	05-06-07	AWA	AWA

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