Operating Instructions
Digital-Energy-Power-Unit DEPU

BARTEC
D-97980 Bad Mergentheim

Type 17-8887-263623**

CE 0044

Contents:

1. Intended Use

The digital DEPU complete solution serves in connection with resistance thermometers (Pt100 DIN) for the temperature control and limitation of operating equipment (heating circuits), which are operated in hazardous rooms. The device also comprises the power section in the form of a full-wave control.
Ex-proof in accordance with RL94/9/EC, EN 50014, EN 50019, EN 50020, EN 50028. EMC test NAMUR NE21.

2. General Characteristics

- Application area EEx m e ib [ib] IIC and EEx m e ib [ib] IIB
- Setting range of controller and limiter 0...450°C
- Intrinsically safe connection of the Pt100 DIN resistance thermometer in 3- or 2-wire circuit
- Measured value processing via a micro controller
- Setting of the switching point by means of a screwdriver
- LED-indication of the main contactor's switching position
- Measured value display via 7-segment-LED-display for controller and limiter
- Signalling of sensor break and sensor short-circuit signal
- Reset of the limiter at the device or externally
- After power failure no reset required
- Power supply 230V~ 50/60 Hz
- No disadvantage effect to the power supply because of full wave control with SSR (solid-state relay)
- Solid aluminium standard enclosure for mounting on base plate

3. Function

a. Limiter

The displayed limit value is set via the "**Sollwert" (Limiter temperature Setpoint)** potentiometer. As soon as the sensor temperature exceeds the set limit value, the load circuit is opened and interlocked (red LED on).
The interlocking can be reset by an internal reset button or a customer-provided external button.

In case of a line break or if no resistance thermometer has been connected, the load circuit is opened and interlocked.

If the supply voltage fails, the power supply of the circuit to be limited is also interrupted. After the supply voltage has been restored, the device returns to the condition it was in before the supply voltage failure.
A sensor short-circuit is detected (interruption of the load circuit) and signalled as fault. The circuit is, however, not interlocked.

b. Controller
Upon operation of the pushbuttons **T1** or **T2,** the corresponding set point is displayed.
The potentiometers **"Haltetemperatur" (Maintain temperature)** and **"Alarmtemperatur" (Alarm temperature)** allow for a separate setting of switching points.

Controller switching point:	set point **"Haltetemperatur" (Maintain temperature)**	**T1**	
Low alarm:	set point **"Alarmtemperatur" (Alarm temperature)**	**T2**	terminals 3, 4, 5 (CO contacts)

In case of a line break or a short-circuit of the resistance thermometer, the main circuit is opened and the fault is signalled.

c. Energy controller
The power section consists of a main contactor and a wear-free full-wave control, which actuates in the phase zero point.
By means of the 10-step switch **"Leistungssteller" (Energy controller)**, the power can be set in steps of 10% from 10% to 100%. This facilitates a smooth adjustment to low-resistance heating lines.
With heating circuit resistances between 3,5 and 9.2 Ohm, the energy controller cannot be used in the complete setting range. The energy controller setting must be selected in a way which ensures that an effective current of 25A is not exceeded.
The calculation of the effective current is explained in detail in Chapter 11.

The device is equipped with a reversible temperature switch, which switches the device off in case of overtemperature.

4. Measuring Circuit Monitoring

With the DEPU, the temperature sensor systems of the controller and the limiter are both monitored in the same way:

Short-circuit of the sensor line or T < -100°C	*Internal signal - LED display flashes with "**---**" value* *External signal - Opens load circuit without interlocking*
Line break of the sensor line or T > 532°C	*Internal signal - LED display flashes with the "**UUU**" value* *External signal - Opens the load circuit with interlocking*
Line break of the sensor line with 3-wire connection	*Internal signal - LED display flashes with the " **UU**" value* *External signal - Opens the load circuit with interlocking*
Sensor line > 22 Ohm	*Internal signal - LED display flashes with displayed value* *External signal - Opens load circuit without interlocking*

5. Tests

● Explosion protection:	EC type examination certificate TÜV 03 ATEX 2088 Ex-proof intrinsic safety EN 50020 Ex-proof increased safety EN 50019 Ex-proof encapsulation EN 50028 Marking EEx m e ib [ib] IIC and EEx m e ib [ib] IIB in acc. with EN 50014
● Electromagnetic compatibility:	EMC tested Namur NE 21 test criterion A
● Additional test	Routine test after thermal ageing

6. Technical Data

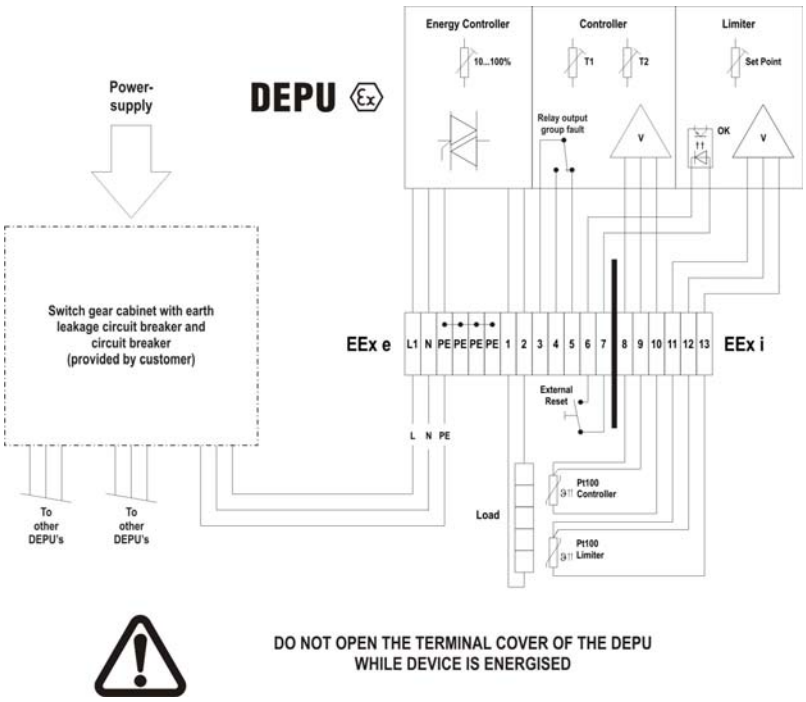
Supply voltage:	230V AC, -15% +10%, 50 - 60Hz
External protection:	25A circuit-breaker, type A, B, C (Siemens), or Z, B, C (ABB)
Load output:	Electronic solid-state relay with 25A nominal current (also refer to Chapter 11)
Power consumption:	≤ 11VA (without load)
Mounting position:	Wall-mounting
Intrinsically safe measuring circuit:	[EEx ib] IIC **Uo =** 6.3 V**, Io =** 22 mA**,** P_O= 35 mW maximum external capacity **31µF** maximum external inductance **50mH** **[EEx ib] IIB** Uo = **6.3 V**, Io = **22 mA**, P_O= **35 mW** maximum external capacity **720µF** maximum internal inductance **200mH**
Measuring / indicating range:	-99 … 460 °C
Setting range controller T1:	0 … 450 °C
Setting range low alarm T2:	-30 …430 °C
Setting range Limiter:	0 … 450 °C
Temperature sensor:	Resistance thermometer in industrial version; Refer to copy of the EC type examination certificate in the Annex
Relay output controller:	1 CO contact 5A, 250 V~,100VA or 5A, 24 V DC, 100W
Limiter switching point shift related to the set point:	tripping value 2°C **below** the defined set point
Switching point accuracy:	< 1K
Controller hysteresis:	2K
External reset: (customer-provided)	Pushbutton bridges terminals 6 and 7; pushbutton data: 250 V~, 0,1A **Caution!** Reset contacts are under voltage 230V~
Ambient temperature:	-20...+40 °C
Overtemperature protection:	Device-integrated temperature switch (switch off temperature approx. 90°C)

Enclosure:	Aluminium, mounting on base plate	
Degree of protection (EN 60529):	IP 65	
Terminals: (Conductor cross-section)	Infeed 0.5..6 mm² Load output 0.2..4 mm²	Reset/rel. output 0.2..4 mm² Sensors 0.08..2.5 mm²
Dimensions:	260 x 160 x 130 mm	
Weight:	Approx. 6.0 kg	

7. Electrical Connection / Device Connections

Terminals L1, N, PE:	Power supply 230 V~, 50/60 Hz
Terminals 1, 2:	Load output
Terminals 3, 4, 5:	Relay output group fault
Terminals 6, 7:	External reset
Terminals 8, 9, 10:	Resistance thermometer Pt 100 controller, 3-wire connection, intrinsically-safe
Terminals 11, 12, 13:	Resistance thermometer Pt 100 limiter, 3-wire-connection, intrinsically-safe

The circuit diagram shows the DEPU connection:



DO NOT OPEN THE TERMINAL COVER OF THE DEPU
WHILE DEVICE IS ENERGISED

8. General Mounting Instructions

- The device corresponds to DIN IEC 100 protection class I
- The general installation standard EN 60079-14 must be observed

- Adhere to DIN VDE 0100, mount the device at all 4 fixing points to the supporting frame
- Any kind of device manipulation is impermissible
- Connect the PE terminal to the enclosure cover
- The terminal cover also serves as protection against contact and must be available during operation
- The cable glands connections must match the cables/lines
- Cables and lines must be firmly routed

9. Start-up (general)

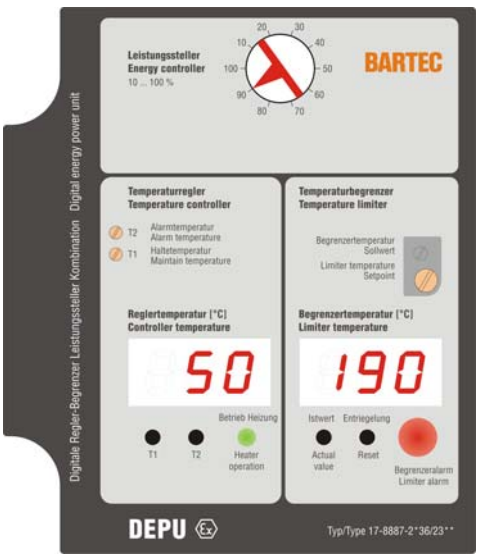
1. Connect the resistance thermometer (Pt100) to the terminals.
2. Connect the power cable and heating circuit cable to the terminals.
3. Limiter:
   a. Use a screwdriver to set the limiter temperature (limit value) at the **"Sollwert" (Limiter temperature Setpoint)** potentiometer.
   b. Operate the reset button; the large red LED extinguishes, the limiter is ready for operation.

4. Controller:
   a. Set the switching point for the heating:
   b. Press the "T1" pushbutton at the device and, at the same time, use a screwdriver to set the switching point at the **"Haltetemperatur T1" (Maintain temperature T1)** potentiometer.
   c. Set the temperature alarm T2 switching point:
   Press the **"T2"** pushbutton at the device and, at the same time, use a screwdriver to set the switching point at the **"Alarmtemperatur T2**" **(Alarm temperature T2)** potentiometer.
5. Energy controller:
   a. The energy controller is to be set in accordance with the Chapter 11.

When using the Pt 100 TWO-wire circuit, a line compensation is required.
A respective manual is available from BARTEC.

10. Front Panel

Front panel:



11. Start-up Instructions for the Energy Controller in the DEPU

a.) General Information:

The advantage of a full-wave control is the possibility of easily operating low-resistance loads in the 230V AC network. As the actuation in the phase zero point is carried out with the help of an SSR (solid-state relay), the network is not exposed to any disturbance loads.
Our full-wave control operates with a fixed clock cycle of 200 msec. The ratio between on- and off-time can be discreetly set in steps of 10% from 10% to 100%.
10 %, for example, corresponds to an on-time of 20 msec (one full wave) and a break time of 180 msec (9 full waves).

b.) Setting Instructions:

The maximum value of the nominal current (I_{eff}) for the Digital-Energy-Power-Unit DEPU of 25A must be observed.
For heating circuits with heating circuit resistances below 9.2 Ohm (refer to Table 1; area A + B), the energy controller must not be set over the entire setting range to avoid overloading of the device.
For such heating circuits, the power regulator has to be set in accordance with the values listed in Table 1 or the respective setting has to be calculated as described in Section c.) to ensure that the max. effective current of 25 A is not exceeded.
In the 10% setting, the maximum effective current (I_{eff}) may amount to max. 21A, which corresponds to a heating circuit resistance of approx. 3.5 Ohm.
This maximum current load in the 10% setting results from the max. surge current load of the SSR.

Setting example energy controller:
The highest possible setting is to be defined for a heating circuit with a resistance of 5.75 Ohm.

Procedure:
A) Searching for the heating circuit resistance in the table
B) Determination of the highest possible current in range I or II (-> 21.91A)
C) Determination of the maximum setting; (-> 30%);
(Remark: In this case, the setting value can be selected from the range between 10 and 30%.)

Heating circuit resistance R_H [Ω]	Current Ieff [A] with energy controller setting									
	10%	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*
3,00 Ω	24,24	34,29	41,99	[illegible]	54,21	59,39	64,14	68,57	72,73	76,67
3,25 Ω	22,38	31,65	38,76	[illegible]	50,04	54,82	59,21	63,30	67,14	70,77
3,50 Ω	20,78	29,39	35,99	[illegible]	46,47	50,90	54,98	58,78	62,34	65,71
3,75 Ω	19,40	27,43	33,59	38,79	43,37	47,51	51,32	54,86	58,19	61,33
4,00 Ω	18,18	25,71	31,49	36,37	40,66	44,54	48,11	51,43	54,55	57,50
4,25 Ω	17,11	24,20	29,64	34,23	38,27	41,92	45,28	48,40	51,34	54,12
4,50 Ω	16,16	22,86	27,99	32,33	36,14	39,59	42,76	45,72	48,49	51,11
4,75 Ω	15,31	21,65	26,52	30,62	34,24	37,51	40,51	43,31	45,94	48,42
5,00 Ω	14,55	20,57	25,20	29,09	32,53	35,63	38,49	41,14	43,64	46,00
5,25 Ω	13,85	19,59	24,00	27,71	30,98	33,93	36,65	39,18	41,56	43,81
5,50 Ω	13,22	18,70	22,90	26,45	29,57	32,39	34,99	37,40	39,67	41,82
5,75 Ω	12,65	17,89	21,91	25,30	28,28	30,98	33,47	35,78	37,95	40,00
6,00 Ω	12,12	17,14	21,00	24,24	27,11	29,69	32,07	34,29	36,37	38,33
6,25 Ω	11,64	16,46	20,16	23,27	26,02	28,51	30,79	32,91	34,91	36,80
6,50 Ω	11,19	15,82	19,38	22,38	25,02	27,41	29,60	31,65	33,57	35,38
6,75 Ω	10,78	15,24	18,66	21,55	24,09	26,39	28,51	30,48	32,33	34,07
7,00 Ω	10,39	14,69	18,00	20,78	23,23	25,45	27,49	29,39	31,17	32,86
7,25 Ω	10,03	14,19	17,38	20,06	22,43	24,57	26,54	28,37	30,10	31,72
7,50 Ω	9,70	13,71	16,80	19,40	21,68	23,75	25,66	27,43	29,09	30,67
7,75 Ω	9,38	13,27	16,25	18,77	20,99	22,99	24,83	26,54	28,15	29,68
8,00 Ω	9,09	12,86	15,75	18,18	20,33	22,27	24,05	25,71	27,27	28,75
8,25 Ω	8,82	12,47	15,27	17,63	19,71	21,59	23,33	24,94	26,45	27,88
8,50 Ω	8,56	12,10	14,82	17,11	19,13	20,96	22,64	24,20	25,67	27,06
8,75 Ω	8,31	11,76	14,40	16,62	18,59	20,36	21,99	23,51	24,94	26,29
9,00 Ω	8,08	11,43	14,00	16,16	18,07	19,80	21,38	22,86	24,24	25,56
9,25 Ω	7,86	11,12	13,62	15,73	17,58	19,26	20,80	22,24	23,59	24,86
9,50 Ω	7,66	10,83	13,26	15,31	17,12	18,75	20,26	21,65	22,97	24,21
9,75 Ω	7,46	10,55	12,92	14,92	16,68	18,27	19,74	21,10	22,38	23,59
10,00 Ω	7,27	10,29	12,60	14,55	16,26	17,82	19,24	20,57	21,82	23,00

A B C I II III

Range I:
Power setting possible without restriction (10 ...100%).

Range II:
Power setting possible with restrictions in the setting range.

Range III:
Forbidden range, device is overloaded.

Table 1: Energy controller setting for heating circuit resistances below 9.2 Ohm:

Heating circuit resistance	Current Ieff [A] with energy controller setting									
R_H [Ω]	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*
3,00 Ω	24,24	34,29	41,99	48,49	54,21	59,39	64,14	68,57	72,73	76,67
3,25 Ω	22,38	31,65	38,76	44,76	50,04	54,82	59,21	63,30	67,14	70,77
3,50 Ω	20,78	29,39	35,99	41,56	46,47	50,90	54,98	58,78	62,34	65,71
3,75 Ω	19,40	27,43	33,59	38,79	43,37	47,51	51,32	54,86	58,19	61,33
4,00 Ω	18,18	25,71	31,49	36,37	40,66	44,54	48,11	51,43	54,55	57,50
4,25 Ω	17,11	24,20	29,64	34,23	38,27	41,92	45,28	48,40	51,34	54,12
4,50 Ω	16,16	22,86	27,99	32,33	36,14	39,59	42,76	45,72	48,49	51,11
4,75 Ω	15,31	21,65	26,52	30,62	34,24	37,51	40,51	43,31	45,94	48,42
5,00 Ω	14,55	20,57	25,20	29,09	32,53	35,63	38,49	41,14	43,64	46,00
5,25 Ω	13,85	19,59	24,00	27,71	30,98	33,93	36,65	39,18	41,56	43,81
5,50 Ω	13,22	18,70	22,90	26,45	29,57	32,39	34,99	37,40	39,67	41,82
5,75 Ω	12,65	17,89	21,91	25,30	28,28	30,98	33,47	35,78	37,95	40,00
6,00 Ω	12,12	17,14	21,00	24,24	27,11	29,69	32,07	34,29	36,37	38,33
6,25 Ω	11,64	16,46	20,16	23,27	26,02	28,51	30,79	32,91	34,91	36,80
6,50 Ω	11,19	15,82	19,38	22,38	25,02	27,41	29,60	31,65	33,57	35,38
6,75 Ω	10,78	15,24	18,66	21,55	24,09	26,39	28,51	30,48	32,33	34,07
7,00 Ω	10,39	14,69	18,00	20,78	23,23	25,45	27,49	29,39	31,17	32,86
7,25 Ω	10,03	14,19	17,38	20,06	22,43	24,57	26,54	28,37	30,10	31,72
7,50 Ω	9,70	13,71	16,80	19,40	21,68	23,75	25,66	27,43	29,09	30,67
7,75 Ω	9,38	13,27	16,25	18,77	20,99	22,99	24,83	26,54	28,15	29,68
8,00 Ω	9,09	12,86	15,75	18,18	20,33	22,27	24,05	25,71	27,27	28,75
8,25 Ω	8,82	12,47	15,27	17,63	19,71	21,59	23,33	24,94	26,45	27,88
8,50 Ω	8,56	12,10	14,82	17,11	19,13	20,96	22,64	24,20	25,67	27,06
8,75 Ω	8,31	11,76	14,40	16,62	18,59	20,36	21,99	23,51	24,94	26,29
9,00 Ω	8,08	11,43	14,00	16,16	18,07	19,80	21,38	22,86	24,24	25,56
9,25 Ω	7,86	11,12	13,62	15,73	17,58	19,26	20,80	22,24	23,59	24,86
9,50 Ω	7,66	10,83	13,26	15,31	17,12	18,75	20,26	21,65	22,97	24,21
9,75 Ω	7,46	10,55	12,92	14,92	16,68	18,27	19,74	21,10	22,38	23,59
10,00 Ω	7,27	10,29	12,60	14,55	16,26	17,82	19,24	20,57	21,82	23,00

Range A: Setting possible without restriction (10 ...100%).
Range B: Setting possible with restrictions in the setting range.
Range C: Forbidden range, device is overloaded.

c.) Calculation of the Effective Current:

For the dimensioning of the heating circuit, the effective current is calculated on the basis of the following general equation:

$$I_{eff} = \sqrt{\frac{I_1^2 * t_1 + I_2^2 * t_2 + I_n^2 * t_n}{T}} \quad \text{or simplified:} \quad I_{eff} = I_{100\%} * \sqrt{\frac{ED}{100}}$$

the following applies: $I_{100\%}$ corresponds to the current at 100% and ED to the on-time in %.

d.) Measurement of the Effective Current:

Only high-quality measuring devices capable of processing signals with a frequency of 5 Hz are suitable for measuring these currents. On the basis of internal examinations, we can recommend the following measuring devices for the current measurement of the full-wave control.

a. FLUKE SCOPEMETER series with AC/DC current clamp FLUKE type 80i-110s
b. METRIX MX 26 with CHAUVIN ARNOUX AC/DC current clamp type E6N CVH 1-100/1
c. METRIX MX 56 in with CHAUVIN ARNOUX AC/DC current clamp type E6N CVH 1-100/1

If you have any further questions, please do not hesitate to contact us under the telephone number + 49 7931 597-352 or under the fax number + 49 7931 597-494.

12. Type Label

Type Label:

CE 0044

BARTEC
D-97980 Bad Mergentheim

Typ 17-8887-26362300
II 2 G EEx m e ib [ib] IIC T4
TÜV 03 ATEX 2088
AC 230V (-15%/+10%) 50...60Hz; 25 A

Ext. Absicherung (s. Betriebsanleitung)/
Ext. circuit breaker (note operation manual): 25A

Abschaltvermögen/
Breaking capacity: 6kA / cos $\varphi \geq 0,7$

Schutzart/Protection: IP65
Messbereich/Measuring range: 0...+450°C

Teile-Nr./Part-No. 217037

Fertigungs-Nr./Serial-No. 000255

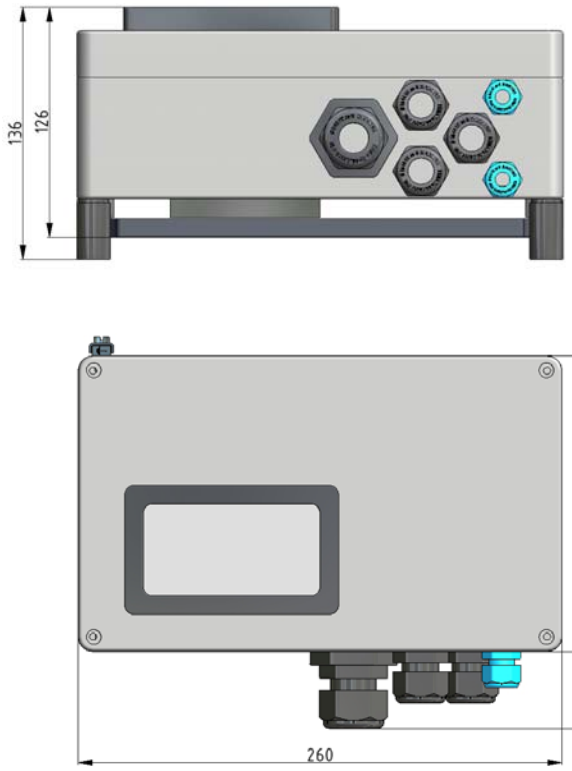
Messstromkreis eigensicher:
measuring circuit intrinsically safe:
U_b =6,3V, I_b =22mA, P_b =35mW

für EEx ib IIC gilt:
for EEx ib IIC applies:
max. äußere Kapazität/
max. ext. capacitance: 31µF
max. äußere Induktivität/
max. ext. inductance: 50mH

für EEx ib IIB gilt:
for EEx ib IIB applies:
max. äußere Kapazität/
max. ext. capacitance: 720µF
max. äußere Induktivität/
max. ext. inductance: 200mH

13. Dimensions / Hole Pattern

Dimensions:



Hole pattern: