Series 430

Pneumatic Indicating Controller for Temperature with Resistance Thermometer Pt 100

Controller Station Type 3432
Transmitter Module Type 3438

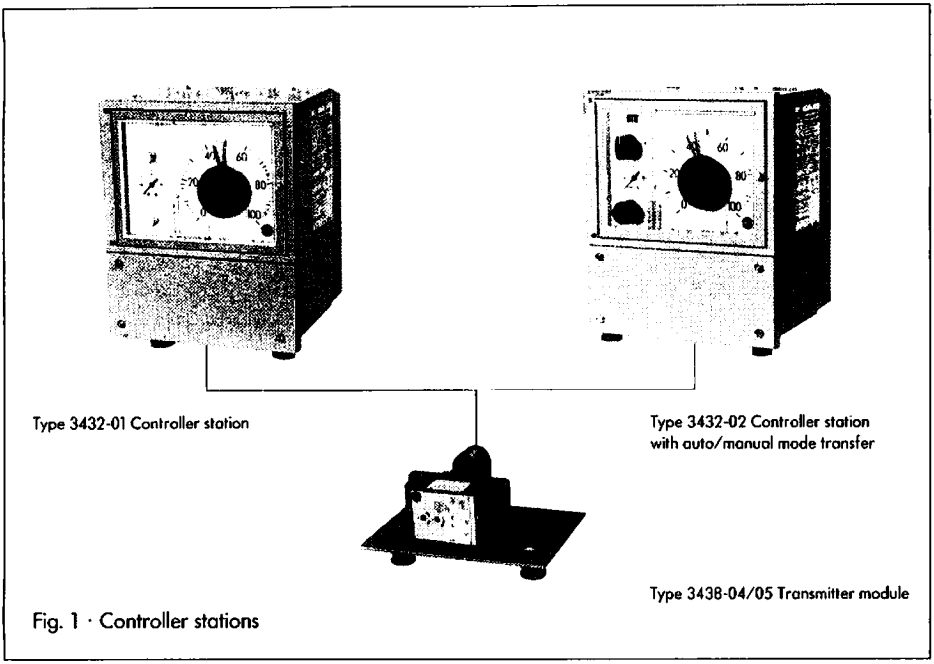

Fig. 1 · Controller stations

1. Application

The pneumatic indicating controller is designed for temperature control in industrial and process plants handling liquids, gases, and steam. The controller directly measures the medium temperature, indicates the value of the temperature measured, compares this measured process variable with the adjusted set point, and produces a pneumatic output signal in the 0.2...1 bar or 3...15 psi range. Depending on which additional equipment has been added to the indicating controller, it can be used as fixed set point controller, follower controller or as combined fixed set point and follower controller.

Edition July 1992

Mounting and operating instruction

EB 7036 E

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2. Construction

The complete pneumatic indicating controller basically consists of a Type 3432 controller station, a Type 3433 or 3434 controller module, and a Type 3438-04/05 transmitter module, comprising an electric transmitter and an i/p converter connected in series. For special control tasks, the Type 3433 controller module can be combined with a Type 3437 additional module. On request, the controller station is also available with an auto/manual mode transfer unit, consisting of a selector switch, an adjuster for manual operation, and a differential pressure indicator.

When used as a combined fixed set point and follower controller, the controller station features an additional w_{int}/w_{ext} changeover unit. When used as a follower controller, the controller has an additional input for the external reference variable w_{ext} (e.g. 4 (0)...20 mA); i.e for application of the external set point.

In addition, 1 or 2 inductive limit switches can be mounted to the indicator gear mechanism as an optional extra. These switches are adjustable at the scale.

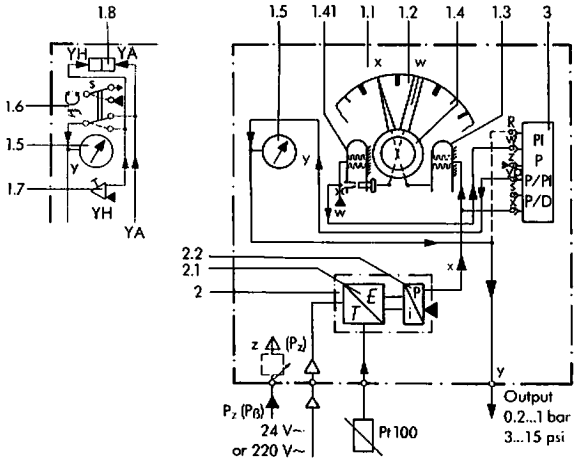
3. Principle of operation

3.1 Transmitter module

The transmitter converts the temperature-proportional resistance formed in the Pt-100 sensor into a d.c. voltage signal via a measuring bridge. Subsequently, a measuring amplifier located in the output stage converts the voltage signal into a 20 mA d.c. current signal. The transmitter features three measuring ranges. These input ranges are selectable via bridges. The transmitter output signal (0...20 mA) flows to the i/p converter where it is converted into a standardized pneumatic signal in the 0.2...1 bar range. This output pressure which is proportional to the sensed temperature is the pneumatic actual value signal (controlled variable x). It acts upon the bellows measuring system of the controlled variable indicator (1.3) and upon the controller module (3).

3.2 Controller station

In the controller station, the pressure signal (controlled variable x) coming from the transmitter causes the bellows measuring system of the controlled variable indicator (1.3) to displace. This movement is transmitted to the pointer via a pointer gear mechanism, causing the pointer to deflect. The set point (reference variable w) can be adjusted at the scale (1.2) from the front of the instrument. The pointer gear mechanism transmits the position of the set point adjuster (1.4) to the set point transmitter. This servo-control system (1.41), in turn, converts the adjusted set point into a pneumatic set point signal (w) which passes to the controller module. The controller module compares the controlled variable and the set point signal (x and w) and produces an output signal yA as a function of the system deviation and the adjusted control parameters. The controller output signal passes to the controller output indicator (1.5) and the output y.



1 Controller station
1.1 Housing with door
1.2 Scale
1.3 Controlled variable indicator with pointer, pointer gear mechanism, and bellows measuring system
1.4 Set point adjuster with pointer, pointer gear mechanism, and set point trasmitter (1.41); with follower controllers set point indicator only
1.5 Controller output indicator
1.6 Manual/auto switch
1.7 Adjuster for manual operation
1.8 Differential pressure indicator for bumpless manual/auto mode transfer
1.9 Supply pressure regulator

2 Transmitter module
2.1 Electric transmitter
2.2 i/p converter

3 Controller module

Fig. 2 · Functional diagram of the controller station with transmitter module (left: detail with manual/auto switch)

Controller stations with manual/auto mode transfer function (Fig. 2, detailed view) additionally have a manual/auto switch (1.6), an adjuster for manual operation (1.7), and a differential pressure indicator (1.8). When the switch is in the "Automatic" position, the related automatic-output signal yA passes to the controller output indicator (1.5) and the output y. When the switch is in the "Manual" position, the manual-output signal yH which has been adjusted with the adjuster (1.7) passes to the controller output indicator and the output y. Bumpless manual/auto mode transfer is possible when the differential pressure indicator shows identical yA and yH values.

3.3 Controller modules

The controller modules are plug-in units. They fit into the self-sealing plug-in connections of the controller station and are secured with a screw.

3.3.1 Type 3433 controller modules

The controller modules consist of the comparator, comprising four metal bellows arranged in a square, and a base plate with the respective plug-in connections. The base plate carries all components required for performing the corresponding controller functions. These components are, e.g. relays and restrictions. They are replaceable or can be added to the instruments at a future date, so that a subsequent change of the controller functions is possible too (see section 7.3).

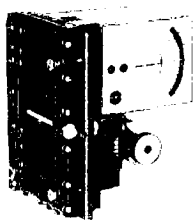
Type 3433-2 PI controller (Fig. 3)

The controlled variable x (actual value) and the reference variable w (set point), both pneumatic signals in the 0.2 and 1 bar range, pass to the metal bellows w and x via the turnbord A. If the pressure x exceeds w, the actual value bellows tilts the cross spring pivoted swashplate towards the set point bellows. Thus, the pressure behind the nozzle which is connected to the swashplate by means of a pin, and the output pressure yA delivered by the amplifier rise.

This output pressure returns to the bellows R2, i.e onto the swashplate, via the turnboard B. The value of the output pressure and the position of the swashplate keep changing until the distance between nozzle and flapper is the same as it was in the beginning, and the output air pressure yA assumes a value related to the controlled variable x and the operator-adjusted proportional gain factor K_p (adjusted with a screw).

Outside the controller module, yA connects to R, so that the output air pressure yA returns to the bellows R1 via the connection R and the adjustable T_n restriction. As a result a pressure equilibrium in the bellows R1 and R2 is reached and system deviation is eliminated.

If a pressure is available at connection S after the controller station has been set to the manual mode, the T_n restriction is by-passed via T_n the relay.



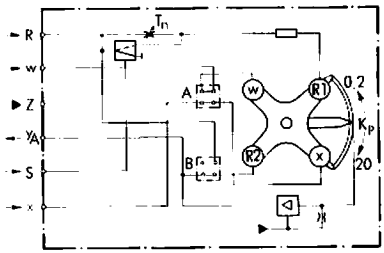


Fig. 3 · Type 3433-2 PI controller module

The turnboard A determines the operating action of the controller, i.e. whether this action is direct or reverse. The action can be changed by changing the installation position of the board. See section 5.1.1.

The turnboard B determines the air delivery to the feedback bellows. The turnboard is supplied pre-set to yA from the factory, i.e. the output air pressure yA directly returns to the bellows R2. To the bellows R1, however, it returns via the manual control unit and the connection R. In this arrangement, the controller features normal air delivery and output pressure damping. If the turnboard is set to R, the signal pressure yA returns to the bellows R1 and R2 via connection R. An increased air delivery results. This arrangement is suitable for applications where the transmission path to the final control element is long, the air delivery is large, and in fast controlled systems.

For adjustment or change of the air delivery by changing the turnboard position, see section 5.1.2.

The controller modules described below largely correspond to the Type 3433-2 PI controller module. Depending on their use, however, they have e.g. an operating point adjuster, a derivative element or a manual/auto transfer switch.

The Type 3433-1 P controller module (Fig. 3.1) corresponds to the Type 3433-2 module. Instead of the integral element, however, it has an operating point adjuster.

The Type 3433-3 PID controller module (Fig. 3.2) corresponds to the Type 3443-2 module. The **Type 3433-4 PD controller module** (3.3) corresponds to the Type 3433-1. Both models, however, have a derivative element, producing the rate action at the controlled variable input. This element features a rate gain of about 10. The rate time can be adjusted at the T_v restriction.

The Type 3433-5 P/PI controller module (Fig. 3.4) with P/PI mode selector switch can be optionally used as a P controller with operating point adjustment or as a PI controller. The design of this module corresponds to that of the PI or P controller module.

The Type 3433-6 PD/PID controller module with PD/PID mode selector switch can be optionally used as a PD or PID controller.

The Type 3433-9 P controller module with set point-dependent operating point (Fig. 3.5) corresponds to the Type 3433-1 P controller module, but in this model the operating point changes proportionally to the set point w.

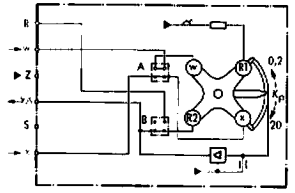


Fig. 3.1
Type 3433-1
P controller module
(turnboard B is fixed)

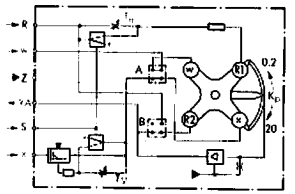


Fig. 3.2
Type 3433-3
PID controller module

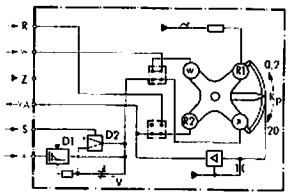


Fig. 3.3
Type 3433-4
PD controller module
(turnboard B is fixed)

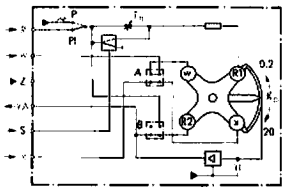


Fig. 3.4
Type 3433-5
P/PI controller module

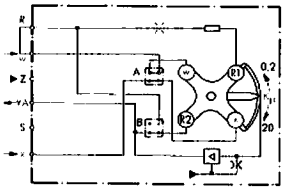


Fig. 3.5
Type 3433-9
P controller module
with set point-
dependent operating
point (turnboard B
is fixed)

3.3.2 Type 3434 controller modules

These controller modules have a tin-shaped comparator, operating according to the force balance principle. The proportional gain factor K_p is adjustable at a restriction within the range of 1 to 25.

Type 3434-2 PI controller module (Fig. 4)

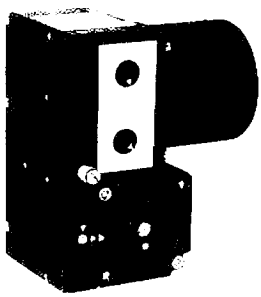
In this controller module, the controlled variable x and the reference variable w, both pneumatic gauge pressures within the 02...1 or 3...15 psi range, pass to the diaphragm chambers (11 and 12) via the turnboard A. If the pressure x exceeds w, the plug of the force switch (21) lowers and opens the hole to the diaphragm chamber. As a result, air flows into the diaphragm chamber R2, and the output pressure yA rises. This pressure then passes to the T_n restriction (18) and to the 1:1 booster (22) whose output pressure returns to the diaphragm chamber R1. Thus, a pressure equilibrium in the diaphragm chambers R1 and R2 results. The plug of the force switch does not change its position until the controller output pressure assumes a value related to the controlled variable x and the adjusted proportional gain factor K_p, i.e. until system deviation is eliminated.

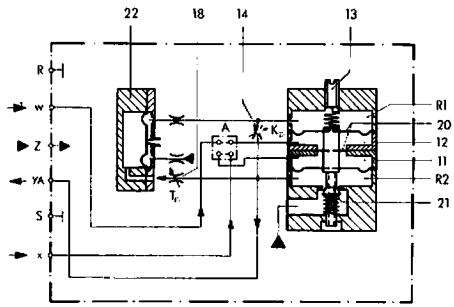
Adjust proportional gain factor K_p at the restriction (14) and the reset time T_n at the restriction (18). Use set point adjuster (13) to calibrate the instrument.

The turnboard A determines the operating action of the controller, i.e. whether this action is direct or reverse. The action can be changed by changing the position of the board. See section 5.1.1.

Type 3434-1 P controller module

The design and principle of operation of this module, largely correspond to that of the Type 3434-2 PI controller module. In this model, however, the output pressure yA does not flow via the T_n restriction (18), since this has been replaced by a spring that ensures a fixed operating point at 0.6 bar.





R1 Diaphragm chamber
R2 Diaphragm chamber
A Turnboard for adjustment of operating direction
11 Diaphragm chamber
12 Diaphragm chamber
13 Zero point adjuster
14 K_p restriction
18 T_n restriction
20 Diaphragm
21 Force switch with plug
22 1:1 booster, fixed operating point with P controller

Fig. 4 · Type 3434-2 PI controller module

3.4 Additional units

3.4.1 Type 6112 i/p converter

With the **follower controller** version, the external reference variable can be adjusted as a current signal within the 4 (0)...20 mA or 1...5 mA ranges. This signal can be converted into a pneumatic standardized signal in the 0.2...1 bar range by the i/p converter. The additional i/p conversion unit has to be installed in the controller station and can only be used in combination with the Type 3433 controller modules.

3.4.2 Selector switch w_{int}/w_{ext}

When the controller is used as a combination of a **fixed set point controller** and a **follower controller,** it is equipped with a w_{int}/w_{ext} selector switch. The related set point adjuster and the differential pressure indicator allow bumpless changeover between w_{int} and w_{ext}, when the differential pressure indicator equals zero.

3.4.3 Supply pressure regulator

When the controller station is equipped with a supply pressure regulator, it is suitable for connection in circuits that have an operating pressure in the 2.0 to 12 bar range. The pressure regulator reduces and controls the operating pressure to the required supply pressure p_z, i.e. to 1.4 bar.

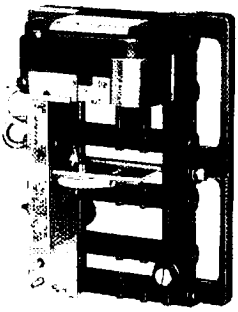


Fig. 5 · Additional unit for i/p conversion with i/p converter for external reference variable w_{ext}

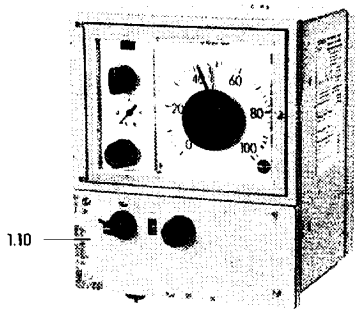


Fig. 6 · Fixed set point and follower controller with additional unit (1.10) for changeover from internal to external reference variable

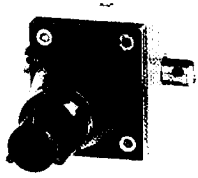


Fig. 7 · Supply pressure regulator

4. Installation

4.1 Mounting

The controller station is designed for tube mounting, wall mounting, and panel mounting. The corresponding dimensions are shown in Fig. 8.

Tube mounting: Mounting to a vertical or horizontal 2" tube using a mounting plate with clamp. The order no. for the required mounting kit is 1400-6302.

Wall mounting: Mounting with three brackets. The order no. for the required mounting kit is 1400-6301.

Panel mounting: Mounting with four fastening elements (DIN 43835, the order no. for the required mounting kit is 1400-6300).

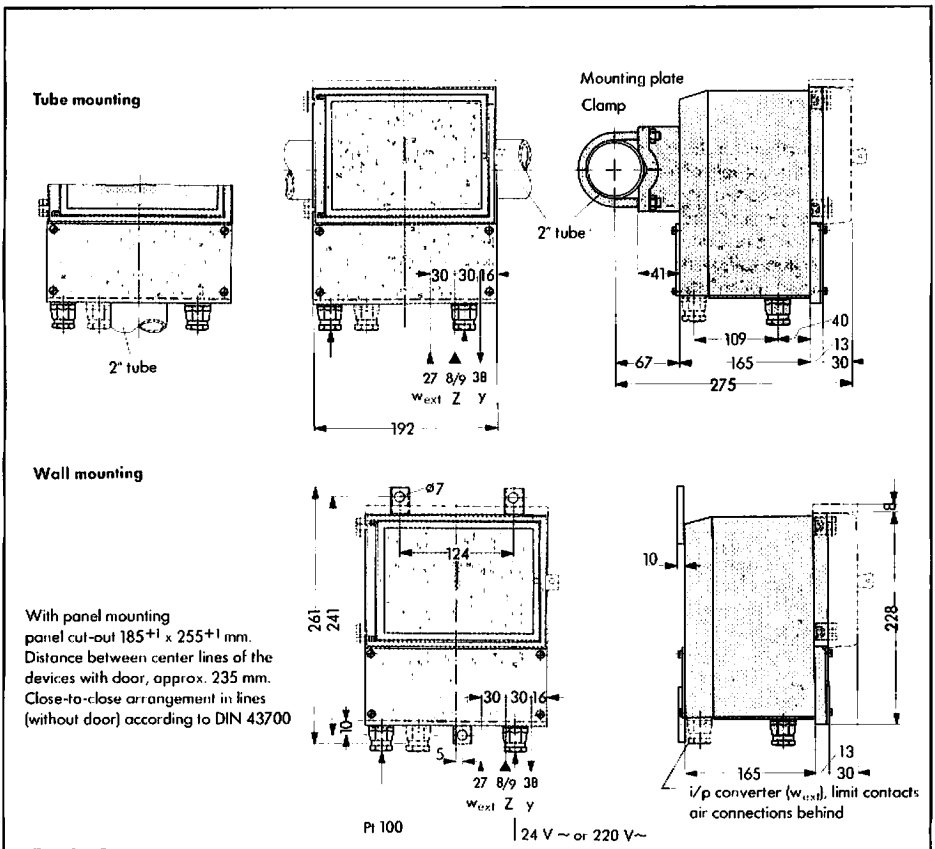


Fig. 8 · Dimensions

4.2 Pneumatic connections

The air connections at the bottom of the device are designed as tapped hole NPT 1/8". The conventional screw glands for tubes or plastic hoses can be used. The designations of the air connections are written on a label. They denote the following:

Output 38 y – Output for manipulated variable, i.e for the controller output signal pressure for operation of the control valve

Supply 8/9 – Input for supply air; supply air pressure is 1.4 ± 0.1 bar or 2 to 12 bar for models with supply pressure regulator (see section 4.2.1)

Input 27 w_{ext} – Input for external reference variable; this connection is **closed** with **fixed set point controllers** and **open** with **follower controllers** for application of an external set point

Input 26 x – Input for controlled variable; this connection is **closed** (temperature is sensed via the transmitter module)

4.2.1 Adjusting and checking the supply air at controller stations with integrated supply pressure regulator (1.9)

The hose connections for the supply air are located directly above the corners of the pressure regulator on the web of the connection board (inside wall of housing). The connections are sealed with hose ends. Remove left hose end. Connect a testing gauge to the free connection, using a hose. Controller stations with manual/auto switch have a test connection (yellow) at the inside of the indicating unit. When using such instruments, use enclosed test plug.

Remove cap of the supply pressure regulator and adjust spindle until the supply pressure assumes the value of 1.4 ± 0.1 bar.

4.3. Electrical connections (Fig. 9)

Access to the terminals at the transmitter or respectively on the terminal base is made by removing the front cover below the indicator and the back cover of the housing.

The transmitter module is designed for three different measuring ranges. Select the measuring range required for your application by making the corresponding terminal assignments (bridge 3 – 4, 2 – 4 or 1 – 4; also see label on the transmitter module).

Important: When connecting the instrument to a 220 V power source, the relevant regulations for power installations must be adhered to, in particular VDE 0100. The sensor connecting leads must be laid separately from the power supply leads and from those via which control signals from relays or contactors are transmitted.

4.3.1 Sensor connection – line compensation

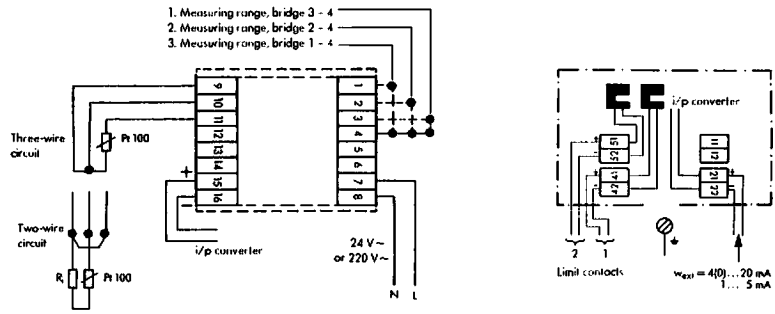
When a three-wire sensor is used, compensation of temperature error is not required, if all connecting leads have the same resistance and this resistance does not exceed the permissible value of 50 Ω per lead. On option, controller models are available that permit connecting the resistance thermometer in a four-wire circuit. In this type of circuit, the max. resistance of the connecting leads can be up to 100 Ω per lead without the need for any compensation.

In a two-wire circuit, the resistance of the connecting leads has to be balanced out to 10 Ω at an external resistor R_v. For this purpose, short-circuit the measuring element at the resistance thermometer and measure the resistance in the overall arrangement (lead and trimming resistor) using a suitable resistance measuring bridge (decade device). Subsequently, adjust the trimming resistor until the total resistance is 10 Ω.

4.3.2 Additional units – i/p converter and limit contacts

Make electrical connections at the terminal base as shown in Fig. 9.

To operate the inductive limit contacts, the corresponding switching amplifiers (transistor relays) have to be included in the output circuit.



Transmitter module

Additional units

Fig. 9 · Terminal connections

5. Operation

5.1 Controller modules

Access to the controller module in the controller station is made by opening the lock of the front cover (Fig. 12) and opening out the indicator unit.

5.1.1 Adjusting the operating action of the controller module (Fig. 10)

The installation position of the turnboard A (7) determines the operating action of the controller module.

The operating action is adjusted or changed in the following way:
Loosen screw in the turnboard (7) and remove screw together with the board. Turn board to align it with the symbol on the base plate that corresponds to the operating action you want to adjust. Install board and secure it with a screw.

Position of board A

△ Operating action increasing/decreasing
▽ as the controlled variable x increases – signal pressure yA falls

△ Operating action increasing/increasing;
△ as the controlled variable x increases – signal pressure yA rises

5.1.2 Adjusting the air delivery (Type 3433 only)

The position of the turnboard B (4) determines the air delivery to the feedback bellows. Access to this board is made from the side, after having removed the screws (2) and having pulled off the comparator (10) from the base plate.

The air delivery is adjusted in the following way:
Loosen screw in the board (4) and remove screw together with board. Turn the board to align the arrow on the board with the symbol yA or R on the base plate. Install board and secure it with a screw.

Position of board B

Y_A
△ – normal air delivery

▷ R – large air delivery (not for P and PD controller module).

5.1.3 Adjusting the proportional gain factor K_p

The gain (K_p) adjustment determines the controller gain and is dependent on the controlled system to be optimized. See also section 6.1.

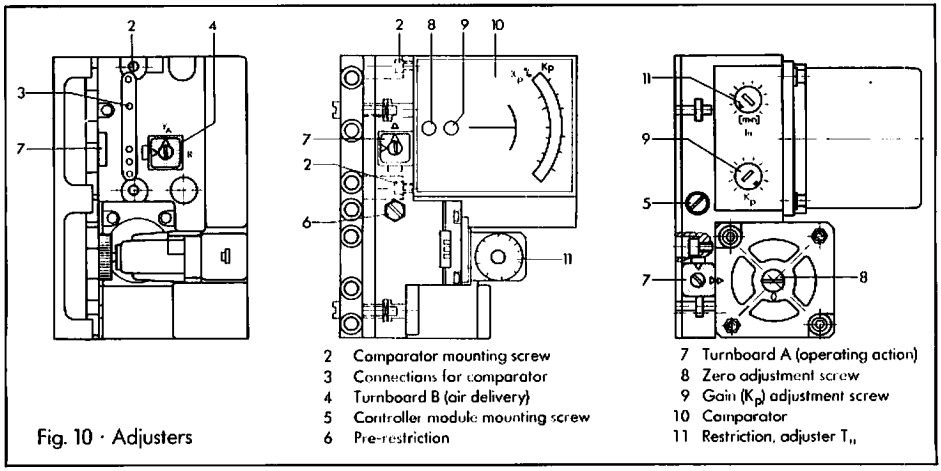
Adjust gain (K_p) with the corresponding adjuster (9).

5.1.4 Adjusting the reset time T_n

If you are using controller models with I action, adjust the reset time at the restriction (11). The adjustment depends on the controlled system to be optimized (section 6.1).

5.1.5 Adjusting the rate time T_v

If you are using Type 3433 controller models with D action, adjust the rate time T_v at the restriction (11). The adjustment depends on the controlled system to be optimized (section 6.1).



2 Comparator mounting screw
3 Connections for comparator
4 Turnboard B (air delivery)
5 Controller module mounting screw
6 Pre-restriction
7 Turnboard A (operating action)
8 Zero adjustment screw
9 Gain (K_p) adjustment screw
10 Comparator
11 Restriction, adjuster T_n

Fig. 10 · Adjusters

5.1.6 Adjusting the operating point

Controller modules that have no I action, such as P or PD controllers, feature an operating point. With the Type 3433 controller module, the operating point is adjustable with an adjuster within the 0...100% ≙ 0.2...1 bar range. The adjustment depends on the value of the manipulated variable y (see section 6.1.1).

The **Type 3434** P controller module has a **fixed operating point** (at 0.6 bar).

5.2 Transmitter module

5.2.1 Checking zero and span

The transmitter module is supplied factory-tested as well as with the input range being adjusted as ordered.

If the controlled variable indicator should show incorrect values, zero and span adjustment for the corresponding adjusted temperature range can be checked as follows:

Connect controller in a test circuit according to Fig. 9. In so doing, replace the measuring resistor of the Pt 100 at the input by a decade device by means of which it is possible to simulate the measuring range. The transmitter output signal which is proportional to the sensed temperature is indicated at the controller as measurement (actual value x) within the 0...100% ≙ 0.2...1 bar range.

Zero

Select the resistance value to be set as lower input range value from the table below, and adjust it with the decade device.

Then, turn **ZERO** potentiometer until the indicator showing the measurements displays 0% ≙ 0.2 bar.

Span

Adjust resistance value to be set as upper range value with the decade device.

Turn **SPAN** potentiometer until the indicator showing the measurements displays 100% ≙ 1 bar.

Since zero and span influence each other, check both values again and correct them if necessary.

5.2.2 Changing the measuring range

The measuring range pre-set in the factory (see label on the transmitter module) can be changed by changing the bridge connections at the terminals 1 to 4 (Fig. 9)

Subsequently, check zero and span as described in section 5.2.1.

5.3 Adjusting the limit contacts (Fig. 11)

To adjust the limit contacts, open the lock of the front cover and open out the indicator unit. The limit contacts are located at the back.

Use screwdriver to shift the limit contacts between 0 and 100% along the ancillary scale until the transistor relays make a contact.

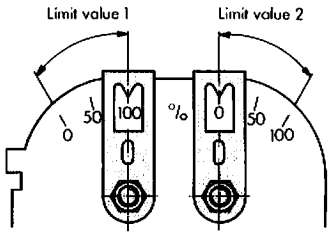


Fig. 11 · Limit contacts

Table Resistance values for Pt 100

(Series of basic values in Ohms acc. to DIN IEC 751 October 1985)

°C	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60	-65	-70	-75	-80	-85	-90	-95	-100
-200	18,49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-100	60,25	58,22	56,19	54,15	52,11	50,06	48,00	45,94	43,87	41,79	39,71	37,63	35,53	33,43	31,32	29,20	27,08	24,94	22,80	20,65	18,49
0	100,00	98,04	96,09	94,12	92,16	90,19	88,22	86,25	84,27	82,29	80,31	78,32	76,33	74,33	72,33	70,33	68,33	66,31	64,30	62,28	60,25

°C	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
0	100,00	101,95	103,90	105,85	107,79	109,73	111,67	113,61	115,54	117,47	119,40	121,32	123,24	125,16	127,07	128,98	130,89	132,80	134,70	136,60	138,50
100	138,50	140,39	142,29	144,17	146,06	147,94	149,82	151,70	153,58	155,45	157,31	159,18	161,04	162,90	164,76	166,61	168,46	170,31	172,16	174,00	175,84
200	175,84	177,68	179,51	181,34	183,17	184,99	186,32	188,63	190,45	192,26	194,07	195,88	197,69	199,49	201,29	203,08	204,88	206,67	208,45	210,24	212,02
300	212,02	213,80	215,57	217,34	219,12	220,88	222,65	224,41	226,17	227,92	229,67	231,42	233,17	234,91	236,65	238,39	240,13	241,86	243,59	245,31	247,03
400	247,04	248,76	250,48	252,19	253,90	255,61	257,32	259,02	260,72	262,42	264,11	265,80	267,49	269,18	270,86	272,54	274,22	275,89	277,56	279,23	280,90
500	280,90	282,56	284,22	285,87	287,53	289,18	290,83	292,47	294,11	295,75	297,39	299,02	300,65	302,28	303,91	305,53	307,15	308,76	310,38	311,99	313,59

6. Start-up

Prior to starting up the control loop, examine all instruments for proper connections, leakage, and operatability.

Access to the operator controls is made by opening the lock of the front cover and opening out the indicator unit.

Check whether the operating action adjusted at the controller corresponds to the turnboard adjustment (see section 5.1.1).

6.1 Optimizing the controller (Figs. 12 and 13)

To ensure that the controller can zero error caused by disturbances for all set point values or can maintain them within specified tolerances, it must be adapted to the behaviour of the controlled system by properly setting the parameters K_p, T_n, and T_v with the corresponding adjuster at the controller module.

It is advisable to determine the setting values in an oscillation test (according to a method proposed by Ziegler an Nichols) which is sufficient for many applications. For this purpose take the following steps:

Turn on the supply air (1.4 $\pm$ 0.1 bar).

Set proportional gain factor at the comparator to a small value.

Set T_n to the highest possible value and T_v to a low value (PI or PID controllers only).

Adjust desired set point with the set point adjustment knob at the indicator unit.

With controller stations that have a **manual/auto mode transfer switch** (1.6), it is advisable to start up the control loop by hand. For this purpose, place manual/auto switch to the **Manual** position.

Turn the adjuster for manual operation (1.7), so that the controlled variable (indicator 1.3) will slowly approach the adjusted set point (set point indicator 1.4).

If the differential pressure indicator (1.8) equals zero, place the auto/manual switch to the **Automatic** position.

Increase the proportional gain K_p, starting from the lowest set value, until the controlled variable encounters harmonic oscillations (uniform amplitudes see Fig. 13). If no oscillations occur, even with a high gain value, impose an upset by moving the set point for a few seconds and then returning it to its original value with the set point adjustment knob. If necessary, increase gain (K_p) a little more until harmonic oscillations occur.

Read off the adjusted gain (K_p) from the corresponding scale, and take it down as critical gain factor $K_{p\,crit}$.

Determine the time period for a full oscillation amplitude (T_{crit}) by taking the time of several oscillations and calculating their average (PI and PID controllers only).

Multiply the values $K_{p,\,crit}$ and T_{crit} by the values given in the table (Fig. 13), and set these values as favourable values for K_p, T_n, and T_v at the controller.

If oscillations should still occur, in spite of these set values, then slightly increase gain (K_p) and decrease T_n.

If necessary, repeat the steps described above until the control loop shows satisfactory dynamic behaviour. After each adjustment, however, the controller should always be given enough time to adapt itself to the new setting.

6.1.1 Adjusting the operating point with P and PD controllers

(Type 3433 controller module only)

When using P or PD controllers, it is necessary that an operating point be adjusted instead of the reset time. This must be done after having adjusted the proportional gain factor K_p as described above.

When the controller is in the steady state condition proceed as follows: Read off the signal pressure yA value from the indicator (1.5). Then set this value with the operating point adjuster (setting values 0.2...1 bar $\triangleq$ 0 ...100 %). Slightly correct the value until system deviation equals zero. If the signal pressure varies, an average value for the operating point has to be determined.

When the set point or the reference variable respectively are changed, readjust the operating point as described above.

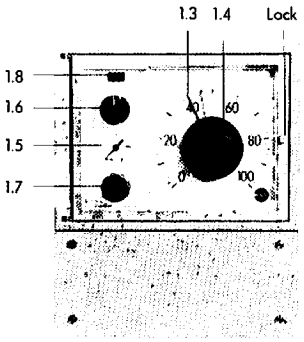
When the value of the reference variable is changed frequently, adjust an operating point of 0.6 bar $\triangleq$ 50 % (average value).

Caution:

If the P/PI controller is set to the P control mode, then the T_n restriction must be fully open to ensure that the operating point adjuster can respond immediately.

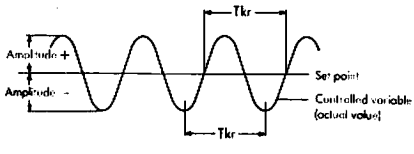
Version with set point-dependent operating point

When using this controller version there is no need for adjusting the operating point, since the operating point automatically follows any changes in the set point w.



1.3 Actual value pointer
1.4 Set point adjuster with pointer
1.5 Signal pressure indicator
1.6 Manual/auto mode switch
1.7 Adjuster for manual signal pressure adjustment
1.8 Differential pressure indicator

Fig. 12 · Indicator unit



Controller	Kp	Tn	Tv
P	0.5	-	-
PI	0.45	0.85	-
PID	0.59	0.5	0.12

Fig. 13 · Harmonic oscillations, Table, setting values

6.2 Bumpless auto/manual transfer and vice versa (Fig. 12)

(only true for controller station with manual/auto mode switch)

Bumpless transfer from the manual to the automatic mode ensures that no pressure surge will be applied to the valve when the manual/auto mode switch is being operated: Proceed as follows:

Automatic/manual transfer

Adjust signal pressure yH with the manual adjuster (1.7) until the differential pressure indicator (1.8) equals zero. Now, the manual/auto switch can be placed to the **Manual** position.

Manual/automatic transfer

If the signal pressure in the system has been adjusted by hand, the 'automatic'-signal pressure yA has to be adjusted with the set point adjuster (1.4) until it has assumed the same value as the signal pressure yH. However, it is not possible to place the switch (16) to the **Automatic** position until the differential pressure indicator equals zero.

6.3 Readjusting the controller zero point

If deviations between set point and actual value should occur during operation, when the controller is in the steady state condition, readjust zero with the **Zero** screw at the back of the indicator unit. Turn this screw until the actual value and the set point value shown on the front indicator coincide.

Such deviations can also be adjusted at the controller module (Pos. 8, Fig. 10).

7. Maintenance

7.1 Checking the air supply

Normally, the components of the pneumatic indicating controller require no maintenance. The air supply, however, should be checked from time to time. Proper operation of the instruments is only then ensured, when the air supplied to the instrument is always in a well cleaned condition. Air filters and traps of the pressure reducing station must be checked at regular intervals. If the air supply in the system reduces, the respective filter has to be cleaned or replaced by a new one if necessary.

Type 3433 Controller modules

If the controller module should not drive to full output or there should be no output signal at all, remove and clean the pre-restriction (pos. 6, Fig. 10) located on the left-hand side, below the comparator. If necessary, pull out the sieve and replace it by a new one (order no. 0550-0193). The plug-in connections of the controller module also have sieves (order no. 0550-0186).

In addition, the connections at the bottom of the housing habe sieves with plastic rims (order no. 0550-0189), which can be removed for cleaning.

7.2 Changing the scale

To change the scale, open the lock of the front cover. Withdraw the scale from the back of the display unit and replace it by a new or special scale.

To mark the measuring points on the scale, use adhesive tapes that are attached inside the housing. Cut the tapes as required and stick them onto the scale.

7.3 Changing the control mode

The control mode can be changed in three different ways, i.e by replacing the complete controller module (Type 3434-1 or 3434-2), by changing the arrangement of the functional components in the controller (such components are e.g. adjusters, restrictions or relays), or by supplementing the controller (Type 3433) with further components.

Type 3433 Controller modules

P to PI mode Remove operating point adjuster (1) and replace it by a T_n restriction (3).

P to P/PI mode Remove operating point adjuster (1) and replace it by an adjuster with control mode selector switch (2) and T_n restriction (3).

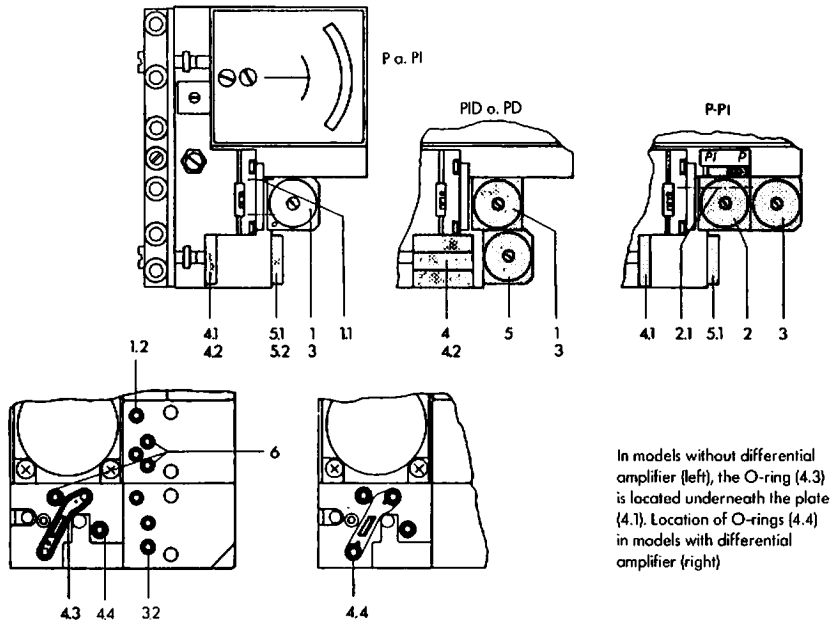
P to PD mode Remove cover plate (4.1). Remove O-ring (4.3) and replace it by two other O-rings (4.4). Install differential amplifier (4). Remove cover plate (5.1) and install T_v restriction (5).

P to PID mode Change mode as specified above, for "P to PD mode". In addition, replace adjuster (1) by T_n restriction (3).

Special P controller version with set point-dependent operating point.

Replace the operating point adjuster by a restriction bridge.

All components required for controller modification are listed in the table on page 17. It is advisable to replace the old O-rings and the sieve in the prerestriction (pos. 6, Fig. 10).



In models without differential amplifier (left), the O-ring (4.3) is located underneath the plate (4.1). Location of O-rings (4.4) in models with differential amplifier (right)

Fig. 14 · Changing the controller action (Type 3433 only)

Table Components for controller modification

Pos.	Number	Designation	Order No.
1	1	Remote adjuster-operating point 1.4 bar	1070-4583
		20 psi	1070-6413
1.1	2	Screws M3 x 8	8333-0479
1.2	4	O-rings 1.78 x 1.02	8421-0010
2	1	Remote adjuster-operating point with change-over switch	1080-6909
2.1	2	Screws M3 x 30	8333-0482
	4	O-rings as pos. 1.2	8421-0010
3	1	T_n restriction	1070-4584
3.1	2	Screws M3 x 16	8333-0476
3.2	3	O-rings 1.78 x 1.02	8421-0010
4	1	Differential amplifier	1080-6924
4.1	1	Cover plate	0360-1598
4.2	1	Screw M3 x 16	8333-0476
4.3	1	O-ring 14 x 1.5 for plate	8421-0070
4.4	4(2)	O-ring 2 x 1.5	8421-0023
5	1	T_v restriction	1070-4585
5.1	1	Cover plate	0360-1597
5.2	2	Screws M3 x 8	8333-0479
5.3	4	O-rings 2 x 1.5	8421-0023
	1	Restriction for set point-dependent operating point	1590-1089

7.4 Checking the controller action

To check the controller action, short-circuit the controlled variable input x and the controller output y at the connections at the bottom of the controller station. The turnboard A must be adjusted to increasing/decreasing operating action, the T_n restriction to „fully open", and the T_V restriction to "closed".

Vary the reference variable with the set point adjuster, i.e. let it pass through its entire range. If the controller operates correctly, the readings of the controlled variable and controller output indicators will follow the reference variable variations over the complete indicator range.

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