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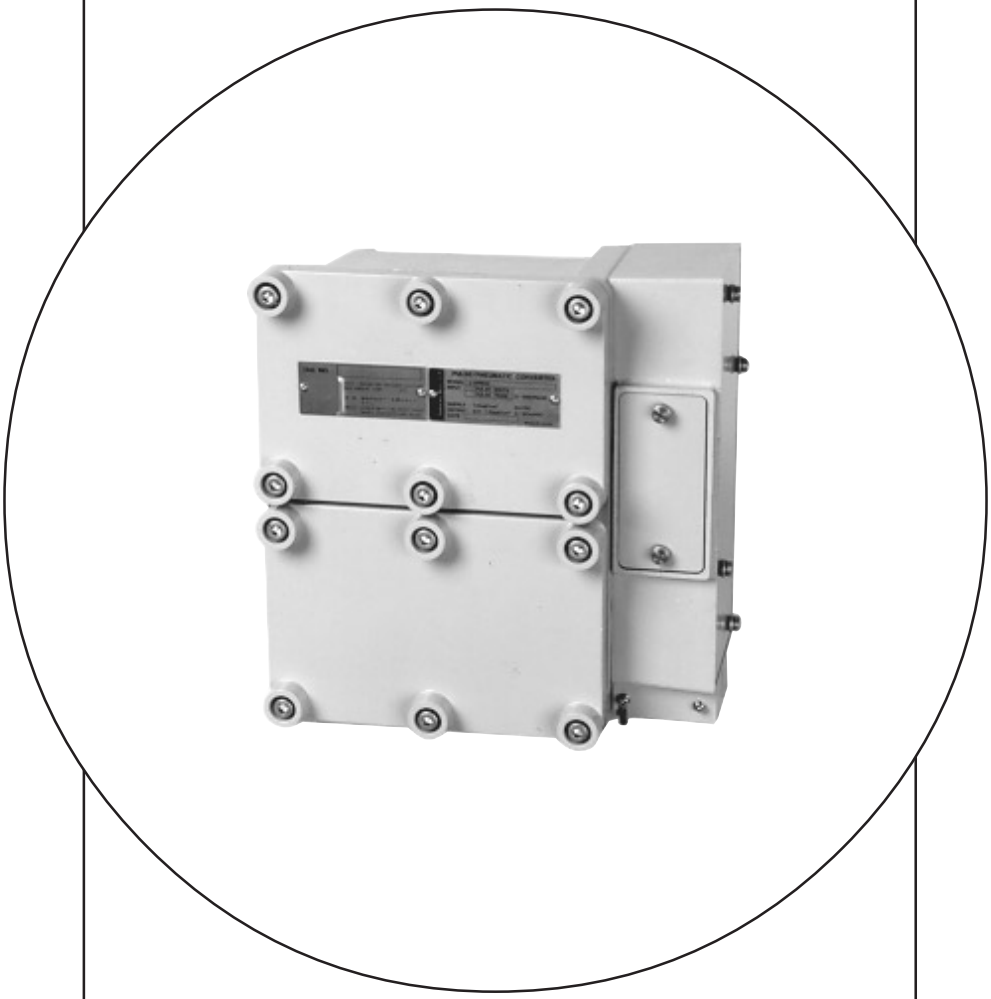
OM2-5910-0300

Explosion-proof Pulse-to-Pneumatic Pressure Converter Model J-APN20

User's Manual



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1. Outline

This Explosion-proof Pulse-to-Pneumatic Pressure Converter meets the requirements of pressure resistant and explosion-proof structure d2G4 for gases in explosion class 2 and flammability 4 (JIS C0903).

The J-APN20 Explosion-proof Pulse-to-Pneumatic Pressure Converter responds to up (upward) and down (downward) pulse signals. It drives pulses and a (four-phase) motor to send pneumatic pressure signals of 20 to 100 kPa {0.2 to 1.0 kgf/cm^2} and feedback signals of 4 to 20 mA through a nozzle and a flapper mechanism.

In case of power failure, the converter's worm gear mechanism keeps the pneumatic pressure signal at its pre-failure position (provided that the pneumatic source is in normal operation).

The converter is structurally divided into three sections. The electrical circuit section and the terminal section are of Explosion-proof structure, and the mechanical section is of waterproof structure.

2. Specifications

2-1 Input Section

1) **Up and down pulse signals**

Pulse width: While ON signals are being entered for up or down pulse signals, output continues to change. The speed depends on response speed changeover signals and speed settings.

Pulse train: When 1,000 pulses are entered, output changes from 0% to 100% FS.

2) **Up and down signals**

Contact input: contact rating
Dry contact
30 VDC, 20 mA or over
Open collector
Vce 30 V or over; Ic 20 mA or over

Pulse train: maximum response frequency: 150 pulses/sec
minimum pulse width: 2.5 ms

Pulse width: minimum response pulse width: 8 ms
output current minimum response time: 15 ms
(at the time of maximum response speed)

3) **Response speed changing signals (valid only at the time of pulse width input)**

Contact input: contact rating
Dry contact
30 VDC, 20 mA or over
Open collector
Vce 30 V or over; Ic 20 mA or over
When signals are on: high speed 7 to 20 sec / FS variable
When signals are off: low speed 20 to 50 sec / FS variable

2-2 Output Section

1) Pneumatic pressure signal: 20 to 100 kPa {0.2 to 1.0 kgf/cm^2} (also changeable in psi, bar units)

Load: 4 ø × 3 m + 20 cc

2) Feedback signal: 4 to 20 mA DC or 20 to 4 mA DC

Signal power source can be switched between external and internal power supplies.
24 VDC ± 15%

Load: 480 Ω maximum at 24 VDC (4 to 20 mA DC output)

3) Limit contact signal: detected by a microswitch (select between NC and NO)

Settings: High limit can be set within the range of 100% to 108% FS (102% ±1% as default).

Low limit can be set within the range of –8% to 0% FS (–2% ±1% as default).

Contact rating: 120 VAC, 0.1 A, resistance load

125 VDC, 0.1 A, resistance load

4) Supplied pneumatic pressure monitor: Switchable between NO and NC (closed as default when the pneumatic source is lost.)

Setting range: 110 to 120 kPa {1.1 to 1.2 kgf/cm^2} or less (set at 110 kPa {1.1 kgf/cm^2} when shipped out of factory)

Contact rating: 120 VAC, 0.1 A, resistance load

125 VDC, 0.1 A, resistance load

5) Power supply monitor

When lost: open or closed

Contact rating: 120 VAC, 0.1 A, resistance load

125 VDC, 0.1 A, resistance load

2-3 Performance

1) Accuracy

Pulse train: Pulse/pneumatic pressure: ± 2.0% FS

Pneumatic pressure signal/feedback signal: ± 0.5% FS

Pulse width: Pneumatic pressure signal/feedback signal: ± 0.5% FS

2) Additional accuracy

Effect of ambient temperature change:

Pneumatic pressure signal: ± 0.5% FS / 25 ± 25 °C

Feedback signal: ± 0.6 % FS / 25 ± 25 °C (against pneumatic pressure signal)

Effect of supplied pneumatic pressure change: ±1.0% FS/20 kPa {±0.2 kgf/cm^2}

Effect of power supply fluctuations (load: 250Ω): ± 0.3 % FS / ±15% of rated voltage

2-4 Other

1) Power supply: 24 VDC ±15% (power consumption: 350 mA)
2) Supplied pneumatic presure: 140±20 kPa {1.4±0.2 kgf/cm^2}

Air consumption (in equilibrium): 6 N*l*/min

Maximum air supply capacity: 20 N*l*/min

Air load capacity: 3 m pipe with internal diameter of 4 mm + 20 cc or larger

3) Ambient temperature range: –10 to + 60 °C
4) Ambient humidity range: 10 to 90 % RH

5) Vibration: 0 to 120 Hz, 0.5 G

6) Structure: pressure resistant and explosion-proof d2G4 (JIS C0903)
Pneumatic pressure conversion section is waterproof (equivalent to JIS F8001, Class 3 water repellent)

7) Mounting: 2B pipe or wall surface

8) Connections
Pneumatic pipe connection: Rc 1/4 internal thread
Electrical pipe connection: G 3/4 internal thread
Electrical wiring: M4 screw

9) Finish: light beige baked acrylic

10) Weight: approximately 17 kg (including air set)

11) Withstand voltage: 40 VAC for 1 minute between each terminal and the case grounding
(500 VAC for 1 minute when the surge absorber is removed)

12) Insulation resistance: 100 MΩ or over between each terminal and the case grounding
(500 VDC when the surge absorber is removed)

13) Electrical wiring: Recommended wiring specifications
Wiring length: 1 km maximum
Recommended wire material:
Up and down signals: KPEV-S cable for pulse train input
CVV-S cable for pulse width input
For other signals: CVV-S cable
To shield the cables, ground to class 3 or higher on the instrument room side.

2-5 Additional Specifications

1) With an air set: reduction valve with filter + ϕ 40 mm pressure gauge
2) With a pneumatic pressure gauge: ϕ 40 mm pressure gauge
3) Anticorrosion coating: baked acrylic coating (for corrosive atmospheres)
4) Heavy anticorrosion coating: baked epoxy coating (for corrosive liquids)
5) General silver coating: baked acrylic coating (prevents the temperature of the converter from rising during exposure to sunshine, radiant heat etc.)
6) Anticorrosion silver coating: baked acrylic coating (prevents the temperature rising in corrosive atmospheres)
7) With (two) cable adapters with pressure resistant packing (packing holes 14 and 15 mm in diameter)

3. Model Number Configuration

Basic Model Number	Selectable Specifications													Additional Specifications	Contents
	Power supply	Input signal	Output air pressure signal	Feedback signal	External connection	Housing finish	Mounting	Cable adapter flame-proof packing	Power-down monitor	Supplied air pressure down monitor	Structure	P/I unit power supply	Limit contact signal		
J-APN20															Explosion-proof Pulse/Air Pressure Converter
	–B														24 VDC isolated
		I													Pulse width
		J													Pulse train
			1												0.2 to 1.0 kgf/cm^2
			2												3 to 15 psi
			3												0.2 to 1.0 bar
			4												20 to 100 kPa
				1											4 to 20 mA DC
				2											20 to 4 mA DC (reverse characteristics)
					R										Air connection: Rc $^1/_4$ Electorical connection: G $^3/_4$ internal thread
						1									Standard finish
						2									Corrosion-resistant finish
						3									Corrosion-proof finish
						4									Silver finish
						5									Corrosion-resistant (silver) finish
							T								2B pipe mounted
							S								Wall mounted
								X							None
								2							With two cable adapters with pressure resistant packing
									X						None
									H						Normally closed
									K						Normally open
										X					Without
										D					With
											E				Explosion-proof case (JIS C 0903 d2G4)
												1			Built-in
												2			Supplied externally
													H		Normally closed
													K		Normally open
														–X	No additional specifications
														–3	Pneumatic output gauge (40 mm)
														–7	Air set

4. Converter Configuration

4-1 Block Diagram

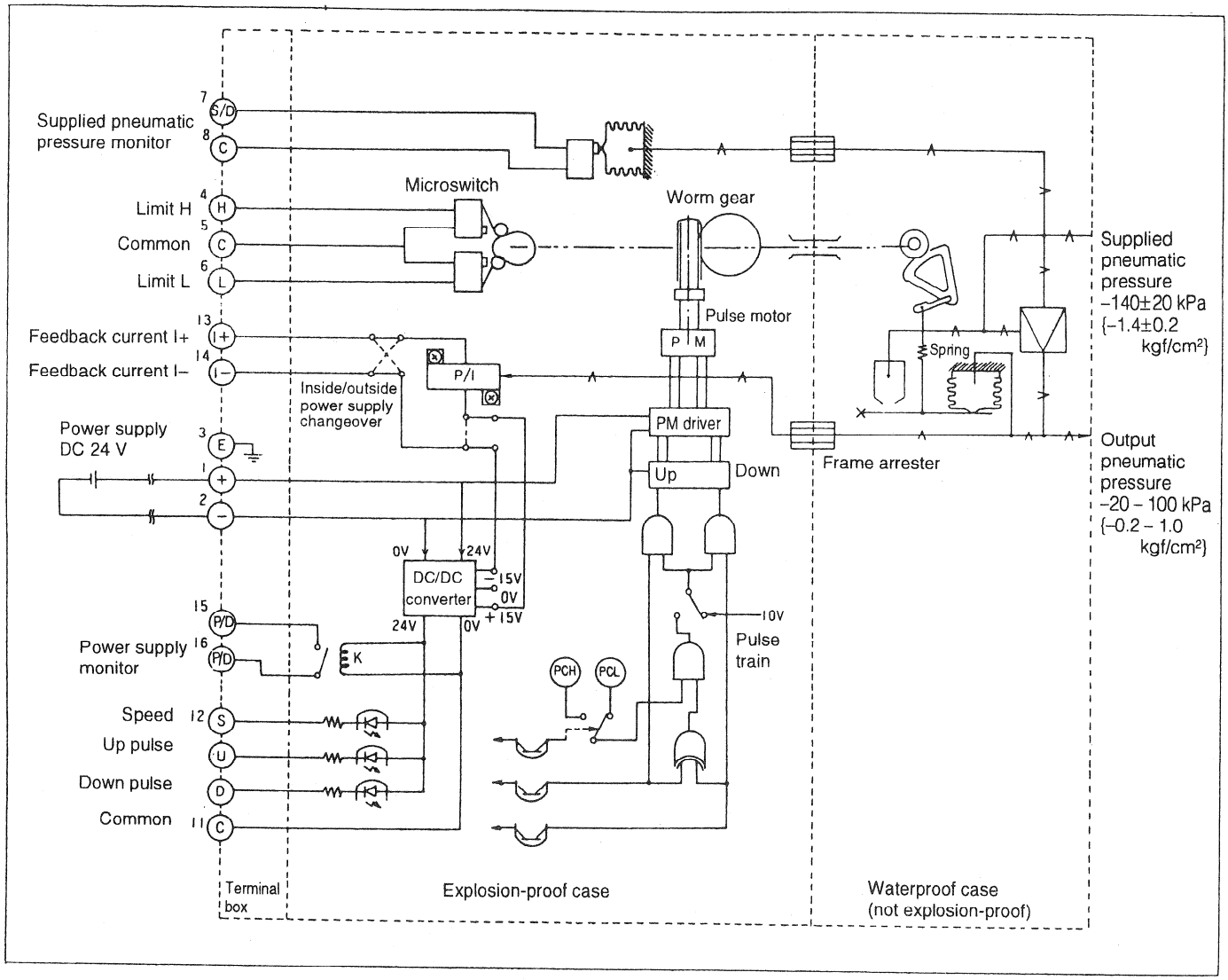


Figure 4-1 Block diagram

Note 1: The up pulse and down pulse input signals should be structured so that pulse input can be cut at or above their limits in an external sequence with the use HI and Lo limit contact outputs.
If input diverges from the calibrated limits and hits the mechanical stopper and the signal is not shut off, the worm gear mechanism will start chattering. Do not use the converter for a long time in this condition; it will damage the worm gear shaft bearing.

4-2 Converter Configuration and Names of Parts

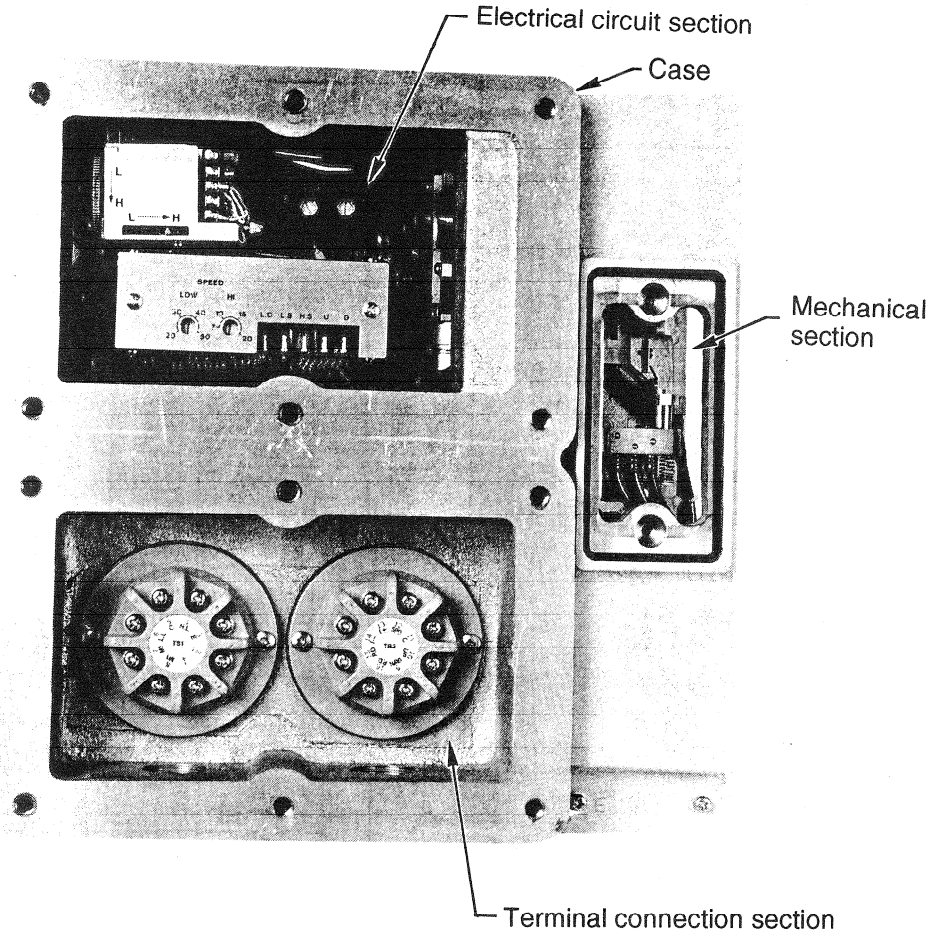


Figure 4-2 Converter configuration and names of parts

4-3 Circuitry

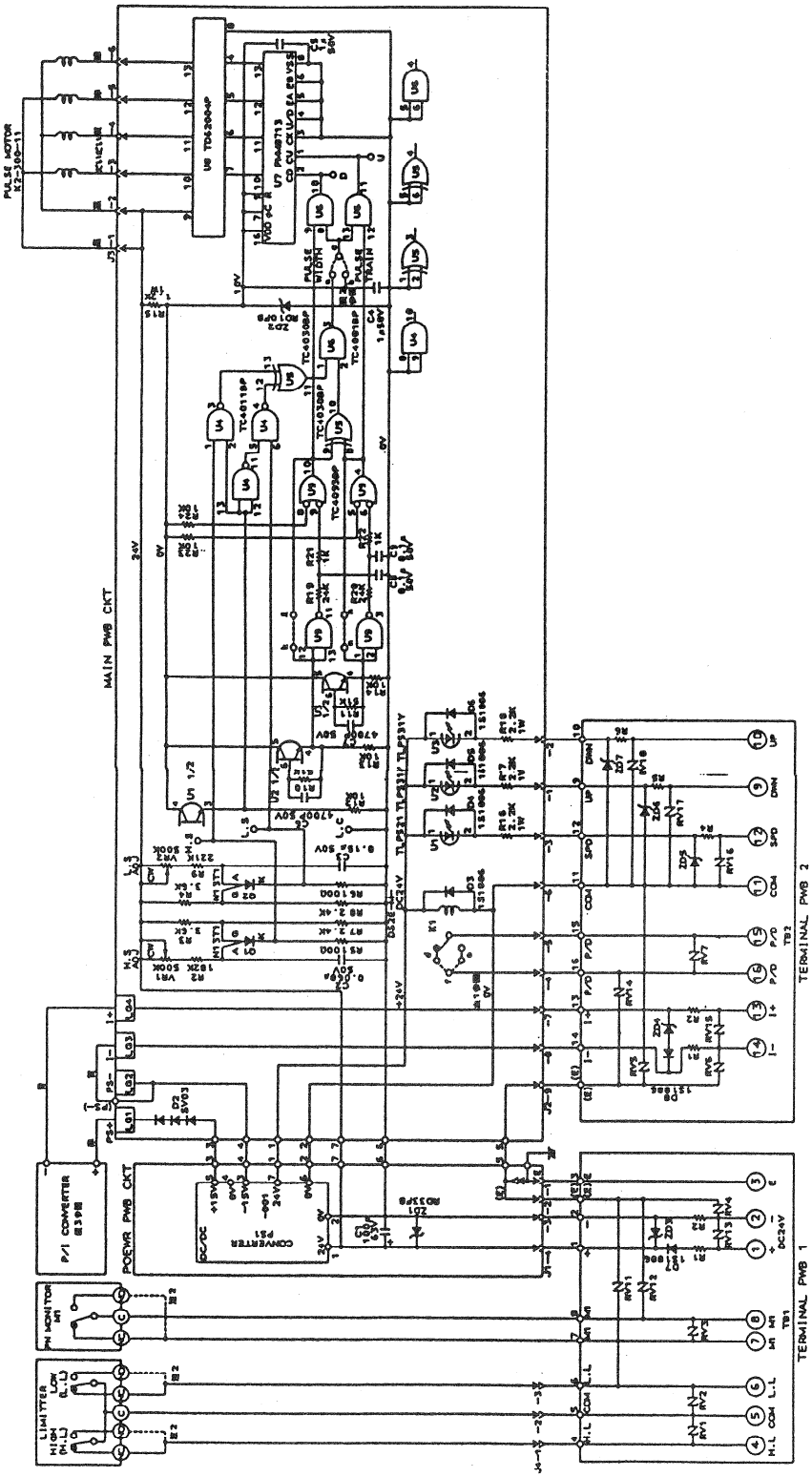


Figure 4-3 Circuitry

Table 1 Power down monitor

Jumper	Contact output
f-d	Normally open
f-e	Normally closed

Table 2 Pulse input (whether parts are present or not according to pulse width and pulse train)

R2	R3	R4	R5	R6	R7	R8	R9	R12	R16	R19	R20	R21	R22	R23	R24	C2	Jumper	Up/down input
✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	×	×	×	×	×	×	✔	k-b, m-n, a-c	Pulse width
×	×	×	×	×	×	×	×	×	×	✔	✔	✔	✔	✔	✔	×	b-c	Pulse train

C3	C6	C7	C8	C9	C4	U1	U4	U5	U9	VR1	VR2	Q1	Q2	Check bit			Up/down input
✔	×	×	×	×	✔	✔	✔	✔	×	✔	✔	✔	✔	✔	✔		Pulse width
×	✔	✔	✔	✔	×	×	×	×	✔	×	×	×	×	×	×		Pulse train

Present: ✔
Not present: ×

Table 3 D/I Power supply

Power supply	Connection
Inside supply	LG1 – red, LG3 – yellow, LG4 – blue
Outside supply	LG2 – yellow, LG3 – blue, LG4 – red

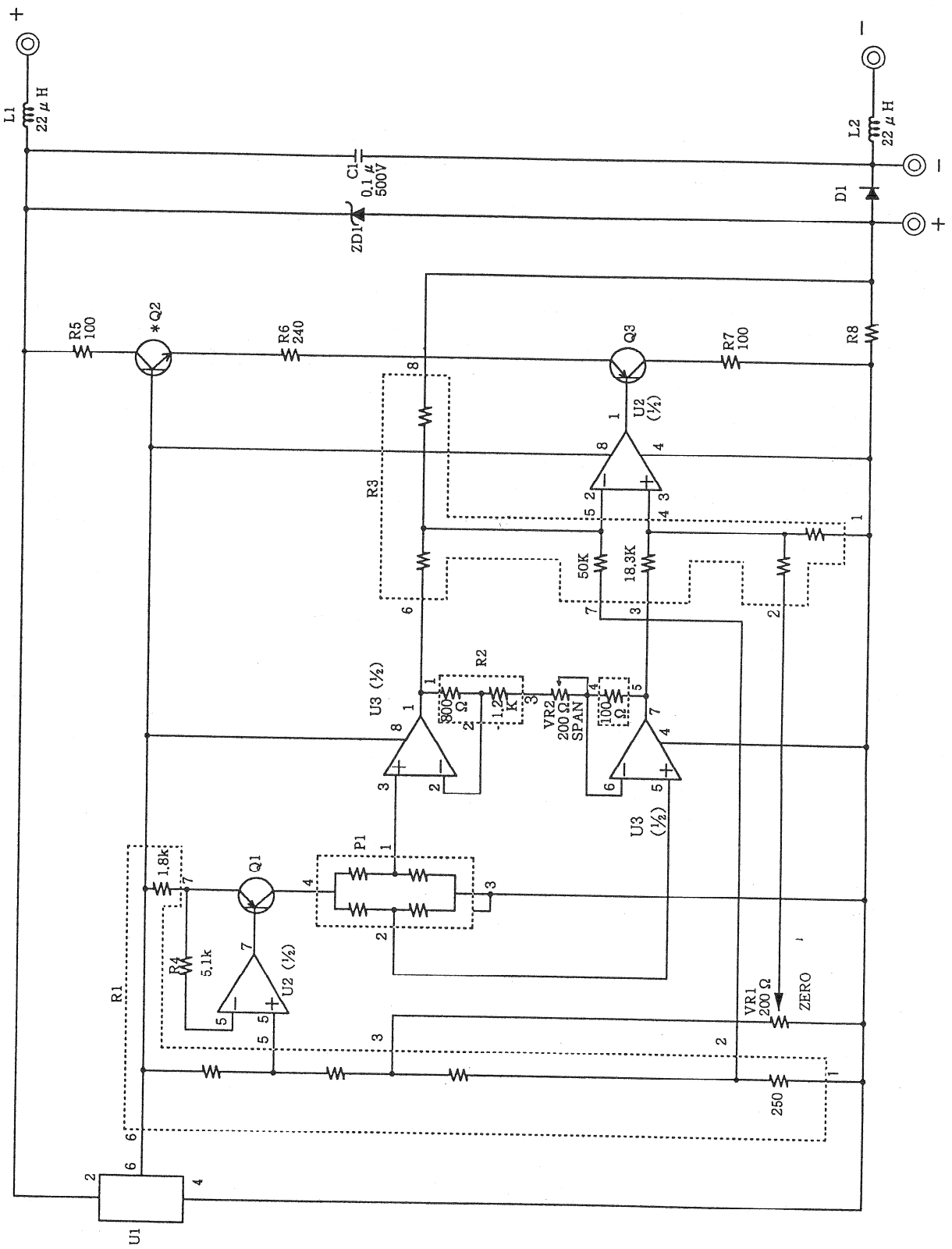


Figure 4-4 P/I unit connection diagram

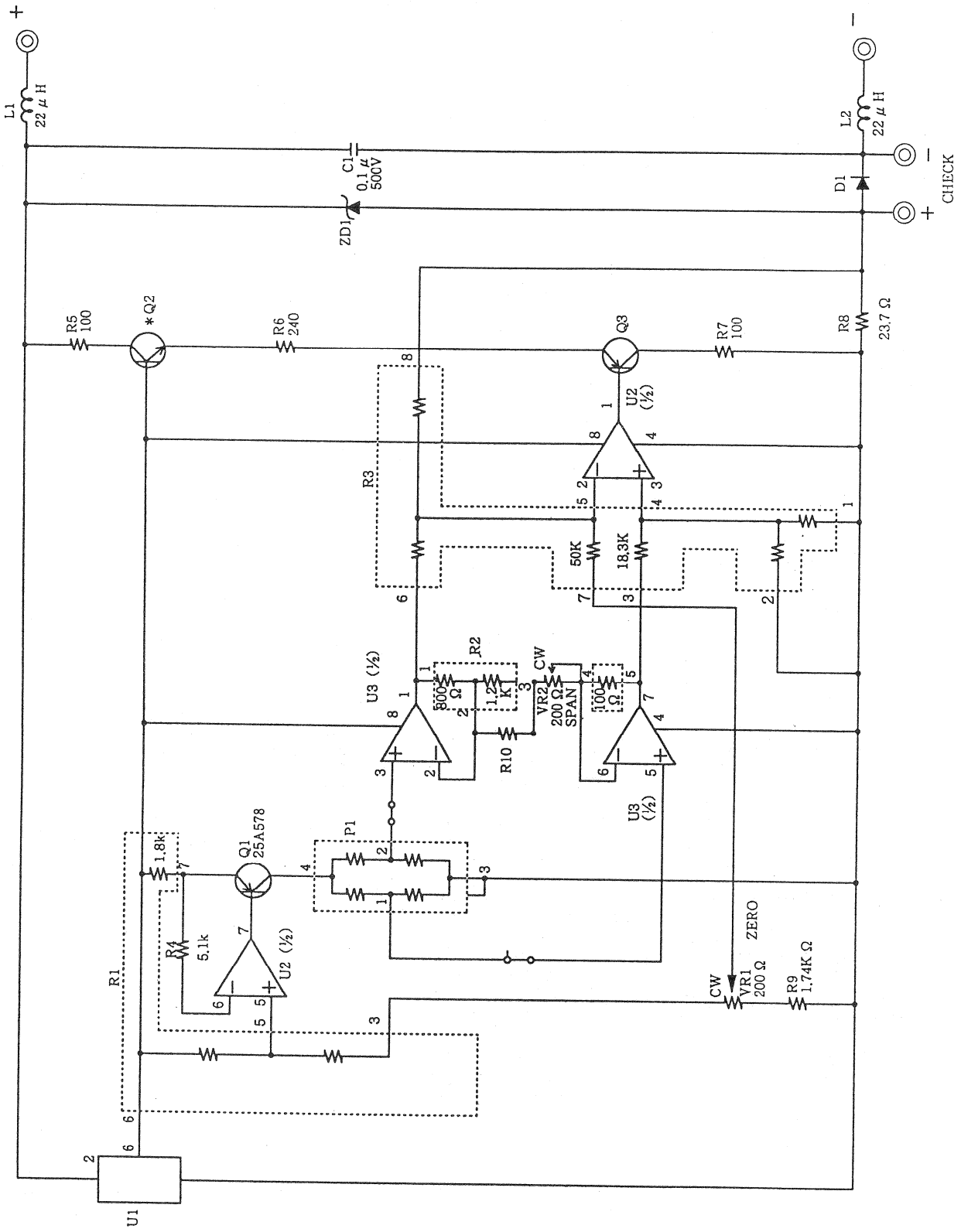


Figure 4-5 P/I unit (reverse characteristics) connection diagram

5. Installation and Operation

5-1 Installation

Refer to Figure 5-1 or Figure 5-2 to mount the converter on a 2B pipe or wall.

Cable specifications

Packing hole diameter	Applicable cable diameter
14	13.0 – 13.9
15	14.0 – 14.9

1) 2B pipe mounted

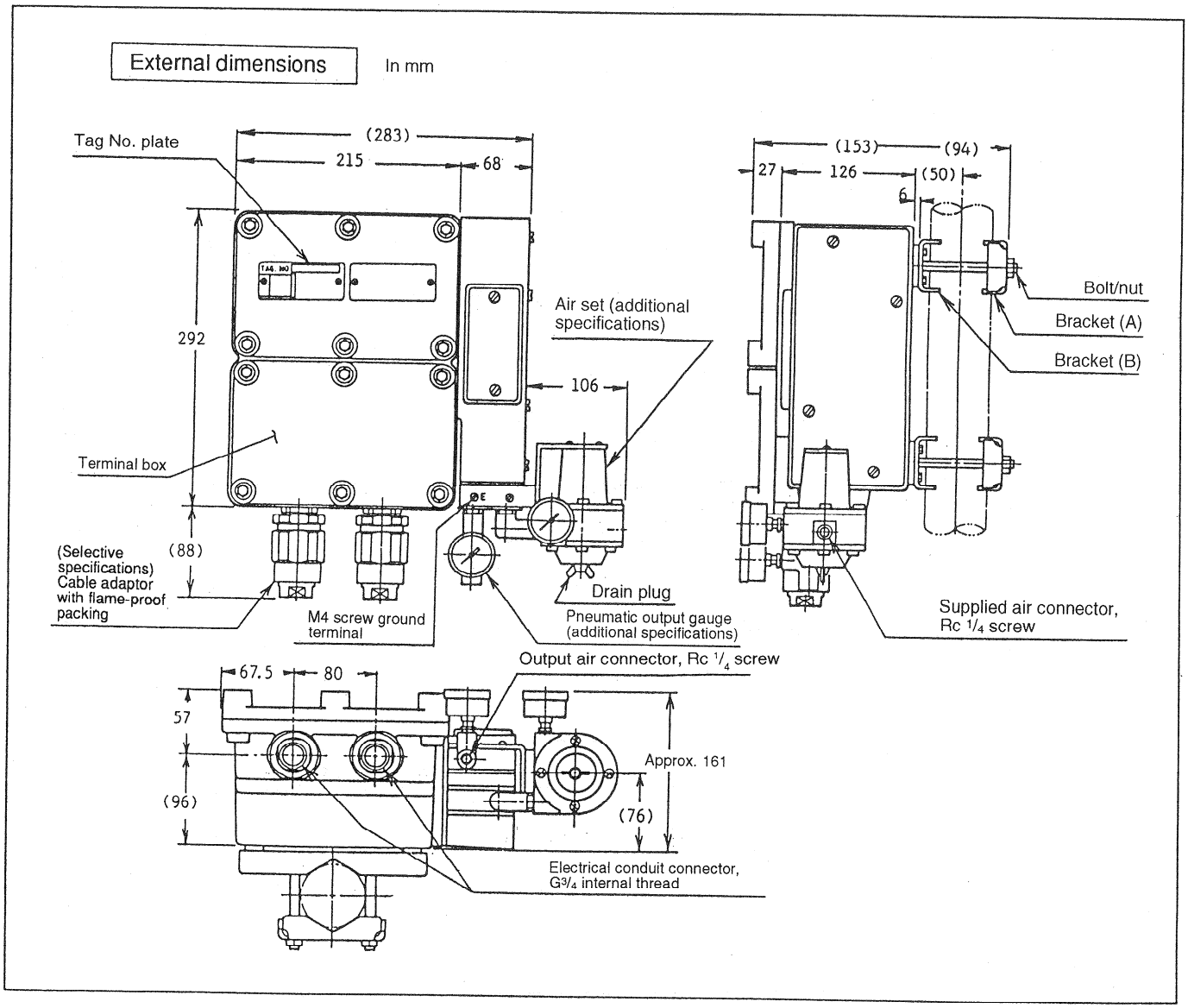


Figure 5-1 2B pipe mounted

2) Wall mounted

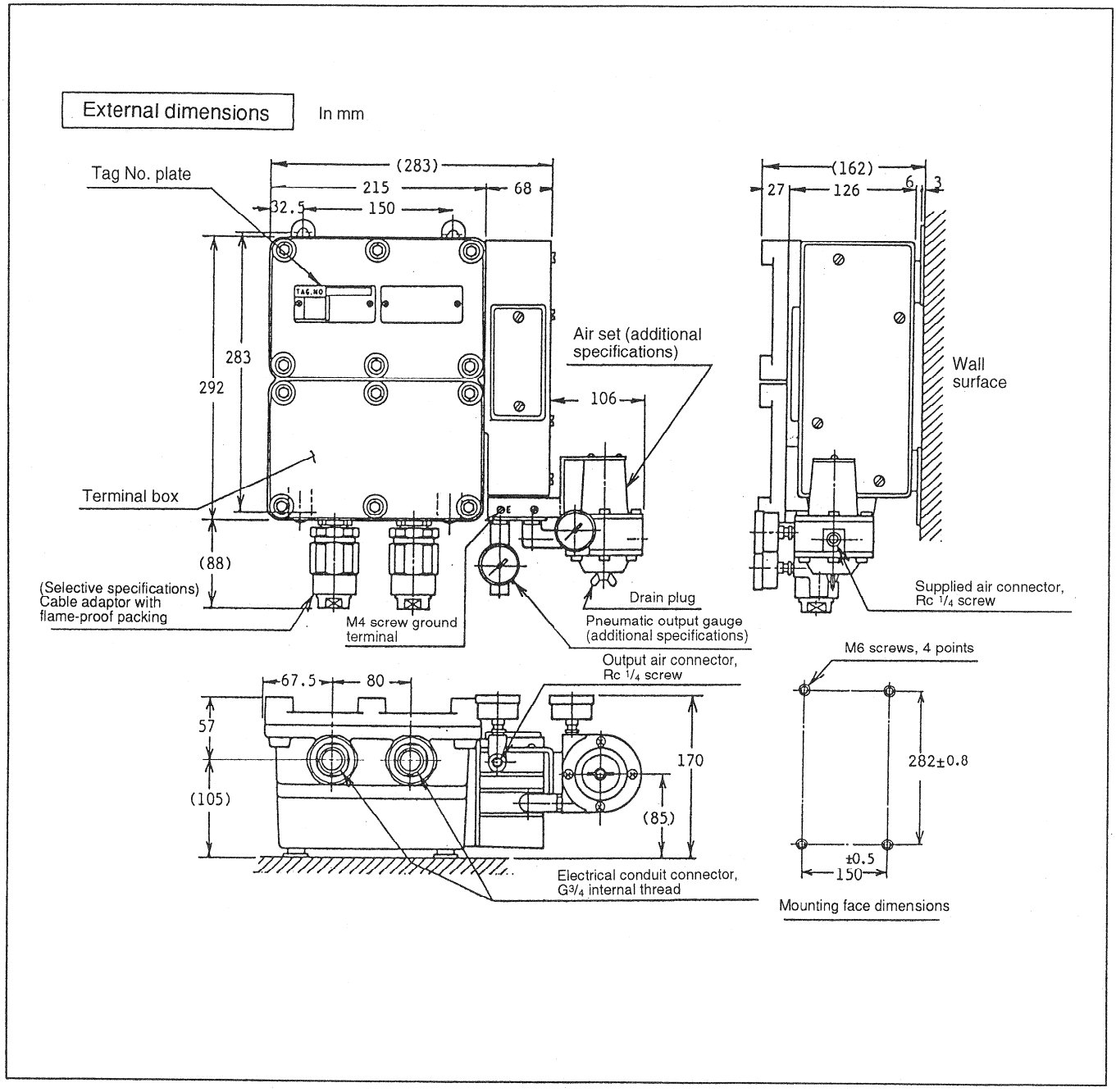


Figure 5-2 Wall mounted

5-2 Piping and Wiring Procedures

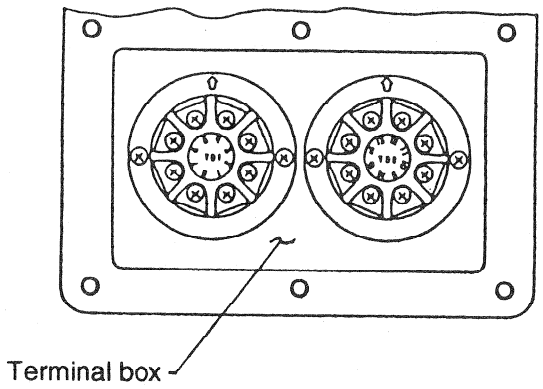
1) Piping

(a) For air supply, use appropriate instrumentation air. The pressure on the primary side of the air set is 200 to 990 kPa {2 to 9.9 kgf/cm^2}, and the pressure on the secondary side is 140±20 kPa {1.4±0.2 kgf/cm^2}.

(b) Pipe matching is Rc$^1/_4$ everywhere. For conducting the work, refer to Figure 5-1 or Figure 5-2.

2) Wiring

Refer to Figures 5-3 and 5-4.



No.	Symbol	Contents
1	+	DC 24 V power supply +
2	–	DC 24 V power supply –
3	E	Ground
4	H. L	High limit contact output
5	C	Limiter output common
6	L. L	Low limit contact output
7	M1	Pneumatic pressure monitor contact output
8	M1	Pneumatic pressure monitor contact output
9	DWN	Down pulse input, collector side
10	UP	Up pulse input, collector side
11	C	Pulse input common (emitter side)/speed changeover switch
12	SPD	Speed changeover switch
13	I +	Feedback current output +
14	I –	Feedback current output -
15	P. D	Power monitor contact output
16	P. D	Power monitor contact output

Figure 5-3 Layout of terminals and connection table

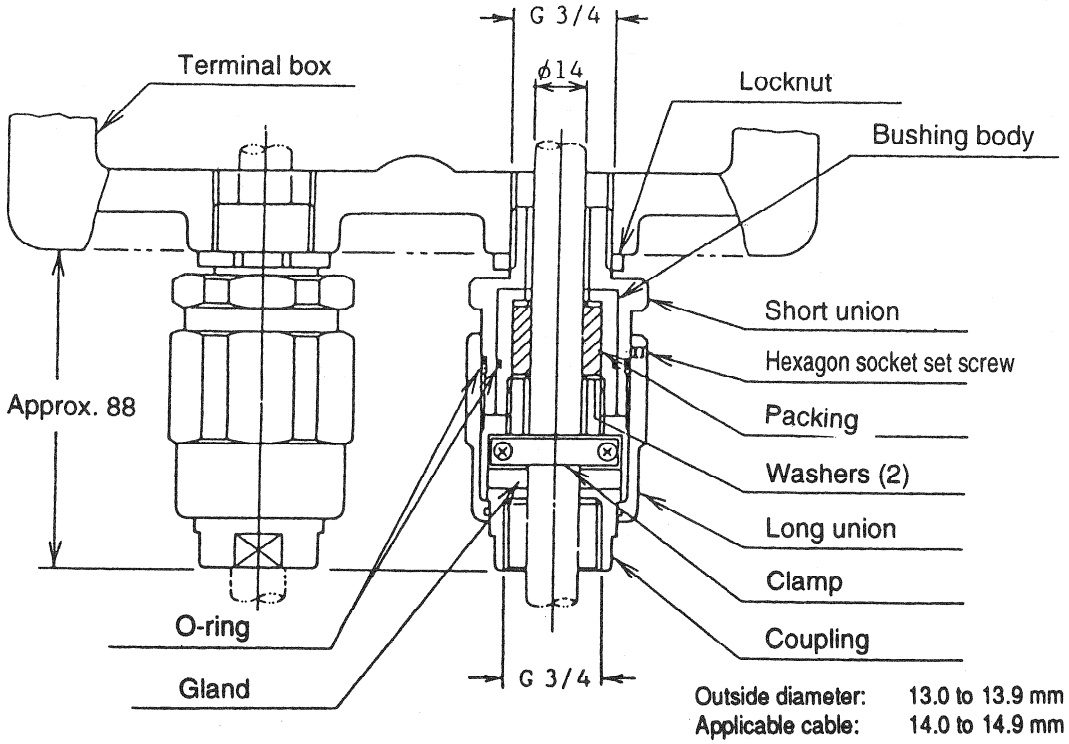
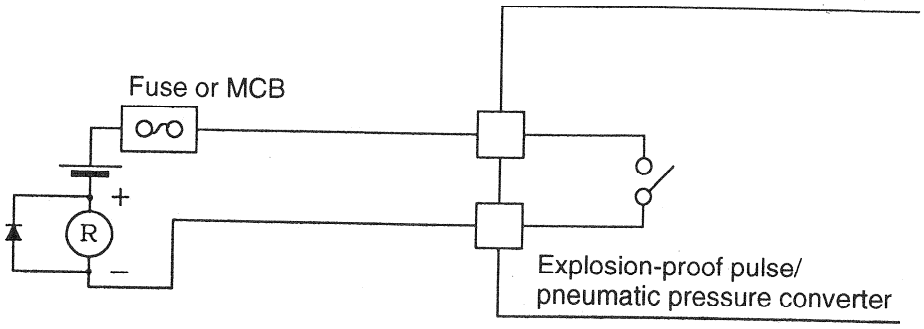


Figure 5-4 With cable adapter with pressure resistant packing

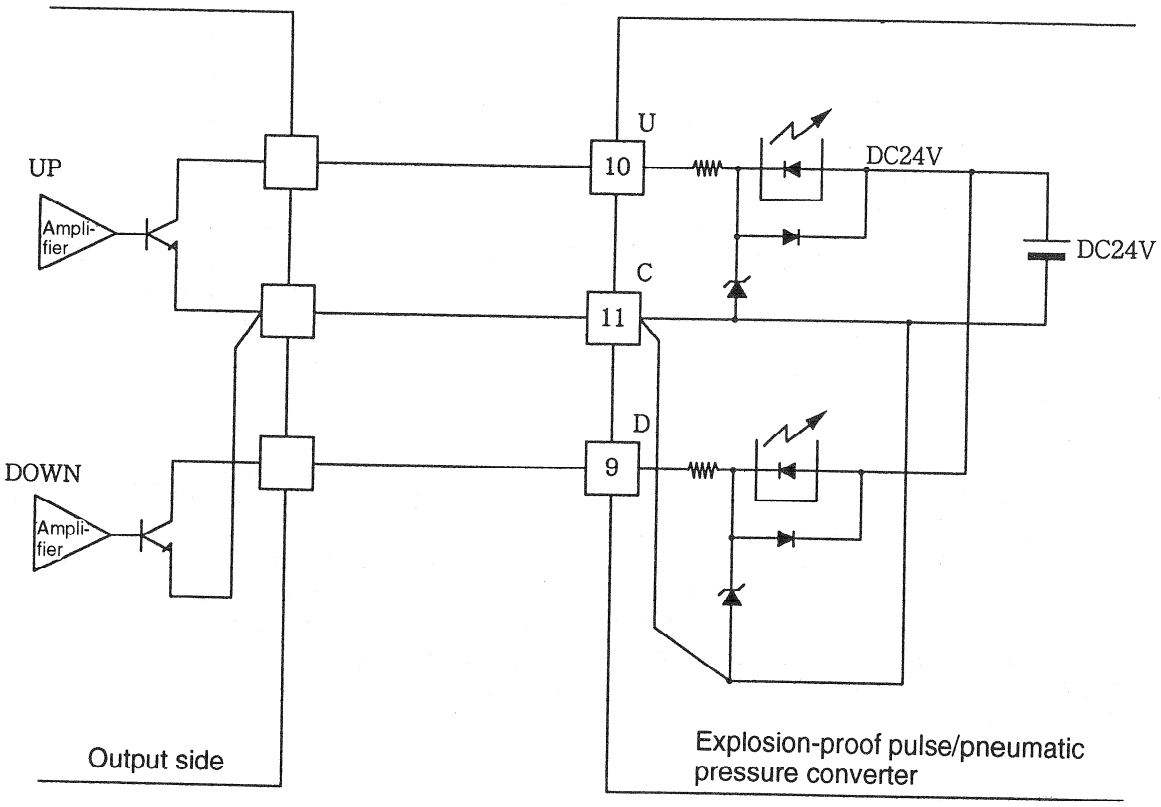
3) Connections

(a) Contact output



For safety, combine the converter with a surge suppression device on the load side of contact output.

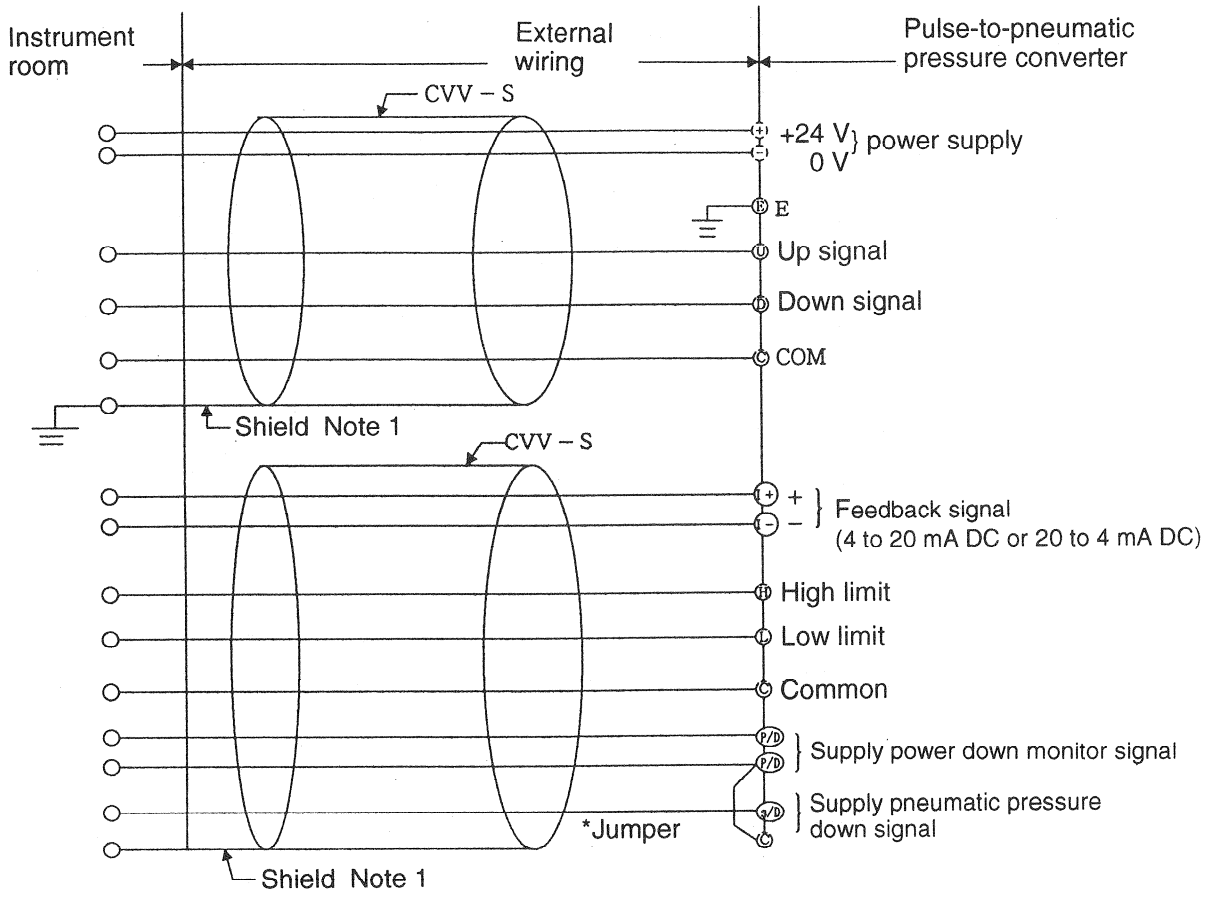
(b) Up/down signals



Open collector output is desirable for up/down signals.

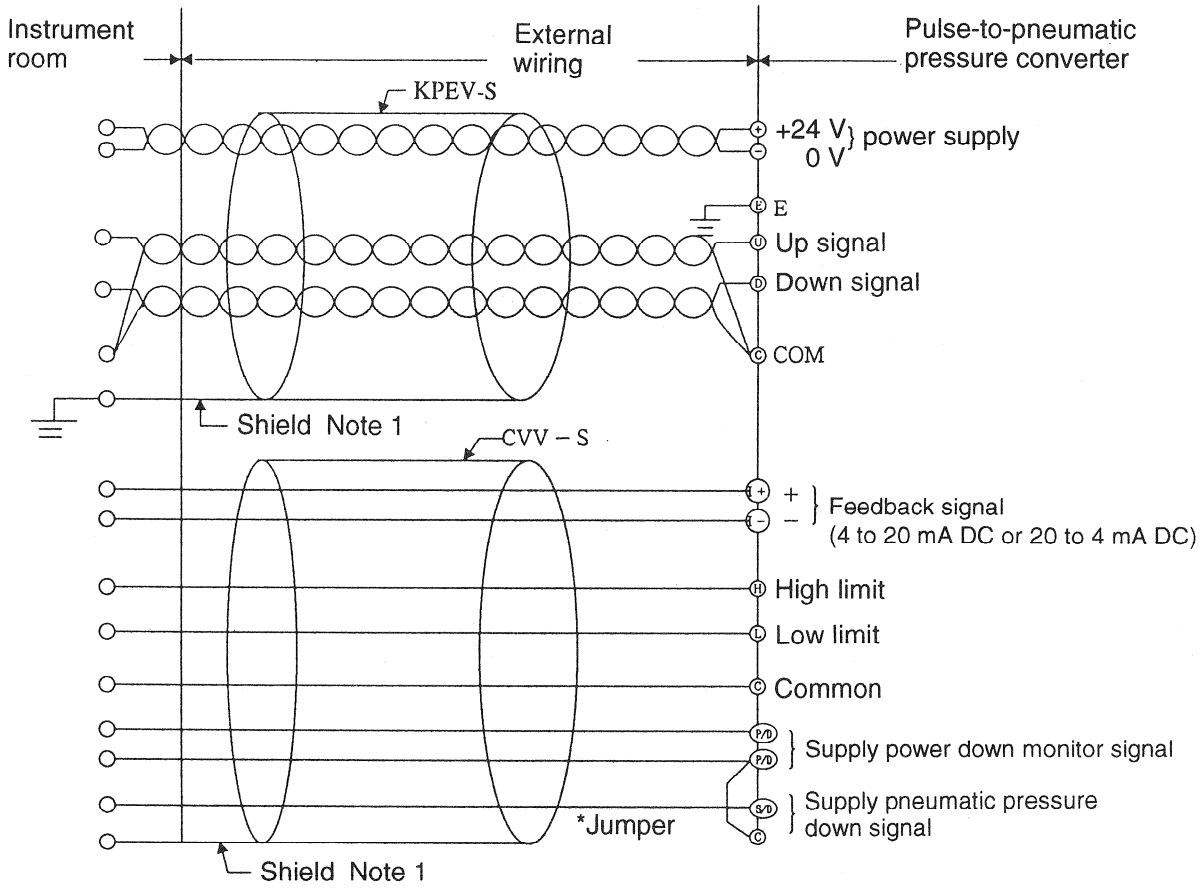
5-3 Wiring Procedure

1) Recommended wiring for pulse width input



Note 1: Ground the cable shield only on the instrument room (Class 3 or higher).
Note 2: Install the jumpers on the external wiring.
Note 3: Although a large number of additional functions can be selected on the pulse-to-pneumatic pressure converter, the number of external wires may be limited depending on the conduit dimensions. The cable shapes and the number of wire cores should be your guides when selecting functions.
Note 4: Ground the main unit to Class 3 or higher.

2) Recommended wiring for pulse train input
Use KPEV-S for up and down signals and CVV-S for other signals.



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Note 4: Ground the main unit to Class 3 or higher.

3) Recommended cables

Up and down signals

Pulse train input cable: KPEV-S.

Pulse width input cable: CVV-S.

Signals other than up and down signals: CVV-S

① KPEV-S cable specifications

(Used for up and down signals for pulse train output)

Polyethylene insulated vinyl sheath cable for shielded instrumentation

Performance:

Conductor: twisted soft copper wire for electrical use (JIS C 3102)

Insulator: polyethylene

Pair twisting: two wire cores twisted together at a proper pitch

Structure: 2P × 3, blanket shielding

Electrical characteristics

Conductor: Nominal cross area:	2 mm^2
Structure:	7 cores/0.6 mm
Conductor resistance:	9.61 Ω/km
Line capacity (reference value):	0.08 μF
Sheath thickness:	1.5 mm
External diameter:	15.0 mm

② CVV-S cable specifications

(Used for signals other than up and down signals for pulse train output)

Vinyl insulated vinyl sheath cable for shielded instrumentation

Performance:

Conductor: twisted soft copper wire for electrical use (JIS C 3102)

Insulator: vinyl

Structure: 6 cores or 8 cores, blanket shielding

Electrical characteristics

Conductor: Nominal cross area:	2 mm^2
Structure:	7 cores/0.6 mm
Outside shape:	1.8 mm
Conductor resistance:	9.42 Ω/km
Line capacity (reference value):	0.12 μF/km
Sheath thickness:	1.5 mm
External diameter:	14.0 to 15.0 mm (depends on the number of cores)

4) Outside cable diameter and number of wire cores

Structure table CVV-S (2–30 x 1.25m²)

No. of cores	Conductor			Insulator thickness	Copper tape thickness (approximate)	Sheath thickness	External diameter (approximate)	Approximate mass
	Nominal profile	Structure	Diameter					
	mm²	Cores/mm	mm	mm	mm	mm	mm	Kg/Km
2	1.25	7/0.45	1.35	0.8	0.1	1.5	9.6	120
3	1.25	7/0.45	1.35	0.8	0.1	1.5	10.5	140
4	1.25	7/0.45	1.35	0.8	0.1	1.5	11.0	160
5	1.25	7/0.45	1.35	0.8	0.1	1.5	12.0	190
6	1.25	7/0.45	1.35	0.8	0.1	1.5	13.0	220
7	1.25	7/0.45	1.35	0.8	0.1	1.5	13.0	230
8	1.25	7/0.45	1.35	0.8	0.1	1.5	13.5	260
10	1.25	7/0.45	1.35	0.8	0.1	1.5	15.5	320
12	1.25	7/0.45	1.35	0.8	0.1	1.5	16.0	355
15	1.25	7/0.45	1.35	0.8	0.1	1.5	17.0	420
20	1.25	7/0.45	1.35	0.8	0.1	1.5	19.0	525
30	1.25	7/0.45	1.35	0.8	0.1	1.6	23	750

Structure table CVV-S (2–30 x 2m²)

No. of cores	Conductor			Insulator thickness	Copper tape thickness (approximate)	Sheath thickness	External diameter (approximate)	Approximate mass
	Nominal profile	Structure	Diameter					
	mm²	Cores/mm	mm	mm	mm	mm	mm	Kg/Km
2	2	7/0.6	1.8	0.8	0.1	1.5	10.5	150
3	2	7/0.6	1.8	0.8	0.1	1.5	11.5	180
4	2	7/0.6	1.8	0.8	0.1	1.5	12.0	210
5	2	7/0.6	1.8	0.8	0.1	1.5	13.0	250
6	2	7/0.6	1.8	0.8	0.1	1.5	14.0	290
7	2	7/0.6	1.8	0.8	0.1	1.5	14.0	310
8	2	7/0.6	1.8	0.8	0.1	1.5	15.0	355
10	2	7/0.6	1.8	0.8	0.1	1.5	17.5	430
12	2	7/0.6	1.8	0.8	0.1	1.5	18.0	490
15	2	7/0.6	1.8	0.8	0.1	1.5	19.5	585
20	2	7/0.6	1.8	0.8	0.1	1.6	22	745
30	2	7/0.6	1.8	0.8	0.1	1.7	26	1,080

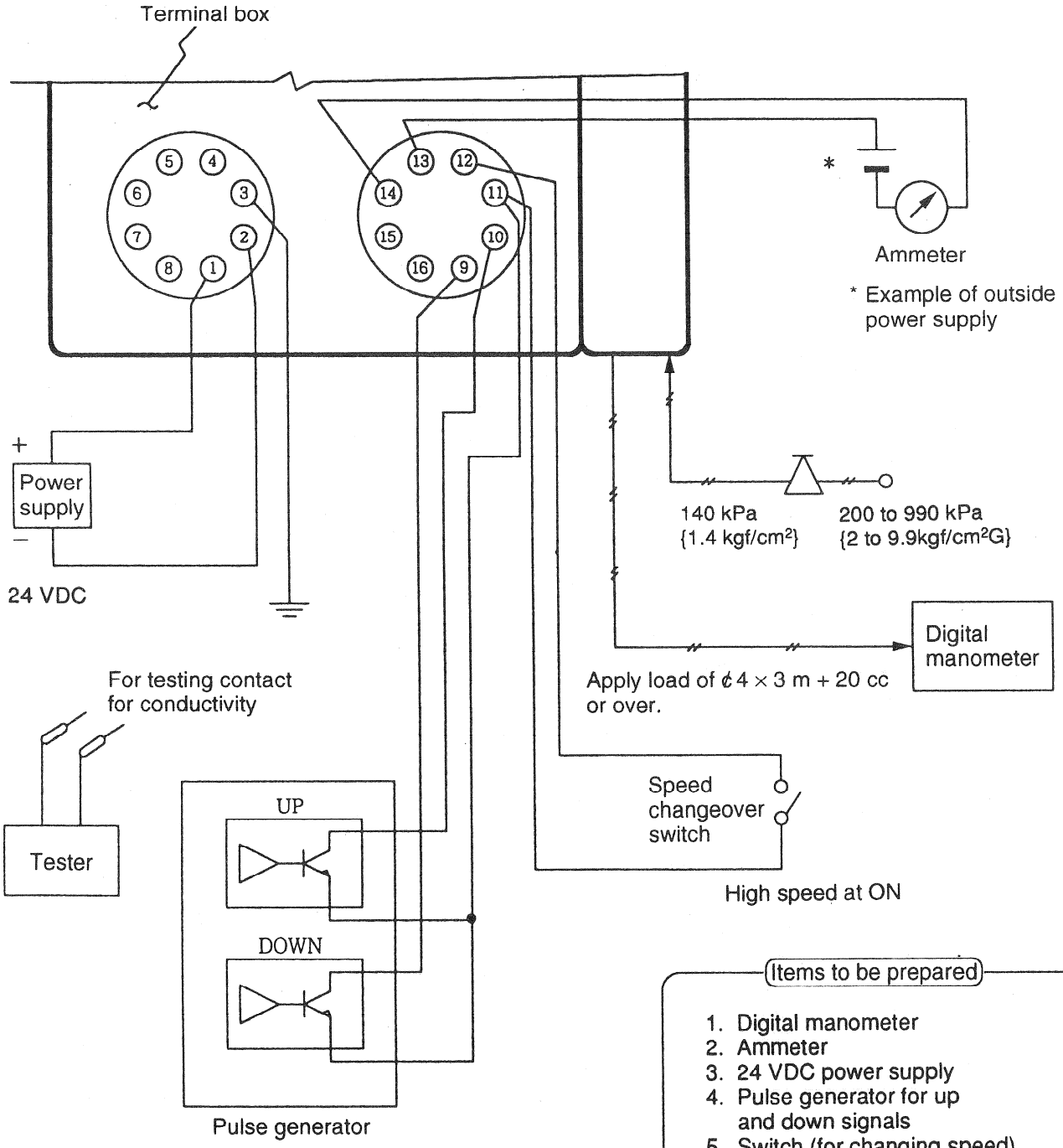
Packing hole diameter applicable to waterproof glands

Use either of two kinds: 14 and 15 in diameter.

6. Adjustment and Settings

6-1 Preparations

Connect the instrument as shown in Figure 6-1. Let the converter run for at least 30 minutes before operation.



Items to be prepared

1. Digital manometer
2. Ammeter
3. 24 VDC power supply
4. Pulse generator for up and down signals
5. Switch (for changing speed)
6. Air supply (with air set attached)
   200 to 990 kPa {2 to 9.9 kgf/cm²}
   No air set
   140 kPa {1.4 kgf/cm²G}
7. Tester for checking contact

Figure 6-1

6-2 Setting the Upper and Lower Limit Switches

Upper limit: 100% + 2% or – 0% FS
Lower limit: 0% + 0% or – 2% FS

Pneumatic pressure output is set at the limits mentioned below.

6-3 Adjustment of Current (Voltage) Output

Conduct the wiring and piping as described in 5-2 and 5-3. Also, see Figure 6-2.

1) Adjust the up and down input so that pneumatic pressure output become approximately *1 20 kPa {0.2 kgf/cm^2} (0% FS), then perform the zero adjustment of the P/I conversion unit to attain the current output corresponding to the pneumatic pressure output *2.

2) Adjust the up and down input so that pneumatic pressure output become approximately 100 kPa {1.0 kgf/cm^2} (100% FS), then perform the span adjustment of the P/I conversion unit to attain the current output corresponding to the pneumatic pressure output.

Repeat steps 1 and 2 until the specified accuracy is achieved. For reverse characteristics, start from step (3).

*1: Pneumatic pressure output cannot be set precisely since it step-changes in steps in accordance with a pulse motor.

*2: To calculate the current output corresponding to pneumatic pressure output: (for voltage output, the output must be (I mA × 0.25) V.)

$$I = 4 + (\frac{P - 0.2}{0.8}) \times 16$$

$$I = 24 - (\frac{P - 0.2}{0.8}) \times 16$$ (In the case of reverse characteristics:)

I: corresponding current output [mA DC]
P: pneumatic pressure output (kPa {kgf/cm^2})

3) Shut off the air supply, and adjust the pneumatic pressure output to 0 kPa {0 kgf/cm^2} (–25% FS).

Perform zero adjustment so that the current output this time becomes 24 mA.

4) Connect the air supply, and adjust the up and down input so that the air output becomes approximately 100 kPa {1.0 kgf/cm^2} (100% FS).

Adjust the span of the P/I conversion unit in a way to achieve the current output corresponding to the air output. (See paragraph (2) Note 2 above.)

Repeat steps (3) and (4) until the specified accuracy is achieved.

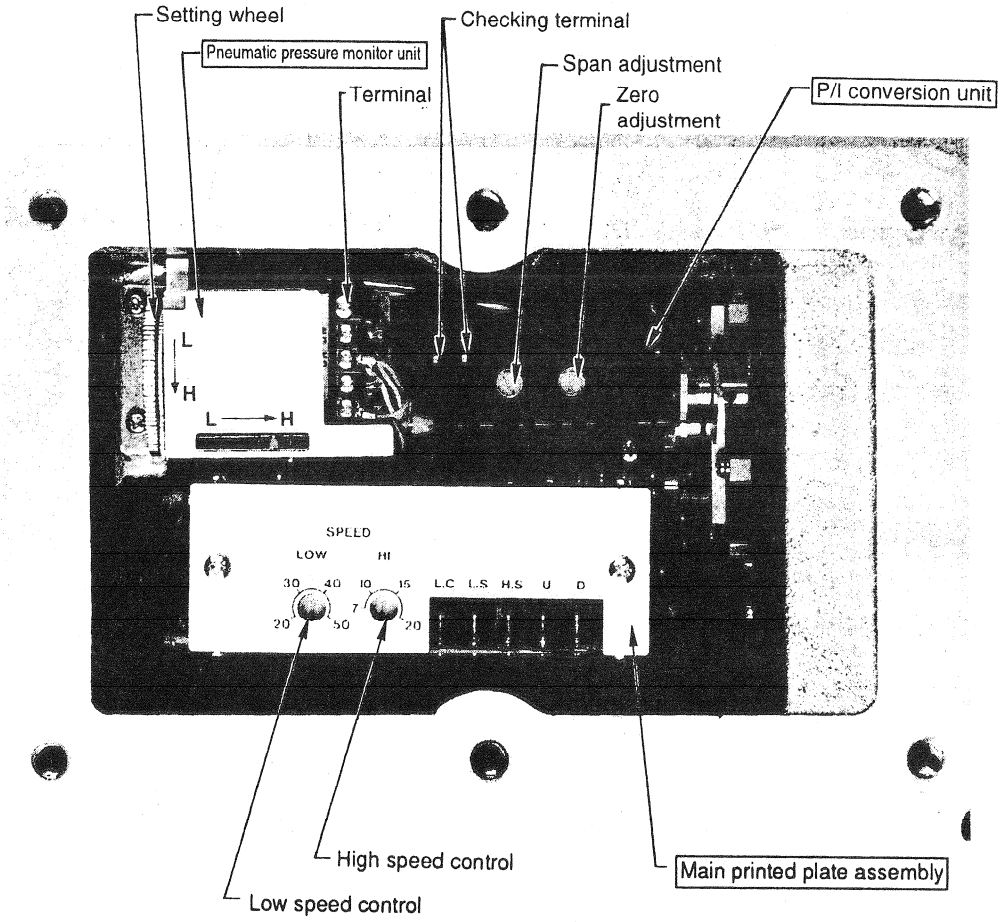


Figure 6-2 Electrical circuit section

6-4 Setting the Pneumatic Pressure Monitor Unit

1) If your model includes the supplied air pressure drop monitor, the alarm setting can be changed by adjusting the setting wheel on the unit (set at 110 kPa {1.1 kgf/cm^2} when shipped). To raise the set value, turn the setting wheel counterclockwise.

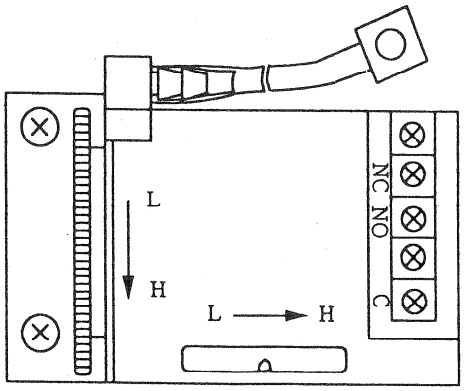
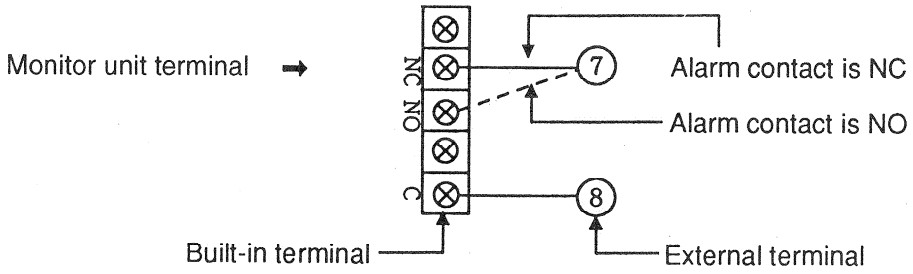


Figure 6-3 Pneumatic pressure monitor unit

2) Connect the monitor unit terminal and customer terminal connection cables.
When used as an upper limit alarm and as a supplied pneumatic pressure-down monitor

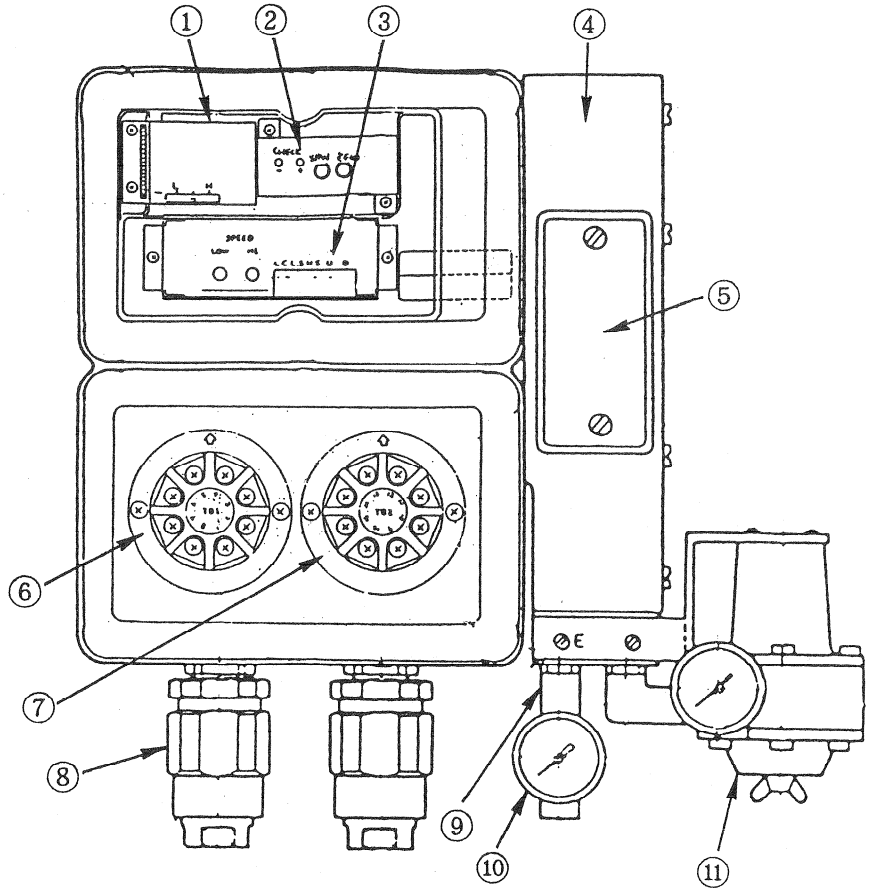


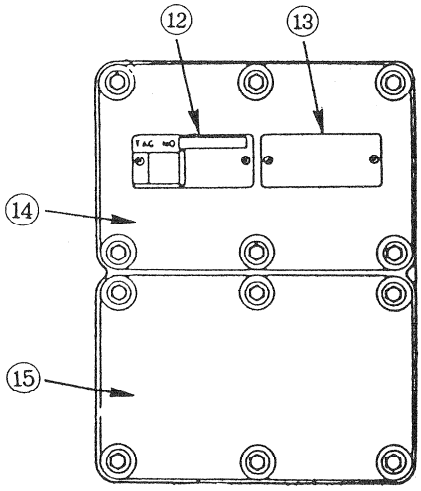
6-5 Setting Output Speed

1) Setting high speed (See Figure 6-2.)
In Figure 5-3, the section between customer terminals ⑪ (COM) and ⑫ (SPD) is turned ON. Adjust the variable resistor for high speed on the main printed plate assembly (See Figure 6-2 above).

2) Setting the low speed (See Figure 6-2.)
In Figure 5-3, the section between customer terminals ⑪ (COM) and ⑫ (SPD) is turned OFF. Adjust the variable resistor for low speed on the main printed plate assembly (See Figure. 6-2 above).

7. Parts List





Key No.	Drawing number	Name	Quantity
①	80355952-001	Pneumatic pressure monitor unit (additional specifications)	1a
②	80355958-ITEM	P/I conversion unit (additional specifications)	1a
③	80355955-ITEM	Main printed plate assembly	1a
④	80355960-ITEM	Mechanical case assembly (additional specification)	1a
⑤	80355991-ITEM	Cover (Window)	1
⑥	80332143-001	Terminal assembly (TB1)	1a
⑦	80332145-001	Terminal assembly (TB2)	1a
⑧	80355951-001	Cable adapter with pressure resistant packing (additional specification)	2
⑨	80028413-001 80152439-001	Adapter for pneumatic output gauge (additional specification)	1

Key No.	Drawing number	Name	Quantity
⑩	80250366-001	ϕ 40 pressure gauge (additional specification)	1
⑪	80355947-ITEM	Air set assembly	1a
⑫	80355933-001	Tag No. plate	1
⑬	80355959-001	Name plate	1
⑭	80355943-ITEM	Cover assembly (main unit)	1a
⑮	80355943-ITEM	Cover assembly (terminal box)	1a

8. Maintenance

8-1 Regular Maintenance

1) Check the supplied air pressure

   Keep the supplied air pressure unit clean. Drain unit and check filters regularly. Check the compressor, the air cleaning and dehumidifying unit, and the tank.

8-2 Periodical Maintenance and Checking

1) Check for air leaks

   Make sure that there is no air leak from the air pipe or the connection joints.

2) Check the nozzle flapper for staining

   Remove stains on the nozzle flapper of the pneumatic pressure sending unit (mechanical parts assembly, see Figure 6-2, with a cloth impregnated with a solvent such as petroleum, naphtha or chlorosene 1,1,1-Trichloroethane (Chloroethene). Wipe gently to prevent damage to the flapper beam (plate spring).

3) Check the gear mechanism of the pulse motor for wear

   Damaged or worn gears, especially the worm gears and worm wheels must be replaced.

4) Check the pilot relay (Figure 8-1)

   (1) Remove the pilot relay from the manifold: remove the two screws (14), the spring washers (15), and the gaskets.

   (2) Disassemble the pilot relay: remove the two flat-head screws (13).

   (3) Dismount parts (6) to (12). Parts (2) to (5) need not be dismounted unless they need replacing.

   (4) Clean the metal parts with a solvent such as petroleum, naphtha or chlorosene. 1, 1, 1-Trichloroethane (Chloroethene).
   Do not stain the diaphragms with the solvent.
   Clean the valve stem (2) on the seal surface and the hole. Let the solvent be absorbed by pressing the conic spring (4) to push the valve stem (2) in the compression direction.

   (5) Check the inside of the exhaust ring (10) for stains. If stained, clean with a cloth impregnated with a solvent.

   (6) Dry all the parts with clean compressed air.

   (7) Replace the rubber diaphragms (8) and (11) if they are worn or damaged.

   (8) Reassemble the pilot relay: replace all parts in correct order and tighten them with two flat-head screws (13).

   (9) Remount the pilot relay on the manifold, position the gasket (1) correctly.

   (10) Fix the pilot relay on the manifold using mounting screws (14) and two spring washers (15).

5) You are recommended to replace rubber parts (such as the diaphragms and gaskets on the pilot relay, the tube for piping, and the O ring for the check plug of the pneumatic pressure sending unit) at intervals of about five years, though this may vary depending on conditions.

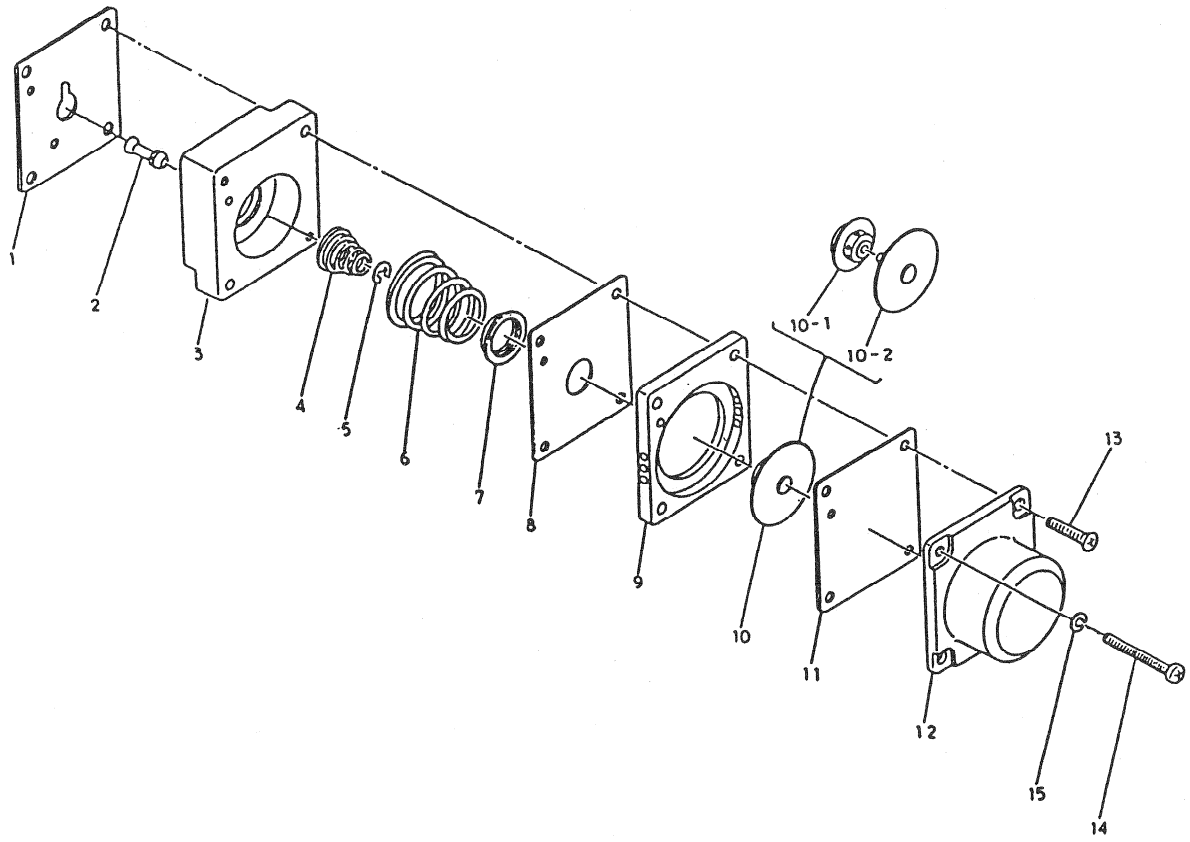


Figure 8-1 Pilot relay disassembled

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