

Remote controlled Transponder

ATC 4401-2-xxx

INSTALLATION AND OPERATION

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RECORD OF REVISIONS

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		DATE	BY			DATE	BY
01	October 15/2002						

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INTRODUCTION

1. General

The remote controlled transponder ATC 4401-2-xxx is described in this manual "Installation and Operation".

2. Manufacturer

The remote transponder ATC 4401-2 was developed and is manufactured by :

Becker Flugfunkwerk GmbH
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CERTIFIED QUALITY SYSTEM

The Becker quality management system is certified according to :

DIN EN ISO 9001 CERT Reg. - Nr. 70 100 M 2082

LICENSES AND APPROVALS

LBA.G.0075	Production Organization Approval, JAR-21, Subpart G
LBA.0166	Maintenance Organization Approval, JAR-145

3. Safety information

- Do not connect the transponder to alternating current voltage or to voltage sources exceeding 32.2 V DC.
- Do not connect the transponder with reversed polarity to a voltage source.
- The use of the transponder in ambient temperatures below -40° and above + 70° C is to be avoided.
- Switch off the unit when starting or shutting down engines.

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- The transponder should be protected from the aircraft power supply by its own 3 A circuit breaker.
- Do not set a code with 75xx / 76xx / 77xx. These special codes are reserved for air emergencies.
- Voltages > 42 V are possible within the transponder.

4. Layout of manual

The manual is divided up into three sections. Section 1 contains a general description of the transponder and the technical data of the device. Section 2 contains the installation instructions and Section 3 describes operation of the device.

5. Revisions to the manual

All changes to the manual are recorded consecutively on the preliminary page "Record of Revisions".

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GENERAL DESCRIPTION

1. Application

The ATC 4401-2 remote controlled transponder forms, together with a corresponding control unit, the airborne component of the Air Traffic Control Radar Beacon System ATCRBS. It functions in accordance with the secondary radar principle and allows the respective ground stations to locate, identify and track aircraft.

2. General description

- A. The ATC 4401-2 is a remote controlled unit designed for installation in the avionic compartment of aircraft.
- B. The 25-pin unit connector for connection to the aircraft interwiring and the TNC antenna socket are located at the rear.
- C. The electronic components of the remote controlled unit consist of the processor board, the receiver board, the transmitter board, the power supply board and the interwiring board.
- D. All control elements are located on the front panel of the corresponding control unit, e.g. BECKER CU 5401-1-(xxx) or RMU 5000-1-xxxx.
- E. The remote controlled transponder permits the following functions:
 - (1) Mode A - in this mode, the code set on the transponder is sent as a reply to interrogation from a ground station.
 - (2) Mode C - in this mode, the encoded flight level is sent in addition to the possibilities of mode A.
 - (3) Indication of flight level (altitude/100) in feet on the corresponding control unit if an encoding altimeter is connected to the transponder.
 - (4) Additional identification function. The Ident button of the corresponding control unit is pressed here when an instruction to this effect is issued by air traffic control personnel. The special pulse (SPI) transmitted as a result permits immediate identification of the aircraft on the controller's radar screen by means of additional marking of the object display.
 - (5) Self-test of the remote controlled transponder via the control unit.

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3. Technical data

A. General data

Supply voltage	9.0 V - 32.2 V DC
Max. current consumption at (without panel illumination)	Code 7777 and 1200 interrogations/s
ATC 4401-2-250	1.1 A at 14 V
ATC 4401-2-175	0.7 A at 14 V
ATC 4401-2-250	0.6 A at 28 V
ATC 4401-2-175	0.4 A at 28 V
- in standby mode	0.3 A at 14 V 0.2 A at 28 V
Power-up time	3 s (internal self-test)
Warm-up time	approx. 15 s
External fuse protection	3 A medium slow-blow
Internal fuse protection	electronic and fuse
- external encoding altimeter fuse	5 A, SMD 1 A, SMD
Serial interface between remote transponder and control unit	RS 422 (9600 baud)
Operating temperature range	- 40° C to + 55° C (short-time + 70° C)
Storage temperature range	- 55° C to + 85° C
Max. operating altitude :	
- ATC 4401-2-175	15000 ft.
- ATC 4401-2-250	50000 ft.
Vibration according to EUROCAE/RTCA ED-14D/DO-160D	Cat. S, vibration curve M Cat. U, vibration curve G
Humidity according to EUROCAE/RTCA ED-14D/DO-160D	Cat. A / + 50°C; 95% RH, 48 h
Magnetic effect	Category Z
Compass safe distance	30 cm
Case dimensions (H x W)	61.1 x 61.1 mm (2.41 x 2.41 inch)
Case depth (without antenna socket)	169.5 mm (6.67 inch)
(with antenna socket)	181.8 mm (7.16 inch)
Weight	≤ 0.75 kg (1.653 lb)

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B. Receiver data

Operating modes	Mode A Mode A + C
Receive frequency	1030 MHz \pm 0.2 MHz
Sensitivity (MTL)	- 74 dBm (for 90 % reply rate)
Selectivity	\pm 15 MHz > 65 dB \pm 25 MHz > 70 dB
Dynamic range	\geq 60 dB
Bandwidth	\pm 3 MHz < 3 dB
Side lobe suppression	3-pulse method
Nominal impedance	50 Ω

C. Transmitter data

Transmit frequency	1090 MHz \pm 3 MHz
Transmitter type	Solid state
Transmit power :	
- ATC 4401-2-175	min. 160 W (at antenna socket of the unit)
- ATC 4401-2-250	min. 250 W (at antenna socket of the unit)
Reply limitation	effective as from 1200 replies/s
Nominal output impedance	50 Ω
Reply code (mode A)	ICAO coding system with 4096 reply possibilities (octal code)
Flight level code (mode C)	ICAO coding system 100-foot steps from
- ATC 4401-2-175	-1000 to 31000 ft.
- ATC 4401-2-250	-1000 to 62700 ft.
Transmit pulse shape	pulse width 0.45 μ s \pm 0.1 μ s rise time 0.05 to 0.1 μ s fall time 0.05 to 0.2 μ s

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- D. Transponder antenna DMNI 70-1 (blade antenna)
- | | |
|----------------------------|--------------------------------|
| Frequency range | 950 MHz to 1220 MHz |
| Standing wave ratio (VSWR) | < 1.5 : 1 |
| Impedance | 50 Ω , nominal |
| Type | corresponds to $\lambda/4$ rod |
| Polarization | vertical |
| Radiation | omnidirectional |
| Peak power output | max. 2 KW |
| Connection | C socket |
| DC resistance | idle (∞) |
| Insulation resistance | > 100 M Ω |
| Weight | approx. 113 g |
- E. Transponder antenna ANT 2000 (rod antenna)
- | | |
|----------------------------|--------------------------------|
| Frequency range | 1030 MHz to 1090 MHz |
| Standing wave ratio (VSWR) | < 1.25 : 1 |
| Impedance | 50 Ω , nominal |
| Type | corresponds to $\lambda/4$ rod |
| Polarization | vertical |
| Radiation | omnidirectional |
| Peak power output | max. 2 KW |
| Connection | BNC socket |
| DC resistance | idle (∞) |
| Insulation resistance | min. 1000 M Ω |
| Weight | approx. 20 g |

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F. Environmental conditions

Input voltage range	9.0 to 33 V DC
- nominal input voltage	27.5 V DC
- emergency input voltage	9.0 V DC
Low operating temperature	-40°C
High operating temperature	+55°C
High short-time operating temperature	+70°C
Storage temperature range	-55°C to +85°C
In-flight loss of cooling	Cat. Z, no auxiliary cooling required
Altitude max. :	
- ATC 4401-2-175	15000 ft.
- ATC 4401-2-250	50000 ft.
Humidity rating	RTCA DO-160D, Cat. B
Vibration	ED-14D/DO-160D, Cat. S, vibration curve M Cat. U, vibration curve G
Operational shocks	6 g in any direction
Crash safety	20 g shocks 20 g acceleration
Compass safe distance	30 cm
Magnetic effect	ED -14D/DO-160D category Z

Environmental categories :

ATC 4401-2-175:
 EUROCAE/RTCA ED14D/DO-160D
 Env.Cat. [A1Z]BAB[(SM)(UG)]XXXXXXZBABA[WW]B[XXXX]XXA

ATC 4401-2-250:
 EUROCAE/RTCA ED14D/DO-160D
 Env.Cat. [D1Z]BAB[(SM)(UG)]XXXXXXZBABA[WW]B[XXXX]XXA

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G. Environmental qualification for ATC 4401-2-175

EUROCAE/RTCA ED-14D/DO-160D, Change 2

CONDITION	SECTION	DESCRIPTION OF TESTS CONDUCTED
Temperature/Altitude	4.0	Equipment tested to Category A1
Low Temperature	4.5.1	Equipment tested to Category A1, Low operating temperature -40°C
High Temperature	4.5.2, 4.5.3	Equipment tested to Category A1
In-Flight Loss of Cooling	4.6.2	Equipment identified as Category Z, No test required
Altitude	4.6.1	Equipment tested to Category A1
Decompression	4.6.2	Equipment tested to Category A1
Overpressure	4.6.3	Equipment tested to Category A1
Temperature Variation	5.0	Equipment tested to Category B
Humidity	6.0	Equipment tested to Category A
Shock	7.0	Equipment tested to Category B
Vibration	8.0	Equipment tested to Category S, aircraft zone 2 for fixed-wing reciprocating and turboprop multi-engine over 5,700 kg, multi-engine less than 5,700 kg and single engine less than 5,700 kg aircraft using vibration curve M. Equipment tested to Category U, aircraft zone 2 for helicopters fixed-wing reciprocating and turbojet engine using vibration curve G.
Explosion Proofness	9.0	Equipment identified as Category X, no test required
Waterproofness	10.0	Equipment identified as Category X, no test required
Fluids Susceptibility	11.0	Equipment identified as Category X, no test required
Sand and Dust	12.0	Equipment identified as Category X, no test required
Fungus Resistance	13.0	Equipment identified as Category X, no test required
Salt Spray	14.0	Equipment identified as Category X, no test required
Magnetic Effect	15.0	Equipment is Category Z
Power Input	16.0	Equipment tested to Category B
Voltage Spike	17.0	Equipment tested to Category A
Audio Frequency Conducted Susceptibility	18.0	Equipment tested to Category B
Induced Signal Susceptibility	19.0	Equipment tested to Category A
Radio-Frequency Susceptibility	20.0	Equipment tested for conducted and radiated susceptibility to Category W
Radio Frequency Emission	21.0	Equipment tested to Category B
Lightning Induced Transients Susceptibility	22.0	Equipment identified as Category XXXX, no test performed
Lightning Direct Effects	23.0	Equipment identified as Category X, no test performed
Icing	24.0	Equipment identified as Category X, no test performed
ESD	25.0	Equipment tested to Category A

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H. Environmental qualification for ATC 4401-2-250
 EUROCAE/RTCA ED-14D/DO-160D, Change 2

CONDITION	SECTION	DESCRIPTION OF TESTS CONDUCTED
Temperature/Altitude	4.0	Equipment tested to Category D1
Low Temperature	4.5.1	Equipment tested to Category D1, Low operating temperature -40°C
High Temperature	4.5.2, 4.5.3	Equipment tested to Category D1
In-Flight Loss of Cooling	4.6.2	Equipment identified as Category Z, No test required
Altitude	4.6.1	Equipment tested to Category D1
Decompression	4.6.2	No test required
Overpressure	4.6.3	No test required
Temperature Variation	5.0	Equipment tested to Category B
Humidity	6.0	Equipment tested to Category A
Shock	7.0	Equipment tested to Category B
Vibration	8.0	Equipment tested to Category S, aircraft zone 2 for fixed-wing reciprocating and turboprop multi-engine over 5,700 kg, multi-engine less than 5,700 kg and single engine less than 5,700 kg aircraft using vibration curve M. Equipment tested to Category U, aircraft zone 2 for helicopters fixed-wing reciprocating and turbojet engine using vibration curve G.
Explosion Proofness	9.0	Equipment identified as Category X, no test required
Waterproofness	10.0	Equipment identified as Category X, no test required
Fluids Susceptibility	11.0	Equipment identified as Category X, no test required
Sand and Dust	12.0	Equipment identified as Category X, no test required
Fungus Resistance	13.0	Equipment identified as Category X, no test required
Salt Spray	14.0	Equipment identified as Category X, no test required
Magnetic Effect	15.0	Equipment is Category Z
Power Input	16.0	Equipment tested to Category B
Voltage Spike	17.0	Equipment tested to Category A
Audio Frequency Conducted Susceptibility	18.0	Equipment tested to Category B
Induced Signal Susceptibility	19.0	Equipment tested to Category A
Radio-Frequency Susceptibility	20.0	Equipment tested for conducted and radiated susceptibility to Category W
Radio Frequency Emission	21.0	Equipment tested to Category B
Lightning Induced Transients Susceptibility	22.0	Equipment identified as Category XXXX, no test performed
Lightning Direct Effects	23.0	Equipment identified as Category X, no test performed
Icing	24.0	Equipment identified as Category X, no test performed
ESD	25.0	Equipment tested to Category A

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INSTALLATION

1. General

Installation of the transponder ATC 4401-2 depends on the aircraft type and its equipment. Therefore, only general information can be provided in this section.

2. Inspection before installation

Before the transponder is installed in an aircraft, a visual inspection for possible transport damages shall be performed.

A. Visual inspection

Please look out for the following defects:

- (1) Dirt, dents, scratches, corrosion, broken fastening elements on housing and housing parts.
- (2) Dirt and scratches on nameplate and inscriptions.
- (3) Dirt, bent or broken pins, cracked insert of unit connector and antenna socket.
- (4) Missing screws.

B. Checking procedure

Connect the transponder to the test setup (e.g. ramp test set) and carry out the following tests :

- (1) Checking receiver sensitivity
- (2) Checking side lobe suppression (SLS)
- (3) Checking reply pulses and output power
- (4) Checking transmit frequency
- (5) Checking reply limiting (AOC)

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- (6) Checking the SPI hold time
- (7) Checking mode A coding
- (8) Checking mode C coding

3. Mechanical installation

- A. The transponder ATC 4401-2 is to be fitted at a suitable place in the aircraft. This is usually the avionics compartment. The necessary dimensions for the installation are shown in Fig. 2-1 and Fig. 2-2.
- B. First secure the unit mounting using three countersunk screws and then slide the transponder into the mounting and lock in position.

4. Aircraft wiring

- A. The aircraft wiring of the transponder is shown in Fig. 2-5 and Fig.2-6.

CAUTION : The transponder supply lines must not be loomed together with other equipment looms. In addition care must be taken to avoid running all transponder wiring in the close vicinity of ADF or other pulse equipment looms.

For installations in a more severe electromagnetical environment use shielded cable connectors (refer to accessories) and a common shielding for the transponder interwiring.

- B. Pin connections of the unit connector

Connector: P 1

<u>Pin</u> :		<u>Input</u> :	<u>Output</u> :
1	Altitude pulse A1	X	
2	Altitude pulse A2	X	
3	Altitude pulse A4	X	
4	Ident button, external	X	

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<u>Pin :</u>		<u>Input :</u>	<u>Output:</u>
5	DME/transponder suppression	X	X
6	Supply voltage switched (altimeter)		X
7	Reply output		X
8	RX-A (RS 422)	X	
9	RX-B (RS 422)	X	
10	Not used		
11	Supply voltage +14V/28V DC	X	
12	Supply voltage +14V/28V DC	X	
13	Supply voltage GND	X	
14	Altitude pulse B1	X	
15	Altitude pulse B2	X	
16	Altitude pulse B4	X	
17	Altitude pulse C1	X	
18	Altitude pulse C2	X	
19	Altitude pulse C4	X	
20	Altitude pulse D4	X	
21	TX-A (RS 422)	X	
22	TX-B (RS 422)	X	

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<u>Pin :</u>	<u>Input :</u>	<u>Output:</u>
23	Not used	
24	Function ON, external	X
25	Supply voltage GND	X

C. DME suppression

If required, connect the suppression in/out of transponder to the corresponding pin of the DME unit using coaxial cable.

D. RS 422 interface

The RS 422 interface enables full remote control of the transponder, i.e. all controls, status and indicating functions (with exception of On/Off function, see section E) are transmitted.

The data format of the RS 422 interface is factory-defined. The transmission rate is 9600 Baud. 8.N.1 = 8 Bit, no parität, 1 stop bit.

E. External FUNCTION ON

The transponder can be externally switched on using this input for the remote control via RS 422 interface. To do this, pin 24 of unit connector P1 must be briefly connected to GND (e.g. by means of a switch).

F. External IDENT push-button

If this input (Pin 4 of unit connector P1) is briefly connected to GND (e.g. by an external push-button), the IDENT function is started in the same way as when using the IDENT push-button on the front panel.

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5. Installing the transponder antennas DMNI 70-1 or ANT 2000

- A. The transponder antenna is fitted to the underside of the aircraft fuselage at a horizontal, flat location. This location should not be in the “shadow” of aircraft structure items. The highest range is achieved when the antenna is located at the low point on the aircraft fuselage.
- B. The installation dimensions of the transponder antennas DMNI 70-1 are shown in Fig. 2-3 those of the ANT 2000 in Fig. 2-4.

CAUTION :

- Transponder antenna DMNI 70-1 is provided with a cork gasket which must be interposed between the skin of the aircraft and the antenna. To mount the antenna use only stainless screws in conjunction with lock washers.
- The transponder antenna ANT 2000 is provided with a silicone rubber gasket which must also be interposed between the skin of the aircraft and the antenna.
- In aircraft having a wooden or plastic airframe an electric counter-weight plate or panel must be located within the fuselage at the antenna location with minimum dimensions 40 x 40 cm.

C. Antenna cable

Use RG-223/U antenna cable with a length of no more than 5 m for installation of the transponder ATC 4401-2-175. RG-58C/U or RG-223/U can be used for the transponder ATC 4401-2-250. RG-223/U should be used preferentially.

6. Checking after installation

A. General

After the installation, check the transponder to ensure satisfactory operation of the unit.

B. Pre-flight check using self test

Switch-on test :

Switch the transponder operating mode switch from OFF to SBY. All the digits of LC display must flash for 3 seconds. At the same time follows unit selftest.

C. Antenna matching

The antenna in the aircraft shall provide a VSWR of $\leq 1.5 : 1$.

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D. Test and adjustment of transmit frequency

Set code 0000 on the transponder and mode A interrogation on the ramp test set. Check transmit frequency by means of the ramp test set. Transmit frequency must be 1090 ± 3 MHz. If necessary use screw driver through hole in the top cover and adjust the transmit frequency.

E. Check of the transmit power

After installation of equipment and antenna the transmit power has to be checked at the antenna end of the feeder line :

Requirement for ATC4401-2-175: ≥ 71 W (18.5 dBW)

Requirement for ATC4401-2-250: ≥ 125 W (21 dBW)

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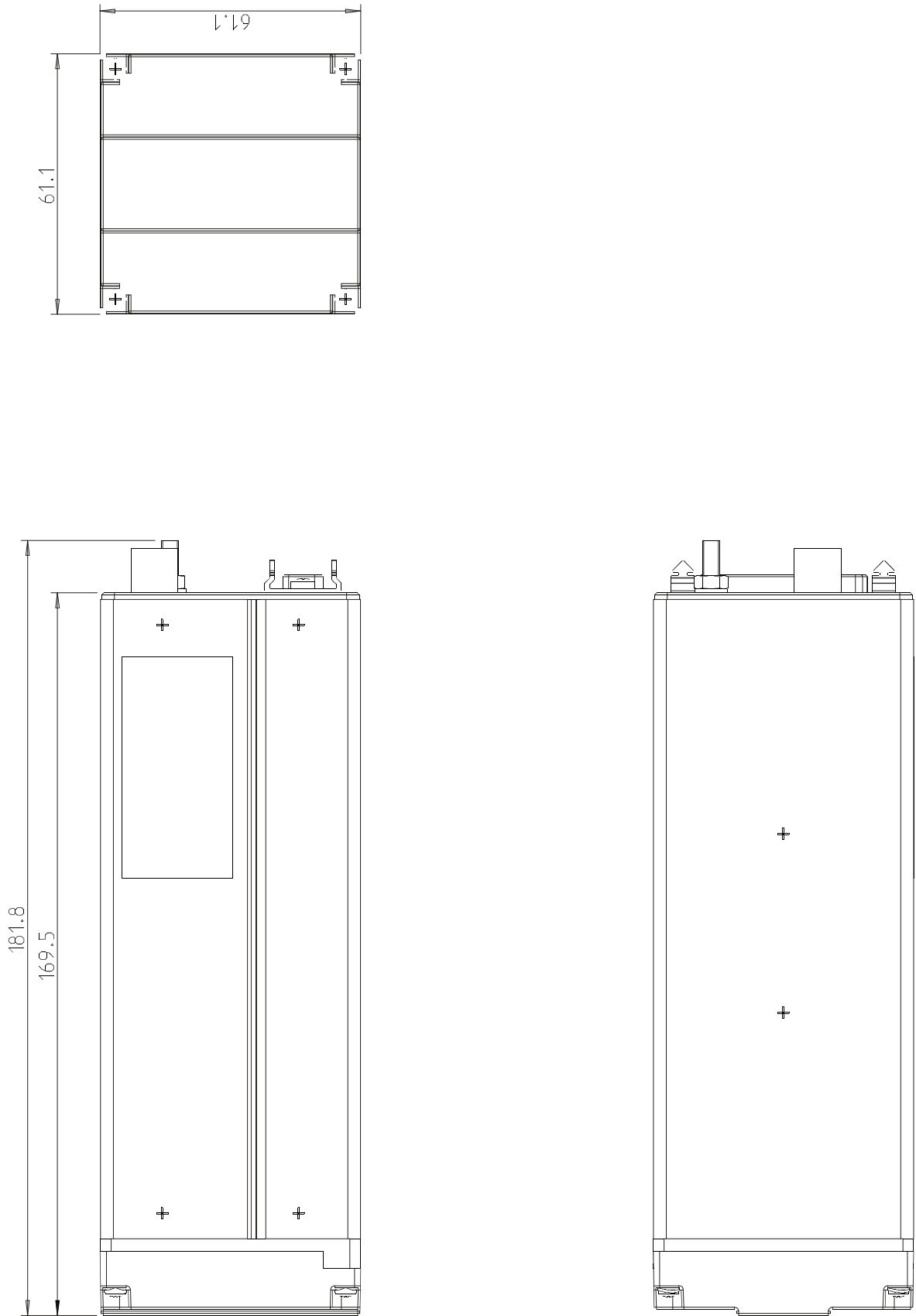


Fig. 2-1 Installation dimensions ATC 4401-2 (measures in mm)

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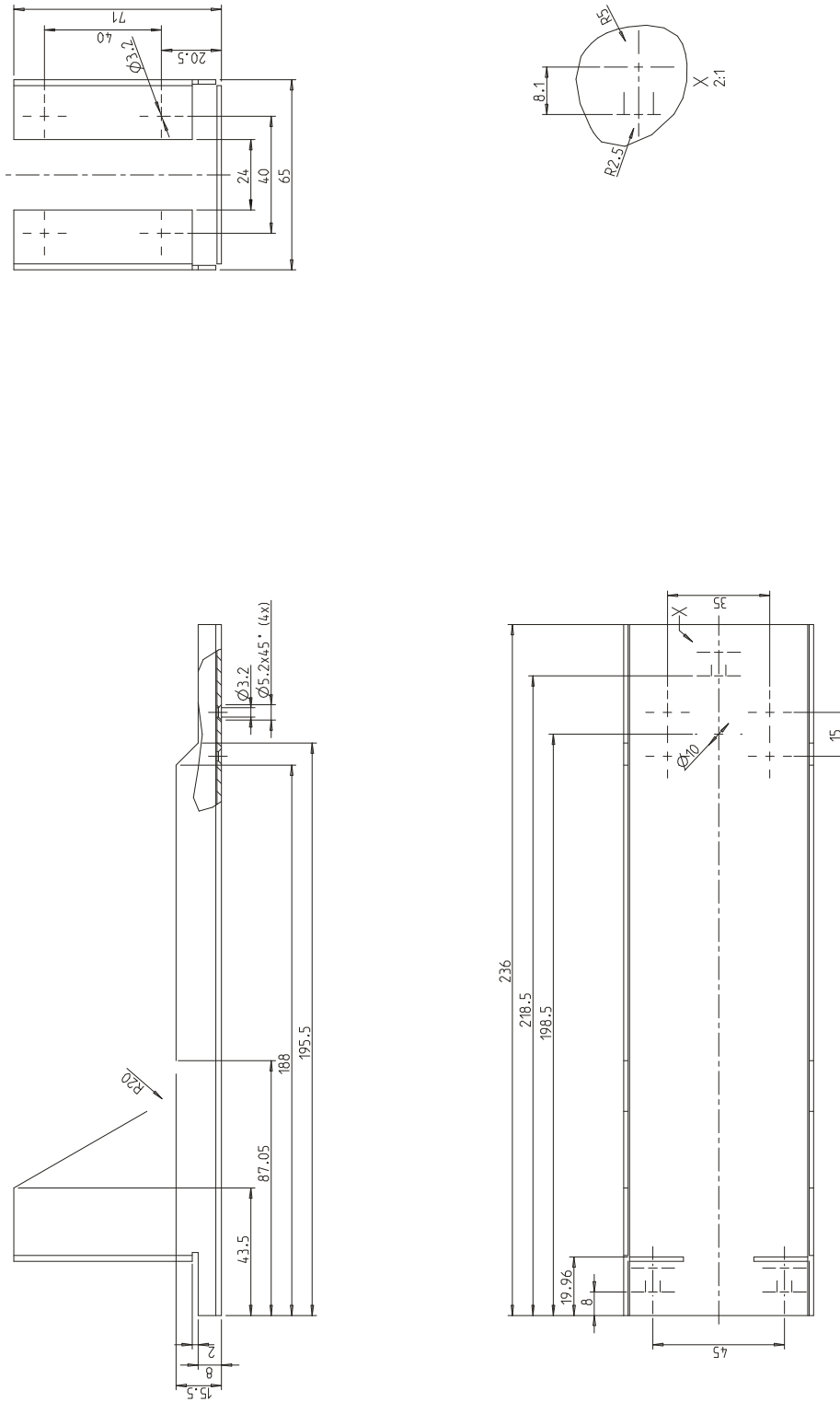


Fig. 2-2 Installation dimensions of the unit mounting (measures in mm)

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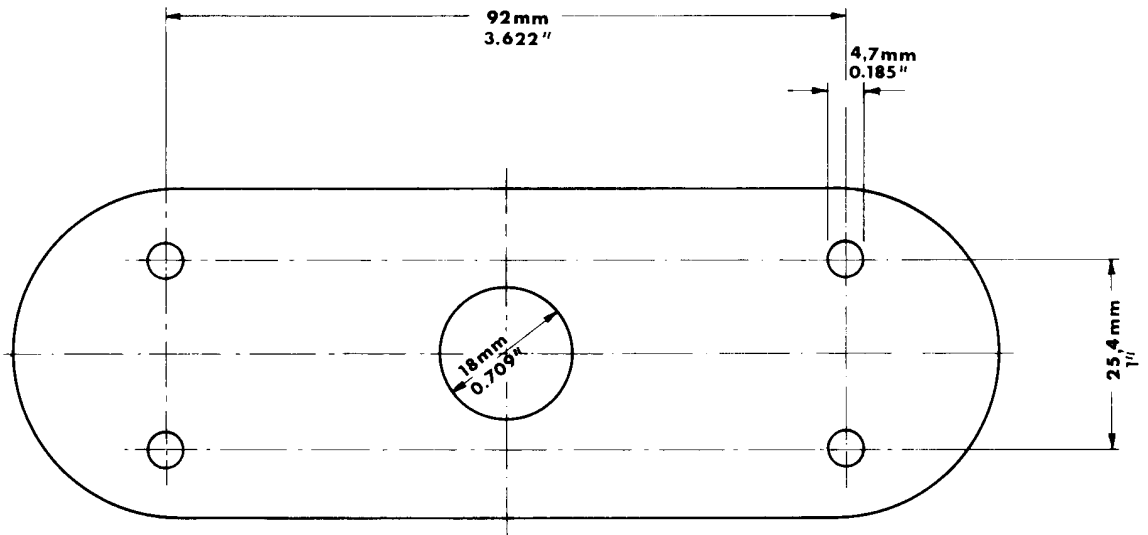
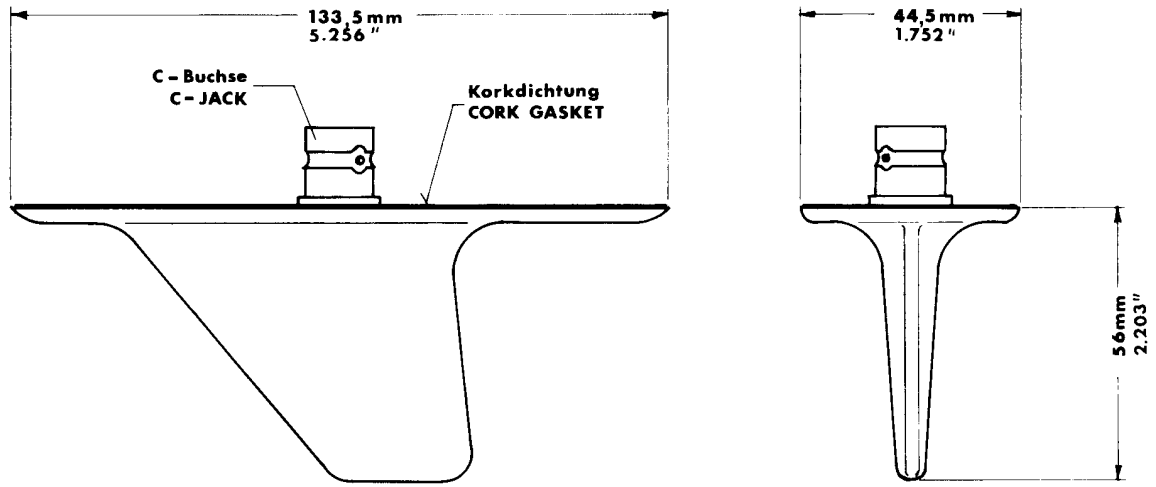


Fig. 2-3 Installation dimensions DMNI 70-1

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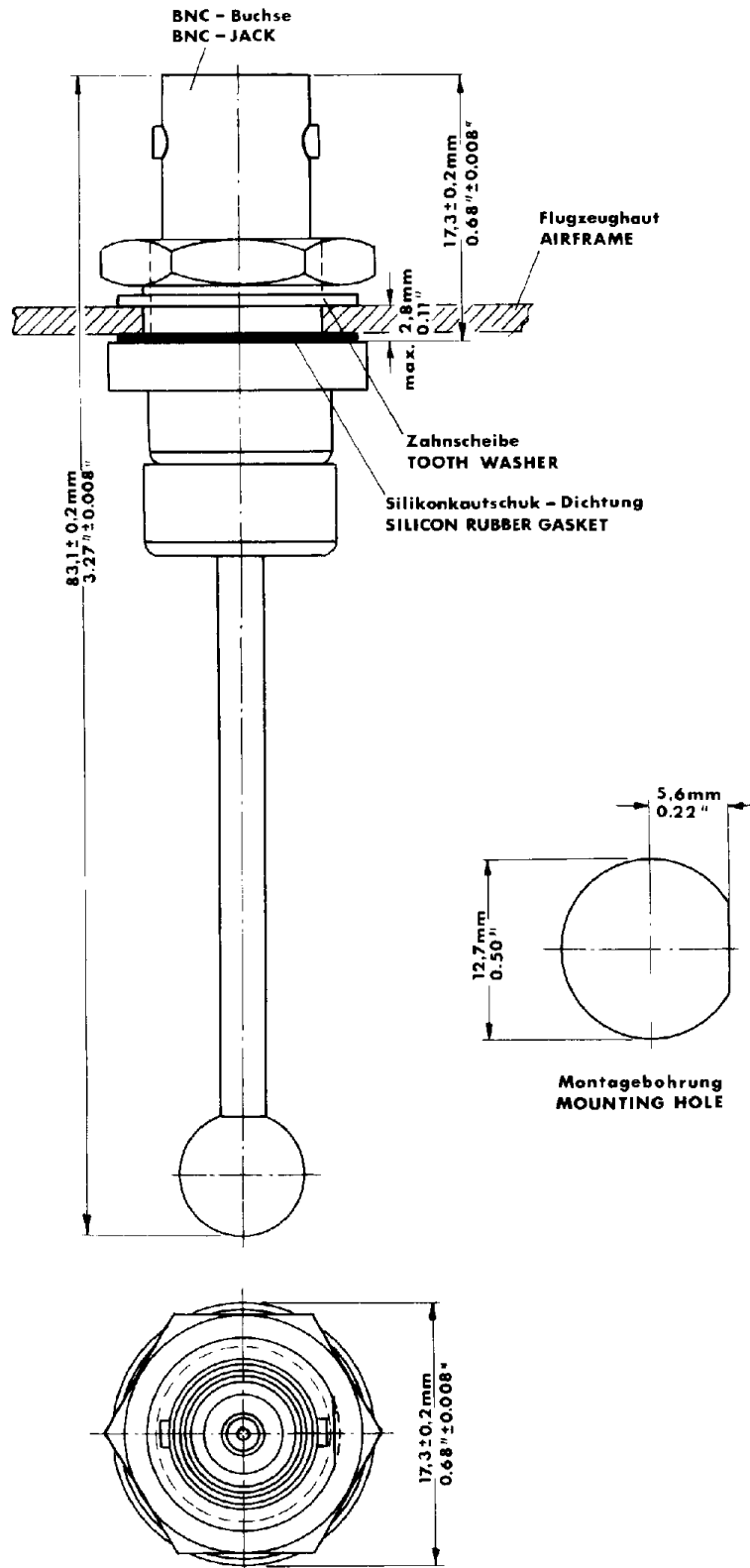


Fig. 2-4 Installation dimensions ANT 2000

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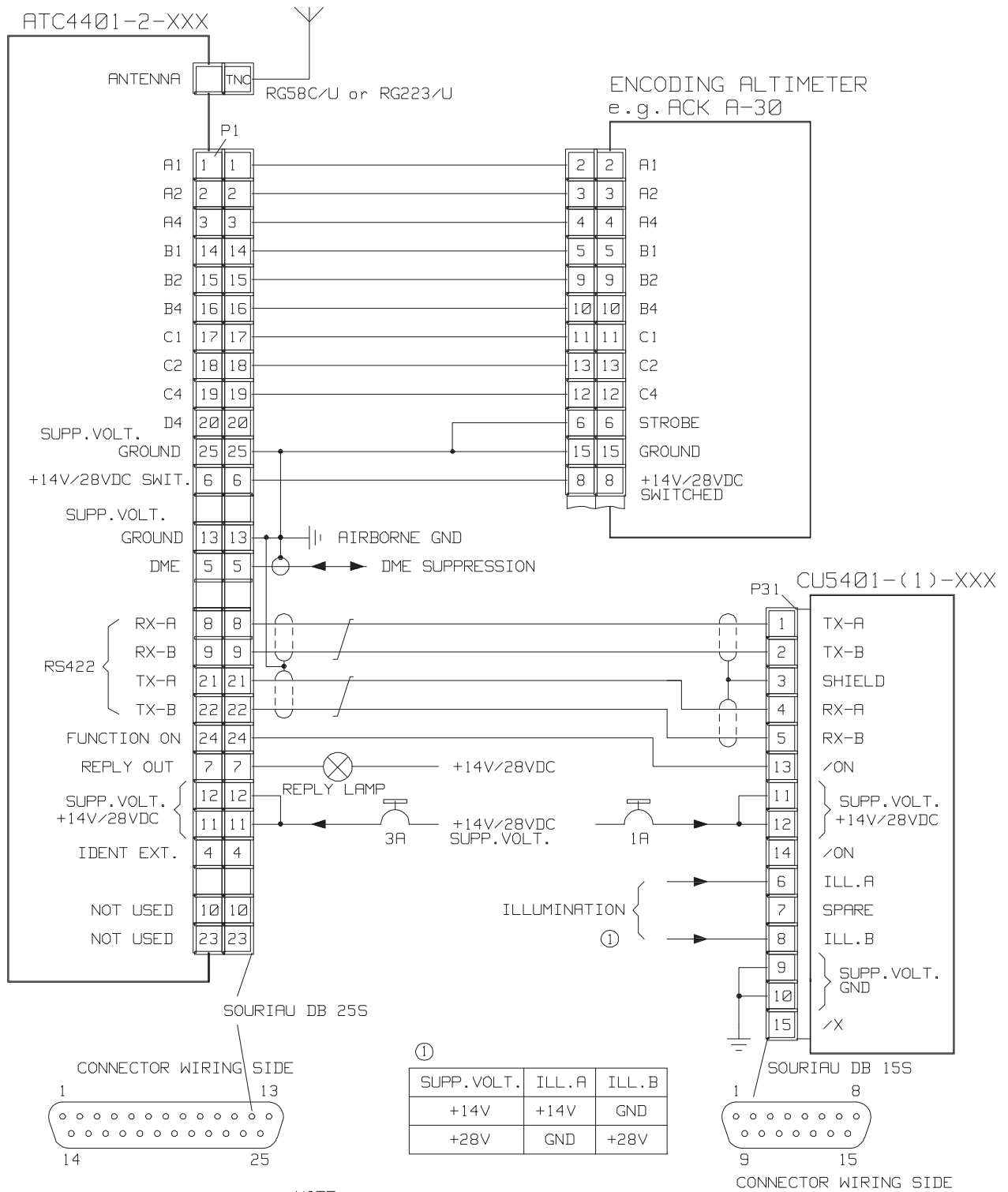


Fig. 2-5 Installation wiring ATC 4401-2 with control unit CU 5401-1-xxx

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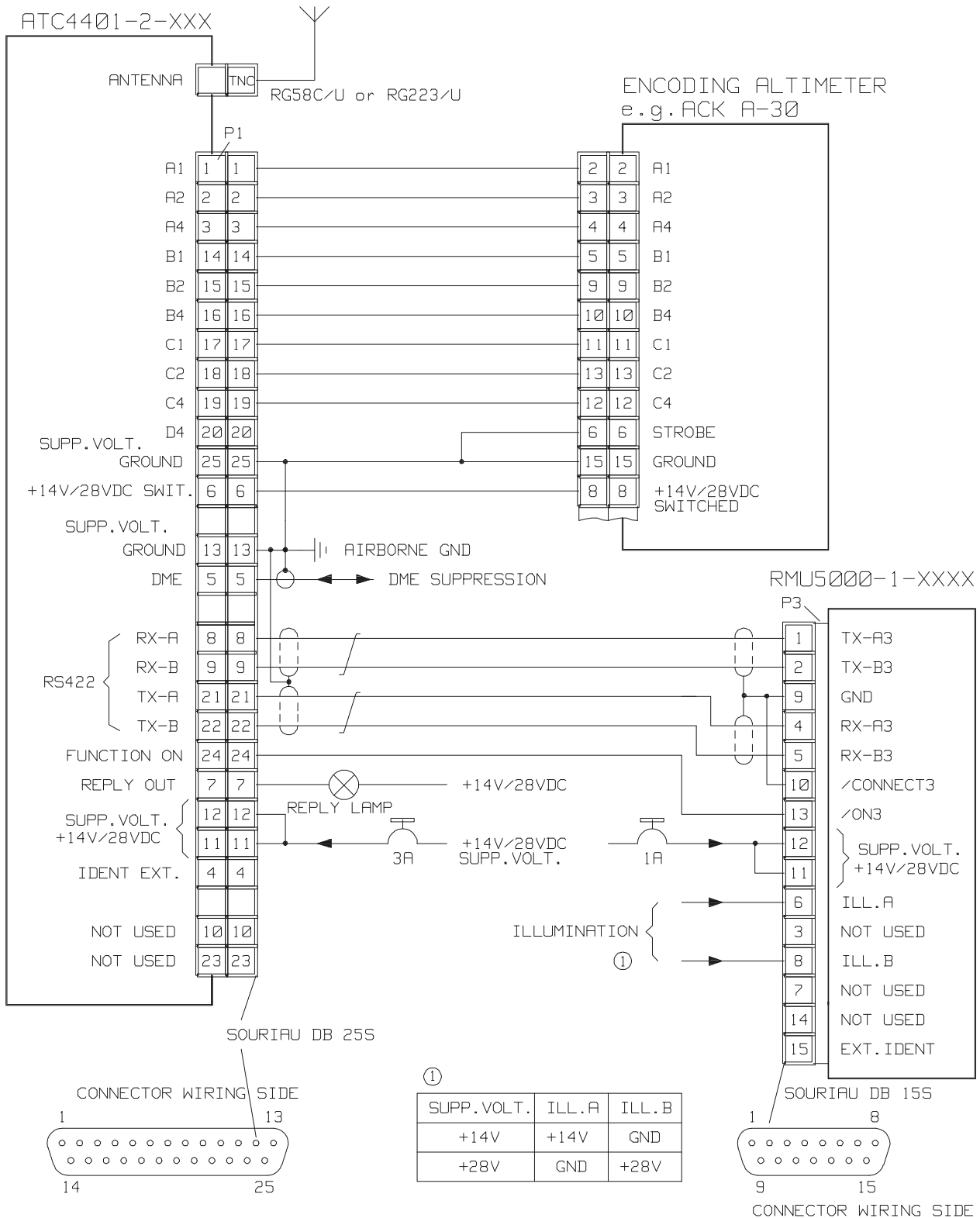


Fig. 2-6 Installation wiring ATC 4401-2 with control unit RMU 5000-1-xxxx