



Remote Controlled Transponder Mode S Level 2es

BXP6402

BXP6402-1R-(XX) Class 1

BXP6402-2R-(XX) Class 2

Software Versions:

upwards from Software Version

DSP: SCI1026S305 Version 47

FPGA: SCI1039S305 Version 55

Installation and Operation

Manual DV69802.03

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Certificates see: <http://www.becker-avionics.com/company-about/> →Certificates

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WARNING - USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Becker Avionics GmbH provide product or system options for further investigation by users having technical knowledge.

The user is responsible for making the final selection of the system and components. The user has to assure that all performance, endurance, maintenance, safety requirements of the application are met and warnings be observed.

For this the user has to include all aspects of the application to be compliant with the applicable industry standards and the requirements of the responsible aviation authority. The product documentations from Becker Avionics GmbH have to be observed.

To the extent that Becker Avionics GmbH provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

Term definition: User in the sense of user, installer, installation company.

Preface

Dear Customer,

Thank you for purchasing a Becker Avionics product.

We are pleased that you have chosen our product and we are confident that it will meet your expectations.

For development and manufacturing of our product, the guidelines for highest quality and reliability have been borne in mind, supplemented by selection of high quality material, responsible production and testing in accordance to the corresponding standards.

Our competent customer support department will respond on any technical question you may have.

Please do not hesitate to contact us at any time.

Transponder Design



BXP6402
(Remote controlled Transponder)

List of Effective Pages and Changes

Only technical relevant modifications are described in this table.

Document:	DV69802.03 / issue 04	Article Number 0584.071-071	
Cover Page	06/2018		
Introduction	06/2018		
Chapter 1 –4	06/2018		
Issue	Page No.:	Section / Chapter	Description
04	all	all	Changed: Editorial adjustments.
	--	Introduction	Added: Address box, User responsibility. Updated: User information.
	--	2.4.3	Changed: Dimension drawing AM6400.
	--	2.5.12	Updated: GPS Configuration.
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List of Abbreviations

List of Abbreviations

AA	Aircraft Address (24-bit ICAO)
ACAS	Airborne Collision Avoidance System
A/D	Analog/Digital
ADLP	Avionics Data Link Processor
ADS	Comm-A Definition Subfield
ADS-B	Automatic Dependent Surveillance-Broadcast
AI	Aircraft Identifier
AICB	Air Initiated Comm-B
ALT	Altitude or Transponder ALT Mode
AM	Address Module
ARINC	Aeronautical Radio Incorporated
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System (US only)
BIT	Built-In Test
BITE	Built-In Test Equipment
CBIT	Continuous Built-In Test
Comm-A	112-bit interrogation containing the 56-bit message field (uplink)
Comm-B	112-bit reply containing the 56-bit message field (downlink)
Class 1	XPDR with transmit power $\geq +21$ dBW (125 W) at antenna foot and ≥ 250 W at equipment output, altitude up to 50 000 ft., aircraft speed > 175 kt.
Class 2	XPDR with transmit power $\geq +18.5$ dBW (70 W) at antenna foot and ≥ 140 W at equipment output, altitude up to 15 000 ft., aircraft speed > 175 kt.
CU	Control Unit
DC	Direct Current
Diversity	Diversity receiving and transmitting with two antennas
DME	Distance Measurement Equipment
DPSK	Differential Phase Shift Keying
DV	Document Identification Number
EASA	European Aviation Safety Agency
ELS	Elementary Surveillance, XPDR mode S supports the altitude and the downlinked aircraft identification (unique ICAO-24-bit-address)
EHS	Enhanced Surveillance, XPDR mode S supports additional parameters to e.g. heading, speed and selected vertical intention
es	e = Extended squitter and s = SI capability
ETSO	European Technical Standard Order
EUROCAE	European Organization for Civil Aviation Equipment
FAA	Federal Aviation Administration
FL	Flight Level
FMS	Flight Management System
FN	Flight Number

List of Abbreviations

GICB	Ground Initiated Comm-B
GND	Ground
GPS	Global Positioning System
IBIT	Initiated Built-In Test
IC	Integrated Circuit
ICAO	International Civil Aviation Organization
ID	Identifier
IDT	Ident (Identification)
IFR	Instrument Flight Rules
I/O	Input and/or Output
Level 2es	Surveillance with Comm A/B capability (transmitting and receiving with data block up to 112 bit). e = Extended squitter and s = SI capability
LCD	Liquid Crystal Display
Mode S	S = Selective Interrogation of the Transponder
MTL	Minimum Triggering Level
ON	Transponder ON mode (without altitude transmission)
PAM	Pulse Amplitude Modulation
PBIT	Power-on Built-In Test
PN	Part Number
PS	Power Supply
R	Reply
RF	Radio Frequency
RX	Receiver
SBY	Standby mode
SEL	Selection
SI	Surveillance Identifier
SPI	Special Position Identification Pulse
SSR	Secondary Surveillance Radar
STO	Store
SUPP	Supply Voltage DC
TCAS	Traffic Alert and Collision Avoidance System (US)
TIS	Traffic Information Service
TIS-B	Traffic Information Service-Broadcast
TNC	Threaded Naval Connector (coaxial)
TSO	Technical Standards Order
TX	Transmitter
VFR	Visual Flight Rules
VSWR	Voltage Standing Wave Ratio
XPDR	Transponder

Units

Units

A	Ampere
mA	Milliampere
°C	Degree Celsius
cm	Centimetre
dBm	Power Ratio In Decibel referenced to 1 mW
dB	Decibel
g	Gram
kg	Kilogram
Hz	Hertz
kHz	Kilohertz
MHz	Megahertz
mm	Millimetre
Nm	Nautical Mile
Ohm (Ω)	Resistance
s	Second
V	Volt
mV	Millivolt
W	Watt
"	Inch

General Safety Definitions



Indicates a hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.



Is used to address practices not related to physical injury.



Safety instructions (or equivalent) signs indicate specific safety-related instructions or procedures.

Disposal

⚠ CAUTION The packaging material is inflammable, if it is disposed of improperly by burning, toxic fumes may develop.

This product contains materials that fall under the special disposal regulation, which corresponds to the EC directive for dangerous disposal material. We recommend disposing of the respective materials in accordance with the respectively valid environmental laws.

Dispose circuit boards via a technical waste dump which is allowed to take on e.g. electrolytic aluminium capacitors. Do under no circumstances dump the circuit boards with normal waste dump.

Warranty Conditions

⚠ CAUTION The device(s) may be installed on an aircraft only by an approved aeronautical company (e.g. EASA Part 145) which shall also examine and verify the installation.

User conversions and changes are not permitted.

Any change made by the user excludes any liability on our part (excluding the work described in this manual).

- The device must not be opened.
- Do not make any modifications to the device, except for those described in the manual.
- Make connections to the inputs, outputs and interfaces only in the manner described in the manual.
- Fix the devices according to the mounting instructions.
We cannot provide any guarantee for other mounting methods.

Conditions of Utilization

General introductory notes

With this device you bought a product which was manufactured and tested before delivery with the utmost care.

Please take your time to read the following notes which you ought to follow closely during installation and operation.

Otherwise all claims under the warranty will become void and a reduced service life or even damages must be expected.

⚠ CAUTION The user is responsible for protective covers and/or additional safety measures in order to prevent damages to persons and electric accidents.

Additional Conditions of Utilization

Please refer to "Safety-Conscious Utilization", page 15.

Non-Warranty Clause

We checked the contents of this publication for compliance with the associated hard and software. We can, however, not exclude discrepancies and do therefore not accept any liability for the exact compliance. The information in this publication is regularly checked, necessary corrections will be part of the subsequent publications.

1. General Description

In this chapter you can read about:

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The remote controlled Mode S transponder BXP6402-XR-(XX) forms together with a control unit (e.g. CU6401) an airborne component of the Air Traffic Control (ATC). It works as a Mode S Secondary Surveillance Radar system with added ADS-B Transmitting Subsystem functionality.

In the selective mode (Mode S), the Ground Control can interrogate the transponder individually using an ICAO 24-bit address, which is unique to the particular aircraft.

BXP6402-XR-(XX) works as a part of the surveillance system in two ways:

- As Mode S transponder which provides responses to ground station interrogations and allows air traffic control (ATC) to locate, identify and track aircraft.
- As ADS-B Broadcast-Only System which continuously transmits aircraft information.

1.1. Introduction

This manual describes the installation and operation of the Mode S transponder BXP6402-XR-(XX). The ID label on your device shows the part number for identification purposes (see "Type Plate", page 25).

Before starting operation of the unit(s) please read this manual carefully, with particular attention to the description referring to your device(s). This manual also contains several optional elements of the system (Blind encoder for example) that may not be contained in your delivery package and in that case are not applicable.

For further descriptions we are using the term BXP6402 instead of writing the complete model number.

The manuals "Maintenance and Repair" (**M&R**) and "Installation and Operation (**I&O**) contain the following sections:

Section		DV69802.04 M&R	DV69802.03 I&O
	General	X	X
	Installation	X	X
	Operation	X	X
	Theory of Operation	X	N/A
	Maintenance and Repair	X	N/A
	Illustrated Parts List	X	N/A
	Modification and Changes	X	N/A
	Circuit Diagrams	X	N/A
	Certifications	X	N/A
	Attachments	X	N/A

1.2. Purpose of Equipment

The BXP6402 transponder is a remote controlled unit designed for installation in the avionic compartment of aircraft.

- All connectors for connection to the aircraft interwiring, address module, antenna and altitude encoder are located at the rear side of the unit.
- Serial interfaces RS422 are available at the unit connectors.
 - Control via: Control unit CU6401.
 - Control via: "External" unit (e.g. ADLP).
- Easy mounting; to meet the conditions for certification use the mounting method with mounting kit MK4401.

Mode S features:

- Individual interrogation of the transponder ICAO 24-bit address.
- Support of the SI code (Surveillance Identifier).
- Register capability for elementary surveillance (ELS) and enhanced surveillance (EHS).
- Extended squitters transmission.
- Data link capability.
- GPS receiver connection capability.
- ADS-B Broadcast-Only System Class B0 e.g. broadcasts following data:
 - Airborne Position Message
 - Surface Position Message
 - Airborne Velocity Message
 - Extended Squitter Aircraft Status Message

NOTICE

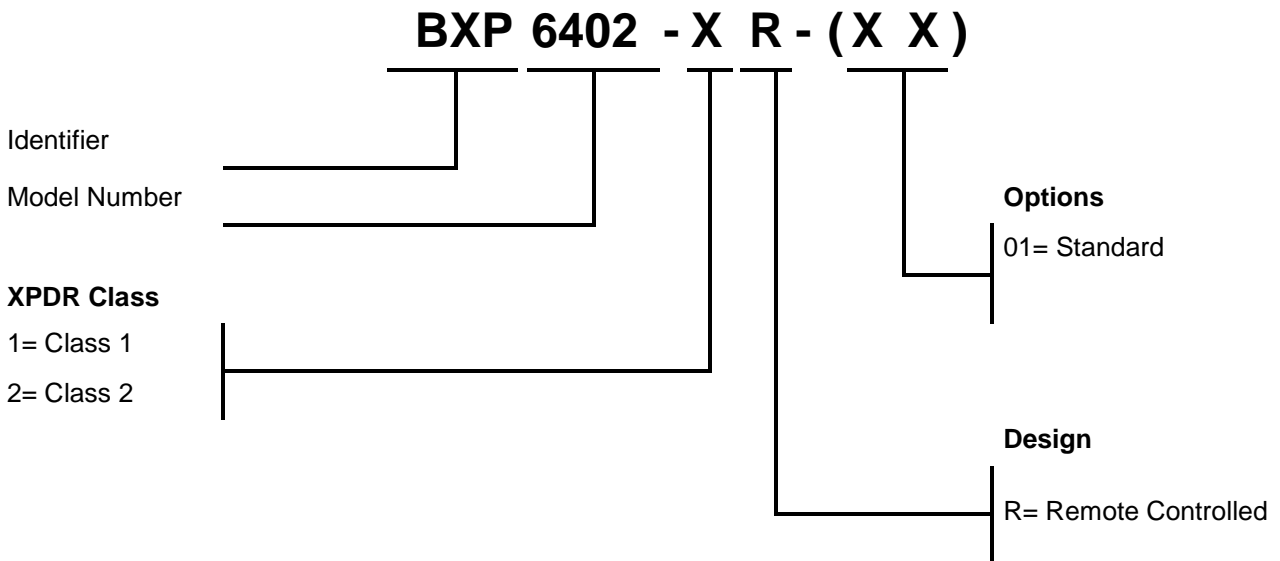
Actual generation of each ADS-B message type and data within each message depends on availability of navigation data and GPS engine capabilities.

Inherent features:

- Mode A - in this mode, the 4096 character code set on the control head is sent as a reply to interrogation from a ground station.
- Mode C - in this mode, the encoded altitude is sent in addition to the mode A reply. The altitude information must be delivered from an external device (e.g. Becker Blind Encoder BE6400).
- A special identifier pulse (SPI) can be activated by pressing the IDT button in Mode A/C and Mode S.
- Selftests (BITs). The Initiated Built-In Test (IBIT), the Continuous Built-In Test (CBIT) and the Power-on Built-In Test (PBIT) are integrated in the transponder.

1.3. Variants Overview

Within the part number, the meaning of "-XR-XX" is:



1.3.1. Software Status

Descriptions see "*Software/Firmware Status – Functionality*", page 25.

1.4. Safety-Conscious Utilization

For safe operation of the product the following notes have to be observed:

SAFETY INSTRUCTIONS

- The installation of the Mode S transponder into an aircraft may be carried out only by an authorized installation company. The country regulations always have to be observed.
- Use the product only within the specified conditions, see "Technical Data" page 16.

Power supply:

- Do not connect the unit to AC sources.
- Make sure that the unit is connected to the mandatory DC source, see "Technical Data" page 16.
- Do not connect the unit with reversed polarity to the DC source.

Circuit breaker:

- If no load is connected to connector P9, pin 6, the unit should be protected from the aircraft power supply by a dedicated 3 A circuit breaker.
- If an external load is connected to connector P9, pin 6, the circuit breaker should be a 5 A type.

Address module:

- The programming of the address module AM6400-1 with the ICAO 24-bit address of the aircraft must be carried out at an installation company or in the manufacturer factory. A programming kit is available see "Order Code" page 21.

SAFETY INSTRUCTIONS

Excessive pulses on the DC bus of the aircraft may cause damage on electrical circuits of any installed instrument.

Do not switch ON the device during engine start or shutdown.

1.5. Restriction for Use

SAFETY INSTRUCTIONS

The BXP6402 is to be used inside the declared limits.

1.6. Technical Data

1.6.1. Electrical Characteristics

BXP6402	Specifications
Power supply	10...33 VDC
Typical consumption	50 Mode S replies/s + Squitter 0.35 A at 14 V 0.20 A at 28 V in standby Mode: 0.18 A at 14 V 0.13 A at 28 V
Serial interfaces	RS422
Data link capability	255 GICB registers
DME suppression	input voltage: < 2 V (no suppression) > 8 V (suppression)
	output voltage < 0.5 V (not active) > 18 V (active)
External Ident input	"0" (active) ≤ 3.5 V "1" (not active) ≥ 4.0 V I _{source} (shorted to GND) ≤ 10 mA
Ground detection input	"ground" ≤ 0.5 V "airborne" ≥ 2 V I _{source} (shorted to GND) ≤ 10 mA
Power-up time	2 s (including internal self-test)
Internal fuse protection	F 5 A
External fuse protection	T 3 A (circuit breaker) (5 A circuit breaker if an external load is connected to P9 pin 6)
Operating temperature	Class 1: -40...+55 °C (short-time +70 °C) Class 2: -20...+55 °C (short-time +70 °C)
Storage temperature	-55...+85 °C
Operating altitude	50 000 ft. max. (class 1) 15 000 ft. max. (class 2)
Mode S	Class 1 or 2, Level 2es (Class 1=250 W, Class 2=140 W at unit output) <ul style="list-style-type: none"> • extended squitter capability • surveillance identifier (SI code)

1.6.2. Transmitter Data

BXP6402 (Transmitter Data)	Specifications
Transmit frequency	1090 MHz \pm 1 MHz
Transmit modulation	12MOM1D PAM (Pulse Amplitude Modulation)
Transmitter type	Solid state
Transmit power (class 1)	\geq 125 W (+21 dBW) at antenna end terminal and \geq 250 W at unit output
Transmit power (class 2)	\geq 70 W (+18.5 dBW) at antenna end terminal and \geq 140 W at unit output
Reply rate capability	Mode A/C: at least 1200 Mode A/C replies/s for a 15 pulse coded reply, can be limited to 500...1200 Mode S: at least 50 Mode S replies/s interval (thereof at least 16 long formats)
Mode S squitter rate (approx.)	Acquisition squitter 4/s Extended squitter 1/s
Reply code (mode A)	ICAO coding system with 4096 pulse reply possibilities (octal code)
Altitude code (mode C)	ICAO coding system 100 ft steps from -1000...62700 ft.
Altitude code (mode S)	25 ft. or 100 ft. steps (depending on source)
Transmit pulse shape	Pulse width 0.45 μ s \pm 0.1 μ s (mode A/C) Pulse width 0.5 μ s \pm 0.05 μ s (mode S) Rise time 0.05...0.1 μ s Fall time 0.05...0.2 μ s
Nominal output impedance	50 Ω

1.6.3. Receiver Data

BXP6402 (Receiver Data)	Specifications
Operating modes	Mode A/C/S, depending on interrogation
Receive frequency	1030 MHz \pm 0.1 MHz (mode A/C) 1030 MHz \pm 0.01 MHz (mode S)
Sensitivity (MTL)	-74 dBm \pm 3 dB (for 90% reply rate in mode A/C and 99% in mode S)
Selectivity	\pm 15 MHz > 40 dB \pm 25 MHz > 60 dB
Dynamic range	\geq 60 dB
Bandwidth	\pm 3 MHz < 3 dB
Modulation (mode A/C)	PAM (Pulse Amplitude Modulation)
Modulation (mode S)	DPSK (Differential Phase Shift Keying)
Side lobe suppression	3-pulse method (mode A/C), P5 (mode S)
Nominal impedance	50 Ω

1.6.4. Dimensions & Weight

	Specifications
	BXP6402-XR-(XX)
Front plate HxW	61x61 mm (2.4x2.4 inch)
Device depth (total)	187.7 mm (7.39 inch)
with antenna socket	186,5 mm (7.34 inch)
with address module	218.5 mm (8.6 inch)
Weight	
BXP6402	\leq 0.7 kg (1.54 lb)
Address module	approx. 0.018 kg (0.04 lb)
Mounting kit MK4401	\leq 0.130 kg (0.27 lb)
Blind encoder BE6400-01	approx. 0.1 kg (0.22 lb)

1.6.5. Software

The transponder BXP6402-XR-(XX) is controlled by a micro controller. The software criticality is determined to be Level C in accordance with EUROCAE/RTCA document ED12B/DO-178B.

1.6.6. Environmental Condition

BXP6402-XR-(XX) was tested in accordance with EUROCAE/RTCA ED-14D/DO-160D under consideration of below listed environmental categories and conditions:

Characteristics	Section	Cat.	Condition
Temperature and Altitude	4.0	D1	Equipment tested to Category D1
Low Ground Survival Temperature	4.5.1	D1	-55 C
Low Operating Temperature	4.5.1	D1	-20 C
High Ground Survival Temperature	4.5.2	D1	+85 C
High Short-Time Operating Temperature	4.5.2	D1	+70 C
High Operating Temperature	4.5.2	D1	+55 C
In-flight Loss of Cooling	4.5.4	Z	No auxiliary cooling required
Altitude	4.6.1	D1 A1	50 000 ft (class 1) for BXP6402-1R-(XX) 15 000 ft (class 2) for BXP6402-2R-(XX)
Decompression	4.6.2	X	No test performed
Overpressure	4.6.3	X	No test performed
Temperature Variation	5.0	B	5 °C minimum per minute
Humidity	6.0	A	Up to 95% humidity at 50 °C
Shock and Crash Safety	7.0	B	Equipment tested to Category B
Vibration	8.0	S U	Cat. S, vibration test curve M Cat. U, vibration test curve G
Explosion Proofness	9.0	X	No test performed
Water Proofness	10.0	X	No test performed
Fluids Susceptibility	11.0	X	No test performed
Sand and Dust	12.0	X	No test performed
Fungus Resistance	13.0	X	No test performed
Salt Spray	14.0	X	No test performed
Magnetic Effect	15.0	Z	Distance for a deflection of Dc = less than 0.3 m
Power Input	16.0	B	Equipment tested to Category B
Voltage Spike	17.0	A	Equipment tested to Category A
Audio Freq. Conducted Susceptibility	18.0	B	Equipment tested to Category B
Induced Signal Susceptibility	19.0	A	Equipment tested to Category A
Radio Frequency Susceptibility	20.0	WW	Equipment tested to Category WW
Spurious RF Emission	21.0	B	Equipment tested to Category B
Lightning Induced Transients Susceptibility	22.0	A3E3X	Equipment tested to Category A3E3X
Lightning Direct Effects	23.0	X	No test performed
Icing	24.0	X	No test performed
Electrostatic Discharge	25.0	A	Equipment tested to Category A

1.6.7. Certifications

Conformity	BXP6402-XR-(XX)
EASA.210.322	ETSO-2C112a, class 1 or 2
FAA	TSO-C112, class 2A or 2B
RTCA	DO-181C
EUROCAE	ED-73B, Level 2es
Software	EUROCAE/RTCA ED12B/DO-178B Level C
In accordance with: EURO CAE/RTCA ED-14D/DO-160D	
Operating altitude	50 000 ft. max. (class 1) 15 000 ft. max. (class 2)
In-flight loss of cooling	Cat. Z, no auxiliary cooling required
Humidity	Cat. A/+50 °C; 95%, 48 h
Vibration resistance	Cat. S, test curve M Cat. U, test curve G
Operational shocks	6 g in any direction
Crash safety	20 g shocks 20 g acceleration
Magnetic effect	Category Z
Environmental categories	BXP6402-XR-(XX): [D1Z]BAB[(SM)(UG)]XXXXXXXXZBABA[WW]B[A3E3X]X XA

1.7. Order Code

1.7.1. BXP6402

Qty	Mode S Transponder (remote controlled)	
1	BXP6402-1R-(01), class 1	Article-No. 0588.695-915
1	BXP6402-2R-(01), class 2	Article-No. 0588.717-915

1.7.2. Accessories

Qty	Control unit for BXP6402	
1	CU6401-1-(01)	Article-No. 0572.896-915

Qty	Address module	
1	AM6400-1-(01)	Article-No. 0572.942-915

Qty	Programming kit for Address module	
1	AMP6400-1, parallel interface	Article-No. 0584.843-954
1	AMP6400-2, USB interface	Article-No. 0604.054-954

Qty	Blind encoder (altitude encoder)	
1	BE6400-1-(01)	Article-No. 0592.137-915

Qty	Antenna	
1	1A032 Transponder antenna KEC-KC-89 (BNC)	Article-No. 0707.007-952

Qty	Mounting kit for BXP6402	
1	Mounting kit MK4401	Article-No. 0556.726-284

Qty	Connector kit CK4401-S (soldering version)	Article-No. 0552.801-954
1	Connector Dsub 25-s	
1	Connector housing	
1	Label XPDR	

Qty	Connector kit CK4401-C (crimp version)	Article-No. 0552.798-954
1	Connector Dsub 25-s	
1	Connector housing	
1	Label XPDR	

Qty	Connector kit CK6400-S (soldering version)	Article-No. 0586.072-954
1	Connector Dsub 25-s	
1	Connector Dsub 25-p	
2	Connector housing	
1	Label XPDR	

Qty	Connector kit CK6400-C (crimp version)	Article-No. 0586.064-954
1	Connector Dsub 25-s	
1	Connector Dsub 25-p	
2	Connector housing	
1	Label XPDR	

Qty	Cable, connectors, ...	
1	1K046 Cable harness, length 1 m	Article-No. 0604.615-276
1	1SK504 BNC connector for cable RG58U, soldering	Article-No. 0725.706-277
1	1SK503 TNC connector for cable RG58U, soldering	Article-No. 0725.900-277
1	TNC coaxial connector for RG-58C/U, crimp	Article-No. 0551.694-277
1	TNC coaxial connector for RG-223/U, crimp	Article-No. 0551.732-277
1	TNC coaxial connector for RG-58C/U, soldering	Article-No. 0552.781-277
1	BNC antenna connector for RG-58C/U, crimp	Article-No. 0551.708-277
1	BNC antenna connector for RG-223/U, crimp	Article-No. 0551.740-277
1	BNC antenna connector for RG-58C/U and RG-223/U, soldering	Article-No. 0552.771-277

Qty	Available Documentation	
1	BXP6402 Installation and Operation Manual, English	Article-No. 0584.071-071
1	BXP6402 Maintenance and Repair Manual, English	Article-No. 0584.088-071
1	BXP6402-XR Control Interface Protocol	Article-No. 0590.241-071
1	BXP640X-XX-(XX) Data Transfer Interface Protocol	Article-No. 0590.258-071

2. Installation

This manual must be available close to the device during the performance of all tasks.

Careful planning should be applied to achieve the desired performance and reliability from the product. Any deviations from the installation instructions prescribed in this document are under own responsibility.

The BXP6402 transponder is a remote-controlled unit designed for installation in the avionic compartment of aircraft. The installation of the BXP6402 depends on the type of aircraft and equipment and therefore only general information can be given in this section.

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2.1. Packaging, Transport, Storage

Visually inspect the package contents for signs of transport damage.

2.1.1. Packaging Material and Transport

⚠ CAUTION The packaging material is inflammable, if it is disposed of improperly by burning, toxic fumes may develop.

The packaging material can be kept and reused in the case of a return shipment. Improper or faulty packaging may lead to transport damages.

Make sure to transport the device always in a safe manner and with the aid of suitable lifting equipment if necessary. Do never use the electric connections for lifting. Before the transport, a clean, level surface should be prepared to place the device on. The electric connections may not be damaged when placing the device.

First Device Checkup

- Check the device for signs of transport damages.
- Please verify if the indications on the type plate correspond to your purchase order.
- Check if the equipment is complete ("Scope of Delivery", page 24).

⚠ WARNING Do not use products with damages!

Storage

If you do not wish to mount and install the device immediately, make sure to store it in a dry and clean environment. Make sure that the device is not stored near strong heat sources and that no metal chippings can get into the device.

2.2. Device Assignment

This manual is valid for the following devices:

- BXP6402-1R-(01) + supplement
- BXP6402-2R-(01) + supplement

2.2.1. Scope of Delivery

- Manuals
 - Operating Instructions
- Transponder
 - BXP6402 (corresponding to your ordered version)
- Documents of Certifications if available

2.2.2. Additional Required Equipment

- Address module AM6400-1-(01) programmed
- Mounting kit
 - MK4401
- Connector kit
- Antenna
- Antenna cable
- CU6401 control unit or OEM control unit

Details see "Accessories", page 21.

2.2.3. Type Plate

The device type is defined by the type plate (on the housing):

Example:



Figure 1: Type Plate (example)

Explanation:

PN:	Example Type designation: BXP6402-1R-(01) BXP6402 = Transponder, BXP640X family Options: -1R-: class 1, remote controlled -2R-: class 2, remote controlled (01): standard
SN:	Unique number of the particular device
AN:	Article number
	Software Corresponding to the displayed version
	Compliance and Certifications Corresponding to the displayed text and logos

2.2.4. Software/Firmware Status – Functionality

The implemented firmware version can be checked with the control unit:

- With control unit CU6401 please see in the "Operating with CU6401 Controller", page 45.
- With other control unit please see in corresponding user manual.

Units equipped with non-ADS B out capable software can be modified from our Customer Service Department..

Software/Firmware Status		Functionality
CU VER	2x	no ADS-B out
CORE VER	42	
FPGA VER	50	
CU VER	2x	ADS-B out not certified according to TSO-C166b; only capable for GA Traffic Receiver e.g. FLARM(R)
CORE VER	47	
FPGA VER	55	

2.3. Mounting Requirements

SAFETY INSTRUCTIONS

The device must not be opened.

When installing the device, make sure the heat dissipators of the device receive sufficient air. Keep an efficient distance of the devices with integrated ventilator fans in order to ensure free circulation of the cooling air.

Make sure that the mounting plate is not exposed to external temperature influences.

The mounting place shall be at least 30 cm from the magnetic aircraft compass, to avoid any interference to the magnetic compass by the transponder.

SAFETY INSTRUCTIONS

The installation of the Mode S transponder into an aircraft may be carried out only by an authorized installation company. The country regulations always have to be observed.

2.3.1. Order of Installation

- Installation with MK4401 (mounting kit), first install the mounting frame using three countersunk screws.
- Loosen the securing-plate from mounting frame.
- Slide the transponder into the mounting.
- Push the security-plate into the locking slot and tighten the securing-plate.
- Carry out removal of the transponder in reversed order.

2.3.2. Blind Encoder (BE6400)

For installation of the Becker Avionics Blind Encoder BE6400 the corresponding manual has to be noticed (BE6400 I&O manual Article-No. 0594.547-071).

- The Blind Encoder BE6400 is intended to be connected to connector J8 of the transponder.
- The Blind Encoder is direct connected without any interwiring.
- It can be used only in installations that do not require connection of other equipment utilizing ADLP interface of the transponder.

2.3.3. Antenna 1A032

- Fit the transponder antenna to the bottom of the aircraft 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 lowest point of the aircraft fuselage.

SAFETY INSTRUCTIONS

The transponder antenna 1A032 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 counterweight plate or panel must be located within the fuselage at the antenna location with minimum dimensions 400x400 mm (15.7x15.7 inch).

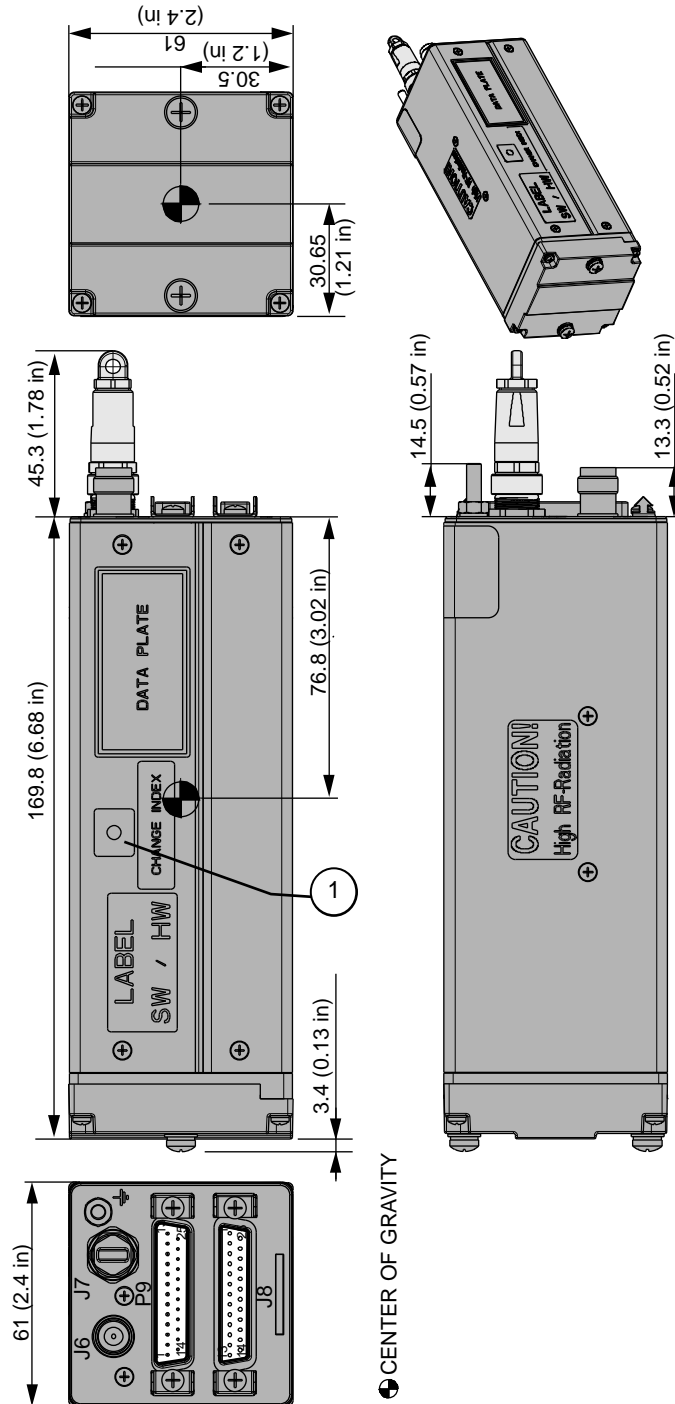
2.3.3.1. Antenna Cable

- Cable types RG-58C/U (0.9 dB/m) or RG-223/U (0.6 dB/m) can be used.
 - With cable length >2 m between unit and antenna, we recommended cable type RG-223/U.
- Recommended cable length ≤5 m.
- Complete loss of the antenna cable ≤3 dB.

2.4. Dimensions

2.4.1. Transponder BXP6402-XR-(XX)

Dimensions mm (inch)



① access to TX frequency adjustment

Figure 2: Transponder BXP6402-XR-(XX)

NOTICE

"Center of Gravity" without address module.

Allowable deviation for dimensions without tolerances: DIN ISO 2768 T1 C		
xx...6 (± 0.3)	>30...120 (± 0.8)	>400...1000 (± 2.0)
>6...30 (± 0.5)	>120...400 (± 1.2)	>1000...2000 (± 3.0)

2.4.2. Transponder BXP6402-XR-(XX) with Mounting Kit MK4401

Dimensions mm (inch)

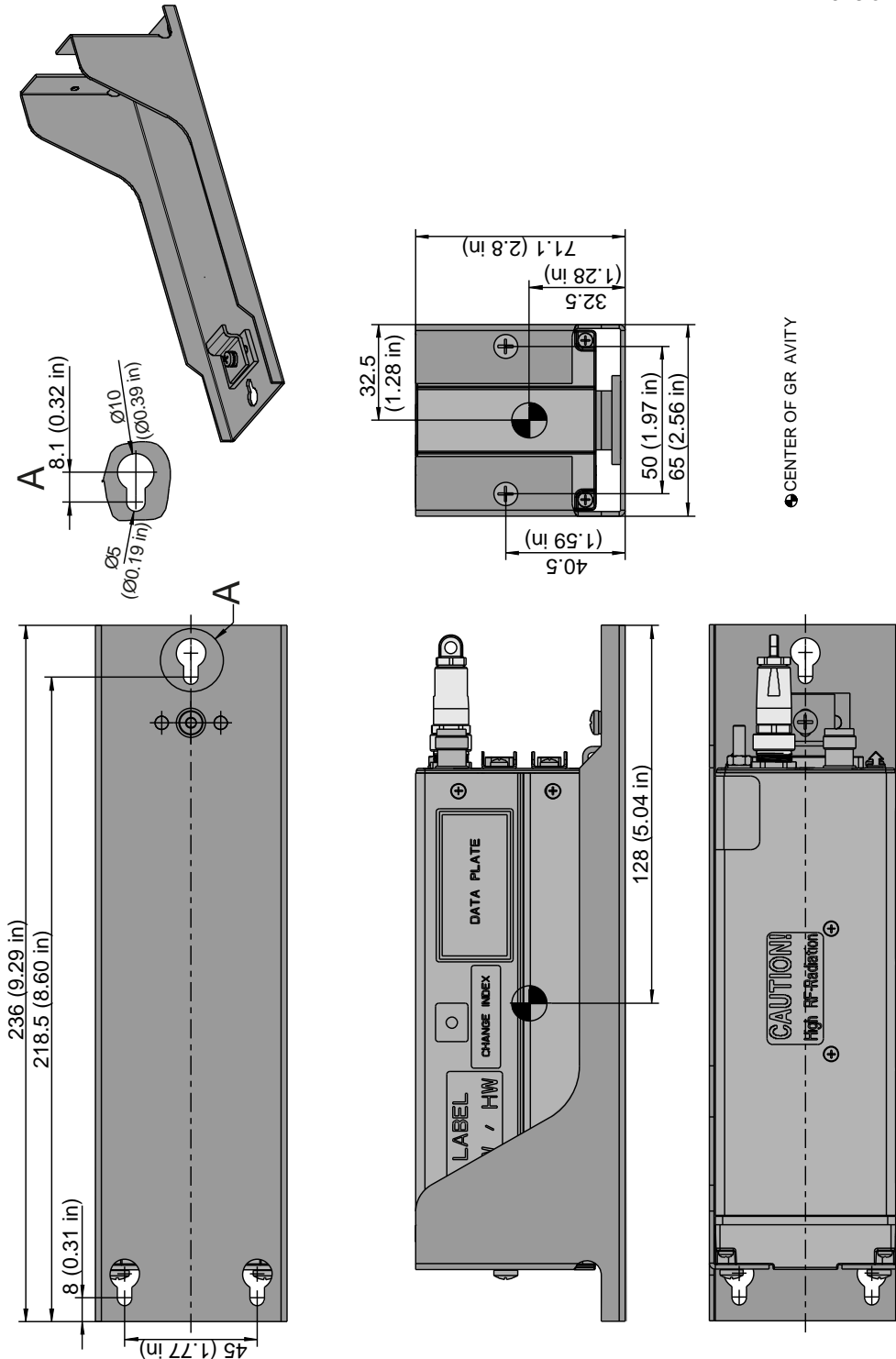


Figure 3: Mounting Kit MK4401

NOTICE

"Center of Gravity" without address module.

Allowable deviation for dimensions without tolerances: DIN ISO 2768 T1 C		
xx...6 (±0.3)	>30...120 (±0.8)	>400...1000 (±2.0)
>6...30 (±0.5)	>120...400 (±1.2)	>1000...2000 (±3.0)

2.4.3. Address Module AM6400-1-(01)

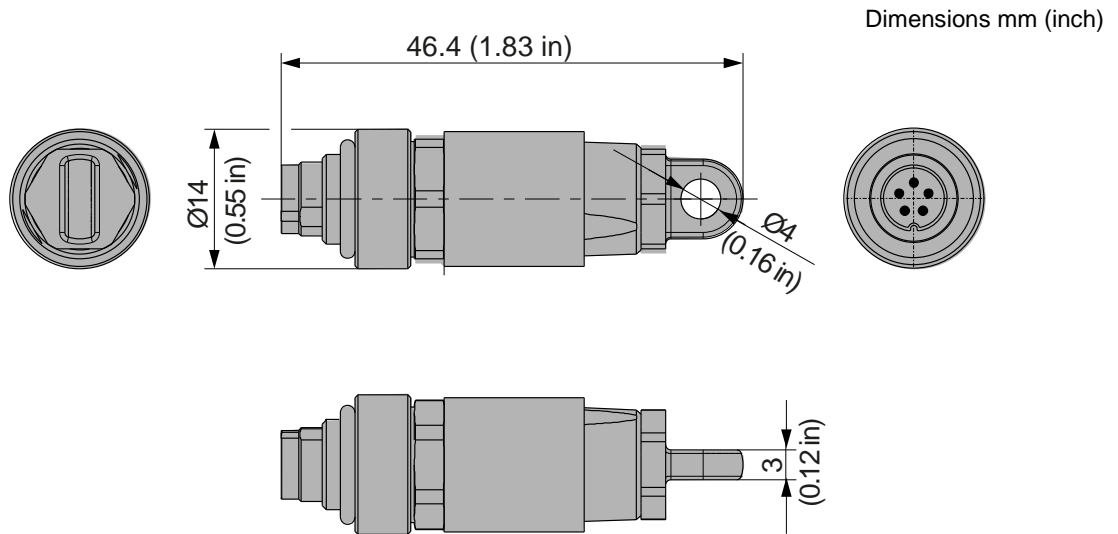


Figure 4: Address Module AM6400-1-(01)

2.4.4. Blind Encoder BE6400

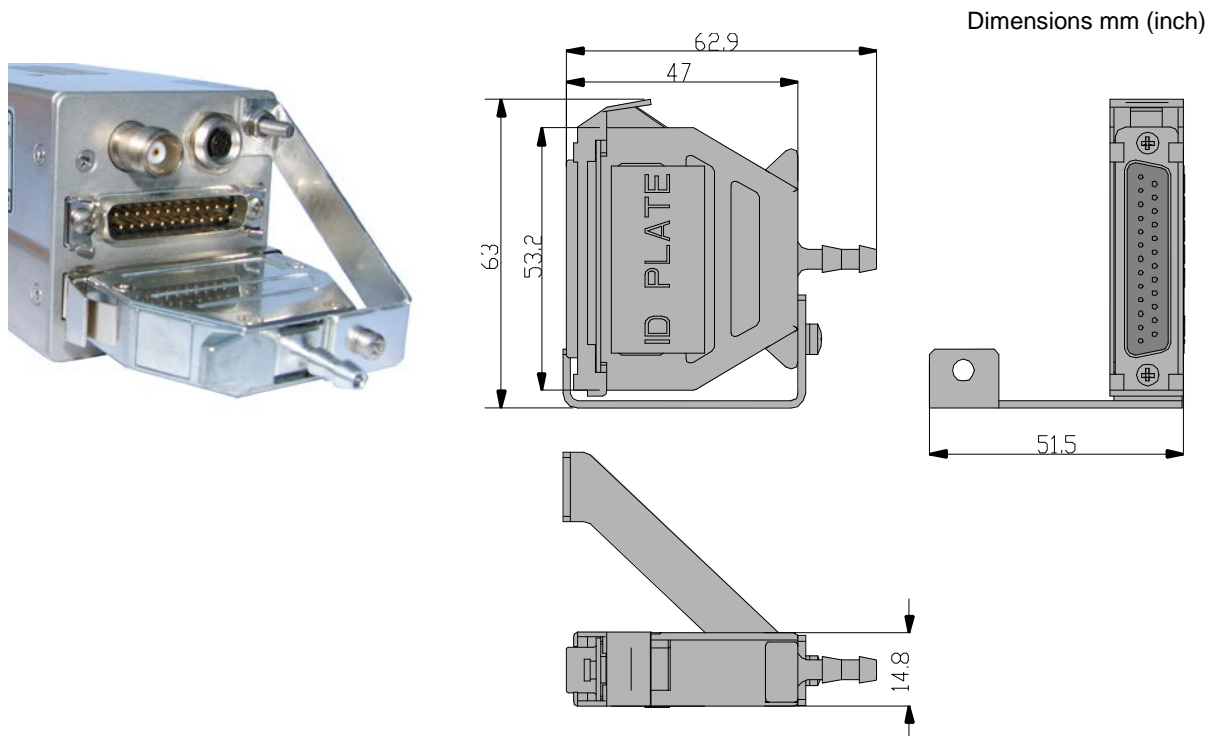


Figure 5: Blind Encoder BE6400

2.4.5. Antenna 1A032

Dimensions mm (inch)

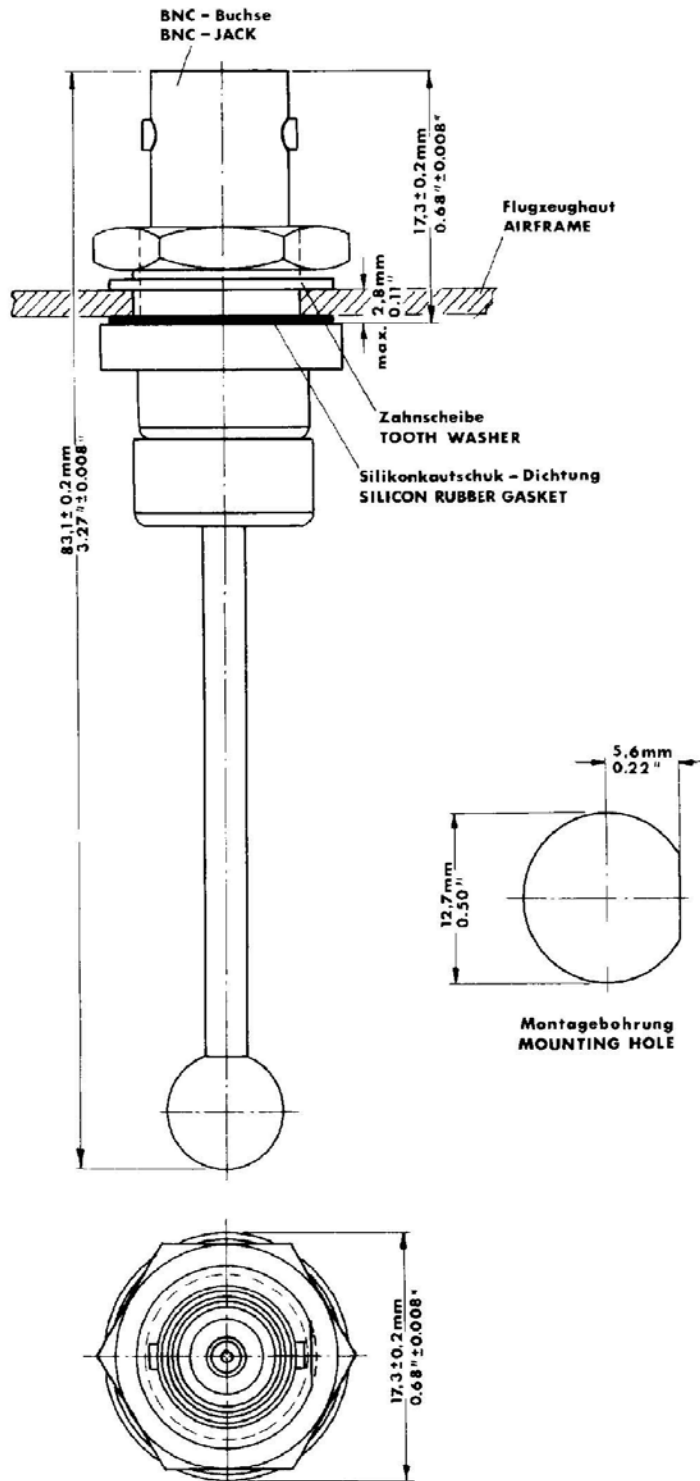


Figure 6: Antenna 1A032

2.5. Electrical Installation

SAFETY INSTRUCTIONS

- The installation of the Mode S transponder into an aircraft may be carried out only by an authorized installation company. The country regulations always have to be observed.

Power supply:

- Do not connect the unit to AC sources.
- Make sure that the unit is connected to the mandatory DC source, see "Technical Data" page 16.
- Do not connect the unit with reversed polarity to the DC source.

Circuit breaker:

- If no load is connected to connector P9, pin 6, or if the unit is used with the retrofit adapter, the unit should be protected from the aircraft power supply by a dedicated 3 A circuit breaker.
- If an external load is connected to connector P9, pin 6, the circuit breaker should be a 5 A type.

Address module:

- The programming of the address module AM6400-1 with the ICAO 24-bit address of the aircraft must be carried out only at an installation company or in the manufacturer factory.

For installations in a more severe electromagnetically environment use shielded cable connectors and a common shielding for the transponder interwiring.

⚠ CAUTION

Radiation risk:

A safe distance to the installed antenna must be ensured by corresponding installation measures around human body damage (e.g. at the eyes) and/or avoid the inflammation of combustible materials by radiated energy.

2.5.1. Grounding

The transponder has a threaded grounding bolt at the rear side of the unit. Use this point as grounding contact.

SAFETY INSTRUCTIONS

Make sure that the grounding contact area is adequate and that the connection has low resistance and low inductance. Never use a grounding point on paint-coated surfaces!

2.5.2. BXP6402 Connector Layout

J6: Antenna
J7: Address module

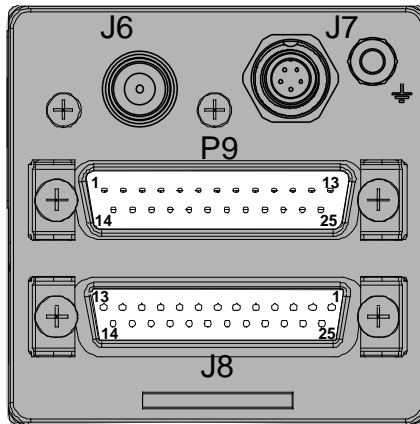


Figure 7: BXP6402 Connector Layout

2.5.3. Connector J6

Antenna RF connector (from transponder via cable to antenna).

- Type: TNC female.
- Antenna cable: low-loss 50 Ω cable, RG 58C/U or RG 223/U type.
- Signal: bi-directional

2.5.4. Connector P9 (Dsub 25-pol male)

P9 Pin	Pin name	Function	Source	Destination	Recommended cable type
1	A1	Altitude A1	encoding altimeter (parallel interface)	BXP6402	AWG24
2*	A2	Altitude A2 or GPS /Enable	encoding altimeter (parallel interface) aircraft DC supply ground*	BXP6402	AWG24 AWG26
3	A4	Altitude A4	encoding altimeter (parallel interface)	BXP6402	AWG24
4	IDENT_N	IDENT button, external	external IDENT button	BXP6402	AWG26
5	EXT. SUPPRESSION	Aircraft suppression system	bi-directional	bi-directional	Coaxial cable
6	SWITCHED POWER OUT	Switched supply voltage I _{max} = 1 A	BXP6402	encoding altimeter	AWG22
7	REPLY OUT	Output for ext. reply lamp, lamp to be connected to positive illumination voltage	BXP6402	reply lamp	AWG26
8	RX+	RS422 interface	CU6401	BXP6402	AWG26 shielded
9	RX-	RS422 interface	CU6401	BXP6402	AWG26 shielded
11	SUPP	Supply voltage input, external 5 A fuse for	DC supply voltage source 10...33 V	BXP6402	AWG20

P9 Pin	Pin name	Function	Source	Destination	Recommended cable type
		current protection			
12	SUPP	Supply voltage input, external 5 A fuse for current protection	DC supply voltage source 10...33 V	BXP6402	AWG20
13	GND	DC supply ground, additionally connected to Pin25	DC supply voltage ground	BXP6402	AWG20
14	B1	Altitude B1	Encoding altimeter (parallel interface)	BXP6402	AWG24
15	B2	Altitude B2	Encoding altimeter (parallel interface)	BXP6402	AWG24
16	B4	Altitude B4	Encoding altimeter (parallel interface)	BXP6402	AWG24
17	C1	Altitude C1	Encoding altimeter (parallel interface)	BXP6402	AWG24
18	C2	Altitude C2	Encoding altimeter (parallel interface)	BXP6402	AWG24
19	C4	Altitude C4	Encoding altimeter (parallel interface)	BXP6402	AWG24
20	D4	Altitude D4	Encoding altimeter (parallel interface)	BXP6402	AWG24
21	TX+	RS422 interface	BXP6402	CU6401	AWG26
22	TX-	RS422 interface	BXP6402	CU6401	AWG26
24	ON_N	ON/OFF signal	CU6401	BXP6402	AWG26
25	GND	Ground, additionally connected to Pin13	DC supply voltage ground	BXP6402	AWG20

Note P9:

*If no parallel altimeter is used then pin2 serves as GPS Enable/Disable input (active LOW). If no GPS receiver is used Pin2 should be left not connected.

For details see "Aircraft Wiring", page 40.

2.5.5. Connector J8 (Dsub 25-pol female)

J8 Pin	Pin name	Function	Source	Destination	Recommended cable type
1	PSEL	Protocol selection	DC supply voltage ground	BXP6402	AWG26
2*	GPS_EN	GPS /Enable	Aircraft DC supply ground	BXP6402	AWG26
3	GND	Ground connection	Aircraft DC supply ground	BXP6402	AWG24
4 ¹⁾	BSUPP	Supply for BE6400	BXP6402	BE6400	-
5	Not connected	-	-	-	-
6	RX+	GPS receiver	GPS receiver	BXP6402	AWG26 shielded

J8 Pin	Pin name	Function	Source	Destination	Recommended cable type
7	RX-	GPS receiver	GPS receiver	BXP6402	AWG26 shielded
8	Not connected	-	-	-	-
9	Not connected	-	-	-	-
10	Not connected	Reserved for SQ	-	-	-
11	GND SWITCH	"Weight on wheel" sensor, active LOW	Aircraft	BXP6402	AWG26
12 ²⁾	ALTS-	RS422 data interface	Serial encoding altimeter	BXP6402	AWG26 shielded
13 ²⁾	ALTS+	RS422 data interface	Serial encoding altimeter	BXP6402	AWG26 shielded
14	TISRX-	RS422 data interface	Avionics Data Link Processor	BXP6402	AWG26 twisted pair, shielded all together
15	TISRX+	RS422 data interface	Avionics Data Link Processor	BXP6402	AWG26 twisted pair, shielded all together
16	Not connected	-	-	-	-
17	TISTX-	RS422 data interface	BXP6402	Avionics Data Link Processor	AWG26 twisted pair, shielded all together
18	TISTX+	RS422 data interface	BXP6402	Avionics Data Link Processor	AWG26 twisted pair, shielded all together
19	Not connected	-	-	-	-
20	Not connected	-	-	-	-
21	GND	ground connection	Aircraft DC supply ground	BXP6402	AWG24
22	Not connected	-	-	-	-
23	Not connected	-	-	-	-
24	Not connected	-	-	-	-
25	Not connected	-	-	-	-

Note J8:

1) Do not connect if no BE6400 is used.
 2) Serial encoding altimeter connection (not for BE6400).
 *If no GPS receiver is used then Pin2 should be left not connected.
 For details see "Aircraft Wiring", page 40.

2.5.6. Connector J7 (5-pol female)

J7 Pin	Pin name	Function	Source	Destination
1	VCC	Power supply	BXP6402	AM6400
2	I ² C_CLK	Clock	AM6400	BXP6402
3	Not connected	Reserved	-	-
4	I ² C_DAT	Data	AM6400	BXP6402
5	GND	Power supply return	BXP6402	AM6400

2.5.7. External Suppression

External suppression should be connected if another transponder or DME is installed in the aircraft. The suppression pulses may not be compatible with all models of DME. In this case, leave the suppression pin open (e.g. P9 pin 5).

In cases when the DME has only a suppression output (e.g. Bendix/King KN62, KN64 and KNS80) inserted a diode in the suppression line. Details see "Aircraft Wiring" page 40.

2.5.8. External IDENT Push-Button

If this input (unit connector P9 pin 4) is briefly connected to GND (e.g. by an external push-button), the IDENT function (SPI) is started in the same way as when using the IDENT push-button on the front panel.

2.5.9. Ground Switch

- If required, connect an automatic ground switch ("Weight on Wheel" sensor) at unit connector J8 pin 11.

2.5.10. Programming of the Address Module

The 24-bit ICAO address once allocated by the local authority is stored for the assigned transponder in the Address Module AM6400.

The address module programmer kit AMP6400 is for reading and storing fixed aircraft data into the Address Module. This tool is for service and maintenance only. The CD-ROM, which is part of the address module programmer kit, includes a description of the programming procedure. Insert the CD-ROM into a PC and follow the instructions. If auto start is disabled on your PC, please start "setup.exe" manually.

2.5.11. Avionics Data Transfer

- The BXP6402 is a "data link transponder" according to RTCA DO-181C, respectively a "level 2" transponder according to Eurocae ED-73B. This stands for the capability to transfer data from the ground to a connected ADLP or a similar device and vice versa.
- The transponder transmits information as reply on a Ground Initiated Comm-B (GICB) request or by means of the extended squitter function. In both cases the valid information must be available in the GICB registers in the transponder.
- The transponder also transmits information by means of the Air Initiated Comm-B (AICB) function. In this case the information must be available in a special register in the transponder. The transponder announces the message and transmits it after authorisation from the ground station.
- In the other direction, the transponder is able to receive information within a Comm-A format from the ground station, which is then buffered and transfer red to the connected device.
- In the BXP6402 a "storage design" is implemented for uplink- as well as for downlink messages. This means that all information that might be transferred from the transponder is buffered inside the transponder first.
- The buffers can be accessed from an ADLP or a similar device via the interface on the rear connector J8. The interface is marked with "TISR" and "TISTX" in the aircraft wiring diagram (see page 40).
- The related protocol is specified in the attachment document "Data Transfer Interface Protocol BXP640X-XX-(XX)". This manual is available at the Becker Product Support under Article-No. 0590.258-071.

2.5.12. GPS Configuration

- If a GPS receiver is used, connect “GPS_EN” to DC supply ground.
 - BXP6402 “GPS_EN” J8 pin2 DC supply ground.

- GPS receiver data line connection to BXP6402 see:
 - “BXP6402 with Parallel Encoding Altimeter & GPS Receiver” page 41.
 - “BXP6402 with Serial Encoding Altimeter & GPS Receiver” page 42.

- GPS receiver supply connection to BXP6402:
 BXP6402 “SWITCHED POWER OUT” P9 pin6* \triangleq supply voltage P9 pin11, 12.
 (if its current consumption \leq 1 A, otherwise it should be connected directly to aircraft supply).

*when the BXP640X is switched ON the output voltage P9 pin6 corresponds to the supply voltage (P9 pin11, 12).

The equipment is capable to operate with following certified GPS receivers:

- FreeFlight System GPS/WAAS 1201 Sensor, part number 84100-02-XXXX
- NexNav miniGNSS/ GPS-SBAS Sensor/ Receiver.

The equipment is capable to operate with GPS receivers providing EIA-232C or EIA-422 interface with serial asynchronous transmission parameters: 4800, n, 8, 1 and transmit data with continuous NMEA-0183 protocol GGA and VTG sentences.

2.5.12.1. GPS Device Protocols

Electrical format – RS232 with the following characteristics:

	FreeFlight 1201	NexNav	NMEA
Baud Rate:	19200 bps	19200 bps	4800 bps
#Data Bits:	8	8	8
Parity:	none	none	none
Stop Bits:	1	1	1
Code:	binary	binary	ASCII

2.5.13. Remote Control

- BXP6402 is a remote-controlled transponder and needs an additional controlling device.
 - Use the control unit CU6401 from Becker Avionics; a special designed control unit, which offers the complete set of control functions and indications.
 - Use another device (e.g. FMS).

- Two interfaces are available for that purpose.
 - "RX", "TX" on connector P9 of the transponder.
The transponder accepts and transmits only control messages via this interface.
 - "TISRX", "TISTX" on connector J8 of the transponder.
A combined interface which handles control and data transfer in parallel.

The protocol for both interfaces is described in the document: "BXP6400 Extended Protocol". This document is available at the Becker Product Support.

2.6. Settings after Installation

Following description is valid for the BXP6402 remote transponder with the control unit CU6401.

With another control unit the control protocol settings must be carried out as they are described in the document "Control Interface Protocol BXP6402-XR" see "Order Code", page 21.

Installation mode is available from SBY mode only.

- Press button SEL,
- Turn the rotary encoder until "INS" appears in the bottom line of the display.
- Select by pressing rotary encoder/push-button.

The installation setup is protected by password "6435".

- Enter password and press store button (STO).

Information front panel see "Operating with CU6401 Controller", page 45

Select with button	Select with rotary encoder		Store button (STO)
ALTM SELECT	GARMIN / TRIMBLE NORTHSTAR UPS AT (BECKER BE6400) UPS AT LORAN MAGELLAN SHADIN ARNAV PARALLEL	default	store store store store store store store store
DIMMING INPUT	None (set illumination intensity manually in the configuration menu) +5 VDC +14 VDC +28 VDC	default	store store store
SQUITTER	Short ACQ SQU *	default on	off/on
REPLY RATE LIMIT	RPL RATE LMT 500-1200 replies/s in Mode A/C (setting in steps of 50)		store
SPECIALS	DATA LINK ** DEFAULT CONFIG *** ALT HIGH RESOL		store store store
Error Latch	LOW VOLT HIGH TEMP ANTENNA RF POWER DME ERR SQRT ERR CORE EE RECEIVER FIX DATA ALTIMETER DATA LINK Clear latch		view only view only view only view only view only view only view only view only view only view only view only clear latch

*Transponders equipped for extended squitter operation should have a means to disable acquisition squitters to facilitate the suppression of acquisition squitters when all TCAS units have been converted to receive extended squitter.

**Shall be disabled if no ADLP or similar device is connected.

*** Default configuration:

Dimming input	none
Brightness	50%
Altitude displayed in ALT mode	
AI in SBY	
AI in ON	
Illumination characteristics	max. range
Code	0000
VFR	0000
Flight number	eight blanks
Flight number	not active

2.7. Warning and Failure Indications

It is possible to read out the error latches. If multiple failures are listed please keep in your mind the listed failures and delete the latches with the "Clear Latch" store sequence.

2.8. Aircraft Wiring

SAFETY INSTRUCTIONS

Installation of the unit varies according to aircraft and equipment design. It is therefore only possible to provide general guidelines in this section.

The following figures show examples of aircraft wiring with BXP6402. For further information of aircraft wiring with other devices refer to the corresponding manuals.

Wiring diagram with CU6401

For detailed information refer to the manual CU6401 Installation and Operation DV69803.03 (Article No. 0584.096-071).

Wiring diagram with OEM Controller

For detailed information refer to the manual of the respective OEM product.

2.8.1. BXP6402 with Parallel Encoding Altimeter & GPS Receiver

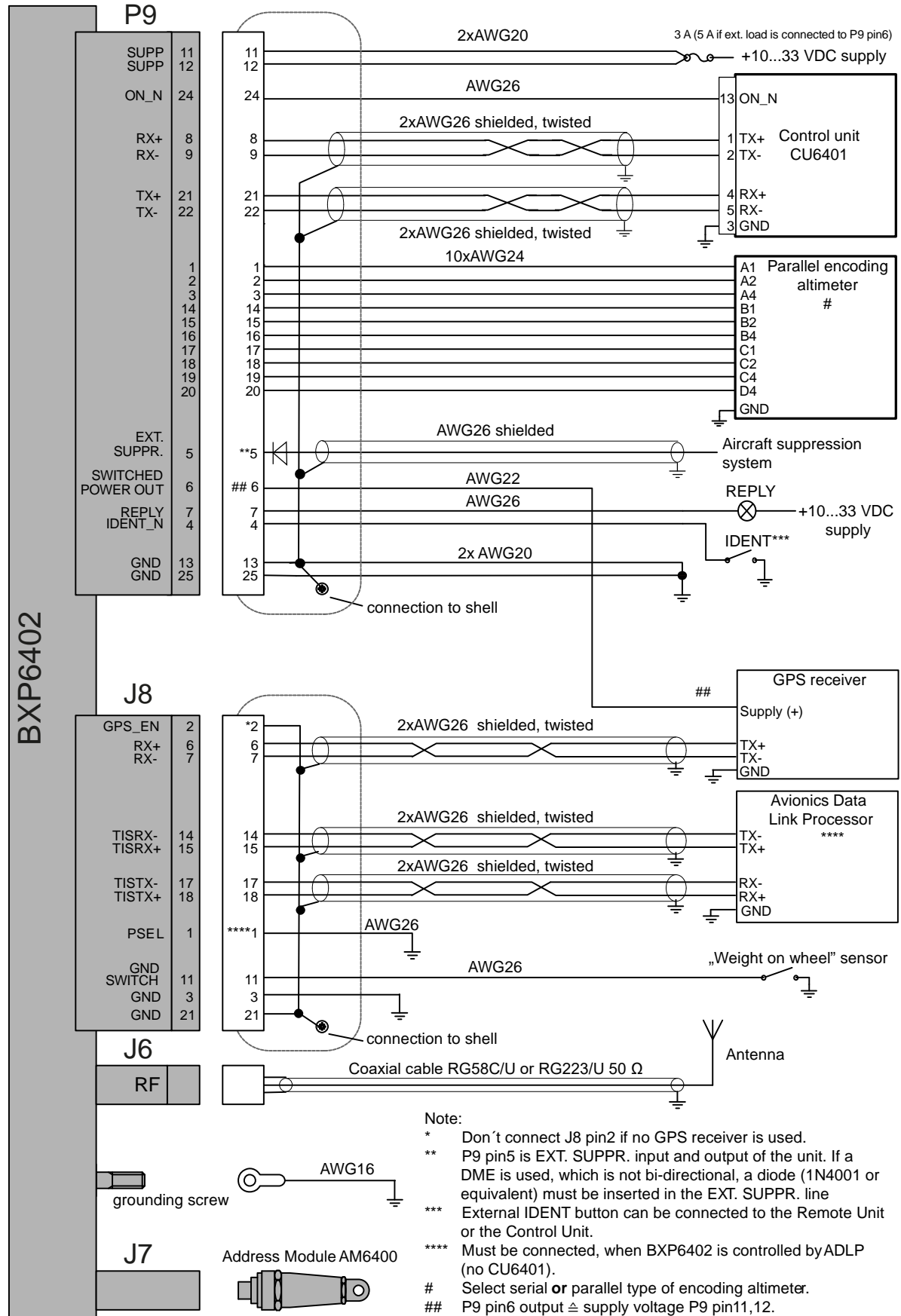


Figure 8: BXP6402 with Parallel Encoding Altimeter & GPS Receiver

2.8.2. BXP6402 with Serial Encoding Altimeter & GPS Receiver

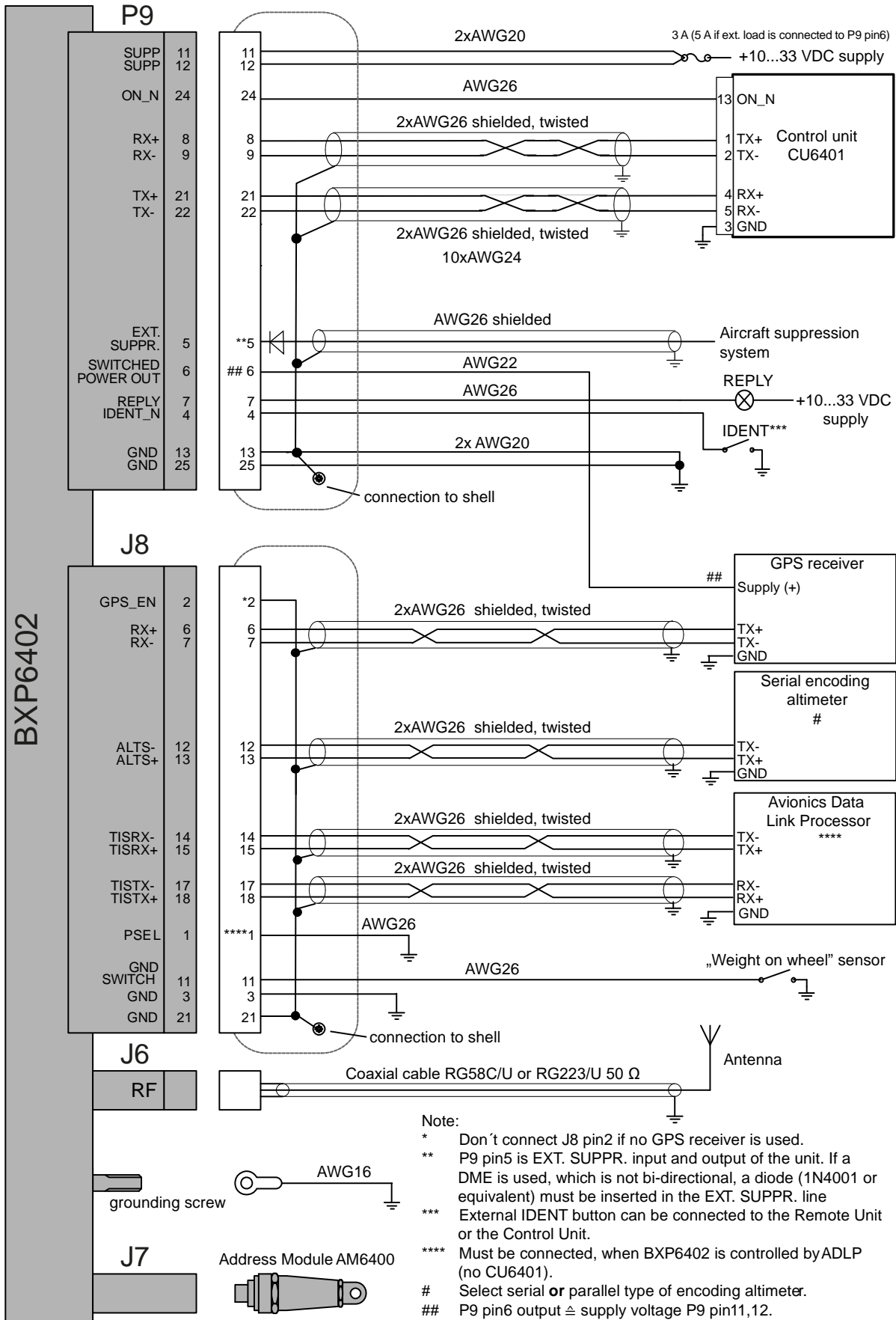


Figure 9: BXP6402 with Serial Encoding Altimeter & GPS Receiver

2.8.3. BXP6402 with Serial Encoding Altimeter (Cutout)

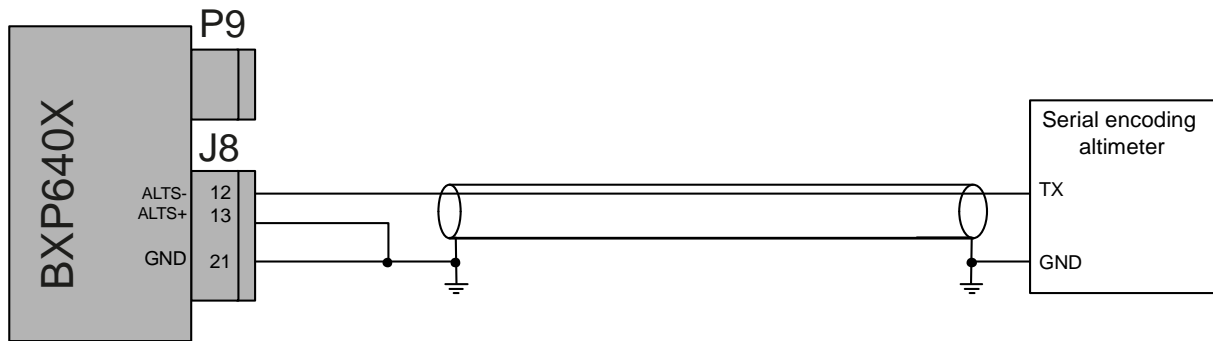


Figure 10: BXP6402 - Serial Encoding Altimeter Connection (not for BE6400)

2.8.4. BXP6402 with RS232 GPS Receiver (Cutout)

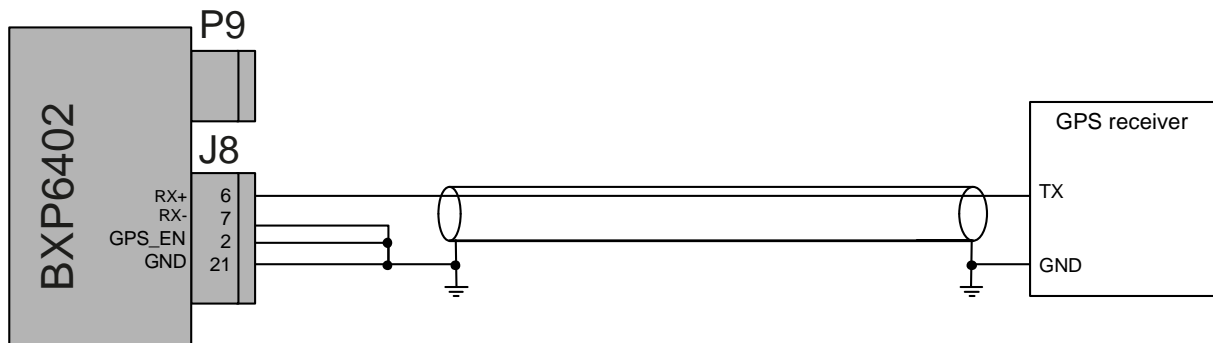


Figure 11: BXP6402 - RS232 GPS Receiver Connection (not with BE6400)

NOTICE

If the blind encoder BE6400 is directly connected to J8 it is not possible to connect a GPS receiver for ADSB-out function to J8.

2.9. Check after Installation

**SAFETY
INSTRUCTIONS**

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

This should be done on the ground. Generally, this should not be used during flight.

2.9.1. Pre-Flight Check Using Self-Test

2.9.1.1. Switch-on test:

- Switch the transponder operating mode switch from OFF to SBY.
 - A power-on built-in test (PBIT) then follows automatically for 1 second.
 - During the test "WAIT" is indicated.
- If the test was successful, the unit switches then to the mode set on the mode switch.

2.9.1.2. Test triggered (IBIT):

- Press the SEL button and STO button at the same time in mode ON or ALT.
 - A test of all available test routines then follows for 1 second.
 - During the test, "IBIT" is indicated on the display.
- If the IBIT was successful, the transponder switches immediately into the normal operating mode.
- In case of a fault appears the report "FAILURE" in the display.
- Switch OFF the transponder at the fault indication.

2.9.2. Check of the Address Module

The installation company has to make sure that the corresponding address module AM6400 is installed with the transponder and that the address module is programmed correctly. Connect the address module with the aircraft tightly.

2.9.3. 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 ± 1 MHz.
 - If out of range send the transponder to authorized service.

2.9.4. Check of Transmit Power

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

≥ 125 W (21 dBW) at class 1 transponder.

≥ 70 W (18.5 dBW) at class 2 transponder.

⚠ CAUTION

Radiation risk:

A safe distance to the installed antenna must be ensured by corresponding installation measures around human body damage (e.g. at the eyes) and/or avoid the inflammation of combustible materials by radiated energy.

3. Operating Instructions

In this chapter you can read about:

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3.1. Device Description

The BXP6402 is intended for installation in an aircraft. It works in accordance with the secondary radar principle and allows air traffic control to locate, identify and track aircraft.

BXP6402 is a remote-controlled transponder and needs an additional controlling device. For further information about Interface and protocol refer to the document "BXP6400 Extended Protocol" available at the Becker Product Support.

3.1.1. Device Assignment

This manual is valid for the following devices:

- See page 24

3.1.2. Packing, Transport, Storage

- See page 24

3.1.3. Scope of Delivery

- See page 24

3.1.4. Type Plate

- See page 25

3.2. Operating with CU6401 Controller

For detailed information refer to the manual CU6401 Installation and Operation DV69803.03 (Article No. 0584.096-071).

3.3. Operating with OEM Controller

For detailed information refer to the manual of the respective OEM product.

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