Remote-Controlled VHF-AM Transceiver

RT6512

RT6512-(100)
RT6512-(200)
RT6512-(201)

Installation and Operation

Manual DV17501.03
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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,

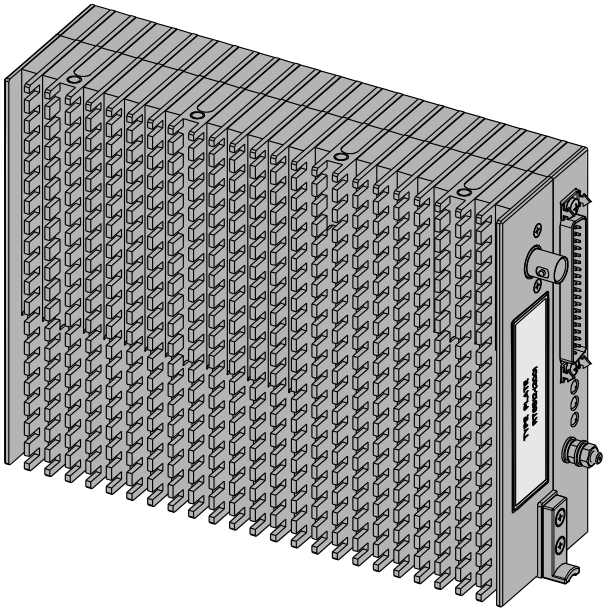
Thank you for purchasing a Becker Avionics product. We are pleased that you have chosen our product and we are confident that it will meet your expectations.

For development of our products, 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 ISO 9001 and DIN EN 9100 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.

Remote - Controlled VHF-AM Transceiver



RT6512
(Remote Transceiver)

List of Effective Pages and Changes

Only technical relevant modifications are described in this table.

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	--	1.5.3	Updated: Descriptions Emergency Mode
	--	2.3.4	Added: More detailed "Antenna Installation"
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List of Abbreviations

List of Abbreviations	
A3E	Amplitude modulation double-sideband with full carrier
AGC	Automatic Gain Control
AM	Amplitude Modulation
AOC	Air Operations Centre
ARINC	Aeronautical Radio Incorporated
ARINC 429	Data bus for commercial aircraft
ATS	Air Traffic Services
BIT	Built In Test
BNC	Bayonet Neill Concelman (connector)
CBIT	Continuous Built In Test
CU	Control Unit
DAL	Design Assurance Level
DC	Direct Current
EUROCAE	European Organization for Civil Aviation Equipment
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
IBIT	Initiated Built In Test
n/a	not applicable
LED	Light Emitting Diode
OEM	Original Equipment Manufacturer
PBIT	Power On Built In Test
PSB	Power Supply Board
PTT	Push To Talk
RCU	Remote Control Unit
RMU	Radio Management Unit
RX	Receiver
Std	Standard
TX	Transmitter
VDC	Volts Direct Current
VHF	Very High Frequency

List of Abbreviations	
VSWR	Voltage Standing Wave Ratio

Units

Units	
A	Ampere
mA	Milliampere
°C	Degree Celsius
dBm	Power ratio in Decibel
dB	Decibel
ft	Foot
g	Gram
in	Inch
kHz	Kilohertz
MHz	Megahertz
mm	Millimeter
NM	Nautical Mile
kΩ (kilo Ohm)	Resistance kilo Ohm
Ohm (Ω)	Resistance
ppm	Part per million
s	Second
V	Volt
mV	Millivolt
W	Watt
mW	Milliwatt

General Safety Instructions

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

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

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

NOTICE Is used to address practices not related to physical injury.

SAFETY INSTRUCTIONS 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. The following table states the materials suitable for recycling and the materials, which have to be disposed of separately.

Material	Suitable for recycling	Disposal
Metal	yes	no
Plastics	yes	no
Circuit boards	no	yes

Dispose of the circuit boards:

- Disposal 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 only if further evaluation by the user/installer documents an acceptable installation that is approved by the appropriate airworthiness authority.

User Conversions and Changes are Not Permitted.
Any change on the product, made by the user, excludes any liability of Becker Avionics GmbH.

- For installation, opening the device is not required.
- 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.
- Install the devices according to the 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 should follow closely during installation and operation. Otherwise, all claims under the warranty will become void and a reduced service life or even partial damage is not excludable.

⚠CAUTION The user is responsible for a safe installation and/or additional safety measures in order to prevent damages to persons or the electric installations of the airplane. In case of deviations to the descriptions in this document perform all work in accordance with the airplane service manual or take the AC43-13, in its latest revision, into account.

Additional Conditions of Utilization

Please refer to "Safety-Conscious Utilization", page 20.

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 undergoing a regularly review, necessary corrections will be part of the subsequent issues of this publications.

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1. General Description

In this chapter you can read about:

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The mechanical design of the remote-controlled VHF-AM transceiver RT6512 is ruggedized and well suited for installation in the avionics compartment (non-pressurized and not temperature controlled) by means of a mounting plate and in all types of aircraft.

The remote controlled VHF-AM transceiver RT6512 meets RTCA and EUROCAE airworthiness requirements applicable at the time the unit received certification. There are no restrictions for installation of the unit as long as it will be installed in areas, where data of the proven environmental categories will not exceed.

1.1. Introduction

The technical information in this manual mainly applies to all variants of the described product. Therefore, we name the product generally with "RT6512" when descriptions are not unique for a product variant. If a description refers to only one of the product variants its full name, e.g. "RT6512-(100)", will be used.

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

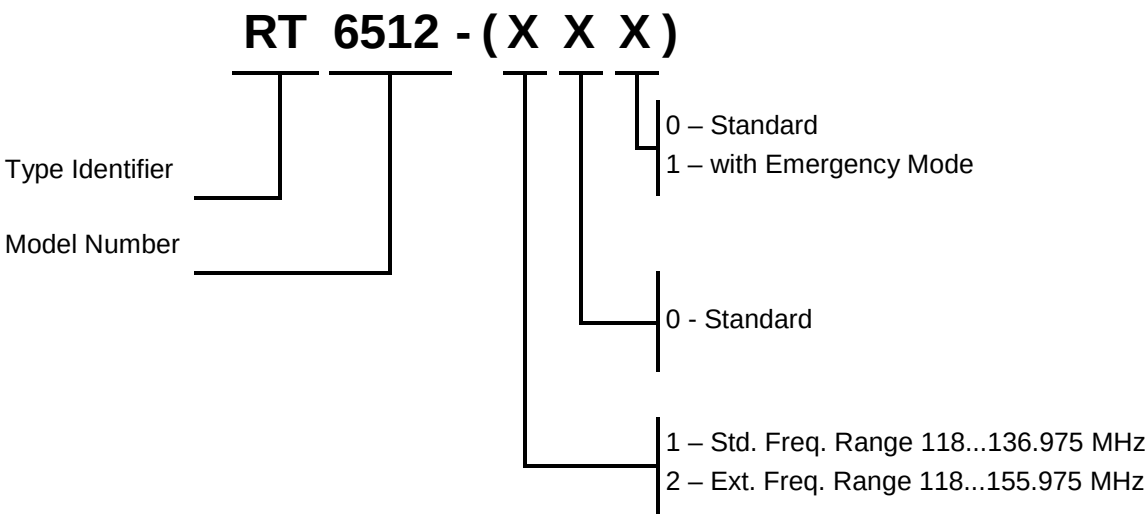
Section		DV 17502.04 M&R	DV 17502.03 I&O
	General Description	X	X
	Installation	X	X
	Operation Instructions	X	X
	Theory of Operation	X	N/A
	Maintenance and Repair	X	N/A
	Illustrated Parts List	X	N/A
	Modification and Changes	X	N/A
	Circuit Diagrams	X	N/A
	Certifications	X	N/A
	Attachments	X	N/A

1.2. Purpose of Equipment

- RT6512 is a simplex voice communication system in the standard avionics VHF frequency range 118.000...136.975 MHz (136.9916 MHz with 8.33 kHz channel spacing), or optional with extended frequency range up to 155.975 MHz and uses standard amplitude modulation (A3E). RT6512 is capable to operate in both, the 25 or 8.33 kHz channel spacing, is primarily intended for aeronautical operational control (AOC) and air traffic services (ATS) safety communications.
- RT6512 uses ARINC 429 and RS422 interfaces for communication with a control device.
- RT6512 provides frequency and mode control, either by means of the Becker RMU5000 controller using the RS422 communication port, or by means of any OEM product using the standard ARINC 429 communication bus.
- With transmitter power of 20W, RT6512 is able to support simultaneous communication over a range exceeding 200 NM direct line of sight, within the frequency range.

1.3. Variants Overview

Within the part number, the meaning of "RT6512-(XXX)", is:



1.4. Associated Devices

Following devices can operate with RT6512-(XXX):

Device	Function/Manufacturer
RMU5000	Becker Avionics Radio Management Unit
Control unit	Gables G7610 (Control unit for VHF-COMM only)
Control unit	Universal RCU
Glass cockpit	Genesys IDU680

1.5. Scope of Functionality

RT6512 performs AM (amplitude modulation) voice communication.

Mechanics: Case serves as heat sink mount it proper as defined in chapter "", page 32.

Front side contains the main connector (D-Sub 37pin, male) for connection to the aircraft wiring system, and the antenna jack (BNC, female).

The green LED indicates the system is operable. The yellow and red LED indicates that a warning or failure has occurred (refer to "Status & Error Indication", page 53).

1.5.1. Receive Mode

RT6512 is equipped with a high quality Class C, E and H2 receiver: standard sensitivity 5 µV, high dynamic range, and high blocking rejection. It can receive a weak signal while a 2nd VHF-AM transceiver in the same aircraft is transmitting. The RT6512 can operate with offset carrier in both 25 kHz and 8.33 kHz channel spacing.

1.5.2. Transmit Mode

RT6512 is equipped with a high quality Class 3 and 5 transmitter: output power of 20 W under standard operating conditions, output power of at least 16 W under the specified environmental operating conditions (when using antenna with VSWR=≤2:1, for VSWR>3:1 output power lowers), AM depth >70% - standard value for airborne application.

During transmission, the transmitter delivers a natural sidetone signal, which is available on the LINE_OUT output (if enabled).

RT6512 is equipped with a protective function to prevent from blocking the frequency channel by a stuck transmit button or a short circuit on the key line. "Stuck PTT" time is set to 30 seconds.

RT6512 provides status information if device is transmitting via serial protocol (RS422 and ARINC429). This status can be used to inform the crew about terminated transmission (as required by TSO-C128a/ETSO-2C128).

RT6512 transmitter is protected from overheating. VSWR on Antenna connector is also monitored. See "Status and Control Outputs", page 18 for details.

1.5.3. Emergency Mode

The RT6512-(201) variant supports Emergency Mode in which device is automatically tuned to emergency channel 121.500 MHz in 25 kHz channel spacing. External control of transceiver is prohibited with remaining device status monitoring.

Note:Operators Remark

121.5 MHz = International voice aeronautical emergency.

123.1 MHz = International worldwide voice SAR use (e.g. Italy).

1.5.4. Audio Inputs and Outputs

1.5.4.1. Microphone Input

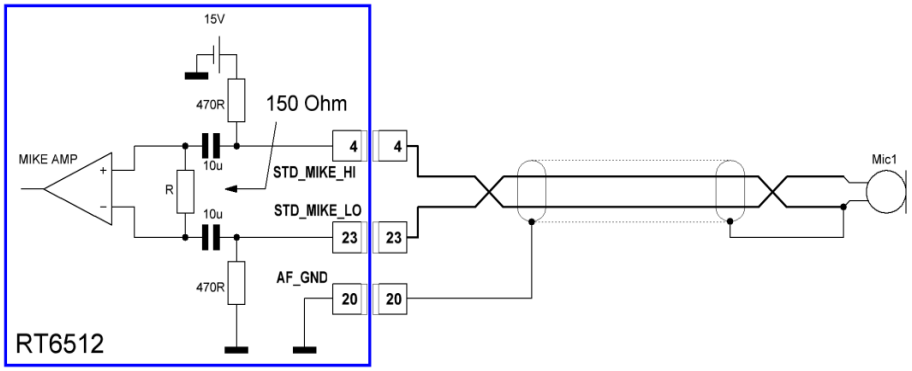


Figure 1 Standard Microphone Input Schematic

RT6512 is designed for a standard microphone:

- Unbalanced,
- DC coupled,
- DC supplied from RT6512.

The bias current for standard microphone is drawn from RT6512 internal source 15 VDC via series resistor 470 Ohm. The input audio signal is routed to a dynamic compressor keeping the modulation factor limited over a wide input voltage range. The microphone input uses the cable guard as ground compensation so microphone input shall be connected exactly as specified on Installation diagrams.

1.5.4.2. Audio Input LINE IN

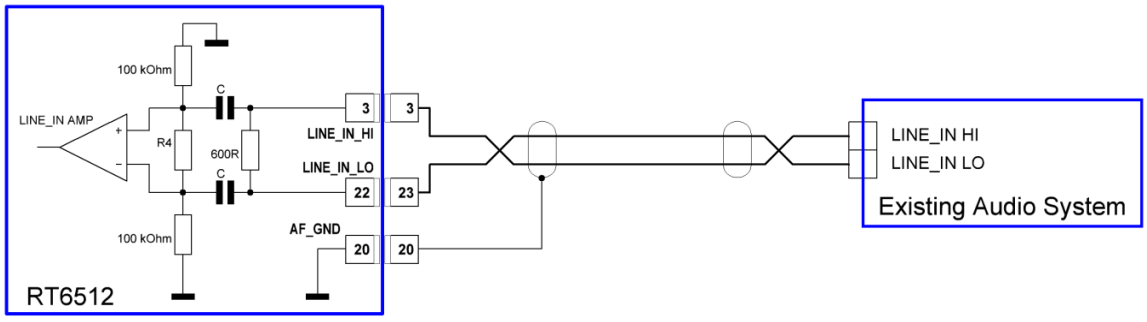


Figure 2 LINE_IN Schematic

The RT6512 symmetrical line input has no DC connection to ground. Input impedance is 600 Ω. The maximum input level without clipping can be set as high as 6 V. The input audio signal is routed to a dynamic compressor keeping the modulation factor limited over a wide input voltage range.

1.5.4.3. Audio Output LINE OUT

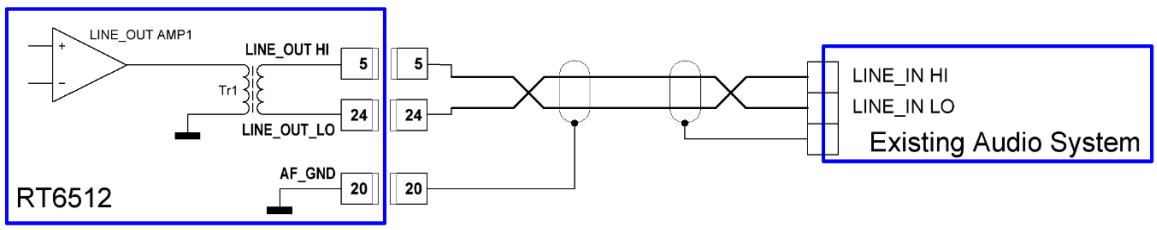


Figure 3 LINE_OUT

The audio output LINE OUT design is symmetrical and has no DC connection to ground. If volume set to maximum, the audio output power delivered is 100…125 mW into 600 Ω or 200 mW into 150 Ω.

1.5.5. Control Inputs

1.5.5.1. /ON (Unit Power ON/OFF Control)

/ON signal to switch ON/OFF the RT6512.

The /ON line is used to activate an internal electronic switch to power-up the unit.

It is active if the level on the /ON pin is less than 4.0 V or a resistance of less than 1 kΩ connects to ground.

The /ON line is inactive if the level on the /ON pin is higher than 8.0 V or a resistance higher than 50 kΩ connects to ground.

1.5.5.2. /PTT (Push-To-Talk)

/PTT is used to initiate transmission.

It is active when /PTT-input level is below 4.0 V, or a resistance to ground of less than 1 kΩ.

The /PTT line is inactive if the level on the /PTT-input is higher than 8.0 V, or a resistance higher than 50 kΩ connects to ground.

1.5.5.3. /COM2 (Com Addressing Line)

/COM2 defines device sub address for ARINC communication.

The device detects a LOW state (Active state) on the /COM2 input when an external resistance of lower than 1 kΩ is connected to ground.

The device detects a HIGH state (Inactive state) on the /COM2 input when an external resistance of higher than 50 kΩ is connected to ground.

- Com addressing line bit:
  - LOW (Active) state selects COM2.
  - HIGH (Inactive) state selects COM1.

1.5.5.4. /SEL422 (Serial Interface Selection Line)

/SEL422 selects RS422 or ARINC 429 communication.

The device detects a LOW state (Active state) on the /SEL422 input when an external resistance of lower than 1 kΩ is connected to ground.

The device detects a HIGH state on the /SEL422 input when an external resistance of higher than 50 kΩ is connected to ground.

- Serial interface selection line:
  - LOW (Active) state selects RS422.
  - HIGH (Inactive) state selects ARINC.

1.5.5.5. /RX_ATT (External RX Attenuation Control)

/RX_ATT reduces the RF gain of the RX section to reduce cross talk effects.

The /RX_ATT line is used for an optional desensitization of the RT6512 receiver. The desensitization can be required when a 2nd VHF-AM transceiver in the same aircraft is transmitting. In such case /PTT line from 1st VHF-AM transceiver shall be connected to /RX_ATT input of 2nd device and /PTT from 2nd device shall be connected to /RX_ATT input of the 1st device.

The /RX_ATT is active if /RX_ATT-input level is less than 4.0 V, or a resistance less than 1 kΩ connects to ground.

The /RX_ATT line is inactive if the level on the /RX_ATT-input is higher than 8.0 V, or a resistance higher than 50 kΩ connects to ground.

1.5.5.6. /SERV_EN (Enabling the Setup Modes)

/SERV_EN enables the setup modes.

/SERV_EN is a read/write access for all setup data, not available for standard user

The device detects a LOW state (Active state) on the /SERV_EN input when an external resistance of lower than 1 kΩ is connected to ground.

The device detects a HIGH state (Inactive state) on the /SERV_EN input when an external resistance of higher than 50 kΩ is connected to ground.

1.5.5.7. /TX-ENABLE (Enabling the TX)

/TX-ENABLE enables the transmitter.

RT6512 detects a low state on the /TX_ENABLE input when an external resistance lower than 1 kΩ connects to ground.

RT6512 is detecting high state on the /TX_ENABLE input when an external resistance higher than 50 kΩ connects to ground. In such case transmission is permanently blocked.

SAFETY INSTRUCTIONS

For an aircraft installation /TX-ENABLE input shall be connected to ground directly on the main connector. /TX-ENABLE line cannot be routed as part of installation cable bundle.

Note: Do not apply DC voltage above 5 Volts to /TX_ENABLE to avoid device damage!

1.5.5.8. /EMERG (Enabling the Emergency Mode)

/EMERG enables the Emergency Mode for variant –(201) only.

RT6512-(201) detects a low state on the /EMERG input when an external resistance lower than 1 kΩ connects to ground. In such case transceiver activates Emergency Mode operation.

RT6512-(201) is detecting high state on the /EMERG input when an external resistance higher than 50 kΩ connects to ground.

1.5.6. Status and Control Outputs

1.5.6.1. /FAILURE

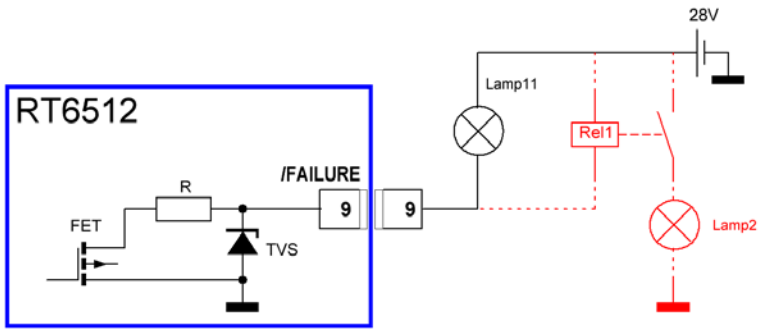


Figure 4 /FAILURE Output Schematic

This /FAILURE output is coupled to the status shown at the status LEDs mounted at the connector side of RT6512. It corresponds to OR function of the red and the yellow LEDs. When the test function **is not ok**, the transistor in the /FAILURE output is ON.

This output is an open collector (drain) type with capability to:

- Draw maximum 100 mA current to ground with a voltage drop of less than 2.5 V (corresponding LEDs is on),
- Draw maximum 0.1 mA current to ground for output voltage 28.0 V when in "inactive" state (corresponding LEDs are off).

It can be used to drive an external relay if 100 mA output current limit at the supply voltage 28.0 V is not sufficient. This /FAILURE output is protected against spikes produced from a relay. See "Status & Error Indication", page 53.

1.5.6.2. RX_AGC (AGC Voltage of the RX-RF-AGC)

The AGC output is a DC coupled output of the RF-AGC used in the receiver.

The output voltage varies monotonic within the range of 0...5 V, when the input level at the antenna input is varied from -105...+13 dBm.

For all antennas input levels from -120...-105 dBm the output voltage is positive and not higher than the output voltage which can be obtained at -105 dBm.

1.5.6.3. /SQL_EVAL

This digital output indicates that the audio signal from the receiver is available on the LINE_OUT.

This output is an open collector type with capability to:

- Draw maximum 100 mA current to ground with a voltage drop of less than 2.5 V (corresponding LED(s) is on).
- Draw maximum 0.1 mA current to ground for output voltage 28.0 V when in "inactive" state (corresponding LEDs are off).
- It can be used to drive an external relay, if 100 mA output current limit at the supply voltage 28.0 V is not sufficient.
- This /SQL_EVAL output is protected against spikes produced from a relay.
- RX indication inactive (HIGH):
  - Squelch ON but no audio goes out on LINE_OUT.
  - RT6512 in TX mode.
- RX indication active (LOW), only possible in RX mode:
  - Squelch ON and audio goes out on LINE_OUT.
  - Squelch OFF (permanent audio out on LINE_OUT).

1.5.7. Digital Interfaces to the Control Unit

1.5.7.1. Interface ARINC 429

Name	Function / Remarks
ARI429_RX_A1	1st ARINC 429 Interface RX Line A
ARI429_RX_B1	1st ARINC 429 Interface RX Line B
ARI429_TX_A1	1st ARINC 429 Interface TX Line A
ARI429_TX_B1	1st ARINC 429 Interface TX Line B
ARI429_RX_A2	2nd ARINC 429 Interface RX Line A
ARI429_RX_B2	2nd ARINC 429 Interface RX Line B
ARI429_TX_A2	2nd ARINC 429 Interface TX Line A
ARI429_TX_B2	2nd ARINC 429 Interface TX Line B

1.5.7.2. Interface RS422

Name	Function / Remarks
RS422_RX+	RS422 Interface RX Line B (high if idle)
RS422_RX-	RS422 Interface RX Line A (low if idle)
RS422_TX+	RS422 Interface TX Line B (high if idle)
RS422_TX-	RS422 Interface TX Line A (low if idle)

1.6. Safety-Conscious Utilization

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

SAFETY INSTRUCTIONS

- Only an authorized installation company may carry out the installation of the device into an aircraft. The country regulations always have to be observed.
- Use the product only within the specified conditions, see "Technical Data", page 21.
- 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 21.
  - Do not connect the unit with reversed polarity to the DC source.
- Circuit breaker:
  - Use the recommended fuses in the power supply line to protect the application, see "Technical Data", 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.

1.7. Restriction for Use

SAFETY INSTRUCTIONS

The product is to be used inside the declared limits.

1.8. Technical Data

1.8.1. General Characteristics

RT6512		Specifications
Nominal supply voltage		28.0 VDC
Extended supply voltage		22.0…30.3 VDC
Emergency operation		18.0 VDC
Frequency range	RT6512-(100)	118.000...136.9916 MHz
	RT6512-(200)	118.000...155.975 MHz
	RT6512-(201)	118.000...155.975 MHz
Channel spacing		25 kHz (only, configuration parameter)
		8.33/25 kHz (default parameter)
Number of channels	8.33 kHz	2280
	25 kHz	760
Storage Temperature range		-55...+85 °C
Operating Temperature range		-40...+70 °C
Operating Altitude		50 000 ft
Vibration		Category S (Curve M) + Category U (Curve G)

1.8.2. Typical Power Consumption

RT6512	Specifications
Receive mode	< 0.6 A
Transmit mode	< 7 A
Power-ON Time (PBIT dependent)	~ 4 s
Recommended power supply protection	10 A (e.g. Klixon 7277-2-10)

1.8.3. **Receiver Data**

RT6512	**Specifications**
Sensitivity	≤ -93 dBm for a (S+N)/N ratio of 12 dB
Effective bandwidth (8.33 kHz channel spacing)	±2.78 kHz at the 6 dB points
	±7.37 kHz at the 60 dB points
Effective bandwidth (25 kHz channel spacing)	±8 kHz at the 6 dB points
	±17 kHz at the 40 dB points
	±25 kHz at the 60 dB points
Squelch	level adjustable
AGC characteristics	≤ 6 dB in range -102...+13 dBm
Distortion	≤ 5% at AM=30% 10 dB below rated output power
	≤ 15% at AM=85% and rated output power
Audio frequency response (8.33 kHz channel spacing)	≤ 6 dB 350...2500 Hz
	≥ 35 dB at 4000… 10000 Hz (Class H2 Receiver)
Audio noise level (S+N)/N	≥ 25 dB
Rated output power for LINE_OUT	≥ 100 mW into 600 Ω ≥ 200 mW into 150 Ω
Offset-carrier operation	YES (25/8.33 kHz), Class C and H2 Receiver

1.8.4. **Transmitter Data**

RT6512	**Specifications**
Output power into 50 Ω (with and without modulation)	≥ 20 W in normal condition; (≥ 16 W under all specified environmental conditions)
Frequency tolerance	≤ 5 ppm
Duty cycle	30 s (TX): 270 s (RX)
Type of modulation	A3E
Modulation capability	≥ 70%
Distortion	≤ 10%
Audio frequency response (8.33 kHz channel spacing)	≤ 6 dB, 350...2500 Hz
Audio frequency response (25 kHz channel spacing)	≤ 6 dB, 300...3400 Hz
Line In	200…6000 mV compressor starting point, adjustable
(with compressor)	Input balanced, 600 Ω Clipping level 6 V
Standard microphone	100…3000 mV compressor starting point, adjustable
(with compressor)	Input unbalanced, 150 Ω Clipping level 3 V
Parasitic FM deviation	≤ 1 kHz
Sidetone signal on LINE_OUT	natural, adjustable
Automatic shutdown of transmit mode	Factory configurable 30…180 s (default 35 s)
Transmitter class	Class 3, Class 5

1.8.5. **Dimensions & Weight**

RT6512	**Specifications**
Without cable connector (W x H x D)	60 x 153 x 210.5 mm (2.36 x 6.02 x 8.29 inch)
With cable connector (W x H x D)	60 x 153 x 258 mm(2.36 x 6.02 x 10.16 inch)
Material	AlCuMg1 Nickel Plated
Weight without mounting tray	2150 g
Weight with mounting tray	2400 g

1.8.6. **Software**

As a result of the safety assessment process the failure condition of the RT6512 was determined to be Category MAJOR.

As the failure condition of the software used in the RT6512 was categorized MAJOR, the Design Assurance Level (DAL) of the unit is determine to be Level C according DO-178C.

1.8.7. **Hardware**

The Complex Electronic Hardware (CEH) included into VHF transceiver RT6512 has been designed in accordance with EUROCAE/RTCA Document ED-80/DO-254; “Design Assurance Guidance for Airborne Electronic Hardware” and satisfy criteria of:

Hardware Assurance Level (HAL) C

1.8.8. **Continued Airworthiness**

- The RT6512 maintenance is defined as "on condition" only.
- No scheduled or regular maintenance of this product is required.
- It is recommended to check the frequency accuracy of the airborne transceiver after 4 years.

1.8.9. **Environmental Conditions**

The following performance standards were proven under environmental test conditions in accordance with the procedures set forth in EUROCAE/RTCA Document No. ED-14G/DO-160G.

Environmental Test	Section	Category	Remarks
Temperature and Altitude	4	D1	-
Ground Survival Low Temperature and Short-Time Operating Low Temperature Test	4.5.1	D1	Short-Time Operating Low Temperature Test extended to -40 °C
Operating Low Temperature Test	4.5.2	D1	Operating Low Temperature Test extended to -40 °C
Ground Survival High Temperature and Short-Time Operating High Temperature Test	4.5.3	D1	Ground Survival High Temperature +85 °C Short-Time Operating High Temperature Test +70 °C
Operating High Temperature Test	4.5.4	D1	+70 °C
In flight Loss of Cooling	4.5.5	Z	n/a
Altitude Test	4.6.1	D1	non-pressurized; 50 000 ft
Decompression Test	4.6.2	-	n/a
Overpressure Test	4.6.3	-	n/a
Temperature Variation	5	B	-
Humidity	6	B	-
Operational Shocks & Crash Safety	7	B	-
Vibration	8	S U	Category S – Curve M Category U – Curve G
Explosion Proofness	9	X	n/a
Water Proofness	10	W	-
Fluids susceptibilities	11	X	n/a
Sand and dust	12	X	n/a
Fungus resistance	13	X	n/a
Salt spray	14	X	n/a
Magnetic effect	15	Z	-
Power Input	16	BXX	Normal: 22.0...30.3 V Abnormal: 20.5...32.2 V Emergency operation: 18.0 V
Voltage spike	17	A	-
Audio Frequency Conducted Susceptibility – Power Inputs	18	B	-
Induced Signal Susceptibility	19	ACX	-

Environmental Test	Section	Category	Remarks
Radio frequency susceptibility	20	WW	Conducted Susceptibility: Cat. W Radiated Susceptibility: Cat. W
Emission of RF	21	M	-
Lightning Induced Transient Susceptibility	22	A3Z3XX	Pin tests: Waveform A Level 3 Cable bundle tests: Waveform Z Level 3
Lightning Direct Effects	23	X	n/a
Icing	24	X	n/a
ESD	25	A	-
Fire, Flammability	26	X	n/a

1.8.10. **Certifications**

1.8.10.1. **RT6512 Certification**

Number	Description
EASA.21O.10060121	in accordance with Commission Regulation (EU) No. 748/2012, Part 21, Section A, Subpart O.

1.8.10.2. **RT6512 meets the Requirements of:**

Number	Description
EASA ETSO-2C169a	"VHF Radio Communication Transceiver Equipment Operating within Radio Frequency Range 117.975 to 137.000 MHz"
FAA TSO-C169a	"VHF Radio Communication Transceiver Equipment Operating within Radio Frequency Range 117.975 to 137.000 MHz "
EASA ETSO-2C128	“Devices That Prevent Blocked Channels Used in Two-Way Radio Communications Due to Unintentional Transmissions”
FAA TSO-C128a	“Equipment That Prevents Blocked Channels Used in Two-Way Radio Communications Due to Unintentional Transmissions”

1.8.10.3. **Guidelines followed for Design and Development**

Number	Description
EUROCAE ED-23C RTCA DO-186B	"MOPS for Airborne VHF Receiver-Transmitter Operating in the Frequency Range 117.975 - 137.000 MHz"
EUROCAE ED-67	"MOPS for Devices That Prevent Unintentional or Continuous Transmissions"
EUROCAE ED-18 RTCA DO-170 RTCA DO-214A	"Audio Systems Characteristics And Minimum Performance Specifications"

Number	Description
EUROCAE ED-12C RTCA DO-178C	"Software Considerations in Airborne Systems and Equipment Certification"
EUROCAE ED-14G RTCA DO-160G	"Environmental Conditions and Test Procedures for Airborne Equipment"
RTCA DO-207	"MOPS For Device that Prevent Blocked Channels Used IN 2-Way-Radios Communications due to Unintentional Transmissions"
EUROCAE ED-80 RTCA DO-254	"Design Assurance Guidance for Airborne Electronic Hardware"
FCC Part 87	“FCC-Standard Part 87 – Aviation Services”
ITU Radio Regulations, Volume 1	ITU Radio Regulations. Articles
ARINC SPECIFICATION 429 PART 1-17	Mark 33 Digital Information Transfer System (DITS), Part 1 Functional Description, Electrical Interface, Label Assignments and Word Formats
GAMA Pub. No 11	ARINC 429, GENERAL AVIATION SUBSET
EIA-422-B	Electrical Characteristics of Balanced Voltage Digital Interface Circuits, TIA/EIA-422-B

1.8.10.4. **FCC Approval**

Radiofrequency radiation exposure information:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 50 cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

NOTE:

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTE:

This device complies with Part 15 of the FCC Rules [and with Industry Canada licence-exempt RSS standard(s)].

Operation is subject to the following two conditions:

- This device may not cause harmful interference, and
- This device must accept any interference received, including interference that may cause undesired operation.

NOTE:

Changes or modifications made to this equipment not expressly approved by Becker Avionics may void the FCC authorization to operate this equipment.

1.9. Order Code

1.9.1. RT6512

Qty	VHF-AM Transceiver	
1	**RT6512-(100)** Frequency Range 118.000-136.975 MHz	Art.-No.: 0644.927-910
1	**RT6512-(200)** Frequency Range 118.000-155.975 MHz	Art.-No.: 0637.300-910
1	**RT6512-(201)** Frequency Range 118.000-155.975 MHz + Emergency Mode	Art.-No.: 0649.643-910

1.9.2. Accessories

Qty	Mounting Tray	
1	Mounting Tray MT6512-(01)*, vertical position	Article-No. 0644.722-284

* install RT6512 using MT6512 to meet the conditions for DO160G, section 7 and 8
(see "Environmental Conditions", page 25).

Qty	Connector Kit	
1	CK6512-C; • Connector D-Sub, 37pin, female (crimp version), • Connector housing, • Label "COMM", • SK504; Antenna Connector BNC for coax cable	Article-No. 0642.568-954
1	CK6512-S; • Connector D-Sub, 37pin, female (soldering version), • Connector housing, • Label "COMM", • SK504; Antenna Connector BNC for coax cable	Article-No. 0642.551-954

Qty	Antenna	
-	Please use only antennas (50 Ohm, vertically polarized with coaxial cable) which are certified to one of the following TSOs: TSO C37 TSO C38 TSO C169.	--

Qty	Manuals	
1	DV17501.03 Installation & Operation (English)	Article-No. 0645.702-071

2. Installation

This manual should be available close to the device when performing the tasks below.

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.

In this chapter you can read about:

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2.1. Packaging, Transport, Storage

Visually inspect the package contents for signs of transport damage.

Packaging material and transport

⚠CAUTION The packaging material or parts of it are inflammable. If disposed improperly, by burning, toxic fumes may develop.

We recommended keeping the packaging material for reuse, 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 transport the unit, a clean and level surface should be prepared. Protect all electrical connections while handling the unit.

First device check up

- 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 30).

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 connectors.

2.2. Device Assignment

This manual is valid for the following devices:

- RT6512-(100)
- RT6512-(200)
- RT6512-(201)

2.2.1. Scope of Delivery

- Manuals
  - Installation & Operation manual (English)
- VHF-AM transceiver
  - RT6512 (corresponding to your ordered version)
- Authorized Release Certificate (EASA Form 1).

2.2.2. Additional Required Equipment (optional)

- Mounting tray MT6512 (for RT6512 to meet the conditions for DO-160G section 7 and 8)
- Connector kit + cables
- Antennas + antenna cables
- Control unit (controlling and operating RT6512)

Details see "Accessories", page 28.

2.2.3. **Type Plate**

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

Figure 5: Type Plate (Example)

Explanation:

P/N:	**Type designation:** **RT6512:** Remote-Controlled VHF-AM transceiver **Options:** **(100)**: Frequency Range 118...136.9916 MHz **(200)**: Frequency Range 118...155.975 MHz **(201):** Frequency Range 118...155.975 MHz + Emergency Mode
S/N:	Unique number of the particular device
A/N:	Article number
DoM:	Date of Manufacturing
	Software: Corresponding to the displayed version (see product label)
	Compliance and Certifications Corresponding to the displayed text and logos (see product label)

2.2.4. **Meaning of Status LEDs**

The front panel LEDs indicate basic information about overall equipment status.
For details, please see "Error Indication" page 53.

2.3. Mounting Requirements

The installation of the device(s) depends on the type of aircraft and its equipment and therefore only general information can be given in this section.

SAFETY INSTRUCTIONS

The device must not be opened after factory exit.

When installing the device, make sure the heat dissipator of the device receive sufficient air. Keep an efficient distance between other heat producing devices in order to ensure proper circulation of the cooling air.

Make sure that the mounting support is not exposed to external heat flux.

The RT6512 is designed for vertical and horizontal mount in an area, which provides sufficient convection cooling. A forced cooling is not required if the RT6512 is installed according to the mounting requirements above.

Refer to FAA AC 43.13-2B Chapter 2 p. 204 for installation methods.

Install RT6512 using mounting tray MT6512 to meet the conditions for DO-160, section 7 and section 8. For details see "Environmental Conditions", page 25.

2.3.1. Mounting Distance

Dimensions mm (inch)

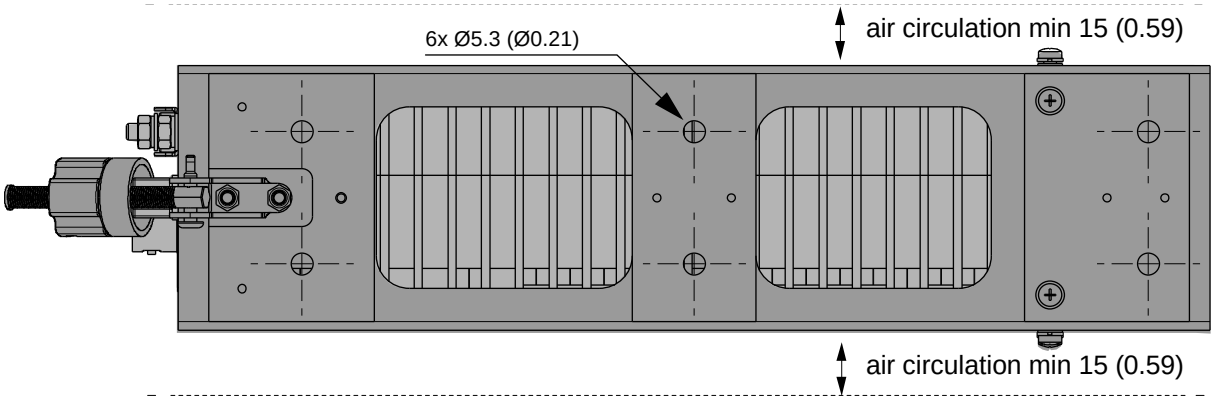

Figure 6:RT6512 with MT6512 - mounting area

2.3.2. Grounding

Provide correct radio bonding.

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!

For details, please refer to FAA AC 43.13-2B Chapter 2 p. 207.

The RT6512 has a threaded grounding bolt at the front side of the unit. Use this point as grounding contact.

- Type: Threaded bolt M4 (stainless steel)

2.3.3. Antenna Cables

NOTICE

The total attenuation of each antenna connection, including cables, connectors, microwave switch (if used), etc. shall be as low as possible.

An aircraft installation should be verified for receiving sensitivity in accordance with ICAO Annex 10, Vol. 3, Part II, §2.3.2.2.1

Observe manufacturer data for characteristic attenuation of the selected cable type, connectors, microwave switch, etc.

NOTICE

All signal characteristics are defined for antenna port of RT6512.

2.3.3.1. Attenuation: Cable length versus coax cable type

Data below shall be used as guideline only.

cable type	maximum loss @ 118 MHz	maximum loss @ 156 MHz
RG400	15.5 dB/100 m	18.1 dB/100 m
RG142	13.6 dB/100 m	15.7 dB/100 m
RG393	7.3 dB/100 m	8.4 dB/100 m
ECS310801	-	4.5 dB/100 m
ECS310701	-	3,5 dB/100 m

2.3.4. Antenna Installation

For antenna installation, refer always to the manufacturer´s maintenance documentation for the aircraft. Carry out the antenna installation in accordance with AC 43.13-2B Chapter 3.

NOTICE Penetration of the pressurized cabin on a pressurized aircraft requires additional data, which are not contained in this installation manual.

⚠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.

2.3.4.1. Required Antenna Type

- Vertical polarized 50 Ω broadband aircraft COM antenna.
- The antenna must be able to radiate RF energy evenly and omnidirectional.

NOTICE The aircraft's manual for antenna installation has to be observed.

2.3.4.2. Antenna Mounting Location

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

- The aircraft-certifying inspector could support you in questions about to achieve best results into all directions (installation instructions must be fully complied with).
- For aircraft with metal fuselage, we recommend a rod antenna.
  - The antenna is mounted vertically (as possible) on or under the fuselage.
  - Location should be even and in a safe distance from horizontally screening metal parts (propeller, undercarriage, vertical metal fins etc.), for maximum radio range into all (horizontal) directions.

The picture shows a typical location for top and bottom antenna installation.

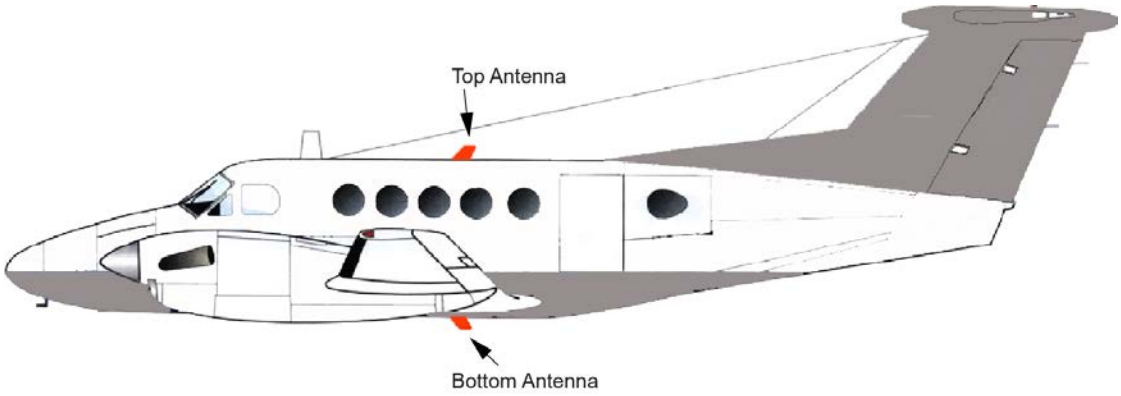

Figure 7: Antenna Installation

- VHF Com 1 and VHF Com 2 can also be mounted on the top with at least ½ wavelength (of the antenna operating frequency) distance between antennas and provided an antenna separation of more than 45 dB.

- Distance to other aircraft antennas (COM, NAV antennas), should be at least 1.5 m/5 ft.
- The antenna mounting area should be as flat as possible.
- When two radios are used:
  - It is required to have an antenna separation of at least 45 dB. This needs to be guaranteed by the installer.
  - It could happen that operational degradations may apply, this needs to be documented from the installer and approved for airworthiness
- Make sure that the metallic contact between aircraft surface/structure and the antenna cable outer conductor (shield) is adequate/solid.
  - Never use a location on paint-coated surfaces!
  - The electrical contact shall remain with low resistance even under vibration.
- For wood and fiberglass (GRP) aircraft (reinforcing the mounting location):
  - 3 or 4 aluminum strips (each 60 cm/2 ft long/5 cm/2 in wide) are recommended.
  - The stripes shall be placed (mostly) horizontally with a shape as a star or cross.
  - These placed counter weights must be centrally screwed together with the antenna socket to ensure a continuous, electrically good contact.
- For aircraft with non-metallic surface structure inside the fuselage:
  - A metal foil (min. 60x60 cm/2x2ft) can be used.
  - The antenna socket should be placed in the foil center, in addition with a metallic ground contact support plate.
- For aircraft with fuselage and/or tail-fin made of non-conductive material:
  - A vertical folded top antenna is suitable.
  - The installation should be made preferably during manufacturing the tail-fin.

NOTICE Carbon fibre is conducting and may shield the antenna!

- Careful sealing of all holes/openings of the outer skin is mandatory.
  - Make sure, that electrical contacts remain continuously good, even under bad environmental conditions.
  - Use only high quality 50 Ω coax cable type RG400 or higher quality.
  - Avoid any sharp cable bend (radius > 50 mm), and any excessive coax cable length.
  - Place all wiring including antenna cable away from other wiring which carries heavy AC currents and away from any aircraft controls.

- Any operating kinematics, trimming and all control handles must be absolutely free in all directions.
- Ensure the BNC antenna plug is not shortened between inner and outer connector (ohmmeter).
- Check the antenna matching:
  - Using 50 Ω SWR meter over the whole frequency range and check for VSWR < 3:1.
  - It may be helpful or necessary to change slightly the length of the middle radiator, or counter weight length for optimized antenna efficiency and matching.

2.3.4.3. Recommendation for Installation of two RT6512 in one Aircraft

This information provides guidance to installers when performing installations with two RT6512 radios on-board the same aircraft.

In order to minimize the risk of cross talk issues, special care has to be applied during the installation of the antennas, as described in "Antenna Installation" on page 34 of this document. Becker recommends to configure the receiver attenuation functionality in the RT6212 and to perform the related wiring as described here.

2.3.4.4. Radio Setting and Wiring for dual installation

To use the RT6512 in a dual COM installation, an attenuation function can be performed using the following procedure.

Therefore, the "Push-To-Talk" output of transceiver A is wired to the "External Receiver Attenuation Control" input of transceiver (B) and vice versa.

External Receiver Attenuation Control (/RX_ATT)

Pin No.	Pin Name	I/O	Function
P1-26	/RX_ATT	IN	Reduces the RF gain of the RX section ACTIVE state – closed contact to GND

Push-To-Talk (/PTT)

Pin No.	Pin Name	I/O	Function
P1-7	/PTT	IN	Push-To-Talk key ACTIVE state – closed contact to GND

2.4. Dimensions

2.4.1. RT6512

Dimensions mm (inch)

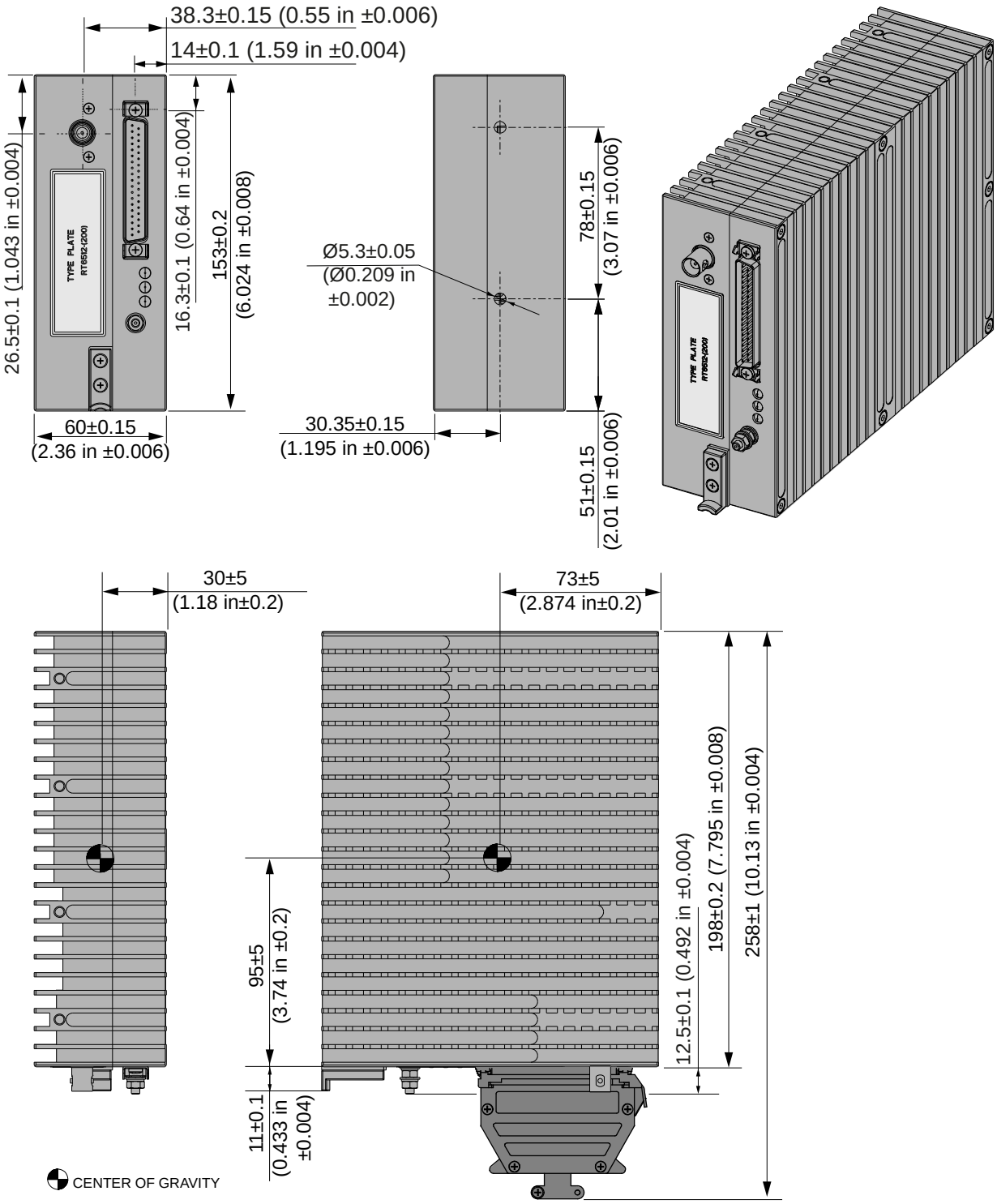

Figure 8: RT6512 Dimensions (without and with Main Connector applied)

2.4.2. **RT6512 with Mounting Tray MT6512**

Dimensions mm (inch)

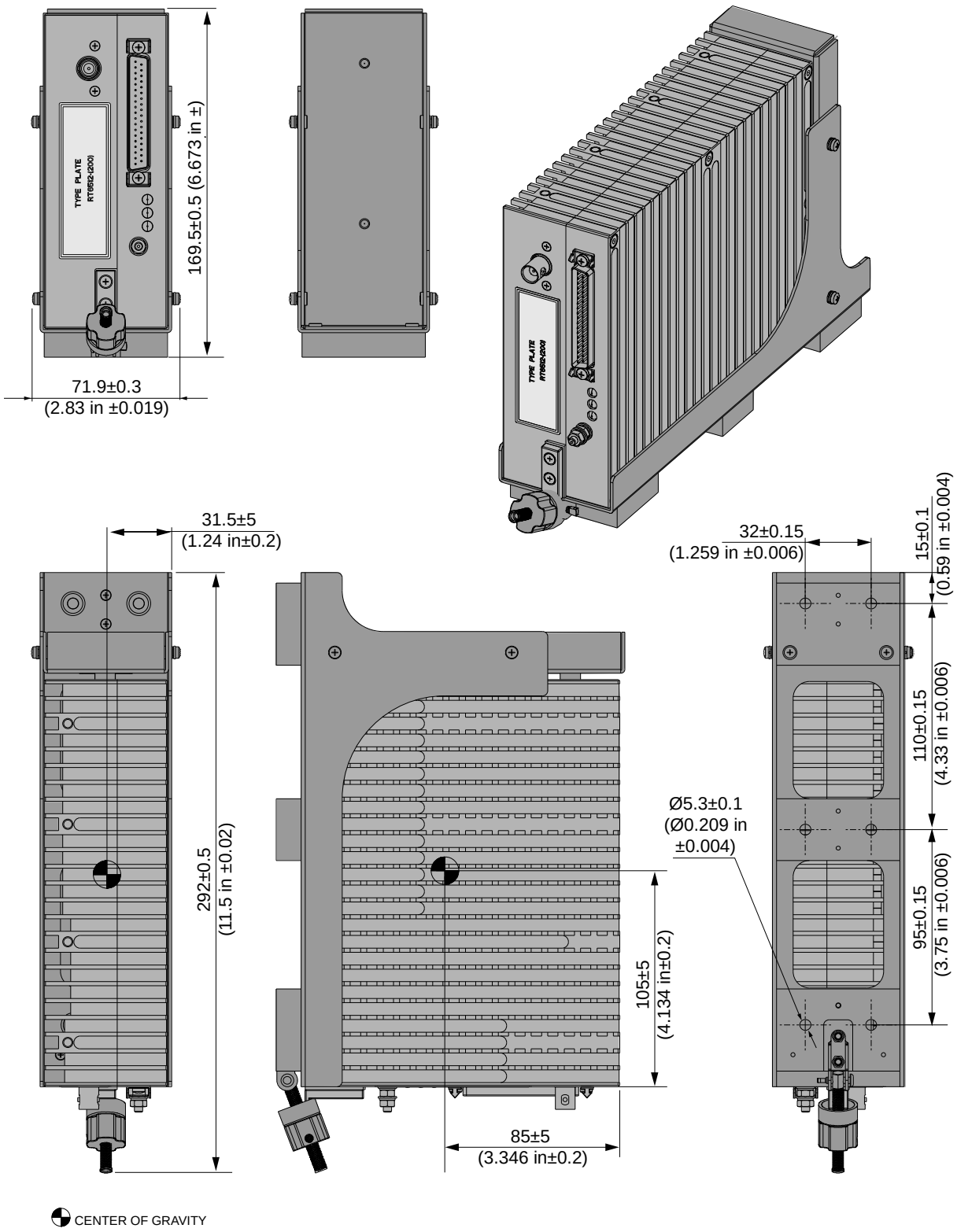

Figure 9: RT6512 with Mounting Tray MT6512

2.5. Connector Pin Assignments

2.5.1. Connector P1 (RT6512)

P1 Pin	Pin Name	Function
1	AF_GND	Audio ground
2	RESERVE	Spare pin for RT6512-(XX0) variants.
	/EMERG	Input which activates the Emergency Mode for **RT6512-(201)** variant
3	LINE_IN_HI	Balanced Line-In HI
4	STD_MIKE_HI	Standard microphone input HI
5	LINE_OUT_HI	Balanced Line-Out HI
6	SIDETONE	Sidetone output
7	/PTT	PTT signal IN (LO active)
8	RX_AGC	Receivers Automatic Gain Control signal (**only for service use!**)
9	/FAILURE	Status line (LO signal if red or yellow LED are ON)
10	ARI429_TX_A1	1st ARINC 429 Interface TX Line A1
11	ARI429_RX_A1	1st ARINC 429 Interface RX Line A1
12	ARI429_RX_B1	1st ARINC 429 Interface RX Line B1
13	ARI429_TX_A2	2nd ARINC 429 Interface TX Line A2
14	RS422_RX+	RS422 Interface RX Line B (HI if idle)
15	RS422_RX-	RS422 Interface RX Line A (LO if idle)
16	/COM2	ARINC addressing line as no. 2 installed in aircraft (LO active)
17	SUPP_28V	Positive power supply line
18	SUPP_28V	Positive power supply line
19	SUPP_GND	Power supply ground (tied to unit housing)
20	AF_GND	Audio ground
21	RESERVE	Spare pin, reserved for future use
22	LINE_IN_LO	Balanced Line-in LO
23	STD_MIKE_LO	Standard microphone input LO
24	LINE_OUT_LO	Balanced Line-out LO
25	/TX_ENABLE	Input which enables the transmitter (LO active), when HI the PTT input is inactive. **Connect /TX_ENABLE to AF_GND directly on the main connector!**
26	/RX_ATT	Reduces RF-Gain of this COM (RX Mode) when connected with PTT of 2nd COM being in TX mode (LO active)
27	/SQL_EVAL	Output which indicates that the receiver receives a signal exceeding the squelch threshold (LO active)
28	/SERV_EN	Input which enables the service mode (LO active). **For service purposes only. Do not use in aircraft installation!**
29	ARI429_TX_B1	1st ARINC 429 Interface TX Line B1
30	ARI429_RX_A2	2nd ARINC 429 Interface RX Line A2
31	ARI429_RX_B2	2nd ARINC 429 Interface RX Line B2

P1 Pin	Pin Name	Function
32	ARI429_TX_B2	2nd ARINC 429 Interface TX Line B2
33	RS422_TX+	RS422 Interface TX Line B (HI if idle)
34	RS422_TX-	RS422 Interface TX Line A (LO if idle)
35	/SEL422	Select RS422 communication-port (LO active), if not LO then ARINC 429 ports are active.
36	/ON	Remote power ON (LO active)
37	SUPP_GND	Power supply ground (tied to unit housing)

2.6. Equipment Configuration Samples

NOTICE

- Selection of active controller type shall be done using /SEL422 line.
- ARINC429 Interface or RS422 interface are exclusive (alternative useable).

2.6.1. RT6512 with RMU5000

RT6512 VHF-AM transceiver operated by one RMU5000 using the RS422 interface.

Figure 10: RT6512 with RMU5000

2.6.2. RT6512 with ARINC 429 Controller

RT6512 VHF-AM transceiver operated by one OEM controller using the ARINC 429 interface

Figure 11: RT6512 with ARINC 429 Controller

2.7. Aircraft Wiring

⚠CAUTION Do not apply reverse voltage!

If the unit has been powered up with a reverse wiring on the power supply line (ground and DC input reversed) then the unit shall be returned to a Becker Avionics service centre for inspection.

The following figures show examples of aircraft wiring with RT6512. For further information of aircraft wiring with other devices refer to the corresponding manuals.

Wiring Diagram with RMU5000

For detailed information refer to the manual RMU5000 Installation and Operation DV64301.03 (Article-No. 0541.958-071).

Wiring Diagram with OEM Controller

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

2.7.1. RT6512-(XX0) with ARINC 429 Controller

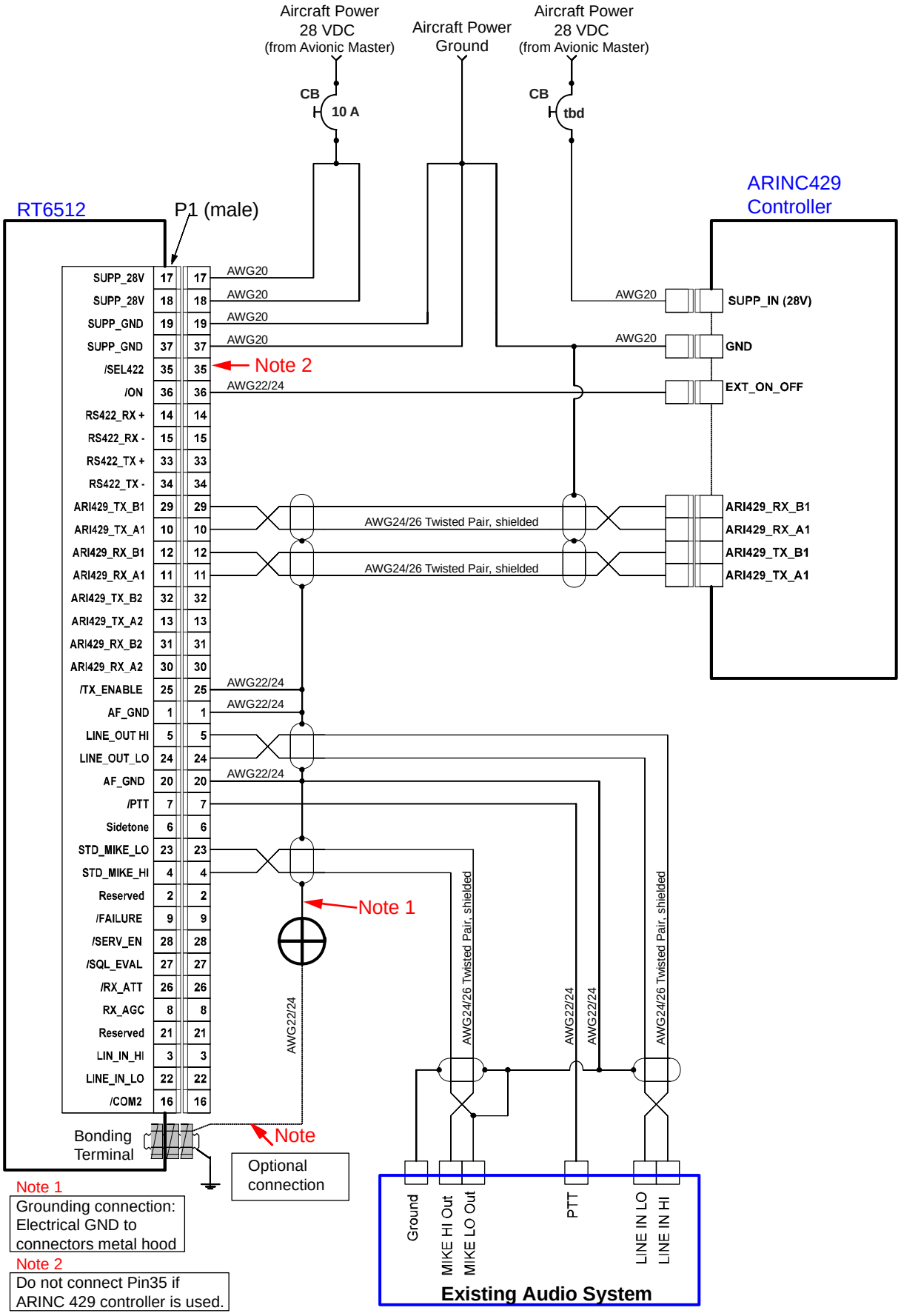

Figure 12: RT6512-(XX0) with ARINC 429 Controller

2.7.2. RT6512-(XX1) with ARINC 429 Controller

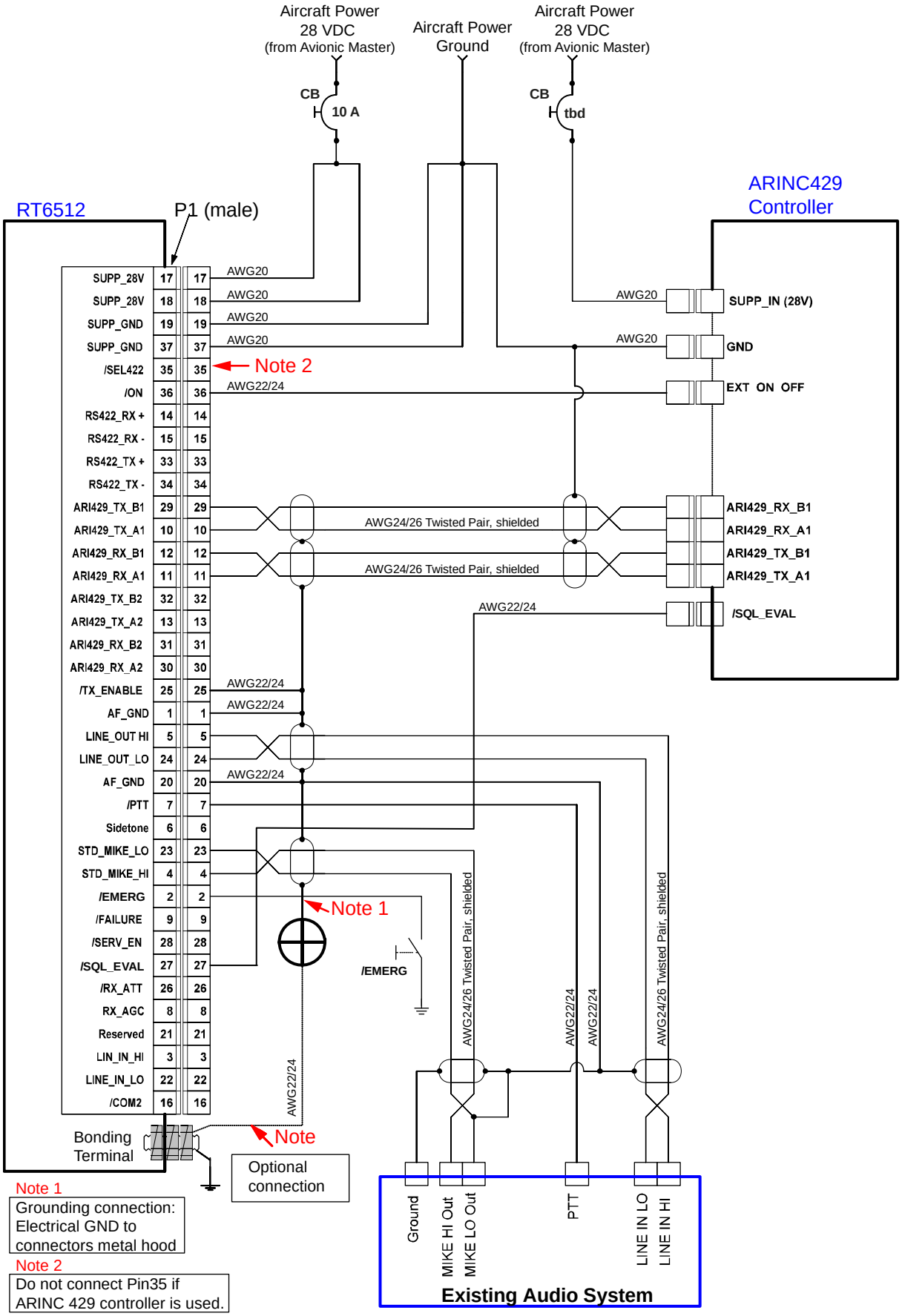

Figure 13: RT6512-(XX1) with ARINC 429 Controller

2.8. Post Installation Tests

Note: It is assumed that the "Installation Setup" has been done before the Post Installation Tests will be carried out.

Once the RT6512 is installed completely perform a test procedure to verify system functionality. Ensure compliance with authority required procedures. Refer to the installation order of the minor change document or use an own approved test protocol for VHF units. The following chapter below provides guidance for such tests.

2.8.1. Mechanical Installation and Wiring Check

- Verify all cables are securely fixed and shields connected properly to signal ground.
- Check the movement of aircraft controls to verify there is no interference.
- Verify all screws are tight, check if all connections are mechanically secured.

2.8.2. Power Supply

- Check the power supply lines and confirm correct polarity. Don´t apply reverse voltage!
- Confirm that the aircraft power supply is within the specified limits, with and without a running engine.

2.8.3. Receiver / Transmitter Operation

- Power up the RT6512 and tune it to a local station for a communication test.
- Verify that the receiver output produces a clear and readable audio and ask the local station for proper readability for the transmit signal of the RT6512.
- Repeat this communication test with an airborne station within ≈ 20-40 NM (Nautical Miles).

2.8.4. Antenna Check

- Check the VSWR (voltage standing wave ratio) over the complete frequency band (e.g. by using a VHF Reflection-Coefficient Meter).
  The VSWR ratio should be less than 2:1 and is not acceptable when exceeding 3:1.

2.8.5. Interference Check

- Check the RT6512 while engine is running and powered on all other avionics/ electrical systems on the aircraft, to verify that no significant interference exists.
- Check also that the RT6512 does not cause significant interference with other systems.

The installer´s standard test procedure may used for the interference check and the following table can be taken as a reference. Depending on the individual avionic systems installed in the aircraft, it might be necessary to extend the following checklist accordingly.

Aircraft System	Function	
	OK	NOT OK
DME		
Audio		
Generators / Inverters		
GPS System		
Compass 1		
ADF		
VHF / NAV1 all channels		
VHF / NAV 2 all channels		
Marker Receiver		
Motor(s)		
Engine Instruments		
Stormscope		
Transponder		
Air Data Computer		
Autopilot and Servos		

- Power the GPS and make sure that not less than 5 satellites are tracked.
- Check the interference between the VHF-COM and the GPS receiver (when activated in NAV mode).
- Select the following channels/frequencies on the RT6512 and on each frequency stay in TX and RX mode for at least 30 seconds.
- Verify that GPS integrity flag is always out of view.

Channel	Frequency (MHz)
121.140	121.1416
121.150	121.1500
121.155	121.1500
121.160	121.1583
121.165	121.1666
121.175	121.1750
121.180	121.1750
121.185	121.1833
121.190	121.1916
121.200	121.2000
121.205	121.2000
121.210	121.2083
131.240	131.2416
131.250	131.2500
131.255	131.2500
131.260	131.2583
131.265	131.2666
131.275	131.2750
131.280	131.2750
131.285	131.2833
131.290	131.2916
131.300	131.3000
131.305	131.3000
131.310	131.3083

For the remaining avionic equipment repeat all interference checks during a flight and include all equipment not previously checked out on ground. A communication performance check in the low, mid and high frequency band of the RT6512 should be included.

- Verify the receiver output produces a clear and understandable audio output.
- Verify the transmitter by contacting another station and getting a report of reliable communications.
- Perform the range check with a station at least 100 m from your own position.
- Check the intercom function by talking into the microphone, while the engine is running at cruising rpm. You should hear yourself and/or your co-pilot loud and clear.
- Switch "ON" the squelch and check that the normal radio noise, without a present carrier signal, it will be constantly suppressed. The threshold of the squelch can be set in the pilots menu.

2.8.6. **Flight Test Check**

It is highly recommended to perform flight test as final installation verification. The performance of the RT6512 may be verified by contacting a ground station at a range of at least 50 NM while maintaining an appropriate altitude and over all normal flight attitudes.

- Check the performance in the low, mid and high band frequencies.

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3. Operating Instructions

In this chapter you can read about:

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3.2. Operating with RMU5000 49
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3.4. Start-Up 50
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3.1. Device Description

The RT6512 is designed to be operated by means of an remote control device which could be the Becker RMU5000 using the RS422 control bus, or any OEM control device using the ARINC 429 control bus with standard label format.

3.1.1. Device Assignment

This manual is valid for the following devices:

See page 30

3.2. Operating with RMU5000

For detailed information refer to the manual RMU5000 Installation and Operation DV64301.03 (Article-No. 0541.958-071).

3.3. Operating with OEM Controller

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

3.4. Start-Up

3.4.1. Built In Tests (BIT)

The RT6512 has advanced Built-In-Test. It monitors most of internal circuits against failures. In addition BIT monitors some external (installation) conditions to increase RT6512's reliability.

There are three types of BIT implemented:

- **PBIT** (performed after Power ON the unit),
- **IBIT** (initiated by special command via serial protocol)
- **CBIT** (which continuously check transceiver operation).

The following functions are checked under BIT:

- Power Supply (PSB Error)
  - BIT function monitors internal Power Supply conditions. "*PSB error*" is classified as an "internal failure".

- Control unit (CU) Lost Connection Error
  - If RT6512 does not receive any valid frame via the RS422 serial interface within each 5 seconds, then the "*CU Lost Connection Error*" appears and classifies as "external failure".
  - If RT6512 is controlled by ARINC 429 interface, detecting "*CU Lost Connection Error*" is disabled.
  - If RT6512 operates in Emergency Mode, detecting "CU Lost Connection Error" is disabled.

- Channel Error
  - If RT6512 receives an invalid channel name, then the "*Channel Error*" appears and classifies as "external failure".

- RX Synthesizer Error
  - RT6512 monitors the RX synthesizer(s).
  - If any error behavior is detected, the *"RX Synthesizer Error"* indication appears and is classified as an "Internal Failure".

- RX AGC Error
  - AGC voltage of the RX (RF-AGC) is monitored. If an error behavior is detected, the device indicate a *"RX AGC Error"*

- TX Output Power Error
  - In TX mode, RT6512 is monitoring the forward power at the antenna connector. If any error behavior is detected a *"TX Output Power Error"* indication appears and is classified as an "internal failure".
  - As long as detecting *"TX Output Power Error"*, RT6512 stays in RX mode.

- TX Synthesizer Error
  - RT6512 monitors the TX synthesizer while generating the TX signal. If error behavior is detected and the /PTT input is active (low), RT6512 indicates *"TX synthesizer error"*.
  - This error classifies as "Internal Failure".
  - As long as detecting the *"TX Synthesizer Error"*, the transmitter stays in TX-Off-condition.

- TX OFF-Overtemp Error

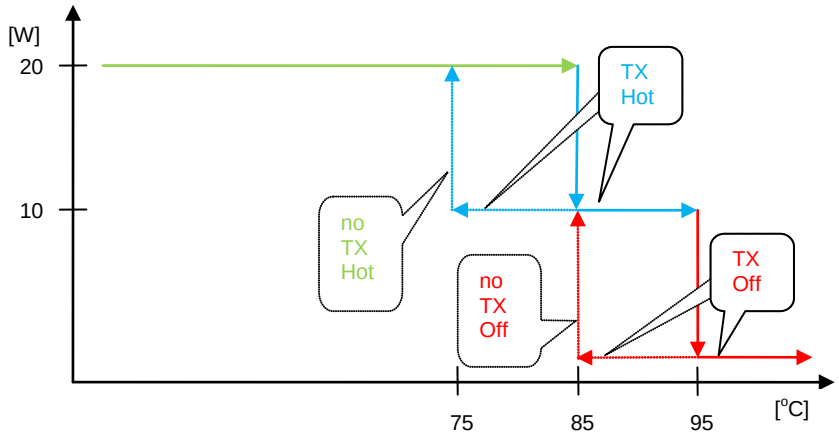

Figure 14 Thermal Behavior for TX Function

  - RT6512 monitors the heat sink temperature. If the heat sink temperature exceeds +95 °C at the point of measurement and on the /PTT input a low state is detected, RT6512 indicates a *"TX OFF-Overtemp Error"*. As long as the error is detected, RT6512 stays in TX-off-condition.
  - The error indication disappears when the heat sink temperature has fallen below +85 °C at the point of measurement.
  - This error is indicated as an *"External Failure"*.

- TX Hot Error
  - RT6512 is monitoring the heat-sink temperature. If the heat sink temperature exceeds +85 °C at the point of measurement and on the /PTT input a low state is detected, RT6512 indicates a *"TX Hot Error"*. The error indication disappears when the heat sink temperature has fallen below +75 °C at the point of measurement.
  - This error is indicated as a warning.
  - As long as the *"TX Hot Error"* indication is ON and RT6512 is in the TX mode, TX output power is reduced to a safe level.

- Antenna VSWR Error
  - In TX mode, RT6512 is monitoring the VSWR at the antenna connector. If the VSWR mismatches to more than 1:8, *"Antenna VSWR Error"* indication is ON.
  - If an *"Antenna VSWR Error"* is detected, RT6512 stays still in TX mode. As long as the error exists, the output power is reduced to a safe level.
  - This error is indicated as an "External Failure".

- Stuck PTT Error
  - When the PTT key is pressed a 35 seconds timer starts.
  - When detecting a *"Stuck PTT Error"*, RT6512 switches to the RX-mode. As long as this error is indicated RT6512 stays in a Stuck-PTT-condition.

3.4.1.1. Initiated Built In Test (IBIT)

- The test routine BIT is activated by a special command via serial interface.
- The green LED on RT6512 flashes for approx. 2 s during IBIT is running.

NOTICE Interrupting an already started self-test is not possible.

The test routine IBIT checks the following functions:

- PSB Error
- CU Lost Connection Error
- Channel Error
- RX Synthesizer Error
- RX AGC Error
- TX Output Power Error
- TX Synthesizer Error
- TX OFF-Overtemp Error
- TX Hot Error
- Antenna VSWR Error
- Stuck PTT Error

3.4.1.2. Power On Built In Test (PBIT)

- The PBIT triggers automatically and runs immediately after RT6512 switches on.
- The PBIT checks the same function as described in the IBIT. The error indication is the same as IBIT.
- RT6512 immediately produces a NOGO-Audio Signal on the LINE_OUT after detecting a failure.

3.4.1.3. Continuous Built In Test (CBIT)

During RT6512 is operating the CBIT test runs permanently "in the background" and controls:

- PSB Error
- CU Lost Connection Error
- Channel Error
- RX Synthesizer Error
- TX Output Power Error
- TX Synthesizer Error
- TX OFF-Overtemp Error
- TX Hot Error
- Antenna VSWR Error

3.4.1.4. Error Indication

Audible Error Announcement

⚠CAUTION

Behavior in the event of a fault:

During flight, switch to another VHF radio and return the unit to a Becker Avionics service centre for repair as soon as landed.

RT6512 immediately produce NOGO-audio signal at the LINE_OUT if the error indication is changing from: *"no error"* or *"warning"* to: *"internal failure"* or/and *"external failure"*.

The NOGO-signal has the following characteristics:

Function	Value
Amplitude	Pulse modulated sine wave
Pulse Frequency	800 Hz
Interrupt duration before first burst	70 milliseconds
Pulse duration	60 milliseconds (3 times)
Interrupt duration	60 milliseconds (3 times)
Interrupt duration after last burst	70 milliseconds
Audio level	same as in RX mode at (90% AM, -53 dBm, AF-AGC on)

Status & Error Indication

The RT6512 error status is indicated by three LEDs, located on front side, underneath the unit connector.

⚠CAUTION

Behavior in the event of a fault:

During flight, switch to another VHF radio and return the unit to a Becker Avionics service centre for repair as soon as landed.

No Error

Output / Indicator	Status	Remarks
Green LED	ON	No error detected.
Yellow LED	OFF	-
Red LED	OFF	-
RS422	-	All errors accessible via the serial RS422 interface are set to zero.
Status output /FAILURE	inactive	-

Test in Progress

Output / Indicator	Status	Remarks
Green LED	blinking	Approx. 0.125 s ON and 0.125 s OFF.
Yellow LED	OFF	-
Red LED	OFF	-
RS422	-	All errors accessible via the serial RS422 interface are set to zero.
Status output /FAILURE	inactive	-

Internal Failure Indication

⚠CAUTION

Behavior in the event of a fault:

During flight, switch to another VHF radio and return the unit to a Becker Avionics service centre for repair as soon as landed.

Output / Indicator	Status	Remarks
Green LED	OFF	-
Yellow LED	OFF	Will also be ON if, simultaneously an "*External Error*" is detected.
Red LED	ON	-
RS422	-	The error is accessible via the serial RS422 interface.
Status output /FAILURE	active	logical “and” of events above

External Failure Indication

⚠CAUTION

Behavior in the event of a fault:

During flight, switch to another VHF radio but if problem remains, use any communication backup mean.

Check the wiring or the control unit.

Output / Indicator	Status	Remarks
Green LED	OFF	-
Yellow LED	ON	-
Red LED	OFF	Will also be ON if, simultaneously an "*Internal Error*" is detected.
RS422	-	The error is accessible via the serial RS422 interface.
Status output /FAILURE	active	-

Failure Indication when an "Internal" or "External" Failure is detected

⚠CAUTION

Behavior in the event of a fault:

During flight, switch to another VHF radio and return the unit to a Becker Avionics service centre for repair as soon as landed.

Output / Indicator	Status	Remarks
Green LED	OFF	-
Yellow LED	ON	-
Red LED	ON	-
RS422	-	The error is accessible via the serial RS422 interface.
Status output /FAILURE	active	-

After test is completed, RT6512 automatically turns to receive mode.

Error-History-Flags in the Service Set up

- Any error occurring one or more time(s) is setting the corresponding error-history-flag.
- The error-history-flag will be hold for a time of 10 operating seconds after the error has disappeared.
- The state of all error-history flags is stored at each power OFF.
- The error-history-flags are readable in the service setup.
- The error history-flags are erasable immediately from the service setup.

3.5. ARINC 429 Protocol supported by RT6512

The Word Format follows standards ARINC SPECIFICATION 429 PART 1-17 Attachment 6 and GAMA Pub. No 11.

Table 1 ARINC word format

	PARITY	SIGN / STATUS MATRIX	10 MHz			1 MHz				100 kHz				10 kHz				1 kHz				SDI		LABEL (VHF COM)							
																								MSB							LSB
BIT No.	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	1	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	1	1	1
Example (Label 047)	-	Normal Operation		(2)			(8)				(5)				(3)				(0)				all call		(0)			(4)				(7)	

Note 1: The 100 MHz character is always 1 and because of this so a not transferred information

Note 2: The Unit shall transmit/receive particular bits of ARINC word in the following order: 8, 7, 6, 5, 4, 3, 2, 1, 9, 10, 11, 12, 13 … 32 (see table below).

Table 2 ARINC transmission order

	LABEL (VHF COM)								SDI		1 kHz				10 kHz				100 kHz				1 MHz				10 MHz			SIGN / STATUS MATRIX		PARITY
	MSB							LSB																								
BIT Order	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	0	0	1	0	0	1	1	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	1
Example (Label 047)	(0)		(4)			(7)			all call		(0)				(3)				(5)				(8)				(2)			Normal Operation		-

Note 3: REMAINDER: label bits are transmitted in opposite order: **MSB bit is transmitted as first.**

ARINC 429 Bitrate

The RT6512 operates with Bitrate 12.0…14.5 kilobits per second (LOW SPEED OPERATION).

ARINC 429 Broadcasting

The RT6512 periodically transmits a package consisting of the following frames:

- label 030/047
- label 377

Each package is transmitted every 100…200 ms

ARINC 429 – Accepted Labels

When the label of a received frame is not equal to (030 or 047) then the complete frame is ignored.

ARINC 429 – Label Selection for outgoing Frames

The RT6512 transmits (broadcast) ARINC 429 label 030 when is tuned to 25 kHz spacing channel.

The RT6512 transmits (broadcast) ARINC 429 label 047 when is tuned to 8.33 kHz spacing channel.

The RT6512 uses label 030 with SSM bits set to No Computed Data when no valid data exists.

Table 3 The SSM bits description (valid for both 030 and 047 labels)

Bit No	Function	Description
31-30	SSM	0 0 – Receive Mode 0 1 – No Computed Data 1 0 – Receive Mode / Self-Test 1 1 – Transmit Mode

Note: SSM status can be used to inform the crew about terminated transmission as required by TSO-C128a/ETSO-2C128

ARINC 429 – CTRL Words Content

The RT6512 accepts Active Frequency change and SQUELCH change commands.

ARINC 429 – Supported Labels

The RT6512 transmits frame 377 which includes Equipment ID.

ARINC 429 – SDI for incoming ARINC Frames

The RT6512 accepts received frame if the SDI does fulfill at least one of the following conditions:

- The received SDI is equal to 00 (regardless of /COM2 input's status)
- The received SDI is equal to Bit10=0 Bit9=1 for **Inactive** (**HIGH** state) /COM2 input
- The received SDI is equal to Bit10=1 Bit9=0 for **Active** (**LOW** state) /COM2 input

Otherwise the device ignores the received frame.

Note: The status of the /COM2 discrete input is monitored permanently (continuously).

ARINC 429 – SDI for outgoing ARINC Frames

The SDI fields in outgoing ARINC 429 frames are equal to:

- Bit10=0 Bit9=1 for **Inactive** (**HIGH** state) /COM2 input
- Bit10=1 Bit9=0 for **Active** (**LOW** state) /COM2 input

Note: The status of the /COM2 discrete input is monitored permanently (continuously).

ARINC 429 – Channel Frequency

In a valid frame the information in the characters "10 MHz to 1 kHz" is handled from the device as a channel frequency. Regarding this information the device behaves as described table below.

Note: The 100 MHz character is not transferred and shall device internally be interpreted as 1.

Channel Name	Channel Frequency	Channel Spacing
118.000	118.0000 MHz	25 kHz
118.005	118.0000 MHz	8.33 kHz
118.010	118.0083 MHz	8.33 kHz
118.015	118.0166 MHz	8.33 kHz
118.025	118.0250 MHz	25 kHz
118.030	118.0250 MHz	8.33 kHz
118.035	118.0333 MHz	8.33 kHz
118.040	118.0416 MHz	8.33 kHz
118.050	118.0500 MHz	25 kHz
118.055	118.0500 MHz	8.33 kHz
118.060	118.0583 MHz	8.33 kHz
118.065	118.0666 MHz	8.33 kHz
118.075	118.0750 MHz	25 kHz
118.080	118.0750 MHz	8.33 kHz
118.085	118.0833 MHz	8.33 kHz
118.090	118.0916 MHz	8.33 kHz
118.100	118.1000 MHz	25 kHz
...	...	...
155.975	155.9750 MHz	25 kHz

ARINC 429 – Minus or Not Computed Data

The RT6512 ignores received frames if in the sign / status matrix the received information is a “Minus“ or “Not Computed Data”

ARINC 429 – Self-test Request

The RT6512 initiates Self-test, when in a valid received frame the contents of the sign / status matrix is changing from “Plus” to “Functional Test”.

ARINC 429 – Parity Bit

The parity bit of a received frame shall have such a value, that the number of received ones (including the parity bit) is odd. If this condition is not fulfilled the frame is ignored.

In case of additional questions contact your local Becker Avionics dealer or forward your request direct to Becker Avionics "Customer Service".

In the event of damage or a defect, the entire device must be returned for repair. The repair must be performed by trained Becker Avionics personnel.

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Customer Service:

Sales

Email: sales@becker-avionics.com

Support

Email: support@becker-avionics.com

User Conversions and Changes are Not Permitted

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

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