

Remote-Controlled VHF-AM Transceiver

RT6512

RT6512-(100)

RT6512-(200)

Installation and Operation

Manual DV17501.03

Issue 01 June 2015

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Preface

Dear Customer,

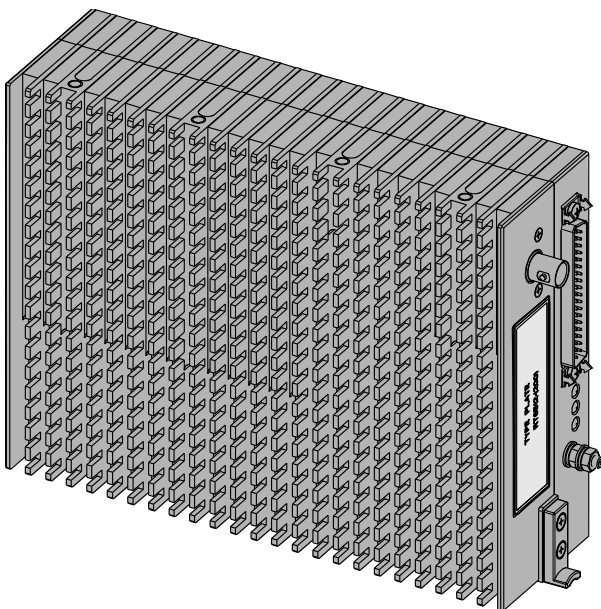
Thank you for purchasing a BECKER product.

We are pleased that you have chosen our RT6512 and we are confident that it will meet all 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.



RT6512

06/2015

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List of Abbreviations

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A3E	Amplitude modulation double-sideband with full carrier
AGC	Automatic Gain Control
AM	Amplitude Modulation
AOC	Air Operations Center
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
DAL	Design Assurance Level
DC	Direct Current
EUROCAE	European Organisation 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

List of Abbreviations

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
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	Millimetre
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



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.

Warranty Conditions

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.



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.

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.

1. Device 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 meets RTCA and EUROCAE airworthiness requirements applicable at the time the unit received certification. There are no restrictions for installation of the unit in any aircraft as long as it will be installed 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.

List of sections, included in the following documents **Maintenance & Repair (M&R)**, **Installation & Operation (I&O)**.

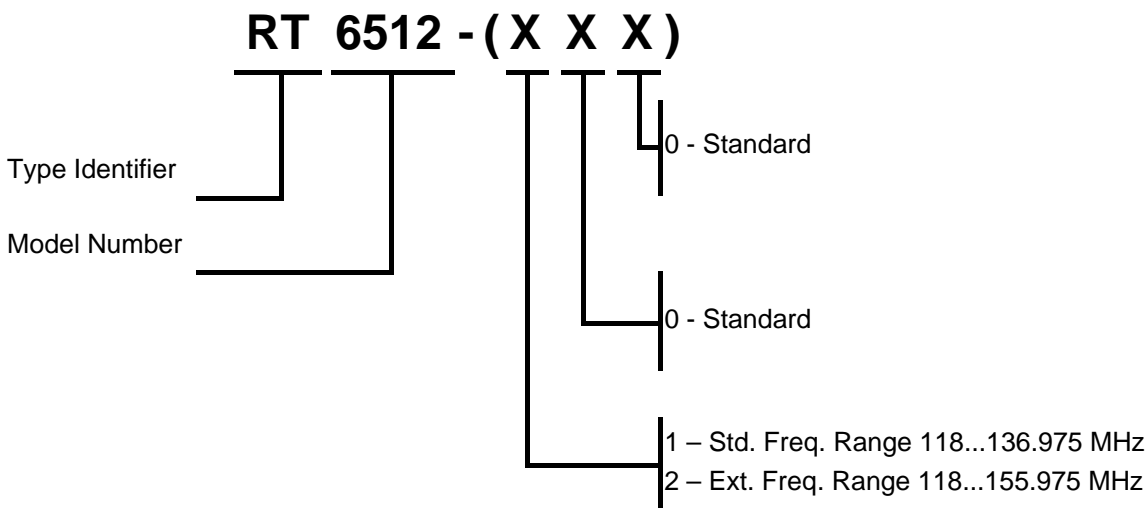
Section		DV 17502.04 M&R	DV 17502.03 I&O
1	General Description	X	X
2	Installation	X	X
3	Operation Instructions	X	X
4	Theory of Operation	X	N/A
5	Maintenance and Repair	X	N/A
6	Illustrated Parts List	X	N/A
7	Modification and Changes	X	N/A
8	Circuit Diagrams	X	N/A
9	Certifications	X	N/A
10	Attachments	X	N/A

1.2. Purpose of Equipment

- The remote-controlled VHF-AM transceiver is a half-duplex 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). The VHF-AM transceiver 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.
- The RT6512 remote controlled VHF-AM transceiver uses ARINC 429 and RS422 interfaces for communication with a control device.
- RT6512 provides frequency and mode control, either by means of the Becker RCU6512 (certification is pending) or RMU5000 controller using the RS422 communication port, or by means of any OEM product using the standard ARINC 429 communication bus.
- With transmitter power at least 16 W under all environmental conditions 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. General Description

The VHF-AM transceiver performs AM voice communication then contains modules: RX, TX, Audio, digital communication.

Mechanics: Case serves as heat sink, mount it proper as defined in chapter Mechanical Installation, page 27.

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 40).

1.4.1. Receive Mode

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

1.4.2. Transmit Mode

The VHF-AM transceiver 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=1, for VSWR>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).

The VHF-AM transceiver is equipped with a protective function to prevent from blocking the frequency channel by a stucked transmit button or a short circuit on the key line. "Stuck PTT" time limit setting can be set by factory between 30 seconds and 3 minutes. Default setting for Stuck PTT time is 35 seconds.

RT6512 transmitter is protected from overheating. VSWR on Antenna connector is also monitored. See chapter Status and Control Outputs, page 13 for details.

1.4.3. Audio Inputs and Outputs

1.4.3.1. Microphone Input

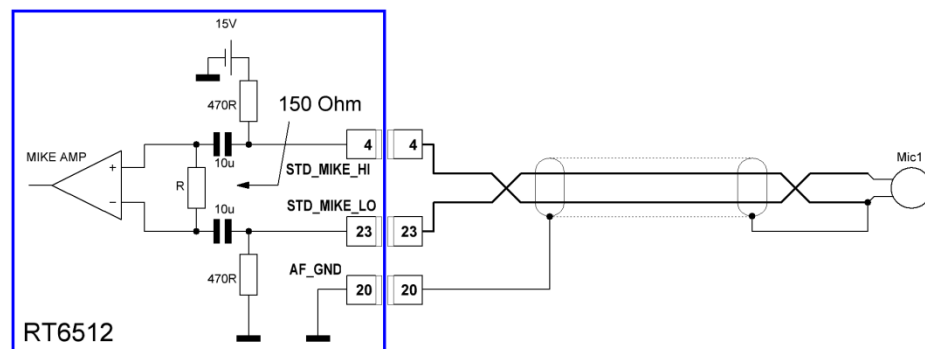


Figure 1 Standard Microphone Input schematic

The VHF-AM transceiver is designed for a standard microphone: unbalanced, DC coupled, DC supplied from VHF-AM transceiver. The bias current for standard microphone is drawn from VHF-AM transceivers 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.

1.4.3.2. Audio Input LINE IN

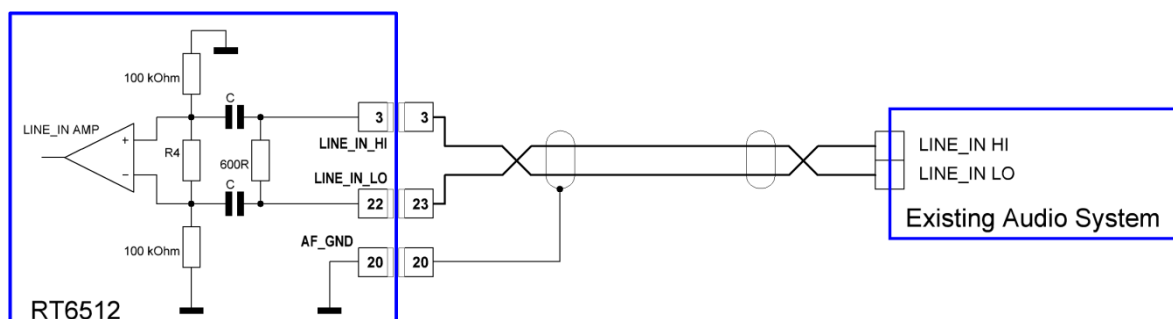


Figure 2 LINE_IN schematic

The VHF-AM transceivers 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.

1.4.3.3. Audio Output LINE OUT

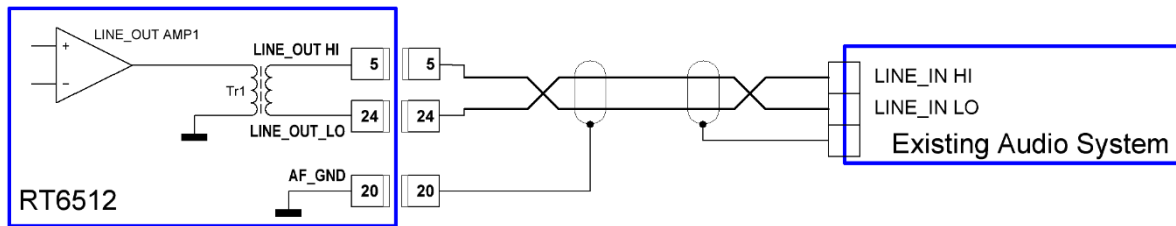


Figure 3 LINE_OUT

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 .

1.4.4. Control In-and Outputs

1.4.4.1. /ON line (Unit Power ON/OFF Control)

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 1000 Ω 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 k Ω connects to ground.

1.4.4.2. /PTT line (Press-To-Talk Input)

The /PTT line 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 1000 Ω .

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

1.4.4.3. /RX_ATT (External RX Attenuation Control)

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 1000 Ω 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 k Ω connects to ground.

1.4.4.4. /TX-ENABLE (Enabling the TX)

The VHF-AM transceiver detects a low state on the /TX_ENABLE input when an external resistance lower than 1000 Ω connects to ground.

The VHF-AM transceiver is detecting high state on the /TX_ENABLE input when an external resistance higher than 50 k Ω 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!

1.4.5. Status and Control Outputs

1.4.5.1. /FAILURE

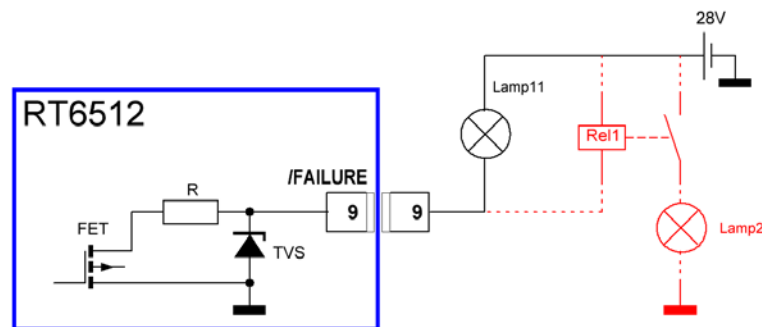


Figure 4 /FAILURE output schematic

This /FAILURE output is coupled to the status shown at the status LEDs mounted at the connector side of the VHF-AM transceiver. 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 40.

1.4.5.2. /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 (the same schematic as for /FAILURE output) with capability to:

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.

1.4.6. Serial Interface to the Control Unit

1.4.6.1. Serial Interface ARINC 429

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

1.4.6.2. **Serial 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)

1.5. Technical Data

1.5.1. Power Supply Data

RT6512	Specifications
Nominal supply voltage	28.0 VDC
Extended supply voltage	22.0...30.3 VDC
Emergency operation	18.0 VDC

1.5.2. 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)

1.5.3. General Data

RT6512	Specifications
Frequency range RT6512-(100) RT6512-(200)	118.000...136.9916 MHz
	118.000...155.975 MHz
Channel spacing	25 kHz
	8.33/25 kHz
Number of channels	2280 +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)

1.5.4. 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

1.5.5. 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	$\leq 5\%$ at AM=30% 10 dB below rated output power
	$\leq 15\%$ 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	≥ 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

1.5.6. Transmitter Data

RT6512	Specifications
Output power into 50 Ω (with and without modulation)	≥ 20 W
Frequency tolerance	≤ 5 ppm
Duty cycle	30 s (TX): 270 s (RX)
Type of modulation	A3E
Modulation capability	$\geq 70\%$
Distortion	$\leq 10\%$
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)

1.5.7. Environmental Qualification Table

The following performance standards had 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	4.0	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	5.0	B	-
Humidity	6.0	B	-
Operational Shocks & Crash Safety	7.0	B	-
Vibration	8.0	S G	Category S – Curve M Category U – Curve G
Explosion Proofness	9.0	X	n/a
Water Proofness	10.0	R	-
Fluids susceptibilities	11.0	X	n/a
Sand and dust	12.0	X	n/a
Fungus resistance	13.0	X	n/a
Salt spray	14.0	X	n/a
Magnetic effect	15.0	Z	-
Power Input	16.0	B	Normal: 22.0... 30.3 V Abnormal: 20.5... 32.2 V Emergency operation: 18.0 V
Voltage spike	17.0	A	-
Audio Frequency Conducted Susceptibility – Power Inputs	18.0	B	-
Induced Signal Susceptibility	19.0	ACX	-
Radio frequency susceptibility	20.0	WW	Conducted Susceptibility: Cat. W Radiated Susceptibility: Cat. W
Emission of RF	21.0	M	-

Environmental Test	Section	Category	Remarks
Lightning Induced Transient Susceptibility	22.0	A3Z3XX	Pin tests: Waveform A Level 3 Cable bundle tests: Waveform Z Level 3
Lightning Direct Effects	23.0	X	n/a
Icing	24.0	X	n/a
ESD	25.0	A	-

1.6. 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 Software Design Assurance Level (DAL) of its operational software was determined to be Level C.

1.7. Certifications and Guidelines

RT6512 certification is pending.

1.7.1. RT6512 meets the Requirements of:

Number	Description
ETSO-2C169a	"VHF Radio Communication Transceiver Equipment Operating within Radio Frequency Range 117.975 to 137.000 MHz"
TSO-C169a	"VHF Radio Communication Transceiver Equipment Operating within Radio Frequency Range 117.975 to 137.000 MHz "
ETSO-2C128	"Devices that prevents blocked channels used in two-way Radio Communications due to unintentional transmissions"
TSO-C128a	"Devices that prevents blocked channels used in two-way Radio Communications due to unintentional transmissions"

1.7.2. Guidelines followed for Design and Development

Number	Description
EUROCAE ED-23C	"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	"Audio Systems Characteristics And Minimum Performance Specifications"
EUROCAE ED-12C	"Software Considerations in Airborne Systems and Equipment Certifications"
EUROCAE ED-14G	"Environmental Conditions and Test Procedures for Airborne Equipment"
RTCA DO-186B	"MOPS For Airborne Radio Communication Equipment Operating 117.975 - 137.000 MHz "
RTCA DO-207	"MOPS For Device that Prevent Blocked Channels Used IN 2-Way-Radios Communications due to Unintentional Transmissions"
RTCA DO-170	"Audio Systems Characteristics And Minimum Performance Specifications"
RTCA DO-178C	"Software Considerations in Airborne Systems and Equipment Certifications"
RTCA DO-160G	"Environmental Conditions and Test Procedures for Airborne Equipment"

1.8. Equipment Configuration Samples

Selection of active controller type shall be done using /SEL422 line.

1.8.1. RT6512 with RCU6512

RT6512 VHF-AM transceiver operated by one RCU6512 controller using the RS422 interface.

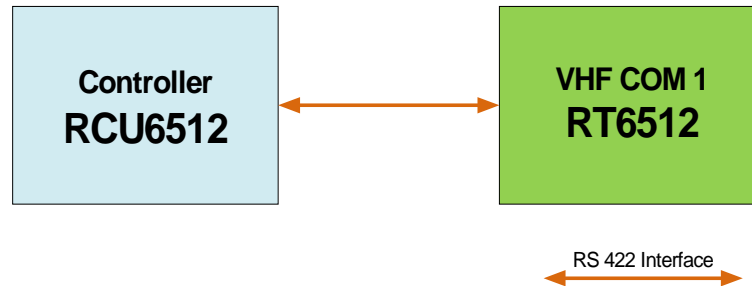


Figure 5: RT6512 with RCU6512

1.8.2. RT6512 with RMU5000

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

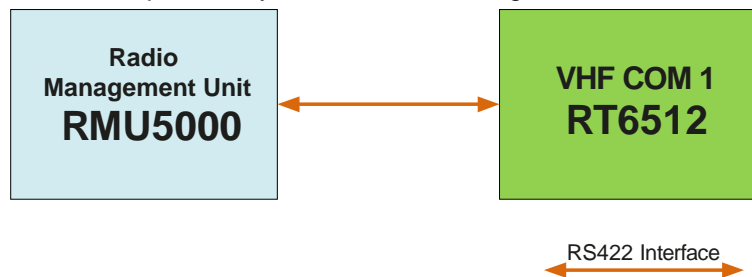


Figure 6: RT6512 with RMU5000

1.8.3. RT6512 with ARINC 429 Controller

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

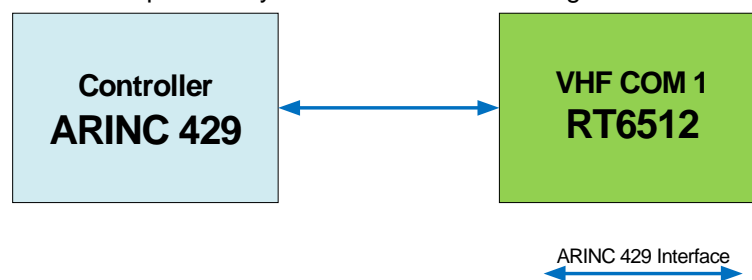


Figure 7: RT6512 with ARINC 429 Controller

1.8.4. RT6512 with RCU6512 and ARINC 429 Controller

RT6512 VHF-AM transceiver operated by one RCU6512 controller using the RS422 interface and one OEM controller using the ARINC 429 interface.

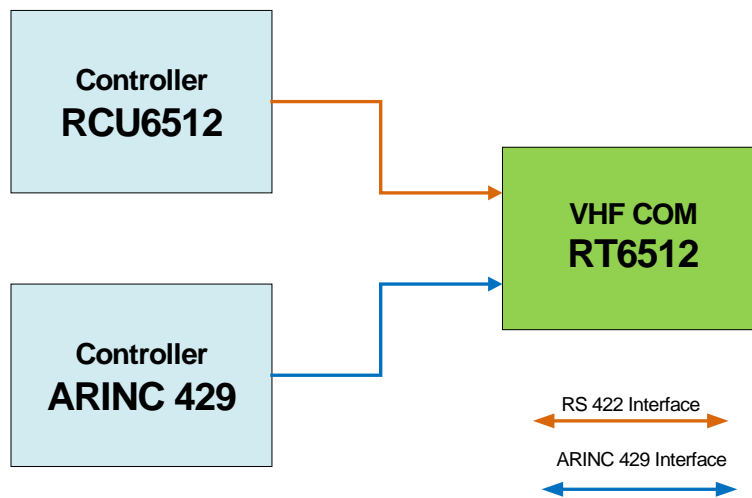


Figure 8: RT6512 with RCU6512 and ARINC 429 Controller

1.8.5. RT6512 with one RCU6512 and two ARINC 429 Controller

One RT6512 VHF-AM transceiver operated by one RCU6512 controller using the RS422 interface and two OEM controllers using the ARINC 429 interface.

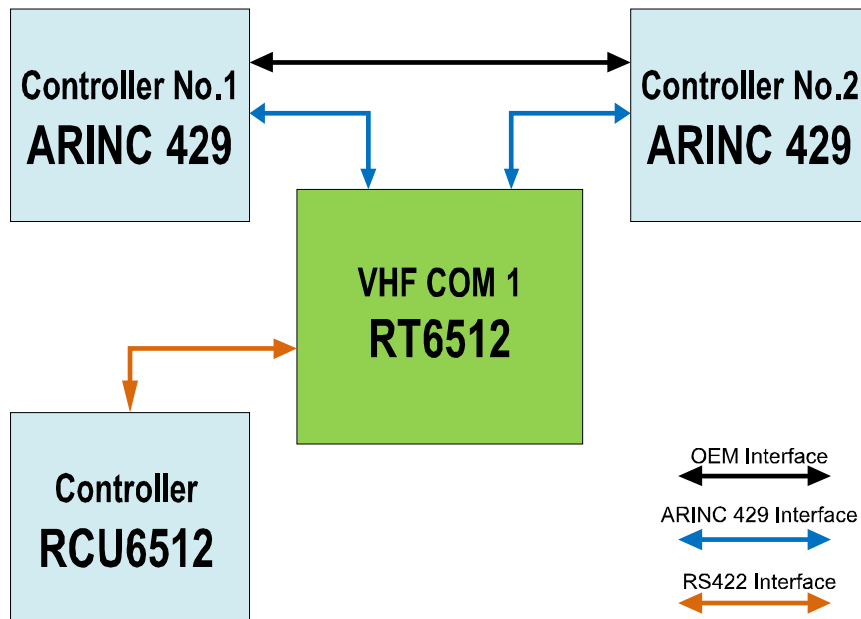


Figure 9: RT6512 with one RCU6512 and two ARINC 429 Controller

1.8.6. Two RT6512 with two RCU6512 and two ARINC 429 Controller

Two RT6512 VHF-AM transceivers operated by two RCU6512 controllers using the RS422 interface and two OEM controllers using the ARINC 429 interface.

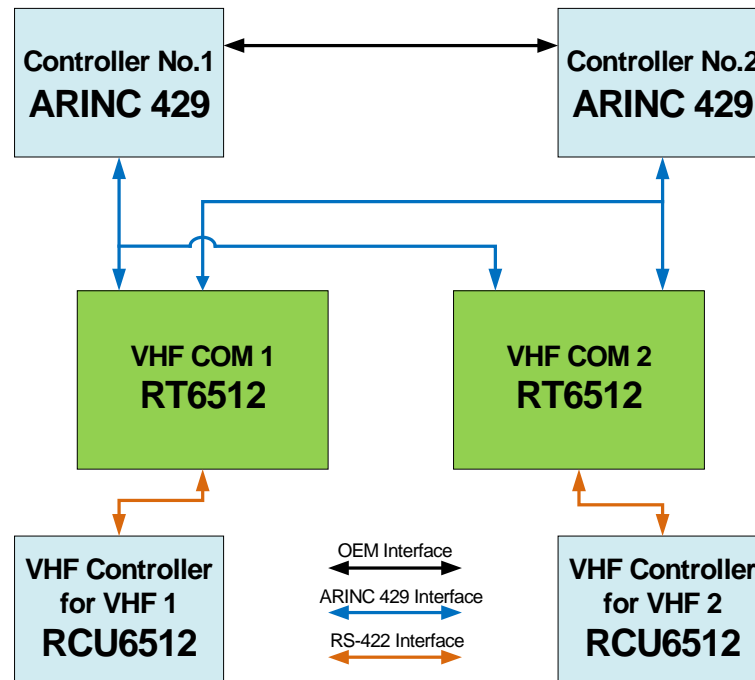


Figure 10: Two RT6512 with two RCU6512 and two ARINC 429 Controller

1.9. Order Code

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

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: chapter 1.5.7, Environmental Qualification Table).

Qty	Connector Kit	
1	CK6512-C; <ul style="list-style-type: none"> Connector D-Sub, 37pin, female (crimp version), Connector housing, Label "COMM", SK504; Antenna Connector BNC for coax cable RG58 	Article-No. 0642.568-954
1	CK6512-S; <ul style="list-style-type: none"> Connector D-Sub, 37pin, female (soldering version), Connector housing, Label "COMM", SK504; Antenna Connector BNC for coax cable RG58 	Article-No. 0642.551-954

Qty	Manuals	
1	DV17501.03 Installation & Operation (English)	Article-No. 0645.702-071
1	DV17501.04 Maintenance & Repair (English)	Article-No. 0645.710-071

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 shall be accomplished in accordance with the requirements set forth in FAA AC 43 (Federal Aviation Administration, Advisory Circular).

In this chapter you can read about:

2.1. Packaging, Transport, Storage	25
2.2. Device Assignment	26
2.3. Mechanical Installation.....	27
2.4. Electrical Installation	30
2.5. Aircraft Wiring.....	31

2.1. Packaging, Transport, Storage

Visually inspect the package contents for signs of transport damage.

Packaging material and transport



The packaging material or parts of it are inflammable. If disposed improperly, by burning, dangerous 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 identification label correspond to your order.
- Check if the consignment is complete.

Disposal

This product contains materials that falls under the special disposal regulation from 1996, which corresponds to the EC directory 91/689/EEC for dangerous disposal material. We recommend disposing the respective materials in accordance with the respectively valid environmental regulation. 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

Please dispose of the printed circuit boards according to one of the following methods:

- Burning at high temperatures (at least 1200 °C) in an incineration plant licensed in accordance with part A or B of the environmental protection act.
- Dispose via a technical waste dump foreseen to take on electrolytic aluminum condensers. Do under no circumstances dump the circuit boards at a place near a normal waste dump.

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)

2.2.1. Scope of Delivery

- Manuals
 - Installation & Operation manual (English)
- VHF-AM transceiver
 - RT6512 (corresponding to your ordered version)
- EASA Form One (when certified)

2.2.2. Additional Required Equipment (optional)

- Connector kit
- Mounting tray MT6512 (for RT6512 to meet the conditions for DO-160G section 7 and 8)
- RCU6512 controller, RMU5000 controller or OEM controller

Details see Accessories.

2.2.3. Type Specification Label

The device type defines by the type specification label (on the housing).

Example:



Figure 11: Type specification label (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
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)

2.3. Mechanical Installation

2.3.1. Mounting Requirements

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 VHF-AM transceiver is designed for vertical 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.

Install RT6512 using mounting tray MT6512 to meet the conditions for DO-160, section 7 and section 8. For details see chapter 1.5.7 Environmental Qualification Table, page 18.

2.3.2.2. RT6512 with Mounting Tray MT6512

Dimensions mm (inch)

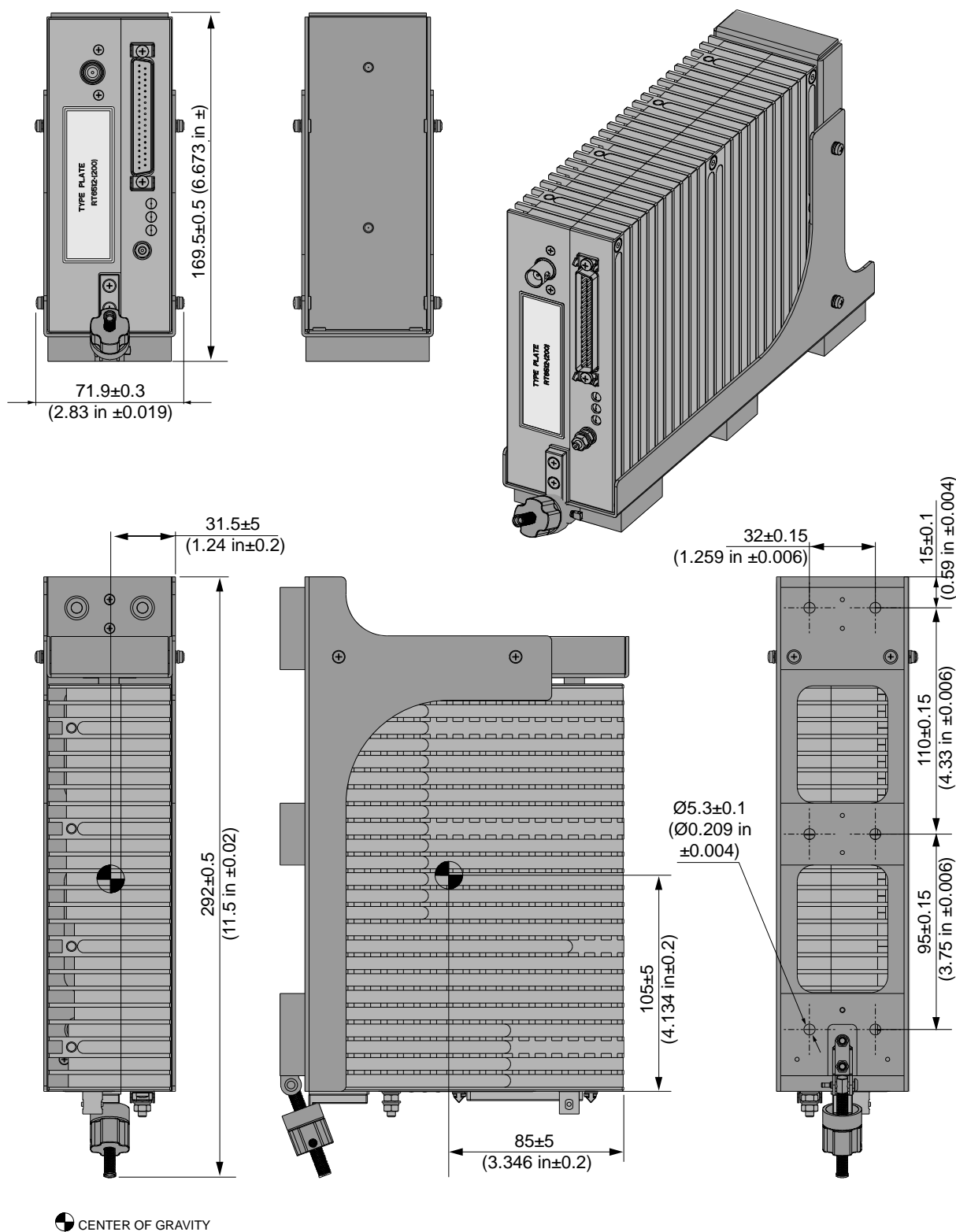


Figure 13: RT6512 with mounting tray MT6512

2.4. Electrical Installation

2.4.1. Pin Assignment RT6512 (Main Connector)

Pin No.	Pin Name	Function
1	AF_GND	Audio Ground
2	RESERVE	Spare pin, reserved for future use
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	1 st ARINC 429 Interface TX Line A1
11	ARI429_RX_A1	1 st ARINC 429 Interface RX Line A1
12	ARI429_RX_B1	1 st ARINC 429 Interface RX Line B1
13	ARI429_TX_A2	2 nd 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	Identify unit 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 2 nd 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	1 st ARINC 429 Interface TX Line B1
30	ARI429_RX_A2	2 nd ARINC 429 Interface RX Line A2
31	ARI429_RX_B2	2 nd ARINC 429 Interface RX Line B2
32	ARI429_TX_B2	2 nd ARINC 429 Interface TX Line B2

Pin No.	Pin Name	Function
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)

2.5. Aircraft Wiring

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 RCU6512

For detailed information refer to the manual RCU6512 Installation and Operation DV17551.03 (Article-No. 0645.230-071).

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.

2.5.1. RT6512 with RCU6512 Controller

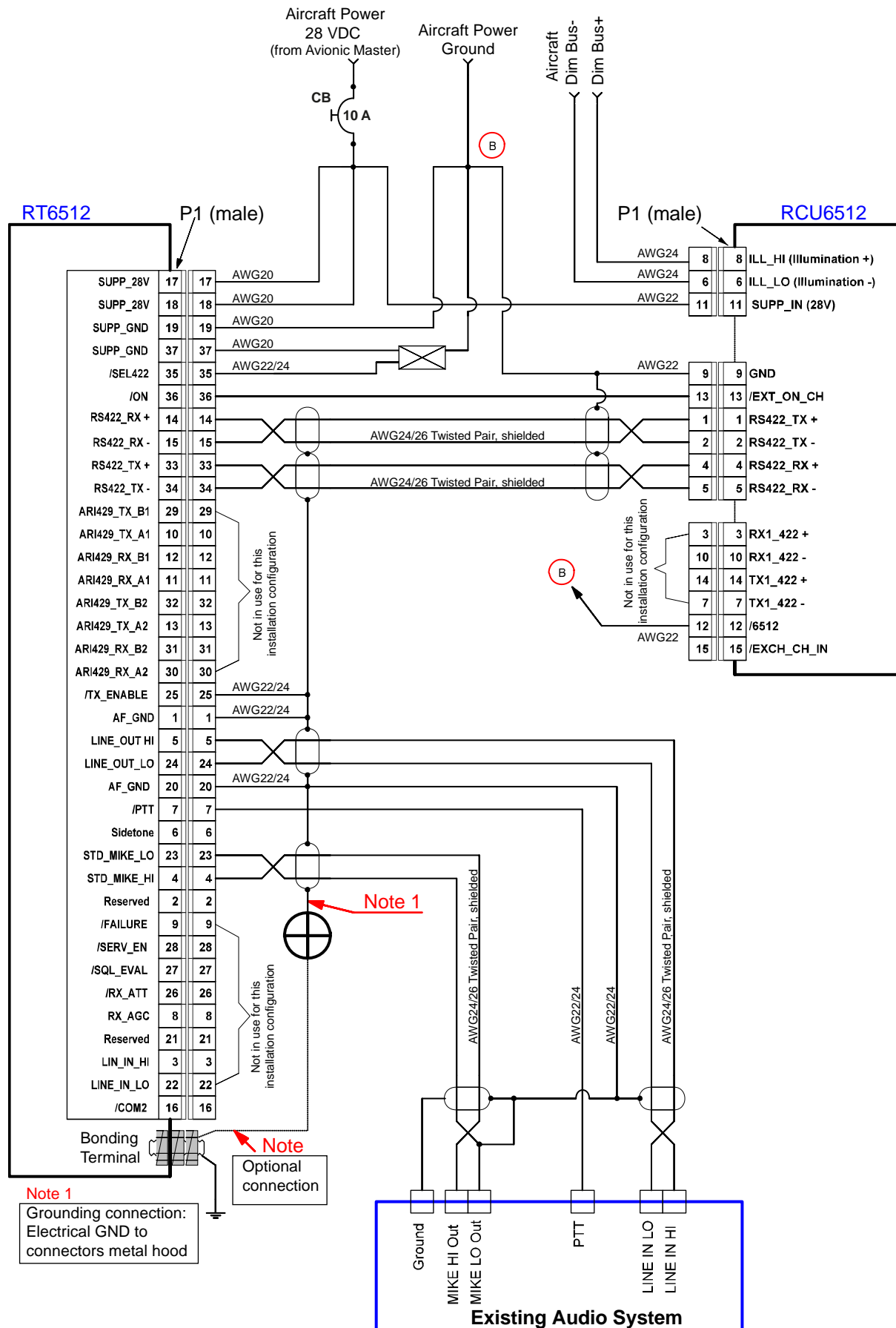


Figure 14: RT6512 with RCU6512 Controller

2.5.2. RT6512 with ARINC 429 Controller

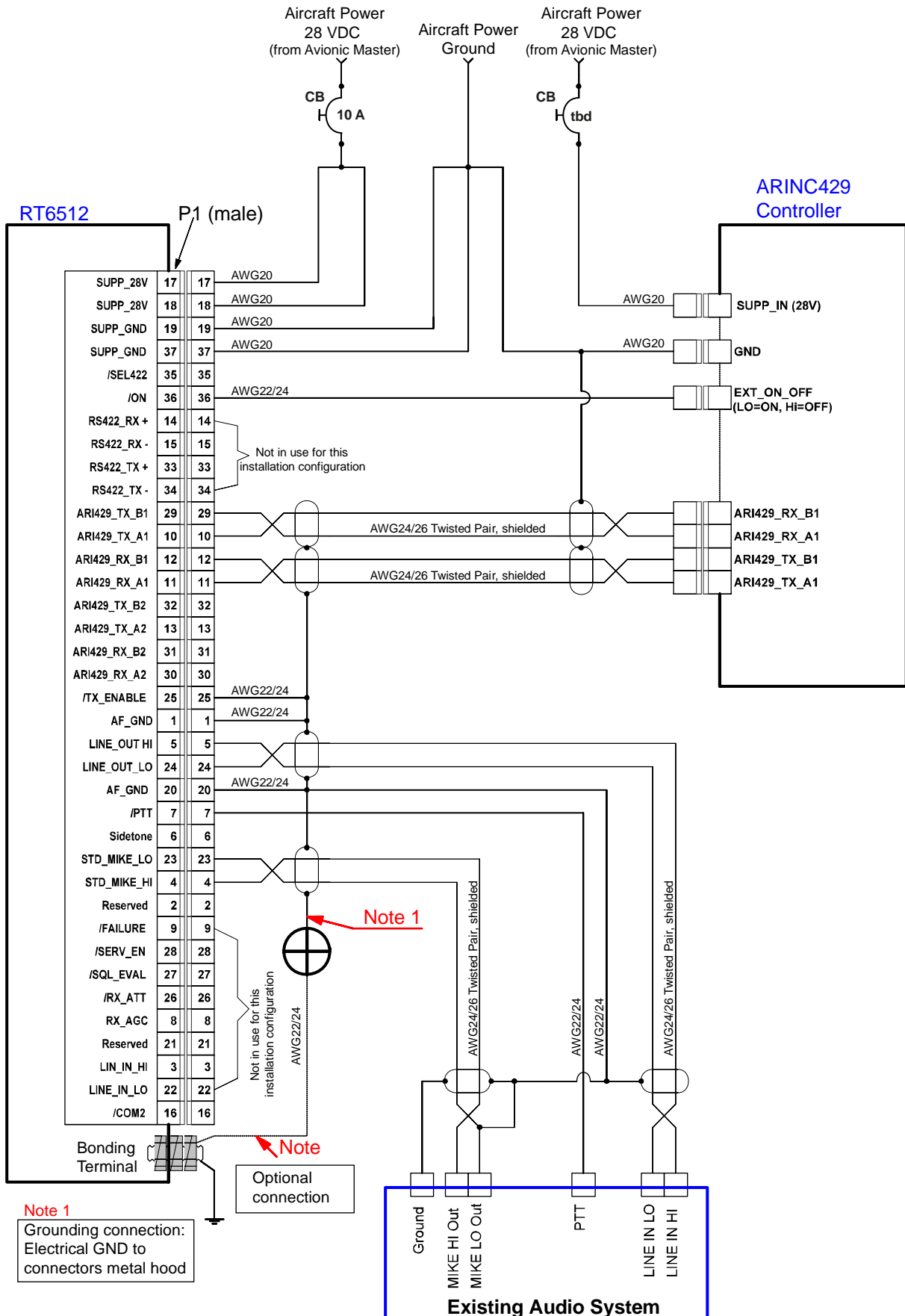


Figure 15: RT6512 with ARINC 429 Controller

2.5.3. RT6512 with RCU6512 and ARINC 429 Controllers

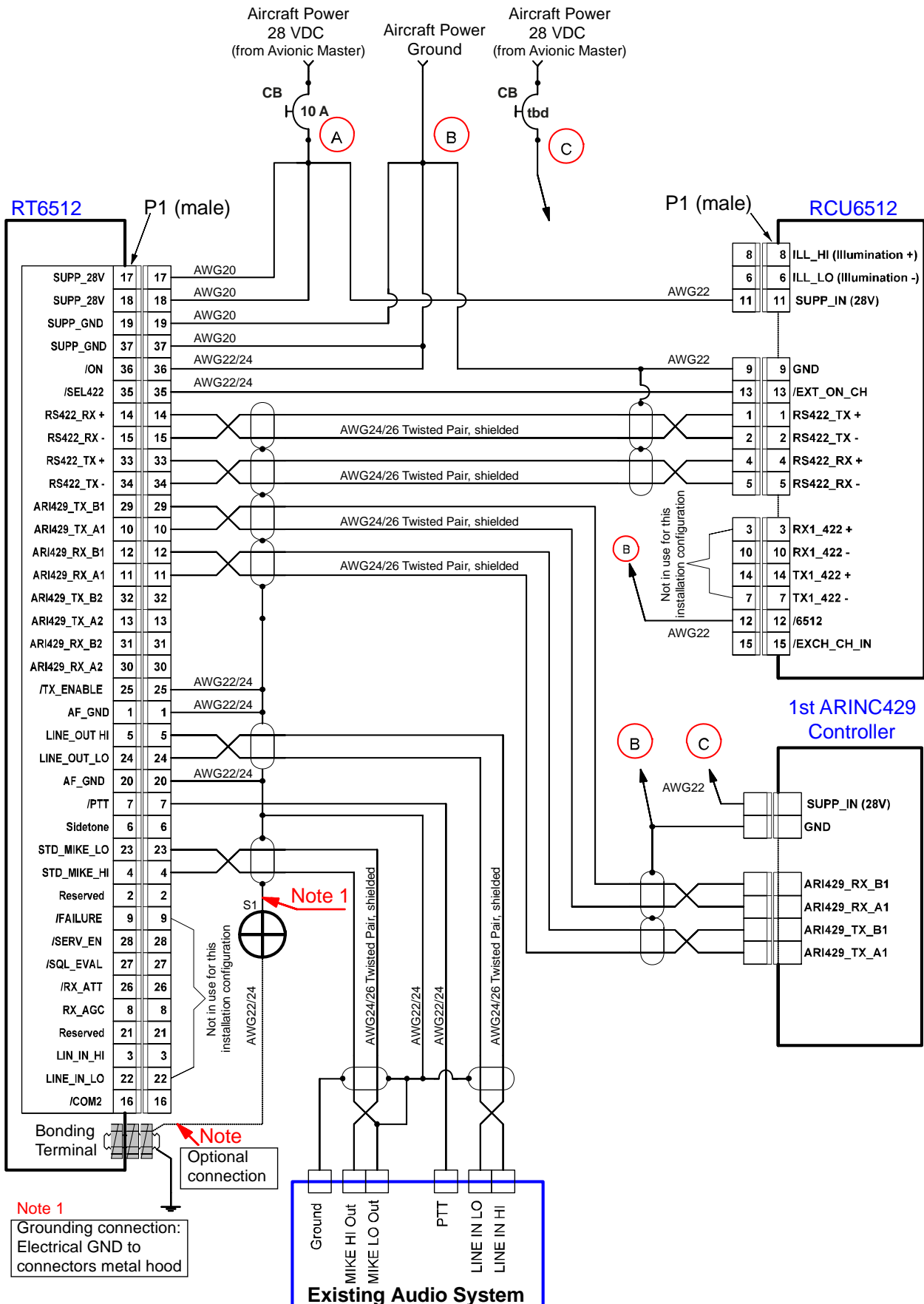


Figure 16: RT6512 with RCU6512 and ARINC 429 Controllers

2.5.4. RT6512 with RCU6512 and two ARINC 429 Controllers

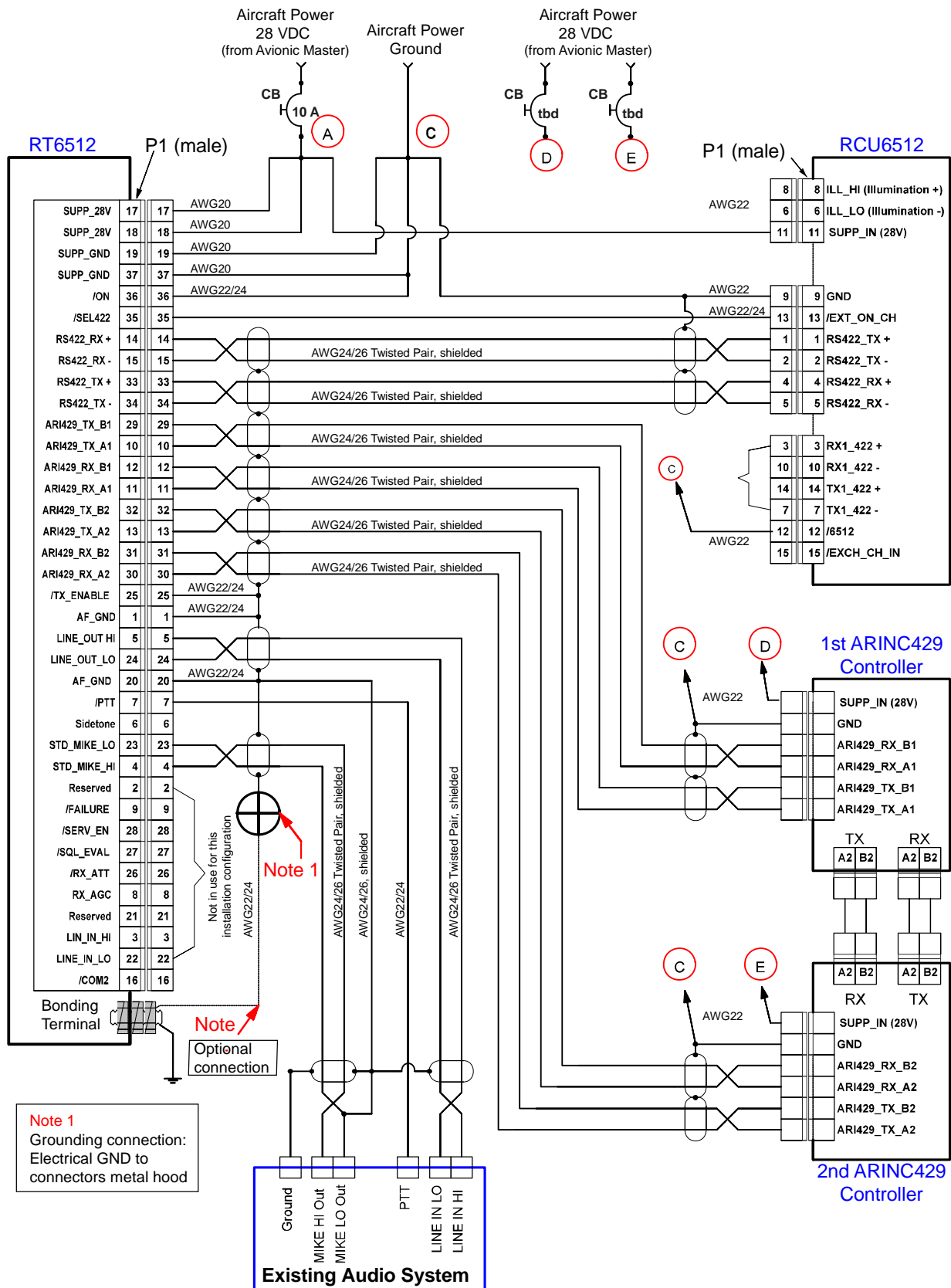


Figure 17: RT6512 with RCU6512 and two ARINC 429 Controllers

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3. Operating Instructions

In this chapter you can read about:

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3.1. Device Description

The RT6512 is designed to be operated by means of an remote control device which could either be the Becker RCU6512, 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 26

3.2. Start-Up

NOTICE

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.

3.2.1. 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 VHF-AM transceiver's reliability. There are three types of BIT implemented: **PBIT** (performed after Power ON the unit), **IBIT** (initiated by special command via serial protocol) and **CBIT** (which continuously check VHF-AM 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".

- **RCU Lost Connection Error**

If the VHF-AM transceiver does not receive any valid frame via the RS422 serial interface within each 5 seconds, then the "*RCU Lost Connection Error*" appears and classifies as "external failure".

If RT6512 is controlled by ARINC 429 interface, detecting "*RCU Lost Connection Error*" is blocked.

- **Channel Error**

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

- **RX Synthesizer Error**

The VHF-AM transceiver 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, the VHF-AM transceiver 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 the "*TX Output Power Error*", the VHF-AM transceiver stays in RX mode.

- **TX Synthesizer Error**

The VHF-AM transceiver monitors the TX synthesizer while generating the TX signal. If error behavior is detected and the /PTT input is active (low), the VHF-AM transceiver 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**

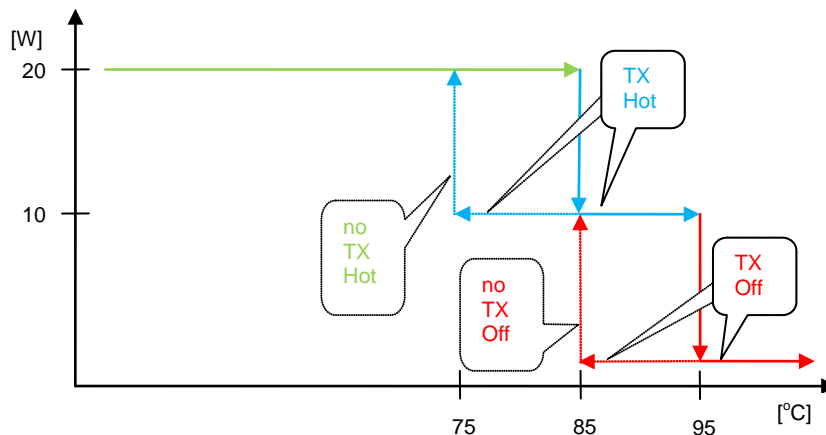


Figure 18 Thermal behavior for TX function

The VHF-AM transceiver 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, the VHF-AM transceiver indicates a "*TX OFF-Overtemp Error*". As long as the error is detected, the VHF-AM transceiver 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**

The VHF-AM transceiver 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, the VHF-AM transceiver 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 the VHF-AM transceiver is in the TX mode, TX output power is reduced to a safe level.

- **Antenna VSWR Error**

In TX mode, the VHF-AM transceiver 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, the VHF-AM transceiver 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 timer starts. The time limit setting is adjustable in the factory setup from 30 seconds to 180 seconds. Factory setup provides "Stuck PTT Error" detection and also the enabling / disabling of this function.

When detecting a "Stuck PTT Error", the VHF-AM transceiver switches to the RX-mode. As long as this error is indicated the VHF-AM transceiver stays in a Stuck-PTT-condition.

3.2.1.1. **Initiated Built In Test (IBIT)**

The test routine BIT activates by special command via serial interface. The green LED on the VHF-AM transceivers front side flashes for approx. 2 seconds during IBIT is running.

Note: Interrupting an already started self-test is not possible.

The test routine IBIT checks the following functions:

- PSB Error
- RCU 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

3.2.1.2. **Power On Built In Test (PBIT)**

The PBIT triggers automatically and runs immediately after the VHF-AM transceiver switches on. The PBIT checks the same function as described in the IBIT. The Error indication is the same as IBIT.

The VHF-AM transceiver immediately produces a NOGO-Audio Signal on the LINE_OUT after detecting a failure.

3.2.1.3. **Continuous Built In Test (CBIT)**

During the VHF-AM transceiver is operating the CBIT test runs permanently "in the background" and controls:

- PSB Error
- RCU 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

3.2.1.4. Audible Error Announcement

The VHF-AM transceiver 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)

3.2.1.5. Status & Error Indication

The RT6512 error status indicates by means of three LEDs, located on front side, underneath the unit connector (D-Sub 37pin).

3.2.1.6. 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	-

3.2.1.7. 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	-

3.2.1.8. Internal Failure Indication

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

3.2.1.9. **External Failure Indication**

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

3.2.1.10. **Failure Indication when an "Internal" or "External" Failure is detected**

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, the VHF-AM transceiver automatically turns to receive mode.

3.2.1.11. **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.

3.3. **Operating with RCU6512**

For detailed information refer to the manual RCU6512 Installation and Operation DV17551.03 (Article-No. 0645.230-071). RCU6512 (certification is pending).

3.4. **Operating with RMU5000**

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

3.5. **Operating with OEM Controller**

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

3.5.1. ARINC 429 Protocol supported by RT6512

The **ARINC 429 Word Format** (according to [ARINC 429]-Appendix-6).

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

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

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.

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 fulfil 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
155.980	155.9750 MHz	8.33 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.

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We reserve the right to make technical changes.
The data correspond to the current status at the time of printing.

***** End of the Document *****