

RF Exposure Warning

Exposure to radio frequency (RF) energy has been identified as a potential environmental factor that must be considered before a radio transmitter can be authorized or licensed. The FCC and IC have therefore developed maximum permissible exposure (MPE) limits for field strength and power density, listed in FCC 47 CFR § 1.1310 and IC RSS-102 Issue 2 Sect 4. The FCC has furthermore determined that determination of compliance with these exposure limits, and preparation of an Environmental Assessment (EA) if the limits are exceeded, is necessary only for facilities, operations and transmitters that fall into certain risk categories, listed in FCC 47 CFR § 1.1307 (b), Table 1. All other facilities, operations and transmitters are categorically excluded from making such studies or preparing an EA, except as indicated in FCC 47 CFR §§ 1.1307 (c) and (d).

Revised FCC OET Bulletin 65 (Edition 97-01) and IC RSS-102 Issue 2 provide assistance in determining whether a proposed or existing transmitting facility, operation or device complies with RF exposure limits. In accordance with OET Bulletin 65, FCC 47 CFR § 1.1307 (b) and RSS-102 Issue Sect 2.5, the Codan Radio Communications transmitter manufactured in Canada is categorically excluded from routine evaluation or preparing an EA for RF emissions and this exclusion is sufficient basis for assuming compliance with FCC/IC MPE limits. This exclusion is subject to the limits specified in FCC 47 CFR §§ 1.1307 (b), 1.1310 and IC RSS-102 Issue 2 Sect 4. Codan Radio Communications has no reason to believe that the excluded transmitter encompasses exceptional characteristics that could cause non-compliance.

Notes:

- The FCC and IC's exposure guidelines constitute exposure limits, not emission limits. They are relevant to locations that • are accessible to workers or members of the public. Such access can be restricted or controlled by appropriate means (i.e., fences, warning signs and others).
- The FCC and IC's limits apply cumulatively to all sources of RF emissions affecting a given site. Sites exceeding these • limits are subject to an EA and must provide test reports indicating compliance.

RF Safety Guidelines and Information

Base and Repeater radio transmitters are designed to generate and radiate RF energy by means of an external antenna, typically mounted at a significant height above ground to provide adequate signal coverage. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that permitted for successful communication. The following antenna installation guidelines are extracted from Appendix A from OET Bulletin 65 and must be adhered to in order to ensure RF exposure compliance:

Non-building-mounted Antennas:

- Height above ground level to lowest point of antenna ≥ 10 m
- Power ≤ 1000 W ERP (1640 W EIRP)

Building-mounted Antennas:

Power ≤ 1000 W ERP (1640 W EIRP)

The following RF Safety Guidelines should be observed when working in or around transmitter sites:

- The minimum safe distance the user should be from the transmitter antenna while transmitting is 142 cm for transmitters 8W or less and 300 cm for amplifiers 30W or less. This assumes a maximum antenna EIRP of 15 dBi.
- Do not work on or around any transmitting antenna while RF power is applied.
- Before working on an antenna, disable the appropriate transmitter and ensure a "DO NOT USE" or similar sign is placed on or near the PTT or key-up control.
- Assume all antennas are active unless specifically indicated otherwise.
- Never operate a transmitter with the cover removed.
- Ensure all personnel entering a transmitter site have electromagnetic energy awareness training.

For more information on RF energy exposure and compliance, please refer to the following:

- FCC Code of Regulations; 47 CFR §§ 1.1307 and 1.1310
- FCC OET Bulletin 65, Edition 97-01, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields"
- <http://www.fcc.gov/oet/rfsafety/>
- IC RSS-102 Issue 2, "Radio Frequency Exposure Compliance of Radio Communication Apparatus"

Power Amplifier AMP-4-470-30-00

1. General description.

The power amplifier (PA) is a one stage unit, working in AB-class operation mode. In addition to the power amplifier section, the PA contains the power control, status monitoring and protecting circuitry, as well as voltage regulation for supplying the RF and main control circuits.

The output power may be controlled either by the external analog signal (remote control), or by potentiometer, accessible from the front panel (local control).

The voltage regulator turns on, when all four of the following conditions are present:

- remote control voltage (in the case of remote control) is greater than 1 V;
- input power is not less than 0.5 W;
- the case temperature does not exceed + 85°C;
- power supply voltage does not exceed 17 V.

If any of three first mentioned conditions is not met, unit remains in stand-by mode.

The PA is provided with a forced air cooling system and is protected against load mismatch, overheating and overvoltage. The load mismatch protection smoothly reduces output power as the load VSWR increases above 2:1.

Three LED on the front panel indicate the unit status. The green LED “TX” shows that the output power is between the nominal (>30 W) and minimum set power (\approx 20 W). The red LED “G/F” (general fault) turns on during overheating or overvoltage. The red LED “VSWR” is active when the load VSWR is above 2:1.

The PA has three outputs (open collector) for remote status monitoring. In an alarm state, the level is pulled low.

The block diagram of PA is represented in Fig. 1.

2. General parameters.

- Frequency range, MHz 450 - 512;
- Output power, W;
 - o nominal \geq 30;
 - o minimum set by local or remote control \leq 20;
 - o in stand-by mode operation $<$ 0.2;
- Harmonic level at the output, dBc $<$ -70;
- Reverse intermodulation attenuation, dB \geq 40;
- Input power, W:
 - o nominal 6.0;
 - o maximum 8.0;
 - o guaranteeing the stand-by mode operation $<$ 0.5;
- Input VSWR \leq 1.8;

- Carrier attack time, ms < 5.0;
- Remote control voltage, V:
 - o working range 0 – 9.5;
 - o guaranteeing the nominal output power > 7.0;
 - o guaranteeing the stand-by mode operation < 1.0;
- Enhancer:
 - o nominal passband gain. 6.7 dB;
 - o nominal bandwidth. 450-512 MHz;
 - o rated mean output power 30 W;
 - o input and output impedances50 ohms;

The Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device.

3. Construction.

Unit is realized as a module – see Fig. 2.

There are at the front panel:

- RF connectors;
- Fan, which pushes the air across an internal heatsink;
- Status LED;
- Access hole to the power set potentiometer;
- Handle for moving the unit into/from a subrack;
- Four quick release fasteners for fastening the unit in a subrack.

Front panel dimensions are 5.585”(W) x 5.055”(H). The full length of PA does not exceed 8.2”.

The PA contains two PCB assemblies: the Main Board Assembly and the DC Connector Board Assembly.

The Main Board is placed inside a shielded compartment and is to the main chassis plate/heat spreader. The heatsink is attached to the outer side of Main Plate, as well as the fan controlling thermal switch.

The Main Board contains RF circuitries and the majority of DC circuits. The DC Connector Board includes the LED, power controlling potentiometer, a fan voltage regulator and three DC connectors. The control, monitoring and supply lines between the Main Board Assembly and the DC Connector Board Assembly are routed through feedthrough filters, screwed into the Main Plate and are connected through an 8-wire cable and two pairs of connectors (6-pin and 3-pin on the cable end, and 6-pin and 4-pin in the DC Connector Board). This allows the same cable to handle the two modes of operation (remote or local, depending on which pins are connected).

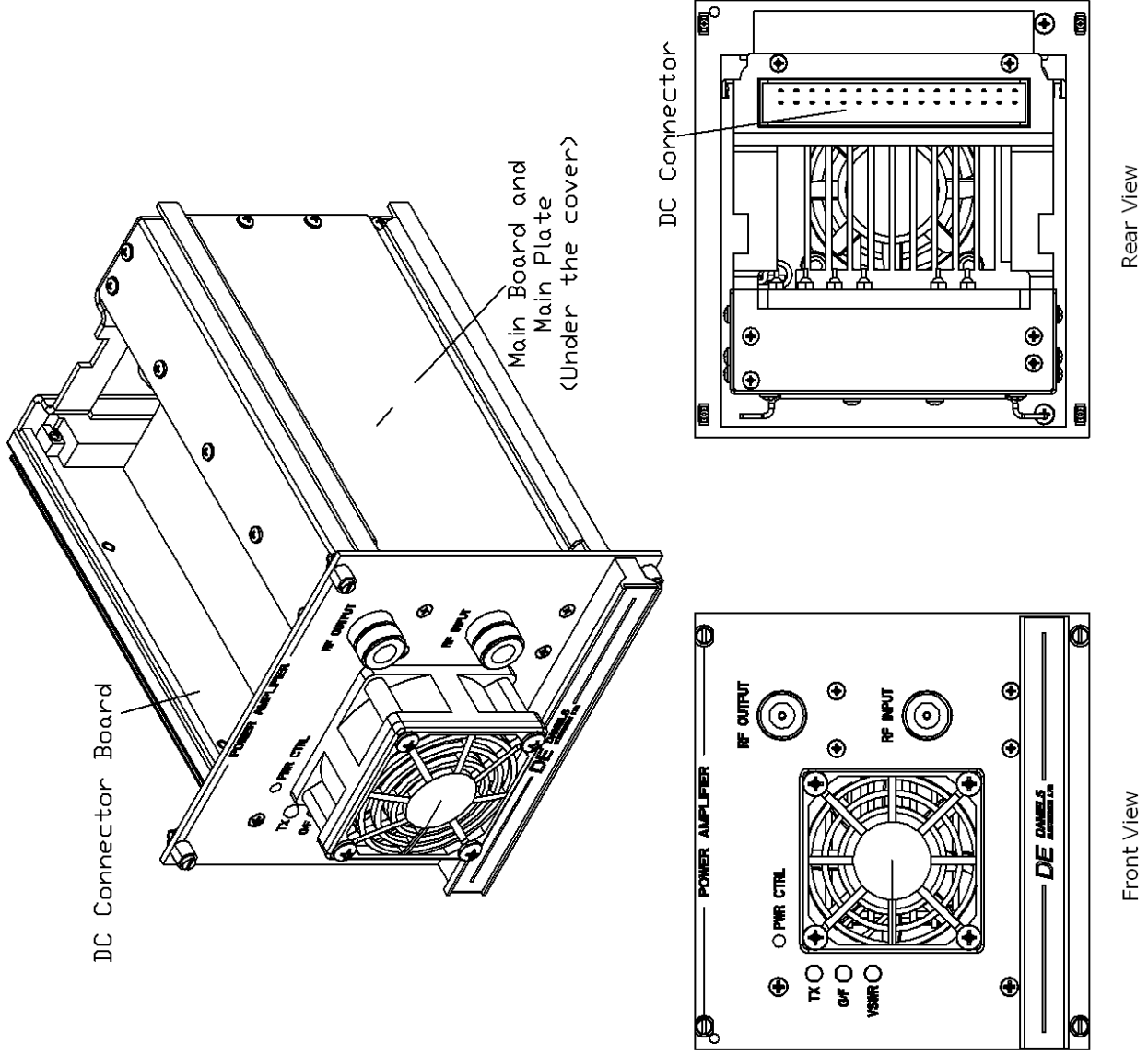


Fig. 2. Construction.

4. Main Board Description.

The RF signal from the input connector comes through the attenuator RA1-...-RA3, PIN attenuator (D2, D3) and attenuator RA7 -...-RA9 to the input of the amplifying stage (Q100). Amplified power passes the harmonic filter (the 50 Ohm stripline and capacitors CF) and directional coupler and goes to the output connector.

When the voltage, coming from the output of the input detector (D1) reaches approximately 1.2V at the base of Q1, Q3 opens and activates the power supply voltage comparator (Q4, Q5). If the power supply voltage is less than $(17.8 \pm 0.2)V$, 5V appears at Zener diode D8, which serves as the source of gate bias voltage for RF transistor Q100, as well as the reference voltage for the main voltage regulator (Q9). This regulator limits the output voltage to the level of about 13.6V or, if the power supply voltage is less than 13.6V, provides a voltage drop of less than 0.15V. Transistor Q6 provides about 0.4V hysteresis in the power supply voltage comparator and keys the “G/F” alarm signal of overvoltage.

In the case of overheating, the thermal switch SW1 via D9 blocks the input power detector and keys the “G/F” alarm signal.

The PA has a power control loop, which is controlled by switched signals, coming from the output forwarded power detector (DD1), output reverse power detector (DR1) and the sensor of RF transistor DC current (R13, U1). Operational amplifiers U2-A, U2-C and diodes D20, D21 form the circuitry that switches the sensed signals and sends the biggest of them to the loop comparator (U3-B), which controls the current of PIN attenuator (D2, D3) – the loop adjusting element. Increase of this current is followed by an attenuation increase.

The circuit U2-B, Q14 controls the output power level and activates a “LOW PWR” alarm signal (i.e., turns off LED “TX”), if the output power is below the rated minimum. The circuit U2-D blocks the “LOW POWER” signal if the load VSWR exceeds 2:1. The circuit U4, Q12 activates the “VSWR” alarm signal, when the voltage from the reverse power sensor exceeds the voltage from the forward one. None of these circuits are active in the stand-by mode.

Operational amplifiers U3-A, U3-C, U3-D convert the outer control voltage to the reference voltage for comparator U3-B, providing the needed level of power regulation and thermal adjustment. Transistors Q10, Q11 form the circuit that blocks the input power detector, when the control voltage is less than 1V.

There are four potentiometers in the Main Board: RP1 sets the DC current limit; RP2 sets the output power; RP3 sets the “TX” indication threshold; RP4 sets the quiescent current of Q100.

5. DC Connector Board Description.

Diodes D1, D2, D3 combine the circuits of local (LED DL1, DL2, DL3) and remote (via J3) PA status monitoring. The current source (Q1, D4) provide the constant current for alarm LED DL2. Q4 shunts LED DL1 when the output power is below the minimum level.

The fan voltage regulator (Q2, Q3, D5) does not allow the fan voltage to be over 13.5V or keeps it at about 1.1V less than the power supply voltage.

With the aid of potentiometer RP1, a customer may set the desirable output power. Diodes D6, D7, D8 neutralize the circuit, blocking the input detector, when the control voltage is less than 1V.

There are two jumpers (JP1, JP2) in the board – see Fig. 3. When JP1 is cut, “G/F” alarm LED at the front panel is disconnected. When JP2 is cut, both “TX” and “VSWR” LED are disconnected.

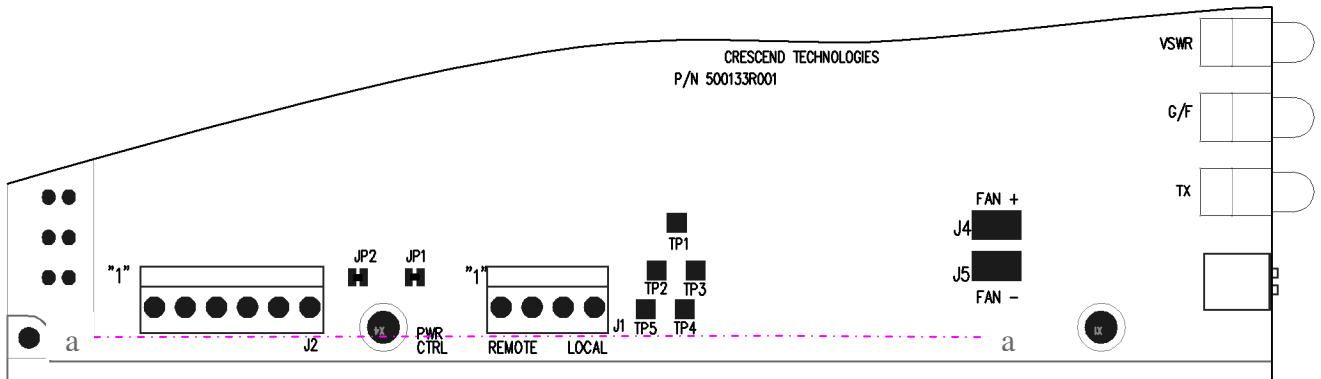


Fig. 3

6. Installation Instructions.

The PA is intended to be placed and operated in the Daniels subrack. Before the unit installation, ensure that:

- The warranty label exists and is not damaged;
- There is no mechanical damages;
- No debris is inside the RF and DC connectors;
- Jumper JP1 and/or JP2 on the DC Control Board Assembly is cut, if LED indication at the front panel is not desirable;
- The 3-pin connector is in position, correct for the chosen power control method – see Fig.4;

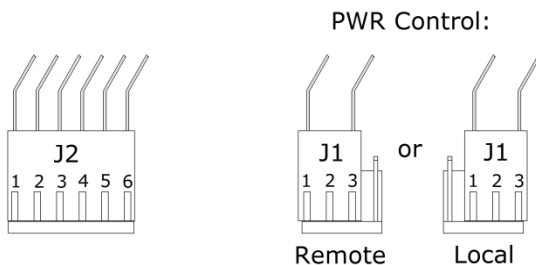


Fig. 4



Fig.5

- DC cables, going to DC Connector Board Assembly are behind the line a---a in Fig. 3;
- All four quick realize fasteners are in position: their screws shall be deep into the plastic cylinders and slots in heads of screws shall be directed horizontally, as it is showed in Fig. 5.

Provide the correct mutual positioning of leading rails of PA and subrack, then slide PA all way through inside the subrack. Press and turn screws of all quick release fasteners by 90° clockwise or counter clockwise, until PA is fixed in the subrack.

Connect RF cables to RF connectors on the front panel of PA.

7. Output power control.

In the local control mode, the 3-turns potentiometer “PWR CTRL” is used to set the output power. The range of regulation lays between more than 30 W (when the potentiometer is rotated completely clockwise) and less than 20 W in the opposite direction (both numbers are valid for the nominal power supply voltage, greater than 13 V, and RF drive, greater than 6 W). The potentiometer will start clicking when the end of the range is met.

In the remote control mode, the output power depends on the voltage at pin Z22 of the DC connector (Vctrl). This voltage may change from 0 to 9.5 V. When $V_{ctrl} < 1$ V, the PA works as an attenuator, and not more than 0.2 W is available at its output. The minimum rated power (20 W) is reachable with $V_{ctrl} \approx 4$ V; the maximum rated power (more than 30 W) is reachable, when $V_{ctrl} = 6...7$ V.

The output power is also controlled by the load mismatching, overvoltage and overheating protection circuits. In the case of the load mismatching the power is reduced proportionally to the VSWR value, starting from $VSWR > 2$. In the case of overheating (when the temperature of the heatsink exceeds $+85^{\circ}\text{C}$), the unit switches to stand-by mode. When the power supply voltage exceeds 17 V, the output power falls to less than 0.2 W.

8. Unit Status Monitoring.

There are two features of unit status monitoring: LED at the Front Panel and signals at pins of the DC connector.

LED “TX” is on, when the output power is not less than 20W.

LED “G/F” (General Fault) is on when the power supply voltage exceeds 17 V (in active mode only), or if the temperature of heatsink exceeds $+85^{\circ}\text{C}$ (in both active and stand-by modes).

LED “VSWR” is on, if the load VSWR is greater than 2:1.

A LOW level of voltage (less than 2 V) at the monitoring pins of DC connector gives details about the alarm:

- at pin B24: The power supply voltage exceeds 17 V (appears in active mode only), or heatsink temperature is greater than $+85^{\circ}\text{C}$;
- at pin B26: The output power is less than 20 W(appears in active mode only);
- at pin Z26: The load VSWR is greater than 2:1.