Description and User Manual

DSDTV100 VHF
MOBILE AMPLIFIER

August 29, 2019 Rev B

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DSDTV100-x VHF Mobile Power Amplifier
Unit Description and User Manual

1. General description

The power amplifier (PA) is nonlinear AB to C class unit that is intended for frequency (phase) modulated (manipulated) signals amplification.

PA has the automatic power control loop, which keeps the output power at the rated level. It reduces this level, when the load VSWR is above 2, and (or) the power supply voltage fails below the rated value. The nominal output power is set in the factory. The input power is also set in the factory by installation of attenuators at the input of PA. The input power may vary within specified limits – see Table 1

PA has the by-pass chain. It is activated, when the power supply voltage Vsup is applied to both clamps "+ BATT" and "+ IGNITION". This status calls RX mode of operation. Unit switches to amplifying mode (TX), when the RF signal, applied to the input (port "XCVR"), exceeds about 1/3 of the minimum rated input power. The switching from RX to TX mode is provided by the couple of PIN-diode switches. The return to RX mode in the case of overheat (more than +85ºC of the heatsink temperature) is anticipated.

There are two status monitoring LED at the face side of unit. LED "DC" turns on and lights up continuously, when Vsup is applied to both clamps "+ BATT" and "+ IGNITION". LED "TX" indicates TX mode of operation. LED "DC" starts flashing in the case of overheat (independent of RF input level) or mismatched load (in TX mode only).

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The general parameters of unit are listed below. The terms *nominal* and *normal operation mode* mean the nominal power supply voltage and the heatsink temperature close to room temperature.

Frequency range of operation (f), MHz 136-174;
Input power (Pin), W . . . . . see Table 1;
Output power at the normal operation (Pout-n), W, not less than 100;
Relative harmonic level, dBc, less than . . . . . -70;
DC power supply voltage (Vsup), V:
- nominal 13.8;
- continuous, allowed . . . . . 10.5 – 17.0;
- pulse, not longer than 30 ms and porosity greater than 10 . . . . . 50;

Reversed polarity DC voltage acting, ms, not longer than 250;
DC current, A, not greater than:
- Vsup at the clamp "+ BATT" only 0.0002;
- in RX mode 0.4;
- in TX mode 20;

Load VSWR, not greater than 2.5;
Input VSWR, less than 1.8;
Switching time between RX and TX mode, ms, not greater than 0.2;
Insertion loss in RX mode, dB, less than 1.2;
Continuous transmit time, min, not greater than 2;
Duty cycle, %, not greater than 25;
Operating temperature range, ºC . . . . . -30 to +60;

RF connectors . . . . . 50 Ohm, TNC (F);
DC connectors . . . . . # 6-32 AWG screws for “+”; # 8-32 AWG for ground.

The block-diagram of PA is represented in Fig.1.
There are the following general blocks:

- RF chain devices:
  - Input power detector;
  - Input PIN diode switch;
  - Two attenuators: flanged Att1 and one more, Att2, formed by SMT resistors in the board, provide the rated input power range setting (see Table 1);

Table 1:

Code	Input Power, W	Attenuation, dB	
		Att1	Att2
DSDTV100-R1	0.1 - 0.2	0	0
DSDTV100-R2	0.2 - 0.5	0	3
DSDTV100-R5	0.5 - 1.0	0	7
DSDTV100-1	1.0 - 2.0	10	0
DSDTV100-2	2.0 - 5.0	10	3
DSDTV100-5	5.0 - 10	10	7
DSDTV100-10	10 – 20	20	0

  - PIN diode blocker that isolate the amplifying part of device from the input in TX mode;
  - High-pass filter with the corner frequency at about 110 MHz;
  - RF hybrid quadrature power splitter;
  - Two working parallel RF amplifying modules;
  - RF hybrid quadrature power combiner;
  - Harmonic filter;
  - Two directional couplers with detectors for forwarded and reversed output power sensing;
  - Output PIN diode switch.

- DC chain devices:
  - RX/TX switching control circuit, activated by the signal from the input detector;
  - Voltage regulator with keying circuit, connected to the output of car ignition key;
  - Reference voltage source for the power control loop;
  - Power control device, controlled by signals from forwarded and reversed power detectors. It forms the bias voltage for RF amplifying modules and the load mismatch alarm signal;
  - The normally open thermal switch, activated when the heatsink temperature reaches +85ºC;
  - Indication control circuit that sends the current to LED at the face panel of unit;
  - Two LED for unit status monitoring.

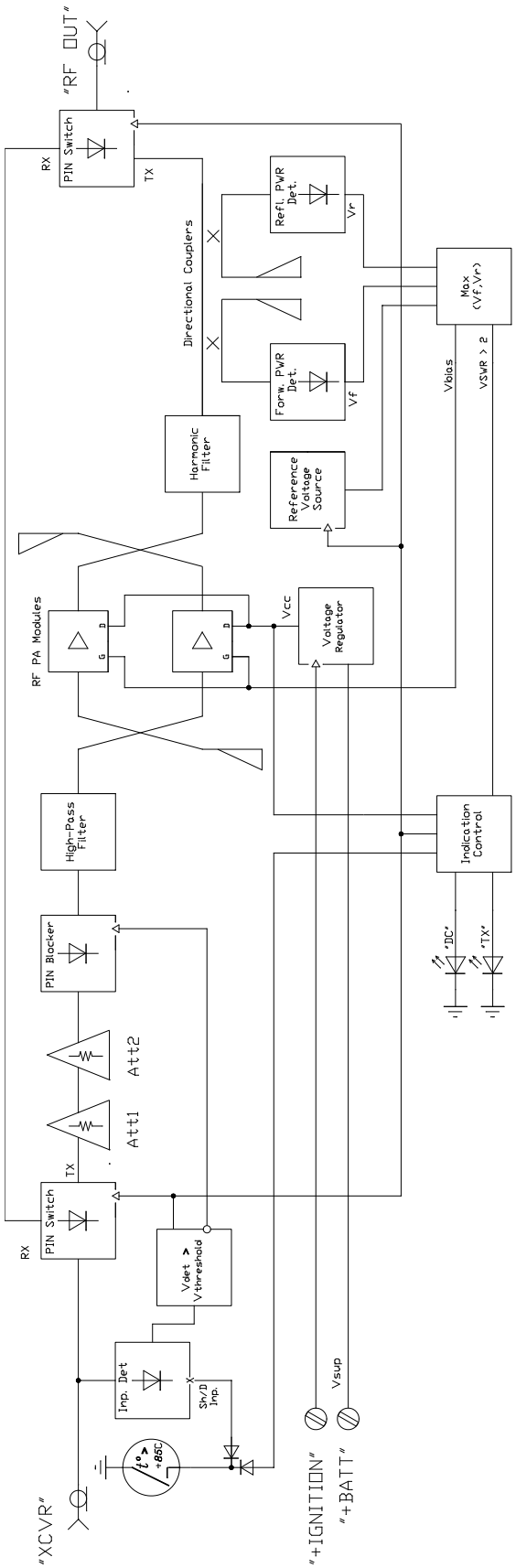

Fig. 1. Block Diagram.

2. Schematic Description

RF Circuit Description

RF signal, applied to the connector “XCVR”, proceeds to the pad J1 of p/c board. RF detector (D1), connected first to J1, forms the activation signal for switching control circuit. Until this signal is low, the unit remains in RX mode. Then PIN diodes D3 and D7 are closed but D2, D5 and D6 are open, and RF signal via the chain D2-D5-D6 goes to the pad J2 and, after it, to the connector “ANT”. PIN diode D10 is also open in RX mode, shunting the RF amplifying stage for preventing the unit self-exciting thought the by-pass line.

When the input power exceeds about 1/3 of minimum rated level, the unit switches in TX mode: PIN diodes D3 and D7 open but D2, D5, D6 and D10 close. Then RF input power passes the flanged attenuator ATT, the second attenuator, formed by resistors R10-R11-R12, high-pass filter CH1-CH3/LH1 -LH2 and comes to the input of the amplifying stage splitter Y1. Output powers of amplifying modules U11 and U12 are united in the combiner Y2. After that the RF power via the harmonic filter L11-L13/C11-C14, the directional couplers Y3, Y4 with detectors D21 (forwarded power) and D22 (reversed power) and PIN diode D7 goes to the pad J2 and connector “ANT”.

DC Circuit Description

The main DC current flows trough the clamp “+ BATT” and the pad J3. The voltage suppressing diode D8 protects the unit against DC voltage spikes and reversed polarity.

For the unit activation DC voltage Vsup has to be also applied to the clamp “+ IGNITION”. From this clamp the voltage comes to the pad J4, opening transistor Q1, with sends the current to 5 V Zenner diode D9 that serves as the reference voltage source for the voltage regulator Q2-Q3-Q20. Regulator keep the voltage at its output lower or equal to 13.6 V.

The voltage from the output of input detector comes to the comparator Q4 that opens, when the mentioned voltage is greater then 0.7 V. In the case of overheating, contacts of thermal switch SW1 come together, shunting the output of the input detector, forcedly keeping the unit in RX mode. Opened Q4 opens Q7 and Q9 and closes Q8. Q7 and Q8 control PIN diodes; Q9 turns on the reference voltage source for power control device and LED “TX” at the face panel.

The power control device consists of:

- combining and levering circuit for signals, coming from forwarded and reversed detectors (U1-A, U1-B, D13);
- differential stage (U1-D);
- final stage Q11 with the voltage limiter D14 and the loop status control circuit Q10-D16.

It controls the bias voltage of RF amplifying modules U11 and U12. The voltage at the inverting input of U1-D is the maximum of levered forwarded and reversed detectors output voltages. The referring voltage comes to U1-D from the potentiometer RP1. The maximum voltage at the output of power control device (emitter of Q11) is about 5 V – it presents, when the control loop is open. Then Q12 is open, and LED D16, placed in the p/c board, is on.

The indication circuitry consists of:

- comparator of levered forwarded and reversed power levels U1-C;
- multivibrator Q13-Q14 with keying transistor Q12;
- two LED at the face panel.

When load VSWR >2, the signal at the output of U1-C is low. This signal and (or) the closed contacts of thermal switch SW1, opens Q12 and launches the multivibrator; as result, LED “DC” starts flashing. LED “TX” is controlled by the key Q9.

3. Construction

The unit is assembled in the chassis with heatsink, intended for conventional cooling (see Fig.2).

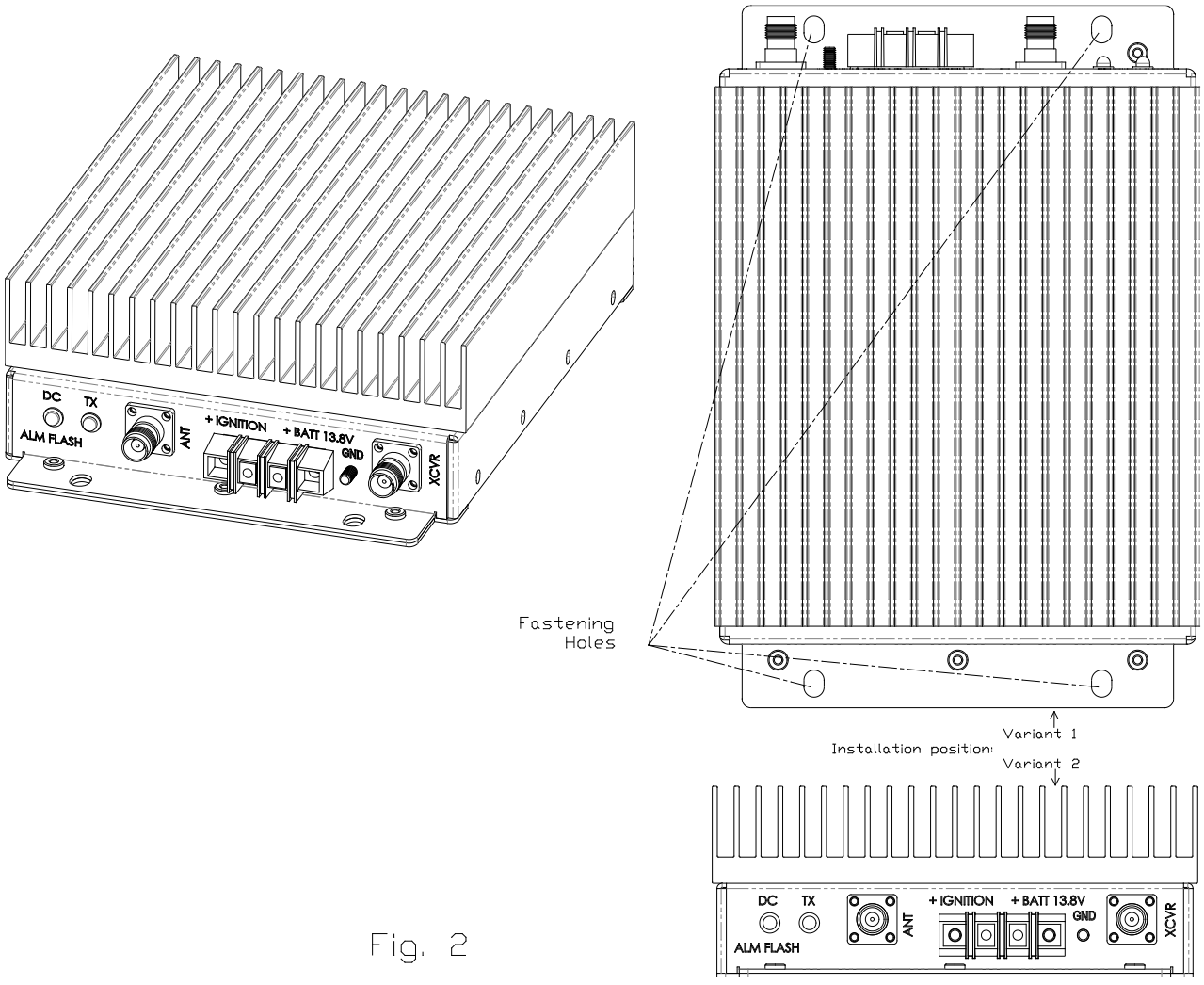

Fig. 2

Unit dimensions are 2.8” x 6.8” x 9.8”.

4. Installation Guide

Install the unit in one of two positions, showed at the right side of Fig. 2: vertical or horizontal. The proper air access to the unit shall be provided: no obstacle for air is allowed closer than 3” from heasink. Also, make sure that status LED can be monitored.
Screws from # 10 to # 1/4-20 are recommended. See the fastening holes positions in Fig. 3.

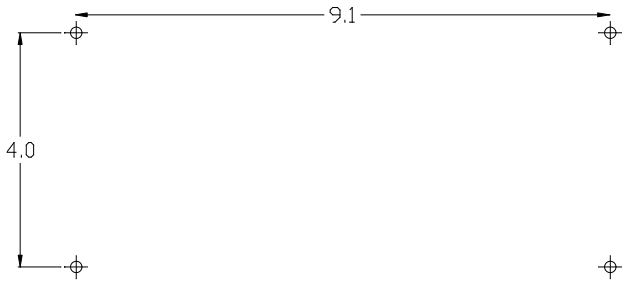

Fig. 3

Use copper wires # 10 AWG shall be used for connecting to clamps “+ BATT” and “GND”. Use copper wire from # 16 AWG to # 12 may by used for connecting to clamp “+ IGNITION”. Wires shall be crimped for making ring terminals.
Connect the clamp “GND” to the car nearest ground screw of suitable size.
Connect the clamp “+ BATT” to the pole “+” of car battery. Use 30 A fuse for protection.
Connect the clamp “+ IGNITION” to the output of car ignition key that is able to provide not less than 8 V and not less than 3 mA when it is keyed on. Use 0.5 A fuse for protection.

Use 50 Ohm coax cables with THC (M) connectors for connecting to “XCVR” and “ANT”.
Connect the port “XCVR” to RF output of radio.
Connect the port “ANT” to antenna.

5. Operation Guide

- LED “DC” goes on continuously, when the car ignition key is ON position;

- LED “TX” goes on continuously, when the RF input power is greater ~1/3 of minimum rated level (see Table 1);

- The continuous transmit time should not exceed 2 min, and the duty cycle should not be greater than 25% for avoiding the overheat;

- In the case of overheat (the heatsink temperature reaches +85ºC) the unit switches to RX mode, and LED “DC” starts flashing independent of the input power presence;

- If the load VSWR exceeds 2-3, the output power reduces, and LED “DC” starts flashing, when RF signal is applied to the unit input.