

PA-350V

135-165 MHz 350W RF Power Amplifier

Operating Manual



FEATURES

- Single-stage wideband VHF power amplifier delivers over 350 Watt RF output typically from 8 Watt of drive power.
- Receiver Low Noise Amplifier (LNA) with bandpass filter to prevent blocking by HF signals.
- Alphanumeric LCD display for various measurements, user configuration and error conditions.
- Automatic Level Control (ALC) for output power regulation and high SWR protection
- Individual DC current sensing and limiting of each sub-amplifier
- Output power (FM) selectable between three user programmable levels.
- Multiple protection features: high drive, high SWR, high/low DC voltage, high temperature
- Two elegant, temperature enabled fans
- Remote PTT link
- Selectable input power range

SPECIFICATIONS

Frequency range: 135 MHz – 165* MHz

Mode: Selectable FM or SSB

RF output power: FM mode: User programmable/selectable between 20W and 360W
SSB mode: Limited at 360W

RF input power: Maximum (user selectable): 15 Watt / 30 Watt

Typical input power to achieve given output power (145 MHz)		
Pout	Pin (range 15W)	Pin (range 30W)
100 W	1.1 W	2.3 W
200 W	2.4 W	5 W
300 W	5 W	10.5 W
350 W	7.5 W	16 W

RF input power,
PA not active (bypass): Maximum: 50 Watt

DC supply voltage: Minimum: 10.5 V
Nominal: 13.6 V**
Maximum: 14.5 V
(Outside above limits, PA operation will be denied)

DC supply current
during transmission: Maximum: 54 Amp
Typical: (145MHz/350W) 48 Amp

Bypass mode insertion
loss: typ. 0.35 dB @ 145 MHz

RX preamplifier gain: typ. 20 dB @ 145 MHz

RF connectors type: N-50

Weight: 3 kg

Overall dimensions: L=350mm, W=184mm, H=90mm

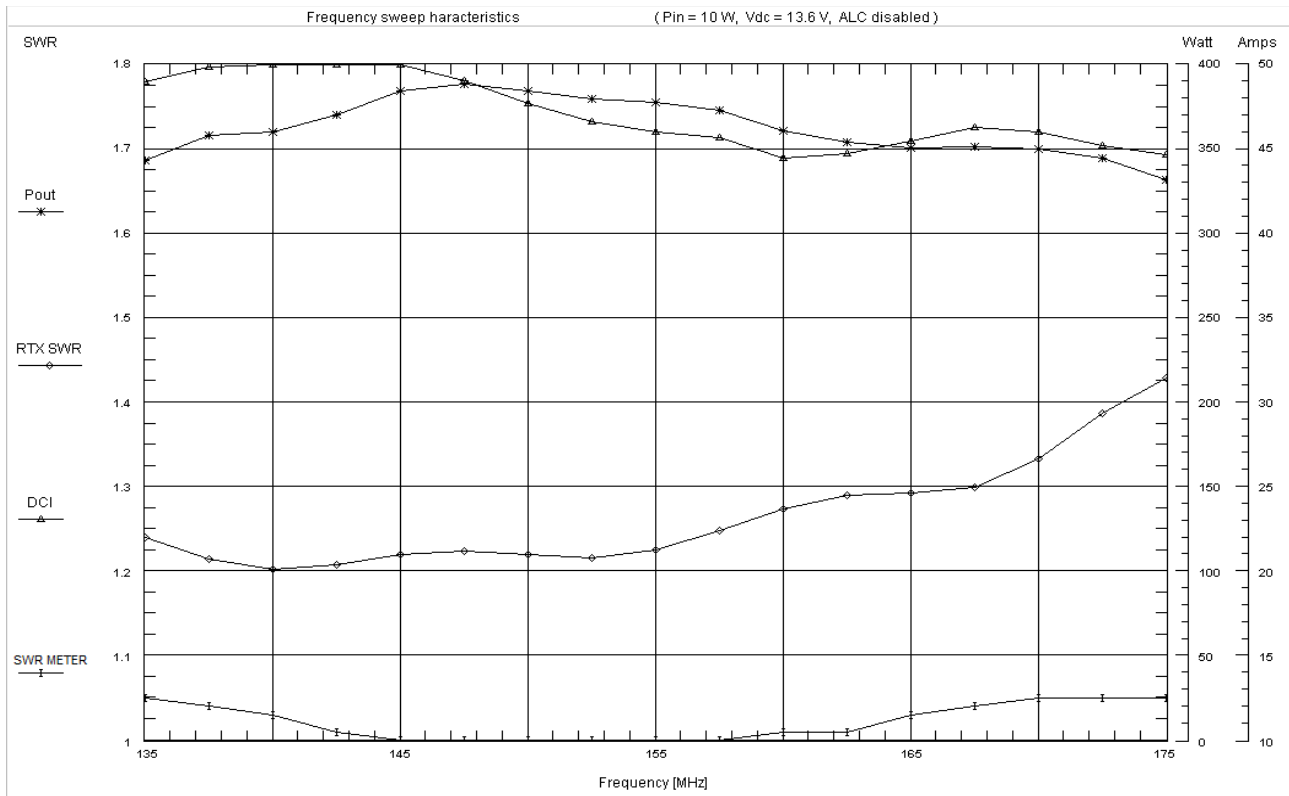
* Refer to performance curves

** At lower voltage amplifier may not reach its specified maximum power

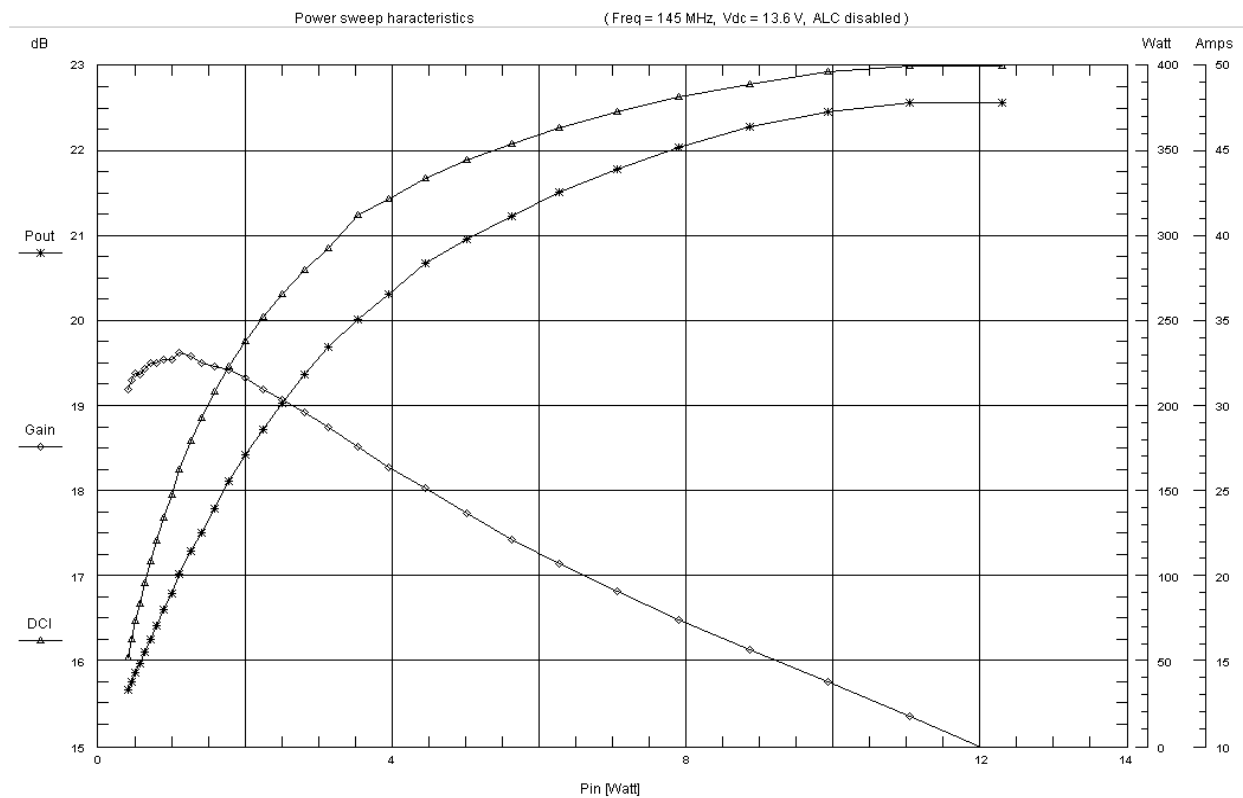
TYPICAL PERFORMANCE CURVES

(Input range 15W)

Power amplifier frequency sweep response in saturation:

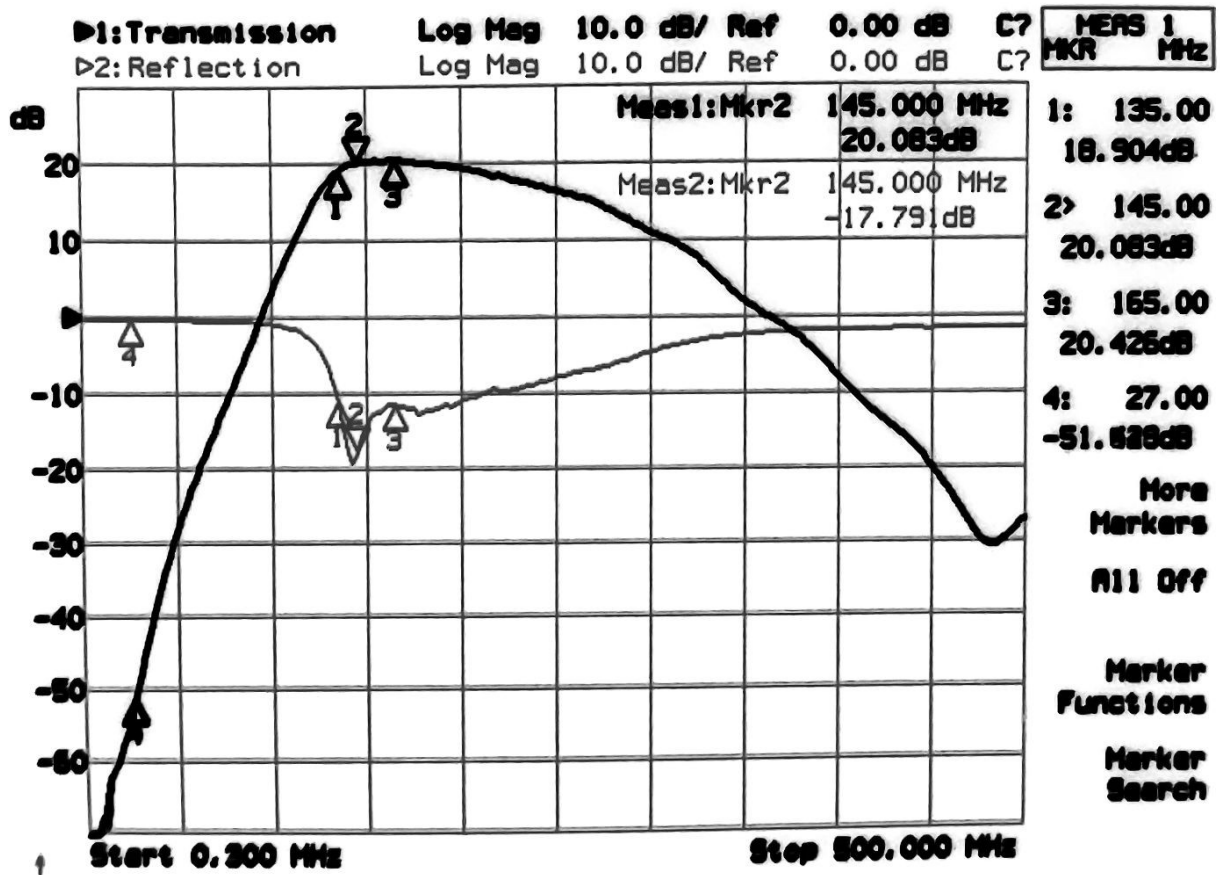


Power amplifier compression curves:

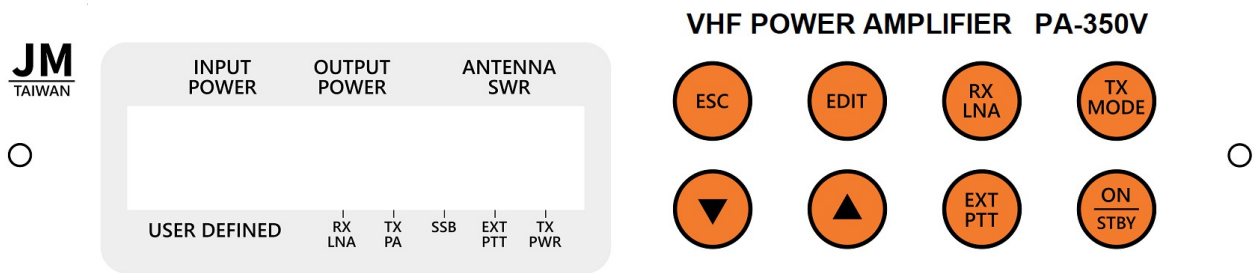


TYPICAL PERFORMANCE CURVES (continued)

Receiver preamplifier (LNA) frequency response:



FRONT PANEL LAYOUT

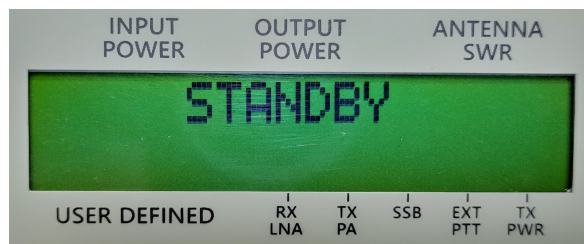


LCD DISPLAY

LCD display content depends on actual state of the amplifier

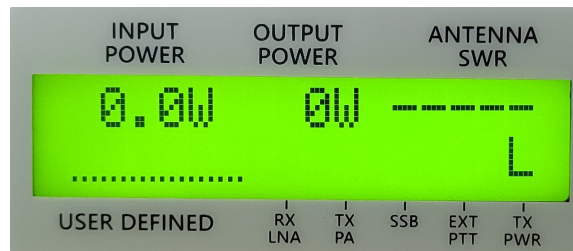
Amplifier is in standby

„STANDBY” message is displayed and LCD backlight turned off to minimize power consumption.



Amplifier operates normally

Display shows items described by legend around it.



„INPUT POWER”

RF power measured as coming into RTX connector (directional coupling).

„OUTPUT POWER”

RF power measured as coming out of ANT connector (directional coupling).

„ANTENNA SWR”

Standing Wave Ratio measured at ANT connector. If output power is too low to perform accurate measurement of SWR, „-----” is displayed.

„USER DEFINED”

User can assign following items to this field:

- a) Output power bar-graph. It's graphic visualization of output power. Shows full scale at 350W. Particularly useful in SSB mode.
- b) SWR bar-graph. It's graphic visualization of SWR. Show full scale at SWR=3.0. Might be useful for antenna tuning.
- c) DC voltage. Useful to indicate how DC voltage drops during RF transmission. May help to identify weak battery or poor DC wiring.
- d) Chassis temperature.
- e) DC current

„RX LNA”

It displays annunciator in the form of triangle or it's blank. Triangle indicates that RX Low Noise Amplifier has been turned on. It is toggled by RX LNA button.

„TX PA”

It displays annunciator in the form of triangle, arrow or it's blank. Triangle indicates that power amplifier is ready and will start transmitting if sufficient RTX power has been applied or external PTT signal activated (only if EXT PTT mode is active). It is toggled by TX MODE button. Once the amplifier is transmitting, triangle annunciator changes shape to arrow.

„SSB”

It displays annunciator in the form of triangle or it's blank. Triangle indicates that SSB mode has been activated. It is toggled by TX MODE button

„EXT PTT”

It displays annunciator in the form of triangle or it's blank. Triangle indicates that external PTT mode is active.

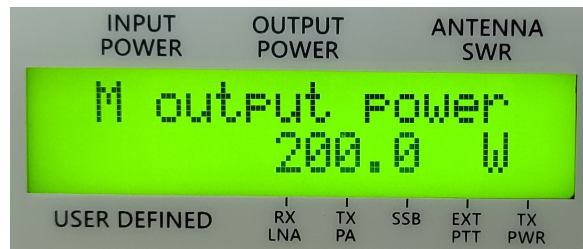
„TX PWR”

It displays selected power level: H,M,L (High, Middle, Low) in FM mode, S in SSB mode. User can assign value to H,M,L levels. The S level is fixed to 170W.

User changes settings (EDIT mode)

User can edit several settings, by entering EDIT mode. In this mode, menu items and their values are displayed. Legend surrounding LCD display window is irrelevant in this mode.

Example of EDIT mode display:



Error occurs

Several fault conditions are handled. If such condition happens, information is displayed and it blinks. Legend surrounding LCD display window is irrelevant in this mode. Example of error condition display:



KEYPAD

There are 8 buttons in keypad:

„ON/STBY”

Toggles between operation and standby mode.

In standby mode, power consumption is minimized, LCD backlight turned off, „STANDBY” message displayed. standby mode, amplifier passes signal in both directions with it's nominal insertion loss.

„TX MODE”

Toggles between 3 modes of operation:

PA OFF (TX PA and SSB annunciators are blank)

PA ON (FM mode, TX PA annunciator is displayed)

PA ON, SSB (SSB mode, both TX PA and SSB annunciators are displayed)

„RX LNA”

Toggles RX Low Noise Amplifier ON and OFF. „RX LNA” annunciator indicates the state.

„EXT PTT”

Toggles external PTT mode. „EXT PTT” annunciator indicates the state.

„AROW UP”

Increments power setting L->M->H in normal operation, non SSB mode.

Increments value of menu item in edit mode.

„ARROW DN”

Decrements power setting H->M->L in normal operation, non SSB mode.

Decrements value of menu item in edit mode.

„EDIT”

Enters edit mode. Toggles between menu items.

„ESC”

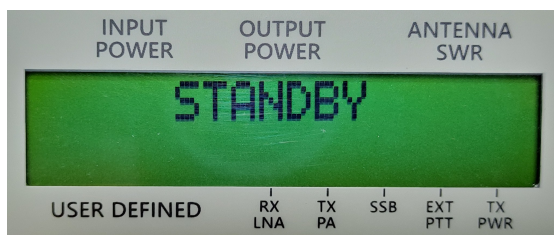
Exits edit mode. Modified menu items are saved to non-volatile memory.

GETTING STARTED

Connect ANT connector to antenna (or dummy load) and RTX connector to transceiver.

Connect DC leads (RED positive, BLACK negative) to DC power source. Power source must be capable of handling maximum DC current of the amplifier (recommended 60A). Extending DC connection length, use sufficient wire gauge to prevent excessive voltage drop.

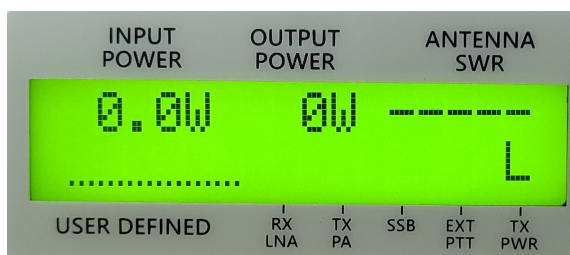
If DC voltage is present, the first-time display of PA350V should show:



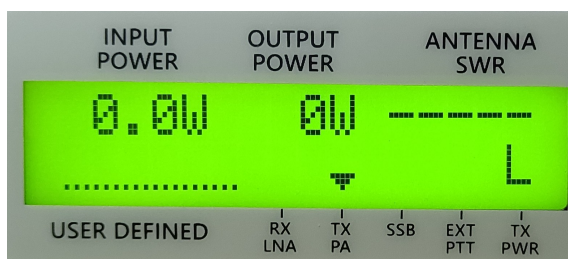
Press ON/STBY button. For a moment, product information is displayed:



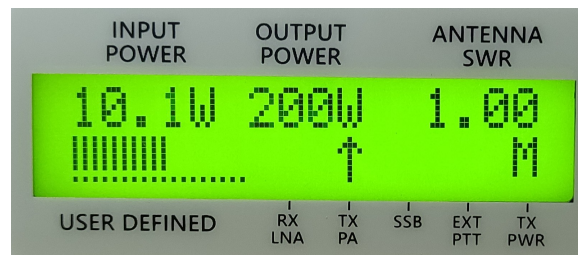
Then normal operation display appears:



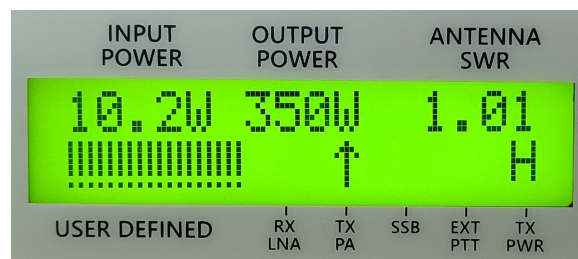
For FM mode (most common), press TX MODE button once. TX PA annunciator appears:



If you wish to increase output power to M setting (factory default 200W), press UP arrow once. The TX PWR indicator changes to M. You may now press PTT button of your transceiver. Amplifier starts transmitting. Display indicates input/output power, SWR, output power bargraph. TX PA annunciator changes shape to up-arrow:



If you wish to increase power further, press UP arrow again. „TX PWR” indicator changes to H (factory default 350W):

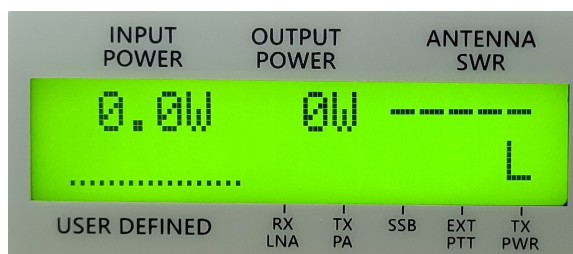


TRANSMISSION MODES

Amplifier has 3 transmission modes: BYPASS, FM and SSB. They are toggled by pressing „TX MODE” button.

1) Bypass mode

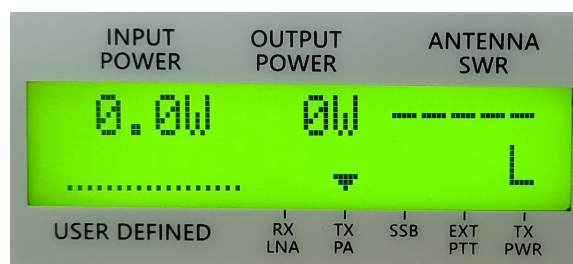
annunciator above „TX PA” is blank.



Signal from transceiver passes to antenna without amplification.

2) FM mode

Annunciator above „TX PA” is displayed but „SSB” annunciator is still blank.



Amplifier can be activated by RF signal from transceiver or by remote PTT signal (if external PTT mode is active).

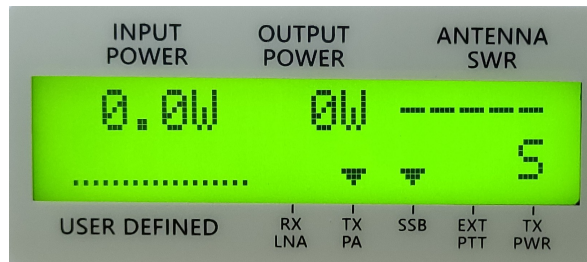
During transmission, amplifier attempts to stabilize its output power by ALC (Automatic Level Control) loop. User can select between L (low), M (middle), H (high) ALC thresholds. Actual selection is displayed in „TX PWR” window and can be changed by arrow buttons. Power levels assigned to L,M,H are user editable.

FM mode is only suitable for constant envelope modulations (FM, PM, FSK...). Other modulations (AM,SSB ...) will be severely distorted in FM mode.

In FM mode power meters and TX/RX switchover respond instantly (there is small delay to prevent jittering)

3) SSB mode

Both „TX PA” and „SSB” annunciators are displayed.



Amplifier can be activated by RF signal from transceiver or by remote PTT signal (if external PTT mode is active).

ALC control loop threshold is set to high level of 360W and can't be altered. „TX PWR” window shows letter „S”. ALC loop is not supposed to act during normal transmission. It is user responsibility to adjust output PEP (Peak Envelope Power) of transceiver correctly.

Power meters operate in QP (Quasi Peak) mode, exhibiting fast rise time and slow decay. In this way, user can observe PEP either with digital display or bargraph.

In non-external PTT mode (internal carrier detect) transmit to receive transition time is increased to prevent undesired TX/RX switchovers during SSB transmission.

The SSB mode is also suitable for AM modulation. User should adjust transceiver output power, so PA350V output carrier level allows headroom for modulation.

User can switch from FM mode to SSB mode only if amplifier is not transmitting. Otherwise, amplifier will go from FM mode to bypass mode, skipping SSB.

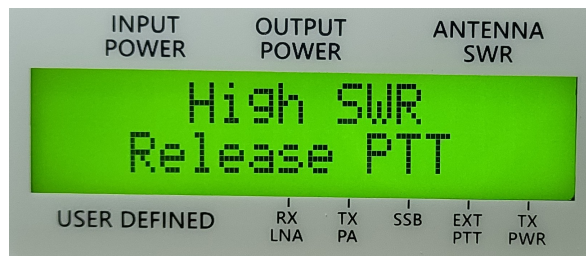
HANDLING OF ANTENNA SWR

PA350V is well protected against load mismatch (excessive Standing Wave Ratio – SWR).

If antenna SWR is less than 1.6, amplifier operates normally. However, as SWR approaches limit of 1.6 output power may not reach specified maximum.

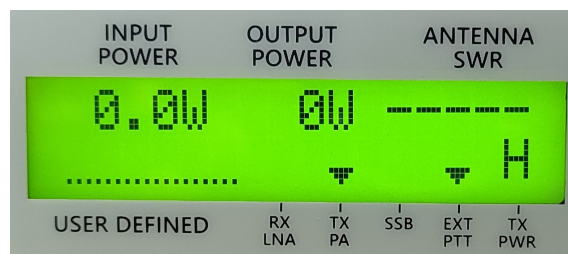
If $SWR > 1.6$ and $SWR < 2.2$, amplifier reduces output power, protecting itself. „ANTENNA SWR” meter blinks, drawing user attention to the problem.

If antenna SWR goes beyond 2.2, amplifier denies transmission. Error message is displayed:



EXTERNAL PTT

External PTT mode is toggled by pressing „EXT PTT” button. Annunciator „EXT PTT” appears.



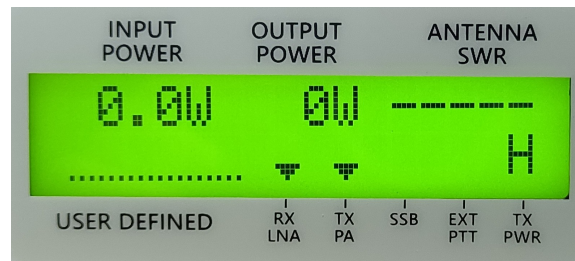
When external PTT mode is active, amplifier does not respond to internal CD (Carrier Detect) signal. Instead, it is activated by shorting external PTT connector „hot” terminal to ground (this signal is internally pulled up to +5V through 4.7 KOhm resistor).

Amplifier responds instantly to external PTT signal, regardless of TX mode (FM or SSB).

However it will deny transmission if error condition has been detected (high SWR, high drive, etc..)

RECEIVER PREAMPLIFIER

Receiver preamplifier is toggled on/off by pressing “RX LNA” button. Annunciator over “RX LNA” legend indicates the state.



Preamplifier is equipped with high-pass filter at the input. It prevents blocking effects caused by HF stations operating nearby (CB radio).

Preamplifier is intended to improve system noise figure in situations when amplifier is installed near antenna but far from transceiver.

EDITING SETTINGS

There are four buttons involved in settings editing (edit mode):

Button „EDIT” starts edit mode after first press. Further pressing selects successive menu items. Selection wraps around.

Button „ESC” exits edit mode. If values have been modified, they are saved to non-volatile memory automatically.

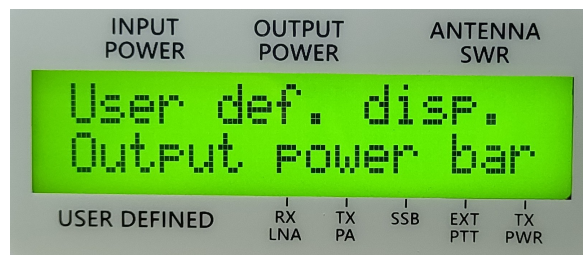
Buttons „UP arrow” and „DOWN arrow” modify numeric values or list selection.

Edit mode is best explained by following practical example:

With amplifier turned on (normal operation), press „EDIT” button.

First menu item appears on display. Upper display row stands for menu item name. Lower display row stands for value or list selection that can be modified. Modifiable parameter in lower row is blinking.

For factory default condition, it looks like this:



User Defined display item is assigned to output power bargraph. This bargraph has full scale of 350W.

Press „UP arrow”:



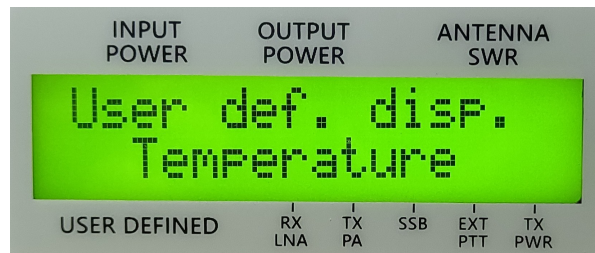
User Defined display has now been assigned to antenna SWR bargraph. This bargraph has full scale of SWR=3 and zero at SWR=1.

Press „UP arrow”:



User Defined display has been assigned to DC voltage.

Press „UP arrow”:



User defined display will be showing chassis temperature near RF power transistors.

Press „UP arrow”:

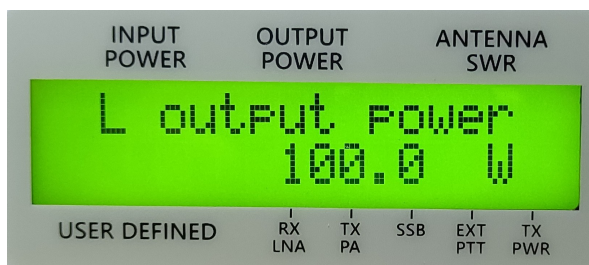


User defined display has been assigned to total DC current draw of RF amplifier stages. It does not include DC current of fans, LCD backlight , etc.

Pressing „DOWN arrow” button goes back through this list. There is no wrapping around. If the end of list has been reached, pressing „UP arrow” or „DOWN arrow” button has no effect. Select User Defined display as you prefer.

Press „EDIT” button.

Next menu item is displayed:



By pressing „UP arrow” or „DOWN arrow” you can adjust the power that is assigned to „L” setting. It is expected, that this power will be „Low”. But in fact you can select any value between 20W and 350W in 5W increments.

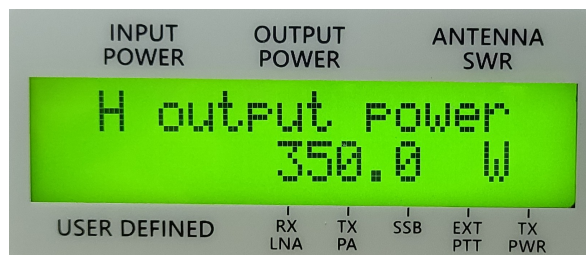
If you press and hold arrow button, auto-repeat function will act.

Press „EDIT” button.



Use arrows to assign value to „M” power setting.

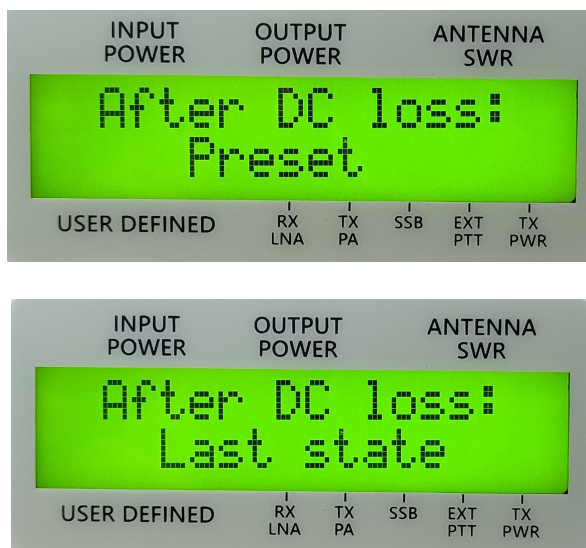
Press „EDIT” button.



Use arrows to assign value to „H” power setting.

Press „EDIT” button.

For this menu item, you may choose between two options (use arrow buttons):

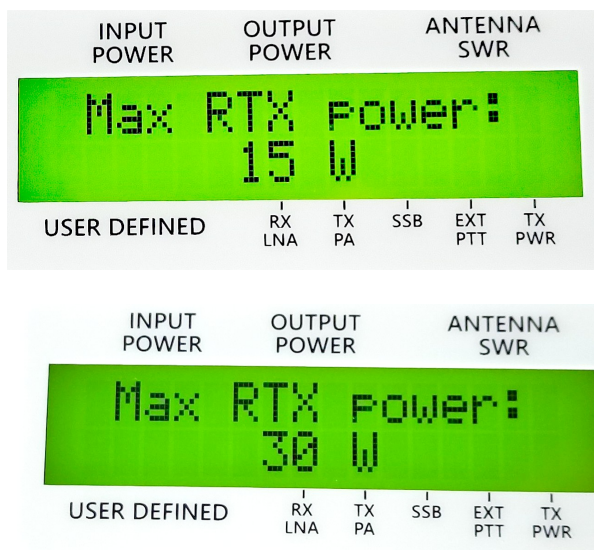


Choosing „Preset” means, that when DC voltage is re-applied after DC loss, amplifier will be in „STANDBY” mode. It will be necessary to press „ON STBY” button to turn it on. Power level setting will be „L” and TX mode will be „BYPASS” (amplifier not activated). However the settings modified in EDIT mode will be retained.

Choosing „Last state” means, that after DC loss, amplifier will return to its state before power loss. If amplifier was ON and ready to transmit, it will also be after reapplying DC. If it was in „STANDBY”, it will also wake up in this state. The „Last state” choice simulates behavior of legacy amplifiers with traditional rocker switches.

Press „EDIT” button.

For this menu item, you may choose between two options (use arrow buttons):



Selecting “30W” enables 3dB attenuator at amplifier input. Please refer to the table *Typical input power to achieve given output power (145 MHz)* in “SPECIFICATIONS” section.

You have reached last menu item. Pressing „EDIT” button again brings back first menu item.
press „ESC” button.

Amplifier exits edit mode and shows it's normal operation display. Settings that have been changed are stored to non-volatile memory.

ERROR CONDITIONS

Amplifier detects and displays several error conditions. Error condition display occupies both upper and lower display row. Both display rows are blinking.

1) High SWR

Antenna SWR beyond 2.2 has been detected. Amplifier denies transmission. Message will persist until transceiver TX signal is being detected or external PTT signal is active (EXT PTT mode). Release PTT to clear the message and return to normal operation.



2) Transceiver power is too high

Amplifier denies transmission. Message will persist until transceiver TX signal is being detected or external PTT signal is active (EXT PTT mode). Release PTT to clear the message and return to normal operation.



3) DC voltage is too low

That typically happens when DC supply source is not capable of handling amplifier DC current. Amplifier denies transmission.



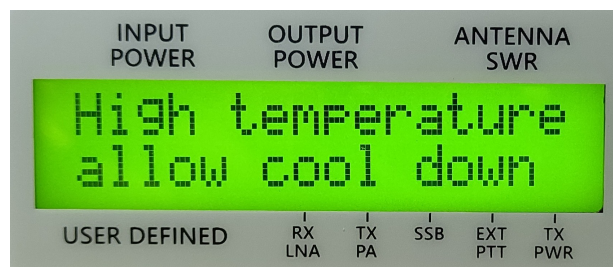
4) DC voltage is too high

That may happen if DC power supply regulator fails. Amplifier denies transmission



5) Temperature too high.

Amplifier has overheated. Allow it to cool down. Fans are working.



6) Symmetry error.

There are four identical amplifiers being summed. If one of these amplifiers malfunctions, it's DC current differs significantly from others. Such condition is detected, causing alarm and transmit denial.



7) Fuse blown

Each of four sub-amplifiers is protected by separate fuse (15A). These fuses will only blow if DC polarity has been reversed or RF transistor burned. Otherwise, maximum current of each RF transistor is limited by DC feedback circuit. Fuses are soldered to PCB and not user serviceable. There would be likely more damage associated with blown fuse, requiring professional service.

