JUMA PA100-D

Operation Manual
(Firmware Version 1.06b - 11 February 2015)
Adrian Ryan - 5B4AIY

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JUMA PA-100D OPERATING MANUAL
5B4AIY Firmware Version: 1.06b

The PA-100D is a companion 100W all-band linear amplifier primarily intended for the Juma TRX-2 all-band 10W transceiver, but can also be used with almost any low-power transceiver, such as the Elecraft KX3 Ultra-Portable HF Transceiver.

This document describes the operation and setup of this equipment using firmware version 1.06a, software modifications and changes made by Adrian Ryan, 5B4AIY.

The revised firmware incorporates a number of changes to enhance the utility of this amplifier. These instructions assume that you have already performed the necessary setup and calibration steps.

The enhancements are:

1. User selectable temperature units of either Centigrade or Fahrenheit.

2. User selectable frequency/band units of either MHz or metres.

3. User selectable fan control option.

4. Enhanced alarm facility.

5. Enhanced serial test facility.

6. Improved resolution and accuracy of voltage, current and power displays.

7. Power Sample Averaging.

8. Improved temperature display, and added serial suite calibration feature.

9. Graphic meter scale selection.

10. Selectable graphical display of parameters.

11. Compatibility with Elecraft KX3 transceiver.

12. Minor user interface modifications, including prompted exit from menus.

13. Safer Auto/Manual Band Change.

14. Auto-Increment added to the User Configuration and System Calibration menus.

15. User selectable start-up page.

16. Power display in either Watts or dBm.

17. Frequency meter display in MHz to a resolution of 1kHz.

18. Both forward and reverse page stepping in Service and Configuration modes.

19. Power meter display active in both operate and standby modes without the necessity to key the amplifier.

20. Improved low-power accuracy of output power meter down to 0.5W.

21. Improved frequency meter accuracy.

22. Brief press of PWR button in normal mode now decrements display page.

23. BAND+/BAND− buttons now auto-repeat.

Front Panel Controls
Control Description
PWR
This button is used to power-up and power-down the amplifier, as well as several secondary functions. To power up the amplifier, briefly press the button. The display will illuminate and a sign-on message will be displayed:

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JUMA-PA100 1.06b
  OH2NLT OH7SV
```

After a short delay, the main screen will be displayed.

This button now has assigned to it the cancel alarms function, which takes priority. This is to make the alarm system consistent with the Juma TRX-2, whose alarms are also cancelled with its PWR button. In the event an alarm cannot be cancelled, press and hold this button for an emergency shutdown. No user settings will be saved, the power latch signal will be immediately dropped.

Press and hold the PWR button for the normal power down. In the previous firmware, a counted down display would appear and the User Configuration settings were always saved to the EEPROM. In this version, if no User Settings have been altered, then the amplifier will simply shut down. However, if you have changed the AUTO/MANUAL setting, altered a gain setting, or if in the manual band select mode you have changed bands, then you will be prompted whether you wish to save these new settings.

To save the new settings, briefly press the BAND+ button. To power down without saving the settings briefly press the PWR button.

In the Calibration and Service and User Configuration modes, a brief press of the button will step back to the previous page. If the button is held, then the pages decrement automatically. The power off function resumes when either the Service or the Configuration mode is terminated.

A long beep will sound, and an increased page switch delay will occur whenever page zero is selected.

In the normal mode, a brief press will step back to the previous measurement display page. This allows for rapid switching between O/P power and SWR, or Voltage and Current, for example.

UP/DOWN
These buttons are used to increment/decrement the various user settings, depending upon the current operating mode. In the normal mode, these buttons alter the gain settings of the amplifier, as shown by the G1 – G4 indicators on the display. G1 is the lowest gain, and the gain can be increased in 2dB steps. In fact, the “gain” changes are simply an attenuator being switched in and out of circuit, but it is convenient to think of this in terms of overall gain.

Note that each of the 9 amateur bands has its own individual gain setting which can be saved to the EEPROM. If you change a gain setting, a band, or the auto/manual setting, then when you power the amplifier off you will be prompted whether you wish to save the new settings.

DISPLAY/CONFIG

This button has two functions. In the normal mode it allows the user to display a number of internal parameters. From the normal display, a single push will show the current output power. The next push will display the SWR, followed by the supply voltage, the amplifier current, and finally the heat-sink temperature in either °C or °F.

If the frequency sense (F-SENSE) mode of automatic band detection is selected, then an additional page can be displayed showing the input frequency in MHz to a resolution of 1kHz and the current output power.

If the button is pressed and held, this will invoke the User Configuration mode, which is fully covered in a later section. To exit from the User Configuration mode, briefly press the OPER button, respond to the prompt, whereupon the normal display will return.

Whilst in the User Configuration mode, a brief press of the button will increment the page. If the button is held, the pages increment automatically. A long beep will sound, and an increased page switch delay will occur whenever page zero is selected.

If this button is pressed and held from the power off state, and then the amplifier is powered up, it invokes the RS-232 loop-back test. If a computer running a terminal program is connected to the RS-232 port, you can verify that the port is functioning correctly. Briefly press the PWR button to exit.

OPER

This button has two primary functions. The first is used to place the amplifier in either the standby mode or the operate mode. In previous versions of the firmware it was also used to cancel alarms, this function has now been moved to the PWR button.

The second is to invoke the save settings menu from either the System Calibration or the User Configuration functions.

With this firmware revision the amplifier will always power up in the standby mode as a precaution, except when the System Setup is selected, when it will power up in the operate state.

In the standby mode the signal path is straight through, with neither filters nor attenuation present. A connected transceiver will be able to transmit and receive directly to the connected antenna. The metering functions of the amplifier will operate to show the output power and SWR, although at low power levels the accuracy is somewhat reduced.

Press this button to select the operate mode. In this mode the amplifier will be fully functional.

If this button is pressed and held, and the power switch operated to turn the amplifier on, the flash writer will be invoked. This is used with the Ingenia loader program to update the firmware. For further details, please see the article on the Juma website which covers this procedure.

AUTO
This button is used to select either the manual or automatic band selection, in conjunction with the BAND+ and BAND− buttons.

The current selection is displayed on the lower line of the display. To use the manual mode, press the button to select M on the lower line, and use the BAND+ or BAND− button to select an amateur band from 160m – 10m.

You can also select the manual mode by simply pressing either the BAND+ or BAND− buttons and selecting the desired band. This will select the appropriate low-pass output filter, but exercise care, as inadvertent selection of the wrong filter could damage the amplifier. For example, selecting the 80m band filter when transmitting on the 40m or higher band at high power levels could seriously damage the filters.

In this version of the firmware a safety feature has been incorporated. Previously the MANUAL mode was absolute – no changes could occur except via the BAND+ and BAND− buttons. It was thus possible to inadvertently select an incorrect band. If an out-of-band condition or an unknown band condition exists, then the default selection is 10m. In this new version, if the currently selected Auto Band detect mode is active, then any band selection occurring via this port will over-ride any manual selection that has been made.

If you wish to use absolute manual band selection, then select an auto mode port that is inactive, typically the FT-817 port.

It is preferable to use the AUTO band select mode, if possible. In this mode there are four detection possibilities, selected via a setting in the User Configuration mode. Please refer to this section for details concerning their use.

BAND+
There is a secondary function to this button. By pressing and holding this button in the power off state, and then powering up the amplifier, the factory defaults can be reloaded. Previously this was assigned to the OPER button, but also assigned to this button at power up is the flash writer. As it can be a little disconcerting to see this prompt, the default reload function has been moved.

Release the BAND+ button and the display will prompt you for a selection, either press the BAND+ to reload the default settings, or the PWR button to abort and continue.

BAND−
In addition to its use in selecting bands, there is a secondary function to this button. By pressing and holding this button in the power off state, and then powering up the amplifier,

the KX3 message timeout value will be changed from its default of 500mS to 5,000mS. A message will be displayed to this effect.

This allows you to test that the PA-100D is responding to KX3 messages by connecting it to a PC via the serial port and using a terminal program to send the necessary ASCII data packets to the amplifier. See Annex C for further details.

In this version of the firmware, the normal band select function of these buttons now auto-repeats if they are held.

User Configuration Mode
This mode is used to setup the various options and settings for proper operation of this amplifier. To select this mode, press and hold the DISPLAY/CONFIG button until you hear a long beep, and the message:

```
     User
Configuration
```

is displayed. Release the button, and the last displayed menu page will be selected. The various settings are changed with the UP/DOWN buttons.

To move from one menu item to the next, briefly press the DISPLAY/CONFIG button. To rapidly scroll to a menu item, press and hold the button, and after a short delay, the page will be incremented. Release the button to stop the scrolling and edit the value/parameter in the normal way with the UP/DOWN buttons.

To decrement the page, briefly press the PWR button. If the button is pressed and held, the page will decrement automatically.

A long beep will sound, and an increased page switch delay will occur whenever page zero is selected.

To exit, briefly press the OPER button. Respond to the prompt, and you will return to the normal operating mode.

Auto Band Detect
Default: F-Sense
This governs the operation of the AUTO feature. There are four selections:

a. **JUMA-TRX2** This mode should be selected when the amplifier is connected to the Juma TRX2 transceiver. It relies on the presence of a serial data link between the amplifier and the transceiver. The transceiver’s RS-232 port mode should be set to JUMA TRX2, and the port speeds must be the same. The default of 9600 Baud is satisfactory.

b. **KX3** This mode is used with the Elecraft KX3 Ultra-Portable HF Transceiver. It uses a serial data link between the ACC1 socket of the KX3 and the RS-232 socket of the PA-100D. See Annex C for further details.

c. **F-Sense** With this mode selected, the incoming RF signal from the transceiver is measured in frequency, and the result used to select the correct low-pass filters. No connections other than the RF cable and the PTT line are required. To use this mode, select the TUNE mode on the connected transceiver and inject between 100mW – 10 watts. The amplifier will detect the signal and select the appropriate filter automatically.

d. **FT-817** This setting will allow automatic band detection when connected to a Yaesu FT-817 or similar transceiver with the appropriate accessory cable. This transceiver outputs a stepped DC voltage which can be detected by the amplifier and used to automatically select the correct band. The rear accessory BAND socket should be used.

Serial Port Test Mode
Default: On
The test mode allows the user to perform various low-level tests, as well as obtain a dump of the current internal configuration and calibration values.

Note: The Test Mode is only active if the Auto Band Detect is set to either F-Sense or FT-817.

Serial Speed
Default: 9600 Baud
Limits : 1200 – 115200 Baud
This sets the communications speed for the RS-232 port and can be set from 1,200 Baud – 115,200 Baud. The other parameters are fixed at 8 data bits, 1 stop bit, no parity.

Polling Interval Time
Default: 5 Seconds
Limits : 0 – 10 Seconds
This determines whether the transceiver connected via the serial port will be polled for band information, and at what interval. The default setting is 5 seconds, but if this is set to zero, then polling is disabled.

If you are using the TRX-2, then any band changes or transmit status changes are normally conveyed automatically via the serial port, but in addition, the PA100D can also query the TRX-2 if desired. Setting the rate to 0 will disable polling.

The latest firmware for the Juma TRX-2 now includes the feature whereby every time the transceiver switches into the transmit mode or a band change is made, it automatically updates the PA-100D, and thus polling is unnecessary.

If you are using the PA-100D with the Elecraft KX3 transceiver, then depending upon the settings for this transceiver polling may be required. Please see Annex C for full details. The default rate of 5 seconds is normally quite sufficient.

In this version of the firmware this feature has been modified. In all previous versions the polling interval was capable of being set in increments of 100mS from 0 to 30 seconds. Extensive testing revealed a number of potential shortcomings, and in this version the polling rate is set in increments of 1 second from 0 to 10 seconds. As before, setting the rate to zero disables polling.

LCD Backlighting
Default: 300
Limits : 50 – 1100
Set the level you wish for the display illumination using the UP/DOWN buttons.

LCD Contrast
Default: 2000
Limits : 0 – 3500
Adjust with the UP/DOWN buttons for a suitable display.

SWR Trip Limit
Default: 3.0
Limits : 1.0 – 10.0
Adjust with the UP/DOWN buttons over a range from 1.0 – 10.0, a default setting of 3.0 is recommended.

Temperature Unit Selection
Default: Celsius
Using the UP/DOWN buttons select either °C or °F. Note that if the units are changed, then the following menu settings for the alarm and fan cut-in temperatures will be automatically preset at their respective default values in the new scale.

Fan Control
Default: Normal
Some users prefer the cooling fan to operate all the time irrespective of the heat sink temperature. Use the UP/DOWN buttons to select one of the following modes.

Normal: In this mode the fan operation is entirely determined by the heat-sink temperature.

Low: In this mode, the fan will run continuously at the low speed, but will switch to the medium or high speed in response to the heat-sink temperature.

Medium: The fan will run at medium speed, but will switch to high speed in response to heat-sink temperature.

High: The cooling fan will operate at high speed all the time.

Over-Temperature Limit
Default: 70°C/160°F
Limits : 50°C – 100°C or 120°F – 212°F
Using the UP/DOWN buttons, select a suitable limit.

Fan Cut-In Temperature
Default: 40°C/104°F
Limits : 0°C – 80°C or 32°F – 170°F
Using the UP/DOWN buttons, select a suitable temperature for the cooling fan to start.

When the heat-sink temperature reaches the cut-in point, the fan will start at low speed, assuming the normal mode of operation has been selected in the previous menu.

When the heat-sink temperature has risen to 5°C/10°F higher than the preset cut-in temperature, the fan speed will increase to the medium setting. If the temperature rises by 10°C/20°F above the cut-in temperature, the fan will run at its maximum speed.

Although the range of cut-in temperatures is from 0°C – 80°C, or 32°F – 160°F, the actual maximum cut-in temperature will be determined by the Over-Temperature Limit setting. The maximum permissible cut-in temperature will always be 20°C/40°F lower than the Over-Temperature Limit setting, or 80°C/160°F.

Although a zero temperature setting may seem somewhat odd, its purpose is to allow you to quickly verify that the fan operates in response to temperature. As an example, assume room temperature is 25°C, if you reduce the cut-in temperature to 25°C you should hear the fan start at low speed. Reduce the setting to 20°C, and the fan should run at medium speed. Reduce it to 15°C, and the fan should run at its maximum speed. Reset the temperature to the desired setting when done.

Note: The fan drop-out temperature is 2°C/4°F lower than the cut-in temperature. This hysteresis prevents "fan twitch" whereby the fan blades would otherwise "twitch" when the cut-in temperature is close to room temperature.

Band Units
Default: MHz
Using the UP/DOWN buttons select either MHz, or metres.

Graphic Limit Display
Default: Off
Using the UP/DOWN button select Off or On. If this feature is turned off, then the graphic meter on the top left of the display acts as in the original firmware, and simply displays RF output power. In fact, whereas in the previous firmware the actual display was the forward voltage from the SWR bridge, this version now displays true power.

The full-scale of the meter is adjustable in the Calibration section to display from 40W to 160W in 1W increments.

If the feature is turned on, then the graphic meter will display the measured parameter in relation to the current trip limits. In other words, when displaying current, the full-scale of the graphic meter is the 24A hardware trip limit, and the display shows the instantaneous value of the current in relation to this limit.

Note: Whilst the graphic meter displays the instantaneous current, the digital meter is a peak reading long hold time meter. The hold time is fixed at approximately 800mS. This allows for a reasonably stable meter display when using either SSB or CW.

When displaying temperature, the lower scale limit is either 0°C or 32°F depending upon the current scale selection, and the full-scale is the current over-temperature limit.

When displaying SWR, the lower limit is a SWR of 1:1, and the full-scale is the current SWR trip limit.

When displaying voltage, the display is effectively a suppressed-zero voltmeter with the minimum reading being the undervoltage trip setting, and the full-scale being the over-voltage trip setting.

The power meter display shows the instantaneous output power as a fraction of the preset full-scale value. It is recommended to set this feature on when using the dBm scale for the output power.

Graphic Display Scale
Default: Original
Select one of three different types of scale displays for the analog bar graph. The selections are Original, Large, or Small scale markers.

RF Power Meter Type
Default: Watts
This page allows you to configure the RF power meter to display in either Watts or dBm. The latter units are often used for professional applications, as it facilitates gains, losses and attenuation measurements.

POWER WATTS	POWER dBm
1	+30.0
2	+33.0
3	+34.8
4	+36.0
5	+37.0
10	+40.0
20	+43.0
30	+44.8

40	+46.0
50	+47.0
100	+50.0

Remember that this is a logarithmic display of output power. It is strongly recommended that the graphic display is turned on when using the dBm power scale, and the maximum value set to 100W to alert you to the current output power in relation to the maximum permitted power.

Start-Up Page
Default: O/P Power
This option allows you to choose which measurement system page is displayed on start-up. The options are: O/P Power – SWR – Voltage – Current – Temperature.

Prompted Save
To exit from the User Configuration Menu, briefly press the OPER button to invoke the prompt screen. To save your current settings, briefly press the BAND+ button. To exit without saving your settings and restore your previous configuration, briefly press the PWR button.

System Configuration & Calibration
To enter the calibration mode, from the power off state press and hold the PWR button until the message:

```
JUMA PA100v1.06b
Calibration Mode
```

is displayed.

To calibrate the amplifier, connect a suitable transceiver to provide a drive signal, and ensure that the amplifier is connected to a dummy load. In this mode, the Frequency Sense mode of band detection is selected. It is recommended that you use a frequency in the 20m band as this is at the centre of the amplifier's frequency range.

Prior to using the System Configuration & Calibration mode, select either the AUTO or MANUAL band select mode.

If the AUTO band select mode is selected, then the output filter will be selected depending upon the frequency measured in the frequency sense logic. If the MANUAL band select mode is selected, then the 10m filter is automatically selected.

To key the amplifier into transmit if you are not using a TRX-2, make a suitable connection to the T/R socket. If using a 3.5mm patch lead, the amplifier can be keyed into transmit by simply grounding the tip.

In the Calibration Mode, the amplifier will power-up in the operate state. If the AUTO band detect mode has been selected, and the input power is too low, then the default 10m band will remain in effect. The mode and band will be displayed on both the ammeter and power meter calibration pages. The amplifier can only be keyed into the transmit mode if either of these pages are selected.

To avoid an accidental over-drive, the input attenuator is set to the minimum gain, which is approximately 10dB. A 5W input signal will drive the amplifier to about 40W – 50W output.

The calibration menu pages can be selected by briefly pressing the DISPLAY/CONFIG button. To rapidly scroll through the pages, press and hold the DISPLAY/CONFIG button until the desired page is displayed. Release the button, and adjust the value/parameter with the UP/DOWN buttons in the usual way.

To return to a previous page, briefly press the PWR button. To rapidly scroll in the reverse direction, press and hold the PWR button.

In either mode, a long beep and an additional page delay will occur whenever page zero is selected.

Voltage Calibration
Default: 5249
Limits : 4750 – 5750
The measurement system of the amplifier has been modified to obtain increased resolution and precision.

The voltage measurement section is the most precise, as its sample voltage is obtained directly from a precision potential divider formed by R27/R28 on the control board, and this voltage is directly sampled by the A-D convertor.

Measure the input voltage at the amplifier's power connector with a precision 4-digit digital multimeter, and using the UP/DOWN buttons alter the calibration factor so that the displayed voltage matches as closely as possible the measured value.

Briefly pressing either button will cause a single increment or decrement of the existing value, if you press and hold the button, a continuous increment or decrement will occur.

It should be possible to arrive at a display that matches within ±1 digit in the least significant figure – if the measured value was 13.84V, then you should be able to adjust the display to read between 13.83 – 13.85.

Note that as with all digital sampling systems there is an inherent quantisation uncertainty of ±1 in the last digit.

The display is a direct sample of the A-D convertor's output, no averaging takes place, and thus you will see significant jitter at some calibration settings. When the display is used with the amplifier in its normal mode, the voltage displayed is the result of a 50-sample running average, and is thus much less prone to jitter. The non-averaged value allows you to adjust the calibration for both the most accurate and the most stable display.

Current Calibration
Default: 2520
Limits : 1500 – 4000
The current sense is obtained from a precision 0.005Ω current shunt resistor, R7, in series with the main power bus. The voltage developed across this shunt is processed by IC1, a MAX4373 high-side current sense amplifier/convertor and the scaled voltage is measured by the A-D convertor. The nominal scale factor is 100mV/A.

The most accurate method of calibrating the ammeter is to use a clip-on DC ammeter and a precision digital multimeter. Alternatively, if you have access to a precision high-current shunt you can connected this in series with your supply and measure the shunt voltage. If neither of these means is available but either your power supply has an accurate digital ammeter, or your digital multimeter has a suitable amps range, then this can be used as the reference.

Inject a suitable drive signal to obtain a CW output power of about 30W – 80W, wait for the current reading to stabilise, then using the UP/DOWN buttons adjust the calibration factor to obtain a match as closely as possible the reference measured value.

This measurement is less accurate than the voltmeter for a number of reasons. First, although the current shunt is principally the current shunt resistor, in addition there is the contact resistance of the four solder pads.

The varying construction techniques as well as differing types of solder will all add a varying contact resistance which will affect the calibration. In addition, at high currents the current shunt resistor tends to heat up as it dissipates a certain amount of power, adding a further uncertainty to the measurement. Thus, although the resolution of the ammeter is 0.1A, the accuracy will probably not be better than ±0.2A at the nominal maximum output power of the amplifier.

Note: The ammeter display in the operating mode is a peak reading long hold meter. In the calibration mode the meter displays the instantaneous current.

RF Power Calibration (High Power)
Default: 1149
Limits: 750 – 1500
The RF output power is measured from the DC output voltage obtained from a dual directional coupler on the main board. This measurement is probably the least accurate.

Because power is proportional to the square of the voltage, any errors or differences in either components or construction will be magnified when the A-D output is squared to perform the power calculation. Further, the reference voltage of the A-D convertor is obtained from the +5V logic supply, and the accuracy and stability of the voltage regulator’s internal precision band-gap reference will also affect the accuracy.

Equally, the output voltage of the diodes is only reasonably linear at fairly high powers, as the output power is reduced the accuracy will degrade.

In order to calibrate this measurement, either you will need access to a fairly accurate RF power meter, or you can use an accurate directional coupler and an oscilloscope. In my case I had access to both methods, and was thus able to confirm the relative accuracy of both methods.

Note that most SWR meters having a power scale are notoriously inaccurate as power meters.

The power meter method is by far the easiest. Inject a suitable RF drive signal to provide an output of 50W – 100W CW, wait for the output power reading to stabilise, and using the UP/DOWN buttons adjust the calibration factor to obtain the closest possible agreement between the display and the measurement reference.

To use the direction coupler/oscilloscope method, connect the output of the amplifier to the directional coupler with as short a piece of co-ax as possible, and connect the output of the directional coupler to a high-power 50Ω dummy load. Connect the oscilloscope to the directional coupler's coupled port and terminate the input to the oscilloscope with a 50Ω feed-through termination.

If it is a digitising oscilloscope, set it up to measure the RMS voltage at the input. With a −30dB coupler, at 100W the coupled port will provide a 100mW signal into the feed-through termination. This will give a 6.3V p-p signal into the oscilloscope. Measure the amplitude of the signal, and calculate the coupled power level. Taking into account the coupler loss, adjust the calibration for the best match.

If you do not have access to either of these pieces of test equipment, then the default calibration value will be accurate enough for most purposes – this is the least accurate of the measurements, and is really intended as an indication of output power rather than a precision measurement.

RF Power Calibration (Low Power)
Default: 120
Limits : 0 – 250
With this version of the firmware the low power accuracy of the power meter has been significantly improved.

Inject a frequency in the 20m band, and at about 4W – 5W power level. Using the UP/DOWN buttons adjust the offset to achieve the most accurate match.

Then, remove the drive signal, briefly press the PWR button to re-select the previous page, and inject the drive signal and, if necessary, re-adjust the calibration. By switching between the high and low power pages and adjusting the calibration factors, it should be possible to achieve a reasonably accurate display at both high and low powers.

Note: It is necessary that the driving source's output power is known fairly accurately in order for this compensation factor to be accurate.

Because there are two calibration factors, the overall adjustment tends to be somewhat divergent. If you find that you are arriving at a setting that is near or at the limit of the adjustment factors, then reset the high power calibration factor to around 1150, and the low power calibration factor to about 120, and start again.

Use a drive power setting that gives an output power in the high power setting of around 50W – 60W. You may have to sacrifice some accuracy at the high power setting in order that the low power reading corresponds with the power meter or the power reading on the drive transceiver.

Nevertheless, provided the reference power meter is reasonably accurate (within ±10%) and the output power of the driving transceiver is also accurately known, then it should be possible to arrive at a set of calibration factors that allow close agreement at the low power end of the range as well as reasonable agreement (within ±10%) at the high power end.

Bear in mind that of all the measurements, accurate RF power measurement is the most difficult. Whereas voltage, current, and temperature can all be measured to an accuracy of better than 1%, RF power is usually a derived measurement from an indirect source, and thus is subject to numerous errors and uncertainties. The best that can usually be achieved with the fairly simple techniques that are common for amateur equipment is about ±10%.

Beep Length
Default: 50mS
Limits : 0 – 100
Using the UP/DOWN buttons, adjust for the desired time.

Note: A time of 0 will disable the beeper, no audio annunciator tones will then be generated. However, certain major function changes, such as selecting the User Configuration menu or invoking the fast page switch feature will always be acknowledged with a beep.

Power Sample Averaging
Default: 1
Limits : 1 – 8
This feature was added at the request of an amateur who was using the amplifier as the driver stage of a high-power linear.

When operating CW there were occasions when there would be a transient high SWR alarm caused by the finite time it took for the transmit/receive relays to operate. Although internally the amplifier requires two successive samples to assert the high SWR alarm, because the overall measurements are performed very quickly this was not long enough to ensure that a transient would be ignored, but a steady-state condition would not.

This feature can also be used when using separate transmit and receive antennas where the relay operating time might also provoke a transient alarm.

Power averaging was added to smooth out such transients. The number of samples can be set from 1 (no sampling) to 8. Bear in mind that each sample adds about 5mSec to the time it takes to register the power, and that two successive averaged samples are required to recognise a high SWR condition. At 8 sample averaging the total recognition time for a high SWR would thus be about 80mSec.

Use this feature at your own risk, and with caution. If you require more than about 6 samples to smooth the transient, then consider an alternative method of using the linear.

This feature is NOT required for normal operation, and the sample count should be left at its default value of 1.

Over-Voltage
Default: On
This setting determines whether the alarm is active or not. Use the UP/DOWN buttons to select the desired settings.

Over-Voltage (Adjust)
Default: 14.80V
Limits : 14.00V – 15.00V
Once every cycle of the main control loop, approximately every 4mSec, the battery voltage is measured and compared with the preset threshold. If it exceeds the threshold, the over-voltage alarm will be raised.

Under-Voltage
Default: On
This setting determines whether the alarm is active or not. Use the UP/DOWN buttons to select the desired settings.

Under-Voltage (Adjust)
Default: 11.00V
Limits : 10.50V – 11.50V
When operating from a sealed lead-acid battery, most manufacturers recommend that the discharge be terminated when the terminal voltage falls to 10.50V. Adjust the value to your preferred settings.

Note: An additional warning will be given when the battery voltage has fallen to 100mV above the threshold set here. This is a pre-limit warning, and once it has been acknowledged it will not recur. The only way to reset this warning is to power the amplifier off and back on.

Maximum Power
Default: 100W
Limits : 40W – 160W
This adjusts the full-scale setting of the graphical power meter. Using the UP/DOWN buttons set the value to your preference.

Note: This only affects the graphic power meter, the digital power meter will still display the actual output power even if it exceeds the full-scale setting of the graphic meter.

Note: The amplifier can only be keyed into transmit if either the Ammeter or the high power RF Power calibration pages are being displayed.

Note: If either the Ammeter or the RF Power calibration pages is displayed, then the current band detect mode (Auto/Manual) as well as the currently selected output filter (1.8MHz – 28MHz) is displayed along with the current data value.

Note: If an alarm is detected, the Calibration mode is immediately aborted. Only the enabled alarms are checked, but the SWR, Over-current and Temperature alarms are always recognised.

Note: To avoid an accidental overdrive, the amplifier is set to the minimum gain irrespective of the current band gain settings. On exit, the previous gain settings are restored.

Frequency Meter Calibration
Default: 999985
Limits : 999625 – 1000345
This is used to calibrate the frequency meter display. Using an input power of 100mW – 5W, and an input frequency in the 10m band set to an integer number of kilo-hertz, and accurate to ±10Hz, adjust the display to agree with the input. The default band-switch frequency of the Juma TRX-2 of 28.850MHz is ideal.

With the calibration factor set to its default value, inject a CW test signal and verify that the correct frequency is displayed. Press the UP button and step the calibration factor up until the display just reads 28.849MHz without any jitter. Note this upper calibration factor.

Release the UP button and using the DOWN button step the calibration factor down until the display just reads 28.851MHz without any jitter. Note this lower calibration factor.

Add the upper and lower calibration factors and divide by two. Use the integer portion of the result as your final calibration factor.

As an example, in my case the upper factor was 1,000,003, the lower factor was 999,966. The calculated factor was therefore:

$$(1,000,003 + 999,966) / 2 = 999,984.5$$

Using the integer portion, the final factor was 999,984.

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Annex A

Serial Test Suite

The amplifier has an enhanced serial test feature that can be useful for a number of test purposes. To use this feature, in the User Configuration mode, ensure that Auto Band Detect is set to either the F-Sense or the FT-817 modes. If either the JUMA TRX2 or the KX3 mode is selected, then the test mode is not available.

In the Serial Port Test Mode, select On, and set the speed to a suitable value, 9600 Baud is usually satisfactory.

Connect your PC running a terminal program to the amplifier via a serial port or a USB to RS-232 convertor if your computer is not equipped with a normal RS-232 port.

Enter the letter I (Capital I) on the terminal, and the amplifier should respond as shown below:

```
JUMA-PA100D Version: 1.06b - Build: 4 - 11/FEB/2015
Copyright: Juha Niinikoski - OH2NLT & Matti Hohtola - OH7SV
(Additional features and modifications - Adrian Ryan - 5B4AIY)

----------------------[COMMAND TABLE]----------------------
I      Help - (This Screen)
A      ADC Channel Dump
a      Test Alarm System
b      LCD Bar Graph & Character Test, any key exits...
C      Clear Factory Default Reset Counter
D      Dump System & User Settings
E      Dump EEPROM contents
f      Toggle Frequency Sense Test On/Off
G      Input Attenuator Status
T      Temperature Sensor Calibration, any key exits...
t      Buzzer Sound Test
W      Write ASCII to LCD, ESC to exit.
w      Write HEX to LCD, 1B to exit.
Z      Divide-By-Zero Trap
-----------------------------------------------------------
```

This “Help” display can also be obtained by entering ?, H, or h.

Enter D, and the following display will be obtained:

```
      System Calibration Settings
----------------------------------------
Battery Voltage Factor : 5250
PA Current Factor      : 2520
RF Power Meter Factor  : 1149
RF Power Meter Offset  : 120
Beep Length Time       : 50 mS
PWR Measurement Samples: 1
Over-Voltage Trip      : 2762 = 14.50V
Under-Voltage Trip     : 2076 = 10.90V
Power Meter Full-Scale : 100W
Freq Meter Calibration : 999985
```

```
      User Configuration Settings
----------------------------------------
Frequency Sense Mode   : F-Sense
Serial Link Polling    : 5 Seconds
RS-232 Port Mode       : Test Mode
RS-232 Port Speed      : 9600 Baud
LCD Backlighting       : 300
LCD Contrast           : 2000
SWR Trip Limit         : 3.00
Temperature Units      : Celsius
Fan Speed Control      : Normal
Temperature Alarm Limit: 70C
Fan Start Temperature  : 40C
Band Display Units     : MHz
Graphic Limits Display : Off
Graphic Display Type   : Original
Power Meter Type       : Watts
Start-Up Page          : O/P Power
Current Amplifier State: Standby
Band Select Mode       : Manual
Last Valid Band Select : 28MHz
----------------------------------------
```

The settings shown above are the standard defaults After calibration, your settings will, naturally, be somewhat different.

Enter A, and the following display will be obtained:

```
CHANNEL VALUE   INPUT        DISPLAY
-------------------------------------------
ADC  9:   809  0.988V  10.193 Amps
ADC 10:  2588  3.160V  13.587 Volts
ADC 11:    22  0.027V   0 - Out-Of-Band!
ADC 12:     4  0.000V   0.0 Watts (Reverse)
ADC 13:  2022  2.468V  52.7 Watts (Forward)
ADC 14:   581  0.709V    35 Celsius
-------------------------------------------
```

This displays the output and scaled values from the Analogue to Digital convertor in the microprocessor.

The display shows the ADC channel number, the raw value, the scaled equivalent input voltage, and the actual display that would be obtained, also scaled by the calibration factor to the measurement unit.

For example, the first line shows the output from ADC channel 9. The raw value is 809, which is equivalent to an input voltage of 0.988V.

The equivalent input voltage is obtained by multiplying the reference voltage (nominally +5.000V) by the raw ADC value divided by 2^{12} or 4096, thus:

ADC * 5.000 / 4,096

809 * 5.000 / 4,096

4,045 / 4,096

= 0.988V

This corresponds to a current of 10.193 amps when scaled with the calibration factor of 2520 obtained from the previous dump. The actual calculation is:

I = ADC * Calibration Factor / 200,000Amps

= 809 * 2520 / 200,000

= 2,038,680 / 200,000

= 10.193 Amps

The second line shows the output of ADC channel 10. The raw value is 2,588, equivalent to an input voltage of 3.160V, and the scaled display reading would be 13.587V. The actual calculation is:

V = ADC * Calibration Factor / 1,000,000

= 2,588 * 5,250 / 1,000,000

= 13.59V

The third line shows the output of ADC channel 11. This channel is used with a Yaesu FT-817 transceiver or similar, and represents the band select voltage. I have simulated the actual voltages and confirmed that when the Auto Band Select is set to Yaesu 817, the appropriate amateur band filters are selected. The voltage thresholds are:

BAND	**VOLTAGE**
1.8MHz – 160m	0.33V
3.5MHz – 75/80m	0.67V
7.0MHz – 40m	1.00V
10.0MHz – 30m	1.33V
14.0MHz – 20m	1.67V
18.0MHz – 17m	2.00V
21.0MHz – 15m	2.33V
24.0MHz – 12m	2.67V
28.0MHz – 10m	3.00V

The tolerance is ±100mV. Note that voltages below 0.23V and above 3.1V are invalid. If the input voltage is below 0.23V, then the Out-Of-Band selection is made. Above 3.1V and the unknown selection will be made corresponding to the 28MHz filter.

The next line shows the output from ADC channel 12, the reverse power channel used for SWR calculations.

The next line shows the output from ADC channel 13, the forward power channel. The calculation for both the forward and reverse power is the same, and uses the same calibration factor. In this case the forward power raw value is 2,022 corresponding to an input voltage of 2.469V.

The calculation is:

P = (((ADC + Offset) * (ADC + Offset)) * Calibration Factor) / 100,000,000

= ((2,022 + 120) * (2,022 + 120) * 1,149) / 100,000,000

= (4,588,164 * 1,149) / 100,000,000

= 5,271,800,436 / 100,000,000

= 52.72W

The last line of the display shows the output from ADC channel 14, the temperature measurement channel.

It shows that the raw output was 581, equivalent to an input voltage of 0.709V. In this case there is no software calibration factor. The design of the temperature measurement system takes advantage of the accurately known change of base-emitter voltage of a silicon transistor with temperature.

The transistor is Q3, a BD139, mounted on the backplate of the power amplifier. It is fed with a constant current, and is used both as a temperature sensor and a temperature compensated voltage source to provide the bias current to the output transistors.

As the temperature of the heat-sink increases the base-emitter voltage will fall. The base-emitter voltage of the output transistors will also fall, and if no temperature compensation were applied, a constant bias voltage would cause their collector currents to increase. This would result in increased dissipation, and even higher heat-sink temperatures, with a resultant further reduction in base-emitter voltage, and eventually thermal runaway. With the temperature compensated bias voltage from Q3, the collector currents of the output transistors are stabilised, and thermal runaway prevented.

From the theory of silicon diodes, it is known that the temperature characteristic of a silicon diode junction is such that the forward voltage of the diode will change by about −2mV/°C.

Thus, in the temperature sense amplifier A1-B, the potentiometer is used to adjust the offset voltage and calibrate the sensor, and the negative change in DC output voltage is amplified by the x10 DC gain of the inverting amplifier giving approximately +20mV/°C over a range from 0°C – 100°C, with an input voltage range to the ADC of 0 – 2V.

The reference voltage for the A-D convertor is the +5V logic supply, and thus at a 2V input the convertor output will be 2 / 5 * 4,096 = 1,638. The scaling factor used is 4,000, and thus the calculation is:

T = ((2 / 5) * 4,096) * 4,000 / 65,536

= 0.4 * 4,096 * 4,000 / 65,536

= 100°C

The potentiometer is used to calibrate the system, and all that is required is to measure the heat-sink temperature, and adjust the potentiometer to suit.

In practice, leave the amplifier to acquire the ambient temperature by letting it sit for an hour or so, use an accurate digital thermometer, and adjust the potentiometer as required.

For the Fahrenheit scale, the conversion is:

T = (((2 / 5) * 4,096) * 7,200) / 65,536) + 32

T = (0.4 * 4,096 * 7,200 / 65,536) + 32

T = (1,638.4 * 7,200 / 65,536) + 32

T = (11,796,480 / 65,536) + 32

T = 180 + 32

T = 212°F

Temperature Sensor Calibration

The previous version of the firmware sampled the temperature channel about once every 4mS, and this could lead to considerable flicker of the display when the temperature was between two display points.

This version of the firmware averages the temperature reading over 250 samples and a period of about 1 second leading to a much more stable display. A side effect of this is that when calibrating the sensor the display responds quite slowly, and you will have to wait several seconds for it to stabilise after each adjustment.

A quicker method is to use the serial test suite temperature calibration method. When you enter T you will receive a prompt to press any key to start. The display will be the current temperature sensor reading, and the reading that will be displayed. It is averaged over 10 samples, and updates about 5 times/second and thus responds very quickly to calibration adjustments.

Carefully adjust the calibration potentiometer so that the displayed reading matches as closely as possible that measured with an accurate digital thermometer.

Note: The display reading is rounded to the nearest degree in either °C or °F.

Note: When using the serial test suite calibration option no display updates occur.

To exit this mode, press any key.

Entering the letter t will invoke the buzzer sound test:

```
Sound Test
Enter Frequency (100 - 5000Hz): 500
Data Value: 7372
Enter duration (10 - 32,000mS): 1500
```

Enter the letter G for the current input attenuator settings:

```
Input Attenuator Status
Band: 1.8MHz G1: = –6dB
Band: 3.5MHz G2: = –4dB
Band:   7MHz G3: = –2dB
Band:  10MHz G4: =  0dB
Band:  14MHz G3: = –2dB
Band:  18MHz G2: = –4dB
Band:  21MHz G1: = –6dB
Band:  24MHz G2: = –4dB
Band:  28MHz G3: = –2dB
```

Note: Each band has its own attenuator settings. If you change the settings from the front panel, be sure to save the new settings when you power the transceiver down.

Enter the letter E and a dump of the EEPROM contents will be obtained:

```
Dump EEPROM contents
ADDR                  DATA
---------------------------------------------
0000: 0000 0000 0000 0000 0000 0000 0000 0000
0010: 0000 0000 0000 0005 0002 0005 07D0 012C
0020: 0001 0003 012C 0001 0000 0046 0028 0000
0030: 0001 0000 0001 0000 0000 F557 FFFF FFFF
0040: 0A4F 14AD 03FB 0032 0001 0003 0AED 081F
0050: 0064 869D 0001 0073 4252 FFFF FFFF FFFF
0060: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
0070: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
0080: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
0090: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
00A0: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
```

```
00B0: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
00C0: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
00D0: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
00E0: FFFF FFFF FFFF FFFF FFFF FFFF FFFF FFFF
00F0: 0000 FFFF FFFF FFFF FFFF FFFF FFFF FFFF
---------------------------------------------
```

It is beyond the scope of this manual to explain the mapping and contents of the EEPROM. If you are curious, you will need to read the source code, with particular reference to the file: `pa100_eeprom.h` which shows how the data values are mapped.

The first 29 words are used by the user setup contents, and the 30th word is the checksum. As an example, note the checksum `F557` at word 30.

Starting at offset `0040` the next 12 words are used for the calibration data, with the checksum at word 13.

At offset `00F0` is a counter showing the number of times the system defaults have been re-loaded.

This information is mainly of use to those wishing to modify the software, to verify that their EEPROM changes have been accomplished correctly.

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Annex B

Juma PA100D Alarm System

The PA100D was provided with an alarm system that would warn the user of over-current, over-temperature, and high SWR conditions. This has now been enhanced with the provision of over-voltage, and under-voltage alarms.

The alarm system can be tested using the serial test facility described previously. Enter the letter a (lower-case a) and you will be prompted to enter a 1, 2, 3 ,4 , 5, or 6. 1 corresponds to a high SWR alarm, 2 an over-current alarm, 3 an over-temperature alarm, 4 an over-voltage alarm, 5 a battery pre-limit warning alarm, and 6 a battery final limit alarm.

High SWR

The SWR notification will blink and will be accompanied by a loud beep. To acknowledge and cancel any alarm, briefly press the PWR button.

The limit at which the alarm is triggered is adjustable from the System Setup & Calibration menu from 1.0 – 10.0

Whilst a setting of 1.0 might seem strange, it is there to allow you to safely test the alarm. If you set the threshold to 1.0, and then save the setting and return to normal operation, with the amplifier connected to a dummy load, if the transmitter is keyed the alarm will be triggered. Release the PTT switch or key, and press the PWR button to cancel the alarm.

Switch the amplifier off and reselect the System Setup & Calibration menu and restore the threshold to a suitable value, 3.0 is recommended.

High Current

The amplifier is fitted with a high-side current sense amplifier and over-current trip, the MAX4373. It is independent of the measurement system and will provide a fast-acting trip in the event that the input current exceeds 24A. The alarm will latch and will force the amplifier to the standby state.

To reset the alarm, release the PTT switch or the key, and briefly press the PWR button. If the alarm cannot be cleared this indicates a serious fault and the amplifier must be immediately powered down, and the fault investigated.

Over-Temperature

The heat-sink temperature is continuously monitored, and in the event of the temperature exceeding the preset threshold, the alarm will be raised. The fan will be running at its maximum speed, but it may take some time for the amplifier to cool sufficiently to clear the alarm.

Over-Voltage

Once every cycle of the main control loop, approximately every 4mSec, the battery voltage is measured and compared with the preset threshold. If it exceeds the threshold, and the alarm is enabled, the over-voltage alarm will be raised.

This alarm is provided primarily for those using the amplifier in a mobile installation powered from an automobile electrical system. Be aware that alternator spikes can cause this alarm to be triggered, as well as a poor battery, poor battery contacts, and high resistance connections.

Although the amplifier can withstand short-term exposure to high voltages, it is inadvisable to continue operation in the event of this alarm. The threshold can be adjusted from the System Setup & Calibration menu.

Under-Voltage
When operating portable from a sealed lead-acid battery it is important that to maximise the service life, operation is terminated before the battery is completely discharged.

Most manufacturers recommend that the discharge be terminated when the voltage has fallen to no lower than 10.5V.

The amplifier is provided with a pre-limit alarm feature that will warn you when the input voltage has fallen to the low voltage threshold plus 100mV, and in that event, this alarm will appear.

Note: Once you have acknowledged the alarm it will clear, and will not return, this is a one-time alarm and warning. The only way to reset this alarm is to power the amplifier off and then back on again. The voltage at which this pre-limit warning will occur is always 100mV higher than the final limit low-voltage alarm.

Low-Voltage (Final Limit)
When the input voltage falls below the final limit low-voltage threshold, this alarm will be triggered. It is resettable, in that if the voltage rises above the threshold, the alarm can be cleared. The threshold is adjustable from the System Setup & Calibration menu. The default value of 11.0V is recommended. This will ensure that the battery voltage does not fall too low. In any event, the battery must be recharged as soon as possible.

Do not leave the battery in a discharged state, a secondary electrochemical reaction occurs that causes sulphation, which is not recoverable, and will severely shorten the service life.

Note that the alarm system can have multiple simultaneous alarms. The design of the firmware is such that the most urgent alarm is cleared first, which will then reveal any lower priority alarms. The next push of PWR button will then clear the most urgent of the remaining alarms, until all the alarms have been cleared.

Annex C

PA-100D & Elecraft KX3 Interconnection

Commencing with PA-100D firmware version 1.05h/13/October/2012 the PA-100D incorporates a facility that allows it to be used with the Elecraft KX3 Ultra Portable HF Transceiver. When used with this transceiver the PA-100D will automatically select an amateur band transmit filter set based upon the frequency data it receives from the KX3 via its serial port.

In order to use this feature certain requirements have to be met.

a. Connect the BNC RF output socket of the KX3 to the BNC RF input socket of the PA-100D.

b. Connect the ACC2 socket of the KX3 to the T/R socket of the PA-100D using the cable described later.

c. Connect the ACC1 socket of the KX3 to the RS-232 socket of the PA-100D using the serial cable described later.

d. On the KX3, set the MENU AUTOINF to ANT CTRL. (See your Owner's Handbook for details on how to do this.)

e. On the PA-100D, in the User Configuration menu set the Frequency Sense mode to KX3. This will automatically set the RS-232 protocol to TRX-2/KX3 as well.

f. The default speed for the KX3 serial port is 4800 baud, if you wish to use this speed, in the PA-100D User Configuration menu, set the port speed from its default of 9600 baud to 4800 baud.

g. In the PA-100D User Configuration Menu, you can select whether to enable or disable polling. If the KX3 is set to use the auto-inform feature, then polling is not required; changes made to the KX3 are automatically sent to the PA-100D using the FA (VFO-A) status message. Even if this mode is used, polling can still be enabled, in which case the PA-100D will periodically query the KX3 using the FA; command to request its current VFO-A frequency. If polling is enabled, the default setting of 5 seconds is satisfactory. If the KX3 is not set to use the auto-inform feature, then polling must be enabled in order to obtain the transceiver's current frequency. In this case, for a slightly faster response, a polling rate of 2 seconds is suitable, although even 5 seconds is quite adequate.

ACC1 to RS-232 Accessory Cable

The KX3 ACC1socket is a RS-232 port, but see Note 5 regarding actual voltage levels. It uses a stereo 3.5mm connector with transmit data from the KX3 appearing on the ring contact, and receive data from a computer on the tip contact. The shield contacts should be connected together.

The PA-100D with its internal jumpers on the frequency sense board in the normal setting has its transmit data from the PA-100D on the ring contact, and the receive data on the tip contact. You will therefore have to make a cable that cross-connects tip and ring each way in order to be able to achieve satisfactory communications.

Alternatively, you can change the setting of the PA-100D internal jumpers to the software update mode, and then a straight 3.5mm to 3.5mm stereo patch cord can be used.

ACC2 to T/R Accessory Cable
To switch the PA-100D into transmit you need to connect from the 2.5mm ACC2 socket of the KX3 to the 3.5mm T/R socket of the PA-100D.

The KX3 has an open-collector transistor connected to the keyline output which is wired to the ring contact, and this must be connected to the tip contact of the 3.5mm stereo plug. The shield is connected straight to the shield.

Note: Do not make ANY connection to the 2.5mm plug's tip contact!

Notes

1. This version of the firmware uses a greatly simplified command/response algorithm. In the previous version when using the Auto-Inform feature, it could take up to 5 seconds for the PA-100D to recognise a band change. An examination of the KX3 serial data packets revealed that in the Auto-Inform mode the IF packet was always being sent last, the first data packet was always the FA frequency data. It therefore made sense to use this data rather than the IF data for band selection.

2. When polling is enabled, the query command is the FA; command. The KX3 will respond very quickly to this command so that there is little or no delay to band changes.

3. If you wish the verify that the PA-100D is correctly responding to KX3 data packets, there is a 'hidden' debug feature available. From the power off state, press and hold the BAND− button and turn the power on. You will see a prompt message stating that the KX3 message time-out is now set to 5,000mSec. The normal time is 500mSec. You can now connect the PA-100D to a PC running a standard terminal program and send KX3 data packets to verify correct operation. For example, to select the 7MHz band, send the ASCII string:

   ```
   FA7000000;
   ```

   and the amplifier should immediately select the 7MHz/40m output filter. By entering the appropriate frequency data in Hz, you should be able to select any of the output filters. Similarly, by turning polling on, and setting the polling interval to, for example, 10 seconds, you can observe the amplifier's actions. You will see the `FA;` query commands from the PA-100D, and if you respond with the ASCII frequency message as before, the amplifier will again select the requested filter. If you fail to respond within the polling interval, then the amplifier will show the ? symbol to indicate that a polling time-out has occurred, and the default 28MHz filter has been selected. To reset the message timer, turn the power off, and then back on again.

4. If polling is disabled, to ensure that the amplifier selects the correct output filter on initial start-up, please use the following sequence. First power up the KX3 and allow it to initialise. Then power up the PA-100D. It will send a single FA query command to the KX3 to request its current frequency. This only occurs once during power-up with polling disabled. This sequence is necessary because even with Auto-Inform enabled in the KX3, it does not send any messages when powering up.

5. Unfortunately Elecraft has decided to make the voltage levels of the RS-232 port non-standard. The standard levels are from −3V to −25V which is a logic one state or mark, and from +3V to +25V which is a logic zero state or space. The voltage between −3V and +3V is undefined. The Elecraft KX3 RS-232 port available on the ACC1 socket uses 0V for logic one, and approximately +12V for logic zero. Whilst many standard RS-232 ports will actually tolerate these incorrect levels, there are some which will not. The PA-100D RS-232 port is designed to provide and accept the standard levels, but is sufficiently tolerant that it will accept the KX3 data. However, if you find that your USB-RS-232 convertor is not working reliably with the KX3 when using a logging program, don’t blame the convertor, it may simply be that it does not accept the KX3's data levels. The Elecraft USB-RS232 connecting lead supplied as standard with the KX3 (KXUSBa) is designed to accept the modified data levels. However, the alternative 3.5mm to DB9 (KXSERa) simply connects the transmit and receive data lines to the appropriate pins of the DB9 connector, there is no level translation. Thus this interface cable may also not always work correctly with a standard RS-232 port.

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PA-100D QUICK REFERENCE GUIDE

BUTTON	SHORT PUSH	LONG PUSH
PWR	Power On Cancel Alarms Cancel Save Decrement display page (Normal mode) Decrement Cal/Config Page (Only in Service or User Configuration mode)	Power Off Select Calibration Mode (From OFF state) Multiple page decrement (Only in Service or User Configuration mode)
UP	Increase Gain Select Calibration/Configuration Value	Repeat Increase Gain Repeat Cal/Config Value
DOWN	Decrease Gain Select Calibration/Configuration Value	Repeat Decrease Gain Repeat Cal/Config Value
DISPLAY/CONFIG	Select Display Mode Increment Cal/Config Display Page	Select User Configuration Menu Multiple Cal/Config Page increment RS-232 Loop Back Test (With PWR, from OFF state)
OPER	Select Operate/Standby Mode Save settings (In User Configuration or System Calibration Mode)	Select Flash Memory Writer (With PWR, from OFF state)
AUTO	Select Auto/Manual Band	Not Assigned
BAND-	Select Lower Band	Repeat band select. Set KX3 message timeout to 5,000mS. (With PWR, from OFF state)
BAND+	Select Higher Band Save Settings	Repeat band select. Reset Defaults (With PWR, from OFF state)

PA-100D CALIBRATION SETTINGS

DATA POINT	USER	DEFAULT
Voltmeter		5250
Ammeter		2520
RF Power Factor (High Power)		1200
RF Power Offset (Low Power)		120
Beep Time		50mS
Poll Rate		5 Sec
Power Averaging Samples		1
Over-Voltage Trip		On
Over-Voltage Trip Limit		14.75
Low Voltage Trip		On
Low Voltage Trip Limit		11.00
Graphic Scale Max Power		100W
Frequency Meter Calibration		999985

PA-100D CONFIGURATION SETTINGS

DATA POINT	USER	DEFAULT
Auto Band Detect		F-Sense
Serial Port Test Mode		On
Port Speed		9600 Baud
LCD Backlighting		300
LCD Contrast		2000
SWR Trip Limit		3.0
Temperature Scale		Celsius
Fan Control Mode		Normal
Over-temperature Limit		70°C
Fan Cut-In Temperature		40°C
Band Units		MHz
Graphic Limits		Off
Graphic Display		Original
RF Power Meter Type		Watts
Start-Up Page		O/P Power