Pi Pico Rx

User Manual
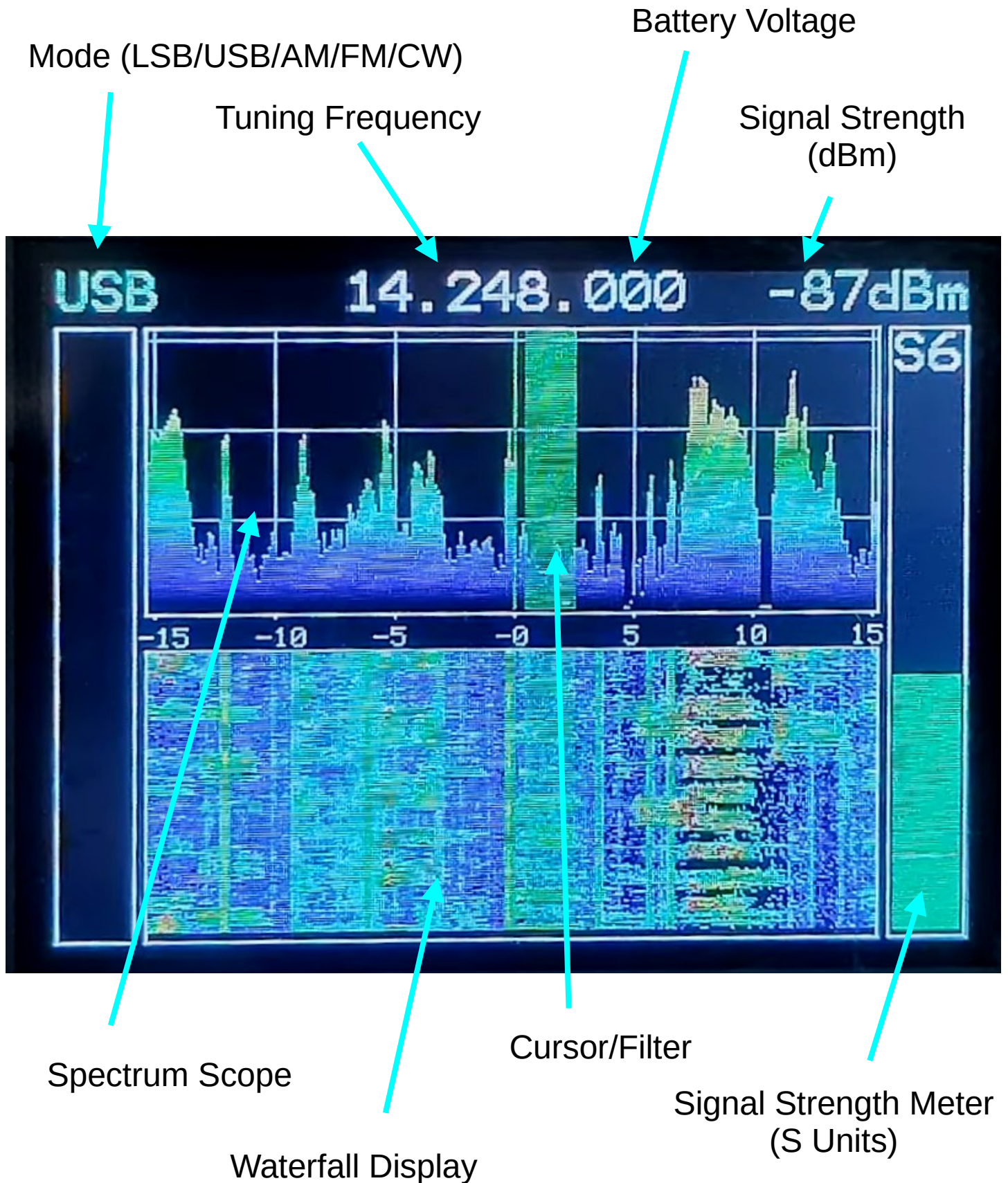
Default Home Screen

Tuning Step   Battery Voltage

Mode (LSB/USB/AM/FM/CW)   Volume   CPU temperature

Tuning Frequency

AM   1kHz   4.1V 20°C

1.413.000

-95dBm

- S5

85% 100%

Signal Strength Meter
(S Units)

CPU load   Signal Strength
(dBm)

USB Buffer Level

Spectrum Display

Optional Secondary TFT Display

Battery Voltage

Mode (LSB/USB/AM/FM/CW)

Signal Strength (dBm)

Tuning Frequency

Spectrum Scope

Cursor/Filter

Signal Strength Meter (S Units)

Waterfall Display

Home Page Actions

Menu	Encoder	Back
press	press	press
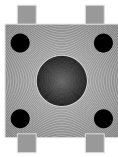
| Enter Menu | Memory Recall | Change View |

Tuning

Menu

Encoder

Back

hold

rotate

hold

Normal

Slow (/10)

Fast (*10)

Very Fast (*100)

Shortcuts

Menu   Encoder   Back

hold   hold
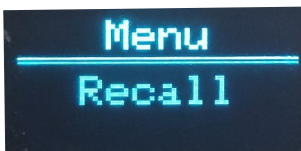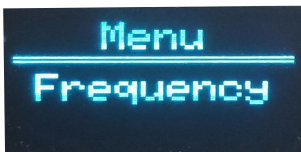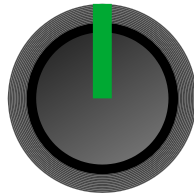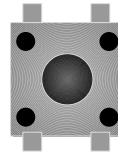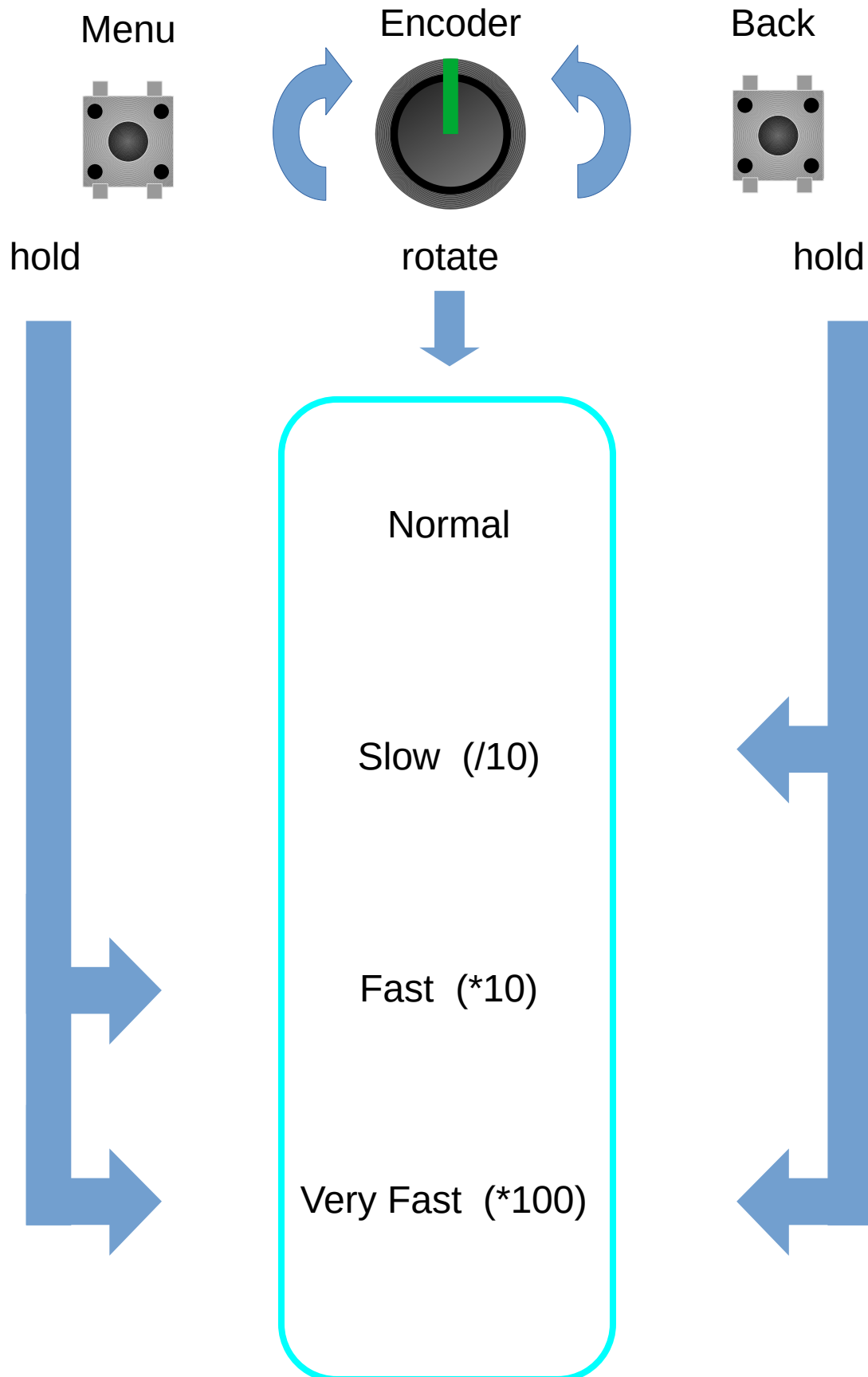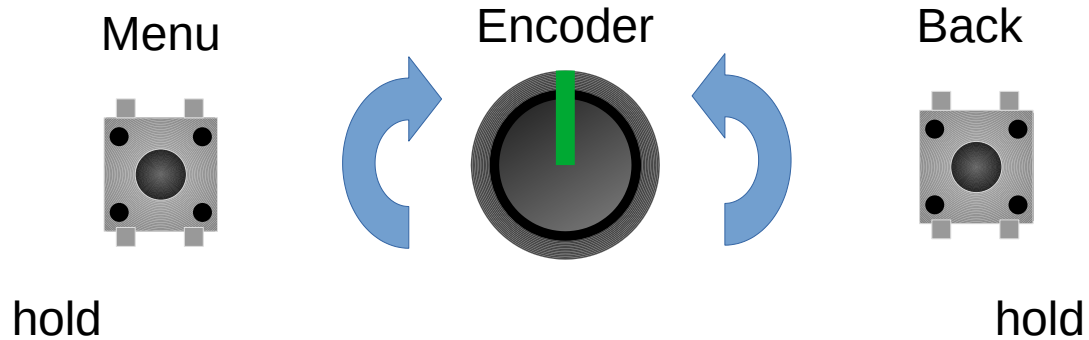
| Shortcut	Description
Encoder Rotate	Tuning Up/Down
Encoder Rotate + Menu held	Tuning Up/Down x10
Encoder Rotate + Menu held + Back held	Tuning Up/Down /10
Encoder Rotate + Menu held + Back held	Tuning Up/Down x100
Encoder Rotate + Encoder Held	Volume Up/Down
Encoder Rotate + Encoder Held + Menu Held	Mode Select (AM/AMS/FM/CW/LSB/USB)
Encoder Rotate + Encoder Held + Back Held	Frequency Step Up/Down

Main Menu

Menu
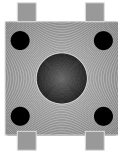
Encoder

Back

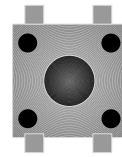press = accept/change
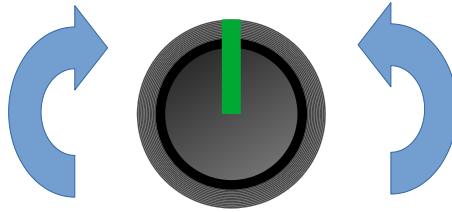
rotate

press = return/cancel

Frequency

Memory Recall

Memory Store

Volume

Mode
AGC Speed
Bandwidth

Squelch
Auto Notch

De-emphasis

IQ Correction

Spectrum Zoom
Band Start

Band Stop

Frequency Step

CW Tone

HW Config

Menu Settings – Part 1

| Setting	Range	Description
Frequency	0-30 MHz	Manual Frequency Entry. Selecting a frequency outside the current band will reset the band limits to allow free-tuning across the full frequency range.
Memory Recall	0-511	Select One of 512 memory channels (A channel can be a single frequency or a band of interest)
Memory Store	0-511	Save the current frequency, mode etc. in one of 512 memory channels
Volume	0-9	Audio Volume 0=mute
Mode		Receiver mode (AM, AMS, FM, LSB, USB, CW)
AGC Speed	Very Slow – Fast (Manual Gain 0dB to 60dB)	Automatic gain control adjusts the gain so that weak and strong stations have a similar volume level. Fast settings respond quickly to changes in signal level, slow settings change more gradually. A slow setting might prevent adjustments to gain during gaps in speech. Manual gain control is also possible, this might be useful when a constant gain is desirable, e.g. when working with digital modes.
Bandwidth	Very Narrow – Very Wide	Adjust the filter bandwidth, a narrow setting reduces background noise and can improve intelligibility of weak signals. A wider settings allows through a greater range of frequencies giving better sound quality for strong signals.
Squelch	S0 - S9+30dB	The squelch function gates background noise. The signal is muted unless the signal strength reaches a defined level. Squelch can be adjusted to allow signals to be audible when active, but remove background noise when inactive.
Auto Notch	On/Off	The automatic notch filter can be used to remove interfering tones. If stable interference is detected consistently at the same frequency, a narrow notch is enabled to automatically suppress the interference.

Menu Settings – Part 2

| Setting	Range	Description
De-Emphasis	off/50us/ 75us	Enable de-emphasis filter
IQ-Correction	On/Off	Compensates for differences in phase/magnitude in the IQ inputs. Enable this setting to improve image rejection (remove mirror frequencies).
Spectrum Zoom	1-4	Zoom level for spectrum scope. 1=30kHz, 2=15kHz, 3=7.5kHz, 4=3.75kHz
Band Start/Band Stop	0-30MHz	The band-start and band-stop settings define the tuning range of the current band. The band-start and band stop settings are stored in memory channels allowing memory channels to hold bands as well as individual frequencies.
Frequency Step	10Hz- 100kHz	Set the default tuning step. Note that fast and slow tuning from /10 to *100 the nominal frequency step can be achieved by holding the menu/back buttons.
CW Tone	100Hz - 3000Hz	When received, the CW signal has a very narrow bandwidth close to DC, lower than the range of human hearing. The CW tone increases the frequency of the CW signal to a frequency that can be heard comfortably A frequency between 500Hz and 1000Hz is typical.
HW Configuration	0-9	The Pi Pico RX is designed to be as flexible as possible to allow different configurations and experimentation by constructors. A separate hardware configuration menu is provided to configure the hardware.

Hardware Configuration Menu

Menu   Encoder   Back
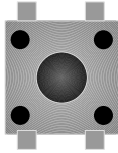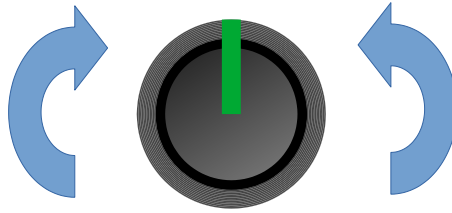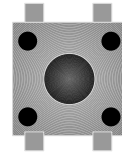
press = accept/change   rotate   press = return/cancel

Display Timeout

Regulator Mode

Reverse Encoder

Encoder Resolution

Swap IQ

Gain Cal

Freq Cal
Flip OLED

OLED Type

TFT Settings

TFT Colour

Bands

Display Contrast
USB Upload

Hardware Configuration Settings-Part 1

Setting	Range	Description
Display Timeout	Never, 5 seconds – 4 minutes	Display turns off after a period of inactivity. This can be useful for power saving when running from batteries. This may also help prevent noise being generated by the display being received.
Regulator Mode	FM/PWM	The Pi Pico contains a switched-mode regulator. Under light loading, the regulator can switch into a FM mode to save power, this does however increase supply ripple. The PWM setting reduces supply ripple.
Reverse Encoder	On/Off	This allows the direction of the encoder to be reversed (clockwise/anticlockwise). This allows for variations in hardware construction where the encoder is wired in a different configuration.
Swap IQ	On/Off	Swap the I/Q ADC input channels. Can be used to correct for a difference in wiring of the LO inputs, or IQ inputs. It causes the received spectrum to be reversed so that positive frequencies become negative and vice-versa. This is also useful for checking image rejection.
Gain Cal	1-100dB	Specifies the gain of the receiver, this is used by the software to calculate the signal strength for the S-meter and dBm signal strength. The breadboard version of the receiver with default components has a gain of 57dB. Constructors may use alternative gain values, additional filters or preamplifiers. This setting also allows the S-meter to be calibrated so that it reads the correct signal strength with a known input signal.
Freq Cal	-100 to +100 ppm	Allows oscillator frequency to be calibrated to account for process variations in the pi-pico crystal oscillator. Frequency can be tuned using a reference oscillator or frequency counter. It may also be possible to calibrate by "zero-beating" a station with a known carrier frequency e.g. WWV.
Flip OLED	On/Off	Allows the display to be flipped horizontally, this may be useful to constructors who need to place the display in a different orientation. Only landscape orientations are supported.

Hardware Configuration Settings-Part 2

Setting	Range	Description
OLED Type	SSD1306 /SH1106	Allows different types of OLED display to be used. I2C OLED displays using SD1306 and SH1106 driver chips are supported.
Display Contrast	0 to 15	Allows contrast of OLED display to be adjusted. Lower values reduce power consumption, higher values improve readability in bright surroundings.
TFT Settings	Off, Rotation 1-8.	An optional SPI TFT (ili9341) display can be connected to provide an enhanced waterfall/spectrum scope. By default the secondary TFT display is disabled. To allow for variations in hardware, 8 different rotation settings are provided.
TFT Colour	RGB/ BGR	To allow for variations in hardware, 2 different colour settings are provided.
Bands	Band 1-5 0 to 32MHz	Pi Pico Rx provides 3 GPIO outputs to control up to 8 band filters. The default settings are intended to work with the PCB version and provide a good compromise for a general coverage receiver. The boundary between the bands can configured through this menu, this allows constructors to define their own custom bands (e.g. one band-pass filter for each amateur radio band).
USB Upload (Memory)		Allows user specified memory channels to be loaded in bulk via USB replacing the default memory channels. A simple Python utility can be used to upload settings from a CSV files via USB serial interface.
USB Upload (Firmware)		Places Pi Pico into USB firmware upload mode. The device appears as a USB drive, and can be upgraded by dropping writing a .uf2 firmware image. This is equivalent to holding the pico push-button during power on.

Scanning

Pi Pico RX provides a scan feature, the scan feature can be accessed as a separate "home screen view". (Different views can be selected by pressing the "back" button on the home screen.

There are 2 scanning modes, *frequency scan* and *memory scan*. In frequency scan mode, the receiver searches for signals in the current band frequency range (e.g. 20m SSB band). In *memory scan* mode, the receiver searches memory channels for active signals.

The encoder controls both the direction and speed of the search.

In both modes, the squelch setting is used to determine the threshold level, if the signal strength exceeds the squelch threshold, the search is halted. Searching can be continued by rotating the encoder.

The current signal strength and squelch level are indicated by a vertical bar on the right hand side.

CAT Control

Cat control is provided through a USB serial port interface. The Pi Pico Rx emulates a subset Kenwood TS-480. The CAT interface allows the receiver to be controlled via a host device by software such as grig, wsjtx and fldigi.

USB Audio

The Pi Pico Rx supports USB audio, and when connected should appear as a USB microphone. This allows a host device to easily make audio recordings (e.g. using audacity), and is compatible with software such as wsjtx, fldigi and QSSTV. When combined with USB cat control allows a fully functional PC connection using only a single USB cable. The direct digital audio connection provides superior audio quality compared to an analogue connection using a sound card.