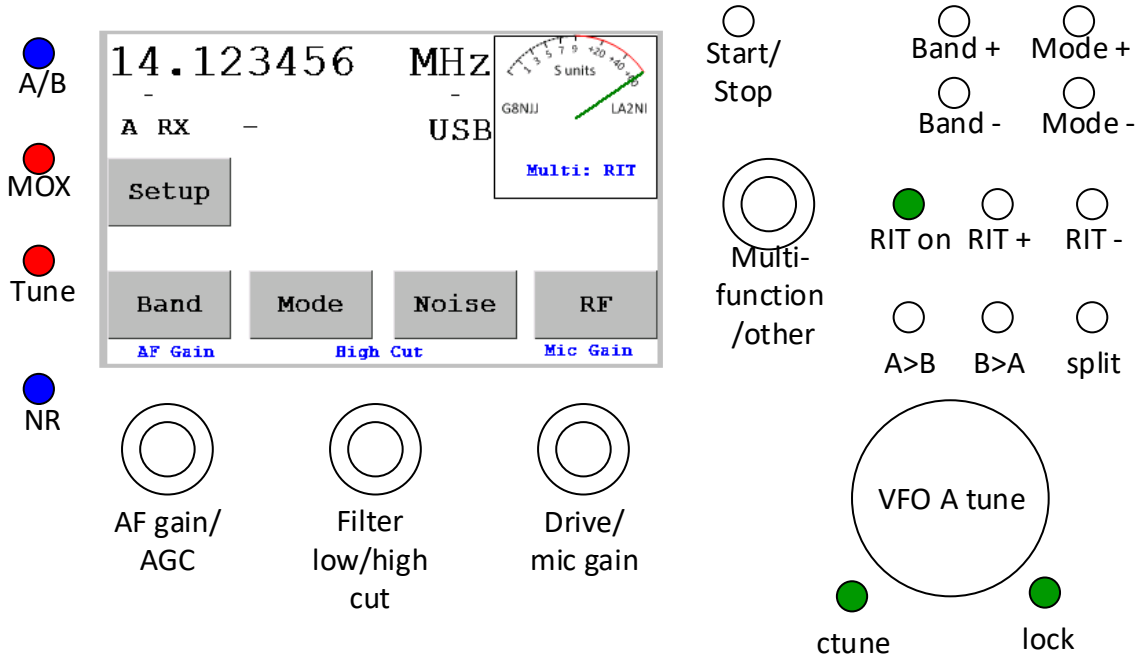
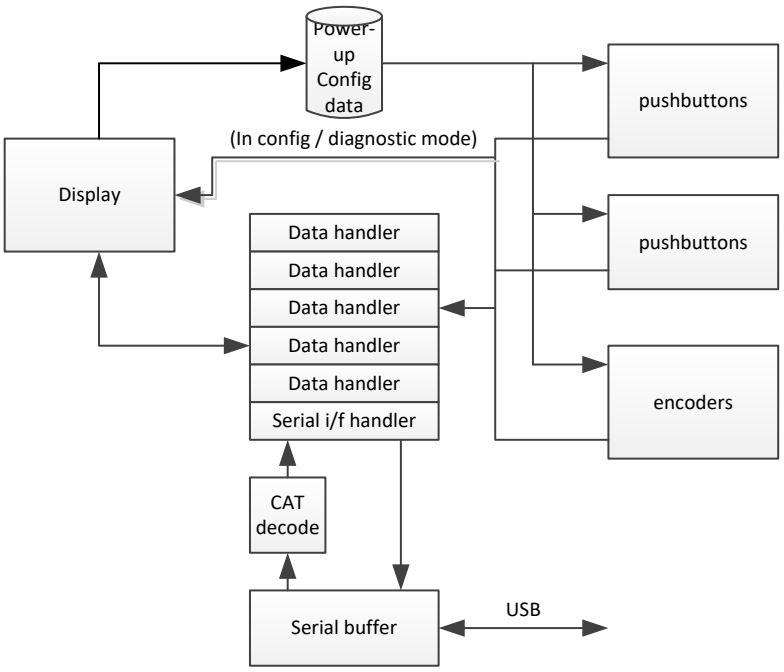
“Odin” Console Implementation Notes



Software Structure

Diagram



Concept for Operation

The serial queue to / from the PC will use normal Arduino library code. On TX, it will simply transfer the requested data. On RX, the CAT messages will be decoded and passed to the appropriate handlers.

The pushbutton, and encoder handlers will simply provide events to the CAT handlers. Each will be assigned by config variables to one CAT handler, so they know where to pass data to. LEDs will provide their ids to CAT handlers from that data; thereafter the CAT handlers will set them lit or not.

The display will have several screens, changed under its control. It can also originate commands to the handlers. It is known to be inefficient to write data to the display that isn't on the current screen: so some awareness of which screen is active is needed in the Arduino. "redraw" and "update" may be relevant for each screen.

An operation could be as follows:

- Volume up encoder event
- Encoder informs the "AF gain" handler of a +1 click event
- AF gain handler requests current gain
- When AF gain handler gets current gain from PC, it increments it and sends a new request

List of Control Types

(Taken from the original specification document)

The list of functions that needs to be assignable to controls is as follows:

Pushbuttons (including encoder “press”)

- A/B VFO select
- MOX
- TUNE
- AF MUTE
- Filter reset
- Band +
- Band –
- Mode +
- Mode –
- AGC speed
- NB step
- NR step
- SNB on/off
- ANF on/off
- RIT on/off
- RIT +
- RIT –
- A>B
- B>A
- A/B swap
- Split
- CTUNE
- Lock
- Radio Start/Stop
- Squelch on/off
- Attenuation Step
- VOX on/off
- Diversity fast/slow step

Indicators (including illuminated pushbuttons & LCD)

- MOX
- TUNE
- RIT on
- Split selected
- CTune selected
- Lock selected
- NB off/on
- NR off/on
- SNB off/on
- ANF off/on
- Squelch on/off
- VFO A/B

Encoders

- AF channel gain
- Master AF gain
- AGC
- Filter high cut
- Filter low cut
- Drive
- Mic Gain
- VFO A tune
- VFO B tune
- VOX gain
- VOX delay
- CW sidetone
- CW speed
- Squelch
- DiversityGain
- DiversityPhase
- Multifunction

Initial Settings for Controls

All controls, other than the VFO encoder, can be reallocated by the user to any function. The “factory default” assignment, noting which push switches are illuminated, is as follows:

Encoder functions

Encoder	Main function	2nd Function
2A	AF Gain	AF Gain
2B	AGC threshold	AGC threshold
3A	Filter high	Filter high
3B	Filter low	Filter low
4A	Drive (?to become Diversity?)	Drive
4B	Mic Gain (?Diversity?)	Mic Gain
5A	Multifunction	Multifunction
5B	Drive	Drive

(This gives the end result of each being single function)

Indicator/switch functions

Switch number	Indicator	Digital pin	Initial function
SW1	LED1	30	Toggle VFO A / VFO B
SW2	LED2	31	MOX
SW3	LED3	32	TUNE
SW4	LED4	33	Click Tune
SW5	LED5	34	VFO LOCK
SW6		35	A>B
SW7		36	B>A
SW8		37	SPLIT operation
SW9	LED6	38	RIT on
SW10		39	RIT step up
SW11		40	RIT step down
SW12		41	Band down
SW13		42	Mode down
SW14		43	Radio start/stop
SW15		44	Band up
SW16		45	Mode up
Encoder 2 push		6	AF MUTE
SW17	LED7	9	NR
Encoder 3 push		12	Filter Reset
Encoder 4 push		23	(No function)
Encoder 5 push		29	Encoder action (for multi)

Note Encoder 1 is the VFO encoder and has no pushbutton)

CAT Messaging

Ideally I should have an LED to show “console in use” ie successful message exchange with PowerSDR. At power up, could send a “request VFO A frequency” message and await response. Would that sit in the serial queue?

Might want to consider if(Serial())….. or if (TX queue != empty)….. to know that we’ve attempted a connection.

Need to allow for the possibility of messages getting corrupted, and needing timeouts / retry

Information Display

There needs to be a periodic scan to update the console for any settings that are displayed (either by LCD or LED). Strictly that might only be needed for those things currently on the display. Aim to update everything every 2-5 seconds?

LED display of TUNE and MOX should be for locally initiated commands. The reason being: a MOX initiated by CAT can't be cancelled from the PC end; so an indication that "I've initiated it from here" would be useful.

CAT 1.5 second update sequence, 1 message per 220ms:
Frequency
S meter/TX power
VFO combined status
Frequency
S Meter/TX power
RX Combined status
S meter/TX power
Mode

Band, AGC threshold – request on demand

There needs to be protection against data that has been requested from the PC but not received yet overwriting new data from the console. Essentially we need to cancel an unactioned request that would result in the arrival of state data. Proposed solution: when the data is periodically requested – set a bool flag; when the data arrives, only process it if that bool flag is active. And when we send new CAT data eg from a pushbutton, clear that flag for that datatype. At the moment this applies to:

- Frequency (ZZFA/FB);
- VFO status (ZZXV);
- RX status ((ZZXN/XO);
- Mode (ZZMD).

Frequency value as a text field

A frequency value arrives from CAT as an 11 digit text field, zero added meaning the frequency in Hz. We need to display a frequency in MHz, and the user can enter a frequency in MHz on the touchscreen. We need to be able to convert between them!

If > 10MHz:

Frequency from CAT	0	0	0	1	4	3	2	4	5	6	7	X	(X=terminating zero)
Displayed	1	4	.	3	2	4	5	6	7	X			

If < 10MHz:

Frequency from CAT	0	0	0	0	3	6	2	4	5	6	7	X
Displayed	3	.	6	2	4	5	6	7	X			

When the string has been edited by the user “enter frequency” screen We can’t assume any format. There is too much to go wrong treating this as an ASCII text manipulation problem - so need to convert as a floating point number.

Suggested approach:

1. For CAT received frequencies:
    a. Start with CAT string as above
    b. Convert to integer, Hz
    c. Convert to float; divide by 1E6; convert to text. Send to display. ftoa()
2. For a frequency step (VFO encoder):
    a. Send the step command to CAT
    b. Update the integer Hz frequency & store.
    c. Convert to float; divide by 1E6; convert to text. Send to display. ftoa()
3. For a user entered frequency:
    a. Start with a text value in MHz
    b. Convert to float; multiply by 1E6; store Hz frequency. atof()
    c. Create zero padded string for CAT message.
    d. Convert to float; divide by 1E6; convert to text. Send to display.

To speed things up: we could give the display both the string and the frequency in Hz. It could use the integer to decide if the number displayed is different, and the string needs to be updated. It will still need persistent storage of the string so it can redraw itself.

ftoa(float input, char* buffer, int numdecimalplaces)

float atof(char* buffer) returns 0.0 if no number found

CAT Commands To be Parsed

Control effect	**CAT message**	**Notes**	**Response Case**
Set Master AF gain	Get: ZZAG; Set: ZZAGnnn;	nnn=000 to 100; meaning a percentage value. ZZAG065; sets to 65%	2
Set A, B AF gain	Get RX1: ZZLA; Get RX2: ZZLE; Set RX1: ZZLAnnn; Set RX2: ZZLEnnn;	nnn=000 to 100; meaning a percentage value.	2
Set/display A, B attenuation	Get RX1: ZZPA; Get RX2: ZZPB; Set RX1: ZZPAn; Set RX2: ZZPBn;	10dB steps only, & settings h/w dependent n=0: -20dB n=1: 0dB n=2: -10dB; n=4: -30dB do a “get” after setting to find outcome.	2
Set/display A/B AGC threshold	Get RX1: ZZAR; Get RX2: ZZAS; Set RX1: ZZARnnnn; Set RX2: ZZASnnnn;	nnnn=-020 to +120 (with mandatory sign)	3

Set/display A/B AGC speed	Get RX1: ZZGT; Get RX2: ZZGU; Set RX1: ZZGTn; Set RX2 ZZGUn;	n=0: fixed; n=1: long; n=2: slow; n=3: med; n=4: fast; n=5: custom	2
Set filter low (possible display)	Get RX1: ZZFL; Get RX2: ZZFS; Set RX1: ZZFLnnnnn; Set RX2: ZZFSnnnnn;	nnnnn=-9999 to +9999 (in Hz, with sign)	3
Set filter high cut (possible display)	Get RX1: ZZFH; Get RX2: ZZFR; RX1: ZZFHnnnnn; RX2: ZZFRnnnnn;	nnnnn=-9999 to +9999 (in Hz, with sign)	3
Set drive	Get: ZZPC; Set: ZZPCnnn;	nnn = 000 to 100	2
Set mic gain	Get: ZZMG; Set: ZZMGnnn;	nnn= -50 to 070. No sign for +.	4
Set / display VFO A/B frequency	Get RX1: ZZFA; Get RX2: ZZFB; Set: RX1: ZZFAnnnnnnnnnnn; RX2: ZZFBnnnnnnnnnnn;	nnnnnnnnnnn: 11 digit frequency in Hz 14.379123MHz = 00014379123	2
Increment VFO A/B frequency by ± N steps	(no get) Set VFO A +: ZZAFnn; Set VFO A -: ZZAEnn; Set VFO B +: ZZBFnn; Set VFO B -: ZZBEnn;	nn=0-99 steps	n/a
Set VOX gain	Get: ZZVG; Set: ZZVGnnnn;	nnnn=0-1000	2
Set VOX delay	Get: ZZXH; Set: ZZXHnnnn;	nnnn = 0-4000	2
Vox On/Off	Get: ZZVE; Set: ZZVEn;	n=0: VOX OFF; n=1: VOX ON;	2
Set CW sidetone freq	Get: ZZCL; Set: ZZCLnnnn;	nnnn=0200 to 2250 (units Hz)	2
Set CW speed	Get: ZZCS; Set: ZZCSnn;	nn=01 to 60	2
Set/display MOX state	Get: ZZTX; Set: ZZTXn;	n=0: RX; n=1: TX	2
Set display TUNE state	Get: ZZTU; Set: ZZTXn;	n=0: RX; n=1: TX	2

Set/display A/B band	Set RX1 down: ZZBD; Set RX1 up: ZZBU; Get RX1: ZZBS; Set RX1: ZZBSnnn; Set RX1 down: ZZBA; Set RX1 up: ZZBB; Get RX2: ZZBT; Set RX2: ZZBTnnn;	BD/BU step down/up in frequency BA/BB step down/up nnn: 160,080,060, 040, 030, 020, 017, 015, 012, 010, 006, 002, 888 (gen) 999 (WWV) transverters could report V01 through V13, but don't necessarily appear in step list if not enabled. after doing a mode up/down, need to do a "get" to check what was selected as a consequence!	5 (transverter response has non numerical digit)
Set/display A/B mode	Get RX1: ZZMD; Set RX1: ZZMDnn; Get RX2: ZZME; Set RX2: ZZMEnn;	nn = 00 (LSB) 01 (USB) 02 (DSB) 03 (CWL) 04 (CWU) 05 (FM) 06 (AM) 07 (DIGU) 08 (SPEC) 09 (DIGL) 10 (SAM) 11 (DRM)	2
Set/display RIT state	Get: ZZRT; Set: ZZRTn;	n=0: same freq; n=1: RIT active	2
Set RIT tune offset up/down	(no Get) Set+: ZZRU; Set-: ZZRD; Set: ZZRDnnnnn;	With no params, a "set" increments or decrements by 10Hz ZZRDnnnnn or ZZRUnnnnn both set to -9999 to +9999 Hz	3
Set/display SPLIT state	Get: ZZSP; Set: ZZSPn;	n=0: no split; n=1: SPLIT active	2
Set/display CTUN state	Get RX1: ZZCN; Set RX1: ZZCNn; Get RX2: ZZCO; Set RX2: ZZCOn;	n=0: no CTUN; n=1: CTUN active	2
Set/display LOCK state	Get VFO A: ZZUX; Set VFO A: ZZUXn; Get VFO B: ZZUY; Set VFO B: ZZUYn;	n=0: no lock; n=1: LOCK active	2
Display S meter	Get RX1: ZZSM0; Get RX2: ZZSM1; Show RX1: ZZSM0nnn; Show RX2: ZZSM1nnn;	nnn=000 to 260 (nnn/2-140) = value in dBm Example values: powerSDR says -89dBm: ZZSM0122; powerSDR says -109dBm: ZZSM00074;	5 (0/1 digit)
Display TX power indication or ALC	Get: ZZRMn; Show: ZZRMnxxxxxxx xxxxxxxxxxxxx; ZZRM4: ALC ZZRM5: fwd power ZZRM7: rev power ZZRM8: VSWR	Response is h/w dependent. When Alex selected in h/w options: ZZRM4-20.0 dB; ZZRM50 W; ZZRM70 W; ZZRM81.0 : 1; when Alex not selected: ZZRM50.00 W; (I presume all are zero padded)	5 (complex response)

Set/display NR mode	Get RX1: ZZNR;/ZZNS; Get RX2: ZZNV;/ZZNW; Set RX1: ZZNRn;/ZZNSn; Set RX2: ZZNVn;/ZZNWn;	NR off: ZZNR0; ZZNS0; NR: ZZNR1; ZZNS0; NR2: ZZNR0; ZZNS1; (RX2 - similarly ZZNV/ZZNW) treat as a pair	2
Set/display NB mode	Get RX1: ZZNA;/ZZNB; Get RX2: ZZNC;/ZZND; Set RX1: ZZNAn; ZZNBn; Set RX2: ZZNCn; ZZNDn;	NB off: ZZNA0; ZZNB0; NB: ZZNA1; ZZNB0; NB2: ZZNA0; ZZNB1; (RX2 - similarly ZZNC/ZZND) treat as a pair	2
Set/display SNB mode	Get: RX1: ZZNN; Get: RX2: ZZNO; Set: RX1: ZZNNn; Set: RX2: ZZNOn;	n=0: SNB off; n=1: SNB on	2
Set/display ANF mode	Get RX1: ZZNT; Get RX2: ZZNU; Set RX1: ZZNTn; Set RX2: ZZNUn;	n=0: ANF off; n=1: ANF on	2
Get Combined RX Status	Get RX1: ZZXN; Get RX2: ZZXO; RX1 Ans: ZZXNnnnn; RX2 Ans: ZZXOnnnn; nnnn=0 to 8191	Combines reporting of NB1/2, NR1/2, SNB, ANF, AGC, Atten, Squelch Bits 2-0: AGC Speed (see ZZGT/GU) Bits 5-3: Attenuation (see ZZPA/PB) Bit 6: Squelch on/off (see ZZSO/SV) Bit 7: NB0 (see ZZNA/NC) Bit 8: NB1 (see ZZNB/ND) Bit 9: NR0 (see ZZNR/NV) Bit 10: NR1 (see ZZNS/NW) Bit 11: SNB (see ZZNN/NO) Bit 12: ANF (see ZZNT/NU)	
Combined VFO Status	Get: ZZXV; Ans: ZZXVNNN; NNN = 0 - 255	Combines reporting of RIT, LOCK, SPLIT, CTUNE, MOX and TUNE status Bit 0: RIT on/off (see ZZRT) Bit 1: VFO A LOCK status (see ZZUX) Bit 2: VFO B LOCK status (see ZZUY) Bit 3: SPLIT status (see ZZSP) Bit 4: VFO A CTUNE status (see ZZCN) Bit 5: VFO B CTUNE status (see ZZCO) Bit 6: MOX status (see ZZTX) Bit 7: TUNE status (see ZZTU)	
Set/clear A/B mute	Get RX1: ZZMA; Get RX2: ZZMB; Set RX1: ZZMAn; Set RX2: ZZMBn;	n=0: no mute; n=1: MUTE on	2
Radio START	Get: ZZPS; Set: ZZPSn;	n=0: radio OFF; n=1: radio ON	2
Reset filters to defaults	No new message – just send out new low, high		
Squelch level	Get RX1: ZZSQ; Get RX2: ZZSX; Set RX1: ZZSQnnn; Set RX2: ZZSXnnn;	nnn= 160-0; it means -160 to 0	2

Squelch on/off	Get RX1: ZZSO; Get RX2: ZZSV; Set RX1: ZZSOn; Set RX2: ZZSVn;	n=0: squelch OFF; n=1: squelch ON	2
VFO copy/swap	(not get) Set: ZZVSn;	n=0: A>B; n=1: B>A; n=2: swap	2
Get VFO tuning step	Get: ZZAC; Set: ZZACnn;	nn=0 to 24, encoding a step size that will need a table lookup	
Diversity on/off	Get: ZZDE; Set: ZZDEn;	N=0: diversity off; n=1: diversity on.	
Diversity RX1 gain	Get: ZZDG; Set: ZZDGnnnn;	nnnn=0 to 5000, for 0.000 to 5.000	
Diversity RX2 gain	Get: ZZDC; Set: ZZDCnnnn;	nnnn=0 to 5000, for 0.000 to 5.000	
Diversity phase	Get: ZZDD; Set: ZZDDnnnnnn;	nnnnnn=-18000 to +18000, with mandatory sign. Meaning -180.00 to +180.00 degrees.	
Diversity reference source	Get: ZZDB; Set: ZZDBn;	n=0: receiver 2; n=1: receiver 1	
Diversity receiver source	Get: ZZDH; Set: ZZDHn;	n=0: RX1 + RX2 n=1: RX1 n=2: RX2	

- There are few commands with no “get” but the control code should know them.
- For parsing there are 5 cases:
    1. No parameters (send only – never happens for messages to console);
    2. Unsigned parameters with a known number of digits;
    3. Signed parameters, known number chars, with a sign always present;
    4. Signed parameters, known number of chars, with a sign present only for negative.
    5. “special cases” eg ZZRM & band display

Handler Algorithm

Type 1 - Set Relative eg Gain Set:

(We need a recent value to be able to send the new setting; recent = 3 seconds)

```
When encoder turned:
If (recent value available)
{
        Calculate new gain
        Send message
        Update the local value
        Restart recent counter
}
Else
{
        Increment /decrement the stored step count
        Send gain request command
        Start timeout count
}



Received msg handler()

Clear timeout
Parse current gain value
Set recent count
If (there is a stored click count)
{
        Add/subtract step count
        Clip result
        Send message
        Store new value
}

// this should run after the RX message handler
Timeout tick()
If (timeout active)
{
        Decrement count
        If (count == 0)
        {
                re-send command
                restart timeout
        }
}
```

Type 2 - Set Absolute, One way (eg VFO steps):

(we can send the new setting straight away, and no response needed)
When encoder turned:
{
    Send VFO step command
}

Type 3 – Set Absolute, Data also displayed (eg NR setting)

(we can send the new value, but we also need periodic updates)

When data changed:

{
    Send CAT command to set new value
    Store value for local use
    Set recency count
}
Periodically re-request data
If a request is active when data sent
    don't store that data when it is received

Type 4-Display only (eg S Meter)

If (StaleCountExpired)
{
    Reload stale count;
    Send request message;
}
Else
    Decrement stale count;

When message arrives:
{
    Store data
    Offer to display
}

Non-persistent parameters

Some parameters are persistently stored, and frequently updated via continual CAT "polling". This includes Frequency, RX settings, VFO settings, S meter and mode. This creates a lot of message traffic, so only frequently needed data is in this category. Others need to be requested on demand.

Band Setting

The "band" value is only needed for the display when the band screen is opened; so it can be called on demand. The band can also be set by "band up" and "band down" pushbutton commands. Those result in a visible response (ie frequency change) but formally the band itself isn't reported as a CAT message. To send a band up or band down does not require the current band to be known. There's no immediately obvious reason why we would have a "recent" value so the concept of having a "recent" band value seems wrong.

For a button event this looks quite simple:

Button / encoder	Display	CAT handler	10ms Tick
Band “+” button pressed	No action	Send “band up” CAT	No action
Band “-” button pressed	No action	Send “band down” CAT	No action

For a display event this might be more involved:

Display	CAT handler	10ms Tick
“band” screen opened. No buttons are set.		
Callback code invoked; requests current band	Initiate a “get band” CAT message with timeout	If timeout happens, re-request
	When get CAT reply: send to display	
Display lights up a button		
A different button click callback occurs: call “set band”	CAT handler sends new CAT “set band” message	

The display code should not have persistent storage of the band balue!

Mode Display

This is a slightly different use case: the data is in the periodic request list, so we always have an up-to-date value.

Button / encoder	Display	CAT handler	10ms Tick
			Periodically send “Get mode”
		When CAT msg arrives: store locally; send to display	
	If different from current: store value; update display		
Mode “+” button press		Mode++, with wrap Send CAT message. Store locally. Send to display.	
Mode “-” button press		Mode--, with wrap Send CAT message. Store locally. Send to display.	
	“Mode” screen opens. Callback sets one button from local data.		
	New button callback. Send CAT update. Set local display value.	Send new CAT message.	

AGC Threshold

This is needed for the display, but infrequently so never held persistently. It can be set by the display, or by an encoder; if the latter, the display may or may not be showing the appropriate page. The concept of "recent data" is relevant because a rapidly turning encoder would otherwise lead to a lot of "get value" requests.

Button / encoder	Display	CAT handler	10ms Tick
	Display RF screen opens. Callback executed. Sends threshold request.	If recent != 0: send to display. If Recent == 0, get CAT & start timeout.	If timeout expires, re-request.
		When CAT response: clear timeout, store locally, set "recent" send to display	Decrement "recent" count till reaches zero (no other action)
	When data made available, send to screen		
	When screen slider moved: send new value to CAT handler	CATSetAGCThreshold() Store locally, send CAT set "recent" count.	Decrement "recent" count till reaches zero (no other action)
Encoder up/down click: Set, increment or decrement click count		If recent != 0: calc new value, CATSetAGCThreshold() [store locally, send CAT, set "recent" count], clear click count Send to Display	
		If recent == 0: If timeout == 0: get CAT & start timeout.	If timeout decrements to 0, get CAT & start timeout.
		When CAT response: clear timeout, store locally, set "recent" if click count != 0: calc new value, CATSetAGCThreshold() [store locally, send CAT, set "recent" count], clear click count. send to display	Decrement "recent" count till reaches zero (no other action)

No persistent storage needed at the display.

AGC Gain

This is never displayed, but can be set from an encoder.

(note we use timeout as an indication that there is a request “in flight”)

Button / encoder	Display	CAT handler	10ms Tick
Encoder up/down click: Set, increment or decrement click count		If recent != 0: calc new value, store locally, send CAT, set “recent” count, clear click count	
		If recent == 0: If timeout == 0, get CAT & start timeout.	If timeout decrements to 0, get CAT & start timeout.
		When CAT response: clear timeout, store locally, set “recent” if click count != 0: calc new value, store locally, send CAT, set “recent” count, clear click count.	

Diversity Gain

Diversity gain has a further complication: we need first to find out which RX is used as the diversity reference source by using ZZDB.

(note we use timeout as an indication that there is a request “in flight”)

Button / encoder	Display	CAT handler	10ms Tick
Encoder up/down click: Set, increment or decrement click count		If recent != 0: calc new value, store locally, send gain CAT, set "recent" count, clear click count, send to display	
		If recent == 0: If RX source timeout == 0, get RX source CAT & start timeout.	If RX source timeout decrements to 0, get RX source CAT & start timeout.
		When RX source CAT response: clear RX source timeout; Store result; get gain CAT & start timeout	If gain timeout decrements to 0, get gain CAT & start timeout.
		When gain CAT response: clear timeout, store locally, set "recent" if click count != 0: calc new value, store locally, send CAT, set "recent" count, clear click count, send to display	

Variables & functions used for encoder actions:

Control	Local Storage	Recent	Timeout	Request	Update
consts		Load VRECENTTHRESHOLD	Load VGETTIMEOUT		
AGC Threshold	GCatAGCThreshold	GAGCThresholdRecent	GAGCThresholdTimeout	CatRequestAGCThreshold	SendAGCThresholdClicks
Filter Low Cut	GCatFilterLow	GFilterLowRecent	GFilterLowTimeout	CatRequestFilterLow	SendFilterLowClicks
Filter High Cut	GCatFilterHigh	GFilterHighRecent	GFilterHighTimeout	CatRequestFilterHigh	SendFilterHighClicks
Squelch Level	GCatSquelchLevel	GSquelchLevelRecent	GSquelchLevelTimeout	CatRequestSquelchLevel	SendSquelchLevelClicks
Channel AF Gain	GCatChanAFGain	GChanAFGainRecent	GChanAFGainTimeout	CatRequestChanAFGain	SendChanAFGainClicks
Master AF Gain	GCatMastAFGain	GMastAFGainRecent	GMastAFGainTimeout	CatRequestMastAFGain	SendMastAFGainClicks
Drive	GCatDriveLevel	GDriveLevelRecent	GDriveLevelTimeout	CatRequestDriveLevel	SendDriveLevelClicks
Mic Gain	GCatMicGain	GMicGainRecent	GMicGainTimeout	CatRequestMicGain	SendMicGainClicks
VOX Gain	GCatVoxGain	GVoxGainRecent	GVoxGainTimeout	CatRequestVoxGain	SendVoxGainClicks
VOX Delay	GCatVoxDelay	GVoxDelayRecent	GVoxDelayTimeout	CatRequestVoxDelay	SendVoxDelayClicks
CW Sidetone	GCatCWTone	GCWToneRecent	GCWToneTimeout	CatRequestCWTone	SendCWToneClicks
CW speed	GCatCWSpeed	GCWSpeedRecent	GCWSpeedTimeout	CatRequestCWSpeed	SendCWSpeedClicks
Diversity phase	GCatDiversityPhase	GDiversityPhaseRecent	GDiversityPhaseTimeout	CatRequestDiversityPhase	SendDiversityPhaseClicks

Diversity gain	GCatDiversityGain	GDiversityGainRecent	GDiversityGainTimeout	CatRequestDiversityGain	SendDiversityGainClicks
DiversitySource	GCatDiversitySource		GDiversitySourceTimeout	CatRequestDiversitySource	

Variables and functions used for pushbutton actions:

Pushbutton	CAT data variable	CAT send function	Display Show function
NB (step values)	GCatStateNB	CATSetNBState(ENBState)	DisplayShowNBState (ENRState z)
NR (step values)	GCatStateNR	CATSetNRState(ENRState)	DisplayShowNRState (ENRState z)
SNB (toggle)	GCatStateSNB	CATSetSNBState(bool)	DisplayShowSNBState(bool z)
ANF (toggle)	GCatStateANF	CATSetANFState(bool)	DisplayShowANFState(bool z)
Squelch (toggle)	GCatStateSquelch	CATSetSquelchOnOff(bool)	(not displayed)
Atten (step values)	GCatStateAtten	CATSetAttenuation(EAtten)	DisplayShowAtten(EAtten x)
AGC speed (step)	GCatStateAGCSpd	CATSetAGCSpeed(EAGCSpeed)	DisplayShowAGCSpeed (EAGCSpeed x)
SPLIT (toggle)	GCatStateSplit	CATSetSplitOnOff(bool)	displayShowSplit(bool x)
CTUNE A/B (toggle)	GCatStateACTune GCatStateBCTune	CATSetCTuneOnOff(bool)	(not displayed)
LOCK A/B (toggle)	GCatStateALock GCatStateBLock	CATSetVFOLock(bool)	DisplayShowLockState(bool x)

(Note this list is incomplete!)

Remember if(Pressed) {} for each!
Red- need to be written!

Display, LED Handling

The display and LED code will have “update” timer tick handlers

They should get the current required state from the CAT handlers and update where the information is displayed.

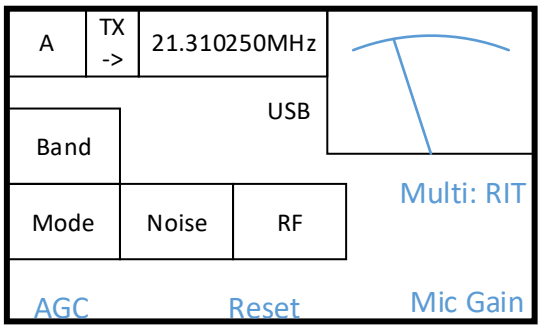
Nextion Display Coding

- To change between pages in the Nextion itself: just add event handlers “page n” to go to page n
- Only send settings to objects that are visible on the current page. To know the page, on each page, add a pre-initialise event with code “printh 65 <page number> 00 00 01 FF FF FF”. A NexPage object will trap this and note the new page number
- To change pages from the Arduino: use the show function of the nexpage object, eg page0.show(). As far as I can see the preinitialise event from the display does NOT happen under those circumstances.

Page 0: base page

The S meter requires a full size background image. I've drawn a 120x120 image using visio but had to use gimp to move the image to top right of a 400x240 image.
Set the display background image. Set the gauge to "crop image" AND set its image to the SAME background image (ie far larger than the gauge). That's the only way not to have a compile error!
(Presumably I can change both image id values to call up a TX power meter image?)

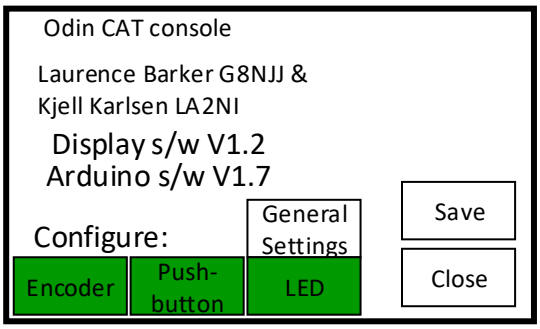
CAT Information shown on display:
A/B; A/B Frequency; A/B Mode; MOX state; LOCK state; TUNE state; SPLIT state; S meter/power meter



Page 2: About page

Encoder, pushbutton and indicator buttons call up the same "editing" page. To identify the correct target, they set a global variable on the editing page.

(no CAT data displayed)



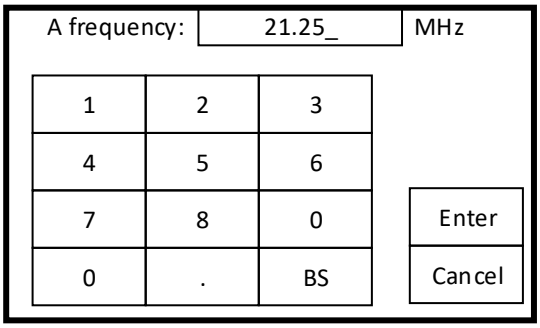
Page 3: Frequency entry

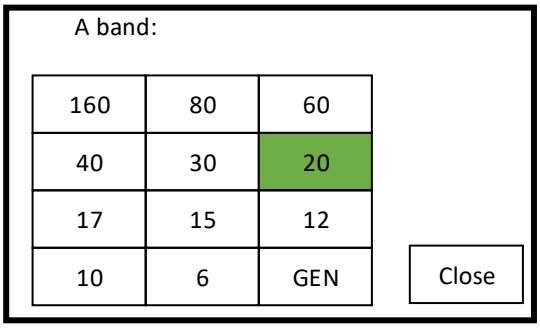
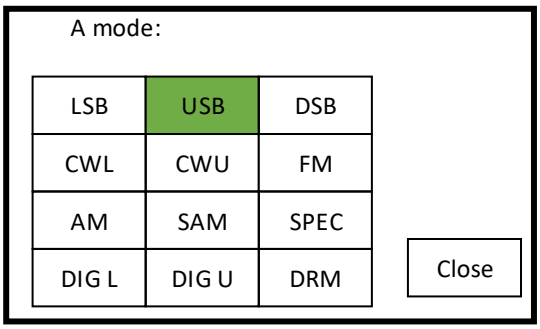
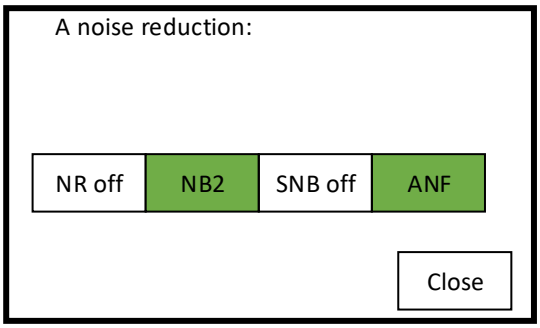
(accessed by clicking the frequency box)

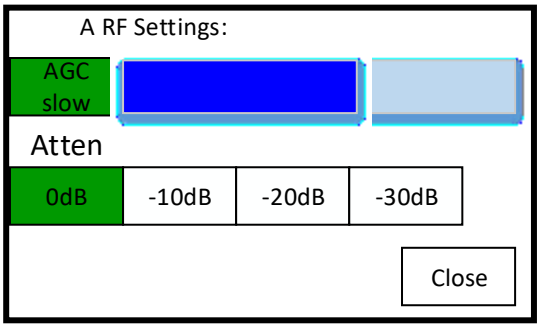
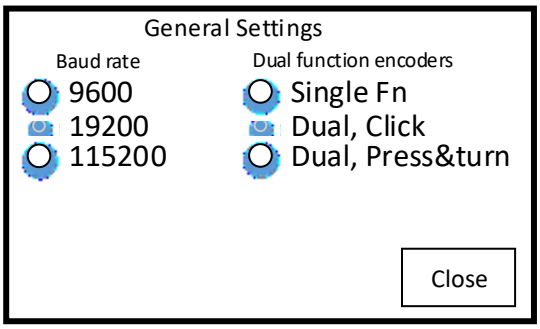
Frequency is edited as a string. The "enter" or "set" button will save the value to be acted upon.

The editing functionality is entirely within the Nextion display. The decimal point has a piece of code to allow it to add characters to the string only if the string doesn't already have a decimal point.

(no CAT data displayed)



Page 4: Band select The band buttons are all dual state buttons. When clicked, they will set the state of all the others to zero (ie unclicked). There is Nextion code to collect into an enum integer variable the current selected band. Programmed an Arduino click handler for ONE button and send that “click” string in the event code for other buttons. The event handler will then read the variable rather than query the button state. (CAT data: A/B Band needed when screen opens)	
Page 5: Mode select The mode buttons are all dual state buttons. When clicked, they will set the state of all the others to zero (ie unclicked). There is Nextion code to collect into an enum integer variable the current selected band. Programmed an Arduino click handler for ONE button and send that “click” string in the event code for other buttons. The event handler will then read the variable rather than query the button state. (CAT data: A/B Mode needed when screen opens)	
Page 6: Noise settings SNB, ANF are simple dual state buttons. NR and NB need multiple buttons; similar logic to above. (CAT data: A/B NR, A/B NB, A/B SNB, A/B ANF needed when screen opens)	

Page 7: RF settings AGC speed and atten are both groups of dual state buttons; similar logic to above. AGC threshold is a slider. Value range 0 to 140 (CAT value range is -20 to +120, so add/subtract a fixed offset) (CAT data: A/B AGC speed, A/B AGC threshold, A/B atten needed when screen opens)	
Page 8: General settings Use dual state buttons again; same logic concept.	

Page 9: Configure

There are 3 variants:

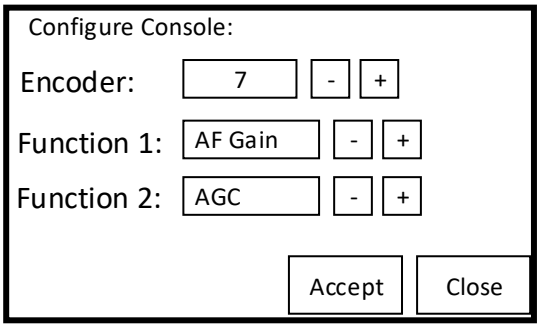
Event handlers needed for +/- buttons. Most of the logic executed in the Arduino.

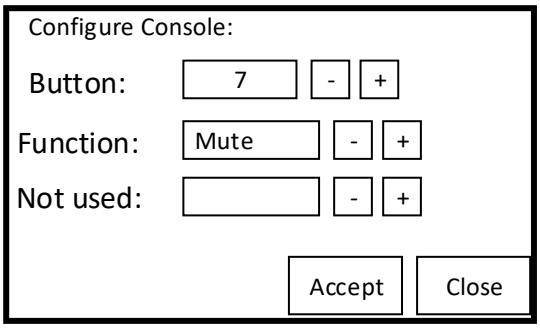
When I/O +/- buttons clicked to select a new LED/encoder/button, Arduino increments the number and changes the displayed string in the "function" box.

When function +/- buttons clicked, Arduino sends next/previous function to the text box.

When accept clicked, current settings saved in the Arduino.

Function 2 visibility set to not visible unless encoder being edited.





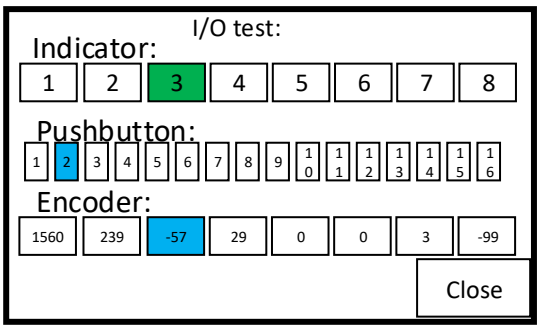
Page1: I/O test

All logic is at the Arduino end.

When an indicator dual state button clicked: Arduino event handler queries the state then sets LED on/off.

When pushbutton or encoder clicked: a pushbutton or encoder text box has its background colour changed to Green until released. There is a "send command" for this – no methods to the class.

Encoder turn increments the displayed number.



Encoder Action Texts

There are texts available to show the functions of encoders 1,3,5 & 7. The idea is:

- They show the encoder function where you have two functions per encoder
- If you have single shaft encoders for encoders 1,3 & 5: the text should show main function or 2nd function depending on which is active
- If you have dual shaft encoders: you don't need texts as you wouldn't have 3 functions per encoder
- The right hand text is for encoder 7, which is single shaft and assumed to be "multi"

- There ought to be a way to turn them off in 2 groups.

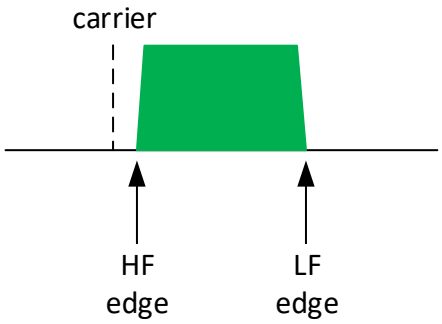
When they are on:

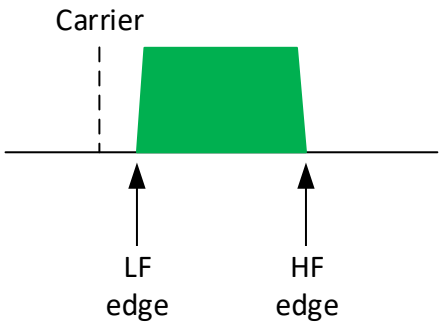
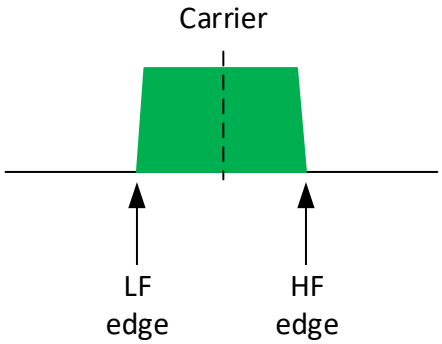
- For the non multi encoder: show main or second function. When 2nd function is activated or deactivated, change the display.
- For the multi encoder: change the display when 2nd function used to change the assigned function. Modify the display with M: preceding the function.

IF Filter Display

There needs to be a display of the variable IF filter settings. There are several ways in which it could be done.

- Show the -10KHz to +10KHz region, with pixels coloured for the region used. The disadvantage is that for SSB only an eighth of the pixels would be displayed; for CW, only a tiny number.
- Show something like twice the “correct” bandwidth, and let the “correct” values decide where that is centred. That would allow a reasonable number of pixels to be lit.
- A complication is that it would be useful to do this is the audio domain (ie if you hear an interfering LF signal, you want to move the left edge). That would mean the controls need to be reversed for LSB and CWL modes.
- I have access to the “correct” values because of the array of “filter reset” values. Could also add a “display width” to that structure (but then we’d need to vary the green part shown on a mode dependent basis)

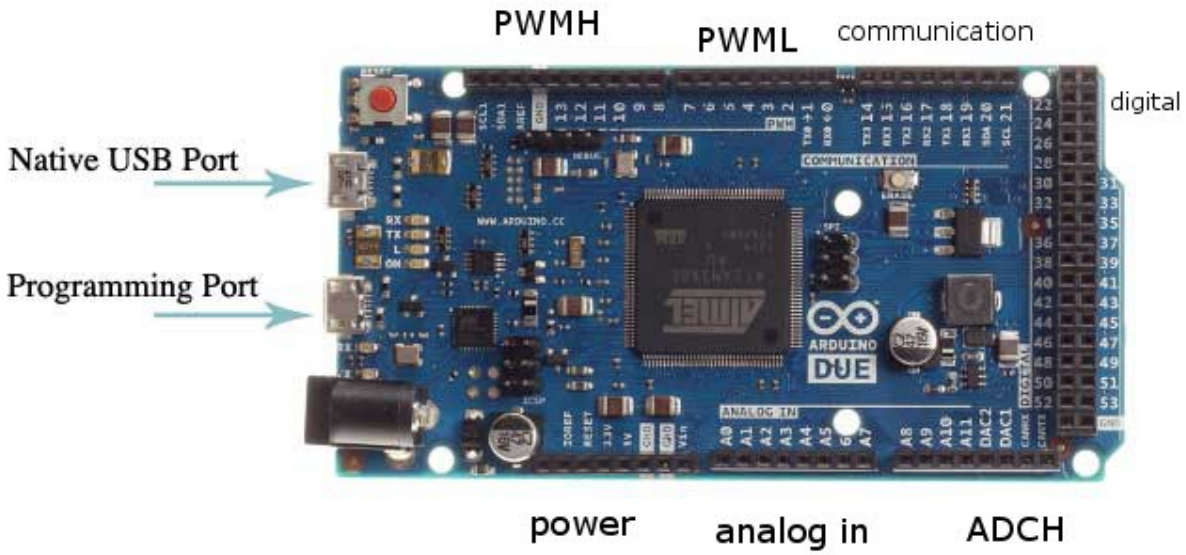
CWL, LSB, DIGL	

CWU, USB, DIGU	
Symmetrical DSB, FM, AM, SAM, SPEC, DRM	

I've created a simple spreadsheet calculator:

Mode:	LSB				
optimum settings					
Low	**-150**	Hz	centre	-1500	Hz
High	**-2850**	Hz	width	2700	Hz
display width	5400	Hz	disp width	120	pixels
display lower	-4200	Hz			
display upper	1200	Hz			
Frequency	**-150**	Hz	USB pixel:	90	
			LSB pixel:	30	

I/O Pin Allocation



Pin Name	Function	Connector	Pin Name	Function	Connector
Digital 0 / RX0	Reserved USB	PWML	Digital 31	SW 2	Digital
Digital 1/ TX0	Reserved USB	PWML	Digital 32	SW 3	Digital
Digital 2	Encoder 1 (VFO) A	PWML	Digital 33	SW 4	Digital
Digital 3	Encoder 1 (VFO) B	PWML	Digital 34	SW 5	Digital
Digital 4	Encoder 2A pin B	PWML	Digital 35	SW 6	Digital
Digital 5	Encoder 2A pin A	PWML	Digital 36	SW 7	Digital
Digital 6	Encoder 2 PUSH	PWML	Digital 37	SW 8	Digital
Digital 7	Encoder 2B pin B	PWML	Digital 38	SW 9	Digital
Digital 8	Encoder 2B pin A	PWMH	Digital 39	SW 10	Digital
Digital 9	SW17	PWMH	Digital 40	SW 11	Digital
Digital 10	Encoder 3A pin B	PWMH	Digital 41	SW 12	Digital
Digital 11	Encoder 3A pin A	PWMH	Digital 42	SW 13	Digital
Digital 12	Encoder 3 PUSH	PWMH	Digital 43	SW 14	Digital
Digital 13 LED	Reserved LED	PWMH	Digital 44	SW 15	Digital
Digital 14 TX3	Encoder 3B pin B	communication	Digital 45	SW 16	Digital
Digital 15 RX3	Encoder 3B pin A	Communication	Digital 46	LED 1 (SW1)	Digital
Digital 16 TX2	Encoder 5B pin A	Communication	Digital 47	LED 2 (SW2)	Digital
Digital 17 RX2	Encoder 4A pin B	Communication	Digital 48	LED 3 (SW3)	Digital
Digital 18 TX1	Display RXD	Communication	Digital 49	LED 4 (SW4)	Digital
Digital 19 RX1	Display TXD	Communication	Digital 50	LED 5 (SW5)	Digital
Digital 20 SDA	Reserved SDA	Communication	Digital 51	LED 6 (SW9)	Digital
Digital 21 SCL	Reserved SCL	Communication	Digital 52	Opto PTT in	Digital
Digital 22	Encoder 4A pin A	Digital	Digital 53	LED 7 (SW17)	Digital
Digital 23	Encoder 4 PUSH	Digital	Analog 0		Analog In
Digital 24	Encoder 4B pin B	Digital	Analog 1		Analog In
Digital 25	Encoder 4B pin A	Digital	Analog 2		Analog In
Digital 26	Encoder 5B pin B	Digital	Analog 3		Analog In
Digital 27	Encoder 5A pin B	Digital	Analog 4		Analog In
Digital 28	Encoder 5A pin A	Digital	Analog 5		Analog In
Digital 29	Encoder 5 PUSH	Digital	Analog 6		Analog In
Digital 30	SW1	Digital	Analog 7		Analog In

This supports:

- VFO encoder (encoder 1)
- 7 normal encoders
    - 4 dual encoders, (encoders 2A/2B, 3A/3B, 4A/4B, %A/5B)
    - Note encoder A is the upper control, with the push switch)
    - (single encoders can be used for 2-5; a second function can be activated by clicking the encoder)
- 4 encoder push switches (2, 3, 4, 5)
- 17 normal push switches;
- 7 LEDs

(Note the VFO encoder (encoder 1) has no push action)

Arduino Libraries

Arduino Due has the Atmel SAM3X8E ARM Cortex-M3 processor. Any input can have an interrupt and it may be possible to select the h/w input debounce. But needs some specific libraries

- "DueFlashStorage" library is an EEPROM equivalent library for Due
- Timer – Due specific "DueTimer"
- Serial – there seem to be several. SerialUSB is probably the "native" port.
- Nextion
- There is a LiquidCrystal_I2C library by MarcoSchwarz. There is also newliquidcrystal.

The programming port is "Serial" and the "native" port is "SerialUSB". Consider using SerialUSB for CAT connection, retaining the other for debug?

Rotary Encoders

It seems that interrupt driven code is poor at debouncing. It does work well with bounce-free optical encoders.

Zacsketches/quadrature works well for the VFO: I'm getting 2400 steps per revolution.

ClickEncoder works well for the other "mechanical" encoders.

Nextion Interface

3.3V TTL serial. Requires 5V power supply.

Issues List

Issue	**Resolution**
1. Add external PTT code	Completed
2. Add diversity gain, phase controls	Completed
3. Add configurable VFO speed steps (2/4/8)	Completed
4. Add display of filter shift & width	Completed
5. Add PTT latch/not latch depending on how long pressed for	
6. Modify PowerSDRmrx to allow step attenuator setting	
7. Consider ballistic tracking for VFO encoder	