Translated in English by Jeff / WB1GBY

406 MHz Distress Beacon decoder: New features with the "DECTRA" PCB

(Part 2/2)

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The frame decoder circuit has been revised from its original design. Performance monitoring system LEDs have been added among other updates. The LEDs ensure that the FM receiver is correctly connected to decoder, is receiving FM noise, and is decoding signals when they are encountered. In addition, the input stage is now designed around a TLC2274 circuit (4 PDO "rail-to-rail") as compared to the TLC227 of the earlier design.

This second part of the document follows the description of the building of the circuit board [1]. It presents the construction of the card, its settings, and its operation. The description of the building is inspired largely from that of the first version. [2]

1 - Component Implementation

The PCB scale (1:1) and the component layout are shown Figures 1 and 2. The IC design is available on the website www.F1LVT.com [3].

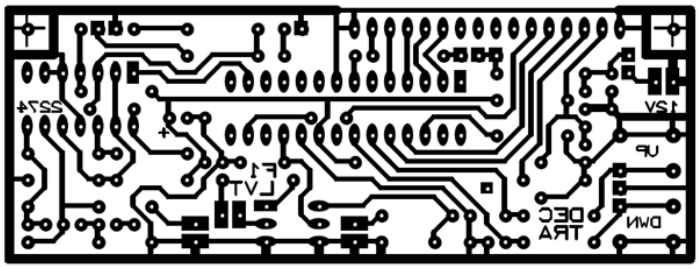

Figure 1: PCB component side seen at scale 1:1

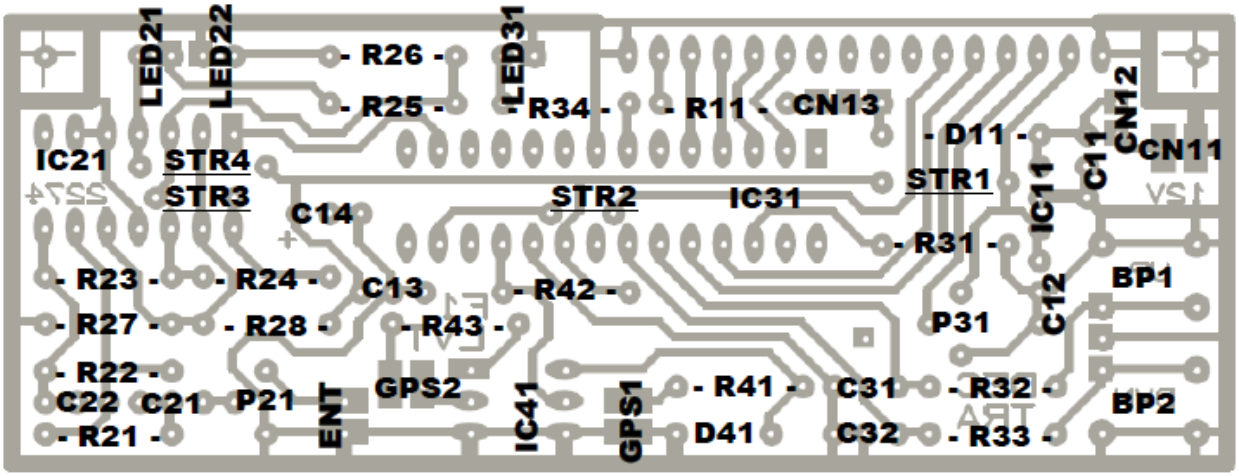

Figure 2: Component Implementation

2 - Construction of the decoder
We will describe the construction of the "4 lines" decoder with the DECTRA printed circuit board.

First you must gather all the components (display 4 lines of 20 characters, the pre- programmed PIC 18F2685 and the PCB), and any peripheral components (Photo 1).

First, 171 0.8 mm holes must be drilled on the circuit board. You must then enlarge the holes BP and the connectors for the display to 1.1 mm. 3 mounting holes must then be drilled to 3mm. The third hole allows a 3 mm nylon screw to be installed which serves as support only between the PCB and the display when the card is mounted under the display.

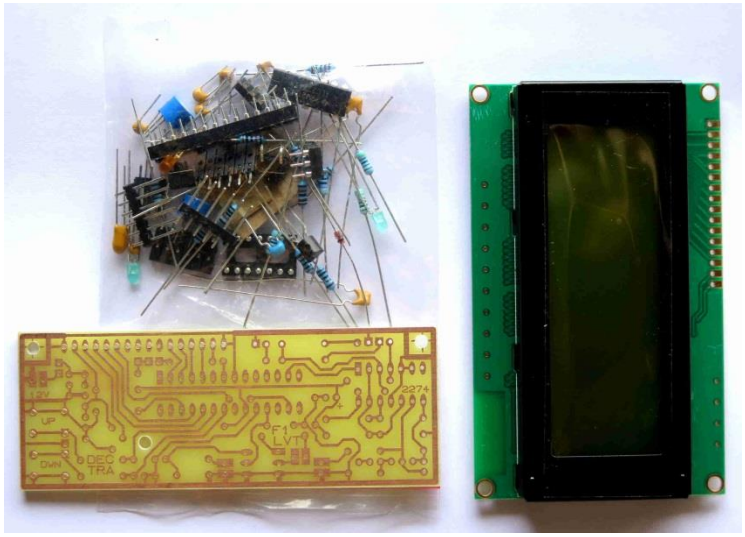

Photo 1: All components for the decoder 406

3 - The steps to building

1 - You must first start with soldering 4 jumpers (Photo 2).

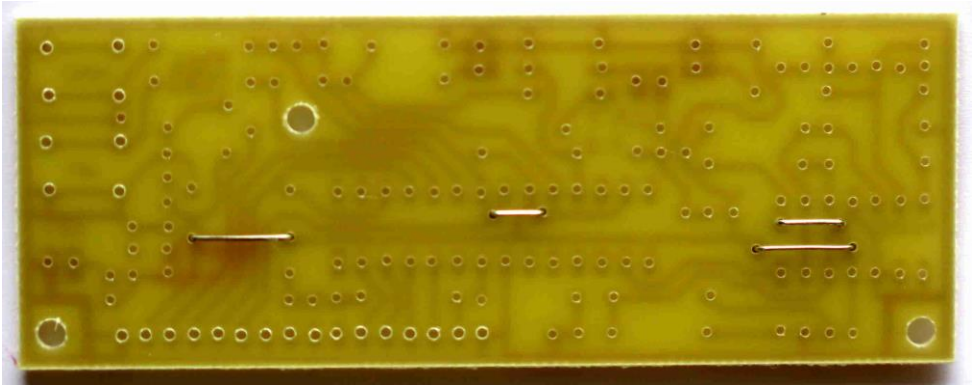

Photo 2: Installation of 4 jumpers

2 –You can then solder the components that lie “flat” on the PCB: resistors, diodes and IC sockets (Photo 3).

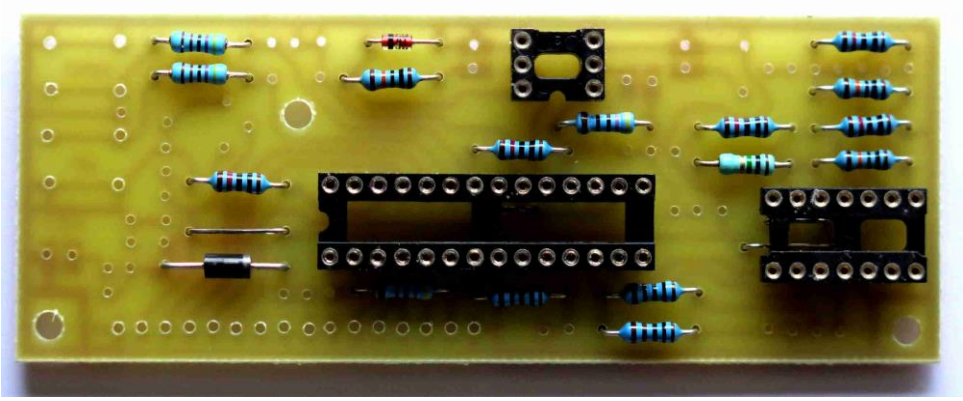

Photo 3: The card with brackets and mounted resistors

3 - The taller components can then be added: capacitors, regulator,and connectors (Photo 4).

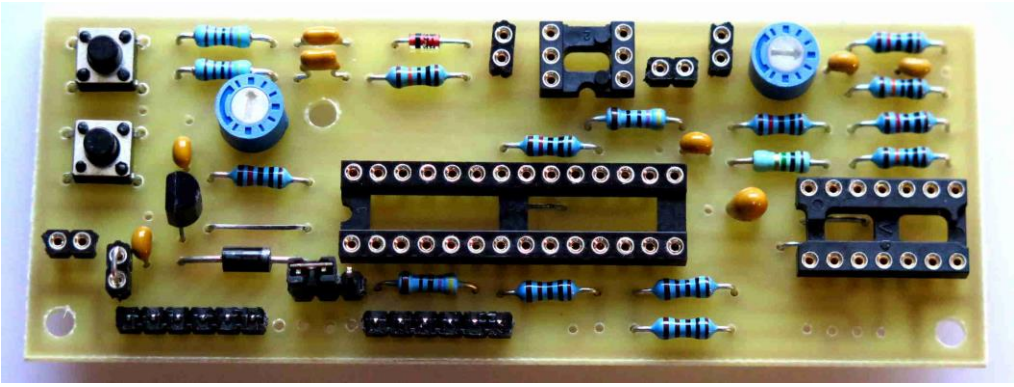

Photo 4 The card is almost finished, there remains the assembly of 3 LED side tracks.

Picture 5 shows the verification of the value of the capacitor C22 of220 pF input filter.

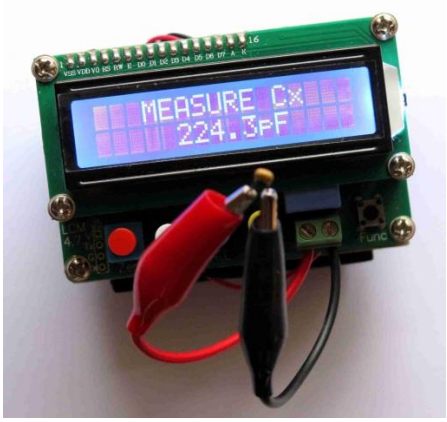

Photo 5: Verify the value of 220 pF capacitor with the LC-meter LC-100A

4 - Installation of the display connectors is performed next (Photo 6). This photo also shows the LED mounted and inclined outwardly in order to be shown above the display. We also see the nylon screw used to hold the card in parallel on the display.

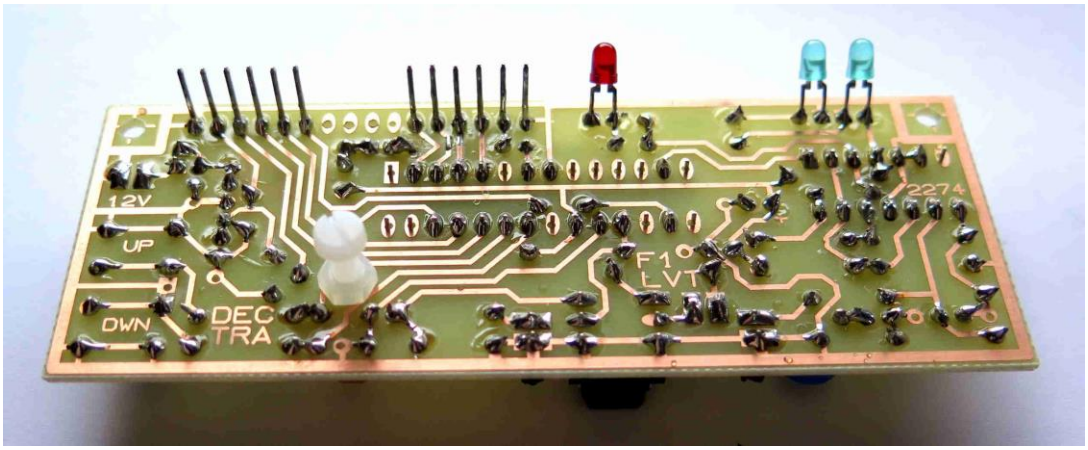

Photo 6: 2 6-pin connectors get soldered to the copper side track. We also see the LED 3outwardly inclined and the nylon screws to hold the card parallel to the display

5 - 2 bars of 6 female pins are soldered under the display (Photo 7)

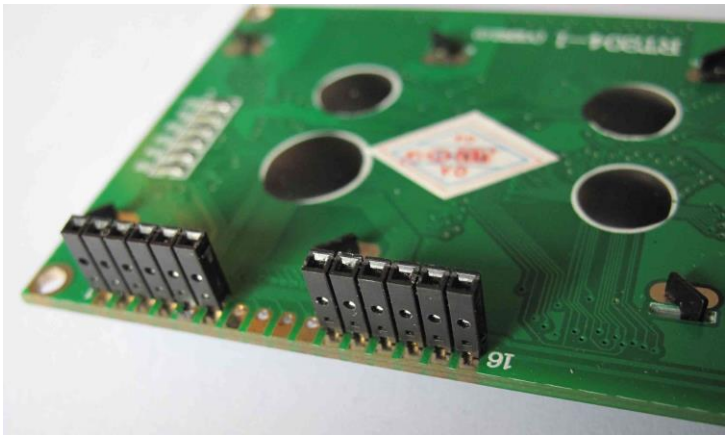

Photo 7: 2 female 6 pin connectors soldered under the display

6 - For the direction of the LEDs, the cathodes are marked on the printed circuit by square pads. On the LEDs themselves, the cathodes are identified by a side plate or by a short leg. Another solution is to power the card without the IC, to link the pin 7 and 20 of the PIC socket and to insert the red LED: it must light on. Always with the power supply and without all the IC, the two green LED must light on.

We can now move to the phase of testing and adjustments.

Test # 1

Check that the power supply is working properly. Apply voltage to the assembly (card only, without display and without integrated circuit) by feeding 12 V (8 to 15 V) and verify that the voltage is 5V on pin 20 of the PIC socket and pin 4 of the TLC2274.

Another solution consists of powering the assembly without integrated circuits, to bridge pins 7 and 20 of the socket for the PIC and the red LED should be on. If both the two green LEDs are properly installed, they will both be illuminated as well.

- Disconnect Power and attach the Display

Test # 2

Energize with the display and adjust the10 kW potentiometer (P31) to reveal a series of black squares ■ on the first and third line of the display (Photo 8).

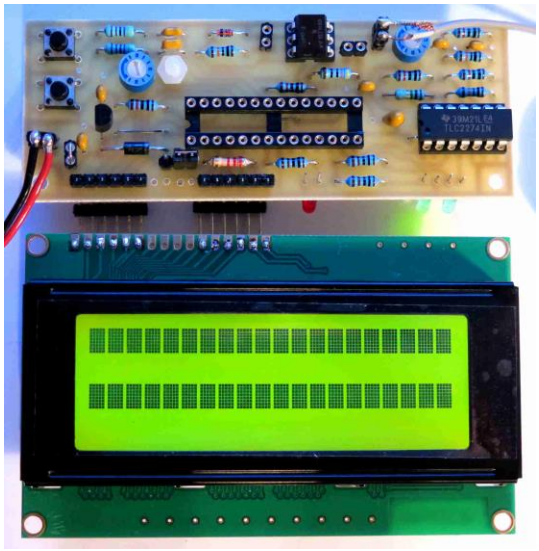

Photo 8: Contrast Adjustment display

- Disconnect power, and insert the PIC into its socket.

Test # 3

Apply power to the display and PIC; Home page should appear on the 4display lines (Photo 9).

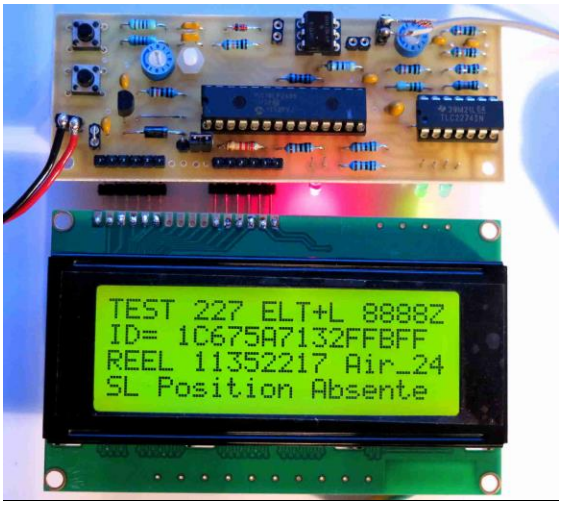

Photo 9: With the programmed PIC installed, the Home screen appears when power is applied

Test # 4

Pre-position the potentiometer P21 halfway. Apply power and apply a signal to the input. This signal can originate either from a frame generator or from a recorded frame. The frame should be displayed (Photo 10).

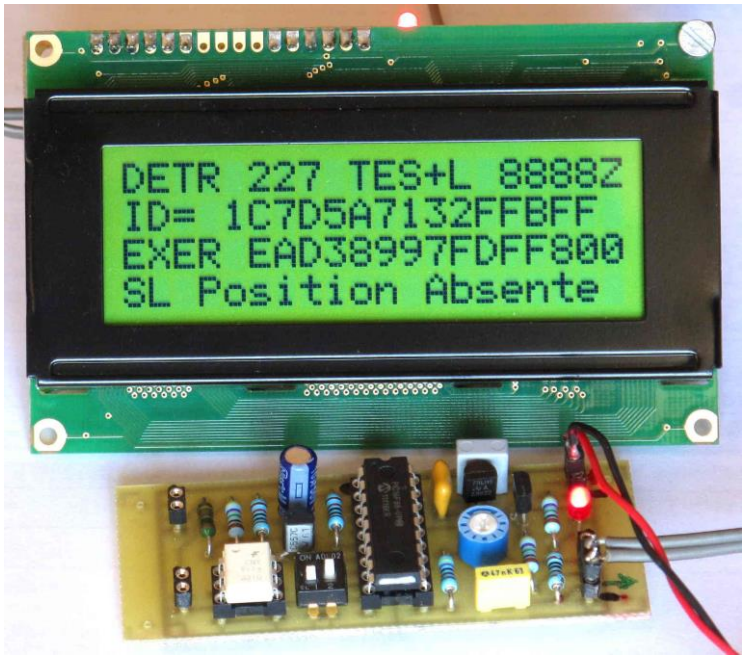

Photo 10: The decoding of an "Exercise" frame from a frame generator.

We can slightly adjust the input level (P21 potentiometer) to fit the source and look for the best position. This level depends on the receiver used.

Test # 5

Connect the receiver to an FM receiver, both of the green LEDs should light. Receiver off, only one green LED remains lit.

Functional test

At this stage of construction, the decoder is fully operational for decoding received frames. By sending a frame (recorded field or frame supplied from a frame generator), the green LEDs and the red LED will light, then the display will show the information contained in the 4 lines of the frame.

4 - Notes on operation

For the system to work correctly, do not take the signal from the audio output (headphone jack). You must use the "discriminator" output of the receiver. That is to say, the receiver's discriminator circuit output signal should be directly connected to the input of the demodulator.
The website http://www.discriminator.nl[4] is very well documented to explain how create a discriminator output from a receiver

At the decoder input, the signal level depends on the potentiometer setting (P21). Ideally it should be adjusted to the level where a frame is properly decoded each time. In practice, the P21 halfway setting is a good value for many receivers.

The decoder also works well with positive signals (start of the frame by + $\Delta\varphi$) or negative signals (start of the frame by - $\Delta\varphi$). The PIC recognizes both types of signals.

The use of GPS is optional. Decoding works fine without GPS. GPS can read the arrival time of the frame. If the GPS is not connected, the time indicated is 8888. The time indicates "Z" after the hour and is added by the decoder to indicate that it is GMT (ZULU).

5 - Summary

The DECTRA card is an evolution of the first card of the frame decoder. It now monitors the connection with the receiver. Its smaller size allows it to be integrated more easily into a box. The function monitoring is performed by three LEDs, one red and two green. The red diode lights during decoding by the PIC.

The 2 green LEDs monitor the operation of the input stage:

- No green LED: the decoder input stage is not powered.
- One green LED lights: the output remains at a steady state, so the FM noise receiver is not detected.
- Two green LEDs lit: the FM receiver is turned on and is properly connected to the decoder.

Having the 2 green LED lit is a prerequisite for the proper functioning of decoder, but not sufficient to decode. In order to properly decode frames, the receiver must be set to the right frequency and the reception level must be high enough.

6 - If you have already built the previous version

If you have already built the frame decoder with the original circuit board, it is possible to "upgrade" it easily and give it exactly the same features as those of the DECTRA card. There are only a few components that need to be added; 3 wires, 3 resistors and 2 LEDs. This change will be described in another article.

References

[1] "Decoder 406 MHz distress beacon frames: with new features
map "DECTRA" (Part 1/2)
http://www.f1lvt.com/files/333-CarteDECTRA-V6P1.179.pdf
[2] "Building a decoder" 4 lines "for reading the information contained in
frame tags 406 "
http://f1lvt.com/files/325-ConstructionDecodeur4Lignes-V3.133.pdf
[3] Circuit board of DECTRA scale map 1
http://www.f1lvt.com/files/332-CI-DECTRA.178.pdf
[4] Addition of a discriminator outlet on a receiver
http://discriminator.nl/index-en.html

List of components by value

resistors

470 Ω	2	R11, R43
1 kΩ	3	R25, R26, R34
4K7	2	R32, R33
10 kΩ	5	R21, R27, R28, R31, R42
100 kΩ	2	R22, R23, R41
1 MΩ	1	R24
10 kΩ linear pot	2	P21, P31

capacitors

220 pF	1	C22
100 nF	6	C11, C12, C13, C21, C31, C32
100 µF (or 10 µF)	1	C14

active components

IC11	78L05	100 mA regulator
IC21	TLC2274 or equivalent (4 AOP, Single-voltage power supply, rail-to-rail output)	
IC31	PIC 18F2685	Programmed microcontroller
IC41	CNY 17-3	Optocoupler
D11	1N4004	
D41	1N4148	
LED21	green LED	Monitoring the input circuit
LED22	green LED	Monitoring the input circuit
LED31	red LED	Indication of decoding by the microcontroller
	Display 4 lines of 20 characters	Format 100 mm x 60 mm

Miscellaneous

IC Sockets

DIL28	1	
DIL14	1	
DIL6	1	
Push buttons	2	BP1, BP2

Connectors

CN11, CN12, CN13, ENT, GPS1, GPS2

Male and female connectors 6 points for the display (N = 2)