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TECHNICAL DESCRIPTION OF THE FASTFIND PLB

The FASTFIND is a 406MHz PLB with a built in 121.5MHz homing beacon. It is used to locate a person in distress. When activated,. data is transmitted in the 406MHz message, allowing identification of the user. Doppler shift position calculation on the 406MHz transmission is used by the Cospas-Sarsat system giving a position accuracy of typically 3 km.

PLB DESCRIPTION

The FASTFIND consists of six mouldings. The two part main body is made from a thermoplastic mix. Both halves of the main body are internally sprayed with a conductive coating to achieve good EMC performance. The internal PCB is connected to the conductive spray by an internal EMC gasket The two mouldings are screwed together. A gasket made from silicone is used to provide a waterproof seal between the two halves of the body.
The antenna is a stainless steel tape antenna, sprayed with a nylon coating. The antenna is coiled and retained in a cavity in the main body moulding. This is accessed by removing the tamper cover; which also exposes the membrane switch assembly. When the tamper cover is removed, the antenna automatically deploys. The unit may then be switched on by momentarily pressing the ON switch.

The detachable battery pack consists of two mouldings which are ultrasonically welded together. Both halves of the battery pack are internally sprayed with a conductive coating to achieve good EMC performance. The battery pack is fixed to the main body by a recessed clip and screw arrangement.

The FASTFIND is programmed via an infra-red data link. This means that a unique serial number can be programmed into the FASTFIND via a RS232 interface. This data is then permanently stored in the PLB. This system enables swift and easy programming of the PLB without having to dismantle it.

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CIRCUIT DESCRIPTION

Refer to drawing 85-630C

The FASTFIND PLB is controlled by IC1, an 8-bit micro-controller, with internal EEPROM. The micro-controller is responsible for all board operations. The micro-controller is powered by a 3V4 regulator, IC3, and run by 4MHz crystal X2. The micro-controller may be programmed during self-test with the data to be encoded in the 406 message. Data is input to the RX line from an infrared photodiode, D20, and stored in EEPROM. In operational mode the micro-controller provides the following control signals:

1) Flashes a red LED every 2.6 seconds to indicate normal operation.
2) Sets the PLL line high to enable the 121.5 MHz oscillator.
3) Generates frequency swept square waves on the MOD line to modulate the 121.5MHz transmission.
4) Every 50 seconds initiates a 406MHz transmission sequence.
5) Sets the PLL line low to enable the PLL and VCO circuits.
6) Loads division ratio data to the PLL via the LAT, DAT and CLK lines.
7) Sets the PA line high to enable the 406MHz PA.
8) Holds the DAT and CLK lines static for 160ms to generate un-modulated carrier.
9) Pulses the DAT and CLK lines for 280ms to phase modulate the carrier with encoded data.
10) Flashes a green LED during SELF TEST to indicate normal operation.

A second micro-controller, IC10, is used to generate a Morse ‘P’ transmission. At the end of every 406MHz transmission. The 8-bit micro-controller (PIC 24C671) monitors the timing and modulation signals from the main micro-controller and inserts the Morse 'P' modulation at the correct points in the 121.5MHz modulation signal.

The ‘Morse’ micro-controller operates independently from the Fastfind micro-controller and has its own 4MHz clock. The micro-controller generates all necessary timing and modulation signals required to generate the Morse 'P' modulation signal as defined by the relevant specification. A fail-safe design is implemented to ensure that, in the event that the adapter micro-controller fails to start up, for whatever reason, the original swept modulation tone will still be fed to the 121.5MHz transmitter.

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121.5MHz TRANSMITTER

Transistor Q4 forms part of a crystal controlled oscillator. IC6 is a regulator which supplies the oscillator with a regulated 5V supply. The oscillator is switched on and off by the micro-controller via D1 and R7.
FET Q5 is a modulator/buffer. Amplitude modulation of the 121.5MHz signal is generated by the micro-controller. Modulation is in the form of a square wave, swept down from 1300Hz to 600Hz, with a duty cycle of around 41%.
During the Morse 'P' transmission, the signal is modulated with a 1KHz tone. The dot length of the Morse 'P' characters is fixed at 115ms under the control of micro-controller IC10.
The power amplifier, Q8, is operated in Class C mode. The output of the power amplifier is fed to a diplexer. The diplexer acts to combine the 121.5MHz signal with the 406MHz signal which is then output to the antenna via the antenna tuning unit (A.T.U).
The 121.5MHz output power level is detected and converted to a DC level by the network C67, L15 and D9. This level is monitored during the self-test sequence to confirm the correct operation of the 121.5MHz circuitry.

406MHz TRANSMITTER

The 406MHz signal is generated by frequency synthesiser IC2 and VCO Q6. The frequency synthesiser reference is an ultra-stable OCXO, OSC1.
The carrier is phase modulated under control of the micro-controller, IC1. The LAT and DAT lines from the micro-controller output the encoded message data to Q2 via the scaling network R8, 9, 49, 80 and VR1. The resultant base drive voltage will result in current being drawn from the charge-pump output thus phase modulating the 406MHz signal. The magnitude of the peak modulation is adjustable by VR1.This is adjusted for a nominal modulation of $\pm$ 1.1 radians..
The modulated signal is amplified by Q7 and IC8 to produce 5W output power at SK2.
The 406MHz output power level is detected and converted to a DC level by the network C67, L15 and D9. This level is monitored during the self-test sequence to confirm the correct operation of the 406MHz circuitry.

Richard Read
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