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# PYROLOGIC 2000 SYSTEM

## Technical Report



## General information

Pyrologic 2000 is a wireless fireworks shooting system. Using a central remote control Terminal Unit (TU), a multitude of Remote Controlled Units (RCUs) are controlled by a coded Radio Frequency link in order to fire upon command a firework electrically connected to each RCU of choice.

The TU (in its stationary option) installed into a Base Unit (BU) the BU is wired connecting an Extension Unit (XU) using a twisted pair 2 wire telephone cable. Any transmission from the TU to the RCUs is wired transferred (RS-485) from the TU to the XU and then RF transmitted by the XU to the RCU.

## Product Description

The Pyrologic 2000 System, referred to as the EUT in this report, is a stationary terminal that include the following items:

- Terminal Unit (TU)
- Base Unit (BU)
- Extension Unit (XU)
- External PTT (XPTT)
- External Power supply (PS)

### The Terminal Unit



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The Terminal Unit (TU) ), is a terminal with a keyboard, LEDs and LCD display that allow the operator to program a fire sequence, store it in a “memory key” and to remotely control the RCU’s.

The TU use the Motorola MC68HC908GP32 micro-controller with external crystal of 32.768KHz, the controller use internal PLL to generate internal bus frequency of 2.4576MHz.

The TU use the EM MICROELECTRONIC-MARIN SA V3021 Real-Time-Clock with external crystal of 32.768KHz.

The TU is powered by 4 x 1.5V AA battery or by a DC supplement via its BU connectors. It use a National Semiconductor LM2704 DC-DC switching regulator.

The TU can operate also as a stand alone, hand held terminal. In that case it transmit using an internal transmitter & its fixed antenna. (a separate FCC ID was certificate for this option).

### **Base Unit**



The base unit accommodates the terminal unit. The communication between the TU and the Base Unit is through mating connectors on the back of the TU and on the top of the BU. An external PTT is connectable to the side of the BU. External power can be connected to the BU by a regulated AC-DC adaptor connected to 120VAC 60 Hz input, providing to the BU its 6 :- 7.5 VDC 500mA output.

The BU use only passive components and is powered by a 5V via its TU connectors.

Connecting an Extension Unit (XU) to the BU is done by using a twisted pair 2 wire telephone cable with RJ11-2/6 connectors, connected to the telephone sockets in both units.

Connecting an XPTT and an XU does not affect the function and operation procedures. In terms of functionality, the XPTT replaces the TU PTT and the XU is an extension of the TU (transmission made through XU antenna instead of TU antenna).

## External PTT

The external PTT (XPTT) is a joy-stick connecting to the BU.



The XPTT use only passive components.

## Extension Unit



The Extension Unit (XU) has one key, 2 LEDs, RJ11 connector, Antenna and TRI-POD mount.

The XU use the Motorola MC68HC908GP32 micro-controller with external crystal of 32.768KHz, the controller use internal PLL to generate internal bus frequency of 2.4576MHz.

The TU is powered by 9V battery and LDO to regulate 5V & 3V DC for its operation.

The RF section of the XU is based on MOTOROLA Tango3 MC33493 UHF transmitter with external crystal of 13.0625MHz, the Tango3 use internal PLL to generate RF frequency of 418MHz. The modulation is ASK (OOK). The bit rate is 2778 bps with Manchester encoding of 50%. Transmission frame is build of transmit block of 40msec & one frame is transmitted every 100msec. The transmission is manually operated and in any

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case cease within 5 sec of switch or key being released. The output power was set to the level allowed under Part 15.231 A-D of the FCC regulation.  
The XU use fixed (screwed) 360° rotated Antenna.

## **Justification**

The PYROLOGIC 2000 System has been designed to operate under the FCC part 15 Unlicensed operation under part 15.231 A-D. The transmission is a control/command signals, the transmitter activation method is manually. The selected transmit frequency is 418 MHz (within the 260-470MHz band).

We choose the MOTOROLA Tango3 MC33493 UHF transmitter. The transmitter designed by Motorola to be used in this band according to the FCC part 15.231. Its output power, band-width and harmonics designed accordantly. We used a 4 layers PCB with large ground planes to get the best emission characteristics.

The ASK modulation (On Off Keying) ,bit rate 2778 bps with Manchester decoding give a good balanced 50%. signal. The transmit frame is a block of 40msec and only one frame maximum is transmitted every 100msec. The transmission is manually operated and an any case cease within 5 sec of switch or key being released. The output power was set to the level allowed under Part 15.231 A-D of the FCC regulation.

## **System Test Configuration Justification**

The system was configured for testing in a typical fashion (as a customer would normally use it). The XU was placed vertically as it will be mount on a regular TRI-POD and the antenna were set vertically to get the maximum emission. The XU was rotated to get the maximum emission position and polarity.

The XU was connected to a BU by a 10m twisted pair 2 wire unshielded cable. An TU was placed on the BU, a XPTT (joystick), and a 9pin cable (for option of far fire signal) were also connected to the BU. The BU were power by a wall mount DC/DC 110V – 6.1V adupotor.

Since the actual transmissions of the XU are short frames, the XU was set for measurement into two special modes. CW transmission & continuously modulated transmission. The results was calculated accordantly.

## **EUT Exercise Software**

The TU exercise software used during radiated and conducted testing was the normal TU software revision 1.15.

The XU exercise software used during radiated and conducted testing was the normal TU software revision 1.10.

The entry to the special modes was dune by entering a special manufactory password, then selecting by menu the mode of transmission.

## **Special Accessories**

No special accessories were needed to achieve compliance.

## **Equipment Modifications**

Resistor R17 value was changed to 18 Kohm (instead of 12 Kohm) to reduce carrier level.