

**Reply® Transmitter Model TX216SYN**  
**FCC ID: FBR-TX216SYN-2**

## **Operational Description**

### **Introduction**

The Fleetwood Model TX216SYN is a low power transmitter designed for operating in the frequency range from 216 to 220 MHz to be type accepted for operation under Part 90.259. The transmitter is manufactured as a printed circuit module approximately 2 inches by 3 9/16 inches using surface mount components. This module replaces an earlier design originally approved in 1989 (FCC ID: FBR-5FKRSPTX-1) which was enclosed in a larger case, crystal controlled on a single frequency, and used more costly through hole technology for manufacture. The new design utilizes surface mount technology and state of the art synthesizer design providing cost reduction in addition to allowing operation on frequencies in the 216-220 MHz range.

### **General System Description**

The Fleetwood Model TX216SYN transmitter is used as a part of a base system which communicates with a number of response keypads (approved under separate applications) to allow feedback from participants in a meeting or classroom situation to be collected and displayed on a personal computer running a controlling application. The base unit composes and sends via the Model TX216SYN transmitter an addressing signal to the keypads which determines when they will transmit their entry back to the base unit. The keypad entries are typically one of ten keys on a membrane switch panel on the keypad.

### **Transmitter Theory of Operation**

The Model TX216SYN transmitter is designed using a National LMX2313 Frequency Synthesizer IC. A crystal controlled oscillator Q4, Y2 and associated components serves as its frequency reference at 10.2 MHz. The precise frequency is adjusted by trimmer capacitor C37. The reference frequency is divided by 1020 in the LMX1601 to generate an internal reference of 10 KHz. The programmable dividers in the LMX1601 are set by a serial bit stream sent from the Atmel microcontroller on power up to set the synthesizer to the appropriate values for the selected channel. The Atmel microcontroller receives the channel assignment by reading the settings of a 4 position dip switch on the interface board. The only function of the Atmel microcontroller is to program up the LMX1601 frequency synthesizer.

The VCO consists of Q1, L2, and D2 and associated components. A portion of the VCO output is provided to the RF input of the LMX1601 synthesizer. Inside the LMX1601 the divided down frequency of the VCO is compared with the 10.2 MHz derived reference frequency and the voltage on the output of the phase detector reflects the relationship between these two signals. The phase detector voltage is conditioned by a low pass filter consisting of C3, C4 and R3 to provide the controlling signal for the VCO. The VCO is thereby locked to one of the channels shown in the frequency table for operation within the 216-220 MHz range.

The output of the VCO is buffered by transistor Q3 which is then fed to amplifier U2 to increase the power level to the 50 mw level. Suppression of harmonics and spurious radiation is accomplished by a bandpass filter consisting of components L7-L10 and C2, C22, C25, C28, and C44. The output is fed to a BNC connector for attachment of an external antenna, typically a quarter wavelength whip.

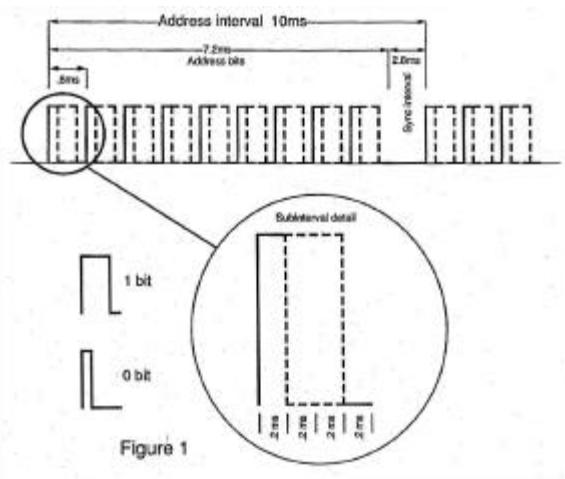
Frequency modulation is accomplished by applying the rail to rail (0 to 5V) signal TXDATA through an appropriate network of components to the VCO resulting in FSK modulation of the VCO.

## **Transmitter Modulation Characteristics**

The Model TX216SYN transmitter operates with Frequency Shift Keyed (FSK) binary data with +/- 10 KHz nominal deviation. It is modulated from a signal provided by a crystal controlled microprocessor part of Model CRS920, separately compliance tested for its digital circuits. This signal has a 0 to 5 volt range and therefore cannot be driven above that level. The occupied bandwidth tests were performed by D.L.S. Electronics at modulation levels of 0, 1/3, 2/3 and full levels and the appropriate plots are included in the D.L.S. test report.

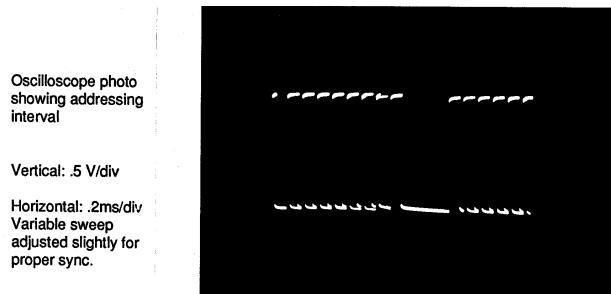
The signal is composed of repeating addressing intervals of 10 ms which are made up of 9 subintervals of .8ms each. Each of these subintervals forms either a 0 or a 1 bit by varying the ratio of on to off time. For a 1 bit, the signal is high for .6ms and low for .2 ms and for a 0 bit the signal is high for .2ms and low for .6ms. After the 9 subintervals a sync interval of 2.8ms is provided before the next addressing interval begins.

The following diagram shows the makeup of the modulating signal:



## **Transmitter Modulation Characteristics (Continued)**

The following is an oscilloscope photo which captures the modulating signal showing an addressing interval:



## **Transmitter Frequency Assignments**

The Model TX216SYN transmitter operates with Frequency Shift Keyed (FSK) binary data with +/-10 KHz nominal deviation.

The eight supported transmit frequencies for the Fleetwood Reply® Response System are shown in the following table:

Channel Number	Transmit Frequency (MHz)
1	216.0125
2	219.0125
3	217.0125
4	218.0125
5	216.5125
6	217.5125
7	219.5125
8	218.5125