

# Theory of Operation

## RFTek-200 2-Function Wireless Control System

### RFTek-200 System Specifications:

System Model# – RFTek-200  
Transmitter Model# – RFT-200  
Receiver Model# – RFR-200  
Transmit Frequency – Typical 433.92MHz  
Modulation Type – CPCA (Carrier Present Carrier Absent)  
Frequency Range – 100 feet

The Hand Held Remote Transmitter is normally powered off until a button is pressed. If a button is pressed the transmitter will power on and begin to monitor the switches and transmit the switch status data. The transmitter will remain powered on and continue to transmit switch status. After a period of 5 seconds of no activity, the transmitter will power itself down and stop transmitting<sup>1</sup>. The 5 second transmit limitation exists for all modes of operation, this includes normal and E-Stop modes<sup>2</sup>.

When a switch closure has been detected the transmitter will send out a data packet that consists of a start bit, mode bits, address, switch status, and error detection bits (see below). The start bit is a bit that is double in length, this will allow the receiver to clearly see the start bit. The Mode bits are to signal to the receiver that the transmitter is in a normal mode or an E-Stop mode. If the transmitter is in the E-Stop mode the data packet will be shortened and will not contain the switch status bits. The E-Stop mode message packet is a small packet length, which means that the overall “On” time of the transmitter will be shortened. This also means that the overall energy output for a E-Stop mode packet will be smaller when compared to a normal message packet<sup>3</sup>. The transmitter address is 12 bits in length and is programmed at the factory at build time. The switch status bits are 16 bits in length. The reason for 16 bits of switch status when only two are used was to standardize a protocol for future use in other applications. The error detection bits a four bits in length. Error detection is a rolling one's count of all one's in the data packet.

Normal Mode	Start Bit	Mode Bit/s	Address (12 bit)	Switch State (16 bit)	Error
	1	0	xxxxxxxxxxxx	xxxxxxxxxxxxxxxx	xxxx

E-Stop Mode	Start Bit	Mode Bit/s	Address (12 bit)	Error
	1	11	xxxxxxxxxxxx	xxxx

E-Stop Reset Mode	Start Bit	Mode Bit/s	Address (12 bit)	Switch State (16 bit)	Error
	1	10	xxxxxxxxxxxx	0000000000000000	xxxx

<sup>1</sup> Correction from Modification Letter per question #4 for American TCB

<sup>2</sup> Answer to question #2 for American TCB.

<sup>3</sup> Answer to question #3 for American TCB

Data packets are transmitted by means of CPCA or Carrier Present Carrier Absent. This is a form of AM modulation sometimes referred to by designations such as CW and OOK. This method represents a logic "1" as a carrier present and represents a logic "0" as no carrier present. The transmitting module is connected to an impedance matched PCB mount antenna specifically designed by the same manufacture.

E-Stop mode is a special emergency function of the transmitter. After any button has been held for more than 3/4 of a second and then the second button is pressed the transmitter will enter E-Stop mode. To indicate E-Stop mode the transmitter will begin to flash the Red LEDs back and forth until it powers down. The transmitter will always remember that it was put into E-Stop mode until this mode is cleared. Holding down both buttons for 7 seconds clears e-Stop mode.

The transmitter has two different styles of backlighting, Green for switch legend viewing and Red for E-Stop mode indication. When the transmitter is first powered up the Green backlight will turn on for 5 seconds and then turn off. This helps to conserve battery life. Each time a button is pressed after this time, the Green backlight will turn on to illuminate the switch and provide an active indication. The Red indicators will only turn on when the transmitter has gone into E-Stop mode. The Red indicators will flash back and forth and will remain on once E-Stop mode has been activated. If the transmitter powers down from no activity and is then powered back on, the Red indicators will continue to flash back and forth to indicate E-Stop mode.

The Vehicle Mount Receiver is powered from the vehicles +12VDC battery system. The tow truck electronics and mechanics have certain interlocks that will not allow the receiver to be powered unless the vehicle is properly set up. AS an example, if the vehicle is not in park the receiver unit will not be powered. These interlocks will allow the system to "not" react to transmitter button presses at undesired times.

The basic purpose of the receiver is to listen and react to button presses on the transmitter. Depending upon the transmitter button pressed the receiver will either turn on or off Relay1 or Relay2. Relay1 and Relay2 will normally be connected to +12VDC winches, one relay will control the winch "in" and the other relay will control the winch "out". Because of this usage, only one relay at a time can be on.

The receiver will be capable of listening to up to four different transmitter addresses. There is a "learn" button located on the receiver, this will allow the user to program additional transmitters for the same receiver. Programming of a new transmitter is done by pressing and holding the "learn" button on the receiver and then pressing and holding a button on the transmitter. Once the receiver reads and remembers the new address a Red "learn" LED will blink at a fast rate. Both buttons can be released and the transmitter has been learned.

Since the relays of the receiver are only active while the corresponding button on the transmitter is being pushed, the receiver has a built in "loss of communications" protocol. If for any reason the transmitter signal is not received for 1 second the receiver will automatically turn off any relays that are on. This will protect the system incase the transmitter goes out of range, or there is interference of the same frequency.

There are several visual and audible diagnostic aids on the receiver PCB. Each relay output has it's own diagnostic Green LED. If the Green LED is on the relay +12VDC should be on. The system itself has a Green LED that is controlled by the main microprocessor. This system OK LED will blink to indicate the system is on and active. AS described above there is also a Red LED for the transmitter learn function. The receiver has an audible tone beeper for RF communication events. If the receiver reacts

to a data packet from a transmitter the beeper will sound once. This “beep” will be generated each time an event occurs, when a relay is turned on or off. The receiver will generate two beeps for a loss of signal event. If any relay was on and the 1-second “loss of communication” delay expired before the receiver got a valid data packet, the relay will be turned off and the double beep will be generated.

E-Stop mode is the last feature of the receiver. If the receiver gets an E-Stop message from a valid transmitter, all relay outputs will be turned off and the E-Stop relay will be turned on. Like the transmitter, the receiver will always remember that it is in E-Stop mode even if it loses power. To clear E-Stop mode from the receiver, a valid E-Stop mode cancel data packet must be received from the transmitter. Additionally, the E-Stop mode can be canceled by grounding the Manual E-Stop mode cancel wire on the receiver.