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Summary of operation for NFA-L25RS transmitter (418 MHz)

This device is a wireless limit switch used on mobile cranes. This type of safety system – called an anti-two block system – is required by law on nearly all cranes built in the U.S. to prevent damage to equipment, injury and loss of life.

Most of the time the limit switch is in a non-alarm state and sends only a periodic update signal (3 packet burst) every 11-16 seconds to report its status (15.231(e)). The aperiodic alarm signals are sent as described below and in accordance with 15.231 (a) (1,2,4) and (b).

Periodic Operation

Data format for this device is a pulse position scheme that consists of 16 data bits (.488 msec each max) and two start bits (first is .976 msec and second is .488 msec). The worst case ON time for one packet is 9.272 msec. The packet is transmitted 3 times in a row, asymmetrical spaced. This packet burst (347.456 msec total length) is repeated every 11 to 16 seconds. This yields a duty cycle of $20 \log (9.272/100) = -20.66\text{dB}$ in a sliding 100 msec window. Average power is limited to 4133 uV/m during periodic operation (15.231(e)) by use of a T-pad attenuator and the transmit power control pin #4 on the transmitter IC.

Aperiodic Operation

The data is sent in the same format as above, except that when the limit switch is tripped by a crane operators unsafe action, the transmitter sends a packet every 125 msec (8 per second) for 5 seconds and then at a rate of 4 per second until 30 seconds has passed (15.231(a)(4)). Then the transmitter sends only at the periodic update rate described above. This signal stops the unsafe operation of the machine.

When the operator clears the unsafe condition the alarm clear signal is sent for 5 seconds at 8 per second (15.231(a)(1,2)). This signal must be sent quickly to insure operation is returned to the operator as soon as possible.

Aperiodic signals are sent at a higher power level which is allowed under 15.231(b). The higher power level is achieved using the transmitter power control pin #4. Under periodic operation the pin sees R17-430 ohms to ground which limits power out to the periodic level requirements. During aperiodic operation the pin is shorted to ground (by the microcontroller) which increases power output by 6 dB - even though an increase of 8 dB is permitted by the rules cited above.